FCC Measurement/Technical Report on

CIR-F-J

FCC ID: S7Y-MV1

Test Report Reference: MDE_ELEM_2201_FCC_01_REV01

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche
Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

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Applied Standards and Test Summary

1.1 APPLIED STANDARDS

Type of Authorization
Certification for a Radar Unit.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Part 95 (10-01-21 Edition). The following subparts are applicable to the results in this test report.

Part 95, Subpart M – The 76-81 GHz Band Radar Service

FCC §95.3379 76-81 GHz Band Radar Service unwanted emissions limits

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.

1.2 TEST REQUIREMENT

Measurement	FCC reference
Radiated Power Limits	§95.3367
Unwanted Emission Limits	§95.3379
Frequency Stability of Fundamental Emissions	§95.3379

1.3 MEASUREMENT SUMMARY / SIGNATURES

FCC §95.3379
Transmit Spurious Emissions Radiated

		Final Result
OP-Mode Radio Technology, Operating Frequency, Measurement range	**Setup**	**FCC**
Radar System, 77 GHz, 110 GHz – 140 GHz	Setup_AA01	Passed
Radar System, 77 GHz, 140 GHz – 220 GHz	Setup_AA01	Passed
Radar System, 77 GHz, 220 GHz – 231 GHz	Setup_AA01	Passed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2022-11-23	--	invalid
REV01	2023-04-12	FCC-ID changed on front page	valid

COMMENT:
On applicant's demand only radiated emissions from 110 GHz up to 231 GHz were performed.

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
B.Sc. Jens Dörwald

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3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-01| -02 | -03
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier	DE0007; ISED#: 3699A
Responsible for accreditation scope:	Dipl.-Ing. Marco Kullik
Report Template Version:	2022-05-25

3.2 PROJECT DATA

Responsible for testing and report:	B.Sc. Jens Dörwald
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2023-04-12
Testing Period:	2022-10-20

3.3 APPLICANT DATA

Company Name:	Element Materials Technology
Address:	Unit E South Orbital Trading Park Hedon Road Hull, HU9 1NJ United Kingdom
Contact Person:	Mrs. Julie Else

3.4 MANUFACTURER DATA

Company Name:	Navtech Radar Limited
Address:	Home Farm, Ardington, Wantage, Oxfordshire OX12 8PD, UK
Contact Person:	Mr. Richard Poulton

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Radar Unit
Product name	CIR-F-J
Declared EUT data by the supplier	
Voltage Type	DC
Voltage Level	24 V
Tested Modulation Type	FMCW
Output Power	43 dBm
Operational Bandwidth	1 GHz
General product description	The EUT is a 76 – 77 GHz ground Radar.
Specific product description	Industrial radar sensor for safety, efficiency and automation applications, operating in the 76-77GHz band.
Ports of the device	DC LAN
Antenna / Gain	internal / 33 dBi
Special software used for testing	-

The main components of the EUT are listed and described in chapter 3.2 EUT Main components.

4.2 EUT MAIN COMPONENTS

Sample Name	Sample Code	Description
DE1296005	aa01	radiated sample
Sample Parameter	**Value**	
Serial No.	3306	
HW Version	CIR-F-J	
SW Version	3.0.0.178	
Comment	-	

NOTE:The short description is used to simplify the identification of the EUT in this test report.

4.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Device	Details (Manufacturer, Type Model, OUT Code)	Description
-	-	-

4.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Device	Details (Manufacturer, HW, SW, S/N)	Description
-	-	-

4.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	Combination of EUTs	Description and Rationale
Setup_AA01	aa01	radiated sample

4.6 OPERATING MODES

This chapter describes the operating modes of the EUTs used for testing.

Radar System TX on 77 GHz

4.7 PRODUCT LABELLING

4.7.1FCC ID LABEL

Please refer to the documentation of the applicant.

4.7.2LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

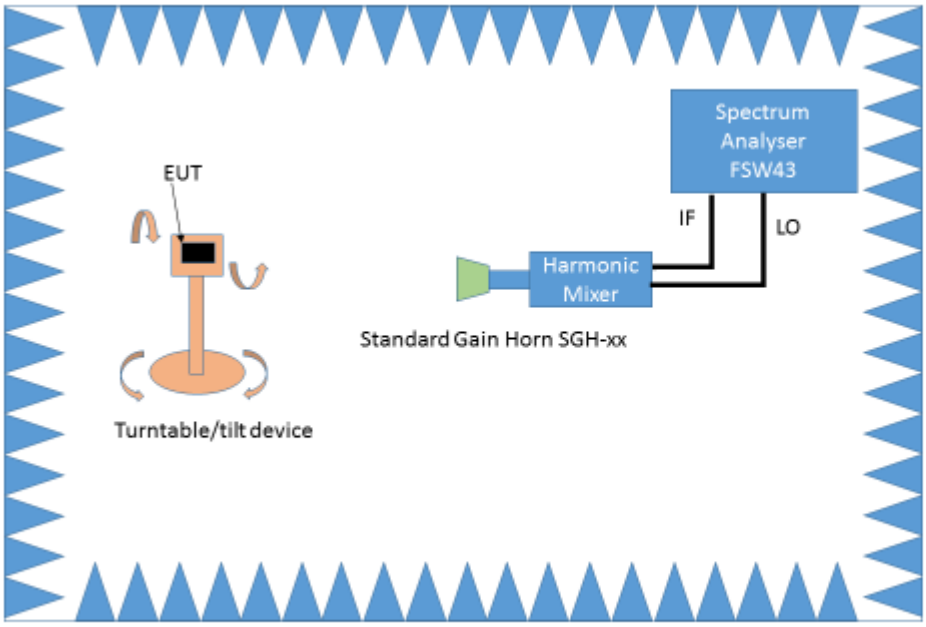
5.1 TRANSMIT SPURIOUS EMISSIONS RADIATED

Standard **FCC Part 95 Subpart M**

The test was performed according to:
ANSI C63.10

5.1.1TEST DESCRIPTION

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table $A = \pi r^2$ (with r = 0.6 m) in the fully-anechoic chamber.
The measurement procedure is implemented into the EMI test software EMC32 from R&S.
Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation.



