TEST REPORT

Test Report No.: UL-RPT-RP-14598511-716-FCC

Applicant *	:	Schreder SA
Model No. *	:	Owlet IV MeshNode N
FCC ID *	:	FCC ID: 2AW4F-OW4NMSAM
Technology *	:	RFID 13.56 MHz
Test Standard(s)	:	**FCC Parts 15.207, 15.209(a) & 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 1.0
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: 10 August 2023

Approved by: Rachid Acharkaoui
Title: Operations Manager
Date: 10 August 2023

Deutsche Akkreditierungsstelle D-PL-19381-02-00

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

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STU.CTECHLab@ul.com

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1. Customer Information *

1.1.Applicant Information

Company Name:	Schreder SA
Company Address:	Rue de Lusambo 67, 1190 Brussels - Belgium
Contact Person:	Filipe Vieira de Almeida
Contact E-Mail Address:	falmeida@schreder.com
Contact Phone No.:	+351 914 110 049

1.2.Manufacturer Information

Company Name:	Schreder SA
Company Address:	Rue de Lusambo 67, 1190 Brussels - Belgium
Contact Person:	Laurent Maghe
Contact E-Mail Address:	lmaghe@schreder.com
Contact Phone No.:	+32 4 224 71 65

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:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications): Part 15 Subpart C (Intentional Radiators) - Sections 15.207 and 15.209

Location

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

Date information

Order Date:	29 November 2022
EUT arrived:	08 May 2023
Test Dates:	02 June 2023 to 07 August 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	☒	☐	☐	☐
Part 15.215(c)	Transmitter 20 dB Bandwidth	☒	☐	☐	☐
Part 15.225(a)(b)(c)(d)	Transmitter Fundamental Field Strength & Spectrum Mask (continued)	☒	☐	☐	☐
Part 15.209(a)/ 15.225(d)	Transmitter Radiated Emissions	☒	☐	☐	☐
Part 15.225(e)	Transmitter Frequency Stability (Temperature & Voltage Variation)	☒	☐	☐	☐

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:	Schréder
Model Name or Number:	Owlet IV MeshNode N
Serial Number:	14EFCF011B00005A (Radiated test sample)
Hardware Version Number:	4.0
Firmware Version Number:	4.3.2.1
FCC ID:	FCC ID: 2AW4F-OW4NMSAM

Brand Name:	Schréder
Model Name or Number:	Owlet IV MeshNode N
Serial Number:	14EFCF011B000056 (Radiated test sample with Terminated antenna)
Hardware Version Number:	4.0
Firmware Version Number:	4.3.2.1
FCC ID:	FCC ID: 2AW4F-OW4NMSAM

3.2. Description of EUT *

The equipment under test was a Luminaire controller with 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	
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	Laptop PC with Test Software: Tera Term STM32 Cube programmer	HP	ProBook 650	5CG614419V

B. . Support Equipment (Manufacturer supplied) *

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Programming JIG	Schréder	Prog JIG Meshnode - V2	-/-
2	Socket	-/-	-/-	-/-
3	USB – UART cable	-/-	-/-	-/-

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 customer supplied document containing the setup instructions "UL_OWLET_IV_HW_Instruction'' issued 09-05-2023 was used for configuration.

EUT Power supply:

- The EUT is powered via the 120VAC / 60 Hz AC mains supply.

Test Mode Activations:

- The EUT can be connected to the laptop via USB-UART cable through the JIG programmer.
- The JIG programmer was mounted on the EUT for configuration and was removed during the testing.
- The ''STM32 cube programmer'' was used to upload the firmware file into the EUT. The commands to activate RFID mode was then given through the terminal tool ''Tera term''.

AC Conducted Emissions Measurements:

- For AC conducted line emissions measurement the EUT was powered with 120VAC / 60 Hz and also 240 VAC / 60 Hz 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 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 Laying-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:	Muhammad Faiq Khan	**Test Date:**	02 June & 25 July 2023
Test Sample Serial Number:	14EFCF011B000056 (Radiated test sample with Terminated antenna)		
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):	23.1 &23.7
Relative Humidity (%):	44 & 62

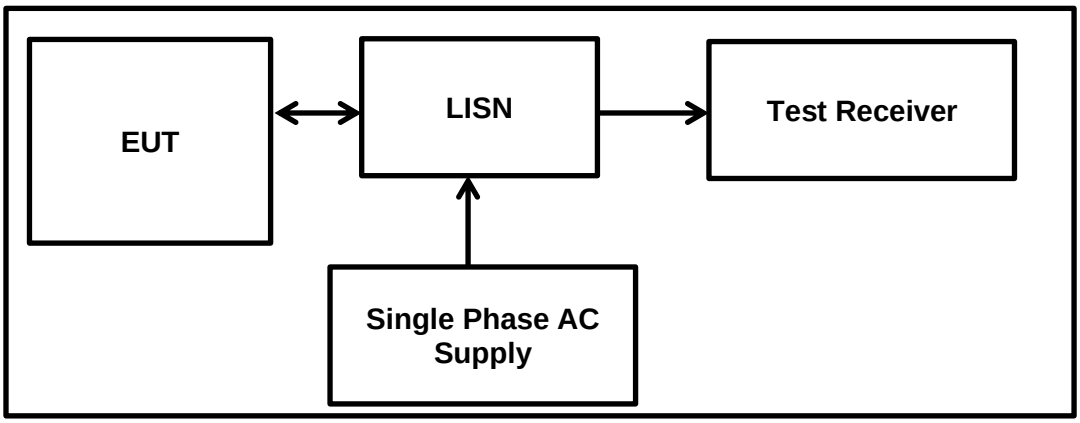
Settings of the Instrument

Detector	Quasi Peak/ Average

Note(s):

1. The EUT was powered with 120VAC / 60 Hz and also 240 VAC / 60 Hz 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. 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.
4. The final measured value, for the given emission, in the table below incorporates the cable loss.
5. 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.
6. Measurements were performed in shielded room (SR7/ 8 Asset Number 1603671). The EUT was placed at a height of 80 cm above the reference ground plane and in a distance of 40 cm from the vertical ground plane at the edge of the table.
7. Measurement software used: Toyo EMI Software; CE measurement software EP5/CE Ver 4.0.1.

Test Setup:



Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17898	Live	40.60	64.50	23.90	Complied
0.22421	Live	40.00	62.70	22.70	Complied
0.30579	Live	31.60	60.10	28.50	Complied
3.19729	Live	49.30	56.00	6.70	Complied
13.56088	Live	99.20	60.00	-39.20	Carrier
13.99604	Live	50.50	60.00	9.50	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17898	Live	28.30	54.50	26.20	Complied
0.22421	Live	26.80	52.70	25.90	Complied
0.30579	Live	18.30	50.10	31.80	Complied
3.19729	Live	32.40	46.00	13.60	Complied
13.56088	Live	96.80	50.00	-46.80	Carrier
13.99604	Live	31.70	50.00	18.30	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18303	Neutral	35.30	64.30	29.00	Complied
0.24249	Neutral	39.60	62.00	22.40	Complied
0.28138	Neutral	31.90	60.80	28.90	Complied
3.22038	Neutral	47.30	56.00	8.70	Complied
13.29263	Neutral	58.90	60.00	1.10	Complied
13.56118	Neutral	98.60	60.00	-38.60	Carrier
17.06632	Neutral	31.00	60.00	29.00	Complied
27.12123	Neutral	34.90	60.00	25.10	Complied

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode

Results: Neutral / Average / 120 VAC 60 Hz

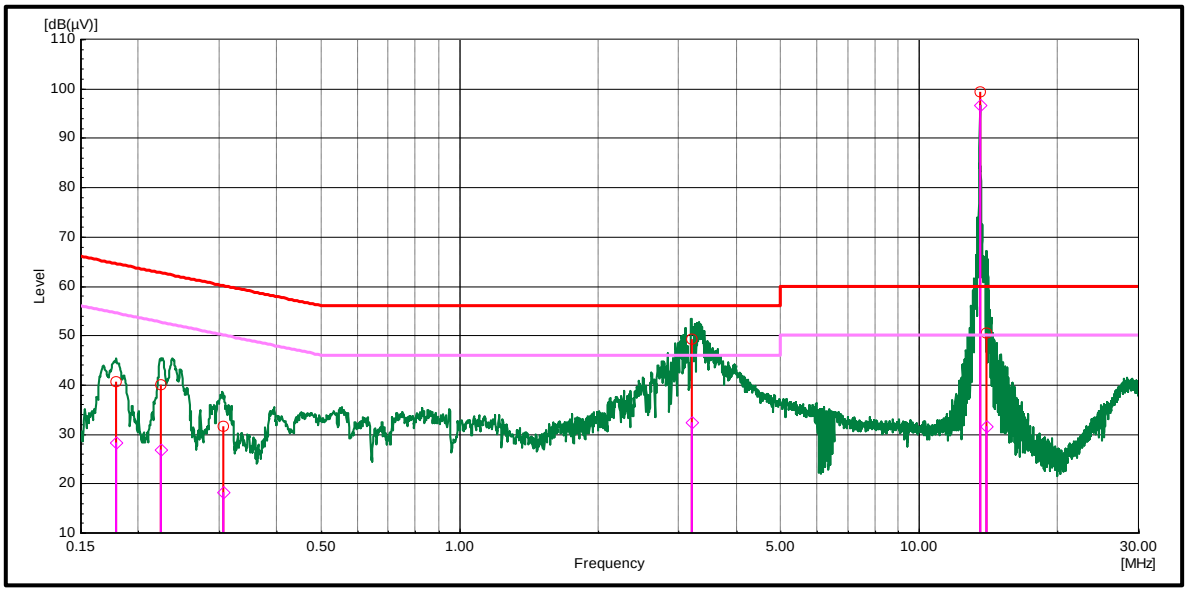
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18303	Neutral	26.50	54.30	27.80	Complied
0.24249	Neutral	30.30	52.00	21.70	Complied
0.28138	Neutral	18.80	50.80	32.00	Complied
3.22038	Neutral	26.60	46.00	19.40	Complied
13.29263	Neutral	41.30	50.00	8.70	Complied
13.56118	Neutral	97.00	50.00	-47.00	Carrier
17.06632	Neutral	15.90	50.00	34.10	Complied
27.12123	Neutral	26.80	50.00	23.20	Complied

