

RF Test Report

Project Number: 5224763 **Proposal:** SUW-202407006851
Report Number: 5224763EMC03 **Revision Level:** 2
Client: Renesas Electronics America, Inc

Equipment Under Test: Arduino Shield
Model Number: WS031-NFCSchield-REFZ PTX105R Arduino Shield
FCC ID: 2AU6X-WS031NFCSD
IC ID: 20519-WS031NFCSD

Applicable Standards: FCC Part 15 Subpart B, § 15.109
FCC Part 15 Subpart C, § 15.209; 15.215; 15.225
ANSI C63.10: 2013
RSS-210, Issue 11, June 2024
RSS-GEN Issue 5, April 2018

Report issued on: 30 October 2024
Report revised on: 10 April 2025
Test Result: Compliant

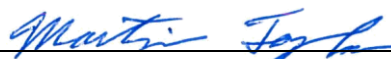


FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER: 3212.01
This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

Prepared by:


Daniel Alvarez, RF/EMC Sr Staff Engineer

Reviewed by:


Martin Taylor, Project Engineer

Remarks: This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>. And for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/terms-e-document.aspx>.

Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for a maximum of 30 days only.

Table of Contents

1	SUMMARY OF TEST RESULTS	4
1.1	MODIFICATIONS REQUIRED FOR COMPLIANCE	4
2	GENERAL INFORMATION.....	5
2.1	CLIENT INFORMATION	5
2.2	TEST LABORATORY	5
2.3	GENERAL INFORMATION OF EUT	5
2.4	OPERATING MODES AND CONDITIONS	5
2.5	EUT CONNECTION BLOCK DIAGRAM – RADIATED MEASUREMENTS	6
2.6	SYSTEM CONFIGURATIONS	6
2.7	CABLE LIST	6
3	ANTENNA REQUIREMENT.....	7
3.1	RESULT.....	7
3.2	REQUIREMENT.....	7
3.3	CONCLUSION	7
3.4	PHOTOGRAPH	7
4	OCCUPIED BANDWIDTH	8
4.1	TEST RESULT.....	8
4.2	TEST METHOD.....	8
4.3	TEST SITE	8
4.4	TEST EQUIPMENT	8
4.5	TEST DATA.....	9
5	RADIATED EMISSIONS.....	10
5.1	TEST RESULT.....	10
5.2	TEST METHOD.....	10
5.3	TEST SITE	11
5.4	TEST EQUIPMENT	11
5.5	TEST SETUP PHOTOGRAPHS.....	11
5.6	9kHz – 30 MHz	12
5.7	30 MHz - 1000 MHz	15
6	FIELD STRENGTH OF FUNDAMENTAL	16
6.1	TEST RESULT.....	16
6.2	TEST METHOD.....	16
6.3	TEST SETUP DIAGRAM.....	16
6.4	TEST SITE	17
6.5	TEST EQUIPMENT	17
6.6	TEST SETUP PHOTOGRAPHS.....	17
6.7	TEST DATA:.....	18
7	RADIATED SPURIOUS EMISSIONS.....	19
7.1	TEST RESULT.....	19
7.2	TEST METHOD.....	19
7.3	TEST SITE	20
7.4	TEST EQUIPMENT	20
7.5	TEST SETUP PHOTOGRAPHS.....	20
7.6	9kHz – 30 MHz	21
7.7	30 MHz - 1000 MHz	24
8	FREQUENCY STABILITY	25
8.1	TEST RESULT.....	25



8.2	TEST METHOD.....	25
8.3	TEST SITE	25
8.4	TEST EQUIPMENT	25
8.5	TEST DATA.....	26
9	MEASUREMENT UNCERTAINTY.....	27
10	REVISION HISTORY.....	28

1 Summary of Test Results

Test Description	Test Specification	Test Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 RSS-GEN Section 8.3	Compliant
Bandwidth	15.215(c); RSS-GEN 6.7	Compliant
Radiated Emissions (Unintentional Radiator)	47 CFR Part 15, Subpart B 15.109 ANSI C63.4:2014, Section 8.3 RSS-210, A.1.2	Compliant
Field strength of fundamental	47 CFR Part 15, Subpart C 15.225; 15.209 ANSI C63.10:2013, Section 6.3 RSS-Gen S7.2.5	Compliant
Radiated Spurious Emissions	47 CFR Part 15, Subpart C; 15.215; 15.225; 15.209; RSS-210 B.6(a) ANSI C63.10:2013, Section 6.2 through 6.5	Compliant
Frequency Stability	15.225(e); RSS-210 B.6(b)	Compliant
Conducted Emissions	47 CFR Part 15, Subpart C 15.207 ANSI C63.10:2013, Section 6.2	N/A ⁽¹⁾

1) Product is DC powered. Test is not applicable.

1.1 Modifications Required for Compliance

None

2 General Information

2.1 Client Information

Name: Renesas Electronics America, Inc
Address: 710 Slater Rd, Suite 200
City, State, Zip, Country: Morrisville, North Carolina 27560

2.2 Test Laboratory

Name: SGS North America, Inc.
Address: 620 Old Peachtree Road NW, Suite 100
City, State, Zip, Country: Suwanee, GA 30024, USA

Accrediting Body: A2LA
Type of lab: Testing Laboratory
Certificate Number: 3212.01
ISED CAB Identifier: US0186
FCC Designation Number: US1126

2.3 General Information of EUT

Product Marketing Name (PMN): Arduino Shield
Model Number (HVIN): WS031-NFCSchield-REFZ PTX105R Arduino Shield
Firmware Version ID (FVIN): N/A
Serial Number: SGS ID# 20240903638
FCC ID: 2AU6X-WS031NFCSD
ISED ID: 20519-WS031NFCSD

Operating Frequency: 13.56 MHz
Transmitter: PTX105R NFC Reader
Data Modes: RFID – ASK
Antenna: PCB Loop Antenna*