FCC Part 95 M; 76-81 GHz Band Radar Service – Test Setup; Radiated Emissions 40 GHz – 231 GHz

The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
All steps were performed with one height (1.5 m) of the receiving antenna, if the beamwidth of the receiving antenna covers the entire EUT, otherwise the height of the receiving antenna was varied. The EUT is turned continuously during the measurement across the elevation axis.

This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Average
- RBW = 1 MHz

- VBW = 3 MHz
- Frequency range: 110 – 231 GHz
- Turntable angle range: –180° to 90°
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement
The turntable azimuth will slowly vary by 360°. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted.
- Antenna distance: 3 m
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Turntable angle range: 360 °
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement
With the settings determined in step 2, the final measurement will be performed:
- Antenna distance: 3 m
- Detector: Average
- Measuring time: 1 s

5.1.2TEST REQUIREMENTS / LIMITS

According to FCC95 Subpart M §95.3379:

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm2 at a distance of 3 meters from the exterior surface of the radiating structure.

5.1.3TEST PROTOCOL

Ambient temperature: 24 °C
Air Pressure: 1007 hPa
Humidity: 45 %

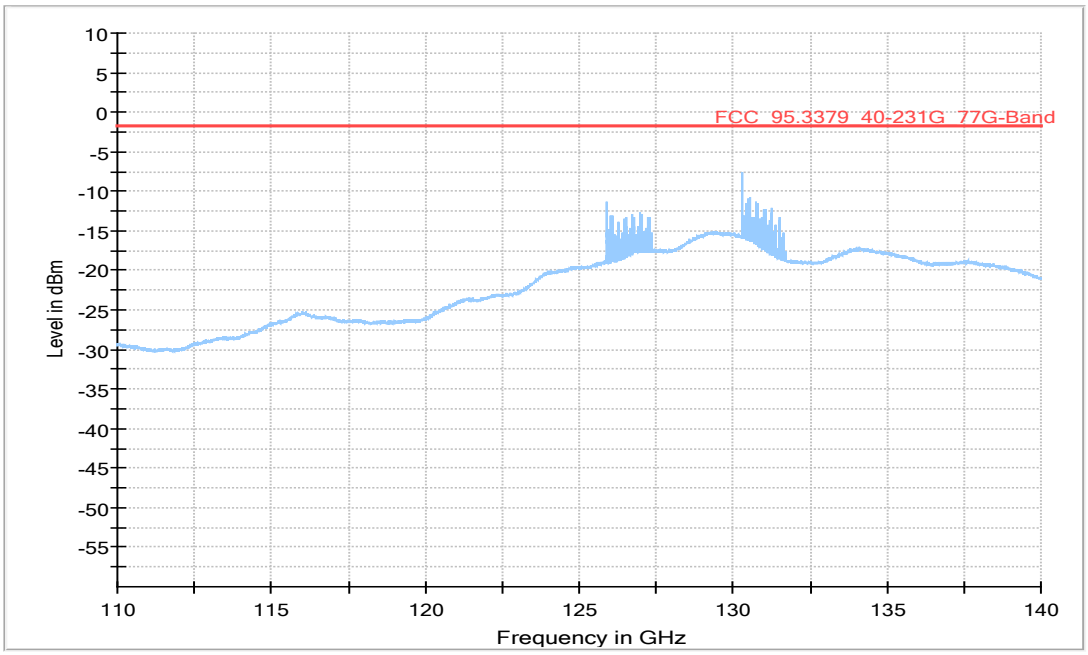
Setup_aa01:

TX Freq. [GHz]	Spurious Freq. [GHz]	Spurious Level [dBm]	Detector	RBW [kHz]	Limit [dBm]	Margin to Limit [dB]
77.0	---	- - -	---	---	- - -	- - -

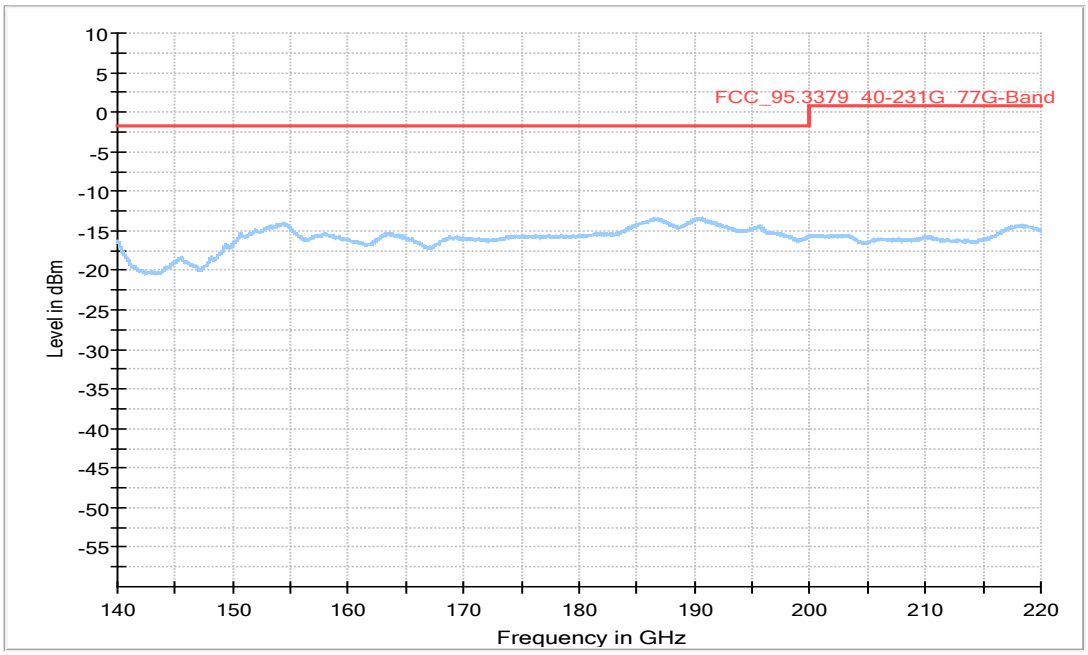
Remark: Please see next sub-clause for the measurement plot.

