

InterLab®

FCC Measurement/Technical Report on

NFC transceiver

WMI2-15W-W167

FCC ID: QWY-WMI2W167W15
IC: 6588A-WMI2W167W15

Report Reference: MDE_PEIKER_1801_FCCb_rev1

Test Laboratory:

7layers GmbH
Borsigstrasse 11
40880 Ratingen
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.

7layers GmbH

Borsigstraße 11
40880 Ratingen, Germany
T +49 (0) 2102 749 0
F +49 (0) 2102 749 350

Geschäftsführer/

Managing Directors:

Frank Spiller
Bernhard Retka
Alexandre Norré-Oudard

Registergericht/registered:

Düsseldorf HRB 75554
USt-Id.-Nr./VAT-No. DE203159652
Steuer-Nr./TAX-No. 147/5869/0385

*a Bureau Veritas
Group Company*

www.7layers.com

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1 Summary

1.1 Technical Report Summary

Type of Authorization

Certification for an intentional radiator operating at 13.56 MHz

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 (10-1-17 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

§ 15.205 Restricted bands of operation

§ 15.207 Conducted limits

§ 15.209 Radiated emission limits; general requirements

§ 15.215 Additional provisions to the general radiated emission limitations

§ 15.225 Operation within the band 13.110-14.010 MHz

Note:

ANSI C63.10-2013 is applied

Summary Test Results:

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

1.2 FCC-IC Correlation Table

The following tables show the correlation of measurement requirements Radio equipment operating in the Band 13.110-14.010 MHz from FCC and IC.

Radio equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5: 8.8
Out-of-band emissions	§ 15.225 (d)	RSS Gen Issue 5: 6.13/8.9/8.10; RSS-210 Issue 9: B.6
In-band emissions	§ 15.225 (a) / (b) / (c)	RSS-210 Issue 9: B.6
Frequency Stability	§ 15.225 (e)	RSS-210 Issue 9: B.6
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 5: 8.3
Receiver spurious emissions	–	RSS-210 Issue 9: 2.3; RSS Gen Issue 5: 5/7 *)
Handling of active and passive tag devices of RFID application	§ 15.225 (f)	RSS Gen Issue 5: 8.7

*) Receivers are exempted from certification besides if operating in stand-alone mode in the frequency range 30–960 MHz or if these are scanner receivers.

1.3 Measurement Summary / Signatures

FCC Part 15, Subpart C § 15.207

Conducted Emissions AC Power line

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
–	–	–	N/A

FCC Part 15, Subpart C §15.209

Radiated Emissions

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
NFC_ext	Setup_01	Enclosure	passed
NFC_int	Setup_01	Enclosure	passed
NFC_int	Setup_02	Enclosure	passed

FCC Part 15, Subpart C § 15.215

Occupied Bandwidth

The measurement was performed according to FCC § 2.1049

OP-Mode	Setup	Port	Final Result
NFC_ext	Setup_01	Enclosure	passed

FCC Part 15, Subpart C § 15.225

Spectrum Mask

The measurement was performed according to ANSI C63.10

OP-Mode	Setup	Port	Final Result
NFC_ext	Setup_01	Enclosure	passed
NFC_int	Setup_01	Enclosure	passed

FCC Part 15, Subpart C § 15.225

Frequency Tolerance

The measurement was performed according to FCC § 2.1055

OP-Mode	Setup	Port	Final Result
NFC_int	Setup_01	Enclosure	passed

N/A not applicable (the EUT is powered by DC and only intended for the use in vehicles)

Different variants of the EUT are available:

- WMI2-15W-W167: Assembly with max. hardware integration, "worst-case" behaviour expected, integral or external NFC antenna can be selected for operation
- WMI2-15W-W167-M1: Variant with LED instead of external NFC antenna, without FAKRA
- WMI2-15W-W167-M2: Variant without external NFC antenna, with FAKRA
- WMI2-15W-W167-M3: Variant without external NFC antenna and without FAKRA

The results of this test report are obtained with the listed devices, please refer to sub-clauses 3.2–3.5.

1.4 Revision History

Version	Release date	Change Description	Version validity
initial	2018-12-20	--	invalid
rev1	2019-01-23	corrections of wrong references to sub-clause numbers, correction of product name and type designation in sub-clause 3.1, correction of wrong measurement distance and distance correction factor for 26.5-40.0 GHz in 6.6, adding measurement uncertainty for test case "frequency tolerance in 8, adding variant "M3" in sub-clause 1.3, minor correction / improvements in 4.1.1 and 4.1.2, clarification of test distance in 4.3.2 and 4.3.3, adding margin,	valid

Responsible for
Accreditation Scope:

D. Gell

Responsible
for Test Report:

A. Pelt



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

2 Administrative Data

2.1 Testing Laboratory

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

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 and IC(ISED) under the registration number: Site# 3699A-1

The test facility is also accredited by the following accreditation organisation:
Laboratory accreditation no.: DAKKS D-PL-12140-01-00

Responsible for Accreditation Scope: Dipl.-Ing. Daniel Gall
Report Template Version: 2019-01-21

2.2 Project Data

Responsible for testing and report: Dipl.-Ing. Andreas Petz
Date of Report: 2019-01-23
Testing Period: 2018-09-14 to 2018-12-14

2.3 Applicant Data

Company Name: Peiker acoustic GmbH
Address: Max-Planck-Straße 28-32
61381 Friedrichsdorf
Germany
Contact Person: Mr. Gerald Mueller

2.4 Manufacturer Data

Company Name: please see applicant data
Address:
Contact Person:

3 Test object Data

3.1 General EUT Description

Equipment under Test	Wireless Charging Module
Product Name	Wireless Mobile Interface2-15W
Type Designation:	WMI2-W15W-W167
Kind of Device:	125 kHz Transceiver Wireless Power Transfer
Voltage Type:	DC
Voltage level:	12 V nominal and tested voltage

3.1.1 General product description:

The EUT is a Wireless Charging Device which is intended to charge devices like mobile phones. It is capable to deliver a power of up to 15 W to a wireless charging receiver.

Two radio technologies are implemented:

1. Wireless charging transceiver operating at 125 kHz nominal frequency.
2. NFC transceiver operating at 13.56 MHz nominal frequency:
An integral or external (dedicated) antenna can be used.

The test setups incl. the auxiliaries are provided by the applicant.

For the test purpose, test cables have been used representing the cable harness that will be assembled later in the car with a length of approx. 1 m.

The auxiliaries are not subject of this test report but may impact test results.

The device is intended for professional installation only.

3.1.2 Specific product description for the EUT:

For a detailed description please refer to the documentation provided by the applicant.

The EUT provides the following ports:

Ports

Enclosure

DC/CAN connector

Connector for either an external NFC antenna or a LED, depending on the variant

Specific connectors to interconnect "peripherals" / units (which are not provided):

FAKRA output from passive antenna coupler, depending on the variant.

3.2 EUT Main components

Type, S/N, Short Descriptions etc. used in this Test Report

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
EUT A (Code: DE1002018aa01)	NFC Transceiver	WMI2-15W-W167	0000032727	0000	E006.4
EUT B (Code: DE1002018ba01)	NFC Transceiver	WMI2-15W-W167-M1	0000051897	0000	E006.4

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

3.3 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.

