

# Measurement of 5G NR FR2 Electromagnetic Fields



**Downconverter-Antennas for omnidirectional and directional measurement of fields and their sources in the frequency range from 24.25 GHz to 29.5 GHz**

With the downconverter antennas, the user gets the possibility to extend the frequency range of the SRM-3006 to frequencies from 24.25 GHz to 29.5 GHz. One of the main applications is to demonstrate compliance with the EMF limits in frequency range FR2 of the 5G NR mobile radio service. Of course all other applications in this frequency range can also be measured. The two antennas differ in their reception characteristics: The Model 3591/01 features a directional characteristic, while the Model 3591/02 offers an omnidirectional characteristic.

- › Extends SRM-3006 to cover 24.25 GHz to 29.5 GHz.
- › Calibrated antennas for reliable measurements
- › Measurements are displayed in field strength or in percent of limit values, e.g. ICNIRP, FCC...
- › Omnidirectional antenna design for environmental measurements
- › Directional antenna design for weak signals
- › Easy to setup
- › Simple operation
- › Fast and reliable measurement results



## Available Antenna Models

Two different antenna models are available. A directional antenna with high sensitivity and an omnidirectional antenna. Both antennas include a downconverter that converts the millimeter wave between 24.25 GHz to 29.5 GHz into the SRM-3006's receive band. This means that the RF cable between antenna and basic unit only transmits frequencies up to a maximum of 6 GHz, which greatly reduces the cable loss compared with a 20 GHz cable. In addition, the downconverter in the antenna avoids the need to modify the base unit, so the antenna can be used on all SRM-3006 devices without hardware modifications. Only a firmware update is required, which can be done by the user.

The antennas have their own batteries, independent from the basic unit. So the runtime of the SRM is not affected by the operation of the downconverter antenna. The battery integrated in the antenna can be charged via an USB-C socket. Connected to a USB power bank, long-term measurements can also be performed.

Narda recommends to operate the antennas only via an extension cable with the SRM.

### Measurement of weak signals (e.g. indoors):

For measurements inside buildings, the field strengths are often very low. For example, a modern, coated glass window can attenuate a signal at 24 GHz by about 30 dB. To be able to detect such a field strength, a high gain antenna is needed. However, such antennas have a high directivity due to their principle. The antenna model 3591/01 has such a characteristic.

In addition, the directional characteristic can be used to detect the field strength of geographically separated base stations..

### Outdoor environmental measurements:

For EMF measurements, national as well as international standards recommend an isotropic measurement. Such antennas are not available for the FR2 frequency range. The antenna 3591/02 offers an omnidirectional reception characteristic that roughly corresponds to that of a donut. Ideal reception results are therefore obtained from an X-Y spatial plane. To cover all three spatial axes for isotropic measurements, the antenna must be connected to the basic unit via an RF cable and moved accordingly during the measurement.

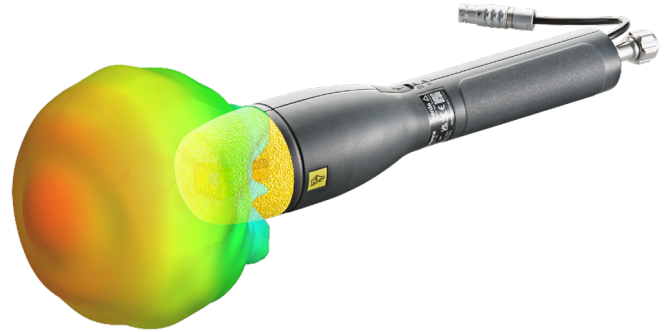


Fig. 1. 3591/01 Directional Antenna (Horn antenna)



Fig. 2. 3591/02 Omnidirectional

### **Conditions**

Unless otherwise noted, specifications apply after 30 minutes warm-up time within the specified environmental conditions. The product is within the recommended calibration cycle.

### **Specifications with limits**

These describe product performance for the given parameter covered by warranty. Specifications with limits (shown as  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , max., min.) apply under the given conditions for the product and are tested during production, considering measurement uncertainty.

### **Specifications without limits**

These describe product performance for the given parameter covered by warranty. Specifications without limits represent values with negligible deviations, which are ensured by design (e.g. dimensions or resolution of a setting parameter).

### **Typical values (typ.)**

These characterize product performance for the given parameter that is not covered by warranty. When stated as a range or as a limit (shown as  $<$ ,  $\leq$ ,  $>$ ,  $\geq$ ,  $\pm$ , max., min.), they represent the performance met by approximately 80% of the instruments. Otherwise, they represent the mean value. The measurement uncertainty is not taken into account.

