

Kalibrierstelle für Antennen und Feldsonden  
*Calibration Body for Antennas and Field Probes*

Akkreditiert durch / *accredited by*  
**AKKREDITIERUNG AUSTRIA**



Kalibrierschein nach ISO/IEC 17025  
*Calibration Certificate according to ISO/IEC 17025*

Kalibrierzeichen  
*Calibration mark*

EH-A876/21
<b>0612</b>
21.06.2021

Gegenstand  
*Object*                      Horn Antenna

Hersteller & Typ  
*Manufacturer & Type*                      EMCO 3116

Herstellernummer  
*Serial number*                      9904-2426

Auftraggeber  
*Customer*                      RISE Research Institutes of Sweden AB501  
15 Borås  
Sweden

Auftragsnummer  
*Order Nr.*                      L.L7.00059.0.0-A-8706\_1  
Ext. Ord. No.: X1003633

Anzahl der Seiten des Kalibrierscheines  
*Number of pages of the certificate*                      1 - 6

Datum der Kalibrierung  
*Date of calibration*                      21.06.2021

Akkreditierung Austria ist Vollmitglied bei der International Laboratory Accreditation Cooperation ILAC und Unterzeichner der MRAs für die Bereiche „Testing, Calibration and Inspection“.

Die Kalibrierung erfolgt auf der gesetzlichen Grundlage des Akkreditierungsgesetzes in gültiger Fassung entsprechend den Anforderungen der ÖVE/ÖNORM EN ISO/IEC 17025.

Dieser Kalibrierschein dokumentiert die Rückführbarkeit auf nationale Normale zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).

Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

*Akkreditierung Austria is a full member of the International Laboratory Accreditation Cooperation ILAC and a signatory of the MRA for "Testing, Calibration and Inspection".*

*The calibration is performed in accordance with the Akkreditierungsgesetz in the amended version and the requirements of ÖVE/ÖNORM EN ISO/IEC 17025.*

*This calibration certificate documents the traceability to national standards, which realize the physical units or measurements according to the International System of Units (SI).*

*The user is obliged to have the object recalibrated at appropriate intervals.*

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverarbeitet werden. Auszüge oder Änderungen sind unzulässig. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.

*This calibration certificate may not be reproduced other than in full. Calibration certificates without signature are not valid.*

Datum  
*Date*

Zeichnungsberechtigter  
*Authorized person*

Bearbeiter  
*Person responsible*

21.06.2021

Patrick Preiner

Markus Vaclav

## Calibration Procedure

### ANSI C63.5, CISPR 16-1-6

Calibration of the freespace antenna factor is carried out in a fully absorber lined anechoic test site using the standard-site method given by ANSI C63.5 and ANSI C63.4 (specified up to 40GHz) and the three antenna method (TAM) given by CISPR 16-1-6 (specified up to 18GHz).

The **gain** is calculated from the calibrated antenna factor ( $AF$ ) using the equation:

$$Gain = 20 * \log\left(\frac{9.73}{\lambda}\right) - AF$$

## Test Equipment

Type	Identification
Network Analyzer Agilent Technologies N5244A	E0190
Double Ridged Horn EMCO 3116	E0539
Double Ridged Horn EMCO 3116	E0541
Cable	LE0147
Cable	LE0151
CalStan 10.0	E0920
Anechoic Chamber (FAR)	LE0128

## Environmental Conditions

Test Site Temperature	24°C	± 3 °C
Test Site Humidity	48 %	± 10 %
Control Room Temperature	25°C	± 3 °C
Control Room Humidity	46 %	± 10 %

## Results

Type	Distance	Fig./Table
Freespace AF	3 m	1
Gain	3 m	2

## Accuracy of Calibration

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EAL Publication EA 4/02.