Short Description	Equipment under Test	Type Designation	Serial No.	HW Status	SW Status
NFCEXTANT	External NFC antenna	peiker LP14556-4, Type-2	18000000090	HW-19-18	–

3.4 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.

Short Description	Device	Type Designation	Serial No.	HW Status	SW Status
AUX 1	USB-CAN converter	VSCOM USB-CAN Plus	380101633	–	–
AUX 2	Laptop	Fujitsu Lifebook Model E782	DSCM004654	2012-08	Win7 Prof. Engl.
AUX 3	AC adapter of Laptop	Fujitsu FMV-AC330 FPCAC88	1231808A	2012.03	–
AUX 4	Smartphone (DE1002018SMP1), used as NFC Tag	Samsung S8 (SM-G950F)	R38K7037W3Y	–	Android 8.0.0
AUX 5	Dummy Load FAKRA	50 ohm termination with Leoni Dacar 031 cable (1 m)	–	–	–

3.5 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 No.	Combination of EUTs	Description and Rationale
Setup_01	EUT A + NFCEXTANT + AUX 1 + AUX 2 + AUX 3 + AUX 4 +AUX 5	EUT A and ancillaries and auxiliaries, representative cables are connected to each connector
Setup_02	EUT B + AUX 1 + AUX 2 + AUX 3 + AUX 4 + AUX 5	EUT B variant and ancillaries and auxiliaries, representative cables are connected to each connector

3.6 Operating Modes

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

Op. Mode	Description of Operating Modes	Remarks
NFC_int	NFC signal transmitted via integral antenna	EUT is transmitting a continuously modulated signal, radiated by the integral antenna
NFC_ext	NFC signal transmitted via external antenna	EUT is transmitting a continuously modulated signal, radiated by the external antenna

3.7 Special software used for testing

EVTP Test Tool and Macros, provided by the applicant.

3.8 Product labelling

Please refer to the documentation of the applicant.

4 Test Results

4.1 Spurious radiated emissions

Standard FCC Part 15, Subpart C

The test was performed according to: ANSI C63.10

4.1.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C63.10 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.

The measurement procedure is implemented into the EMC32 test software 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 performed at 2 axes. A pre-check is also performed while the EUT is powered from DC (battery) power in order to find the worst-case operating condition.

1. Measurement up to 30 MHz

The Loop antenna HFH2-Z2 is used.

Step 1: pre measurement

- Anechoic chamber
- Antenna distance: 3 m
- Antenna height: 1 m (lowest part to ground)
- Detector: Peak-Maxhold
- Frequency range: 0.009 – 0.15 and 0.15 – 30 MHz
- Frequency steps: 0.1 kHz and 5 kHz
- IF-Bandwidth: 0.2 kHz and 10 kHz
- Measuring time / Frequency step: 100 ms (FFT-based)

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: final measurement

For the relevant emissions determined in step 1, an additional measurement with the following settings will be performed. Intention of this step is to find the maximum emission level.

- Detector: Quasi-Peak besides 9–90 kHz and 110–490 kHz: Average and Peak
- Measuring time / Frequency step: 1 s

2. Measurement above 30 MHz and up to 1 GHz

Step 1: Preliminary scan

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 – 3 m
- Height variation step size: 2 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 $\pm 45^{\circ}$ around this value. 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 by ± 100 cm around the antenna height determined. 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: $\pm 45^{\circ}$ around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector

With the settings determined in step 3, the final measurement will be performed:

EMI receiver settings for step 4:

- 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. It 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.

4.1.2 Test Requirements / Limits

FCC Part 15, Subpart C, §15.225 (d)

The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

FCC Part 15, Subpart C, §15.209, Radiated Emission Limits

Frequency in MHz	Limit (μV/m)	Measurement distance (m)	Limits (dBμV/m)
0.009 – 0.49	2400/F(kHz)@300m	3	(48.5 – 13.8)@300m
0.49 – 1.705	24000/F(kHz)@30m	3	(33.8 – 23.0)@30m
1.705 – 30	30@30m	3	29.5@30m

The measured values are corrected with an inverse linear distance extrapolation factor (40 dB/decade) according FCC §15.31 (2).

Frequency in MHz	Limit (μV/m)	Measurement distance (m)	Limits (dBμV/m)
30 – 88	100@3m	3	40.0@3m
88 – 216	150@3m	3	43.5@3m
216 – 960	200@3m	3	46.0@3m
960 - 26000	500@3m	3	54.0@3m
26000 - 40000	500@3m	1	54.0@3m

§15.35(b)

..., there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit....

Used conversion factor: $\text{Limit (dB}\mu\text{V/m)} = 20 \log (\text{Limit } (\mu\text{V/m})/1\mu\text{V/m})$

4.1.3 Test Protocol

Temperature: 23-24 °C
 Air Pressure: 1000-1014 hPa
 Humidity: 35-40 %

4.1.3.1 Measurement up to 30 MHz

Op. Mode		Setup		Port	
NFC_int		Setup_01		Enclosure	

Antenna orientation	EUT orientation	Frequency MHz	Corrected value dB μ V / m			Limit dB μ V / m	Limit dB μ V / m	Limit dB μ V / m	Margin dB	Margin dB
			QP	Peak	AV	QP	Peak	AV	QP / Peak	AV
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed.
 13.56 MHz is the wanted signal of the EUT.

Op. Mode		Setup		Port	
NFC_ext		Setup_01		Enclosure	

Antenna orientation	EUT orientation	Frequency MHz	Corrected value dB μ V / m			Limit dB μ V / m	Limit dB μ V / m	Limit dB μ V / m	Margin dB	Margin dB
			QP	Peak	AV	QP	Peak	AV	QP / Peak	AV
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed.
 13.56 MHz is the wanted signal of the EUT.

Op. Mode		Setup		Port	
NFC_int		Setup_02		Enclosure	

Antenna orientation	EUT orientation	Frequency MHz	Corrected value dB μ V / m			Limit dB μ V / m	Limit dB μ V / m	Limit dB μ V / m	Margin dB	Margin dB
			QP	Peak	AV	QP	Peak	AV	QP / Peak	AV
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found therefore step 2 was not performed.
 13.56 MHz is the wanted signal of the EUT.

4.1.3.2 Measurement above 30 MHz

Op. Mode	Setup	Port
NFC_int	Setup_01	Enclosure

Antenna orientation	EUT orientation	Frequency MHz	Corrected value dB μ V / m			Limit dB μ V / m	Limit dB μ V / m	Limit dB μ V / m	Margin dB	Margin dB
			QP	Peak	AV					
Vertical	Horizontal	50.85	19.8	–	–	40.0	–	–	20.2	–
Vertical	Horizontal	53.40	20.5	–	–	40.0	–	–	19.5	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

Op. Mode	Setup	Port
NFC_ext	Setup_01	Enclosure

Antenna orientation	EUT orientation	Frequency MHz	Corrected value dB μ V / m			Limit dB μ V / m	Limit dB μ V / m	Limit dB μ V / m	Margin dB	Margin dB
			QP	Peak	AV					
Vert.&Hor.	Horizontal	–	–	–	–	–	–	–	–	–

Remark: No (further) spurious emissions in the range 20 dB below the limit found.

