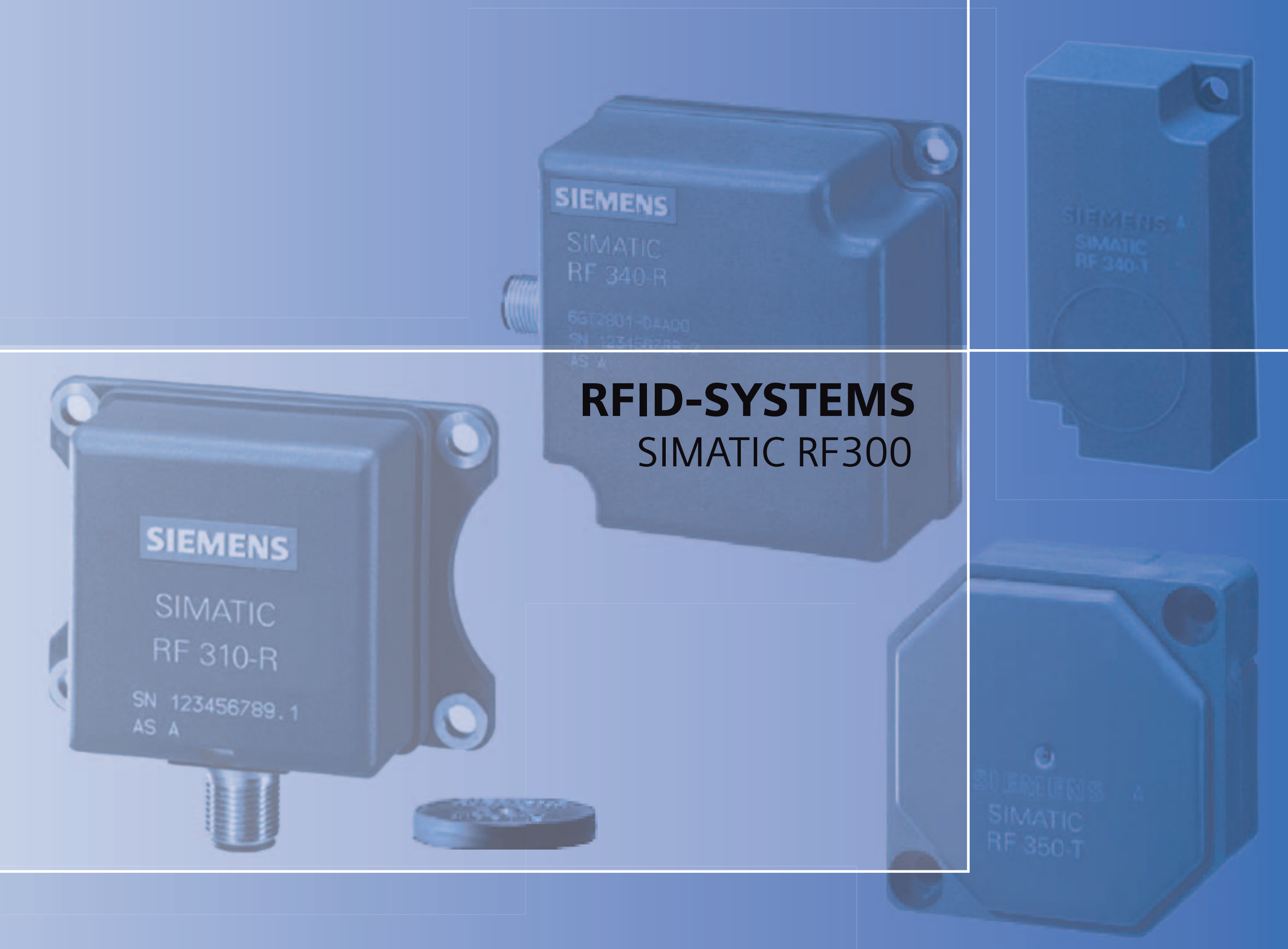
System Manual Edition 04/2006



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System Manual

Release 04/2006

J31069 D0166-U001-A2-7618

Safety Guidelines

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 device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

Warning

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

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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.

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Technical data subject to change

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Introduction

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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 the product/system 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
Transponder	Description of transponders which can be used for SIMATIC RF300
Communication modules	Description of communication modules used for SIMATIC RF300
System diagnostics	Description of system diagnostics available for SIMATIC RF300
Accessories	Products available in addition to SIMATIC RF300
Appendix	Service and support, contact partners, training centers

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 April 2006.

History

Previous editions of these operating instructions:

Edition	Remarks
04/2006	Revised edition, modules added: RF340R as well as RF350R with the antenna types ANT 1, ANT 18 and ANT 30
11/2005	Revised edition, modules added: RF310R with RS 422 interface, RF350T and RF360T; ASM 452, ASM 456, ASM 473 and ASM 475
05/2005	First Edition

Declaration of conformity

The EC declaration of conformity and the corresponding documentation are made available to authorities in accordance with the EC directives stated above. Your sales representative can provide these on request.

Observance of installation guidelines

The installation guidelines and safety instructions given in this documentation must be followed during commissioning and operation.

2 Safety information

> **Caution**
>
> Please observe the safety instructions on the back cover of this documentation.

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.	Memory, max.	Data transfer rate (typical) in byte/s	Temperature, max.	Special features
RF300	13.56 MHz	0.1 m	20 byte EEPROM, 32 KB FRAM	3750	Reader: -25 °C to +70 °C Transponder: -40 °C to +85 °C	IQ-Sense interface available; integrated diagnostic functions; battery-free data memory
MOBY D	13.56 MHz	0.8 m	112 byte EEPROM	110	+ 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	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 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.

The RF300 for low-performance applications offers a particularly low-cost solution concept. It comprises the system components:

- 8xIQ-Sense communication module for ET 200M (PROFIBUS) and for direct connection to an S7-300
- RF310R reader with IQ-Sense interface
- RF320T, RF340T, RF350T and RF360T transponders

The high-performance components of RF300 provide advantages in terms of speed. The system configuration includes the following components:

- ASM 452, ASM 456 and ASM 473 (PROFIBUS) and ASM 475 (S7-300 / ET 200M) communication modules
- RF310R, RF340R, RF350R readers with RS 422 interface
- RF320T, RF340T, RF350T and RF360T transponders.

RF300 is ready for multi-tag operation, but in this expansion stage, only the faster single-tag operation is possible.

3.2.2 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

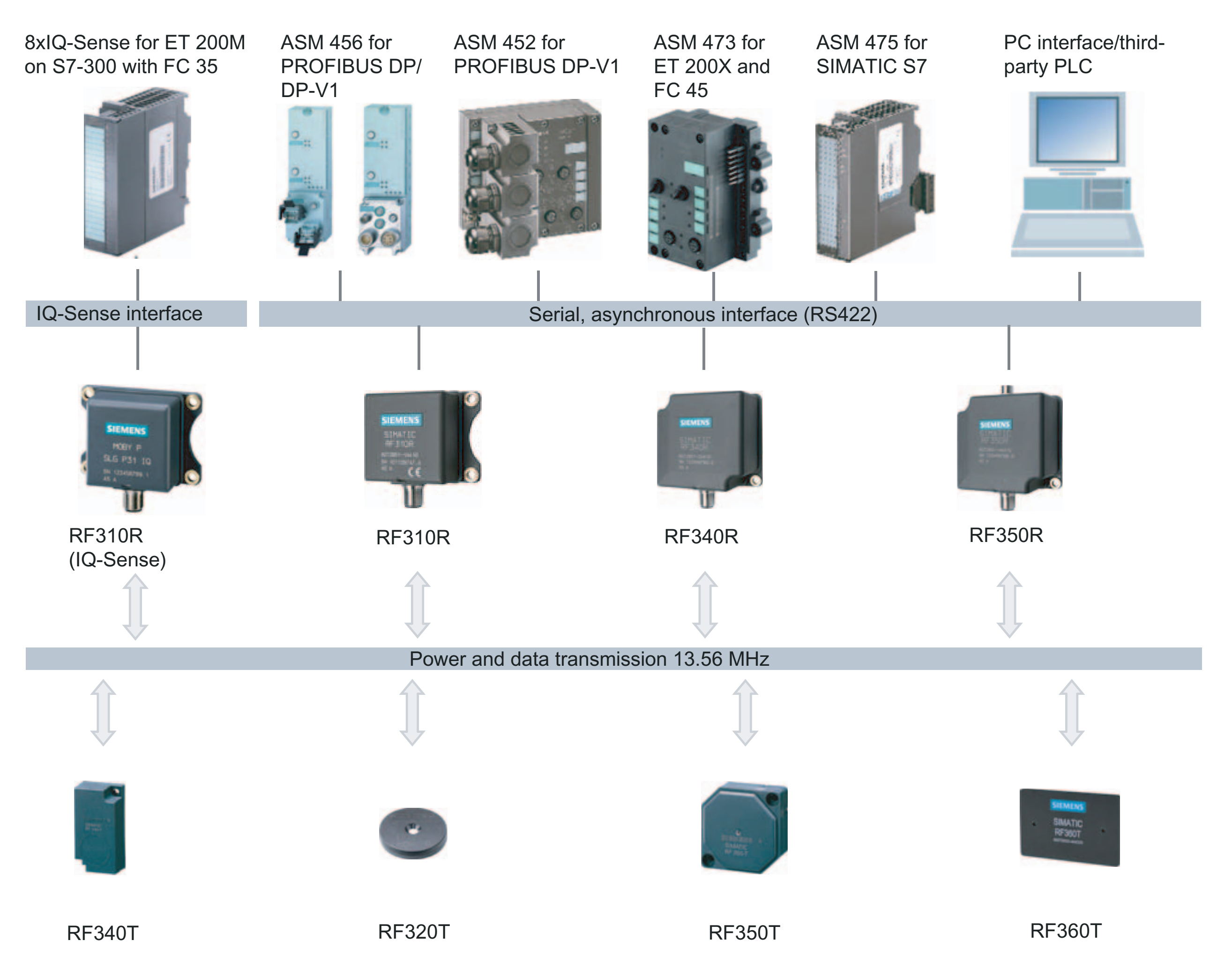
- Production lines for engines, gearboxes, axles, etc.
- Assembly lines for ABS systems, airbags, brake systems, doors, cockpits, etc.
- Assembly lines for household electrical appliances, consumer electronics and electronic communication equipment
- Assembly lines for PCs, low-power motors, contactors,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

Customer benefits

- Reading and writing of large data volumes within a short time enable reductions in product 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 startup times, and reductions in plant faults and downtimes thanks to integral diagnostics functionalities
- Cost savings thanks to maintenance-free components

3.2.3 RFID components and their function

RF300 system components



Communication modules	A communication module (interface module) is used to integrate the RF identification system in PLC/automation systems.
Reader	The reader (read/write device) ensures inductive communication, supplies power to the transponder, and handles the connection to the various PLCs (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.

