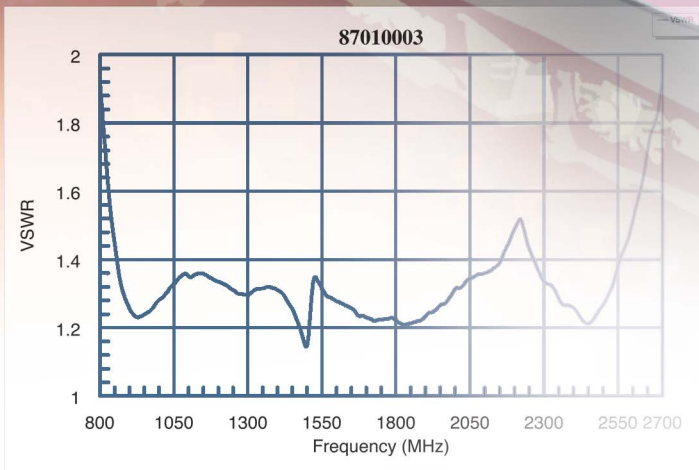
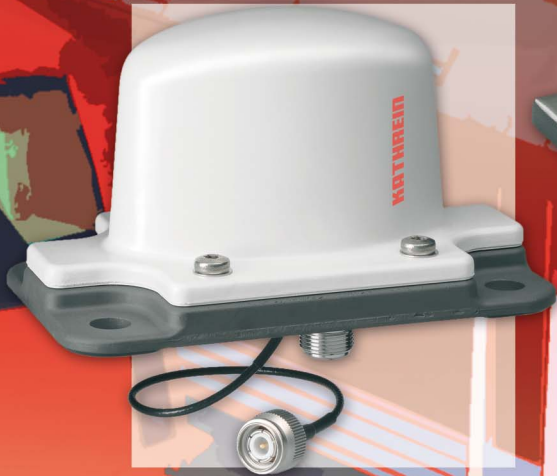


# Antennas for Trains and Buses

More than 50 years experience in train antennas

68-3800  
MHz



**KATHREIN**

Antennen · Electronic

**Photo on title page:** Train antennas and combiner.

**Catalogue Issue 08/2010**

All data published in previous catalog issues hereby becomes invalid.

We reserve the right to make alterations in accordance with the requirements of our customers.

**Please note:**

**The details given in our data sheets have to be followed carefully when installing the antennas and accessories.**

**The installation team must be properly qualified and also be familiar with the relevant national safety regulations.**



**“Quality leads the way”**

As the world's oldest and largest antenna manufacturer, we live up to claim “Quality leads the way” on a daily basis. One of the fundamental principles is to always be on the lookout for the best solution for our customers.

Our quality assurance system and our environmental management system apply to the entire company and are certified by TÜV according to EN ISO 9001 and EN ISO 14001.

# Summary

## Antennas for trains and buses

### 68 ... 3800 MHz

Frequency band	Type No.	Operating frequency range	Type approved by "Deutsche Bahn AG"	Remarks	Page
4m-band	K502141	Tunable in the range 68 ... 87.5 MHz	Yes		7
FM radio	727313	87.5 – 108 MHz	Yes	Only for receiving	8
2m-band	K502221 . K502222 .	146 – 156 MHz 156 – 174 MHz		Low profile	9
	733707	146 – 172 MHz	Yes		10
2m-/70cm-band	731495	165 – 174 MHz 457.4 – 468.3 MHz		Two-band antenna	11
70cm-band	87010008	380 – 430 MHz	Yes		12
	K70232. .	406 ... 470 MHz		Low profile	14
	K702021	410 – 470 MHz	Yes		15
	725892 K702121	410 – 430 MHz 450 – 470 MHz	Yes	Gain 2 dB	16
70cm-band 800/900 MHz	741557	380 – 400 MHz 870 – 960 MHz	Yes	Two-band antenna	17
	87010009	430 – 470 MHz 870 – 960 MHz	Yes	Two-band antenna	18
	K702061	450 – 470 MHz 790 – 960 MHz	Yes	Two-band antenna	20
900 MHz	741009	870 – 960 MHz	Yes	Special radome	21
	K7021631	876 – 960 MHz	Yes	Gain 3.5 dB	22
800/900/1800 MHz / UMTS / WLAN / WIMAX	87010007	790 – 2700 MHz	Yes	Low profile	23
1800/1900 MHz / UMTS / LTE / WLAN / WIMAX	87010010 <b>new</b>	1710 – 3800 MHz	Yes	Low profile	25

### Antennas with integrated GPS-Module

70cm-band / GPS	87010005	380 – 430 MHz 1575.42 ± 1 MHz	Yes		13
70cm-band / 900 MHz / GPS	87010006	430 – 470 MHz 870 – 960 MHz 1575.42 ± 1 MHz	Yes		19
800/900/1800 MHz / UMTS / WLAN / WIMAX / GPS	87010003	790 – 2700 MHz 1575.42 ± 1 MHz	Yes	Low profile	24
1800/1900 MHz / UMTS / LTE / WLAN / WIMAX / GPS	87010011 <b>new</b>	1710 – 3800 MHz 1575.42 ± 1 MHz	Yes	Low profile	26
GPS	86010142 <b>new</b>	1575.42 ± 1 MHz		Low noise amplifier	27

Installation Guidelines see from page 28 onwards

Additional antenna types available on request. Please contact: mobilcom@kathrein.de

**Article summary**  
**The articles are listed by type number**  
**in numerical order**

Type No.	Page	Type No.	Page
719035	5	791145	5
719792	5	86010142	27
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723013	5	87010005	13
725892	16	87010006	19
727313	8	87010007	23
728954	5, 17	87010008	12
731495	11	87010009	18
733707	10	87010010	25
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78210278, 279	5	K5022212	9
78210305, 306	5	K5022221	9
78210341	5	K5022222	9
78210457, 458, 460	5	K64504	5
78210469	5	K702021	15
78210620, 1, 2, 3, 4, 5	5	K702061	20
78210630,1, 2, 3, 4, 5	5, 6	K702121	16
78210640, 641, 642, 643	5	K7021631	22
78210660, 1, 2, 3, 4, 5, 9	5	K702321	14
78210680, 681, 682, 683	5	K7023210	14
78210800	5	K7023211	14
78210808, 809, 810	5	K702323	14
78210970, 971, 972, 973	5	K7023230	14
78211091, 2, 3, 4, 5	5	K7023231	14
790244	5, 11		

## Frequency Combinations

Type No.	Frequency / MHz													
	PMR		CDMA800 GSM/UMTS900				GSM1800		UMTS2100		WLAN LTE/WIMAX			
	200	400	600	800	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800
<b>Dual-band Combiners</b>														
K64504, 719035		68 - 87.5 / 146 - 174												
719792		68 - 108 / 146 - 174												
721138, 723013	68 - 174		380 - 470											
790244	68 - 174		400 - 470											
728954		68 - 470			870 - 970									
791145			50 - 1000						1600 - 2000					
78210457, 458, 460		50 - 470						806 - 2500						
78210341				824 - 880		890 - 960								
78210970, 972, 971, 973				790 - 862		880 - 960								
78210660, 1, 2, 3, 4, 5, 9				470 - 960						1710 - 2700				
78210680, 681, 682, 683				380 - 960						1710 - 2700				
78210278, 279, 305, 306						806 - 1880				1920 - 2170				
78210620, 1, 2, 3, 4, 5								1710 - 1880		1920 - 2170				
78210264					50 - 2200							2400 - 2500		
78210800, 78211091, 2, 3, 4, 5									1710 - 2180				2400 - 2700	
78210469, 808, 809, 810							1710 - 1755	1850 - 1910	2110 - 2155					
<b>Triple-band Combiners</b>														
78210630, 1, 2, 3, 4, 5				380 - 960				1710 - 1880		1920 - 2170				
<b>Quad-band Combiners</b>														
78210640, 641, 642, 643				380 - 960				1710 - 1880		1920 - 2200			2500 - 2690	

For multi-band antennas, several combiners for combining the bands are available. All devices undergo vibration- und shock tests according to ETS-300019-1-4.

Separate catalogues and our homepage <[www.kathrein.de](http://www.kathrein.de)> provide information for the combiners. Of course any question may also be directly put to [mobilcom@kathrein.de](mailto:mobilcom@kathrein.de).

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Triple-band Combiner GSM-R/GSM 900 – GSM 1800 – UMTS

## Example:

### Triple-band Combiners

Type No.	78210630, Single Unit 78210631, Double Unit	78210632, Single Unit 78210633, Double Unit	78210634, Single Unit 78210635, Double Unit
Pass band		380 – 960 MHz 1710 – 1880 MHz 1920 – 2170 MHz	
Band 1 (TETRA ... GSM 900)			
Band 2 (GSM 1800)			
Band 3 (UMTS)			
Insertion loss		< 0.2 dB ( 380 – 960 MHz) < 0.3 dB (1710 – 1880 MHz) < 0.3 dB (1920 – 2170 MHz)	
Port 1 ↔ Port 4			
Port 2 ↔ Port 4			
Port 3 ↔ Port 4			
Isolation		> 45 dB (380 – 600 MHz) / > 50 dB (600 – 960 / 1710 – 1880 MHz) > 45 dB (380 – 600 MHz) / > 50 dB (600 – 960 / 1920 – 2170 MHz) > 50 dB (1710 – 1880 / 1920 – 2170 MHz)	
Port 1 ↔ Port 2			
Port 1 ↔ Port 3			
Port 2 ↔ Port 3			
VSWR		< 1.25 (380 – 960 / 1710 – 1880 / 1920 – 2170 MHz)	
Impedance		50 Ω	
Input power		< 700 W / < 300 W / < 300 W	
Band 1 / Band 2 / Band 3			
Intermodulation products		< -160 dBc (3 <sup>rd</sup> order; with 2 x 20 W)	
Temperature range		-40 ... +60 °C	
Connectors		7-16 female (long neck)	

# Train Antenna

## 68 ... 87.5 MHz

### K502141

- Aluminum antenna in fiberglass radome.
- Fully tunable in the 68 ... 87.5 MHz range.

