SIEMENS

SIMATIC Ident

RFID systems SIMATIC RF300

System Manual

Note: This document is a draft document. This document is not released for publication. Siemens accepts no liability for the completeness and correctness of the contents.

07/2016
C79000-G8976-C345-0x

Legal information

Warning notice system

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

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

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

⚠CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

Siemens AG
Division Process Industries and Drives
Postfach 48 48
90026 NÜRNBERG
GERMANY

Document order number: C79000-G8976-C345
Ⓟ 07/2016 Subject to change

Table of contents

Introduction 1

1.1 Navigating in the system manual

Structure of the content	Content
Contents	Detailed organization of the documentation, including the index of pages and chapters
Introduction	Purpose, structure 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 from the product/system view and with reference to statutory regulations.
System overview	Overview of all RF identification systems, system overview of SIMATIC RF300
Planning the RF300 system	Information about possible applications of SIMATIC RF300, support for application planning, tools for finding suitable SIMATIC RF300 components.
Reader	Description of readers which can be used for SIMATIC RF300
Antennas	Description of antennas which can be used for SIMATIC RF300
RF300 transponder	Description of RF300 transponders which can be used for SIMATIC RF300
ISO transponder	Description of ISO transponders which can be used for SIMATIC RF300
System integration	Overview of the communications modules and function blocks that can be used for SIMATIC RF300
System diagnostics	Description of system diagnostics available for SIMATIC RF300
Appendix	• Certificates and approvals • Accessories • Connecting cables • Ordering data • Service & Support

1.2 Preface

Purpose of this document

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

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

Scope of validity of this document

This documentation is valid for all variants of the SIMATIC RF300 system and describes the devices shipped as of July 2016.

Additional information

You will find further information about the readers RF350M, RF310R Scanmode and RF382R Scanmode in the relevant manuals.

Additional information (https://support.industry.siemens.com/cs/ww/en/ps/15033)

Registered trademarks

SIMATIC ®, SIMATIC RF ®, MOBY ®, RF MANAGER ® and SIMATIC Sensors ® are registered trademarks of Siemens AG.

History

Currently released versions of the SIMATIC RF300 system manual:

Edition	Remark
05/2005	First Edition
11/2005	Revised edition, components added: RF310R with RS-422 interface, RF350T and RF360T; ASM 452, ASM 456, ASM 473 and ASM 475
04/2006	Revised edition, components added: RF340R as well as RF350R with the antenna types ANT 1, ANT 18 and ANT 30
12/2006	Revised edition, components added: RF370T, RF380T and RF170C
07/2007	Revised edition, degrees of protection changed for the RF300 readers
09/2007	Revised edition, components added: RF380R and RF180C
06/2008	Revised edition
01/2009	Revised edition, expanded by the reader functionalities "RF300 transponder" and "ISO transponder" for the SIMATIC RF310R and SIMATIC RF380R readers

Edition	Remark
03/2014	Revised edition, expanded by the reader functionalities "RF300 transponder" and "ISO transponder" for the SIMATIC RF340R and SIMATIC RF350R readers Expanded by the following components: • Reader RF310R with Scanmode, RF382R with Scanmode • Communications module RF120C • Antennas ANT 12 (in conjunction with RF350R) and ANT 8 (in conjunction with RF310M) • RF300 transponder RF330T • ISO transponder MDS D117, D126, D127, D165, D200, D261, D339, D400, D422, D423, D425, D426
07/2016	Revised and expanded edition Expanded by the following components: • Readers of the second generation RF310R, RF340R, RF350R • Reader RF380R Scanmode • Antenna ANT 3, ANT 3S • ISO transponder MDS D5xx • MOBY E migration in SIMATIC RF300 • MOBY Y adapter for MOBY I migration in SIMATIC RF300

Abbreviations and naming conventions

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

Reader	Write/read device (SLG)
Transponder, tag	Data carrier, mobile data storage, (MDS)
Communications module (CM)	Interface module (ASM)

Safety information 2

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

> ⚠ WARNING
>
> **Opening the device**
>
> Do not open the device when when the power supply is on. Unauthorized opening of and improper repairs to the device may result in substantial damage to equipment or risk of personal injury to the user.

> NOTICE
>
> **Alterations not permitted**
>
> 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.

Installation instructions

> NOTICE
>
> **Switch/fuse to disconnect the reader from the power supply**
>
> Make sure that the readers can be disconnected from the power supply with a switch or a fuse. The function of the switch or fuse must be clearly recognizable.

Operating temperature

> ⚠ CAUTION
>
> **Danger of burns**
>
> Note that some outer components of the reader are made of metal. Depending on the environmental conditions temperatures can occur on the device that are higher than the maximum permitted operating temperature.

Repairs

WARNING

Repairs only by authorized qualified personnel

Repairs may only be carried out by authorized qualified personnel. 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 expansions

Only install system expansions intended for this system. If you install other expansions, you may damage the system or violate the safety requirements and regulations for radio frequency interference suppression. Contact Technical Support or your local sales department to find out which system expansions are suitable for installation.

NOTICE

Warranty conditions

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

Safety distances

CAUTION

Safety distance between reader/antenna and persons

Note that for permanent exposure, the following safety distances must be adhered to:

- RF310R: ≥ 80 mm
- RF340R: ≥ 130 mm
- RF350R + ANT 1: ≥ 140 mm
- RF350R + ANT 3: ≥ 80 mm
- RF350R + ANT 12: ≥ 25 mm
- RF350R + ANT 18: ≥ 50 mm
- RF350R + ANT 30: ≥ 80 mm
- RF380R: ≥ 250 mm
- RF382R: ≥ 130 mm

Note

Safety distance with pacemakers

A safety distance between reader/antenna and persons with pacemakers is not necessary.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. You will find more information about Industrial Security in:
Industrial security (http://www.siemens.com/industrialsecurity)

To stay informed about product updates as they occur, sign up for a product-specific newsletter. You will find more information about this in
Product support (https://support.industry.siemens.com/cs/ww/en/ps/15247/pm)

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 or workpiece carrier.

Table 3- 1 Overview of SIMATIC RFID systems

Frequency range	**HF**			**UHF**
RFID system	**SIMATIC RF200**	**SIMATIC RF300**	**MOBY D**	**SIMATIC RF600**
Transmission frequency	13.56 MHz	13.56 MHz	13.56 MHz	865 ... 928 MHz [1)]
Range, max.	650 mm	210 mm	380 mm	8 m
Protocols (air interface)	• ISO 15693 • ISO 18000-3	• ISO 15693 • ISO 18000-3 • RF300 (proprietary)	• ISO 15693 • ISO 18000-3	• EPCglobal Class 1 Gen 2 • ISO 18000-6B • ISO 18000-6C
Standards, specifications, approvals	• EN 300330, EN 301489, CE • FCC Part 15 • UL/CSA	• EN 300330, EN 301489, CE • FCC Part 15 • UL/CSA • ATEX	• EN 300330, EN 301489, CE • FCC Part 15 • UL/CSA	• ETSI EN 3002208, CE • FCC • UL
Memory capacity, max.	992 bytes (EEPROM) 8192 bytes (FRAM)	64 kB (EEPROM) 8192 bytes (FRAM)	922 bytes (EEPROM) 2000 bytes (FRAM)	496 bits (EPC), 3424 bytes
Maximum data transfer rate for wireless transmission	25.5 kbps	106 kbps	26.5 kbps	300 kbps
Multitag capability	With RF290R reader only	Yes/No [2)]	Yes	Yes
Special characteristics	• Particularly compact designs • For particularly low-cost RFID solutions • IO-Link for simple identification tasks	• High data transmission speed • Extended diagnostics options • High memory capacity	• SIMATIC or PC/IT integration • External antennas for industrial applications	• SIMATIC or PC/IT integration • Data preprocessing in the readers • Special antennas for industrial applications

[1)] Depends on the country of deployment and the frequency regulations that apply there

[2)] Multitag capability only with the readers of the second generation and in conjunction with ISO transponders.

3.2 SIMATIC RF300

3.2.1 System overview of SIMATIC RF300

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.

Scanmode applications

In applications without command control, the transponders are read automatically. The type of data acquisition and transfer is preset in the reader using parameters.

Medium-performance applications

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

High-performance applications

The high-performance components of RF300 in conjunction with the RF300 transponders provide advantages in terms of high data transmission speeds and storage capacities.

SIMATIC RF300 - second generation

As of the delivery stage in the first quarter of 2017 an innovative second generation of the readers RF310R, RF340R und RF350R is available. These readers apart from additional performance characteristics are 100% compatible with the RF300s of the first generation. The second generation of the RF380R comes later.

Additional performance features:

- Additional transponder protocol ISO 14443 (air interface) for MDS E transponders
- Automatic detection of different transponder types (RF300, ISO 15693, ISO 14443)
- Emulation of MOBY I write/read devices (SLG 4x) in conjunction with RF300 transponders for simplified migration
- Setup help integrated in the reader

  The setup help serves the simple optimization of the reader-transponder positioning during installation/commissioning. Further installation or software are not necessary. The setup help becomes active directly after turning the device on.
- Improved 5-color LED display

- User-friendly parameter assignment and configuration with TIA Portal technological object (as of STEP 7 Basic / Professional V14 SP 1)
- Expanded functions for trained users:
  - Address information for the "INIT" command no longer necessary
  - Expanded "RESET" parameter
  - The MDS-STATUS "Mode 3" functions with all transponder types
  - Automatic antenna recognition with the reader RF350R (depending on the antenna)

Table 3- 2 Differences in the features

Feature	SIMATIC RF300 first generation	SIMATIC RF300 second generation
Transponder protocol RF300	✓	✓
Transponder protocol ISO 15693	✓	✓
Transponder protocol ISO 14443	--	✓
MOBY I emulation to the controller	--	✓
Integrated setup help	--	✓
LED display	1 x	2 x
RFID technological object	--	✓ [1]

1) With the TIA Portal as of STEP 7 Basic / Professional V14 SP 1

3.2.2 RFID components and their function

System components overview

Table 3- 3 RF300 system components

Component	Description
Communications module	A communications module is used to integrate the RF identification system in controllers/automation systems.
Reader	The reader ensures inductive communication and power supply to the transponder, and handles the connection to the various controllers (e.g. SIMATIC S7) through the communications module (e.g. ASM 456).
Transponder	The transponder stores all data relevant for production and is used, for example, instead of barcode.

RF300 system components for high-performance applications

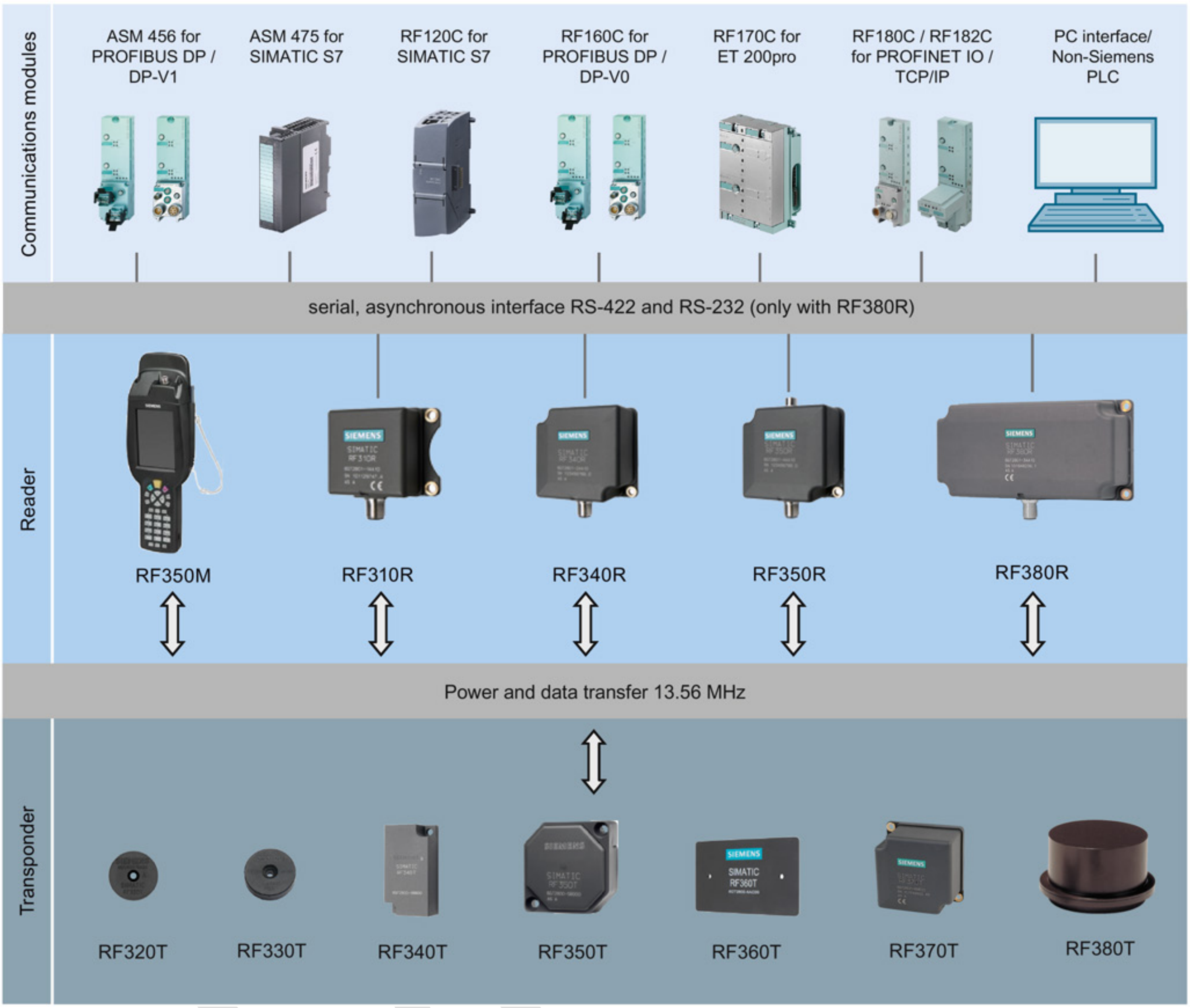


Figure 3-1 High performance system overview

Table 3- 4 Reader-transponder combination options for high-performance applications

Transponder	RF310R	RF340R	RF350R with ANT 1	RF350R with ANT 3	RF350R with ANT 18	RF350R with ANT 30	RF380R
RF320T	✓	✓	✓	✓	✓	✓	✓
RF330T	✓	✓	✓	✓	✓	✓	✓
RF340T	✓	✓	✓	✓	✓	✓	✓
RF350T	✓	✓	✓	✓	--	✓	✓
RF360T	✓	✓	✓	✓	--	✓	✓

Transponder	RF310R	RF340R	RF350R with ANT 1	RF350R with ANT 3	RF350R with ANT 18	RF350R with ANT 30	RF380R
RF370T	✓ [1)]	✓	✓	--	--	--	✓
RF380T	--	✓	✓	--	--	--	✓

1) as of reader version "AS ≥ D"

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

RF300 system components for medium-performance applications

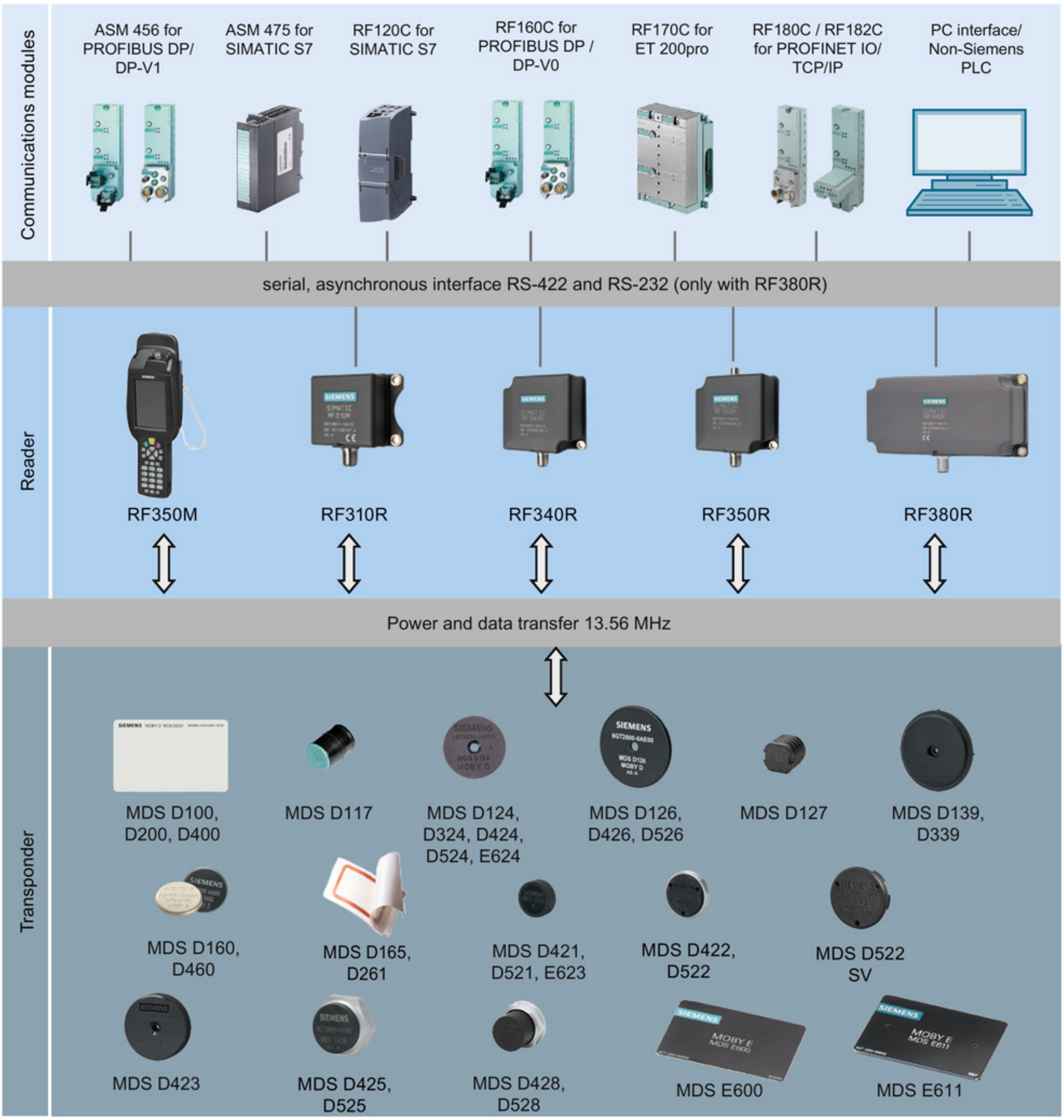


Figure 3-2 System overview medium-performance

Table 3- 5 Reader-transponder combination options for medium-performance applications