## References

- [1] ANSI C63.5-2017/Cor 1-2019 American National Standard for Electromagnetic Compatibility--Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration and Qualification of Antennas (9 kHz to 40 GHz) – Corrigendum 1
- [2] ANSI C63.4-2014 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- [3] CISPR 16-1-6:2014/AMD1:2017 Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-6: Radio disturbance and immunity measuring apparatus - EMC antenna calibration
- [4] EA-4/02 M:2013 Evaluation of the Uncertainty of Measurement in Calibration

Figure 1: Freespace AF; distance = 3 m

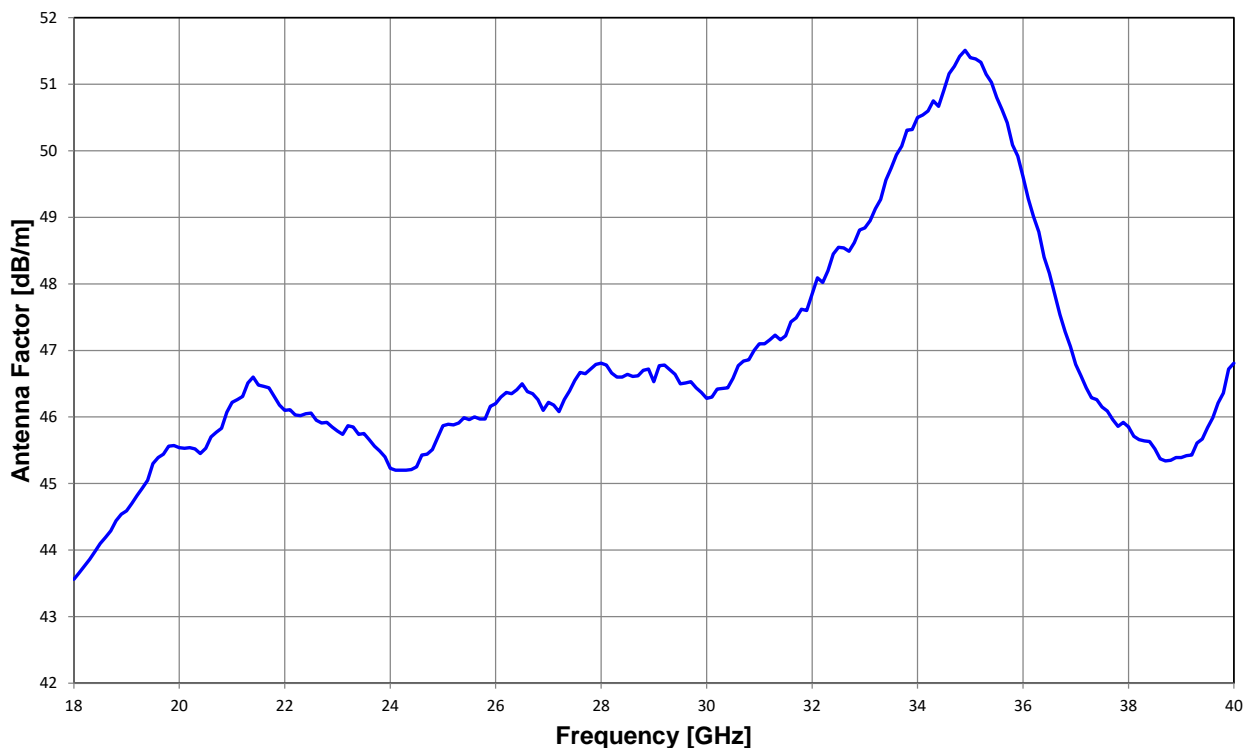


Table 1: Freespace AF; distance = 3 m

f [GHz]	AF [dB/m]	U [dB]	f [GHz]	AF [dB/m]	U [dB]	f [GHz]	AF [dB/m]	U [dB]
18.000	43.56	1.50	25.000	45.87	2.00	32.000	47.85	3.00
18.100	43.66	1.50	25.100	45.89	2.00	32.100	48.09	3.00
18.200	43.76	1.50	25.200	45.88	2.00	32.200	48.02	3.00
18.300	43.86	1.50	25.300	45.91	2.00	32.300	48.20	3.00
18.400	43.98	1.50	25.400	45.99	2.00	32.400	48.45	3.00
18.500	44.10	1.50	25.500	45.96	2.00	32.500	48.55	3.00
18.600	44.19	1.50	25.600	46.00	2.00	32.600	48.54	3.00
18.700	44.29	1.50	25.700	45.97	2.00	32.700	48.49	3.00
18.800	44.44	1.50	25.800	45.97	2.00	32.800	48.62	3.00
18.900	44.54	1.50	25.900	46.16	2.00	32.900	48.81	3.00
19.000	44.59	1.50	26.000	46.20	2.00	33.000	48.84	3.00
19.100	44.70	1.50	26.100	46.30	2.00	33.100	48.95	3.00
19.200	44.82	1.50	26.200	46.37	2.00	33.200	49.13	3.00
19.300	44.93	1.50	26.300	46.35	2.00	33.300	49.27	3.00
19.400	45.05	1.50	26.400	46.41	2.00	33.400	49.56	3.00
19.500	45.30	1.50	26.500	46.50	3.00	33.500	49.74	3.00
19.600	45.39	1.50	26.600	46.38	3.00	33.600	49.94	3.00
19.700	45.44	1.50	26.700	46.35	3.00	33.700	50.07	3.00
19.800	45.56	1.50	26.800	46.26	3.00	33.800	50.31	3.00
19.900	45.57	1.50	26.900	46.10	3.00	33.900	50.32	3.00
20.000	45.54	2.00	27.000	46.22	3.00	34.000	50.50	3.00
20.100	45.53	2.00	27.100	46.18	3.00	34.100	50.54	3.00
20.200	45.54	2.00	27.200	46.08	3.00	34.200	50.60	3.00
20.300	45.52	2.00	27.300	46.26	3.00	34.300	50.75	3.00
20.400	45.45	2.00	27.400	46.39	3.00	34.400	50.67	3.00
20.500	45.53	2.00	27.500	46.55	3.00	34.500	50.91	3.00
20.600	45.70	2.00	27.600	46.67	3.00	34.600	51.16	3.00
20.700	45.77	2.00	27.700	46.65	3.00	34.700	51.27	3.00
