FCC Measurement/Technical Report on

LevelRay HT P

FCC ID: 2BSNSNCLS
IC: 34800-NCLS

Test Report Reference: MDE_BVUS_2407_FCC_02_rev05

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche
Akkreditierungsstelle
D-PL-12140-01-00

Table of Contents

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 Subpart C §15.207 **§ 15.207**

AC Power Line Conducted Emissions
The measurement was performed according to ANSI C63.10 (2020) Chapter 6.2 **Final Result**

OP-Mode Radio Technology, Measurement range	**Setup**	**Date**	**FCC**	**IC**
FMCW Radar, 150 kHz - 30 MHz	S01_AC01	2025-08-25	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.215 **§ 15.215 (c)**

Emission Bandwidth
The measurement was performed according to ANSI C63.10 (2020) Chapter 6.9 **Final Result**

OP-Mode Radio Technology, Operating Frequency, Measurement range	**Setup**	**Date**	**FCC**	**IC**
FMCW Radar, 58.2 – 63.2 GHz, 56 GHz - 65 GHz	S01_AB01	2026-01-30	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.255 **§ 15.255 (c) (1-3) & (e)**

Peak Output Power
The measurement was performed according to ANSI C63.10 (2020) **Final Result**

OP-Mode: outside tank enclosure Radio Technology, Operating Frequency, Measurement range	**Setup**	**Date**	**FCC**	**IC**
FMCW Radar, 58.2 – 63.2 GHz, 56 GHz - 65 GHz	S01_AB01	2025-12-03	Passed	Passed

47 CFR CHAPTER I FCC PART 15 Subpart C §15.255 **§ 15.209 & 15.255 (d)**

Unwanted Emissions
The measurement was performed according to ANSI C63.10 (2020) Chapter 6.4, 6.5, 6.6 **Final Result**

OP-Mode Radio Technology, Operating Frequency, Measurement range	**Setup**	**Date**	**FCC**	**IC**
FMCW Radar, 58.2 – 63.2 GHz, 9 kHz – 30 MHz	S01_AC01	2025-08-15	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 30 MHz – 1 GHz	S01_AB01	2025-08-07	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 1 GHz – 26 GHz	S01_AB01	2025-08-10	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 26 GHz – 40 GHz	S01_AB01	2025-08-19	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 40 GHz – 60 GHz	S01_AB01	2025-09-18	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 60 GHz – 90 GHz	S01_AB01	2025-09-23	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 90 GHz – 140 GHz	S01_AB01	2025-08-20	Passed	Passed
FMCW Radar, 58.2 – 63.2 GHz, 140 GHz – 200 GHz	S01_AB01	2025-09-08	Passed	Passed

47 CFR CHAPTER I FCC PART 15 § 15.255 (f)
Subpart C §15.255

Frequency Stability
The measurement was performed according to ANSI C63.10 (2020) Chapter 6.8

Final Result

OP-Mode Radio Technology, Operating Frequency, Measurement range	Setup	Date	FCC	IC
FMCW Radar, 58.2 – 63.2 GHz, 56 GHz - 65 GHz	S01_AB01	2025-09-12	Passed	Passed

N/A: Not applicable
N/P: Not performed

2 REVISION HISTORY

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2025-12-04	--	Invalid
Rev01	2026-01-12	- Antenna gain corrected on page 10 - Test requirements and limits corrected in chapter 5.3.2 - Duty Cycle chapter (4.7) added on page 13 - Table of conducted output power removed from chapter 5.3.3	Invalid
Rev02	2026-01-26	- PMN, HVIN and FVIN changed	Invalid
Rev03	2026-01-28	- Resuts for 99% and 6dB BW on chapter 5.2 have been corrected	Invalid
Rev04	2026-01-30	- Results for 6 dB BW test on chapter 5.2 have been corrected - Declared OBW on page 10 changed	Valid
Rev05	2026-02-02	- Duty cycle and Off time requirements values on chapter 4.7 (duty cycle) changed	Valid

COMMENT:

According to the customer:
NCLS module will be used in following LevelRay devices:
LevelRay HT
LevelRay HT P
LevelRay HS
LevelRay HS P

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

(responsible for accreditation scope)
Marco Kullik

(responsible for testing and report)
Mohamed Fraitat

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:	2026-02-02
Testing Period:	2025-08-06 to 2026-02-02

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 P
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 B	DE1094025ab01	Radar Sample
Sample Parameter	**Value**	
Serial No.	370_S2509014	
HW Version	A1	
SW Version	0.2.3.7	
Comment	-	

Sample Name	Sample Code	Description
EUT C	DE1094025ac01	Radar Sample
Sample Parameter	**Value**	
Serial No.	370_S2509019	
HW Version	A1	
SW Version	0.2.3.7	
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, 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_AB01	EUT B + AUX1	Setup for radiated measurements
S01_AC01	EUT C + AUX1 + AUX2	Setup for AC mains measurements

4.6 OPERATING MODES

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

4.6.1 TEST CHANNELS

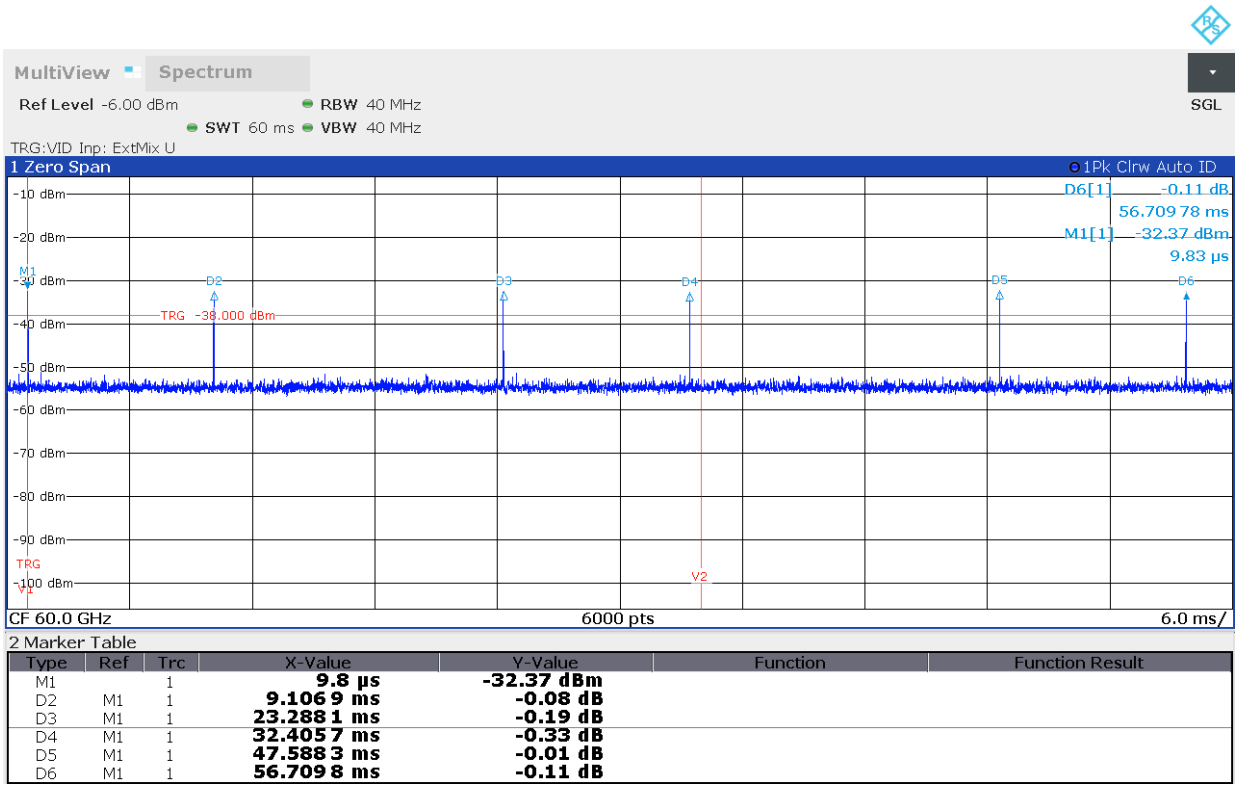
FMCW Radar Signal with an operational frequency range from 58.2 GHz to 63.2 GHz

4.7 DUTY CYCLE

This duty cycle calculation is given to show the applicability of the selected radiated output power limit

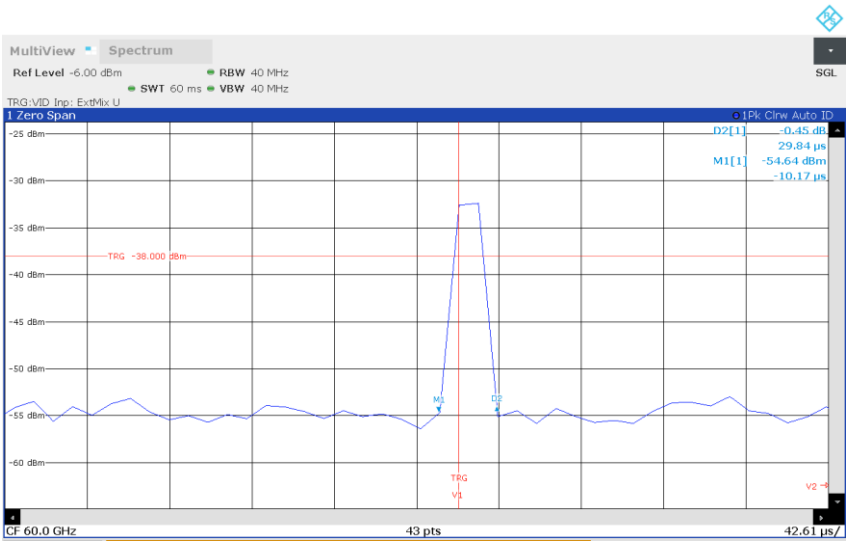
Test Mode	T_{on+off} (ms)	T_{on} (ms)	Total T_{on} (ms)	Individual OFF-times	Total OFF-time (ms)	Duty cycle (%)
FMCW	33 ms	0.03	0.03*4=0.12	1st off-time:9.1ms 2nd off-time:14.1ms 3rd off-time: 9.3ms → all off-times > 2ms	32.5ms > 16.5ms	0.36

