TEST REPORT

Test Report No.: UL-RPT-RP-14951907-416

Applicant *	:	Balluff GmbH
Model No. / PMN *	:	BF-IDM30
FCC / ISED ID *	:	FCC ID:2AGZY-BFIDM30 IC: 20739-BFIDM30
HVIN *	:	BIS VM-341-401-S4 BIS VM-351-401-S4
Technology	:	RFID 13.56 MHz
Test Standard(s)	:	**FCC Parts 15.207, 15.209(a) & 15.225** **Innovation, Science and Economic Development Canada Section B.6, Annex B, RSS-210 Issue 10 December 2019, Amendment (April 2020) & RSS-Gen Issue 5, April 2018, Amendment 2 (February 2021)** 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   Test Report No. UL-RPT-RP-14951907-416 Version 1.1, Issue Date 24 MAY 2024, which is no longer valid is replaced by Test Report No. UL-RPT-RP-14951907-416 Version 1.2, Issue Date 24 MAY 2024.
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: 24 May 2024

Approved by: Rachid Acharkaoui
Title: Operations Manager
Date: 24 May 2024

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.

UL INTERNATIONAL GERMANY GMBH
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1. Customer Information *

1.1.Applicant Information

Company Name:	Balluff GmbH
Company Address:	Schurwaldstraße 9, 73765 Neuhausen auf den Fildern, Germany
Contact Person:	Thomas Graf
Contact E-Mail Address:	thomas.graf@balluff.de
Contact Phone No.:	+49 7158 173-8417

1.2.Manufacturer Information

Company Name:	Balluff GmbH
Company Address:	Schurwaldstraße 9, 73765 Neuhausen auf den Fildern, Germany
Contact Person:	Thomas Graf
Contact E-Mail Address:	thomas.graf@balluff.de
Contact Phone No.:	+49 7158 173-8417

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
Specification Reference:	RSS-Gen Issue 5, April 2018, Amendment 2 (February 2021)
Specification Title:	General Requirements for Compliance of Radio Apparatus
Specification Reference:	RSS-210 Issue 10 December 2019, Amendment (April 2020)
Specification Title:	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment Annex B-Devices operating in frequency bands for any application B.6 Band 13.110-14.010 MHz

Location

Location of Testing:	UL International Germany GmbH Hedelfinger Str. 61 70327 Stuttgart Germany
Test Firm Registration:	399704
Company Number:	22511
CABID:	DE0008

Date information

Order Date:	30 August 2023
EUT arrived:	05 February 2024
Test Dates:	05 February 2024 to 15 February 2024
EUT returned:	-/-

2.2.Summary of Test Results

FCC Clause	ISED Clause	Measurement	Complied	Did not comply	Not performed	Not applicable
Part 15.207	RSS-Gen 8.8	Transmitter AC Conducted Emissions	☒	☐	☐	☐
Part 15.215(c)	-/-	Transmitter 20 dB Bandwidth	☒	☐	☐	☐
-/-	RSS-Gen 6.7	Transmitter 99% Emission Bandwidth	☒	☐	☐	☐
Part 15.225 (a)(b)(c)(d)	RSS-Gen 6.12 / RSS-210 B6	Transmitter Fundamental Field Strength & Spectrum Mask	☒	☐	☐	☐
Part 15.209(a)/ 15.225(d)	RSS-Gen 6.13 / RSS-210 B6	Transmitter Radiated Emissions	☒	☐	☐	☐
Part 15.225(e)	RSS-Gen 6.11 / RSS-210 B6	Transmitter Frequency Stability (Temperature & Voltage Variation)	☒	☐	☐	☐

Decision rule:
Where not otherwise specified or communicated in writing, statements of conformity (e.g. Pass/Fail) are established according to the following decision rule: considering the ILAC G8:2019 chapter 4.2.1 (simple acceptance rule). This leads to a maximum 50% of false accept or false reject when the measured value equals the tolerance limit. See ILAC-G8:09/2019 for further details.

2.3. Methods and Procedures

Reference:	ANSI C63.10-2013
Title:	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Reference:	FCC KDB 174176 D01 Line Conducted FAQ v01r01 June 3, 2015
Title:	AC Power-Line Conducted Emissions Frequently Asked Questions
Reference:	Notice 2020 - DRS0023
Title:	Guidance on magnetic field strength radiated emission measurements (9 kHz – 30 MHz)

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:	BALLUFF
Model Name / PMN:	BF-IDM30
Serial Number:	NH20230262 (Radiated Test Sample BIS VM-341-401-S4)
Hardware Version Number:	3.0
Firmware Version Number:	3.0
HVIN:	BIS VM-341-401-S4
FVIN:	-/-
FCC ID:	2AGZY-BFIDM30
ISED Certification No.:	IC: 20739-BFIDM30

Brand Name:	BALLUFF
Model Name / PMN:	BF-IDM30
Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)
Hardware Version Number:	3.0
Firmware Version Number:	3.0
HVIN:	BIS VM-351-401-S4
FVIN:	-/-
FCC ID:	2AGZY-BFIDM30
ISED Certification No.:	IC: 20739-BFIDM30

Brand Name:	BALLUFF
Model Name / PMN:	BF-IDM30
Serial Number:	NH2023xxxx (Radiated Test Sample with terminated antenna)
Hardware Version Number:	3.0
Firmware Version Number:	3.0
HVIN:	BIS VM-351-401-S4
FVIN:	-/-
FCC ID:	2AGZY-BFIDM30
ISED Certification No.:	IC: 20739-BFIDM30

3.2. Description of EUT *

The equipment under test was a RFID Read-/Write Head with Model name: BF-IDM30 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):	24V DC via AC/DC power supply through BIS V	
Modulation:	ASK	
Tested Temperature Range:	Minimum	-20 °C
	Maximum	+50 °C
Antenna Used: **BF-IDM30**	BIS VM-351-401-S4	Ferrite Antenna
	BIS VM-341-401-S4	PCB Antenna

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	AC/DC Power Supply	Good Will	GPC-1850D	7662217

B. Support Equipment (Manufacturer supplied) *

Item	Description	Brand Name	Model Name or Number	Serial Number
1	Multi-Frequency Processor	BALLUFF	BIS V-6107-039-C105	-/-

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 by default to transmit a continuous modulated carrier with maximum power at 13.56 MHz as soon as it is powered on.

EUT Power supply:

- The EUT was powered with 120V 60 Hz via the AC/DC power supply through the BIS-V controller.

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 and also 240 VAC / 60 Hz via the AC/DC Power supply as it is in the range of the supply being used for testing.
- In accordance with FCC KDB 174176 Q5, AC conducted emissions was also performed with EUT RFID 13.56 MHz Antenna terminated (dummy load).
- The Toyo EMI Software EP5/CE Ver 4.0.1. was used for these measurements.

Radiated Measurements:

- The radiated samples with integrated antenna were used for the 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 with Ferrite antenna (BIS VM-351-401-S4) in laying position was found to be the worst case therefore this report includes relevant results.
- The EUT with PCB antenna (BIS VM-341-401-S4) 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:	Muhammad Faiq Khan	**Test Date:**	05 February 2024 & 15 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH2023xxxx (Radiated Test Sample with terminated antenna)		
Test Site Identification	SR 7/8		

FCC Reference:	Part 15.207
ISED Reference:	RSS-Gen 8.8
Test Method Used:	ANSI C63.10 Section 6.2 / FCC KDB 174176 RSS-Gen 8.8 and notes below

Environmental Conditions:

Temperature (°C):	22.1 to 22.6
Relative Humidity (%):	44.5 to 45.1

Settings of the Instrument

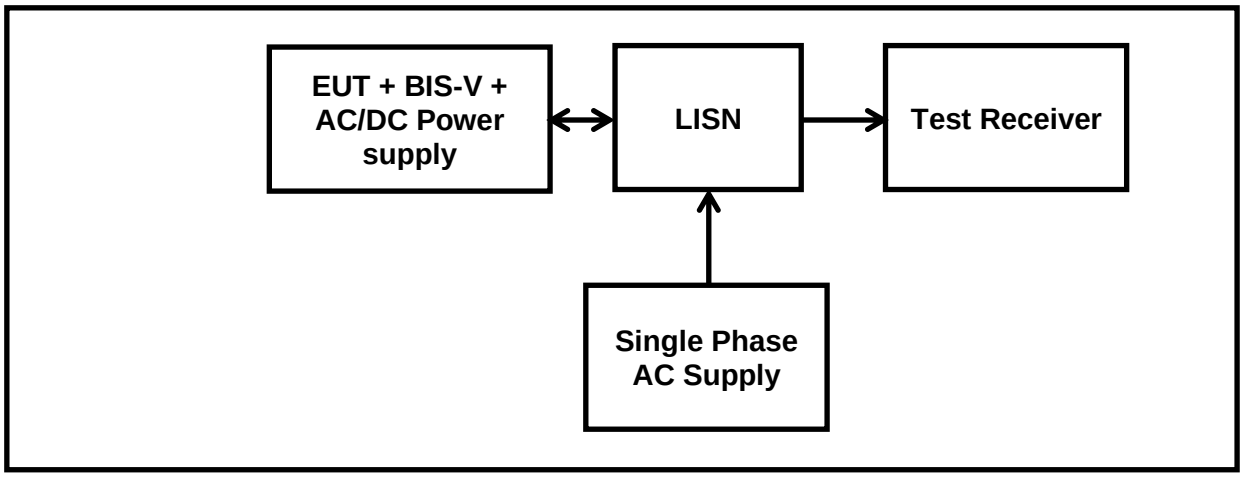
Detector	Quasi Peak/ Average

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. Measurements were performed only with EUT with Ferrite antenna (BIS VM-351-401-S4) as it was found out to be the worst-case w.r.t field strength.
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 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 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.

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 (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15935	Live	22.00	65.50	43.50	Complied
0.24853	Live	27.40	61.80	34.40	Complied
0.41105	Live	10.60	57.60	47.00	Complied
13.56037	Live	72.70	60.00	-12.70	Carrier
19.79817	Live	23.90	60.00	36.10	Complied
27.12151	Live	36.30	60.00	23.70	Complied

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

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15935	Live	12.90	55.50	42.60	Complied
0.24853	Live	12.40	51.80	39.40	Complied
0.41105	Live	6.40	47.60	41.20	Complied
13.56037	Live	71.20	50.00	-21.20	Carrier
19.79817	Live	13.50	50.00	36.50	Complied
27.12151	Live	34.70	50.00	15.30	Complied

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

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.26852	Neutral	20.40	61.20	40.80	Complied
0.29183	Neutral	18.30	60.50	42.20	Complied
0.3992	Neutral	12.20	57.90	45.70	Complied
13.40136	Neutral	36.00	60.00	24.00	Complied
13.56017	Neutral	73.40	60.00	-13.40	Carrier
13.72029	Neutral	35.30	60.00	24.70	Complied
19.81213	Neutral	26.60	60.00	33.40	Complied
27.12123	Neutral	36.00	60.00	24.00	Complied

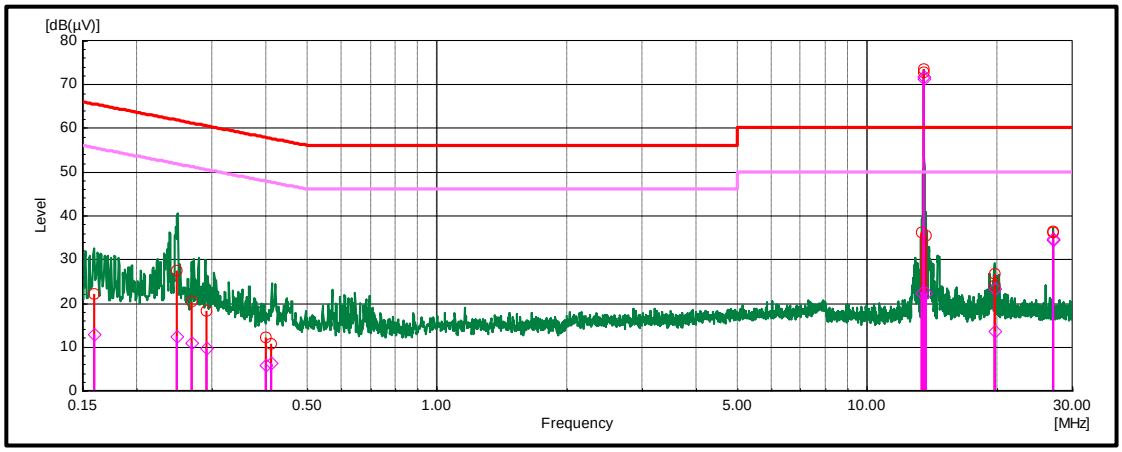
Transmitter AC Conducted Spurious Emissions (continued)

