User Guide
V 3.00

IMPORTANT
Read carefully before use!

LoRa
ULoRa
MiRa
S-MiRa
SMSH
WRA 6060
WRA 7070
WRA 3070
English

Kathrein UHF RFID Antennas

Quality made in Germany

KATHREIN

Content

1 Preface

Dear customer,
Please follow all the information given in this GUIDE. KATHREIN Solutions GmbH has made every effort to ensure the information and descriptions are correct and complete. We reserve the right to make changes to this guide without prior notice. In particular, this applies to changes made due to technical advancements.

2 About this guide

This document describes installation, configuration and operation of the UHF RFID antennas from KATHREIN Solutions. Furthermore, it provides detailed technical data in order to better familiarise the user with the features of the antenna. The target group of this guide is specialist personal who install, configure and put the antennas into operation. **This document is valid for all Kathrein RFID antennas.**

Tip Keep these instructions for further reference, and if the device passes to another owner, pass them on to the new owner.

► For more information, visit our website www.kathrein-solutions.com.
The manuals are available for download at the internet product page.

3 Devices

This guide applies to the following antennas:

Type	Order number ETSI / FCC
LoRa – Low Range antenna	52010084 / 52010085
ULoRa – Ultra Low Range antenna	52010092
MiRa 100 – Mide Range antenna	52010082 / 52010083
S-MiRa 100 – Short Mid Range antenna	52010172
SMSH – Smart Shelf antenna	52010523 / 52010525
SMSH KRAI – Smart Shelf ©KRAI antenna	52010524 / 52010526
WRA 7070 – Wide Range antenna 70°	52010333 / 52010334
WRA 7070 KRAI – Wide Range ©KRAI antenna 70°	52010335 / 52010336
WRA 6060 – Wide Range antenna 60°	52010423 / 52010424
WRA 3070 – Wide Range antenna 30°	52010583 / 52010584

If you are looking for older Kathrein UHF RFID antennas, you can find them in chapter "12. Classification of the UHF RFID Antenna".

4 Explanation of symbols and signal words

4.1 Symbols

	General warning sign
	Fire hazard
	Radiation hazard
	Risk of material damage or malfunction in safety instructions or call for attention

4.2 Signal words

WARNING	This signal word indicates a hazard with a medium level of risk which can lead to death or severe injuries.
CAUTION	This signal word indicates a hazard with a low level of risk which can lead to minor or moderate injuries.
NOTICE	This signal word indicates a hazard which can lead to damage to property or malfunction.
Tip	This signal word indicates useful tips and recommendations.

5 Professional installation guidelines for the U.S.

5.1 Installation personnel

UHF RFID readers require professional installation!

- ► You must be a professional installer with RF and related rule knowledge.
- ► The installation requires special trained professionals to access and setup the system.
- ► The system is not to be installed by the general public, general user shall not attempt to install the device or change the settings.

5.2 External antennas

- ► You must follow Part 15 of the FCC rules, and specifically Part 15.203 pertaining antenna requirements of an intentional radiator.
- ► Make sure to use a 13 dBi or less patch antenna.
- ► Only use antennas which have been approved by the applicant. The use of none-approved antenna(s) may produce unwanted spurious emissions or excessive RF transmitting power which may lead to the violation of the FCC/ISED limit and is prohibited.

5.3 Final output power

WARNING

- ► Carefully select the installation position.
- ► Make sure that the final output power does not exceed the limit set in relevant rules. The violation of the rule could lead to serious federal penalty!

If you are not a professional installer, **STOP**.

- ► Do not proceed any further with the installation.
- ► Do not install the unit or change the settings.

6 Safety instructions

6.1 General safety instructions

WARNING

Danger to life from electric shock! Fire hazard!

Improper interventions in the device may jeopardise its electrical safety. Unauthorized changes to the unit and the use of spare parts and peripheral devices which are not sold or recommended by the manufacturer can result in fire, electric shock and injuries.

The manufacturer accepts no liability for accidents caused by the user opening or changing the device. Opening the device and attempting to repair it yourself voids all warranty and guarantee claims. The applicable version of the manufacturer's guarantee is that which was valid at the time of purchase. We accept no liability for unsuitable manual or automatic adjustments made to the unit's parameters and inappropriate use of the unit.

- ► Make sure that all the connection, installation and maintenance work as well as all other work on the unit is carried out by properly qualified and trained staff.
- ► Make sure that the installation team is properly qualified, familiar with and comply with the safety regulations applicable in the respective country.
- ► Do not open, change or damage the device and its components.
- ► Make sure that any repairs on the device are carried out by personnel authorised to perform them.
- ► Keep and operate the device out of reach of children.
- ► Do not modify, remove or disfigure the notices and markings applied by the manufacturer.
- ► Only use the unit for the purpose intended by the manufacturer.
- ► Before each use, make sure that the device is not damaged.
- ► Only use the power supply unit supplied.
- ► Make sure that the power supply cable is not damaged.
- ► Make sure that a unit with a damaged power supply cable is repaired by an electrical specialist before being used again.

WARNING

Danger to life from electric shock or fire hazard due to incorrect voltage, insufficient ventilation, moisture, direct sunlight, heat or naked flames!

If the supply voltage is too high, there is a risk of fire.

- ► Make sure the unit is operated only at the stated supply voltage; see the rear of the device or the external power supply unit.
- ► When installing the unit in cabinets or shelves, make sure there is sufficient ventilation.
- ► Do not cover the ventilation slots on the unit.
- ► Protect the unit from moisture, dripping and splash water.
- ► Do not operate the unit in damp areas.
- ► Only use the unit in a moderate climate, not in tropical conditions.
- ► Do not place any liquid-filled items on top of the unit.
- ► Do not expose the unit to inadmissible heat, direct sunlight or fire.
- ► Do not install the device close to the sources of heat, e.g. heating.
- ► Do not place anything with a naked flame on the device.

NOTICE

Risk of malfunction!

- ► Make sure the reader is properly grounded according to the corresponding national standards.
- ► Make sure that the diameter of the ground cable is min. 6 mm^2 (typ. 10 mm^2).
- ► Make sure to ground the reader such that the distance between the reader ground point and the ground point in the building is as short as possible.
- ► Note that the equipotential bonding does not replace lighting protection.

6.2 CE marking for the Kathrein RFID antennas with the type designation ETSI

WARNING

Danger to life due to radiation electromagnetic field!

This reader is designed ETSI for operation according to EN 302208. In some circumstances, heart pacemakers may suffer interference if wearers are close to the antenna when the unit is in operation (reader and antenna).

- ► When the unit is operated with antennas connected, comply with the human exposure regulations in accordance with EN 50364.
- ► Ensure a minimum clearance of 35 cm between the antenna and the human body.
- ► Comply with the operating instructions for RFID antennas.
- ► In case of doubt, make sure people with peacemakers contact the manufacturer of their peacemaker or their doctor.

6.3 FCC and ISED Canada regulatory information

The operator and the specialist company which carries out the installation are responsible for ensuring that only certified systems are used in the United States. Use of this system in any other combination (e.g. several antennas which transmit the same information in the same location) is expressly prohibited. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. To meet the certification regulations according to Part 15 of the FCC regulations in the United States:

- ► Make sure the operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
- ► Make sure the unit is properly installed, see FCC RF Radiation Exposure Statement and ISED RF Radiation Exposure Statement, which follow on the next pages.

The readers with the grantee code WJ9 are designed to operate under FCC Part 15 and can be found at the FCC homepage. This device complies with Part 15 of the FCC Rules and with ISED license-exempt RSS standard(s).

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference;

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Please ensure that you operate the antennas with the Kathrein RFID or use RFID readers with comparable standards. In case of doubt, please contact the Kathrein Sales Team.

ISDE

Cet appareil contient des émetteurs / récepteurs exemptés de licence conformes aux RSS (RSS) d'Innovation, Sciences et Développement économique Canada. Le fonctionnement est soumis aux deux conditions suivantes:

(1) Cet appareil ne doit pas causer d'interférences;

(2) Cet appareil doit accepter toutes les interférences, y compris celles susceptibles de provoquer un fonctionnement indésirable de l'appareil.

- ► En vertu des réglementations d'ISDE, cet émetteur radio ne peut être utilisé qu'avec une antenne de type et un gain maximum (ou inférieur) approuvé pour l'émetteur par ISDE.
- ► Pour réduire les interférences radio potentielles avec d'autres utilisateurs, choisissez le type d'antenne et le gain de sorte que la puissance isotrope rayonnée équivalente (PIRE) ne soit pas supérieure à celle nécessaire pour une communication réussie. This radio transmitter has been approved by ISED to operate with the antenna types listed in *Recommended Antenna Types* with the maximum permissible gain and required antenna impedance for each antenna type indicated. Cet émetteur radio a été approuvé par ISDE pour être utilisé avec les types d'antennes énumérés dans *Recommended Antenna Types* avec le gain maximum admissible et l'impédance d'antenne requise pour chaque type d'antenne indiqué.

Modifications or conversions which are carried out on this unit without the express permission of Kathrein may invalidate the FCC permit for the operation of this unit.

6.3.1 Radiation exposure statements

WARNING

Danger to life due to radiation electromagnetic field!

- ► As a result of the RF exposure information given in the *FCC RF Radiation Exposure Statement, p. 10 and ISED RF Radiation Exposure Statement, p. 11.* Ensure a minimum clearance of 35 cm between the antenna and the human body.
- ► Comply with the operating instructions for RFID antennas.
- ► In case of doubt, make sure people with peacemakers contact the manufacturer of their peacemaker or their doctor.

FCC RF Radiation Exposure Statement

This transmitter must not be co-location or operating in conjunction with any other antenna or transmitter.

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment.

- ► Ensure a typical clearance of 20 cm between the antenna and the human body. The exact values for each antenna you can find in the chapter 11. Characteristics and specific Limits of the Antennas.

ISED RF Radiation Exposure Statement

This equipment complies with ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment.

► Ensure a typical clearance of 20 cm between the antenna and the human body. The exact values for each antenna you can find in the chapter 11. Characteristics and specific Limits of the Antennas.

6.3.2 Safety instructions

NOTICE

Risk of harmful radio communication interference!

Following corresponding tests, it has been ascertained that this unit adheres to the limit values for class B digital units in accordance with Part 15 of the FCC regulations. These limit values are intended to provide private user's systems with appropriate protection against harmful radio interference. This unit generates and uses energy in the radio frequency range and is also able to radiate this; if it is not installed and used in accordance with the regulations, the unit may cause harmful radio communication interference. However, there is no guarantee that interference will not occur in a specific system. If this unit causes harmful radio or television reception interference, which can be ascertained by switching the unit on and off, we recommend that the user attempts to rectify this interference via one or more of the following measures.

► Turn the unit on and off to make sure the radio or television reception interference is caused by the unit.

► Realign the receive antenna or change its position.

► Increase the distance between the unit and the receiver.

► Plug the unit into a socket in a current circuit other than that to which the receiver is connected.

► Seek advice from the retailer or an experienced radio/television technician.

6.3.3 Recommended antenna types

Antenna types not included in this list or having a gain greater than the maximum gain indicated for that type are strictly prohibited for use with this device.

Les types d'antennes non inclus dans cette liste ou avec un gain supérieur au gain maximum indiqué pour ce type sont strictement interdits pour l'utilisation avec cet appareil.