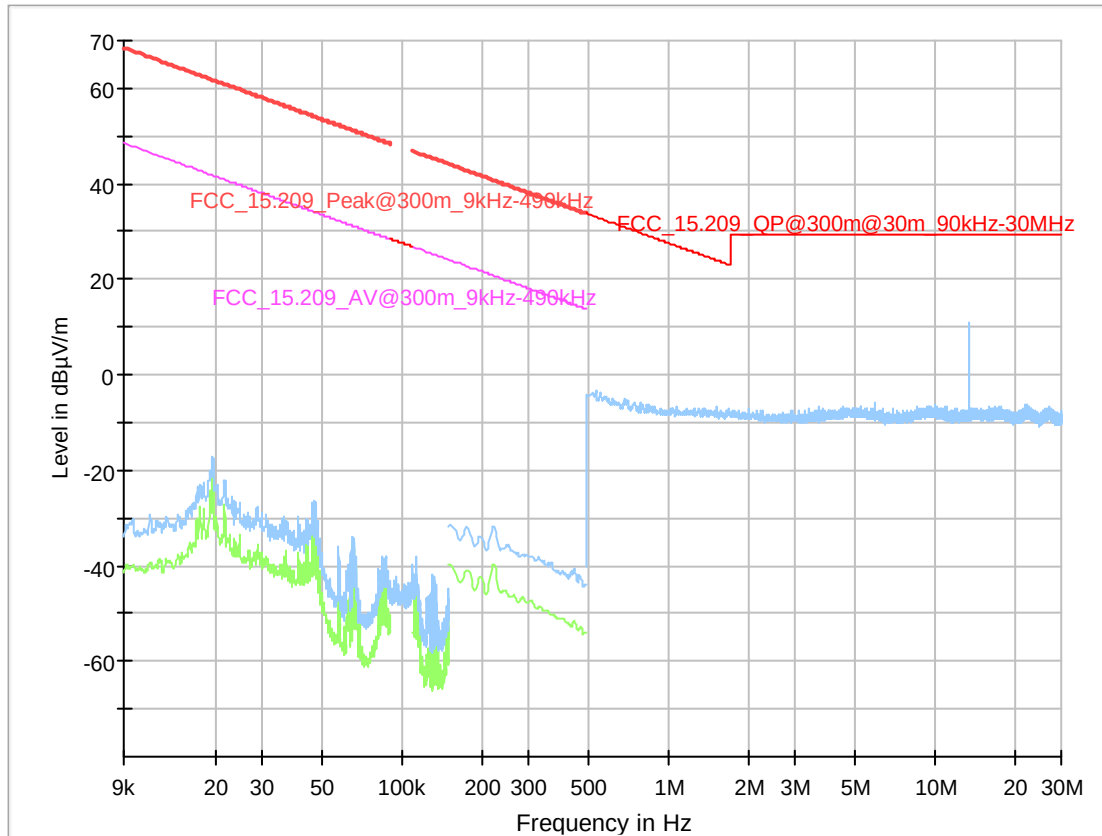
Op. Mode	Setup	Port
NFC_int	Setup_02	Enclosure

Antenna orientation	EUT orientation	Frequency MHz	Corrected value dB μ V / m			Limit dB μ V / m	Limit dB μ V / m	Limit dB μ V / m	Margin dB	Margin dB
			QP	Peak	AV					
Vertical	Horizontal	53.40	20.7	–	–	40.0	–	–	19.3	–

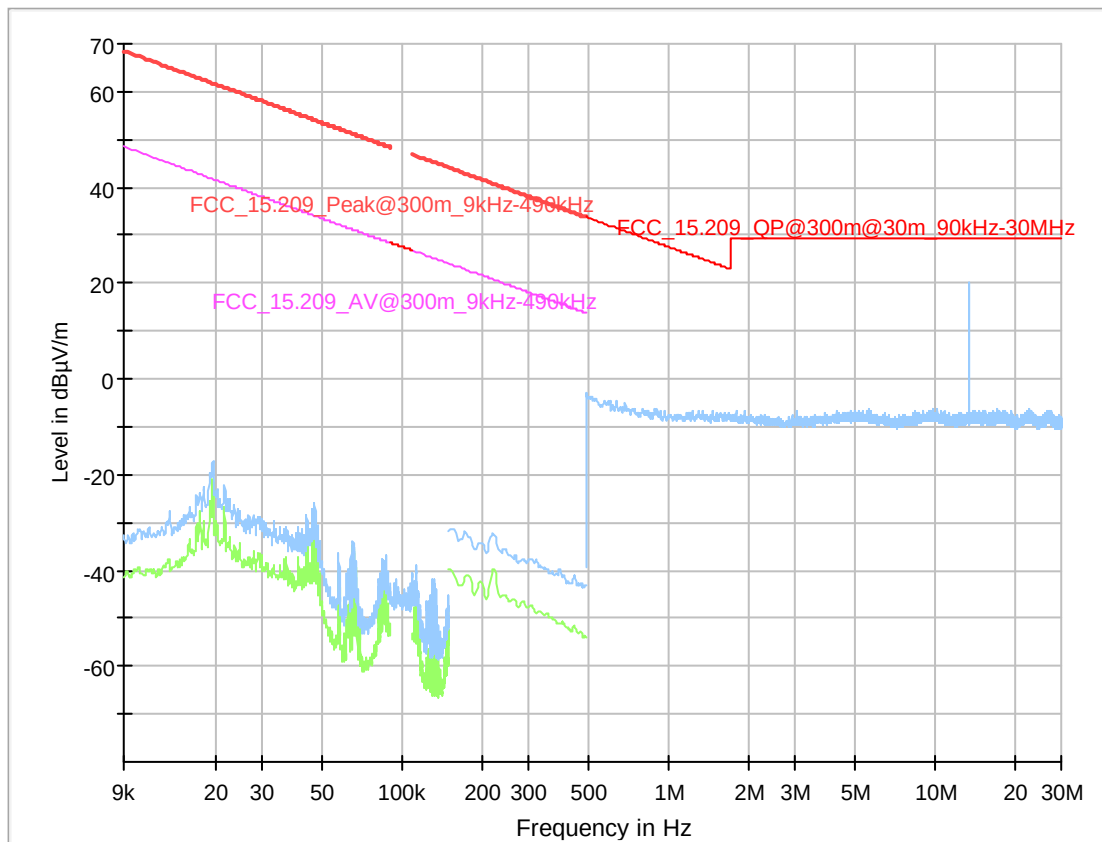
Remark: No (further) spurious emissions in the range 20 dB below the limit found.

