

FCC Measurement/Technical Report on

LevelRay HT

FCC ID: 2BSNSNCLS
IC: 34800-NCLS

Test Report Reference: MDE_BVUS_2407_FCC_06

Test Laboratory:

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Germany



Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization

Certification for an Intentional Radiator.

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 15 (10-1-24 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement

§ 15.209 Radiated emission limits; general requirements

§ 15.255 Operation within the band 57–71 GHz.

ANSI C63.10-2020 + Cor. 1-2023 + C63.10a-2024 + Errata to C63.10a-2024 is applied.

Summary Test Results:

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

1.2 FCC-IC CORRELATION TABLE

Correlation of measurement requirements for Radar equipment within the band 57-71 GHz FCC and IC

Measurement	FCC reference	IC reference
AC Power Line Conducted Emissions	§ 15.207	RSS-Gen Issue 5: 8.8
Emission Bandwidth	§ 15.215 (c)	RSS-Gen Issue 5: 6.7 RSS210 Issue 11: Annex J, J.2.1
Peak Output Power	§ 15.255 (c)(1-3) & (e)	RSS-Gen Issue 5: 6.12 RSS210 Issue 11: Annex J, J.3.1
Unwanted Emissions	§ 15.209 & 15.255 (d)	RSS-Gen Issue 5: 6.13 RSS210 Issue 11: Annex J, J.4
Frequency Stability	§ 15.255 (f)	RSS-Gen Issue 5: 6.11 RSS210 Issue 11: Annex J, J.6

1.3 MEASUREMENT SUMMARY / SIGNATURES

47 CFR CHAPTER I FCC PART 15

§ 15.209 & 15.255 (d)

Subpart C §15.255

Unwanted Emissions

The measurement was performed according to ANSI C63.10 (2020)

Chapter 6.4, 6.5, 6.6

Final Result

OP-Mode	Setup	Date	FCC	IC
Radio Technology, Operating Frequency, Measurement range				
FMCW Radar, 58.2 – 63.2 GHz, 9 kHz – 30 MHz	S01_AD02	2026-01-19	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 30 MHz – 1 GHz	S01_AD02	2026-01-19	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 1 GHz – 26 GHz	S01_AD02	2026-01-23	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 26 GHz – 40 GHz	S01_AD02	2026-01-19	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 40 GHz – 60 GHz	S01_AD02	2026-01-19	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 60 GHz – 90 GHz	S01_AD02	2026-01-19	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 90 GHz – 140 GHz	S01_AD02	2026-01-16	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 140 GHz – 200 GHz	S01_AD02	2026-01-16	Passed	Passed

N/A: Not applicable

N/P: Not performed

2 REVISION HISTORY

Report version control			
Version	Release date	Change Description	Version validity
initial	2026-05-19	-	valid

COMMENT: -

According to customer the variants LevelRay HT and LevelRay HT P are including the same RF part. Therefore, only unwanted emissions tests were performed.
For other measurements please refer to reference test report
"MDE_BVUS_2407_FCC_02_rev05"



(responsible for accreditation scope)
Marco Kullik



(responsible for testing and report)
Mohamed Fraitat



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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-12140-01-00
FCC Designation Number: DE0015
FCC Test Firm Registration: 929146
ISED CAB Identifier DE0007; ISED#: 3699A

Responsible for accreditation scope: Marco Kullik
Report Template Version: 2025-02-28

3.2 PROJECT DATA

Responsible for testing and report: Mohamed Fraitat
Employees who performed the tests: documented internally at 7Layers
Date of Report: 2026-05-15
Testing Period: 2026-01-19 to 2026-01-23

3.3 APPLICANT DATA

Company Name: Teledyne ISCO, A business unit of Teledyne Instruments Inc.
Address: 4700 Superior Street, Lincoln,
Nebraska USA 68504
Contact Person: Paul Spieker

3.4 MANUFACTURER DATA

Company Name: please see Applicant Data

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	NCLS are electronic modules used in LevelRay devices. The electronic modules contain the main electronics of the devices and a Bluetooth module with a chip antenna on the PCB. The Bluetooth interface is for communication with the device via smartphone, tablet pc or laptop. LevelRay devices consist of an electronic NCLS and different interface options.
Product name / PMN	LevelRay
Type / HVIN	LevelRAY HT
FVIN	0.2.3.7
Declared EUT data by the supplier	
Voltage Type	12 V DC
Voltage Level	12 V
Low Voltage	9 V
High Voltage	27 V
Normal Temperature	20 °C
Low Temperature	-20 °C
High Temperature	+60 °C
Tested Modulation Type	60 GHz FMCW
Antenne type	Integrated
OBW	5030 MHz
Rated Output power	12 dBm
Center frequency	60746 MHz
Sweep- & Re-Trace Time	524 µs
Declared environment operation (Outdoor/Indoor)	Outdoor
Antenna Gain	21 dBi
General product description	The EUT is a Level Probing Radar including Bluetooth Low Energy.
Special software used for testing	ISCO NCLS

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
EUT D2	DE1094025ad02	Radar Sample (LevelRAY HT)
Sample Parameter	Value	
Serial No.	370_S2509013	
HW Version	A1	
SW Version	0.2.3.7	
Comment	Same sample as LevelRAY HT P, but the pressure sensor was removed.	

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, Type Model, HW, SW, S/N)	Description
AUX1	Fujitsu Laptop RE05, Lifebook U758, 2018-07, Win10 Pro, DSAL009811	Monitoring Laptop
AUX2	Rohde & Schwarz, NGSM 32/10, -, -, 3456	Power supply

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
S01_AD02	EUT D2 + AUX1	Setup for radiated measurements

4.6 OPERATING MODES

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

4.6.1 TEST CHANNELS

FMCW Radar Signal with an operational frequency range from 58.2 GHz to 63.2 GHz

4.7 PRODUCT LABELLING

4.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

4.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

5.1 UNWANTED EMISSIONS

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.1.1 TEST DESCRIPTION

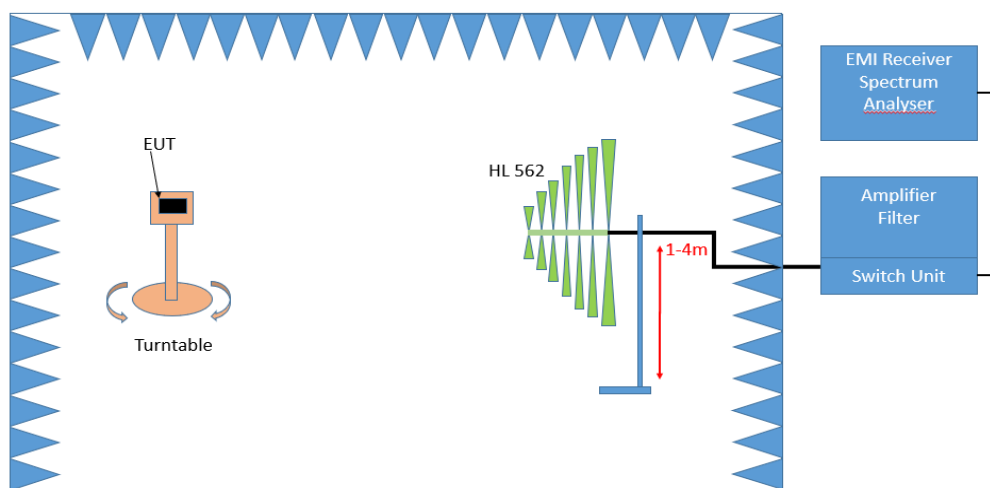
The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration.

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 of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered.

Below 1 GHz:

The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

1. Measurement 30 MHz up to 1 GHz



Test Setup; Spurious Emission Radiated (SAC), 30 MHz- 1GHz

Step 1: Preliminary scan

This is a preliminary test to identify the highest amplitudes relative to the limit.

Settings for step 1:

- Antenna distance: 3 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz

- IF-Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: -180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 4 m
- Height variation step size: 1.5 m
- 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

In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.

For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. 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. In this position, the antenna height will also slowly vary between 1 – 4 meter. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.

- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: 360°
- Height variation range: 1 – 4 m
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 2, the final measurement will be performed:

EMI receiver settings for step 3:

- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

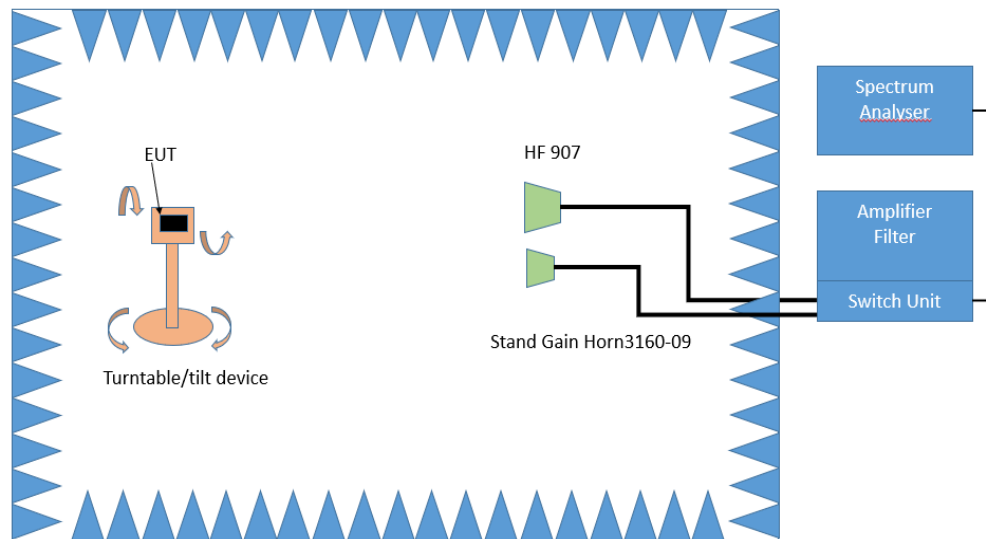
After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Above 1 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 only.

2. Measurement 1 up to 26 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

Step 1:

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz

Step 2:

The turn table azimuth will slowly vary by $\pm 22.5^\circ$.

The elevation angle will slowly vary by $\pm 45^\circ$

Spectrum analyser settings:

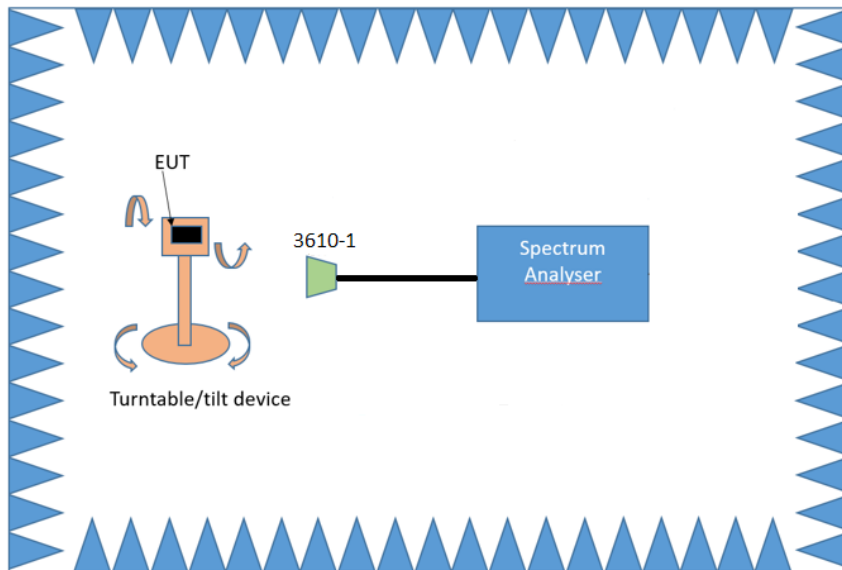
- Detector: Peak

Step 3:

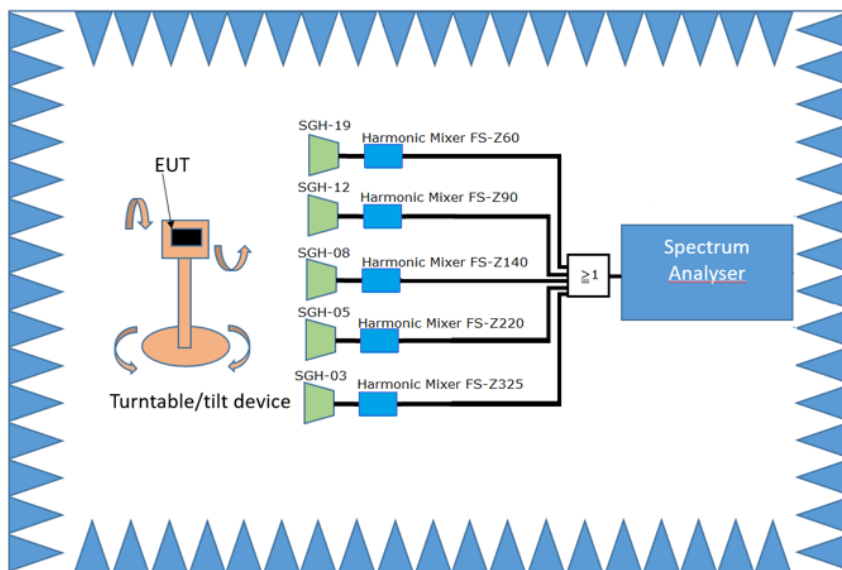
Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

3. Measurement above 26 GHz



Test Setup (26 - 40 GHz)



Test Setup (40 GHz - 320 GHz)

Step 1:

The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.

The turn table step size (azimuth angle) for the preliminary measurement is 45 °.

Spectrum analyser settings:

- Detector: Peak, Average
- RBW = 1 MHz
- VBW = 3 MHz
- Measurement distance:
 - 26 – 40 GHz: 1 m
 - 40 – 60 GHz: 1 m
 - 60 – 90 GHz: 1 m

- 90 – 140 GHz: 0.5 m
- 140 – 200 GHz: 0.5 m

Step 2:

The turn table azimuth will slowly vary by $\pm 22.5^\circ$.

The elevation angle will slowly vary by $\pm 45^\circ$

Spectrum analyser settings:

- Detector: Peak

Step 3:

Spectrum analyser settings for step 3:

- Detector: Peak / CISPR Average
- Measured frequencies: in step 1 determined frequencies
- RBW = 1 MHz
- VBW = 3 MHz
- Measuring time: 1 s

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.255 (d)

Limits on spurious emissions:

- (1) The power density of any emissions outside the 57–71 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Used limit conversion calculation:

- $PD = EIRP / (4\pi d^2)$
- $\text{Limit (dB}\mu\text{V/m)} = EIRP [\text{dBm}] - 20 \log (d [\text{m}]) + 104.8$
- Distance-Correction Factor is: $20 \log (d [\text{m}])$

RSS 210 Annex J, J.3

The power of any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed:

- a. the fundamental emission levels
- b. the general field strength limits specified in RSS-Gen for emissions below 40 GHz
- c. 90 pW/cm² at a distance of 3 m for emissions between 40 GHz and 200 GHz

