ifm electronic

Short instructions

RFID-UHF-Antenna Mid Range

efector190®

ANT820

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704979 / 00 01 / 2012

Inhalt

1 Preliminary note

Read this document before use to familiarise yourself with operating conditions, installation and operation. Keep the document during the entire duration of use of the device.

Adhere to the safety instructions.

2 General safety notes

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Before starting installation work or replacing the unit, the accompanying application notes must be read carefully and the content understood.

The detailed information in the data sheets and in these application notes must be complied with carefully during installation and operation!

The installation team must be properly qualified and familiar with the safety regulations applicable in the country concerned.

Connection, installation and maintenance work, as well as all other work on the unit, may only be carried out by properly qualified and trained employees. The unit may only be used for the purpose intended by the manufacturer.

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 fires,electric shocks and injuries. Such actions therefore result in exclusion of liability and make the manufacturer’s guarantee (warranty) null and void.

The version of the manufacturer’s guarantee (warranty) applies which was valid at the time of purchase. We accept no liability for unsuitable manual or automatic adjustments made to the unit parameters and inappropriate use of the unit.

Repairs may only be undertaken by authorised personnel. Opening or attempting to repair the unit makes all guarantee/warranty claims null and void. Improper work on the unit may jeopardise electrical safety.

The manufacturer is not liable for accidents caused by the user opening the unit!

When carrying out work on the unit, the valid safety regulations must be complied with.

3 Product description

The ifm electronic antenna range includes a variety of UHF reader antennas, which can fulfil the requirements of almost all RFID applications. The antennas are divided into three product lines according to read range: low range, mid range and wide range antennas.

3.1 Low range antennas

With dimensions of 90 x 63 mm, the low range antennas have a high field concentration in the near-field, with significantly reduced antenna gain in the far-field. With these properties, the antennas achieve writing/reading results at ranges of up to 10 cm with a typical selectivity of 5 cm.

Low range antennas are available in Low Range (ANT810/ANT910) and Ultra Low Range (ANT805). The ultra low range antenna was designed to read dipole tags (far-field tags) at an extremely limited distance. These antennas can also activate loop tags ("near-field tags") up to 3 cm. The Low range antenna was developed for larger ranges and is particularly suited to near-field tags. The antenna allocation according to read range and transponder shape is outlined in Chapter 3.4.

Figure: ANT810 / ANT910 Low Range Antenna

Figure: ANT805 Ultra Low Range Antenna

3.2 Mid range antennas

The mid range antenna ANT820 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. The mid range antenna 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 with a variety of transponder types.

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Figure: ANT820 Mid Range Antenna

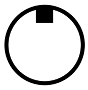
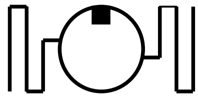
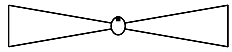
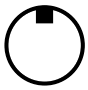
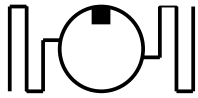
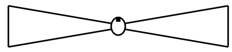
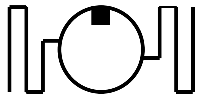
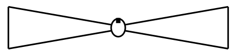
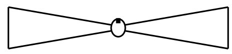
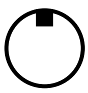
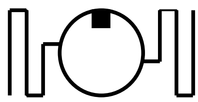
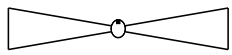
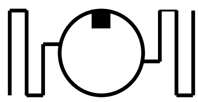
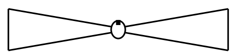
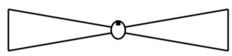
3.3 Wide range antennas

For traditional wide-range applications with read ranges of over 10 m, ifm electronic offers a wide range antenna model characterised by a half width of 70° (ANT830). The circular polarization usually required for UHF applications has been significantly improved compared with other antennas available on the market. For the so-called axis ratio, which is used as a characteristic value for circular polarization, the new model achieves typical values of 1 dB. If specified at all, the usual value on the market lies at around 3 dB.

Figure: ANT830 Wide Range Antenna

The improved circularity leads to a significant reduction in the dependence of the reading results on the position or alignment of the transponder. Great importance was also placed on the front-to-back ratio of the antennas to reduce the influence of the close (assembly) environment on the antenna properties.All antennas have an extremely high protection class which guarantees problemfree use in any environment.

3.4 Antenna type according to read range and transponder shape

Antenna type	Read range	Tag type		
		Loop tag	Hybrid	Dipole tag
ANT805 ANT810 ANT910	0-10 cm			
	10-30 cm			
ANT820	30-100 cm			
	> 100 cm			
	10-30 cm			
ANT830	30-200 cm			
	> 200 cm			

The correct combination of reader antenna and transponder is essential for every RFID application. The correct selection ensures a high read rate and reliable operation of the system.