4.1.4 Measurement Plots (worst case)

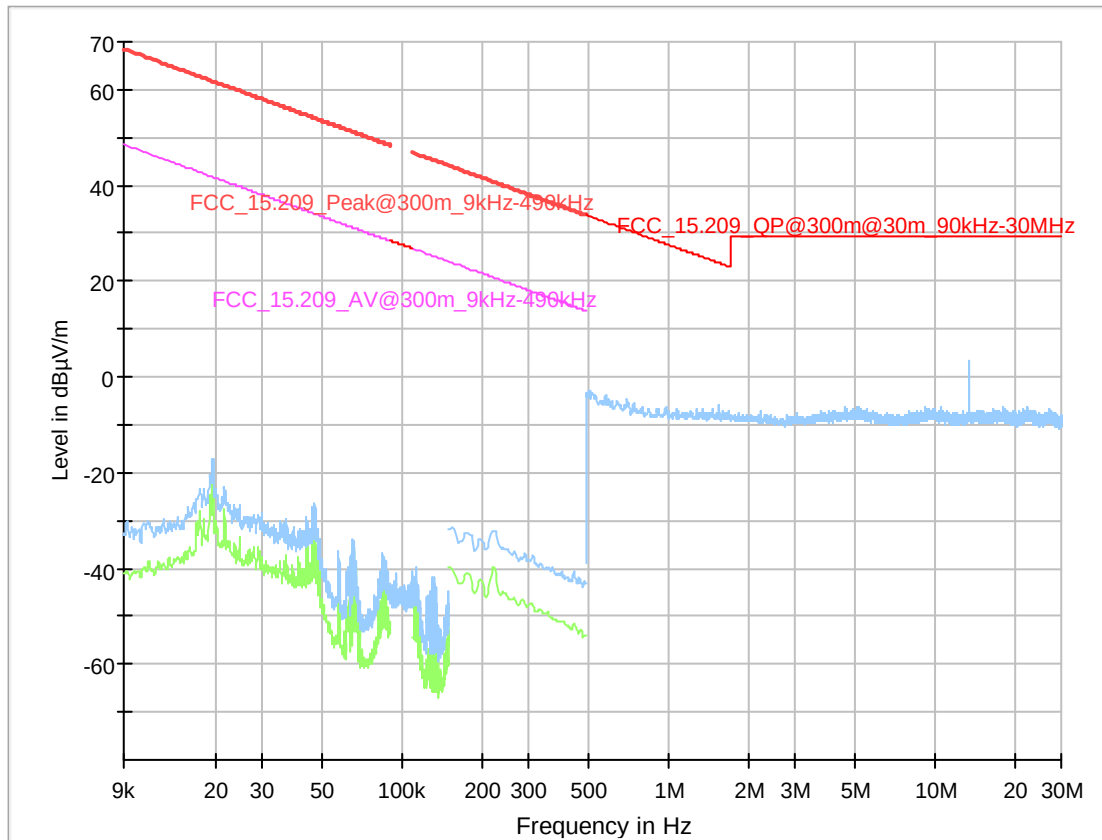
4.1.4.1 Below 30 MHz, EUT A, integral NFC antenna



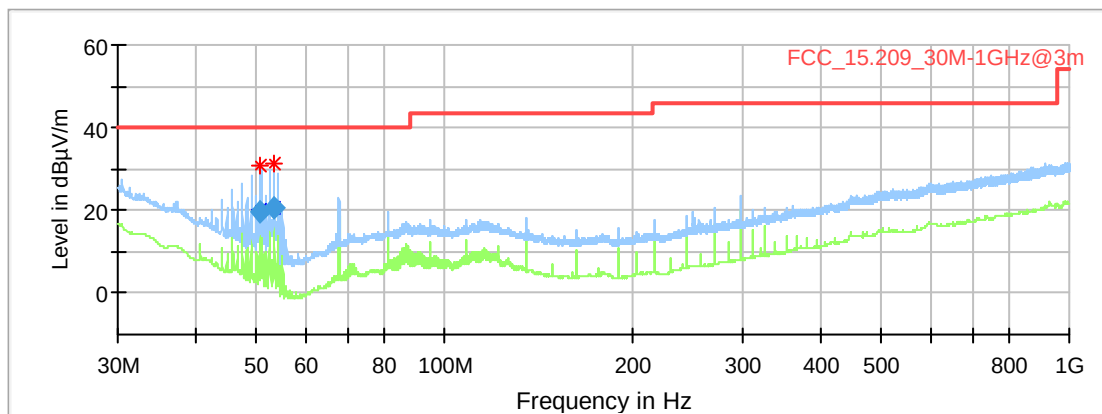
4.1.4.2 Below 30 MHz, EUT A, external NFC antenna



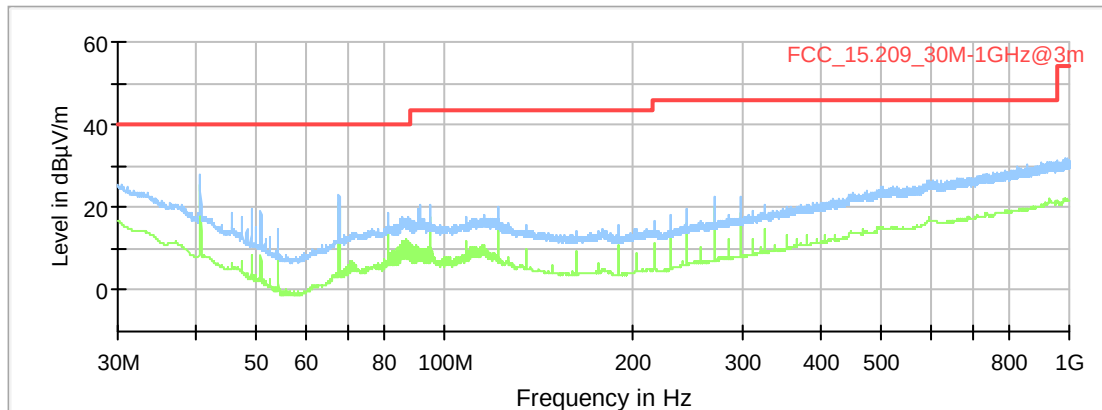
4.1.4.3 Below 30 MHz, EUT B



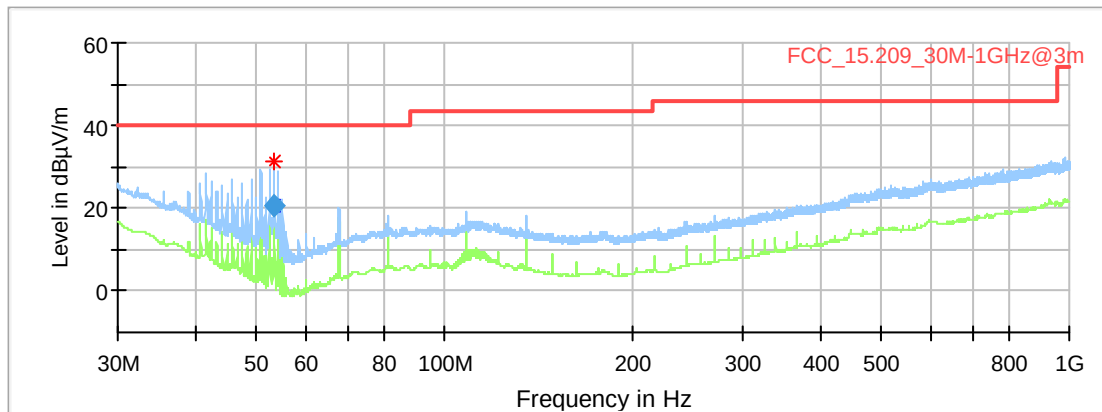
4.1.4.4 Above 30 MHz, EUT A, integral NFC antenna



4.1.4.5 Above 30 MHz, EUT A, external NFC antenna



4.1.4.6 Above 30 MHz, EUT B, integral NFC antenna



4.1.5 Test Equipment used

- Radiated Emissions

4.2 Occupied bandwidth

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.31

4.2.1 Test Description

The Equipment Under Test (EUT) was setup in a shielded room to perform the occupied bandwidth measurements.

The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical.