Transponder / MDS	RF310R (RS-422)	RF340R	RF350R with ANT 1	RF350R with ANT 3	RF350R with ANT 12	RF350R with ANT 18	RF350R with ANT 30	RF380R
MDS D100	✓	✓	✓	--	--	--	○	✓
MDS D117	--	--	--	--	✓	✓	--	--
MDS D124	✓	✓	✓	✓	○	✓	✓	✓
MDS D126	✓	✓	✓	--	--	--	✓	✓
MDS D127	--	--	--	--	✓	✓	--	--
MDS D139	✓	✓	✓	--	--	--	○	✓
MDS D160	✓	✓	✓	✓	✓	✓	✓	✓
MDS D165	✓	✓	✓	--	--	--	○	✓
MDS D200	✓	✓	✓	--	--	--	○	✓
MDS D261	✓	✓	✓	--	--	--	○	✓
MDS D324	✓	✓	✓	✓	--	✓	✓	✓
MDS D339 [1]	✓	✓	✓	--	--	--	--	✓
MDS D400	✓	✓	✓	--	--	--	--	✓
MDS D421	--	--	--	--	✓	✓	--	--
MDS D422	--	--	--	✓	--	✓	✓	--
MDS D423	✓	✓	✓	✓	--	--	✓	✓
MDS D424	✓	✓	✓	✓	○	✓	✓	✓
MDS D425	✓	✓	✓	✓	○	✓	✓	✓
MDS D426	✓	✓	✓	--	--	--	✓	✓
MDS D428	✓	✓	✓	✓	✓	✓	✓	✓
MDS D460	✓	✓	✓	✓	✓	✓	✓	✓
MDS D521	--	--	--	--	✓	✓	--	--
MDS D522	--	--	--	--	--	✓	✓	--
MDS D524	✓	✓	✓	--	○	✓	✓	✓
MDS D525	✓	✓	✓	--	○	✓	✓	✓
MDS D526	✓	✓	✓	--	--	--	✓	✓
MDS D528	✓	✓	✓	--	✓	✓	✓	✓
MDS E600 [2]	✓	✓	✓	--	--	--	○	✓
MDS E611 [2]	✓	✓	✓	--	--	--	○	--
MDS E623 [2]	--	--	--	--	✓	✓	--	--
MDS E624 [2]	✓	✓	✓	--	○	✓	✓	--

1) as of reader version "AS ≥ D"

2) Product to be discontinued; only relevant for migration projects.

✓ Combination possible

-- Combination not possible

○ Combination possible, but not recommended

Note

Note on operation of the transponders MDS D5xx and MDS E6xx

Note that the transponders MDS D5xx and MDS E6xx can only be operated in conjunction with the readers of the second generation (article number "6GT2801-xBAxx").

RF300 system components for Scanmode applications

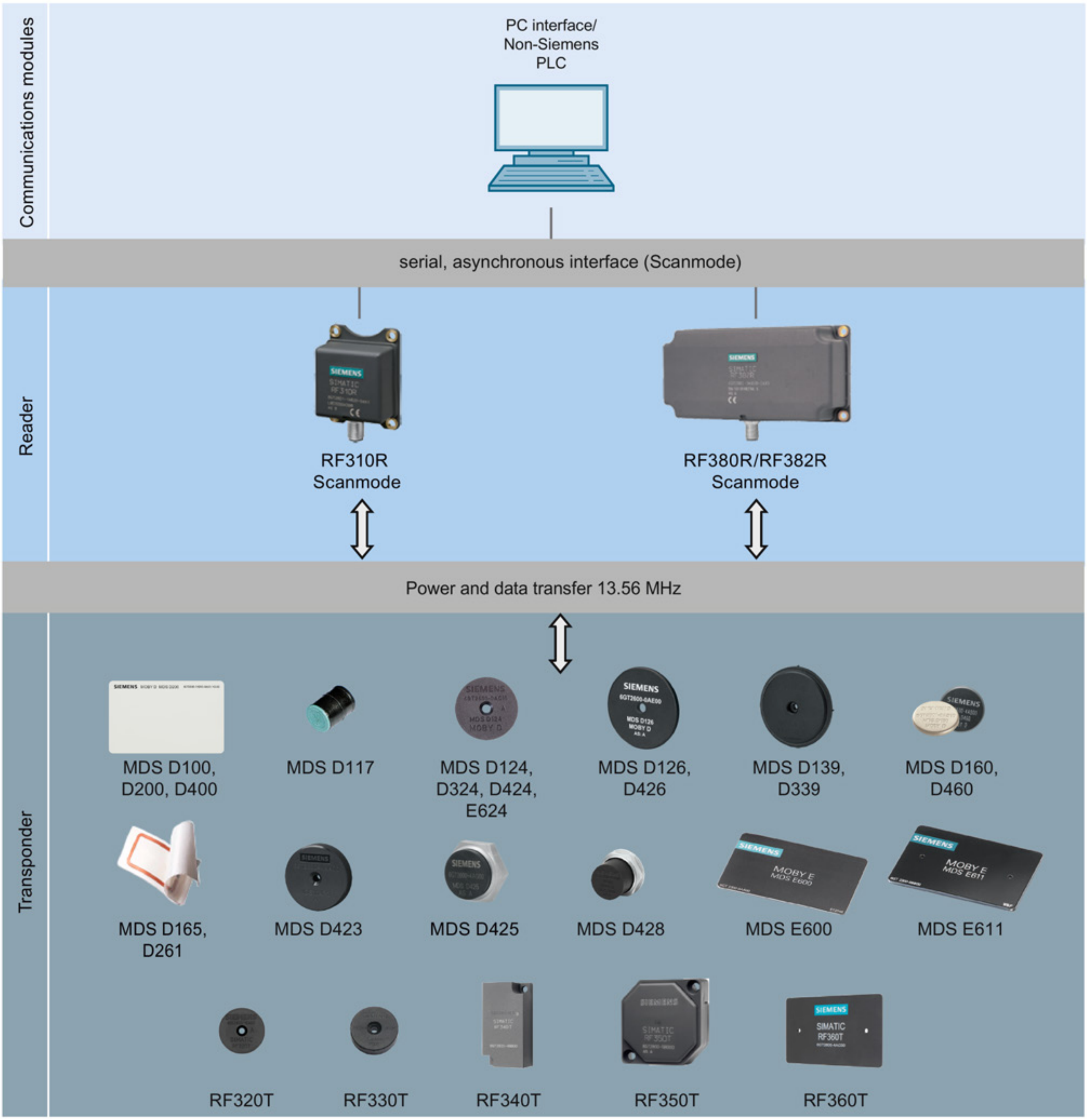


Figure 3-3 Scanmode system overview

Table 3- 6 Reader-transponder combination options for Scanmode applications

Transponder / MDS	RF310R	RF380R	RF382R
MDS D100	✓	✓	--
MDS D124	✓	✓	✓
MDS D126	✓	✓	--
MDS D139	✓	✓	--
MDS D160	✓	✓	✓
MDS D165	✓	✓	--
MDS D200	✓	✓	--
MDS D261	✓	✓	--
MDS D324	✓	✓	✓
MDS D339	✓	✓	--
MDS D400	✓	✓	--
MDS D423	✓	✓	--
MDS D424	✓	✓	✓
MDS D425	✓	✓	--
MDS D426	✓	✓	--
MDS D428	✓	✓	--
MDS D460	✓	✓	✓
MDS E610 [1)]	✓	--	--
MDS E611 [1)]	✓	--	--
MDS E624 [1)]	✓	--	--
RF320T	✓	✓	--
RF330T	✓	✓	--
RF340T	✓	✓	--
RF350T	✓	✓	--
RF360T	✓	✓	--
RF370T	--	✓	--
RF380T	--	✓	--

[1)] Product to be discontinued; only relevant for migration projects.

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

Note

Note on operation of the transponders MDS D5xx and MDS E6xx

Note that the transponders MDS D5xx and MDS E6xx can only be operated in conjunction with the readers of the second generation (article number "6GT2801-xBAxx").

3.2.3 Application areas of RF300

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

Main applications

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

Application examples

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

Advantages

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

3.3 System configuration

3.3.1 Overview

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

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

3.3.2 Assembly line example: Use of RF300 transponders

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

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

Advantages at a glance:

- redundant data storage on the basis of large memory, availability of decentralized data
- high data rate
- data management savings on the host system

Features of the scenario

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

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

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

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

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

The production order data can also be read for servicing purposes via the mobile SIMATIC RF350M reader.

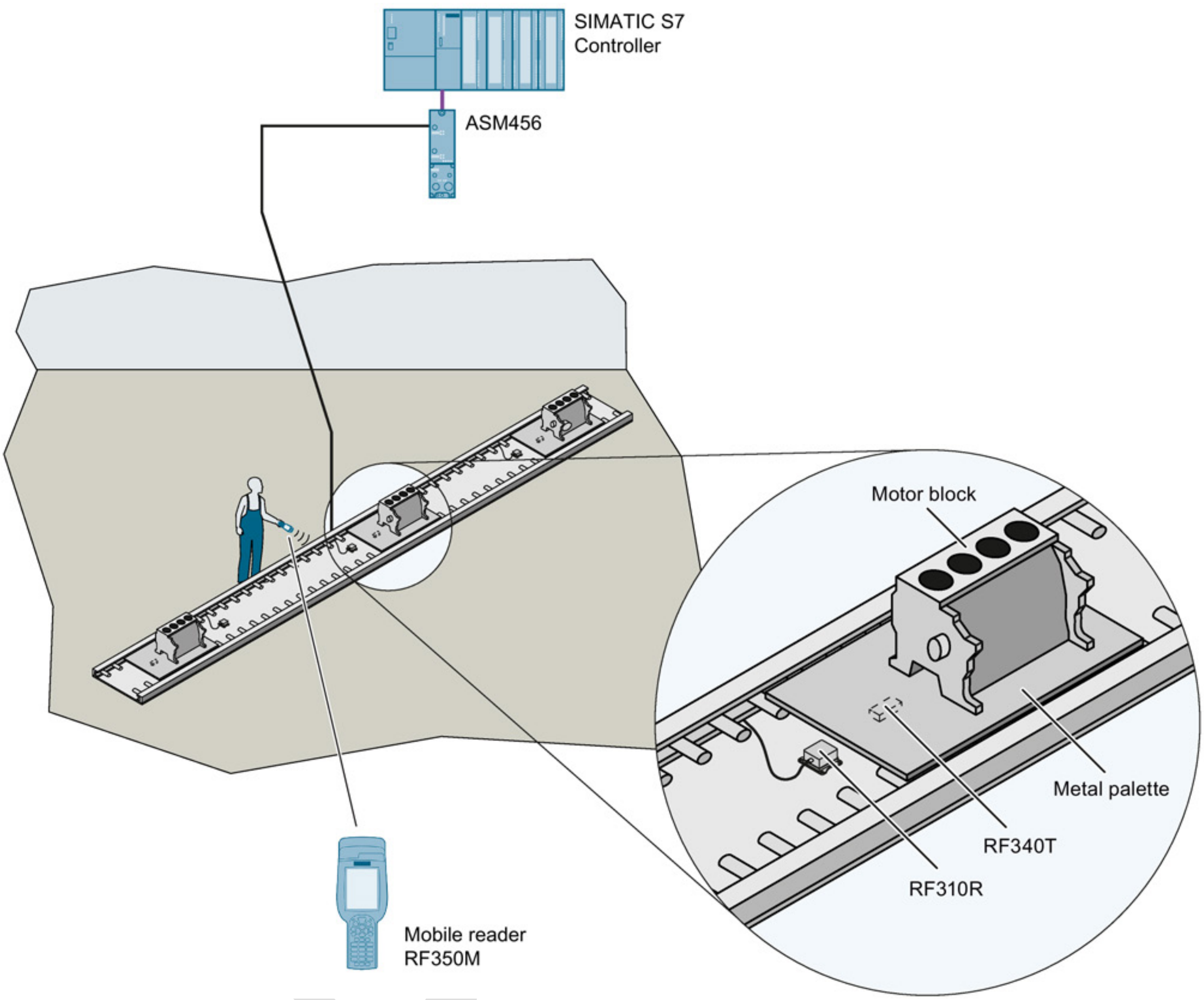


Figure 3-4 Example of engine block production

3.3.3 Example of container and cardboard container handling: Use of ISO transponders

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

Advantages at a glance:

- Decision points in the conveyor system can be installed in a more favorable way (mechanically)
- Different sizes of containers with different depths can be identified due to the range
- In contrast to bar codes, the transponders can also be written to
- Different types of transponders can be processed using one and the same reader

Features of the scenario

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

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

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

In addition, flexible identification is possible at each location and at any time using the mobile SIMATIC RF350M reader.

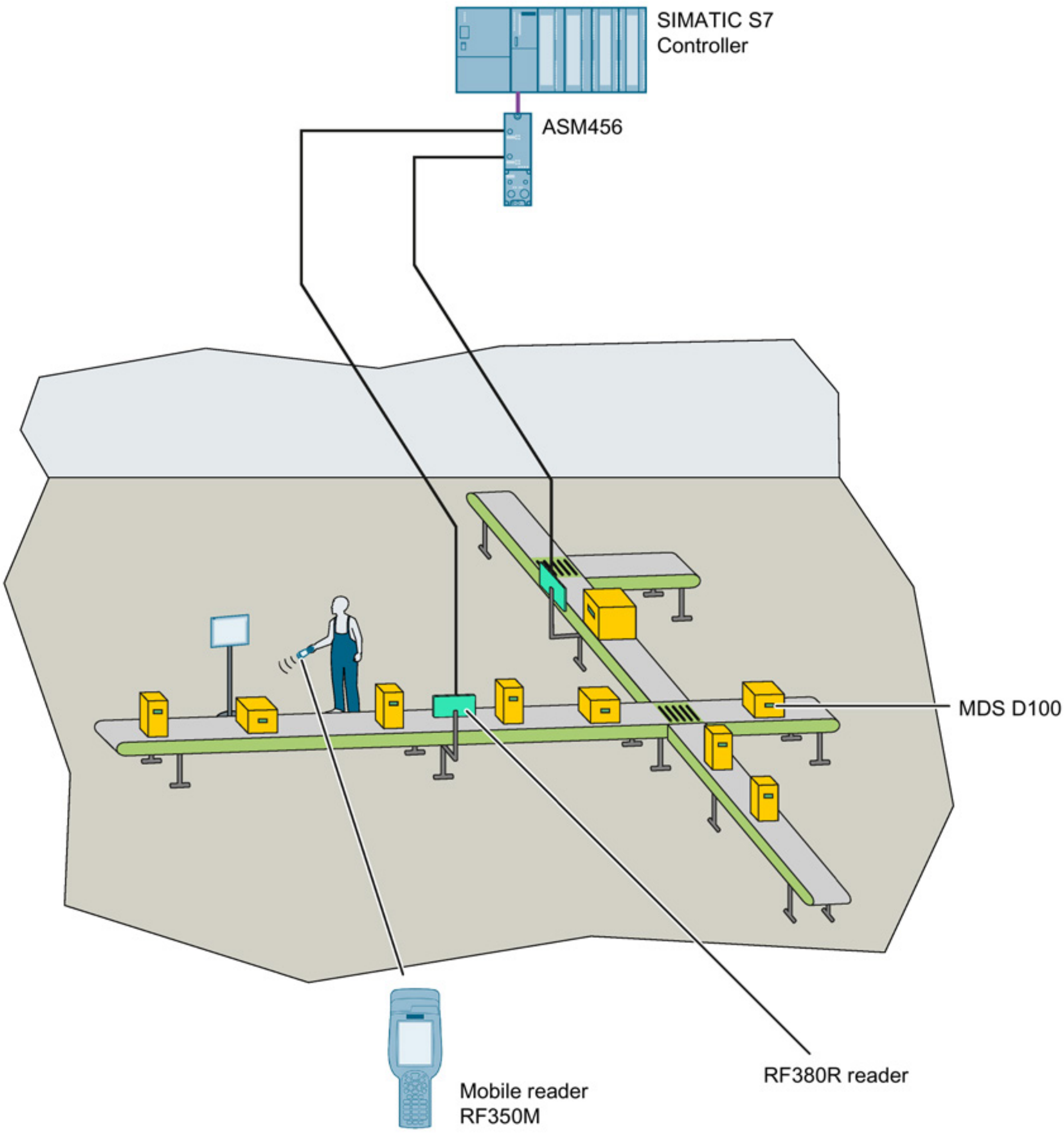


Figure 3-5 Example of container and cardboard container handling

Planning the RF300 system 4

4.1 Fundamentals of application planning

4.1.1 Selection criteria for SIMATIC RF300 components

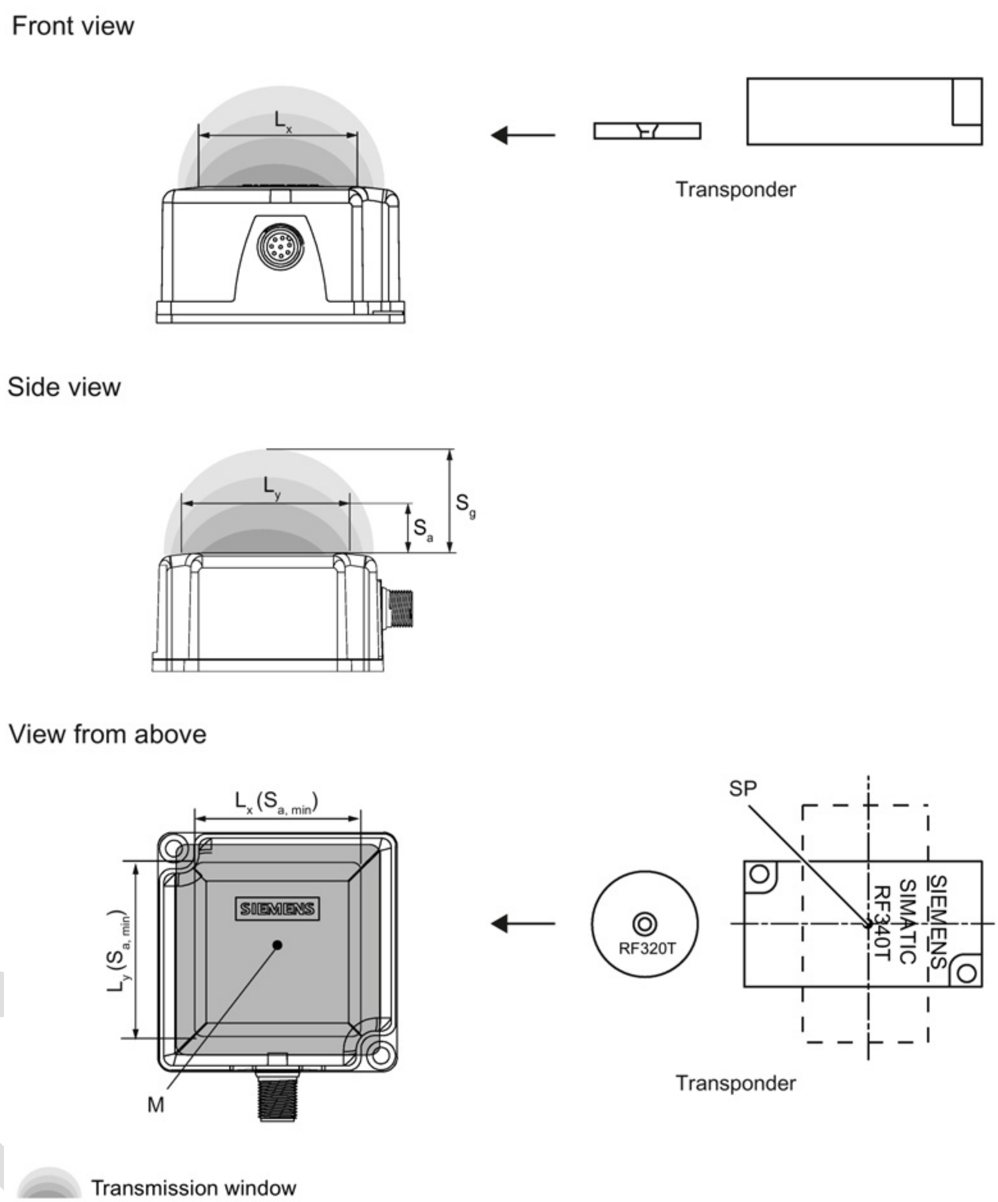
Assess your application according to the following criteria, in order to choose the right SIMATIC RF300 components:

- 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 antenna field is largest near to the reader. The size of the field decreases strongly the further away from the reader. The distribution of the antenna field depends on the structure and geometry of the antennas in the reader and transponder.

For the transponder to function correctly, a minimum field strength at the transponder must be achieved at a distance S_g from the reader or the antenna. The figures below show the transmission window between transponder and reader or between transponder and antenna:



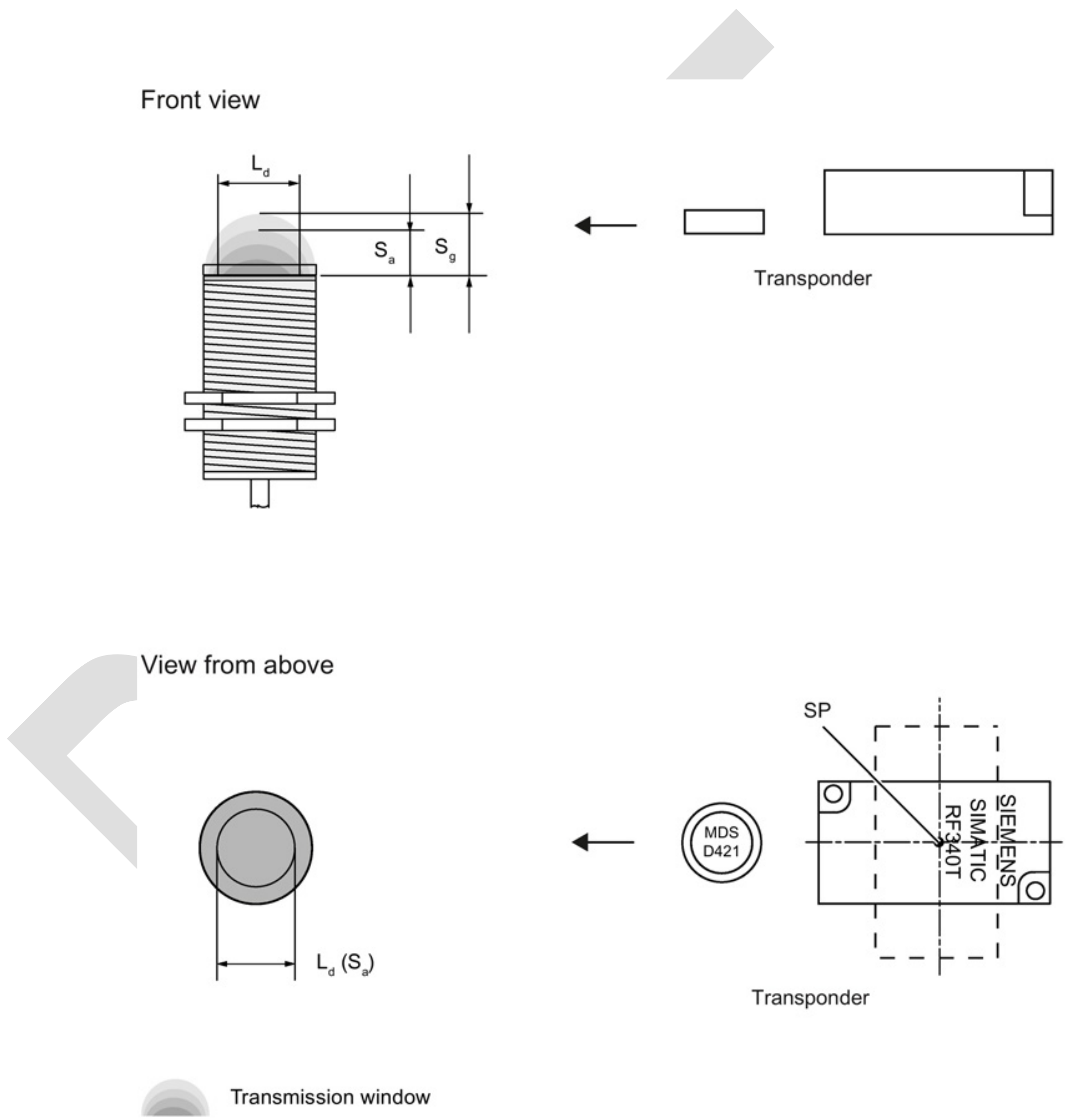
S_a	Operating distance between transponder and reader
S_g	Limit distance (maximum clear distance between upper surface of the reader and the transponder, at which the transmission can still just function under normal conditions)
L_x	Length of a transmission window in the x direction while maintaining the working distance ($L_x \neq L_y$ with RF380R and RF382R)
L_y	Length of a transmission window in the y direction while maintaining the working distance ($L_x \neq L_y$ with RF380R and RF382R)
M	Field centerpoint
SP	Intersection of the axes of symmetry of the transponder

Figure 4-1 Transmission window and read/write distance reader

Note

Transmission window with RF380R and RF382R

Note that the transmission window of the reader RF380R is not square ($L_x \neq L_y$). To obtain as large a transmission window as possible, make sure that the transponder only crosses the reader in the x direction.



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 just function under normal conditions)

L_d Diameter of a transmission window

SP Intersection of the axes of symmetry of the transponder

Figure 4-2 Transmission window and read/write distance round antenna

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

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

Aids for calculating the field data

Note

Determining the operating distance, limit distance and transmission window

Remember that you can obtain the values S_a, S_g and L simply and quickly using the tool for field data acquisition. You will find this on the DVD "Ident Systems, Software & Documentation".

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

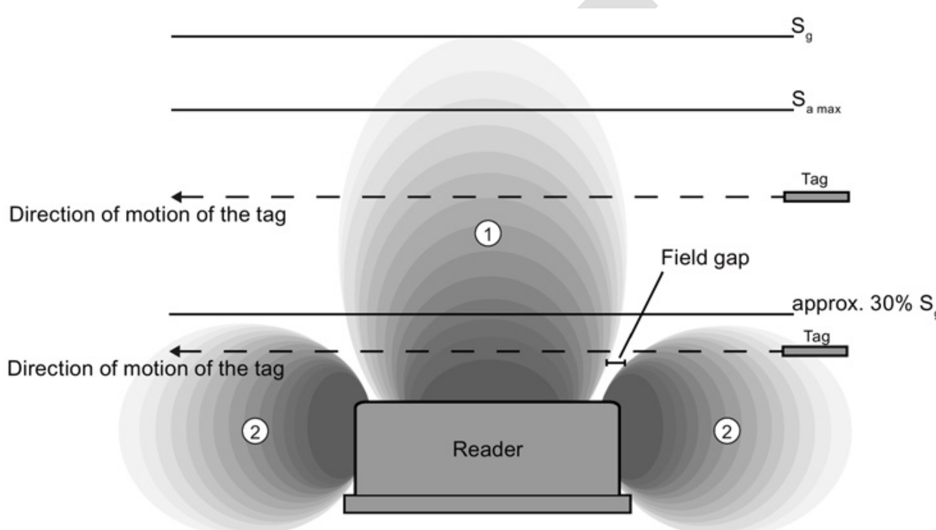
L: Length of the transmission window

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 mm to 30% of the limit distance (S_g) generally always exist.
They should, however, only be used during configuration in exceptional cases, 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.
When working in dynamic mode, remember that during the transition from the secondary field to the main field the presence of the tag is lost temporarily. It is therefore advisable to select a distance > 30 % of S_g.

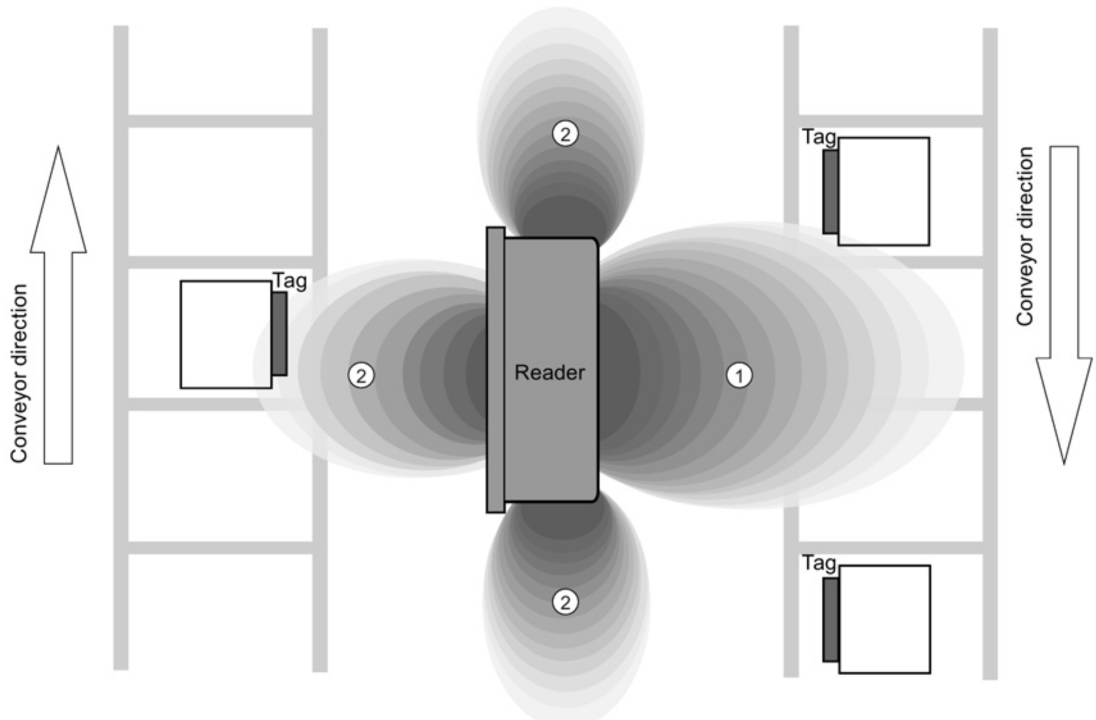


① Main field
② Secondary field

Figure 4-3 Gap in the field resulting from secondary fields

Secondary fields without shielding

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



① Main field
② Secondary field

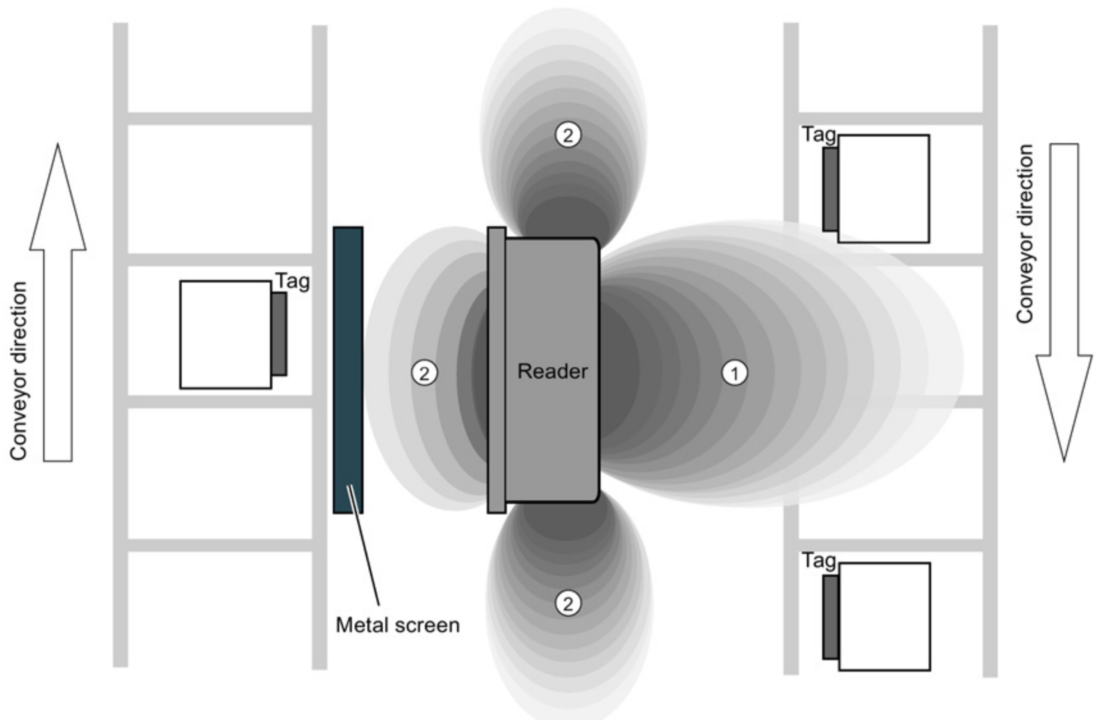
Figure 4-4 Secondary field without shielding

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

Secondary fields with shielding

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

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



① Main field
② Secondary field

Figure 4-5 Secondary field with shielding

4.1.5 Setup help of the readers of the second generation

After turning on the reader (connection to the power supply) and the following startup phase, the reader automatically changes to the "Setup" mode. The antenna (reader internal or external) is also turned on.

In this status "search for transponders" the reader scans the antenna field for transponders with all HF protocols (RF300, ISO 15693, ISO 14443). If a transponder is recognized in the antenna field of the reader only the HF protocol of the recognized transponder type is used and there is a change in the status to "Show quality". In this status you obtain direct feedback of the communication with the transponder via the LED. If no transponder is recognized for a longer period of time, the reader changes back to the "Search for transponders" status.

When a "RESET" command is received, the reader changes back to the normal operation as known from the RF300.

Meaning of the LED operating display in the "Setup" mode

The operational statuses of the reader are displayed by two LEDs. The LEDs can adopt the colors white green, red, yellow or blue and the statuses off, on , flashing:

Table 4- 1 Display elements

LED	Meaning
	The reader is turned off.
	The reader is turned on and is searching for transponders. The reader is in the "Setup" mode, in the "Search for transponders" status and has not yet received a "RESET" command and is not ready.
/	There is transponder in the antenna field. The reader is in the "Setup" mode, in the status "Show quality", has not yet received a "RESET" command and is not ready. Depending on the receive strength, the LED flashes or is lit permanently.