### **Nominal values (nom.)**

These characterize expected product performance for the given parameter that is not covered by warranty. Nominal values are verified during product development but are not tested during production.

### **Uncertainties**

These characterize the dispersion of the values attributed to the measurands with an estimated confidence level of approximately 95%. Uncertainty is stated as the standard uncertainty multiplied by the coverage factor  $k=2$  based on the normal distribution. The evaluation has been carried out in accordance with the rules of the "Guide to the Expression of Uncertainty in Measurement" (GUM).

# Specifications

## 3591/01 LNB Antenna, 24.25 GHz to 29.5 GHz, directional

General specification			
Antenna type	E-Field		
Sensor type	Downconverter with directional antenna design		
RF connector	N-connector, 50 Ω, male		
Frequency			
Frequency range	Band A: 24.25 GHz to 27.5 GHz Band B: 26.5 GHz to 29.5 GHz The frequency band can be selected in the user interface of the basic unit.		
SSB phase noise	$f_c$	df = 10 kHz	df = 100 kHz      df = 10 MHz
	26 GHz	< -83 dBc (1/Hz)	< -90 dBc (1/Hz)      < -112 dBc (1/Hz)
Internal reference frequency	Deviation:	< 1 ppm	
	Aging:	< 1 ppm/year, < 5 ppm over 15 years	
	Thermal drift:	< 1.5 ppm (-10 °C to +50 °C)	
Amplitude			
Dynamic Range	Noise Figure @ attenuator = 0 dB	24.25 GHz ≤ f ≤ 29.5 GHz	< 33 dB
		24.25 GHz ≤ f ≤ 29.5 GHz	26 dB (typ.)
	2nd order intercept point (IP2, 2 tones) @ attenuator = 0 dB	24.25 GHz ≤ f ≤ 29.5 GHz	
3rd order intercept point (IP3, 2 tones) @ attenuator = 0 dB	24.25 GHz ≤ f ≤ 29.5 GHz	10 dBm (typ.)	
Level uncertainty	24.25 GHz ≤ f ≤ 29.5 GHz	< ± 1.8 dB	without cable
Residual spurs @ attenuator = 0 dB	24.25 GHz ≤ f ≤ 29.5 GHz	< -80 dBm	exceptions < -60 dBm
IF rejection	> 60 dB		
Image rejection	70 dB typ.		
Attenuator	10 dB The attenuator of the antenna can be switched on/off in the user interface of the basic unit.		
RF input			
Type	Directional antenna		
RF destruction limit	225 V/m		
Max. nominal RF level	100 V/m		
Spurs Emmisions	> -70 dBm		
Measurement uncertainty			
Expanded measurement uncertainty b) (in conjunction with SRM basic unit and 1.5 m RF cable)	tbd		

## 3591/02 LNB Antenna, 24.25 GHz to 29.5 GHz, omnidirectional

General specification			
Antenna type	E-Field		
Sensor type	Downconverter with omnidirectional antenna design		
RF connector	N-connector, 50 $\Omega$ , male		
Frequency			
Frequency range	Band A: 24.25 GHz to 27.5 GHz Band B: 26.5 GHz to 29.5 GHz The frequency band can be selected in the user interface of the basic unit.		
SSB phase noise	$f_c$	df = 10 kHz	df = 100 kHz
	26 GHz	< -83 dBc (1/Hz)	< -90 dBc (1/Hz)
			df = 10 MHz
			< -112 dBc (1/Hz)
Internal reference frequency	Deviation:		< 1 ppm
	Aging:		< 1 ppm/year, < 5 ppm over 15 years
	Thermal drift:		< 1.5 ppm (-10 °C to +50 °C)
Amplitude			
Dynamic Range	Noise Figure @ attenuator = 0 dB	24.25 GHz $\leq$ f $\leq$ 29.5 GHz	< 33 dB
		24.25 GHz $\leq$ f $\leq$ 29.5 GHz	26 dB (typ.)
	2nd order intercept point (IP2, 2 tones) @ attenuator = 0 dB	24.25 GHz $\leq$ f $\leq$ 29.5 GHz	
	3rd order intercept point (IP3, 2 tones) @ attenuator = 0 dB	24.25 GHz $\leq$ f $\leq$ 29.5 GHz	10 dBm (typ.)
Level uncertainty	24.25 GHz $\leq$ f $\leq$ 29.5 GHz	< $\pm$ 1.8 dB	without cable
Residual spurs @ attenuator = 0 dB	24.25 GHz $\leq$ f $\leq$ 29.5 GHz	< -80 dBm	exceptions < -60 dBm
IF rejection	> 60 dB		
Image rejection	70 dB typ.		
Attenuator	10 dB The attenuator of the antenna can be switched on/off in the user interface of the basic unit.		
RF input			
Type	Omnidirectional antenna		
RF destruction limit	435 V/m		
Max. nominal RF level	200 V/m		
Spurs Emmissions	> -70 dBm		
Measurement uncertainty			
Expanded measurement uncertainty b) (in conjunction with SRM basic unit and 1.5 m RF cable)	tbd		