TX $_{on+off}$

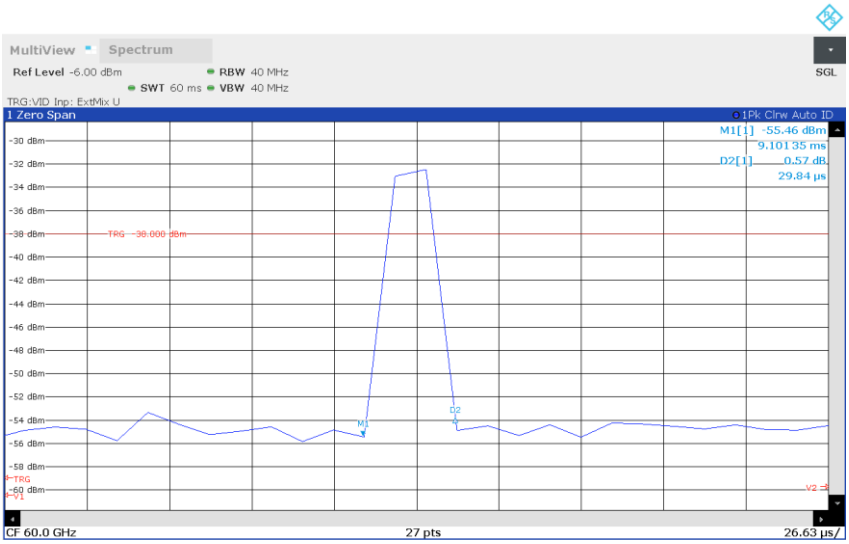


*The vertical display lines V1 (0ms) and V2 (33ms) mark the observation period according RSS-210 Annex J §J.3.2(b)(iii)(2)

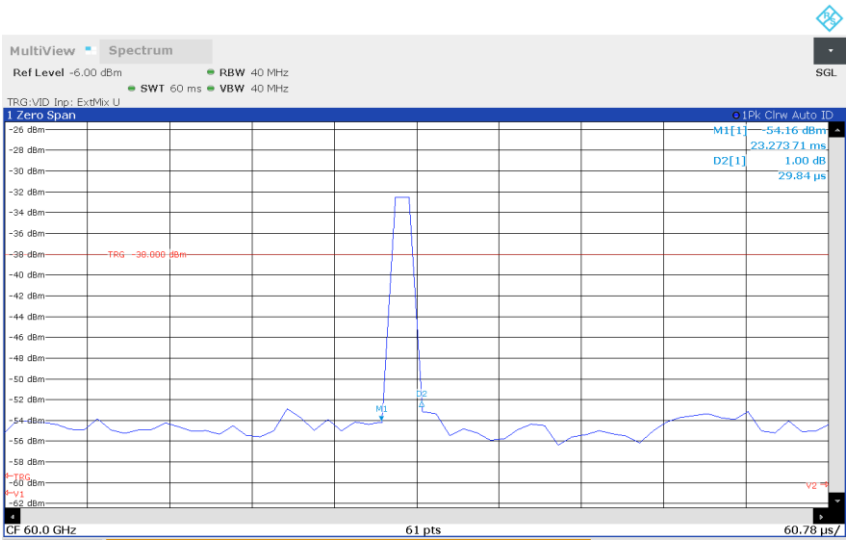
1st TX_{on}



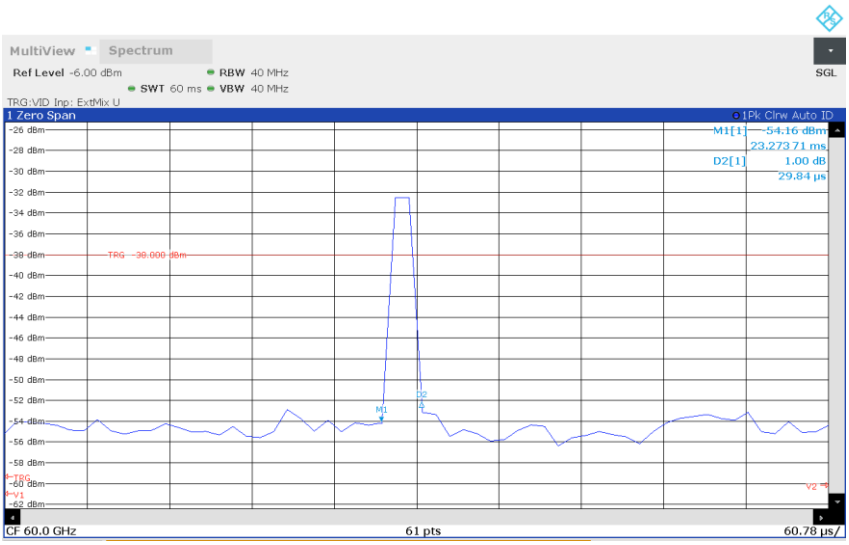
2nd TX_{on}



3rd TX_{on}



4th TX_{on}



4.8 PRODUCT LABELLING

4.8.1 FCC ID LABEL

Please refer to the documentation of the applicant.

4.8.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

5 TEST RESULTS

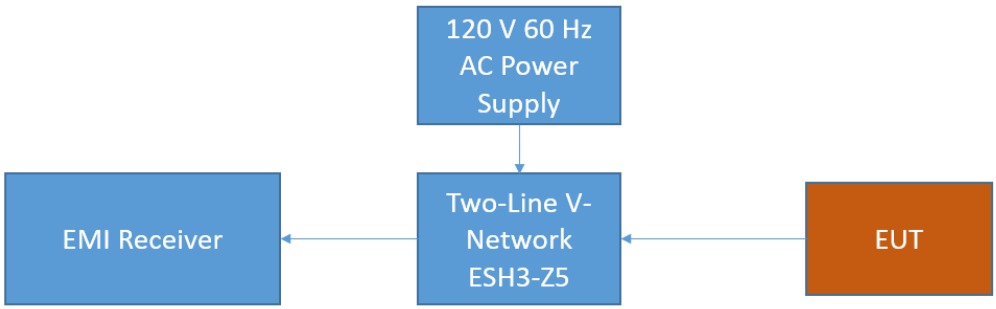
5.1 AC POWER LINE CONDUCTED EMISSIONS

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 with the general provisions of ANSI C 63.10.
The Equipment Under Test (EUT) was setup in a shielded room to perform the conducted emissions measurements in a typical installation configuration. The EUT was powered from 50µH || 50 Ohm Line Impedance Stabilization Network (LISN). The LISN's unused connections were terminated with 50 Ohm loads.



FCC Conducted Emissions on AC

The measurement procedure consists of two steps. It is implemented into the EMI test software EMC-32 from R&S.

Step 1: Preliminary scan
Intention of this step is, to determine the conducted EMI-profile of the EUT.
EMI receiver settings:
- Detector: Quasi-Peak & Average, trace Max-hold
- Frequency range: 150 kHz – 30 MHz
- Frequency steps: 2.5 kHz
- IF–Bandwidth: 9 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)
- Measurement combinations:
1) Neutral lead - reference ground (PE grounded)
2) Phase lead - reference ground (PE grounded)
3) Neutral lead - reference ground (PE floating)
4) Phase lead - reference ground (PE floating)

On basis of this preliminary scan the highest amplitudes and the corresponding frequencies relative to the limit are identified. Emissions above the limit and emissions which are in the 10 dB range below the limit are considered.

Step 2: Final measurement
Intention of this step is, to determine the highest emissions with the settings defined in the test specification for the frequencies and leads identified in step 1.
EMI receiver settings:
- Detector: Quasi-Peak & CISPR-Average
- IF Bandwidth: 9 kHz
- Measuring time: 15 x 1 s / frequency

The highest value is reported in the table.

5.1.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart B, §15.207

Frequency (MHz)	QP Limits (dBµV)	AV Limits (dBµV)
0.15 – 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

RSS GEN Issue 5 (April 2018), Clause 8.8

AC power-line conducted emissions limits
Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table, as measured using a 50 µH / 50 Ωline impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Frequency (MHz)	QP Limits (dBµV)	AV Limits (dBµV)
0.15 – 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

5.1.3 TEST PROTOCOL

Temperature: 25 °C
Air Pressure: 1010 hPa
Humidity: 40 %

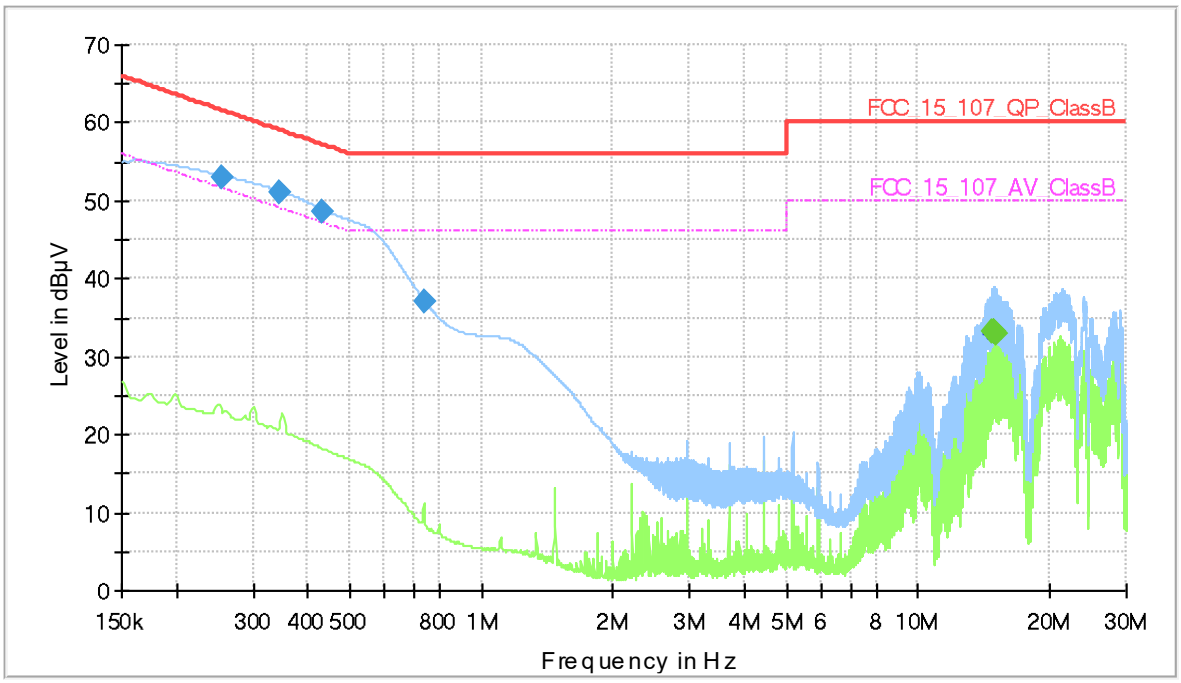
Power line	PE	Frequency [MHz]	Level [dBµV]	Detector	Limit [dBµV]	Margin [dB]
N	GND	0.25	52.9	QP	61.6	8.7
N	GND	0.34	51.0	QP	59.1	8.1
N	GND	0.43	48.6	QP	57.2	8.6
N	GND	0.74	36.9	QP	56.0	19.1
L1	GND	14.84	33.2	AV	50.0	16.8
L1	GND	14.88	33.2	AV	50.0	16.8
L1	GND	14.92	33.1	AV	50.0	16.9
L1	GND	14.96	33.2	AV	50.0	16.8
L1	GND	15.00	33.3	AV	50.0	16.7
L1	GND	15.04	33.0	AV	50.0	17.0

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

Note: The measurement was performed according to FCC Part 15B requirements, as the same limits are applicable.