5.1.3 TEST PROTOCOL

Ambient temperature: 24 °C
 Air Pressure: 997 hPa
 Humidity: 30 %

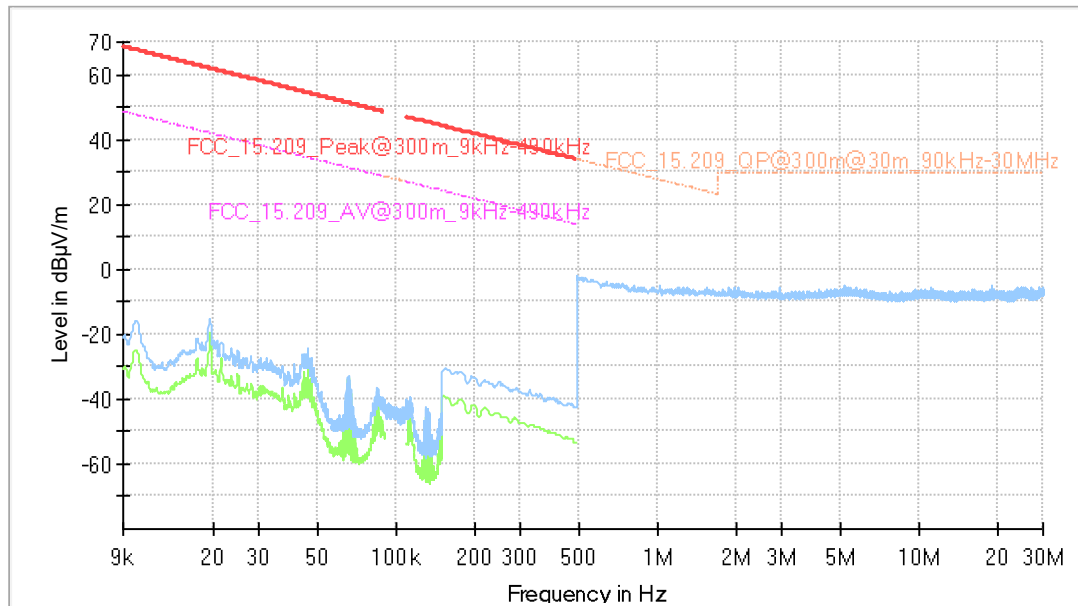
S01_AD02

Spurious Freq. [MHz]	Spurious Level [dBμV/m]	Detector	RBW [kHz]	Limit [dBμV/m]	Margin to Limit [dB]
880.5	17.6	QP	120	46	28.5
892.5	17.6	QP	120	46	58.4
49265	65.6	PEAK	1000	105.2	19.7
58223	67.2	PEAK	1000	105.2	38
58550	66.8	PEAK	1000	105.2	38.4
58957	66.9	PEAK	1000	105.2	38.3
59316	68.6	PEAK	1000	105.2	36.6
59613	66.7	PEAK	1000	105.2	38.5
59972	67.1	PEAK	1000	105.2	38.2
87984	72.4	PEAK	1000	58.3	12.9
88995	37.8	PEAK	1000	58.3	11.5
186781	78.9	PEAK	1000	85.3	6.4

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

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

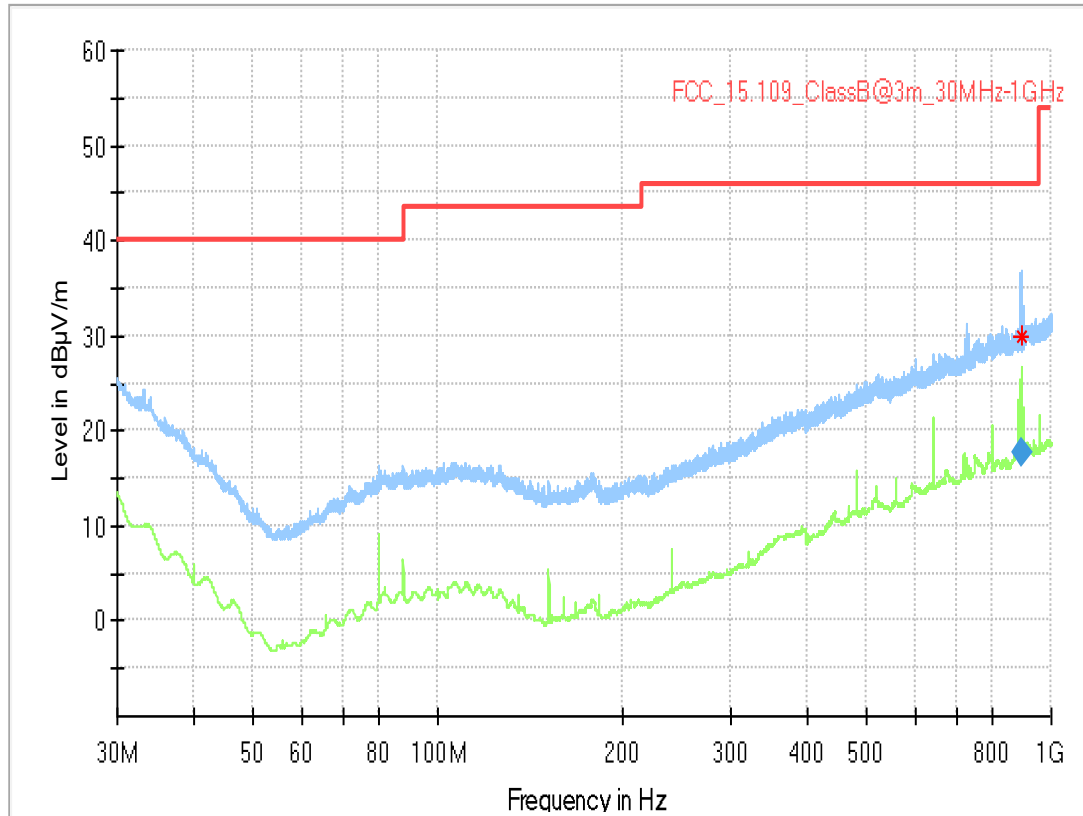
S01_AD02
9 kHz – 30 MHz



Final Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Azimuth (deg)	Corr. (dB/m)
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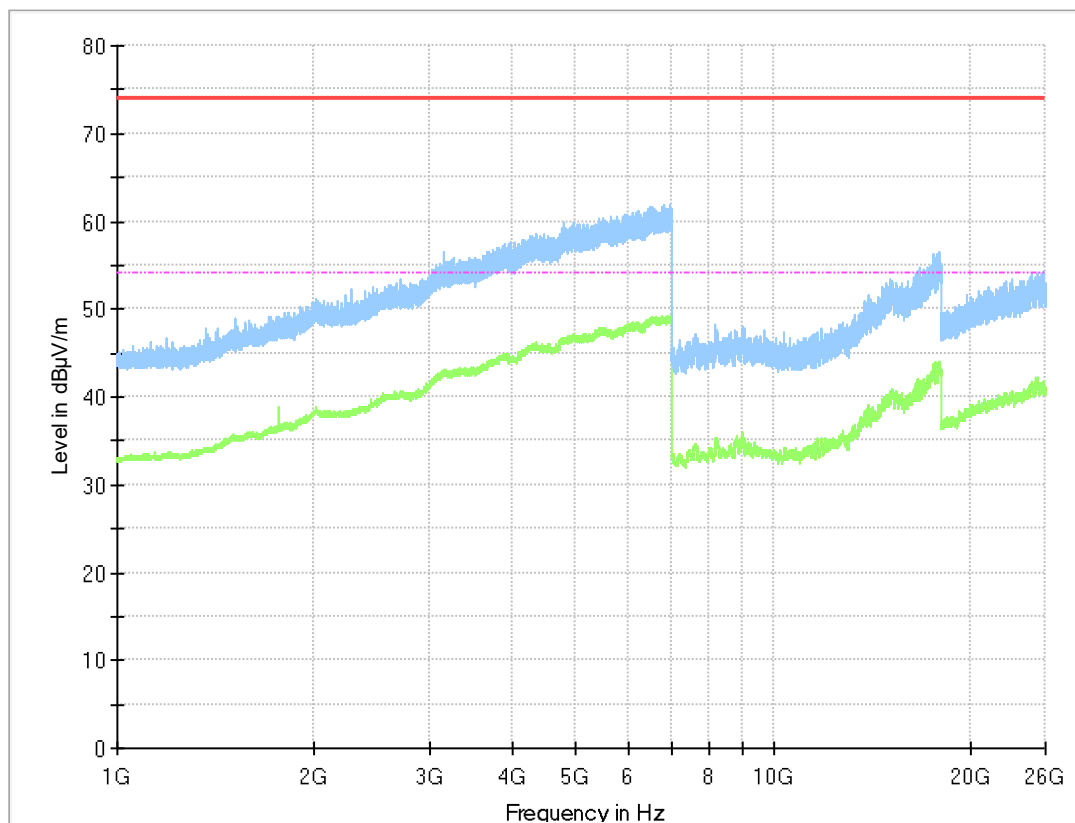
S01_AD02
 30 MHz – 1 GHz