## General

General specification			
Operating temperature		-10 °C to 50 °C (same as SRM basic unit)	
Compliance	Climatic	Storage	1K3 (IEC 60721-3) extended to -10 °C to +50 °C
		Transport	2K3 (IEC 60721-3) extended to -30 °C to +70 °C
		Operating	7K2 (IEC 60721-3) extended to -10 °C to +50 °C
	Mechanical	Storage	1M3 (IEC 60721-3)
		Transport	2M3 (IEC 60721-3)
		Operating	7M3 (IEC 60721-3)
	Ingress protection		IP 52 (USB flap closed)
	EMC	EU	Complies with EMC Directive 2014/30/EU and EN 61326 -1: 2013
		Immunity	EN: 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-5, 61000-4-6, 61000-4-8, 61000-4-11
Emissions		EN: 61000-3-2, 61000-3-3, EN 55011 (CISPR 11) Class B	
Safety		Complies with European Low Voltage Directive 2014/35/EU and EN 61010-1: 2010	
Material		Complies with European RoHS Directive 2011/65/EU	
Air humidity (operating range)		< 29 g/m <sup>3</sup> (< 93 % RH at +30 °C), non-condensing	
Weight		615 g	
Dimensions		485 mm length; 78 mm antenna head diameter (19.1" length; 3.1" antenna head diameter)	
Power supply		USB C, operation and charge at least 1 A	
Operating time		Appr. 4h operation with internal battery. Can also be operated with an external USB power bank.	
Recommended calibration interval		24 months	
Country of origin		Germany	

## Ordering information

Your local Narda representative will inform you of all possible options as well as the current ordering information and will be pleased to provide you with advice.

### Antennas

Set 5G FR2 Antenna, directional, 24.25 to 29.5 GHz	Part number
Includes:	3591/101
<ul style="list-style-type: none"> <li>› LNB Antenna, 24.25 to 29.5GHz, dir. (3591/01)</li> <li>› Power Supply USB-C with cable</li> <li>› LNB Antenna - Quick Start and Safety Instructions (3591/98.12)</li> </ul>	

Set 5G FR2 Antenna, omnidir., 24.25 to 29.5 GHz	Part number
Includes:	3591/102
<ul style="list-style-type: none"> <li>› LNB Antenna, 24.25 to 29.5GHz, omn. (3591/02)</li> <li>› Power Supply USB-C with cable</li> <li>› LNB Antenna - Quick Start and Safety Instructions (3591/98.12)</li> </ul>	

Set 5G FR2 Antenna, dir. + omni., 24.25 to 29.5 GHz	Part number
Includes:	3591/103
<ul style="list-style-type: none"> <li>› LNB Antenna, 24.25 to 29.5GHz, dir. (3591/01)</li> <li>› LNB Antenna, 24.25 to 29.5GHz, omn. (3591/02)</li> <li>› 2 x Power Supply USB-C with cable</li> <li>› LNB Antenna - Quick Start and Safety Instructions (3591/98.12)</li> </ul>	

### Software

Description	Part number
Software, SRM-3006 Tools, Configuration SW (free Download)	-
Software, SRM-3006 TS, PC Evaluation and Remote	3006/93.10

### Accessories

Description	Part number
Power Supply USB-C PD, AU/EU/UK/US Plugs with cable	tbd
Car Charger Adapter, USB 5V	tbd
LNB Antenna - Quick Start and Safety Instruct	3591/98.12
RF-Cable, 9 kHz to 6 GHz, N 50 ohm, 1.5m	3602/01
RF-Cable, 9 kHz to 6 GHz, N 50 ohm, 5m	3602/02
Antenna Holder for Uniaxial/Triaxial Antenna	3501/90.01
Antenna Holder for Triaxial Antenna	3501/90.02
Tripod Ball Joint Adapter for 3501/90.02	tbd
Tripod, Non-Conductive, 1.65 m with carrying bag	2244/90.31
Tripod Extension, 0.50m, Non-Conductive	2244/90.45

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