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

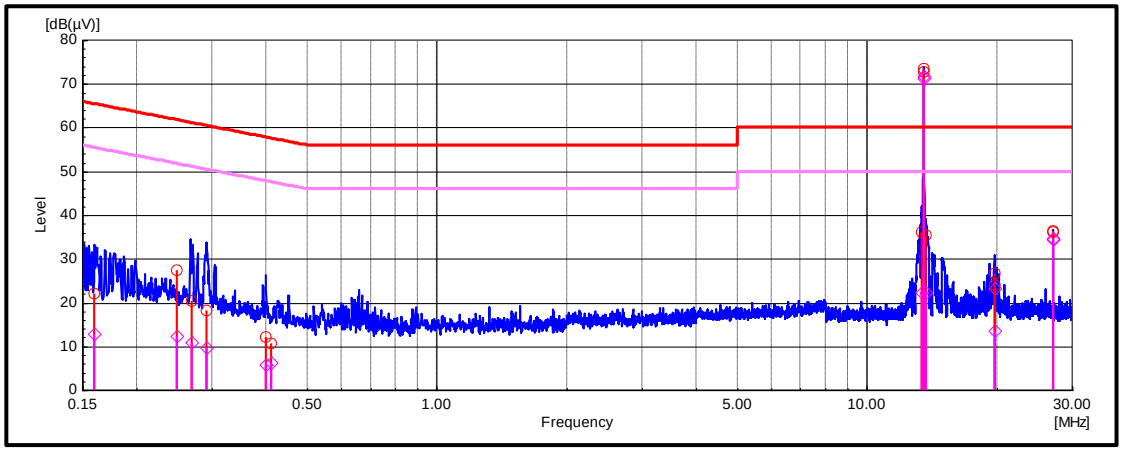
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.26852	Neutral	11.00	51.20	40.20	Complied
0.29183	Neutral	9.70	50.50	40.80	Complied
0.3992	Neutral	5.80	47.90	42.10	Complied
13.40136	Neutral	22.20	50.00	27.80	Complied
13.56017	Neutral	71.80	50.00	-21.80	Carrier
13.72029	Neutral	22.20	50.00	27.80	Complied
19.81213	Neutral	23.20	50.00	26.80	Complied
27.12123	Neutral	34.40	50.00	15.60	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 (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18802	Live	17.40	64.10	46.70	Complied
0.39347	Live	21.60	58.00	36.40	Complied
0.41936	Live	22.10	57.50	35.40	Complied
0.63883	Live	17.60	56.00	38.40	Complied
13.56088	Live	75.70	60.00	-15.70	Carrier
27.12165	Live	34.70	60.00	25.30	Complied

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

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.18802	Live	12.60	54.10	41.50	Complied
0.39347	Live	7.20	48.00	40.80	Complied
0.41936	Live	6.50	47.50	41.00	Complied
0.63883	Live	4.30	46.00	41.70	Complied
13.56088	Live	74.20	50.00	-24.20	Carrier
27.12165	Live	33.90	50.00	16.10	Complied

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

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.29895	Neutral	16.30	60.30	44.00	Complied
0.41779	Neutral	22.90	57.50	34.60	Complied
0.55455	Neutral	18.10	56.00	37.90	Complied
13.56088	Neutral	75.70	60.00	-15.70	Carrier
14.84514	Neutral	22.10	60.00	37.90	Complied
27.12222	Neutral	32.80	60.00	27.20	Complied

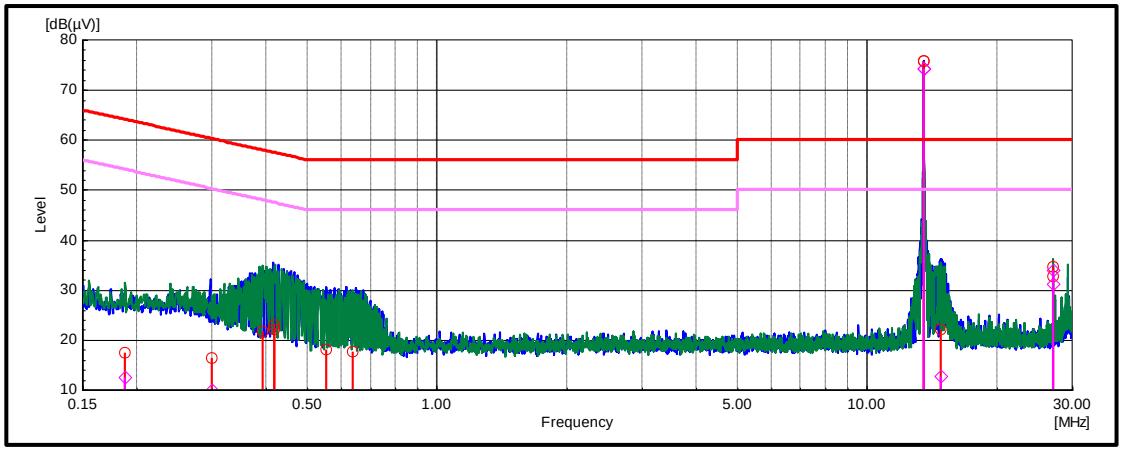
Transmitter AC Conducted Spurious Emissions (continued)

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

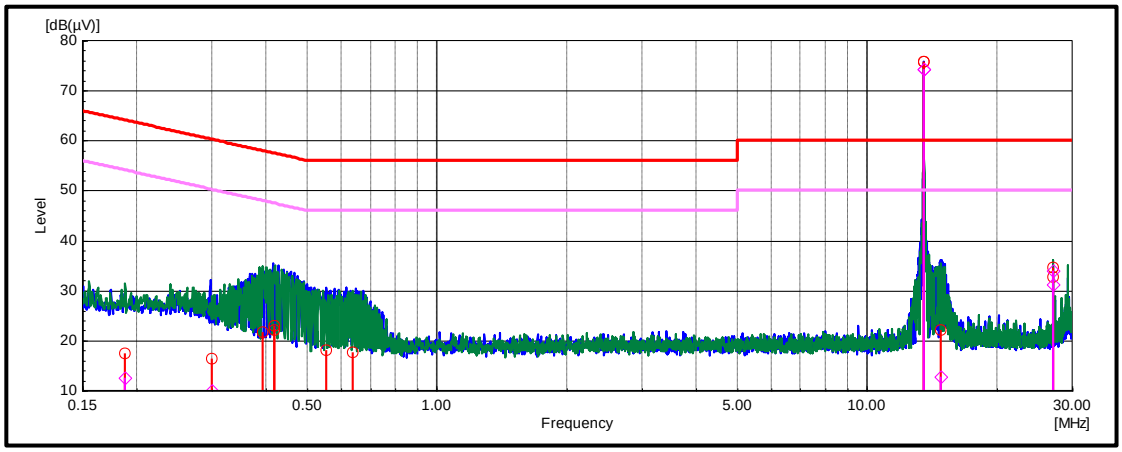
Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.29895	Neutral	10.10	50.30	40.20	Complied
0.41779	Neutral	6.50	47.50	41.00	Complied
0.55455	Neutral	4.30	46.00	41.70	Complied
13.56088	Neutral	74.30	50.00	-24.30	Carrier
14.84514	Neutral	12.80	50.00	37.20	Complied
27.12222	Neutral	31.10	50.00	18.90	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 with Dummy Load

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15523	Live	22.10	65.70	43.60	Complied
0.64503	Live	8.80	56.00	47.20	Complied
13.14904	Live	31.50	60.00	28.50	Complied
13.55977	Live	43.50	60.00	16.50	Complied
14.17189	Live	31.70	60.00	28.30	Complied
21.23012	Live	25.20	60.00	34.80	Complied

Results: Live / Average / 120 VAC 60 Hz / Antenna terminated with Dummy Load

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.15523	Live	22.10	65.70	43.60	Complied
0.64503	Live	8.80	56.00	47.20	Complied
13.14904	Live	31.50	60.00	28.50	Complied
13.55977	Live	43.50	60.00	16.50	Complied
14.17189	Live	31.70	60.00	28.30	Complied
21.23012	Live	25.20	60.00	34.80	Complied

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

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.16062	Neutral	21.40	65.40	44.00	Complied
0.59872	Neutral	8.40	56.00	47.60	Complied
13.15155	Neutral	32.30	60.00	27.70	Complied
13.56037	Neutral	44.10	60.00	15.90	Complied
14.16228	Neutral	33.10	60.00	26.90	Complied
21.23325	Neutral	24.90	60.00	35.10	Complied

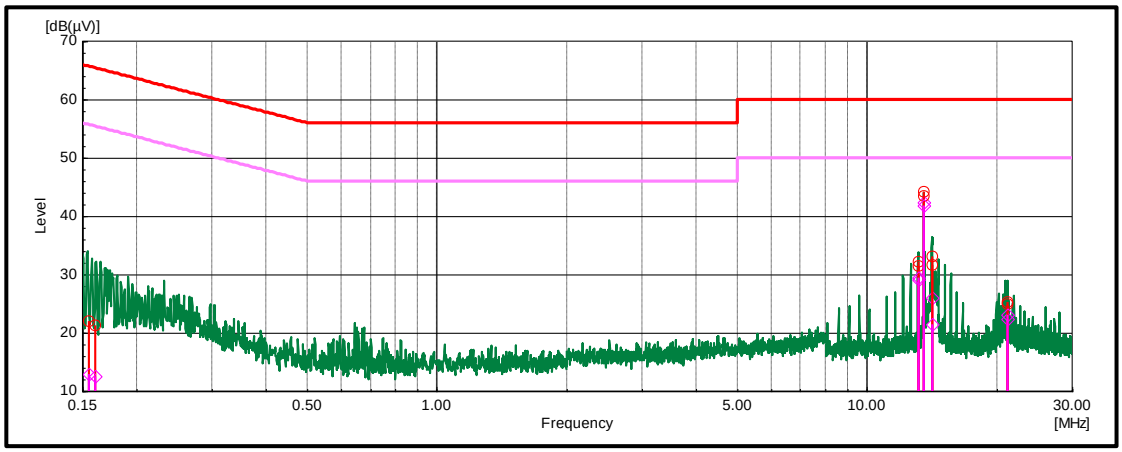
Results: Neutral / Average / 120 VAC 60 Hz / Antenna terminated with Dummy Load

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.16062	Neutral	12.60	55.40	42.80	Complied
0.59872	Neutral	5.20	46.00	40.80	Complied
13.15155	Neutral	29.10	50.00	20.90	Complied
13.56037	Neutral	42.40	50.00	7.60	Complied
14.16228	Neutral	26.00	50.00	24.00	Complied
21.23325	Neutral	22.40	50.00	27.60	Complied

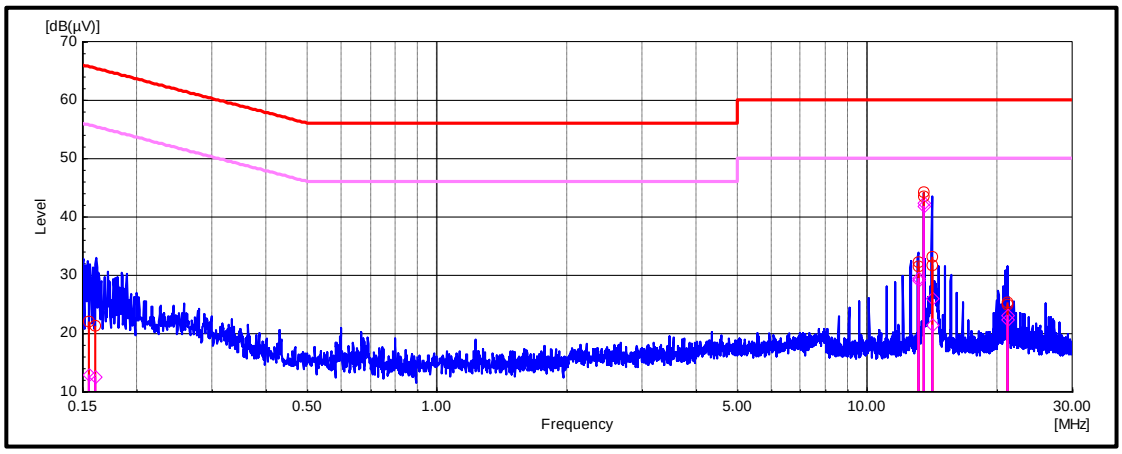
Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live Line / 120 VAC 60 Hz / Antenna terminated with Dummy Load



Plot: Neutral Line / 120 VAC 60 Hz / Antenna terminated with Dummy Load



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 with Dummy Load

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.42158	Live	21.20	57.40	36.20	Complied
0.44178	Live	20.50	57.00	36.50	Complied
0.6064	Live	16.50	56.00	39.50	Complied
13.56088	Live	44.30	60.00	15.70	Complied
14.17019	Live	33.90	60.00	26.10	Complied
20.99565	Live	26.20	60.00	33.80	Complied

Results: Live / Average / 240 VAC 60 Hz / Antenna terminated with Dummy Load

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.42158	Live	7.10	47.40	40.30	Complied
0.44178	Live	5.70	47.00	41.30	Complied
0.6064	Live	4.20	46.00	41.80	Complied
13.56088	Live	42.60	50.00	7.40	Complied
14.17019	Live	26.20	50.00	23.80	Complied
20.99565	Live	23.60	50.00	26.40	Complied

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

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.38759	Neutral	21.30	58.10	36.80	Complied
0.4177	Neutral	22.10	57.50	35.40	Complied
0.59027	Neutral	17.00	56.00	39.00	Complied
13.55937	Neutral	44.80	60.00	15.20	Complied
14.1742	Neutral	34.30	60.00	25.70	Complied
20.99866	Neutral	27.10	60.00	32.90	Complied

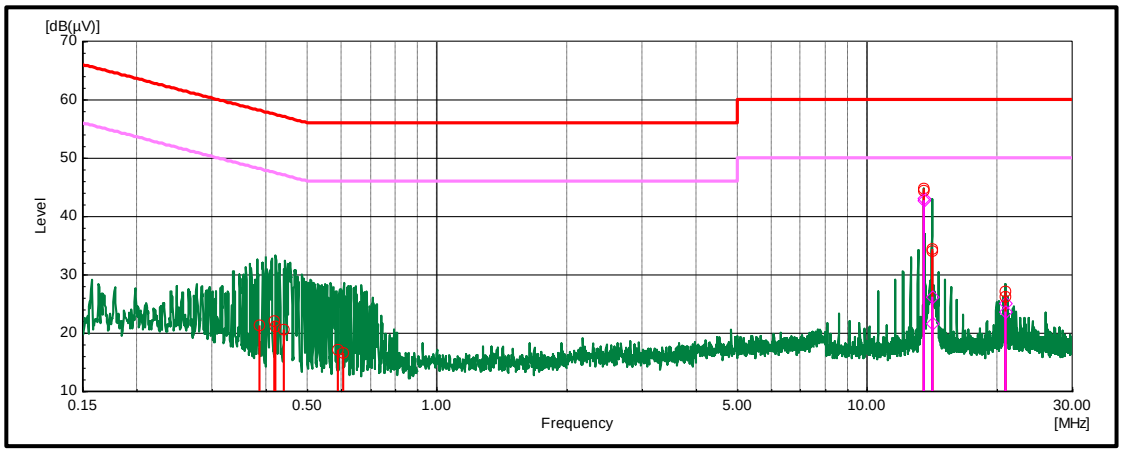
Results: Neutral / Average / 240 VAC 60 Hz / Antenna terminated with Dummy Load