Final Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
892.470000	17.6	46.00	28.4	1000.0	120.000	123.0	V	129	25.2

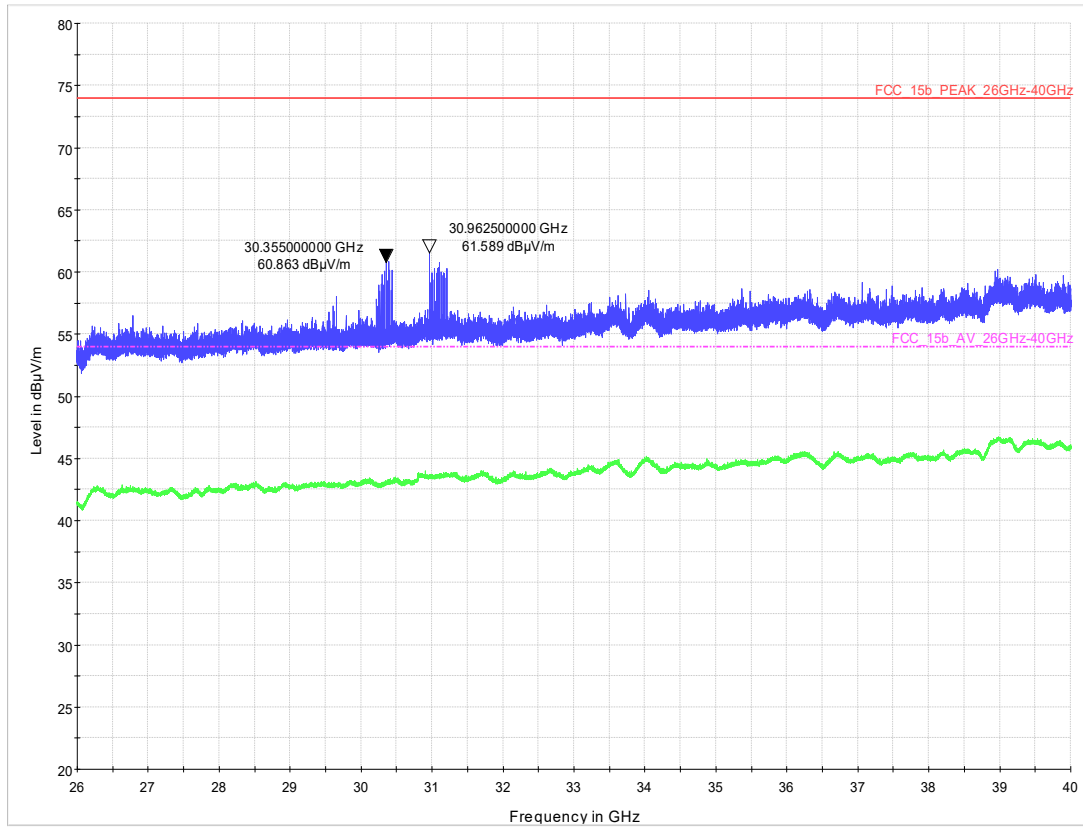
S01_AD02
1 GHz – 26 GHz



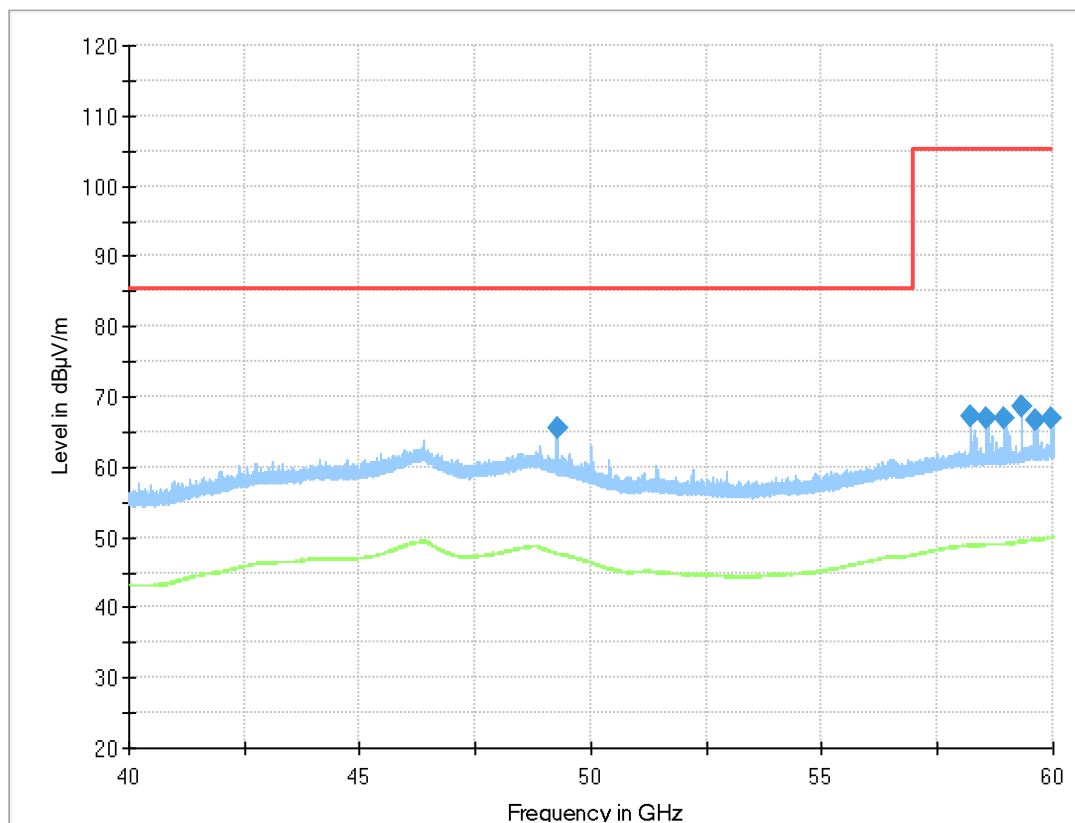
Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	CAverage (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)
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S01_AD02
26 GHz – 40 GHz