Actual antenna types from Kathrein Solutions:

Order number	Type	Shortened designation	Gain	
			circular	linear
52010084	LoRa FCC	low-range antenna FCC, 902–928 MHz	n.a.	-15 dBi
52010092	U-LORA-ETSI-FCC	ultra low-range antenna FCC, 865–928 MHz	n.a.	-30 dBi
52010083	MIRA-100-circular-FCC	mid-range antenna FCC, 902–928 MHz, 100° circular	2.5 dBiC	-0.5 dBi
52010172	S-MIRA-100-circular-ETSI-FCC	short m id-range antenna ETSI/FCC, 865–928 MHz, 100° circular	-10 dBiC	-13 dBi
52010334	WRA 7070 antenna unit	wide-range antenna, 902–928 MHz, circular	8.5 dBiC	5.5 dBi
52010336	WRA 7070 KRAI antenna unit	wide-range 70° KRAI antenna FCC, 902–928 MHz, 70° circular	6.5 dBiC	7 dBi
52010424	WRA 6060	wide-range 60° antenna FCC, 902–928 MHz, 60° circular	5.5 dBiC	2.5 dBi
52010525	SMSH antenna	SMSH antenna FCC, 902-928 MHz	5 dBiC	2 dBi
52010526	SMSH KRAI antenna	SMSH KRAI antenna FCC, 902-928 MHz	4.5 dBiC	1.5 dBi
52010584	WRA 3070	wide-range 30° antenna FCC, 902–928 MHz, 30° circular	11.5 dBiC	8.5 dBi

Earlier antenna types from Kathrein Solutions

Order number	Type	Shortened designation	Gain	
			circular	linear
52010087	WIRA-30-circular-FCC	wide-range 30° antenna FCC, 902–928 MHz, 30° circular	11 dBiC	8 dBi
52010228	WIRA-30-CSB-KRAI-FCC	wide-range 30° CSB KRAI antenna FCC, 902–928 MHz, 30° circular	6 dBiC	3 dBi
52010249	WIRA-30-linear-FCC	wide-range 30° antenna FCC, 902–928 MHz, 30° linear	n.a.	11 dBi
52010252	WIRA-40-linear-FCC	wide-range 40° antenna FCC, 902–928 MHz, 40° linear	n.a.	13 dBi
52010079	WIRA-70-circular-FCC	wide-range 70° antenna FCC, 902–928 MHz, 70° circular	8.3 dBiC	5.3 dBi
52010194	WIRA-70-KRAI-FCC	wide-range 70° KRAI antenna FCC, 902–928 MHz, 70° circular	7/7/n.a./n.a	4.5/4.5/ 7.5/7.5
52010219	SMSH-30-30-ETSI-FCC antenna modul	SMSH antenna/-module, 865–928 MHz, circular	-7 dBiC	-10 dBi
52010258	SMSH-30-30-KRAI-ETSI-FCC antenna	SMSH KRAI antenna/-module, 865–928 MHz, circular	-7 dBiC	-10 dBi
52010318	SMSH-HighGain-30-30-KRAI-FCC	SMSH antenna/-module, 902–928 MHz, circular	5 dBiC	2 dBi
52010319	SMSH-HighGain-30-30-FCC	SMSH antenna/-module, 902–928 MHz, circular	5 dBiC	2 dBi

7 Introduction

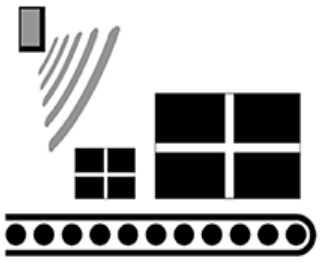
7.1 RFID UHF Antenna

The Kathrein antenna family consists of various UHF reader antennas, which can meet the needs of virtually any RFID application. The antennas are divided into four product lines with respect to the reading range: low range, mid range and wide range antennas. The fourth group are the Smart Shelf antennas.

This allows up to 4 standard antennas to be used simultaneously in any combination and range with Kathrein RFID readers. With the Kathrein ©KRAI SMSH antennas, even up to 32 antennas can be controlled by one Kathrein RAIN RFID reader. This modularity is only possible with Kathrein RFID readers and antennas.

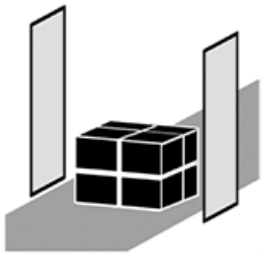
7.2 Standard antennas

The antennas shown are examples from the respective antenna series.
You will find further information under 8. product description



Low Range

Mid Range



Wide Range

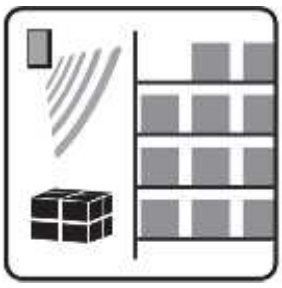
0 to 10 cm -
with LoRa antenna

20 cm to 2 m -
with MiRa antenna

1m to 20 m -
with WiRa antenna

7.2.1 SMSH antennas

The smart shelf antennas are ideal for the use on shelves or whenever little headroom is required.



Read range 0 - 3 m -
with SMSH

7.2.2 SMSH antennas

KRAI antennas are a special variant of Kathrein antennas. This allows the antenna properties to be changed dynamically. These changes are controlled by the Kathrein RFID reader via the existing antenna cable. External controls or connections are not necessary. This improves the reading properties in the system and simplifies the installation of the antennas.

The designation KRAI stands for Kathrein RFID Antenna Interface.

The following antennas are available and functions can be fulfilled:

Order number	Type	Description	Function
52010525 / 52010526	SMSH KRAI ETSI / SMSH KRAI FCC	Smart Shelf Antenna	Antenna cascading
52010340	ARU 8500 ETSI	Switch Beam Antenna	Direction detection
52010335 / 52010336	WRA 7070 KRAI ETSI / WRA 7070 KRAI FCC	Polarisation Switching Antenna (linear/circular)	Polarisation switching LED

8 Product description

8.1 Low Range Antenna

The low-range antennas are a unique series of antennas developed exclusively for the reading range < 20 cm. On the one hand, this is necessary to detect reading positions very precisely, as the transponder is only read when it is spatially very close in front of the antenna. On the other hand, it is very easy to write precisely on transponders with the low range antennas, because only the tag that is physically close to the antenna can be written to. A complex selection process is not necessary.

With dimensions of 90 x 63 mm, these antennas have a high field concentration in the near field, with significantly reduced antenna gain in the far field. With these characteristics, the antennas achieve excellent read/write performance at ranges of up to 10 cm with a typical selectivity of 5 cm. Low range antennas are available as LORA (Low Range) and ULORA (Ultra Low Range). The ULORA antenna is designed to read dipole-shaped tags ("far-field tags") at extremely close range. These antennas can also read loop-shaped tags ("near-field tags") up to 3 cm. The LORA was developed for longer ranges and is particularly suitable for near-field tags.

Figure 1: Low Range antenna
ETSI: 52010084
FCC: 52010085

Figure 2: Ultra Low Range antenna
ETSI/FCC: 52010092

The technical data can be found here: https://www.kathrein-solutions.com/products/rfid/antennas

Useful combination of transponder type and low range antenna

Looped tags
(near field tags)

Hybrid tags

dipolar tags
(far field tags)

LORA (Low Range)
suitable for:
- near field tags

ULORA (Ultra Low Range)
suitable for:
- near field tags
- Hybrid tags
- far field tags
52010092 (ETSI/FCC)

Mounting

Due to the small reading range, it is not necessary to align the antenna. It can be mounted plain onto a wall or mounting surface.

Accessories

Order number	Type	Description
Antenna cable to connect ARU 3000, ARU 8500 and RRU 4000 reader		
52010174	R-AC 3 TNC-TNCR	3m, Low Loss 240 Flex, IP67
52010175	R-AC 6 TNC-TNCR	6m, Low Loss 240 Flex, IP67
52010176	R-AC 10 TNC-TNCR	10m, Low Loss 240 Flex, IP67
52010177	R-AC 15 TNC-TNCR	15m, Low Loss 240 Flex, IP67
Antenna cable to connect ARU 2400 and RRU 1400 reader		
52010461	R-AC 1 TNC-FAKRA	1m, LMR 195, IP40
52010462	R-AC 3 TNC-FAKRA	3m, LMR 195, IP40
52010463	R-AC 5 TNC-FAKRA	5m, LMR 195, IP40
Antenna adapter		
52010598	R-AA TNC - TNC	TNC (f) to TNC(m), right angle plug

8.2 Mid Range Antenna

The MIRA 100° was developed for applications in the area between near field and far field. Particular importance was placed on creating a compact construction to enable integration into environments with limited space. Read ranges of over 2 m are still possible even with dimensions of 156 x 126 mm. MiRa also offers increased selectivity at lower reading distances compared with conventional antennas. This antenna design is therefore also suitable for use in the so-called transition area (0 – 1m) with a variety of transponder types.

The S-MiRa antenna is optimised for the range 0-1 m and can also be used excellently in highly reflective areas (e.g. in machines or in metal construction).

The typical area of application for the Mid Range antennas is in logistics, where the antennas are used for the detection of containers on conveyor belts. In addition, the antenna can be used for access systems because, despite its small dimensions, it can cover a reading zone of up to 2m. If the installation space for antennas is limited, the MiRa antenna can also be chosen for gate applications.

Figure 1: Mid Range antenna
ETSI: 52010082
FCC: 52010083

Figure 2: Short Mid Range antenna
ETSI/FCC: 52010172

The technical data can be found here: https://www.kathrein-solutions.com/products/rfid/antennas

Antenna Directivity

The antenna directivity shows the propagation characteristics of the EM field of the antenna. The half power beam width and the front to back ratio can be read from it.

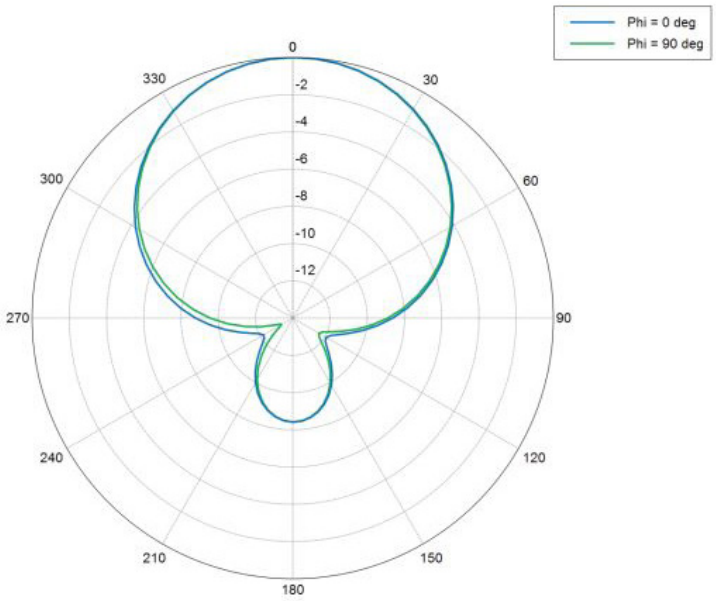


Figure 3: Antenna directivity
MiRa/S-MIRA-100-circular

Mounting

Due to the spherical reading zone of the MiRa antenna, alignment is usually not necessary. However, the antenna can still be mounted with the following mounting kit.

Order number	Type	Description
52010351	MK-WPM3-OSS	Wall mount kit
Option for 52010351		
5210368	MK-PMA-OGV	Pole mount adapter

Accessoires

Order number	Type	Description
Antenna cable to connect ARU 3000, ARU 8500 and RRU 4000 reader		
52010174	R-AC 3 TNC-TNCR	3m, Low Loss 240 Flex, IP67
52010175	R-AC 6 TNC-TNCR	6m, Low Loss 240 Flex, IP67
52010176	R-AC 10 TNC-TNCR	10m, Low Loss 240 Flex, IP67
52010177	R-AC 15 TNC-TNCR	15m, Low Loss 240 Flex, IP67
Antenna cable to connect ARU 2400 and RRU 1400 reader		
52010461	R-AC 1 TNC-FAKRA	1m, LMR 195, IP40
52010462	R-AC 3 TNC-FAKRA	3m, LMR 195, IP40
52010463	R-AC 5 TNC-FAKRA	5m, LMR 195, IP40
Antenna adapter		
52010598	R-AA TNC - TNC	TNC (f) to TNC(m), right angle plug

8.3 Smart Shelf Antenna

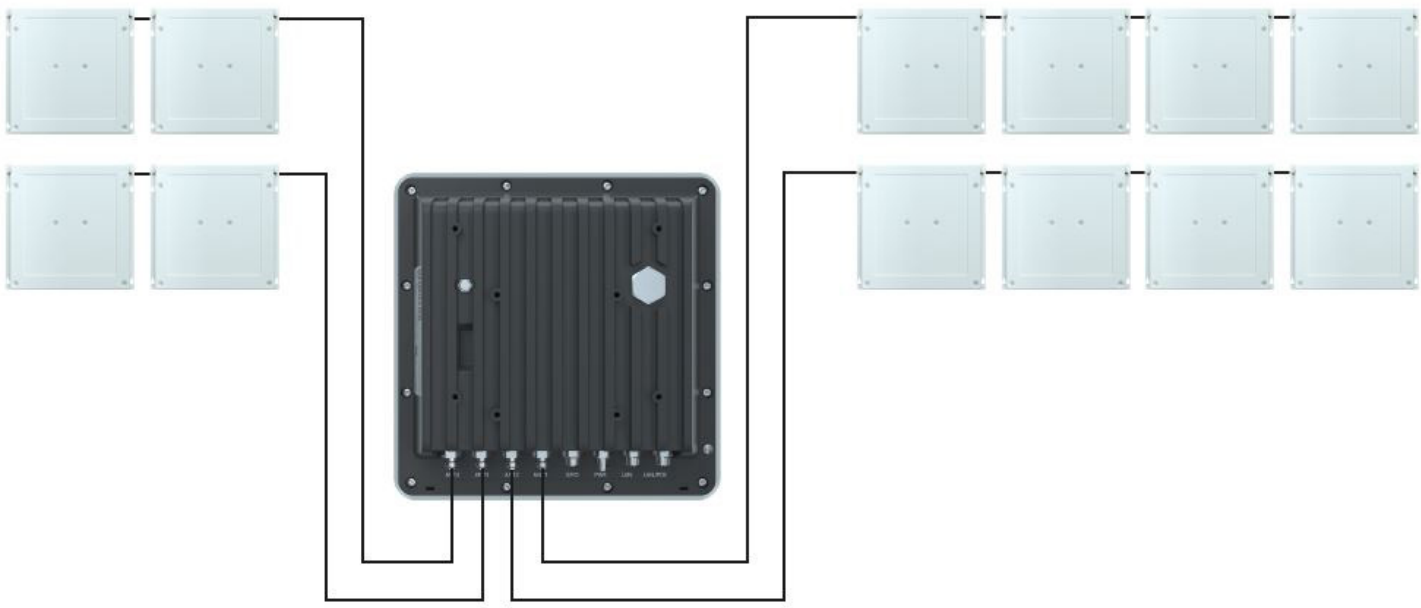
The SMSH antennas are ideal for use in shelving. This can be planned during installation, but can also be retrofitted for existing shelves. The height of the antenna is < 20mm so that the available installation space is retained.