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

Setup: S01_AB01



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.253500	52.94	---	61.64	8.70	1000.0	9.000	N	GND	10.1
0.343500	51.01	---	59.12	8.11	1000.0	9.000	N	GND	10.1
0.433500	48.63	---	57.19	8.56	1000.0	9.000	N	GND	10.1
0.737250	36.94	---	56.00	19.06	1000.0	9.000	N	GND	10.1
14.842500	---	33.17	50.00	16.83	1000.0	9.000	L1	GND	10.8
14.880750	---	33.24	50.00	16.76	1000.0	9.000	L1	GND	10.9
14.919000	---	33.12	50.00	16.88	1000.0	9.000	L1	GND	10.9
14.959500	---	33.20	50.00	16.80	1000.0	9.000	L1	GND	10.9
14.997750	---	33.32	50.00	16.68	1000.0	9.000	L1	GND	10.9
15.036000	---	32.98	50.00	17.02	1000.0	9.000	L1	GND	10.9

5.1.5 TEST EQUIPMENT USED

- Conducted Emissions FCC

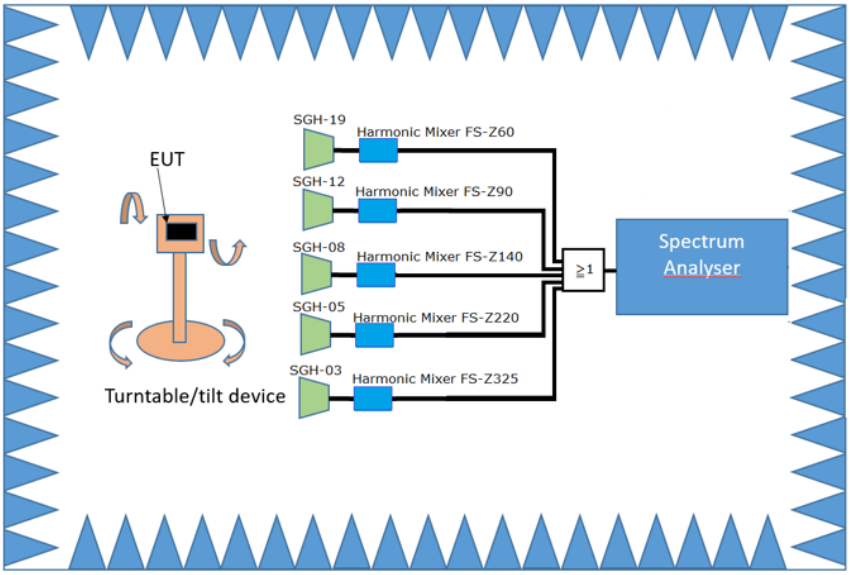
5.2 EMISSION BANDWIDTH

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.2.1 TEST DESCRIPTION

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.



Test Setup (40 GHz - 320 GHz)

Analyzer settings:

- Resolution Bandwidth (RBW): 100 kHz
- Video Bandwidth (VBW): 300 kHz
- Span: 500 MHz
- Trace: Maxhold
- Sweeps: allow the trace to stabilize
- Sweeptime: 100 ms
- Detector: Peak

5.2.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In

the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

§15.255 (e)(1)
[…] For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

RSS GEN Issue 5 (April 2018), Clause 6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs. […]

5.2.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1004 hPa
Humidity: 34 %

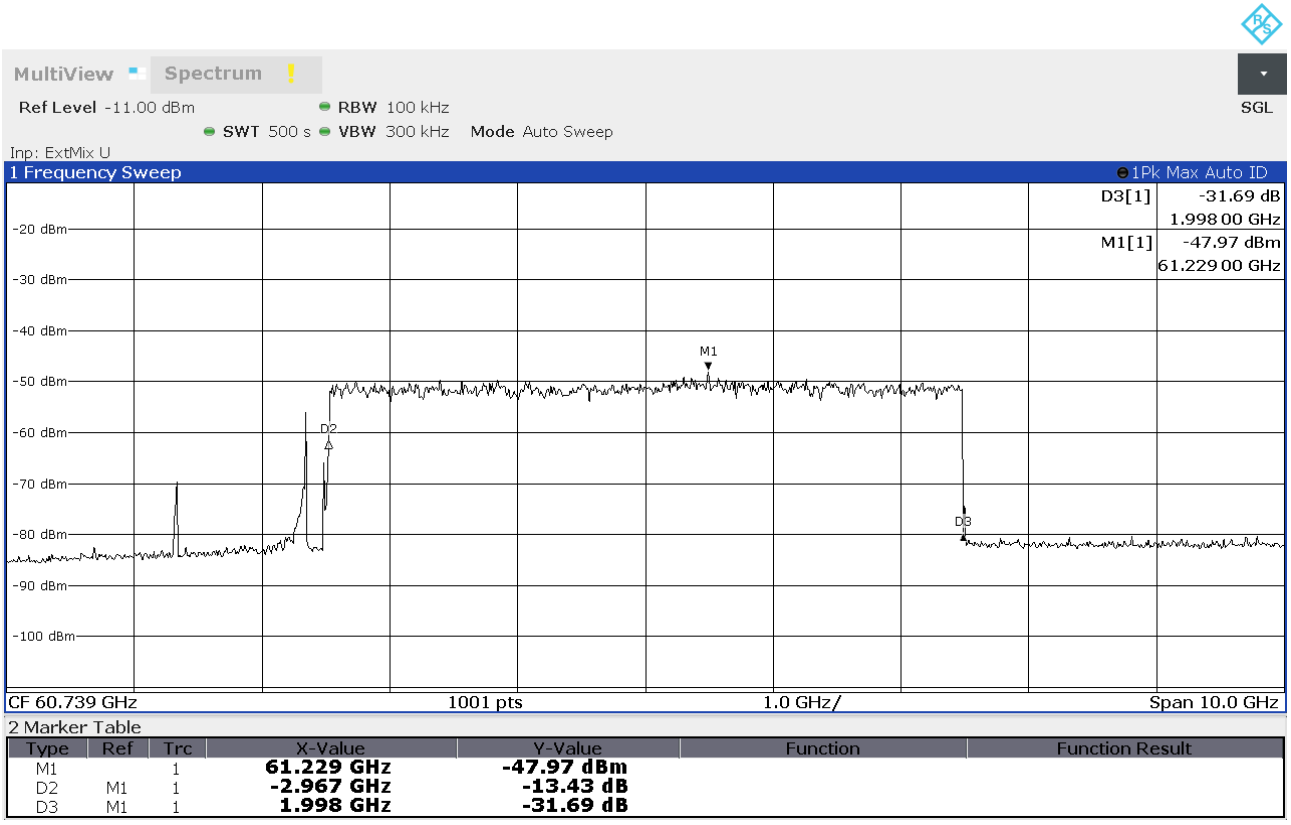
Mode	Low Frequency [MHz]	High Frequency [MHz]	6 dB [MHz]	Lower Limit [MHz]	Upper Limit [MHz]	Lower Margin [MHz]	Upper Margin [MHz]
FMCW	58262.0	63227.0	4965	57000	64000	1262.0	773.0

Mode	Low Frequency [MHz]	High Frequency [MHz]	99 % BW [MHz]	lower Limit [MHz]	upper Limit [MHz]	Lower Margin [MHz]	Upper Margin [MHz]
FMCW	58221.5	63243.4	5030	57000	64000	1221.5	756.6

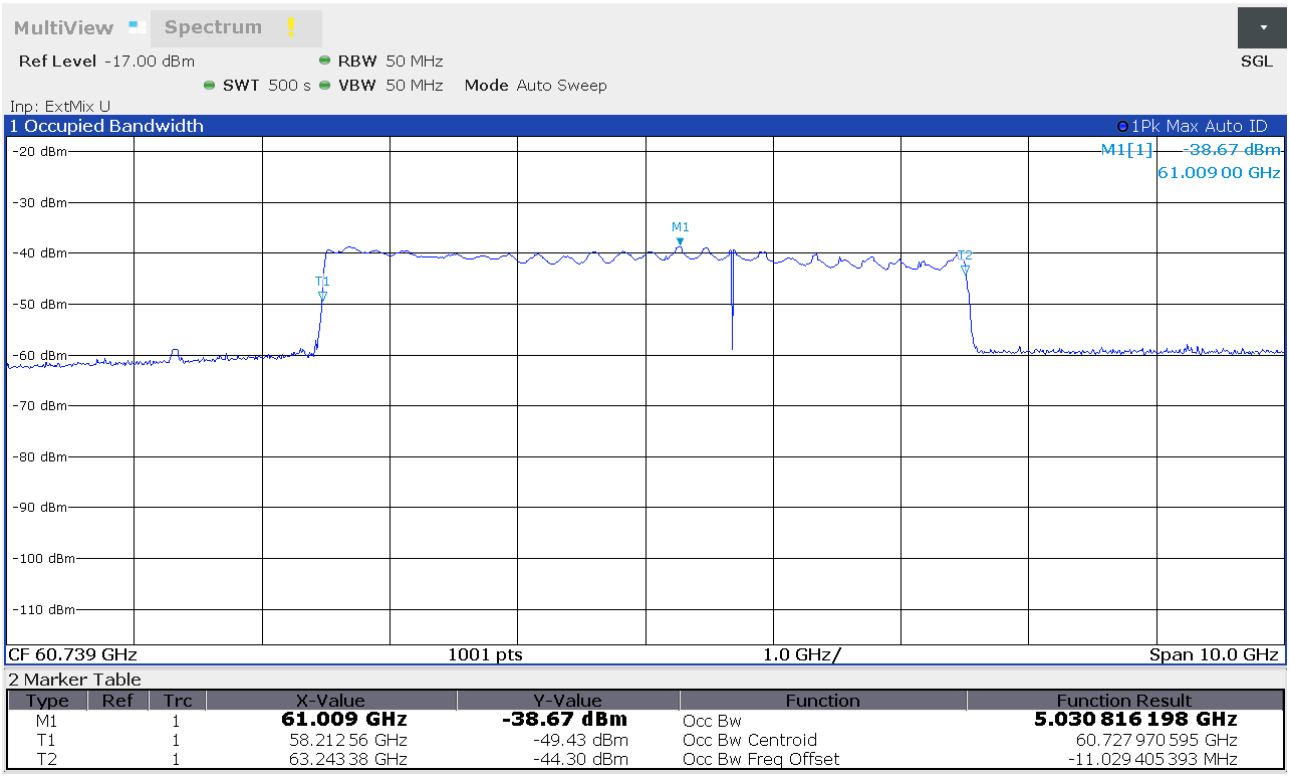
Remark: Please see next sub-clause for the measurement plot.