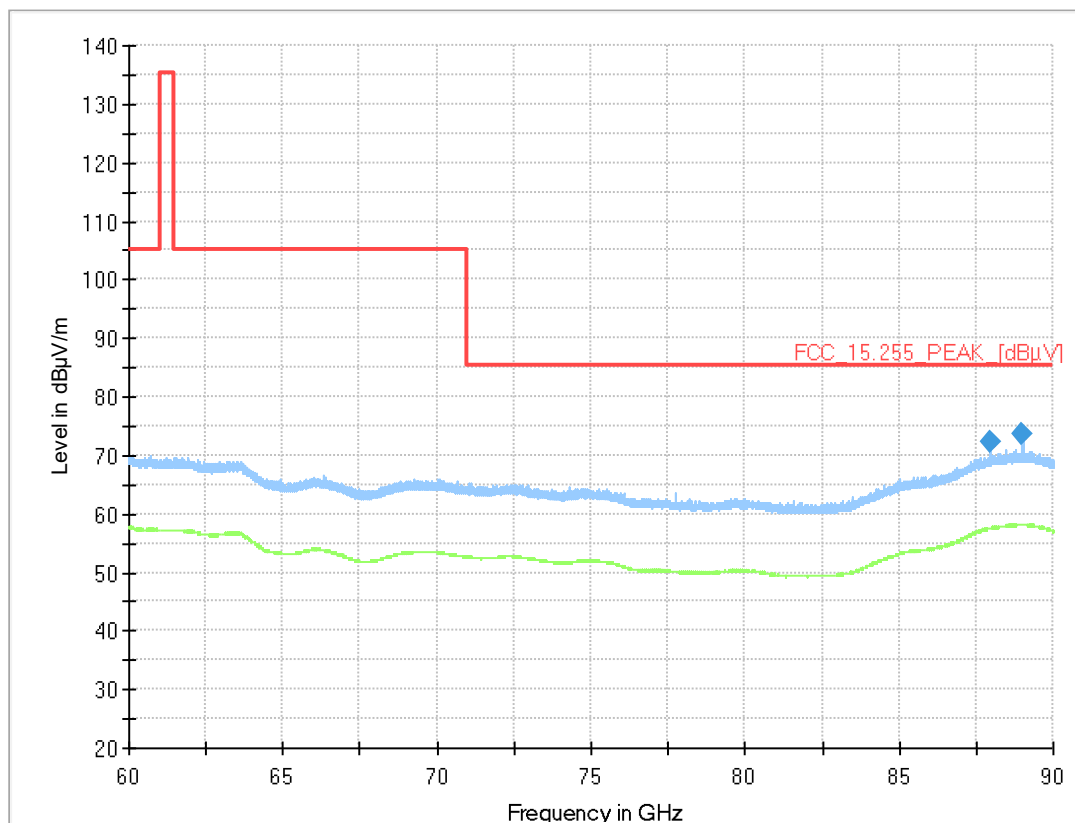
S01_AD02
40 GHz – 60 GHz



Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth	Elevation	Corr. (dB/m)
49265.000000	65.61	85.31	19.70	15000.0	1000.000	150.0	V	90.0	90.0	31.1
58223.000000	67.23	105.23	38.00	15000.0	1000.000	150.0	V	90.0	90.0	32.3
58550.000000	66.85	105.23	38.38	15000.0	1000.000	150.0	V	60.0	90.0	32.3
58957.000000	66.90	105.23	38.33	15000.0	1000.000	150.0	V	60.0	90.0	32.4
59316.000000	68.65	105.23	36.58	15000.0	1000.000	150.0	V	60.0	90.0	32.5
59613.000000	66.72	105.23	38.51	15000.0	1000.000	150.0	V	60.0	90.0	32.5
59972.000000	67.07	105.23	38.16	15000.0	1000.000	150.0	V	60.0	90.0	32.5

S01_AD02 60 GHz – 90 GHz



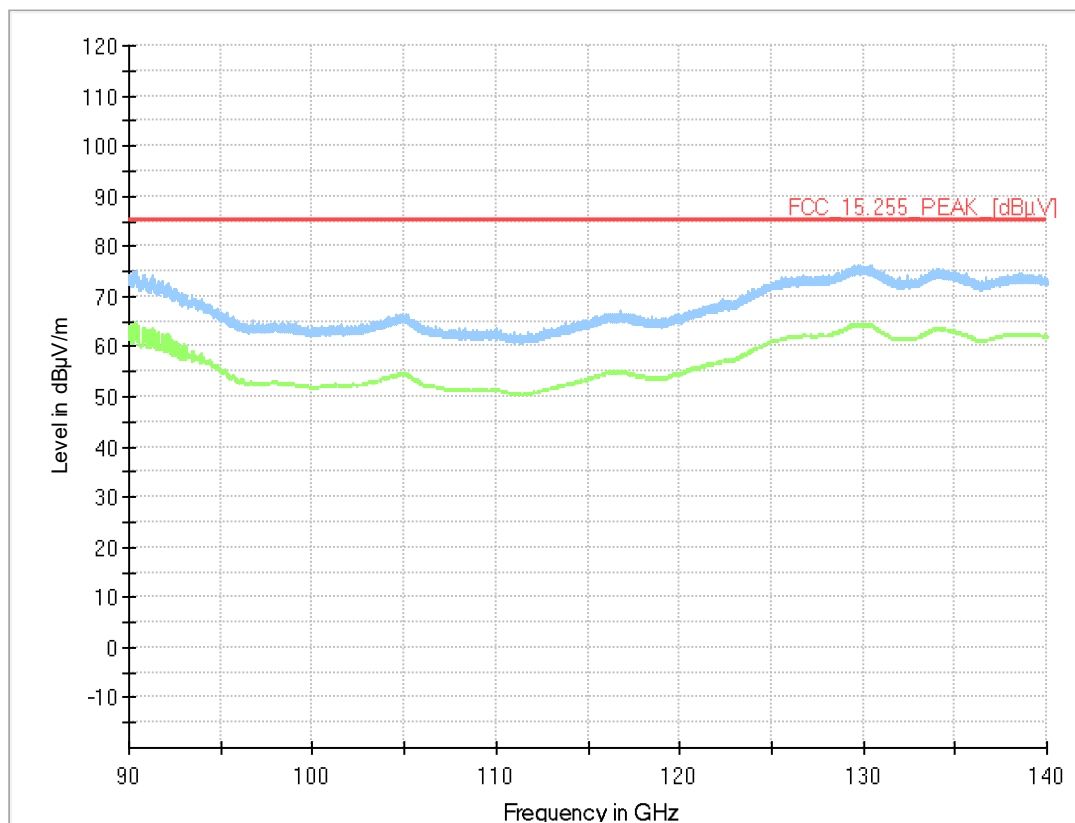
Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth	Elevation	Corr. (dB/m)
87984.000000	72.45	85.31	12.86	15000.0	1000.000	150.0	V	60.0	90.0	35.9
88995.000000	73.79	85.31	11.52	15000.0	1000.000	150.0	V	60.0	90.0	36.0

Final_Result

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth	Elevation	Corr. (dB/m)
87984.000000	72.45	85.31	12.86	15000.0	1000.000	150.0	V	60.0	90.0	35.9
88995.000000	73.79	85.31	11.52	15000.0	1000.000	150.0	V	60.0	90.0	36.0

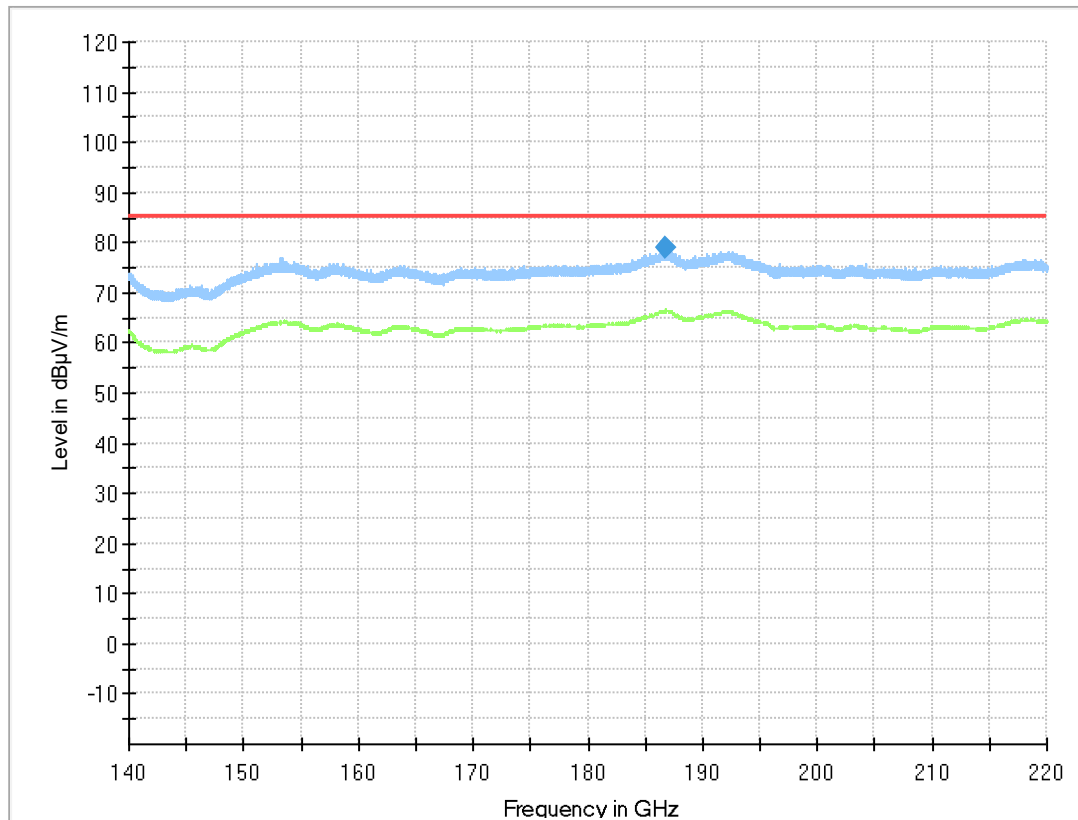
S01_AD02
 90 GHz – 140 GHz



Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth (h)	Height	Pol	Azimuth (h)	Elevation (n)	Corr. (dB/m)
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S01_AD02
140 GHz – 220 GHz