Result: Pass

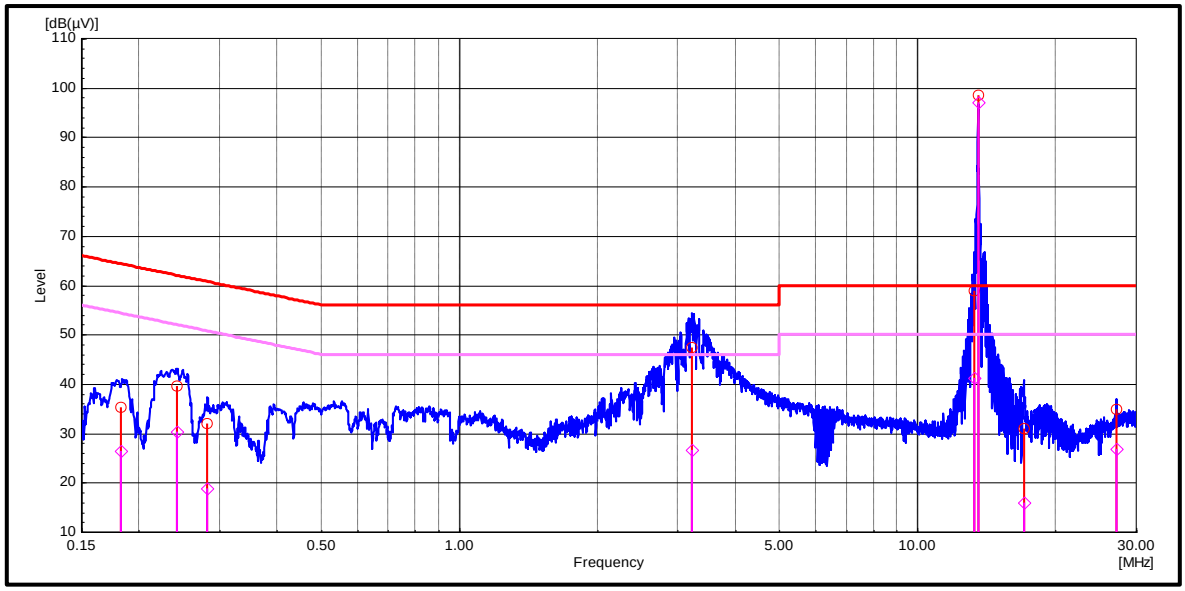
Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode

Plot: Live / 120 VAC 60 Hz



Plot: Neutral / 120 VAC 60 Hz



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables. The peaks at 13.56 MHz are the fundamental frequency of the tested technology

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode

Results: Live / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.23139	Live	38.60	62.40	23.80	Complied
3.28359	Live	49.70	56.00	6.30	Complied
13.56027	Live	99.00	60.00	-39.00	Carrier
13.98222	Live	50.00	60.00	10.00	Complied
27.12236	Live	30.80	60.00	29.20	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.23139	Live	26.80	52.40	25.60	Complied
3.28359	Live	32.40	46.00	13.60	Complied
13.56027	Live	93.50	50.00	-43.50	Carrier
13.98222	Live	29.20	50.00	20.80	Complied
27.12236	Live	22.00	50.00	28.00	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.19301	Neutral	35.60	63.90	28.30	Complied
0.30681	Neutral	40.00	60.10	20.10	Complied
3.25381	Neutral	50.70	56.00	5.30	Complied
13.56058	Neutral	98.50	60.00	-38.50	Carrier
14.00717	Neutral	51.40	60.00	8.60	Complied
17.05201	Neutral	29.90	60.00	30.10	Complied
17.97629	Neutral	32.90	60.00	27.10	Complied
27.12053	Neutral	34.10	60.00	25.90	Complied

.

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode

Results: Neutral / Average / 240 VAC 60 Hz

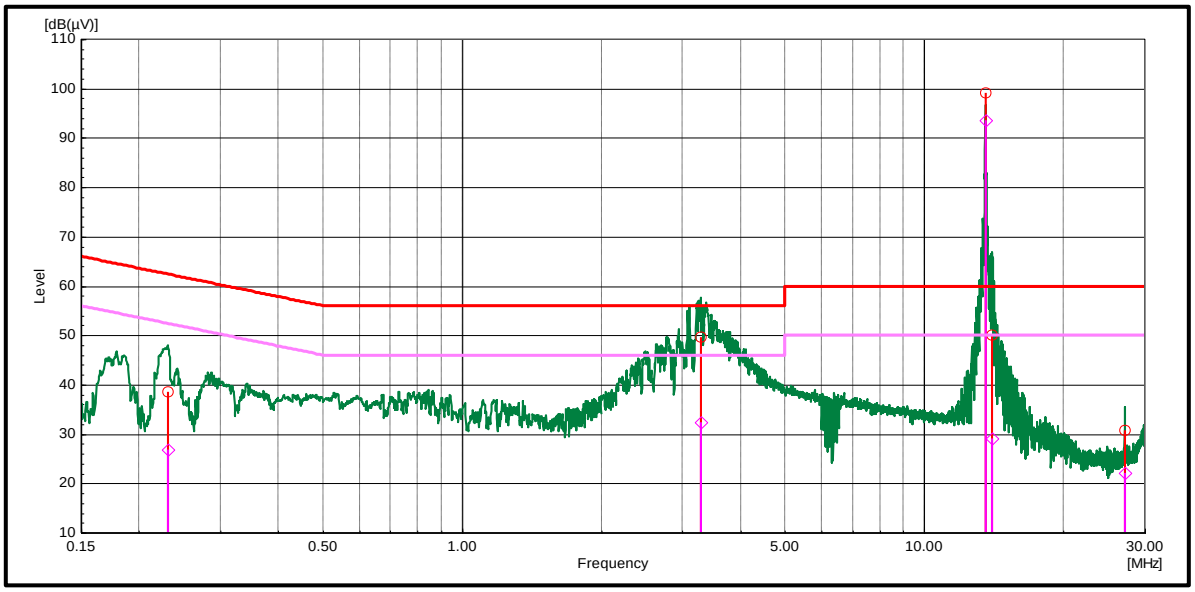
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.19301	Neutral	22.90	53.90	31.00	Complied
0.30681	Neutral	27.50	50.10	22.60	Complied
3.25381	Neutral	33.70	46.00	12.30	Complied
13.56058	Neutral	93.00	50.00	-43.00	Carrier
14.00717	Neutral	33.70	50.00	16.30	Complied
17.05201	Neutral	17.40	50.00	32.60	Complied
17.97629	Neutral	16.80	50.00	33.20	Complied
27.12053	Neutral	23.50	50.00	26.50	Complied

Result: Pass

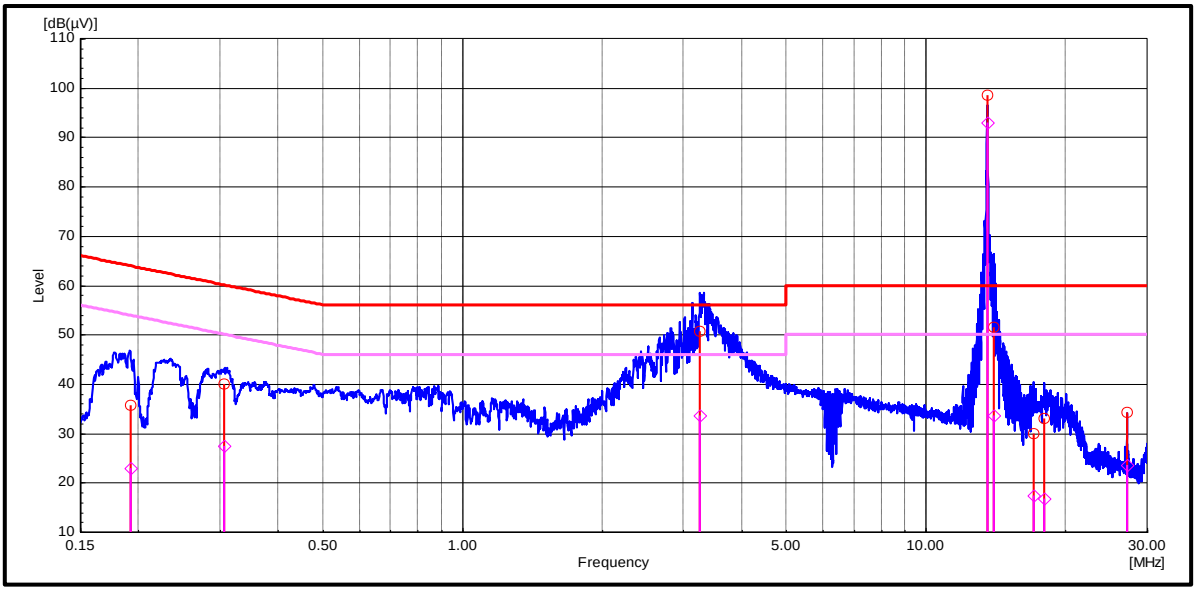
Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode

Plot: Live / 240 VAC 60 Hz



Plot: Neutral / 240 VAC 60 Hz



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables. The peaks at 13.56 MHz are the fundamental frequency of the tested technology

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode / Antenna Terminated

Results: Live / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17981	Live	40.50	64.50	24.00	Complied
0.24277	Live	37.80	62.00	24.20	Complied
0.30522	Live	28.70	60.10	31.40	Complied
3.1482	Live	40.30	56.00	15.70	Complied
3.38972	Live	44.40	56.00	11.60	Complied
3.511	Live	45.70	56.00	10.30	Complied
8.46876	Live	22.60	60.00	37.40	Complied
19.36447	Live	26.90	60.00	33.10	Complied
20.02074	Live	27.10	60.00	32.90	Complied

Results: Live / Average / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17981	Live	29.70	54.50	24.80	Complied
0.24277	Live	30.00	52.00	22.00	Complied
0.30522	Live	24.10	50.10	26.00	Complied
3.1482	Live	27.10	46.00	18.90	Complied
3.38972	Live	29.10	46.00	16.90	Complied
3.511	Live	31.70	46.00	14.30	Complied
8.46876	Live	17.90	50.00	32.10	Complied
19.36447	Live	17.40	50.00	32.60	Complied
20.02074	Live	17.60	50.00	32.40	Complied

Results: Neutral / Quasi Peak / 120 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18254	Neutral	40.30	64.40	24.10	Complied
0.24216	Neutral	37.40	62.00	24.60	Complied
0.30272	Neutral	30.20	60.20	30.00	Complied
3.3902	Neutral	44.70	56.00	11.30	Complied
3.50936	Neutral	46.30	56.00	9.70	Complied
19.48579	Neutral	31.30	60.00	28.70	Complied
20.02676	Neutral	31.60	60.00	28.40	Complied
20.21349	Neutral	31.40	60.00	28.60	Complied
20.80976	Neutral	30.60	60.00	29.40	Complied

.