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

6 dB Bandwidth



99% Bandwidth



5.2.5 TEST EQUIPMENT USED

- Radiated Emissions FAR FCC

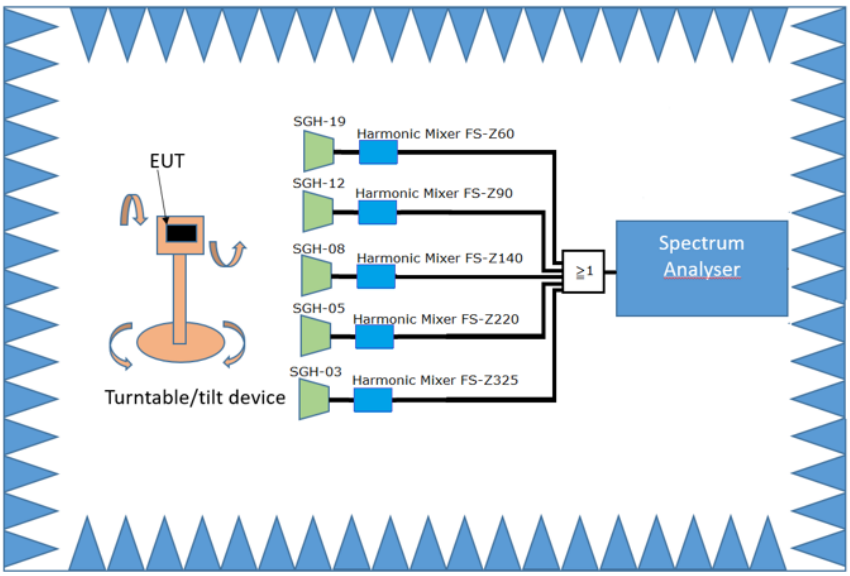
5.3 PEAK OUTPUT POWER

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.3.1 TEST DESCRIPTION

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.
The EUT is turned during the pre-measurement to find the direction where the highest output power is emitted by the EUT, the turn table step size (azimuth angle) for the measurement is 1°, the Turntable angle range: –180° to +180°. When the position of the highest radiation is detected, the output power is measured in this position.



Test Setup (40 GHz - 320 GHz)

Deviation from standard:
The device under test is a FMCW Radar device. In this mode a narrow transmission is swept rapidly across the range of frequencies over a short time. Each narrow transmission during a single chirp has a Bandwidth less than 1 MHz.

Analyzer settings:

- Resolution Bandwidth (RBW): 1 MHz
- Video Bandwidth (VBW): 3 MHz
- Span: 500 MHz
- Trace: Maxhold
- Sweeps: allow the trace to stabilize
- Sweeptime: 1 s
- Detector: Peak
- Measurement distance: 1 m

5.3.2 TEST REQUIREMENTS / LIMITS

§15.255 (c)
Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Devices other than field disturbance sensors shall comply with one of the following power limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

(A) The provisions in this paragraph (c) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (c)(1)(i) of this section.

(B) The provisions of § 15.204(c)(2) and (4) that permit the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in § 2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.

(2) Field disturbance sensors/radars shall not exceed −10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:

(i) ***57.0-59.4 GHz:*** the peak EIRP level shall not exceed 20 dBm for indoor operation or 30 dBm for outdoor operation;

(ii) ***57.0-61.56 GHz:*** the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds;

(iii) ***57.0-64.0 GHz:***

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

(B) The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors:
(*1*) As part of a temporary or permanently fixed application; or
(*2*) When being used in vehicular applications to perform specific tasks of moving something or someone, except for in-cabin applications;

(iv) A field disturbance sensor may operate in any of the modes in the above sub-sections so long as the device operates in only one mode at any time and does so for at least 33 milliseconds before switching to another mode.

(v) ***61.0-61.5 GHz:*** For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0-61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0-61.5 GHz band, measured during the transmit interval, but still within the 57-71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

(3) For pulsed field disturbance sensors/radars operating in the 57-64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 µs time window. In addition, the average integrated EIRP within the frequency band 61.5-64.0 GHz shall not exceed 5 dBm in any 0.3 µs time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. The radar bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna.

(4) The provisions in § 15.35(b) and (c) that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (c)(2) and (3) of this section.

§15.255 (e)

(1) Except as specified in paragraph (e)(2) of this section, the peak transmitter conducted output power of devices other than field disturbance sensors/radars shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.

(2) Devices other than field disturbance sensors/radars with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (*e.g.,* for frequency hopping devices).

RSS210 Issue 11: Annex J, J.2.1, J.4
J.2.1:
Following are the conditions for fixed field disturbance sensors and interactive motion sensors:

a. For fixed field disturbance sensors that occupy a bandwidth of 500 MHz or less and for which the bandwidth is contained wholly within the frequency band 61.0-61.5 GHz, the equipment's average and peak e.i.r.p. in the channel bandwidth shall not exceed 40 dBm and 43 dBm respectively. In addition, the average and peak e.i.r.p. of any emission outside of the band 61.0-61.5 GHz, but still within the band 57-71 GHz, shall not exceed 10 dBm and 13 dBm respectively.

b. For fixed field disturbance sensors other than those operating under the provisions of (a) above and for interactive motion sensors, the peak transmitter output power shall not exceed -10 dBm, and the peak e.i.r.p. shall not exceed 10 dBm.

J.4:
Following are the conditions for peak transmitter output power:

a. For devices with an emission bandwidth greater than or equal to 100 MHz, the peak transmitter output power shall not exceed 500 mW. For devices with an emission bandwidth less than 100 MHz, the peak transmitter output power shall be less than the product of 500 mW and their emission bandwidth divided by 100 MHz.

5.3.3 TEST PROTOCOL

Ambient temperature: 25 °C
Air Pressure: 1004 hPa
Humidity: 34 %

Mode	Measured Peak Power E.I.R.P. [dBm]	FMCW desensitization factor [dB]	Peak Power E.I.R.P (incl. desensitization factor) [dBm]	Limit [dBm]	Margin to Limit [dB]	Verdict
FMCW	11.9	0	11.9	20	8.1	Passed

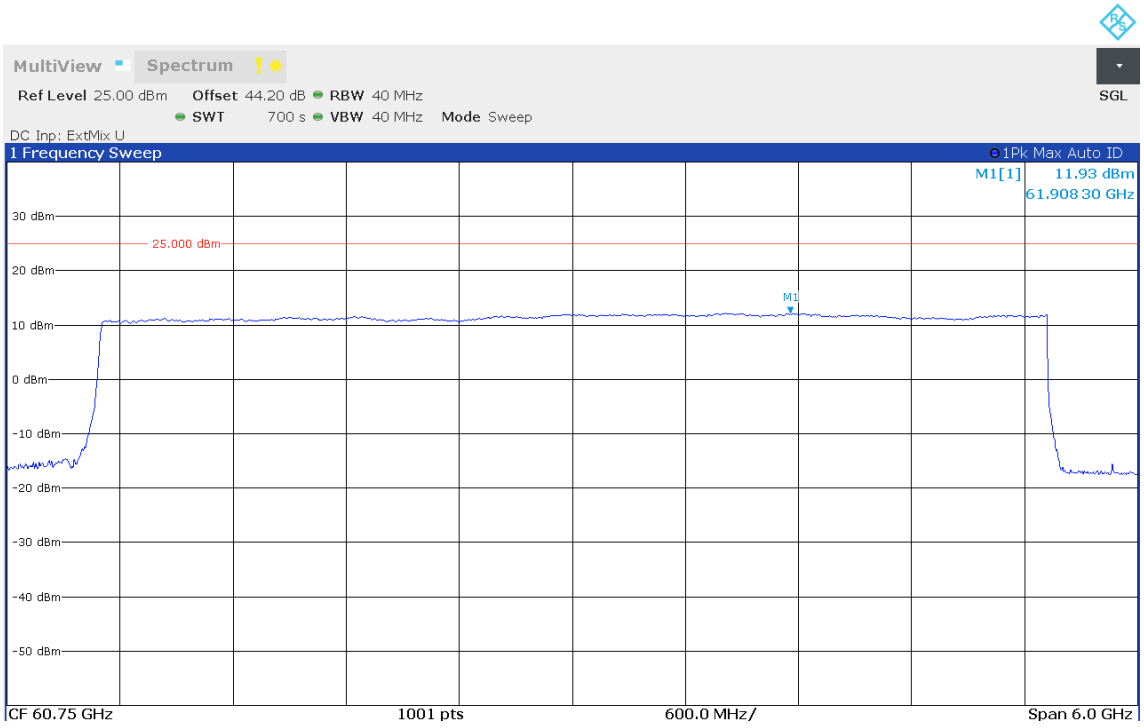
Desensitization Factor:

$$\alpha = \frac{1}{\left(1+\left[\left(\frac{2\times\ln(2)}{\pi}\right)^2\times\left(\frac{BW_{\text{Chirp}}}{T_{\text{Chirp}}\times RBW^2}\right)^2\right]\right)^{0.25}}$$

$BW_{Chirp} = 4900\ MHz$
$T_{Chirp} = 524\ \mu s$

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

Output power



Duty Cycle

5.3.5 TEST EQUIPMENT USED

- Radiated Emissions FAR FCC

5.4 UNWANTED EMISSIONS

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.4.1 TEST DESCRIPTION

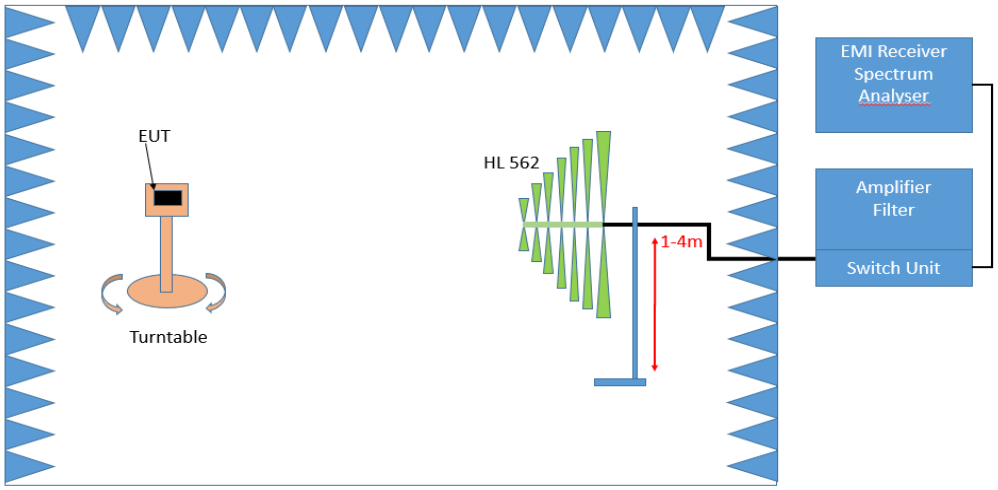
The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration.