Final Result

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation	Corr. (dB/m)
186781.000000	78.93	85.31	6.39	7000.0	1000.000	150.0	H	60.0	0.0	36.6

5.1.5 TEST EQUIPMENT USED

- Radiated Emissions SAC H-Field
- Radiated Emissions SAC up to 1 GHz
- Radiated Emissions FAR FCC

6 TEST EQUIPMENT

1.1 TEST EQUIPMENT HARDWARE

- 1 Radiated Emissions SAC H-Field
Radiated emission tests in the H-Field in a semi anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
1.2	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
1.3	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
1.4	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
1.5	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
1.6	HFH2-Z2	Loop Antenna + 3 Axis Tripod	Rohde & Schwarz GmbH & Co. KG	829324/006	2024-04	2027-04
1.7	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100451	2025-07	2027-07

- 2 Radiated Emissions SAC up to 1 GHz
Radiated emission tests up to 1 GHz in a semi anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
2.2	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
2.3	Anechoic Chamber 01	SAC/FAR, 10.58 m x 6.38 m x 6.00 m	Frankonia Germany EMC Solution GmbH	none	N/A	N/A
2.4	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
2.5	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
2.6	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2024-10	2027-10

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.7	HL562E ULTRALOG	Biconical-log- per Antenna (30 MHz - 6 GHz)	Rohde & Schwarz GmbH & Co. KG	102299	2024-07	2027-07
2.8	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100451	2025-07	2027-07
2.9	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/1192 0513	N/A	N/A

3 Radiated Emissions FAR FCC

Radiated emission tests in a fully anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12 2026-2	2025-12 2028-2
3.2	HL 562 ULTRALOG	Biconical-log- per antenna (30 MHz - 3 GHz) with HL 562E biconicals	Rohde & Schwarz GmbH & Co. KG	830547/003	2025-04	2028-04
3.3	Innco Systems CO3000	Controller for bore sight mast FAC	innco systems GmbH	CO3000/1460/54 740522/P	N/A	N/A
3.4	AMF- 7D00101800- 30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq		N/A	N/A
3.5	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001- PRB	N/A	N/A
3.6	JS4-18002600- 32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785	N/A	N/A
3.7	FSW43	Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	103779	2024-12	2026-12
3.8	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
3.9	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069	N/A	N/A
3.10	WHKX 7.0/18G- 8SS	High Pass Filter	Wainwright Instruments GmbH	09	N/A	N/A
3.11	MA3000/0800- XP-ET-compact	Bore Sight Antenna Mast	innco systems GmbH	9210522	N/A	N/A
3.12	TT 1.5 WI	Turn Table	Maturo GmbH	-	N/A	N/A
3.13	5HC3500/18000 -1.2-KK	High Pass Filter	Trilithic	200035008	N/A	N/A

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
3.14	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709	N/A	N/A
3.15	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324	N/A	N/A
3.16	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2024-10	2027-10
3.17	FS-Z60	Harmonic Mixer 40 - 60 GHz	Rohde & Schwarz Messgerätebau GmbH	100178	2023-06	2026-06
3.18	FS-Z220	Harmonic Mixer 140 - 220 GHz	Rohde & Schwarz Messgerätebau GmbH	101005	2023-05	2026-05
3.19	SGH-05	Standard Gain / Pyramidal Horn Antenna (140 - 220 GHz)	RPG-Radiometer Physics GmbH	075	N/A	N/A
3.20	SGH-19	Standard Gain / Pyramidal Horn Antenna (40 - 60 GHz)	RPG-Radiometer Physics GmbH	093	N/A	N/A
3.21	FS-Z325	Harmonic Mixer 220 - 325 GHz	Rohde & Schwarz Messgerätebau GmbH	101006	2023-06	2026-06
3.22	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronik GmbH	00086675	N/A	N/A
3.23	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none	N/A	N/A
3.24	SGH-08	Standard Gain / Pyramidal Horn Antenna (90 - 140 GHz)	RPG-Radiometer Physics GmbH	064	N/A	N/A
3.25	SGH-12	Standard Gain / Pyramidal HornAntenna (60 - 90 GHz)	RPG-Radiometer Physics GmbH	326	N/A	N/A
3.26	FS-Z140	Harmonic Mixer 90 -140 GHz	Rohde & Schwarz Messgerätebau GmbH	101007	2023-05	2026-05
3.27	SGH-03	Standard Gain / Pyramidal Horn Antenna (220 - 325 GHz)	RPG-Radiometer Physics GmbH	060	N/A	N/A
3.28	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069	N/A	N/A

The calibration interval is the time interval between "Last Calibration" and "Calibration Due"

1.2 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 Controller	11.10
MATURO Mast Controller	12.10
INNCO Mast Controller	1.02.62
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

$$U_{\text{LISN}} (\text{dB } \mu\text{V}) = U (\text{dB } \mu\text{V}) + \text{Corr. (dB)}$$

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 MHz	AF HFH-Z2) dB (1/m)	Corr. dB	cable loss 1 (inside chamber) dB	cable loss 2 (outside chamber) dB	cable loss 3 (switch unit) dB	cable loss 4 (to receiver) dB	distance corr. (-40 dB/ decade) dB	d _{Limit} (meas. distance (limit) m	d _{used} (meas. distance (used) 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

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

U = Receiver reading

AF = Antenna factor

Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)

distance correction = $-40 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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)

($d_{\text{Limit}} = 3 \text{ m}$)

Frequency	AF R&S HL562	Corr.
MHz	dB (1/m)	dB
30	18.6	0.6
50	6.0	0.9
100	9.7	1.2
150	7.9	1.6
200	7.6	1.9
250	9.5	2.1
300	11.0	2.3
350	12.4	2.6
400	13.6	2.9
450	14.7	3.1
500	15.6	3.2
550	16.3	3.5
600	17.2	3.5
650	18.1	3.6
700	18.5	3.6
750	19.1	4.1
800	19.6	4.1
850	20.1	4.4
900	20.8	4.7
950	21.1	4.8
1000	21.6	4.9

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))
dB	dB	dB	dB	dB	m	m
0.29	0.04	0.23	0.02	0.0	3	3
0.39	0.09	0.32	0.08	0.0	3	3
0.56	0.14	0.47	0.08	0.0	3	3
0.73	0.20	0.59	0.12	0.0	3	3
0.84	0.21	0.70	0.11	0.0	3	3
0.98	0.24	0.80	0.13	0.0	3	3
1.04	0.26	0.89	0.15	0.0	3	3
1.18	0.31	0.96	0.13	0.0	3	3
1.28	0.35	1.03	0.19	0.0	3	3
1.39	0.38	1.11	0.22	0.0	3	3
1.44	0.39	1.20	0.19	0.0	3	3
1.55	0.46	1.24	0.23	0.0	3	3
1.59	0.43	1.29	0.23	0.0	3	3
1.67	0.34	1.35	0.22	0.0	3	3
1.67	0.42	1.41	0.15	0.0	3	3
1.87	0.54	1.46	0.25	0.0	3	3
1.90	0.46	1.51	0.25	0.0	3	3
1.99	0.60	1.56	0.27	0.0	3	3
2.14	0.60	1.63	0.29	0.0	3	3
2.22	0.60	1.66	0.33	0.0	3	3
2.23	0.61	1.71	0.30	0.0	3	3

($d_{\text{Limit}} = 10 \text{ m}$)

30	18.6	-9.9
50	6.0	-9.6
100	9.7	-9.2
150	7.9	-8.8
200	7.6	-8.6
250	9.5	-8.3
300	11.0	-8.1
350	12.4	-7.9
400	13.6	-7.6
450	14.7	-7.4
500	15.6	-7.2
550	16.3	-7.0
600	17.2	-6.9
650	18.1	-6.9
700	18.5	-6.8
750	19.1	-6.3
800	19.6	-6.3
850	20.1	-6.0
900	20.8	-5.8
950	21.1	-5.6
1000	21.6	-5.6