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode / Antenna Terminated

Results: Neutral / Average / 120 VAC 60 Hz

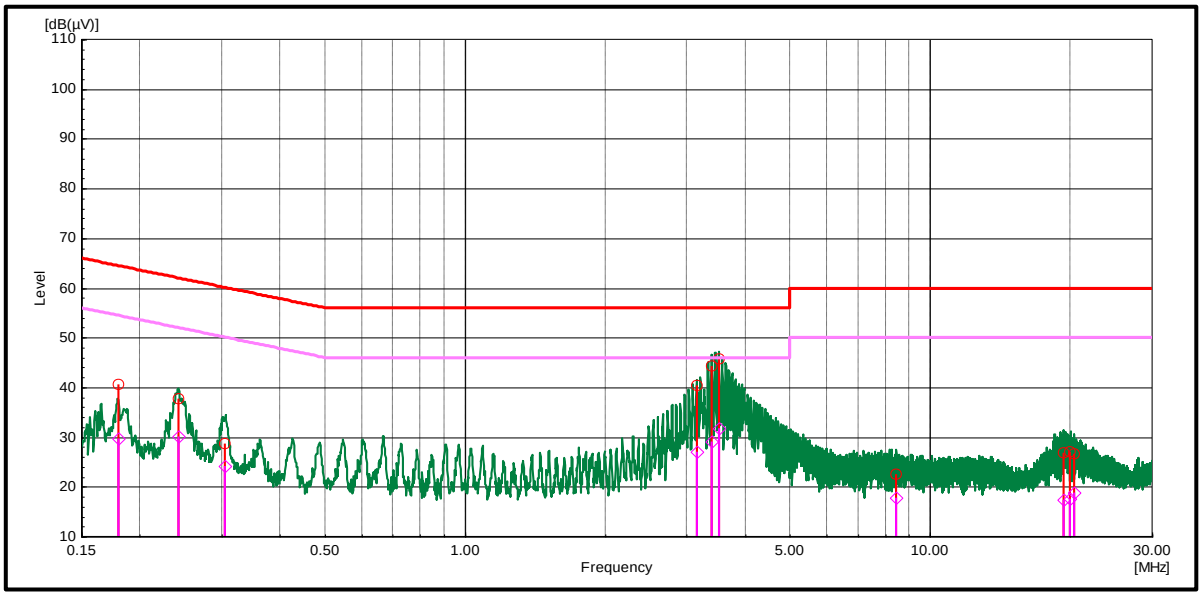
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18254	Neutral	32.60	54.4	21.80	Complied
0.24216	Neutral	33.70	52.00	18.30	Complied
0.30272	Neutral	26.50	50.2	23.70	Complied
3.3902	Neutral	29.60	46.00	16.40	Complied
3.50936	Neutral	32.20	46.00	13.80	Complied
19.48579	Neutral	19.10	50.00	30.90	Complied
20.02676	Neutral	20.60	50.00	29.40	Complied
20.21349	Neutral	20.40	50.00	29.60	Complied
20.80976	Neutral	21.20	50.00	28.80	Complied

Result: Pass

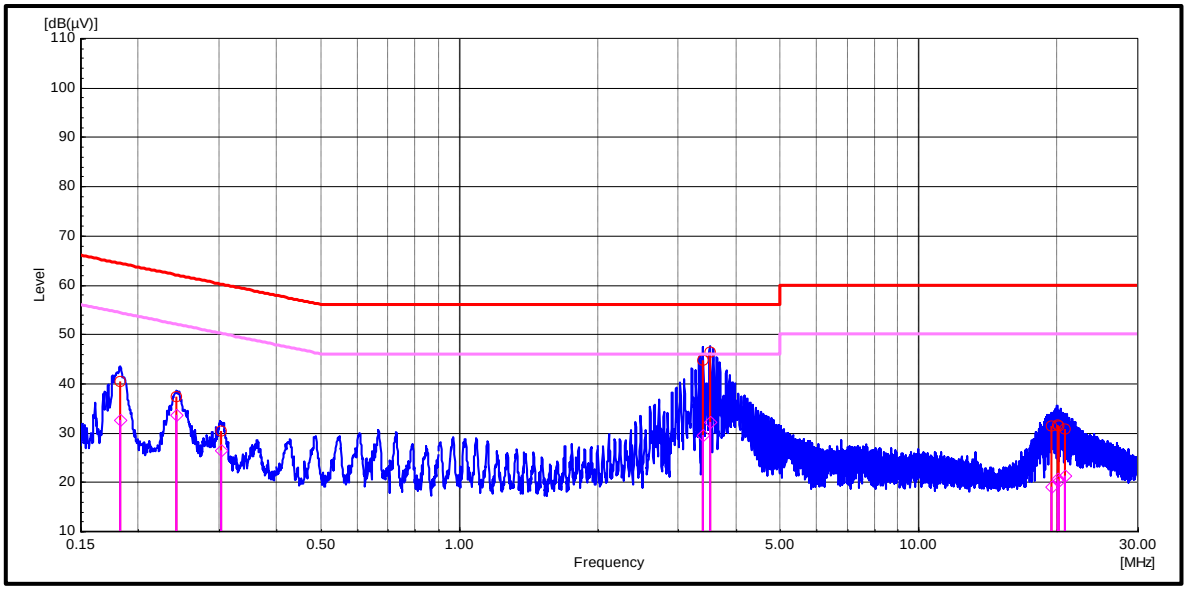
Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode / Antenna Terminated

Plot: Live / 120 VAC 60 Hz



Plot: Neutral / 120 VAC 60 Hz



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

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode / Antenna Terminated

Results: Live / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17644	Live	35.60	64.70	29.10	Complied
0.87654	Live	26.20	56.00	29.80	Complied
2.76162	Live	39.20	56.00	16.80	Complied
3.17689	Live	42.00	56.00	14.00	Complied
3.48663	Live	47.60	56.00	8.40	Complied
6.90567	Live	34.40	60.00	25.60	Complied
15.41758	Live	23.60	60.00	36.40	Complied
19.46475	Live	29.20	60.00	30.80	Complied

Results: Live / Average / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.17644	Live	25.70	54.70	29.00	Complied
0.87654	Live	16.70	46.00	29.30	Complied
2.76162	Live	25.80	46.00	20.20	Complied
3.17689	Live	28.50	46.00	17.50	Complied
3.48663	Live	30.60	46.00	15.40	Complied
6.90567	Live	22.70	50.00	27.30	Complied
15.41758	Live	13.60	50.00	36.40	Complied
19.46475	Live	16.30	50.00	33.70	Complied

Results: Neutral / Quasi Peak / 240 VAC 60 Hz

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18948	Neutral	37.00	64.10	27.10	Complied
1.09755	Neutral	28.70	56.00	27.30	Complied
2.46547	Neutral	37.90	56.00	18.10	Complied
2.77012	Neutral	39.10	56.00	16.90	Complied
3.48748	Neutral	47.80	56.00	8.20	Complied
6.52957	Neutral	34.50	60.00	25.50	Complied
15.67479	Neutral	24.00	60.00	36.00	Complied
18.93978	Neutral	32.20	60.00	27.80	Complied

.

Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode / Antenna Terminated

Results: Neutral / Average / 240 VAC 60 Hz

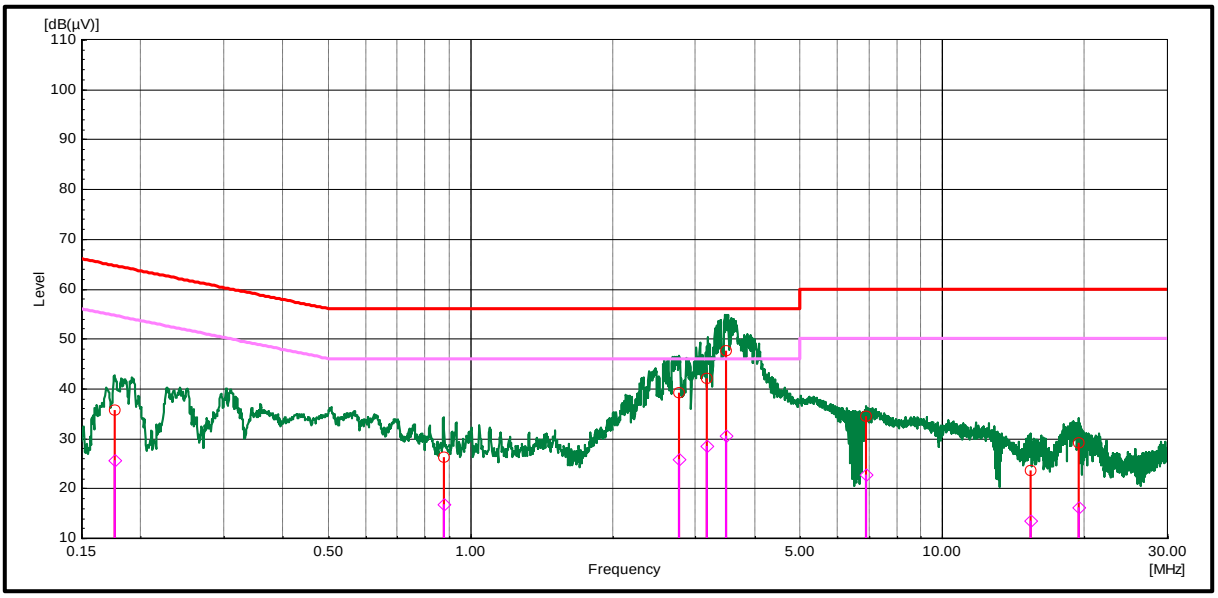
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18948	Neutral	27.10	54.10	27.00	Complied
1.09755	Neutral	15.70	46.00	30.30	Complied
2.46547	Neutral	26.00	46.00	20.00	Complied
2.77012	Neutral	26.00	46.00	20.00	Complied
3.48748	Neutral	30.50	46.00	15.50	Complied
6.52957	Neutral	32.80	50.00	17.20	Complied
15.67479	Neutral	12.50	50.00	37.50	Complied
18.93978	Neutral	15.30	50.00	34.70	Complied