4.1.6 Permissible directions of motion of the transponder

Detection area and direction of motion of the transponder

The transponder and reader have no polarization axis, i.e. the transponder can come in from any direction, assume any position as parallel as possible to the reader, and cross the transmission window. The figure below shows the active area for various directions of transponder motion:

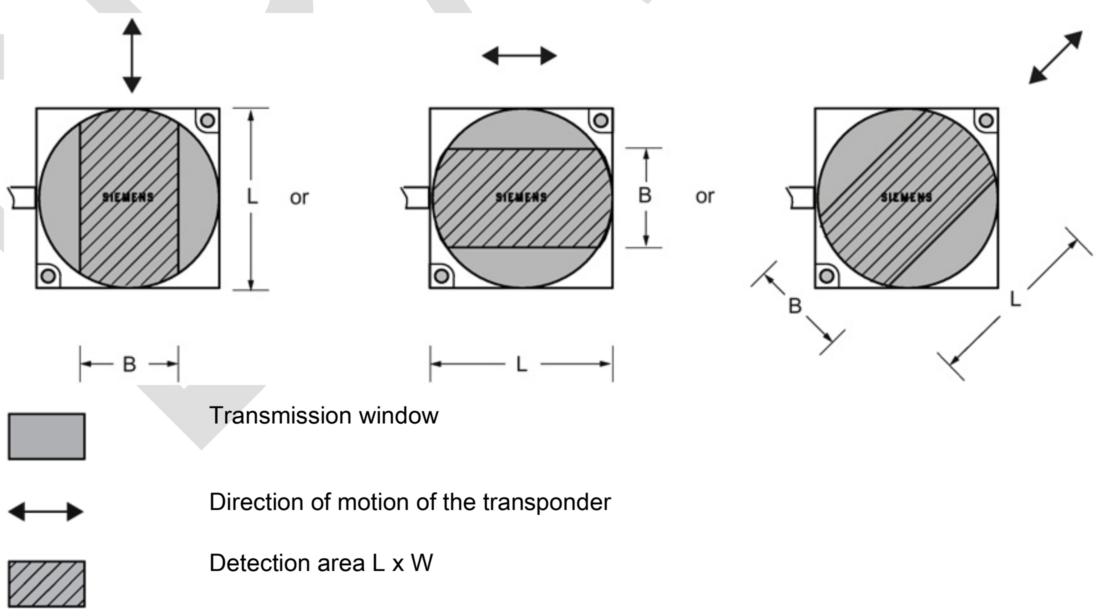


Figure 4-6 Detection areas of the reader for different directions of transponder motion

4.1.7 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:

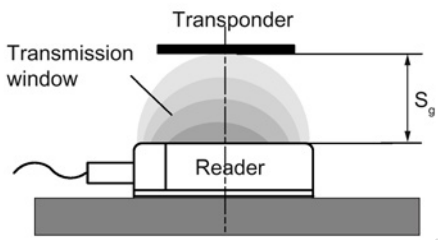


Figure 4-7 Operation in static mode

Operation in dynamic mode

When working in dynamic mode, the transponder moves past the reader. The transponder can be used as soon as the intersection (SP) of the transponder enters the circle of the transmission window. In dynamic mode, the operating distance (S_a) is of primary importance. [Operating distances, see Chapter Field data for transponders, readers and antennas (Page 48)]

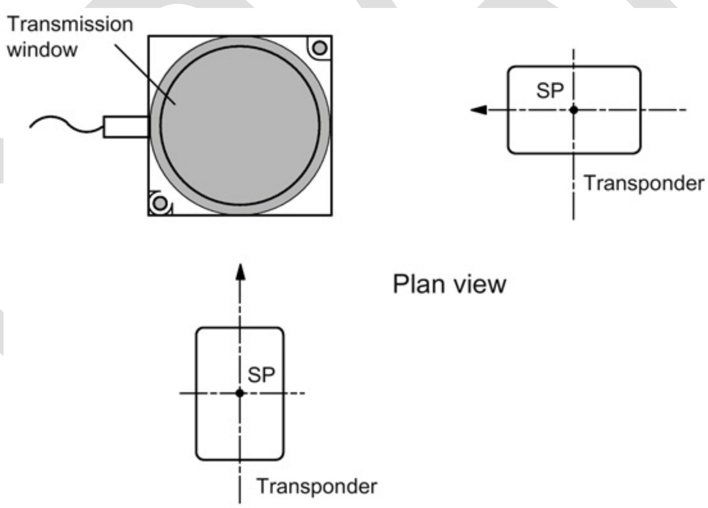


Figure 4-8 Operation in dynamic mode

4.1.8 Dwell time of the transponder

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

The dwell time is calculated thus:

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

t_V: Dwell time of the transponder

L: Length of the transmission window

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

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

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

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

$$t_V \geq t_K$$

t_V:: Dwell time of the data memory within the field of the reader

t_K: Communication time between transponder and communication module

4.1.9 Communication between communications module, reader and transponder

Aids for calculating the data transmission times

User-friendly calculation tools are available for the communications modules ASM 456, RF160C, RF170C and RF180C to calculate data transfer times. The calculation tools can be found on the DVD "Ident Systems Software & Documentation", article number 6GT2080-2AA20.

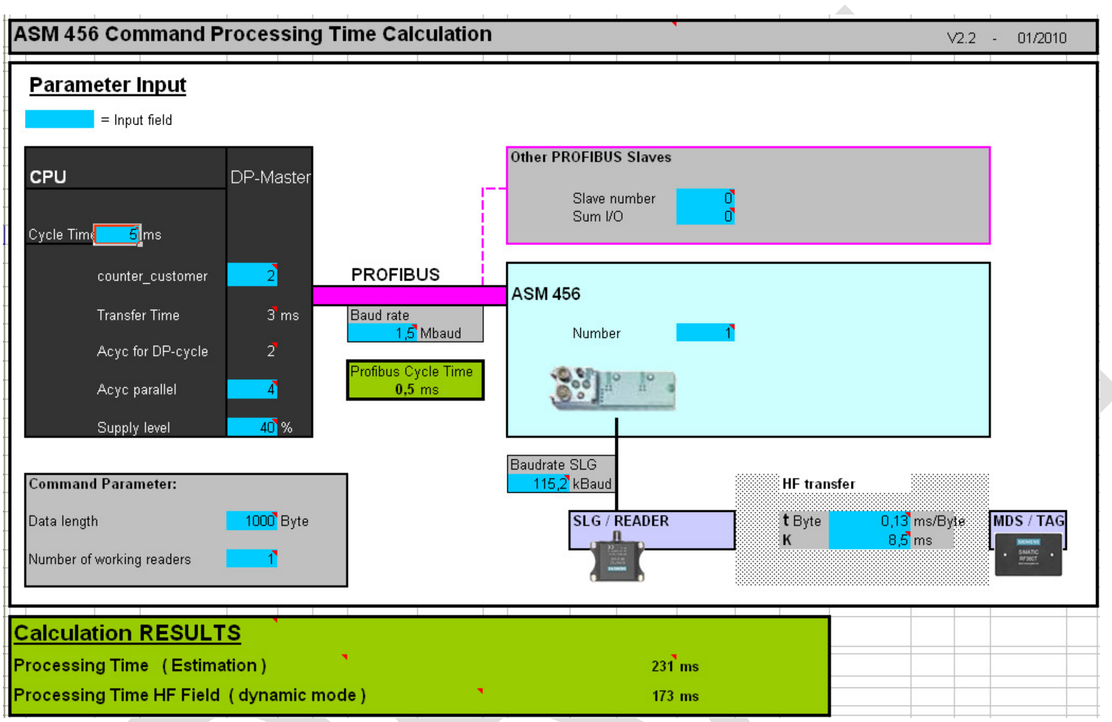


Figure 4-9 User interface of the calculation tool for command processing time

Aids for calculating the field data

You will also find a tool for calculating field data on the DVD "Ident Systems, Software & Documentation". Using this tool, among other things you can calculate the operating distance (S_a), limit distance (S_g) and transmission window (L).

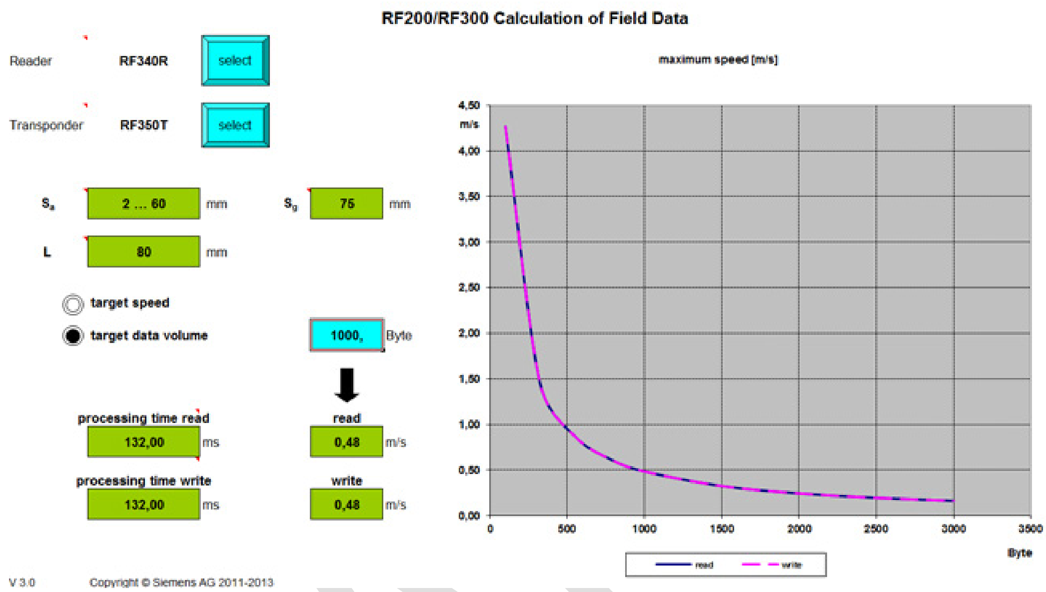


Figure 4-10 User interface of the calculation tool for field data acquisition

4.2 Field data for transponders, readers and antennas

The following tables show the field data for all SIMATIC RF300 components of transponders and readers. This makes the correct selection of a transponder and reader particularly easy.

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

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

Note

Transmission gaps

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

Note

Possible reader-transponder combinations

The tables of the following section show the possible reader-transponder combinations.

4.2.1 Field data of RF300 transponders

The limit distances (S_g) and operating distances (S_a) along with the length of the transmission window for each reader-transponder combination are listed in the tables below.

In dynamic mode, make sure that rectangular transponders cross the antenna field in the longitudinal direction.

Table 4- 2 Field data RF310R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	30	1...23	26
RF330T	30	2...18	21
RF340T	40	2...36	41
RF350T	45	2...47	53
RF360T	45	2...60	68
RF370T	70	2...45	60

All values are in mm

The values relate to the RF310R reader as of version "D".

Table 4- 3 Field data RF340R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	45	1...20	25
RF330T	40	2...20	24
RF340T	80	2...50	65
RF350T	80	2...60	75
RF360T	90	2...65	85
RF370T	85	5...60	80
RF380T	90	5...80	100

All values are in mm

Table 4- 4 Field data RF350R reader / ANT 1

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	45	1...30	40
RF330T	40	1...25	30
RF340T	80	2...55	70
RF350T	80	2...65	85
RF360T	90	2...75	100
RF370T	85	5...65	85
RF380T	90	5...90	110

All values are in mm

Table 4- 5 Field data RF350R reader / ANT 3

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
RF320T	??	1...16	20
RF330T	??	1...16	20
RF340T	??	2...32	40
RF350T	??	2...35	42
RF360T	??	2...40	50

All values are in mm

Table 4- 6 Field data RF350R reader / ANT 18

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
RF320T	10	0...10	15
RF330T	10	0...11	13
RF340T	20	0...20	25

All values are in mm

Table 4- 7 Field data RF350R reader / ANT 30

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
RF320T	15	0...15	20
RF330T	22	0...15	18
RF340T	25	0...30	35

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
RF350T	25	0...35	40
RF360T	??	2...25	35

All values are in mm

Table 4- 8 Field data RF380R reader

	Length of the transmission window		Operating distance (S_a)	Limit distance (S_g)
	in the x direction (L_x)	in the y direction (L_y)		
RF320T	100	40	2...45	60
RF330T	120	30	5...45	52
RF340T	120	50	2...80	105
RF350T	140	60	2...100	125
RF360T	160	70	2...120	150
RF370T	160	65	5...100	135
RF380T	180	75	5...125	160

All values are in mm

The RF380R with MLFB 6GT2801-3AB10 allows the transmission output power to be set with the aid of the "distance_limiting" input parameter (you will find more detailed information in "Function manual FB 45 (https://support.industry.siemens.com/cs/ww/en/view/21738808)"). For this, values from approx. 0.5 W to approx. 2.0 W can be set in 0.25 W increments. Depending on the setting, the change to the transmission output power increases the performance in the lower operating distance (low performance) or in the upper limit distance (high performance).

The "distance_limiting" range of values is from:

- 02 (= 0.5 W) through
- 05 (= 1.25 W; default value) to
- 08 (= 2 W).

Note

A 'distance_limiting' value setting outside of the range of "02 to 08" leads to the default setting 5 and does not generate an error message.

You will find more information on this subject in the chapter "Minimum clearances (Page 59)" section "Minimum distance from reader to reader".

You will find precise information about the parameters in "Product Information "FB 45 and FC 45 input parameters for RF300 and ISO transponders" (https://support.industry.siemens.com/cs/ww/en/view/33315697)".

4.2.2 Field data of ISO transponders (MDS D)

The limit distances (S_g) and operating distances (S_a) along with the length of the transmission window for each reader-transponder combination are listed in the tables below.

Observe the following information for field data of ISO transponders:

- A maximum median deviation of ±2 mm is possible in static mode (without affecting the field data).
- In dynamic mode, make sure that rectangular transponders cross the antenna field in the longitudinal direction.

Table 4- 9 Field data RF310R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D100	40	2...93	105
MDS D124	30	2...64	72
MDS D126	90	2...65	73
MDS D139	105	5...96	109
MDS D160	30	2...39	44
MDS D165	130	2...90	102
MDS D200	120	2...84	95
MDS D261	80	2...74	83
MDS D324	30	2...47	63
MDS D339	85	5...74	84
MDS D400	90	2...104	117
MDS D423	55	2...35	45
MDS D424	35	1...70	78
MDS D425	30	1...22	25
MDS D426	90	5...100	113
MDS D428	30	1...43	48
MDS D460	30	1...37	41
MDS D524	35	1...70	78
MDS D525	??	??	??
MDS D526	90	5...100	113
MDS D528	30	1...43	48

All values are in mm

The values relate to the RF310R reader as of version "D".

Table 4- 10 Field data RF340R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D100	90	5...110	140
MDS D124	60	2...60	75
MDS D126	80	2...85	110
MDS D139	90	5...80	110
MDS D160	50	2...35	60
MDS D165	130	5...100	125
MDS D200	125	5...80	110
MDS D261	95	5...60	70
MDS D324	50	2...55	70
MDS D339	100	5...75	85
MDS D400	140	2...100	130
MDS D423	65	2...40	55
MDS D424	50	2...55	70
MDS D425	45	2...20	30
MDS D426	110	0...80	100
MDS D428	45	2...35	50
MDS D460	45	2...25	40
MDS D524	50	2...55	70
MDS D525	??	??	??
MDS D526	110	0...80	100
MDS D528	45	2...35	50

All values are in mm

Table 4- 11 Field data RF350R reader / ANT 1

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D100	80	5...110	140
MDS D124	55	2...65	85
MDS D126	150	2...90	120
MDS D139	75	5...85	115
MDS D160	50	2...35	60
MDS D165	140	5...100	120
MDS D200	130	5...95	115
MDS D261	100	5...80	95
MDS D324	50	2...70	90
MDS D339	110	5...90	105
MDS D400	140	2...110	140
MDS D423	85	2...50	70

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS D424	50	2...60	80
MDS D425	40	2...25	35
MDS D426	110	0...85	110
MDS D428	40	2...35	50
MDS D460	40	2...35	50
MDS D524	50	2...60	80
MDS D525	??	??	??
MDS D526	110	0...85	110
MDS D528	40	2...35	50

All values are in mm

Table 4- 12 Field data RF350R reader / ANT 3

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS D124	??	0...35	42
MDS D160	??	1...16	20
MDS D324	??	2...32	40
MDS D422	??	1...12	15
MDS D423	??	0...24	30
MDS D424	??	0...42	48
MDS D425	??	0...16	20
MDS D428	??	0...25	32
MDS D460	??	0...18	25

All values are in mm

Table 4- 13 Field data RF350R reader / ANT 12

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS D117	2	0...3	4
MDS D127	2	0...3	4
MDS D160	15	0...8	15
MDS D421	6	0...3	5
MDS D428	15	1...10	17
MDS D460	8	1...10	14
MDS D521	6	0...3	5
MDS D528	15	1...10	17

All values are in mm

Table 4- 14 Field data RF350R reader / ANT 18

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS D117	3	0...4	5
MDS D124	27	2...24	34
MDS D127	3	0...4	5
MDS D160	20	1...18	27
MDS D324	25	1...22	28
MDS D421	10	0...6	8
MDS D422	20	1...10	13
MDS D424	25	1...27	35
MDS D425	17	1...10	14
MDS D428	17	1...12	14
MDS D460	15	1...12	18
MDS D521	??	??	??
MDS D522	20	1...10	13
MDS D524	25	1...27	35
MDS D525	??	??	??
MDS D528	17	1...12	14

All values are in mm

Table 4- 15 Field data RF350R reader / ANT 30

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS D124	30	1...35	46
MDS D126	70	0...47	60
MDS D160	25	1...25	30
MDS D324	30	1...35	45
MDS D422	30	0...15	19
MDS D423	45	2...30	40
MDS D424	28	0...45	50
MDS D425	25	1...15	20
MDS D426	65	0...45	57
MDS D428	25	1...25	34
MDS D460	22	1...18	25
MDS D522	??	??	??
MDS D524	28	0...45	50
MDS D525	??	??	??
MDS D526	65	0...45	57
MDS D528	25	1...25	34

All values are in mm

Table 4- 16 Field data RF380R reader

	Length of the transmission window		Operating distance (S_a)	Limit distance (S_g)
	in the x direction (L_x)	in the y direction (L_y)		
MDS D100	140	100	5...170	210
MDS D124	80	80	1...120	140
MDS D126	180	140	2...145	190
MDS D139	140	90	5...160	200
MDS D160	80	40	2...64	80
MDS D165	200	140	5...170	200
MDS D200	200	160	5...150	195
MDS D261	190	120	5..120	160
MDS D324	100	60	2...96	120
MDS D339	290	140	5...160	180
MDS D400	240	120	2...200	240
MDS D423	110	60	5...75	90
MDS D424	100	70	2...120	140
MDS D425	80	45	2...35	50
MDS D426	220	160	0...155	195
MDS D428	80	50	2…70	95
MDS D460	80	70	2…65	90
MDS D524	100	70	2...120	140
MDS D525	??	??	??	??
MDS D526	220	160	0...155	195
MDS D528	80	50	2…70	95

All values are in mm

Table 4- 17 Field data RF382R reader

	Length of the transmission window		Operating distance (S_a)	Limit distance (S_g)
	in the x direction (L_x)	in the y direction (Ly)		
MDS D124	70	130	40...65	75
MDS D160	50	100	35...50	65
MDS D324	60	120	40...65	75
MDS D424	65	120	40...65	75
MDS D460	40	80	30...50	60

All values are in mm

4.2.3 Field data of ISO transponders (MDS E)

The limit distances (S_g) and operating distances (S_a) along with the length of the transmission window for each reader-transponder combination are listed in the tables below.

Observe the following information for field data of ISO transponders:

- A maximum median deviation of ±2 mm is possible in static mode (without affecting the field data).
- In dynamic mode, make sure that rectangular transponders cross the antenna field in the longitudinal direction.