The SMSH antenna impresses with a selective reading zone. The range between reading and non-reading is maintained with a high degree of separation and repeatability. The reading range is a cube with the groundplane of 30 cm x 30 cm and covers the range 0 - 3m. Due to the ideal front-to-back ratio, reading also takes place exclusively in front of the antenna. This also means that metal shelves have no negative effect on the reading performance.

The ideal use of these antennas is for eKanban shelves or in the retail sector. But also for applications where the height of the antenna is limited. e.g. for laundry collection where the antenna can be mounted under the table.

Two options are available for the antenna. The standard SMSH antenna, which can be used as a single antenna, and the KRAI version of the SMSH antennas, which, with a Kathrein reader, allows a unique RFID system in which the SMSH antennas are cascaded. This makes it easy to equip a large area of a shelf with antennas that are all controlled by one reader.

©KRAI SMSH (Smart Shelf) Antenna



The SMSH KRAI antennas, which have an input and an output port, are simply connected in a daisy chain arrangement. The Kathrein reader initialises all antennas in the network and can thus control a maximum of 32 (=4 * 8 antennas). The reader collects all the read results and assigns them to each individual SMSH antenna, so that a direct image of the container placement of the shelf can be created.

Figure 1: SMSH antenna
ETSI: 52010523
FCC: 52010525

Figure 2: SMSH ©KRAI antenna
ETSI: 52010524
FCC: 52010526

The technical data can be found here: https://www.kathrein-solutions.com/products/rfid/antennas

Antenna Directivity

The antenna directivity shows the propagation characteristics of the EM field of the antenna. The half power beam width and the front to your ratio can be read from it.

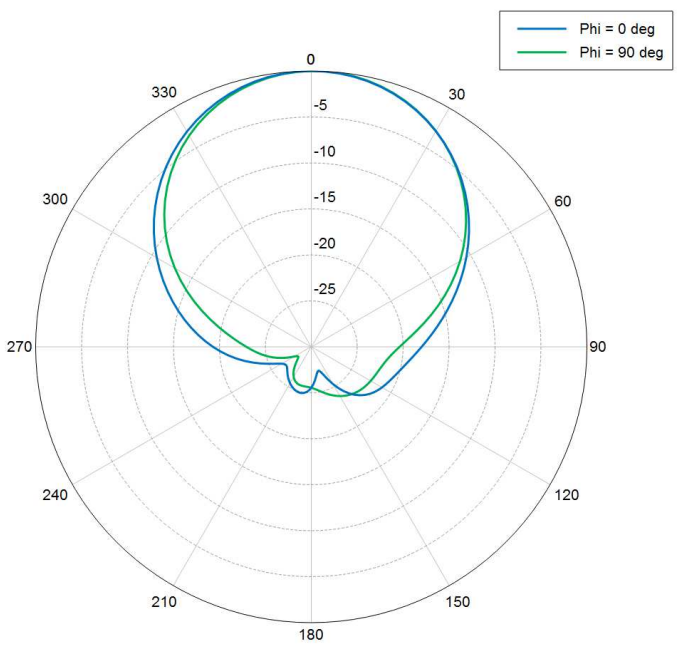


Figure 3: Antenna directivity
SMSH antennas

Mounting

As the antenna is usually installed in a shelf or flat on a base, a mounting kit is not necessary. However, the antenna can still be mounted with the following mounting kit, if the backplane is installed for this purpose.

Order number	Type	Description
Necessary for mounting kits		
52010398	SMSH-BP-ALU-340	Backplate[1)] for SMSH with 100x100 mm fixing holes
Mounting kit Indoor		
52010261	MK-WPM-100-100	Wall mount kit indoor
Necessary for mounting kits		
52010351	MK-WPM3-OSS	Wall mount kit
Necessary for mounting kits		
52010368	MK-PMA-OGV	Pole mount adapter

[1)] Requirement for assembly with the mounting kits.

Accessoires

Order number	Type	Description
Antenna cable to connect ARU 3000, ARU 8500 and RRU 4000 reader		
52010527	R-AC1 FAKRA-TNCR	1m, LMR 195, IP40, FAKRA z-coded
52010528	R-AC3 FAKRA-TNCR	3m, LMR 195, IP40, FAKRA z-coded
52010529	R-AC5 FAKRA-TNCR	5m, LMR 195, IP40, FAKRA z-coded
Antenna cable to connect ARU 2400 and RRU 1400 reader		
52010485	R-AC 0.5 FAKRA-FAKRA	0.5m, LMR 195, IP40, FAKRA z-coded
52010486	R-AC 1 FAKRA-FAKRA	1m, LMR 195, IP40, FAKRA z-coded
52010487	R-AC 3 FAKRA-FAKRA	3m, LMR 195, IP40, FAKRA z-coded
52010488	R-AC 5 FAKRA-FAKRA	5m, LMR 195, IP40, FAKRA z-coded

8.4 Wide Range Antenna WRA 6060

The Wide Range Antenna WRA 6060 is the perfect solution when the read range needs to be focused and should be smaller than 5 m. In its robust IP 67 housing, it can also be used outdoors. The antenna forms a homogeneous reading field and convinces with an ideal front/back ratio.

The WRA 6060 antenna can be used in point-of-sale and smart shelf applications, as well as for material handling in production.

Figure 1: WRA 6060 antenna
ETSI: 52010423
FCC: 52010424

The technical data can be found here: https://www.kathrein-solutions.com/products/rfid/antennas

Antenna Directivity

The antenna directivity shows the propagation characteristics of the EM field of the antenna.
The half power beam width and the front to back ratio can be read from it.

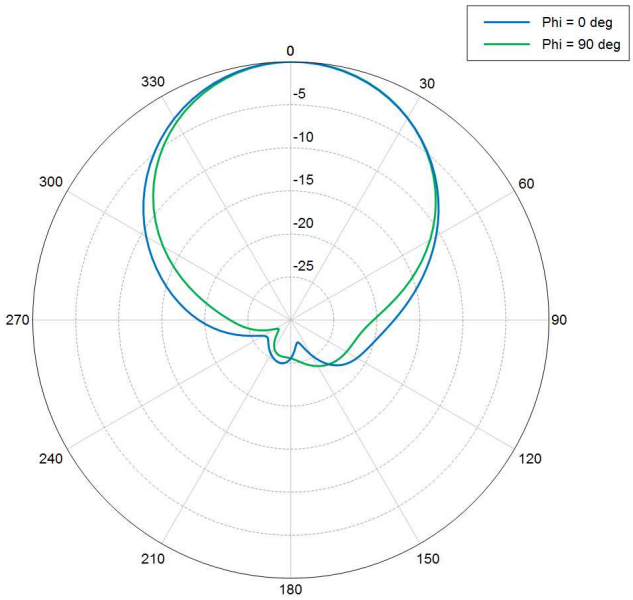
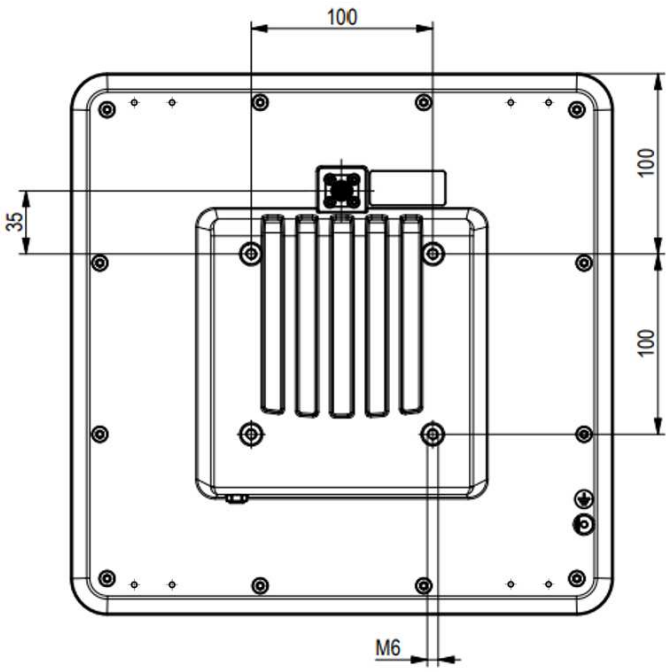


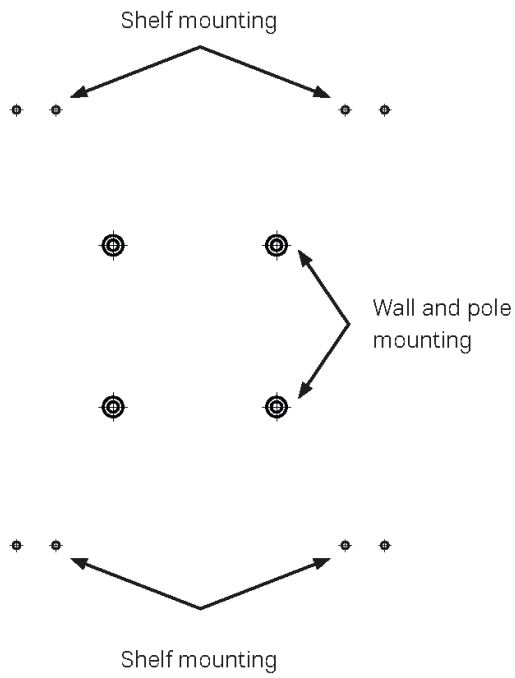
Figure 2: Antenna directivity
WRA 6060

Mounting

The WRA 6060 antenna can be mounted in various ways. On the one hand, the antenna has 100x100 mm mounting holes for the Kathrein mounting kits. On the other hand, there is a suitable mounting kit for mounting directly on a shelf. There are 8 mounting holes for this on the back of the antenna.

Order number	Type	Description
Mounting kit Indoor		
52010261	MK-WPM-100-100	Wall mount kit indoor
Mounting kit Outdoor		
52010351	MK-WPM3-OSS	Wall mount kit
Option for 52010351		
5210368	MK-PMA-OGV	Pole mount adapter
Shelf mounting		
52010479	MK-SHM-4IP	Shelf mount kit





Accessoires

Order number	Type	Description
Antenna cable to connect ARU 3000, ARU 8500 and RRU 4000 reader		
52010174	R-AC 3 TNC-TNCR	3m, Low Loss 240 Flex, IP67
52010175	R-AC 6 TNC-TNCR	6m, Low Loss 240 Flex, IP67
52010176	R-AC 10 TNC-TNCR	10m, Low Loss 240 Flex, IP67
52010177	R-AC 15 TNC-TNCR	15m, Low Loss 240 Flex, IP67
Antenna cable to connect ARU 2400 and RRU 1400 reader		
52010461	R-AC 1 TNC-FAKRA	1m, LMR 195, IP40
52010462	R-AC 3 TNC-FAKRA	3m, LMR 195, IP40
52010463	R-AC 5 TNC-FAKRA	5m, LMR 195, IP40
Antenna adapter		
52010598	R-AA TNC - TNC	TNC (f) to TNC(m), right angle plug

8.5 Wide Range Antenna WRA 7070

For classic far-field applications with large reading distances, the Wide Range Antenna WRA 7070 is the best choice. It is the standard antenna for many applications because it features an optimal axial ratio for circular polarisation. This means that all transponders can be detected regardless of their orientation.

This makes the antenna the ideal selection for logistics and production applications, but also for vehicle detection. The WRA 7070 is also available in a KRAI version. While the standard antenna has only one circular polarisation (RHCP = right hand circular polarised), the KRAI version of the WRA 7070 allows 4 polarisations to be selected. In addition to the two circular polarisations (LHCP/RHCP), the linear polarisations - vertical and horizontal - can also be used.

With the two circular polarisations, the reading performance can be increased. This is all the more evident the more metal is in the environment and the more the RFID signals are diffused. The linear polarisations can be used to separate transponders and also serve to increase the reading performance.

In addition, with the KRAI version of the WRA 7070, up to 4 multi-colour LEDs can be controlled, thus providing additional feedback for the user with a passive antenna.

Figure 1: WRA 7070 antenna
ETSI: 52010333
FCC: 52010334

Figure 2: WRA 7070 KRAI antenna
ETSI: 52010335
FCC: 52010336

The technical data can be found here: https://www.kathrein-solutions.com/products/rfid/antennas

Antenna Directivity

The antenna directivity shows the propagation characteristics of the EM field of the antenna. The half power beam width and the front to back ratio can be read from it.