0.29	0.04	0.23	0.02	-10.5	10	3
0.39	0.09	0.32	0.08	-10.5	10	3
0.56	0.14	0.47	0.08	-10.5	10	3
0.73	0.20	0.59	0.12	-10.5	10	3
0.84	0.21	0.70	0.11	-10.5	10	3
0.98	0.24	0.80	0.13	-10.5	10	3
1.04	0.26	0.89	0.15	-10.5	10	3
1.18	0.31	0.96	0.13	-10.5	10	3
1.28	0.35	1.03	0.19	-10.5	10	3
1.39	0.38	1.11	0.22	-10.5	10	3
1.44	0.39	1.20	0.19	-10.5	10	3
1.55	0.46	1.24	0.23	-10.5	10	3
1.59	0.43	1.29	0.23	-10.5	10	3
1.67	0.34	1.35	0.22	-10.5	10	3
1.67	0.42	1.41	0.15	-10.5	10	3
1.87	0.54	1.46	0.25	-10.5	10	3
1.90	0.46	1.51	0.25	-10.5	10	3
1.99	0.60	1.56	0.27	-10.5	10	3
2.14	0.60	1.63	0.29	-10.5	10	3
2.22	0.60	1.66	0.33	-10.5	10	3
2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + \text{AF (dB 1/m)} + \text{Corr. (dB)}$
 U = Receiver reading
 AF = Antenna factor
 Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
 distance correction = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$
 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.
MHz	dB (1/m)	dB
1000	24.4	-19.4
2000	28.5	-17.4
3000	31.0	-16.1
4000	33.1	-14.7
5000	34.4	-13.7
6000	34.7	-12.7
7000	35.6	-11.0

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)		
dB	dB	dB	dB		
0.99	0.31	-21.51	0.79		
1.44	0.44	-20.63	1.38		
1.87	0.53	-19.85	1.33		
2.41	0.67	-19.13	1.31		
2.78	0.86	-18.71	1.40		
2.74	0.90	-17.83	1.47		
2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.
MHz	dB (1/m)	dB
3000	31.0	-23.4
4000	33.1	-23.3
5000	34.4	-21.7
6000	34.7	-21.2
7000	35.6	-19.8

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
dB	dB	dB	dB	dB	
0.47	1.87	0.53	-27.58	1.33	
0.56	2.41	0.67	-28.23	1.31	
0.61	2.78	0.86	-27.35	1.40	
0.58	2.74	0.90	-26.89	1.47	
0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.
MHz	dB (1/m)	dB
7000	35.6	-57.3
8000	36.3	-56.3
9000	37.1	-55.3
10000	37.5	-56.2
11000	37.5	-55.3
12000	37.6	-53.7
13000	38.2	-53.5
14000	39.9	-56.3
15000	40.9	-54.1
16000	41.3	-54.1
17000	42.8	-54.4
18000	44.2	-54.7

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)
dB	dB	dB	dB	dB	dB
0.56	1.28	-62.72	2.66	0.94	1.46
0.69	0.71	-61.49	2.84	1.00	1.53
0.68	0.65	-60.80	3.06	1.09	1.60
0.70	0.54	-61.91	3.28	1.20	1.67
0.80	0.61	-61.40	3.43	1.27	1.70
0.84	0.42	-59.70	3.53	1.26	1.73
0.83	0.44	-59.81	3.75	1.32	1.83
0.91	0.53	-63.03	3.91	1.40	1.77
0.98	0.54	-61.05	4.02	1.44	1.83
1.23	0.49	-61.51	4.17	1.51	1.85
1.36	0.76	-62.36	4.34	1.53	2.00
1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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)	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))
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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	Corr.	cable	cable	cable	Harmonic	distance	d _{Limit}	d _{used}
GHz	SGH-19		loss 1	loss 2	loss 3	Mixer	corr.	(meas.	(meas.
	dB (1/m)	dB	(inside	(outside	(switch	FS-Z60	(-20 dB/	distance	distance
			chamber)	chamber)	unit)		decade)	(limit)	(used)
			dB	dB	dB	dB	dB	m	m
40.0	39.6	3.8				19.4	-15.6	3	0.5
41.0	39.7	2.7				18.3	-15.6	3	0.5
42.0	39.8	3.3				18.9	-15.6	3	0.5
43.0	39.9	2.7				18.3	-15.6	3	0.5
44.0	40.1	4.0				19.6	-15.6	3	0.5
45.0	40.2	3.8				19.4	-15.6	3	0.5
46.0	40.3	4.0				19.6	-15.6	3	0.5
47.0	40.4	4.3				19.9	-15.6	3	0.5
48.0	40.5	3.5				19.1	-15.6	3	0.5
49.0	40.6	3.2				18.8	-15.6	3	0.5
50.0	40.8	3.6				19.2	-15.6	3	0.5
51.0	40.9	2.6				18.2	-15.6	3	0.5
52.0	41.1	1.5				17.1	-15.6	3	0.5
53.0	41.1	0.1				15.7	-15.6	3	0.5
54.0	41.3	-1.0				14.6	-15.6	3	0.5
55.0	41.4	-0.8				14.8	-15.6	3	0.5
56.0	41.5	-1.2				14.4	-15.6	3	0.5
57.0	41.6	-0.8				14.8	-15.6	3	0.5
58.0	41.8	-0.9				14.7	-15.6	3	0.5
59.0	41.9	0.0				15.6	-15.6	3	0.5
60.0	42.1	1.3				16.9	-15.6	3	0.5

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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 GHz	AF SGH-12 dB (1/m)	Corr. dB	cable loss 1 (inside chamber) dB	cable loss 2 (outside chamber) dB	cable loss 3 (switch unit) dB	Harmonic Mixer FS-Z90 dB	distance corr. (-20 dB/ decade) dB	d _{Limit} (meas. distance (limit) m	d _{used} (meas. distance (used) m
60.0	43.3	8.2				24.4	-15.6	3	0.5
61.5	43.4	7.3				23.8	-15.6	3	0.5
63.0	43.5	4.2				22.9	-15.6	3	0.5
64.5	43.6	4.2				19.8	-15.6	3	0.5
66.0	43.7	2.0				19.8	-15.6	3	0.5
67.5	43.8	3.4				17.6	-15.6	3	0.5
69.0	43.9	3.2				19.0	-15.6	3	0.5
70.5	44.0	2.4				18.8	-15.6	3	0.5
72.0	44.1	1.6				18.0	-15.6	3	0.5
73.5	44.2	1.7				17.2	-15.6	3	0.5
75.0	44.4	0.1				17.3	-15.6	3	0.5
76.5	44.5	-0.5				15.7	-15.6	3	0.5
78.0	44.6	-0.5				15.1	-15.6	3	0.5
79.5	44.7	-1.6				15.1	-15.6	3	0.5
81.0	44.8	-1.7				14.0	-15.6	3	0.5
82.5	45.0	-0.3				13.9	-15.6	3	0.5
84.0	45.1	2.2				15.3	-15.6	3	0.5
85.5	45.2	3.7				17.8	-15.6	3	0.5
87.0	45.4	5.9				19.3	-15.6	3	0.5
88.5	45.5	5.2				21.5	-15.6	3	0.5
90.0	45.6	8.2				20.8	-15.6	3	0.5