The results recorded were measured with the modulation which produces the worst-case (widest) occupied bandwidth.

4.2.2 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. ...

4.2.3 Test Protocol

Temperature: 22-24 °C
Air Pressure: 1006-1011 hPa
Humidity: 29-39 %

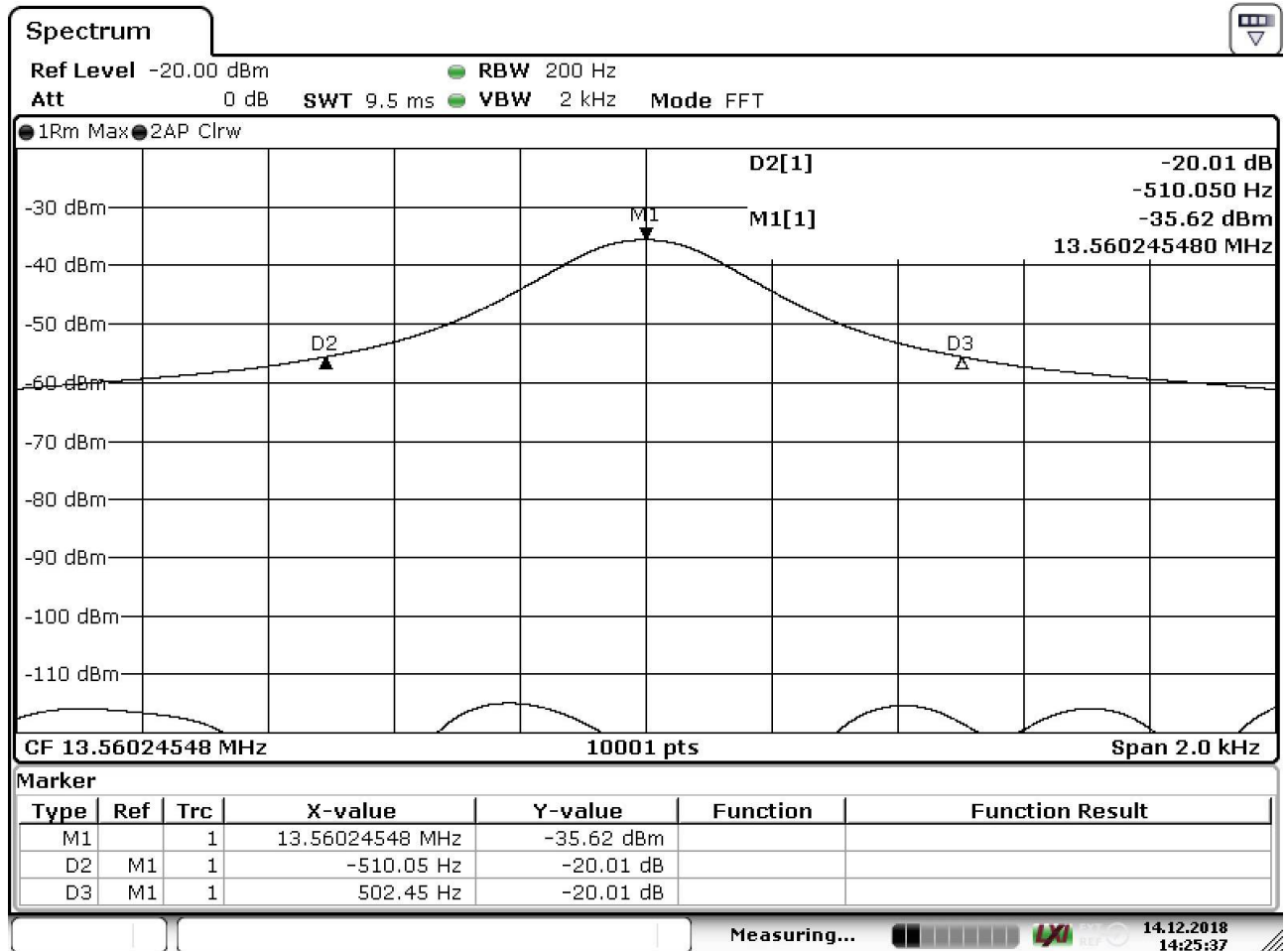
Op. Mode	Setup	Port
NFC_ext	Setup_01	Enclosure

20 dB bandwidth kHz	99 % bandwidth kHz	Remarks
1.13	2.22	The 20 dB bandwidth from 13.559736 MHz to 13560749 MHz is contained within the designated frequency band 13.110 MHz to 14.010 MHz.

Remark: None

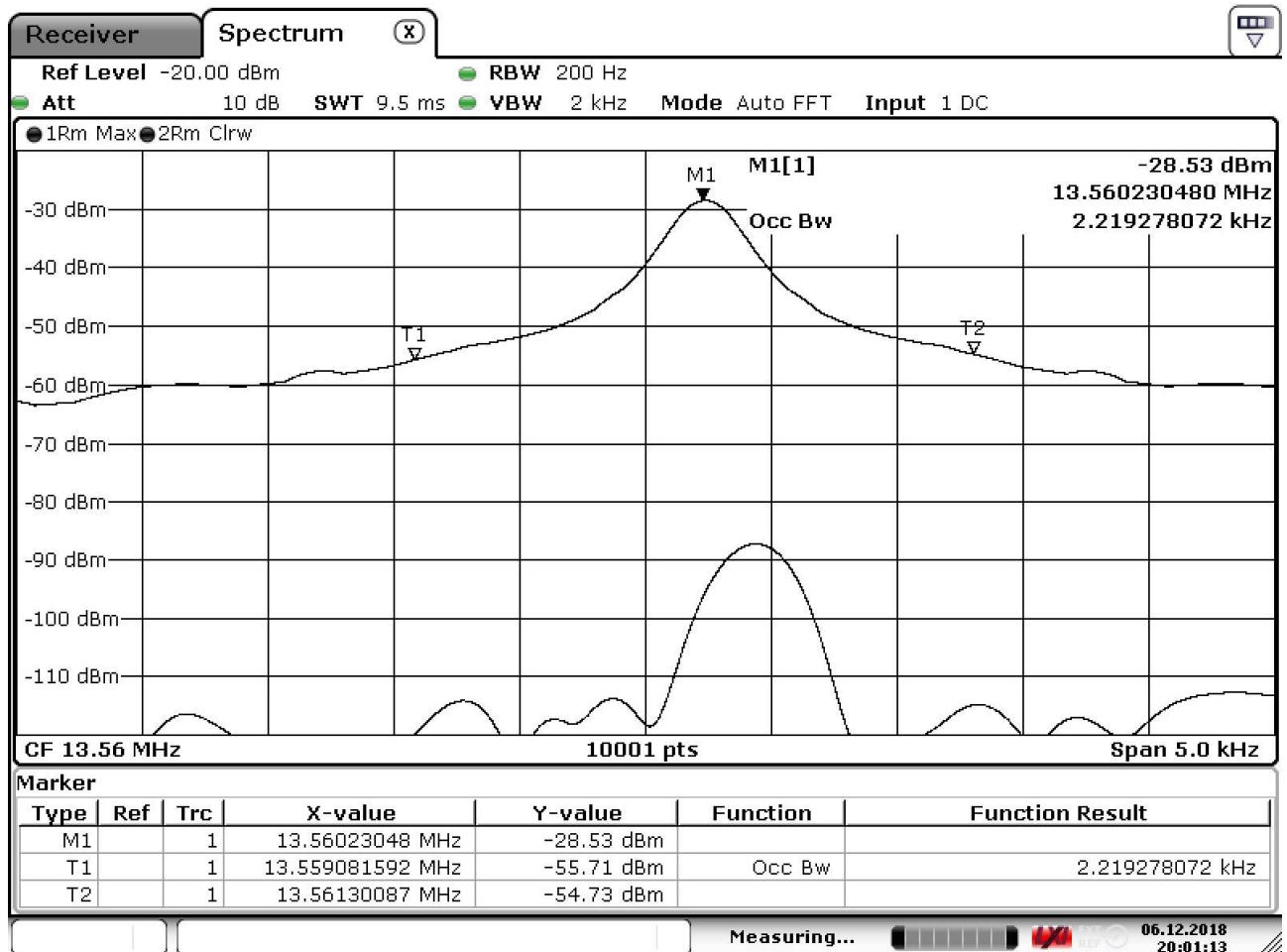
4.2.4 Measurement Plots (worst case)