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:

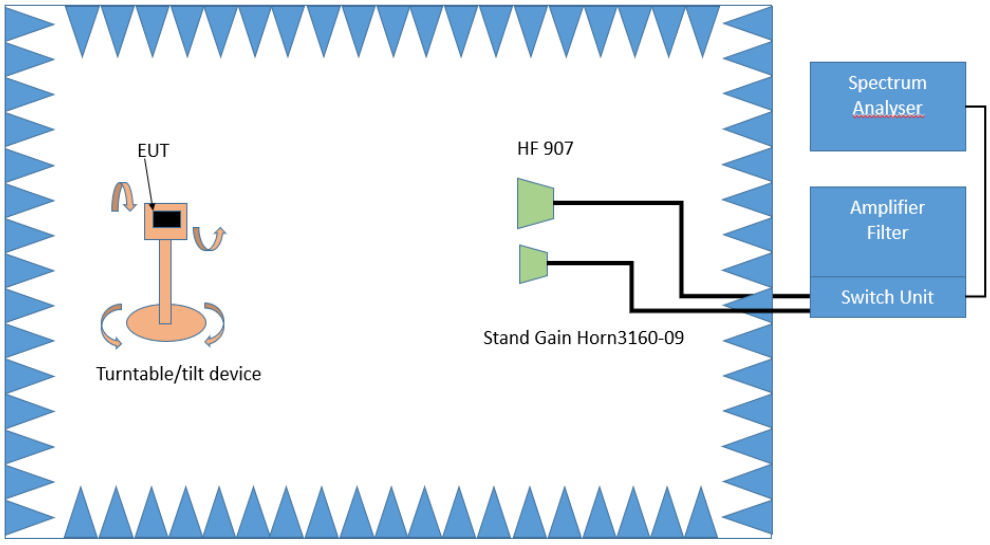
- Detector: Quasi-Peak (< 1 GHz)
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

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



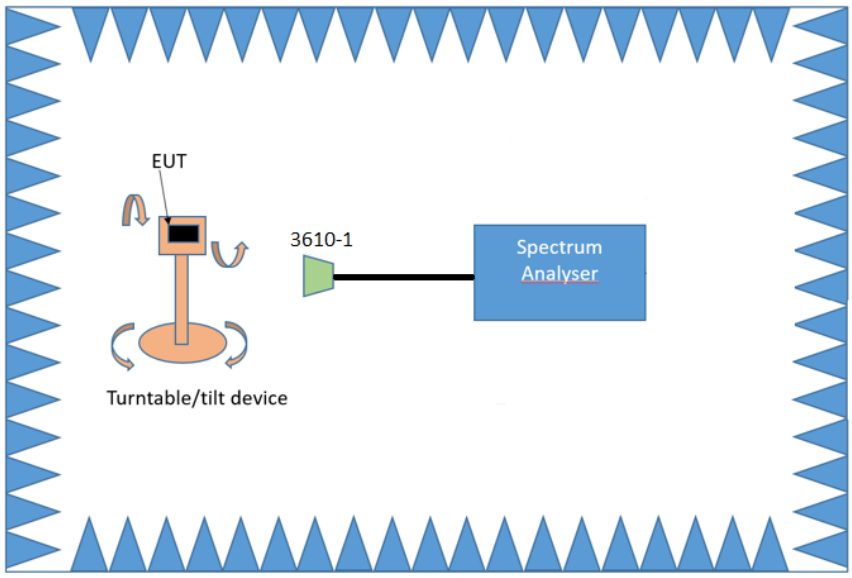
Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

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

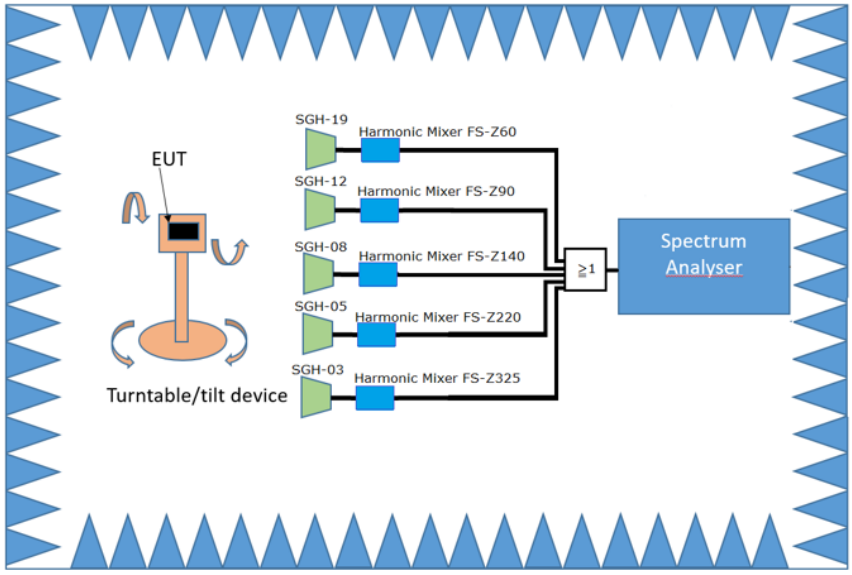
Step 2:
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
Spectrum analyser settings:
- Detector: Peak

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 ± 22.5°.
The elevation angle will slowly vary by ± 45°
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

5.4.2 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 / (4πd²)
- Limit (dBµV/m) = EIRP [dBm] – 20 log (d [m]) + 104.8
- Distance-Correction Factor is: 20 log (d [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

5.4.3 TEST PROTOCOL

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

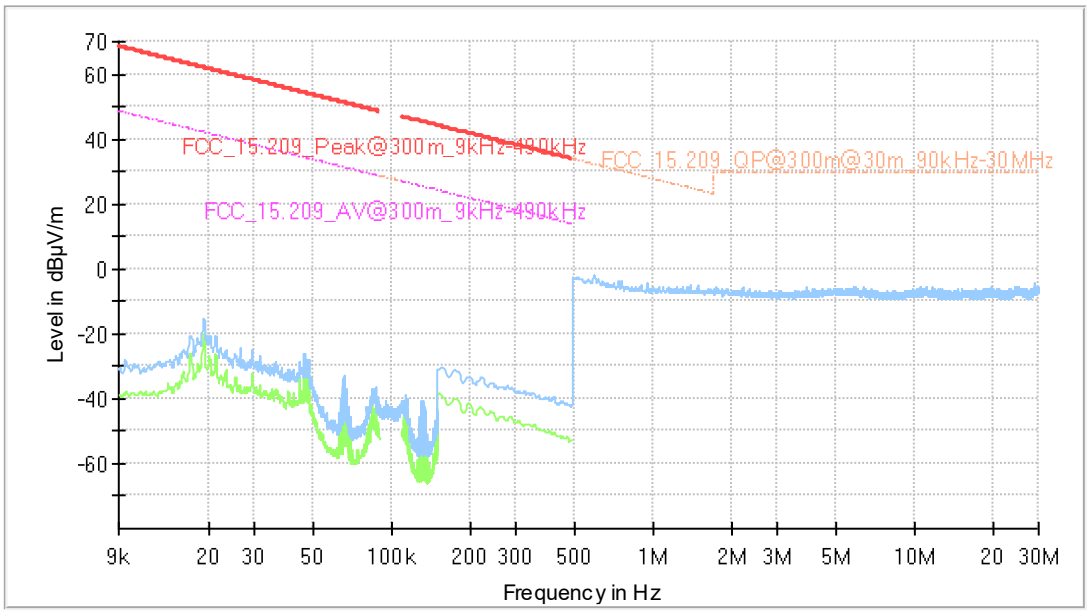
S01_AA01

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
6807.2	61.7	PEAK	1000	74	12.3
6917.2	47.3	AV	1000	54	6.6
11159.1	34.0	AV	1000	54	20
11159.1	63.2	PEAK	1000	74	10.8

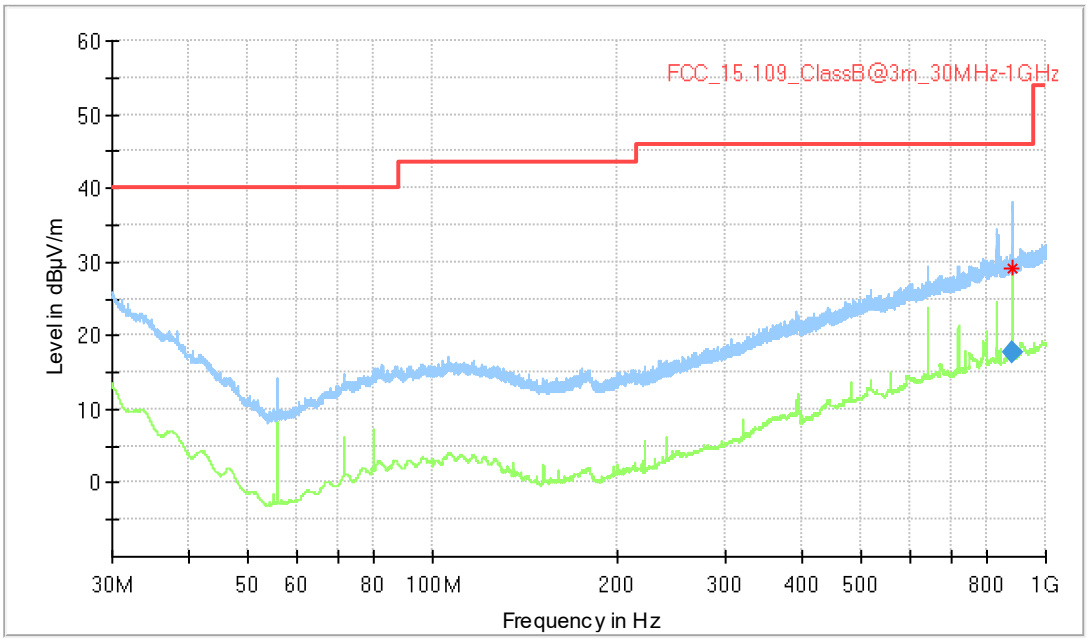
Remark: Please see next sub-clause for the measurement plot.