Rated Voltage: +5 VDC
Test Voltage: +5 VDC

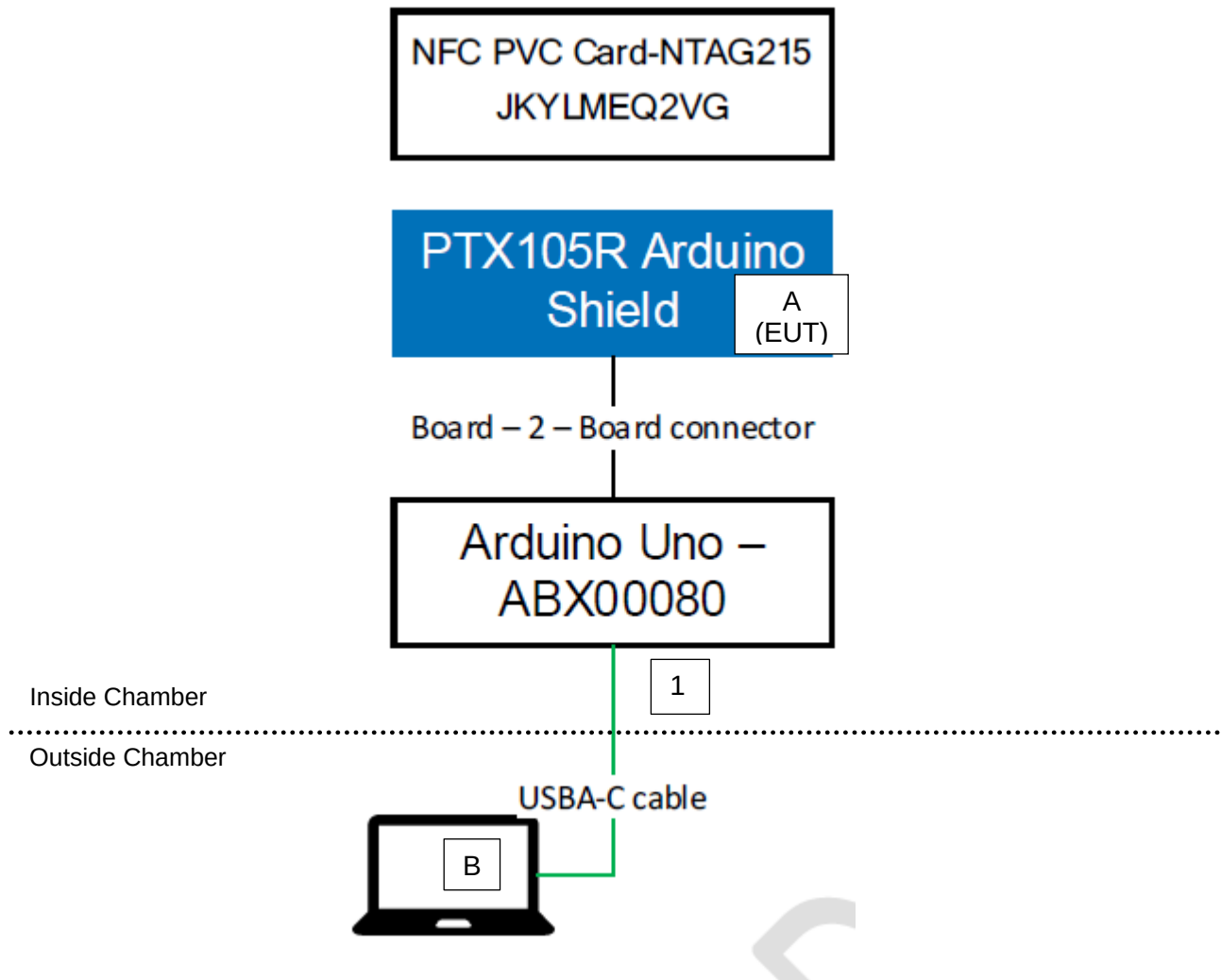
Sample Received Date: 14 September 2024
Dates of testing: 14 September 2024 – 08 April 2025

**Data was not measured; therefore, the lab is not responsible for accuracy. Data was obtained via customer, specification sheet, previous regulatory filing, or other means.*

2.4 Operating Modes and Conditions

During emissions testing, the EUT was powered and set into a test mode to exercise the product transmitter during testing. NFC was set with a high duty cycle and continuously read the RFID card during testing.

2.5 EUT Connection Block Diagram – Radiated Measurements



2.6 System Configurations

Device reference	Manufacturer	Description	Model Number	Serial Number
A	Renesas	Arduino Shield	WS031-NFCSchield-REFZ PTX105R Arduino Shield	SGS ID# 20240903638
B	Lenovo	ThinkPad	T440p	Lab PC#2

2.7 Cable List

Cable reference	Port Name	Start	End	Cable Length (m)	Ferrite installed?	Shielded?
1	USB Cable	EUT	External AC Adapter	1	N	N

3 Antenna Requirement

3.1 Result

Test Description	Test Specification		Test Result
Antenna requirement	FCC 15.203	RSS-GEN S8.3	Compliant

3.2 Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

3.3 Conclusion

PCB Loop Antenna is permanently attached and does not allow the user to disconnect. This meets the antenna requirements for FCC and ISED.

3.4 Photograph

The photograph of the antenna is shown in a separate exhibit.

4 Occupied Bandwidth

4.1 Test Result

Test Description	Basic Standards	Test Result
99% Bandwidth	RSS-GEN 6.7	Compliant
20dB Bandwidth	15.215(c)	Compliant

4.2 Test Method

The 99% occupied bandwidth and 20dB down measurement was employed.

4.3 Test Site

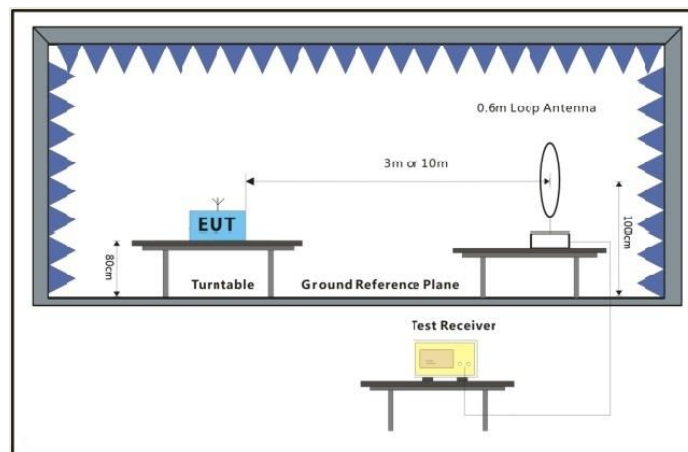
SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.4 °C

