



Solutions

TEST REPORT

Test Report No.: UL-RPT-RP-14875953-216-FCC

Applicant * : Wallbox USA Inc

Model No. * : PATRF54

FCC ID * : 2BB8L-RFID02

Technology : RFID 13.56 MHz

Test Standard(s) : **FCC Parts 15.209(a), 15.207 & 15.225**

For details of applied tests refer to test result summary

1. This test report shall not be reproduced in full or partial, without the written approval of UL International Germany GmbH.
2. The results in this report apply only to the sample tested.
3. The test results in this report are traceable to the national or international standards.
4. **Test Report Version 1.2 supersede Version 1.1 with immediate effect**
Test Report No. UL-RPT-RP-14875953-216-FCC Version 1.2, Issue Date 15 MARCH 2024 replaces
Test Report No. UL-RPT-RP-14875953-216-FCC Version 1.1, Issue Date 16 JANUARY 2024, which is no longer valid.
5. Result of the tested sample: **PASS**
6. All information marked with a (*) were provided by customer / applicant or authorized representative

Prepared by: Muhammad Faiq Khan
Title: Project Engineer
Date: 15 March 2024

Approved by: Rachid Acharkaoui
Title: Operations Manager
Date: 15 March 2024



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This laboratory is accredited by DAkkS.
The tests reported herein have been performed in
accordance with its' terms of accreditation.

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1. Customer Information *

1.1.Applicant Information

Company Name:	Wallbox USA Inc
Company Address:	723 N Shoreline Blvd, Mountain View, CA 94043, USA
Contact Person:	Certification Department
Contact E-Mail Address:	wallbox.compliance@wallbox.com
Contact Phone No.:	+34 673 308 511

1.2.Manufacturer Information

Company Name:	Wallbox USA Inc
Company Address:	2240 Forum Dr, Arlington TX 76010-7000 US
Contact Person:	Certification Department
Contact E-Mail Address:	wallbox.compliance@wallbox.com
Contact Phone No.:	+34 673 308 511

2. Summary of Testing

2.1. General Information

Applied Standards

Specification Reference:	47CFR15.225
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Radio Frequency Devices) - Section 15.225
Specification Reference:	47CFR15.209 & 15.207
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Section 15.209 & 15.207

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
Test Firm Registration:	399704

Date information

Order Date:	08 September 2023
EUT arrived:	20 November 2023
Test Dates:	29 November 2023 to 30 November 2023
EUT returned:	-/-

2.2. Summary of Test Results

Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	Transmitter AC Conducted Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.215(c)	Transmitter 20 dB Bandwidth	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.225(a)(b)(c)(d)	Transmitter Fundamental Field Strength & Spectrum Mask (continued)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.209(a)/ 15.225(d)	Transmitter Radiated Emissions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Part 15.225(e)	Transmitter Frequency Stability (Temperature & Voltage Variation)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Decision rule:

If the decision rule is not included in the applied customer specification or testing standard, the binary statement for simple acceptance, as defined in ILAC G8: 2019 Section 4.2.1, is applied as the decision rule for a pass/ fail statement.

If the measured value is on the limit, the result is defined as a pass. In this case the risk of a false positive is 50%. For further information regarding risk assessment refer to ILAC G8: 2019.

2.3. Methods and Procedures

Reference:	ANSI C63.4-2014
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	KDB 414788 D01 Radiated Test Site v01r01
Title:	TEST SITES FOR RADIATED EMISSION MEASUREMENTS
Reference:	FCC KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT) *

Brand Name:	WALLBOX
Model Name or Number:	PATRF54
Serial Number:	839186 (Radiated Test Sample)
Hardware Version Number:	RFID PCBA: PATRF54A2
Firmware Version Number:	N/A
FCC ID:	2BB8L-RFID02

Brand Name:	WALLBOX
Model Name or Number:	PATRF54
Serial Number:	839172 (Radiated Test Sample with antenna terminated)
Hardware Version Number:	RFID PCBA: PATRF54A2
Firmware Version Number:	N/A
FCC ID:	2BB8L-RFID02

3.2. Description of EUT *

The equipment under test was a Host product with integrated PCBA (including RFID Module) inside Electric Vehicle Charging Station (EVSE) for user authentication through RFID technology supporting RFID 13.56MHz technology.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing *

Tested Technology:	RFID 13.56 MHz	
Category of Equipment:	Transceiver	
Channel Spacing:	Single channel device	
Transmit Frequency Range:	13.56 MHz	
Power supply Requirement(s):	120V AC / 60 Hz – 1 Phase 240V AC / 60Hz – 2 Phase	
Tested Temperature Range:	Minimum	-20 °C
	Maximum	+50 °C

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

A. Support Equipment (In-house)

Item	Description	Brand Name	Model Name or Number	Serial Number
1	-/-	-/-	-/-	-/-

B. . Support Equipment (Manufacturer supplied) *

Item	Description	Brand Name	Model Name or Number	Serial Number
1	-/-	-/-	-/-	-/-

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- ☒ Continuous transmitting modulated carrier at maximum power in RFID-13.56 MHz test mode.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- The EUT was configured to transmit a continuous modulated carrier with maximum power at 13.56 MHz by default.

EUT Power supply:

- The EUT was powered via 120V 60 Hz.
- Voltage variations tests done with a laboratory power supply with varying the input voltage.

Test Mode Activations:

- The RFID 13.56 MHz test mode was activated by default as soon as the device is powered up.

AC Conducted Measurements:

- For AC conducted line emissions measurement the EUT was powered with 120VAC / 60 Hz – 1 Phase and also 240 VAC / 60 Hz – 2 Phase as it is in the range.
- In accordance with FCC KDB 174176 Q5, AC conducted emissions was also performed with the EUT's RFID 13.56 MHz Antenna removed and terminated with a 50Ω termination (dummy load).
- The Toyo EMI Software EP5/CE Ver 4.0.1. was used for these measurements.

Radiated Measurements:

- Before starting final radiated spurious emission measurements "worst case verification" with the EUT in Standing-position & Laying-position was performed by Lab.
- The EUT in Standing-position was found to be the worst case therefore this report includes relevant results.
- Radiated measurements below 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the loop antenna height was set to 100 cm.
- Radiated measurements above 30 MHz were performed with the EUT positioned on the turn table and rotating 360 degrees while the antenna height varies from 1 to 4 m over the measurement frequency range.
- R&S®EMC32 Measurement Software V11.30.00 was used for the radiated spurious emission measurements.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 6 *Measurement Uncertainty* for details.

In accordance with DAkkS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results

5.2.1. Transmitter AC Conducted Spurious Emissions

Test Summary:

Test Engineer:	Tobias Koch	Test Date:	29 November 2023
Test Sample Serial Number:	839186 (Radiated Test Sample)		
Test Sample Serial Number:	839172 (Radiated Test Sample with antenna terminated)		
Test Site Identification	SR 7/8		

FCC Reference:	Part 15.207
Test Method Used:	ANSI C63.10 Section 6.2 / FCC KDB 174176 and notes below

Environmental Conditions:

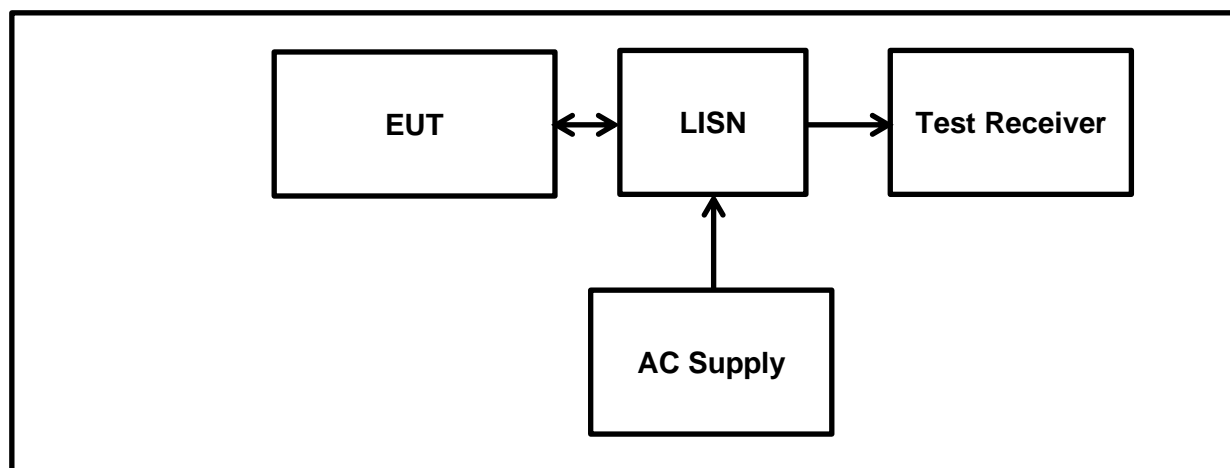
Temperature (°C):	22.7
Relative Humidity (%):	44.4

Settings of the Instrument

Detector	Quasi Peak/ Average Peak
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Note(s):

1. The EUT was powered with 120VAC / 60 Hz – 1 Phase and also 240 VAC / 60 Hz – 2 Phase as it is in the range of the used power supply.
2. As mentioned in FCC KDB 174176 Q5 a suitable dummy load for radio frequency termination used in place of the antenna, which has the same electrical properties as the intended antenna without radiated emissions.
3. The EUT was configured on RFID 13.56 MHz: Single Channel.
4. Pre-scans were performed, and markers placed on the highest live and neutral measured levels. Final measurements were performed on the marker frequencies and the results entered into the tables below.
5. The final measured value, for the given emission, in the table below incorporates the cable loss.
6. All other emissions shown on the pre-scan plot were investigated. Only the highest 6 emissions have been reported in the tables below in accordance with ANSI C63.10 section 6.2.5.
7. Measurements were performed in shielded room (SR7/ 8 Asset Number 1603671). The EUT was placed on ground plane since it is floor standing equipment and in a distance of 40 cm from the vertical ground plane.
8. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.

Transmitter AC Conducted Spurious Emissions (continued)**Test setup:**

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / 120 VAC 60 Hz / RFID Active**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15094	Live	31.50	65.90	34.40	Complied
0.84598	Live	7.20	56.00	48.80	Complied
1.42177	Live	7.30	56.00	48.70	Complied
13.56098	Live	49.20	60.00	10.80	Carrier/Complied
13.77600	Live	9.70	60.00	50.30	Complied
15.02189	Live	9.30	60.00	50.70	Complied
27.12362	Live	15.50	60.00	44.50	Complied