4.2.4.1 20 dB bandwidth



Date: 14.DEC.2018 14:25:37

4.2.4.2 99% bandwidth



Date: 6.DEC.2018 20:01:12

4.2.5 Test Equipment used

- R&S TS8997

4.3 Spectrum mask

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.225

4.3.1 Test Description

The test set-up was made in accordance to the general provisions of ANSI C 63.10. The Equipment Under Test (EUT) was set up on a non-conductive table in the anechoic chamber. The radiated emissions measurements were made in a typical installation configuration. The measurement procedure is implemented into the EMI test software EMC32 from R&S. The Loop antenna HFH2-Z2 is used.

- Semi-anechoic chamber
- Antenna distance: 3 m
- Detector: Quasi-Peak
- Frequency range: 13.06 – 14.06 MHz
- Frequency steps: 5 kHz
- IF-Bandwidth: 10 kHz
- Measuring time / Frequency step: 1 s

4.3.2 Test Limits

FCC Part 15, Subpart C, §15.225 (a-d), and §15.209, corrected by the means of the extrapolation of §15.31 due to the reduced measuring distance from 30 m to 3 m. The merits of the maximum value as well as the limit are referencing to a distance of 30 m.

4.3.3 Test Protocol

Temperature: 24 °C
 Air Pressure: 1006 hPa
 Humidity: 37 %

Op. Mode	Setup	Port
NFC_ext	Setup_01	Enclosure

Maximum value dB μ V / m	Limit dB μ V / m	Margin dB	Remarks
14.9	84.0	69.1	measuring distance 3 m

Remark: None

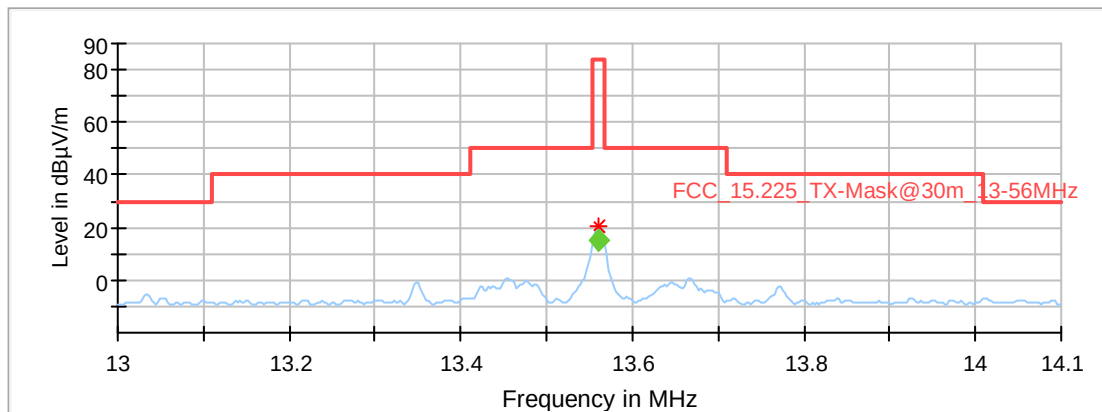
Op. Mode	Setup	Port
NFC_int	Setup_01	Enclosure

Maximum value dB μ V / m	Limit dB μ V / m	Margin dB	Remarks
-0.8	84.0	84.8	measuring distance 3 m

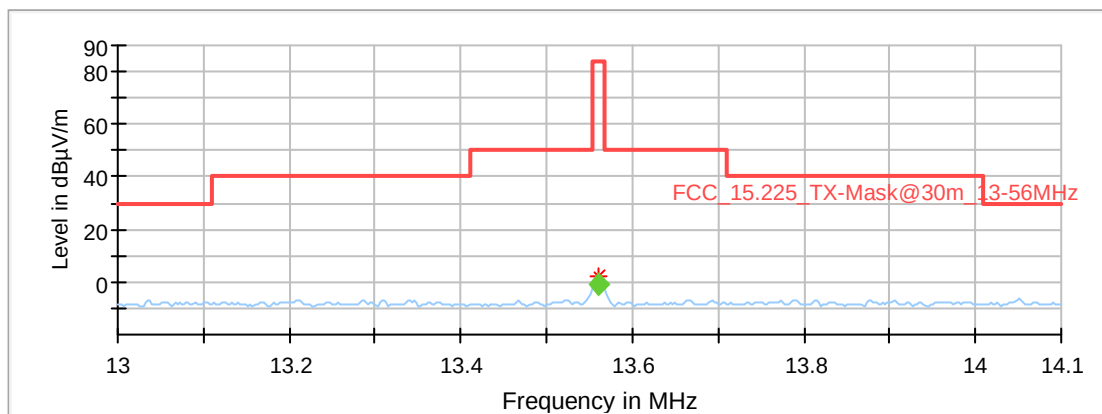
Remark: None

4.3.4 Measurement Plots (worst case)

4.3.4.1 EUT A, Mode NFC_ext



4.3.4.2 EUT A, Mode NFC_int



4.3.5 Test Equipment used

- Radiated Emissions

4.4 Frequency tolerance

Standard FCC Part 15, Subpart C

The test was performed according to: FCC §15.225

4.4.1 Test Description

The Equipment Under Test (EUT) is placed in a temperature chamber.

The frequency drift during temperature and voltage variation is measured by the means of a spectrum analyser with frequency counter function.

The temperature was varied from -20°C to $+50^{\circ}\text{C}$. At $+20^{\circ}\text{C}$ the wider extreme power supply voltages of 8.0 and 16.0 V (instead of 85% and 115%) are applied. After reaching each target temperature and waiting sufficient time allowing the temperature to stabilize, one measurement is performed immediately after powering on the EUT, and two further measurements are performed after 5 and 10 minutes continuous operation of the EUT.

4.4.2 Test Limits

FCC Part 15, Subpart C, §15.225 (e): The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20°C to $+50^{\circ}\text{C}$ at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C .