Relative Humidity: 19.7 %

Atmospheric Pressure: 7.8 kPa



Below 30MHz

4.4 Test Equipment

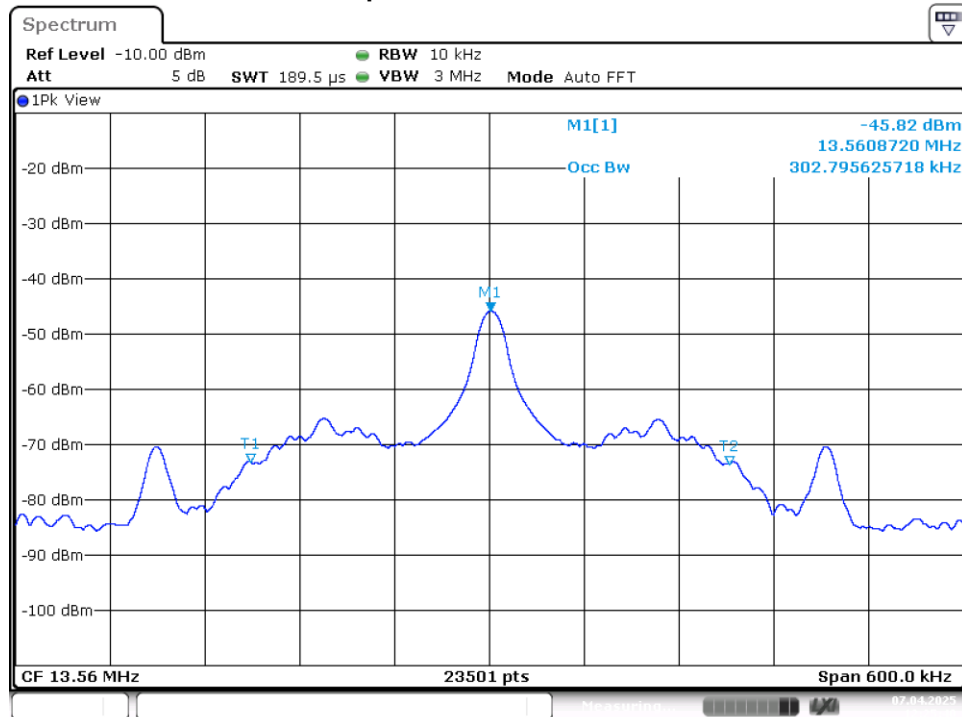
Test End Date: 7-April-2025

Tester: DA

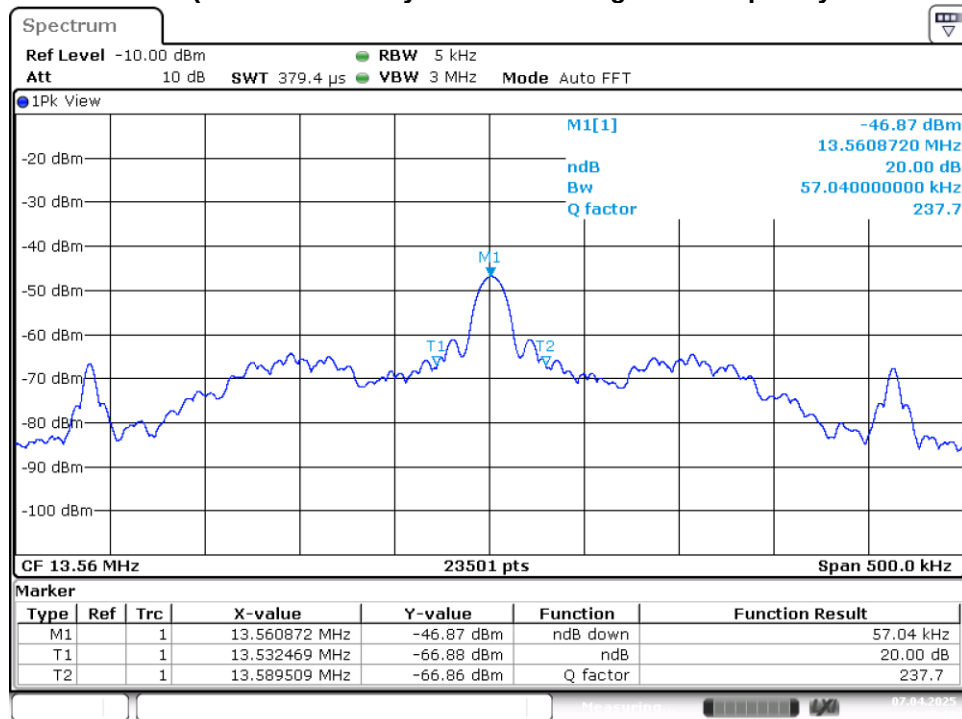
Equipment	Manufacturer	Model	Asset Number	Cal Date	Cal Due Date
RF CABLE (TS8997)	HUBER & SUHNER	141	B095585	8-Jul-2024	8-Jul-2025
NEAR FIELD PROBES	COM-POWER CORPORATION	N/A	16016	CNR	CNR
SIGNAL ANALYZER (TS8997)	ROHDE & SCHWARZ	FSV30	B085749	4-Mar-2025	4-Mar-2026

4.5 Test Data

99% Occupied Bandwidth = 302.796kHz



20dB Bandwidth = 57.04kHz (This falls entirely within the designated frequency band 13.110-14.010MHz)



5 Radiated Emissions

5.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15, Subpart B, 15.109 RSS-Gen S7.2.5 ANSI C63.4: 2014	Compliant

5.2 Test Method

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak and Average detector above 1GHz. The receivers resolution bandwidth was set to 1kHz for measurements taken below 150kHz, 9kHz for in the 150kHz to 30MHz range, 120 kHz in the 30MHz to 1GHz frequency range, and 1MHz for measurements of 1GHz and higher. For testing below 30MHz, a loop antenna was employed, and peak scans were taken with the loop open towards the EUT (Co-Axial) and with the loop in-line with the EUT (Co-Planar). Above 30MHz, a biconilog antenna was used and measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limits (testing above 1GHz was not required for this device)

Frequency Range (MHz)	Limits (uV/m) Quasi-Peak or Average	Measurement Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note: Limits were converted to dBuV/m using the equation $20 \cdot \text{LOG}(x)$. Additionally, for measurements below 30MHz, the limits were adjusted to a distance of 3m using a 40dB/decade correction per §15.31(f)(2)

Example: at 20MHz, the limit is expressed as 30uV/m at 30m

$$20 \cdot \log(30) = 29.5 \text{ dBuV/m}$$

30 to 3 meters is a single decade, so $29.5 + 40 = 69.5 \text{ dBuV/m}$

5.3 Test Site

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.72
Relative Humidity: 55%
Atmospheric Pressure: 98.26 kPa

5.4 Test Equipment

Test End Date: 2-Oct-2024

Tester: SGM

Equipment	Manufacturer	Model	Asset Number	Cal Date	Cal Due Date
PASSIVE LOOP ANTENNA, 9KHZ - 30MHZ	ETS LINDGREN	6512	20151	13-Feb-2024	13-Feb-2025
N to N RF Cable	ECHELON	EM-B810NM-276	23007	31-Mar-2024	31-Mar-2025
N-FEMALE TO N-MALE RF CABLE	ECHELON	EM-B810NMNF-118	23010	17-Apr-2024	17-Apr-2025
RF CABLE NM TO NM, 0.01-18GHZ	TELEDYNE STORM MICROWAVE	90-195-118	20126	6-Feb-2024	6-Feb-2025
BROADBAND PREAMPLIFIER 9KHZ-2GHZ	SCHWARZBECK MESS ELEKTRONIK	BBV 9745	20157	10-Oct-2023	10-Oct-2024
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	22032	15-Nov-2023	15-Nov-2024

Software:

“Radiated Emissions” TILE! profile dated (12- 2015)