Note

Relenace of the MDS E transponders

The MDS E transponders are products that will be discontinued. These are relevant for migration projects in which existing RFID systems are replaced by SIMATIC RF300.

Table 4- 18 Field data RF310R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS E600	40	2...93	105
MDS E611	40	2...93	105
MDS E624	30	2...64	72

All values are in mm

The values relate to the RF310R reader as of version "D".

Table 4- 19 Field data RF340R reader

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS E600	90	5...110	140
MDS E611	90	20...50	70
MDS E624	60	2...60	75

All values are in mm

Table 4- 20 Field data RF350R reader / ANT 1

	Length of the transmission window (L)	Operating distance (S_a)	Limit distance (S_g)
MDS E600	80	5...110	140
MDS E611	80	5...110	140
MDS E624	55	2...65	85

All values are in mm

Table 4- 21 Field data RF350R reader / ANT 12

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS E623	6	0...3	5

All values are in mm

Table 4- 22 Field data RF350R reader / ANT 18

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS E623	10	0...6	8
MDS E624	27	2...24	34

All values are in mm

Table 4- 23 Field data RF350R reader / ANT 30

	Diameter of the transmission window (L_d)	Operating distance (S_a)	Limit distance (S_g)
MDS E624	30	1...35	46

All values are in mm

4.2.4 Minimum clearances

Minimum distance from transponder to transponder

The specified distances refer to a metal-free environment. For a metallic environment, the specified minimum distances must be multiplied by a factor of 1.5. The transponders designed specifically for installation in/on metal are an exception to this.

Table 4- 24 Minimum distances RF300 transponder

	RF310R	RF340R	RF350R / ANT 1	RF350R / ANT 3	RF350R / ANT 18	RF350R / ANT 30	RF380R
RF320T	≥ 50	≥ 70	≥ 70	??	≥ 20	≥ 40	≥ 120
RF330T	≥ 40	≥ 50	≥ 50	??	≥ 20	≥ 30	≥ 120
RF340T	≥ 60	≥ 80	≥ 80	??	≥ 40	≥ 40	≥ 140
RF350T	≥ 60	≥ 80	≥ 80	??	--	≥ 50	≥ 150
RF360T	≥ 60	≥ 80	≥ 80	??	--	??	≥ 120
RF370T	--	≥ 80	≥ 80	--	--	--	≥ 130
RF380T	??	≥ 80	≥ 80	--	--	--	≥ 150

All values are in mm, relative to the operating distance (S_a) between reader and transponder, and between transponder edge and transponder edge

Table 4- 25 Minimum distances ISO transponder

	RF310R	RF340R	RF350R / ANT 1	RF350R / ANT 3	RF350R / ANT 12	RF350R / ANT 18	RF350R / ANT 30	RF380R	RF382R [1)]
MDS D100	≥ 120	≥ 240	≥ 240	--	--	--	--	≥ 420	--
MDS D117	--	--	--	--	≥ 20	≥ 30	--	--	--
MDS D124	≥ 100	≥ 180	≥ 180	??	--	≥ 50	≥ 80	≥ 360	≥ 100, 150
MDS D126	≥ 120	≥ 140	≥ 140	--	--	--	≥ 100	≥ 400	--
MDS D127	--	--	--	--	≥ 25	≥ 30	--	--	--
MDS D139	--	≥ 200	≥ 200	--	--	--	≥ 80	≥ 450	--
MDS D160	≥ 120	≥ 150	≥ 150	??	≥ 30	≥ 50	≥ 60	≥ 300	≥ 100, 120
MDS D165	≥ 120	≥ 140	≥ 140	--	--	--	--	≥ 500	--
MDS D200	≥ 120	≥ 150	≥ 150	--	--	--	--	≥ 500	--
MDS D261	≥ 160	≥ 200	≥ 200	--	--	--	--	≥ 400	--
MDS D324	≥ 120	≥ 180	≥ 180	??	--	≥ 50	≥ 80	≥ 360	≥ 100, 150
MDS D339	??	≥ 140	≥ 140	--	--	--	--	≥ 450	--
MDS D400	≥ 220	≥ 240	≥ 240	--	--	--	--	≥ 500	--
MDS D421	--	--	--	--	≥ 15	≥ 15	--	--	--
MDS D422	--	--	--	??	--	≥ 30	≥ 40	--	--
MDS D423	≥ 100	≥ 120	≥ 120	??	--	≥ 40	≥ 60	≥ 250	--

	RF310R	RF340R	RF350R / ANT 1	RF350R / ANT 3	RF350R / ANT 12	RF350R / ANT 18	RF350R / ANT 30	RF380R	RF382R [1]
MDS D424	≥ 100	180	≥ 180	??	--	≥ 50	≥ 80	≥ 360	≥ 100, 180
MDS D425	≥ 70	≥ 100	≥ 100	??	--	--	≥ 60	≥ 250	--
MDS D426	≥ 120	≥ 120	≥ 140	--	--	≥ 30	≥ 60	≥ 400	--
MDS D428	≥ 100	≥ 150	≥ 150	??	≥ 30	≥ 50	≥ 60	≥ 300	--
MDS D460	≥ 100	≥ 150	≥ 150	??	≥ 30	≥ 50	≥ 60	≥ 300	≥ 100, 120
MDS D521	--	--	--	--	≥ 15	≥ 15	--	--	--
MDS D522	--	--	--	--	--	≥ 30	≥ 40	--	--
MDS D524	≥ 100	180	≥ 180	--	--	≥ 50	≥ 80	≥ 360	≥ 100, 180
MDS D525	≥ 70	≥ 100	≥ 100	??	--	--	≥ 60	≥ 250	--
MDS D526	≥ 120	≥ 120	≥ 140	--	--	≥ 30	≥ 60	≥ 400	--
MDS D528	≥ 100	≥ 150	≥ 150	--	≥ 30	≥ 50	≥ 60	≥ 300	--
MDS E600 [2]	≥ 120	≥ 240	≥ 240	--	--	--	--	--	--
MDS E611 [2]	≥ 120	≥ 240	≥ 240	--	--	--	--	--	--
MDS E623 [2]	--	--	--	--	≥ 15	≥ 15	--	--	--
MDS E624 [2]	≥ 100	180	≥ 180	??	--	≥ 50	≥ 80	--	--

[1] The first value is the minimum distance of the transponders in the horizontal field, the second value is the minimum distance of the transponders in the vertical field.

[2] Product to be discontinued; only relevant for migration projects.

All values are in mm, relative to the operating distance (S_a) between reader and transponder, and between transponder edge and transponder edge

Minimum distance from reader to reader

Table 4- 26 Minimum distances reader

	RF310R to RF310R	RF340R to RF340R	RF380R to RF380R [1]	RF382R to RF382R
with 2 readers	≥ 150	≥ 200	≥ 400	≥ 200
with several readers	≥ 200	≥ 250	≥ 500	≥ 200

All values are in mm

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

Table 4- 27 Effect on the minimum distance of the transmit power with RF380R

'distance_limiting' byte	Factor
02; 03	0.8
04; 05; 06	1.0
07; 08	1.2

Minimum distance from antenna to antenna

Table 4- 28 Minimum distances antennas

ANT 1	ANT 3	ANT 3S	ANT 8	ANT 12	ANT 18	ANT 30
≥ 100	≥ 80	≥ 20	≥ 50	≥ 70	≥ 100	≥ 100

All values are in mm

You will find detailed information on the minimum distances between antennas the section "Minimum distance between antennas (Page 200)".

Note

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

If the values fall below the values specified in the "Minimum distance readers" and "Minimum distances antennas" tables , there is a risk of the function being affected by inductive fields. In this case, the data transfer time would increase unpredictably or a command would be aborted with an error.

Keeping to the values specified in the "Minimum distance readers" and "Minimum distances antennas" tables is therefore essential.

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

Note

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

4.3 Installation guidelines

4.3.1 Overview

The transponder and reader complete with their antennas are inductive devices. Any type of metal in the vicinity of these devices affects their functionality. Some points need to be considered during planning and installation if the values described in the "Field data (Page 48)" 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 RFID system when mounted in the vicinity of metal.

4.3.2 Reduction of interference due to metal

Table 4- 29 Interference due to metal rack

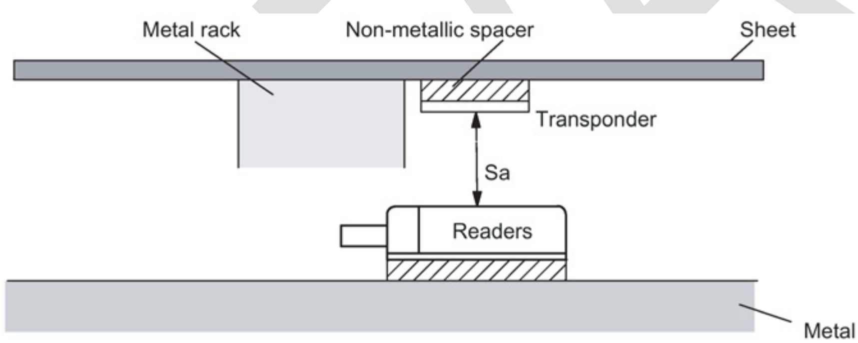
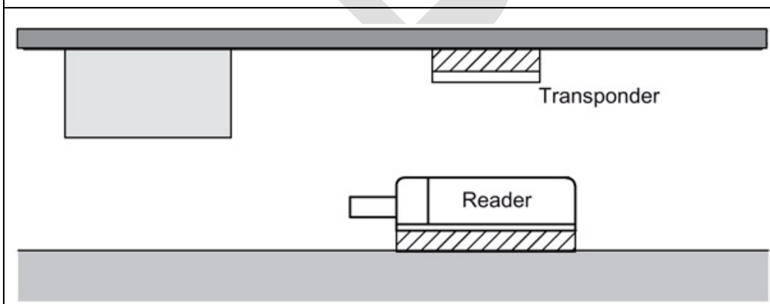
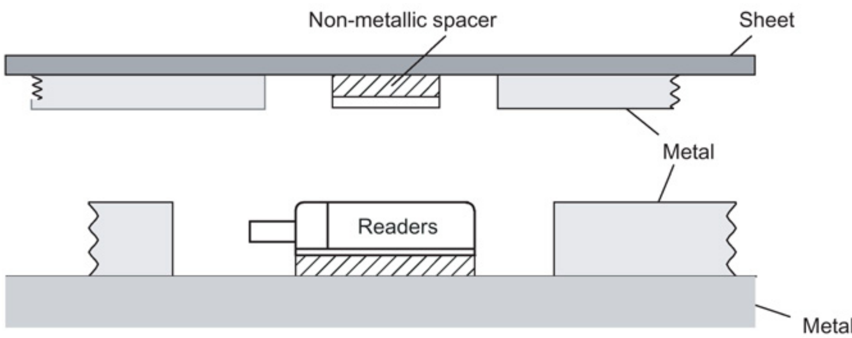
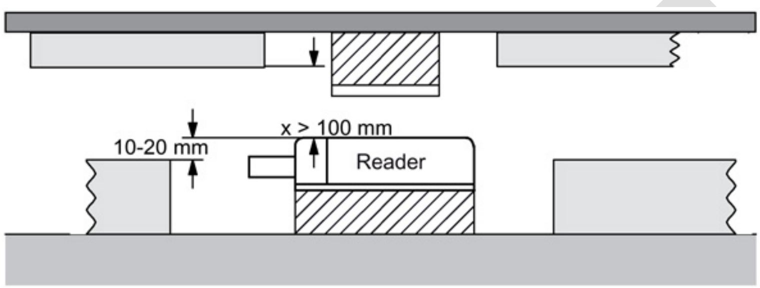
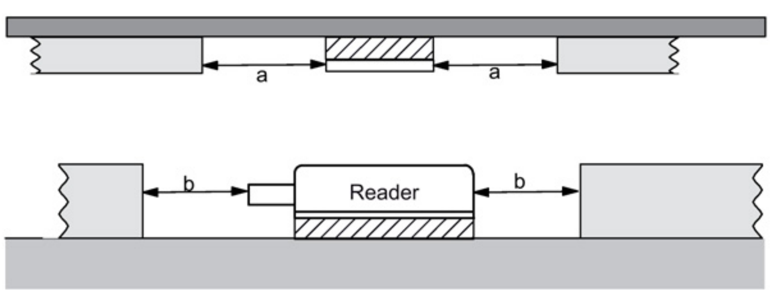
Representation	Description
	**Problem:** A metal rack is located above the transmission window of the reader. This affects the entire field. In particular, the transmission window between reader and transponder is reduced.
	**Remedy:** The transmission window is no longer affected if the transponder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

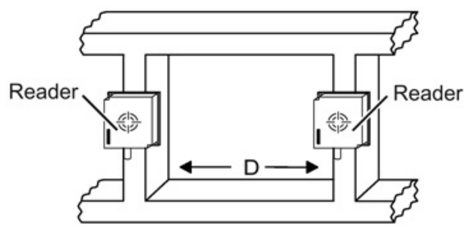
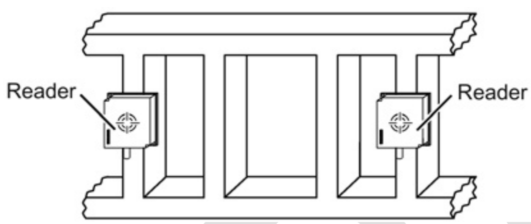
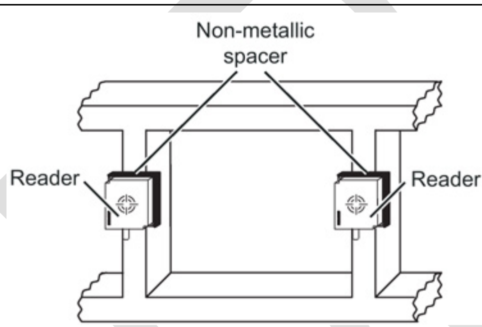
Table 4- 30 Flush-mounting of transponders and readers

Representation	Description
	**Problem:** Flush-mounting of transponders and readers is possible in principle. However, the size of the transmission window is significantly reduced. The following measures can be used to counteract the reduction of the window:
	**Remedy:** Enlargement of the non-metallic spacer below the transponder and/or reader. The transponder and/or reader are 10 to 20 mm higher than the metal surround. (The value x ≥ 100 mm is valid, e.g. for RF310R. It indicates that, for a distance x ≥ 100 mm, the reader can no longer be significantly affected by metal.)
	**Remedy:** Increase the distances a, b to metal. 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.

Table 4- 31 Mounting several readers on metal frames or racks

Representation	Description
	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:

4.3.3 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.

4.3.4 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, make sure that no metal rail (or similar part) intersects the transmission field.
  The metal rail would affect the field data.
- With readers with a large antenna surface (e.g. RF260R) for reasons of communication reliability, when the transponders are flush mounted in metal, a metal-free space around the transponders is recommended. This metal-free space should match the size of the antenna surface.

The impact of metal on the field data (S_g, S_a, L) is shown in a table in this section. The values in the tables describe field data reduction and show the reduced range as a percentage. The range relates to use in a non-metallic environment. A value of 100% means no influence on the range.

Note

Possible reader-transponder combinations

The tables of the following section show the possible reader-transponder combinations.

4.3.4.1 Impact on the transmission window by metal

With RF300 transponders

Table 4- 32 Reduction of field data due to metal, range as %: Transponder and RF310R

Transponder		**RF310R reader**		
		Without metal	**On metal**	**Flush-mounted in metal (20 mm all-round)**
RF320T[1)]	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
RF330T	Without metal	100	95	80
	On metal; distance 0 mm	100	85	75
	Flush-mounted in metal; distance all round 10 mm	85	80	70
	Flush-mounted in metal; without surrounding clearance	30	30	25

Transponder		RF310R reader		
		Without metal	**On metal**	**Flush-mounted in metal (20 mm all-round)**
RF340T	Without metal	100	95	80
	On metal; distance 0 mm	80	80	80
	Flush-mounted in metal; distance all round 20 mm	70	70	70
RF350T	Without metal	100	95	85
	On metal; distance 0 mm	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
RF370T	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

With ISO transponders (MDS D)

Table 4- 33 Reduction of field data due to metal, range as %: Transponder and RF310R

Transponder		RF310R reader		
		Without metal	**On metal**	**Flush-mounted in metal (20 mm all-round)**
MDS D100[1)]	Without metal	100	95	80
	On metal; distance 20 mm	75	70	65
	Flush-mounted in metal; distance all round 20 mm	55	55	50
MDS D124[1)]	Without metal	100	95	80
	On metal; distance 15 mm	90	95	85
	Flush-mounted in metal; distance all round 20 mm	80	75	60
MDS D126[1)]	Without metal	100	90	85
	On metal; distance 25 mm	85	80	75
	Flush-mounted in metal; distance all round 50 mm	80	75	70

Transponder		RF310R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D139[1)]	Without metal	100	90	80
	On metal; distance 30 mm	100	90	80
	Flush-mounted in metal; distance all round 100 mm	100	90	80
MDS D160[1)]	Without metal	100	90	80
	On metal; distance 10 mm	75	75	75
MDS D165	Without metal	100	90	85
	On metal; distance 25 mm	90	80	75
MDS D200[1)]	Without metal	100	90	80
	On metal; distance 20 mm	80	70	65
	Flush-mounted in metal; distance all round 20 mm	60	60	60
MDS D261	Without metal	100	80	85
	On metal; distance 25 mm	90	75	80
MDS D324[1)]	Without metal	100	95	75
	On metal; distance 15 mm	80	80	75
	Flush-mounted in metal; distance all round 25 mm	80	75	70
MDS D339	without metal	??	??	??
	on metal; distance 30 mm	??	??	??
	flush-mounted in metal; distance all round 100 mm	??	??	??
MDS D400[1)]	Without metal	100	80	75
	On metal; distance 20 mm	65	60	55
	Flush-mounted in metal; distance all round 20 mm	55	50	45
MDS D423	Without metal	100	95	90
	On metal; distance 0 mm	150[2)]	140[2)]	140[2)]
	Flush-mounted in metal; distance all round 0 mm	70	60	60
MDS D424[1)]	Without metal	100	90	80
	On metal; distance 15 mm	80	80	70
	Flush-mounted in metal; distance all round 25 mm	60	60	50
MDS D425	Without metal	100	100	95
	On metal; distance 0 mm	90	85	80
MDS D426[1)]	Without metal	100	90	80
	On metal; distance 25 mm	85	80	70
	Flush-mounted in metal; distance all round 50 mm	80	75	65