4.4.3 Test Protocol

Temperature: 23 °C
 Air Pressure: 1018 hPa
 Humidity: 30 %

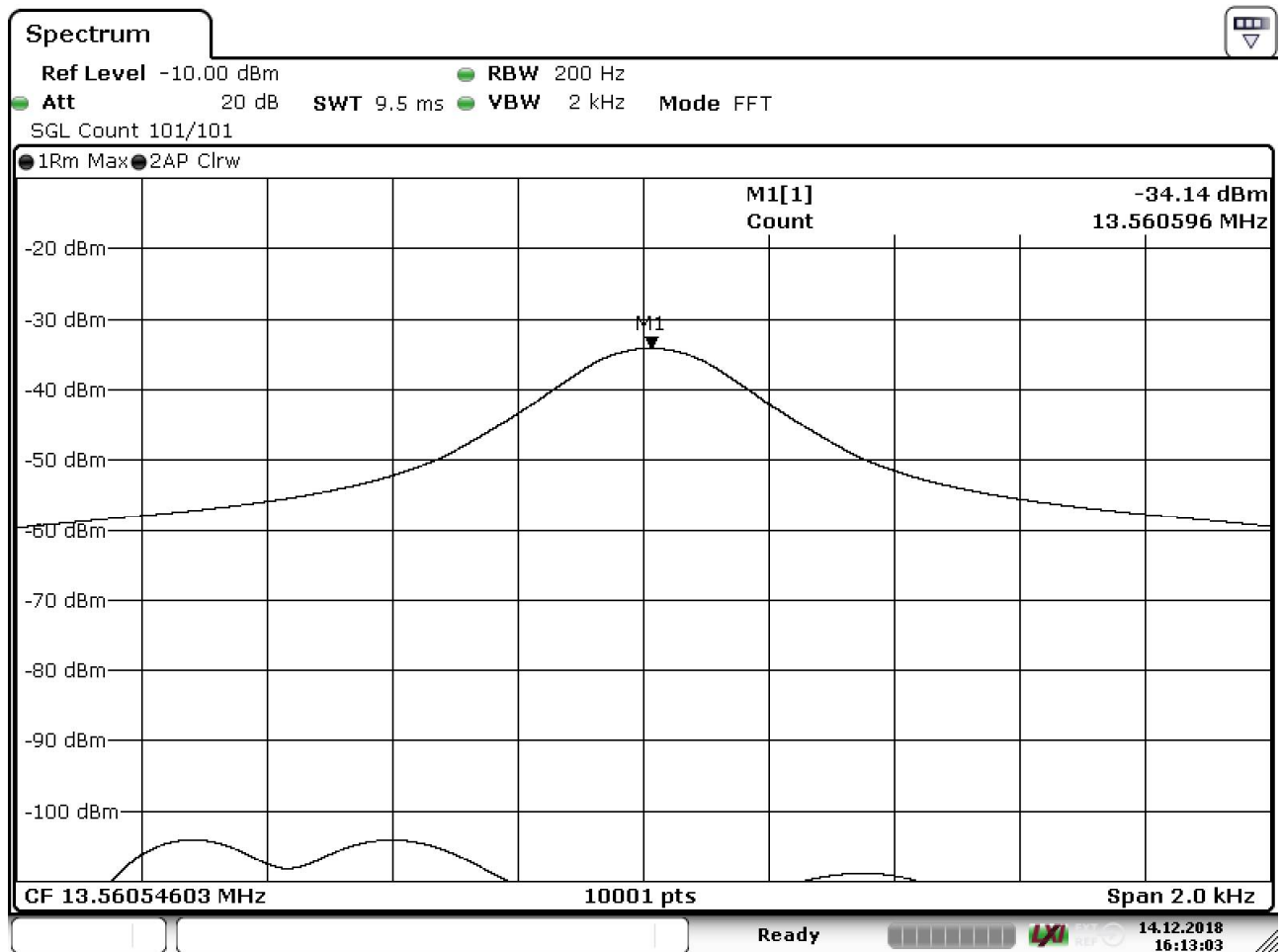
Op. Mode	Setup	Port
NFC_int	Setup_01	Enclosure

Temperature / °C	Voltage / V	Time / min.	Frequency / MHz	Delta / Hz
50	12.0	0	13.560316	316
50	12.0	5	13.560333	333
50	12.0	10	13.560220	220
40	12.0	0	13.560323	323
40	12.0	5	13.560255	255
40	12.0	10	13.560305	305
30	12.0	0	13.560280	280
30	12.0	5	13.560300	300
30	12.0	10	13.560285	285
20	8.0	0	13.560396	396
20	8.0	5	13.560310	310
20	8.0	10	13.560280	280
20	12.0	0	13.560477	477
20	12.0	5	13.560303	303
20	12.0	10	13.560325	325
20	16.0	0	13.560277	277
20	16.0	5	13.560303	303
20	16.0	10	13.560323	323
10	12.0	0	13.560472	472
10	12.0	5	13.560431	431
10	12.0	10	13.560442	442
0	12.0	0	13.560539	539
0	12.0	5	13.560566	566
0	12.0	10	13.560592	592
-10	12.0	0	13.560596	596
-10	12.0	5	13.560549	549
-10	12.0	10	13.560523	523
-20	12.0	0	13.560546	546
-20	12.0	5	13.560568	568
-20	12.0	10	13.560541	541

Remark: The limit is a delta of max. ± 1356 Hz (0.01 %).
 Extreme voltage values greater than ± 15 % chosen within the EUT is specified to operate.

Maximum deviation from nominal frequency: 596 Hz

4.4.4 Measurement Plots (worst case)



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4.4.5 Test Equipment used

- R&S TS8997

5 Test Equipment

- 1 Radiated Emissions
Lab to perform radiated emission tests

Ref. No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	NRV-Z1	Sensor Head A	Rohde & Schwarz GmbH & Co. KG	827753/005	2018-07	2019-07
1.2	MFS	Rubidium Frequency Normal MFS	Datum GmbH	002	2018-10	2019-10
1.3	Opus10 TPR (8253.00)	ThermoAirpressure Datalogger 13 (Environ)	Lufft Mess- und Regeltechnik GmbH	13936	2017-04	2019-04
1.4	ESW44	EMI Test Receiver	Rohde & Schwarz GmbH & Co. KG	101603	2018-05	2019-05
1.5	Anechoic Chamber	10.58 x 6.38 x 6.00 m ³	Frankonia	none	2018-06	2020-06
1.6	FS-Z60	Harmonic Mixer 40 - 60 GHz	Rohde & Schwarz Messgerätebau GmbH	100178	2016-12	2019-12
1.7	FS-Z220	Harmonic Mixer 140 - 220 GHz	Rohde & Schwarz Messgerätebau GmbH	101005	2017-03	2020-03
1.8	SGH-05	Standard Gain / Pyramidal Horn Antenna (140 - 220 GHz)		075		
1.9	HL 562	Ultralog new biconicals	Rohde & Schwarz	830547/003	2018-07	2021-07
1.10	5HC2700/12750 -1.5-KK	High Pass Filter	Trilithic	9942012		
1.11	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
1.12	Fully Anechoic Room	8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2018-06	2020-06
1.13	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2018-04	2020-04
1.14	NRVD	Power Meter	Rohde & Schwarz GmbH & Co. KG	828110/016	2018-07	2019-07
1.15	HF 906	Double-ridged horn	Rohde & Schwarz	357357/002	2018-09	2021-09
1.16	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
1.17	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2016-12	2018-12
1.18	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronik GmbH	00083069		