5.5 Test Setup Photographs

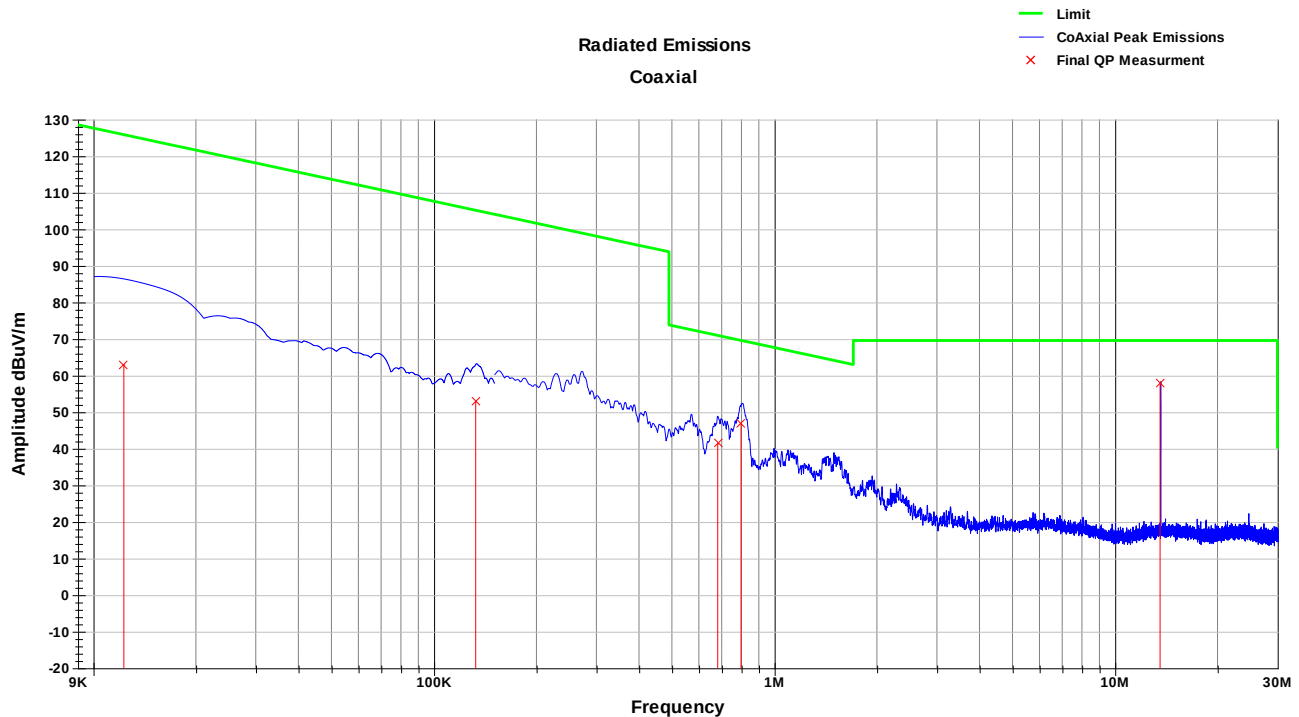
Photographs are shown in a separate exhibit.

5.6 9kHz – 30 MHz

No discernable difference in emissions between axis. Worst case reported.

No discernable difference in emissions between axis. Worst case reported.

Coaxial Plot

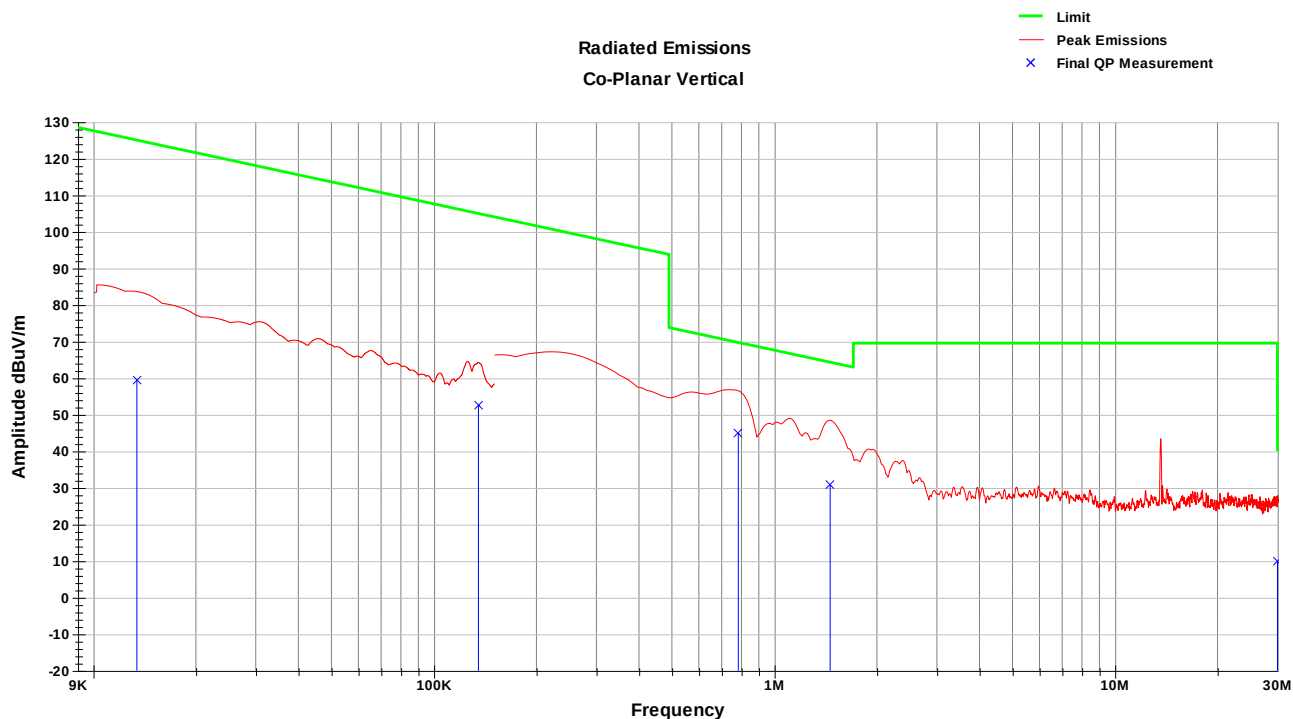


Note: Frequency at 0.012 MHz was noise floor related and not related to the transmitter emissions.

Coaxial Data

Frequency MHz	Raw QP dBuV	Azimuth degrees	Height cm	AF dB	CL dB	QP Value dBuV/m	QP Limit dBuV/m	Margin dB
0.012	12.0	226.0	0.0	82.8	0.0	63.0	125.8	-62.8
0.133	21.7	170.0	0.0	63.1	0.0	53.0	105.1	-52.2
0.681	23.5	281.0	0.0	49.3	0.1	41.5	70.9	-29.5
0.798	30.0	60.0	0.0	48.1	0.1	46.8	69.6	-22.8
13.560	54.4	328.0	0.0	34.1	0.2	57.8	69.5	-11.7
Level + AF + CL - Amp								
Margin = QP Value - Limit								