Conventions

The RF310R and RF340R 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.

3.2.4 Technical data

RFID system RF300	
Type	Inductive identification system for industrial applications
Transmission frequency data/energy	13.56 MHz
Memory capacity	20 bytes up to 32 KB user memory (r/w) 4 bytes fixed code as serial number (ro)
Memory type	EEPROM / FRAM
Write cycles	EEPROM: > 100 000 FRAM: Unlimited
Read cycles	Unlimited
Data management	Byte-oriented access
Data transfer rate Transponder-Reader	3 KB/s (approx.)
Read/write distance (system limit; depends on reader and transponder)	Up to 0.1 m
Operating temperature	Reader: -25°C to +70°C Transponder: -40°C to +85°C
Degree of protection	Reader: IP 65 Transponder: > IP 67
Can be connected to	SIMATIC S7-300, Profibus DP V1, PC [1)], non-Siemens PLC [1)]
Special features	High noise immunity Compact components Extensive diagnostic options A reader with IQ-Sense interface
Approvals	ETS 300 330 (Europe) FCC Part 15 (USA), UL/CSA (available soon) CE
1) By means of RS 422 interface and 3964R protocol	

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:

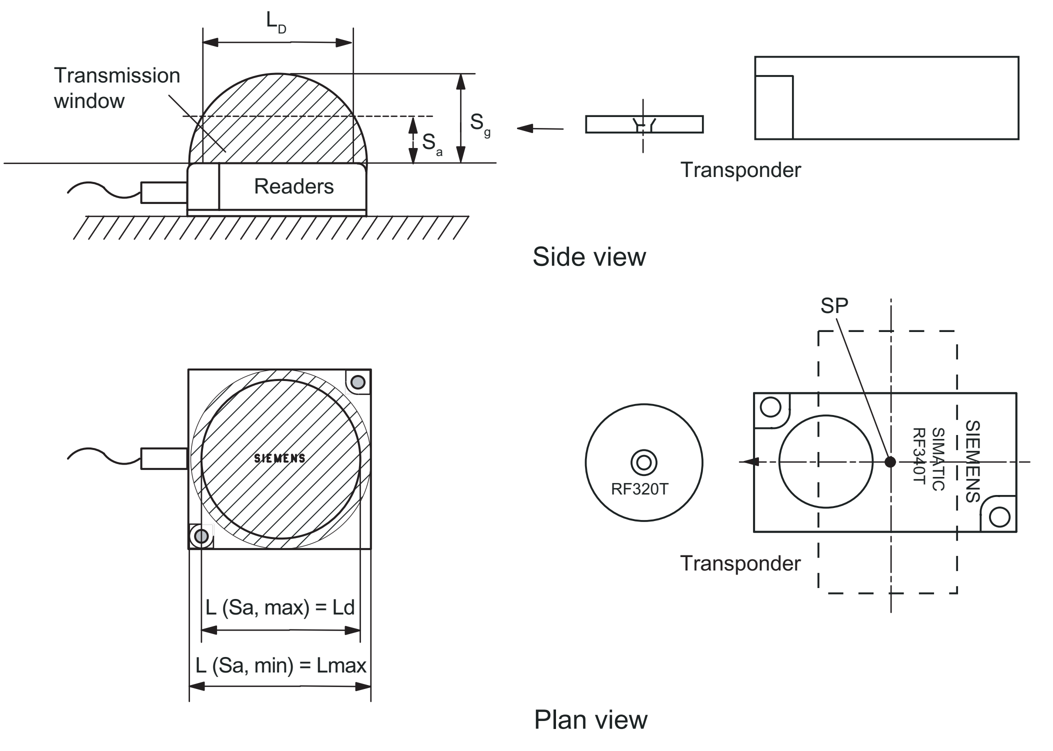
- Transmission distance (read/write distance)
- Tracking tolerances
- Static or dynamic data transfer
- Data volume to be transferred
- Speed in case of dynamic transfer
- Metal-free rooms for transponders and readers
- Ambient conditions such as relative humidity, temperature, chemical impacts, etc.

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.

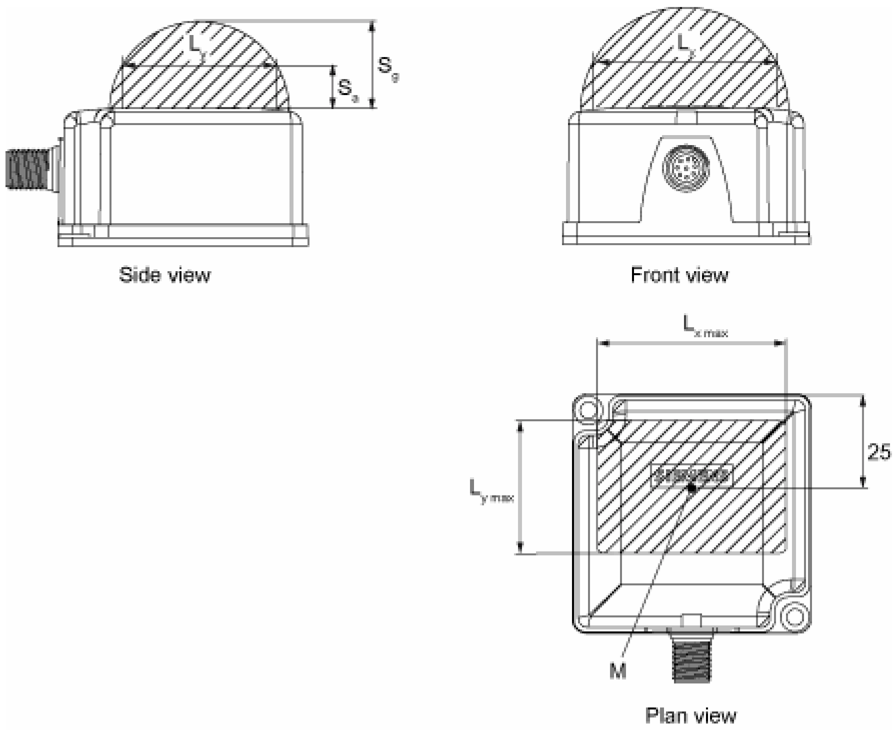
A prerequisite for the function of the transponder is a minimum field strength at the transponder achieved at a distance S_g from the reader. The picture below shows the transmission window between transponder and reader:

Table 4-1 Reader and ANT1 transmission window and read/write distance



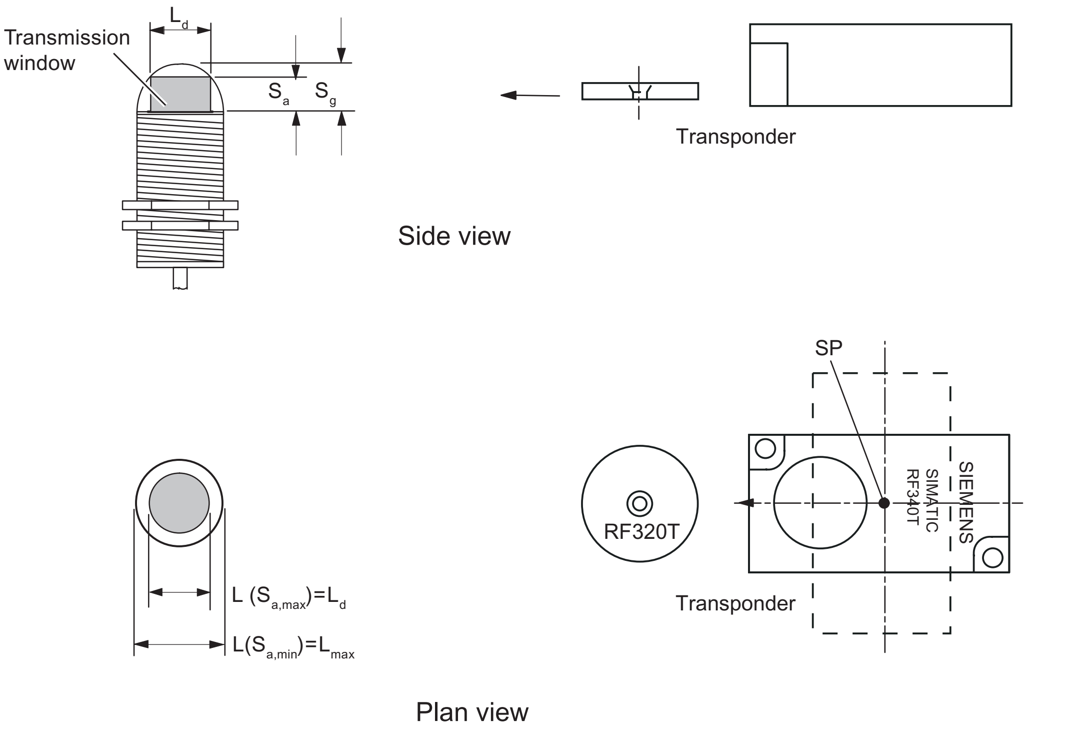
S_a:	Operating distance between transponder and reader
S_g	Limit distance (maximum clear distance between upper surface of the reader and the transponder, at which the transmission can still function under normal conditions)
L	Length of a transmission window The length L_D is valid for the calculation. 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 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}, see field data.
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 $L_{y\,max}$, see field data.
M	Center of antenna

Table 4-3 ANT18 and ANT30 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	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

The active field for the transponder consists of a circle (cf. plan view).

The transponder can be used as soon as the intersection (SP) of the transponder enters the circle 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.