Ref. No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.19	SGH-19	Standard Gain / Pyramidal Horn Antenna (40 - 60 GHz)		093		
1.20	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright	09		
1.21	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
1.22	Chroma 6404	AC Power Source	Chroma ATE INC.	64040001304		
1.23	JS4-00102600-42-5A	Broadband Amplifier 30 MHz - 26 GHz	Miteq	619368		
1.24	TT 1.5 WI	Turn Table	Maturo GmbH	-		
1.25	HL 562 Ultralog	Log.-per. Antenna	Rohde & Schwarz	100609	2016-04	2019-04
1.26	HF 906	Double-ridged horn	Rohde & Schwarz	357357/001	2018-03	2021-03
1.27	FS-Z325	Harmonic Mixer 220 - 325 GHz	Rohde & Schwarz Messgerätebau GmbH	101006	2017-03	2020-03
1.28	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronik GmbH	00086675		
1.29	SGH-08	Standard Gain / Pyramidal Horn Antenna (90 - 140 GHz)		064		
1.30	SGH-12	Standard Gain / Pyramidal HornAntenna (60 - 90 GHz)		326		
1.31	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
1.32	FS-Z140	Harmonic Mixer 90 -140 GHz	Rohde & Schwarz Messgerätebau GmbH	101007	2017-02	2020-02
1.33	HFH2-Z2	Loop Antenna	Rohde & Schwarz	829324/006	2018-01	2021-01
1.34	Opus10 THI (8152.00)	ThermoHygro Datalogger 12 (Environ)	Lufft Mess- und Regeltechnik GmbH	12482	2017-03	2019-03
1.35	ESR 7	EMI Receiver / Spectrum Analyzer	Rohde & Schwarz	101424		
1.36	JS4-00101800-35-5P	Broadband Amplifier 30 MHz - 18 GHz	Miteq	896037		
1.37	AS 620 P	Antenna mast	HD GmbH	620/37		
1.38	Tilt device Maturo (Rohacell)	Antrieb TD1.5-10kg	Maturo GmbH	TD1.5-10kg/024/3790709		
1.39	SGH-03	Standard Gain / Pyramidal Horn Antenna (220 - 325 GHz)		060		

Ref. No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.40	FS-Z90	Harmonic Mixer 60 - 90 GHz	Rohde & Schwarz Messgerätebau GmbH	101686	2017-03	2020-03
1.41	ESIB 26	Spectrum Analyzer	Rohde & Schwarz	830482/004	2018-01	2020-01
1.42	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
1.43	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
1.44	AM 4.0	Antenna mast	Maturo GmbH	AM4.0/180/11920513		
1.45	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2018-07	2021-07

2 R&S TS8997
Lab to perform bandwidth test

Ref. No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
2.1	SMB100A	Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	107695	2017-07	2020-07
2.2	MFS	Rubidium Frequency Standard	Datum-Beverly	5489/001	2018-07	2019-07
2.3	1515 / 93459	Broadband Power Divider SMA (Aux)	Weinschel Associates	LN673		
2.4	FSV30	Signal Analyzer 10 Hz - 30 GHz	Rohde & Schwarz	103005	2018-04	2020-04
2.5	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2018-04	2020-04
2.6	VT 4002	Temperature Chamber	Vötsch	58566002150010	2018-04	2020-04
2.7	A8455-4	4 Way Power Divider (SMA)		-		
2.8	Opus10 THI (8152.00)	ThermoHygro Datalogger 03 (Environ)	Lufft Mess- und Regeltechnik GmbH	7482	2017-03	2019-03
2.9	SMBV100A	Vector Signal Generator 9 kHz - 6 GHz	Rohde & Schwarz	259291	2016-10	2019-10
2.10	OSP120	Switching Unit with integrated power meter	Rohde & Schwarz	101158	2018-05	2021-05

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

6 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.

6.1 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.

6.2 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

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

U = Receiver reading

AF = Antenna factor

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

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

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

Table shows an extract of values

6.3 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 = $-20 \cdot \text{LOG} (d_{\text{Limit}} / d_{\text{used}})$

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

Tables show an extract of values.

6.4 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.

6.5 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.

6.6 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
27,0	43,4	-11,2	4,4				-9.5	3	1
28,0	43,4	-11,1	4,5				-9.5	3	1
29,0	43,5	-11,0	4,6				-9.5	3	1
30,0	43,5	-10,9	4,7				-9.5	3	1
31,0	43,5	-10,8	4,7				-9.5	3	1
32,0	43,5	-10,7	4,8				-9.5	3	1
33,0	43,6	-10,7	4,9				-9.5	3	1
34,0	43,6	-10,6	5,0				-9.5	3	1
35,0	43,6	-10,5	5,1				-9.5	3	1
36,0	43,6	-10,4	5,1				-9.5	3	1
37,0	43,7	-10,3	5,2				-9.5	3	1
38,0	43,7	-10,2	5,3				-9.5	3	1
39,0	43,7	-10,2	5,4				-9.5	3	1
40,0	43,8	-10,1	5,5				-9.5	3	1

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)

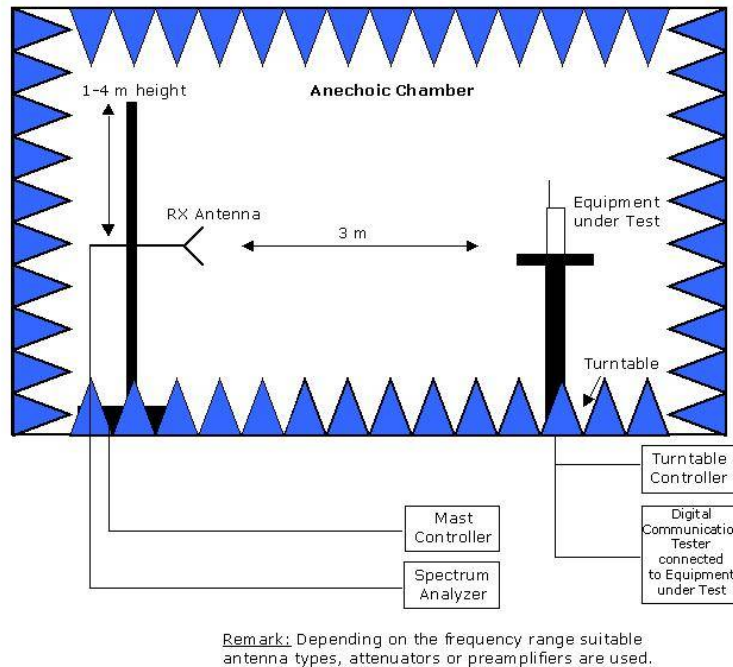
Linear interpolation will be used for frequencies in between the values in the table.

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 Setup Drawings



Drawing 1: Setup in the Anechoic chamber:
Measurements below 1 GHz: Semi-anechoic, conducting ground plane.
Measurements above 1 GHz: Fully-anechoic, absorbers on all surfaces.

8 Measurement uncertainty

Test Case	Parameter	Uncertainty
Peak power output	Fieldstrength	± 5.5 dB
Occupied bandwidth	Power Frequency:	± 2.9 dB ± 0.125 kHz
Spurious radiated emissions	Fieldstrength Frequency:	± 5.5 dB ± 11.2 kHz
AC Power Line	Power	± 3.4 dB
Frequency tolerance (frequency counter)	Frequency	± 2 Hz

9 Photo Report

Photos are included in an external report.