Type No.	K502141
Input	N female
Frequency range	68 ... 87.5 MHz
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50 °C ambient temperature)
Weight	5.3 kg
Packing size (outside)	502 x 162 x 370 mm

**Material:** Radiator and base: Aluminum.  
Radome: Fiberglass; Colour: Grey.

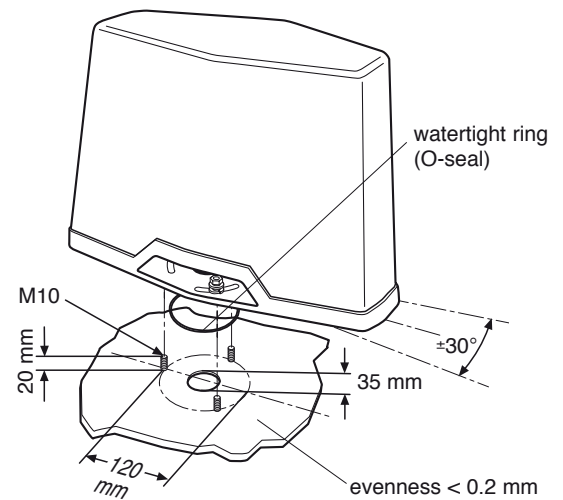
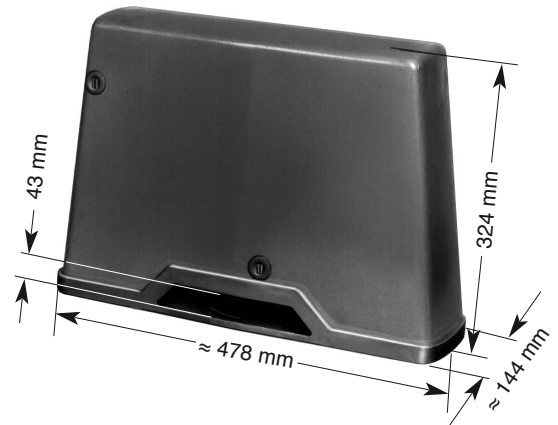
**Mounting:** On a conductive surface 200 x 100 cm min. with 3 studs M10.

**Tuning:** The antenna can be tuned to the transmitter frequency in the range 68 ... 87.5 MHz by two tuning screws.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.

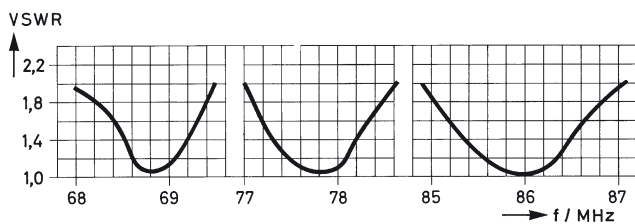
**Special features:** After mounting the antenna can be turned  $\pm 30^\circ$  when the mounting elements are still loose. The tuning screws are inside the fiberglass cover and easily accessible from the outside by means of plastic caps.

**Scope of supply:** Antenna and watertight ring (O-seal).

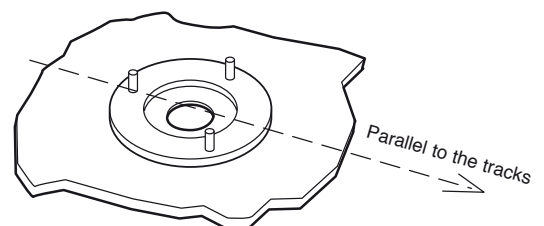


#### Typical Standing Wave Ratio (VSWR)

Examples for tuning to different frequencies measured against a 2 x 1 m conductive plane.



Welding flange:



# Train Antenna

## 87.5 – 108 MHz

### 727313

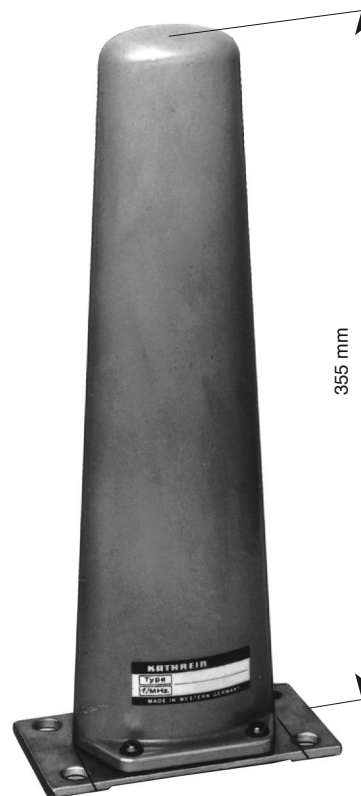
- FM-broadcast receiving antenna for rail vehicles in fiberglass radome.
- Only for receiving.

Type No.	727313
Input	N female
Frequency range	87.5 – 108 MHz
Impedance	50 Ω
Polarization	Vertical
Weight	0.9 kg
Packing size (outside)	151 x 90 x 415 mm

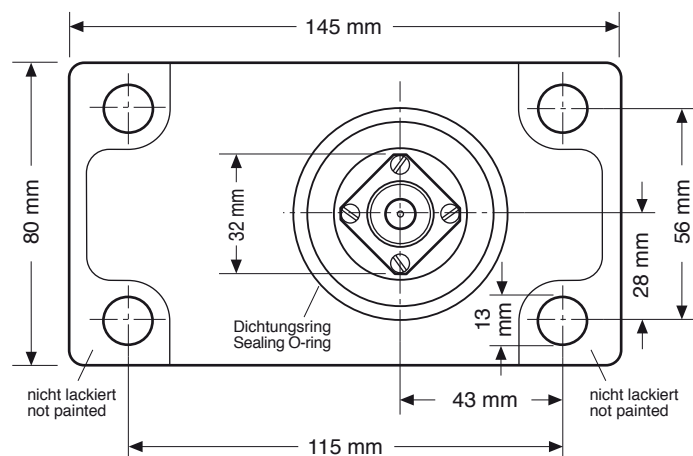
**Material:** Flange: Aluminum.  
Radiator: Copper.  
Radome: Fiberglass; Colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface with a minimum size of 100 x 200 cm by means of existing M10 studs.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.



**Mounting flange:**



Mounting hole for the connector: 33 (max. 35) mm diameter.  
**Note:** Keep mounting surface clear of paint for electrical contact.

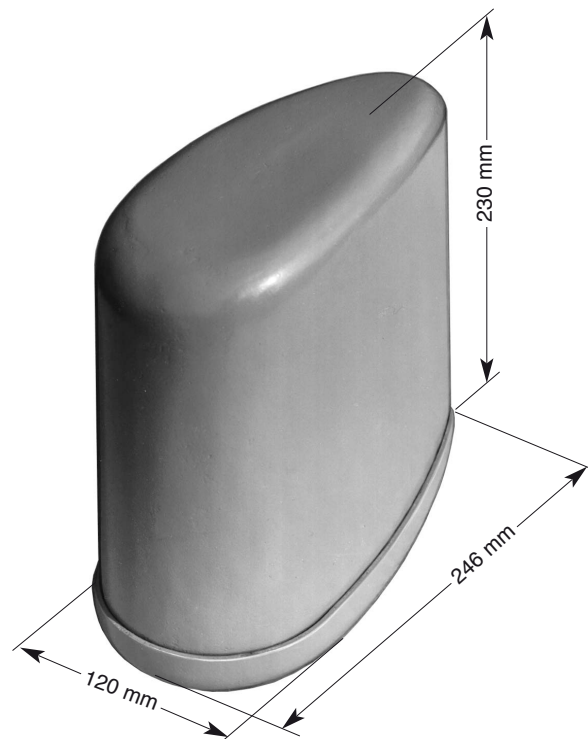


# Tram and Bus Antenna 146 – 174 MHz K50222. .

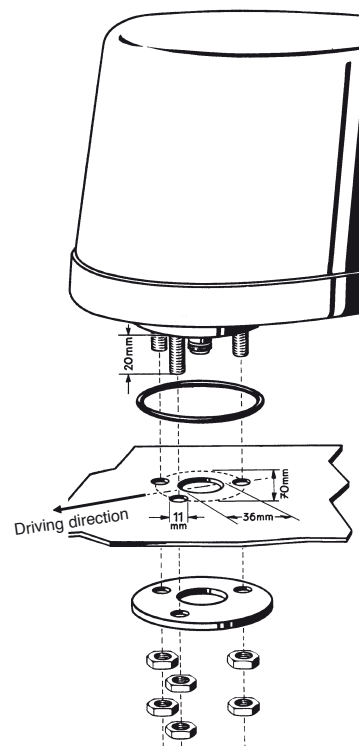
- Broadband antenna in fiberglass radome.

Type No.	K5022211	K5022212
Input	N female	UHF female
Frequency range	143 – 162 MHz but preferred range 146 – 156 MHz	
VSWR	< 1.4	
Gain	0 dB (ref. to the quarter-wave antenna)	
Impedance	50 Ω	
Polarization	Vertical	
Max. power	100 W (at 50° C ambient temperature)	
Weight	1.2 kg	
Packing size	260 x 260 x 130 mm	

Type No.	K5022221	K5022222
Input	N female	UHF female
Frequency range	152 – 178 MHz but preferred range 156 – 174 MHz	
VSWR	< 1.4	
Gain	0 dB (ref. to the quarter-wave antenna)	
Impedance	50 Ω	
Polarization	Vertical	
Max. power	100 W (at 50° C ambient temperature)	
Weight	1.2 kg	
Packing size	260 x 260 x 130 mm	



- Material:** Radiator and Base: Aluminum.  
Radome: Fiberglass, colour: Grey.  
Studs and all screws and nuts: Stainless steel.
- Mounting:** On a conductive surface 100 x 100 cm min. with 3 studs M10 and counterflange.  
**Note:** No superstructures in this area.
- Grounding and high voltage protection:** D.C. grounded to protect against lightning and high tension lines.
- Scope of supply:** Antenna with 3 studs, each with 2 nuts, 1 rubber gasket and 1 counterflange.



# Train Antenna 146 – 172 MHz 733707

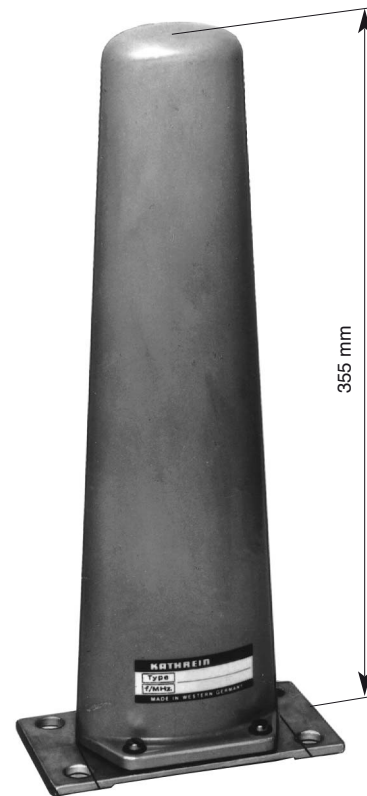
- Aluminum antenna in fiberglass radome.

