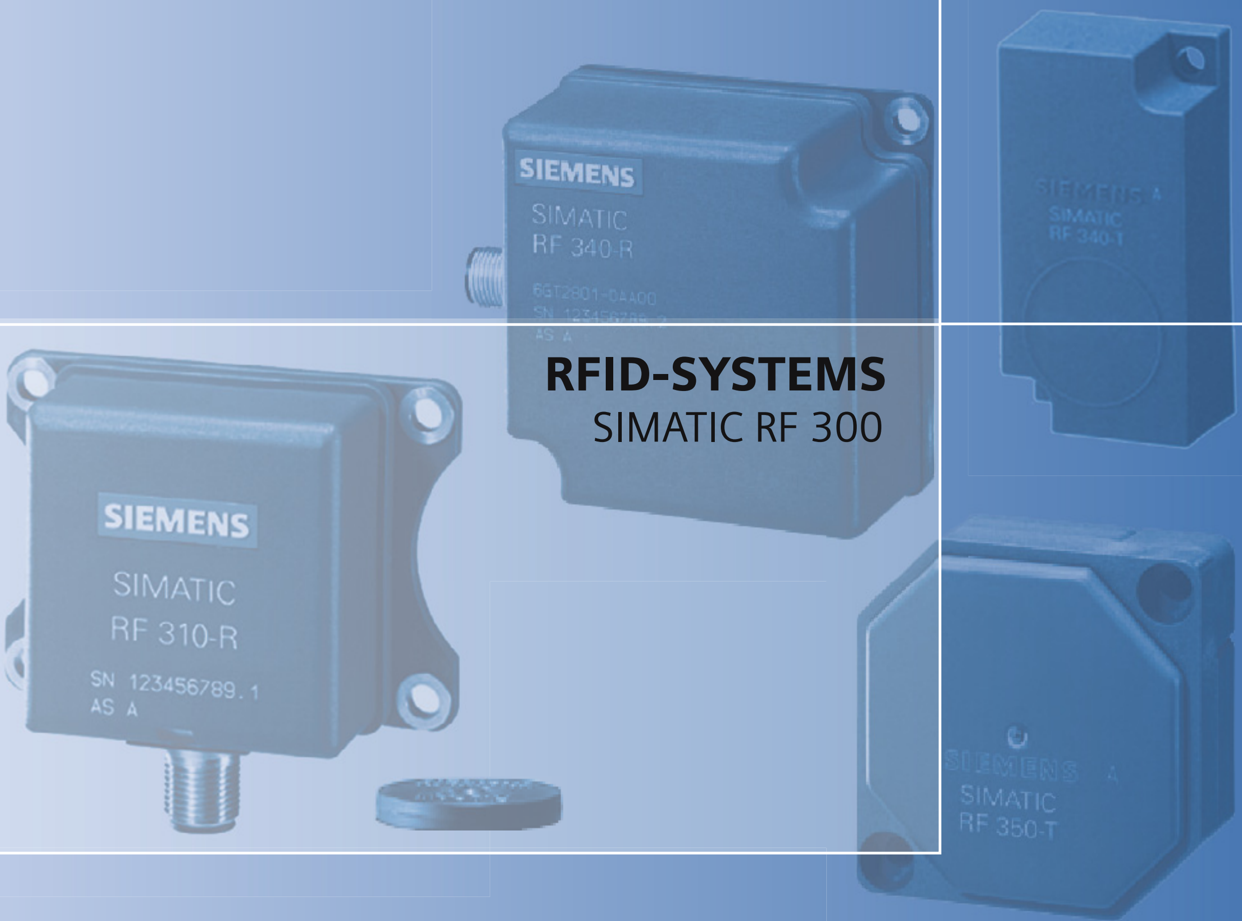
System Manual Edition 05/2005



RFID-SYSTEMS

SIMATIC RF 300

simatic sensors

SIEMENS

SIEMENS

SIMATIC

RFID systems
RF 300

System Manual

Introduction	1
Safety information	2
System overview	3
RF 300 system planning	4
Readers	5
Transponder/tags	6
Communication modules	7
Accessories	8
Appendix	A

Edition 05/2005

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 to property damage only 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

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.

Siemens AG
Automation and Drives
Postfach 4848, 90327 Nuremberg, Germany

Siemens AG 2005
Technical data subject to change

Table of contents

1	Introduction		1-1
	1.1	Navigating in the system manual	1-2
2	Safety information		2-1
3	System overview		3-1
	3.1	RFID systems	3-1
	3.2	RF 300	3-2
	3.2.1	RF 300 application areas	3-2
	3.2.2	RFID components and their function	3-3
	3.2.3	Technical data	3-4
4	RF 300 system planning		4-1
	4.1	Fundamentals of application planning	4-1
	4.1.1	Transmission window and read/write distance	4-2
	4.1.2	Width of the transmission window	4-3
	4.1.3	Impact of secondary fields	4-3
	4.1.4	Permissible directions of motion of the transponder	4-4
	4.1.5	Operation in static and dynamic mode	4-5
	4.1.6	Dwell time of the transponder	4-6
	4.1.7	Communication between communication module, reader and transponder	4-7
	4.1.8	Calculation example	4-9
	4.2	Field data of transponders and readers	4-12
	4.3	Impact of the data volume on the transponder speed with RF 310-R (IQ-Sense)	4-13
	4.4	Installation guidelines	4-14
	4.4.1	Overview	4-14
	4.4.2	Reduction of interference due to metal	4-15
	4.4.3	Effects of metal on different transponders and readers	4-18
	4.4.4	Impact on the transmission window by metal	4-19
	4.5	Chemical resistance of the transponders	4-21
	4.6	EMC Guidelines	4-26
	4.6.1	Overview	4-26
	4.6.2	Definition	4-27
	4.6.3	Basic rules	4-28
	4.6.4	Propagation of electromagnetic interference	4-29
	4.6.5	Cabinet configuration	4-32
	4.6.6	Prevention of interference sources	4-35
	4.6.7	Equipotential bonding	4-36
	4.6.8	Cable shielding	4-37

