

# Antennas and Accessories

## RAD-ISM-2400-...

### 1. Antennas

The goal of Phoenix Contact radio transmission solutions is to provide users with the simplest possible access to the radio transmission medium.

This explanation of the complex area of antenna technology will therefore be kept as simple as possible. However, in order to build reliable systems, a few basic properties of antenna technology must be taken into account.

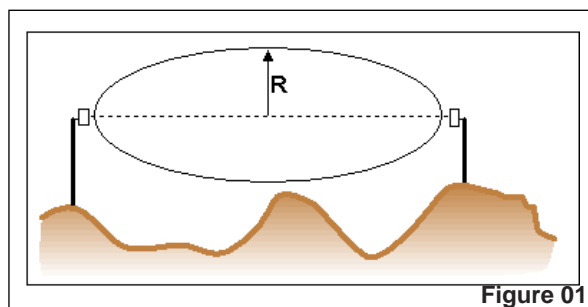


Figure 01

### 2. Antenna Alignment

When installing two antennas, it is generally desirable to have a line of sight between them wherever possible, as any obstacles between the antennas will adversely affect the connection.

The Fresnel zone, which extends around the direct connecting line between transmitting and receiving antennas should also be taken into account. If obstacles or the terrain disturb this zone, this will adversely affect the radio connection.

Figure 01 illustrates an ideal installation with undisturbed connection.

In Figure 02, the Fresnel zone is adversely affected by the terrain. With the antenna masts at this low level, although there is still a line of sight, the Fresnel zone is not completely clear.

In Figure 03 the connection is attenuated by obstacles in the Fresnel zone, even though there is a line of sight.

The radius of the Fresnel zone depends on the transmission frequency and the distance between the transmitting and receiving antennas.

The radius corresponds to the minimum height of the antenna mast (if the terrain is level). For a 2.4 GHz system, the mast height  $R/m$ , depending on the distance to be covered  $D/m$ , is given in the characteristic curve in Figure 04.

**Example (Figure 04):** For a distance of 100 m (328.084 ft.), the antenna should be installed at a minimum height of 1.80 m (5.906 ft.) to provide a clear Fresnel zone.

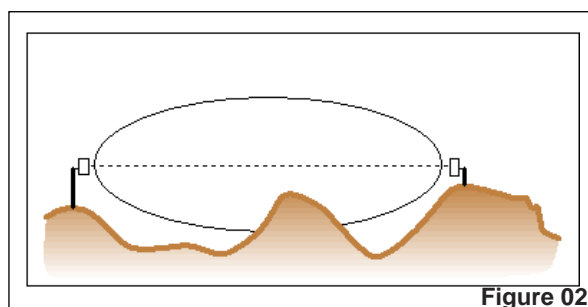


Figure 02

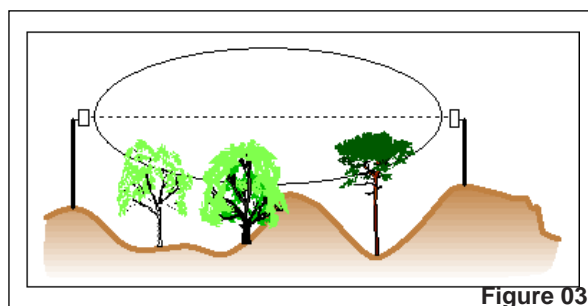


Figure 03

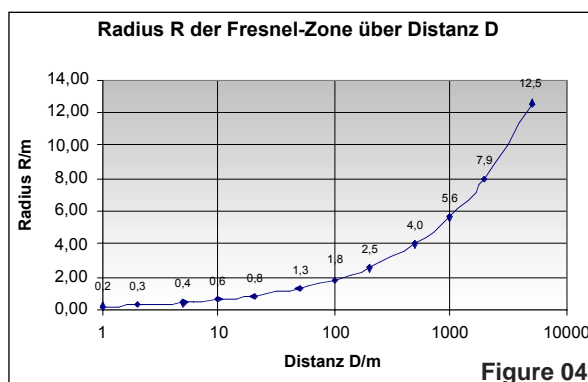


Figure 04

### 3. Omni-Directional Antennas

Omni-directional antennas, also known as rod or omni antennas, are usually used if the position between the transmitter and receiver can change, i.e., for moving applications, or for example for creating multiple receiver systems where the transmitter sends the signal in several directions. The use of omni-directional antennas is also recommended for applications with

**no line of sight** because the signal then travels from the transmitter to the receiver via reflections, and their path and direction cannot be predicted.