Frequency (MHz)	Line	Level (dBµV)	Limit (dBµV)	Margin (dB)	Result
0.38759	Neutral	7.80	48.10	40.30	Complied
0.4177	Neutral	6.50	47.50	41.00	Complied
0.59027	Neutral	4.30	46.00	41.70	Complied
13.55937	Neutral	43.20	50.00	6.80	Complied
14.1742	Neutral	21.60	50.00	28.40	Complied
20.99866	Neutral	25.00	50.00	25.00	Complied

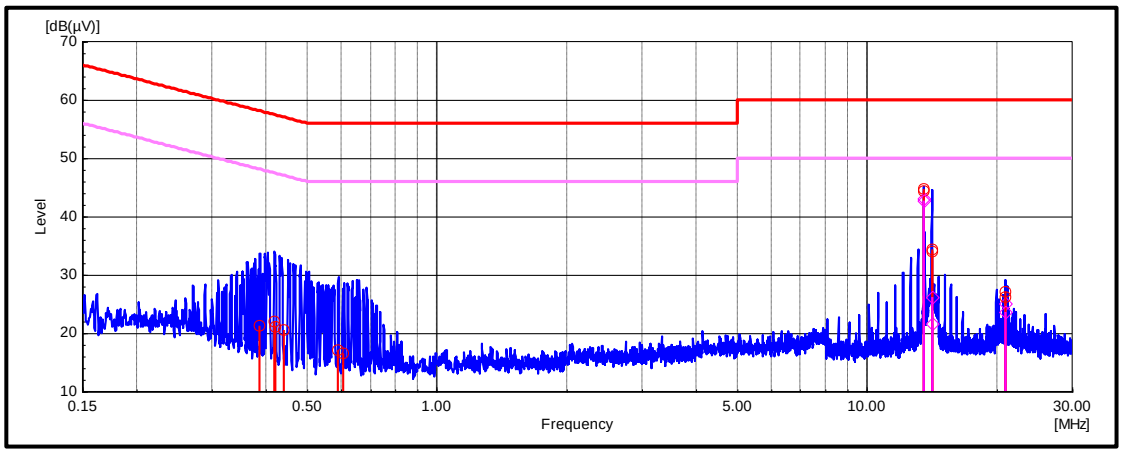
Result: Pass

Transmitter AC Conducted Spurious Emissions (continued)

Plot: Live Line / 240 VAC 60 Hz / Antenna terminated with Dummy Load



Plot: Neutral Line / 240 VAC 60 Hz / Antenna terminated with Dummy Load



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

5.2.2. Transmitter 99 % Emission Bandwidth

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	09 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH20230262 (Radiated Test Sample BIS VM-341-401-S4)		
Test Site Identification	SR 9		

ISED Reference:	RSS-Gen 6.7
Test Method Used:	RSS-Gen 6.7

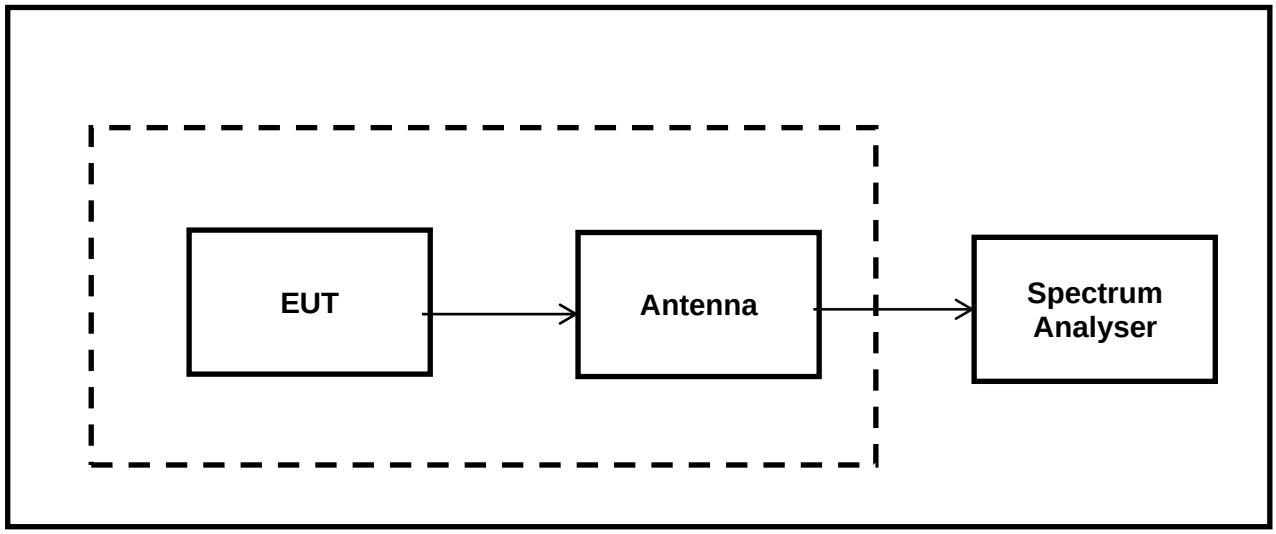
Environmental Conditions:

Temperature (°C):	20.7
Relative Humidity (%):	39.6

Settings of the Instrument

RBW/VBW	10 Hz / 30 Hz
Span	1.5 kHz
Sweep time	Auto
Detector	MaxPeak

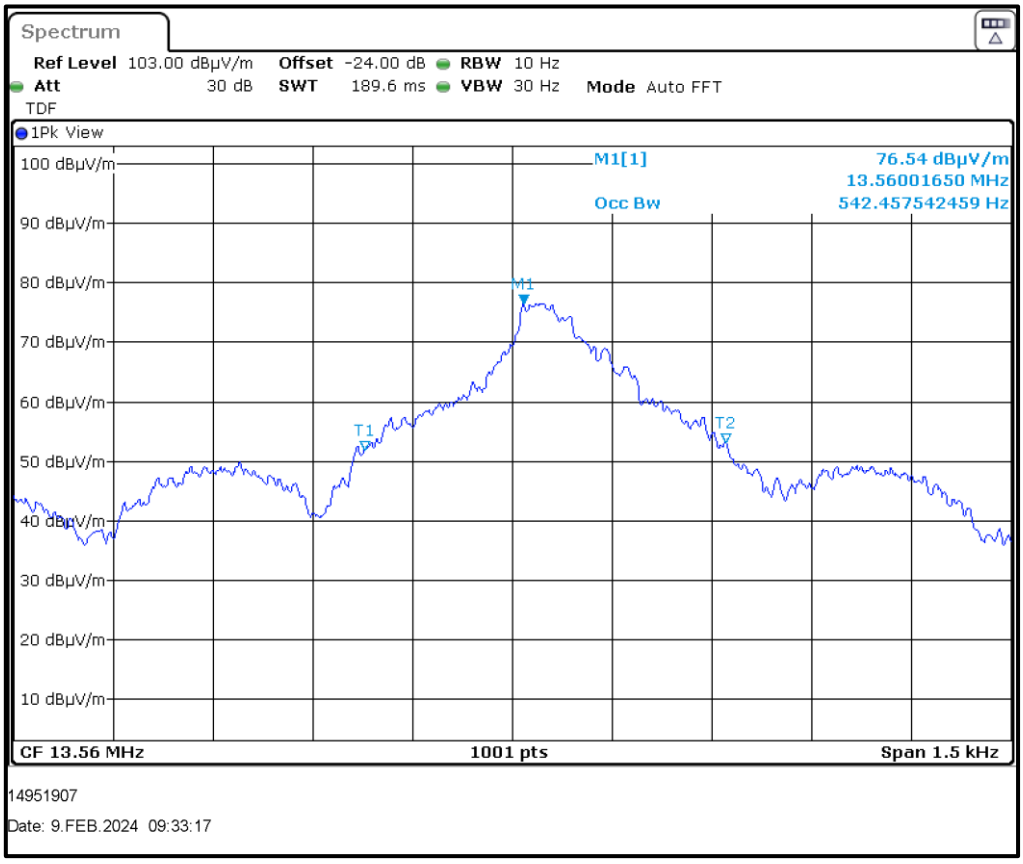
Test Setup:



Transmitter 99 % Emission Bandwidth (continued)

Results: RFID 13.56 MHz / BIS VM-351-401-S4

RFID Channel	99% Emission Bandwidth (Hz)
13.56 MHz	542.457

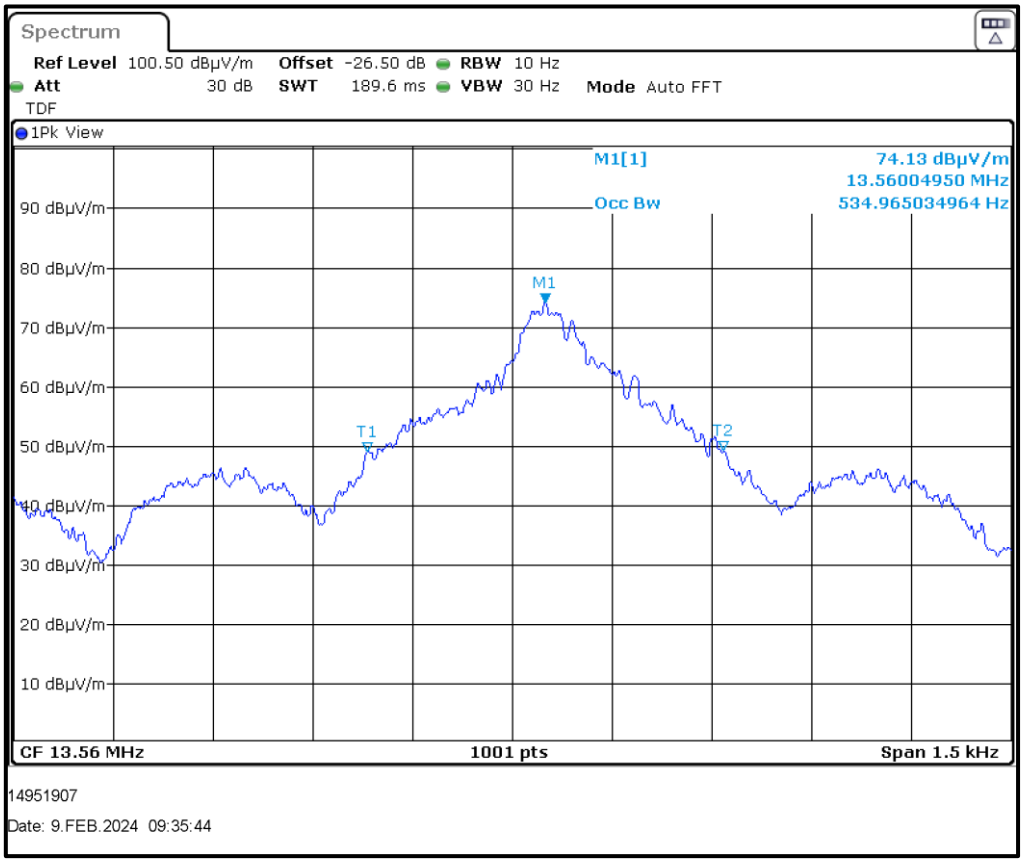


Result: Pass

Transmitter 99 % Emission Bandwidth (continued)

Results: RFID 13.56 MHz / BIS VM-341-401-S4

RFID Channel	99% Emission Bandwidth (Hz)
13.56 MHz	534.965



Result: Pass

5.2.3. Transmitter 20 dB Bandwidth

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	09 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH20230262 (Radiated Test Sample BIS VM-341-401-S4)		
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):	20.7
Relative Humidity (%):	39.6

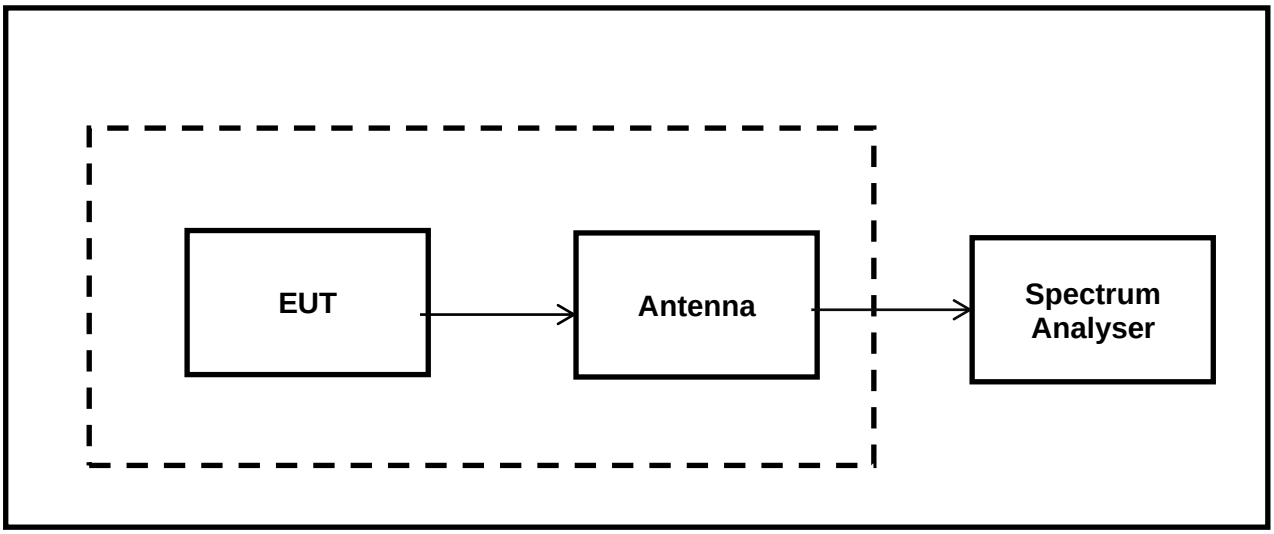
Settings of the Instrument:

RBW/VBW	10 Hz / 30 Hz
Span	1.5 kHz
Sweep time	Auto
Detector	MaxPeak

Notes:

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

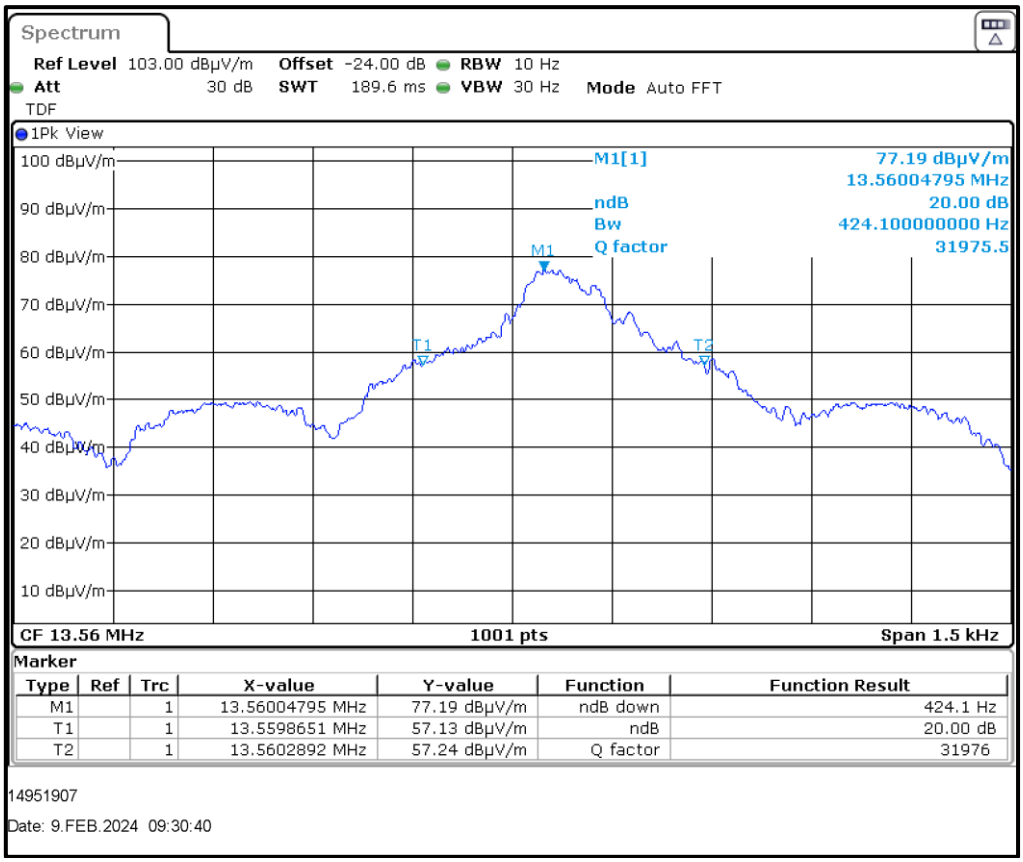
Test Setup:



Transmitter 20 dB Bandwidth (continued)

Results: RFID 13.56 MHz / BIS VM-351-401-S4

RFID Channel	20 dB Bandwidth (Hz)
13.56 MHz	424.10



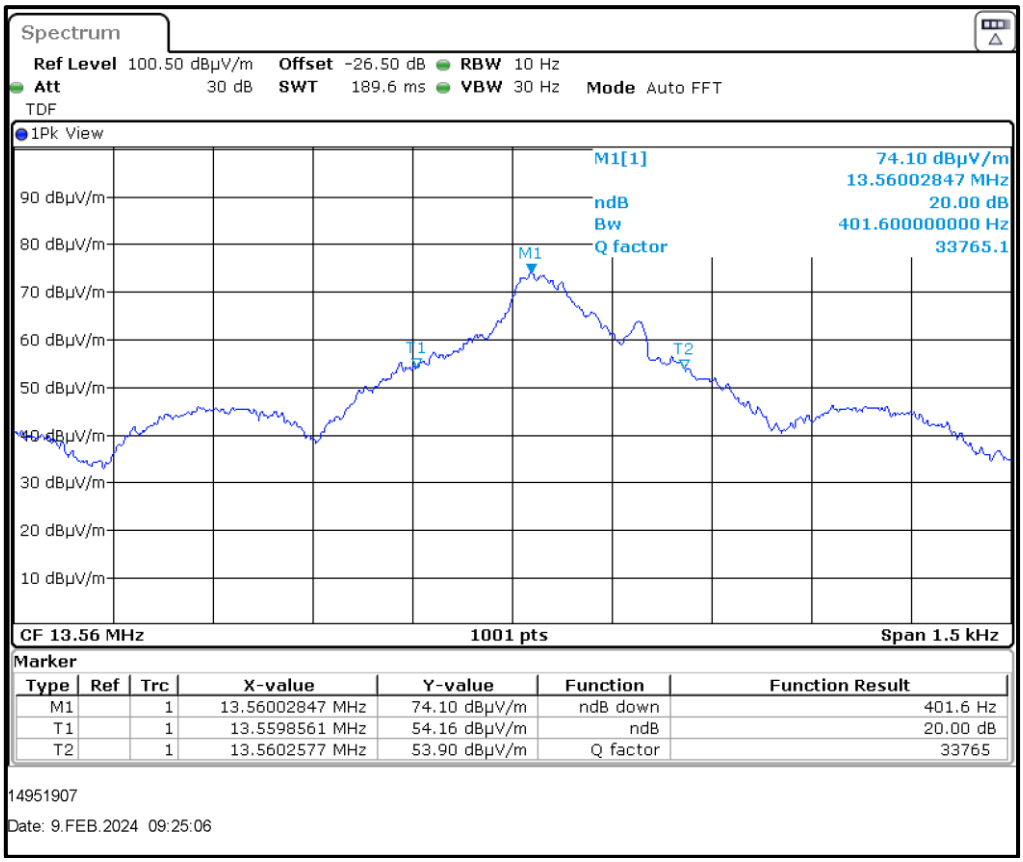
RFID 13.56 MHz

Result: Pass

Transmitter 20 dB Bandwidth (continued)

Results: RFID 13.56 MHz / BIS VM-341-401-S4

RFID Channel	20 dB Bandwidth (Hz)
13.56 MHz	401.60



RFID 13.56 MHz

Result: Pass

5.2.4. Transmitter Fundamental Field Strength & Spectrum Mask

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	05 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH20230262 (Radiated Test Sample BIS VM-341-401-S4)		
Test Site Identification	SR 1/2		

FCC Reference:	Part 15.225(a)(b)(c)(d)
ISED Reference:	RSS-Gen 6.12 / RSS-210 B.6
Test Method Used:	ANSI C63.10 Section 6.4

Environmental Conditions:

Temperature (°C):	21.9
Relative Humidity (%):	34.0

Note(s):

1. The limit is specified at a test distance of 30 metres. However, as specified in ANSI C63.10 clause 6.4.3, measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clauses 6.4.4, specifically sub-clause 6.4.4.1 which specifies that the measured level shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade. Therefore, measurements were performed at a measurement distance of 3 m.
2. As allowed by ANSI C63.10 clause 5.2 an alternative test site that can demonstrate equivalence to a open area test site may be used. Therefore, the measurement was performed in a Semi Anechoic Chamber to which the delta of 1.38 dB at 13.56 MHz (as detailed in section 8. Open-Area-Test Site comparison of this report) and for all other frequencies already included in the measured values represented below in the table.
3. FCC rule part 15.209(a) specifies limits at 300 m / 30 m in µV/m but RSS GEN specifies limits at 300 m / 30 m in µA/m. The relevant limits are the same after accounting for E-field to H-field correction. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table). According to Notice 2020-DRS0023 converting the magnetic field strength into electrical field strength using the following equation while considering free space impedance of 377 Ω results in a factor of 51.5 dBΩ.

   $$AF^{E}\,[dB(m^{-1})] = AF^{H}\,[dB(\Omega^{-1}m^{-1})] + Z_0[dB\Omega]$$

   For example, the measurement frequency X KHz resulted in a level of Y dBµV/m, which is equivalent to Y -51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Section 8.9, Table 6 limit as it has to the 15.209(a) limit.
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. The emissions shown at frequencies approximately at 13.56 MHz on the plot represent EUT's fundamental field strength for RFID 13.56 MHz.

Transmitter Fundamental Field Strength & Spectrum Mask(continued)

Note(s):

6. The measured values at 3 m were extrapolated to the required measurement distance of 30 m and compared the specified limit at this distances as follows:

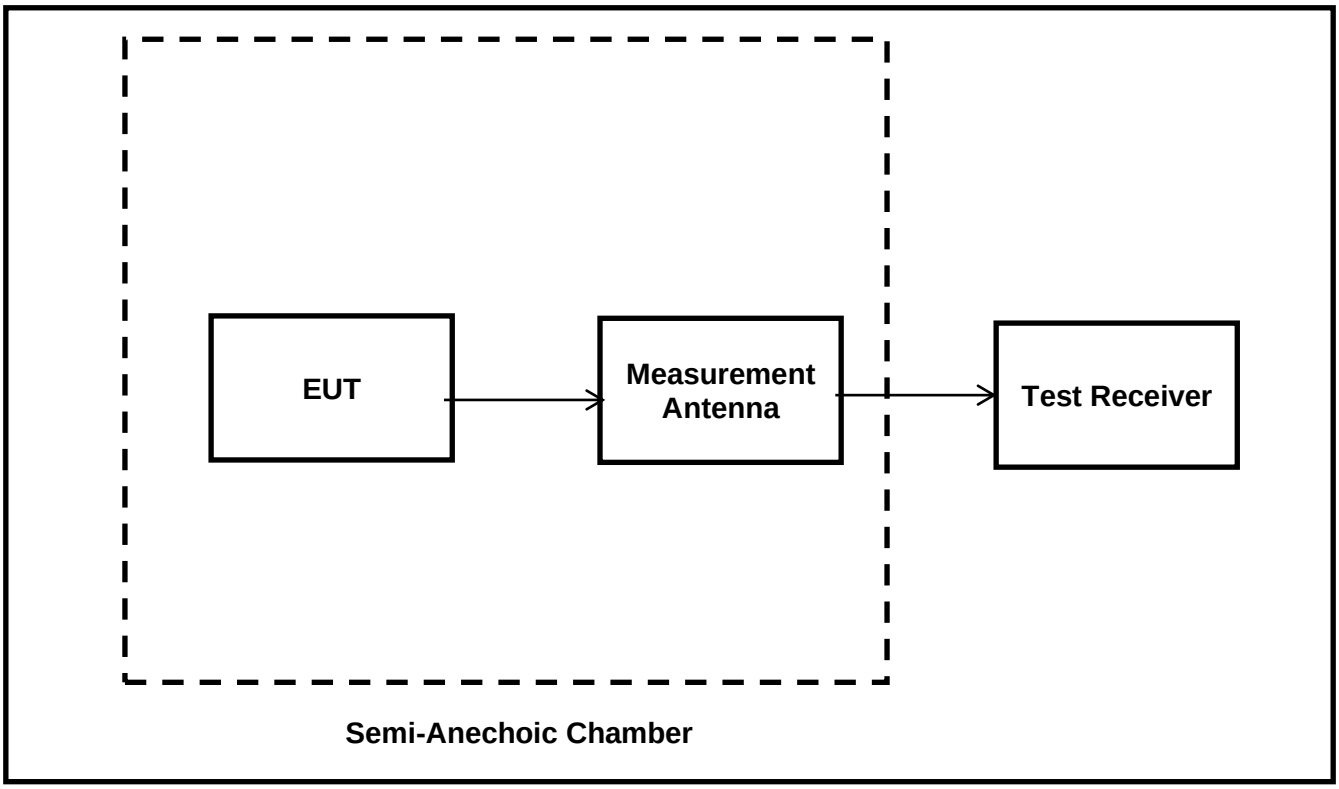
   • 490 kHz-30 MHz: measured value extrapolated from 3 m to 30 m by subtracting 40 dB at 40 dB /decade.

   The results table shows both the measured levels at 3 m and the same measurement values extrapolated to the actual measurement distance for the limits specified at 30 metres.

   Conversely, the limit line shown on the spectrum plot was extrapolated to 3 m from 30 m using the 40 dB /decade rule.

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) limits and ISED RSS-210 Annex B.6 a. i, ii and iii.
8. 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.
9. For the emissions appearing outside of the 13.110-14.010 MHz band, compliance with the spectrum mask is shown in accordance with RSS-210 B.6(a)(iv) referencing RSS-Gen general field strength limits.