5 Readers ... 5-1
5.1 RF 310-R ... 5-2
5.1.1 Features ... 5-2
5.1.2 Indicators ... 5-2
5.1.3 Transmission window ... 5-3
5.1.4 Metal-free area ... 5-3
5.1.5 Minimum distance between several RF 310-R units ... 5-4
5.1.6 RF 310-R field data ... 5-4
5.1.7 Pin assignment of the IQ-Sense interface ... 5-5
5.1.8 Cable and connector pin assignment ... 5-5
5.1.9 Technical data of the RF 310-R ... 5-6
5.1.10 FCC information ... 5-7
5.1.11 RF 310-R ordering data ... 5-7
5.1.12 Dimension drawing ... 5-8
6 Transponder/tags ... 6-1
6.1 RF 320-T ... 6-2
6.1.1 Features ... 6-2
6.1.2 Metal-free area ... 6-3
6.1.3 Field data ... 6-4
6.1.4 Technical data ... 6-5
6.1.5 Ordering data ... 6-6
6.1.6 Dimension drawing ... 6-6
6.2 RF 340-T ... 6-7
6.2.1 Features ... 6-7
6.2.2 Metal-free area ... 6-8
6.2.3 Field data ... 6-9
6.2.4 Technical data ... 6-10
6.2.5 Ordering data ... 6-11
6.2.6 Dimension drawing ... 6-11
7 Communication modules ... 7-1
7.1 8xIQ-Sense ... 7-2
7.1.1 Features ... 7-2
7.1.2 Indicators ... 7-3
7.1.3 Configuration ... 7-4
7.1.4 Addressing ... 7-5
7.1.5 Technical data ... 7-7
7.1.6 Ordering data ... 7-7
8 Accessories ... 8-1
8.1 MOBY software ... 8-1
A Appendix ... A-1
A.1 Certificates and approvals ... A-1
A.2 Service and support ... A-3
A.3 Contact partners ... A-3
A.4 Application consulting ... A-4
A.5 Training ... A-4
List of abbreviations ... Glossary-1
Glossary ... Glossary-1
Index

Tables

Table 4-1 Reduction of field data by metal (in %): Transponder and RF 310-R.................................... 4-20
Table 4-2 Interference sources: origin and effect 4-30
Table 4-3 Causes of coupling paths.. 4-31
Table 5-1 RF 310-R indicators 5-2
Table 5-2 RF 310-R pin assignment 5-5
Table 5-3 Technical data of the RF 310-R 5-6
Table 6-1 Field data for transponder RF 320-T to reader RF 310-R 6-4
Table 6-2 Field data for transponder RF 320-T to RF 320-T 6-4
Table 6-3 Technical data of the RF 320-T 6-5
Table 6-4 Field data for transponder RF 340-T to reader RF 310-R 6-9
Table 6-5 Transponder RF 340-T to transponder RF 340-T.. 6-9
Table 6-6 Technical data of the RF 340-T 6-10

Introduction 1

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 RF 300 system and describes the state of delivery as of May 2005.

Conventions

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

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

History

Previous editions of these operating instructions:

Edition	Remarks
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.

1.1 Navigating in the system manual

Structure of contents	Contents
Contents	Organization of the documentation, including the index of pages and chapters
Introduction	Purpose, layout and description of the important topics.
Safety information	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 RF 300
RFID system planning	Information about possible applications of SIMATIC RF 300, support for application planning, tools for finding suitable SIMATIC RD 300 components.
Readers	Description of readers which can be used for SIMATIC RF 300
Transponders	Description of transponders which can be used for SIMATIC RF 300
Communication modules	Description of communication modules used for SIMATIC RF 300
Accessories	Products available in addition to SIMATIC RF 300
Appendix	Service and support, contact partners, training centers
Error messages	Overview of error messages
List of abbreviations	List of all abbreviations used in the document

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 admissibility of the installation in the designated 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	Max. range	Max. memory	Data transfer rate (typical) in byte/s	Max. temperature	Special features
RF 300	13.56 MHz	0.25 m	20 byte EEPROM 64 KB FRAM	3750	SLG: -25 °C to +70 °C MDS: -40 °C to +85 °C or + 220 °C cyclic	IQ-Sense interface available; Battery-free data memory
MOBY F	125 kHz	0.4 m	192 byte EEPROM	100	+130 °C	Multitag capability
MOBY D	13.56 MHz	0.8 m	112 byte EEPROM	110	+ 85 °C or + 200 °C	SmartLabels based on ISO 15693 e.g. Tagit/Icode
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
MOBY U	2.45 GHz	3.0 m	32 KB RAM	4800	+ 85 °C or + 220 °C cyclic	Frequency hopping

3.2 RF 300

SIMATIC RF 300 is an inductive identification system specially designed for use in industrial production for the control and optimization of material flow. Thanks to its compact components it is particularly suited to small assembly lines and conveyor systems with restricted space for installation. The rugged components feature an attractive price/performance ratio.

3.2.1 RF 300 application areas

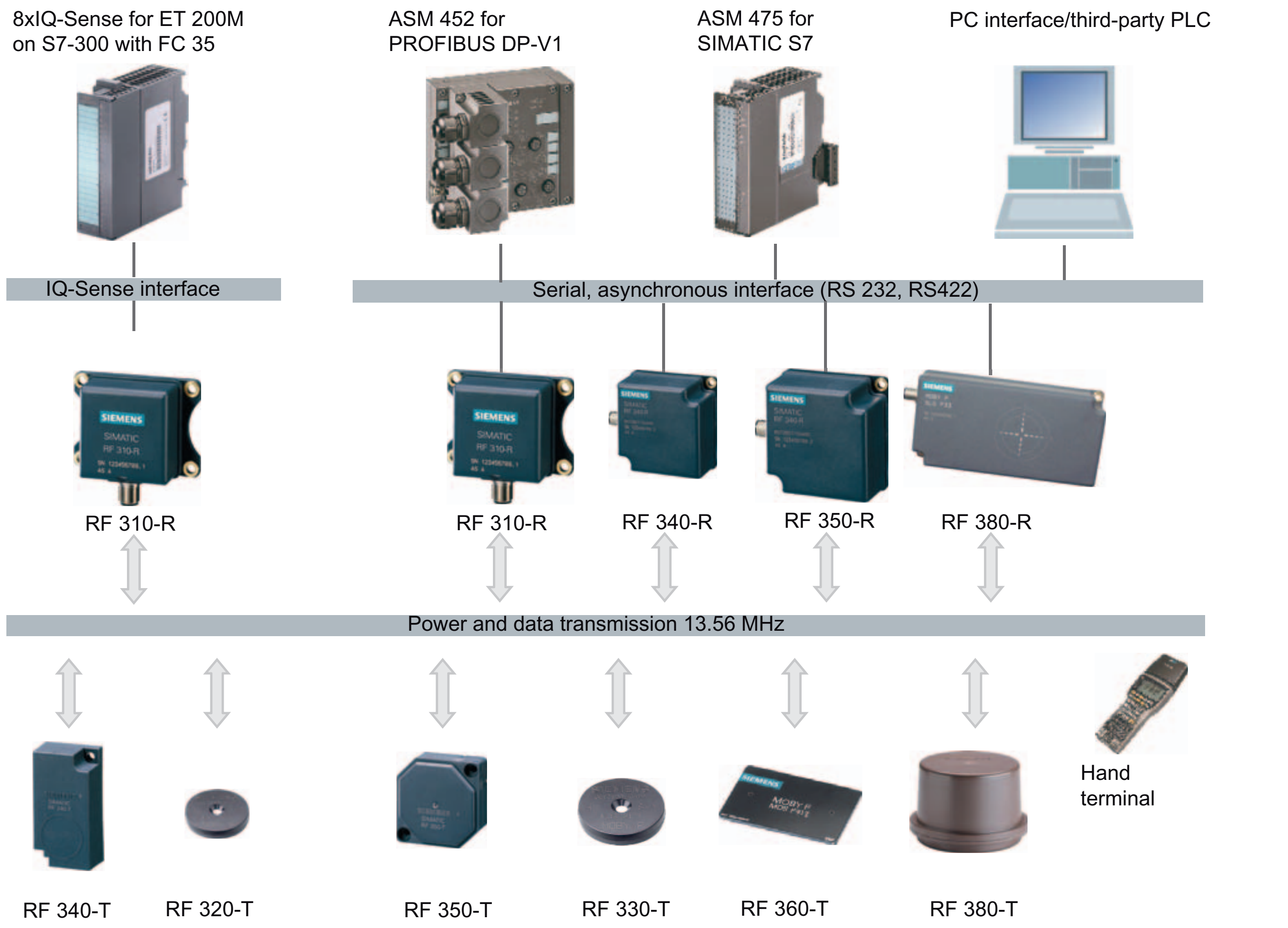
SIMATIC RF 300 is used primarily for contactless identification of containers, pallets and workpiece carriers in a closed production loop, i.e. the data carriers (transponders) remain in the production chain and are not shipped out with the products. Thanks to the compact enclosure dimensions of both the transponders and readers, SIMATIC RF 300 is particularly suitable for (small) assembly lines where space is at a premium.