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

S01_AB01
9 kHz – 30 MHz



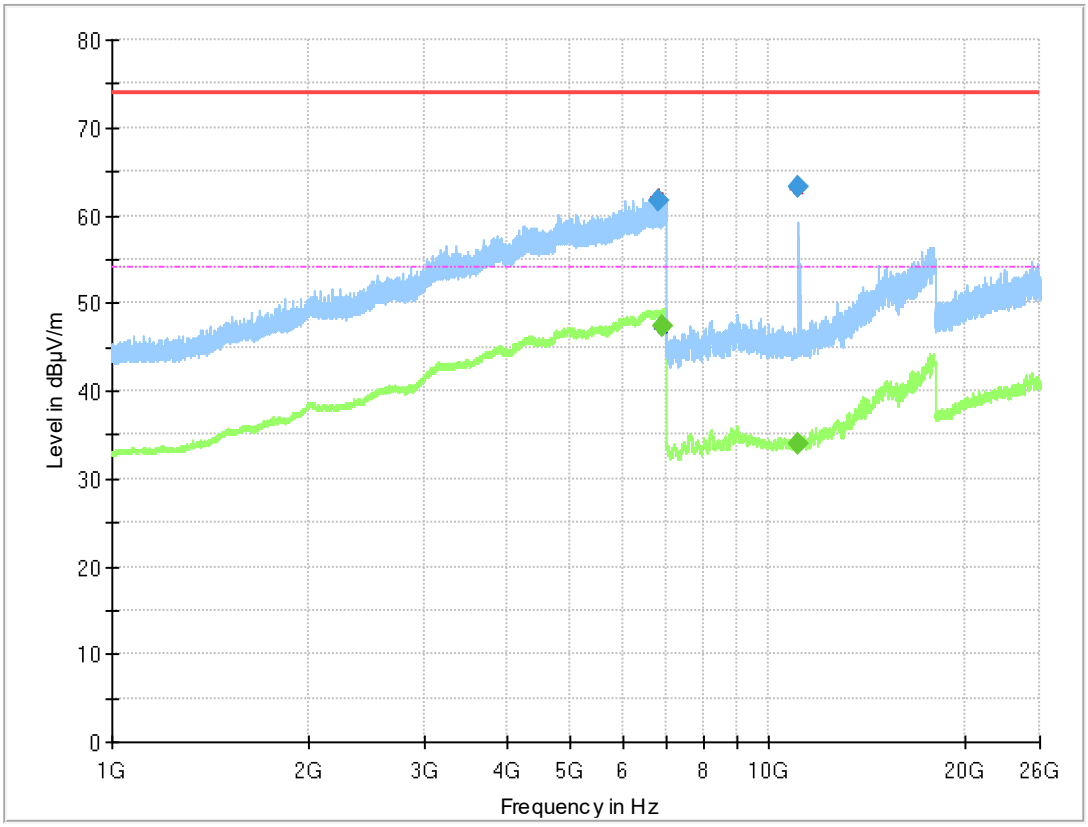
S01_AB01
30 MHz – 1 GHz



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)
880.470000	17.6	46.00	28.5	1000.0	120.000	186.0	H	153	25.1

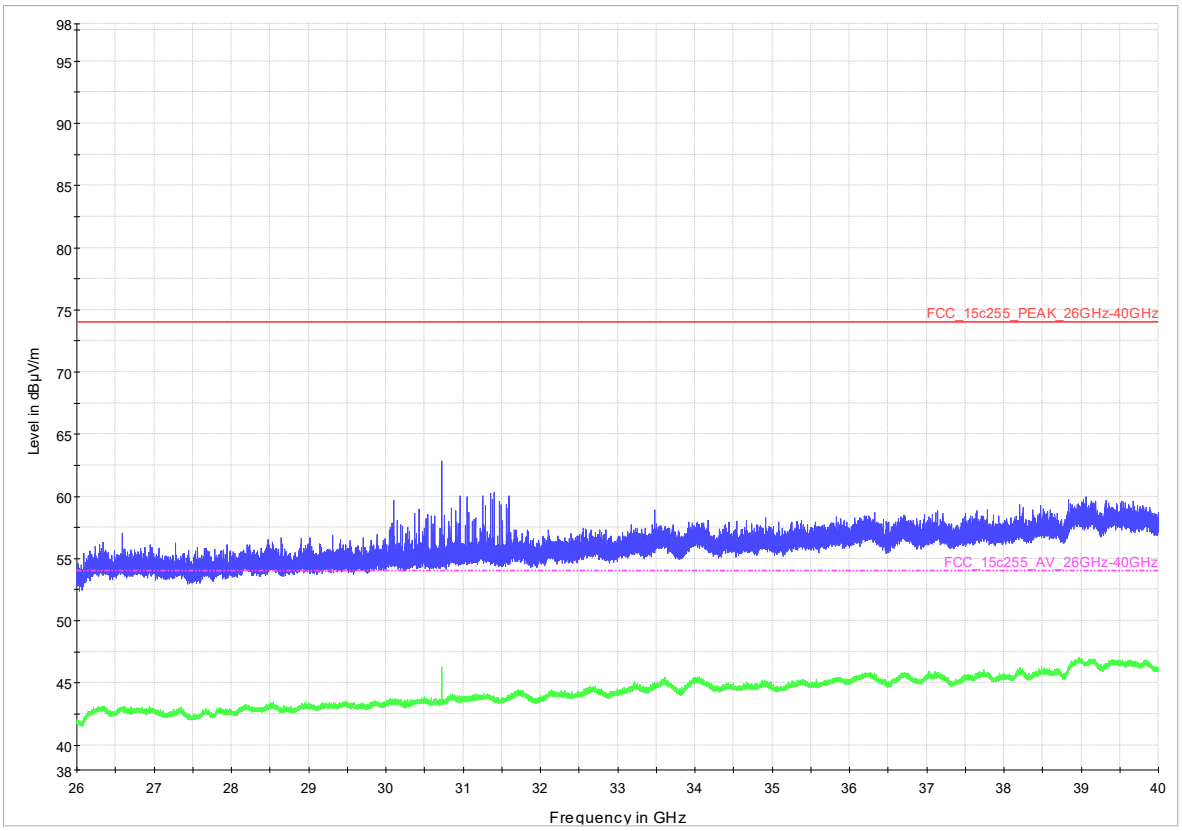
S01_AB01
1 GHz – 26 GHz



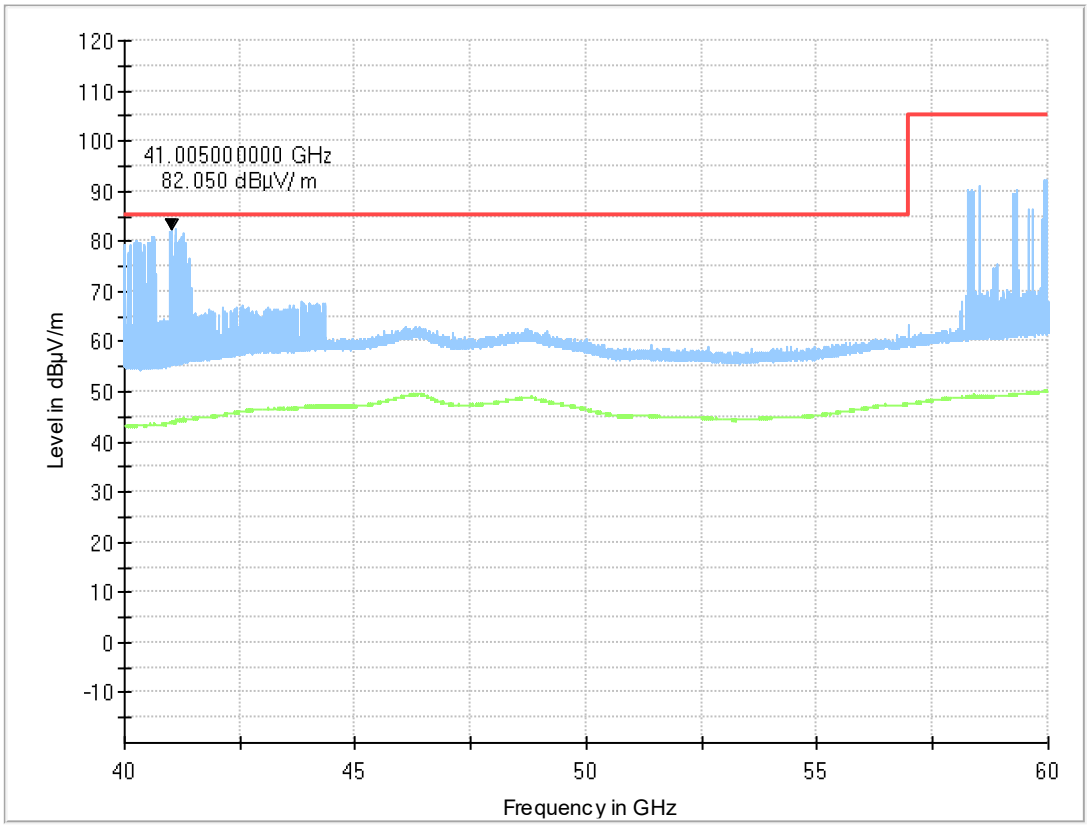
Final_Result

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)
6807.200	61.7	---	74.00	12.32	1000.0	1000.000	150.0	V	-185.0	88.0	19.0
6917.200	---	47.3	54.00	6.65	1000.0	1000.000	150.0	H	63.0	15.0	19.2
11159.100	---	34.0	54.00	19.98	1000.0	1000.000	150.0	H	-31.0	105.0	4.7
11159.100	63.2	---	74.00	10.78	1000.0	1000.000	150.0	V	-7.0	81.0	4.7