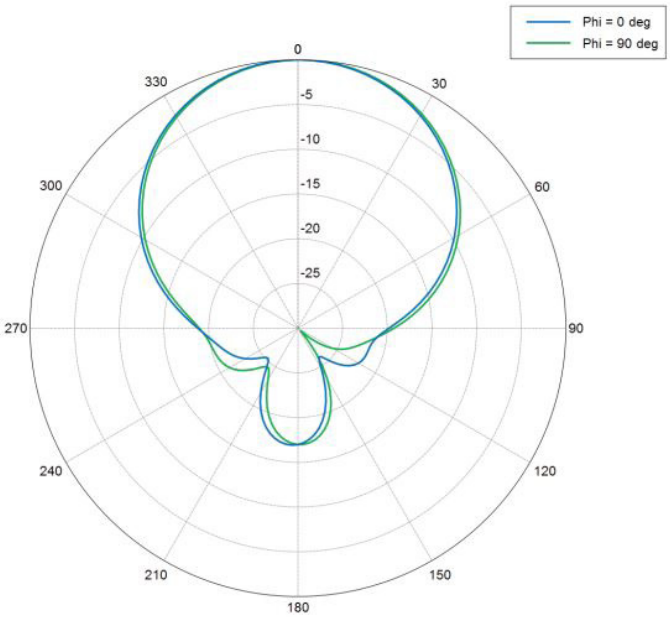
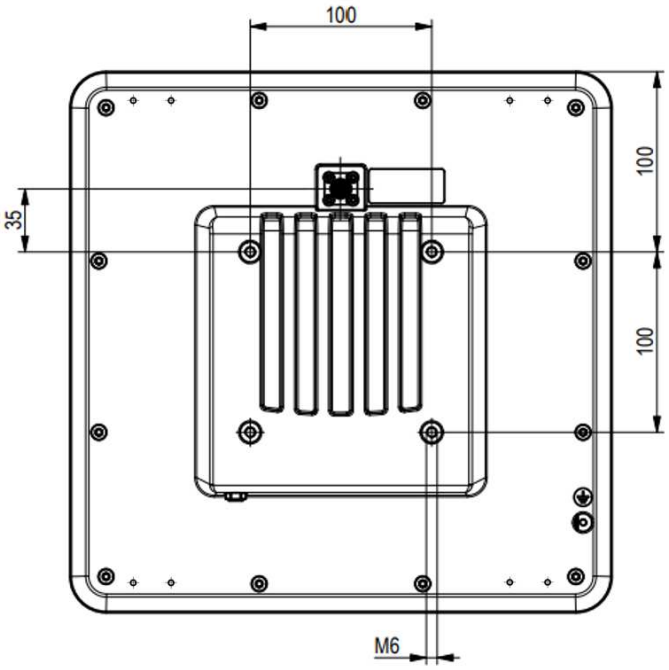


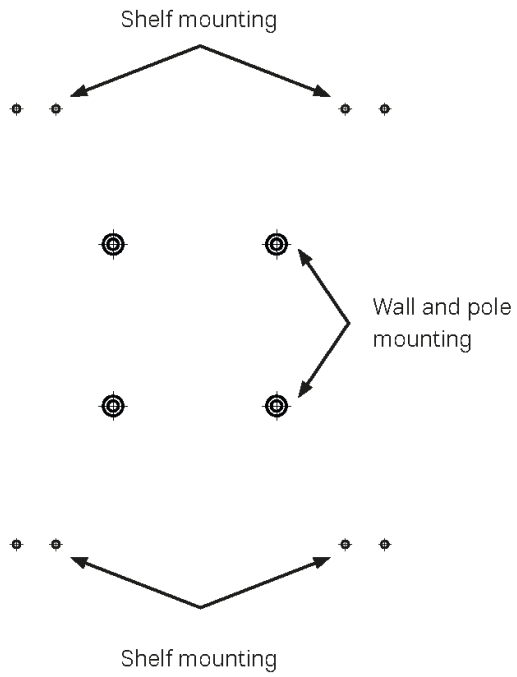
Figure 3: Antenna directivity
WRA 7070 and
WRA 7070 KRAI antennas

Mounting

The WRA 7070 antenna can be mounted in various ways. On the one hand, the antenna has mounting holes spaced 100 mm x100 mm for the Kathrein mounting kits. On the other hand, there is a suitable mounting kit for mounting directly on a shelf. There are 8 mounting holes on the back of the antenna.

Order number	Type	Description
Mounting kit Indoor		
52010261	MK-WPM-100-100	Wall mount kit indoor
Mounting kit Outdoor		
52010351	MK-WPM3-OSS	Wall mount kit
Option for 52010351		
5210368	MK-PMA-OGV	Pole mount adapter
Shelf mounting		
52010479	MK-SHM-4IP	Shelf mount kit



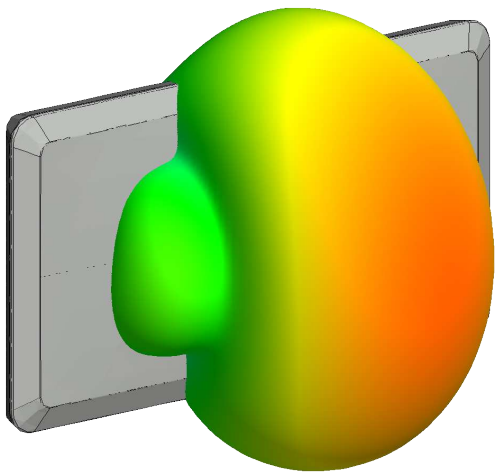


Accessoires

Order number	Type	Description
Antenna cable to connect ARU 3000, ARU 8500 and RRU 4000 reader		
52010174	R-AC 3 TNC-TNCR	3m, Low Loss 240 Flex, IP67
52010175	R-AC 6 TNC-TNCR	6m, Low Loss 240 Flex, IP67
52010176	R-AC 10 TNC-TNCR	10m, Low Loss 240 Flex, IP67
52010177	R-AC 15 TNC-TNCR	15m, Low Loss 240 Flex, IP67
Antenna cable to connect ARU 2400 and RRU 1400 reader		
52010461	R-AC 1 TNC-FAKRA	1m, LMR 195, IP40
52010462	R-AC 3 TNC-FAKRA	3m, LMR 195, IP40
52010463	R-AC 5 TNC-FAKRA	5m, LMR 195, IP40
Antenna adapter		
52010598	R-AA TNC - TNC	TNC (f) to TNC(m), right angle plug

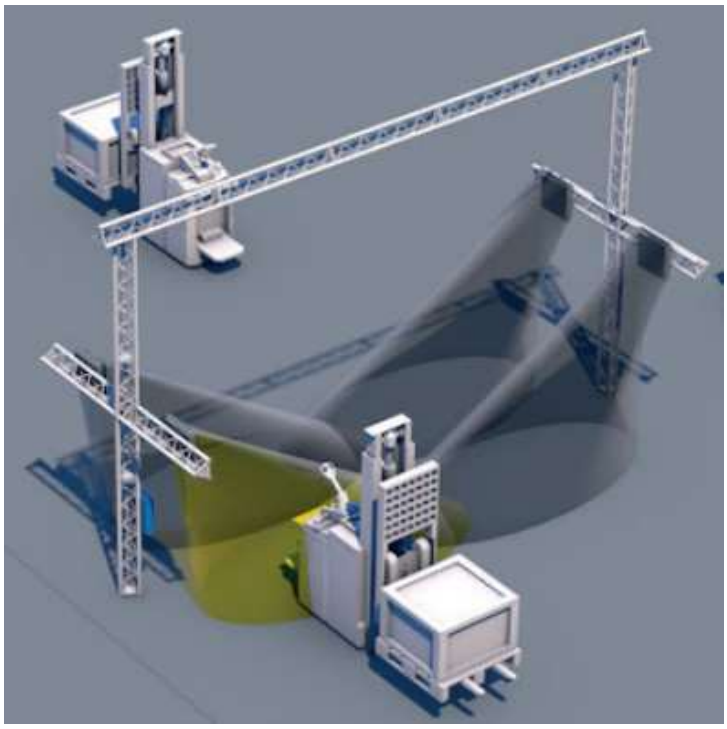
8.6 Wide Range Antenna WRA 3070

If the focus of the application is on the maximum reading range, the WRA 3070 antenna is used. This is achieved by the largest antenna gain in the Kathrein antenna portfolio and at the same time by the focused 30° beam.



In this view, it can be seen that the WRA 3070 antenna focuses with an aperture of 30° in the plane of the larger dimension. The selectivity over the short vertical side is with an aperture of 70° not as high. The following illustration shows the WRA 3070 antenna in use on a typical logistic gate. Here, 4 antennas are mounted horizontally. When passing through the gate, a first selective area (30° plane) is passed through. Because the other plane is not focused (70° plane), there is a continuous reading zone in this dimension. Since a second pair of antennas is mounted on the exit side, a further selective reading takes place there.

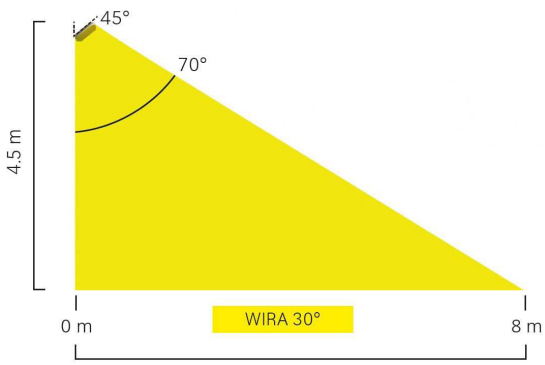
This 30° focus also allows selective reading, making the WRA 3070 the ideal antenna for gate applications. In the typical gate application with 4 antennas, this results in 4 very selective read zones



Multi Lane Flow

For vehicle detection, the WRA 3070 is attached to the gantry and detects the passing vehicles selectively.

Side view



Top view

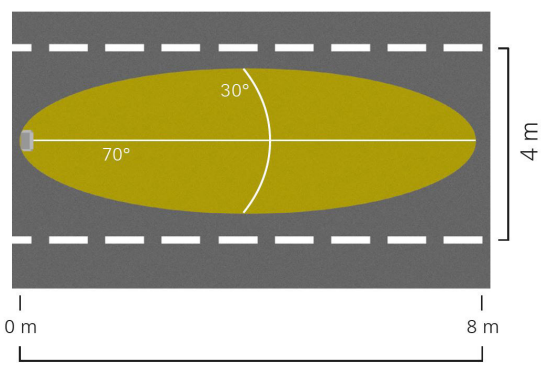


Figure 1: WRA 3070 antenna
ETSI: 52010583
FCC: 52010584

The technical data can be found here: https://www.kathrein-solutions.com/products/rfid/antennas

Antenna Directivity

The antenna directivity shows the propagation characteristics of the EM field of the antenna. The half power beam width and the front to back ratio can be read from it.

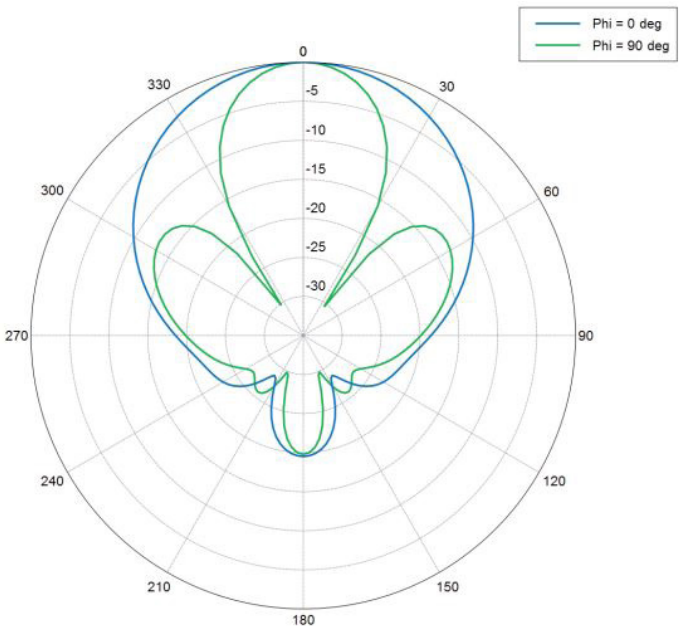
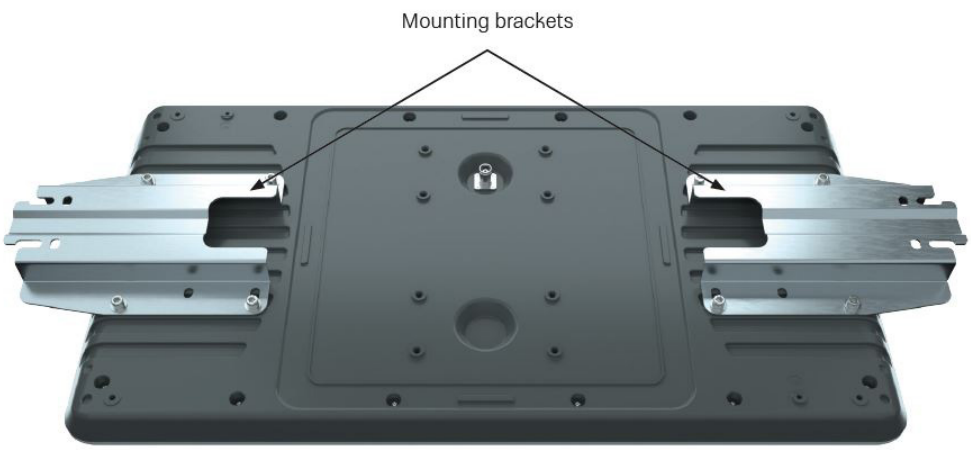


Figure 2: Antenna directivity
WRA 3070

Mounting

The WRA 3070 antenna can be mounted in various ways. On the one hand, the antenna has mounting holes spaced 100 mm x100 mm for the Kathrein mounting kits. On the other hand, the mounting brackets for wall and mast mounting are already supplied with the antenna.