Result: Pass

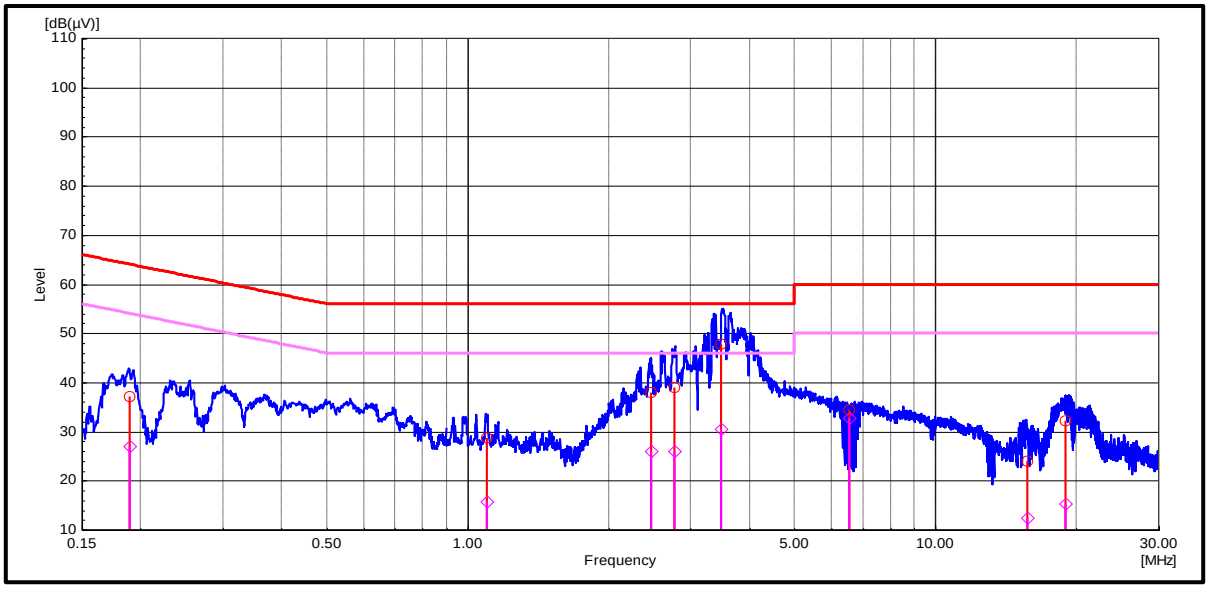
Transmitter AC Conducted Spurious Emissions (continued)

Results: RFID Active mode / Antenna Terminated

Plot: Live / 240 VAC 60 Hz



Plot: Neutral / 240 VAC 60 Hz



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:	Muhammad Faiq Khan	**Test Dates:**	07 August 2023
Test Sample Serial Number:	14EFCF011B000064 (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):	22.5
Relative Humidity (%):	45.1

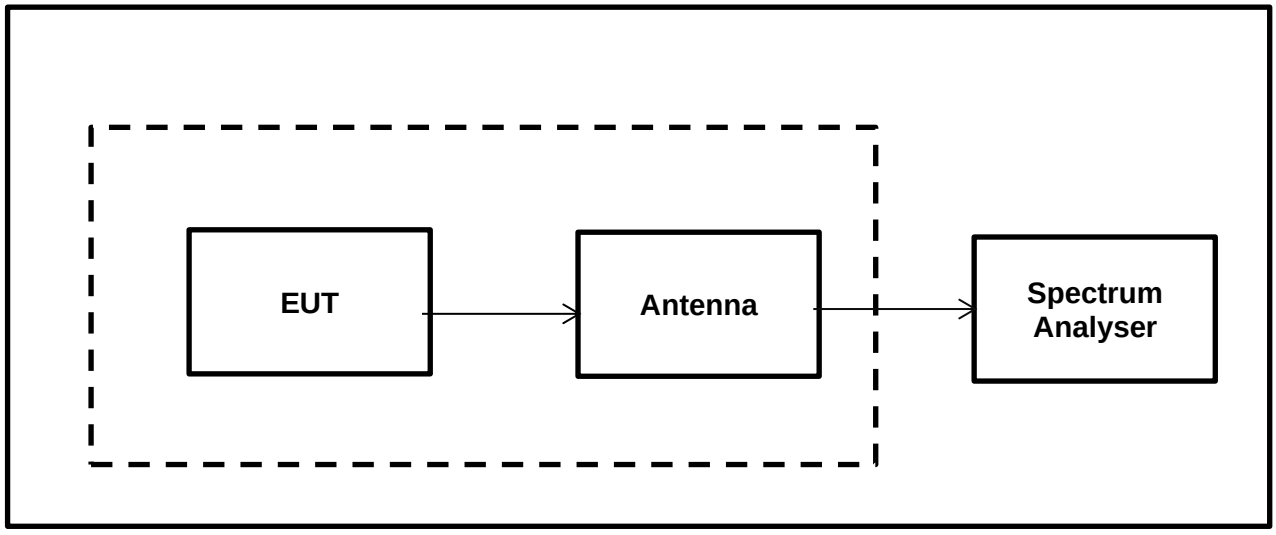
Settings of the Instrument:

RBW/VBW	5 kHz / 20 kHz
Span	450 kHz
Sweep time	Auto
Detector	MaxPeak

Notes:

The measurement was performed by setting the RBW to 5 kHz and the VBW to 20 kHz. The span was set to 450 kHz and Peak detector was set on Max hold. Markers were placed 20 dB below the peak level and the difference measured.

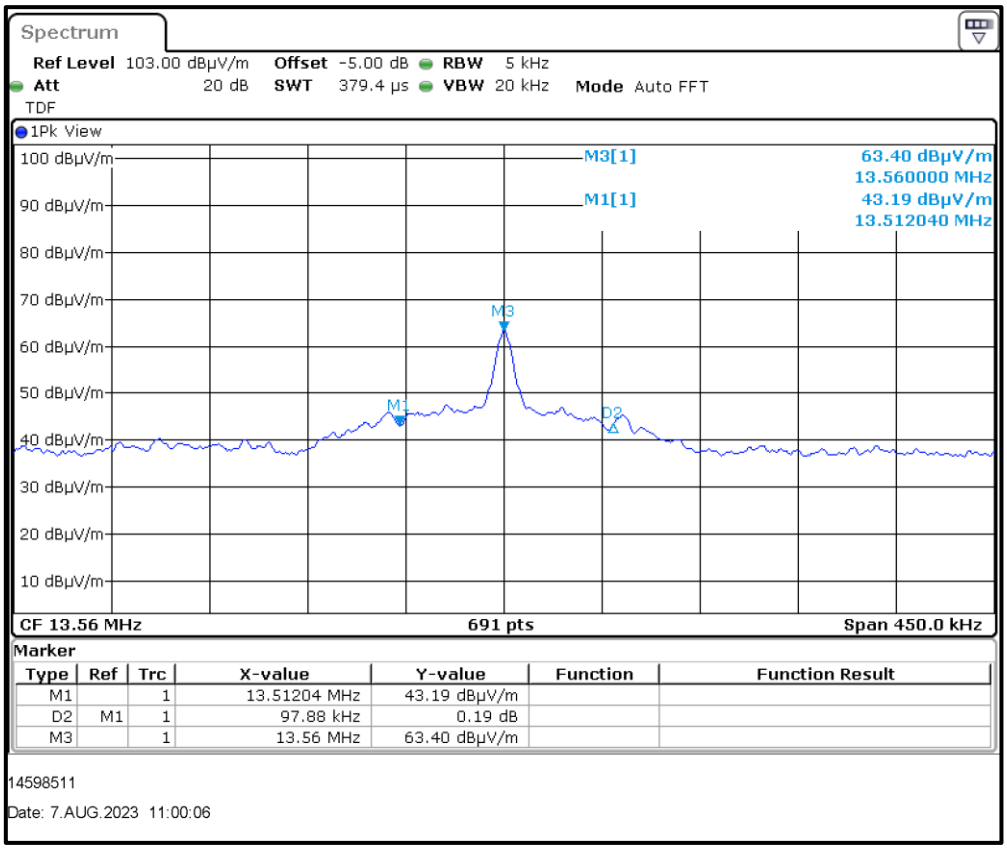
Test Setup:



Transmitter 20 dB Bandwidth (continued)

Results: RFID 13.56 MHz

RFID Channel	20 dB Bandwidth (kHz)
13.56 MHz	97.88



RFID 13.56 MHz

Result: Pass

5.2.3. Transmitter Fundamental Field Strength & Spectrum Mask

Test Summary:

Test Engineer:	Abbas Al-Hussainy	**Test Date:**	02 June 2023
Test Sample Serial Number:	14EFCF011B000064 (Radiated test sample)		
Test Site Identification	SR 1/2		

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

Environmental Conditions:

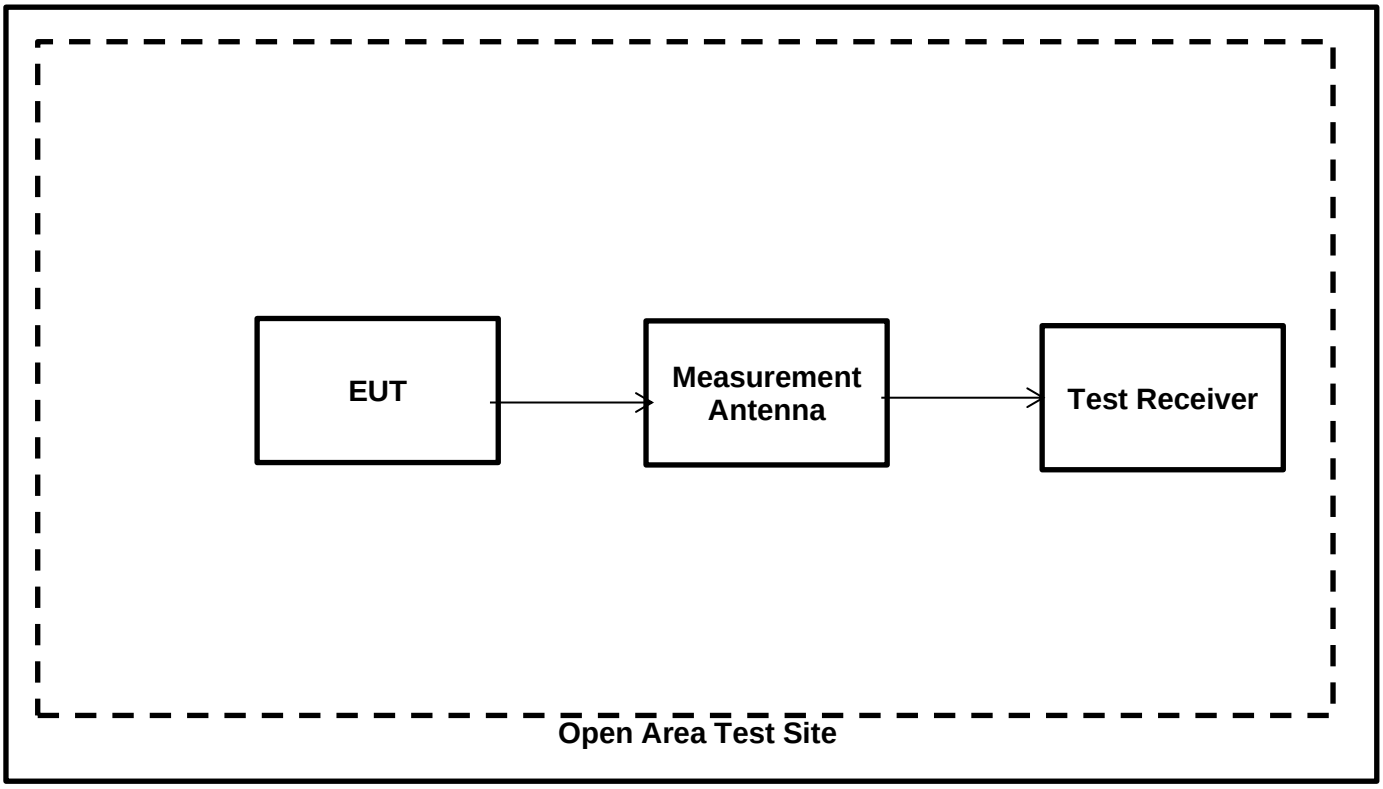
Temperature (°C):	25.9
Relative Humidity (%):	41.4

Note(s):

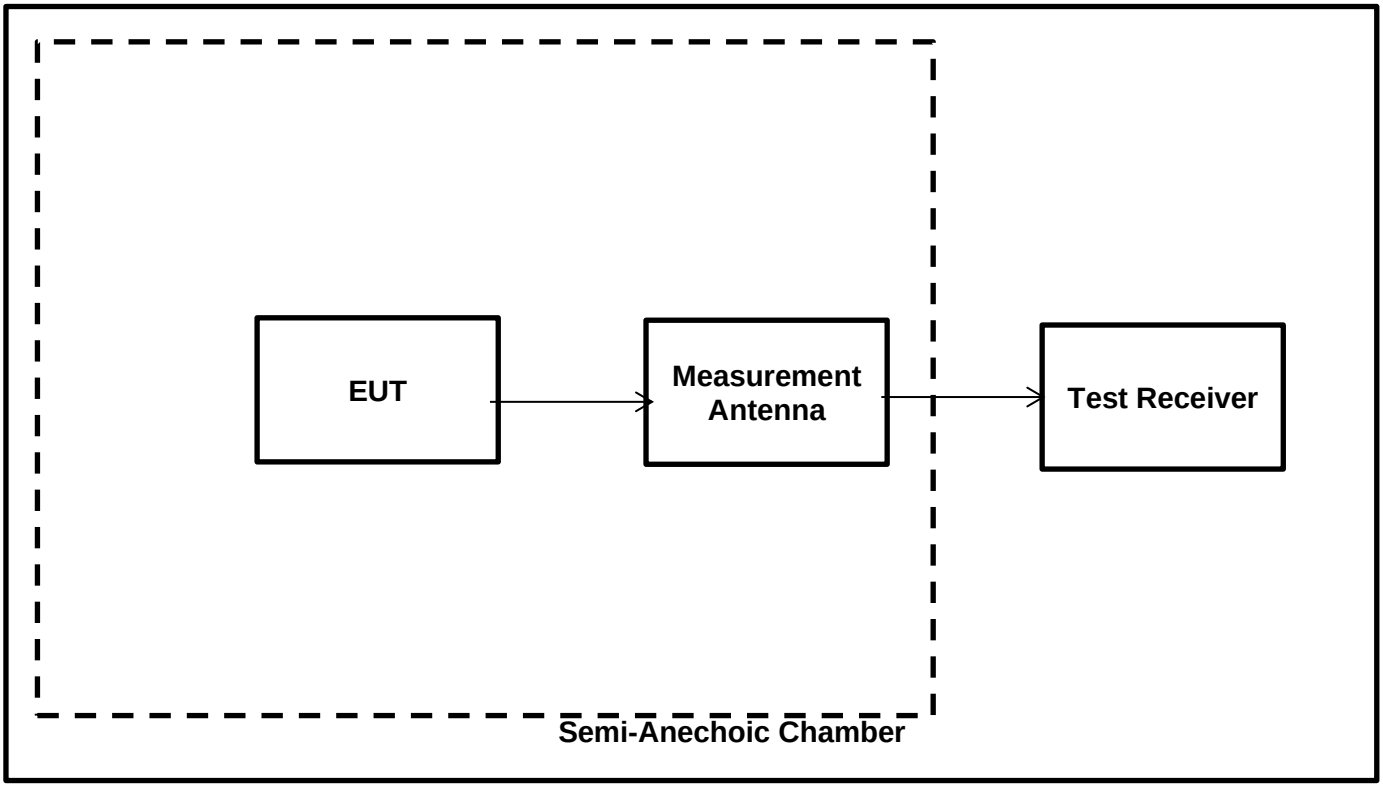
1. The limit is specified at a test distance of 30 metres. However, as specified by FCC Section 15.31 (f)(2), measurements may be performed at a closer distance and the measured level corrected to the specified measurement distance by using the square of an inverse linear distance extrapolation factor (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



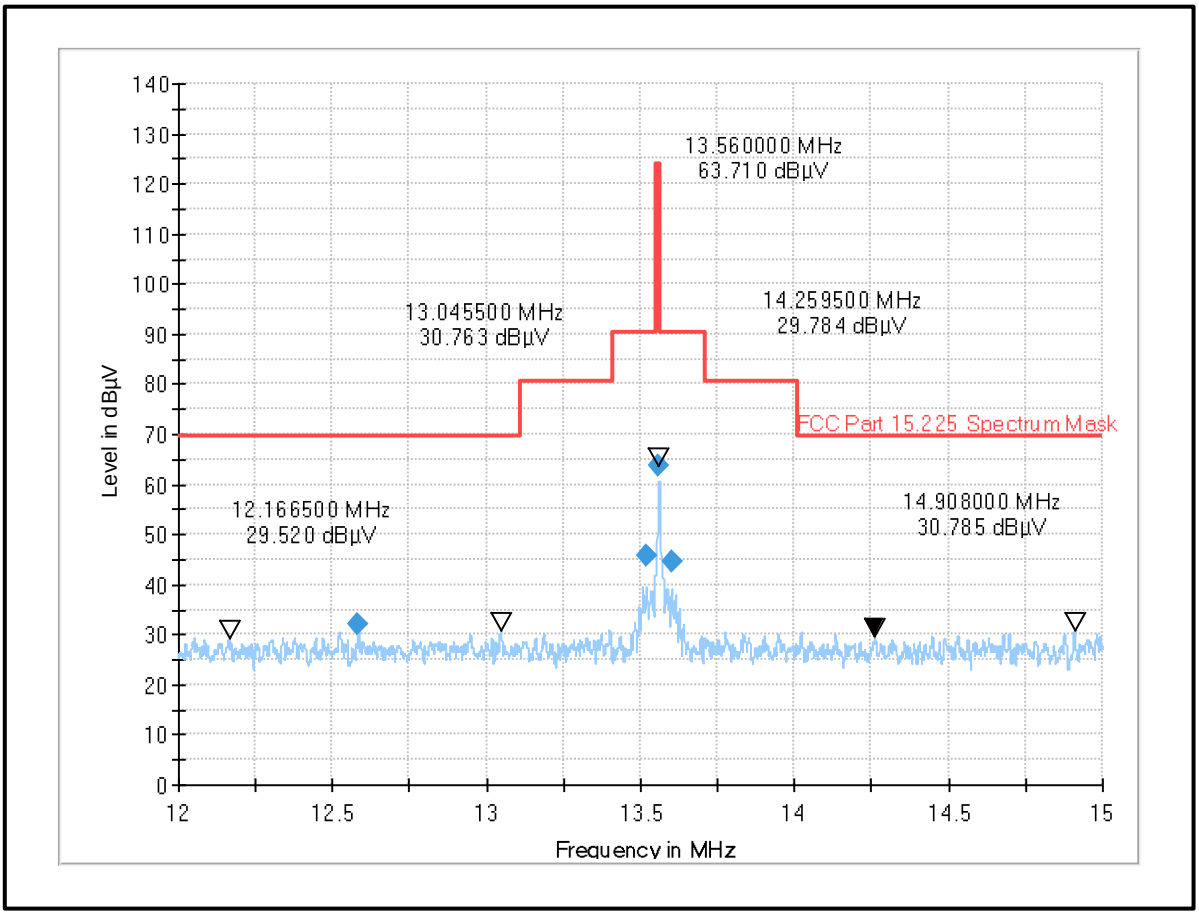
Semi Anechoic Chamber



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 (dBµV/m) Note 3	Deviation from OATS to SAC) (dB)	Deviation Corrected Level at 3 m (dBµV/m)	Limit at 3 m (dBµV/m) Note 3	Margin (dB)	Result
12.000 to 13.110	12.95	90° to EUT	32.18	0.48	32.66	69.50	36.84	Complied
13.110 to 13.410	All emissions were found to be below system noise floor							Complied
13.410 to 13.553	13.52	0° to EUT	45.77	1.38	47.15	90.50	43.35	Complied
13.553 to 13.567	13.56	0° to EUT	63.71	1.38	65.09	124.00	58.91	Complied
	13.60	0° to EUT	44.62	1.38	46.00	90.50	44.50	Complied
13.567 to 13.710	All emissions were found to be below system noise floor							Complied
13.710 to 14.010	All emissions were found to be below system noise floor							Complied
14.010 to 15.000	All emissions were found to be below system noise floor							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:	Muhammad Faiq Khan	**Test Date:**	02 June 2023
Test Sample Serial Number:	14EFCF011B000064 (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