Vertical Co-Planar Plot

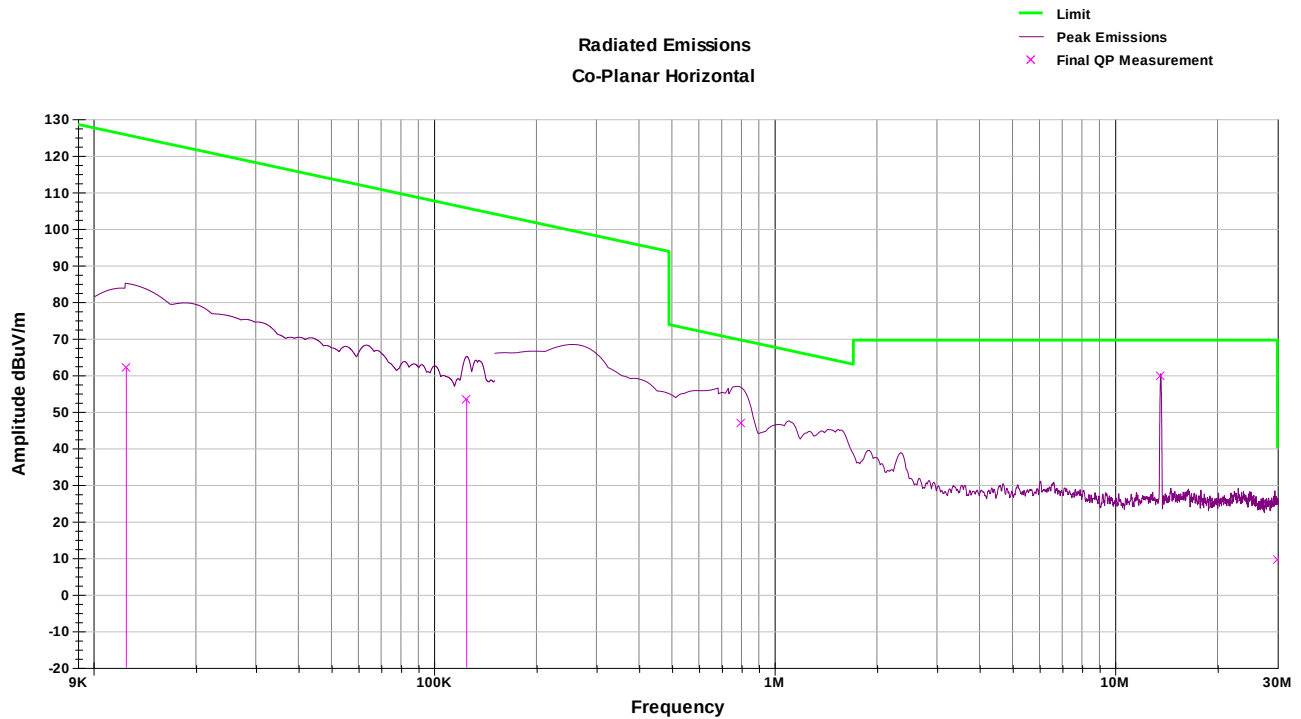


Note: Frequencies at 0.013, 0.135, 0.783 MHz was noise floor or un-intentional emissions and not related to the transmitter emissions.

Vertical Co-Planar Data

Frequency MHz	Raw QP dBuV	Azimuth degrees	Height cm	AF dB	CL dB	QP Value dBuV/m	Limit dBuV/m	Margin dB
0.013	9.0	360.0	0.0	82.4	0.0	59.6	125.0	-65.5
0.135	21.5	155.0	0.0	62.9	0.0	52.6	105.0	-52.4
0.783	28.0	194.0	0.0	48.2	0.1	44.9	69.7	-24.8
1.46	17.9	-1.0	0.0	43.9	0.1	30.8	64.3	-33.6
30.00	6.7	175.0	0.0	33.8	0.3	9.8	40.0	-30.2
QP Value = Level + AF + CL - Amp								
Margin = QP Value - Limit								

Horizontal Co-Planar Plot

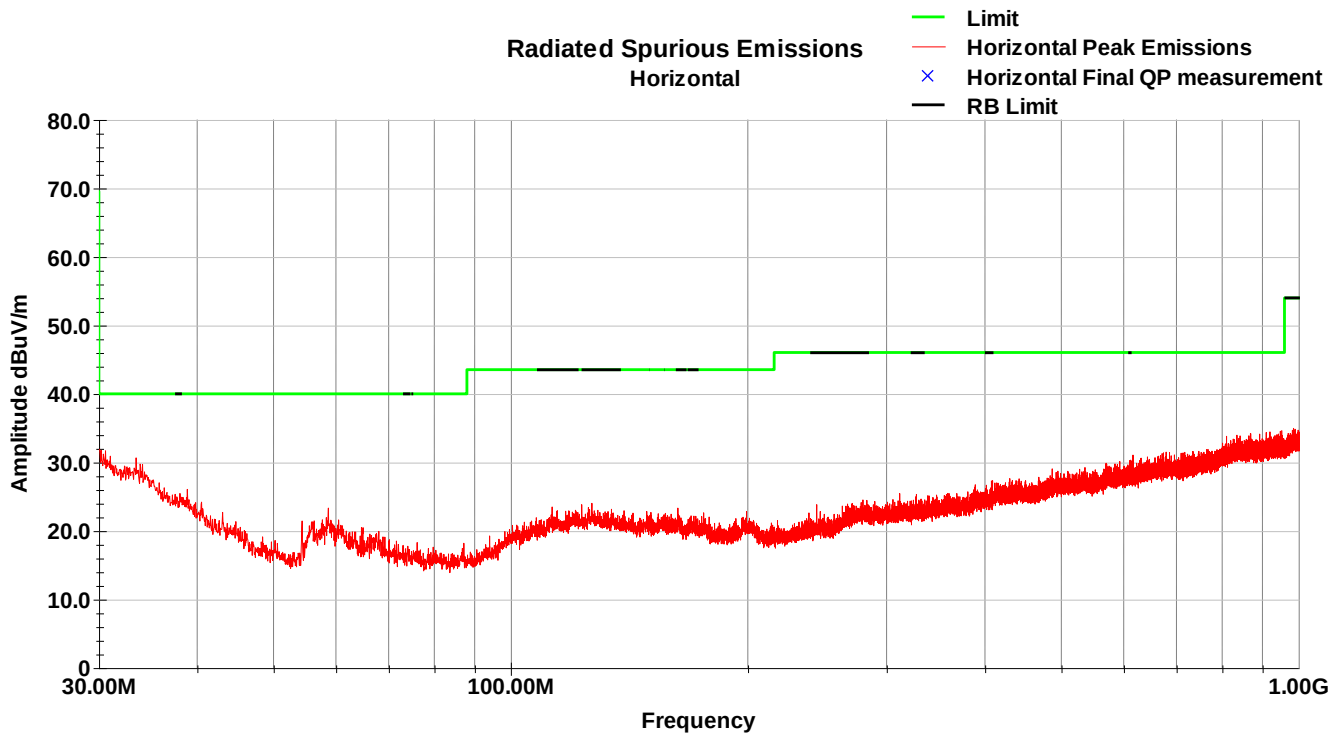
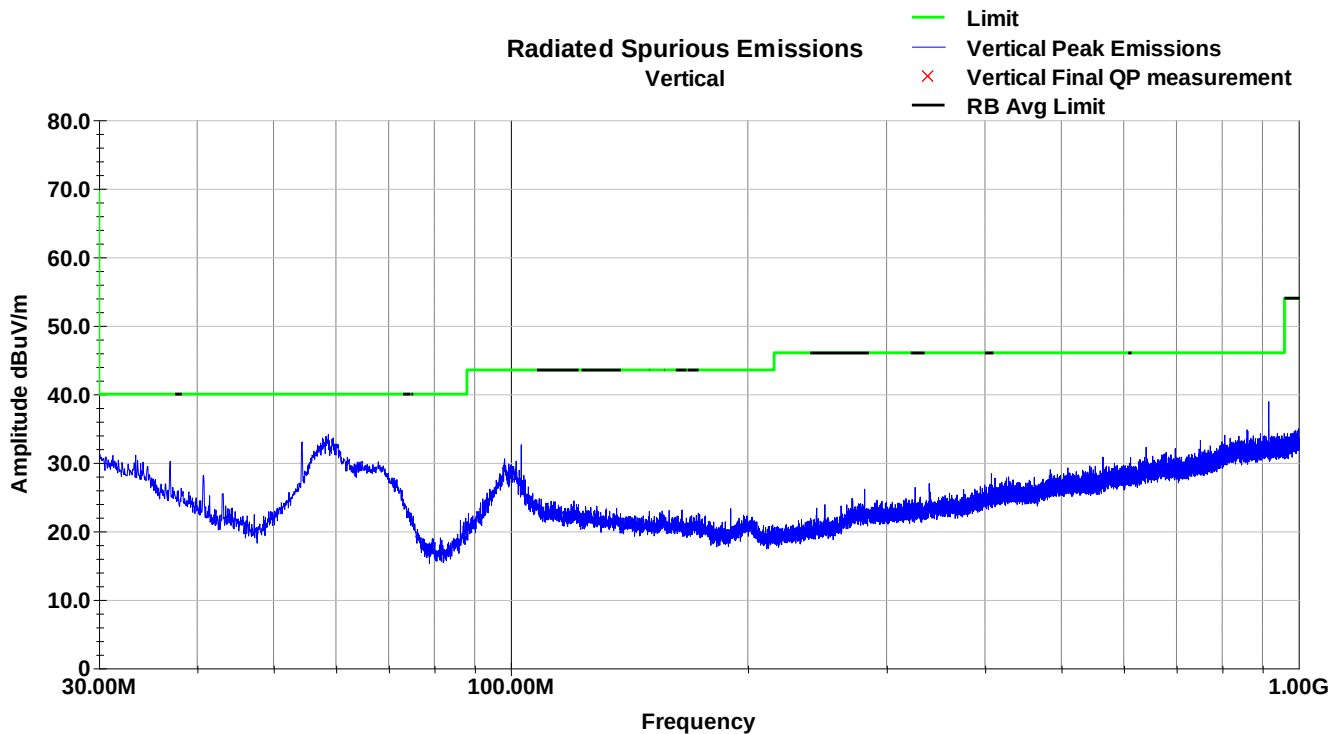