The main application areas of SIMATIC RF 300 are:

- Assembly and handling systems, assembly lines (identification of workpiece carriers)
- Production logistics (material flow control, identification of containers and other vessels)
- Parts identification (e.g. transponder is attached to product/pallet).
- Conveyor systems

3.2.2 RFID components and their function

RF 300 system components



Communication modules	A communication module (interface module) is used to integrate the RF identification system in PLC/automation systems. In the case of SIMATIC RF 300, the reader is connected to an S7 automation system either via the 8xIQ-Sense module or an equivalent MOBY interface module (e.g. ASM 475).
Readers	The reader ensures inductive communication, supplies power to the transponders, and handles the connection to the various PLCs (e.g. SIMATIC S7).
Transponders	Transponders (mobile data memories) are used, for example, in place of barcodes and can contain all product-specific data in addition to the product number.

3.2.3 Technical data

RFID system RF 300	
Type	Inductive identification system for industrial applications
Transmission frequency data/energy	13.56 MHz
Memory capacity	20 bytes up to 64 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
Read/write distance (system limit; depends on reader and transponder)	Up to 250 mm
Operating temperature	Reader: -25°C to +70°C Transponder: -40°C to +85°C and up to +220°C cyclic
Degree of protection	Reader: IP 65 Transponder: > IP 67
Can be connected to	SIMATIC S7-300, Profibus DP V1, PC, third-party PLC
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 CE

RF 300 system planning 4

4.1 Fundamentals of application planning

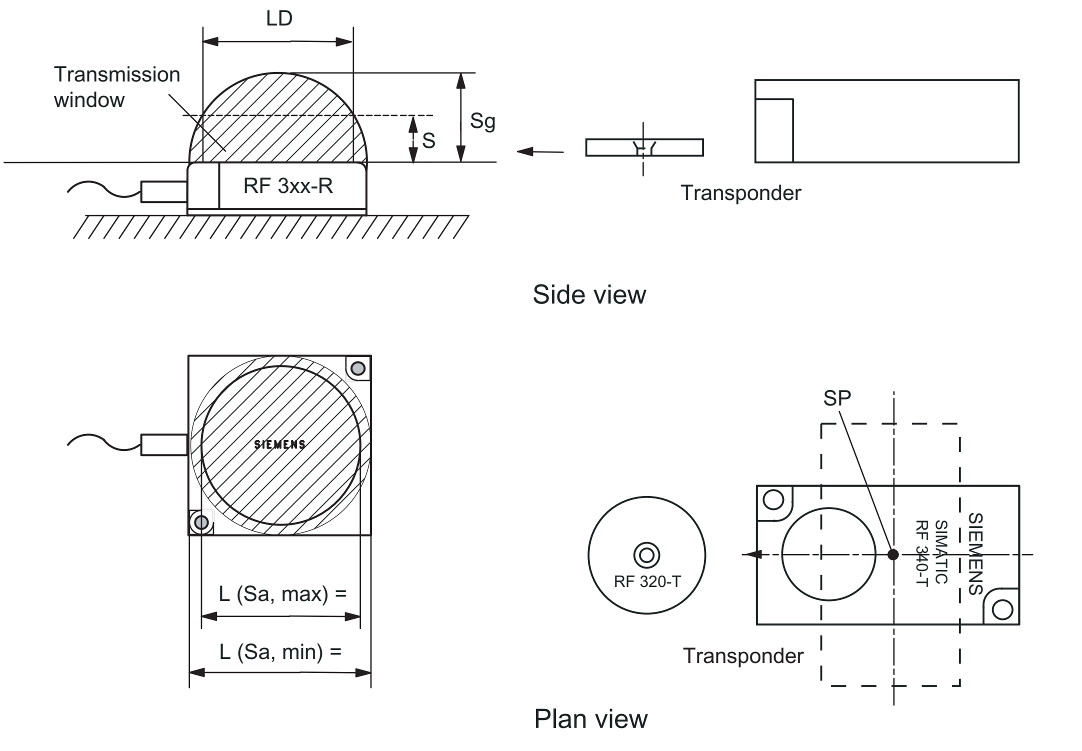
Assess your application according to the following criteria, in order to choose the right SIMATIC RF 300 components:

- 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.

4.1.1 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:



Sa	Operating distance between transponder and reader
Sg	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 Ld is valid for the calculation. At Sa,min, the field length increases from Ld to Lmax.
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 diagram above, it can also be seen that operation is possible within the area between Sa and Sg. The active operating area reduces as the distance increases, and shrinks to a single point at distance Sg. Only static mode should thus be used in the area between Sa and Sg.

4.1.2 Width of the transmission window

Determining the width of the transmission window

The following approximation formula can be used for practical applications:

$$B = 0,4 \cdot L$$

Figure 4-1 Formula: Width of the transmission window

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.

4.1.3 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.