4.1.5 Permissible directions of motion of the transponder

Active 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:

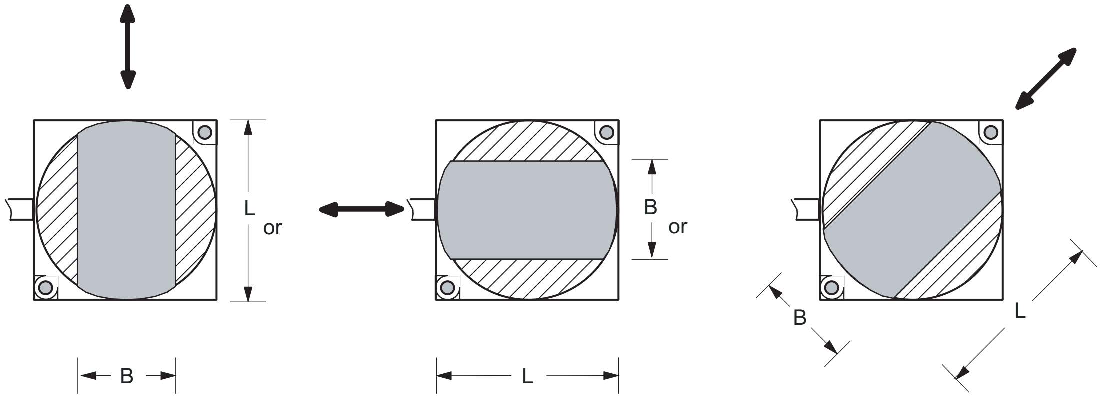


Figure 4-1 Active areas of the transponder for different directions of transponder motion

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:

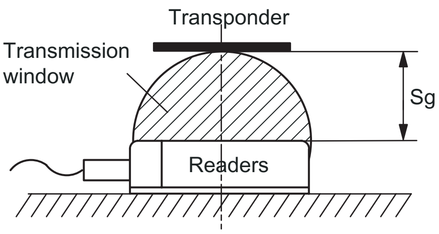


Figure 4-2 Operation in static mode

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.

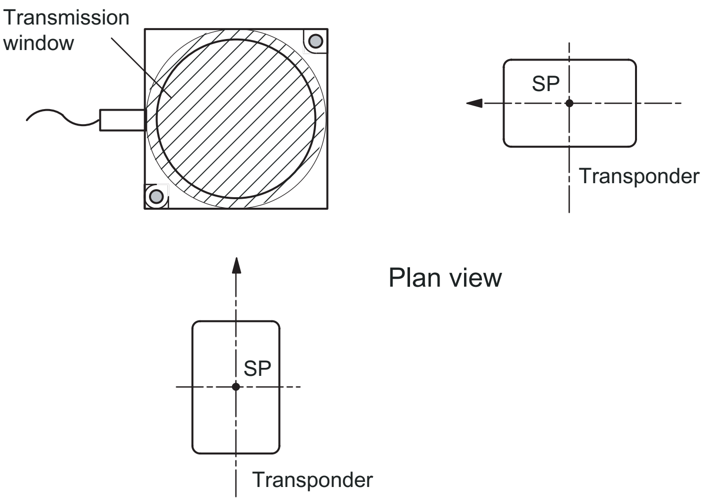


Figure 4-3 Operation in dynamic mode

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:

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

t_V:	Dwell time of the transponder
L:	Length of the transmission window
v_{TPDR}:	Speed of the transponder (TPDR) 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 (with IQ-Sense interface) and transponder

Communication between the communication module (IQ-Sense), RF310R reader and transponder takes place in fixed telegram cycles. 3 cycles of approximately 3 ms are always needed for the transfer of a read or write command. 1 or 2 bytes of user data can be transferred with each of these commands. The acknowledgement transfer (status or read data) takes place in 3 further cycles. The transponder must be present within the field of the reader during the message frame cycle.

Calculation of the communication time for interference-free transfer

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

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

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, RF310R IQ-Sense 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 (internal system time) This contains the time for power buildup on the transponder and for command transfer

Time constants K and t_{Byte}

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 (IQ-Sense)

A transport system moves pallets with transponders at a maximum velocity of V_{TPDR} = 0.14 m/s. The following RFID components were chosen:

- 8xIQ-Sense module
- Reader RF310R
- Transponder RF340T

Task specification

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

b) The programmer should be given the maximum number of words 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

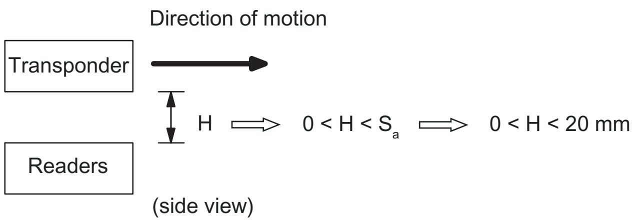


Figure 4-4 Tolerance of pallet transport height

Determine tolerance of pallet side transport

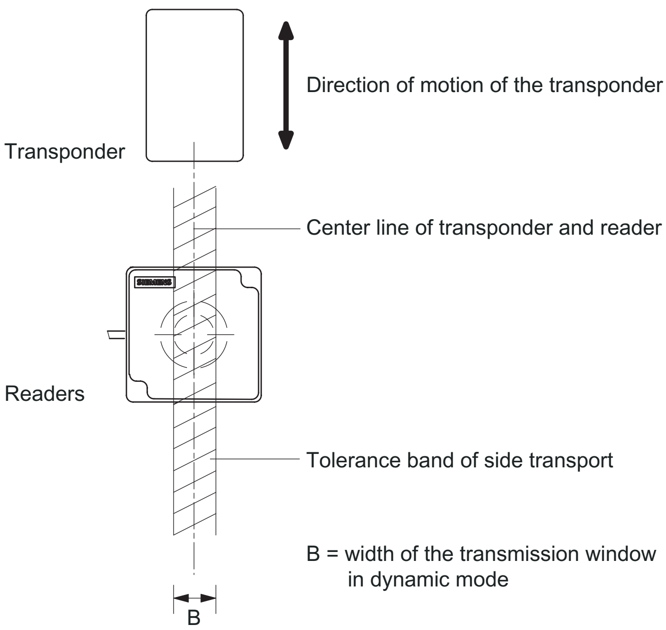


Figure 4-5 Tolerance of pallet side transport

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_{TPDR} = 0.14m/s $t_v = \frac{L \cdot 0{,}8}{v_{TPDR}} = \frac{0{,}038m \cdot 0{,}8}{0{,}14m/s} = 0{,}217s = 217ms$
2.	Calculate maximum user data (n_{max}) for reading	Take value t_v from Step 1. Take values K and t_{Byte} from Table "Time constants K and t_{Byte}". Read: $\frac{t_v - K}{t_{Byte}} = \frac{217ms - 15ms}{15ms} = 13.47 \Rightarrow n_{max.} = 13\,byte$
3.	Calculate maximum user data (n_{max}) for writing (FRAM area)	Take value t_v from Step 1. Take values K and t_{Byte} from Table "Time constants K and t_{Byte}". Write: $\frac{t_v - K}{t_{Byte}} = \frac{217ms - 15ms}{15ms} = 13.47 \Rightarrow n_{max.} = 13\,byte$

Result

A maximum of 13 bytes can be read or written when passing the transponder.

4.1.10 Communication between communication module, reader (with RS 422 interface) and transponder

Communication between the communication module, reader and transponder takes place asynchronously through the RS 422 interface. Depending on the communication module (ASM) used, transmission rates of 19200 bytes, 57600 bytes or 115200 bytes can be selected.

Calculation of the communication time for interference-free transfer

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

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

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

Time constants K and t_{byte}

<table>
<tr><th>Transmission rate [baud]</th><th>K [ms]</th><th>t_{byte} [ms]</th></tr>
<tr><td>19200</td><td>28</td><td>0,85</td></tr>
<tr><td>57600</td><td>14</td><td>0,38</td></tr>
<tr><td>115200</td><td>11</td><td>0,28</td></tr>
<tr><td colspan="3">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.</td></tr>
</table>

<table>
<tr><th>Transmission rate [baud]</th><th>Memory area</th><th>K [ms]</th><th>t_{byte} [ms]</th></tr>
<tr><td>Independent</td><td>FRAM</td><td>8,5</td><td>0,13</td></tr>
<tr><td>Independent
Write
Read</td><td>EEPROM</td><td>
8,5
8,5</td><td>
12,2
0,13</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

4.1.11 Calculation example (RS 422)

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

- Communication module ASM 475
- RF310R reader with RS 422 interface
- Transponder RF340T

Task specification

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

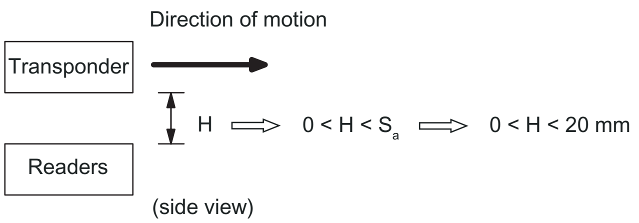


Figure 4-6 Tolerance of pallet transport height

Determine tolerance of pallet side transport

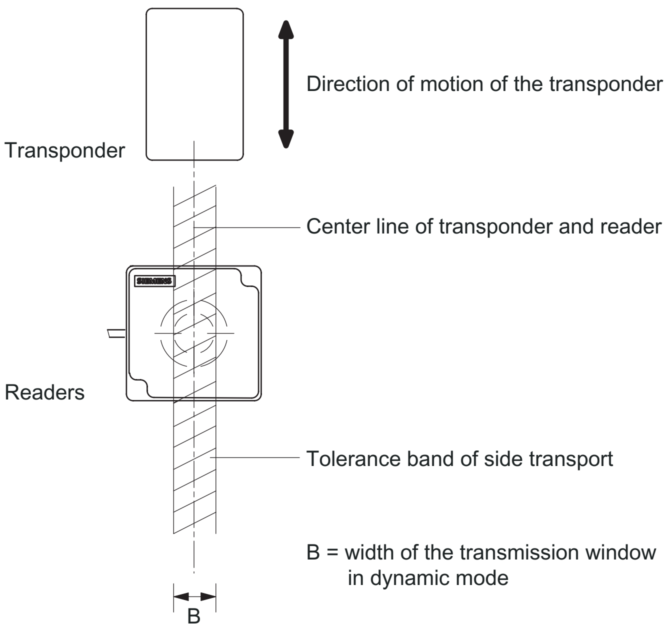


Figure 4-7 Tolerance of pallet side transport

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_{TPDR} = 1,00 m/s $t_v = \frac{L \cdot 0{,}8}{v_{TPDR}} = \frac{0{,}038m \cdot 0{,}8}{1{,}0m/s} = 0{,}0304s = 30{,}4ms$
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: $\frac{t_v - K}{t_{Byte}} = \frac{30{,}4ms - 8{,}5ms}{0{,}13ms} = 168{,}46 \Rightarrow n_{max} = 168\,Byte$

Result

A maximum of 168 bytes can be read or written when passing the transponder.