Note: Frequency at 0.013MHz was noise floor and not related to the transmitter emissions.

Horizontal Co-Planar Data

Frequency MHz	Raw QP dBuV	Azimuth degrees	Height cm	AF dB	CL dB	QP Value dBuV/m	Limit dBuV/m	Margin dB
0.013	11.1	62.0	0.0	82.7	0.0	62.0	125.7	-63.6
0.125	21.8	90.0	0.0	63.5	0.0	53.5	105.7	-52.2
0.798	30.1	142.0	0.0	48.1	0.1	46.9	69.6	-22.7
13.56	56.6	-1.0	0.0	34.1	0.2	60.0	69.5	-9.6
29.99	6.5	146.0	0.0	33.8	0.3	9.6	69.5	-59.9
Level + AF + CL - Amp								
Margin = QP Value - Limit								

5.7 30 MHz - 1000 MHz



6 Field Strength of Fundamental

6.1 Test Result

Test Description	Test Specification		Test Result
Field strength of fundamental	FCC Part 15, Subpart C, 15.225; 15.209	RSS-210, B.6(a)	Compliant
	ANSI C63.10:2013, Section 6.3		

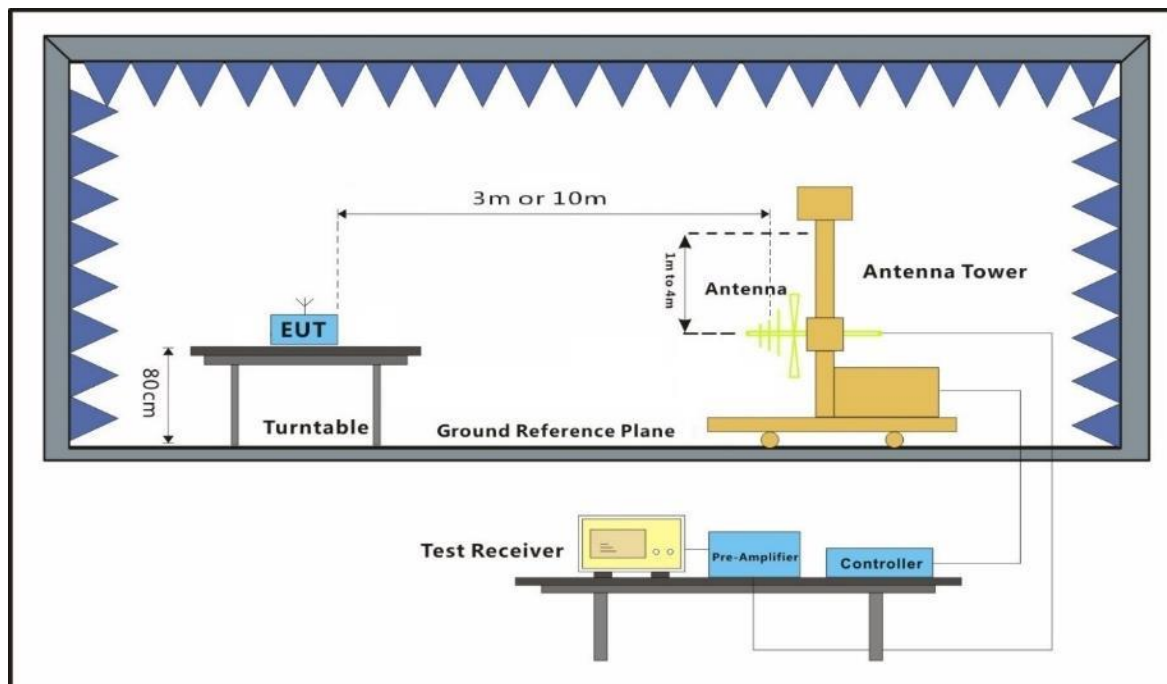
6.2 Test Method

The test data was measured using a Peak detector. Average measurements were made by correcting the peak value with the duty cycle correction factor. The receiver's resolution bandwidth was set to 200 Hz for measurements taken in the 9kHz to 30MHz frequency range and 120kHz for measurements for 30MHz and higher. Measurements were made with the antenna positioned at a 3m distance from the EUT in both the horizontal and vertical planes of polarization. The antenna height varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

The radiation measurements were performed in X, Y, Z axis positioning.