4.1.4 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:

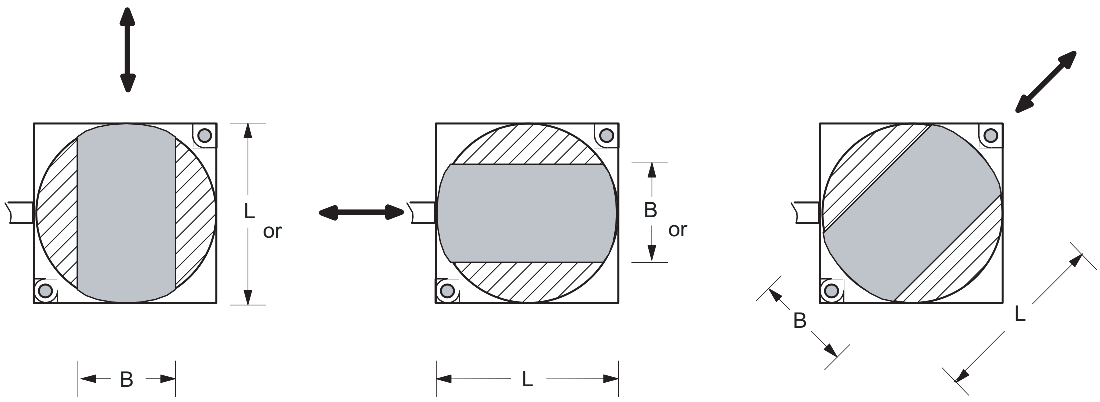


Figure 4-2 Active areas of the transponder for different directions of transponder motion

4.1.5 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:

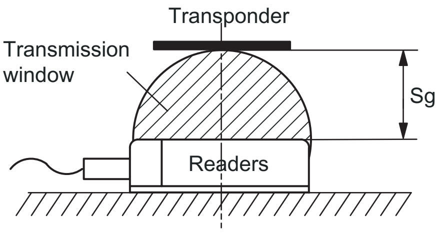


Figure 4-3 Operation in static mode

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.

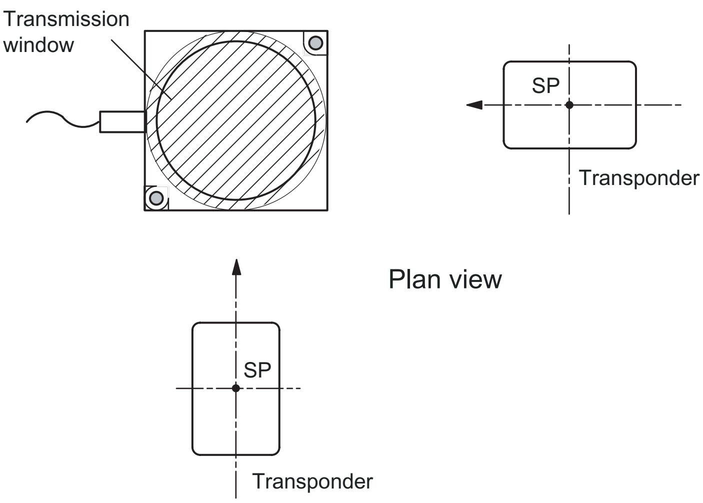


Figure 4-4 Operation in dynamic mode

4.1.6 Dwell time of the transponder

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

The dwell time is calculated thus:

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

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

4.1.7 Communication between communication module, reader and transponder

Communication with RF 310-R

Communication between the communication module (IQ Sense), RF 310-R reader and transponders 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. Approximately 18 ms are thus needed for a complete command acknowledgement sequence with up to 2 bytes of user data. The transponder must be present within the field of the reader.

Calculation of the communication time for interference-free transfer

$$t_K = K + t_{Wort} \cdot n$$

Calculation of the maximum amount of user data

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

t_K	Communication time between communication module, RF 310-R (IQ-Sense) reader and transponder
t_V	Dwell time
n	Amount of user data in words (2 bytes)
n_{max}	Max. amount of user data in words (2 bytes) in dynamic mode
t_{Word}	Transfer time for 1 word (2 bytes)
K	Constant (internal system time) This contains the time for power buildup on the transponder and for command transfer

Note

If only 1 byte of user data is transferred, you still need to allow the time for 1 word.

Time constants K and t_{Word}

K (ms)	t_{Word} (ms)	Command
9	18	Read
9	27	Write (EEPROM area)
9	18	Write (FRAM 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.

4.1.8 Calculation example

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
- RF 310-R reader
- RF 340-T transponder

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

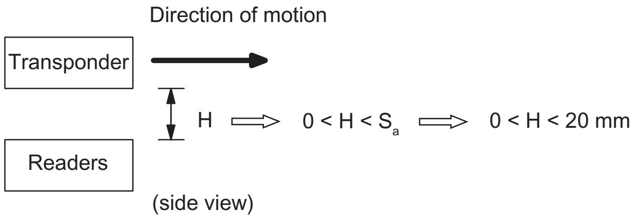


Figure 4-5 Tolerance of pallet transport height

Determine tolerance of pallet side transport

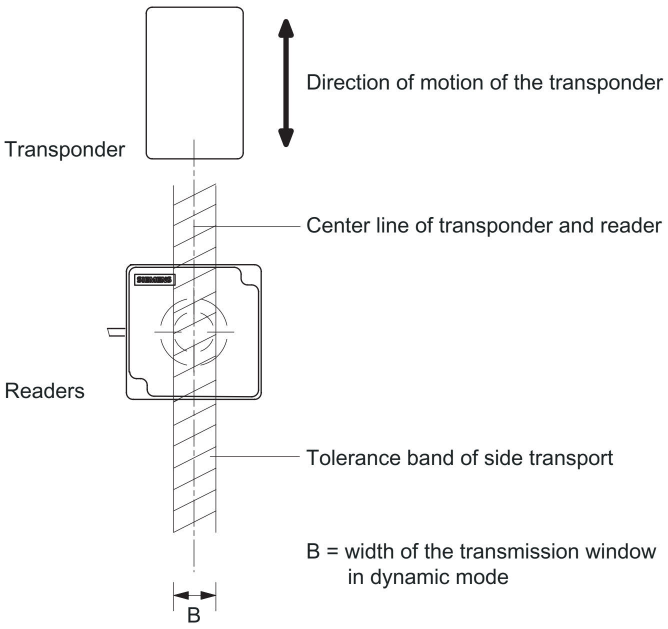


Figure 4-6 Tolerance of pallet side transport

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 $t_v = \frac{L \cdot 0,8}{v_{TPDR}} = \frac{0,04m \cdot 0,8}{0,14m/s} = 0,228s = 228ms$
2.	Calculate maximum user data (n_{max}) for reading	Take value t_v from Step 1. Take values K and t_{Word} from Table "Time constants K and t_{Word}". Read: $\frac{t_v - K}{t_{Wort}} = \frac{228ms - 9ms}{18ms} = 12,17 \Rightarrow n_{max} = 12 Words$
3.	Calculate maximum user data (n_{max}) for writing (FRAM area)	Take value t_v from Step 1. Take values K and t_{Word} from Table "Time constants K and t_{Word}". Schreiben: $\frac{t_v - K}{t_{Wort}} = \frac{228ms - 9ms}{18ms} = 12,17 \Rightarrow n_{max} = 12 Worte$

Result

A maximum of 12 words can be read or written when passing the transponder.