The mounting brackets allow vertical or horizontal mounting of the antenna.

Order number	Type	Description
Mounting kit Indoor		
52010261	MK-WPM-100-100	Wall mount kit indoor
Mounting kit Outdoor		
52010351	MK-WPM3-OSS	Wall mount kit
Option for 52010351		
5210368	MK-PMA-OGV	Pole mount adapter

Accessoires

Order number	Type	Description
Antenna cable to connect ARU 3000, ARU 8500 and RRU 4000 reader		
52010174	R-AC 3 TNC-TNCR	3m, Low Loss 240 Flex, IP67
52010175	R-AC 6 TNC-TNCR	6m, Low Loss 240 Flex, IP67
52010176	R-AC 10 TNC-TNCR	10m, Low Loss 240 Flex, IP67
52010177	R-AC 15 TNC-TNCR	15m, Low Loss 240 Flex, IP67
Antenna cable to connect ARU 2400 and RRU 1400 reader		
52010461	R-AC 1 TNC-FAKRA	1m, LMR 195, IP40
52010462	R-AC 3 TNC-FAKRA	3m, LMR 195, IP40
52010463	R-AC 5 TNC-FAKRA	5m, LMR 195, IP40
Antenna adapter		
52010598	R-AA TNC - TNC	TNC (f) to TNC(m), right angle plug

9 Standards for exposure to electromagnetic fields

9.1 Harmonised standards

There are three basic standards for human exposure that are coordinated with each other and comprehensively describe the area of application of RFID systems. It should only be noted here that the description refers to use in Europe. For the application in other areas of the world, there are adequate standards that are to be applied accordingly.

The relevant standards cover the following areas:
- ► Electromagnetic compatibility according to EN 302208 with the determination of the permitted transmission power
- ► Limitation of the exposure of persons to electromagnetic fields according to EN 50364:2018
- ► Determination of the exposure of persons to electromagnetic fields according to EN 62369-1:2009

These three standards are based on the Radio Equipment Directive 2014/53 / EU (RED).

The coordination of these standards with each other and the general validity is described as harmonised and ensures a single market for radio equipment by setting essential requirements for health and safety, electromagnetic compatibility and efficient use of the radio spectrum.

UHF RFID Specification		
EN 302 208:2020-08	EN 50364:2018	EN 62369-1:2009
Electromagnetic compatibility and radio bandwidth limits the radiated power to 2 W ERP (lower band 866MHz) limits the radiated power to 4 W ERP (upper band 915MHz)*.	Limitation of exposure of persons to electromagnetic fields Note: 1999/519/EG 2013/35/EU	Determination of the exposure of persons to electromagnetic fields Determines 3 procedures to ensure conformity with standards
Radio Equipment Directive 2014/53 / EU (RED)		

* All calculations are performed for the lower band at 866MHz, but are adequate for the upper band.

The basic parameter for the assessment of electromagnetic fields is the Specific Absorption Rate (SAR).

This value is not only valid for RFID systems, but also for other electromagnetic devices and uses the same limit values and derivations. For example, the limits for mobile phone systems and especially the effects of using mobile phones are considered equivalently.

Based on established studies for health effects and biological aspects, the specific absorption rate is defined as follows:

- ► SAR is the rate at which electromagnetic energy is absorbed per unit mass.
- ► It is expressed in watts per kilogram (W/kg) and indicates how much energy is absorbed in the body.

$$SAR = \frac{\sigma E^2}{\rho}$$

E – Electric field strength in the body
σ – Electrical conductivity of the body
ρ – Density of the body

Reference values are determined by applying mathematical modelling and extrapolations of the following basic data. This allows the given scenario to be estimated and enables a practical evaluation in relation to the limit values specified in the standards.

9.2 Occupational and general exposure according to EN 50364:2018

The product standard EN 50364 defines the procedures and limits for the exposure of persons to electromagnetic fields from equipment operating in the frequency range from 0 Hz to 300 GHz and used in electronic article surveillance (EAS), radio frequency identification (RFID) and similar applications.

A distinction is made between occupational exposure, of persons working in the vicinity of such equipment and having an influence on the operation of the equipment.

In contrast, there are persons who work in the vicinity of such systems and have no influence on the operation of the system. This group of people is described in the relevant standards as the "general population".

Pregnant women and wearers of active implants, e.g. hearing aids or pacemakers, also fall into the group of this general population.

The following table gives the limit values for the respective group:

Occupational exposure (European Directive 2013/35/EU, EMFV)					**Exposure for general population (Recommendation of European Council 1999/519/EC)**				
Basic limits			Reference values		Basic limits			Reference values	
∅ SAR-Value of the whole body (W/kg)	Local SAR-Value (limb and body) (W/kg)	Local SAR-Value (limb) (W/kg)	E- Field strength (dBV/m)	H-Field strength (dBA/m)	SAR-Value of the whole body (W/kg)	Local SAR-Value (limb and body) (W/kg)	Local SAR-Value (limb) (W/kg)	E- Field strength (dBV/m)	H-Field strength (dBA/m)
0,4	10*	20*	39,11**	- 12,57**	0,08	2*	4*	32,15**	- 19,25**

* Localised SAR averaged over 10 g tissue, all SAR values should be averaged over 6 min.
** rms Value

9.3 Standard assessment procedure according to EN 62369-1:2009

The following paragraph serves to explain and derive the standard assessment procedures according to EN 62369. This is to ensure that the limit values are based on generally valid prerequisites and at the same time the different requirements for the respective body parts (torso, arms, head) are taken into account accordingly.

9.3.1 Three methods for demonstrating conformity

The methods can be divided as follows:

a) Simple measurement to demonstrate compliance with the reference levels
b) Measurement and analysis to demonstrate compliance with the basic limits
c) Numerical modelling to demonstrate compliance with the basic limits

It is sufficient if one of the methods shows that the device complies with the limit values. This makes the device compliant for occupational and general exposure to electromagnetic fields.

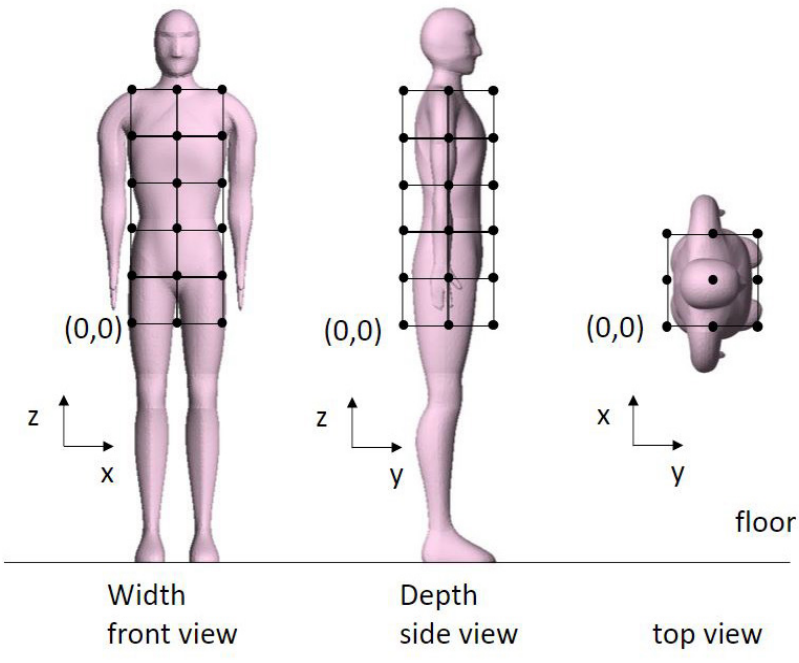
The following is a brief explanation of the three individual methods.

9.3.1.1 Simple measurement to demonstrate compliance with the reference levels

Basically, this method is described by the following two steps

Step 1: Measurement of the field strength at a distance of 20 cm in front of the test antenna is compared to the reference level

Step 2: Measurement of the field strength at defined grid points (depending on antenna type and application) Arithmetically averaged value is compared to the reference level



9.3.1.2 Measurement and analysis to demonstrate compliance with the basic limits

For inductive systems up to 50 MHz, an approximation formula for the H-field and the excited surface current in human tissue through the loop antennas applies. The conductivity of the tissue is also approximated.

$$SAR = \frac{\sigma E^2}{\rho}$$

E – Electric field strength in the body
σ – Electrical conductivity of the body
ρ – Density of the body

For systems in the frequency range 100 kHz to 10 GHz, one assumes a localised SAR value.
- ► Localised SAR above 10 g body weight is taken into account
- ► The limit is 2 W/kg, which is equivalent to 20 mW per 10 g body weight
- ► All conducted power is delivered to this 10 g body weight
- ► Any device that delivers less than 20 mW conducted power is considered compliant

9.3.1.3 Numerical modelling to demonstrate compliance with the basic limits

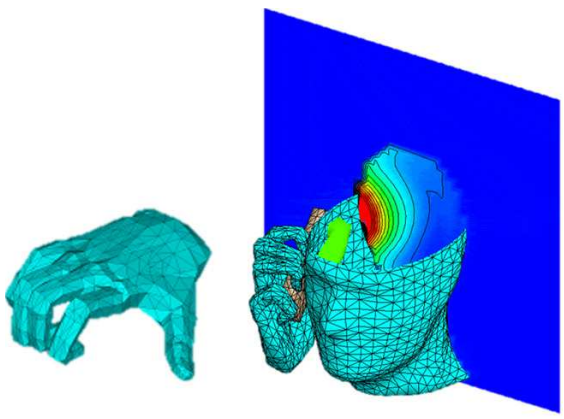
In numerical modelling, the properties of a human model are applied and evaluated using a simulation principle and techniques. The following values are defined as properties of the human model:

Size 1.76 m ± 5%
Weight 73 kg ± 5%

The representation of the inhomogeneous human structure takes place:
- ► With realistic body permeability (frequency-dependent)
- ► With volume pixel (voxel) resolution smaller than 10 mm
- ► For the voxel with the highest SAR when more than one type of tissue is present in a single voxel.

It is acceptable that the local exposure models only a certain part of the body.

The simulation principles and techniques are carried out with the finite element method (FEM) in the frequency domain or in the time domain with the finite difference method (FDTD). Other techniques are also permissible if they lead to the same results.



9.4 Compliance with the basic limits using the example of the Wide Range Antenna WRA 7070

This chapter shows how to comply with the basic limits using the WRA 7070 antenna as an example. This procedure can also be used for all other Kathrein antennas.

The limits for human exposure in the EU are based on scientific data that aim to prevent negative effects of transmitters. For this purpose, the physical property of heating of human tissue exposed to radiation is taken as a basis.

The following basic principles must be taken into account. To increase the core temperature of a human body by 1°C within 30 minutes, 4W/kg of high-frequency power is required. In order to guarantee a large margin from these limit values in practice, additional safety buffers are specified by so-called reduction factors:

- ► Reduction factor 10: for persons, e.g. workers, who are knowingly in the radiation range of an RFID antenna.
- ► Reduction factor 50: for persons who are unknowingly in the radiation range of an RFID antenna

This results in these Specific Absorption Rate (SAR) limits:

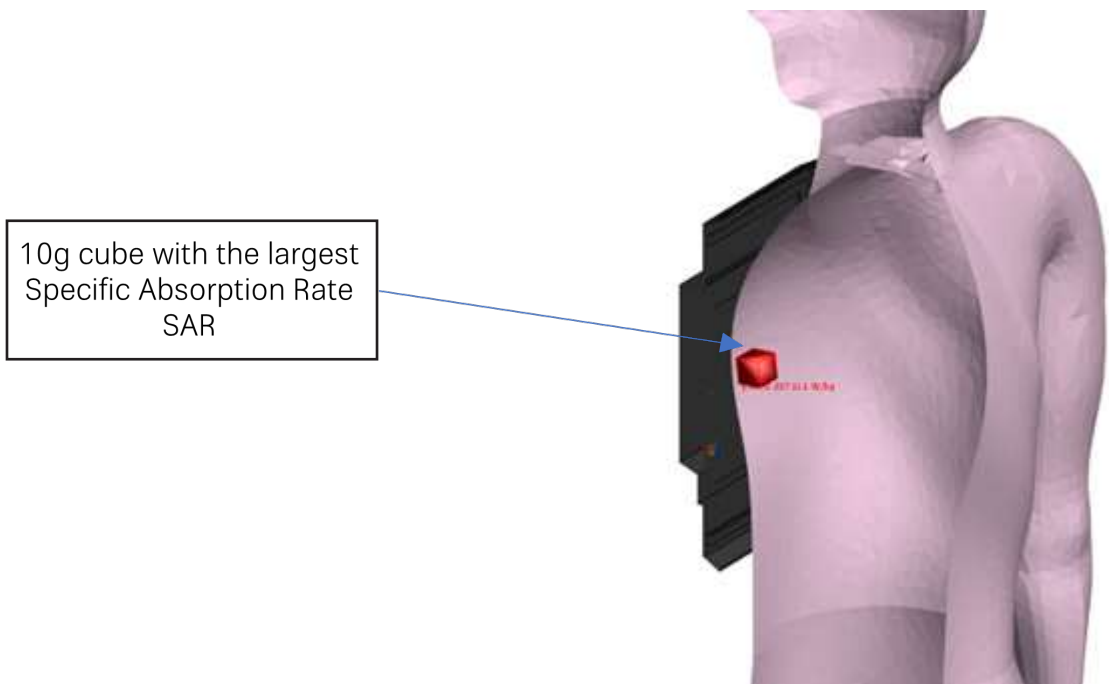
- ► Limit value occupational exposure: 0,4 W/kg
- ► Limit value general population: 0,08 W/kg

According to EN 62369-1:2009, an electromagnetic simulation can be used to calculate the exposure values. The RFID antenna, in this example the WRA 7070, is positioned at chest height of the dummy (maximum irradiation).