The ideal installation location is the top of a mast, so that the antenna has the greatest possible free space in all directions.

Unfortunately it is not always possible to mount the antenna on the top of a mast. If an omni-directional antenna is mounted on the side of a mast, specific masses and distances must be observed.

The mast (usually made from a conductive material) also affects the emission characteristic curve of the antenna. Both the mast diameter and the distance of the antenna from the mast influence the resulting emission diagram.

An omni-directional antenna mounted on the top of the mast usually has an almost even emission characteristic curve over 360° on the horizontal plane (Figure 06).

If the same antenna is mounted on the side of an aluminum or steel mast, the emission characteristic curve may change considerably depending on the mast diameter (D) and the distance between the mast and antenna (a). The two examples given here are for a 2.4 GHz system:

In Figure 07a, the omni-directional antenna acts as an antenna with a preferred direction.

In Figure 07b, the range is considerably shorter on the side facing away from the mast. This type of installation could have an unexpectedly poor result.

Wall mounting should be avoided at all costs, as the wall has an extremely negative effect on the properties of the antenna.



Figure 05

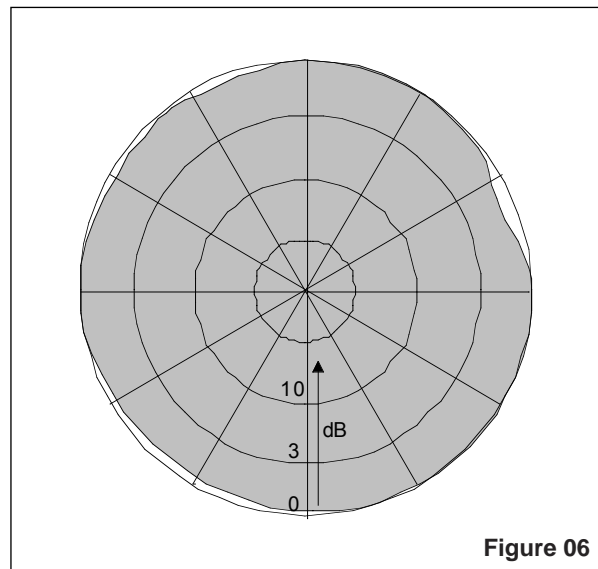


Figure 06

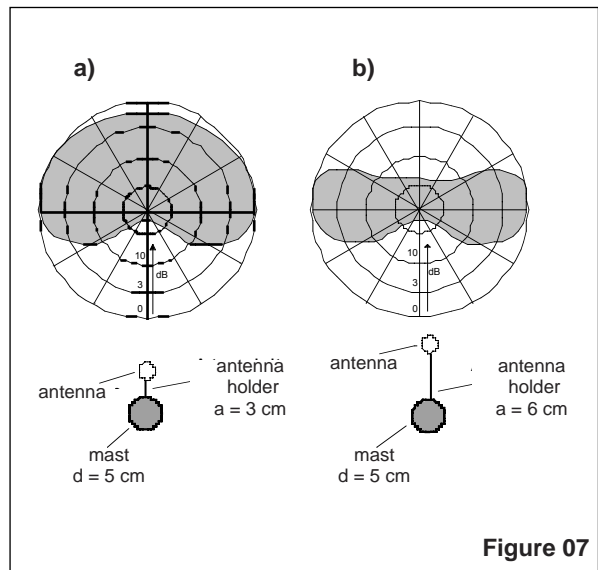
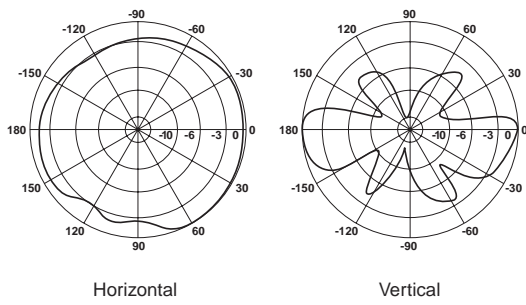