5.1.4MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

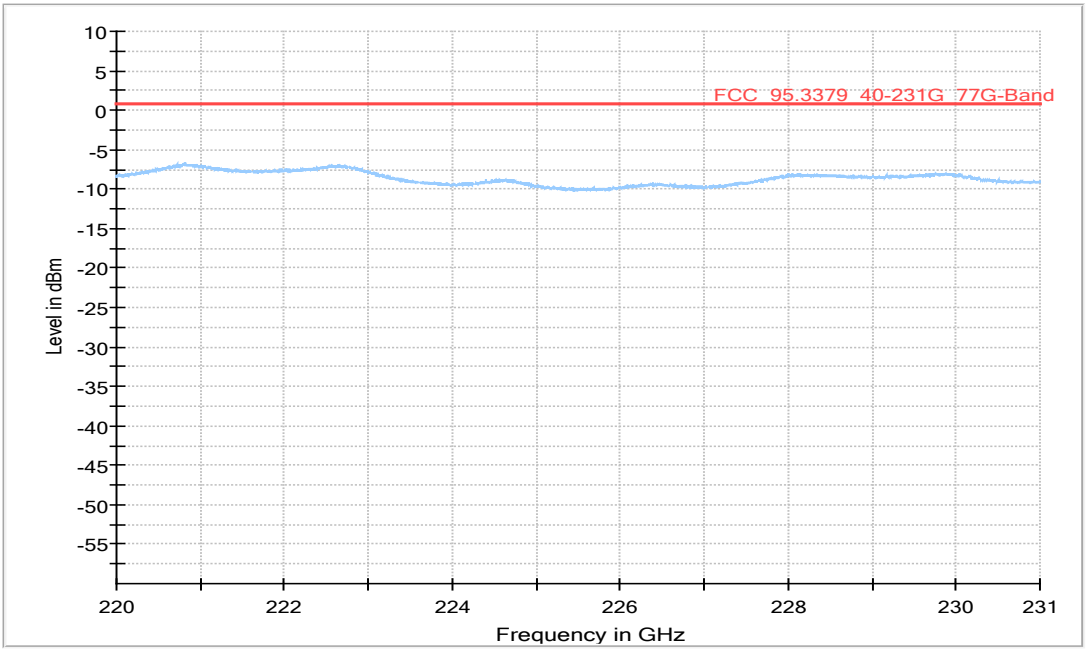
Setup_AA01
Radio Technology = Radar System
Measurement range: 110 GHz – 140 GHz



Setup_AA01
Radio Technology = Radar System
Measurement range:140 GHz – 220 GHz



Setup_AA01
Radio Technology = Radar System
Measurement range:220 GHz – 231 GHz



5.1.5TEST EQUIPMENT USED

Radiated Emissions

6 TEST EQUIPMENT

1 Radiated Emissions
Lab to perform radiated emission tests

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	Fully Anechoic Room	8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB		
1.2	TT 1.5 WI	Turn Table	Maturo GmbH	-		
1.3	Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	Maturo GmbH	TD1.5-10kg/024/3790709		
1.4	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2021-06	2023-06
1.5	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936		
1.6	FS-Z60	Harmonic Mixer	Radiometer Physics	100178	2020-03	2023-03
1.7	FS-Z90	Harmonic Mixer	Radiometer Physics	101989	2020-03	2023-03
1.8	FS-Z140	Harmonic Mixer	Radiometer Physics	101007	2020-03	2023-03
1.9	FS-Z220	Harmonic Mixer	Radiometer Physics	101005	2020-03	2023-03
1.10	FS-Z325	Harmonic Mixer	Radiometer Physics	101006	2020-03	2023-03
1.11	SGH-19	Antenna	Millitech	093		
1.12	SGH-12	Antenna	Millitech	326		
1.13	SGH-08	Antenna	Millitech	064		
1.14	SGH-05	Antenna	Millitech	075		
1.15	SGH-03	Antenna	Millitech	060		

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

6.1 TEST EQUIPMENT SOFTWARE

Semi-Anechoic Chamber:	
Software	Version
EMC32 Measurement Software	10.60.10
INNCO Mast Controller	1.02.62
MATURO Mast Controller	12.19
MATURO Turn-Table Controller	30.10
Fully-Anechoic Chamber:	
Software	Version
EMC32 Measurement Software	10.60.10
MATURO Turn-Unit Controllller	11.10
MATURO Mast Controller	12.10
MATURO Turntable Controller	12.11
Conducted AC Emissions:	
Software	Version
EMC32 Measurement Software	10.60.20

7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

7.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0,15		10,1	0,1	10,0
5		10,3	0,1	10,2
7		10,5	0,2	10,3
10		10,5	0,2	10,3
12		10,7	0,3	10,4
14		10,7	0,3	10,4
16		10,8	0,4	10,4
18		10,9	0,4	10,5
20		10,9	0,4	10,5
22		11,1	0,5	10,6
24		11,1	0,5	10,6
26		11,2	0,5	10,7
28		11,2	0,5	10,7
30		11,3	0,5	10,8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