Results: Live / Average / 120 VAC 60 Hz / RFID Active

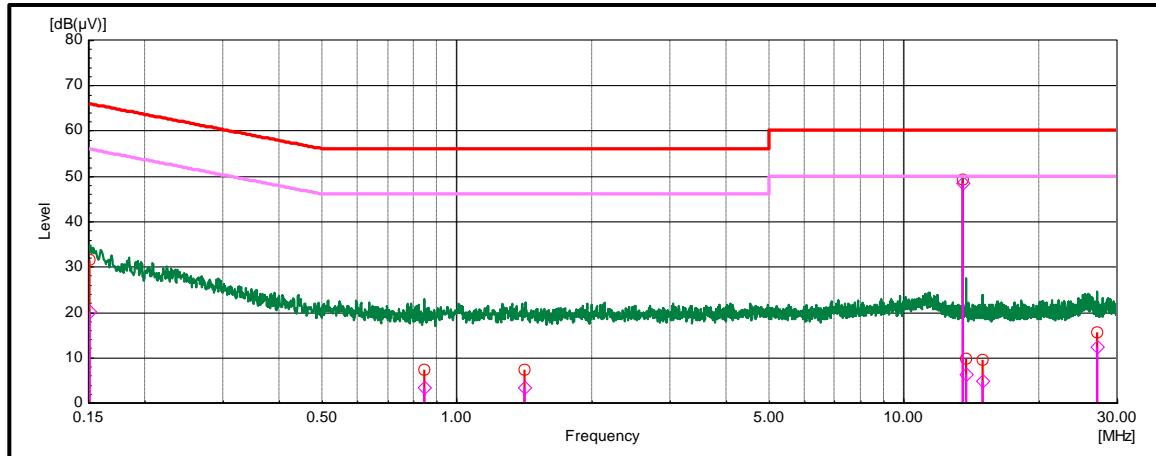
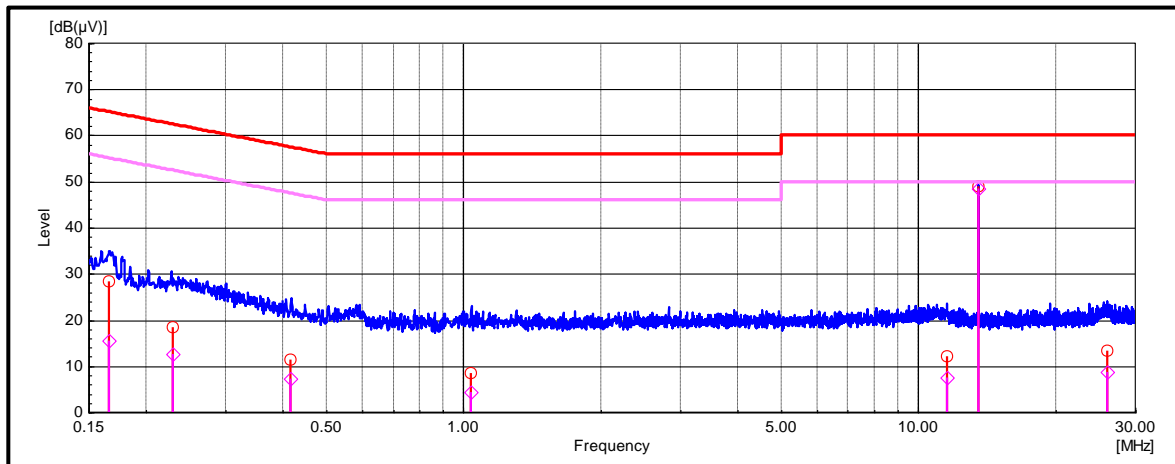
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15094	Live	20.00	55.90	35.90	Complied
0.84598	Live	3.30	46.00	42.70	Complied
1.42177	Live	3.40	46.00	42.60	Complied
13.56098	Live	48.50	50.00	1.50	Carrier/Complied
13.77600	Live	6.20	50.00	43.80	Complied
15.02189	Live	4.70	50.00	45.30	Complied
27.12362	Live	12.40	50.00	37.60	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz / RFID Active

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.16592	Neutral	28.50	65.20	36.70	Complied
0.22933	Neutral	18.50	62.50	44.00	Complied
0.41554	Neutral	11.50	57.50	46.00	Complied
1.03655	Neutral	8.40	56.00	47.60	Complied
11.58007	Neutral	12.20	60.00	47.80	Complied
13.56098	Neutral	48.90	60.00	11.10	Carrier/Complied
25.99029	Neutral	13.40	60.00	46.60	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Average / 120 VAC 60 Hz / RFID Active**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.16592	Neutral	15.50	55.20	39.70	Complied
0.22933	Neutral	12.60	52.50	39.90	Complied
0.41554	Neutral	7.20	47.50	40.30	Complied
1.03655	Neutral	4.30	46.00	41.70	Complied
11.58007	Neutral	7.60	50.00	42.40	Complied
13.56098	Neutral	48.50	50.00	1.50	Carrier/Complied
25.99029	Neutral	8.70	50.00	41.30	Complied

Result: Pass**Plot: Live Line / 120 VAC 60 Hz / RFID Active****Plot: Neutral Line / 120 VAC 60 Hz / RFID Active**

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / 240 VAC 60 Hz / RFID Active**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.18555	Live	28.50	64.20	35.70	Complied
0.24696	Live	25.90	61.90	36.00	Complied
0.73242	Live	18.70	56.00	37.30	Complied
0.92834	Live	19.80	56.00	36.20	Complied
11.13377	Live	19.80	60.00	40.20	Complied
13.56138	Live	49.00	60.00	11.00	Carrier/Complied
25.71141	Live	15.90	60.00	44.10	Complied

Results: Live / Average / 240 VAC 60 Hz / RFID Active

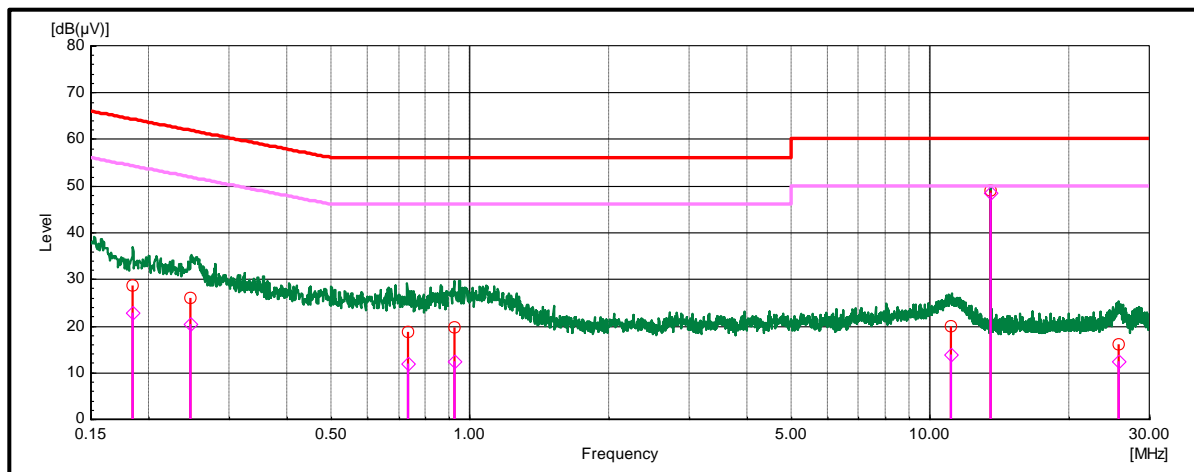
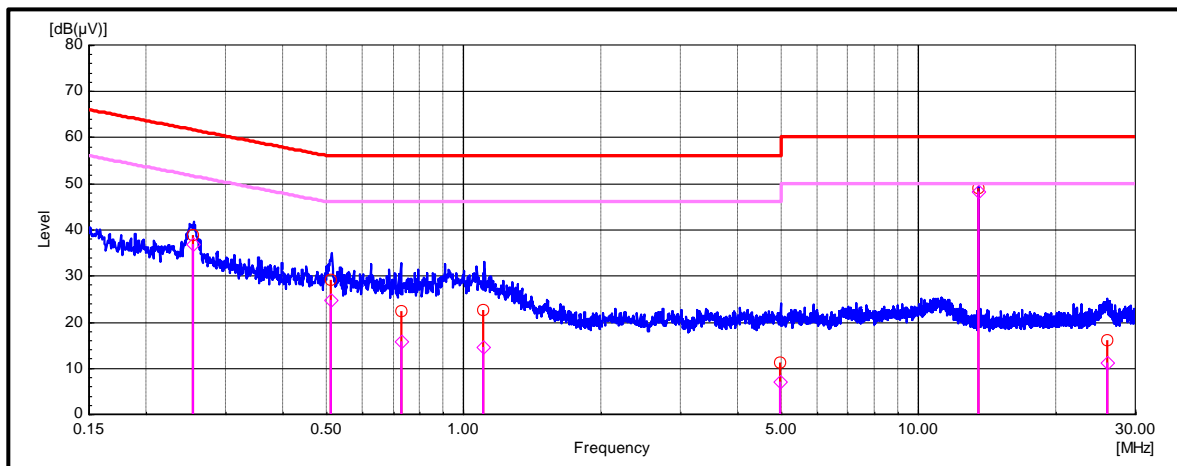
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.18555	Live	22.80	54.20	31.40	Complied
0.24696	Live	20.40	51.90	31.50	Complied
0.73242	Live	11.80	46.00	34.20	Complied
0.92834	Live	12.30	46.00	33.70	Complied
11.13377	Live	13.80	50.00	36.20	Complied
13.56138	Live	48.40	50.00	1.60	Carrier/Complied
25.71141	Live	12.30	50.00	37.70	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz / RFID Active

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.25472	Neutral	38.70	61.60	22.90	Complied
0.51088	Neutral	29.00	56.00	27.00	Complied
0.73044	Neutral	22.30	56.00	33.70	Complied
1.10701	Neutral	22.50	56.00	33.50	Complied
4.96755	Neutral	11.10	56.00	44.90	Complied
13.56047	Neutral	49.00	60.00	11.00	Carrier/Complied
25.99015	Neutral	16.00	60.00	44.00	Complied

Transmitter AC Conducted Spurious Emissions (continued)**Results: Neutral / Average / 240 VAC 60 Hz / RFID Active**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.25472	Neutral	36.90	51.60	14.70	Complied
0.51088	Neutral	24.70	46.00	21.30	Complied
0.73044	Neutral	15.70	46.00	30.30	Complied
1.10701	Neutral	14.40	46.00	31.60	Complied
4.96755	Neutral	6.90	46.00	39.10	Complied
13.56047	Neutral	48.30	50.00	1.70	Carrier/Complied
25.99015	Neutral	11.20	50.00	38.80	Complied

Result: Pass**Plot: Live Line / 240 VAC 60 Hz / RFID Active****Plot: Neutral Line / 240 VAC 60 Hz / RFID Active**

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / 120 VAC 60 Hz / Antenna terminated**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15267	Live	33.20	65.90	32.70	Complied
0.18684	Live	25.60	64.20	38.60	Complied
0.58800	Live	11.50	56.00	44.50	Complied
2.11116	Live	8.90	56.00	47.10	Complied
5.31979	Live	10.50	60.00	49.50	Complied
27.38398	Live	12.00	60.00	48.00	Complied

Results: Live / Average / 120 VAC 60 Hz / Antenna terminated

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15267	Live	18.50	55.90	37.40	Complied
0.18684	Live	16.10	54.20	38.10	Complied
0.58800	Live	6.50	46.00	39.50	Complied
2.11116	Live	4.30	46.00	41.70	Complied
5.31979	Live	6.00	50.00	44.00	Complied
27.38398	Live	7.40	50.00	42.60	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz / Antenna terminated

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15289	Neutral	30.40	65.80	35.40	Complied
0.35344	Neutral	12.50	58.90	46.40	Complied
0.56272	Neutral	15.90	56.00	40.10	Complied
2.65541	Neutral	9.10	56.00	46.90	Complied
11.93954	Neutral	12.00	60.00	48.00	Complied
29.15025	Neutral	10.80	60.00	49.20	Complied