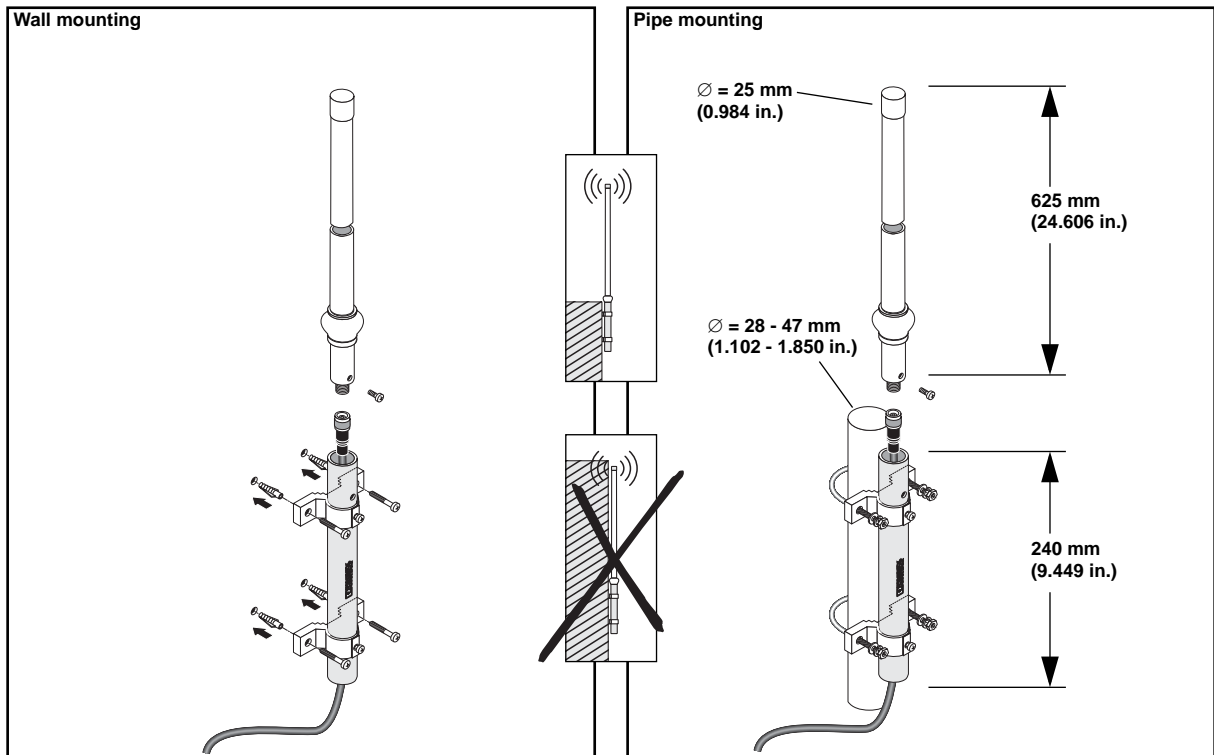
Figure 07

3.1 Technical Data for RAD-ISM-2400-ANT-OMNI-9-0

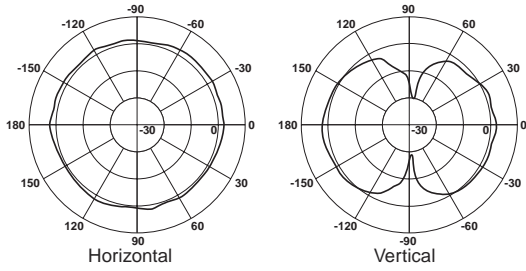


**RAD-ISM-2400-ANT-OMNI-9-0**

<b>Description</b>	<b>Type</b>	<b>Order No.</b>	<b>Pcs. Pkt.</b>
Omni-directional antenna	RAD-ISM-2400-ANT-OMNI-9-0	28 67 62 3	1
<b>Technical Data</b>			
Temperature range	-40°C to +75°C (-40°F to +167°F)		
Degree of protection	IP65		
Gain	9 dBi		
Connection	N (female)		