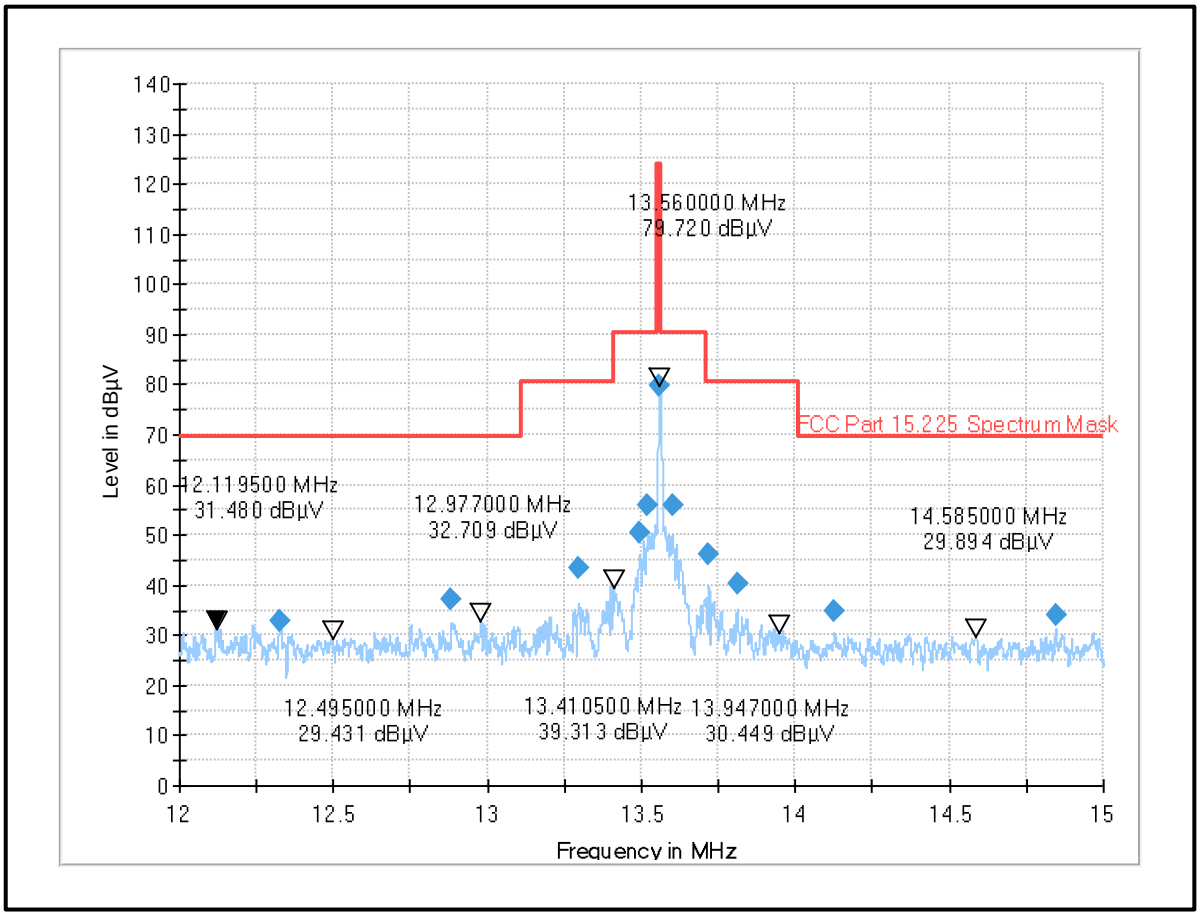
Test Setup:



Transmitter Fundamental Field Strength & Spectrum Mask (continued)
Results: RFID 13.56 MHz / BIS VM-351-401-S4

Frequency Band (MHz)	Emission Frequency (MHz)	Loop Antenna Orientation	MaxPeak Emission Level at 3 m (dBµV/m)	Extrapolated Max Peak Level (dBuV/m)	Limit (dBµV/m)	Limit Distance (m)	Margin (dB)	Result
12.000 to 13.110	12.884	90° to EUT	37.45	-2.55	29.50	30	32.05	Complied
13.110 to 13.410	13.295	90° to EUT	44.68	4.68	40.50	30	35.82	Complied
13.410 to 13.553	13.520	90° to EUT	57.4	17.4	50.50	30	33.1	Complied
13.553 to 13.567	13.560	90° to EUT	81.1	41.1	84.00	30	42.9	Complied
13.567 to 13.710	13.601	90° to EUT	57.13	17.13	50.50	30	33.37	Complied
13.710 to 14.010	13.811	90° to EUT	41.43	1.43	40.50	30	39.07	Complied
14.010 to 15.000	14.127	90° to EUT	35.74	-4.26	29.50	30	33.76	Complied

Transmitter Fundamental Field Strength & Spectrum Mask (continued)
Plot: RFID 13.56 MHz / BIS VM-351-401-S4



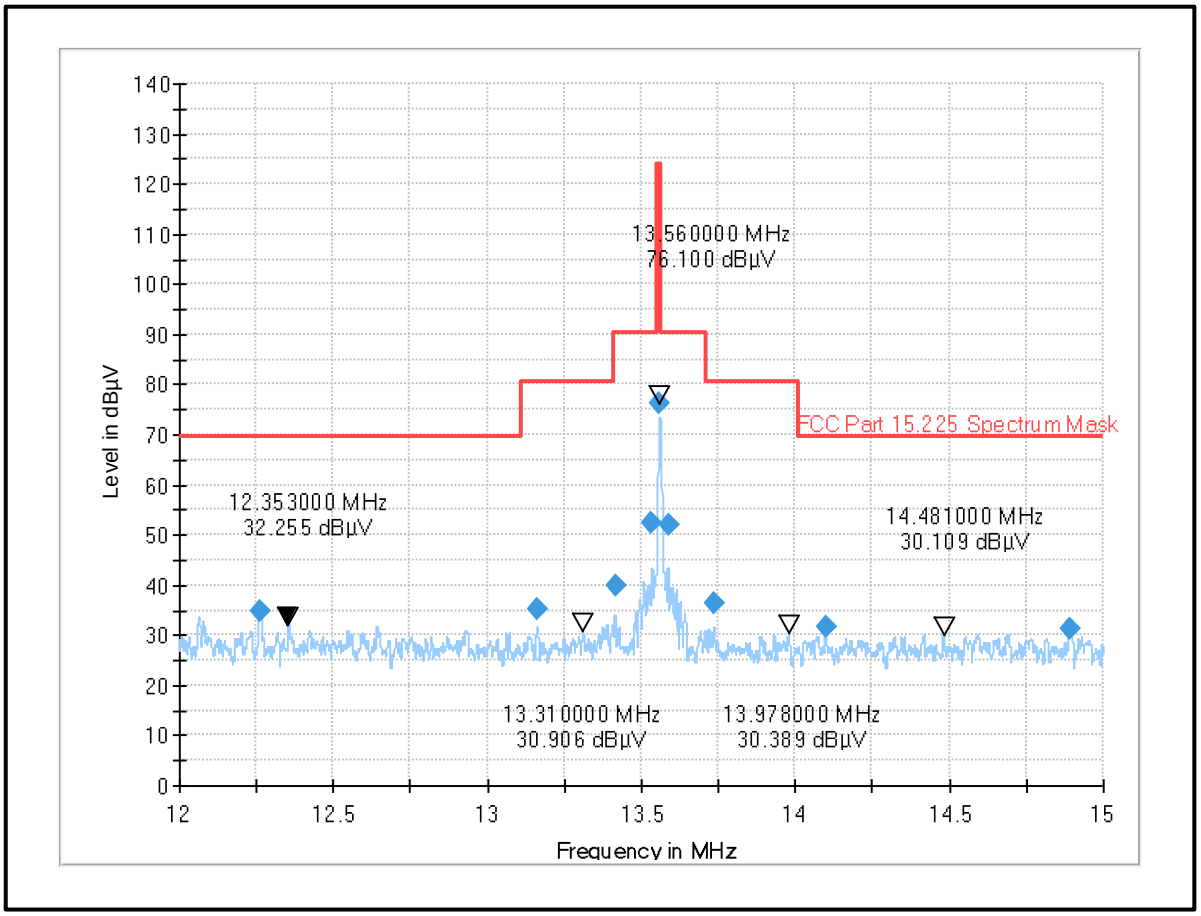
Fundamental field strength and spectrum mask / measured at 3 metres/ measured in a semi-anechoic chamber

Result: Pass

Transmitter Fundamental Field Strength & Spectrum Mask (continued)
Results: RFID 13.56 MHz / BIS VM-341-401-S4

Frequency Band (MHz)	Emission Frequency (MHz)	Loop Antenna Orientation	MaxPeak Emission Level at 3 m (dBµV/m)	Extrapolated Max Peak Level (dBuV/m)	Limit (dBµV/m)	Limit Distance (m)	Margin (dB)	Result
12.000 to 13.110	12.263	90° to EUT	35.19	-4.81	29.50	30	34.31	Complied
13.110 to 13.410	13.159	90° to EUT	36.71	-3.29	40.50	30	43.79	Complied
13.410 to 13.553	13.533	90° to EUT	53.65	13.65	50.50	30	36.85	Complied
13.553 to 13.567	13.560	90° to EUT	77.48	37.48	84.00	30	46.52	Complied
13.567 to 13.710	13.586	90° to EUT	53.24	13.24	50.50	30	37.26	Complied
13.710 to 14.010	13.735	90° to EUT	37.6	-2.4	40.50	30	42.9	Complied
14.010 to 15.000	14.099	90° to EUT	32.57	-7.43	29.50	30	36.93	Complied

Transmitter Fundamental Field Strength & Spectrum Mask (continued)
Plot: RFID 13.56 MHz / BIS VM-341-401-S4



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

Result: Pass

5.2.5. Transmitter Radiated Spurious Emissions

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	05 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-341-401-S4)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.225(d) & 15.209(a)
ISED Reference:	RSS-Gen 6.13 / RSS-210 B6
Test Method Used:	ANSI C63.10:2013 Sections 6.3, 6.4
Frequency Range:	9 kHz to 30 MHz

Environmental Conditions:

Temperature (°C):	21.9
Relative Humidity (%):	34.0

Note(s):

1. As allowed by ANSI C63.10 clause 5.2 an alternative test site that can demonstrate equivalence to a open area test site may be used. Therefore, the measurement was performed in a Semi Anechoic Chamber. The OATS / SAC comparison data is detailed in section 8. Open-Area-Test Site comparison of this report.
2. FCC rule part 15.209(a) specifies limits at 300 m / 30 m in µV/m but RSS GEN specifies limits at 300 m / 30 m in µA/m. The relevant limits are the same after accounting for E-field to H-field correction. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table). According to Notice 2020-DRS0023 converting the magnetic field strength into electrical field strength using the following equation while considering free space impedance of 377 Ω results in a factor of 51.5 dBΩ.

   $$AF^{E}\,[dB(m^{-1})] = AF^{H}\,[dB(\Omega^{-1}m^{-1})] + Z_0[dB\Omega]$$

   For example, the measurement frequency X KHz resulted in a level of Y dBµV/m, which is equivalent to Y -51.5 = Z dBµA/m, which has the same margin, W dB, to the corresponding RSS-GEN Section 8.9, Table 6 limit as it has to the 15.209(a) limit.
3. The limits are specified at a test distances of 30 m & 300 metres. However, as specified in ANSI C63.10 clause 6.4.3, measurements may be performed at a closer distance and the measured level extrapolated to the specified measurement distance using the method described in clauses 6.4.4, specifically sub-clause 6.4.4.1 which specifies that the measured level shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade. Therefore, measurements were performed at a measurement distance of 3 m.
4. The measured values at 3 m were extrapolated to the required measurement distances of 300 m and 30 m and compared the specified limits at those distances as follows:

   • 9 kHz- 490 kHz: measured value extrapolated from 3 m to 300 m by subtracting 80 dB at 40 dB /decade.

   • 490 kHz-30 MHz: measured value extrapolated from 3 m to 30 m by subtracting 40 dB at 40 dB /decade.

   The results table shows both the measured levels at 3 m and the same measurement values extrapolated to the actual measurement distance for the limits specified at 30 and 300 metres.

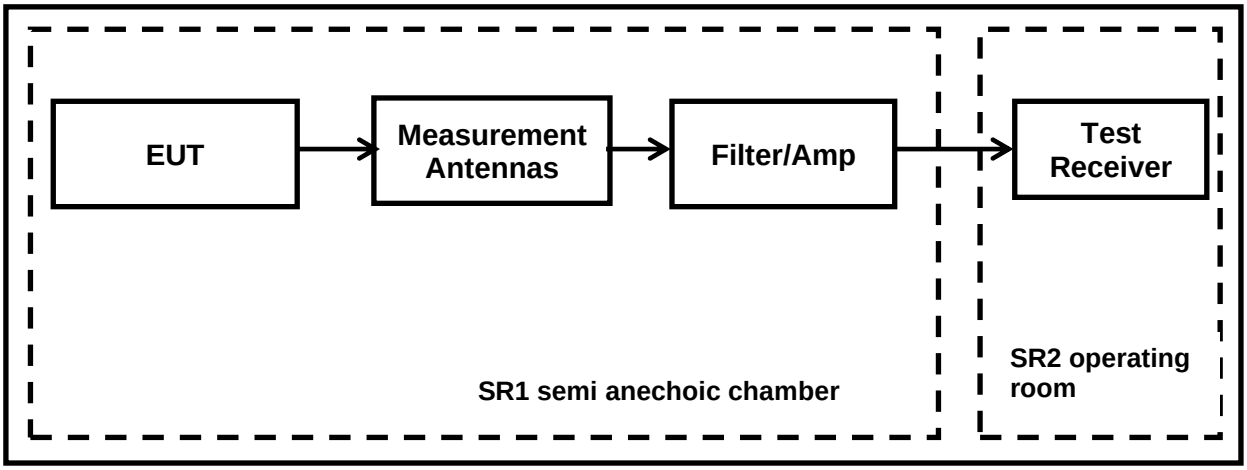
   Conversely, the limit line shown on the spectrum plot was extrapolated to 3 m from 300 m and 30 m using the 40 dB /decade rule.

Transmitter Radiated Emissions (continued)

Note(s):

5. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
6. Measurements below 30 MHz were performed in a semi-anechoic chamber SR1/ 2 (Asset Number 1603665) at a distance of 3 m. The EUT placed on table 80 cm from ground plane in the centre of the chamber turntable. The measurement loop antenna height was at 1 m.
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.
8. Pre-scans were performed, and markers placed on the highest measured levels. The test receiver was set to:
9. Frequency range: 9 kHz-150 kHz : RBW: 300 Hz /VBW: 1 kHz
10. Frequency range: 150 kHz – 30 MHz: RBW: 10 kHz /VBW: 30 kHz
11. Detector: Peak detector
12. Trace Mode: Max Hold
13. Final measurements performed with Quasi-peak detector as per CISPR requirements.