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 data 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.

Field data of all transponders and readers without interference from metal

Reader		Transponder RF320T	Transponder RF340T	Transponder RF350T	Transponder RF360T
					
Reader RF310R 	Length of the transmission window (L)	30 mm	38 mm	45 mm	45 mm
	Width of the transmission window (W)	12 mm	15 mm	18 mm	18 mm
	Operating distance (S_a)	1- 10 mm	1 - 20 mm	2 - 22 mm	2 - 26 mm
	Limit distance (S_g)	16 mm	26 mm	30 mm	35 mm

Reader		Transponder RF320T	Transponder RF340T	Transponder RF350T	Transponder RF360T
Reader RF340R 	Length of the transmission window (L)	45 mm	60 mm	60 mm	70 mm
	Width of the transmission window (W)	18 mm	24 mm	24 mm	28 mm
	Operating distance (S_a)	1- 20 mm	2- 25 mm	5- 35 mm	8- 40 mm
	Limit distance (S_g)	25 mm	35 mm	50 mm	60 mm
Antenna RF350R / ANT1 	Length of the transmission window (L)	45 mm	60 mm	60 mm	70 mm
	Width of the transmission window (W)	18 mm	24 mm	24 mm	28 mm
	Operating distance (S_a)	1- 20 mm	2- 25 mm	5- 35 mm	8- 40 mm
	Limit distance (Sg)	25 mm	35 mm	50 mm	60 mm
Antenna RF350R / ANT18 	Diameter of the transmission window (L_d)	10 mm	20 mm	- [1]	- [1]
	Operating distance (S_a)	1- 8 mm	1- 10 mm	- [1]	- [1]
	Limit distance (S_g)	10 mm	13 mm	- [1]	- [1]
Antenna RF350R / ANT30 	Diameter of the transmission window (L_d)	15 mm	25 mm	25 mm	- [1]
	Operating distance (S_a)	0- 11 mm	0- 15 mm	0- 16 mm	- [1]
	Limit distance (S_g)	15 mm	20 mm	22 mm	- [1]
- [1] : not enabled					

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

Minimum distance from transponder to transponder

RF320T	RF340T	RF350T	RF360T
≥ 100 mm	≥ 100 mm	≥ 200 mm	≥ 300 mm

Minimum distance from reader to reader

RF310R to RF310R	RF340R to RF340R
≥ 400 mm	≥ 500 mm

Minimum distance from antenna to antenna

ANT1	ANT18	ANT30
≥ 800 mm	≥ 125 mm	≥ 200 mm

Notice

Adherence to the values specified in the "Minimum distance from reader to reader" table is essential. The inductive fields may be affected if the distance is smaller. In this case, the data transfer time would increase unpredictably or a command would be aborted with an error.

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.

4.3 Relationship between the volume of data and the transponder speed

4.3.1 RF310R with IQ-Sense

The curves shown here show the relationship between the speed of the RF320T and RF340T transponders and the volume of data transferred.

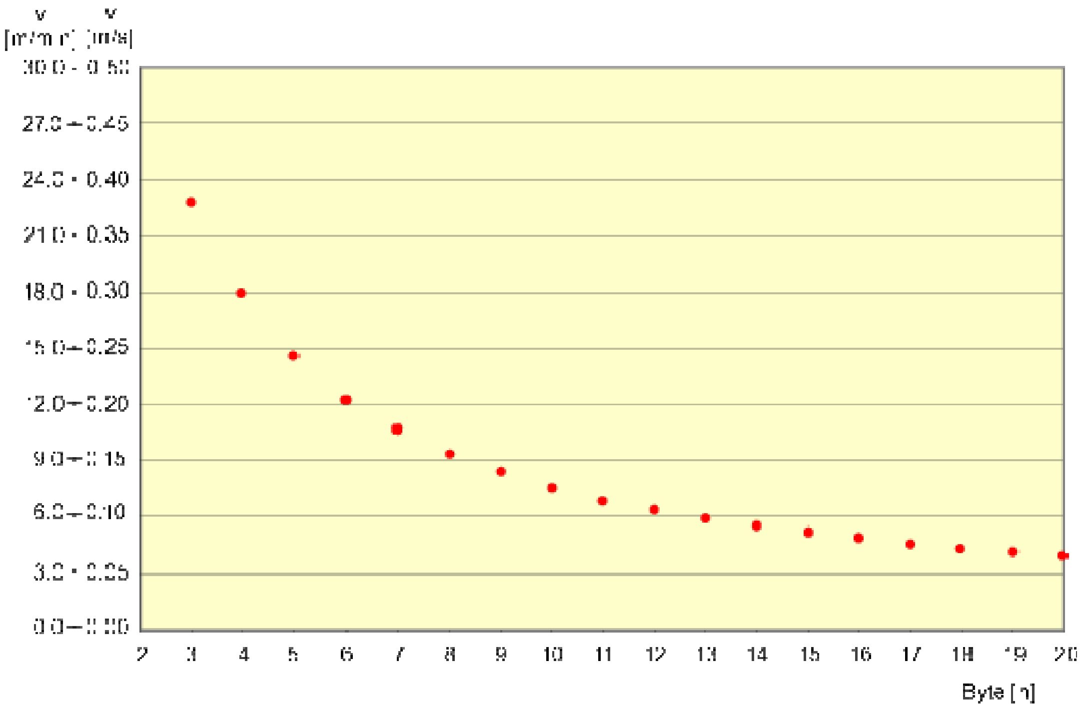


Figure 4-8 Relationship between speed and volume of data when using the RF310R (IQ-Sense)

4.3.2 RF310R with RS 422

The curves depicted here show the relationship between the speed of the RF320T, RF340T, RF350T and RF360T transponders and the RF310R reader with RS 422 interface and the corresponding volume of data.

They should make it easier to preselect the transponders for dynamic use.

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF320T	RF340T	RF350T	RF360T
Length of the transmission window (L)	30 mm	38 mm	45 mm	45 mm
Working distance (Sa)	10 mm	20 mm	22 mm	26 mm

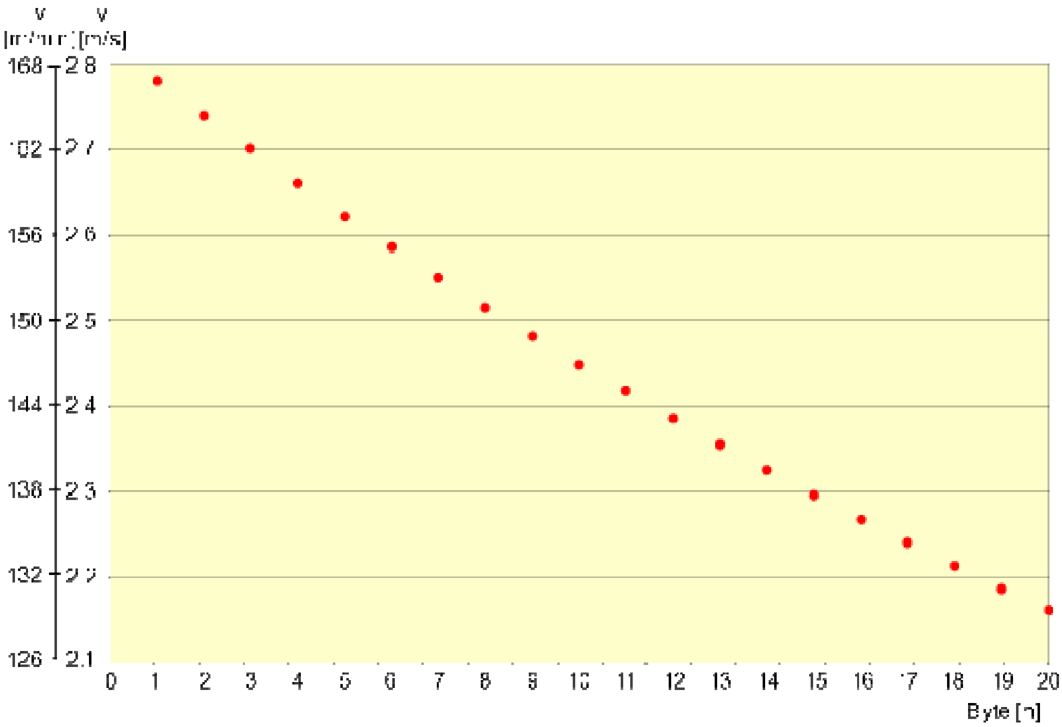


Figure 4-9 Relationship between speed and volume of data (reading from EEPROM) when using the RF310R (RS 422) and RF320T

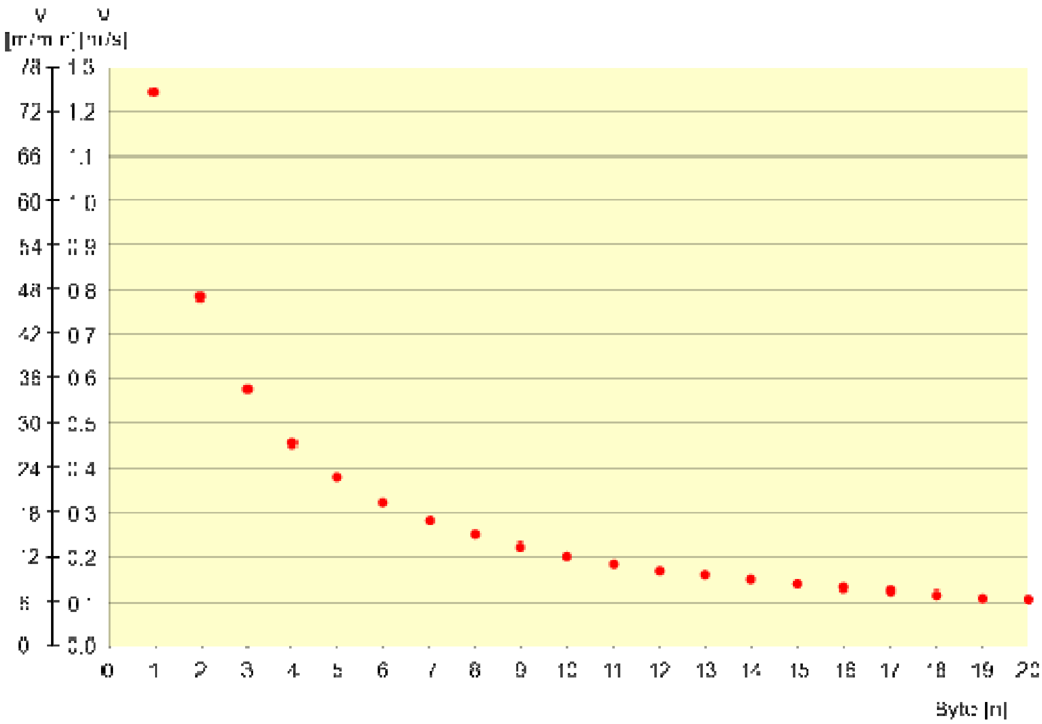


Figure 4-10 Relationship between speed and volume of data (writing to EEPROM) when using the RF310R (RS 422) and RF320T