Type No.	733707
Input	N female
Frequency range	146 – 172 MHz
VSWR	< 2.0
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50 °C ambient temperature)
Weight	0.8 kg
Packing size (outside)	151 x 90 x 415 mm

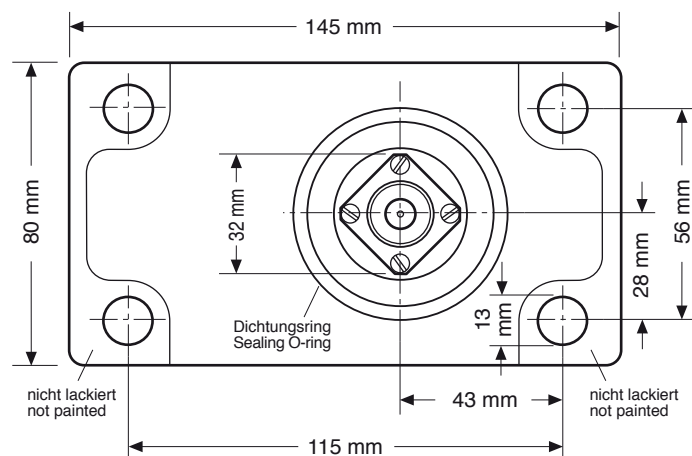
**Material:** Radiator and flange: Aluminum.  
Radome: Fiberglass, colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface 100 x 100 cm min.  
with 4 studs M10.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.



**Mounting flange:**



Mounting hole for the connector: 33 (max. 35) mm diameter.  
**Note:** Keep mounting surface clear of paint for electrical contact.

# Train Antenna

## 165 – 174 MHz and 457.4 – 468.3 MHz

### 731495

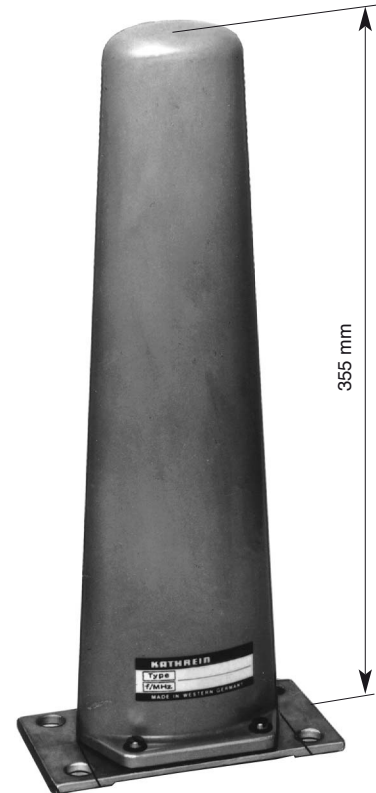
- Two-band antenna in fiberglass radome.
- The antenna can be operated in both frequency ranges simultaneously by using the combiner 790244.

Type No.	731495
Input	N female
Frequency range	165 – 174MHz   457.4 – 468.3 MHz
VSWR	< 1.6
Gain	0 dB   2 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	10 W (at 50 °C ambient temperature)
Weight	0.8 kg
Packing size (outside)	151 x 90 x 415 mm

**Material:** Radiator and flange: Aluminum.  
Radome: Fiberglass; Colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface 100 x 100 cm min. with 4 studs M10.

**Grounding and high voltage protection:** This antenna is D.C. grounded to protect against lightning and high-tension lines.

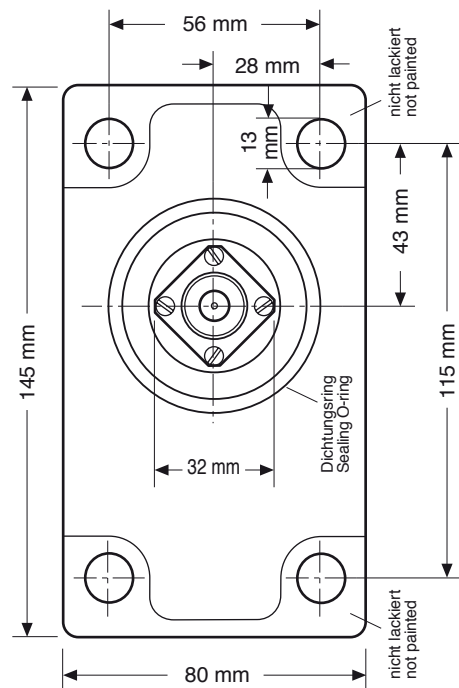


### Accessories: Combiner (order separately)

Type No.	790244
Frequency range	
Band 1	68 – 174 MHz
Band 2	400 – 470 MHz
Insertion loss	
Band 1	< 0.5 dB
Band 2	< 0.5 dB
Isolation	> 45 dB
VSWR	< 1.25
Impedance	50 Ω
Input power	< 50 W of each input
Temperature range	-20 ... +50 °C
Connectors	N female



Mounting flange:



Mounting hole for the connector:  
33 (max. 35) mm diameter.

**Note:** Keep mounting surface clear of paint for electrical contact.

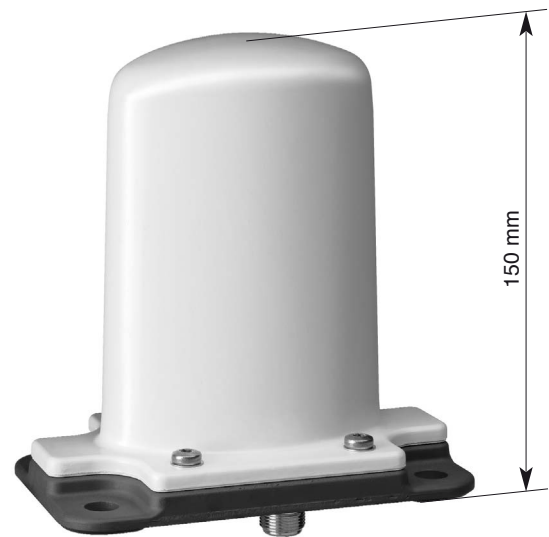
# Train Antenna

## 380 – 430 MHz

### 87010008

- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010008
<b>Antenna</b>	
Input	N female
Frequency range	380 – 430 MHz
VSWR	< 1.7
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
Weight	Approx. 0.5 kg
Packing size, L x W x H	150 x 90 x 190 mm
Height	150 mm

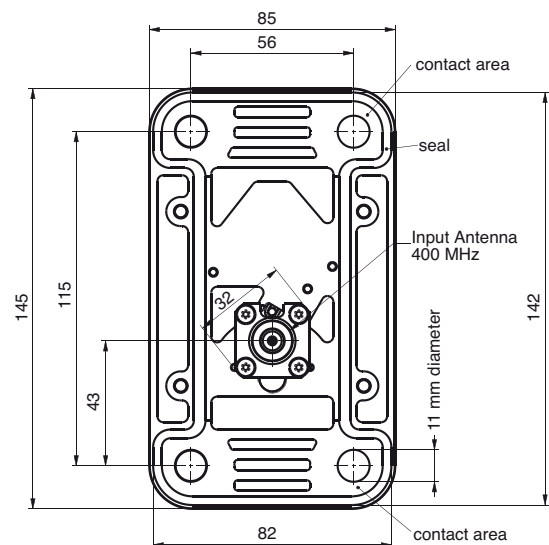


**Material:**  
Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.

**Mounting:**  
On a conductive surface with a minimum size of 1000 x 1000 mm using 4 M10 bolts.

**Grounding and high voltage protection:**  
This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.

Mounting flange:

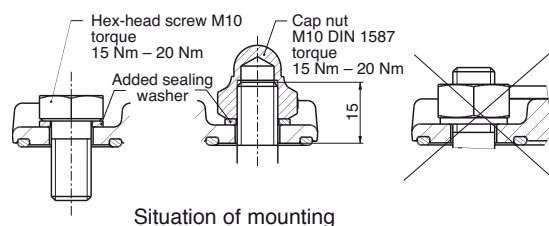


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.



# Train Antenna

## 380 – 430 MHz and GPS 1575 MHz

### 87010005

- Two-band antenna: 380 – 430 MHz and GPS.
- The antenna can be operated in both frequency ranges simultaneously.
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010005
<b>Antenna 380 – 430 MHz</b>	
Input	N female
Frequency range	380 – 430 MHz
VSWR	< 1.7
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
<b>Antenna GPS</b>	
Input	Cable RG 316/U of 225 mm length with TNC male connector
Frequency range	1575.42 ±1 MHz
VSWR	< 1.5
Polarization	Right hand circular
Gain (90° elevation)	2 dB (ref. to the circularly polarized isotropic antenna)
Impedance	50 Ω
Inner conductor	D.C. grounded
Weight	Approx. 0.5 kg
Packing size	150 x 90 x 190 mm
Height	150 mm

**Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.

**Mounting:** On a conductive surface with a minimum size of 1000 x 1000 mm using 4 M10 bolts.

**Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.

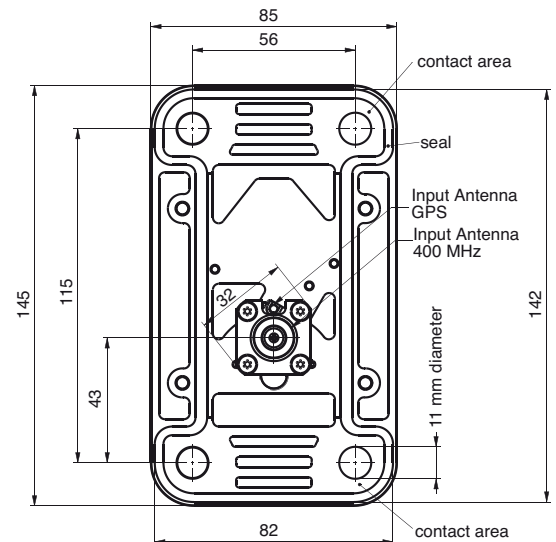
**Accessories:** Low noise amplifier GPS 86010142 (please order separately).