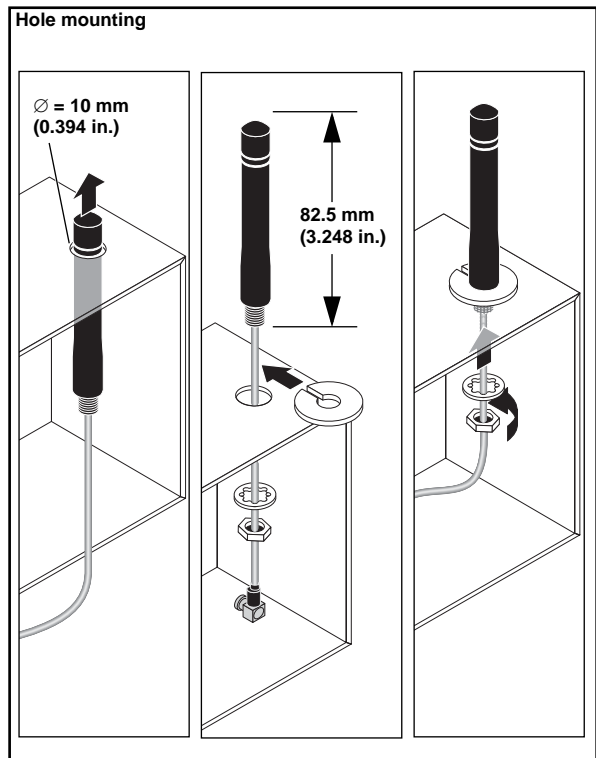
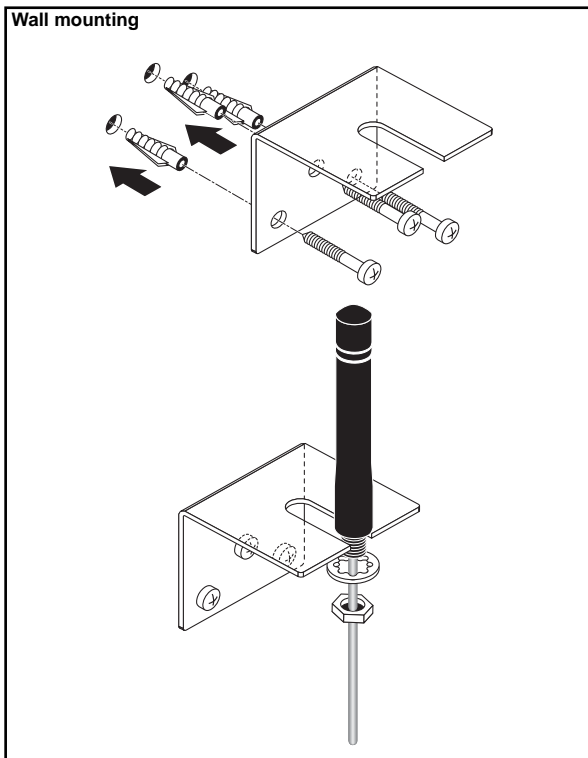
3.2 Technical Data for RAD-ISM-2400-ANT-OMNI-2-1



**RAD-ISM-2400-ANT-OMNI-2-1**

<b>Description</b>
Omni-directional antenna
<b>Technical Data</b>
Temperature range
Degree of protection
Gain
Cable length

<b>Type</b>	<b>Order No.</b>	<b>Pcs. Pkt.</b>
RAD-ISM-2400-ANT-OMNI-2-1	28 67 46 1	1
-20°C to +65°C (-4°F to +149°F)		
IP65		
2 dBi		
1.5 m (4.92 ft.)		