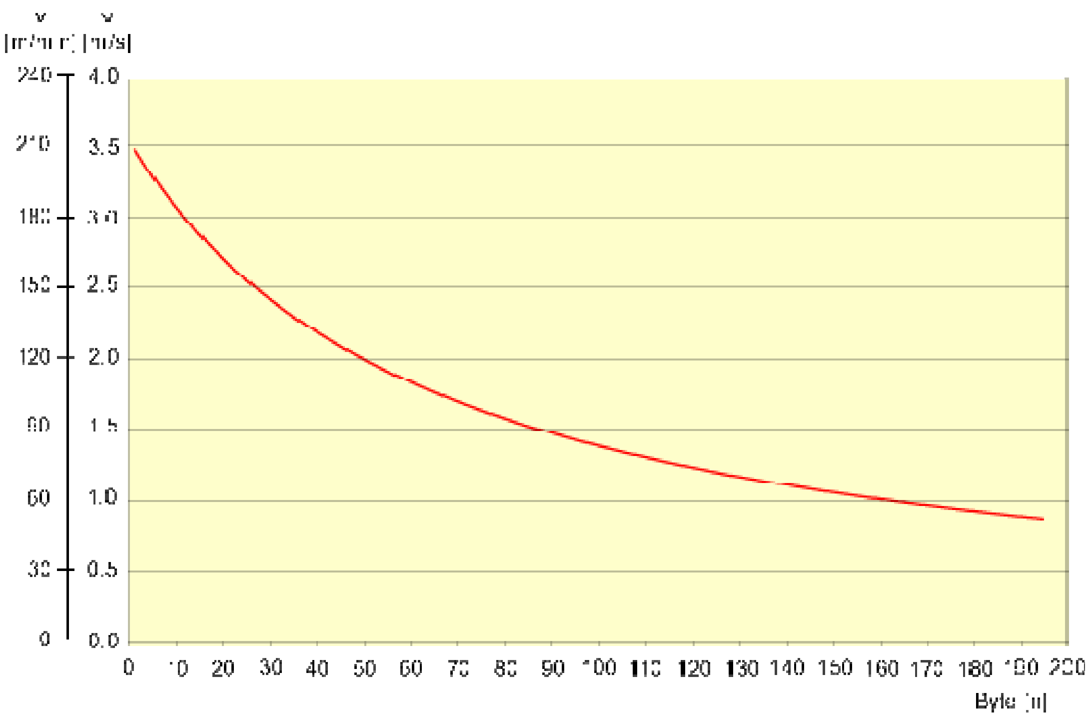


Figure 4-11 Relationship between speed and volume of data (reading/writing) when using the RF310R (RS 422) and RF340T

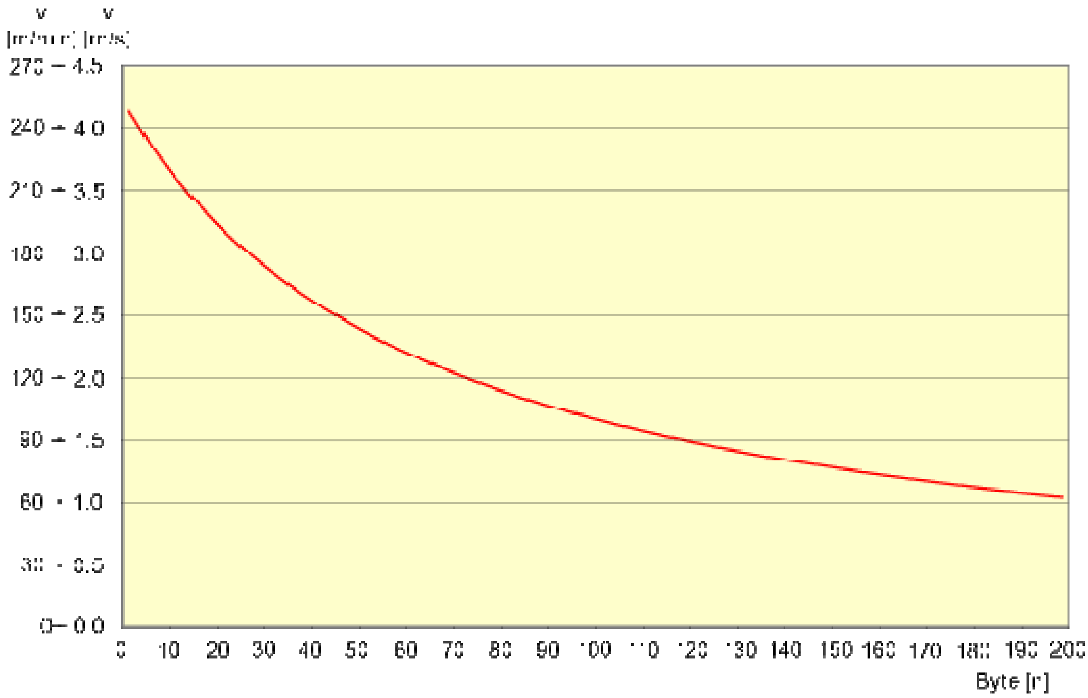


Figure 4-12 Relationship between speed and volume of data (reading/writing) when using the RF310R (RS 422) and RF350T/RF360T

Note:

The curves for the RF320T are valid for reading/writing to the EEPROM memory area of the RF340T, RF350T and RF360T transponders.

4.3.3 RF340R

The curves shown here show the relationship between the speed of the RF320T, RF340T, RF350T and RF360T transponders and the RF340R reader and the corresponding volume of data.

They should make it easier to preselect the transponders for dynamic use.

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF320T	RF340T	RF350T	RF360T
Length of the transmission window (L)	30 mm	38 mm	45 mm	45 mm
Working distance (Sa)	10 mm	20 mm	22 mm	26 mm

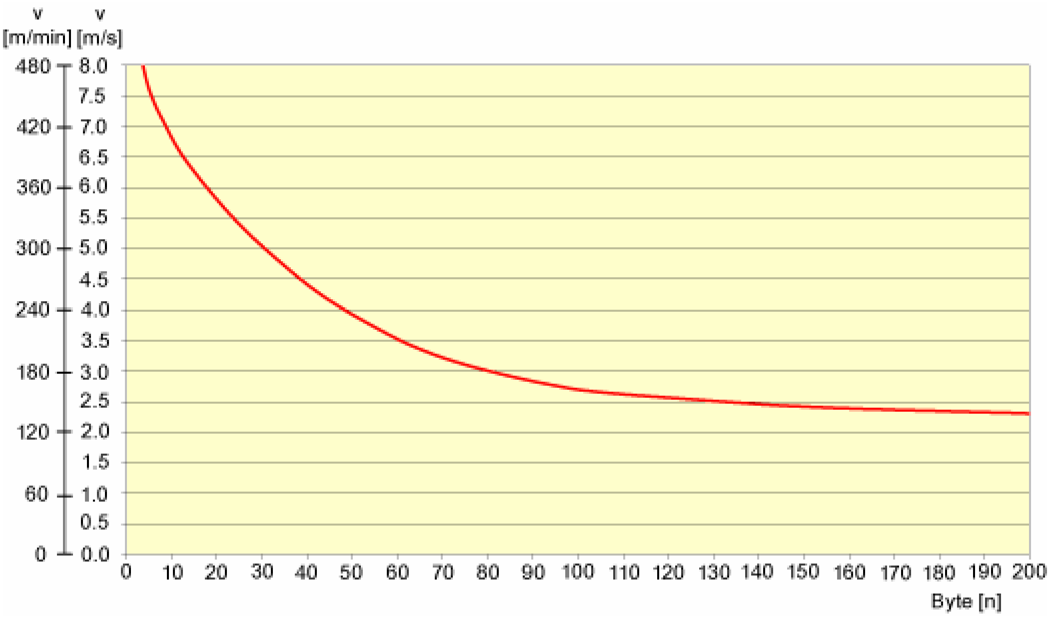


Figure 4-13 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF340R and RF320T

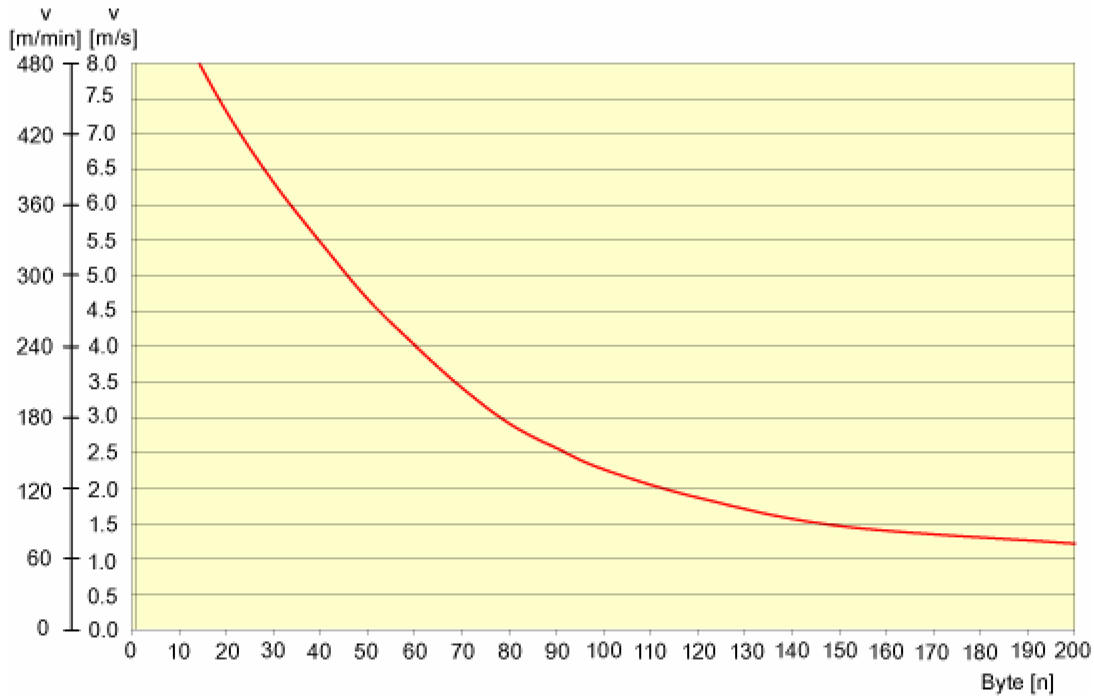


Figure 4-14 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF340R and RF340T