**Warning:** If the antenna is operated without the pre-amplifier type no. 86010142, please note the following points.

- Due to the fact that the inner conductor of the antenna GPS is DC grounded, the input of the GPS receiver is loaded with a DC short circuit. If the GPS receiver provides a remote DC power supply, this could damage the GPS receiver.
- At the input of the antenna GPS a level of –25 dB below the signal applied at the input of the antenna 380 – 430 MHz appears. Depending on the level of the signal applied at the input of the antenna 380 – 430 MHz, the GPS receiver may be overloaded or damaged.



Mounting flange:

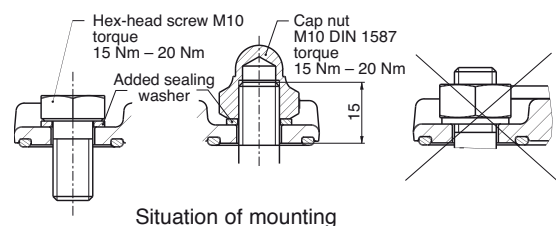


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.



Situation of mounting

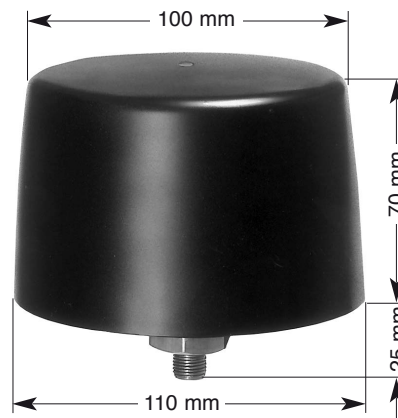
# Tram and Bus Antenna

## 406 ... 470 MHz

### K702321., K702323.

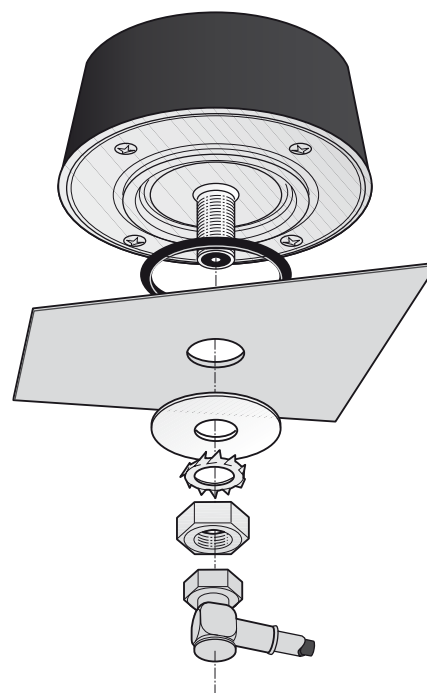
#### Frequency range 406 – 428 MHz

Type No.	K7023210	K702321	K7023211
Input	M 11 x 1 female (the connector for cable RG 58 C/U is supplied).	M 11 x 1 female (the connector for cable RG 213/U is supplied).	N-female
Drill hole dimension	12 mm	12 mm	17 mm
Frequency range	406 – 428 MHz		
VSWR	< 1.9		
Gain	0 dB (ref. to the quarter-wave antenna)		
Impedance	50 Ω		
Polarization	Vertical		
Max. power	50 W (at 50 °C ambient temperature)		
Weight	0.40 kg		
Packing size (outside)	117 x 117 x 114 mm		
Height	70 mm		
Mounting	On a conductive surface 70 x 70 cm min.		



#### Frequency range 440 – 470 MHz

Type No.	K7023230	K702323	K7023231
Input	M 11 x 1 female (the connector for cable RG 58 C/U is supplied).	M 11 x 1 female (the connector for cable RG 213/U is supplied).	N-female
Drill hole dimension	12 mm	12 mm	17 mm
Frequency range	440 – 470 MHz		
VSWR	< 1.6: 440 – 450 MHz < 1.5: 450 – 470 MHz		
Gain	0 dB (ref. to the quarter-wave antenna)		
Impedance	50 Ω		
Polarisation	Vertical		
Max. power	50 W (at 50 °C ambient temperature)		
Weight	0.40 kg		
Packing size (outside)	117 x 117 x 114 mm		
Height	70 mm		
Mounting	On a conductive surface 50 x 50 cm min.		



**Material:** Radiator and base: Aluminum.  
Radome: High impact plastic.  
All screws and nuts: Stainless steel.

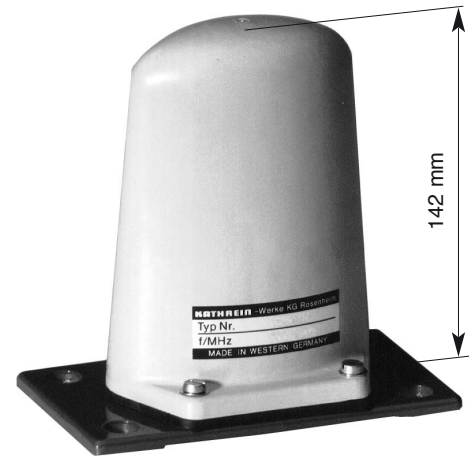
**Mounting:** The drilling diameter is 12 mm except the N connector versions: 17 mm.  
A special zinc washer ensures a good contact at the edges of the hole.

**Special features:** All metall parts of this antenna are D.C. grounded.  
Extreme robust and car-wash proof vehicular antenna.

# Train Antenna 410 – 470 MHz K702021

- Low profile broadband antenna in fiberglass radome.

Type No.	K702021
Input	N-female
Frequency range	410 – 470 MHz
VSWR	< 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ohm
Polarization	Vertical
Max. power	170 W (at 50° C ambient temperature)
Weight	0.5 kg
Packing size (outside)	151 x 87 x 210 mm

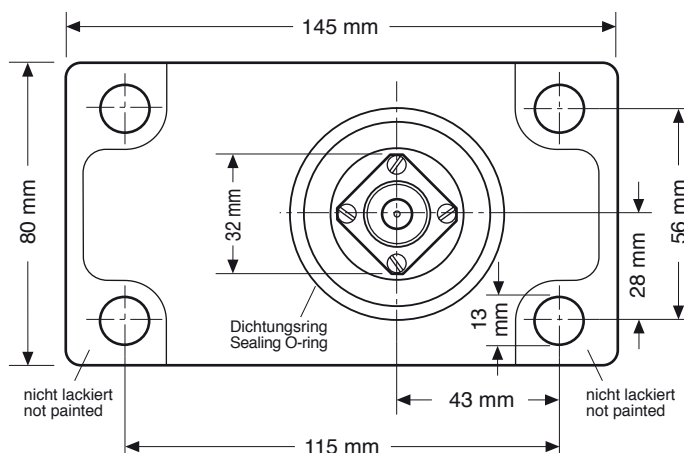


**Material:** Radiator and Flange: Aluminum.  
Radome: Fiberglass, colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface with a minimum size of 50 x 50 cm by means of existing M10 studs.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.

**Mounting flange:**



Mounting hole for the connector: 33 (max. 35) mm diameter.

**Note:** Keep mounting surface clear of paint for electrical contact.

# Train Antenna

## 410 – 430 / 450 – 470 MHz

### K702121, 725892

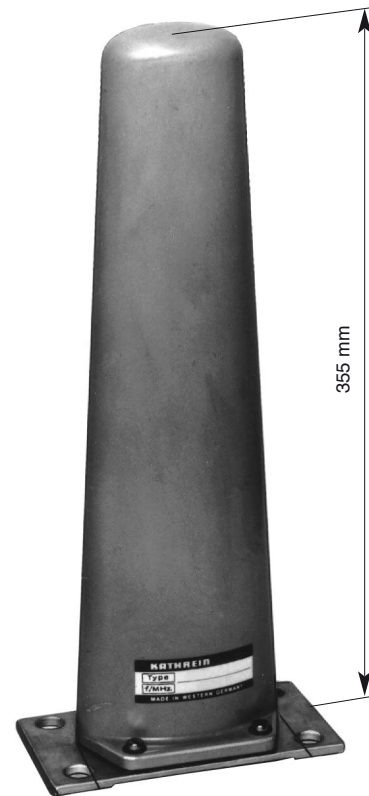
- 2 dB gain broadband antenna in fiberglass radome.

Type No.	K702121	725892
Input	N-female	
Frequency range	450 – 470 MHz	410 – 430 MHz
VSWR	< 1.5	
Gain	2 dB (ref. to the quarter-wave antenna)	
Impedance	50 Ohm	
Polarization	Vertical	
Max. power	640 W (at 50° C ambient temperature)	
Weight	0.8 kg	
Packing size (outside)	151 x 90 x 415 mm	

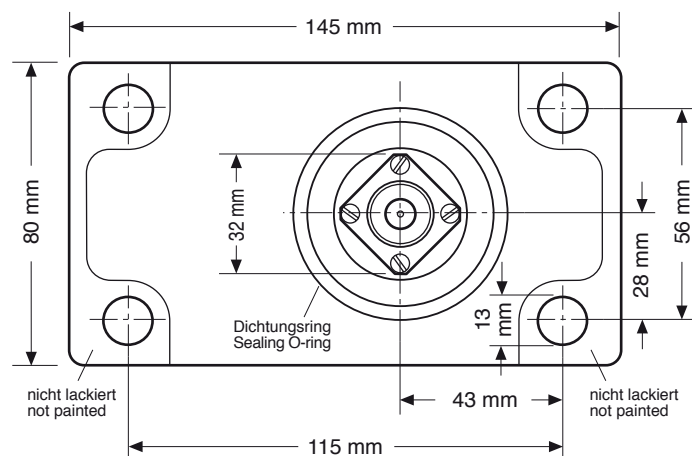
**Material:** Radiator and Flange: Aluminum.  
Radome: Fiberglass, colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface with a minimum size of 50 x 50 cm by means of existing M10 studs.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.



**Mounting flange:**



Mounting hole for the connector: 33 (max. 35) mm diameter.  
**Note:** Keep mounting surface clear of paint for electrical contact.



# Train Antenna

## 380 – 400 MHz and 870 – 960 MHz

### 741557

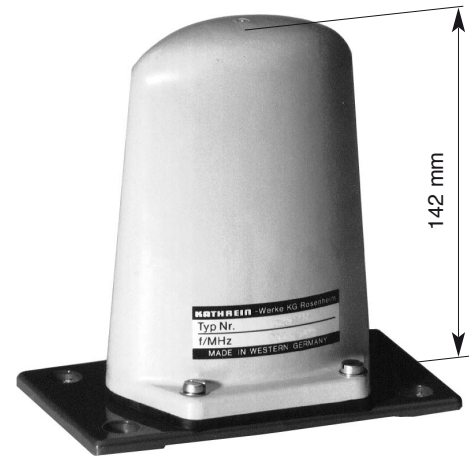
- Two-band antenna in fiberglass radome working in the 380 – 400 MHz and 870 – 960 MHz range.
- The antenna can be operated in both frequency ranges simultaneously by using the combiner 728954.