7.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0,009	20,50	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,01	20,45	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,015	20,37	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,02	20,36	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,025	20,38	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,03	20,32	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,05	20,35	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,08	20,30	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,1	20,20	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,2	20,17	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,3	20,14	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,49	20,12	-79,6	0,1	0,1	0,1	0,1	-80	300	3
0,490001	20,12	-39,6	0,1	0,1	0,1	0,1	-40	30	3
0,5	20,11	-39,6	0,1	0,1	0,1	0,1	-40	30	3
0,8	20,10	-39,6	0,1	0,1	0,1	0,1	-40	30	3
1	20,09	-39,6	0,1	0,1	0,1	0,1	-40	30	3
2	20,08	-39,6	0,1	0,1	0,1	0,1	-40	30	3
3	20,06	-39,6	0,1	0,1	0,1	0,1	-40	30	3
4	20,05	-39,5	0,2	0,1	0,1	0,1	-40	30	3
5	20,05	-39,5	0,2	0,1	0,1	0,1	-40	30	3
6	20,02	-39,5	0,2	0,1	0,1	0,1	-40	30	3
8	19,95	-39,5	0,2	0,1	0,1	0,1	-40	30	3
10	19,83	-39,4	0,2	0,1	0,2	0,1	-40	30	3
12	19,71	-39,4	0,2	0,1	0,2	0,1	-40	30	3
14	19,54	-39,4	0,2	0,1	0,2	0,1	-40	30	3
16	19,53	-39,3	0,3	0,1	0,2	0,1	-40	30	3
18	19,50	-39,3	0,3	0,1	0,2	0,1	-40	30	3
20	19,57	-39,3	0,3	0,1	0,2	0,1	-40	30	3
22	19,61	-39,3	0,3	0,1	0,2	0,1	-40	30	3
24	19,61	-39,3	0,3	0,1	0,2	0,1	-40	30	3
26	19,54	-39,3	0,3	0,1	0,2	0,1	-40	30	3
28	19,46	-39,2	0,3	0,1	0,3	0,1	-40	30	3
30	19,73	-39,1	0,4	0,1	0,3	0,1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18,6	0,6	0,29	0,04	0,23	0,02	0,0	3	3
50	6,0	0,9	0,39	0,09	0,32	0,08	0,0	3	3
100	9,7	1,2	0,56	0,14	0,47	0,08	0,0	3	3
150	7,9	1,6	0,73	0,20	0,59	0,12	0,0	3	3
200	7,6	1,9	0,84	0,21	0,70	0,11	0,0	3	3
250	9,5	2,1	0,98	0,24	0,80	0,13	0,0	3	3
300	11,0	2,3	1,04	0,26	0,89	0,15	0,0	3	3
350	12,4	2,6	1,18	0,31	0,96	0,13	0,0	3	3
400	13,6	2,9	1,28	0,35	1,03	0,19	0,0	3	3
450	14,7	3,1	1,39	0,38	1,11	0,22	0,0	3	3
500	15,6	3,2	1,44	0,39	1,20	0,19	0,0	3	3
550	16,3	3,5	1,55	0,46	1,24	0,23	0,0	3	3
600	17,2	3,5	1,59	0,43	1,29	0,23	0,0	3	3
650	18,1	3,6	1,67	0,34	1,35	0,22	0,0	3	3
700	18,5	3,6	1,67	0,42	1,41	0,15	0,0	3	3
750	19,1	4,1	1,87	0,54	1,46	0,25	0,0	3	3
800	19,6	4,1	1,90	0,46	1,51	0,25	0,0	3	3
850	20,1	4,4	1,99	0,60	1,56	0,27	0,0	3	3
900	20,8	4,7	2,14	0,60	1,63	0,29	0,0	3	3
950	21,1	4,8	2,22	0,60	1,66	0,33	0,0	3	3
1000	21,6	4,9	2,23	0,61	1,71	0,30	0,0	3	3

(d_{Limit} = 10 m)