20.800	45.83	2.00	27.800	46.72	3.00	34.800	51.42	3.00
20.900	46.07	2.00	27.900	46.79	3.00	34.900	51.51	3.00
21.000	46.22	2.00	28.000	46.81	3.00	35.000	51.40	3.00
21.100	46.26	2.00	28.100	46.78	3.00	35.100	51.38	3.00
21.200	46.31	2.00	28.200	46.66	3.00	35.200	51.33	3.00
21.300	46.51	2.00	28.300	46.60	3.00	35.300	51.15	3.00
21.400	46.60	2.00	28.400	46.60	3.00	35.400	51.03	3.00
21.500	46.48	2.00	28.500	46.64	3.00	35.500	50.80	3.00
21.600	46.46	2.00	28.600	46.61	3.00	35.600	50.62	3.00
21.700	46.44	2.00	28.700	46.62	3.00	35.700	50.42	3.00
21.800	46.31	2.00	28.800	46.70	3.00	35.800	50.09	3.00
21.900	46.18	2.00	28.900	46.72	3.00	35.900	49.92	3.00
22.000	46.10	2.00	29.000	46.53	3.00	36.000	49.61	3.00
22.100	46.11	2.00	29.100	46.77	3.00	36.100	49.28	3.00
22.200	46.03	2.00	29.200	46.78	3.00	36.200	49.01	3.00
22.300	46.02	2.00	29.300	46.71	3.00	36.300	48.78	3.00
22.400	46.05	2.00	29.400	46.64	3.00	36.400	48.40	3.00
22.500	46.06	2.00	29.500	46.50	3.00	36.500	48.16	3.00
22.600	45.95	2.00	29.600	46.51	3.00	36.600	47.85	3.00
22.700	45.91	2.00	29.700	46.53	3.00	36.700	47.54	3.00
22.800	45.92	2.00	29.800	46.44	3.00	36.800	47.28	3.00
22.900	45.85	2.00	29.900	46.37	3.00	36.900	47.06	3.00
23.000	45.79	2.00	30.000	46.28	3.00	37.000	46.79	3.00
23.100	45.74	2.00	30.100	46.30	3.00	37.100	46.62	3.00
23.200	45.87	2.00	30.200	46.42	3.00	37.200	46.44	3.00
23.300	45.85	2.00	30.300	46.43	3.00	37.300	46.29	3.00
23.400	45.74	2.00	30.400	46.44	3.00	37.400	46.26	3.00
23.500	45.75	2.00	30.500	46.58	3.00	37.500	46.15	3.00
23.600	45.66	2.00	30.600	46.77	3.00	37.600	46.09	3.00
23.700	45.56	2.00	30.700	46.84	3.00	37.700	45.96	3.00
23.800	45.49	2.00	30.800	46.86	3.00	37.800	45.86	3.00
23.900	45.40	2.00	30.900	47.00	3.00	37.900	45.92	3.00
24.000	45.23	2.00	31.000	47.10	3.00	38.000	45.85	3.00
24.100	45.20	2.00	31.100	47.10	3.00	38.100	45.71	3.00
24.200	45.20	2.00	31.200	47.16	3.00	38.200	45.66	3.00
24.300	45.20	2.00	31.300	47.23	3.00	38.300	45.64	3.00
24.400	45.21	2.00	31.400	47.16	3.00	38.400	45.63	3.00
24.500	45.25	2.00	31.500	47.22	3.00	38.500	45.52	3.00
24.600	45.43	2.00	31.600	47.43	3.00	38.600	45.37	3.00
24.700	45.44	2.00	31.700	47.49	3.00	38.700	45.34	3.00
24.800	45.51	2.00	31.800	47.62	3.00	38.800	45.35	3.00
24.900	45.69	2.00	31.900	47.60	3.00	38.900	45.39	3.00