The low range (ANT810/ANT910) and ultra low range antennas (ANT805) can read loop, hybrid and dipole transponders up to 10 cm and offer a very good defined read range.

The mid range antenna (ANT820) can activate loop transponders up to 30 cm, hybrid up to 100 cm and dipole transponders up to several meters.

The wide range antenna (ANT830) is designed for typical far-field dipole transponders with read ranges of over 10 m, but it can also read the near-field and hybrid transponders at a short distance.

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The typical read ranges of the presented antennas can be seen in the following figure.

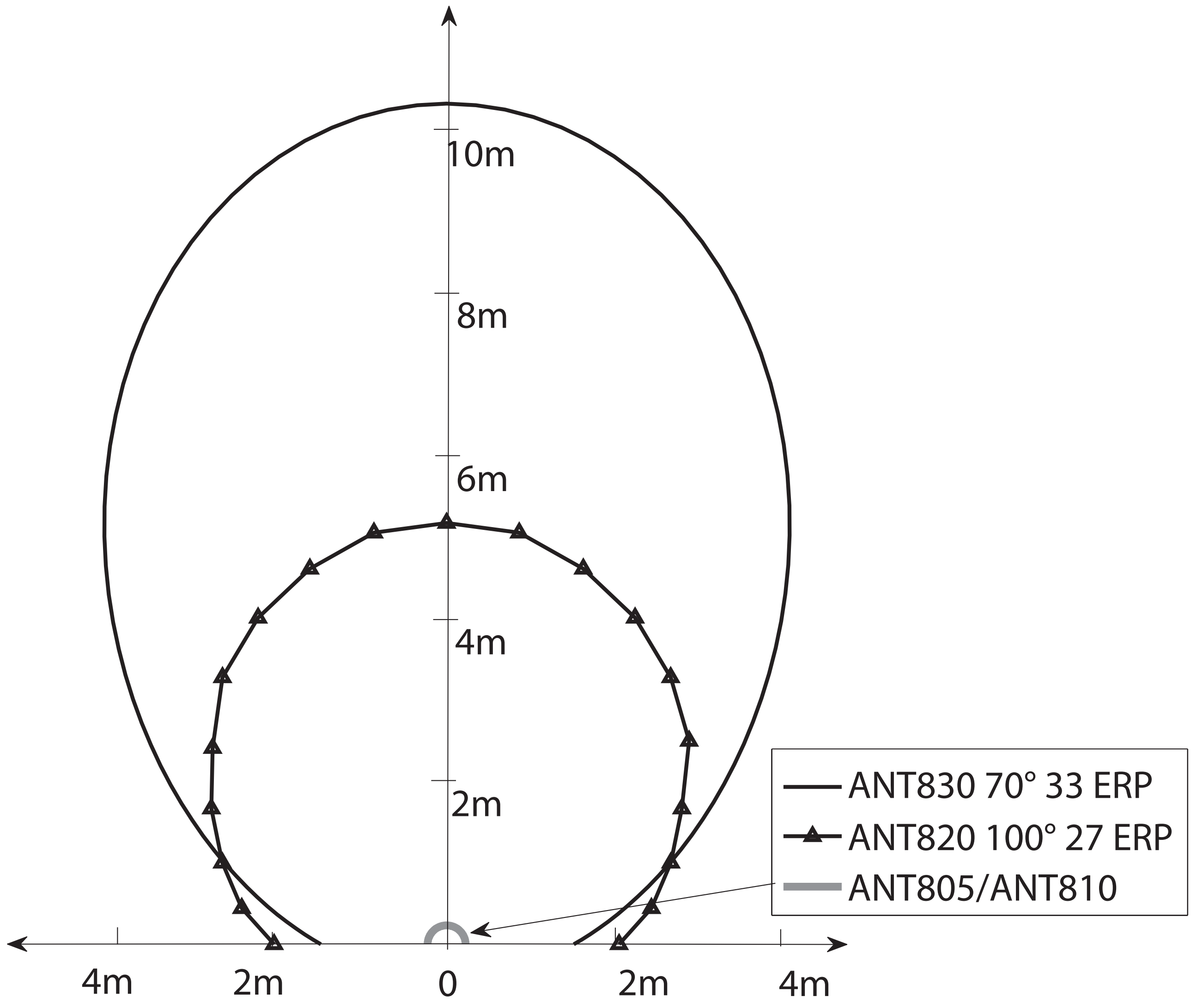

Figure: Read ranges of the RFID-UHF-Antennas

To achieve the best reading and writing results, we recommend operating the ifm UHF RFID reader antennas exclusively with UHF readers from ifm electronic.