30	18,6	-9,9	0,29	0,04	0,23	0,02	-10,5	10	3
50	6,0	-9,6	0,39	0,09	0,32	0,08	-10,5	10	3
100	9,7	-9,2	0,56	0,14	0,47	0,08	-10,5	10	3
150	7,9	-8,8	0,73	0,20	0,59	0,12	-10,5	10	3
200	7,6	-8,6	0,84	0,21	0,70	0,11	-10,5	10	3
250	9,5	-8,3	0,98	0,24	0,80	0,13	-10,5	10	3
300	11,0	-8,1	1,04	0,26	0,89	0,15	-10,5	10	3
350	12,4	-7,9	1,18	0,31	0,96	0,13	-10,5	10	3
400	13,6	-7,6	1,28	0,35	1,03	0,19	-10,5	10	3
450	14,7	-7,4	1,39	0,38	1,11	0,22	-10,5	10	3
500	15,6	-7,2	1,44	0,39	1,20	0,19	-10,5	10	3
550	16,3	-7,0	1,55	0,46	1,24	0,23	-10,5	10	3
600	17,2	-6,9	1,59	0,43	1,29	0,23	-10,5	10	3
650	18,1	-6,9	1,67	0,34	1,35	0,22	-10,5	10	3
700	18,5	-6,8	1,67	0,42	1,41	0,15	-10,5	10	3
750	19,1	-6,3	1,87	0,54	1,46	0,25	-10,5	10	3
800	19,6	-6,3	1,90	0,46	1,51	0,25	-10,5	10	3
850	20,1	-6,0	1,99	0,60	1,56	0,27	-10,5	10	3
900	20,8	-5,8	2,14	0,60	1,63	0,29	-10,5	10	3
950	21,1	-5,6	2,22	0,60	1,66	0,33	-10,5	10	3
1000	21,6	-5,6	2,23	0,61	1,71	0,30	-10,5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24,4	-19,4	0,99	0,31	-21,51	0,79		
2000	28,5	-17,4	1,44	0,44	-20,63	1,38		
3000	31,0	-16,1	1,87	0,53	-19,85	1,33		
4000	33,1	-14,7	2,41	0,67	-19,13	1,31		
5000	34,4	-13,7	2,78	0,86	-18,71	1,40		
6000	34,7	-12,7	2,74	0,90	-17,83	1,47		
7000	35,6	-11,0	2,82	0,86	-16,19	1,46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31,0	-23,4	0,47	1,87	0,53	-27,58	1,33	
4000	33,1	-23,3	0,56	2,41	0,67	-28,23	1,31	
5000	34,4	-21,7	0,61	2,78	0,86	-27,35	1,40	
6000	34,7	-21,2	0,58	2,74	0,90	-26,89	1,47	
7000	35,6	-19,8	0,66	2,82	0,86	-25,58	1,46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35,6	-57,3	0,56	1,28	-62,72	2,66	0,94	1,46
8000	36,3	-56,3	0,69	0,71	-61,49	2,84	1,00	1,53
9000	37,1	-55,3	0,68	0,65	-60,80	3,06	1,09	1,60
10000	37,5	-56,2	0,70	0,54	-61,91	3,28	1,20	1,67
11000	37,5	-55,3	0,80	0,61	-61,40	3,43	1,27	1,70
12000	37,6	-53,7	0,84	0,42	-59,70	3,53	1,26	1,73
13000	38,2	-53,5	0,83	0,44	-59,81	3,75	1,32	1,83
14000	39,9	-56,3	0,91	0,53	-63,03	3,91	1,40	1,77
15000	40,9	-54,1	0,98	0,54	-61,05	4,02	1,44	1,83
16000	41,3	-54,1	1,23	0,49	-61,51	4,17	1,51	1,85
17000	42,8	-54,4	1,36	0,76	-62,36	4,34	1,53	2,00
18000	44,2	-54,7	1,70	0,53	-62,88	4,41	1,55	1,91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40,2	-23,5	0,72	-35,85	6,20	2,81	2,65
18500	40,2	-23,2	0,69	-35,71	6,46	2,76	2,59
19000	40,2	-22,0	0,76	-35,44	6,69	3,15	2,79
19500	40,3	-21,3	0,74	-35,07	7,04	3,11	2,91
20000	40,3	-20,3	0,72	-34,49	7,30	3,07	3,05
20500	40,3	-19,9	0,78	-34,46	7,48	3,12	3,15
21000	40,3	-19,1	0,87	-34,07	7,61	3,20	3,33
21500	40,3	-19,1	0,90	-33,96	7,47	3,28	3,19
22000	40,3	-18,7	0,89	-33,57	7,34	3,35	3,28
22500	40,4	-19,0	0,87	-33,66	7,06	3,75	2,94
23000	40,4	-19,5	0,88	-33,75	6,92	3,77	2,70
23500	40,4	-19,3	0,90	-33,35	6,99	3,52	2,66
24000	40,4	-19,8	0,88	-33,99	6,88	3,88	2,58
24500	40,4	-19,5	0,91	-33,89	7,01	3,93	2,51
25000	40,4	-19,3	0,88	-33,00	6,72	3,96	2,14
25500	40,5	-20,4	0,89	-34,07	6,90	3,66	2,22
26000	40,5	-21,3	0,86	-35,11	7,02	3,69	2,28
26500	40,5	-21,1	0,90	-35,20	7,15	3,91	2,36

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	m	m
26,5	43,4	-11,2	4,4	-15,6	3	0,5
27,0	43,4	-11,2	4,4	-15,6	3	0,5
28,0	43,4	-11,1	4,5	-15,6	3	0,5
29,0	43,5	-11,0	4,6	-15,6	3	0,5
30,0	43,5	-10,9	4,7	-15,6	3	0,5
31,0	43,5	-10,8	4,7	-15,6	3	0,5
32,0	43,5	-10,7	4,8	-15,6	3	0,5
33,0	43,6	-10,7	4,9	-15,6	3	0,5
34,0	43,6	-10,6	5,0	-15,6	3	0,5
35,0	43,6	-10,5	5,1	-15,6	3	0,5
36,0	43,6	-10,4	5,1	-15,6	3	0,5
37,0	43,7	-10,3	5,2	-15,6	3	0,5
38,0	43,7	-10,2	5,3	-15,6	3	0,5
39,0	43,7	-10,2	5,4	-15,6	3	0,5
40,0	43,8	-10,1	5,5	-15,6	3	0,5

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7.7 ANTENNA SGH-19 (40 GHZ – 60 GHZ)