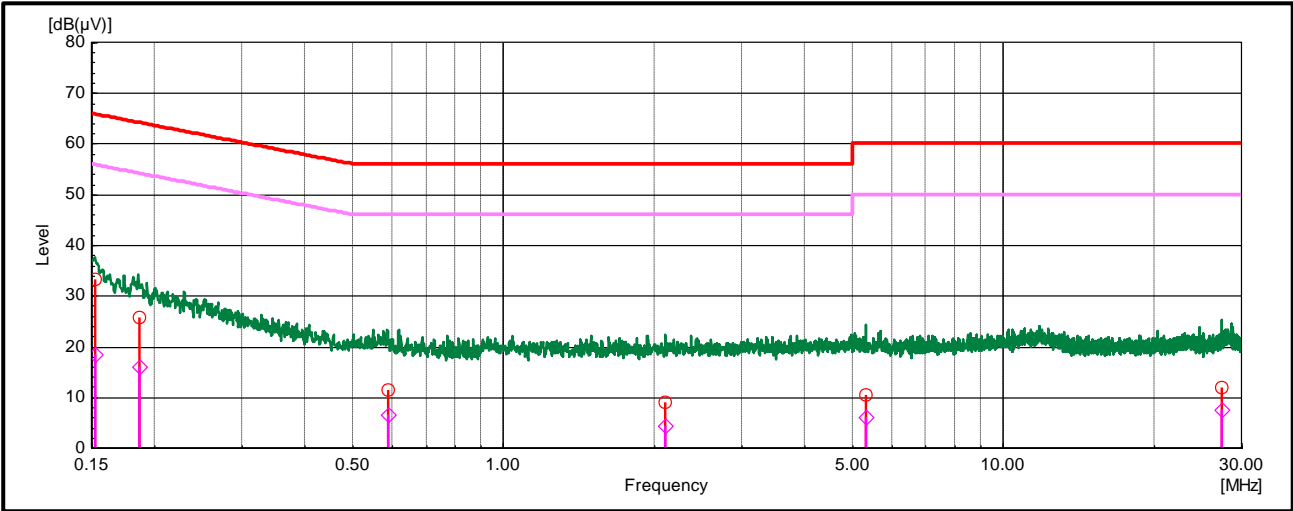
Results: Neutral / Average / 120 VAC 60 Hz / Antenna terminated

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15289	Neutral	17.90	55.80	37.90	Complied
0.35344	Neutral	8.30	48.90	40.60	Complied
0.56272	Neutral	9.40	46.00	36.60	Complied
2.65541	Neutral	4.50	46.00	41.50	Complied
11.93954	Neutral	7.70	50.00	42.30	Complied
29.15025	Neutral	6.10	50.00	43.90	Complied

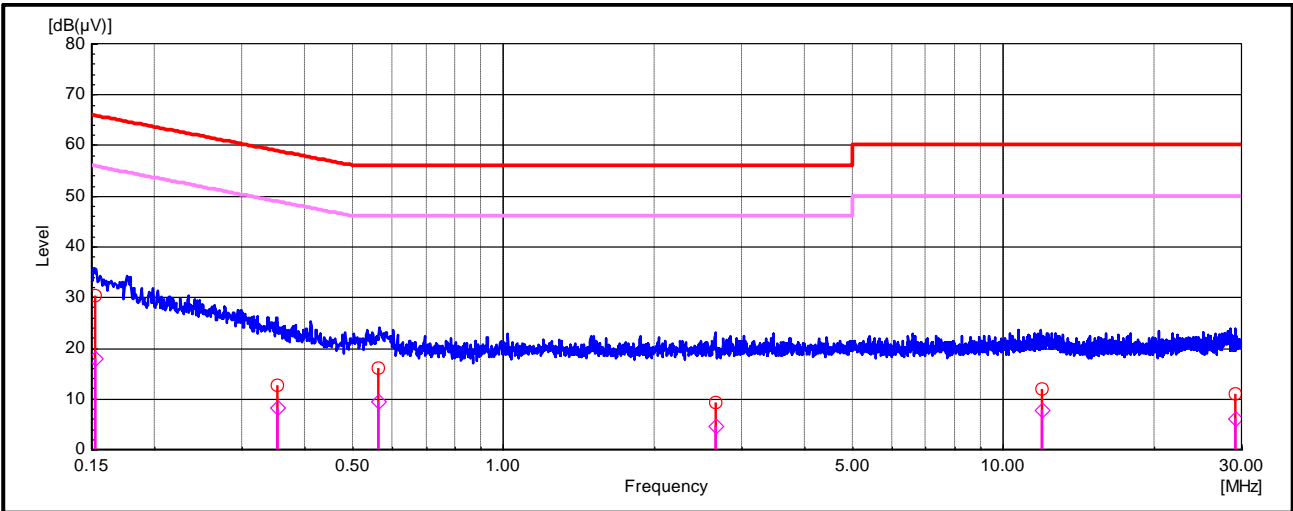
Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live Line / 120 VAC 60 Hz / Antenna terminated



Plot: Neutral Line / 120 VAC 60 Hz / Antenna terminated



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak / 240 VAC 60 Hz / Antenna terminated**

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15097	Live	37.90	65.90	28.00	Complied
0.25012	Live	29.30	61.80	32.50	Complied
0.47530	Live	19.80	56.40	36.60	Complied
0.58664	Live	19.80	56.00	36.20	Complied
0.95146	Live	20.20	56.00	35.80	Complied
12.11658	Live	17.90	60.00	42.10	Complied

Results: Live / Average / 240 VAC 60 Hz / Antenna terminated

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15097	Live	28.70	55.90	27.20	Complied
0.25012	Live	24.30	51.80	27.50	Complied
0.47530	Live	13.80	46.40	32.60	Complied
0.58664	Live	14.10	46.00	31.90	Complied
0.95146	Live	12.60	46.00	33.40	Complied
12.11658	Live	11.50	50.00	38.50	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz / Antenna terminated

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15088	Neutral	37.70	66.00	28.30	Complied
0.25067	Neutral	37.60	61.70	24.10	Complied
0.50635	Neutral	27.70	56.00	28.30	Complied
0.90872	Neutral	22.70	56.00	33.30	Complied
2.81802	Neutral	13.20	56.00	42.80	Complied
11.67621	Neutral	15.80	60.00	44.20	Complied

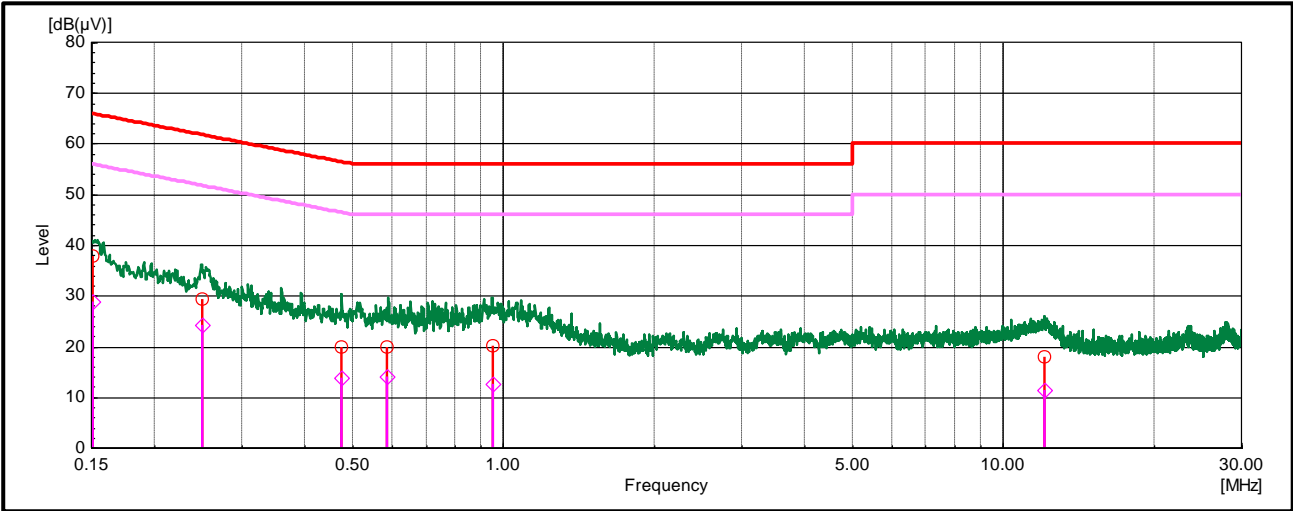
Results: Neutral / Average / 240 VAC 60 Hz / Antenna terminated

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.15088	Neutral	30.60	56.00	25.40	Complied
0.25067	Neutral	34.70	51.70	17.00	Complied
0.50635	Neutral	23.60	46.00	22.40	Complied
0.90872	Neutral	15.10	46.00	30.90	Complied
2.81802	Neutral	8.10	46.00	37.90	Complied
11.67621	Neutral	10.20	50.00	39.80	Complied

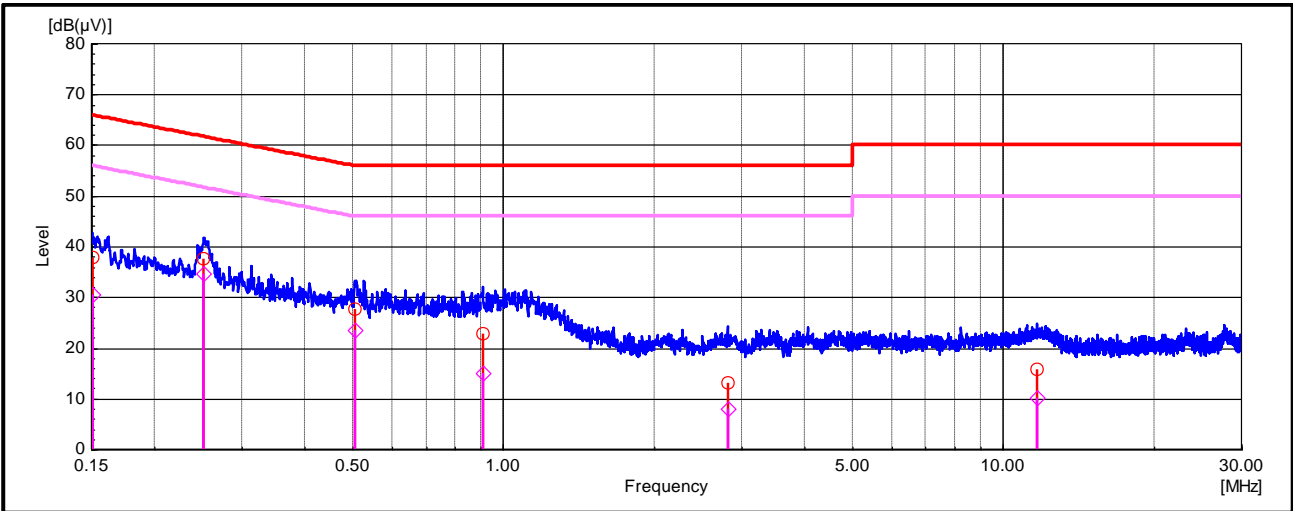
Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live Line / 240 VAC 60 Hz / Antenna terminated



Plot: Neutral Line / 240 VAC 60 Hz / Antenna terminated



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

5.2.2. Transmitter 20 dB Bandwidth**Test Summary:**

Test Engineer:	Abbas Al-Hussainy	Test Dates:	29 November 2023
Test Sample Serial Number:	839186 (Radiated Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.215(c)
Test Method Used:	ANSI C63.10 Section 6.9.2

Environmental Conditions:

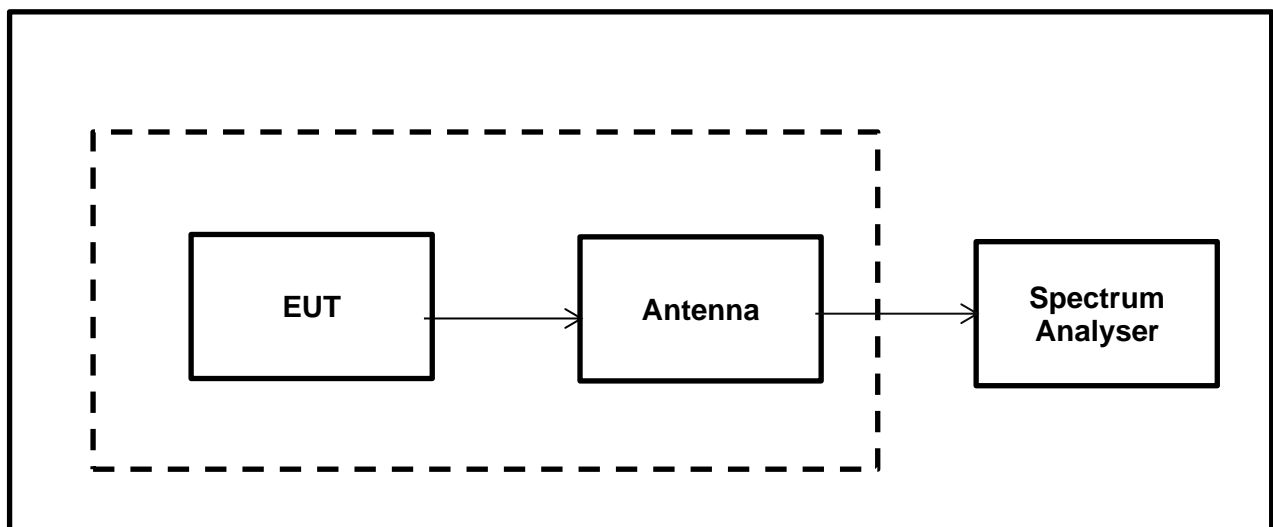
Temperature (°C):	20.1
Relative Humidity (%):	39.7

Settings of the Instrument:

RBW/VBW	10 Hz / 30 Hz
Span	800 Hz
Sweep time	Auto
Detector	MaxPeak

Notes:

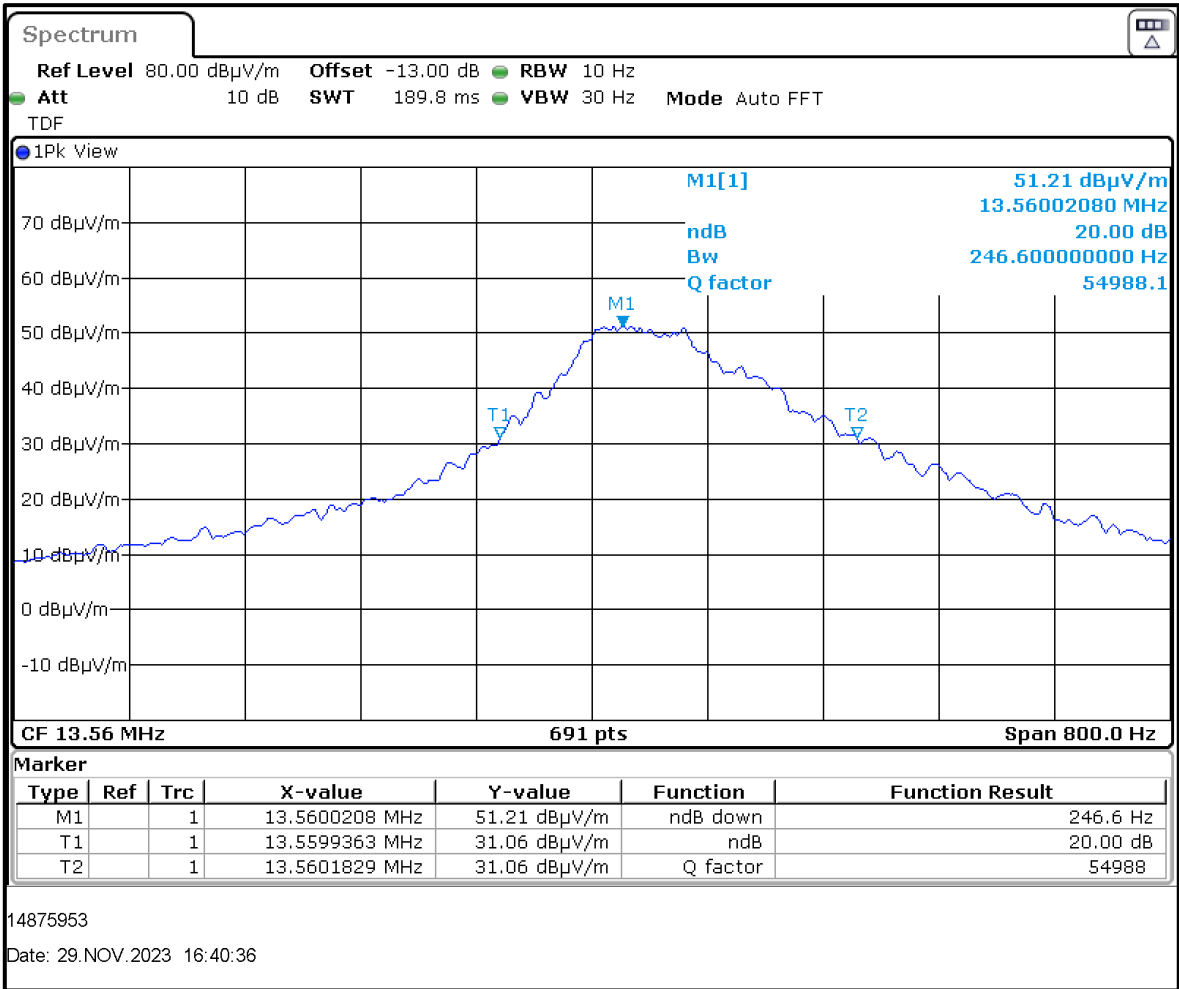
1. The n dB down function of the spectrum analyzer was set to 20 dB.

Test Setup:

Transmitter 20 dB Bandwidth (continued)

Results: RFID 13.56 MHz

RFID Channel	20 dB Bandwidth (Hz)
13.56 MHz	246



RFID 13.56 MHz

Result: Pass

5.2.3. Transmitter Fundamental Field Strength & Spectrum Mask**Test Summary:**

Test Engineer:	Tobias Koch	Test Dates:	29 November 2023
Test Sample Serial Number:	839186 (Radiated Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.225(a)(b)(c)(d)
Test Method Used:	ANSI C63.10 Section 6.4

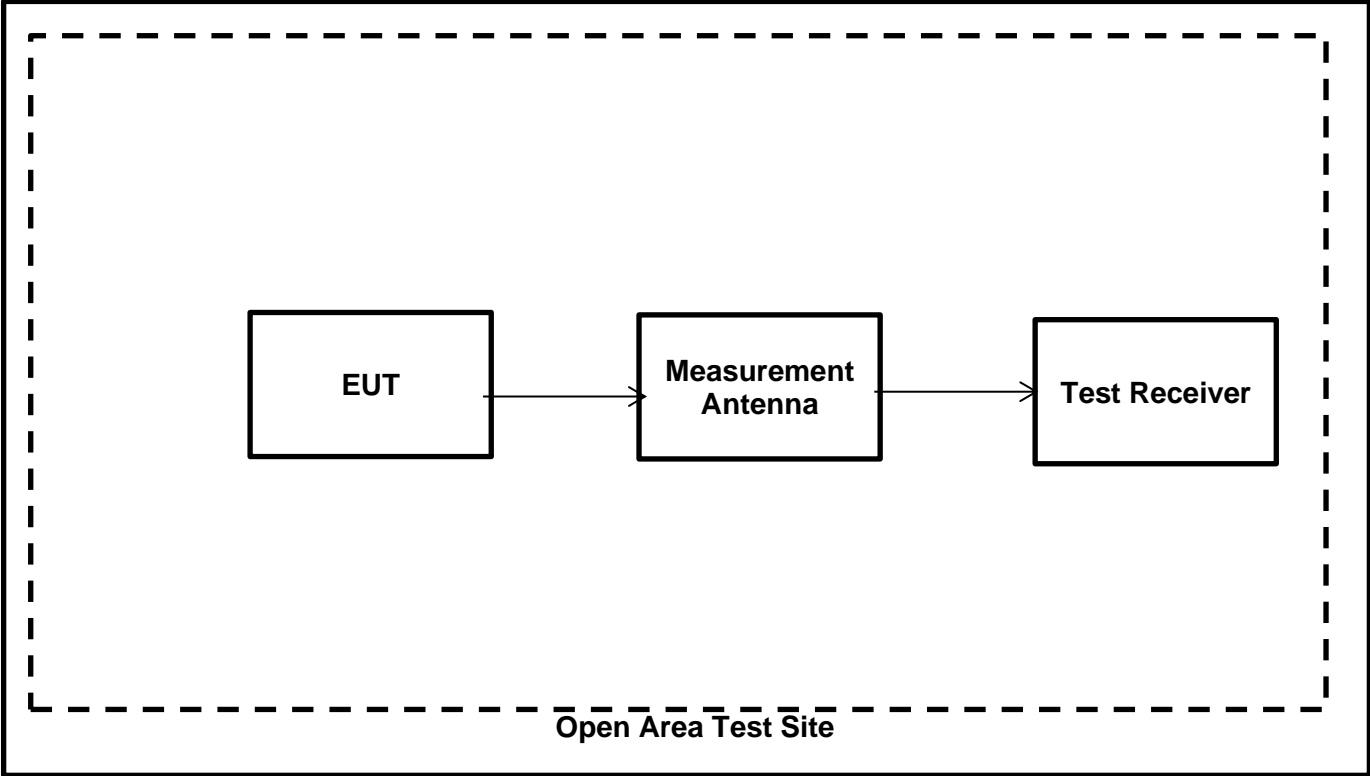
Environmental Conditions:

Temperature (°C):	19.3
Relative Humidity (%):	39.6

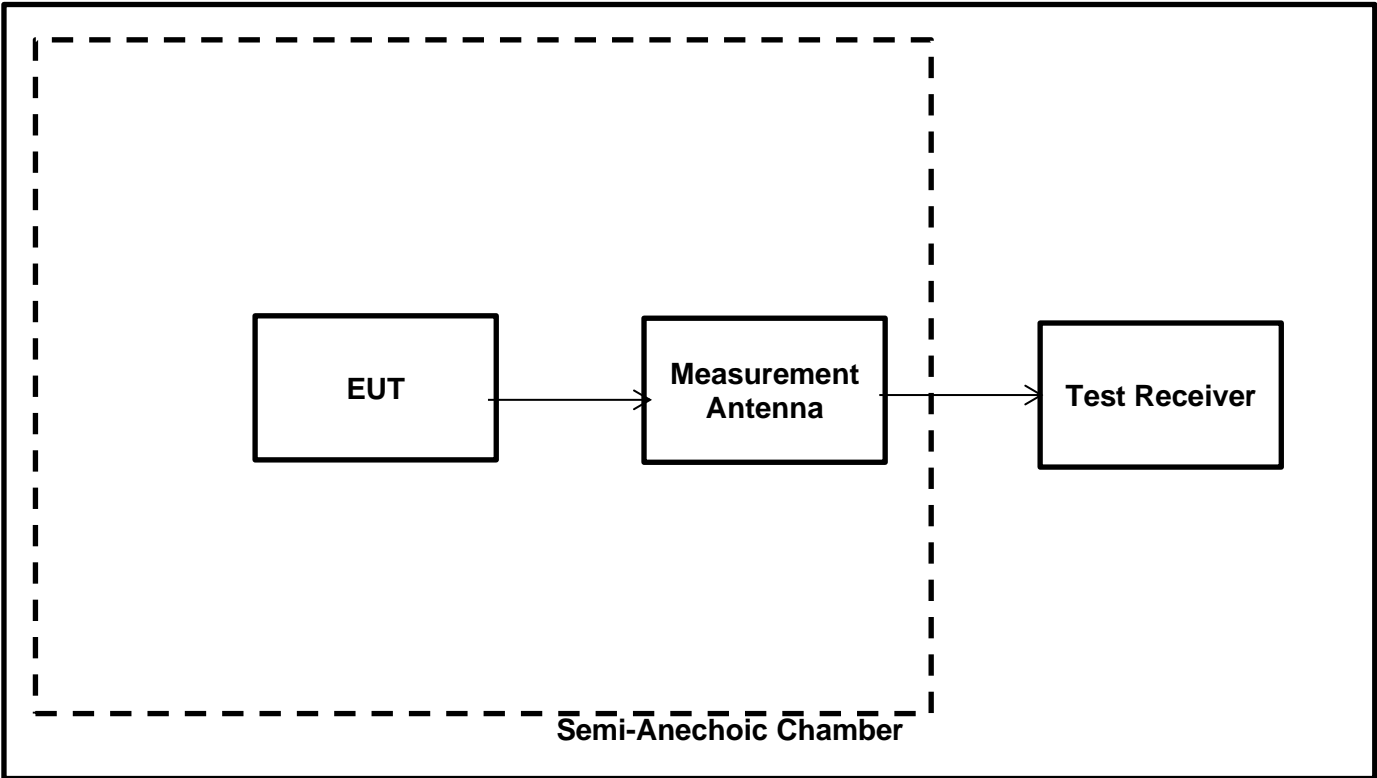
Note(s):