4 Technical Data

Typ Nr.		ANT820
Frequency range	MHz	865-870
Antenna gain	dBic	4
Polarisation		Right-hand circular (RHC)
VSWR		< 1,3 : 1
Impedance	Ω	50
Front-to-back ratio	cm	> 10
Max. radiated power (ETSI EN 302 208)	W ERP	0,5
Far-field divergence	°	100
Connection		TNC socket
Protection class		IP 67
Weight	g	320
Dimensions (W x H x D)	mm	156 x 126 x 36
Material		Antenna cover: Polymer-Blend
Installation		Four through holes Ø 4.2 mm for M4 screws
Temperature range		Storage temperature: -40° C – +85° C Ambient temperature: -20° C – +55°C

The antenna ANT820 is right-hand circular polarised and has a typical antenna gain of 4 dBic. In the figure “Circular antenna gain against frequency for the ANT820” the circular gain is plotted against frequency. The operating range of the antenna is shown in grey. Outside the operating range the gain of the antenna ANT820 drops off. Due to this drop off, interference from other systems is minimised, as is interference to other systems. The figure “Directional characteristic of the ANT820 (RHC)” shows the righthand circular directional characteristic of the ANT820. The half power beam width is approx. 100° and the front-to-back ratio is >10 dB. The axial ratio (AR) of the ANT820 is significantly less than 2 dB for the major part of the upper hemisphere (θ = ± 90°). The matching against frequency is below -18 dB in the working range of the antenna. The 10 dB bandwidth is greater than 20 MHz. The figures relate to a reflection-free environment. For real environments with reflections, there may be variations from the values shown here (on this topic see chapter 7 Installation / Attachment).

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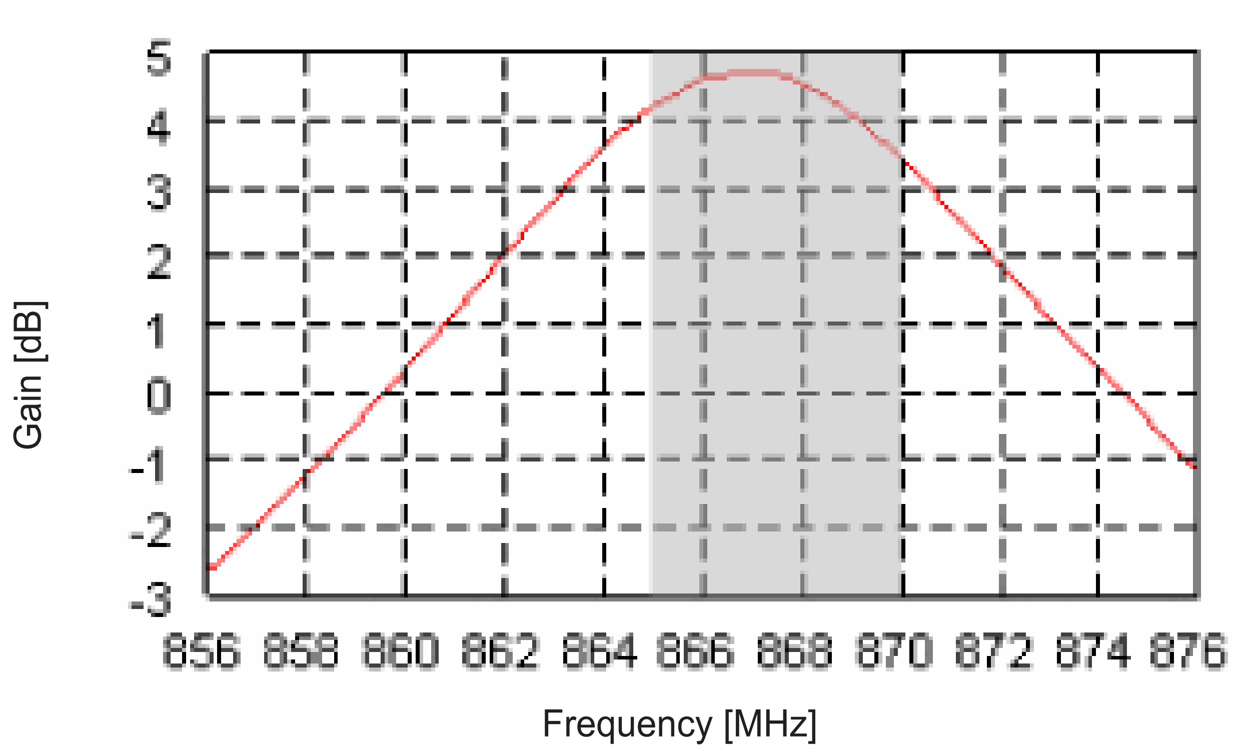