Transponder		RF310R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D428	Without metal	100	100	75
	On metal; distance 0 mm	100	100	75
MDS D460[1)]	Without metal	100	100	80
	On metal; distance 10 mm	80	80	60
MDS D524[1)]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 25 mm	??	??	??
MDS D525	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
MDS D526[1)]	without metal	??	??	??
	on metal; distance 25 mm	??	??	??
	flush-mounted in metal; distance all round 50 mm	??	??	??
MDS D528	without metal	??	??	??
	on metal; distance 0 mm	??	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

With ISO transponders (MDS E)

Table 4- 34 Reduction of field data due to metal, range as %: Transponder and RF310R

Transponder		RF310R reader		
		without metal	on metal	flush-mounted in metal (20 mm all-round)
MDS E600[1)]	without metal	100	95	80
	on metal; distance 20 mm	75	70	65
	flush-mounted in metal; distance all round 20 mm	55	55	50
MDS E611[1)]	without metal	100	95	80
	on metal; distance 20 mm	75	70	65
	flush-mounted in metal; distance all round 20 mm	55	55	50

Transponder		RF310R reader		
		without metal	on metal	flush-mounted in metal (20 mm all-round)
MDS E624[1)]	without metal	100	95	80
	on metal; distance 15 mm	90	95	85
	flush-mounted in metal; distance all round 20 mm	80	75	60

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

4.3.4.2 RF340R

With RF300 transponders

Table 4- 35 Reduction of field data due to metal, range as %: Transponder and RF340R

Transponder		RF340R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
RF320T	Without metal	100	95	90
	On metal; distance 20 mm	85	85	80
	Flush-mounted in metal; distance all round 20 mm	75	75	65
RF330T[1)]	Without metal	100	95	90
	On metal; distance 0 mm	90	90	80
	Flush-mounted in metal; distance all round 10 mm	65	65	60
RF340T	Without metal	100	95	80
	On metal; distance 0 mm	65	65	55
	Flush-mounted in metal; distance all round 20 mm	60	60	55
RF350T	Without metal	100	90	85
	On metal; distance 0 mm	75	70	70
	Flush-mounted in metal; distance all round 20 mm	55	55	45
RF360T	Without metal	100	95	80
	On metal; distance 20 mm	75	70	65
	Flush-mounted in metal; distance all round 20 mm	70	60	50

Transponder		RF340R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
RF370T	Without metal	100	95	80
	On metal; distance 0 mm	95	90	75
	Flush-mounted in metal; distance all round 20 mm	70	65	65
RF380T	Without metal	100	95	75
	On metal; distance 0 mm	100	95	70
	Flush-mounted in metal; distance all-round 40 mm	80	75	60

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

With ISO transponders (MDS D)

Table 4- 36 Reduction of field data due to metal, range as %: Transponder and RF340R

Transponder		RF340R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D100[1]	Without metal	100	90	75
	On metal; distance 20 mm	70	65	60
	Flush-mounted in metal; distance all round 20 mm	60	45	45
MDS D124[1]	Without metal	100	95	80
	On metal; distance 15 mm	85	85	75
	Flush-mounted in metal; distance all round 20 mm	80	80	45
MDS D126[1]	Without metal	100	90	85
	On metal; distance 25 mm	80	80	70
	Flush-mounted in metal; distance all round 50 mm	75	75	65
MDS D139[1]	Without metal	100	95	80
	On metal; distance 30 mm	100	90	75
	Flush-mounted in metal; distance all round 100 mm	100	90	75
MDS D160[1]	Without metal	100	95	80
	On metal; distance 10 mm	85	85	75
MDS D165	Without metal	100	95	85
	On metal; distance 25 mm	90	80	75

Transponder		RF340R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D200[1)]	Without metal	100	95	90
	On metal; distance 20 mm	90	85	80
	Flush-mounted in metal; distance all round 20 mm	75	50	65
MDS D261	Without metal	100	100	100
	On metal; distance 25 mm	70	95	90
MDS D324[1)]	Without metal	100	95	80
	On metal; distance 15 mm	90	85	75
	Flush-mounted in metal; distance all round 25 mm	80	80	60
MDS D339	Without metal	100	95	80
	On metal; distance 30 mm	100	90	75
	Flush-mounted in metal; distance all round 100 mm	100	90	75
MDS D400[1)]	Without metal	100	90	80
	On metal; distance 20 mm	70	65	80
	Flush-mounted in metal; distance all round 20 mm	55	50	50
MDS D423	Without metal	100	95	85
	On metal; distance 0 mm	120[2)]	120[2)]	115[2)]
	Flush-mounted in metal; distance all round 0 mm	65	60	60
MDS D424[1)]	Without metal	100	95	80
	On metal; distance 15 mm	85	85	75
	Flush-mounted in metal; distance all round 25 mm	75	75	70
MDS D425	Without metal	100	95	95
	On metal; distance 0 mm	100	90	90
MDS D426[1)]	Without metal	100	90	80
	On metal; distance 25 mm	80	75	70
	Flush-mounted in metal; distance all round 50 mm	75	70	65
MDS D428	Without metal	100	95	80
	On metal; distance 0 mm	95	80	75
MDS D460[1)]	Without metal	100	95	95
	On metal; distance 10 mm	85	85	85
MDS D524[1)]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 25 mm	??	??	??

Transponder		RF340R reader		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D525	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
MDS D526[1]	without metal	??	??	??
	on metal; distance 25 mm	??	??	??
	flush-mounted in metal; distance all round 50 mm	??	??	??
MDS D528	without metal	??	??	??
	on metal; distance 0 mm	??	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

With ISO transponders (MDS E)

Table 4- 37 Reduction of field data due to metal, range as %: Transponder and RF340R

Transponder		RF340R reader		
		without metal	on metal	flush-mounted in metal (20 mm all-round)
MDS E600[1]	without metal	100	90	75
	on metal; distance 20 mm	70	65	60
	flush-mounted in metal; distance all round 20 mm	60	45	45
MDS E611[1]	without metal	100	90	75
	on metal; distance 20 mm	70	65	60
	flush-mounted in metal; distance all round 20 mm	60	45	45
MDS E624[1]	without metal	100	95	80
	on metal; distance 15 mm	85	85	75
	flush-mounted in metal; distance all round 20 mm	80	80	45

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

4.3.4.3 RF350R

Reader RF350R with ANT 1 and with RF300 transponders

Table 4- 38 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 1

Transponder		ANT 1 without metal	ANT 1 on metal	ANT 1 flush-mounted in metal (40 mm all-round)
RF320T[1)]	Without metal	100	90	90
	On metal; distance 20 mm	85	85	75
	Flush-mounted in metal; distance all round 20 mm	75	75	65
RF330T	Without metal	100	90	90
	On metal; distance 0 mm	95	85	75
	Flush-mounted in metal; distance all round 10 mm	65	60	60
RF340T	Without metal	100	90	90
	On metal; distance 0 mm	65	65	60
	Flush-mounted in metal; distance all round 20 mm	60	60	55
RF350T	Without metal	100	90	85
	On metal; distance 0 mm	75	70	65
	Flush-mounted in metal; distance all round 20 mm	55	55	45
RF360T	Without metal	100	90	85
	On metal; distance 20 mm	75	75	65
	Flush-mounted in metal; distance all round 20 mm	65	60	50
RF370T	Without metal	100	90	85
	On metal; distance 0 mm	95	88	75
	Flush-mounted in metal; distance all round 20 mm	70	65	65
RF380T	Without metal	100	90	80
	On metal; distance 0 mm	100	90	70
	Flush-mounted in metal; distance all round 40 mm	80	75	60

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 1 and with ISO transponders (MDS D)

Table 4- 39 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 1

Transponder		ANT 1 without metal	ANT 1 on metal	ANT 1 mounted in metal (40 mm all-round)
MDS D100 [1)]	Without metal	100	85	80
	On metal; distance 20 mm	70	60	65
	Flush-mounted in metal; distance all round 20 mm	60	45	45
MDS D124 [1)]	Without metal	100	95	85
	On metal; distance 15 mm	85	85	80
	Flush-mounted in metal; distance all round 20 mm	85	80	50
MDS D126 [1)]	Without metal	100	85	85
	On metal; distance 25 mm	85	75	75
	Flush-mounted in metal; distance all round 50 mm	80	70	70
MDS D139 [1)]	Without metal	100	90	85
	On metal; distance 30 mm	95	85	85
	Flush-mounted in metal; distance all round 100 mm	95	85	85
MDS D160 [1)]	Without metal	100	95	90
	On metal; distance 10 mm	85	85	80
MDS D165	Without metal	100	85	85
	On metal; distance 25 mm	90	80	75
MDS D200 [1)]	Without metal	100	85	80
	On metal; distance 20 mm	85	75	75
	Flush-mounted in metal; distance all round 20 mm	75	65	65
MDS D261	Without metal	100	90	85
	On metal; distance 25 mm	85	80	80
MDS D324 [1)]	Without metal	100	85	85
	On metal; distance 15 mm	90	80	80
	Flush-mounted in metal; distance all round 25 mm	80	75	65
MDS D339 [1)]	Without metal	100	90	85
	On metal; distance 30 mm	95	85	85
	Flush-mounted in metal; distance all round 100 mm	95	85	85
MDS D400 [1)]	Without metal	100	90	85
	On metal; distance 20 mm	80	70	65
	Flush-mounted in metal; distance all round 20 mm	65	60	60

Transponder		ANT 1 without metal	ANT 1 on metal	ANT 1 mounted in metal (40 mm all-round)
MDS D423	Without metal	100	90	90
	On metal; distance 0 mm	115[2]	115[2]	115[2]
	Flush-mounted in metal; distance all round 0 mm	80	65	65
MDS D424[1]	Without metal	100	90	75
	On metal; distance 15 mm	85	80	75
	Flush-mounted in metal; distance all round 25 mm	75	70	70
MDS D425	Without metal	100	95	95
	On metal; distance 0 mm	90	85	85
MDS D426[1]	Without metal	100	90	85
	On metal; distance 25 mm	85	80	75
	Flush-mounted in metal; distance all round 50 mm	80	75	x
MDS D428	Without metal	100	90	85
	On metal; distance 0 mm	85	80	80
MDS D460[1]	Without metal	100	90	80
	On metal; distance 10 mm	85	80	75
MDS D524[1]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 25 mm	??	??	??
MDS D525	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
MDS D526[1]	without metal	??	??	??
	on metal; distance 25 mm	??	??	??
	flush-mounted in metal; distance all round 50 mm	??	??	??
MDS D528	without metal	??	??	??
	on metal; distance 0 mm	??	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

Reader RF350R with ANT 1 and with ISO transponders (MDS E)

Table 4- 40 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 1

Transponder		ANT 1 without metal	ANT 1 on metal	ANT 1 mounted in metal (40 mm all-round)
MDS E6001)	without metal	100	85	80
	on metal; distance 20 mm	70	60	65
	flush-mounted in metal; distance all round 20 mm	60	45	45
MDS E6111)	without metal	100	85	80
	on metal; distance 20 mm	70	60	65
	flush-mounted in metal; distance all round 20 mm	60	45	45
MDS E6241)	without metal	100	95	85
	on metal; distance 15 mm	85	85	80
	flush-mounted in metal; distance all round 20 mm	85	80	50

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 3 and with RF300 transponders

Table 4- 41 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 3

Transponder		ANT 3 without metal	ANT 3 on metal	ANT 3 flush-mounted in metal (40 mm all-round)
RF320T1)	without metal	??	??	??
	on metal; distance 20 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??
RF330T	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
	flush-mounted in metal; distance all round 10 mm	??	??	??
RF340T	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??

Transponder		ANT 3 without metal	ANT 3 on metal	ANT 3 flush-mounted in metal (40 mm all-round)
RF350T	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??
RF360T	without metal	??	??	??
	on metal; distance 20 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??

[1)] Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 3 and with ISO transponders (MDS D)

Table 4- 42 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 3

Transponder		ANT 3 without metal	ANT 3 on metal	ANT 3 flush-mounted in metal (40 mm all-round)
MDS D124[1)]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??
MDS D160[1)]	without metal	??	??	??
	on metal; distance 10 mm	??	??	??
MDS D324[1)]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 25 mm	??	??	??
MDS D422	without metal	??	??	??
	on metal, distance 0 mm	??	??	??
	flush-mounted in metal; distance all round 0 mm	??	??	??
MDS D423	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
	flush-mounted in metal; distance all round 0 mm	??	??	??

Transponder		ANT 3 without metal	ANT 3 on metal	ANT 3 flush-mounted in metal (40 mm all-round)
MDS D424[1]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 25 mm	??	??	??
MDS D425	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
MDS D428	without metal	??	??	??
	on metal; distance 0 mm	??	??	??
MDS D460[1]	without metal	??	??	??
	on metal; distance 10 mm	??	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

Reader RF350R with ANT 3 and with ISO transponders (MDS E)

Table 4- 43 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 3

Transponder		ANT 3 without metal	ANT 3 on metal	ANT 3 flush-mounted in metal (40 mm all-round)
MDS E624[1]	without metal	??	??	??
	on metal; distance 15 mm	??	??	??
	flush-mounted in metal; distance all round 20 mm	??	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 12 and with ISO transponders (MDS D)

Table 4- 44 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 12

Transponder		ANT 12 without metal	ANT 12 mounted in metal (0 mm all-round)
MDS D117	Without metal	100	85
	On metal; distance 0 mm	90	85
	Flush-mounted in metal; distance all round 0 mm	65	65
MDS D127	Without metal	100	85
	On metal; distance 0 mm	95	85
	Flush-mounted in metal; distance all round 0 mm	65	65
MDS D160 1)	Without metal	100	80
	On metal; distance 10 mm	100	80
MDS D421	Without metal	100	80
	On metal; distance 0 mm	90	75
	Flush-mounted in metal; distance all round 0 mm	70	60
MDS D428	Without metal	100	75
	On metal; distance 0 mm	95	75
MDS D460 1)	Without metal	100	80
	On metal; distance 10 mm	100	80
MDS D521	without metal	??	??
	on metal; distance 0 mm	??	??
	flush-mounted in metal; distance all round 0 mm	??	??
MDS D528	without metal	??	??
	on metal; distance 0 mm	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 12 and with ISO transponders (MDS E)

Table 4- 45 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 12

Transponder		ANT 12 without metal	ANT 12 mounted in metal (0 mm all-round)
MDS E623	without metal	100	80
	on metal; distance 0 mm	90	75
	flush-mounted in metal; distance all round 0 mm	70	60

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 18 and with RF300 transponders

Table 4- 46 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 18

Transponder		ANT 18 without metal	ANT 18 mounted in metal (10 mm all-round)
RF320T[1)]	Without metal	100	65
	On metal; distance 20 mm	85	55
	Flush-mounted in metal; distance all round 20 mm	75	45
RF330T	Without metal	100	85
	On metal; distance 0 mm	120[2)]	100
	Flush-mounted in metal; distance all round 10 mm	115[2)]	95
	Flush-mounted in metal; without surrounding clearance	95	90
RF340T	Without metal	100	85
	On metal; distance 0 mm	65	60
	Flush-mounted in metal; distance all round 20 mm	60	55

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

Reader RF350R with ANT 18 and with ISO transponders (MDS D)

Table 4- 47 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 18

Transponder		ANT 18 without metal	ANT 18 mounted in met-al (10 mm all-round)
MDS D124[1)]	Without metal	100	85
	On metal, distance 15 mm	85	75
	Flush-mounted in metal; distance all round 15 mm	85	45
MDS D127	Without metal	100	90
	On metal, distance 0 mm	95	85
	Flush-mounted in metal; distance all round 0 mm	60	60
MDS D160[1)]	Without metal	100	80
	On metal, distance 10 mm	85	75
MDS D324[1)]	Without metal	100	80
	On metal; distance 15 mm	90	75
	Flush-mounted in metal; distance all round 25 mm	80	65
MDS D421	Without metal	100	85
	On metal, distance 0 mm	90	65
	Flush-mounted in metal; distance all round 0 mm	40	20
MDS D422	Without metal	100	85
	On metal, distance 0 mm	95	85
	Flush-mounted in metal; distance all round 0 mm	90	80
MDS D424[1)]	Without metal	100	85
	On metal 15 mm	85	80
	Flush-mounted in metal; distance all round 25 mm	75	75
MDS D425	Without metal	100	85
	On metal, distance 0 mm	100	85
MDS D428	Without metal	100	95
	On metal, distance 0 mm	95	95
MDS D460[1)]	Without metal	100	95
	On metal, distance 15 mm	95	95
MDS D521	without metal	??	??
	on metal, distance 0 mm	??	??
	flush-mounted in metal; distance all round 0 mm	??	??