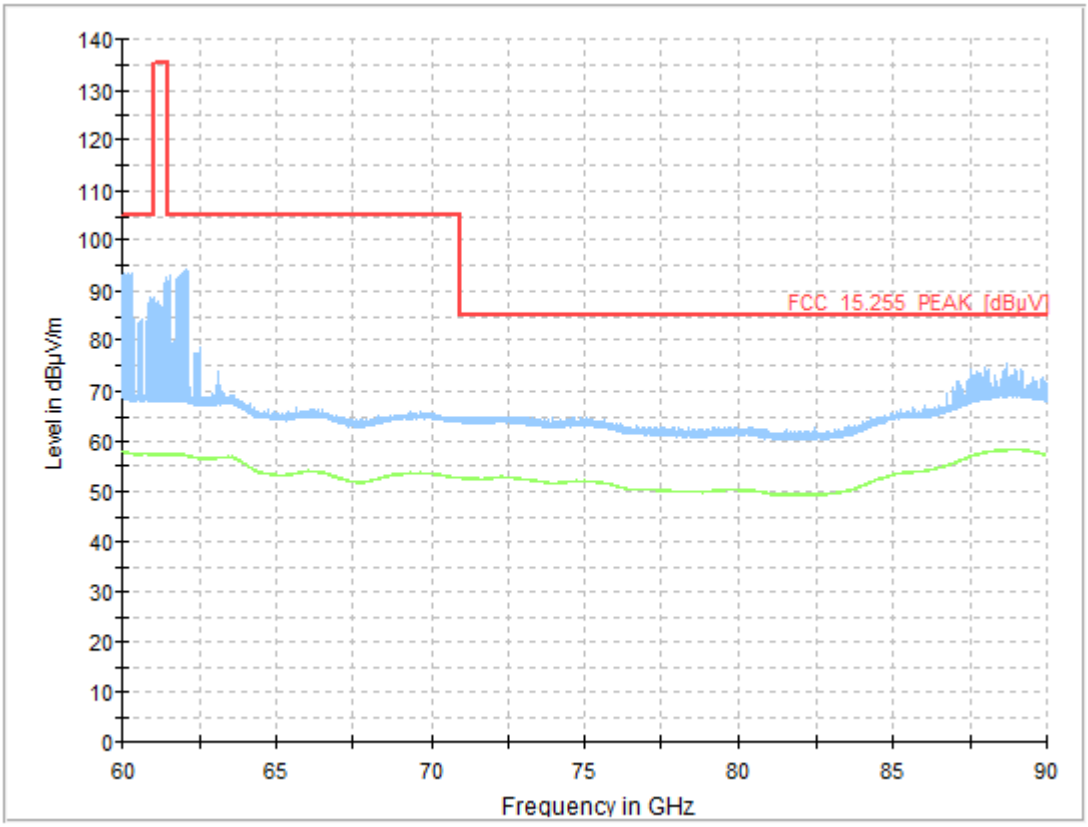
S01_AB01
26 GHz – 40 GHz



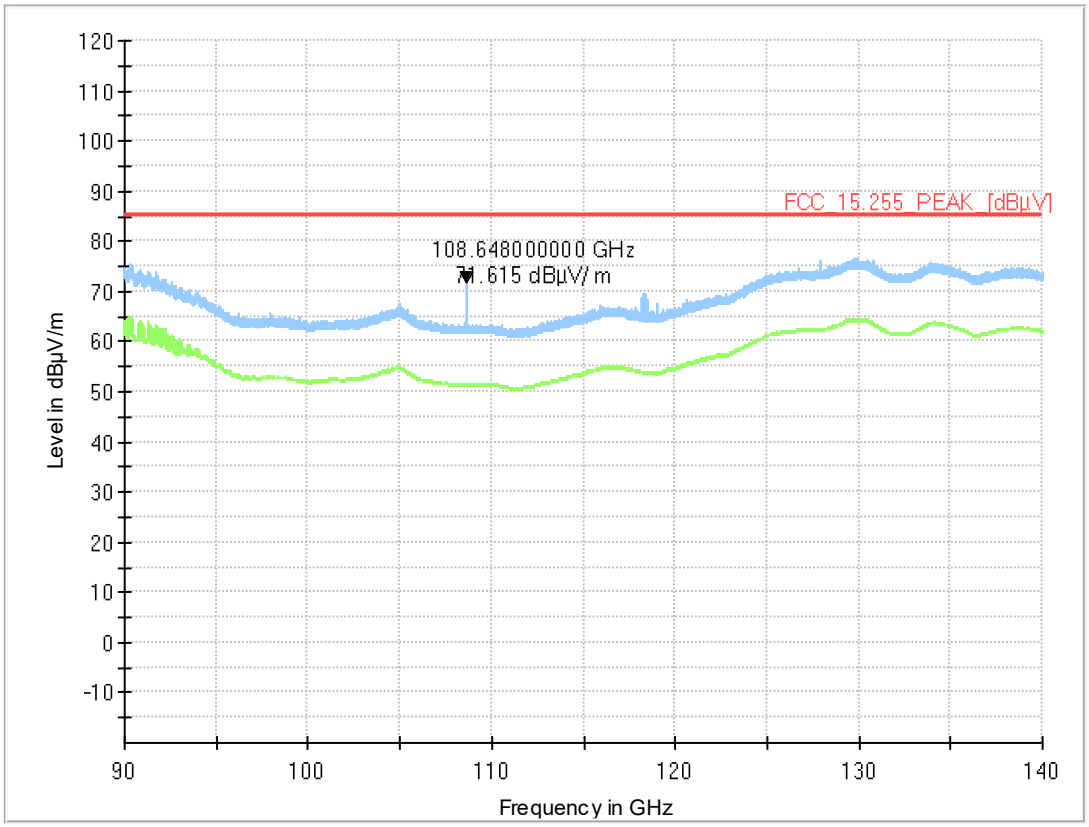
S01_AB01
40 GHz – 60 GHz



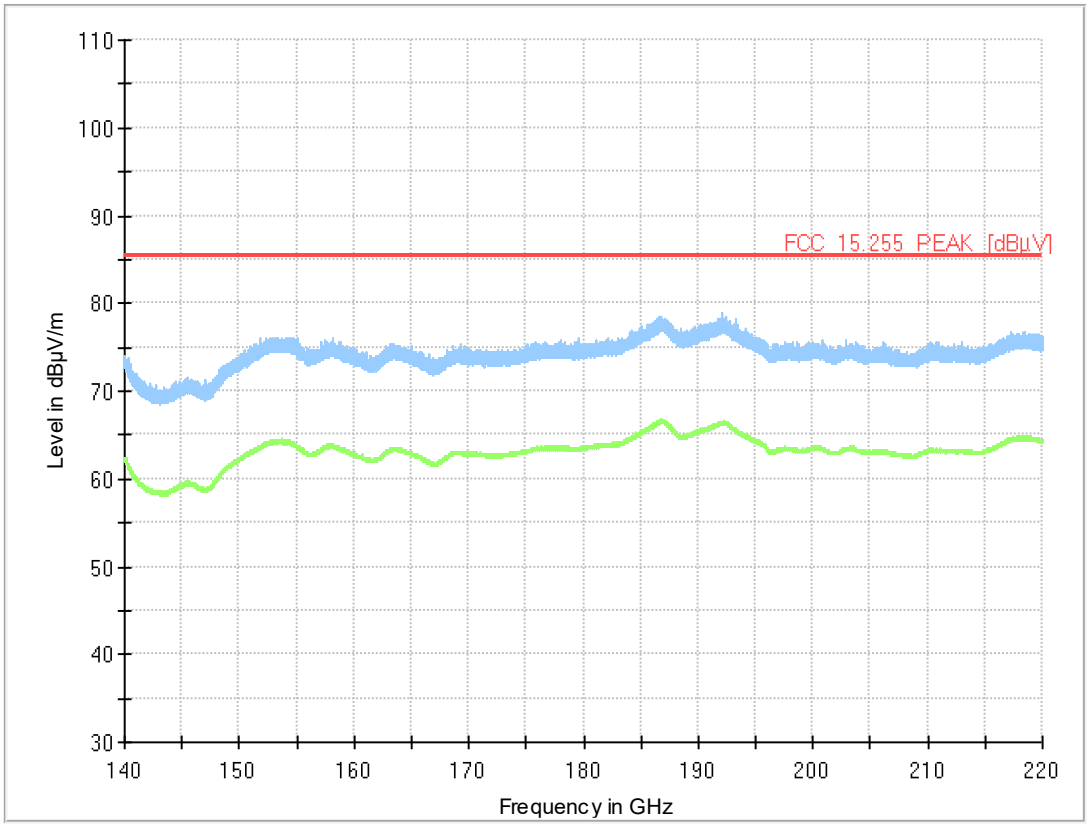
S01_AB01
60 GHz – 90 GHz



S01_AB01
90 GHz – 140 GHz



S01_AB01
140 GHz – 220 GHz



5.4.5 TEST EQUIPMENT USED

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

5.5 FREQUENCY STABILITY

Standard **FCC Part 15 Subpart C**

The test was performed according to:
ANSI C63.10

5.5.1 TEST DESCRIPTION

As specified in Section 15.215(c), the bandwidth of the fundamental emission must be contained within the frequency band over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage. Frequency stability is to be measured according to Section 2.1055 at the highest and lowest frequency of operation and with the modulation that produces the widest emission bandwidth.

5.5.2 TEST REQUIREMENTS / LIMITS

FCC Part 15, Subpart C, §15.215 (c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §15.217 through §15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

RSS 210 Annex J, J.6

Fundamental emissions shall be contained within the 57-71 GHz frequency band during all conditions of operation when tested at the temperature and voltage variations specified for the frequency stability measurement in RSS-Gen.

5.5.3 TEST PROTOCOL

Ambient temperature: 24 °C
Air Pressure: 1002 hPa
Humidity: 44 %

S01_AB01

Temp [°C]	Voltage [V]	Nominal Frequency [GHz]	Time after power on [sec]	Measured Frequency [GHz]	Deviation [Hz]
-20	9.0	60.73950	0	60.7395112382	11.238
-20	9.0	60.73950	120	60.7395047436	4.744
-20	9.0	60.73950	300	60.7395039601	3.960
-20	27.0	60.73950	0	60.7395038507	3.851
-20	27.0	60.73950	120	60.7395005067	0.507
-20	27.0	60.73950	300	60.7395133619	13.362
-10	9.0	60.73950	0	60.7395060326	6.033
-10	9.0	60.73950	120	60.7395134065	13.407
-10	9.0	60.73950	300	60.7395074746	7.475
-10	27.0	60.73950	0	60.7395068719	6.872
-10	27.0	60.73950	120	60.7395099618	9.962
-10	27.0	60.73950	300	60.7395125613	12.561
0	9.0	60.73950	0	60.7395076593	7.659
0	9.0	60.73950	120	60.7395098267	9.827
0	9.0	60.73950	300	60.7395130510	13.051
0	27.0	60.73950	0	60.7395175696	17.570
0	27.0	60.73950	120	60.7395169953	16.995
0	27.0	60.73950	300	60.7395167657	16.766
10	9.0	60.73950	0	60.7395152664	15.266
10	9.0	60.73950	120	60.7395099279	9.928
10	9.0	60.73950	300	60.7395092921	9.292
10	27.0	60.73950	0	60.7395147775	14.777
10	27.0	60.73950	120	60.7395105989	10.599
10	**27.0**	**60.73950**	**300**	**60.7395223689**	**22.369**
20	9.0	60.73950	0	60.7395168539	16.854
20	9.0	60.73950	120	60.7395072249	7.225
20	9.0	60.73950	300	60.7395126555	12.656
20	27.0	60.73950	0	60.7395060169	6.017
20	27.0	60.73950	120	60.7395153867	15.387
20	27.0	60.73950	300	60.7395086748	8.675
30	9.0	60.73950	0	60.7395106663	10.666
30	9.0	60.73950	120	60.7395022922	2.292

30	9.0	60.73950	300	60.7395194542	19.454
30	27.0	60.73950	0	60.7395120417	12.042
30	27.0	60.73950	120	60.7395124358	12.436
30	27.0	60.73950	300	60.7395152610	15.261
40	9.0	60.73950	0	60.7395177882	17.788
40	9.0	60.73950	120	60.7395077428	7.743
40	9.0	60.73950	300	60.7395134788	13.479
40	27.0	60.73950	0	60.7395087332	8.733
40	27.0	60.73950	120	60.7395162524	16.252
40	27.0	60.73950	300	60.7395163262	16.326
50	9.0	60.73950	0	60.7395114447	11.445
50	9.0	60.73950	120	60.7395130593	13.059
50	9.0	60.73950	300	60.7395127322	12.732
50	27.0	60.73950	0	60.7395174578	17.458
50	27.0	60.73950	120	60.7395166032	16.603
50	27.0	60.73950	300	60.7395075861	7.586