Figure: Circular antenna gain against frequency

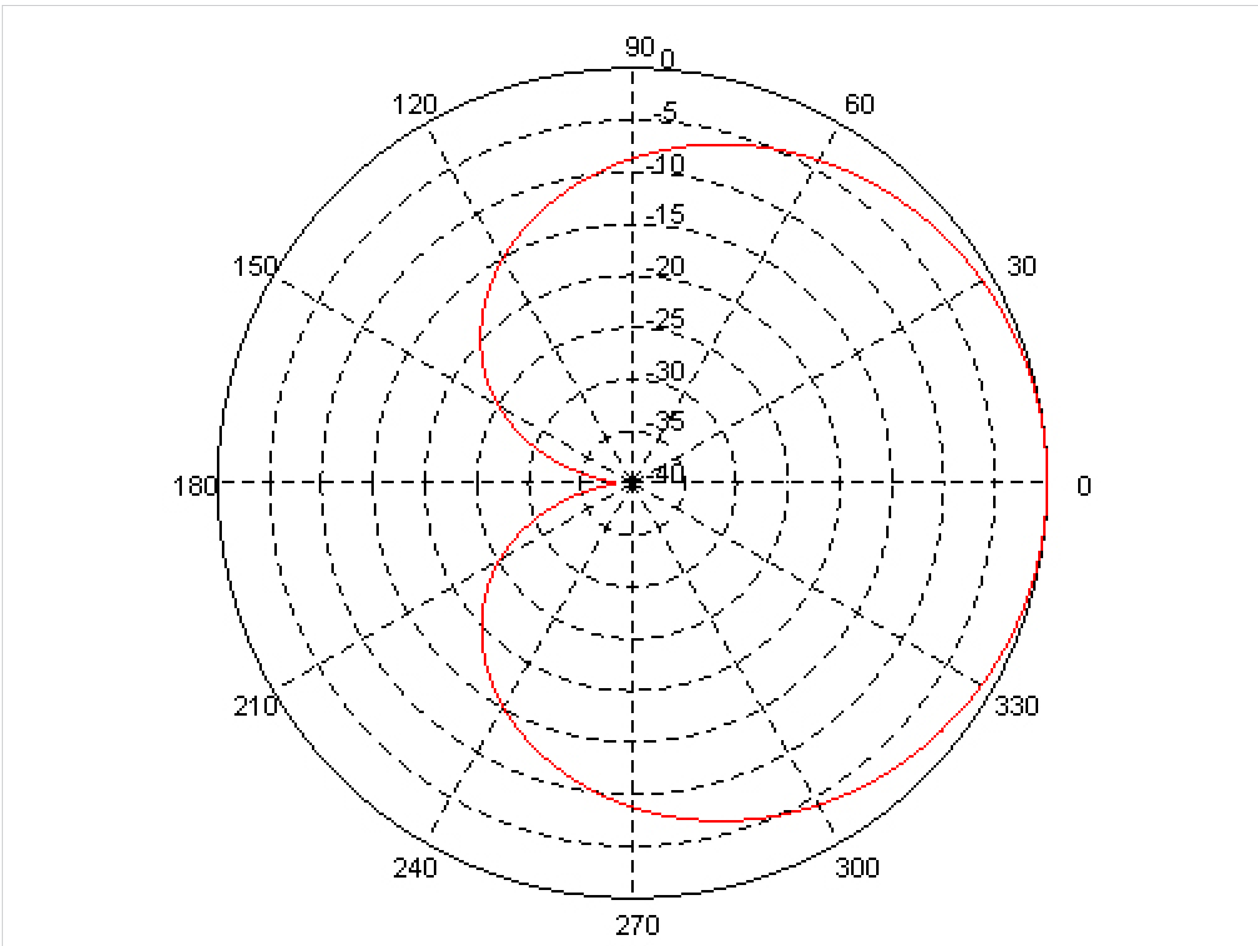

Figure: Directional characteristic in azimuth (RHC)