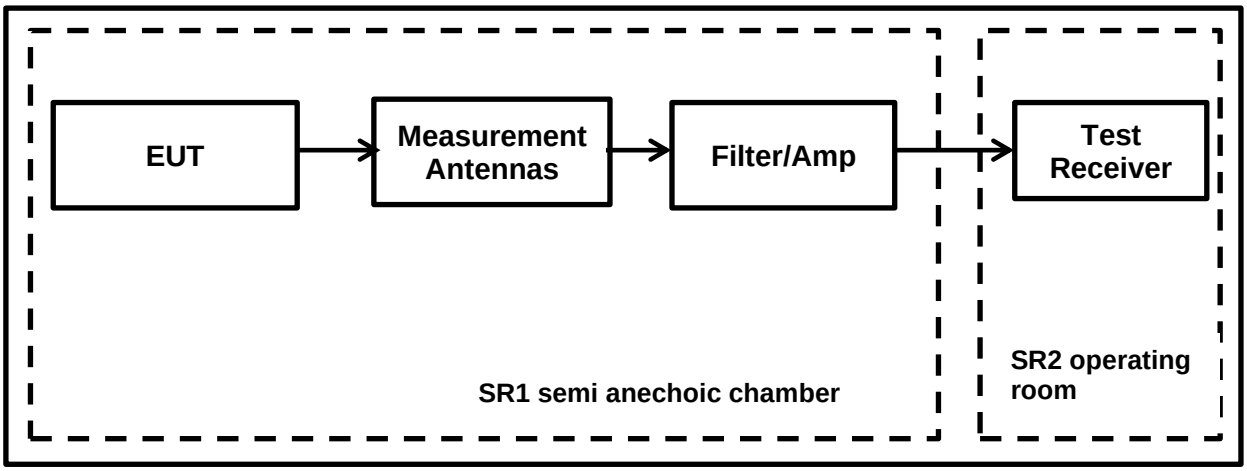
Environmental Conditions:

Temperature (°C):	25.9
Relative Humidity (%):	41.4

Note(s):

1. 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.
2. 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.
3. 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.
4. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
5. 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.
6. 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
7. 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.

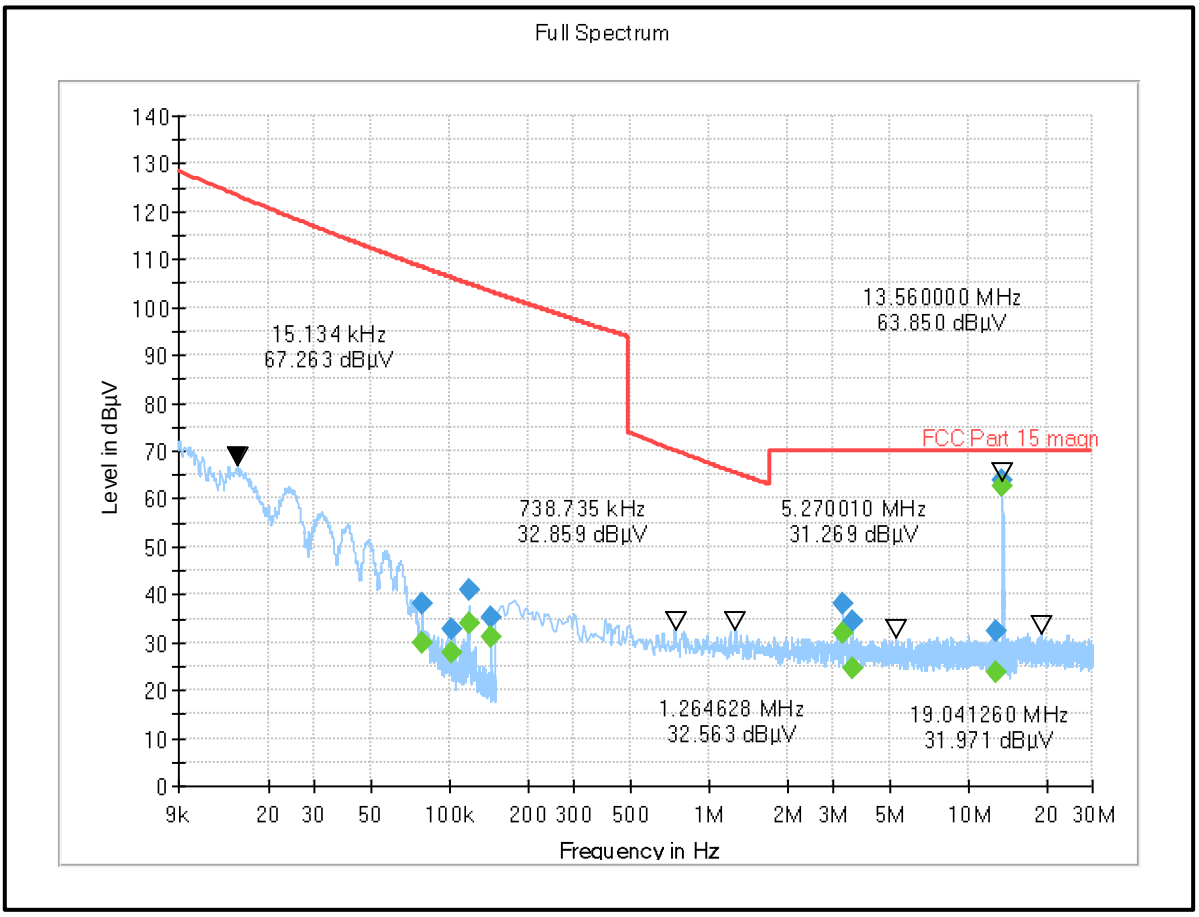
Transmitter Radiated Spurious Emission test setup
Test Setup:



Transmitter Radiated Emissions (continued)

Results: AC Power supply / RFID 13.56 MHz

Frequency (MHz)	Loop Antenna Orientation	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
0.078161	90° to EUT	37.89	108.39	70.50	Complied
0.101990	90° to EUT	32.62	106.14	73.52	Complied
0.118557	0° to EUT	40.92	104.89	63.97	Complied
0.145065	0° to EUT	35.38	103.24	67.86	Complied
3.259050	90° to EUT	38.16	70.00	31.84	Complied
3.586493	90° to EUT	34.41	70.00	35.59	Complied
12.698930	0° to EUT	32.29	70.00	37.71	Complied



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Abbas Al-Hussainy	**Test Date:**	02 June 2023
Test Sample Serial Number:	14EFCF011B000064 (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

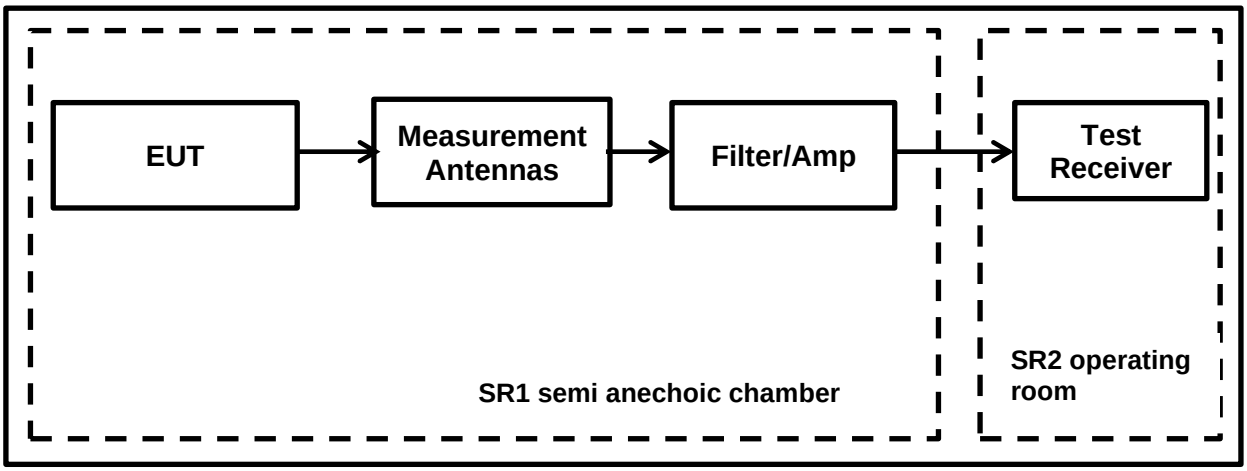
Environmental Conditions:

Temperature (°C):	26.0
Relative Humidity (%):	40.8

Note(s):

1. All emissions shown on the pre-scan plot were investigated and found to be ambient or >20 dB below the appropriate limit or below the measurement system noise floor.
2. 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.
3. 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.