Frequency	AF SGH-19	Corr.	cable loss 1 (inside chamber)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	m	m
40,0	22,6	-14,6	1	-15,6	3	0,5
40,5	22,7	-14,6	1	-15,6	3	0,5
41,0	22,8	-14,6	1	-15,6	3	0,5
41,5	22,8	-14,6	1	-15,6	3	0,5
42,0	22,9	-14,6	1	-15,6	3	0,5
42,5	22,9	-14,6	1	-15,6	3	0,5
43,0	23	-14,6	1	-15,6	3	0,5
43,5	23	-14,6	1	-15,6	3	0,5
44,0	23	-14,6	1	-15,6	3	0,5
44,5	23,1	-14,6	1	-15,6	3	0,5
45,0	23,1	-14,6	1	-15,6	3	0,5
45,5	23,2	-14,6	1	-15,6	3	0,5
46,0	23,2	-14,6	1	-15,6	3	0,5
46,5	23,2	-14,6	1	-15,6	3	0,5
47,0	23,3	-14,6	1	-15,6	3	0,5
47,5	23,3	-14,6	1	-15,6	3	0,5
48,0	23,3	-14,6	1	-15,6	3	0,5
48,5	23,4	-14,6	1	-15,6	3	0,5
49,0	23,4	-14,6	1	-15,6	3	0,5
49,5	23,4	-14,6	1	-15,6	3	0,5
50,0	23,5	-14,6	1	-15,6	3	0,5
50,5	23,5	-14,6	1	-15,6	3	0,5
51,0	23,5	-14,6	1	-15,6	3	0,5
51,5	23,5	-14,6	1	-15,6	3	0,5
52,0	23,5	-14,6	1	-15,6	3	0,5
52,5	23,6	-14,6	1	-15,6	3	0,5
53,0	23,6	-14,6	1	-15,6	3	0,5
53,5	23,6	-14,6	1	-15,6	3	0,5
54,0	23,6	-14,6	1	-15,6	3	0,5
54,5	23,6	-14,6	1	-15,6	3	0,5
55,0	23,6	-14,6	1	-15,6	3	0,5
55,5	23,6	-14,6	1	-15,6	3	0,5
56,0	23,7	-14,6	1	-15,6	3	0,5
56,5	23,7	-14,6	1	-15,6	3	0,5
57,0	23,7	-14,6	1	-15,6	3	0,5
57,5	23,7	-14,6	1	-15,6	3	0,5
58,0	23,7	-14,6	1	-15,6	3	0,5
58,5	23,7	-14,6	1	-15,6	3	0,5
59,0	23,7	-14,6	1	-15,6	3	0,5
59,5	23,7	-14,6	1	-15,6	3	0,5
60,0	23,7	-14,6	1	-15,6	3	0,5

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr, (dB)
U = Receiver reading
AF = Antenna factor
Corr, = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table,
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table,
Table shows an extract of values,

7.8 ANTENNA SGH-12 (60 GHZ – 90 GHZ)

Frequency	AF SGH-19	Corr,	cable loss 1 (inside chamber)	distance corr, (-20 dB/ decade)	d_{Limit} (meas, distance (limit)	d_{used} (meas, distance (used)
GHz	dB (1/m)	dB	dB	dB	m	m
60,00	22,6	-14,6	1	-15,6	3	0,5
60,75	22,7	-14,6	1	-15,6	3	0,5
61,50	22,8	-14,6	1	-15,6	3	0,5
62,25	22,8	-14,6	1	-15,6	3	0,5
63,00	22,9	-14,6	1	-15,6	3	0,5
63,75	22,9	-14,6	1	-15,6	3	0,5
64,50	23	-14,6	1	-15,6	3	0,5
65,25	23	-14,6	1	-15,6	3	0,5
66,00	23	-14,6	1	-15,6	3	0,5
66,75	23,1	-14,6	1	-15,6	3	0,5
67,50	23,1	-14,6	1	-15,6	3	0,5
68,25	23,2	-14,6	1	-15,6	3	0,5
69,00	23,2	-14,6	1	-15,6	3	0,5
69,75	23,2	-14,6	1	-15,6	3	0,5
70,50	23,3	-14,6	1	-15,6	3	0,5
71,25	23,3	-14,6	1	-15,6	3	0,5
72,00	23,3	-14,6	1	-15,6	3	0,5
72,75	23,4	-14,6	1	-15,6	3	0,5
73,50	23,4	-14,6	1	-15,6	3	0,5
74,25	23,4	-14,6	1	-15,6	3	0,5
75,00	23,5	-14,6	1	-15,6	3	0,5
75,75	23,5	-14,6	1	-15,6	3	0,5
76,50	23,5	-14,6	1	-15,6	3	0,5
77,25	23,5	-14,6	1	-15,6	3	0,5
78,00	23,5	-14,6	1	-15,6	3	0,5
78,75	23,6	-14,6	1	-15,6	3	0,5
79,50	23,6	-14,6	1	-15,6	3	0,5
80,25	23,6	-14,6	1	-15,6	3	0,5
81,00	23,6	-14,6	1	-15,6	3	0,5
81,75	23,6	-14,6	1	-15,6	3	0,5
82,50	23,6	-14,6	1	-15,6	3	0,5
83,25	23,6	-14,6	1	-15,6	3	0,5
84,00	23,7	-14,6	1	-15,6	3	0,5
84,75	23,7	-14,6	1	-15,6	3	0,5
85,50	23,7	-14,6	1	-15,6	3	0,5
86,25	23,7	-14,6	1	-15,6	3	0,5
87,00	23,7	-14,6	1	-15,6	3	0,5
87,75	23,7	-14,6	1	-15,6	3	0,5
88,50	23,7	-14,6	1	-15,6	3	0,5
89,25	23,7	-14,6	1	-15,6	3	0,5
90,00	23,7	-14,6	1	-15,6	3	0,5

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr, (dB)
U = Receiver reading
AF = Antenna factor
Corr, = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table,
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table,
Table shows an extract of values,