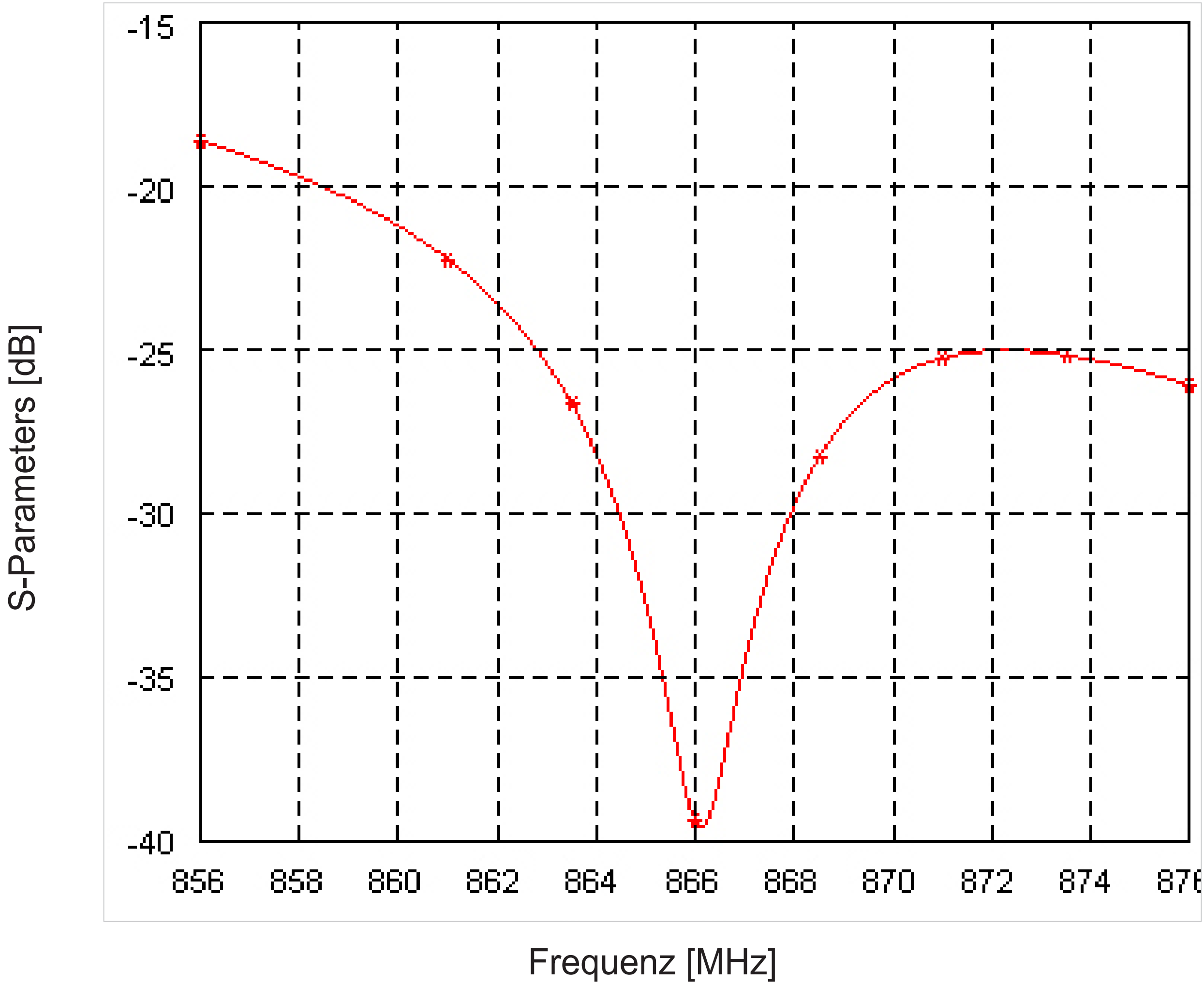

Figure: Matching S11

5 Reader output power

The maximum output power for the reader is defined by the ETSI standard EN 302 208-1 V1.2.1 (dated April 2008). It is defined by the antenna gain, the half power beam width and the cable attenuation on the reader - antenna connection.

For antennas with a half power beam width of up to 70° a power of $P_{ERP,max}$ = 2 W ERP (Effective Radiated Power) is allowed. For other half power beam widths the power is limited to $P_{ERP,max}$ = 0,5 W ERP.

The ERP is converted in accordance with EN 302 208-1 into output power PC at the reader as follows:

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$P_{C,max} = P_{ERP,max} - G_{IC} + 5{,}15 + C_L$

For the antenna ANT820 the following maximum output power is then obtained:
$P_{C,max}$ = 27 dBm - 4 dBic + 5,15 + 0 dB = 28,15 dBm = 0,653 W

Where:
$P_{C,max}$: refers to the maximum output power of the reader in dBm,
$P_{ERP,max}$: refers to the maximum effective radiated power of the antenna in dBm,
G_{IC}: refers to the circular antenna gain in dBic,
C_L: the cable loss in dB (here assumed to be 0 dB)

6 Compliance with standards

As RFID systems are radio installations, they fall under the European Commission directive 1999/5/EC (Radio Equipment and Telecommunications Terminal Equipment R&TTE).

A series of harmonised standards are in place to prove conformity with the basic requirements of this directive, which are published in the official journal of the European Union.

The ifm antenna ANT820 is a passive antenna structure. It is therefore the system integrator who is responsible for ensuring compliance with the standards – i.e. the person who combines the individual components of an RFID system with each other, in particular the reader and antennas. We therefore strongly recommend acquiring these standards.

Two important standards in relation to antennas are (with no claim of completeness) EN 302208 and EN 50364: The first deals with frequency spectrum issues and limits the maximum radiated power, while the EN 50364 addresses the limits regarding exposure of people to electromagnetic fields.