1. The limit is specified at a test distance of 30 metres. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
2. In accordance with FCC KDB 414788 D01 Radiated Test Site v01 an alternative Test Site was used. Instead of an OATS a Semi Anechoic Chamber was used where evidence was shown that the behaviour is the same. A maximum deviation of 1.38 dB for 13.56 MHz could be determined. This deviation is also taken into account to the result.
3. Therefore, applicable limits were extrapolated from 30 m to 3 m using a distance extrapolation factor of 40 dB/decade. The transducer factor on the measuring instrument was used to extrapolate the measured values from 30 m to 3 m using a distance extrapolation factor of 40 dB/decade.
4. Pre-scan measurements were performed using a spectrum analyser with a peak detector and measurement bandwidth of 10 kHz. The fundamental field strength was maximized by rotating the measurement antenna and EUT. The spectrum analyser was then switched to test receiver mode and the final measurement on the maximized level was performed.
5. Compliance with the spectrum mask is shown by final measurements performed in a semi-anechoic chamber. For the field strength measurements in a semi-anechoic chamber, a transducer factor on the measuring instrument was used to extrapolate the results at 3 m to a distance of 30 m. A distance extrapolation factor of 40 dB was used.
6. A transducer factor was used on the spectrum analyser during measurement. This factor includes correction between the fixed gain of the magnetic loop antenna and the calibration values. It also includes the value of the RF cable used to connect the antenna to the spectrum analyser which was incorporated into the annual calibration of the magnetic loop antenna.
7. For the emissions appearing within the 13.110-14.010 MHz band, compliance with the spectrum mask is shown in accordance with FCC Part 15.225(a)(b)(c)(d) limits.
8. The emissions shown at frequencies approximately at 13.56 MHz on the plot represent EUT's fundamental field strength for RFID 13.56 MHz.
9. For the emissions appearing outside of the 13.110-14.010 MHz band, compliance with the spectrum mask is shown in accordance with FCC Part 15.225(d) referencing FCC Part 15.209 general radiated emission limits.

Transmitter Fundamental Field Strength & Spectrum Mask(continued)
Open Area Test Site



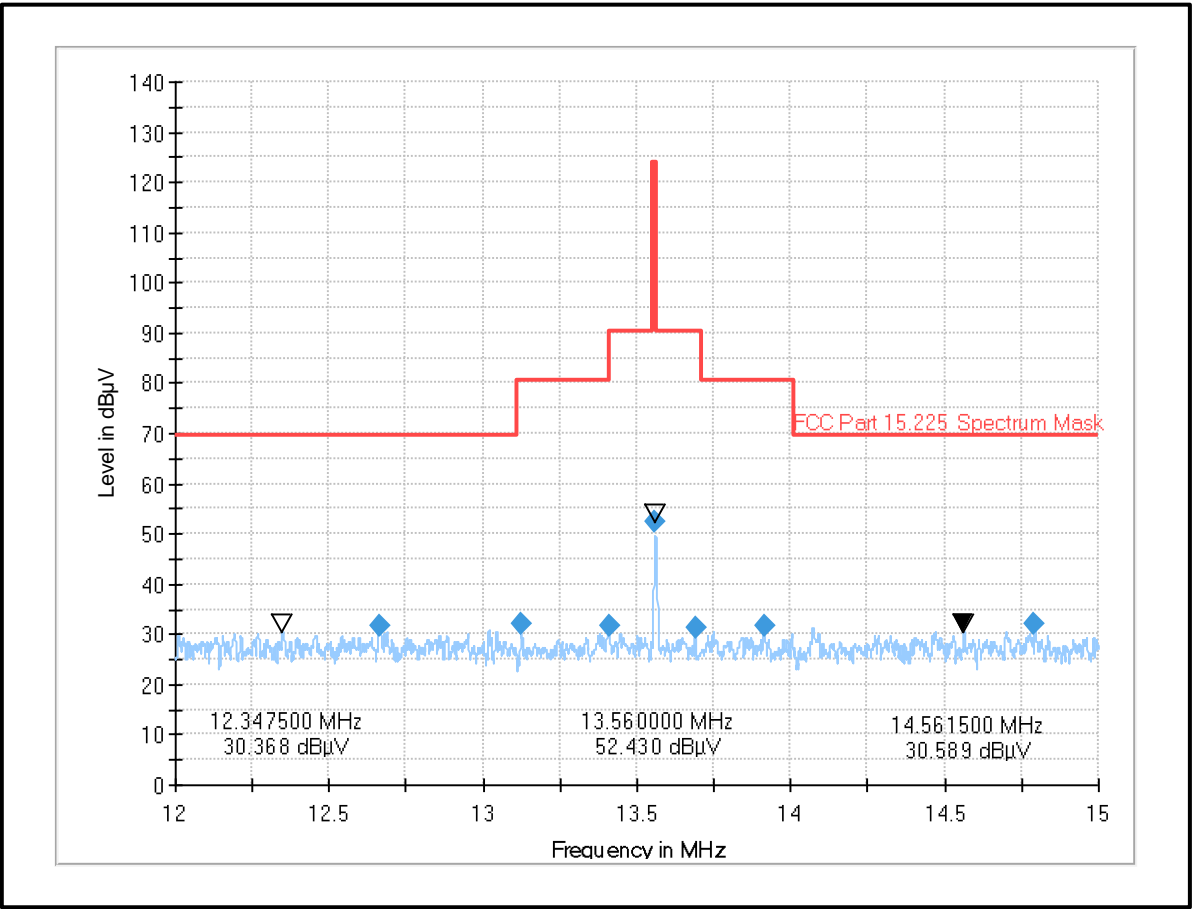
Semi Anechoic Chamber



Transmitter Fundamental Field Strength & Spectrum Mask (continued)**Results: AC Power supply / RFID 13.56 MHz**

Frequency Band (MHz)	Emission Frequency (MHz)	Loop Antenna Orientation	MaxPeak Emission Level at 3 m (dB μ V/m) <small>Note 3</small>	Deviation from OATS to SAC (dB)	Deviation Corrected Level at 3 m (dB μ V/m)	Limit at 3 m (dB μ V/m) <small>Note 3</small>	Margin (dB)	Result
12.000 to 13.110	12.66	0° to EUT	31.55	0.48	32.03	69.50	37.47	Complied
13.110 to 13.410	13.12	90° to EUT	32.04	1.38	33.42	80.50	47.08	Complied
13.410 to 13.553	13.41	90° to EUT	31.72	1.38	33.10	90.50	57.4	Complied
13.553 to 13.567	13.56	90° to EUT	52.43	1.38	53.81	124.00	70.19	Complied
13.567 to 13.710	13.59	90° to EUT	45.40	1.38	46.78	90.50	43.72	Complied
13.710 to 14.010	13.91	90° to EUT	31.69	1.07	32.76	80.50	47.74	Complied
14.010 to 15.000	14.79	90° to EUT	32.09	1.07	33.16	69.50	36.34	Complied

Transmitter Fundamental Field Strength & Spectrum Mask (continued)
Plot: AC Power supply / RFID 13.56 MHz



Fundamental field strength and spectrum mask / measured at 3 metres/ measured in a semi-anechoic chamber

Result: Pass

5.2.4. Transmitter Radiated Spurious Emissions**Test Summary:**

Test Engineer:	Tobias Koch	Test Dates:	29 November 2023
Test Sample Serial Number:	839186 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.225(d) & 15.209(a)
Test Method Used:	ANSI C63.10:2013 Sections 6.3 and 6.4
Frequency Range:	9 kHz to 30 MHz

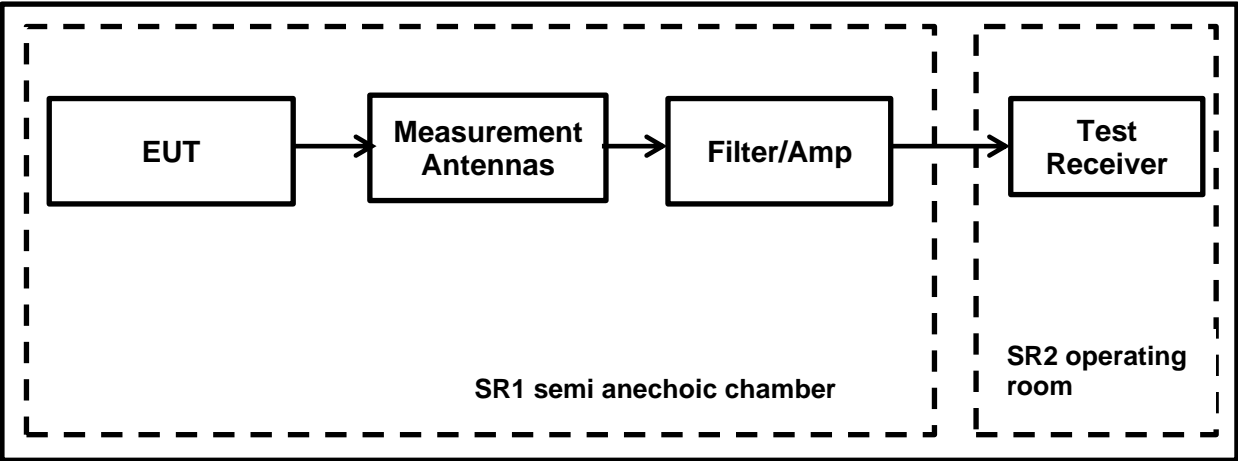
Environmental Conditions:

Temperature (°C):	19.3
Relative Humidity (%):	39.6

Note(s):