The dummy consists of muscle tissue, which due to its properties represents the worst case for SAR simulations. The maximum permitted radiated power is used for the calculation.

Two values are determined in the simulation:

- ► Maximum Specific Absorption Rate (SAR) in a 10g cube.
- ► Average Specific Absorption Rate (SAR) for the entire body volume - Whole Body Average (WBA)



The following values result from the simulation:

	SAR [W/kg]	Basic limit value EN 50364:2018 [W/kg]	
	Radiated power 2 W e.r.p. (33 dBm)	General population	Occupational exposure
Based on a 10g cube	0,42 Gen. pop. 21,0 % Occu. exposure: 4,2 %	2 (100 %)	10
Whole body average WBA	0,0035 Gen. pop. 4,4 % Occu. exposure: 0,9 %	0,08	0,4

In the case of exposure to the maximum permitted transmission power of 2 W e.r.p., the limit value for the general population is 2 W/kg with reference to the 10g cube. The simulation of the SAR values with the WRA 7070 shows that for the general population the SAR is 21% of the permitted value. For workers, only 4.2% of the limit value is reached.

In the Whole Body Average method, the limits for the general population are reached by 4.4% and those for workers by only 0.9% and are therefore far below the required limits.

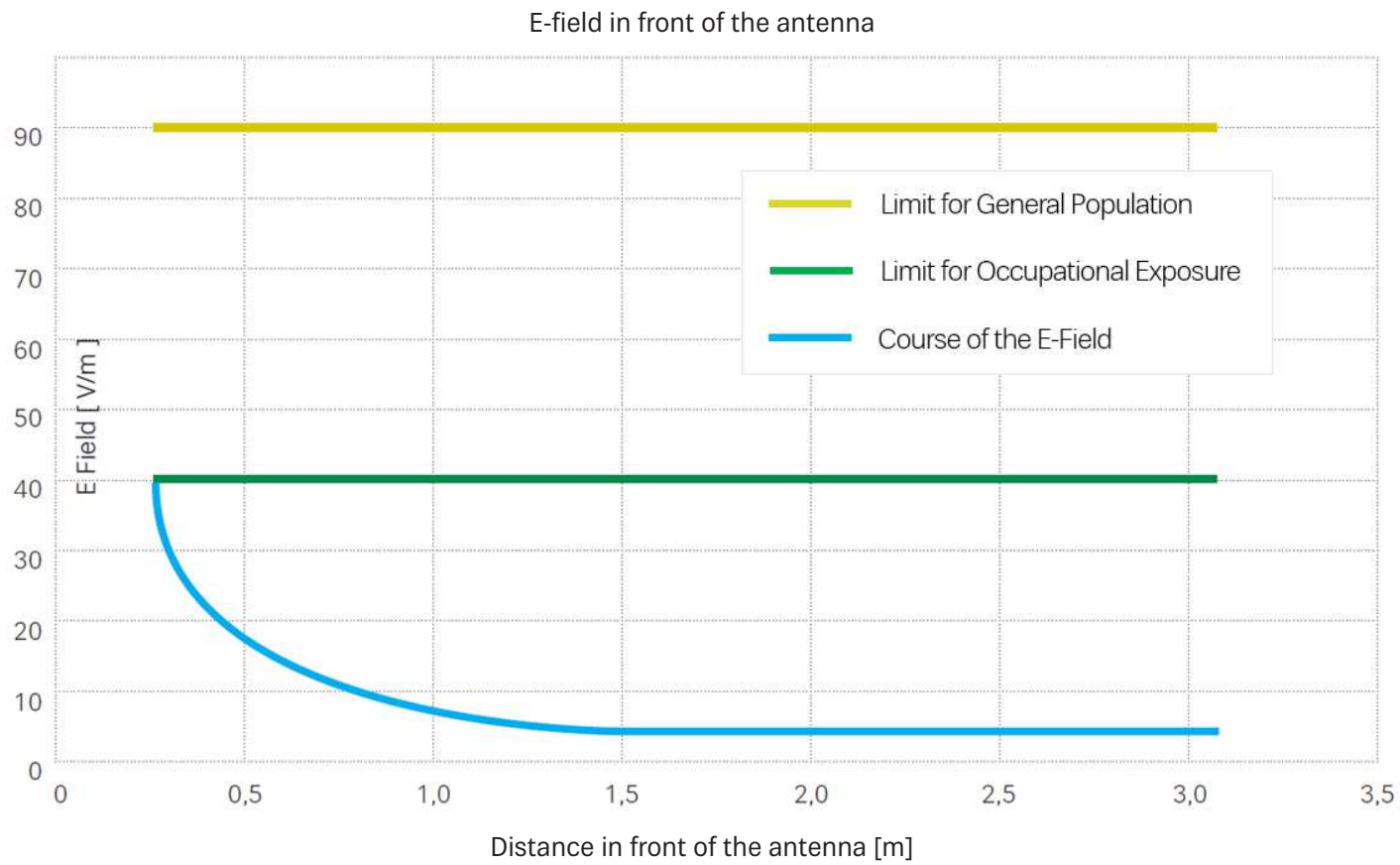
Thus, the simulation shows the values falling short of the limit values, even at the maximum transmission power allowed by the legislator. This applies both for the spatial peak Specific Absorption Rate (SAR) in a 10g cube and for the SAR for the entire body volume - Whole Body Average (WBA).

9.5 Course of the E-Field strength over the distance to the antenna

Starting from the limits and conditions mentioned in the previous chapter, the electric field strength decreases as you move away from the antenna.

Occupational exposure	Exposure for general population
Occupational safety, trigger level, wearers of passive implants (EMFV)*	General population, pregnant women, wearers of active implants (1999/519/EG)
0,00307 √f (f in Hz)	1,375 √f (f in MHz)
90,3V/m (39,11dBV/m)	40,4V/m (32,15dBV/m)

The graph below shows the E field of the WRA Antenna power with 2W ERP and the limits for general public and occupational exposure.



The power fed into the WRA 7070 antenna is set such that the maximum radiated power is 2W e.r.p. This results in values of the electric field in front of the antennas for the occupational exposure and general population that are below the limit values in every case of use.

10 RFID antenna concepts and possible exposure scenarios

10.1 Antenna concepts and families from Kathrein Solutions

The UHF RFID antennas from Kathrein Solutions can be divided into the following groups.

a) Near Field antennas - reading range up to 20 cm
b) Low Gain antennas - reading range from up to 2m
c) Mid Gain antennas - reading range from up to 5 m
d) High Gain antennas - reading range of more than 10 m

Smart shelf antennas (SMSH antennas) have a special role. They belong to the mid gain antennas in terms of the reading range, but form a separate group due to their design.

10.2 Characteristics of the individual antenna groups

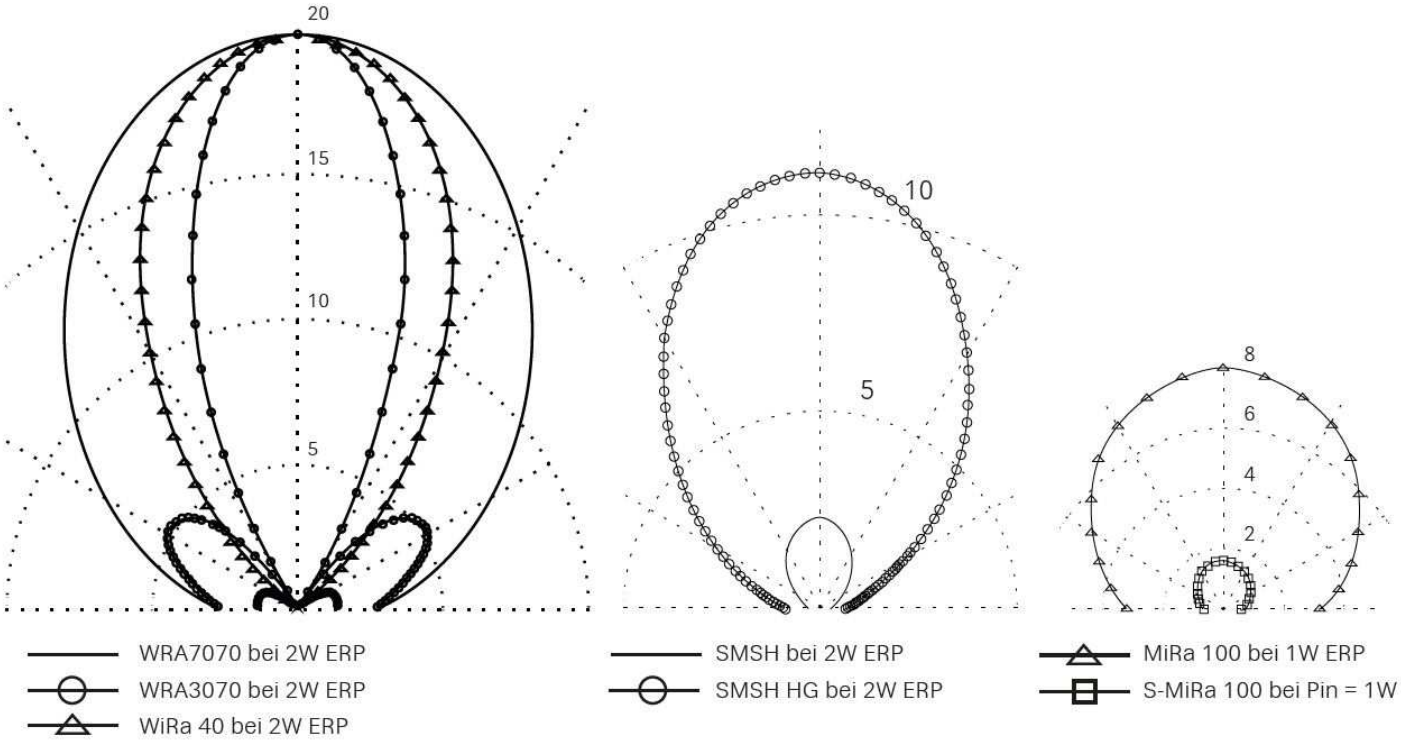
a) Near Field antennas - read range up to 20 cm
- For applications in their reactive near fields
- Realised in a small design (8x9 cm)
- Extremely low antenna gain (e.g. -15 dBi)
- Very high selectivity
- Not affected by metal in the vicinity of the antennas

b) Low Gain Antennas - reading range from up to 2 m
- For reactive near field and far field applications
- Small in size (15x12 cm)
- Reading range limited by 0.5 W ERP radiated power
- Selectivity is strongly dependent on the reading distance

c) Mid Gain antennas - reading range up to 5 m
- For applications in the radiated near field
- Extremely thin design
- Very homogeneous reading field
- Extremely high front-to-back ratio

d) High Gain antennas - reading range of more than 10 m
- For applications in the far field
- Variants with 30° and 70° 3dB beam width angle
- Radiated power is max 2 W ERP or 4W ERP in upper band
- Selectivity is strongly dependent on the reading range

To illustrate the reading range, a comparison of the antennas is shown.



The reading ranges of the low gain antennas are too small in relation, so that a display was omitted.

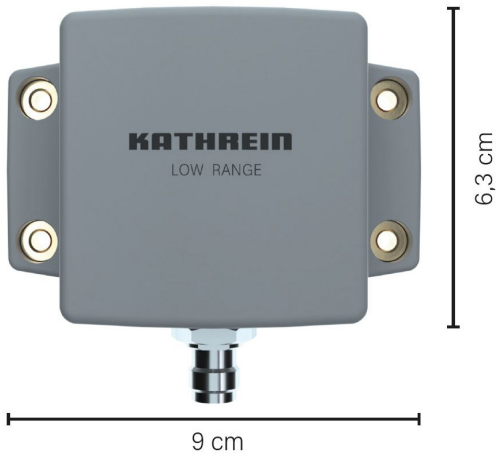
11 Characteristics and specific limits of the antennas

11.1 Near Field Antenna

The Near Field antenna family includes the LoRa and ULoRa antennas.