### 4. Panel Antennas

Panel antennas emit the transmission power in a preferred direction. This leads to a range gain (similar to the effect of the reflector in a flashlight). The existing transmission power is therefore not amplified, but simply focused. The same applies for the receiving end. A panel antenna receives signals specifically from the "area" that it is directed at.

The use of a panel antenna is recommended when covering large distances **with a line of sight**.



Figure 16

With panel antennas, it is particularly important to ensure that the antenna is mounted securely. An unstable antenna may "sway" or "wobble" in strong winds, which can move the transmitter or receiver beam a long distance away from the target area (Figure 18).

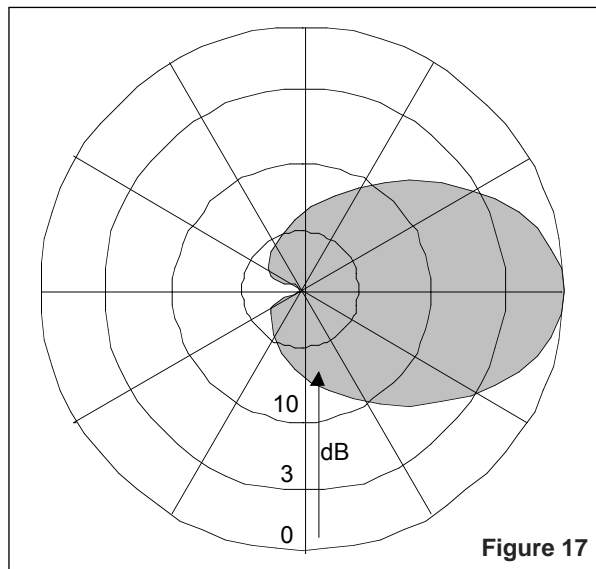


Figure 17

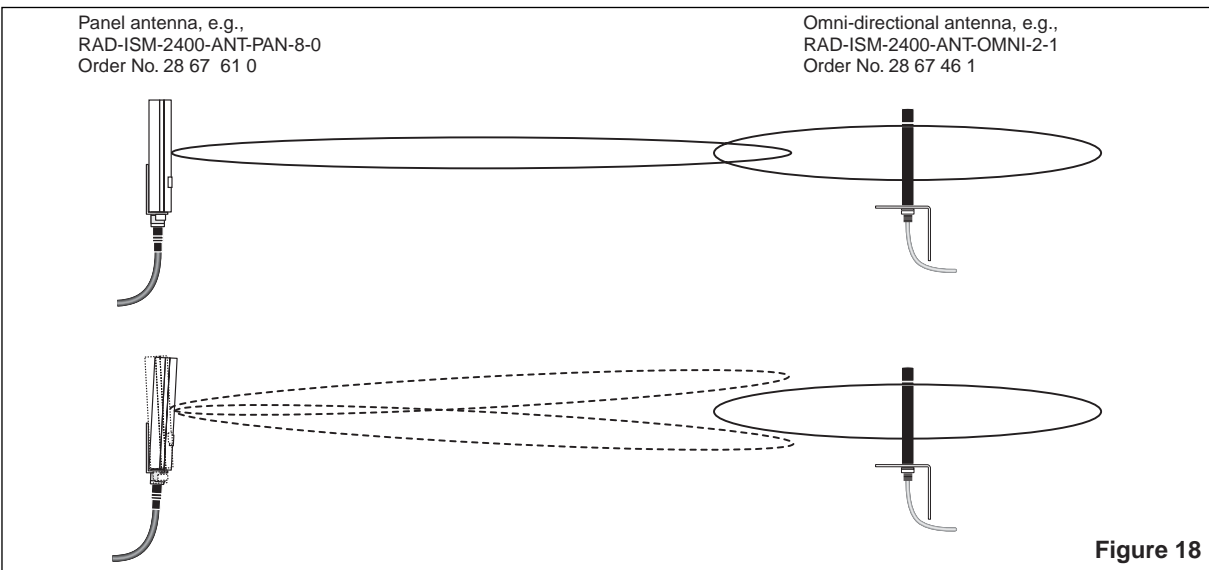
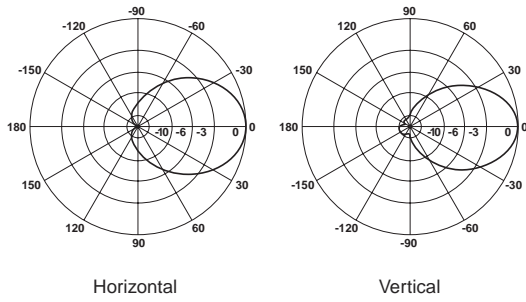