f [GHz]	AF [dB/m]	U [dB]	f [GHz]	AF [dB/m]	U [dB]	f [GHz]	AF [dB/m]	U [dB]
39.000	45.39	3.00	39.400	45.67	3.00	39.800	46.36	3.00
39.100	45.42	3.00	39.500	45.84	3.00	39.900	46.72	3.00
39.200	45.43	3.00	39.600	45.99	3.00	40.000	46.81	3.00
39.300	45.61	3.00	39.700	46.21	3.00			

Figure 2: Gain; distance = 3 m

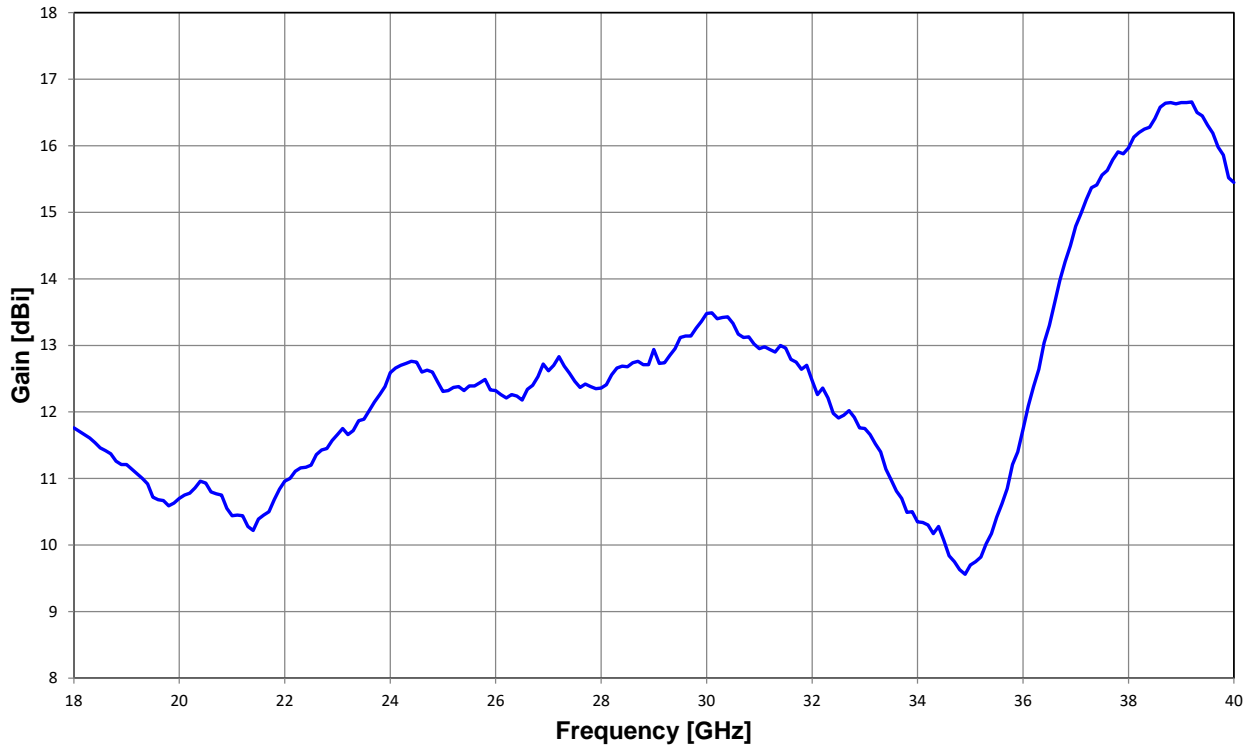


Table 2: Gain; distance = 3 m

f [GHz]	G [dBi]	U [dB]	f [GHz]	G [dBi]	U [dB]	f [GHz]	G [dBi]	U [dB]
18.000	11.76	1.50	20.600	10.80	2.00	23.200	11.66	2.00
18.100	11.71	1.50	20.700	10.77	2.00	23.300	11.72	2.00
18.200	11.66	1.50	20.800	10.75	2.00	23.400	11.87	2.00
18.300	11.61	1.50	20.900	10.55	2.00	23.500	11.89	2.00
18.400	11.54	1.50	21.000	10.44	2.00	23.600	12.02	2.00
18.500	11.46	1.50	21.100	10.45	2.00	23.700	12.15	2.00
18.600	11.42	1.50	21.200	10.44	2.00	23.800	12.26	2.00
18.700	11.37	1.50	21.300	10.28	2.00	23.900	12.38	2.00
18.800	11.26	1.50	21.400	10.22	2.00	24.000	12.59	2.00