Calculations: Field Strength = measured value + antenna factor + cable loss – pre-amp factor

6.3 Test Setup Diagram



6.4 Test Site

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.72
Relative Humidity: 55%
Atmospheric Pressure: 98.26 kPa

6.5 Test Equipment

Test End Date: 2-Oct-2024

Tester: SGM

Equipment	Manufacturer	Model	Asset Number	Cal Date	Cal Due Date
PASSIVE LOOP ANTENNA, 9KHZ - 30MHZ	ETS LINDGREN	6512	20151	13-Feb-2024	13-Feb-2025
N to N RF Cable	ECHELON	EM-B810NM-276	23007	31-Mar-2024	31-Mar-2025
N-FEMALE TO N-MALE RF CABLE	ECHELON	EM-B810NMNF-118	23010	17-Apr-2024	17-Apr-2025
RF CABLE NM TO NM, 0.01-18GHZ	TELEDYNE STORM MICROWAVE	90-195-118	20126	6-Feb-2024	6-Feb-2025
BROADBAND PREAMPLIFIER 9KHZ-2GHZ	SCHWARZBECK MESS ELEKTRONIK	BBV 9745	20157	10-Oct-2023	10-Oct-2024
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	22032	15-Nov-2023	15-Nov-2024

Software:

“Radiated Emissions” TILE! profile dated (12- 2015)

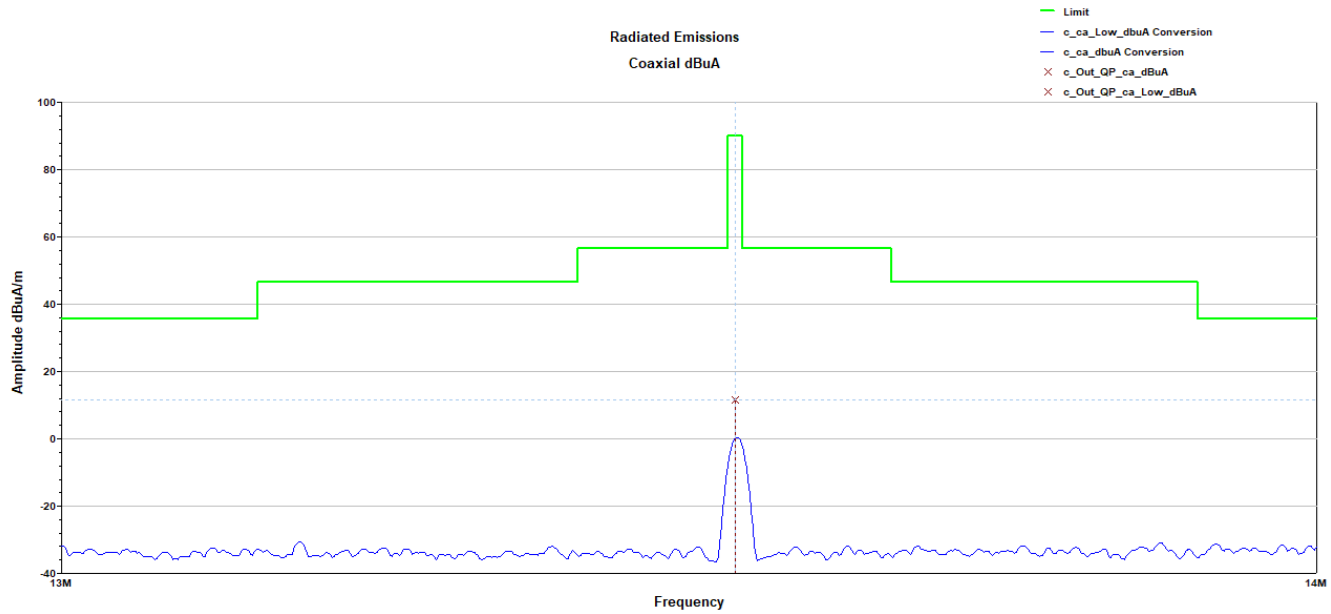
6.6 Test Setup Photographs

Photographs are shown in a separate exhibit.

6.7 Test Data:

No discernable difference in emissions between axis. Worst case reported.

Coaxial Plot – 3m



Coaxial Data

Frequency MHz	Azimuth degrees	Height cm	AF dB	CL dB	Limit dBuA/m	QP Value dBuA/m	Raw QP Value dBuA	Margin dB
0.26	38.0	0.0	57.4	0.0	65.3	1.3	-24.5	-64.0
13.56	122.0	0.0	34.1	0.2	90.0	11.6	8.2	-78.4
27.13	288.0	0.0	33.6	0.3	35.5	-28.7	-31.5	-64.2

QP Value = Level + AF + CL - Amp

Margin = QP Value - Limit

7 Radiated Spurious Emissions

7.1 Test Result

Test Description	Basic Standards	Test Result
Radiated Emissions	FCC Part 15, Subpart C, 15.209, 15.215, 15.225 RSS-Gen S8 ANSI C63.10: 2013	Compliant

7.2 Test Method

Exploratory scans were performed over the frequency range as indicated in the tables below using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak and Average detector above 1GHz. The receivers resolution bandwidth was set to 1kHz for measurements taken below 150kHz, 9kHz for in the 150kHz to 30MHz range, 120 kHz in the 30MHz to 1GHz frequency range, and 1MHz for measurements of 1GHz and higher. For testing below 30MHz, a loop antenna was employed, and peak scans were taken with the loop open towards the EUT (Co-Axial) and with the loop in-line with the EUT (Co-Planar). Above 30MHz, a biconilog antenna was used and measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated in the table below.

Radiated emissions limits (testing above 1GHz was not required for this device)

Frequency Range (MHz)	Limits (uV/m) Quasi-Peak or Average	Measurement Distance (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note: Limits were converted to dBuV/m using the equation $20 \cdot \text{LOG}(x)$. Additionally, for measurements below 30MHz, the limits were adjusted to a distance of 3m using a 40dB/decade correction per §15.31(f)(2)

Example: at 20MHz, the limit is expressed as 30uV/m at 30m

$$20 \cdot \log(30) = 29.5 \text{ dBuV/m}$$

$$30 \text{ to } 3 \text{ meters is a single decade, so } 29.5 + 40 = 69.5 \text{ dBuV/m}$$

7.3 Test Site

10m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

Environmental Conditions

Temperature: 22.72
Relative Humidity: 55%
Atmospheric Pressure: 98.26 kPa

7.4 Test Equipment

Test End Date: 2-Oct-2024

Tester: SGM

Equipment	Manufacturer	Model	Asset Number	Cal Date	Cal Due Date
PASSIVE LOOP ANTENNA, 9KHZ - 30MHZ	ETS LINDGREN	6512	20151	13-Feb-2024	13-Feb-2025
N to N RF Cable	ECHELON	EM-B810NM-276	23007	31-Mar-2024	31-Mar-2025
N-FEMALE TO N-MALE RF CABLE	ECHELON	EM-B810NMNF-118	23010	17-Apr-2024	17-Apr-2025
RF CABLE NM TO NM, 0.01-18GHZ	TELEDYNE STORM MICROWAVE	90-195-118	20126	6-Feb-2024	6-Feb-2025
BROADBAND PREAMPLIFIER 9KHZ-2GHZ	SCHWARZBECK MESS ELEKTRONIK	BBV 9745	20157	10-Oct-2023	10-Oct-2024
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	22032	15-Nov-2023	15-Nov-2024