Figure 18

4.1 Technical Data for RAD-ISM-2400-ANT-PAN-8-0

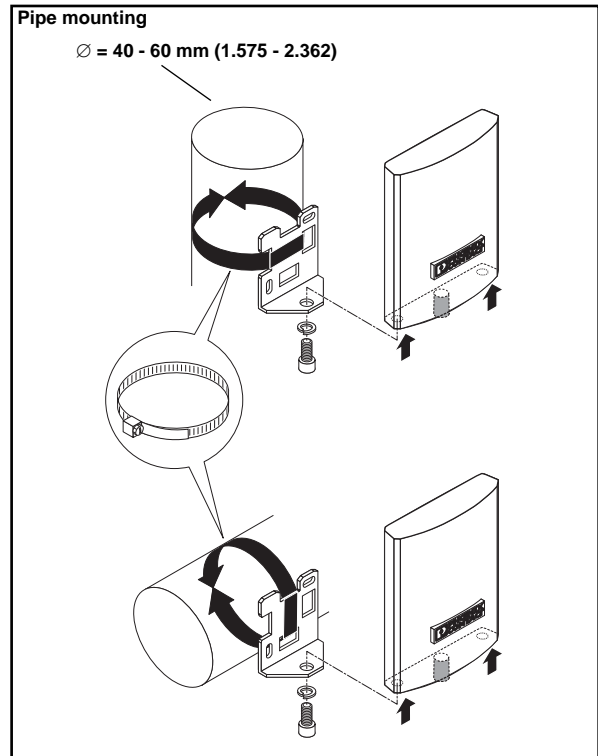
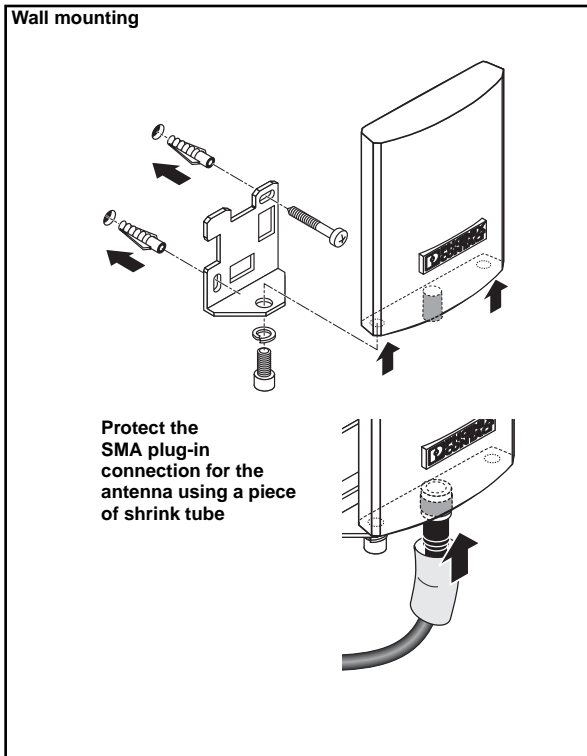
Directional characteristic curve