18.900	11.21	1.50	21.500	10.39	2.00	24.100	12.66	2.00
19.000	11.21	1.50	21.600	10.45	2.00	24.200	12.70	2.00
19.100	11.14	1.50	21.700	10.50	2.00	24.300	12.73	2.00
19.200	11.07	1.50	21.800	10.68	2.00	24.400	12.76	2.00
19.300	11.00	1.50	21.900	10.84	2.00	24.500	12.75	2.00
19.400	10.92	1.50	22.000	10.96	2.00	24.600	12.60	2.00
19.500	10.72	1.50	22.100	11.00	2.00	24.700	12.63	2.00
19.600	10.68	1.50	22.200	11.11	2.00	24.800	12.60	2.00
19.700	10.67	1.50	22.300	11.16	2.00	24.900	12.45	2.00
19.800	10.59	1.50	22.400	11.17	2.00	25.000	12.31	2.00
19.900	10.63	1.50	22.500	11.20	2.00	25.100	12.32	2.00
20.000	10.70	2.00	22.600	11.36	2.00	25.200	12.37	2.00
20.100	10.75	2.00	22.700	11.43	2.00	25.300	12.38	2.00
20.200	10.78	2.00	22.800	11.45	2.00	25.400	12.32	2.00
20.300	10.86	2.00	22.900	11.57	2.00	25.500	12.39	2.00
20.400	10.96	2.00	23.000	11.66	2.00	25.600	12.39	2.00
20.500	10.93	2.00	23.100	11.75	2.00	25.700	12.44	2.00