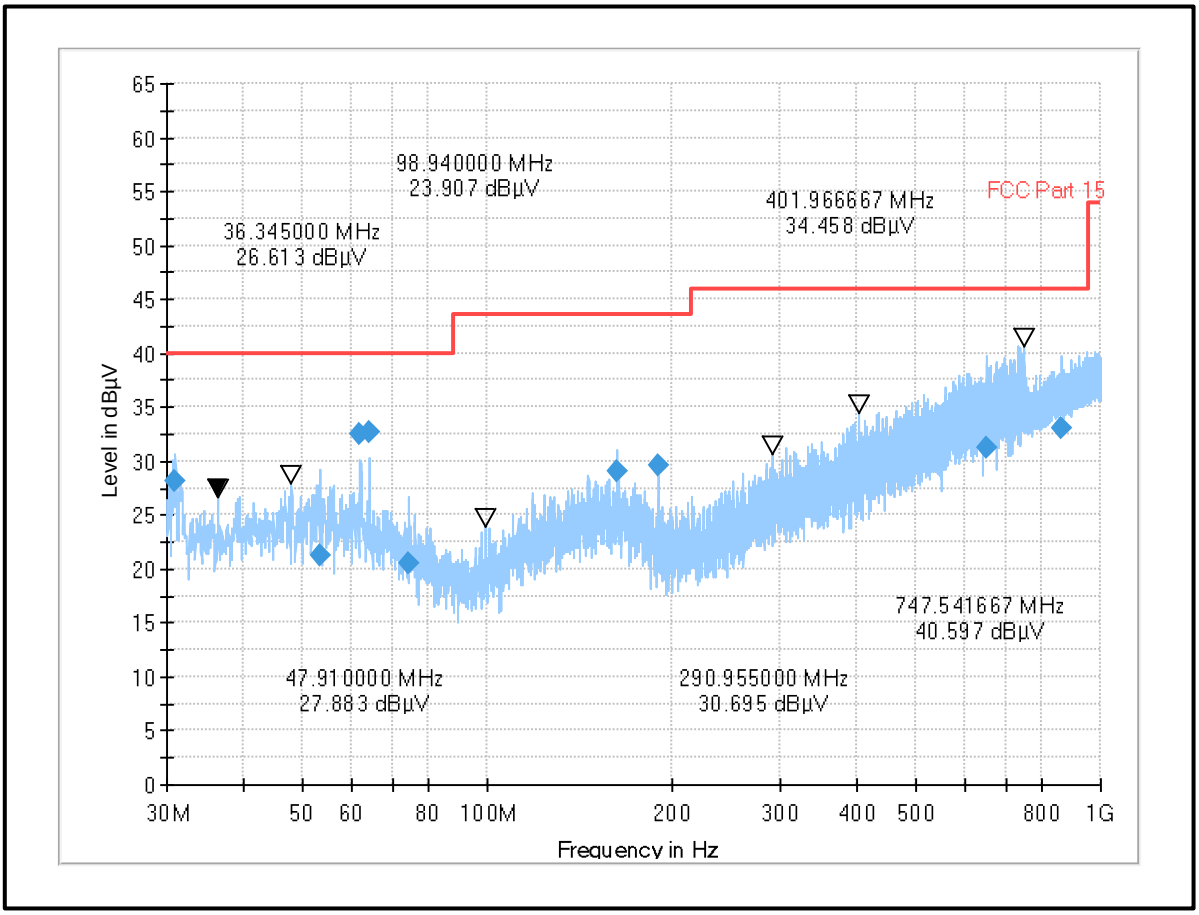
Test Setup:



Transmitter Radiated Emissions (continued)

Results: AC Power supply / RFID 13.56 MHz

Frequency (MHz)	Antenna Polarization	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
30.945000	Vertical	28.05	40.00	11.95	Complied
53.490000	Vertical	21.29	40.00	18.71	Complied
62.040000	Vertical	32.45	40.00	7.55	Complied
64.200000	Vertical	32.76	40.00	7.24	Complied
74.505000	Vertical	20.54	40.00	19.46	Complied
162.750000	Vertical	29.14	43.50	14.36	Complied
189.840000	Vertical	29.66	43.50	13.84	Complied
653.166667	Horizontal	31.29	46.00	14.71	Complied
863.375000	Horizontal	33.05	46.00	12.95	Complied



Result: Pass

UL-RPT-RP-1459851 1-316-FCC.docx

5.2.5. Transmitter Frequency Stability (Temperature & Voltage Variation)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Dates:**	26 June 2023 & 27 June 2023
Test Sample Serial Number:	14EFCF011B000064 (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):	23.5 to 24.5
Ambient Relative Humidity (%):	45.4 to 48.6

Settings of the Instrument

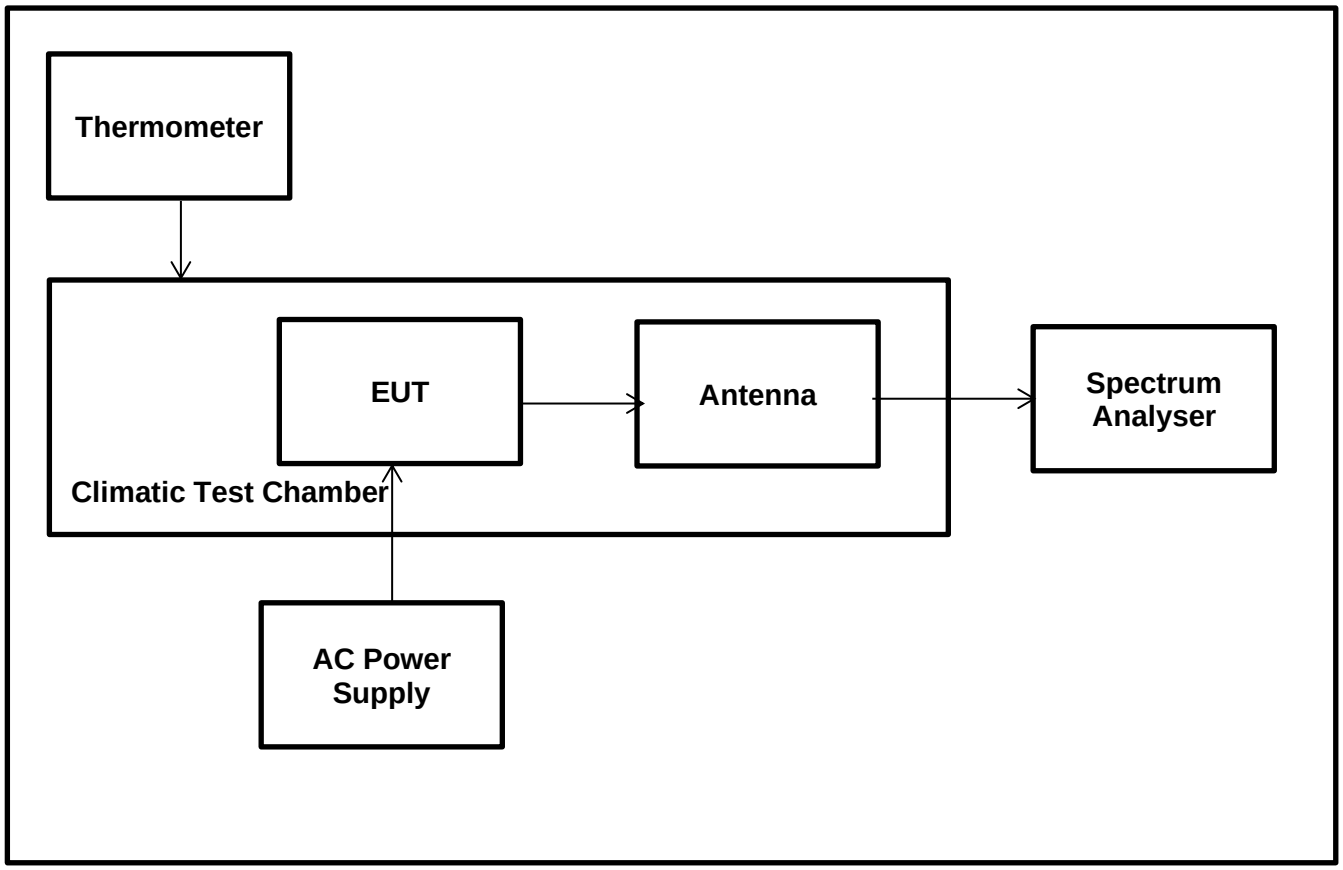
RBW/VBW	30 Hz/30 kHz
Span	4 kHz
Sweep Time	Auto
Sweep Mode	Single Sweep
Detector	Peak
Marker Function	Signal Count

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 ±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	13.560347096	0.002559705	25.60	± 0.01	± 100	Complied
	at 2 minutes	13.560378252	0.002789469	27.89	± 0.01	± 100	Complied
	at 5 minutes	13.560381390	0.002812611	28.13	± 0.01	± 100	Complied
	at 10 minutes	13.560382504	0.002820826	28.21	± 0.01	± 100	Complied
-10	at 0 minutes	13.560363361	0.002679653	26.80	± 0.01	± 100	Complied
	at 2 minutes	13.560386146	0.002847684	28.48	± 0.01	± 100	Complied
	at 5 minutes	13.560388530	0.002865265	28.65	± 0.01	± 100	Complied
	at 10 minutes	13.560389340	0.002871239	28.71	± 0.01	± 100	Complied
0	at 0 minutes	13.560383830	0.002830605	28.31	± 0.01	± 100	Complied
	at 2 minutes	13.560380161	0.002803547	28.04	± 0.01	± 100	Complied
	at 5 minutes	13.560378592	0.002791976	27.92	± 0.01	± 100	Complied
	at 10 minutes	13.560377472	0.002783717	27.84	± 0.01	± 100	Complied
+10	at 0 minutes	13.560376796	0.002778732	27.79	± 0.01	± 100	Complied
	at 2 minutes	13.560367924	0.002713304	27.13	± 0.01	± 100	Complied
	at 5 minutes	13.560365149	0.002692839	26.93	± 0.01	± 100	Complied
	at 10 minutes	13.560363153	0.002678119	26.78	± 0.01	± 100	Complied
+20	at 0 minutes	13.560363410	0.002680015	26.80	± 0.01	± 100	Complied
	at 2 minutes	13.560355520	0.002621829	26.22	± 0.01	± 100	Complied
	at 5 minutes	13.560350491	0.002584742	25.85	± 0.01	± 100	Complied
	at 10 minutes	13.560347231	0.002560701	25.61	± 0.01	± 100	Complied
+30	at 0 minutes	13.560354465	0.002614049	26.14	± 0.01	± 100	Complied
	at 2 minutes	13.560342377	0.002524904	25.25	± 0.01	± 100	Complied
	at 5 minutes	13.560338126	0.002493555	24.94	± 0.01	± 100	Complied
	at 10 minutes	13.560333531	0.002459668	24.60	± 0.01	± 100	Complied
+40	at 0 minutes	13.560327296	0.002413687	24.14	± 0.01	± 100	Complied
	at 2 minutes	13.560325300	0.002398968	23.99	± 0.01	± 100	Complied
	at 5 minutes	13.560324261	0.002391305	23.91	± 0.01	± 100	Complied
	at 10 minutes	13.560323991	0.002389314	23.89	± 0.01	± 100	Complied
+50	at 0 minutes	13.560325213	0.002398326	23.98	± 0.01	± 100	Complied
	at 2 minutes	13.560322901	0.002381276	23.81	± 0.01	± 100	Complied
	at 5 minutes	13.560322693	0.002379742	23.80	± 0.01	± 100	Complied
	at 10 minutes	13.560326028	0.002404336	24.04	± 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 AC Voltage (V)	Measured Frequency (MHz)	Frequency Error		Frequency Error Limits		Result
			%	ppm	%	ppm	
85% of Rated Primary Supply Voltage	102	13.560354095	0.002611	26.11	± 0.01	± 100	Complied
Rated Primary Supply Voltage	120	13.560344434	0.002540	25.40	± 0.01	± 100	Complied
115% of Rated Primary Supply Voltage	138	13.560353560	0.002607	26.07	± 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	10/07/2020	36
377	BONN Elektronik	Amplifier, Low Noise Pre	BLMA 0118-1A	025294B	13/07/2022	12
423	Bonn Elektronik	Amplifier, Low Noise Pre	BLMA 1840-1A	55929	13/07/2022	12
460	Deisel	Turntable	DT 4250 S	n/a	n/a	n/a
452	Schwarzbeck	Antenna, Trilog Broadband	VULB 9168	9168-240	02/09/2020	36
495	Rohde & Schwarz	Antenna, log. - periodical	HL050	100296	06/08/2021	24
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	13/07/2022	12
669	Rohde & Schwarz	EMI Test Receiver	ESW 44	103087	03/02/2022	18
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 9