In accordance with EN 50364, compliance is achieved if the defined limit values of the electrical and magnetic field strength are not exceeded at a distance of 20 cm around the antennas. On compliance with the maximum antenna input power specified in the standard EN 302208, the electrical and magnetic field strength from the antenna ANT820 are below the defined limits at a distance of 20 cm. Compliance with the standards is therefore ensured.

As the antenna ANT820 can be used for special applications also with a read range of less than 20 cm, numerical calculations have also been made on the specific absorption rate (SAR). The calculated SAR values are compared with the basic limit values of EN 50364 – separated according to professional exposure and exposure to the general public, as well as local exposure to head and body or the extremities. The assumptions made here (such as the operating mode of the RFID system and properties of the human skin) guarantee a conservative estimation of the exposure (worst case scenario).

The calculation was also carried out for the most sensitive constellation, i.e. for the event that members of the general public are permanently located in close proximity to the antenna with head and body. If the distance between the person and the antenna is less than 3 cm, with the ANT820 it is ensured the rate remains below the maximum SAR allowed with an antenna input power of up to 0.34 W (25.31 dBm). In all other cases the ANT820 can be operated using the maximum radiated power specified in the data sheet of 0.5 W ERP (27 W ERP) or an antenna input power of 0.653 W (28.15 dBm).

The table below shows the maximum input powers with which the antenna can be supplied to ensure that the basic limit values for the SAR are not exceeded. A difference is made here between the different types of exposure.

Maximum input power ANT805	Distance person - antenna < 3 cm	Distance person - antenna ≥ 3 cm
General public Limit values head and body 2 W/kg	P_{ein} = 340 mW (25,31 dBm)	P_{ein} = 653 mW (28,15 dBm)
General public Limit values local limbs 4 W/kg Professional exposure Limit values head and body 10 W/kg Limit values local limbs 20 W/kg	P_{ein} = 653 mW (28,15 dBm)	

Table: The maximum input powers

7 Installation / Attachment

To achieve the maximum range with the antenna, there must not be any interfering objects between the antenna and the tag to be read. The function of the antenna is affected by the type of fixing and the surrounding materials. For optimum antenna behaviour there should not be any conducting objects in the vicinity of the antenna. The following dimensions are given as adequate distances:

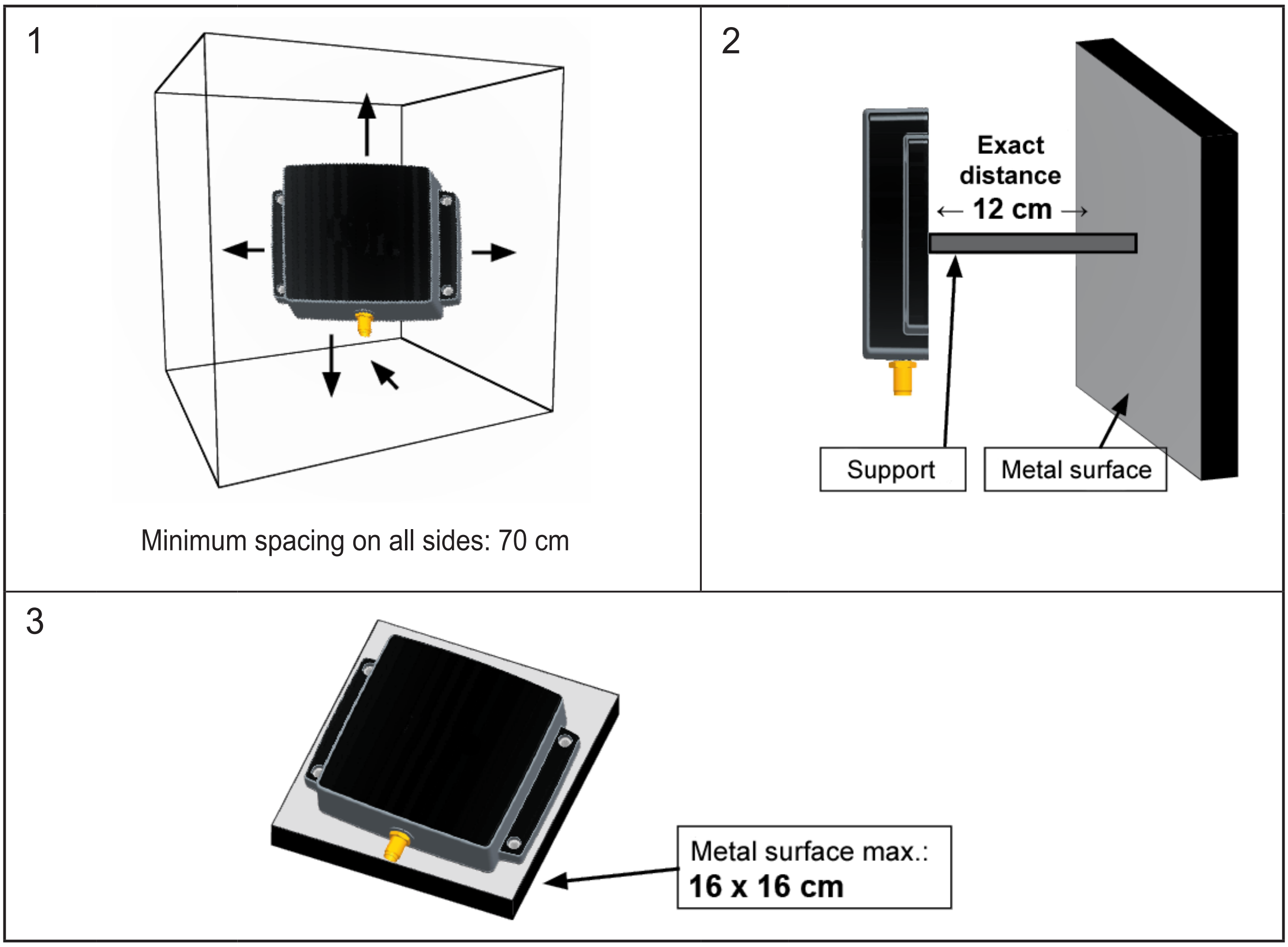
The distance to large metal surfaces and to the ground should be at least 70 cm (see Figure 1).