7.9 ANTENNA SGH-08 (90 GHZ – 140 GHZ)

Frequency	AF SGH-19	Corr,	cable loss 1 (inside chamber)	distance corr, (-20 dB/ decade)	d_{Limit} (meas, distance (limit)	d_{used} (meas, distance (used)
GHz	dB (1/m)	dB	dB	dB	m	m
90,00	22,4	-14,6	1	-15,6	3	0,5
91,25	22,5	-14,6	1	-15,6	3	0,5
92,50	22,6	-14,6	1	-15,6	3	0,5
93,75	22,6	-14,6	1	-15,6	3	0,5
95,00	22,7	-14,6	1	-15,6	3	0,5
96,25	22,7	-14,6	1	-15,6	3	0,5
97,50	22,8	-14,6	1	-15,6	3	0,5
98,75	22,9	-14,6	1	-15,6	3	0,5
100,00	22,9	-14,6	1	-15,6	3	0,5
101,25	23	-14,6	1	-15,6	3	0,5
102,50	23	-14,6	1	-15,6	3	0,5
103,75	23,1	-14,6	1	-15,6	3	0,5
105,00	23,1	-14,6	1	-15,6	3	0,5
106,25	23,1	-14,6	1	-15,6	3	0,5
107,50	23,2	-14,6	1	-15,6	3	0,5
108,75	23,2	-14,6	1	-15,6	3	0,5
110,00	23,3	-14,6	1	-15,6	3	0,5
111,25	23,3	-14,6	1	-15,6	3	0,5
112,50	23,3	-14,6	1	-15,6	3	0,5
113,75	23,4	-14,6	1	-15,6	3	0,5
115,00	23,4	-14,6	1	-15,6	3	0,5
116,25	23,4	-14,6	1	-15,6	3	0,5
117,50	23,5	-14,6	1	-15,6	3	0,5
118,75	23,5	-14,6	1	-15,6	3	0,5
120,00	23,5	-14,6	1	-15,6	3	0,5
121,25	23,5	-14,6	1	-15,6	3	0,5
122,50	23,6	-14,6	1	-15,6	3	0,5
123,75	23,6	-14,6	1	-15,6	3	0,5
125,00	23,6	-14,6	1	-15,6	3	0,5
126,25	23,6	-14,6	1	-15,6	3	0,5
127,50	23,6	-14,6	1	-15,6	3	0,5
128,75	23,6	-14,6	1	-15,6	3	0,5
130,00	23,6	-14,6	1	-15,6	3	0,5
131,25	23,7	-14,6	1	-15,6	3	0,5
132,50	23,7	-14,6	1	-15,6	3	0,5
133,75	23,7	-14,6	1	-15,6	3	0,5
135,00	23,7	-14,6	1	-15,6	3	0,5
136,25	23,7	-14,6	1	-15,6	3	0,5
137,50	23,7	-14,6	1	-15,6	3	0,5
138,75	23,7	-14,6	1	-15,6	3	0,5
140,00	23,7	-14,6	1	-15,6	3	0,5

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr, (dB)
U = Receiver reading
AF = Antenna factor
Corr, = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table,
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table,
Table shows an extract of values,

7.10 ANTENNA SGH-05 (140 GHZ – 220 GHZ)

Frequency	AF SGH-05	Corr,	cable loss 1 (inside chamber)	distance corr, (-20 dB/ decade)	d_{Limit} (meas, distance (limit)	d_{used} (meas, distance (used)
GHz	dB (1/m)	dB	dB	dB	m	m
140,00	22,4	-14,6	1	-15,6	3	0,5
142,00	22,5	-14,6	1	-15,6	3	0,5
144,00	22,5	-14,6	1	-15,6	3	0,5
146,00	22,6	-14,6	1	-15,6	3	0,5
148,00	22,7	-14,6	1	-15,6	3	0,5
150,00	22,7	-14,6	1	-15,6	3	0,5
152,00	22,8	-14,6	1	-15,6	3	0,5
154,00	22,8	-14,6	1	-15,6	3	0,5
156,00	22,9	-14,6	1	-15,6	3	0,5
158,00	22,9	-14,6	1	-15,6	3	0,5
160,00	23	-14,6	1	-15,6	3	0,5
162,00	23	-14,6	1	-15,6	3	0,5
164,00	23,1	-14,6	1	-15,6	3	0,5
166,00	23,1	-14,6	1	-15,6	3	0,5
168,00	23,2	-14,6	1	-15,6	3	0,5
170,00	23,2	-14,6	1	-15,6	3	0,5
172,00	23,3	-14,6	1	-15,6	3	0,5
174,00	23,3	-14,6	1	-15,6	3	0,5
176,00	23,3	-14,6	1	-15,6	3	0,5
178,00	23,4	-14,6	1	-15,6	3	0,5
180,00	23,4	-14,6	1	-15,6	3	0,5
182,00	23,4	-14,6	1	-15,6	3	0,5
184,00	23,5	-14,6	1	-15,6	3	0,5
186,00	23,5	-14,6	1	-15,6	3	0,5
188,00	23,5	-14,6	1	-15,6	3	0,5
190,00	23,5	-14,6	1	-15,6	3	0,5
192,00	23,6	-14,6	1	-15,6	3	0,5
194,00	23,6	-14,6	1	-15,6	3	0,5
196,00	23,6	-14,6	1	-15,6	3	0,5
198,00	23,6	-14,6	1	-15,6	3	0,5
200,00	23,6	-14,6	1	-15,6	3	0,5
202,00	23,7	-14,6	1	-15,6	3	0,5
204,00	23,7	-14,6	1	-15,6	3	0,5
206,00	23,7	-14,6	1	-15,6	3	0,5
208,00	23,7	-14,6	1	-15,6	3	0,5
210,00	23,7	-14,6	1	-15,6	3	0,5
212,00	23,7	-14,6	1	-15,6	3	0,5
214,00	23,7	-14,6	1	-15,6	3	0,5
216,00	23,7	-14,6	1	-15,6	3	0,5
218,00	23,7	-14,6	1	-15,6	3	0,5
220,00	23,7	-14,6	1	-15,6	3	0,5

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr, (dB)
U = Receiver reading
AF = Antenna factor
Corr, = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table,
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table,
Table shows an extract of values,