f [GHz]	G [dBi]	U [dB]	f [GHz]	G [dBi]	U [dB]	f [GHz]	G [dBi]	U [dB]
25.800	12.49	2.00	30.700	13.12	3.00	35.600	10.62	3.00
25.900	12.33	2.00	30.800	13.13	3.00	35.700	10.85	3.00
26.000	12.32	2.00	30.900	13.02	3.00	35.800	11.21	3.00
26.100	12.26	2.00	31.000	12.95	3.00	35.900	11.40	3.00
26.200	12.21	2.00	31.100	12.98	3.00	36.000	11.74	3.00
26.300	12.26	2.00	31.200	12.94	3.00	36.100	12.09	3.00
26.400	12.24	2.00	31.300	12.90	3.00	36.200	12.38	3.00
26.500	12.18	3.00	31.400	13.00	3.00	36.300	12.64	3.00
26.600	12.34	3.00	31.500	12.96	3.00	36.400	13.04	3.00
26.700	12.40	3.00	31.600	12.79	3.00	36.500	13.30	3.00
26.800	12.53	3.00	31.700	12.75	3.00	36.600	13.64	3.00
26.900	12.72	3.00	31.800	12.64	3.00	36.700	13.98	3.00
27.000	12.62	3.00	31.900	12.70	3.00	36.800	14.26	3.00
27.100	12.70	3.00	32.000	12.47	3.00	36.900	14.50	3.00
27.200	12.83	3.00	32.100	12.26	3.00	37.000	14.79	3.00
27.300	12.69	3.00	32.200	12.36	3.00	37.100	14.98	3.00
27.400	12.58	3.00	32.300	12.21	3.00	37.200	15.19	3.00
27.500	12.46	3.00	32.400	11.98	3.00	37.300	15.37	3.00
27.600	12.37	3.00	32.500	11.91	3.00	37.400	15.41	3.00
27.700	12.42	3.00	32.600	11.95	3.00	37.500	15.56	3.00
27.800	12.38	3.00	32.700	12.02	3.00	37.600	15.63	3.00
27.900	12.35	3.00	32.800	11.92	3.00	37.700	15.79	3.00
28.000	12.36	3.00	32.900	11.76	3.00	37.800	15.91	3.00
28.100	12.41	3.00	33.000	11.75	3.00	37.900	15.88	3.00
28.200	12.56	3.00	33.100	11.66	3.00	38.000	15.97	3.00
28.300	12.66	3.00	33.200	11.52	3.00	38.100	16.13	3.00
28.400	12.69	3.00	33.300	11.40	3.00	38.200	16.20	3.00
28.500	12.68	3.00	33.400	11.14	3.00	38.300	16.25	3.00
28.600	12.74	3.00	33.500	10.98	3.00	38.400	16.28	3.00
28.700	12.76	3.00	33.600	10.81	3.00	38.500	16.41	3.00
28.800	12.71	3.00	33.700	10.70	3.00	38.600	16.58	3.00
28.900	12.71	3.00	33.800	10.49	3.00	38.700	16.64	3.00
29.000	12.94	3.00	33.900	10.50	3.00	38.800	16.65	3.00
29.100	12.73	3.00	34.000	10.35	3.00	38.900	16.63	3.00
29.200	12.74	3.00	34.100	10.34	3.00	39.000	16.65	3.00
29.300	12.85	3.00	34.200	10.30	3.00	39.100	16.65	3.00
29.400	12.95	3.00	34.300	10.17	3.00	39.200	16.66	3.00
29.500	13.12	3.00	34.400	10.28	3.00	39.300	16.50	3.00
29.600	13.14	3.00	34.500	10.07	3.00	39.400	16.45	3.00
29.700	13.14	3.00	34.600	9.84	3.00	39.500	16.31	3.00
29.800	13.26	3.00	34.700	9.75	3.00	39.600	16.19	3.00
29.900	13.36	3.00	34.800	9.63	3.00	39.700	15.98	3.00
30.000	13.48	3.00	34.900	9.56	3.00	39.800	15.86	3.00
30.100	13.49	3.00	35.000	9.70	3.00	39.900	15.52	3.00
30.200	13.40	3.00	35.100	9.75	3.00	40.000	15.45	3.00
30.300	13.42	3.00	35.200	9.82	3.00			
30.400	13.43	3.00	35.300	10.02	3.00			
30.500	13.33	3.00	35.400	10.17	3.00			
30.600	13.17	3.00	35.500	10.42	3.00			