Test Setup:

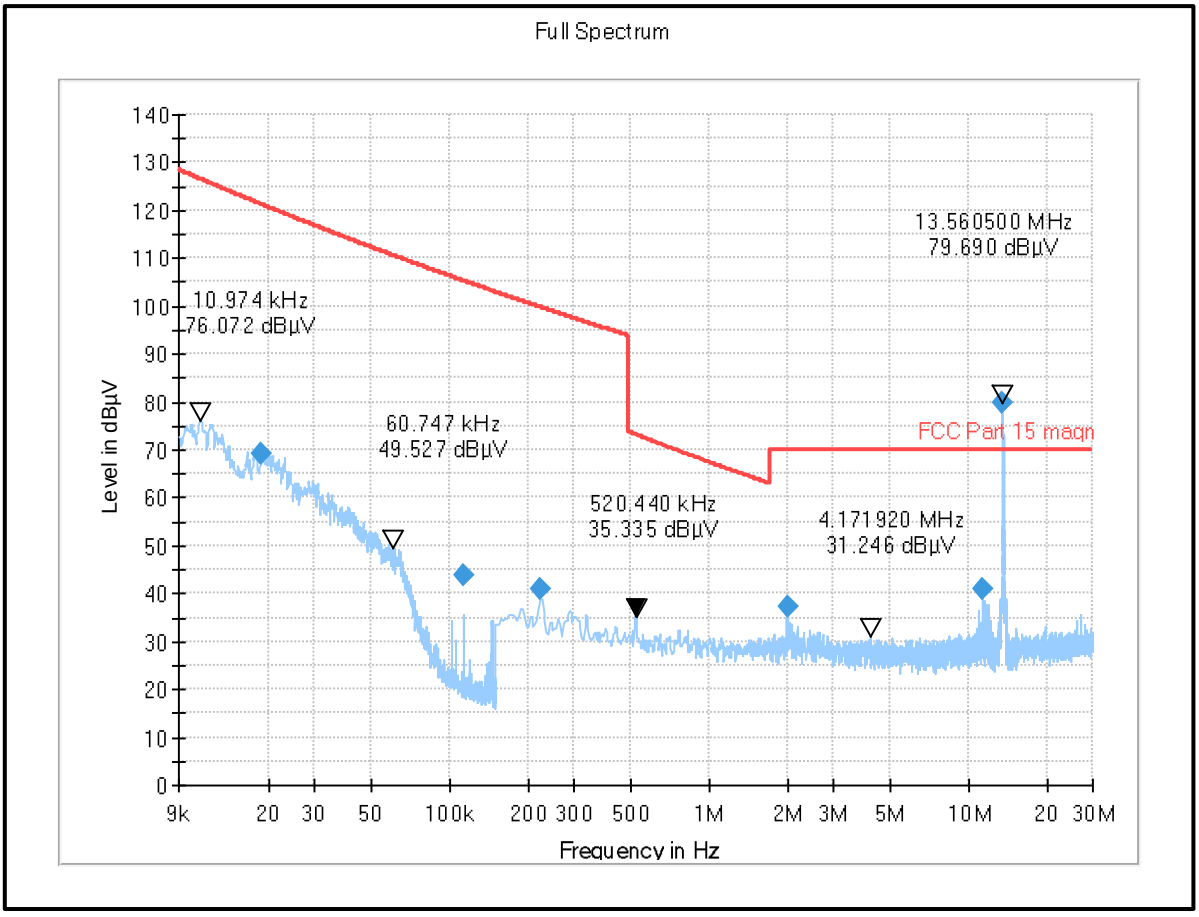


Transmitter Radiated Emissions (continued)

Results: RFID 13.56 MHz / BIS VM-351-401-S4

Frequency (MHz)	Loop Antenna Orientation	Level @ 3m (dBµV/m)	Extrapolated Level (dBµV/m)	Limit (dBµV/m)	Limit Distance (m)	Margin (dB)	Result
0.018870	90° to EUT	69.35	-10.65	41.22	300	51.87	Complied
0.112283	90° to EUT	43.68	-36.32	25.34	300	61.66	Complied
0.222765	0° to EUT	40.83	-39.17	19.81	300	58.98	Complied
1.992278	0° to EUT	37.07	-2.93	30.00	30	32.93	Complied
11.243305	0° to EUT	41.11	1.11	30.00	30	28.89	Complied

Plot: 9kHz – 30MHz – Active RFID



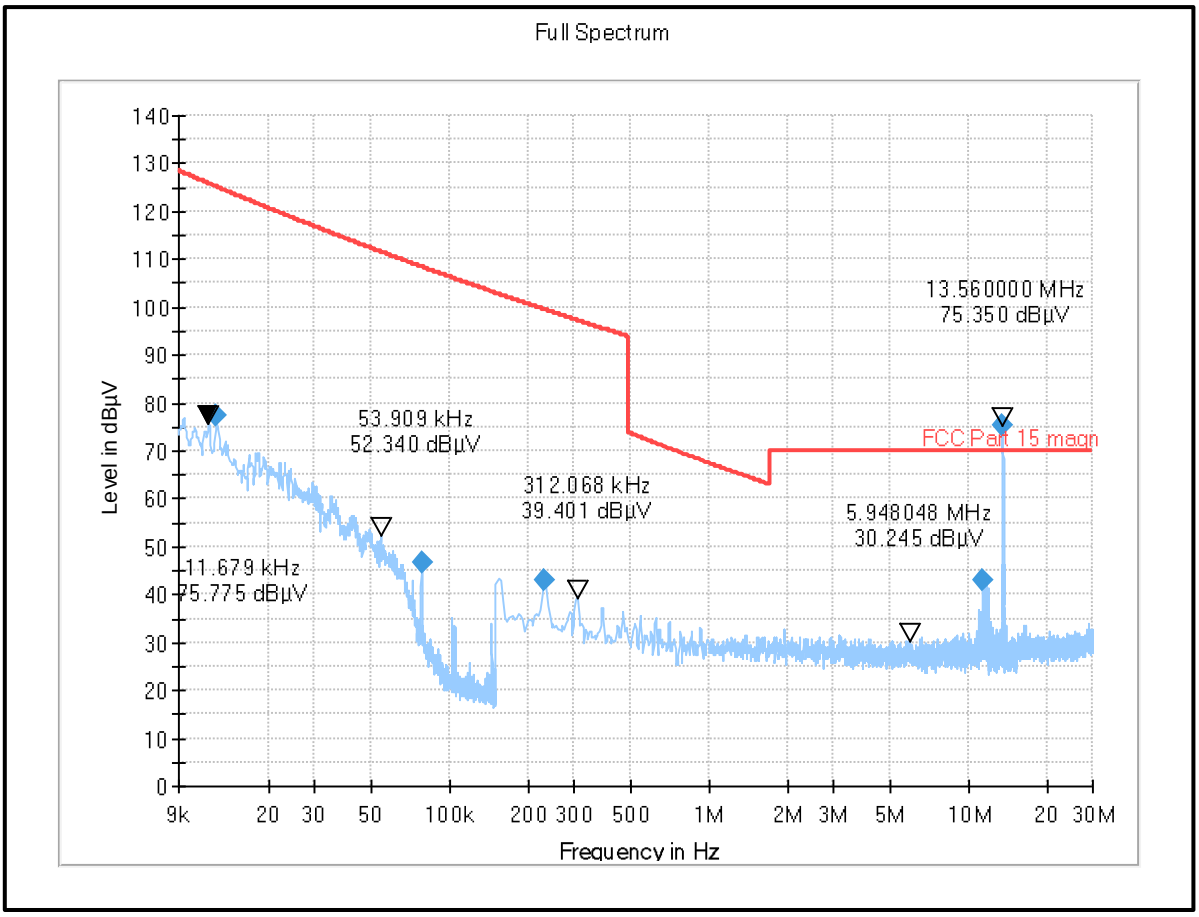
Result: Pass

Transmitter Radiated Emissions (continued)

Results: RFID 13.56 MHz / BIS VM-341-401-S4

Frequency (MHz)	Loop Antenna Orientation	Level @3m (dBµV/m)	Extrapolated Level (dBµV/m)	Limit (dBµV/m)	Limit Distance (m)	Margin (dB)	Result
0.012596	90° to EUT	77.18	-2.82	45.14	300	47.96	Complied
0.077667	90° to EUT	46.48	-33.52	28.44	300	61.96	Complied
0.232688	90° to EUT	43.16	-36.84	19.47	300	56.31	Complied
11.255843	90° to EUT	42.89	2.89	30.00	30	27.11	Complied

Plot: 9kHz – 30MHz – Active RFID



Result: Pass

Transmitter Radiated Emissions (continued)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	05 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-341-401-S4)		
Test Site Identification	SR 1/2		

FCC Reference:	Parts 15.225(d) & 15.209(a)
ISED Reference:	RSS-Gen 6.13 / RSS-210 B6
Test Method Used:	ANSI C63.10:2013 Sections 6.3 and 6.5
Frequency Range:	30 MHz to 1000 MHz

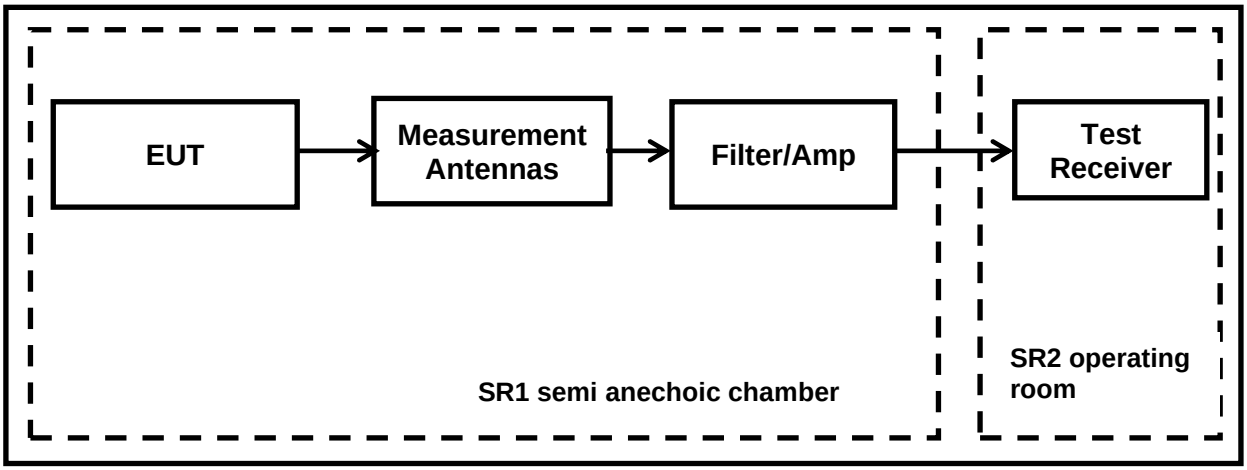
Environmental Conditions:

Temperature (°C):	21.9
Relative Humidity (%):	34.0

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 placed on table 80 cm from 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.
4. Final measurements were performed on the marker frequencies. The results entered in the table below incorporates the calibrated antenna factor and cable loss. The test receiver resolution bandwidth was set to 120 kHz, using a CISPR quasi-peak detector and span big enough to see the whole emission.

Test Setup:

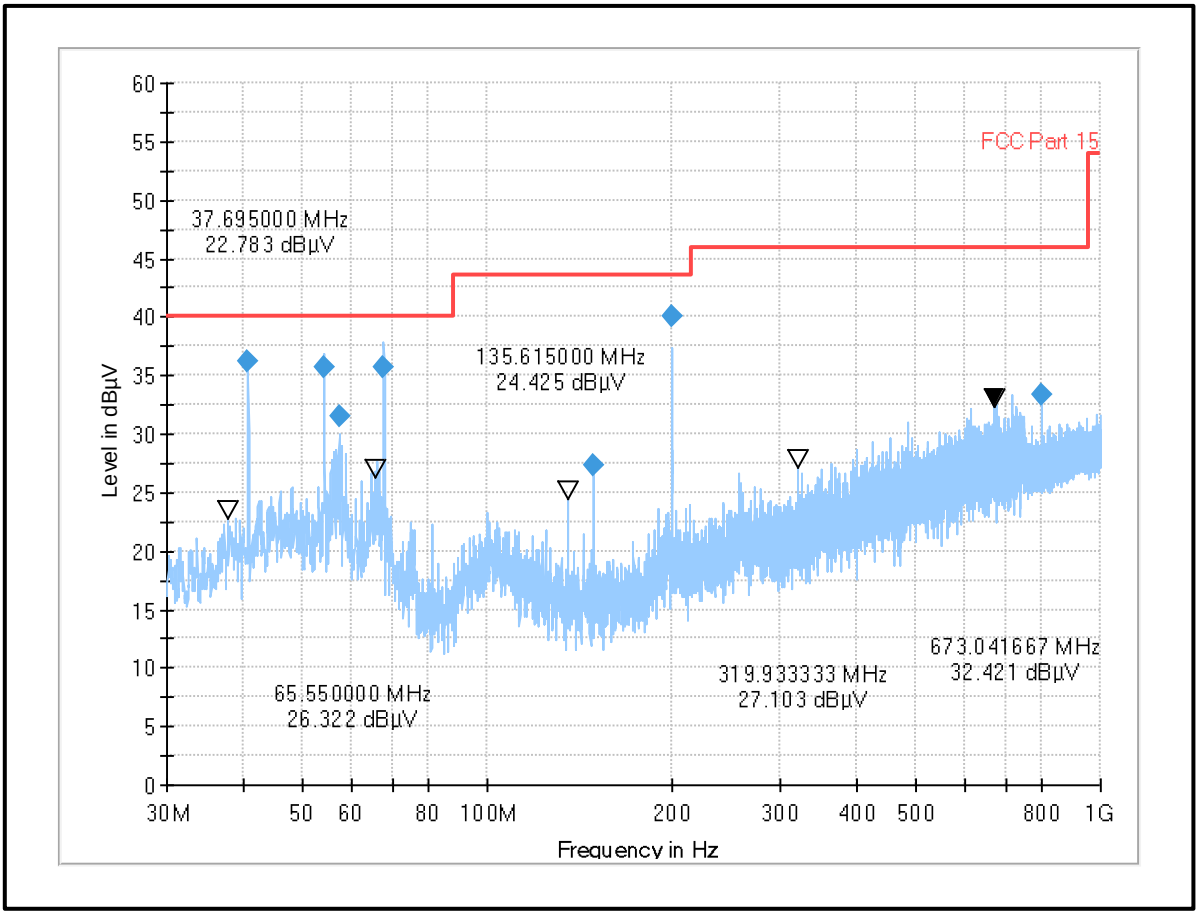


Transmitter Radiated Emissions (continued)