4.2 Field data of transponders and readers

The following table shows the field data for all SIMATIC RF 300 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

RF 310-R reader	RF 320-T transponder	RF 340-T transponder
Length of the transmission window in mm (L)	30 mm	40 mm
Width of the transmission window in mm (W)	12 mm	16 mm
Working distance in mm (Sa)	0-12 mm	0-20 mm
Limit distance in mm (Sg)	18 mm	30 mm

- 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

Readers	RF 320-T transponder	RF 340-T transponder
RF 310-R	> 100 mm	400 mm

Minimum distance from reader to reader

The minimum distance from RF 310-R to RF 310-R must be at least 400 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.

4.3 Impact of the data volume on the transponder speed with RF 310-R (IQ-Sense)

The curves shown here show the relationship between the speed of the RF 320 and RF 340 transponders and the volume of data transferred.

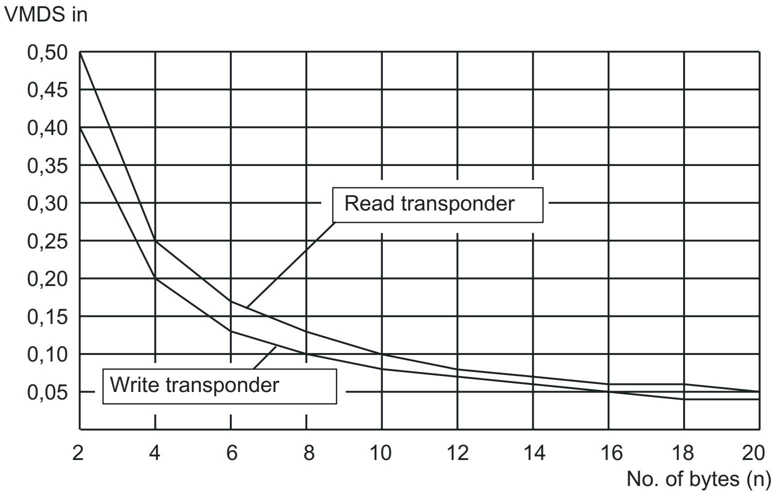


Figure 4-7 Relationship between speed and data volume when using the RF 310-R (IQ-Sense)

4.4 Installation guidelines

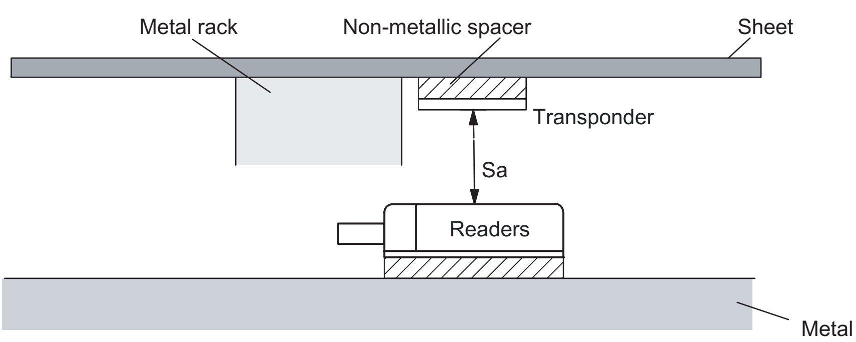
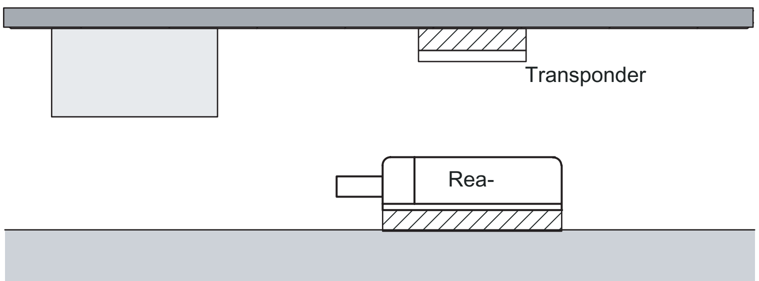
4.4.1 Overview

The transponder and reader 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:

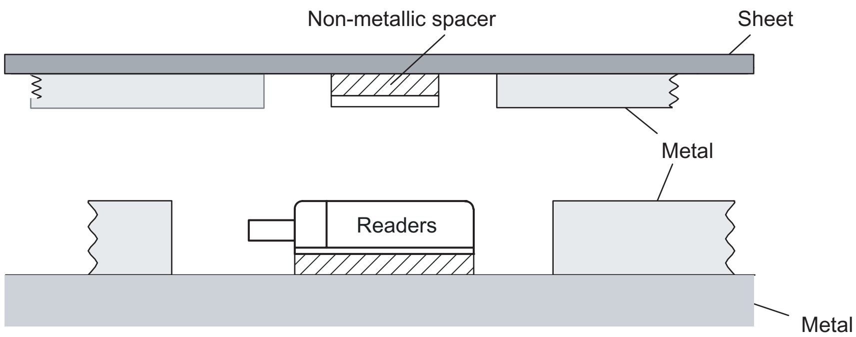
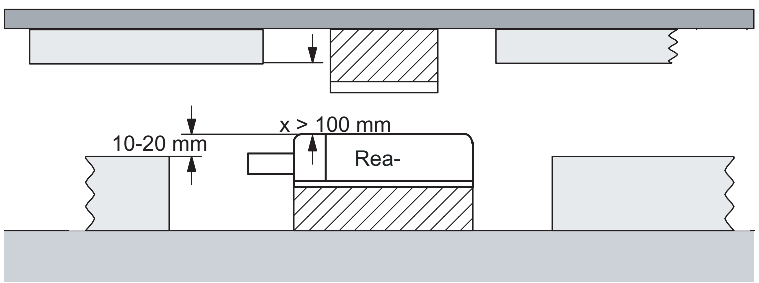
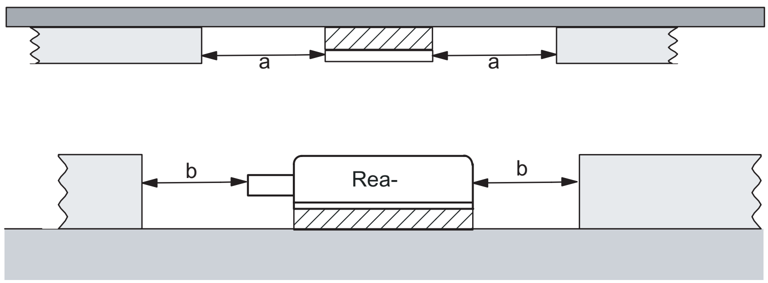
- Minimum distance between two readers
- Minimum distance between two adjacent data memories
- Metal-free area for flush-mounting of readers and transponders in metal
- Mounting of several readers on metal frames or racks