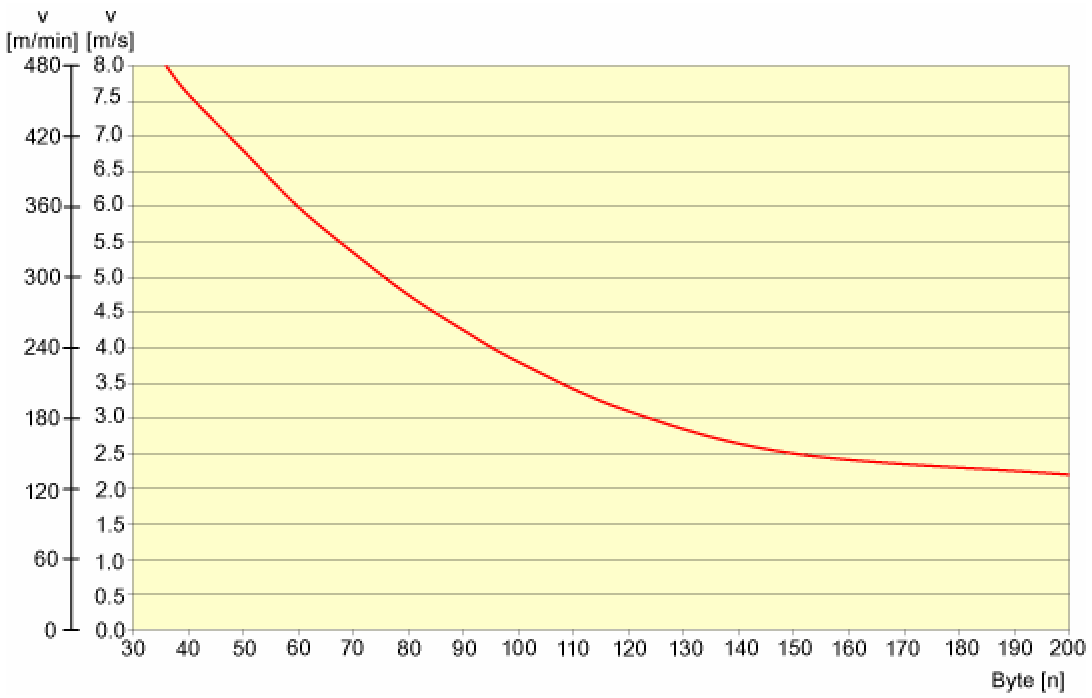


Figure 4-15 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF340R and RF350T

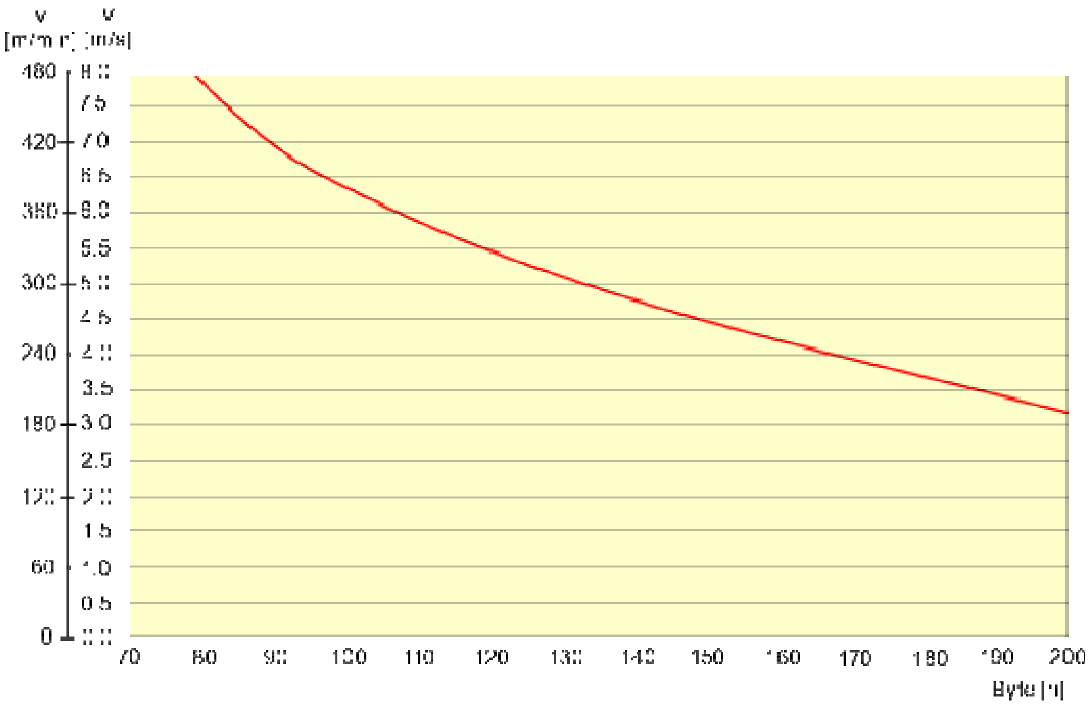


Figure 4-16 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF340R and RF360T

Note:

The curve for the RF320T is valid for reading/writing to the EEPROM memory area of the RF340T, RF350T and RF360T transponders.

4.3.4 RF350R

The curves shown here show the relationship between the speed of the RF320T, RF340T, RF350T and RF360T transponders and the RF350R reader and the corresponding volume of data.

They should make it easier to preselect the transponders and the plug-in antenna ANT1 for dynamic use.

The following table is used to calculate the curves.

The indicated speeds are applicable for operation without presence check.

	RF320T	RF340T	RF350T	RF360T
Length of the transmission window (L)	30 mm	38 mm	45 mm	45 mm
Working distance (Sa)	10 mm	20 mm	22 mm	26 mm

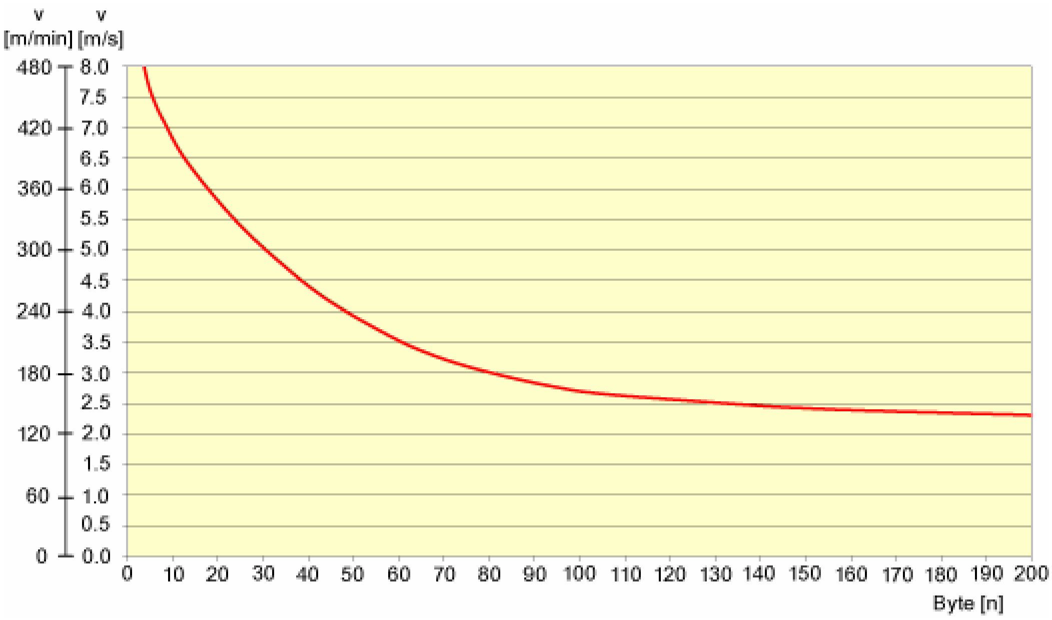


Figure 4-17 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF350R with ANT1 and RF320T

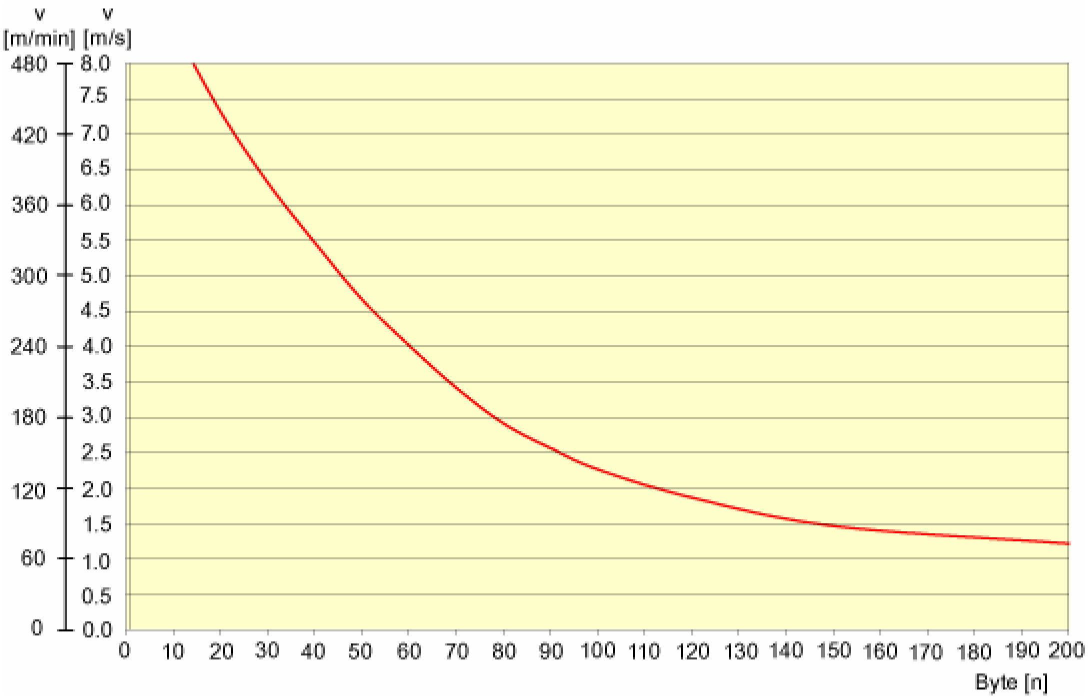


Figure 4-18 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF350R with ANT1 and RF340T