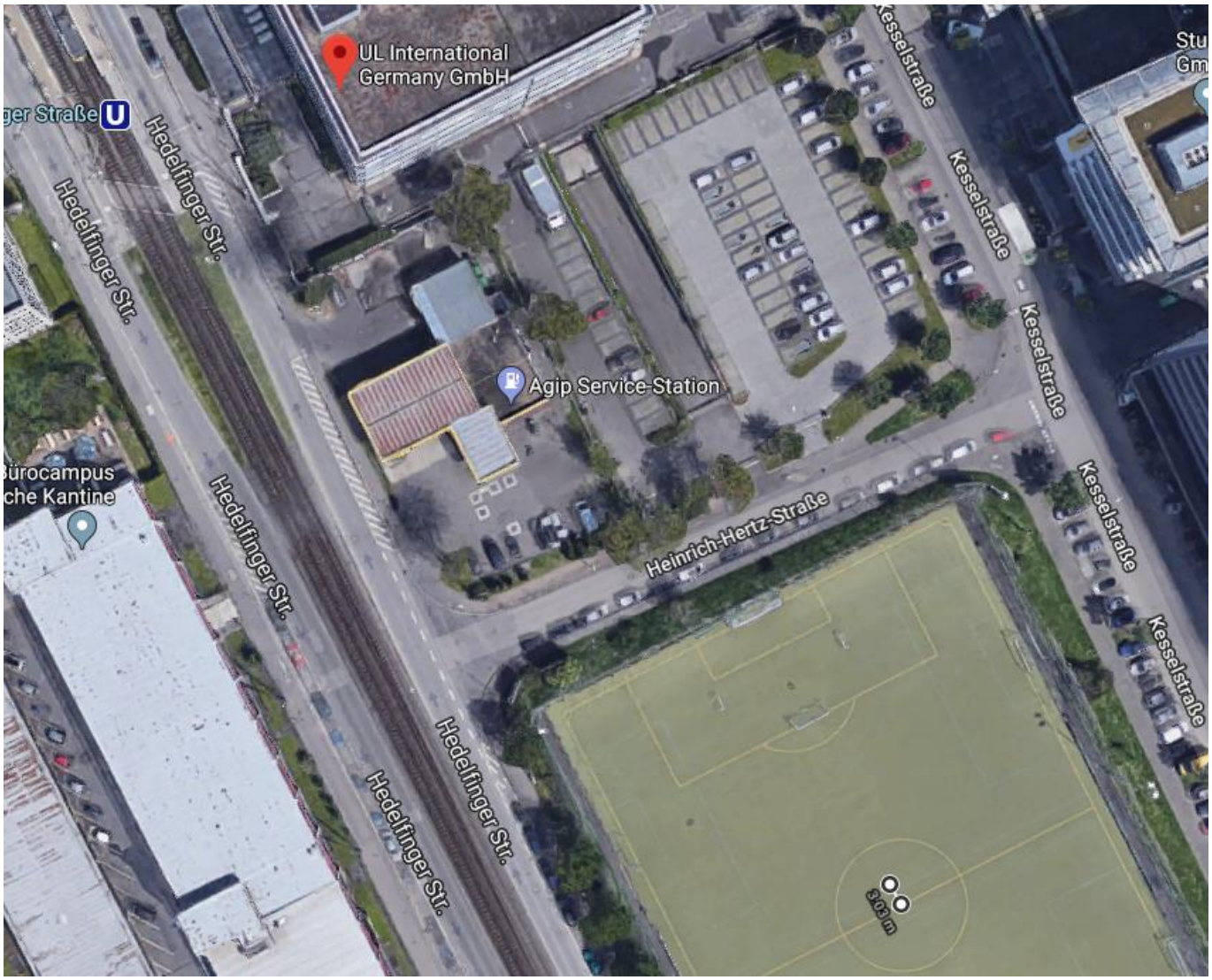
ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
625	Schwarzbeck	Antenna, H-field	HFSL 7101	109	lab verification only relative measurements	n/a
637	Rohde & Schwarz	Spectrum Analyser	FSV40	101587	12/07/2023	12
327	SPS	AC/DC power distribution system	PAS 5000	A2464 00/1 0200	lab verification	n/a
-/-	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

Test site: SR 7/8

ID	Manufacturer	Type	Model	Serial	Calibration Date	Cal. Cycle (months)
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	11/07/2022	12
349	Rohde & Schwarz	Receiver, EMI Test	ESIB7	836697/009	12/07/2022	12
351	Rohde & Schwarz	network, Artificial Mains	ESH3-Z5	862770/018	11/07/2022	12
-/-	Testo	Thermo-Hygrometer	608-H1	08	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:

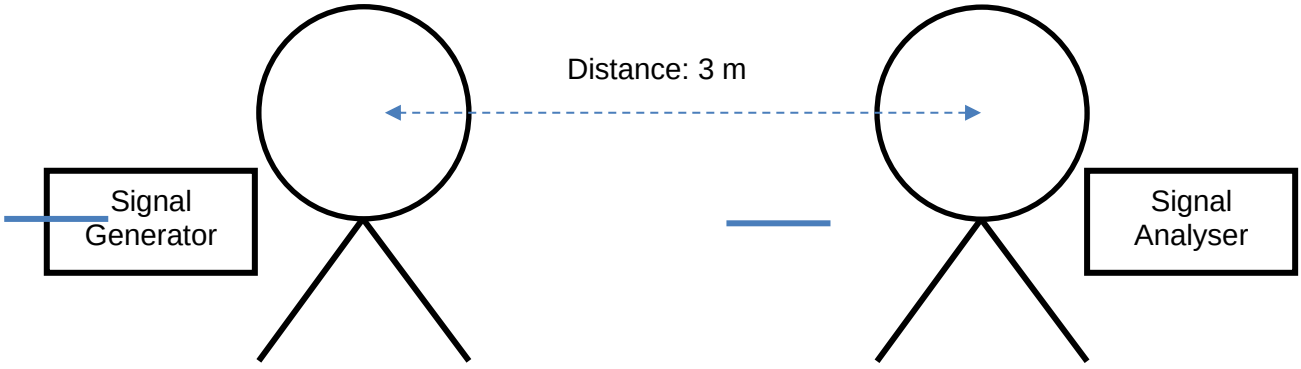
Manufacturer	Type	Model	Frequency Range
Rohde & Schwarz	Signal generator	SML03	9 kHz – 30 MHz
Rohde & Schwarz	Receiver, EMI Test	ESIB7	20 Hz – 7 GHz
Rohde & Schwarz	Antenna, Loop	HFH2-Z2	1 kHz – 30 MHz
ETS LINDGREN	Antenna, Loop	6512	1 kHz – 30 MHz
HUBER+SUHNER	RF Cable	-/-	-/-
Elspec	BNC Cable	-/-	-/-

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

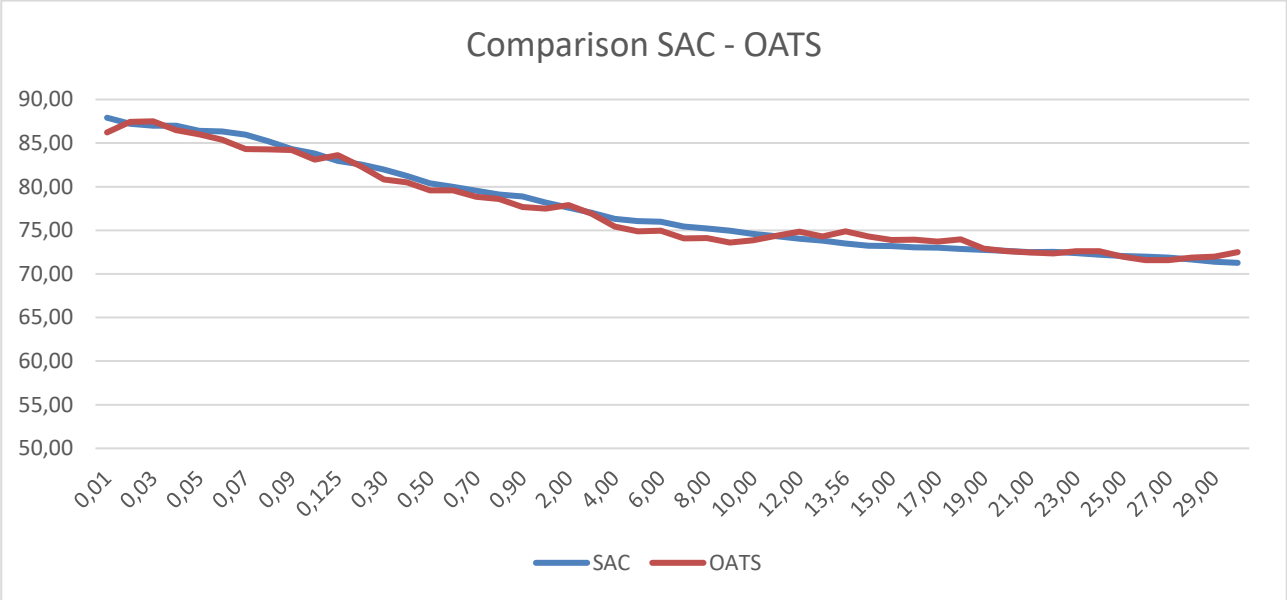
Frequency (MHz)	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	2.00	3.00	4.00	5.00
SR1 Measured power (dBµV)	81.98	81.23	80.39	80.00	79.53	79.10	78.87	78.20	77.60	77.01	76.32	76.04
OATS Measured power (dBµV)	80.84	80.49	79.58	79.58	78.85	78.59	77.69	77.50	77.91	76.90	75.45	74.90
Delta (dB)	-1.14	-0.74	-0.81	-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	45	-	Initial Version

END of Test Report