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

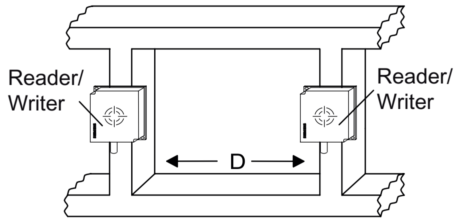
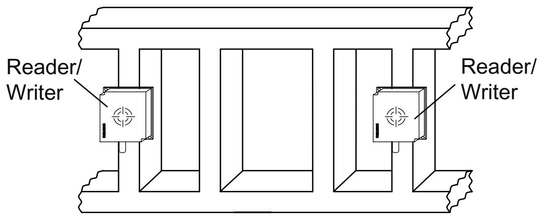
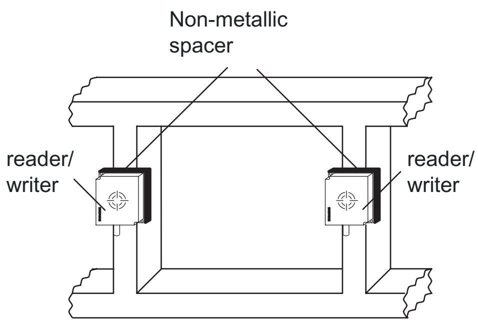
Interference due to metal rack	Problem
	A metal rack is located above the transmission window of the reader. This affects the entire field. In particular, the transmission window between reader and transponder is reduced.
	**Remedy:** The transmission window is no longer affected if the transponder is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

Flush-mounting

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 RF 310-R. It indicates that the reader is no longer affected significantly by the metal at a distance of x ≥ 100 mm.)
	**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.

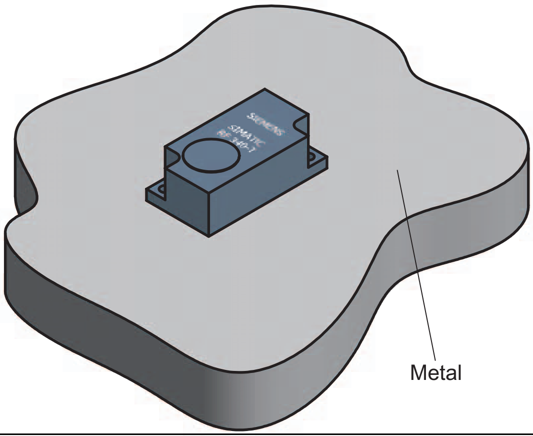
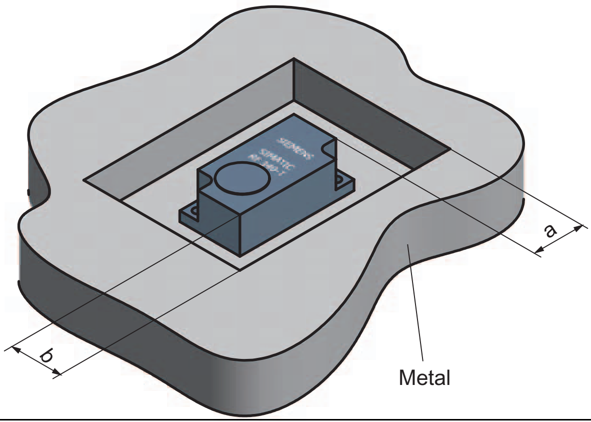
Mounting of several readers on metal racks	Problem: Interaction between readers
	**Remedy** Increase the distance D between the two readers.
	**Remedy** Introduce one or more iron struts in order to short-circuit the stray fields.
	**Remedy** Insert a non-metallic spacer of 20 to 40 millimeter thickness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

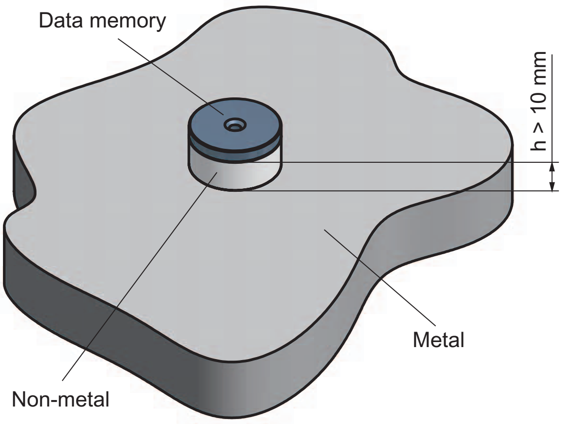
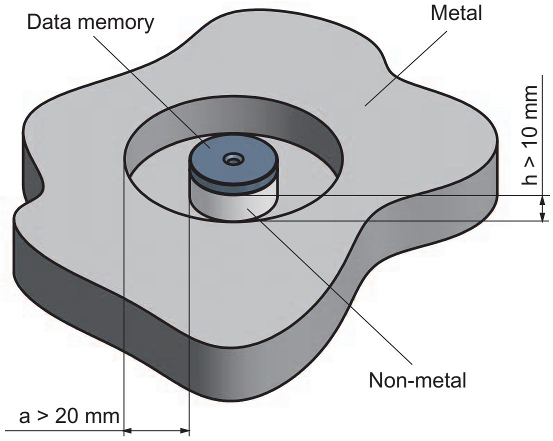
4.4.3 Effects of metal on different transponders and readers

Mounting different transponders on metal or flush-mounting

Not all transponders can be mounted directly on metal. For more information, please refer to the descriptions of the individual transponders in the relevant sections.

The following section illustrates various possibilities for mounting, allowing for the effect of metal on the particular transponder.

Transponders which can be mounted directly on metal Any transponder whose operation is not affected by direct contact with metal can be mounted directly on metal.	
	Mounting of a transponder directly on metal
	Flush-mounting of a transponder in metal (a, b = required distance from metal)

<table>
<tr><td colspan="2">Transponders which cannot be mounted directly on metal
Any transponder whose operation is interrupted by direct contact with metal cannot be mounted directly on metal. The applicable minimum distance to metal must be maintained for the relevant transponder.</td></tr>
<tr><td>
</td><td>Mounting of a transponder on metal with a non-metallic spacer</td></tr>
<tr><td>
</td><td>If the minimum guide values (a, h) are not observed, a significant reduction of the field data results. It is possible to mount the transponder with metal screws (M4 countersunk head screws). This has no tangible impact on the range.</td></tr>
</table>

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 and graphical 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 Reader RF 310-R

Table 4-1 Reduction of field data by metal (in %): Transponder and RF 310-R

Transponder	Reader RF 310-R		
	without metal	on metal	flush-mounted in metal (20 mm surround)
RF 320-T			
Transponder without metal	100	95	80
Transponder on metal, distance 20 mm	100	80	70
Flush-mounted in metal	80	70	60
RF 340-T			
Transponder without metal	100	95	80
Transponder on metal, distance 20 mm	100	95	80
Flush-mounted in metal distance 20 mm/ 20 mm surround	90	85	70

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). The plastic housing has a notably high resistance to chemicals used in automobiles (e.g.: oil, grease, diesel fuel, gasoline, etc,); these are not specified separately.