Transponder		ANT 18 without metal	ANT 18 mounted in metal (10 mm all-round)
MDS D522	without metal	??	??
	on metal, distance 0 mm	??	??
	flush-mounted in metal; distance all round 0 mm	??	??
MDS D524[1)]	without metal	??	??
	on metal 15 mm	??	??
	flush-mounted in metal; distance all round 25 mm	??	??
MDS D525	without metal	??	??
	on metal, distance 0 mm	??	??
MDS D528	without metal	??	??
	on metal, distance 0 mm	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 18 and with ISO transponders (MDS E)

Table 4- 48 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 18

Transponder		ANT 18 without metal	ANT 18 mounted in metal (10 mm all-round)
MDS E623	without metal	100	85
	on metal, distance 0 mm	90	65
	flush-mounted in metal; distance all round 0 mm	40	20
MDS E624[1)]	without metal	100	85
	on metal, distance 15 mm	85	75
	flush-mounted in metal; distance all round 15 mm	85	45

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

Reader RF350R with ANT 30 and with RF300 transponders

Table 4- 49 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 30

Transponder		Mounting the antenna	
		ANT 30 without metal	ANT 30 mounted in metal (20 mm all-round)
RF320T[1]	Without metal	100	90
	On metal; distance 30 mm	85	75
	Flush-mounted in metal; distance all round 20 mm	75	65
RF330T	Without metal	100	90
	On metal;	110[2]	100
	Flush-mounted in metal; distance all round 10 mm	105[2]	95
	Flush-mounted in metal; without surrounding clearance	90	80
RF340T	Without metal	100	85
	On metal; distance 30 mm	65	55
	Flush-mounted in metal; distance all round 20 mm	60	55
RF350T	Without metal	100	85
	Directly on metal	75	65
	Flush-mounted in metal; distance all round 20 mm	55	45
RF360T	without metal	??	??
	on metal; distance 20 mm	??	??
	flush-mounted in metal; distance all round 20 mm	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

Reader RF350R with ANT 30 and with ISO transponders (MDS D)

Table 4- 50 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 30

Transponder		ANT 30 without metal	ANT 30 mounted in metal (20 mm all-round)
MDS D124[1]	Without metal	100	85
	On metal; distance 15 mm	85	75
	Flush-mounted in metal; distance all round 15 mm	80	45

Transponder		ANT 30 without metal	ANT 30 mounted in metal (20 mm all-round)
MDS D126[1)]	Without metal	100	85
	On metal; distance 25 mm	90	75
	Flush-mounted in metal; distance all round 50 mm	85	70
MDS D160[1)]	Without metal	100	80
	On metal, distance 10 mm	85	75
MDS D324[1)]	Without metal	100	80
	On metal; distance 15 mm	90	70
	Flush-mounted in metal; distance all round 25 mm	80	65
MDS D422	Without metal	100	85
	On metal, distance 0 mm	95	85
	Flush-mounted in metal; distance all round 0 mm	90	80
MDS D423	Without metal	100	80
	On metal, distance 0 mm	125[2)]	115[2)]
	Flush-mounted in metal; distance all round 0 mm	80	70
MDS D424[1)]	Without metal	100	85
	On metal 15 mm	95	85
	Flush-mounted in metal; distance all round 25 mm	85	75
MDS D425	Without metal	100	80
	On metal, distance 0 mm	95	80
MDS D426[1)]	Without metal	100	85
	On metal; distance 25 mm	90	75
	Flush-mounted in metal; distance all round 50 mm	80	70
MDS D428	Without metal	100	90
	On metal, distance 0 mm	95	90
MDS D460[1)]	Without metal	100	90
	On metal, distance 10 mm	95	85
MDS D522	without metal	??	??
	on metal, distance 0 mm	??	??
	flush-mounted in metal; distance all round 0 mm	??	??
MDS D524[1)]	without metal	??	??
	on metal 15 mm	??	??
	flush-mounted in metal; distance all round 25 mm	??	??
MDS D525	without metal	??	??
	on metal, distance 0 mm	??	??

Transponder		ANT 30 without metal	ANT 30 mounted in metal (20 mm all-round)
MDS D526[1)]	without metal	??	??
	on metal; distance 25 mm	??	??
	flush-mounted in metal; distance all round 50 mm	??	??
MDS D528	without metal	??	??
	on metal, distance 0 mm	??	??

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

2) Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

Reader RF350R with ANT 30 and with ISO transponders (MDS E)

Table 4- 51 Reduction of field data due to metal, range as %: Transponder and RF350R with ANT 30

Transponder		ANT 30 without metal	ANT 30 mounted in metal (20 mm all-round)
MDS E624[1)]	without metal	100	85
	on metal; distance 15 mm	85	75
	flush-mounted in metal; distance all round 15 mm	80	45

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

4.3.4.4 RF380R

With RF300 transponders

Table 4- 52 Reduction of field data due to metal, range as %: Transponder and RF380R

Transponder		Reader RF380R (RF300 mode)		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
RF320T[1)]	Without metal	100	95	90
	On metal; distance 20 mm	85	75	70
	Flush-mounted in metal; distance all round 20 mm	60	55	50

Transponder		Reader RF380R (RF300 mode)		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
RF330T	Without metal	100	90	80
	On metal; distance 0 mm	70	65	60
RF340T	Without metal	100	90	80
	On metal; distance 0 mm	70	65	60
	Flush-mounted in metal; distance all round 20 mm	60	60	55
RF350T	Without metal	100	85	80
	On metal; distance 0 mm	70	65	60
	Flush-mounted in metal; distance all round 20 mm	55	50	45
RF360T 1)	Without metal	100	95	85
	On metal; distance 20 mm	75	70	65
	Flush-mounted in metal; distance all round 20 mm	60	55	50
RF370T	Without metal	100	95	85
	On metal; distance 0 mm	90	85	80
	Flush-mounted in metal; distance all round 20 mm	65	60	60
RF380T	Without metal	100	95	85
	On metal; distance 0 mm	95	90	80
	Flush-mounted in metal; distance all-round 40 mm	65	60	55

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

With ISO transponders (MDS D)

Table 4- 53 Reduction of field data due to metal, range as %: Transponder and RF380R

Transponder		Reader RF380R (ISO mode)		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D100 1)	Without metal	100	95	80
	On metal; distance 20 mm	65	60	55
	Flush-mounted in metal; distance all round 20 mm	55	50	45

Transponder		Reader RF380R (ISO mode)		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D124[1)]	Without metal	100	95	90
	On metal; distance 15 mm	95	90	85
	Flush-mounted in metal; distance all round 20 mm	70	65	50
MDS D126[1)]	Without metal	100	90	80
	On metal; distance 25 mm	80	75	70
	Flush-mounted in metal; distance all round 50 mm	75	65	65
MDS D139[1)]	Without metal	100	90	75
	On metal; distance 30 mm	95	85	70
	Flush-mounted in metal; distance all round 100 mm	90	80	70
MDS D160[1)]	Without metal	100	95	90
	On metal; distance 10 mm	85	85	80
MDS D165	Without metal	100	90	80
	On metal; distance 25 mm	80	75	70
MDS D200[1)]	Without metal	100	90	80
	On metal; distance 20 mm	80	75	70
	Flush-mounted in metal; distance all round 20 mm	65	60	55
MDS D261	Without metal	100	95	85
	On metal; distance 25 mm	85	80	75
MDS D324[1)]	Without metal	100	95	85
	On metal; distance 15 mm	85	85	80
	Flush-mounted in metal; distance all round 25 mm	70	65	60
MDS D339[1)]	Without metal	100	90	80
	On metal; distance 30 mm	85	80	75
	Flush-mounted in metal; distance all round 100 mm	80	75	70
MDS D400[1)]	Without metal	100	90	80
	On metal; distance 20 mm	75	70	60
	Flush-mounted in metal; distance all round 20 mm	60	60	55
MDS D423	Without metal	100	95	85
	On metal; distance 0 mm	100	100	90
	flush-mounted in metal; distance all round 10 mm	75	65	60

Transponder		Reader RF380R (ISO mode)		
		Without metal	On metal	Flush-mounted in metal (20 mm all-round)
MDS D424 1)	Without metal	100	90	75
	On metal; distance 15 mm	75	75	60
	Flush-mounted in metal; distance all round 25 mm	60	55	40
MDS D425	Without metal	100	70	90
	On metal; distance 0 mm	75	70	60
MDS D426 1)	Without metal	100	90	80
	On metal; distance 25 mm	80	75	70
	Flush-mounted in metal; distance all round 50 mm	75	65	65
MDS D428	Without metal	100	90	80
	On metal; distance 0 mm	85	80	65
MDS D460 1)	Without metal	100	95	80
	On metal; distance 10 mm	80	75	60
MDS D524 1)	without metal			
	on metal 15 mm			
	flush-mounted in metal; distance all round 25 mm			
MDS D525	without metal			
	on metal; distance 0 mm			
MDS D526 1)	without metal			
	on metal; distance 25 mm			
	flush-mounted in metal; distance all round 50 mm			
MDS D528	without metal			
	on metal, distance 0 mm			

1) Mounting the transponder on or in metal is only possible with the appropriate spacer or if there is adequate clearance to the metal.

4.3.4.5 RF382R

Note

RF382R not suitable for metallic surroundings

The RF382R was not developed for reading transponders in a metallic environment.

With ISO transponders (MDS D)

Table 4- 54 Reduction of field data by metal (in %): Transponder and RF382R

Transponder		Reader RF382R (ISO mode)	
		Without metal	On metal
MDS D124	Without metal	100	110 [1)]
MDS D160	Without metal	100	100
MDS D324	Without metal	100	110 [1)]
MDS D424	Without metal	100	105 [1)]
MDS D460	Without metal	100	115 [1)]

[1)] Values of > 100 % can occur if transponders were developed specifically for mounting in/on metallic surroundings.

4.4 Chemical resistance of the transponders

4.4.1 Overview of the transponders and their housing materials

The following sections describe the resistance to chemicals of the various transponders. Resistance to chemicals depends on the housing materials used to manufacture the transponders.

The following table provides an overview of the housing materials of the transponders:

Table 4- 55 Overview of the housing materials of the transponders

Housing material	Transponder
Polyamide 12	RF340T RF350T RF370T
Polyphenylene sulfide (PPS)	RF380T MDS D117 MDS D124 (6GT2600-0AC10) MDS D139 MDS D160 MDS D339 MDS D423
Polycarbonate (PC)	MDS D100 (6GT2600-0AD10)
Polyvinyl chloride (PVC)	MDS D100 (6GT2600-0AD00-0AX0) MDS D200 MDS D400
Epoxy resin	RF320T RF360T MDS D124 (6GT2600-0AC00) MDS D324 MDS D421 MDS D424 MDS D460 MDS D521 MDS D524 MDS E610 MDS E611 MDS E623 MDS E624

Housing material	Transponder
PA6	MDS D127
PA6.6 GF30	MDS D126 MDS D422 MDS D425 MDS D426 MDS D428 MDS D522 MDS D525 MDS D526 MDS D528

Note

Chemical substances not listed

The following sections describe the resistance of the various transponders to specific substances. If you require information about chemical substances that are not listed, contact Customer Support.

4.4.2 Polyamide 12

The resistance of the plastic housing to chemicals used in the automobile sector (e.g.: oils, greases, diesel fuel, gasoline, etc,) is not listed extra.

Table 4- 56 Chemical resistance - Polyamide 12

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Battery acid	30%	20 °C	○○
Ammonia, gaseous		60 °C	○○○○
Ammonia, w.	conc.	60 °C	○○○○
	10%	60 °C	○○○○
Benzene		20 °C	○○○○
		60 °C	○○○
Bleach solution (12.5% effective chlo-rine)		20 °C	○○
Butane, gas, liquid		60 °C	○○○○
Butyl acetate (acetic acid butyl ester)		60 °C	○○○○
n(n)		20 °C	○○○○
		60 °C	○○○
Calcium chloride, w.		20 °C	○○○○
		60 °C	○○○

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Calcium nitrate, w.	c. s.	20 °C	○○○○
	c. s.	60 °C	○○○
Chlorine		20 °C	-
Chrome baths, tech.		20 °C	-
Iron salts, w.	c. s.	60 °C	○○○○
Acetic acid, w.	50%	20 °C	-
Ethyl alcohol, w., undenaturated	95%	20 °C	○○○○
	95%	60 °C	○○○
	50%	60 °C	○○○○
Formaldehyde, w.	30%	20 °C	○○○
	10%	20 °C	○○○○
	10%	60 °C	○○○
Formalin		20 °C	○○○
Glycerine		60 °C	○○○○
Isopropyl alcohol		20 °C	○○○○
		60 °C	○○○
Potassium hydroxide, w.	50%	60 °C	○○○○
Lysol		20 °C	○○
Magnesium salts, w.	c. s.	60 °C	○○○○
Methyl alcohol, w.	50%	60 °C	○○○○
Lactic acid, w.	50%	20 °C	○○
	10%	20 °C	○○○
	10%	60 °C	○○
Sodium carbonate, w. (soda)	c. s.	60 °C	○○○○
Sodium chloride, w.	c. s.	60 °C	○○○○
Sodium hydroxide		60 °C	○○○○
Nickel salts, w.	c. s.	60 °C	○○○○
Nitrobenzene		20 °C	○○○
		60 °C	○○
Phosphoric acid	10%	20 °C	○
Propane		60 °C	○○○○
Mercury		60 °C	○○○○
Nitric acid	10%	20 °C	○
Hydrochloric acid	10%	20 °C	○
Sulfur dioxide	low	60 °C	○○○○
Sulfuric acid	25%	20 °C	○○
	10%	20 °C	○○○
Hydrogen sulfide	low	60 °C	○○○○
Carbon tetrachloride		60 °C	○○○○
Toluene		20 °C	○○○○
		60 °C	○○○

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Detergent	high	60 °C	○○○○
Plasticizer		60 °C	○○○○

Explanation of the rating	
○○○○	Resistant
○○○	Practically resistant
○○	Conditionally resistant
○	Less resistant
-	Not resistant
w.	Water solution
c. s.	Cold saturated

4.4.3 Polyphenylene sulfide (PPS)

The data memory has special chemical resistance to solutions up to a temperature of 200 °C. A reduction in the mechanical properties has been observed in aqueous solutions of hydrochloric acid (HCl) and nitric acid (HNO3) at 80 °C. The plastic housings are resistant to all types of fuel including methanol.

Table 4- 57 Chemical resistance - polyphenylene sulfide (PPS)

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Acetone		55 °C	○○○○
n-Butanol (butyl alcohol)		80 °C	○○○○
Butanone-2 (methyl ethyl ketone)		60 °C	○○○○
n-Butyl acetate		80 °C	○○○○
Brake fluid		80 °C	○○○○
Calcium chloride (saturated)		80 °C	○○○○
Diesel fuel		80 °C	○○○○
Diethyl ether		23 °C	○○○○
Frigen 113		23 °C	○○○○
Anti-freeze		120 °C	○○○○
Kerosene		60 °C	○○○○
Methanol		60 °C	○○○○
Engine oil		80 °C	○○○○
Sodium chloride (saturated)		80 °C	○○○○
Sodium hydroxide	30%	80 °C	○○○○
Sodium hypochlorite (30 or 180 days)	5%	80 °C	○○
	5%	80 °C	-

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Sodium hydroxide solution	30%	90 ℃	○○○○
Nitric acid	10%	23 ℃	○○○○
Hydrochloric acid	10%	80 ℃	-
Sulfuric acid	10%	23 ℃	○○○○
	10%	80 ℃	○○
	30%	23 ℃	○○○○
Tested fuels		80 ℃	○○○○
FAM testing fluid acc. to DIN 51 604-A Toluene		80 ℃	○○
1, 1, 1-Trichloroethane Xylene		80 ℃	○○○○
Zinc chloride (saturated)		80 ℃	○○
		75 ℃	○○○○

Explanation of the rating	
○○○○	Resistant
○○○	Practically resistant
○○	Conditionally resistant
○	Less resistant
-	Not resistant

4.4.4 Polycarbonate (PC)

Table 4- 58 Chemical resistance - polycarbonate (PPS)

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Mineral lubricants			○○
Aliphatic hydrocarbons			○○○○
Aromatic hydrocarbons			-
Gasoline			-
Weak mineral acids			○○○○
Strong mineral acids			○○
Weak organic acids			○○○○
Strong organic acids			○○
Oxidizing acids			-
Weak alkaline solutions			-
Strong alkaline solutions			-
Trichloroethylene			-

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Perchloroethylene			-
Acetone			-
Alcohols			○○
Hot water (hydrolysis resistance)			-

Explanation of the rating	
○○○○	Resistant
○○○	Practically resistant
○○	Conditionally resistant
○	Less resistant
-	Not resistant

4.4.5 Polyvinyl chloride (PVC)

Table 4- 59 Chemical resistance - polyvinyl chloride (PVC)

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Salt water	5%		○○○○
Sugared water	10%		○○○○
Acetic acid, w.	5%		○○○○
Sodium carbonate, w.	5%		○○○○
Ethyl alcohol, w.	60%		○○○○
Ethylene glycol	50%		○○○○
Fuel B (acc. to ISO 1817)			○○○○
Human sweat			○○○○

Explanation of the rating	
○○○○	Resistant
○○○	Practically resistant
○○	Conditionally resistant
○	Less resistant
-	Not resistant

4.4.6 Epoxy resin

Table 4- 60 Chemical Resistance - epoxy resin

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Allyl chloride		20 °C	○○○○
Formic acid	50%	20 °C	○○○○
	100%	20 °C	○○
Ammonia, gaseous		20 °C	○○○○
Ammonia, liquid, water-free		20 °C	-
Ammonium hydroxide	10%	20 °C	○○○○
Ethanol		40 °C	○○○○
		60 °C	○○○○
Ethyl acrylate		20 °C	○○○○
Ethyl glycol		60 °C	○○○○
Gasoline, aroma-free		20 °C	○○○○
Gasoline, containing benzene		20 °C	○○○○
Benzoates (Na–, Ca– among others)		40 °C	○○○○
Benzoic acid		20 °C	○○○○
Benzene		20 °C	○○○○
Borax		60 °C	○○○○
Boric acid		20 °C	○○○○
Bromine, liquid		20 °C	-
Bromides (K–, Na– among others)		60 °C	○○○○
Bromoform	100%	20 °C	○○○○
Bromine water		20 °C	-
Butadiene (1,3–)		20 °C	○○○○
Butane, gaseous		20 °C	○○○○
Butanol		20 °C	-
Butyric acid	100%	20 °C	○○
Carbonates (ammonium–, Na– among others)		60 °C	○○○○
Chlorine, liquid		20 °C	-
Chlorine, gaseous, dry	100%	20 °C	-
Chlorobenzene		20 °C	○○○○
Chlorides (ammonium–, Na– among others)		60 °C	○○○○
Chloroform		20 °C	-
Chlorophyll		20 °C	○○○○
Chlorosulfuric acid	100%	20 °C	-
Chlorine water (saturated solution)		20 °C	○○
Chromates (K–, Na– among others)	Up to 50 %	40 °C	○○○○
Chromic acid	Up to 30 %	20 °C	-