7.11 ANTENNA SGH-03 (220 GHZ – 325 GHZ)

Frequency	AF SGH-05	Corr,	cable loss 1 (inside chamber)	distance corr, (-20 dB/ decade)	d_{Limit} (meas, distance (limit)	d_{used} (meas, distance (used)
GHz	dB (1/m)	dB	dB	dB	m	m
220,00	22,6	-14,6	1	-15,6	3	0,5
223,00	22,7	-14,6	1	-15,6	3	0,5
226,00	22,7	-14,6	1	-15,6	3	0,5
229,00	22,8	-14,6	1	-15,6	3	0,5
232,00	22,8	-14,6	1	-15,6	3	0,5
235,00	22,9	-14,6	1	-15,6	3	0,5
238,00	23	-14,6	1	-15,6	3	0,5
241,00	23	-14,6	1	-15,6	3	0,5
244,00	23,1	-14,6	1	-15,6	3	0,5
247,00	23,1	-14,6	1	-15,6	3	0,5
250,00	23,1	-14,6	1	-15,6	3	0,5
253,00	23,2	-14,6	1	-15,6	3	0,5
256,00	23,2	-14,6	1	-15,6	3	0,5
259,00	23,3	-14,6	1	-15,6	3	0,5
262,00	23,3	-14,6	1	-15,6	3	0,5
265,00	23,3	-14,6	1	-15,6	3	0,5
268,00	23,4	-14,6	1	-15,6	3	0,5
271,00	23,4	-14,6	1	-15,6	3	0,5
274,00	23,4	-14,6	1	-15,6	3	0,5
277,00	23,5	-14,6	1	-15,6	3	0,5
280,00	23,5	-14,6	1	-15,6	3	0,5
283,00	23,5	-14,6	1	-15,6	3	0,5
286,00	23,5	-14,6	1	-15,6	3	0,5
289,00	23,6	-14,6	1	-15,6	3	0,5
292,00	23,6	-14,6	1	-15,6	3	0,5
295,00	23,6	-14,6	1	-15,6	3	0,5
298,00	23,6	-14,6	1	-15,6	3	0,5
301,00	23,6	-14,6	1	-15,6	3	0,5
304,00	23,6	-14,6	1	-15,6	3	0,5
307,00	23,7	-14,6	1	-15,6	3	0,5
310,00	23,7	-14,6	1	-15,6	3	0,5
313,00	23,7	-14,6	1	-15,6	3	0,5
316,00	23,7	-14,6	1	-15,6	3	0,5
319,00	23,7	-14,6	1	-15,6	3	0,5
322,00	23,7	-14,6	1	-15,6	3	0,5
325,00	23,7	-14,6	1	-15,6	3	0,5

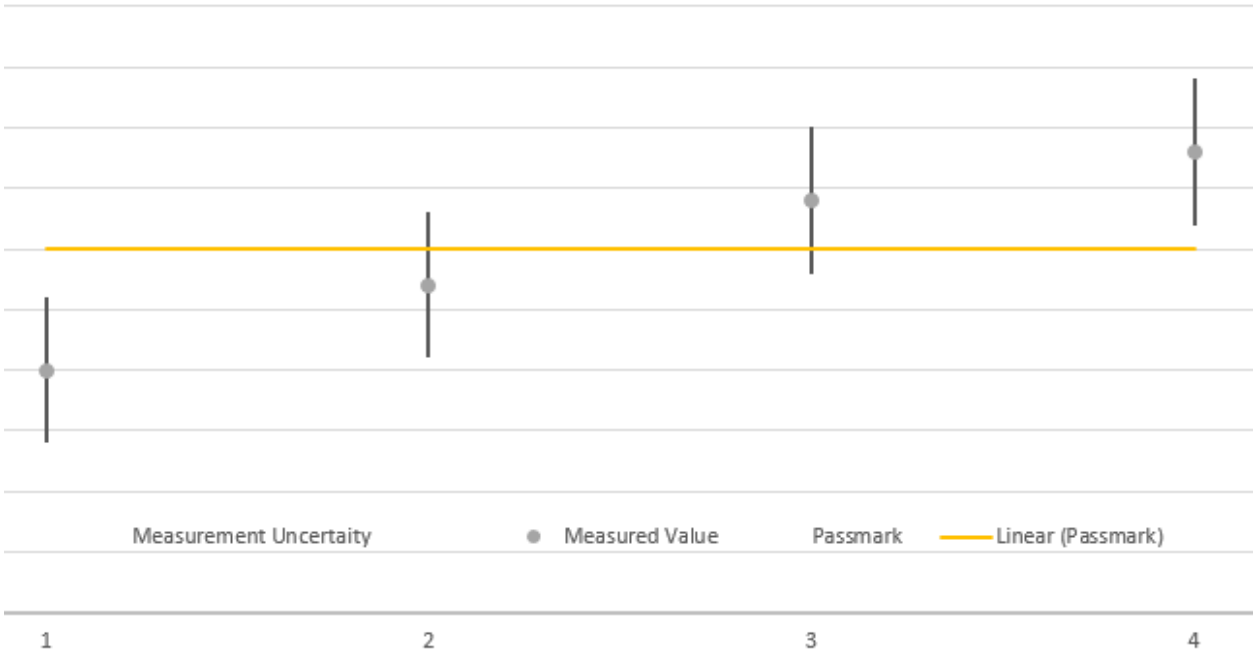
Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr, (dB)
U = Receiver reading
AF = Antenna factor
Corr, = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table,
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table,
Table shows an extract of values,

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Uncertainty
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation	Power	± 5.5 dB
6 dB / 26 dB / 99% Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
Conducted Output Power	Power	± 2.2 dB
Band Edge Compliance	Power Frequency	± 2.2 dB ± 11.2 kHz
Frequency Stability	Frequency	± 25 Hz
Power Spectral Density	Power	± 2.2 dB

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so called shared risk principle.

9 PHOTO REPORT

Please see separate photo report,