RF 320-T transponder

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

	Concentration	20°C	40°C	60°C
Allylchloride		J		
Formic acid	50 %	J		
	100 %	F		
Ammonia gas		J		
Ammonia liquid, water-free		j		
Ammonium hydroxide	10 %	J		
Ethyl acrylate		J		
Ethyl glycol				J
Gasoline, aroma-free		J		
Gasoline, containing benzol		J		
Benzoate (Na–, Ca.a.)			J	
Benzoic acid		J		
Benzol		J		
Benzenesulphonic acid		J		
Benzyl chloride		j		
Borax				J
Boric acid		J		
Bromine, liquid		j		
Bromine, gas, dry		j		
Bromide (K–, Na.a.)				J
Bromoform	100 %	J		
Bromine water		j		
Butadiene (1,3–)		J		
Butane gas		J		
Butanol		j		
Butyric acid	100 %	F		
Carbonate (ammonium, Na.a.)				J
Chlorine, liquid		j		
Chlorine, gas, dry	100 %	j		

	Concentration	20°C	40°C	60°C
Chlorobenzene		J		
Chloride (ammonium, Na.a.)				J
Chloroform		j		
Chlorophyl		J		
Chlorosulphonic acid	100 %	j		
Chlorine water (saturated solution)		F		
Chromate (K–, Na.a.)	Up to 50 %		J	
Chromic acid	Up to 30 %	j		
Chromosulphuric acid		j		
Citric acid		J		
Cyanamide		J		
Cyanide (K–, Na.a.)				J
Dextrin (aqueous solution)				J
Diethyl ether		J		
Diethylene glycol				J
Dimethyl ether		J		
Dioxane		j		
Developer			J	
Acetic acid	100 %	F		
Ethanol			J	J
Fixer			J	
Fluoride (ammonium, K–, Na.a.)			J	
Hydrofluoric acid	Up to 40 %	J		
Formaldehyde	50 %	J		
Formamide	100 %	J		
Glucon acid		J		
Glycerine				J
Glycol				J
Urine		J		
Uric acid		J		
Hydroxide (ammonium)	10 %	J		
Hydroxide (Na–, K–)	40 %	J		
Hydroxide (alkaline earth metal)				J
Hypochlorite (K–, Na.a.)				J
Iodide (K–, Na.a.)				J
Silicic acid				J
Cresol	Up to 90 %	j		
Methanol	100 %		J	
Methylene chloride		j		
Lactic acid	100 %	F		

	Concentration	20°C	40°C	60°C
Mineral oils			J	
Nitrate (ammonium, K.a.)				J
Nitroglycerine		j		
Oxalic acid		J		
Phenol	1 %	J		
Phosphate (ammonium, Na.a.)				J
Phosphoric acid	50 %			J
	85 %	J		
Propanol		J		
Nitric acid	25 %	j		
Hydrochloric acid	10 %	j		
Brine				j
Sulphur dioxide	100 %	F		
Carbon disulfide 100 %		j		
Sulphuric acid	40 %	j		
Sulphurous acid		F		
Soap solution				J
Sulfate (ammonium, Na.a.)				J
Sulfite (ammonium, Na.a.)				j
Tar, aroma-free				J
Turpentine		J		
Trichloroethylene		j		
Hydrogen peroxide	30 %	J		
Tartaric acid		J		

RF 340-T transponder

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, etc,); these are not specified separately.

	Concentration	20°C	60 °C
Battery acid	30	F	j
Ammonia gas		J	J
Ammonia, w.	conc.	J	J
	10	J	J
Benzol		J	Y
Bleach solution (12.5% effective chlorine)		F	j
Butane, gas, liquid		J	J
Butyl acetate (acetic acid butyl ester)		J	J
n(n)		J	Y
Calcium chloride, w.		J	Y
Calcium nitrate, w.	c.s.	J	Y
Chlorine		j	j
Chrome baths, tech.		j	j
Iron salts, w.	c.s.	J	J
Acetic acid, w.	50	j	j
Ethyl alcohol, w. undenaturated	96	J	Y
	50	J	J
Formaldehyde, w.	30	Y	j
	10	J	Y
Formalin		Y	j
Glycerine		J	J
Isopropanol		J	Y
Potassium hydroxide, w.	50	J	J
Lysol		F	j
Magnesium salts, w.	c.s.	J	J
Methyl alcohol, w.	50	J	J
Lactic acid, w.	50	F	j
	10	Y	F
Sodium carbonate, w. (soda)	c.s.	J	J
Sodium chloride, w.	c.s.	J	J
Sodium hydroxide		J	J
Nickel salts, w.	c.s.	J	J
Nitrobenzol		Y	F
Phosphoric acid	10	f	V
Propane		J	J
Mercury		J	J
Nitric acid	10	f	j

	Concentration	20°C	60 °C
Hydrochloric acid	10	f	j
Sulphur dioxide	Low	J	J
Sulphuric acid	25	F	j
	10	Y	j
Hydrogen sulphide	Low	J	J
Carbon tetrachloride		J	J
Toluene		J	Y
Detergent	High	J	J
Plasticizer		J	J

Abbreviations	
J	Resistant
Y	Virtually resistant
F	Partially resistant
f	Less resistant
j	Not resistant
w.	Aqueous solution
c.s.	Cold saturated

4.6 EMC Guidelines

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 control 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 can rectify defects in this area in the event of interference.

Warning

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 Definition

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

- Increasing density of components
- Increasing power electronics
- Increasing switching rates
- Lower power consumption of components

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 ambient 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 BAPT 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 salient national specifications and regulations must be observed. 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 when erecting a control cabinet:

Shielding by enclosure

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

Laminar 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.

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

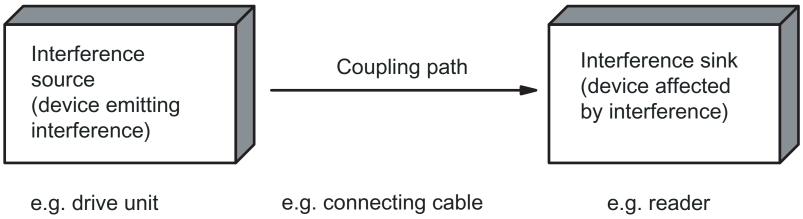


Figure 4-8 Propagation of interference

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 cabinet must be such that mutual interference between individual components is precluded or kept as small as possible.
- Measures must be taken to eliminate the impact of external interference.