Type No.	741557
Input	N female
Frequency range	380 – 400 MHz and 870 – 960 MHz
VSWR	< 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	500 W (at 50 °C ambient temperature)
Weight	0.5 kg
Packing size (outside)	151 x 87 x 210 mm

**Material:** Radiator: Brass.  
Flange: Aluminum.  
Radome: Fiberglass; Colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface with a minimum size of 50 x 50 cm by means of 4 existing M10 studs.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.

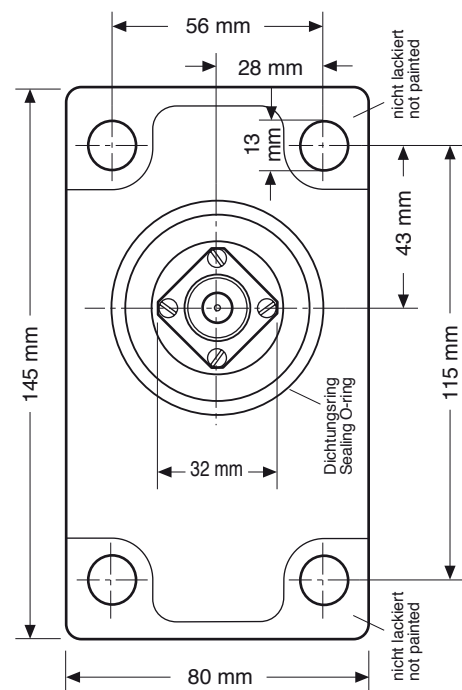


### Accessories: Combiner (order separately)

Type No.	728954
Frequency range	
Input 1	68 – 470 MHz
Input 2	870 – 970 MHz
Insertion loss	
68 – 470 MHz	< 0.5 dB
870 – 970 MHz	< 0.5 dB
Isolation	> 45 dB
VSWR	< 1.2
Impedance	50 Ω
Input power	
68 – 470 MHz	< 50 W
870 – 970 MHz	< 50 W
Temperature range	-20 ... +70 °C
Connectors	N female



Mounting flange:



Mounting hole for the connector:

33 (max. 35) mm diameter.

**Note:** Keep mounting surface clear of paint for electrical contact.

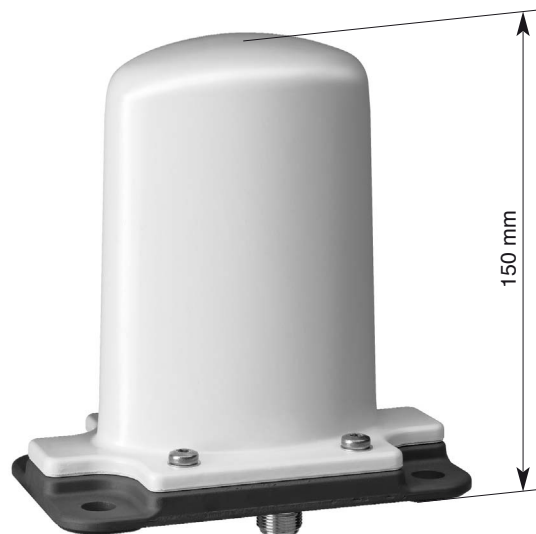
# Train Antenna

## 430 – 470 MHz and 870 – 960 MHz

### 87010009

- Two-band Antenna: 430 – 470 MHz / 870 – 960 MHz
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010009
<b>Antenna two-band</b>	
Input	N female
Frequency range	430 – 470 MHz 870 – 960 MHz
VSWR	< 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
Weight	Approx. 0.5 kg
Packing size, L x W x H	150 x 90 x 190 mm
Height	150 mm

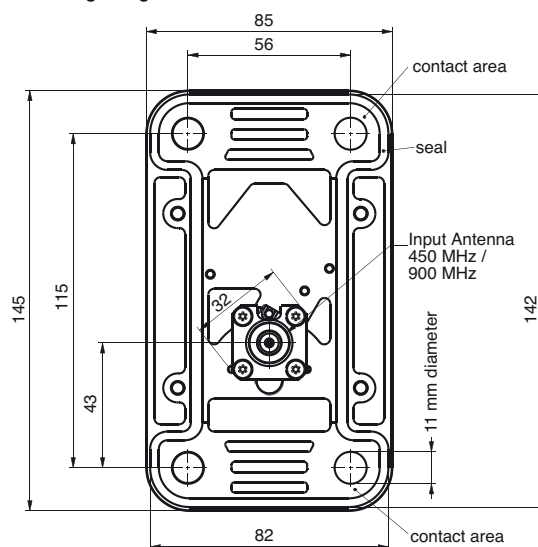


**Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.

**Mounting:** On a conductive surface with a minimum size of 1000 mm x 1000 mm using 4 M10 bolts.

**Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.

Mounting flange:

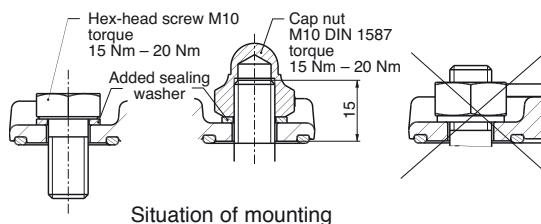


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.



# Train Antenna

## 430 – 470 MHz / 870 – 960 MHz and GPS 1575 MHz 87010006

**KATHREIN**

Antennen · Electronic

- Multi-band antenna: 430 – 470 MHz / 870 – 960 MHz and GPS.
- The antenna can be operated in all frequency ranges simultaneously.
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

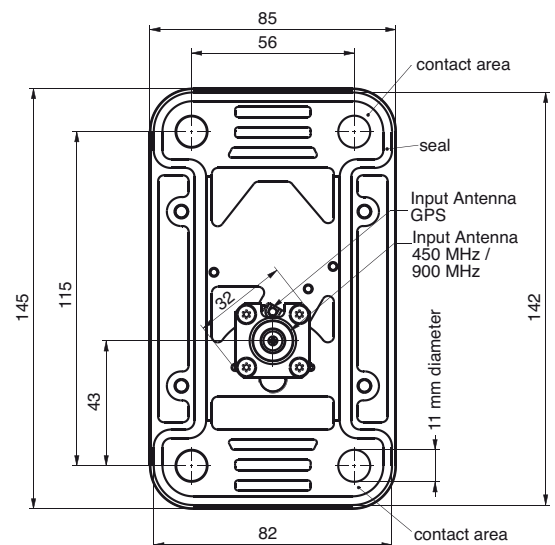
Type No.	87010006
<b>Antenna multi-band</b>	
Input	N female
Frequency range	430 – 470 MHz 870 – 960 MHz
VSWR	< 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
<b>Antenna GPS</b>	
Input	Cable RG 316/U of 225 mm length with TNC male connector
Frequency range	1575.42 ±1 MHz
VSWR	< 1.5
Polarization	Right hand circular
Gain (90° elevation)	2 dB (ref. to the circularly polarized isotropic antenna)
Impedance	50 Ω
Inner conductor	D.C. grounded
Weight	Approx. 0.5 kg
Packing size, L x W x H	150 x 90 x 190 mm
Height	150 mm

- Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.
- Mounting:** On a conductive surface with a minimum size of 1000 x 1000 mm using 4 M10 bolts.
- Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.
- Accessories:** Low noise amplifier GPS type no. 86010142 (please order separately).

- Warning:** If the antenna is operated without the pre-amplifier type no. 86010142, please note the following points.
- Due to the fact that the inner conductor of the antenna GPS is DC grounded, the input of the GPS receiver is loaded with a DC short circuit. If the GPS receiver provides a remote DC power supply, this could damage the GPS receiver.
  - At the input of the antenna GPS a level of –25 dB below the signal applied at the input of the antenna two-band appears. Depending on the level of the signal applied at the input of the antenna two-band, the GPS receiver may be overloaded or damaged.



Mounting flange:

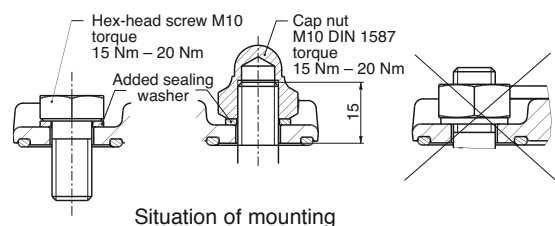


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.



# Train Antenna

## 450 – 470 MHz and 790 – 960 MHz

### K702061

- Two-band antenna in fiberglass radome working in the 450 – 470 MHz and 790 – 960 MHz range.
- The antenna can be operated in both frequency ranges simultaneously by using the combiner 728954.

Type No.	K702061
Input	N female
Frequency range	450 – 470 MHz and 790 – 960 MHz
VSWR	< 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	500 W (at 50 °C ambient temperature)
Weight	0.5 kg
Packing size (outside)	151 x 87 x 210 mm

**Material:**  
 Radiator: Brass.  
 Flange: Aluminum.  
 Radome: Fiberglass; Colour: Light grey.  
 All screws and nuts: Stainless steel.