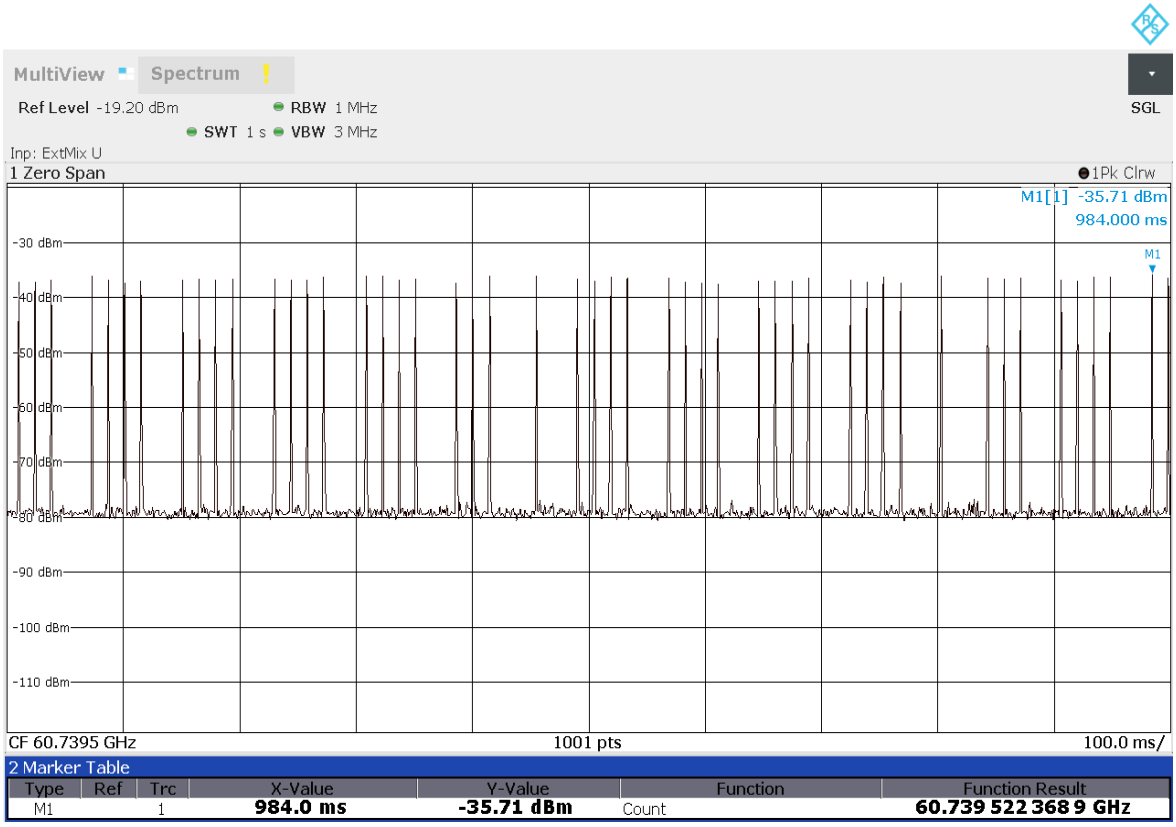
Remark:Please see next sub-clause for the measurement plot.

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

Example Plot
S01_AB01

Voltage = high; Temperature = 10 °C; Minutes = 5

1



5.5.5 TEST EQUIPMENT USED

- Radiated Emissions FAR FCC

6 TEST EQUIPMENT

1.1 TEST EQUIPMENT HARDWARE

1 Conducted Emissions FCC
Conducted Emissions AC Mains for FCC standards

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
1.2	Chroma 6404	AC Source	Chroma ATE INC.	64040001304	N/A	N/A
1.3	Shielded Room 02	Shielded Room 4m x 3m	Frankonia Germany EMC Solution GmbH	-	N/A	N/A
1.4	ESH3-Z5	Two-Line V-Network (EUT)	Rohde & Schwarz GmbH & Co. KG	829996/002	2023-09	2025-09
1.5	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424	2025-04	2027-04
1.6	Opus10 THI (8152.00)	T/H Logger 02	Lufft Mess- und Regeltechnik GmbH	7489	2023-12	2025-12
1.7	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100451	2025-07	2027-07

2 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**
2.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
2.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
2.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
2.4	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
2.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
2.6	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
2.7	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
2.8	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
2.9	HFH2-Z2	Loop Antenna + 3 Axis Tripod	Rohde & Schwarz GmbH & Co. KG	829324/006	2024-04	2027-04

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.10	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100451	2025-07	2027-07

3 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
3.1	N5000/NP	Filter for EUT, 2 Lines, 250 V, 16 A	ETS-LINDGREN	241515	N/A	N/A
3.2	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
3.3	ESW44	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	101603	2024-03	2026-03
3.4	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
3.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2023-08	2025-08
3.6	Opus10 THI (8152.00)	T/H Logger 10	Lufft Mess- und Regeltechnik GmbH	12488	2023-12	2025-12
3.7	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
3.8	DS 420S	Turn Table 2 m diameter	HD GmbH	420/573/99	N/A	N/A
3.9	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2024-10	2027-10
3.10	HL562E ULTRALOG	Biconical-log-per Antenna (30 MHz - 6 GHz)	Rohde & Schwarz GmbH & Co. KG	102299	2024-07	2027-07
3.11	Chase CBL6111C + INMET 64671 18N-6dB	Hybrid Antenna with 6dB Attenuator		2624 | Kartei-Nr E-003226/K1026	2023-03	2026-03
3.12	CS-RUB6	Rubidium Frequency Standard	Rohde & Schwarz GmbH & Co. KG	100451	2025-07	2027-07
3.13	AM 4.0	Antenna Mast 4 m	Maturo GmbH	AM4.0/180/1192 0513	N/A	N/A

4 Radiated Emissions FAR FCC

Radiated emission tests in a fully anechoic room

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
4.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2023-12	2025-12
4.2	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
4.3	Innco Systems CO3000	Controller for bore sight mast FAC	innco systems GmbH	CO3000/1460/54740522/P	N/A	N/A
4.4	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq		N/A	N/A
4.5	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
4.6	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785	N/A	N/A
4.7	FSW43	Spectrum Analyzer	Rohde & Schwarz GmbH & Co. KG	103779	2024-12	2026-12
4.8	EP 1200/B, NA/B1	AC Source, Amplifier with integrated variable Oscillator	Spitzenberger & Spies GmbH & Co. KG	B6278	N/A	N/A
4.9	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069	N/A	N/A
4.10	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09	N/A	N/A
4.11	MA3000/0800-XP-ET-compact	Bore Sight Antenna Mast	innco systems GmbH	9210522	N/A	N/A
4.12	TT 1.5 WI	Turn Table	Maturo GmbH	-	N/A	N/A
4.13	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008	N/A	N/A
4.14	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709	N/A	N/A
4.15	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324	N/A	N/A
4.16	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2024-10	2027-10
4.17	FS-Z60	Harmonic Mixer 40 - 60 GHz	Rohde & Schwarz Messgerätebau GmbH	100178	2023-06	2026-06
4.18	FS-Z220	Harmonic Mixer 140 - 220 GHz	Rohde & Schwarz Messgerätebau GmbH	101005	2023-05	2026-05

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
4.19	SGH-05	Standard Gain / Pyramidal Horn Antenna (140 - 220 GHz)	RPG-Radiometer Physics GmbH	075	N/A	N/A
4.20	SGH-19	Standard Gain / Pyramidal Horn Antenna (40 - 60 GHz)	RPG-Radiometer Physics GmbH	093	N/A	N/A
4.21	FS-Z325	Harmonic Mixer 220 - 325 GHz	Rohde & Schwarz Messgerätebau GmbH	101006	2023-06	2026-06
4.22	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronic GmbH	00086675	N/A	N/A
4.23	MA4985-XP-ET	Bore Sight Antenna Mast	innco systems GmbH	none	N/A	N/A
4.24	SGH-08	Standard Gain / Pyramidal Horn Antenna (90 - 140 GHz)	RPG-Radiometer Physics GmbH	064	N/A	N/A
4.25	SGH-12	Standard Gain / Pyramidal HornAntenna (60 - 90 GHz)	RPG-Radiometer Physics GmbH	326	N/A	N/A
4.26	FS-Z140	Harmonic Mixer 90 -140 GHz	Rohde & Schwarz Messgerätebau GmbH	101007	2023-05	2026-05
4.27	SGH-03	Standard Gain / Pyramidal Horn Antenna (220 - 325 GHz)	RPG-Radiometer Physics GmbH	060	N/A	N/A
4.28	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic 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 Cotrollller	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_{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)	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 (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)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	Harmonic Mixer FS-Z60	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
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 (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-12	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	Harmonic Mixer FS-Z90	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
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 (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)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	Harmonic Mixer FS-Z140	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
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 (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 – 200 GHZ)

Frequency	AF SGH-19	Corr.		cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	Harmonic Mixer FS-Z140	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
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

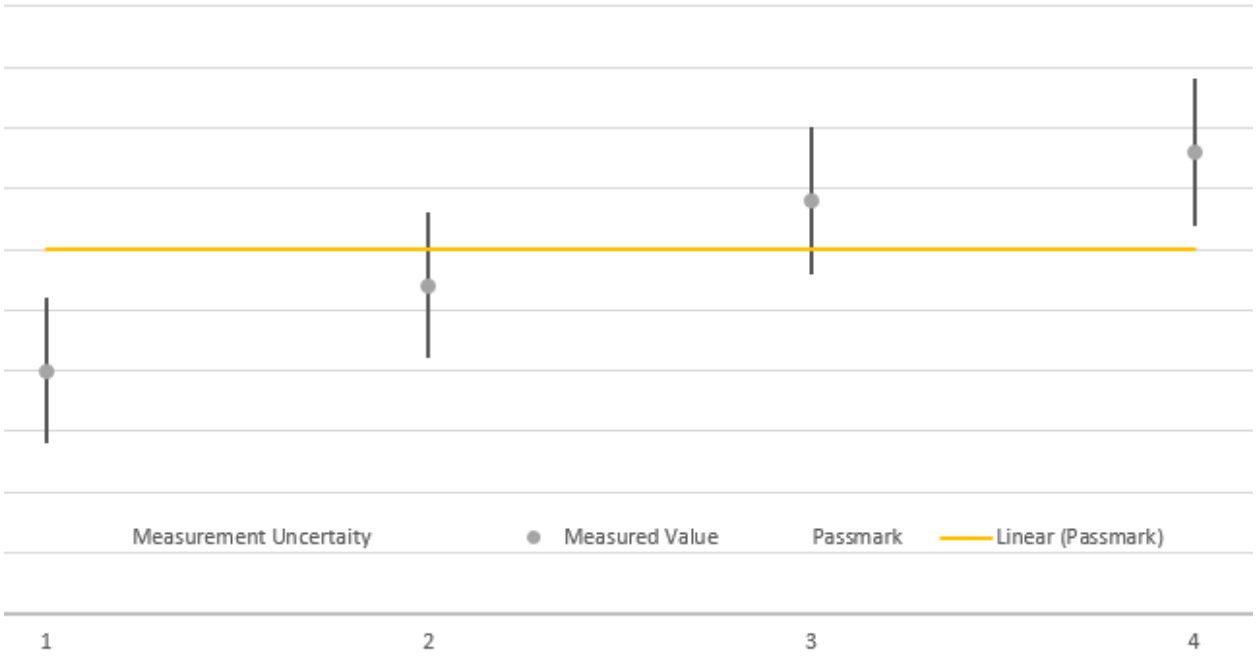
Sample calculation

E (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	Maximum expanded Measurement uncertainty
Radio frequency	Frequency	± 1 x 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