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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 GHz	AF SGH-19 dB (1/m)	Corr. dB	cable loss 1 (inside chamber) dB	cable loss 2 (outside chamber) dB	cable loss 3 (switch unit) dB	Harmonic Mixer FS-Z140 dB	distance corr. (-20 dB/ decade) dB	d _{Limit} (meas. distance (limit) m	d _{used} (meas. distance (used) m
90.0	46.9	12.2				27.8	-15.6	3	0.5
92.5	47.0	10.8				26.4	-15.6	3	0.5
95.0	47.1	9.2				24.8	-15.6	3	0.5
97.5	47.2	7.5				23.1	-15.6	3	0.5
100.0	47.3	5.8				21.4	-15.6	3	0.5
102.5	47.4	6.0				21.6	-15.6	3	0.5
105.0	47.6	7.0				22.6	-15.6	3	0.5
107.5	47.7	5.8				21.4	-15.6	3	0.5
110.0	47.8	4.7				20.3	-15.6	3	0.5
112.5	47.9	4.1				19.7	-15.6	3	0.5
115.0	48.0	6.8				22.4	-15.6	3	0.5
117.5	48.2	7.3				22.9	-15.6	3	0.5
120.0	48.3	7.5				23.1	-15.6	3	0.5
122.5	48.4	10.4				26.0	-15.6	3	0.5
125.0	48.6	13.6				29.2	-15.6	3	0.5
127.5	48.7	15.5				31.1	-15.6	3	0.5
130.0	48.9	18.1				33.7	-15.6	3	0.5
132.5	49.0	13.5				29.1	-15.6	3	0.5
135.0	49.2	14.6				30.2	-15.6	3	0.5
137.5	49.3	14.1				29.7	-15.6	3	0.5
140.0	49.4	11.5				27.1	-15.6	3	0.5

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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 – 200 GHZ)

Frequency	AF	Corr.	cable	cable	cable	Harmonic	distance	d _{Limit}	d _{used}
GHz	SGH-19		loss 1	loss 2	loss 3	Mixer	corr.	(meas.	(meas.
	dB (1/m)	dB	(inside	(outside	(switch	FS-Z140	(-20 dB/	distance	distance
			chamber)	chamber)	unit)		decade)	(limit)	(used)
			dB	dB	dB	dB	dB	m	m
140.0	50.8	15.1				30.7	-15.6	3	0.5
142.0	50.8	11.0				26.6	-15.6	3	0.5
144.0	50.9	11.1				26.7	-15.6	3	0.5
146.0	50.9	12.1				27.7	-15.6	3	0.5
148.0	51.0	13.1				28.7	-15.6	3	0.5
150.0	51.0	15.4				31.0	-15.6	3	0.5
152.0	51.1	15.0				30.6	-15.6	3	0.5
154.0	51.1	16.9				32.5	-15.6	3	0.5
156.0	51.2	15.1				30.7	-15.6	3	0.5
158.0	51.3	15.3				30.9	-15.6	3	0.5
160.0	51.3	14.5				30.1	-15.6	3	0.5
162.0	51.4	14.2				29.8	-15.6	3	0.5
164.0	51.4	15.4				31.0	-15.6	3	0.5
166.0	51.5	13.5				29.1	-15.6	3	0.5
168.0	51.6	14.0				29.6	-15.6	3	0.5
170.0	51.6	15.1				30.7	-15.6	3	0.5
172.0	51.7	14.3				29.9	-15.6	3	0.5
174.0	51.8	14.7				30.3	-15.6	3	0.5
176.0	51.8	14.8				30.4	-15.6	3	0.5
178.0	51.9	14.6				30.2	-15.6	3	0.5
180.0	51.9	14.9				30.5	-15.6	3	0.5
182.0	52.0	14.7				30.3	-15.6	3	0.5
184.0	52.1	15.6				31.2	-15.6	3	0.5
186.0	52.1	16.8				32.4	-15.6	3	0.5
188.0	52.2	15.2				30.8	-15.6	3	0.5
190.0	52.3	16.8				32.4	-15.6	3	0.5
192.0	52.3	16.1				31.7	-15.6	3	0.5
194.0	52.4	14.8				30.4	-15.6	3	0.5
196.0	52.5	15.1				30.7	-15.6	3	0.5
198.0	52.6	13.8				29.4	-15.6	3	0.5
200.0	52.6	13.7				29.3	-15.6	3	0.5
202.0	52.7	14.0				29.6	-15.6	3	0.5
204.0	52.8	13.7				29.3	-15.6	3	0.5
206.0	52.8	13.4				29.0	-15.6	3	0.5
208.0	52.9	13.4				29.0	-15.6	3	0.5
210.0	53.0	13.9				29.5	-15.6	3	0.5
212.0	53.1	12.9				28.5	-15.6	3	0.5
214.0	53.2	13.1				28.7	-15.6	3	0.5
216.0	53.2	13.5				29.1	-15.6	3	0.5
218.0	53.3	14.5				30.1	-15.6	3	0.5
220.0	53.4	14.0				29.6	-15.6	3	0.5

Sample calculation

$E \text{ (dB } \mu\text{V/m)} = U \text{ (dB } \mu\text{V)} + AF \text{ (dB 1/m)} + Corr. \text{ (dB)}$

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 = $-20 * \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

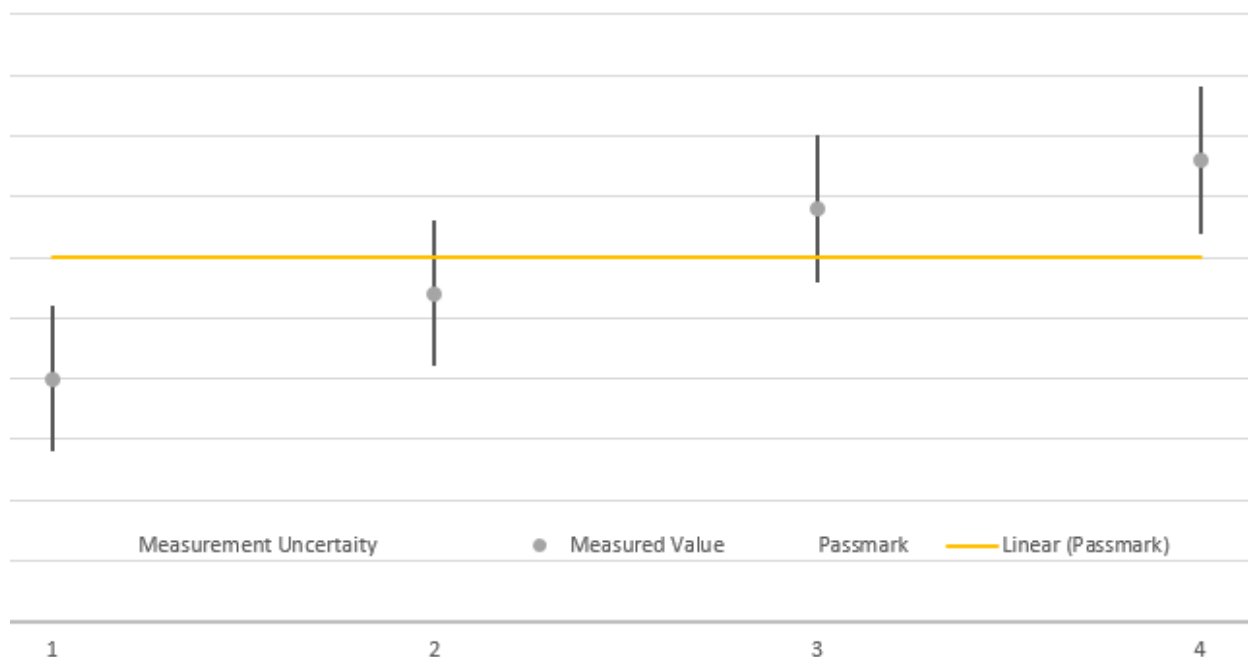
Linear interpolation will be used for frequencies in between the values in the table.

Table shows an extract of values.

8 MEASUREMENT UNCERTAINTIES

Test Case	Parameter	Maximum expanded Measurement uncertainty
Radio frequency	Frequency	$\pm 1 \times 10^{-7}$
AC Power Line	Power	± 3.4 dB
Field Strength of spurious radiation (up to 40 GHz)	Power	± 5.5 dB
Field Strength of spurious radiation (40 to 66 GHz)	Power	± 8 dB
Field Strength of spurious radiation (66 to 100 GHz)	Power	± 10 dB
Field Strength of spurious radiation (above 100 GHz)	Power	± 10 dB
Temperature	Temperature	± 1 °C
Humidity	Humidity	± 5 %
DC and low voltages	Voltage	± 3 %

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.

END OF REPORT