**Mounting:**  
 On a conductive surface with a minimum size of 50 x 50 cm by means of 4 existing M10 studs.

**Grounding and high voltage protection:**  
 This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.

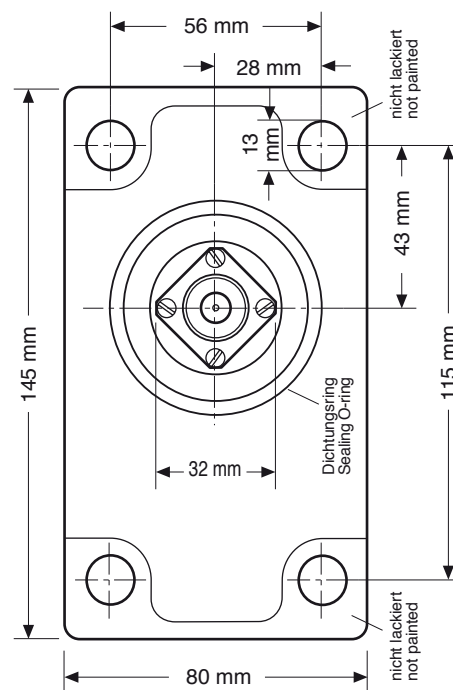


### Accessories: Combiner (order separately)

Type No.	728954
Frequency range	
Input 1	68 – 470 MHz
Input 2	870 – 970 MHz
Insertion loss	
68 – 470 MHz	< 0.5 dB
870 – 970 MHz	< 0.5 dB
Isolation	> 45 dB
VSWR	< 1.2
Impedance	50 Ω
Input power	
68 – 470 MHz	< 50 W
870 – 970 MHz	< 50 W
Temperature range	-20 ... +70 °C
Connectors	N female



Mounting flange:



Mounting hole for the connector:

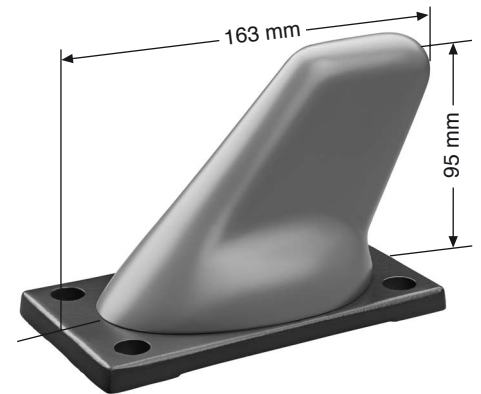
33 (max. 35) mm diameter.

**Note:** Keep mounting surface clear of paint for electrical contact.

# Train Antenna 870 – 960 MHz 741009

- Broadband antenna of very low profile in fiberglass radome.

Typ Nr.	741009
Input	N-female
Frequency range	870 – 960 MHz
VSWR	< 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50 °C ambient temperature)
Weight	0.5 kg
Packing size (outside)	137 x 92 x 174 mm

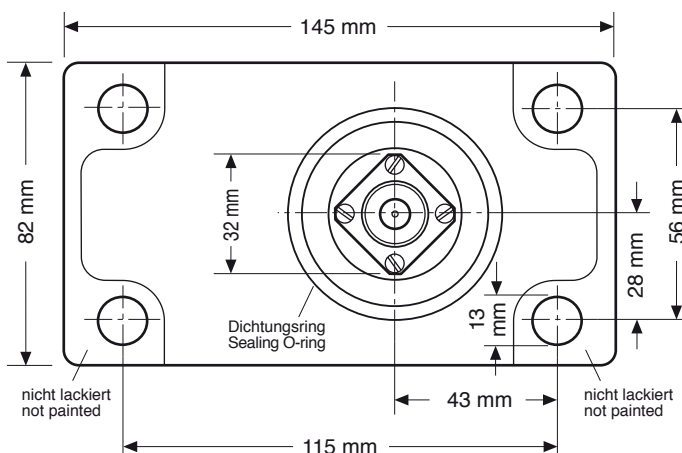


**Material:** Radiator: Brass.  
Flange: Aluminum.  
Radome: Fiberglass; Colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface of a minimum size of 50 x 50 cm by means of 4 existing M10 studs.

**Grounding and high voltage protection:** This antenna approved by the "Deutsche Bahn AG" is D.C. grounded to protect against lightning and high-tension lines.

Mounting flange:



Mounting hole for the connector: 33 (max. 35) mm diameter.  
**Note:** Keep mounting surface clear of paint for electrical contact.

# Train Antenna

## 876 – 960 MHz

### K7021631

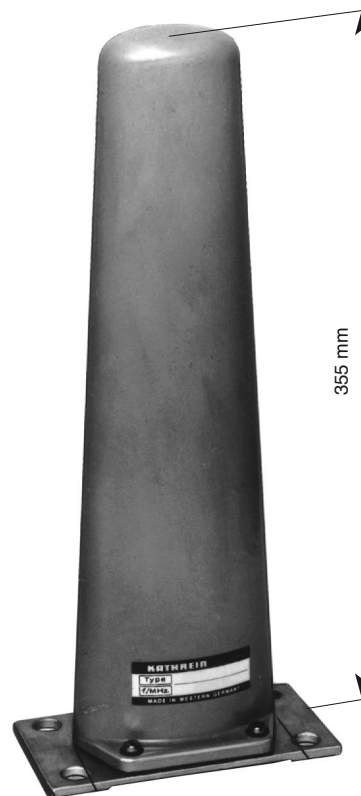
- Broadband gain antenna in fiberglass radome.

Type No.	K7021631
Input	N female
Frequency range	876 – 960 MHz
VSWR	< 1.5
Gain	3.5 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	500 W (at 50 °C ambient temperature)
Weight	1 kg
Packing size (outside)	151 x 90 x 415 mm

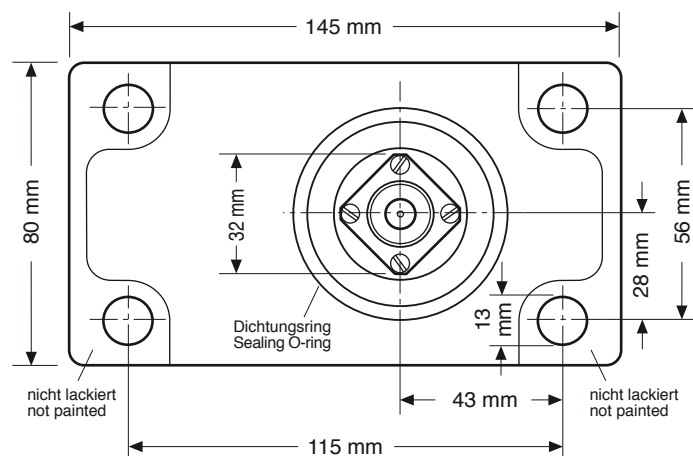
**Material:** Radiator: Brass.  
Flange: Aluminum.  
Radome: Fiberglass; Colour: Light grey.  
All screws and nuts: Stainless steel.

**Mounting:** On a conductive surface with a minimum size of 50 x 50 cm by means of 4 existing M10 studs.

**Grounding and high voltage protection:** This antenna approved by the “Deutsche Bahn AG” is D.C. grounded to protect against lightning and high-tension lines.



**Mounting flange:**



Mounting hole for the connector: 33 (max. 35) mm diameter.  
**Note:** Keep mounting surface clear of paint for electrical contact.

# Train Antenna

## 790 – 2700 MHz

### 87010007

- Multi-band antenna: 800/900/1800/1900/UMTS/UMTS II/W-LAN.
- The antenna can be operated in all frequency ranges simultaneously.
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010007
<b>Antenna multi-band</b>	
Input	N female
Frequency range	790 – 2700 MHz
VSWR	790 – 806 MHz: < 2.2 806 – 870 MHz: < 2.0 870 – 2550 MHz: < 1.5 2550 – 2700 MHz: < 2.0
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
Weight	approx. 0.5 kg
Packing size	152 x 91 x 125 mm
Height	81 mm

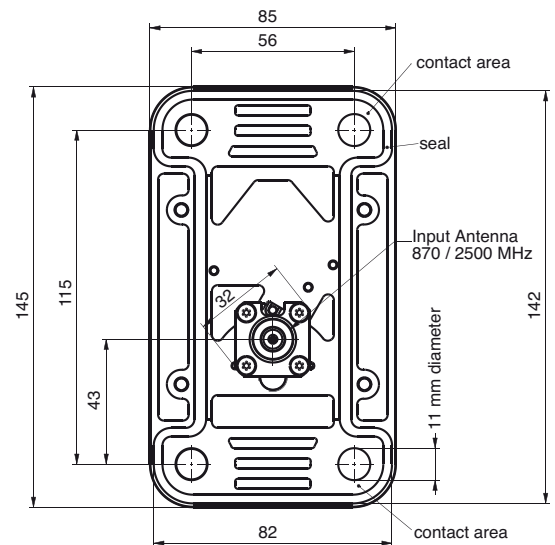
**Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.

**Mounting:** On a conductive surface with a minimum size of 50 x 50 cm using 4 M10 bolts.

**Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.



Mounting flange:

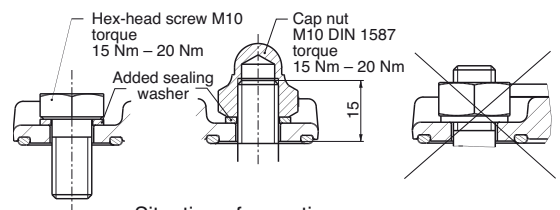


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.



Situation of mounting

# Train Antenna

## 790 – 2700 MHz and GPS 1575 MHz

### 87010003

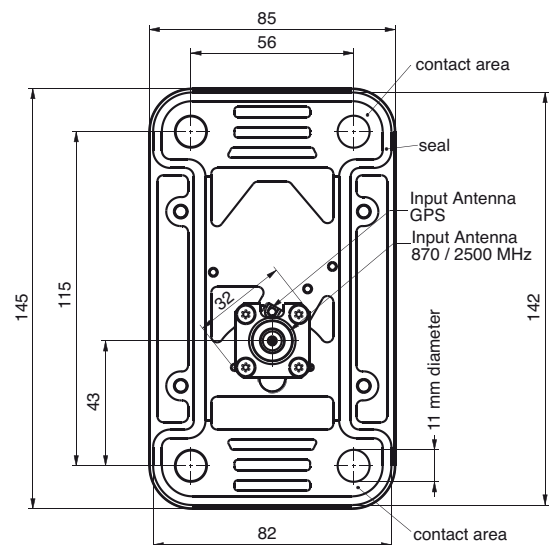
- Multi-band antenna: 800/900/1800/1900/UMTS/UMTS II/W-LAN and GPS.
- The antenna can be operated in all frequency ranges simultaneously.
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010003
<b>Antenna multi-band</b>	
Input	N female
Frequency range	790 – 2700 MHz
VSWR	790 – 806 MHz: < 2.2 806 – 870 MHz: < 2.0 870 – 2550 MHz: < 1.5 2550 – 2700 MHz: < 2.0
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
<b>Antenna GPS</b>	
Input	Cable RG 316/U of 225 mm length with TNC male connector
Frequency range	1575.42 ±1 MHz
VSWR	< 1.5
Polarization	Right hand circular
Gain (90° elevation)	2 dB (ref. to the circularly polarized isotropic antenna)
Impedance	50 Ω
Inner conductor	D.C. grounded
Weight	approx. 0.5 kg
Packing size	152 x 91 x 125 mm
Height	81 mm

- Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.
- Mounting:** On a conductive surface with a minimum size of 50 x 50 cm using 4 M10 bolts.
- Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.
- Accessories:** Low noise amplifier GPS 86010142 (please order separately).
- Warning:** If the antenna is operated without the pre-amplifier type no. 86010142, please note the following points.
- Due to the fact that the inner conductor of the antenna GPS is DC grounded, the input of the GPS receiver is loaded with a DC short circuit. If the GPS receiver provides a remote DC power supply, this could damage the GPS receiver.
  - At the input of the antenna GPS a level of –25 dB below the signal applied at the input of the antenna multi-band appears. Depending on the level of the signal applied at the input of the antenna multi-band, the GPS receiver may be overloaded or damaged.