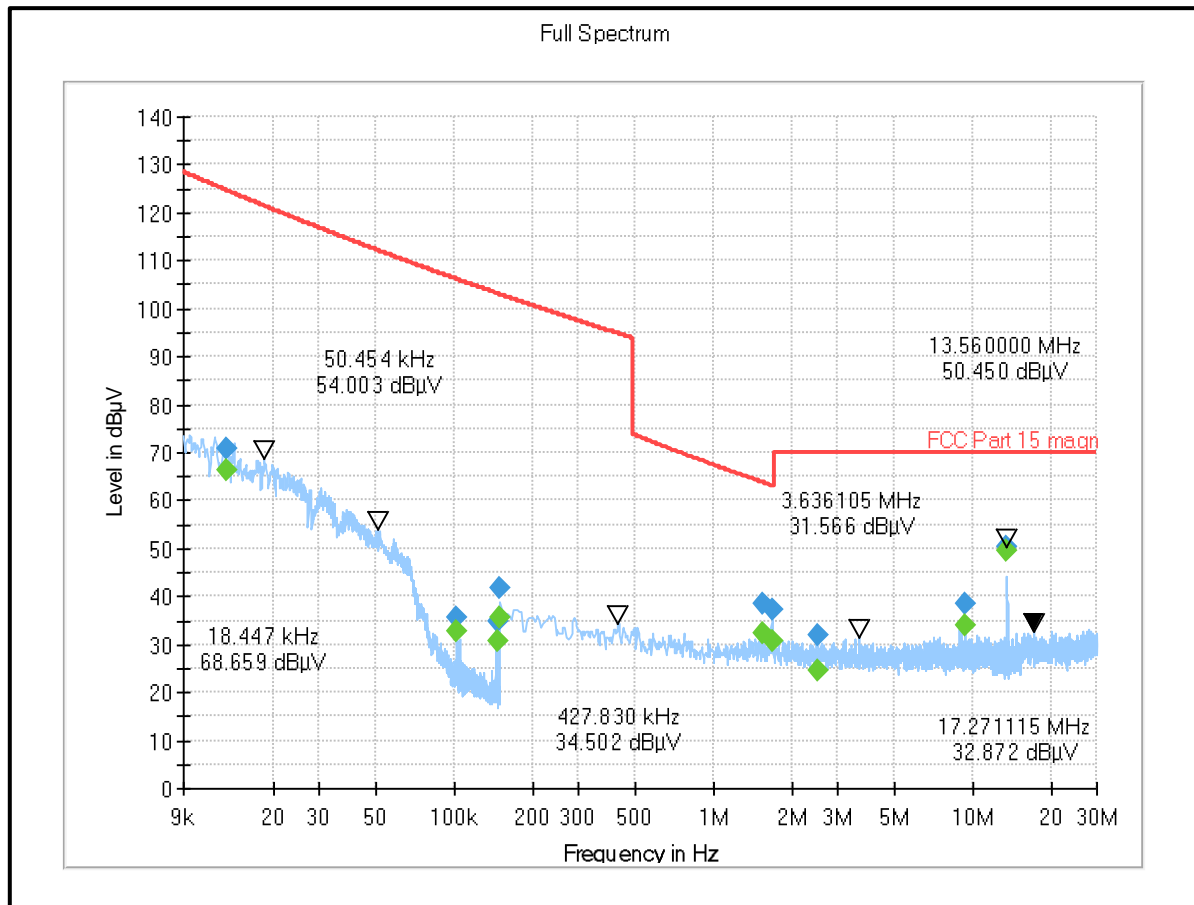
- In accordance with FCC KDB 414788, an alternative test site may be used for the measurement below 30 MHz (The OATS / SAC comparison data is available upon request). Therefore the result from the semi-anechoic chamber tests is shown in this section of the test report.
- The limits are specified at a test distance of 30 m & 300 m. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor.
- Therefore the limit values are extrapolated to a measurement distance of 3 m where field strength of X dBμV/m was measured.
 - 9 kHz- 490 kHz: limits extrapolated from 300 m to 3 m adding 80 dB at 40 dB /decade.
 - 490 kHz-1705 kHz: limits extrapolated from 30 m to 3 m by adding 40 dB at 40 dB /decade.
- The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
- Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. The EUT was floor standing equipment and placed at on ground plane in the centre of the chamber turntable. The measurement loop antenna height was at 1 m.
- Pre-scans were performed and markers placed on the highest measured levels. The test receiver was set to:
 - Frequency range: 9 kHz-150 kHz : RBW: 300 Hz /VBW: 1 kHz
 - Frequency range: 150 kHz – 30 MHz: RBW: 10 kHz /VBW: 30 kHz
 - Detector: Max-Peak detector
 - Trace Mode: Max Hold
- The emissions shown at frequencies approximately 13.56 MHz on the 9 kHz to 30 MHz plots are the EUT RFID 13.56 MHz fundamental for the tested channel.

Transmitter Radiated Spurious Emission test setup
Test Setup:



Transmitter Radiated Emissions (continued)**Results: AC Power supply / RFID 13.56 MHz**

Frequency (MHz)	Loop Antenna Orientation	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
0.013301	90° to EUT	70.93	124.61	53.68	Complied
0.101567	90° to EUT	35.41	106.18	70.76	Complied
0.145559	0° to EUT	34.70	103.21	68.51	Complied
0.150000	0° to EUT	41.87	102.96	61.09	Complied
1.542458	90° to EUT	38.33	63.78	25.45	Complied
1.674758	90° to EUT	37.07	63.11	26.04	Complied
2.511555	90° to EUT	31.95	70.00	38.05	Complied
9.262380	90° to EUT	38.56	70.00	31.44	Complied
13.560000	90° to EUT	50.45	70.00	19.55	Complied

Plot: 9kHz – 30MHz – Active RFID**Result: Pass**

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	Tobias Koch	Test Dates:	29 November 2023
Test Sample Serial Number:	839186 (Radiated Test Sample)		
Test Site Identification	SR 1/2		

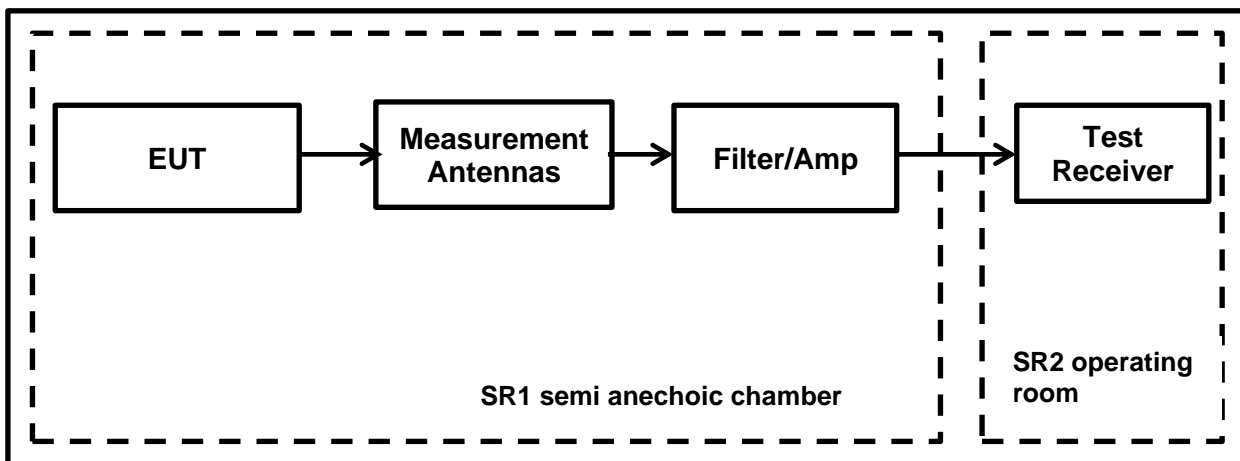
FCC Reference:	Parts 15.225(d) & 15.209(a)
Test Method Used:	ANSI C63.10:2013 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	19.3
Relative Humidity (%):	39.6

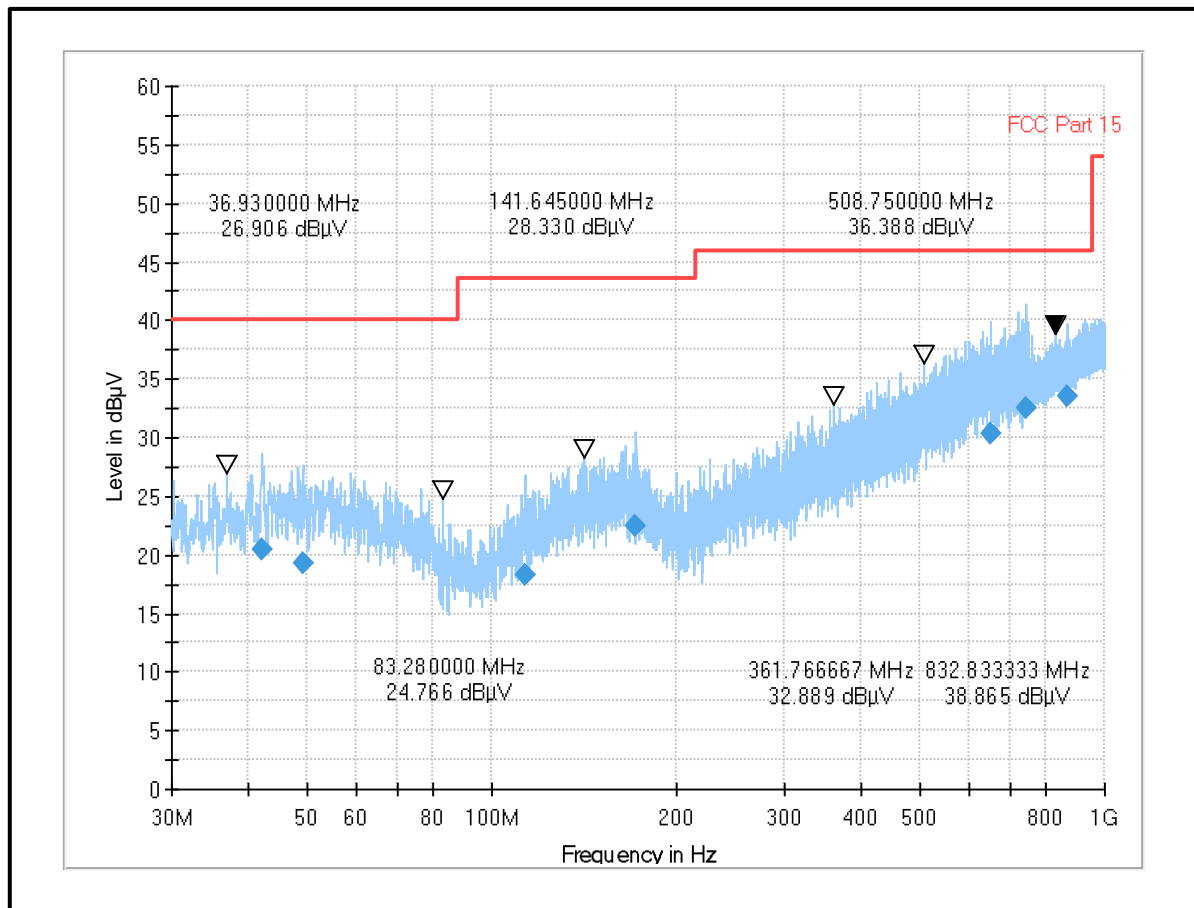
Note(s):

1. Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. The EUT was floor standing equipment and placed at on ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 m to 4 m.
2. Pre-scans were performed and markers placed on the highest measured levels. The test receiver resolution bandwidth was set to 100 kHz and video bandwidth 300 kHz. A peak detector was used, sweep time was set to auto and trace mode was Max Hold.
3. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.