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 4-2 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

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:

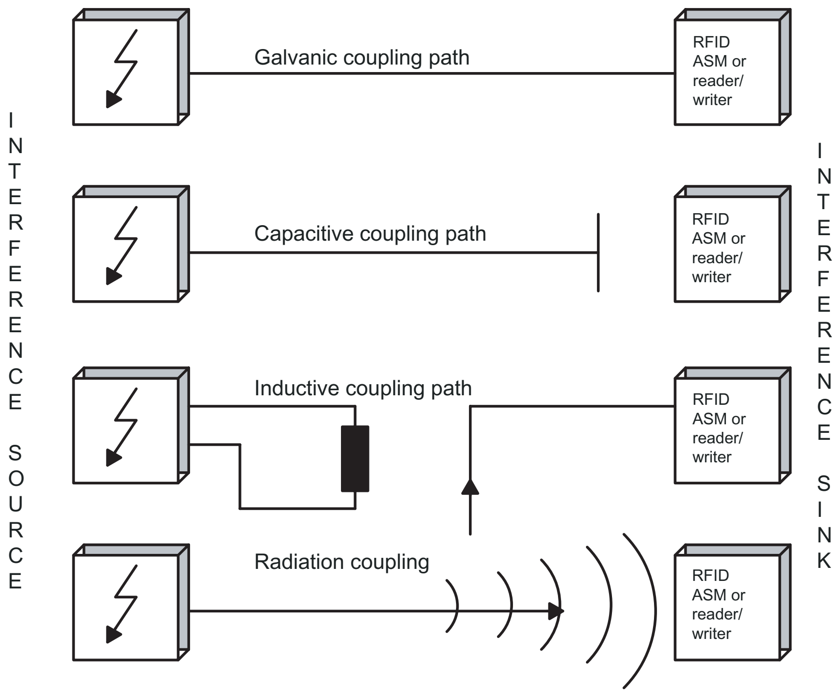


Figure 4-9 Ways in which interference can be coupled in

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

Table 4-3 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 SIMATIC enclosure	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.

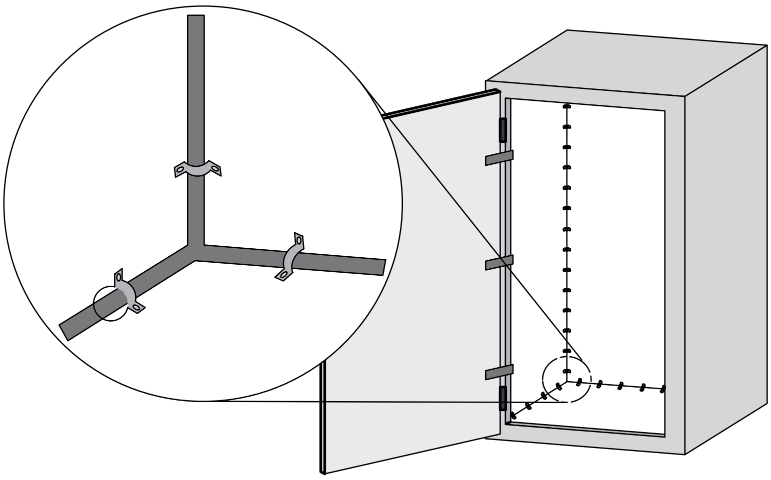


Figure 4-10 Shielding by enclosure

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:

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

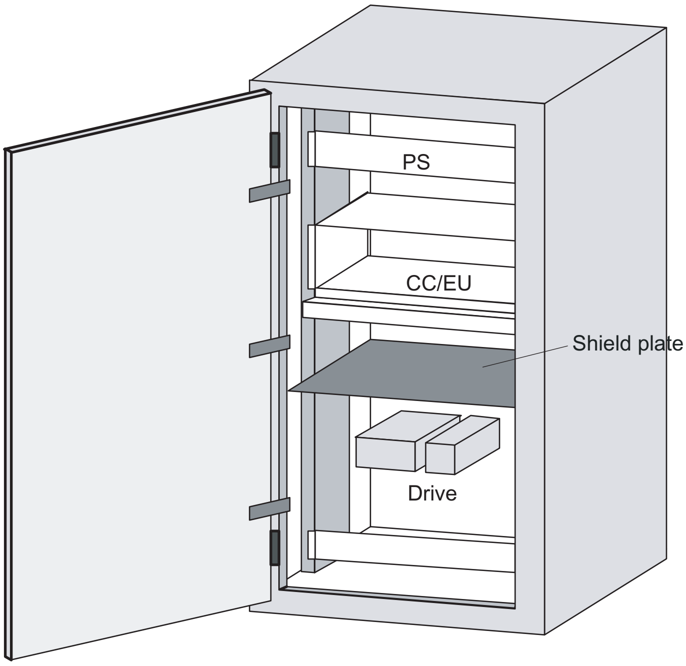


Figure 4-11 Prevention of interference by optimum configuration

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.

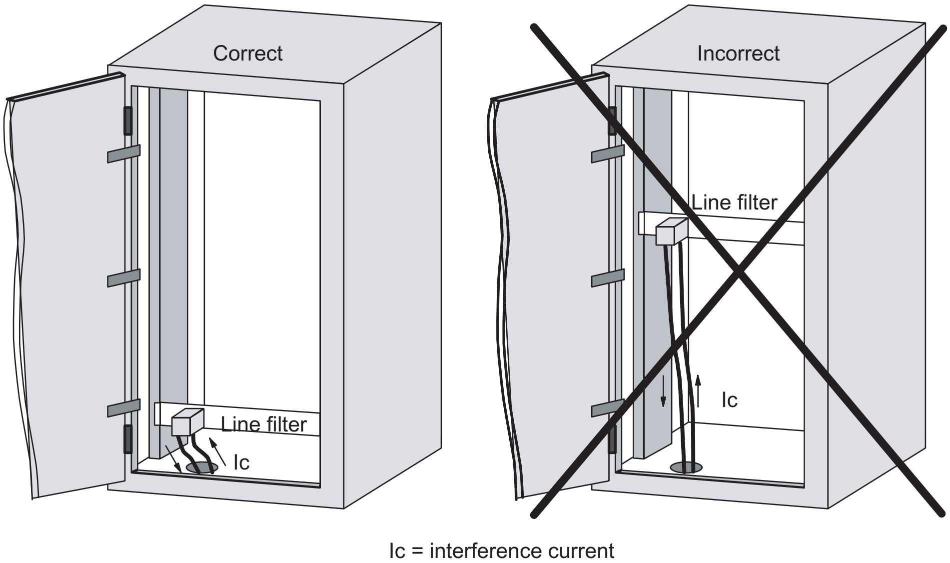


Figure 4-12 Filtering of the supply voltage