Mounting flange:

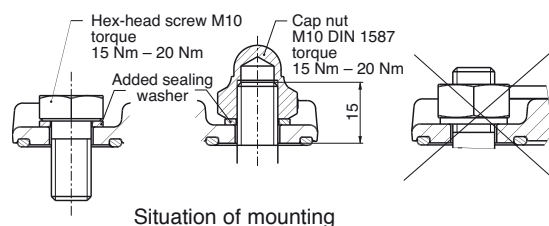


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.





# Train Antenna

## 1710 – 3800 MHz

### 87010010

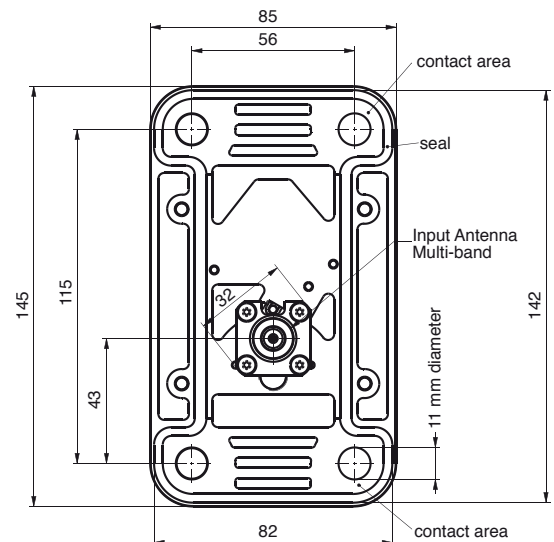
- Multi-band antenna: 1800/1900/UMTS/LTE/W-LAN/WiMAX.
- The antenna can be operated in all frequency ranges simultaneously.
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010010
<b>Antenna multi-band</b>	
Input	N female
Frequency range	1710 – 3800 MHz
VSWR	1710 – 1920 MHz: < 1.6 1920 – 3800 MHz: < 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
Weight	0.45 kg
Packing size	152 x 91 x 125 mm
Height	81 mm

- Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.
- Mounting:** On a conductive surface with a minimum size of 50 x 50 cm.
- Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.



Mounting flange:

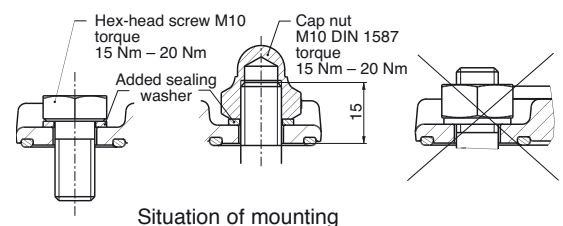


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

Use a cap nut or hex-head screw plus the enclosed sealing washer.



Situation of mounting

# Train Antenna

## 1710 – 3800 MHz and GPS 1575 MHz

### 87010011

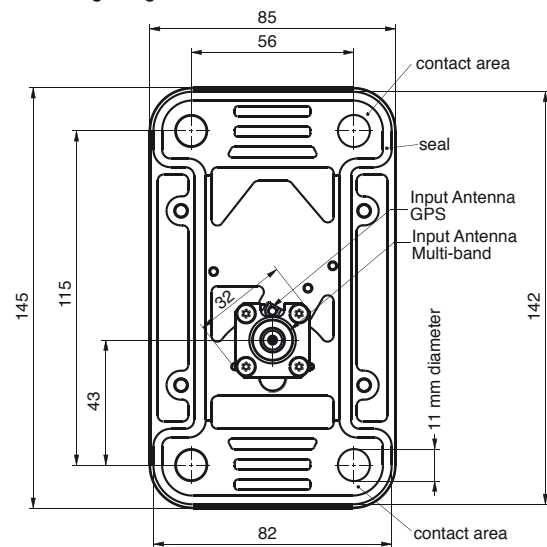
- Multi-band antenna: 1800/1900/UMTS/LTE/W-LAN/WiMAX and GPS.
- The antenna can be operated in all frequency ranges simultaneously.
- Low profile antenna in fiberglass radome.
- The antenna fulfils the requirements according to EN 50155.

Type No.	87010011
<b>Antenna multi-band</b>	
Input	N female
Frequency range	1710 – 3800 MHz
VSWR	1710 – 1920 MHz: < 1.6 1920 – 3800 MHz: < 1.5
Gain	0 dB (ref. to the quarter-wave antenna)
Impedance	50 Ω
Polarization	Vertical
Max. power	100 W (at 50° C ambient temperature)
Inner conductor	D.C. grounded
<b>Antenna GPS</b>	
Input	Cable RG 316/U of 225 mm length with TNC male connector
Frequency range	1575.42 ±1 MHz
VSWR	< 1.5
Polarization	Right hand circular
Gain (90° elevation)	2 dB (ref. to the circularly polarized isotropic antenna)
Impedance	50 Ω
Inner conductor	D.C. grounded
Weight	approx. 0.5 kg
Packing size	152 x 91 x 125 mm
Height	81 mm



- Material:** Radiator: Copper and brass.  
Flange: Aluminum. Radome: Fiberglass.  
All screws and nuts: Stainless steel.  
Colour: Grey.
- Mounting:** On a conductive surface with a minimum size of 50 x 50 cm.
- Grounding and high voltage protection:** This antenna, tested by an independent institute and approved by the "Deutsche Bahn AG", is D.C. grounded to protect against lightning and high-tension lines.
- Accessories:** Low noise amplifier GPS 86010142 (please order separately).
- Warning:** If the antenna is operated without the pre-amplifier type no. 86010142, please note the following points.
- Due to the fact that the inner conductor of the antenna GPS is DC grounded, the input of the GPS receiver is loaded with a DC short circuit. If the GPS receiver provides a remote DC power supply, this could damage the GPS receiver.
  - At the input of the antenna GPS a level of –25 dB below the signal applied at the input of the antenna multi-band appears. Depending on the level of the signal applied at the input of the antenna multi-band, the GPS receiver may be overloaded or damaged.

Mounting flange:

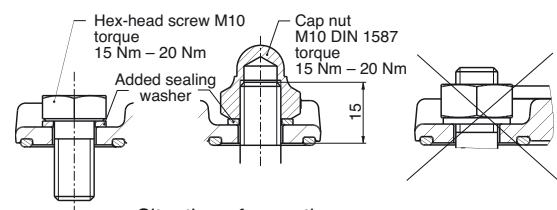


Mounting hole for the connector: 33 mm (max. 35 mm)

**Note:** Mounting surface must be free from paint for electrical contact.

Evenness of opposite surface 0.2 mm.

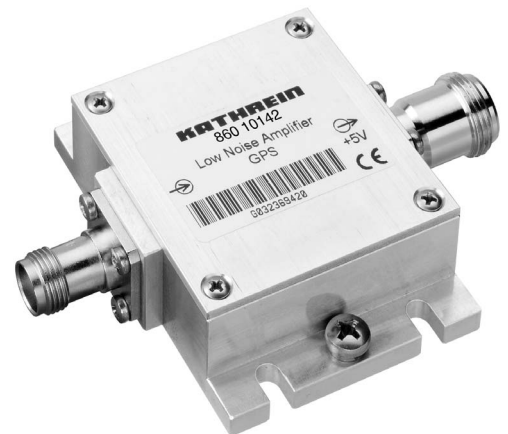
Use a cap nut or hex-head screw plus the enclosed sealing washer.



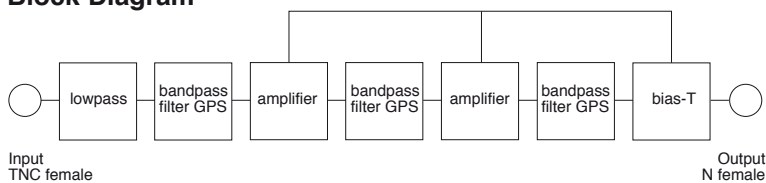
Situation of mounting

# Low Noise Amplifier GPS 86010142

- The low noise amplifier 86010142 is designed for the use inside vehicles with train antennas with GPS.
- It includes a preselection filter to prevent the interference in case of simultaneous operation at the frequency range 380 – 960 / 1710 – 3800 MHz and GPS.
- The product fulfils the requirements according to EN 50155.



## Block Diagram



Type No.	86010142
Frequency	1575.42 MHz, L1-signal
Gain	25 ±2 dB
Noise figure	< 2.0 dB
VSWR (input, output)	< 1.8
Operation voltage	3.3 ... 5.5 V, ripple < 50 mV, supplied at inner conductor RF-output
Operation current	≤ 25 mA
Connector input	TNC female
Connector output	N female
Dimensions (w x h x l)	70 x 22 x 50 mm
Mounting	4 holes, 4.5 mm diameter

## Additional features:

- The maximum input power at the input of the amplifier at the frequency range 380 – 960 MHz and 1710 – 3800 MHz is limited to +25 dBm.
- The noise level at the GPS-frequency generated by the operation at the frequency range 380 – 960 MHz and 1710 – 3800 MHz should not exceed the thermal noise level at the input of the GPS-amplifier, otherwise the noise figure will be increased.