If it is not possible to avoid mounting in front of a metallic surface, a mounting support can be used that establishes a distance of exactly 12 cm between the rear wall of the antenna and the metal surface (see Figure 2).

In case of direct mounting on a metallic surface (e. g. a plate as part of a mounting support), the metal plate should be square and have dimensions that do not exceed 16 x 16 cm (see Figure 3).

Other objects such as, e.g., containers with liquids in the immediate vicinity affect the functionality of the antenna.

If these recommended distances cannot be met due to the local situation, the antenna characteristics will change such that it will be necessary to re-assess the antenna in this special installation situation.



The cable should be laid vertical (see figure below right) away from the antenna and should be laid direct. The cable length is to be selected as short as possible to minimise cable losses. Cable loops around the antenna or laying the cable in front of the antenna (see figure below left) are to be avoided.

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8 Typical applications

- Logistics applications on attachment to industrial trucks
- Conveyor system applications
- Gate applications for article identification
- Bulk tag and single tag applications
- Access systems (e.g. ski lift, control systems for travel tickets and admission tickets)

! When using the antennas, comply with the relevant valid regulations in your country and any standards and guidelines valid specifically for the area or place of use.

9 Technical appendix

9.1 Antenna gain

The gain is the ratio between the radiated power density in the main radiation direction for the antenna in question and a reference antenna with the same supply power.

Reference antennas are isotropic radiators or λ/2 – dipole

Frequent logarithmic tasks:

- dBi: linear gain based on isotropic radiator
- dBd: linear gain based on dipole
- dBic: circular gain based on isotropic radiator