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Chromosulfuric acid		20 °C	-
Citric acid		20 °C	○○○○
Cyanamide		20 °C	○○○○
Cyanides (K–, Na– among others)		60 °C	○○○○
Dextrin, w.		60 °C	○○○○
Diethyl ether		20 °C	○○○○
Diethylene glycol		60 °C	○○○○
Dimethyl ether		20 °C	○○○○
Dioxane		20 °C	-
Developer		40 °C	○○○○
Acetic acid	100%	20 °C	○○
Ethanol		60 °C	○○○○
Fixing bath		40 °C	○○○○
Fluorides (ammonium–, K–, Na– among others)		40 °C	○○○○
Hydrofluoric acid	Up to 40 %	20 °C	○○○○
Formaldehyde	50%	20 °C	○○○○
Formamide	100%	20 °C	○○○○
Gluconic acid		20 °C	○○○○
Glycerine		60 °C	○○○○
Glycol		60 °C	○○○○
Urine		20 °C	○○○○
Uric acid		20 °C	○○○○
Hydroxides (ammonium...)	10%	20 °C	○○○○
Hydroxides (Na–, K–)	40%	20 °C	○○○○
Hydroxides (alkaline earth metal)		60 °C	○○○○
Hypochlorites (K–, Na– among others)		60 °C	○○○○
Iodides (K–, Na– among others)		60 °C	○○○○
Silicic acid		60 °C	○○○○
Cresol	Up to 90 %	20 °C	-
Methanol	100%	40 °C	○○○○
Methylene chloride		20 °C	-
Lactic acid	100%	20 °C	○○
Mineral oils		40 °C	○○○○
Nitrates (ammonium..., K– among others)		60 °C	○○○○
Nitroglycerin		20 °C	-
Oxalic acid		20 °C	○○○○
Phenol	1%	20 °C	○○○○
Phosphates (ammonium..., Na– among others)		60 °C	○○○○

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Phosphoric acid	50%	60 °C	○○○○
	85%	20 °C	○○○○
Propanol		20 °C	○○○○
Nitric acid	25%	20 °C	-
Hydrochloric acid	10%	20 °C	-
Brine		60 °C	-
Sulfur dioxide	100%	20 °C	○○
Carbon disulfide	100%	20 °C	-
Sulfuric acid	40%	20 °C	-
Sulfurous acid		20 °C	○○
Soap solution		60 °C	○○○○
Sulphates (ammonium..., Na– among others)		60 °C	○○○○
Sulfites (ammonium..., Na– among others)		60 °C	-
Tar, aroma-free		60 °C	○○○○
Turpentine		20 °C	○○○○
Trichloroethylene		20 °C	-
Hydrogen peroxide	30%	20 °C	○○○○
Tartaric acid		20 °C	○○○○

Explanation of the rating	
○○○○	Resistant
○○○	Practically resistant
○○	Conditionally resistant
○	Less resistant
-	Not resistant

4.4.7 PA6.6 GF30

Table 4- 61 Chemical resistance - PA6.6 GF30

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Mineral lubricants			○○○○
Aliphatic hydrocarbons			○○○○
Aromatic hydrocarbons			○○○○
Gasoline			○○○○
Weak mineral acids			○○○

Substance	Test conditions		Rating
	Concentration [%]	Temperature [°C]	
Strong mineral acids			-
Weak organic acids			○○
Strong organic acids			-
Oxidizing acids			-
Weak alkaline solutions			○○
Strong alkaline solutions			-
Trichloroethylene			○○○○
Perchloroethylene			○○○○
Acetone			○○○○
Alcohols			○○○○
Hot water (hydrolysis resistance)			○○

Explanation of the rating	
○○○○	Resistant
○○○	Practically resistant
○○	Conditionally resistant
○	Less resistant
-	Not resistant

4.5 Guidelines for electromagnetic compatibility (EMC)

4.5.1 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.

Note

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.

4.5.2 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:

- Internal immunity to interference:

  Immunity to internal (own) electrical disturbance
- External immunity to interference:

  Immunity to external electromagnetic disturbances
- 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 R&TTE directives. 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 directives 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 directives; 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.

4.5.3 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

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

Plan the cable installation

- Break the cabling down into cable groups and install these separately.
- Always route power cables, signal cables and HF cables through separated ducts or in separate bundles.
- Feed the cabling into the cabinet from one side only and, if possible, on one level only.

- Route the signal cables as close as possible to chassis surfaces.
- Twist the feed and return conductors of separately installed cables.
- Routing HF cables:
  avoid parallel routing of HF cables.
- Do not route cables through the antenna field.

Shielding for the cables

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

Line and signal filter

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

4.5.4 Propagation of electromagnetic interference

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

- Interference source
- Coupling path
- Interference sink

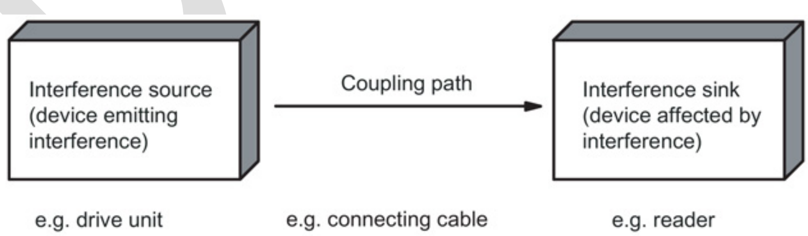


Figure 4-11 Propagation of interference

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- 62 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 shield-ed	Better cable shielding
	The reader is not connected to ground.	Ground the reader
HF interference over the antennas	caused by another reader	• Position the antennas further apart. • Erect suitable damping materials between the antennas. • Reduce the power of the readers. Please follow the instructions in the section *Installation guidelines/reducing the effects of metal*

Coupling paths

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

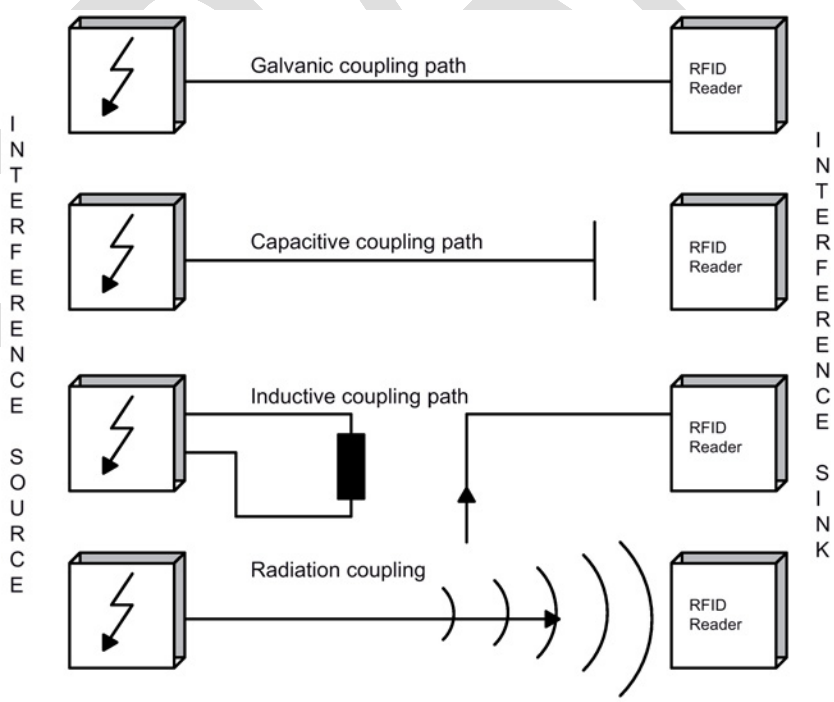


Figure 4-12 Ways in which interference can be coupled in

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

Table 4- 63 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

4.5.5 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.

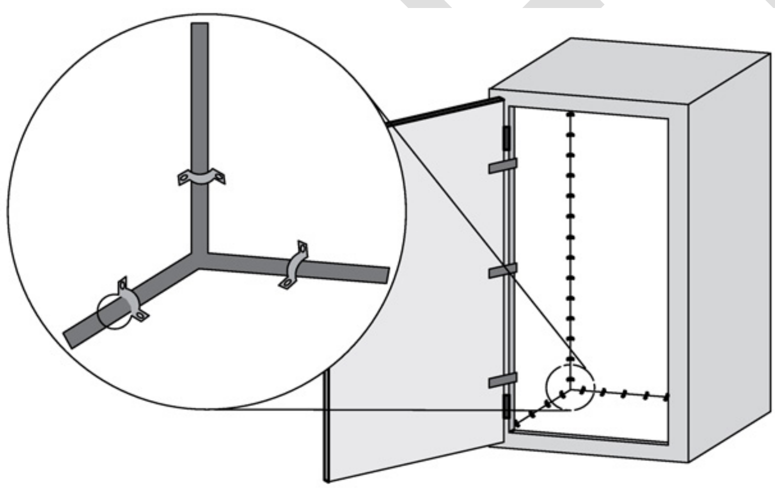


Figure 4-13 Shielding by enclosure

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

Prevention of interference by optimum configuration

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

As a rule:

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

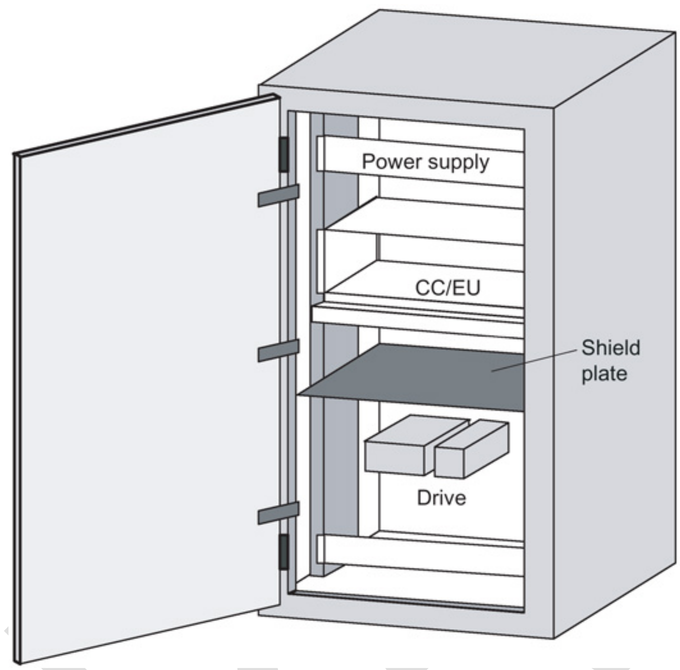


Figure 4-14 Prevention of interference by optimum configuration

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.

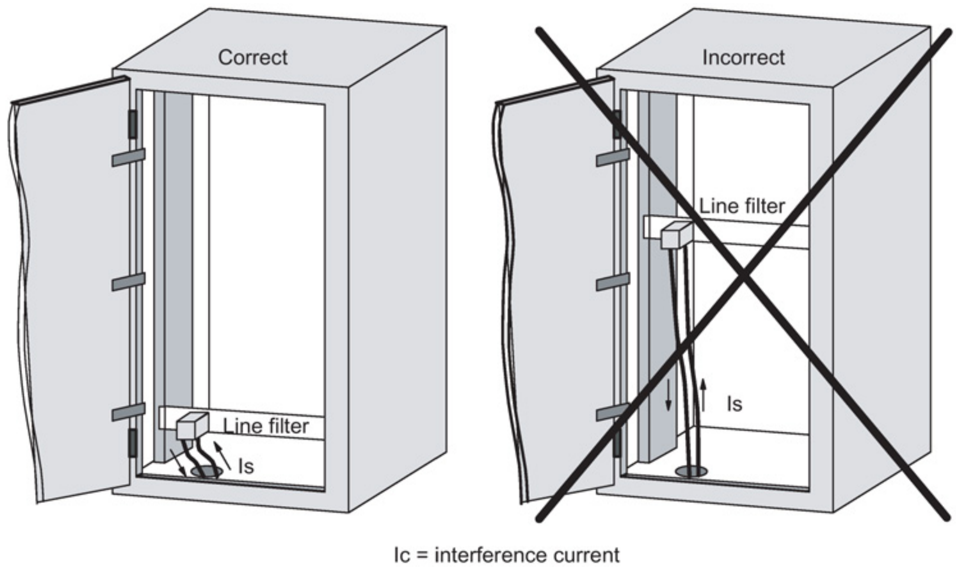


Figure 4-15 Filtering of the supply voltage

4.5.6 Prevention of interference sources

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

Suppression of inductance

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

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

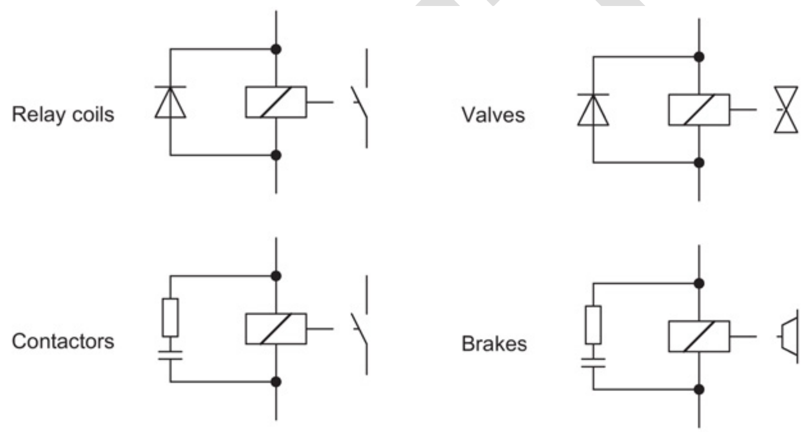


Figure 4-16 Suppression of inductance

Note

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

4.5.7 Equipotential bonding

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

Proper equipotential bonding is thus essential.

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

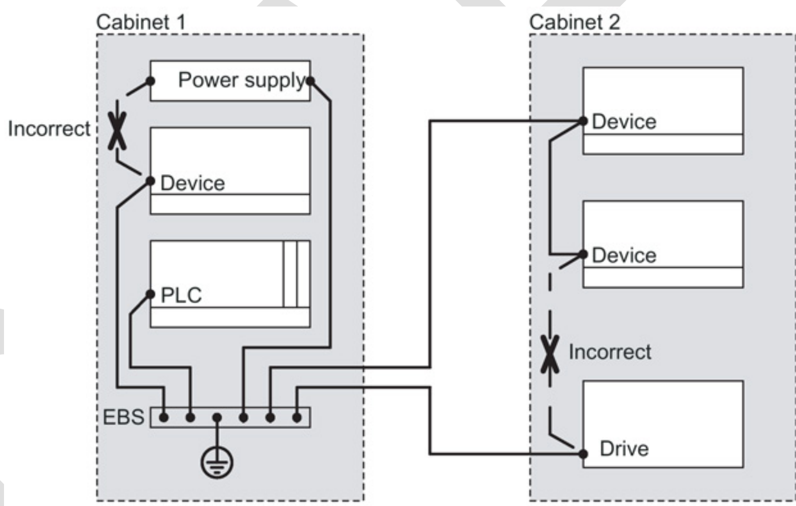


Figure 4-17 Equipotential bonding (EBS = Equipotential bonding strip)

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

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

4.5.8 Cable shielding

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

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

Note

An unconnected or incorrectly connected shield has no shielding effect.

As a rule:

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

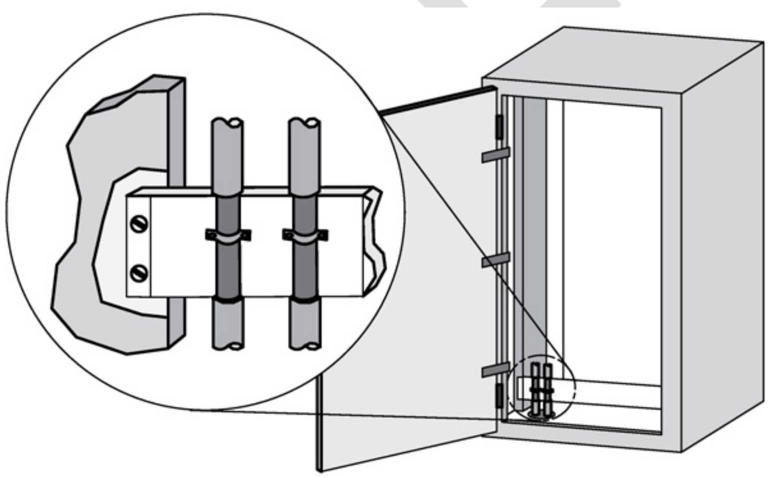


Figure 4-18 Cable shielding

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

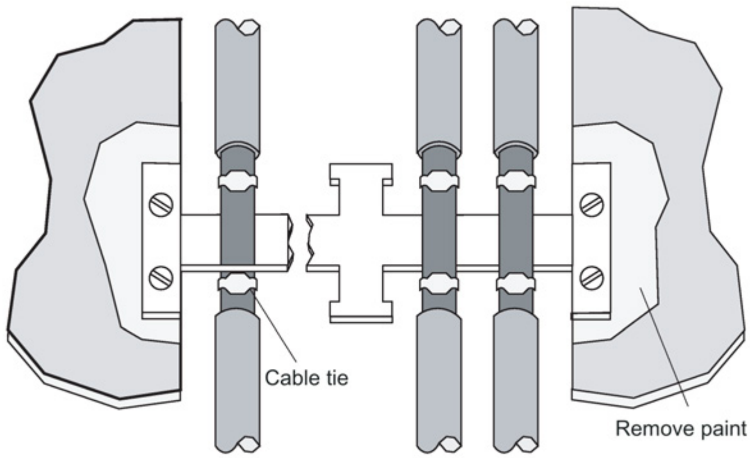


Figure 4-19 Connection of shielding bus

The shielding bus must be connected to the PE busbar.

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

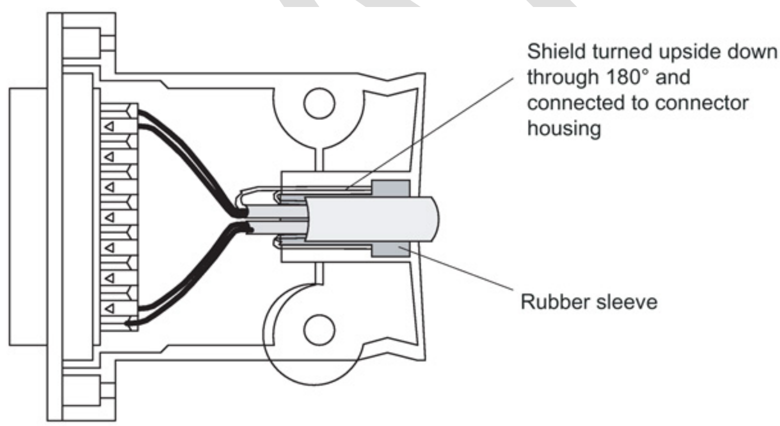


Figure 4-20 Interruption of shielded cables

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