Results: RFID 13.56 MHz / BIS VM-351-401-S4

Frequency (MHz)	Antenna Polarization	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
40.665000	Vertical	36.19	40.00	3.81	Complied
54.210000	Vertical	35.75	40.00	4.25	Complied
57.315000	Vertical	31.45	40.00	8.55	Complied
67.800000	Vertical	35.69	40.00	4.31	Complied
149.205000	Vertical	27.26	43.50	16.24	Complied
200.010000	Vertical	40.08	43.50	3.42	Complied
800.041667	Horizontal	33.27	46.00	12.73	Complied

Plot: 30Mz – 1000MHz – Active RFID



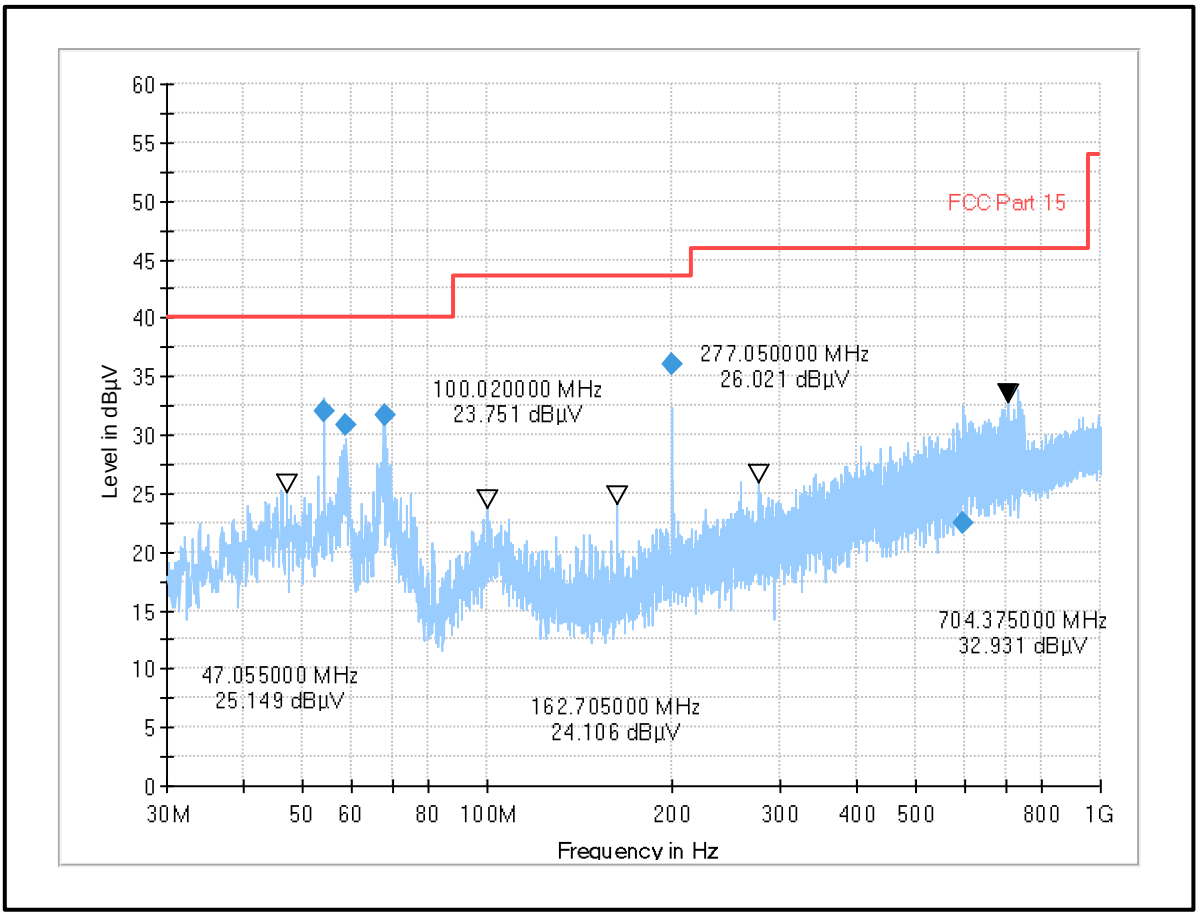
Result: Pass

Transmitter Radiated Emissions (continued)

Results: RFID 13.56 MHz / BIS VM-341-401-S4

Frequency (MHz)	Antenna Polarization	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
54.210000	Vertical	31.94	40.00	8.06	Complied
58.890000	Vertical	30.82	40.00	9.18	Complied
67.845000	Vertical	31.67	40.00	8.33	Complied
200.010000	Vertical	36.01	43.50	7.49	Complied
598.541667	Horizontal	22.49	46.00	23.51	Complied

Plot: 30Mz – 1000MHz – Active RFID



Result: Pass

5.2.6. Transmitter Frequency Stability (Temperature & Voltage Variation)

Test Summary:

Test Engineer:	Muhammad Faiq Khan	**Test Date:**	09 February 2024
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-351-401-S4)		
Test Sample Serial Number:	NH2023000E (Radiated Test Sample BIS VM-341-401-S4)		
Test Site Identification	SR 9		

FCC Reference:	Part 15.225(e)
ISED Reference:	RSS-Gen 6.11 / RSS-210 B6
Test Method Used:	ANSI C63.10 Sections 6.8.1 and 6.8.2

Environmental Conditions:

Ambient Temperature (°C):	20.7
Ambient Relative Humidity (%):	39.6

Settings of the Instrument

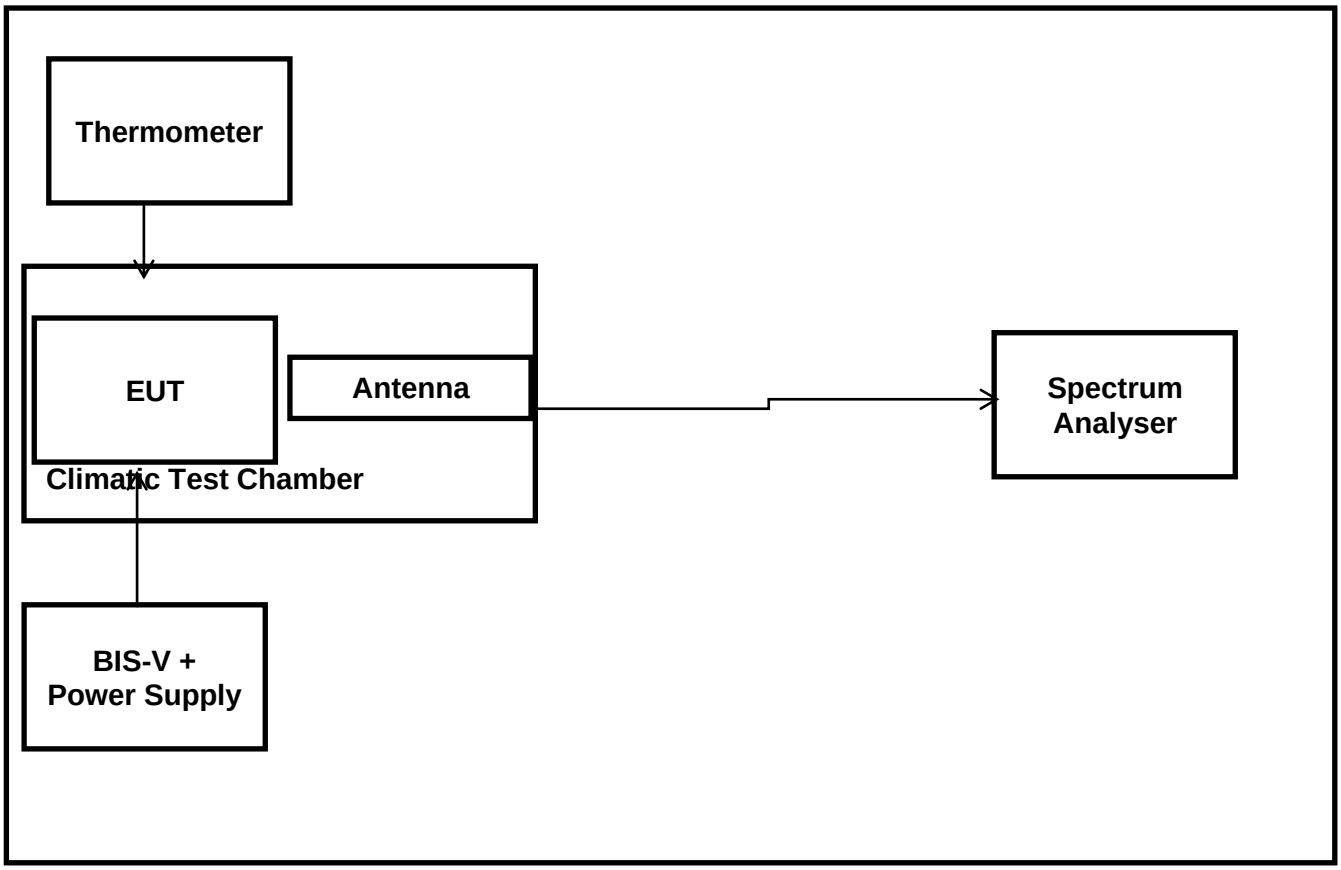
RBW/VBW	30 Hz/30 kHz
Span	3 kHz
Sweep Time	Auto
Sweep Mode	Single Sweep
Detector	Peak
Marker Function	Signal Count

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. Voltage variations tests done with AC/DC laboratory power supply connected directly to BIS-V input ports and with variating the input voltage.
4. For accurate measurement of frequency deviations, Signal Count / frequency counter function was activated on the spectrum analyser.
5. The applicant’s declared operating frequency 13.560 MHz was used as reference frequency.
6. The difference between operating /reference frequency & measured frequency was reported as a frequency error.
7. 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: RFID 13.56 MHz / BIS VM-351-401-S4 / 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	13.560463598	0.003418864	34.19	± 0.01	± 100	Complied
	at 2 minutes	13.560470058	0.003466504	34.67	± 0.01	± 100	Complied
	at 5 minutes	13.560469783	0.003464476	34.64	± 0.01	± 100	Complied
	at 10 minutes	13.560469611	0.003463208	34.63	± 0.01	± 100	Complied
-10	at 0 minutes	13.560468200	0.003452802	34.53	± 0.01	± 100	Complied
	at 2 minutes	13.560461320	0.003402065	34.02	± 0.01	± 100	Complied
	at 5 minutes	13.560457954	0.003377242	33.77	± 0.01	± 100	Complied
	at 10 minutes	13.560457954	0.003377242	33.77	± 0.01	± 100	Complied
0	at 0 minutes	13.560449929	0.003318060	33.18	± 0.01	± 100	Complied
	at 2 minutes	13.560429108	0.003164513	31.65	± 0.01	± 100	Complied
	at 5 minutes	13.560424211	0.003128400	31.28	± 0.01	± 100	Complied
	at 10 minutes	13.560422406	0.003115088	31.15	± 0.01	± 100	Complied
+10	at 0 minutes	13.560418672	0.003087552	30.88	± 0.01	± 100	Complied
	at 2 minutes	13.560389043	0.002869049	28.69	± 0.01	± 100	Complied
	at 5 minutes	13.560380309	0.002804639	28.05	± 0.01	± 100	Complied
	at 10 minutes	13.560376701	0.002778031	27.78	± 0.01	± 100	Complied
+20	at 0 minutes	13.560364454	0.002687714	26.88	± 0.01	± 100	Complied
	at 2 minutes	13.560344229	0.002538562	25.39	± 0.01	± 100	Complied
	at 5 minutes	13.560330823	0.002439698	24.40	± 0.01	± 100	Complied
	at 10 minutes	13.560324753	0.002394934	23.95	± 0.01	± 100	Complied
+30	at 0 minutes	13.560341660	0.002519617	25.20	± 0.01	± 100	Complied
	at 2 minutes	13.560301762	0.002225383	22.25	± 0.01	± 100	Complied
	at 5 minutes	13.560283754	0.002092581	20.93	± 0.01	± 100	Complied
	at 10 minutes	13.560274607	0.002025125	20.25	± 0.01	± 100	Complied
+40	at 0 minutes	13.560274378	0.002023437	20.23	± 0.01	± 100	Complied
	at 2 minutes	13.560240830	0.001776032	17.76	± 0.01	± 100	Complied
	at 5 minutes	13.560230060	0.001696608	16.97	± 0.01	± 100	Complied
	at 10 minutes	13.560223730	0.001649926	16.50	± 0.01	± 100	Complied
+50	at 0 minutes	13.560241059	0.001777721	17.78	± 0.01	± 100	Complied
	at 2 minutes	13.560208092	0.001534602	15.35	± 0.01	± 100	Complied
	at 5 minutes	13.560197347	0.001455361	14.55	± 0.01	± 100	Complied
	at 10 minutes	13.560190224	0.001402832	14.03	± 0.01	± 100	Complied

Result: Pass

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

Results: RFID 13.56 MHz / BIS VM-351-401-S4/ Voltage Variations

Extreme DC Voltage Conditions	Extreme DC Voltage (V)	Measured Frequency (MHz)	Frequency Error		Frequency Error Limits		Result
			%	ppm	%	ppm	
85% of Rated Primary Supply Voltage	20.4	13.56002170	0.002660	26.60	± 0.01	± 100	Complied
Rated Primary Supply Voltage	24	13.56002600	0.002671	26.71	± 0.01	± 100	Complied
115% of Rated Primary Supply Voltage	27.6	13.56002600	0.002804	28.04	± 0.01	± 100	Complied