**RAD-ISM-2400-ANT-PAN-8-0**

<b>Description</b>
Omni-directional antenna
<b>Technical Data</b>
Temperature range
Degree of protection
Gain
Dimensions (H x W x D)
Connection

<b>Type</b>	<b>Order No.</b>	<b>Pcs. Pkt.</b>
RAD-ISM-2400-ANT-PAN-8-0	28 67 61 0	1
-40°C to +80°C (-40°F to +176°F)		
IP55		
8 dBi		
101 x 80 x 20 mm (3.976 x 3.150 x 0.787 in.)		
SMA (female)		



## 5. Accessories

### 5.1 Installation Examples/Use of Accessories

Depending on the various types of antennas and various cable diameters, different connector types are used (e.g., MCX, SMA, N).

RAD-CAB-... antenna extension cables are designed for outdoor use and for low attenuation. They require rugged N type connectors.

For short cable paths (e.g., out of the control box), smaller cable diameters and therefore smaller connectors (MCX or SMA) can be used.

Various adapter cables, known as pigtails, are therefore required to connect all components in the system.

**Important note:** Connectors that are located outdoors should also be protected against humidity using shrink tube.

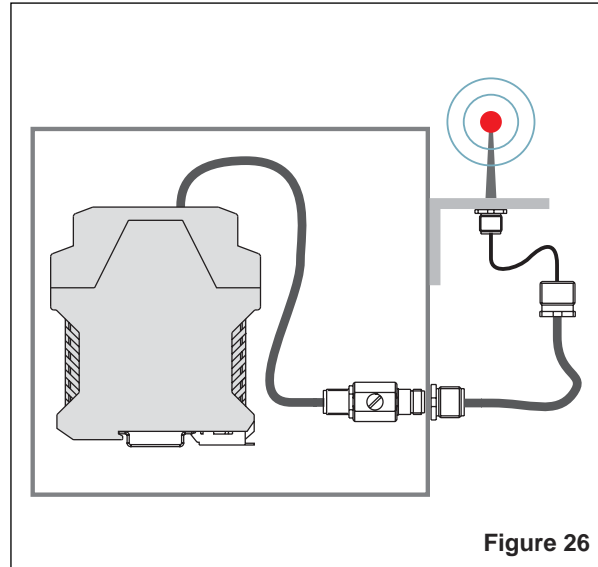


Figure 26

### 5.2 Pigtail Selection Table

Pigtail	A	B	C	D
Designation	RAD-PIG-EF316-MCX-SMA	RAD-PIG-EF316-MCX-N	RAD-PIG-EF316-N-SMA	RAD-PIG-EF316-N-N
Order No.	28 67 67 8	28 67 68 1	28 67 69 4	28 67 70 4

Type of Antenna Used	Is an Antenna Extension Cable Used?	Is Surge Voltage Protection Used?	The Following Pigtails Are Required:
<b>Panel antenna</b> Order No. 28 67 61 0	Yes	Yes = Type BB	<b>B + C</b>
		–	<b>1)</b>
	No	Yes = Type SB	<b>B + C</b>
		No	<b>A</b>
<b>Omni-directional antenna</b> Order No. 28 67 62 3	Yes	Yes = Type BB	<b>B</b>
		–	<b>1)</b>
	No	Yes = Type SB	<b>B + D</b>
		No	<b>B</b>

1) When using an antenna extension cable, please provide surge voltage protection.

**5.3 Antenna Extension Cables**

All the accessories required for installing the antennas - cables, connecting parts, and surge voltage protection - are available from Phoenix Contact.

**Note:**

Please note that every connection element between the antenna and the device causes signal attenuation. The attenuation of a cable is proportional to the cable length. Therefore use only as much cable as is absolutely necessary for the application.



**RAD-CAB-EF393...**

Description
<b>Extension cable</b> 3 m (9.84 ft.)
<b>Extension cable</b> 5 m (16.40 ft.)
<b>Extension cable</b> 10 m (32.81 ft.)