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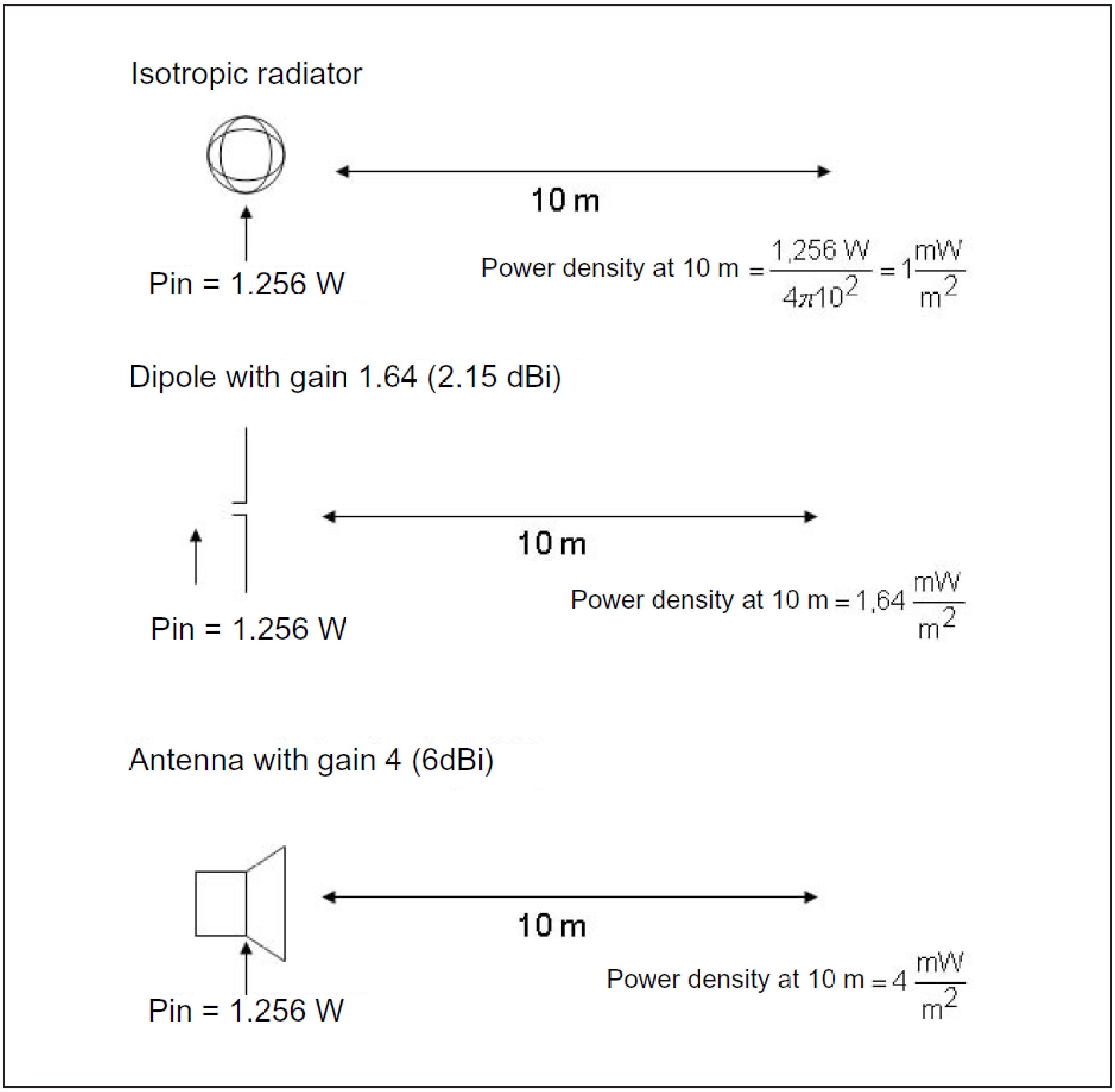

The isotropic radiator is a loss-free point radiator with an even spherical radiation pattern in all directions. Its power density is distributed evenly over a sphere with a surface of $4\pi^2 r$, where r is the radius of the sphere.

The gain of the λ/2 – dipole is 1.64 and the power density it produces is 1.64 times greater than the power density from the isotropic radiator.

An example antenna with a gain of 6 dBi achieves a power density 6 dB greater than that of the isotropic radiator. If the gain of this antenna is referred to the gain of the λ/2 dipole, the gain in dBb is obtained:

6 dBi – 2.15 dBi = 3.85 dBd

The circular polarized gain (dBic) is also 3 dB greater than the gain in dBi.

9.2 ERP: Effective radiated power

Product of the power supplied to a transmitter antenna multiplied by its gain relative to a λ/2 dipole.

EIRP: Equivalent Isotropically Radiated Power

Product of the power supplied to a transmitter antenna and its gain relative to the isotropic radiator.

With UHF-RFID, the maximum ERP is specified by law. When using antennas with a high gain, the reader power must be reduced accordingly. This means that the read range doesn't increase with the antenna gain – the width of the read range is merely changed.

ERP [dBm] = P_{in} [dBm] + G [dBd]	EIRP = ERP * 1,64
EIRP [dBm] = P_{in} [dBm] + G [dBi]	EIRP [dBm] = ERP [dBm] + 2,15 dB

9.3 Examples – antennas – input power

Europe: ERP power is limited according to EN 302208 to 2 W (33 dBm).

An antenna has a gain of 8.5 dBic

dBic converted to dBi:
8.5 dBic = 8.5 - 3 = 5.5 dBi

dBi converted into dBd:
5.5 dBi = 5.5 - 2.15 = 3.35 dBd

Antenna input power: 33 dBm - 3.35 dBd = 29.65 dBm (0.922 W)

USA: EIRP power is limited according to FCC Part 15 to 4 W (36 dBm).

1. Antenna gain smaller or equal to 6 dBi
   Antenna input power is equal to 30 dBm (1 W)
2. Antenna gain larger than 6 dBi (e.g. 7 dBi)
   Antenna input power must be reduced: 36 dBm – 7 dBi = 29 dBm (0.794 W)

10 Abbreviations

Abbreviations used in this application notes:	
DIN	German Institute for Standardisation
EIFF	Effective Isotropic Field Factor, shows the field isolation of far-field to near-field standardised to an isotropic radiator.
EIRP	Equivalent Isotropically radiated power
EN	European Standard
ERP	Effective Radiated Power
RFID	Radio Frequency Identification
SAR	Specific Absorption Rate
UHF	Ultra High Frequency