Technical features:

- Use depends on data carrier type
- Loop or dipole transponder
- Limited read range < 20 cm
- Extremely high selectivity (typ. 5 cm)
- Extremely low gain (< -15 dBi)
- Dimensions: 6.3 cm x 9 cm
- High mechanical robustness (IP67)
- Ideal for conveyor belts and access systems
- Little or no interference from metallic objects in the vicinity



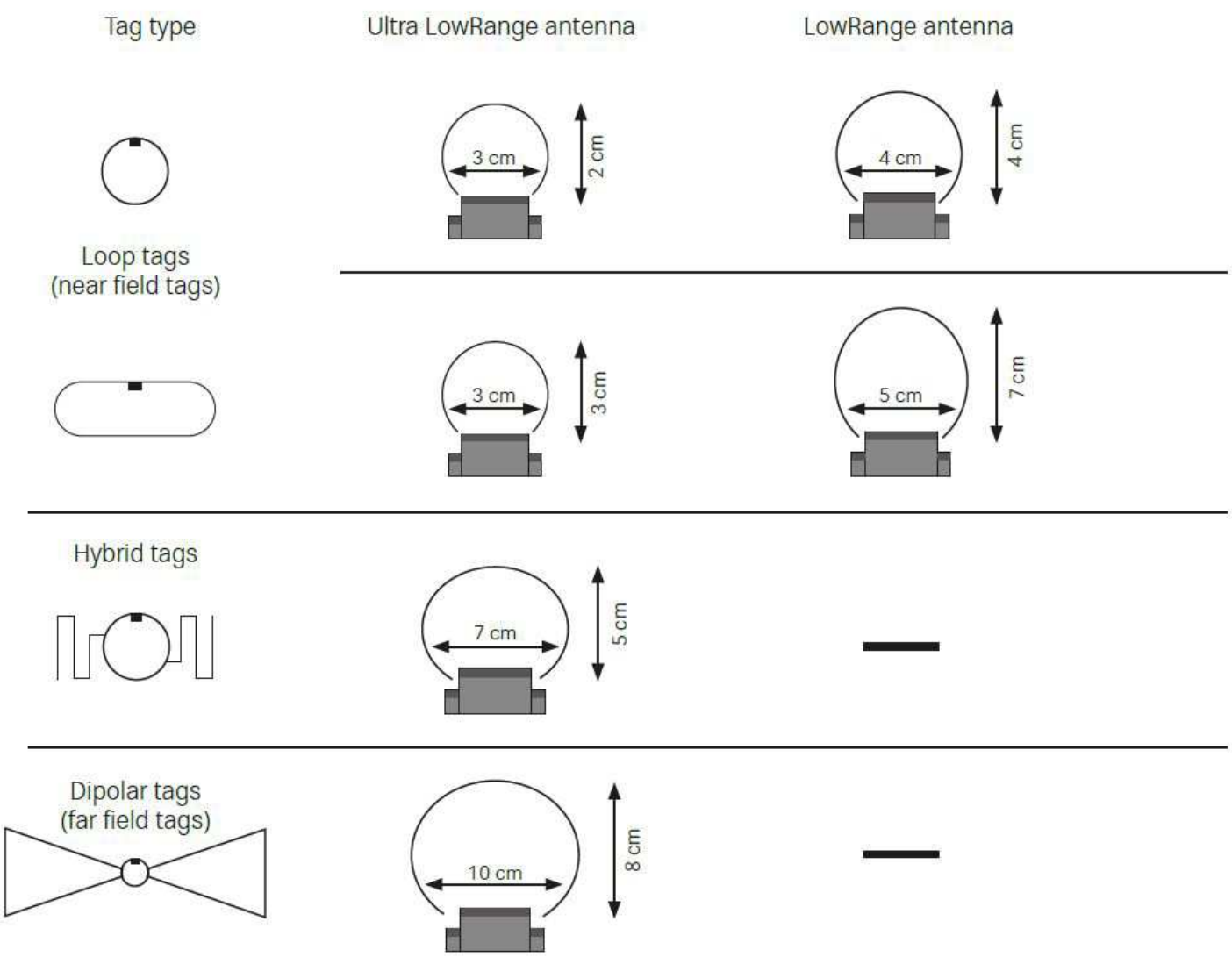
Typical applications in logistics are:
Logistics

- Separation of containers
- Alignment of components

Industrial automation
- Accurate position detection on conveyor belts
- Selective writing on tags

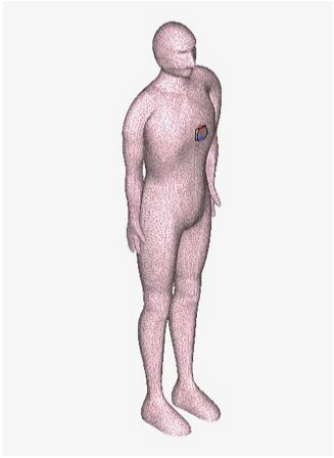
Pharmaceutical applications
- Selectively reading small packages

Please refer to the following diagram for the assignment of the different transponders to the respective antenna type.



Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for LoRa Antennas have been calculated.

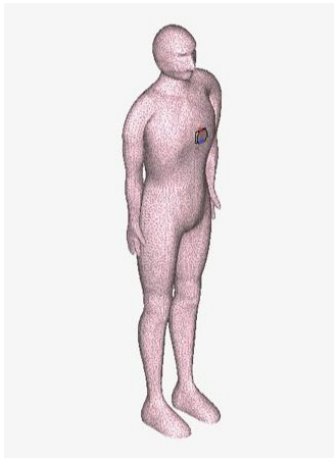
Reference value	LoRa Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Antenna input power 27 dBm	General population	Occupational exposure
Based on a 10g cube	0,53 = 27%	2 (100%)	10
Whole body average WBA	0,0008 = 1%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. input power of 27 dBm, the SAR values are 73% below the limit for a 10g cube and 99% below the WBA limit for general population.

Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for ULoRa Antennas have been calculated.

Reference value	ULoRa Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Antenna input power 30 dBm	General population	Occupational exposure
Based on a 10g cube	0,43 = 22%	2 (100%)	10
Whole body average WBA	0,0004 = 0,5%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. input power of 30 dBm, the SAR values are 78% below the limit for a 10g cube and 99,5% below the WBA limit for general population.

11.2 Low Gain Antenna

The Low Gain Antenna family includes the MiRa and the S-Mira antenna.

Technical features:

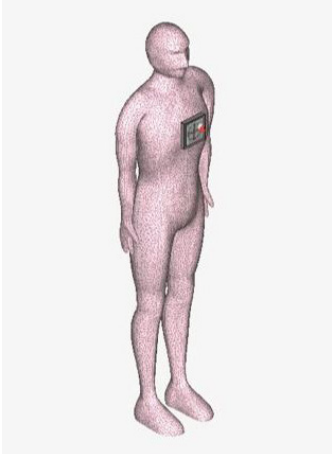
- 100° aperture angle
- Dimensions 15 cm x 12 cm
- Antenna gain = 2,5 dBiC (MiRa)
  = -12 dBiC (S-MiRa)
- Integration in applications with limited space
- Suitable for industrial environment and outdoor use (IP 67)
- Circular polarisation
- Low axial ratio
- Low VSWR
- For bulk and single tag applications

Typical applications are:

- Forklift trucks
- Small industrial trucks
- Access systems

Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for MiRa Antennas have been calculated.

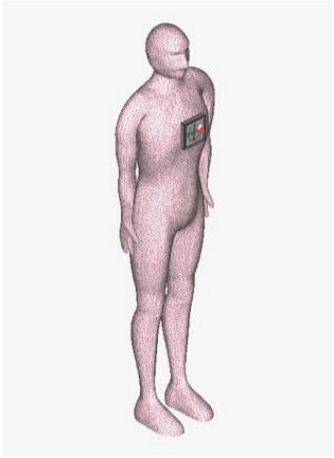
Reference value	MiRa Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Radiated power 30 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	1,68 = 84%	2 (100%)	10
Whole body average WBA	0,006 = 8%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. allowed radiated power of 30 dBm, the SAR values are 16% below the limit for a 10g cube and 92% below the WBA limit for general population.

Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for S-MiRa Antennas have been calculated.

Reference value	S-MiRa Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Antenna input power 30 dBm	General population	Occupational exposure
Based on a 10g cube	1,67 = 84%	2 (100%)	10
Whole body average WBA	0,006 = 8%	0,08	0,4



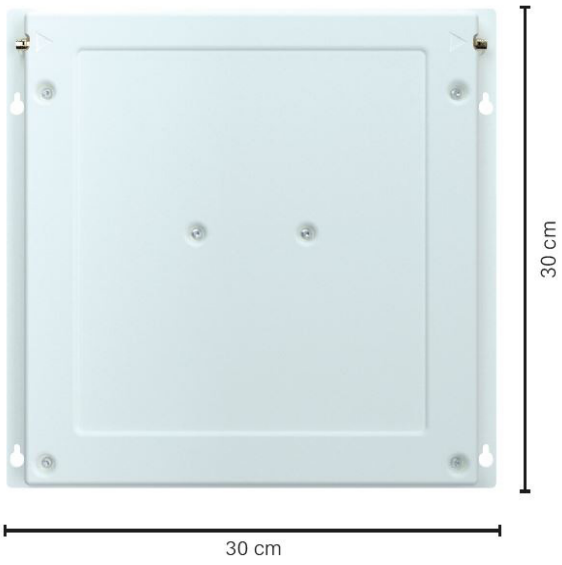
It can be seen that when the antenna is in accordance with the max. input power of 30 dBm, the SAR values are 16% below the limit for a 10g cube and 92% below the WBA limit for general population.

11.3 Mid Gain Antenna

The SMSH family of antennas includes the standard version (only input) and the cascadable version with the Kathrein RFID Antenna Interface (©KRAI). Since the WRA 6060 has the same structural design as the SMSH antennas, it is also considered here, even if it is not always mentioned in detail.

Technical features:

- Easy to install or retrofit
- Strong separation of reading/non-reading zone
- Extremely thin design
- Near-field applications
- Reading range: 0-3 m
- Very high, homogeneous detection field
- Optional cascade function for up to 32 antennas (only with ©KRAI Reader)

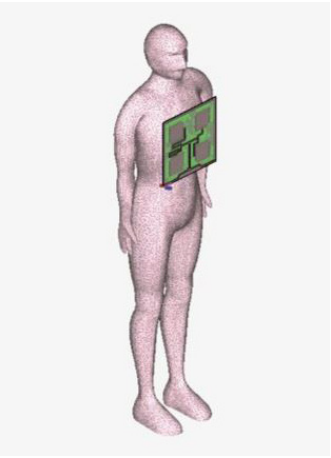


Typical applications are:

- eKanBan applications
- Point of sales verification
- Asset registration
- Book-and-collect workstation

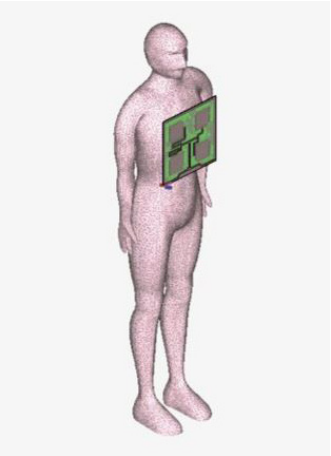
Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for SMSH Antennas have been calculated.

Reference value ETSI Lower Band	**SMSH Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 33 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,47 = 23%	2 (100%)	10
Whole body average WBA	0,005 = 6,25%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. allowed radiated power of 33 dBm, the SAR values are 77% below the limit for a 10g cube and 94,75% below the WBA limit for general population.

Reference value ETSI Upper Band	**SMSH Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 36 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,93 = 47%	2 (100%)	10
Whole body average WBA	0,009 = 11,25%	0,08	0,4



In the case of use in the ETSI Upper Band at 916 - 919 MHz, the SAR values are 53% below the limit for a 10g cube and 88,75% below the WBA limit for general population.

Technical features WRA 6060:

- Strong separation of reading/non-reading zone
- Suitable for industrial environment and outdoor use (IP 67)

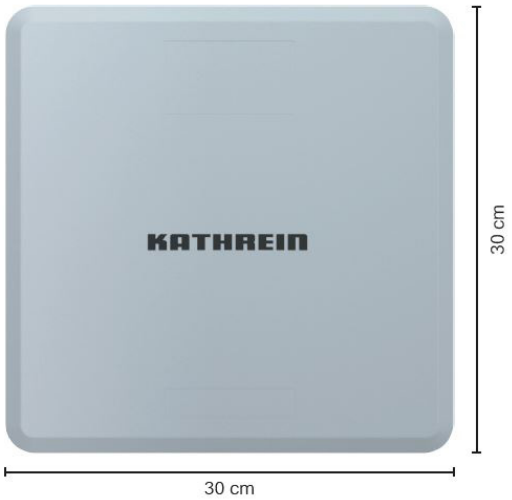
Typical applications are:

Logistics

- Gate applications
- Tunnel detection

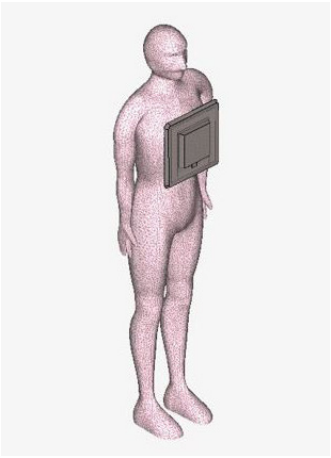
Industrial automation

- Conveyor belt
- Assembly line (especially with selective acquisition)



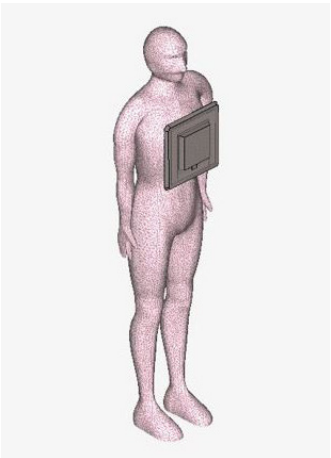
Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for WRA 6060 Antennas have been calculated.