Test Setup:

Transmitter Radiated Emissions (continued)**Results: AC Power supply / RFID 13.56 MHz**

Frequency (MHz)	Antenna Polarization	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
42.105000	Vertical	20.38	40.00	19.62	Complied
49.080000	Vertical	19.26	40.00	20.74	Complied
113.250000	Vertical	18.27	43.50	25.23	Complied
171.885000	Vertical	22.53	43.50	20.97	Complied
653.375000	Vertical	30.36	46.00	15.64	Complied
746.250000	Horizontal	32.57	46.00	13.43	Complied
867.041667	Horizontal	33.47	46.00	12.53	Complied

Plot: 30Mz – 1000MHz – Active RFID**Result: Pass**

5.2.5. Transmitter Frequency Stability (Temperature & Voltage Variation)**Test Summary:**

Test Engineer:	Abbas Al-Hussainy	Test Dates:	29 November 2023 & 30 November 2023
Test Sample Serial Number:	839186 (Radiated Test Sample)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.225(e)
Test Method Used:	ANSI C63.10 Sections 6.8.1 and 6.8.2

Environmental Conditions:

Ambient Temperature (°C):	20.1 to 22.8
Ambient Relative Humidity (%):	39.7 to 43.5

Settings of the Instrument

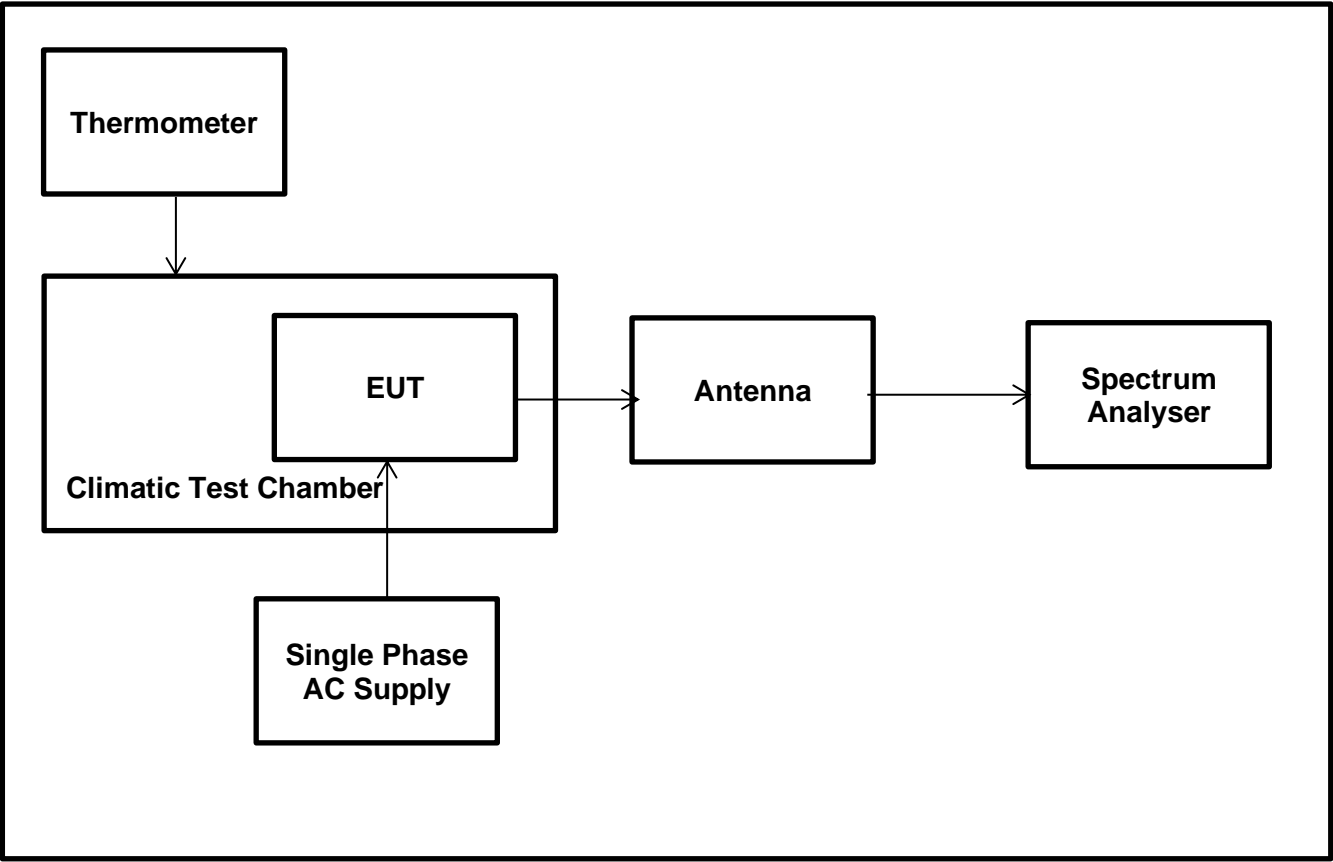
RBW/VBW	30 Hz/30 kHz
Span	4 kHz
Sweep Time	Auto
Sweep Mode	Single Sweep
Detector	Peak
Marker Function	Signal Count

Note(s):

1. The EUT was kept inside the environmental/climatic test chamber. The tests were performed with extreme temperature & extreme voltage variations.
2. The temperature variations were monitored throughout the tests using a calibrated digital thermometer. The voltage variations were monitored throughout the tests using a calibrated digital multimeter.
3. For accurate measurement of frequency deviations, Signal Count / frequency counter function was activated on the spectrum analyser.
4. The applicant's declared operating frequency 13.560 MHz was used as reference frequency.
5. The difference between operating /reference frequency & measured frequency was reported as a frequency error.
6. The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ or 100 ppm of the operating frequency

Transmitter Frequency Stability (Temperature & Voltage Variation) (continued)

Test Setup:



Transmitter Frequency Stability (Temperature & Voltage Variation) (continued)**Results: AC Power supply / RFID 13.56 MHz / Temperature Variations**

Extreme Temperature (°C)	Time after EUT Power-up	Measured Frequency (MHz)	Frequency Error		Frequency Error Limits		Result
			%	ppm	%	ppm	
-20	at 0 minutes	13.560276975	0.002042588	20.43	± 0.01	± 100	Complied
	at 2 minutes	13.560324743	0.002394860	23.95	± 0.01	± 100	Complied
	at 5 minutes	13.560336497	0.002481541	24.82	± 0.01	± 100	Complied
	at 10 minutes	13.560344980	0.002544100	25.44	± 0.01	± 100	Complied
-10	at 0 minutes	13.560336626	0.002482493	24.82	± 0.01	± 100	Complied
	at 2 minutes	13.560353654	0.002608068	26.08	± 0.01	± 100	Complied
	at 5 minutes	13.560354695	0.002615745	26.16	± 0.01	± 100	Complied
	at 10 minutes	13.560355817	0.002624019	26.24	± 0.01	± 100	Complied
0	at 0 minutes	13.560352650	0.002600664	26.01	± 0.01	± 100	Complied
	at 2 minutes	13.560353212	0.002604808	26.05	± 0.01	± 100	Complied
	at 5 minutes	13.560351496	0.002592153	25.92	± 0.01	± 100	Complied
	at 10 minutes	13.560347418	0.002562080	25.62	± 0.01	± 100	Complied
+10	at 0 minutes	13.560346660	0.002556490	25.56	± 0.01	± 100	Complied
	at 2 minutes	13.560336482	0.002481431	24.81	± 0.01	± 100	Complied
	at 5 minutes	13.560331581	0.002445288	24.45	± 0.01	± 100	Complied
	at 10 minutes	13.560329554	0.002430339	24.30	± 0.01	± 100	Complied
+20	at 0 minutes	13.560321727	0.002372618	23.73	± 0.01	± 100	Complied
	at 2 minutes	13.560313137	0.002309270	23.09	± 0.01	± 100	Complied
	at 5 minutes	13.560311243	0.002295302	22.95	± 0.01	± 100	Complied
	at 10 minutes	13.560308413	0.002274432	22.74	± 0.01	± 100	Complied
+30	at 0 minutes	13.560323112	0.002382832	23.83	± 0.01	± 100	Complied
	at 2 minutes	13.560310365	0.002288827	22.89	± 0.01	± 100	Complied
	at 5 minutes	13.560304900	0.002248525	22.49	± 0.01	± 100	Complied
	at 10 minutes	13.560300704	0.002217581	22.18	± 0.01	± 100	Complied
+40	at 0 minutes	13.560308567	0.002275568	22.76	± 0.01	± 100	Complied
	at 2 minutes	13.560298964	0.002204749	22.05	± 0.01	± 100	Complied
	at 5 minutes	13.560295780	0.002181268	21.81	± 0.01	± 100	Complied
	at 10 minutes	13.560295058	0.002175944	21.76	± 0.01	± 100	Complied
+50	at 0 minutes	13.560296615	0.002187426	21.87	± 0.01	± 100	Complied
	at 2 minutes	13.560307090	0.002264676	22.65	± 0.01	± 100	Complied
	at 5 minutes	13.560309555	0.002282854	22.83	± 0.01	± 100	Complied
	at 10 minutes	13.560313000	0.002308260	23.08	± 0.01	± 100	Complied

Result: Pass

Transmitter Frequency Stability (Temperature & Voltage Variation) (continued)**Results: AC Power supply / RFID 13.56 MHz / Voltage Variations**

Extreme Voltage Conditions	Extreme DC Voltage (V)	Measured Frequency (MHz)	Frequency Error		Frequency Error Limits		Result
			%	ppm	%	ppm	
85% of Rated Primary Supply Voltage	102	13.560318878	0.002352	23.52	± 0.01	± 100	Complied
Rated Primary Supply Voltage	120	13.560297109	0.002191	21.91	± 0.01	± 100	Complied
115% of Rated Primary Supply Voltage	138	13.560320357	0.002363	23.63	± 0.01	± 100	Complied

Result: Pass

6. Measurement Uncertainty

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	95%	±2.49 dB
20 dB Bandwidth	95%	±0.87 %
Fundamental Field Strength	95%	±3.10 dB
Radiated Spurious Emissions	95%	±3.10 dB
Frequency Stability	95%	±92 Hz

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Used equipment

Test site: SR 1/2

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
1	Rohde & Schwarz	Antenna, Loop	HFH2-Z2	831247/012	18/07/2023	36
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	18/07/2023	12
460	Deisel	Turntable	DT 4250 S	n/a	n/a	n/a
465	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	02/09/2020	42
496	Rohde & Schwarz	Antenna, log. - periodical	HL050	100297	22/08/2022	24
588	Maturo	Controller	NCD	029/7180311	n/a	n/a
591	Rohde & Schwarz	Receiver	ESU 40	100244/040	13/07/2023	12
669	Rohde & Schwarz	EMI Test Receiver	ESW 44	103087	13/07/2023	18
694	Rohde & Schwarz	Signal Analyzer	FSW 50	101847	09/05/2023	12
607	Schwarzbeck	Antenna broadband horn antenna	BBHA 9170	9170-561	15/10/2019	48
608	Rohde & Schwarz	Switch Matrix	OSP 120	101227	lab verification	n/a
628	Maturo	Antenna mast	CAM 4.0-P	224/19590716	n/a	n/a
629	Maturo	Kippeinrichtung	KE 2.5-R-M	MAT002	n/a	n/a
-/-	Testo	Thermo-Hygrometer	608-H1	01	lab verification	n/a
328	SPS	AC/DC power distribution system	PAS 5000	A2464 00/2 0200	lab verification	n/a
1603665	Siemens Matsushita Components	semi-anechoic chamber SR1/ 2	-/-	B83117-A1421-T161	n/a	n/a
681	Maturo	Antenna mast, tilting	BAM4.5-P	402/0718.1	n/a	n/a

Test site: SR 7/8

ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
22	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/014	18.07.2023	12
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	18.07.2023	12
28	Rohde & Schwarz	Passive Probe	ESH2-Z3	none	13.07.2022	36
215	Rohde & Schwarz	Artificial Mains Network	ESH2-Z5	879675/002	18.07.2023	24
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	18.07.2023	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	18.07.2023	12
505	Rohde & Schwarz	Absorbing Clamp	MDS21	100005	21.07.2023	48