Result: Pass

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

Results: RFID 13.56 MHz / BIS VM-341-401-S4 / 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	13.560402016	0.002964720	29.65	± 0.01	± 100	Complied
	at 2 minutes	13.560409080	0.003016814	30.17	± 0.01	± 100	Complied
	at 5 minutes	13.560410841	0.003029801	30.30	± 0.01	± 100	Complied
	at 10 minutes	13.560411619	0.003035538	30.36	± 0.01	± 100	Complied
-10	at 0 minutes	13.560422128	0.003113038	31.13	± 0.01	± 100	Complied
	at 2 minutes	13.560422128	0.003113038	31.13	± 0.01	± 100	Complied
	at 5 minutes	13.560422087	0.003112736	31.13	± 0.01	± 100	Complied
	at 10 minutes	13.560422308	0.003114366	31.14	± 0.01	± 100	Complied
0	at 0 minutes	13.560418257	0.003084491	30.84	± 0.01	± 100	Complied
	at 2 minutes	13.560412675	0.003043326	30.43	± 0.01	± 100	Complied
	at 5 minutes	13.560410304	0.003025841	30.26	± 0.01	± 100	Complied
	at 10 minutes	13.560409031	0.003016453	30.16	± 0.01	± 100	Complied
+10	at 0 minutes	13.560327061	0.002411954	24.12	± 0.01	± 100	Complied
	at 2 minutes	13.560338065	0.002493105	24.93	± 0.01	± 100	Complied
	at 5 minutes	13.560355898	0.002624617	26.25	± 0.01	± 100	Complied
	at 10 minutes	13.560367553	0.002710568	27.11	± 0.01	± 100	Complied
+20	at 0 minutes	13.560341322	0.002517124	25.17	± 0.01	± 100	Complied
	at 2 minutes	13.560332835	0.002454535	24.55	± 0.01	± 100	Complied
	at 5 minutes	13.560330918	0.002440398	24.40	± 0.01	± 100	Complied
	at 10 minutes	13.560330376	0.002436401	24.36	± 0.01	± 100	Complied
+30	at 0 minutes	13.560311356	0.002296136	22.96	± 0.01	± 100	Complied
	at 2 minutes	13.560294373	0.002170892	21.71	± 0.01	± 100	Complied
	at 5 minutes	13.560288113	0.002124727	21.25	± 0.01	± 100	Complied
	at 10 minutes	13.560284396	0.002097316	20.97	± 0.01	± 100	Complied
+40	at 0 minutes	13.560285866	0.002108156	21.08	± 0.01	± 100	Complied
	at 2 minutes	13.560262706	0.001937360	19.37	± 0.01	± 100	Complied
	at 5 minutes	13.560249808	0.001842242	18.42	± 0.01	± 100	Complied
	at 10 minutes	13.560242599	0.001789078	17.89	± 0.01	± 100	Complied
+50	at 0 minutes	13.560223680	0.001649558	16.50	± 0.01	± 100	Complied
	at 2 minutes	13.560212582	0.001567714	15.68	± 0.01	± 100	Complied
	at 5 minutes	13.560208559	0.001538046	15.38	± 0.01	± 100	Complied
	at 10 minutes	13.560206026	0.001519366	15.19	± 0.01	± 100	Complied

Result: Pass

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

Results: RFID 13.56 MHz / BIS VM-341-401-S4/ Voltage Variations

Extreme DC Voltage Conditions	Extreme DC Voltage (V)	Measured Frequency (MHz)	Frequency Error		Frequency Error Limits		Result
			%	ppm	%	ppm	
85% of Rated Primary Supply Voltage	20.4	13.5603471	0.002560	25.60	± 0.01	± 100	Complied
Rated Primary Supply Voltage	24	13.5603515	0.002592	25.92	± 0.01	± 100	Complied
115% of Rated Primary Supply Voltage	27.6	13.5603440	0.002537	25.37	± 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 %
99% Emission 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
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
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

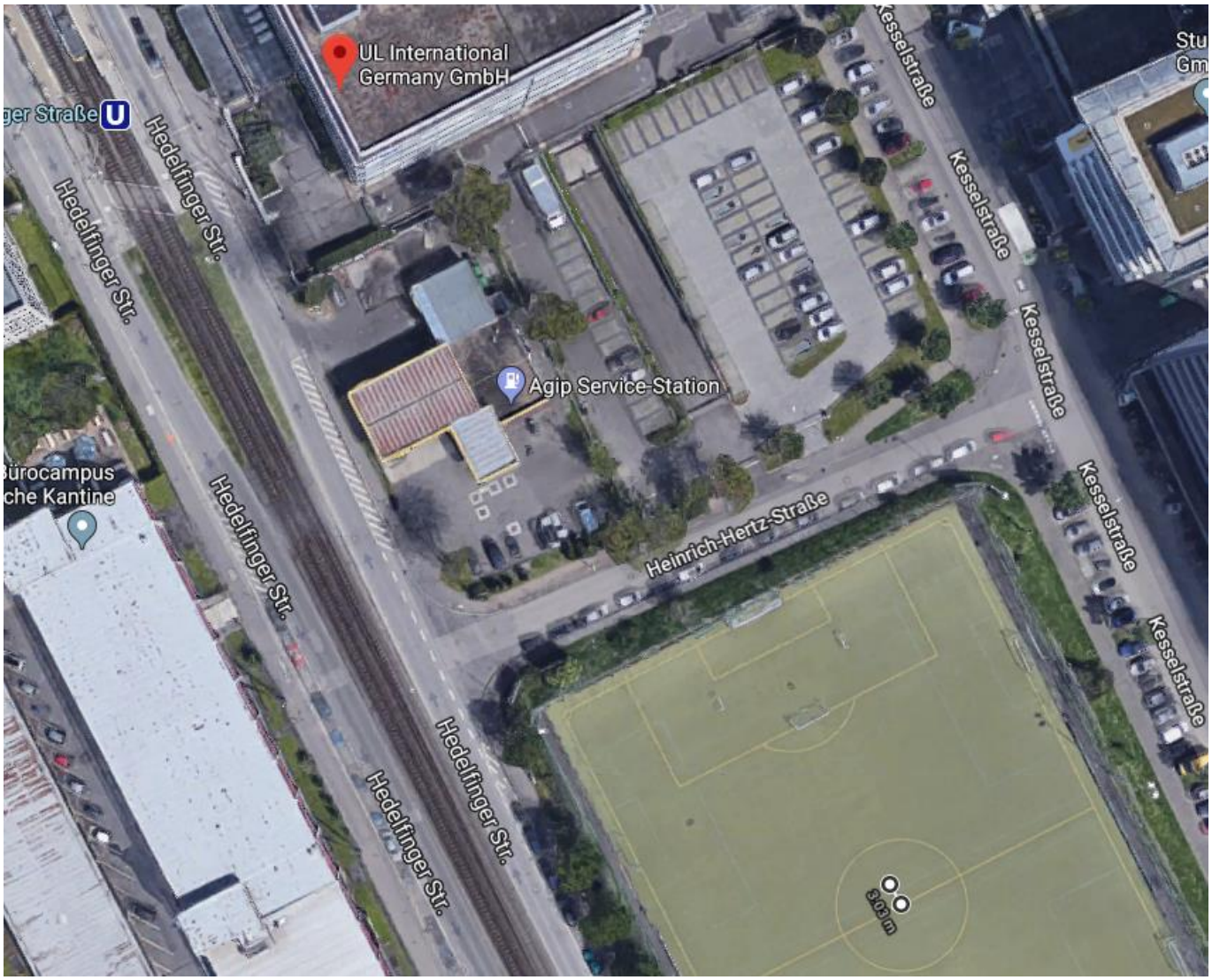
ID	Manufacturer	Type	Model	Serial No.	Calibration Date	Cal. Cycle
22	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/014	18.07.2023	12
23	Rohde & Schwarz	Artificial Mains	ESH3-Z5	831767/013	18.07.2023	12
28	Rohde & Schwarz	Passive Probe	ESH2-Z3	none	13.07.2022	36
215	Rohde & Schwarz	Artificial Mains 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:

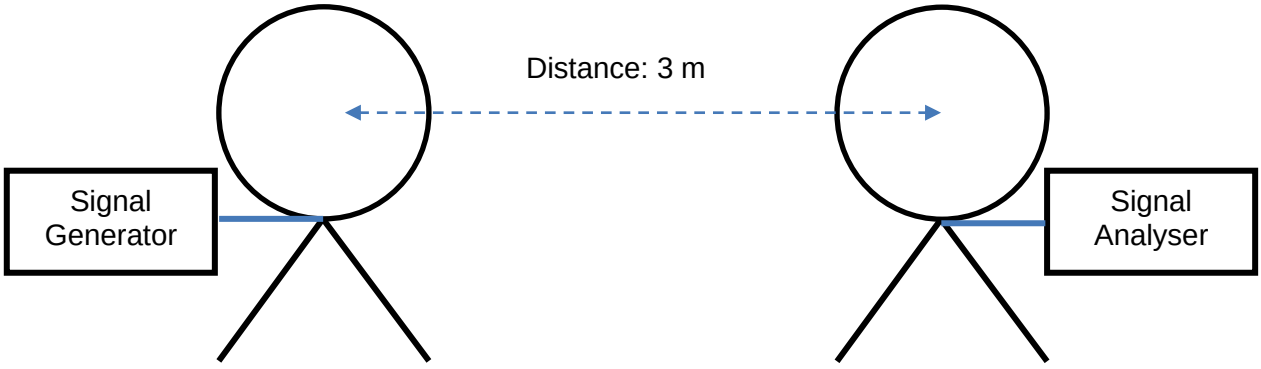
Manufacturer	Type	Model	Frequency Range
Rohde & Schwarz	Signal generator	SML03	9 kHz – 30 MHz
Rohde & Schwarz	Receiver, EMI Test	ESIB7	20 Hz – 7 GHz
Rohde & Schwarz	Antenna, Loop	HFH2-Z2	1 kHz – 30 MHz
ETS LINDGREN	Antenna, Loop	6512	1 kHz – 30 MHz
HUBER+SUHNER	RF Cable	-/-	-/-
Elspec	BNC Cable	-/-	-/-

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

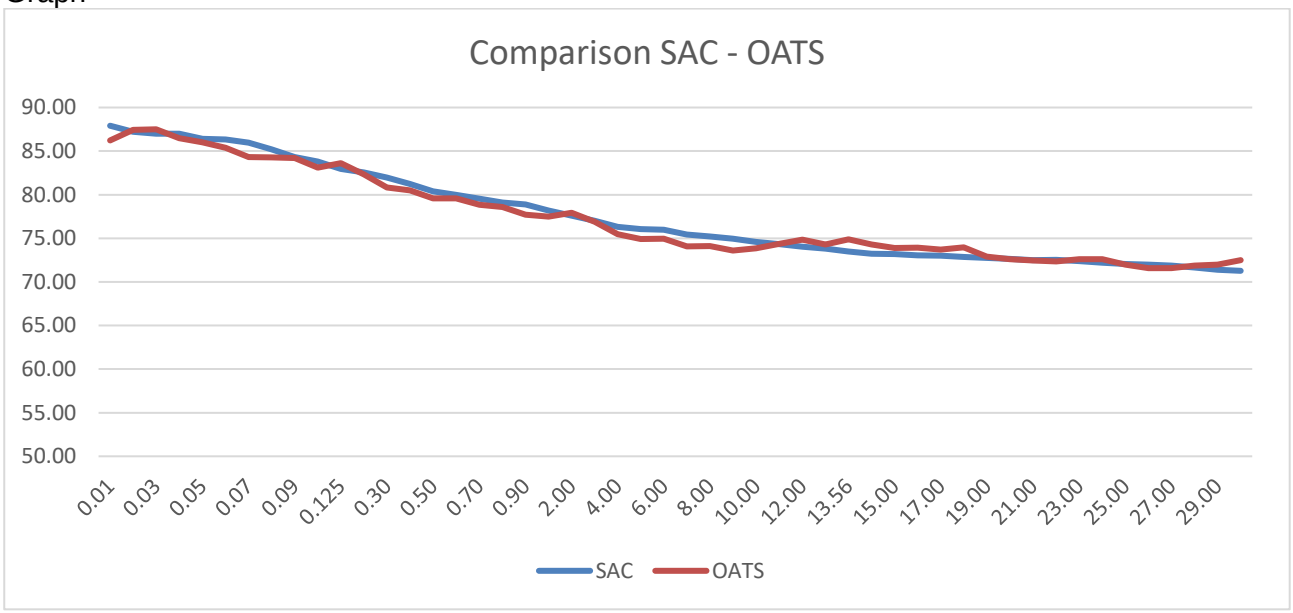
Frequency (MHz)	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	2.00	3.00	4.00	5.00
SR1 Measured power (dBµV)	81.98	81.23	80.39	80.00	79.53	79.10	78.87	78.20	77.60	77.01	76.32	76.04
OATS Measured power (dBµV)	80.84	80.49	79.58	79.58	78.85	78.59	77.69	77.50	77.91	76.90	75.45	74.90
Delta (dB)	-1.14	-0.74	-0.81	-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	-	-	Initial Version
1.1	27-28	5.2.4	Notes updated
	29 & 31	5.2.4	Result table updated
	33 & 34	5.2.5	Notes updated
	35 & 36	5.2.5	Result table updated
	41	5.2.6	Test setup diagram updated
	47	7	Used equipment list updated
Test Report Version 1.2 supersede Version 1.1 with immediate effect Test Report No. UL-RPT-RP-14951907-416 Version 1.1, Issue Date 24 MAY 2024, which is no longer valid is replaced by Test Report No. UL-RPT-RP-14951907-416 Version 1.2, Issue Date 24 MAY 2024.			
1.2	**Page No(s)**	**Clause**	**Details**
	28	5.2.4	Notes updated
	33	5.2.5	Notes updated

--- **END OF TEST REPORT** ---