Type	Order No.	Pcs. Pkt.
<b>RAD-CAB-EF393-3M</b>	<b>28 67 64 9</b>	1
<b>RAD-CAB-EF393-5M</b>	<b>28 67 65 2</b>	1
<b>RAD-CAB-EF393-10M</b>	<b>28 67 66 5</b>	1

**Technical Data**

Connector type
Outer material
Temperature range
Cable type
External diameter
Minimum bending radius
Weight
Insertion attenuation
Sheath material
Temperature range

Type N (male) at both ends
Brass
-65°C to +165°C (-85°F to +329°F)
EF 393
10 mm (0.394 in.)
50 mm (1.969 in.)
23 Kg/100 m (328.08 ft.)
0.45 dB/m, approximately
Fluorine ethylene propylene (FEP)
-100°C to +200°C (-148°F to +392°F)



**5.4 Adapter Cables (Pigtails)**

All the accessories required for installing the antennas - cables, connecting parts, and surge voltage protection - are available from Phoenix Contact.

**Note:**

Please note that every connection element between the antenna and the device causes signal attenuation. The attenuation of a cable is proportional to the cable length. Therefore use only as much cable as is absolutely necessary for the application.



**RAD-IPIG-EF316...**

Description
<b>Adapter cable</b> pigtail 100 cm (39.37 in.) MCX(m)->SMA(m)
<b>Adapter cable</b> pigtail 50 cm (19.69 in.) MCX(m)->N(m)
<b>Adapter cable</b> pigtail 30 cm (11.81 in.) N(f)->SMA(m)
<b>Adapter cable</b> pigtail 50 cm (19.69 in.) N(f)->N(m)

Type	Order No.	Pcs. Pkt.
<b>RAD-PIG-EF316-MCX-SMA</b>	<b>28 67 67 8</b>	1
<b>RAD-PIG-EF316-MCX-N</b>	<b>28 67 68 1</b>	1
<b>RAD-PIG-EF316-MCX-N-SMA</b>	<b>28 67 69 4</b>	1
<b>RAD-PIG-EF316-MCX-N-N</b>	<b>28 67 70 4</b>	1

**Technical Data**

Connector type	See above
Outer material	Brass or high-grade steel
Temperature range	-65°C to +165°C (-85°F to +329°F)
Cable type	EF 316
External diameter	2.5 mm (0.098 in.)
Minimum bending radius	12.5 mm (0.492 in.)
Weight	1.6 Kg/100 m (328.08 ft.)
Insertion attenuation	1.5 dB/m, approximately
Sheath material	Fluorine ethylene propylene (FEP)
Temperature range	-100°C to +200°C (-148°F to +392°F)

See above
Brass or high-grade steel
-65°C to +165°C (-85°F to +329°F)
EF 316
2.5 mm (0.098 in.)
12.5 mm (0.492 in.)
1.6 Kg/100 m (328.08 ft.)
1.5 dB/m, approximately
Fluorine ethylene propylene (FEP)
-100°C to +200°C (-148°F to +392°F)

**5.5 Surge Voltage Protection**

All the accessories required for installing the antennas - cables, connecting parts, and surge voltage protection - are available from Phoenix Contact.

**Note:**

Please note that every connection element between the antenna and the device causes signal attenuation. The attenuation of a cable is proportional to the cable length. Therefore use only as much cable as is absolutely necessary for the application.



**CN-UB-280DC-...**

Description	Type	Order No.	Pcs. Pkt.
<b>Surge voltage protection</b> female/female	<b>CN-UB-280DC-BB</b>	<b>28 18 85 0</b>	<b>1</b>
<b>Surge voltage protection</b> male/female	<b>CN-UB-280DC-SB</b>	<b>28 18 14 8</b>	<b>1</b>
<b>Technical Data</b>	<b>See above</b>		
Connector type	< 0.3 dB @ 2.4 - 2.5 GHz		
Insertion attenuation	IP55		
Degree of protection	-25°C to +80°C (-13°F to +176°F)		
Temperature range			