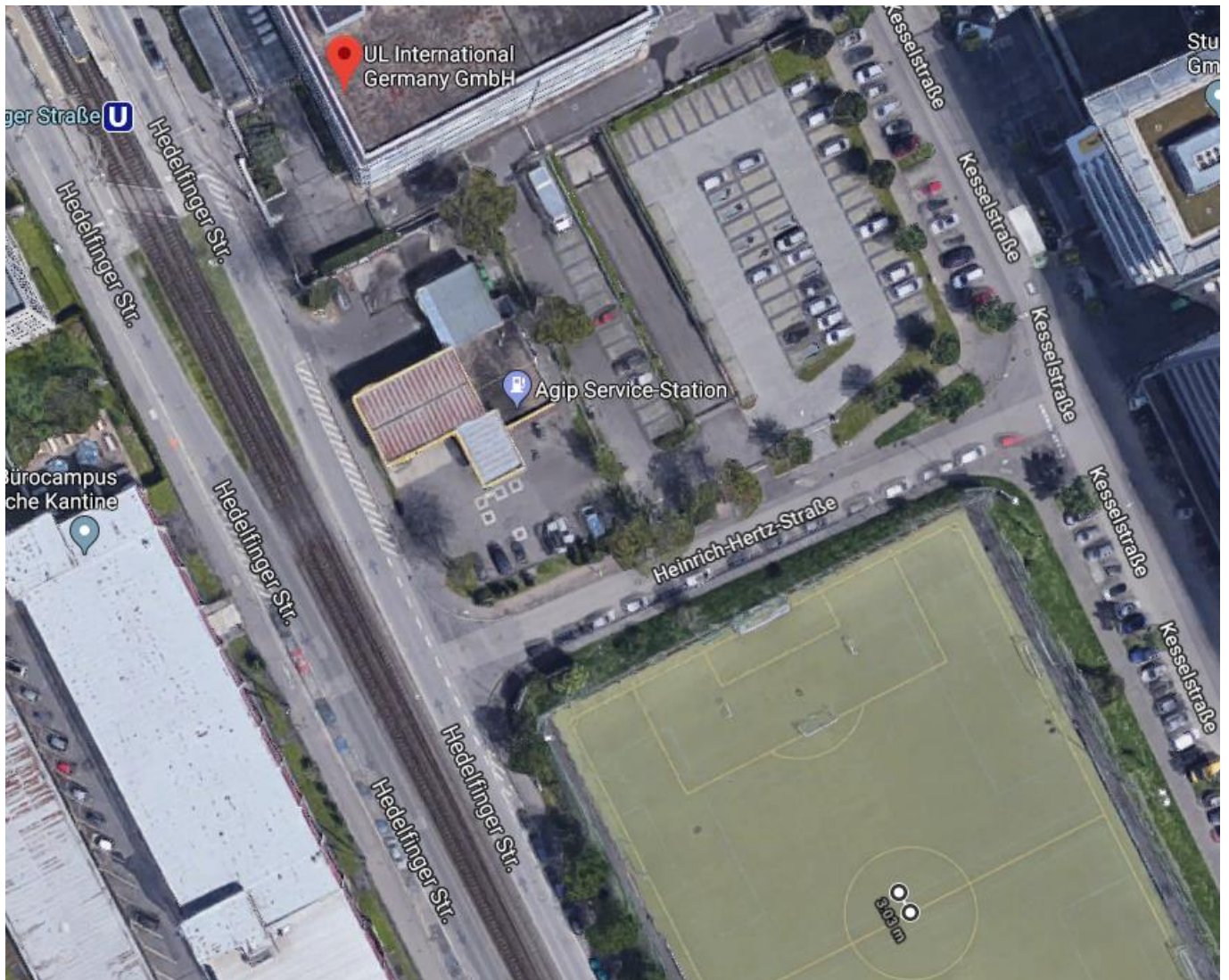
Test site: SR 9

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
625	Schwarzbeck	Antenna, H-field	HFSL 7101	109	lab verification only relative measurements	n/a
637	Rohde & Schwarz	Spectrum Analyser	FSV40	101587	12/07/2023	12
-/-	Testo	Thermo-Hygrometer	608-H1	07	lab verification	n/a
645	Weiss Umwelttechnik	Climatic Chamber	LabEvent T/110/70/3	5822619794 0010	lab verification	n/a
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	lab verification	n/a

8. Open-Area-Test Site comparison

GPS coordinates

Latitude: 48.765746, Longitude: 9.250684



Open-Area-Test Site comparison (continued)

The following listed equipment was used for the measurement:

Manufacturer	Type	Model	Frequency Range
Rohde & Schwarz	Signal generator	SML03	9 kHz – 30 MHz
Rohde & Schwarz	Receiver, EMI Test	ESIB7	20 Hz – 7 GHz
Rohde & Schwarz	Antenna, Loop	HFH2-Z2	1 kHz – 30 MHz
ETS LINDGREN	Antenna, Loop	6512	1 kHz – 30 MHz
HUBER+SUHNER	RF Cable	-/-	-/-
Elspec	BNC Cable	-/-	-/-

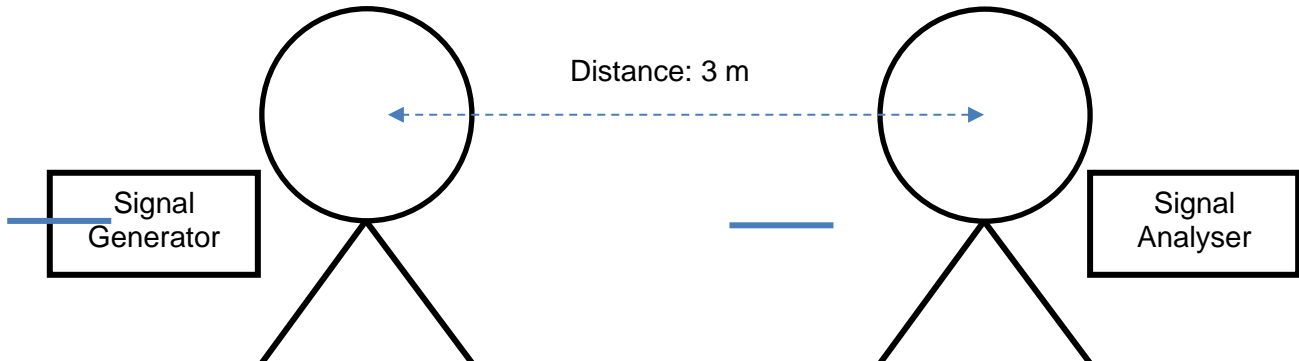
The transmit signal to the ETS Lindgren loop antenna is supplied by the SML signal generator.

The distance of the transmit and receive antenna was 3 m. No other distances can be achieved in SR1 so 10 m and 30 m distances are not possible. Due to this no comparison is possible.

The Results are valid for equipment which is not larger as the loop antenna which represents in the comparison the EUT.

If an EUT is bigger measurements on an OATS are needed.

The measurement was performed on the lowest frequency 9 kHz and was increased by 10 kHz Steps up to 100 kHz. Then the step size was 100 kHz up to 1000 kHz. From 1 MHz up to the last frequency of 30 MHz the step size was 1 MHz. The HFH2-Z2 loop antenna placed at 80 cm height was used as the receive antenna. The intercepted RF signal from this antenna was measured with the ESIB7 Test Receiver and the values were recorded accordingly.



Open-Area-Test Site comparison (continued)

Numeric values:

Frequency (MHz)	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.125	0.20
SR1 Measured power (dBμV)	87.91	87.22	87.01	86.98	86.40	86.32	85.98	85.20	84.30	83.80	82.96	82.55
OATS Measured power (dBμV)	86.22	87.42	87.50	86.49	86.01	85.39	84.32	84.29	84.20	83.10	83.60	82.32
Delta (dB)	-1.69	0.20	0.49	-0.49	-0.39	-0.93	-1.66	-0.91	-0.10	-0.70	0.64	-0.23

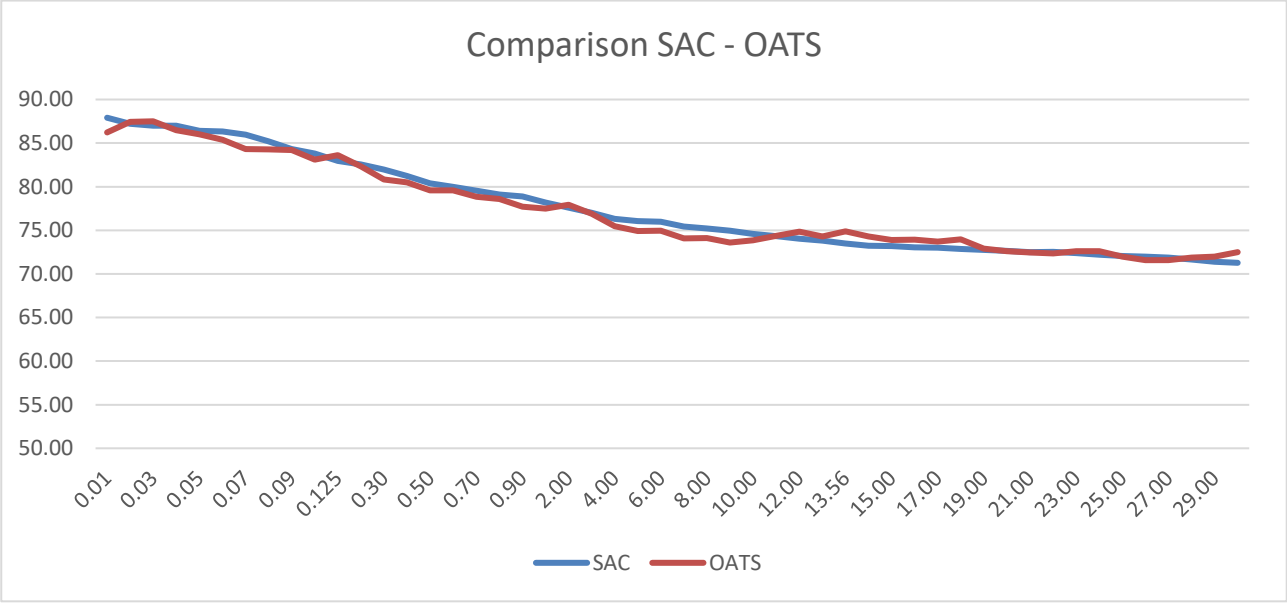
Frequency (MHz)	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	2.00	3.00	4.00	5.00
SR1 Measured power (dBμV)	81.98	81.23	80.39	80.00	79.53	79.10	78.87	78.20	77.60	77.01	76.32	76.04
OATS Measured power (dBμV)	80.84	80.49	79.58	79.58	78.85	78.59	77.69	77.50	77.91	76.90	75.45	74.90
Delta (dB)	-1.14	-0.74	-0.81	-0.42	-0.68	-0.51	-1.18	-0.70	0.31	-0.11	-0.87	-1.14

Frequency (MHz)	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	13.56	14.00	15.00	16.00
SR1 Measured power (dBμV)	75.98	75.43	75.20	74.97	74.59	74.32	74.05	73.83	73.50	73.22	73.20	73.05
OATS Measured power (dBμV)	74.94	74.09	74.11	73.58	73.87	74.38	74.84	74.31	74.88	74.29	73.90	73.93
Delta (dB)	-1.04	-1.34	-1.09	-1.39	-0.72	0.06	0.79	0.48	1.38	1.07	0.70	0.88

Frequency (MHz)	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00	30.00
SR1 Measured power (dBμV)	73.00	72.86	72.74	72.64	72.50	72.52	72.39	72.20	72.04	71.97	71.86	71.64	71.41	71.27
OATS Measured power (dBμV)	73.70	73.98	72.90	72.60	72.45	72.34	72.59	72.59	71.97	71.59	71.58	71.88	71.98	72.49
Delta (dB)	0.70	1.12	0.16	-0.04	-0.05	-0.18	0.20	0.39	-0.07	-0.38	-0.28	0.24	0.57	1.22

Open-Area-Test Site comparison (continued)

Graph



Conclusion: Maximum difference is 1.69 dB @ 9 kHz

9. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	42	-	Initial Version
1.1	17-20	5.2.1	Results table header updated
	25	5.2.3	Results table updated
	29	5.2.4	Results table updated
	30	5.2.4	Notes updated
Test Report Version 1.2 supersede Version 1.1 with immediate effect Test Report No. UL-RPT-RP-14875953-216-FCC Version 1.2, Issue Date 15 MARCH 2024 replaces Test Report No. UL-RPT-RP-14875953-216-FCC Version 1.1, Issue Date 16 JANUARY 2024, which is no longer valid.			
1.2	as below	as below	Current Version
	7	3.2	EUT description updated.

END of Test Report