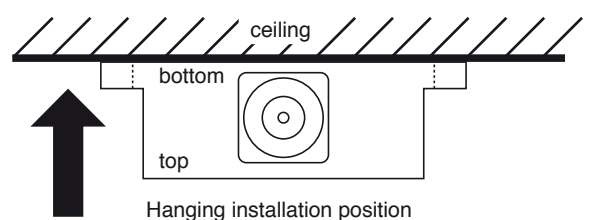
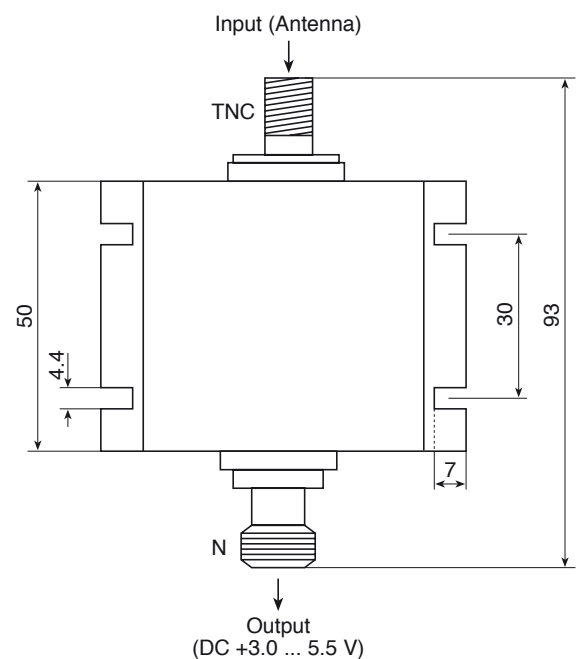
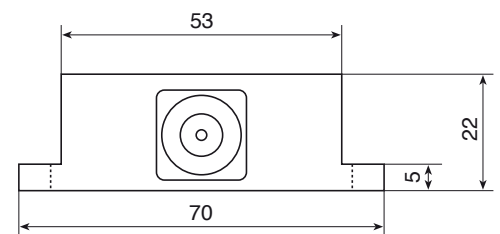
## Environmental conditions:

- Temperature range: –25 °C ... +55 °C (data as specified)  
–40 °C ... +85 °C (extended range) \*)
- Protection class: IP 54 (DIN 40050 / IEC 144)  
(hanging installation position)

### \*) Extended range of operation:

Within an extended temperature range of –40 °C ... +85 °C and an extended supplied voltage range of 3.0 V ... 6.0 V operation is possible with the following restrictions:

Noise figure: < 2.5 dB  
Gain: > 20 dB



## Abstract

### Quality is the key

Train antennas made by Kathrein are well known as reliable and highly sophisticated products. Our antennas are distinguished by excellent voltage protection against accidentally high voltage contacts due to well developed grounding elements implemented in the overall design.

Train antennas are faced to extreme environmental conditions and need to withstand tremendous operational conditions. The following documents should help to understand functionality and learn more about proper installation procedures.

## Design

Depending on frequency and design constrains Kathrein antennas are designed as  $\lambda/4$  radiators or as  $\lambda/2$  radiators. For proper functionality  $\lambda/4$  radiators have to be mounted on a conductive surface creating a ground plane. Train antennas are usually vertical polarized. Impedance is 50 Ohm.

Kathrein antennas are tested from an independent institute and type approved by the "Deutsche Bahn AG" (German Railway).

Key features of Kathrein antennas to pass the "Deutsche Bahn AG" requirements is the ability to limit connector voltage to 60 V in case of contact with the high tension lines. Current flow of 40 kA over a time frame of 100 ms and high voltages of up to 42 kV could be applied under worst case conditions.



68 – 87.5 MHz



410 – 470 MHz



Broadband + GPS  
(incl. amplifier)

## Installation

### Ground Plane

Fundamental RF basics require metallic surfaces for certain antenna designs. Utilizing  $\lambda/4$  technologies depends on a sufficient ground plane surface to finally distribute RF wave into the surroundings. Thus those particular antennas need to be mounted against a conductive surface to create the required ground plane.

Each data sheet leaves detailed information about surface size. We strongly recommend not to stay under the minimum mounting requirements. Antennas easily will lose VSWR performance, and radiation pattern may change dramatically.

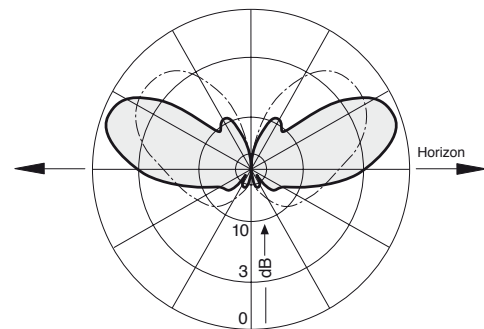
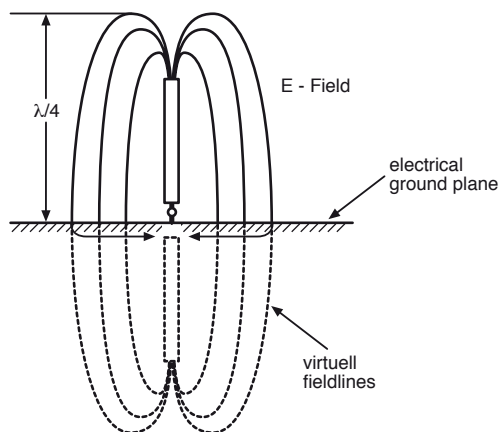


Figure 1: Electrical field and radiation pattern of a  $\lambda/4$  antenna design

### Metallic Surfaces

In most of the cases the roof of trains is made out of metallic materials. These materials have a reasonable conductivity to achieve best radiation results. For safety reasons these surfaces need to offer sufficient grounding to finally guide high voltages and currents to the ground.

### Non-Metallic Surfaces

Trains designs appear more and more with non-metallic surfaces mostly present at the front or the end of a train. Apparently those areas are preferred installation areas for antennas.

designs may apply to create such a plane. Metallic foils might be placed underneath a non-metallic train body. Other metals might be laminated into Fiberglass constructions. The antenna flange needs to have good electrical contact to these additional ground planes

The same mandatory rule applies as with metallic surfaces: A sufficient grounding of the antenna needs to be considered in the design. Any kind of grounding needs to handle high currents and voltages, and finally lead it to the ground.

As explained previously antennas require ground planes made out of conductive material. Several

## Grounding

In case of an accident or a failure of the high tension line (overhead contact line) high voltage and current might be applied to the antenna. To protect personal and equipment, connector voltage of the antenna is supposed not to exceed 60 V. To guarantee low connector voltages, antenna flanges need to be grounded thoroughly.

- Unpainted areas near the four mounting holes of the antenna flange.

To achieve best conductivity mounting surfaces at the antenna socket and the mating surface of the train should be clean. Any paint residues or other pollution needs to be removed prior to the mounting process.

- In case of non-metallic roof surfaces with an additional ground plane of e. g. thin material, a separate grounding of the antenna mounting flange is required.

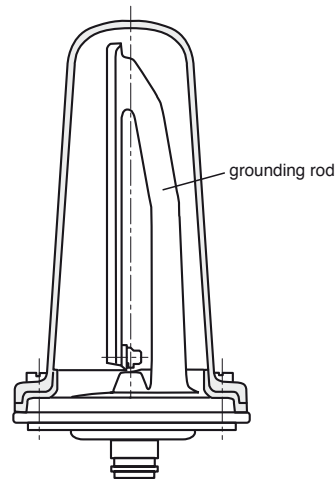


Figure 2: Inside grounding

## Mounting

Most antennas are designed with a standardized foot print of the mounting socket. Dimensions are stated in the data sheets.

### Mounting Sockets

Most antenna sockets offer four screw holes to tighten the flange against the mounting surface.

We recommend the following:

- Mounting against a separate flange with integrated mounting bolts. This flange is usually welded to the train.

In general, mounting screws or nuts should not add more than 15 mm to the mounting surface, especially if cap nuts are used.

In case of an antenna installation with screws through the antenna socket into the vehicle, particular attention should be paid to the sealing of the screws under consideration of the grounding instructions.

### Mounting Position

The antennas have to be mounted directly to the ground plane.

Depending on the overall mounting situation (please refer to "Obstacles close to the antenna") it's tempted to elevate antennas against the trains roof with high flanges or other challenging constructions. To avoid mistuning and malfunctioning antennas it is mandatory not to follow these installation ideas. Resonance frequency, radiation pattern, and VSWR would change dramatically or could be lost completely.

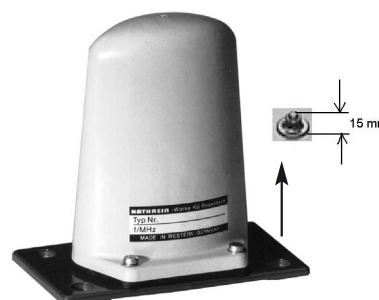


Figure 3: Low profile broad band antenna with mounting screws

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## Sealing

To avoid corrosion and leaky into the vehicle, antenna connectors need to be sealed against the mounting plate. Every Kathrein antenna is supplied with detailed mounting instructions. An O-ring is supplied with each antenna to seal the through hole into the vehicles body against the antennas connector. For certain types, this ring runs around the whole flange. To achieve advanced sealing mating

surfaces between the antenna socket and mounting flange/mounting surface are supposed of being flat.

Sealing also needs to be performed around mounting holes if no mounting flanges are used. Corrosion at mating surfaces between the antenna and the mounting plane is critical for proper function of the antenna.

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## Painting

For optical reasons the color of train antennas sometimes has to match certain colors. Kathrein antennas are particularly suitable for subsequent, long-lasting painting since the visible parts (radomes) are generally made of fiberglass (polyester), to which paint adheres very well. A thin layer of paint eventually has only a negligible influence on the electrical characteristics.

General remarks:

- We recommend that painting is only performed by qualified professional painting companies. If required painting on site may also be possible (and permissible).

- We recommend that painting should only be applied to visible surfaces: e.g.
  - Fiberglass radome
  - Antenna socket, upper surface – please refer to instructions stated in our data sheets

- The contact area on the lower part of the flange must be kept unpainted at all events.

- Suitable commercial paints consist of one or two components. The manufacturer's instruction for use and processing must be observed. Paints with metallic effects or metallic components are not permissible.

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## Obstacles close to the antenna

For proper wave propagation from the antenna into the surroundings a flat roof without any obstacles would be preferred.

Trains sometimes have a number of structures for multiple purposes on the trains top. Any obstacles

close to the antenna may impact radiation pattern and radiated waves. It is difficult to leave general guidelines about minimum distances. As a rule over the thumb antennas should face no obstacles within a radius of approximately 1 m or more.

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## Distances to other antennas

The distance to other antennas depends on the required antenna isolation. This value has to be clarified with the suppliers of the installed mobile communication system.

An isolation of 30 dB is a preferred value. As a rule over the thumb, a distance of approximately

5–7 Lambda is required for antennas operating the same frequency band.

Due to the selectivity of different systems, antennas operating in different frequency bands require distances that can be even smaller.

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