Reference value ETSI Lower Band	**WRA 6060 Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 33 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,47 = 23%	2 (100%)	10
Whole body average WBA	0,005 = 6,25%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. allowed radiated power of 33 dBm, the SAR values are 77% below the limit for a 10g cube and 94,75% below the WBA limit for general population.

Reference value ETSI Upper Band	**WRA 6060 Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 36 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,93 = 47%	2 (100%)	10
Whole body average WBA	0,009 = 11,25%	0,08	0,4

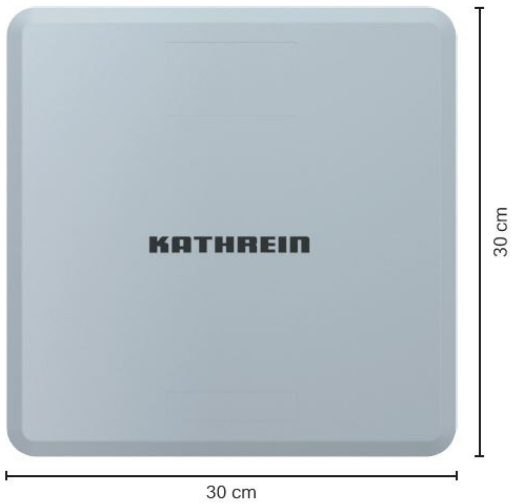


In the case of use in the ETSI Upper Band at 916 - 919 MHz, the SAR values are 53% below the limit for a 10g cube and 88,75% below the WBA limit for general population.

11.4 High Gain Antenna

The High Gain Antenna family includes the WRA 7070 and WRA 3070 antennas.

Technical features:
- Models with 70° and 30° half-beam width
- Antenna gain = 8.5 dBic (WRA7070)
  = 11.3 dBic (WRA3070)
- Bulk and single tag applications
- High front-to-back ratio
- Circular polarisation
- Low VSWR
- Extremely low axial ratio
- Optimised for far-field use
- Suitable for industrial environment and outdoor use (IP 67)

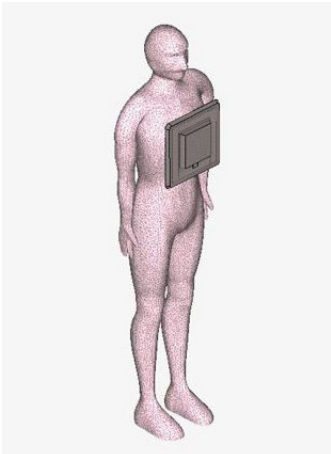


Typical applications are:
- Gate applications logistics
- Industrial automation
- Vehicle identification

The SAR value at a distance of 0 cm in front of the antenna up to the maximum reading range is well below the limit values. This means that the conformity for this antenna is given (see chapter 9.4 and 9.5).

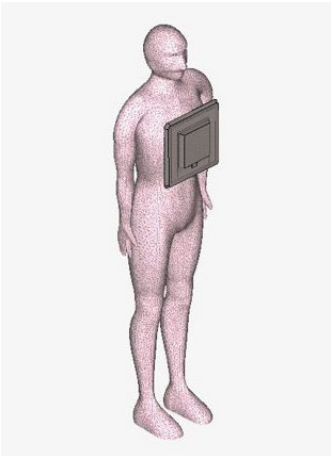
Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for WRA 7070 Antennas have been calculated.

Reference value ETSI Lower Band	**WRA 7070 Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 33 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,53 = 25%	2 (100%)	10
Whole body average WBA	0,003 = 3,75%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. allowed radiated power of 33 dBm, the SAR values are 75% below the limit for a 10g cube and 96,25% below the WBA limit for general population.

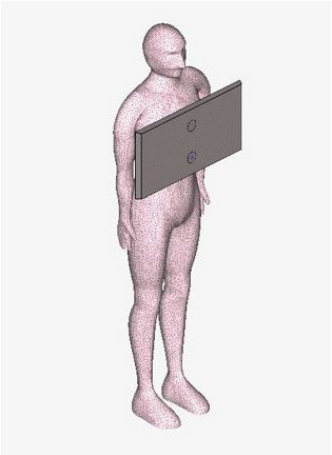
Reference value ETSI Upper Band	WRA 7070 Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Radiated power 36 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	1,0 = 50%	2 (100%)	10
Whole body average WBA	0,006 = 7,5%	0,08	0,4



In the case of use in the ETSI Upper Band at 916 - 919 MHz, the SAR values are 50% below the limit for a 10g cube and 92,5% below the WBA limit for general population.

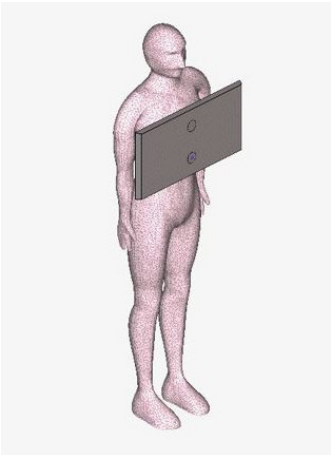
Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for WRA 3070 Antennas (mounted horizontal) have been calculated.

Reference value ETSI Lower Band	WRA 3070 Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Radiated power 33 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,20 = 10%	2 (100%)	10
Whole body average WBA	0,002 = 2,5%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. allowed radiated power of 33 dBm, the SAR values are 90% below the limit for a 10g cube and 97,5% below the WBA limit for general population.

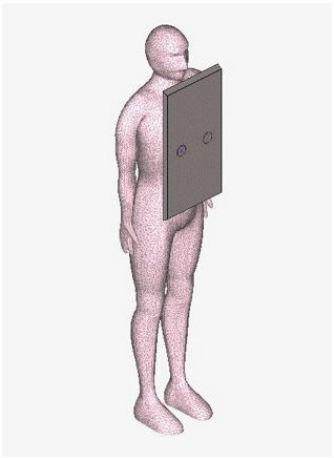
Reference value ETSI Upper Band	WRA 3070 Antenna SAR [W/kg]	Limit value EN 50364:2018 [W/kg]	
	Radiated power 36 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,41 = 20,5%	2 (100%)	10
Whole body average WBA	0,003 = 4%	0,08	0,4



In the case of use in the ETSI Upper Band at 916 - 919 MHz, the SAR values are 79,5% below the limit for a 10g cube and 96% below the WBA limit for general population.

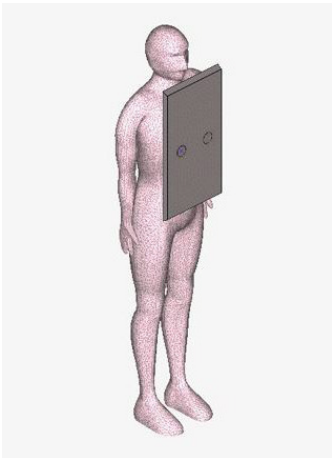
Based on the simulation at 9.4. „Compliance with the reference values using the example of the Wide Range Antenna WRA 7070" the following SAR-Values for WRA 3070 Antennas (vertical horizontal) have been calculated.

Reference value ETSI Lower Band	**WRA 3070 Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 33 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,37 = 18,5%	2 (100%)	10
Whole body average WBA	0,003 = 4%	0,08	0,4



It can be seen that when the antenna is in accordance with the max. allowed radiated power of 33 dBm, the SAR values are 90% below the limit for a 10g cube and 97,5% below the WBA limit for general population.

Reference value ETSI Upper Band	**WRA 3070 Antenna SAR [W/kg]**	**Limit value EN 50364:2018 [W/kg]**	
	Radiated power 36 dBm e.r.p.	General population	Occupational exposure
Based on a 10g cube	0,74 = 37%	2 (100%)	10
Whole body average WBA	0,006 = 8%	0,08	0,4



12 Classification of the UHF RFID Antenna

12.1 Low Range Antenna – read range up to 20 cm

Order number	Type	Description
52010084	LoRa ETSI	Low Range Antenna, 868-868MHz
52010085	LoRa FCC	Low Range Antenna, 902-928 MHz
52010092	ULoRa ETSI-FCC	Low Range Antenna, 865-928 MHz

12.2 Mid Range Antenna – read range 20 cm up to 500 cm

Order number	Type	Description
52010082	MiRa 100 ETSI	Mid Range Antenna 100°, 868-868MHz
52010083	MiRa 100 FCC	Mid Range Antenna 100°, 902-928 MHz
52010172	S-MiRa ETSI-FCC	Short Mid Range Antenna 100°, 865-928 MHz

12.3 Mid Range Antenna – read range 20 cm up to 500 cm

Order number	Type	Description
52010078	WiRa 70 ETSI	Gen2-Wide Range Antenna 70°, 868-868MHz
52010079	WiRa 70 FCC	Gen2-Wide Range Antenna 70°, 902-928 MHz
52010193	WiRa 70 KRAI ETSI	Gen2-Wide Range Antenna 70° ©KRAI, 868-868MHz
52010194	WiRa 70 KRAI FCC	Gen2-Wide Range Antenna 70° ©KRAI, 902-928 MHz

Wide Range Antenna 70° 3rd Generation

Order number	Type	Description
52010333	WRA 7070 ETSI	Gen3-Wide Range Antenna 70°, 868-868 MHz
52010334	WRA 7070 FCC	Gen3-Wide Range Antenna 70°, 902-928 MHz

52010335	WRA 7070 KRAI ETSI	Gen3-Wide Range Antenna 70° ©KRAI, 868-868 MHz
52010336	WRA 7070 KRAI FCC	Gen3-Wide Range Antenna 70° ©KRAI, 902-928 MHz

The Wide Range Antennas 30° of the 2nd generation are no longer available and are only listed here. If you are using the antennas and are looking for a successor, select the corresponding antenna of the 3rd generation from the table below.

Wide Range Antenna 30° 2nd Generation

Order number	Type	Description
52010086	WiRa 30 ETSI	Wide Range Antenna 30°, 868-868 MHz
52010087	WiRa 30 FCC	Wide Range Antenna 30°, 902-928 MHz

Wide Range Antenna 30° 3rd Generation

Order number	Type	Description
52010583	WRA 3070 ETSI	Wide Range Antenna 30°, 868-868 MHz
52010584	WRA 3070 FCC	Wide Range Antenna 30°, 902-928 MHz

12.4 SMSH Antenna – read range 20 cm up to 300 cm

The SMSH Antenna 70° of the 2nd generation are no longer available and are only listed here. If you are using the antennas and are looking for a successor, select the corresponding antenna of the 3rd generation from the table below.

SMSH-Antenna 2nd Generation

Order number	Type	Description
52010197	SMSH-30-30-KRAI-Slave	RFID UHF Smart Shelf Antenna module EU-FCC - 30cmx30cm - KRAI Interface, 868-928 MHz
52010219	SMSH-30-30	RFID UHF Smart Shelf Antenna module EU-FCC - 30cmx30cm, 868-928 MHz
52010258	SMSH-30-30-KRAI-ETSI-FCC	SMSH-30-30-KRAI-ETSI-FCC, 865-928 MHz
52010259	SMSH-HighGain-30-30-KRAI-ETSI	SMSH-30-30-HG-KRAI-ETSI, 865-868 MHz

52010260	SMSH-HighGain-30-30--ETSI	SMSH-30-30-HG-ETSI, 865-868 MHz
52010318	SMSH-HighGain-30-30-KRAI-FCC	SMSH-30-30-HG-KRAI-FCC, 902-928 MHz
52010319	SMSH-HighGain-30-30--FCC	SMSH-30-30-HG-FCC, 902-928 MHz

SMSH-Antenna 3rd Generation

Order number	Type	Description
52010523	SMSH ETSI	Smart Shelf Antenna, 865-868 MHz
52010524	SMSH KRAI ETSI	Smart Shelf Antenna, KRAI, 865-868 MHz
52010525	SMSH FCC	Smart Shelf Antenna, 902-928 MHz
52010526	SMSH KRAI FCC	Smart Shelf Antenna, KRAI, 902-928 MHz

Electronic equipment is not domestic waste – in accordance with directive 2002/96/EC OF THE EUROPEAN PARLIAMENT AND THE COUNCIL dated 27th January 2003 concerning used electrical and electronic appliances, it must be disposed of properly. At the end of its service life, take this unit for disposal at a designated public collection point.

Kathrein Solutions GmbH, Kronstaudener Weg 1, 83071 Stephanskirchen, Germany, Phone +49 8036 90831 20, Fax +49 8036 90831 69