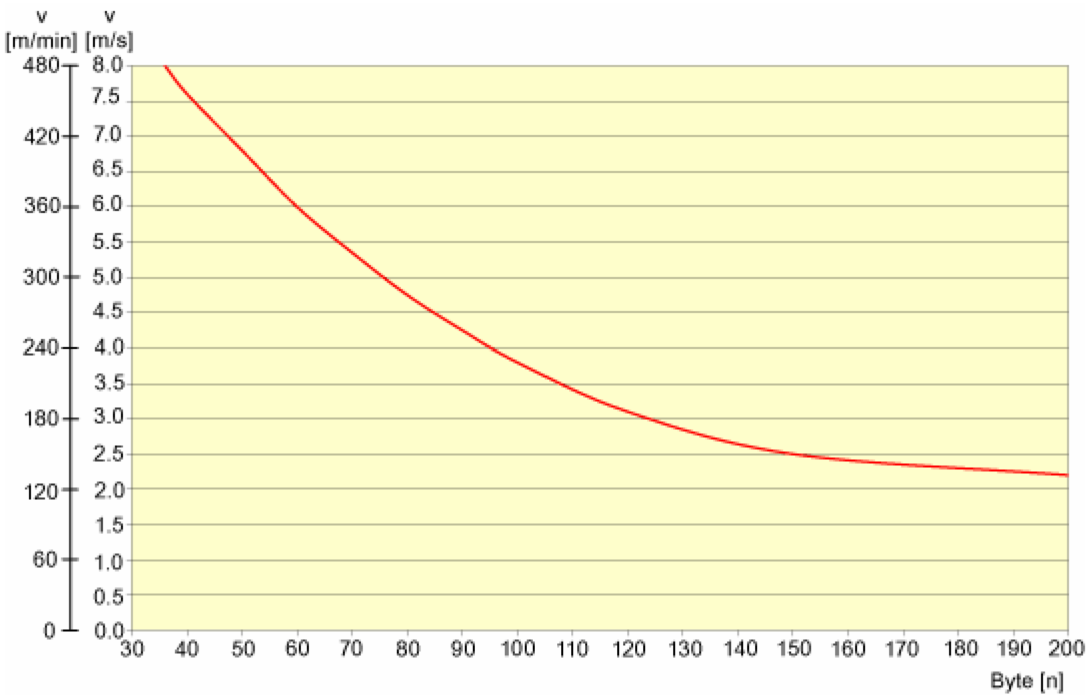


Figure 4-19 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF350R with ANT1 and RF350T

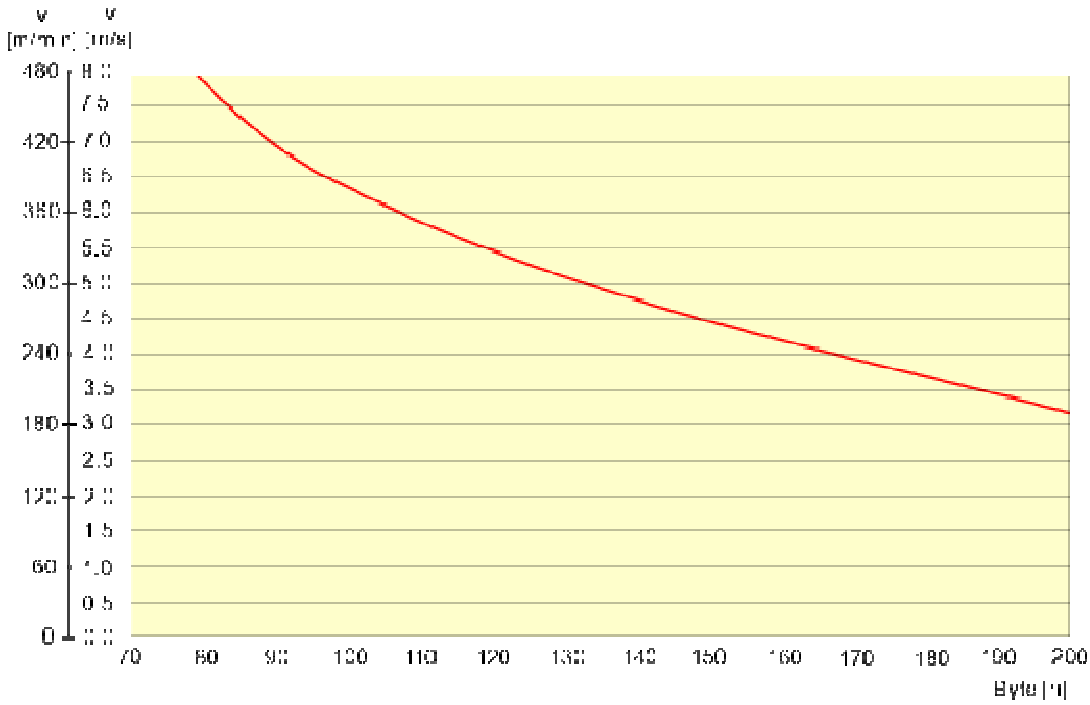


Figure 4-20 Relationship between speed and volume of data (reading/writing from FRAM) in dynamic operation when using the RF350R with ANT1 and RF360T

Note:

The curves for the RF320T are valid for reading/writing to the EEPROM memory area of the RF340T, RF350T and RF360T transponders.

Note:

The antennas ANT18 and ANT30 only have small transmission windows. They are therefore only suitable for dynamic operation to a limited extent. It was not necessary to show corresponding curves.

4.4 Installation guidelines

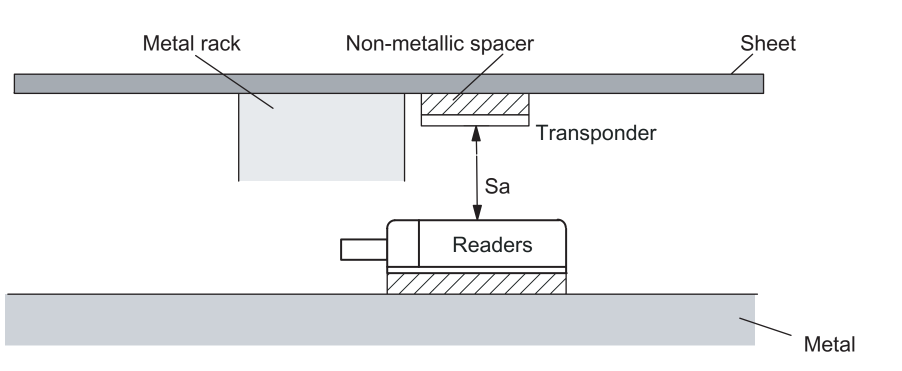
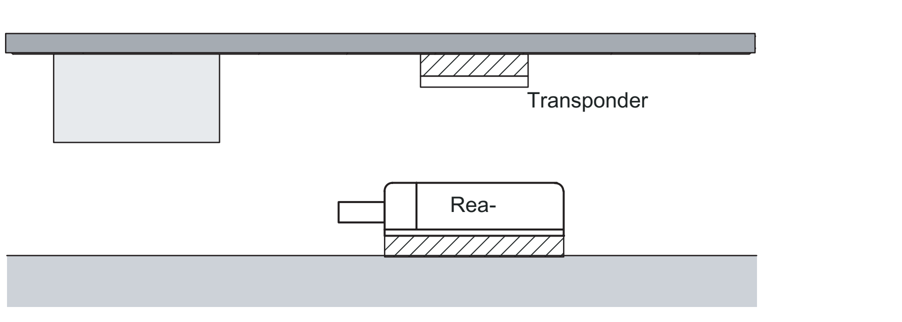
4.4.1 Overview

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:

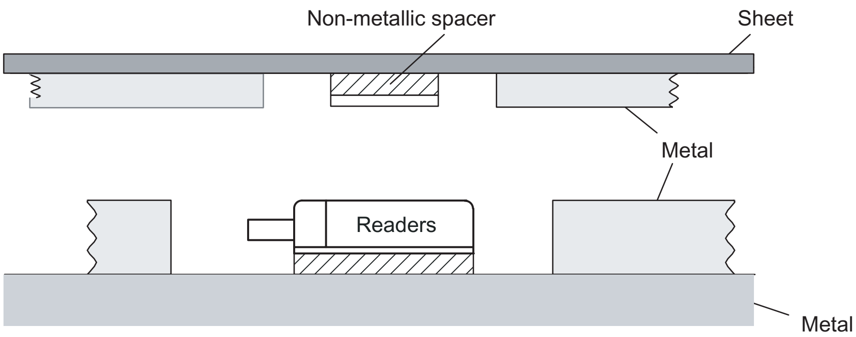
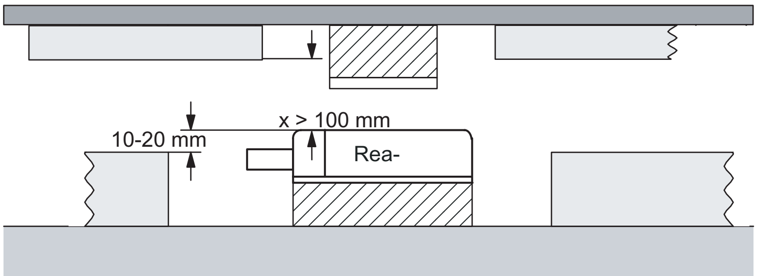
- Minimum spacing between two readers or their antennas
- Minimum distance between two adjacent data memories
- Metal-free area for flush-mounting of readers or their antennas and transponders in metal
- Mounting of multiple readers or their antennas on metal frames or racks

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

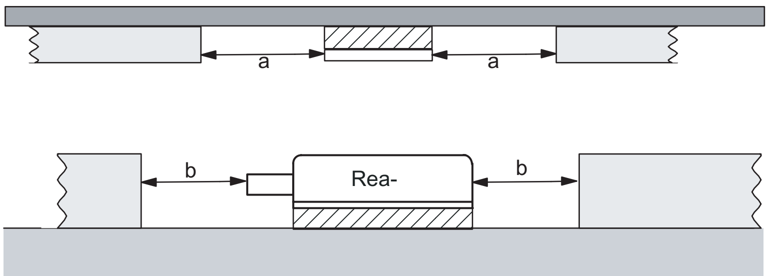
4.4.2 Reduction of interference due to metal

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

<table>
<tr><th>Flush-mounting of transponders and readers</th><th>Problem</th></tr>
<tr><td>
</td><td>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:</td></tr>
<tr><td rowspan="2">
</td><td>Remedy:</td></tr>
<tr><td>Enlargement of the non-metallic spacer below the transponder and/or reader.

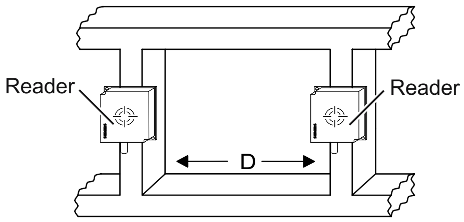
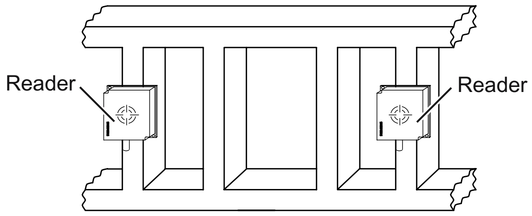
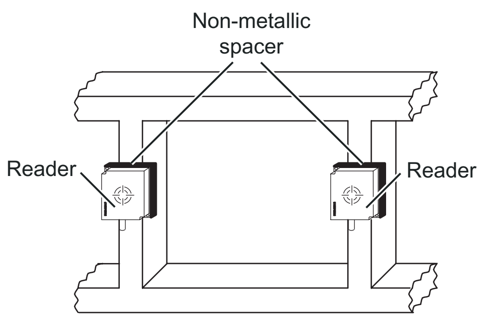
The transponder and/or reader are 10 to 20 mm higher than the metal surround.

(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.)</td></tr>
<tr><td rowspan="2">
</td><td>Remedy:</td></tr>
<tr><td>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.</td></tr>
</table>

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:

4.4.3 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.

4.4.4 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).

Reduction of field data: Transponder and RF310R reader

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

	Reader RF310R		
Transponder	**Without metal**	**on metal**	**flush-mounted in metal (20 mm surround)**
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

Reduction of field data: Transponder and RF340R reader

Table 4-5 Reduction of field data by metal (in %): Transponder and RF340R

	Reader RF340R		
Transponder	Without metal	on metal	flush-mounted in metal (20 mm surround)
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

Reduction of field data: Transponder and RF350R reader with ANT1

Table 4-6 Reduction of field data by metal (in %): Transponder and RF350R with ANT1

	Mounting the antenna		
Transponder	**Without metal**	**on metal**	**flush-mounted in metal (20 mm surround)**
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

Reduction of field data: Transponder and RF350R reader with ANT18

Table 4-7 Reduction of field data by metal (in %): Transponder and RF350R with ANT18

	Mounting the antenna	
Transponder	**Without metal**	**flush-mounted in metal (10 mm surround; 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
RF350T		
Without metal	1)	1)
on metal	1)	1)
Flush-mounted in metal; distance all-round 20 mm	1)	1)
RF360T		
Without metal	1)	1)
On metal; distance 20 mm	1)	1)
Flush-mounted in metal; distance all-round 20 mm	1)	1)
1) combination not permitted		

Reduction of field data: Transponder and RF350R reader with ANT30

Table 4-8 Reduction of field data by metal (in %): Transponder and RF350R with ANT30

	Mounting the antenna	
Transponder	**Without metal**	**flush-mounted in metal (20 mm surround; 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
RF360T		
Without metal	1)	1)
On metal; distance 20 mm	1)	1)
Flush-mounted in metal; distance all-round 20 mm	1)	1)
1) combination not permitted		

4.5 Chemical resistance of the transponders

The following table provides an overview of the chemical resistance of the data memories made of glass-fiber-reinforced epoxy resin (E624). 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		○○○○		
Benzol		○○○○		
Benzenesulphonic acid		○○○○		
Benzyl chloride		–		
Borax				○○○○
Boric acid		○○○○		
Bromine, liquid		–		
Bromine, gas, dry		–		
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 %	–		

	Concentration	20°C	40°C	60°C
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		○○○○		
Hydroxide (ammonium)	10 %	○○○○		
Hydroxide (Na–, K–)	40 %	○○○○		
Hydroxide (alkaline earth metal)				○○○○
Hypochlorite (K–, Na.a.)				○○○○
Iodide (K–, Na.a.)				○○○○

	Concentration	20°C	40°C	60°C
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		○○○○		

Transponders RF340T, RF350T

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	○○○	○○

	Concentration	20°C	60 °C
Sodium carbonate, w. (soda)	k. g.	○○○○	○○○○
Sodium chloride, w.	k. g.	○○○○	○○○○
Sodium hydroxide		○○○○	○○○○
Nickel salts, w.	k. g.	○○○○	○○○○
Nitrobenzol		○○○	○○
Phosphoric acid	10	○	-
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

4.6 EMC Directives

4.6.1 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.

4.6.2 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.

4.6.3 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 high-voltage and signal 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.
- Cable routing of HF cables:
  Avoid installing cables in parallel over long distances and maintain minimum distances between the cables (at least 25 cm).

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.

4.6.4 Propagation of electromagnetic interference

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

- Interference source
- Coupling path
- Interference sink

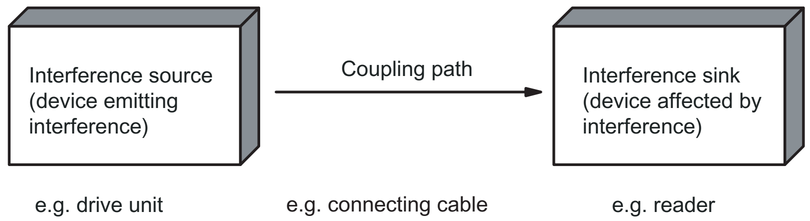


Figure 4-21 Propagation of interference

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 4-9 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
HF interference over the antennas	caused by another reader	• Change the operating mode of the reader. • Position the antennas further apart. • Erect suitable damping materials between the antennas. • Reduce the power of the readers.

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:

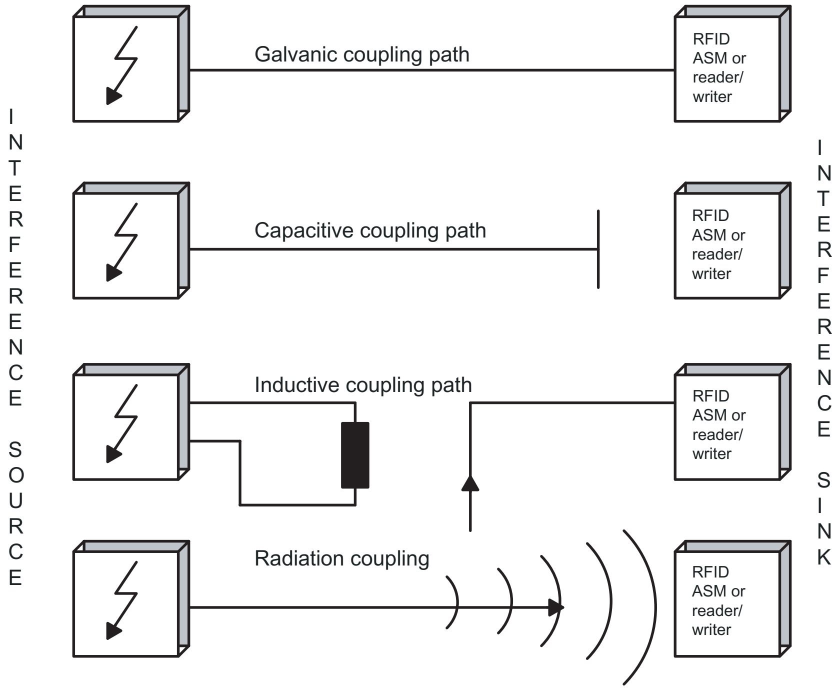


Figure 4-22 Ways in which interference can be coupled in

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

Table 4-10 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

4.6.5 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.

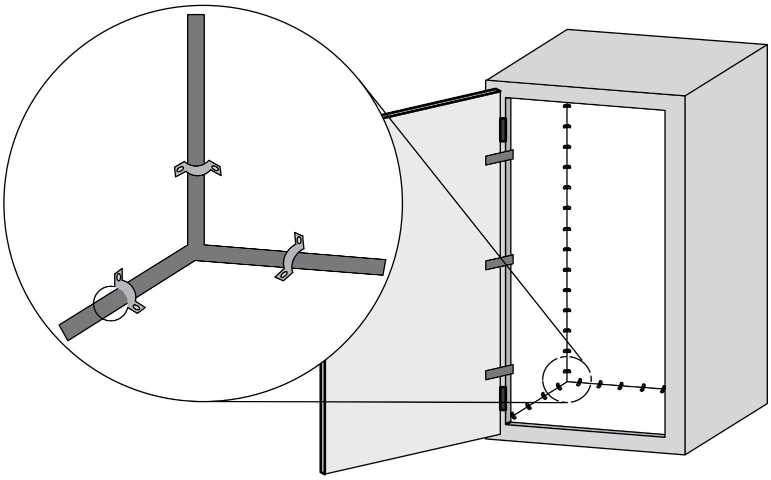


Figure 4-23 Shielding by enclosure

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.