Software:

“Radiated Emissions” TILE! profile dated (12- 2015)

7.5 Test Setup Photographs

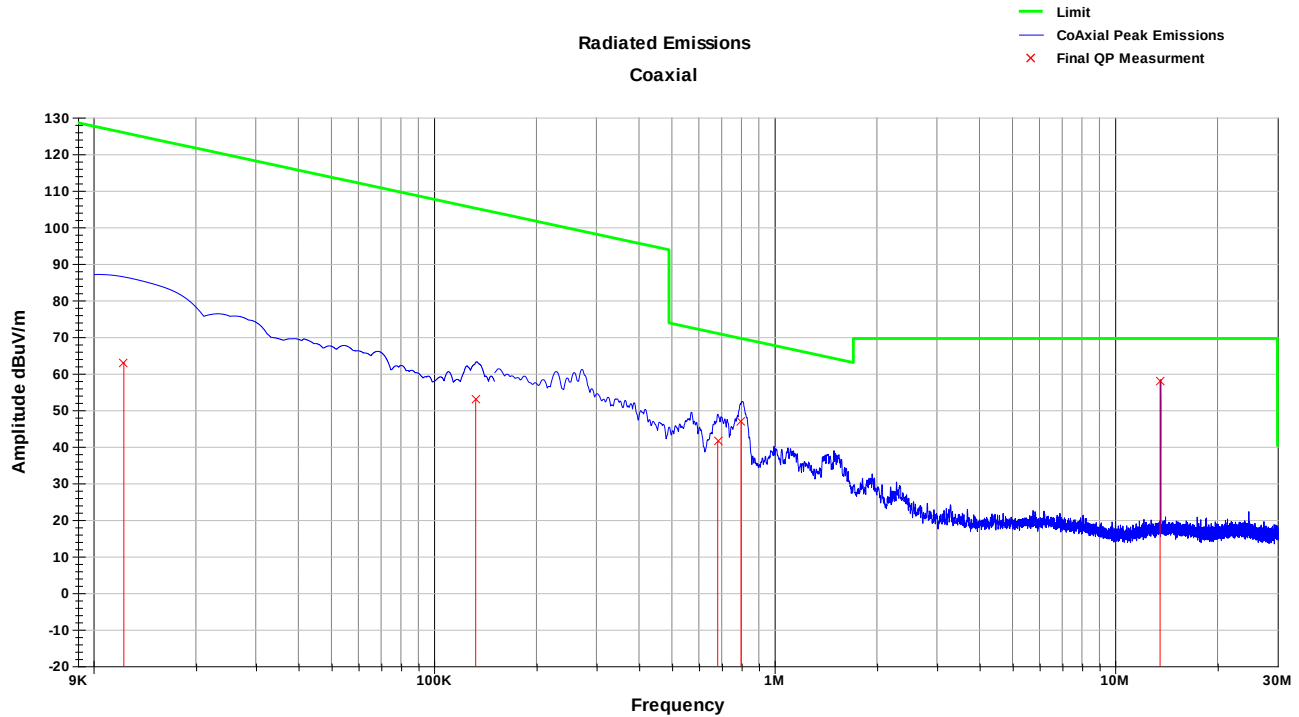
Photographs are shown in a separate exhibit.

7.6 9kHz – 30 MHz

No discernable difference in emissions between axis. Worst case reported.

No discernable difference in emissions between axis. Worst case reported.

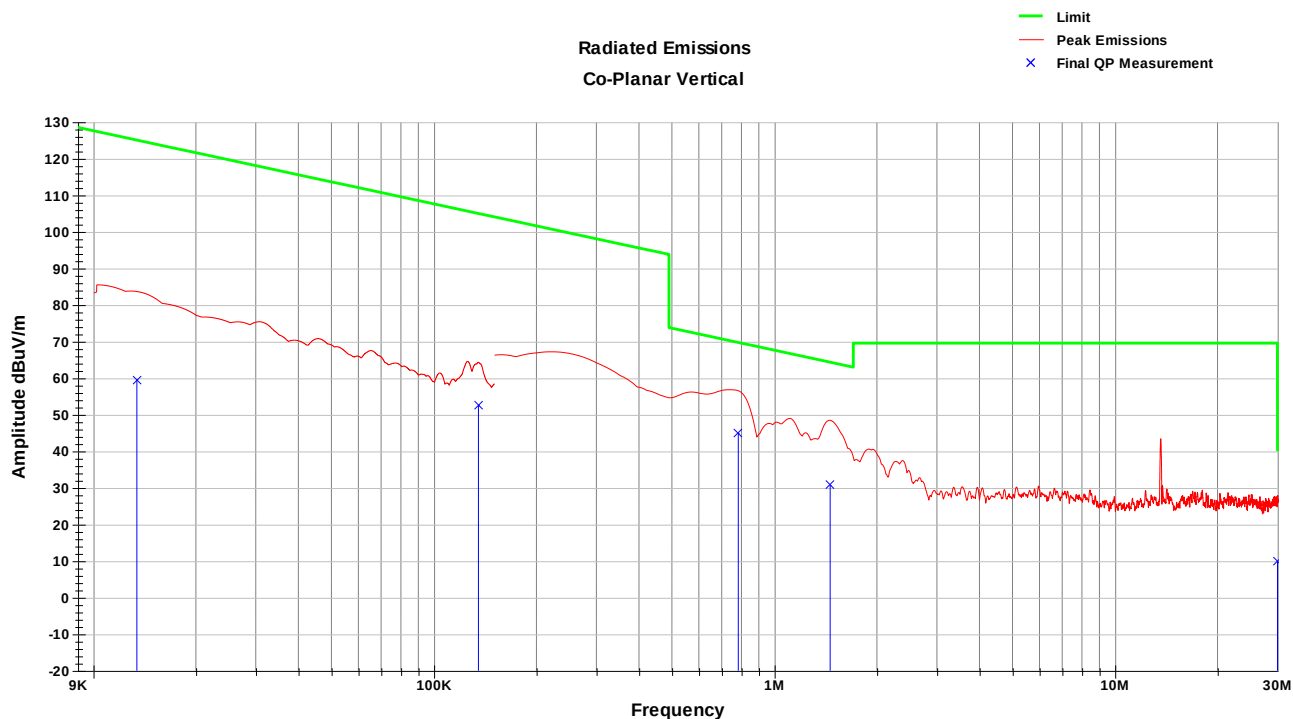
Coaxial Plot



Coaxial Data

Frequency MHz	Raw QP dBuV	Azimuth degrees	Height cm	AF dB	CL dB	QP Value dBuV/m	QP Limit dBuV/m	Margin dB
0.012	12.0	226.0	0.0	82.8	0.0	63.0	125.8	-62.8
0.133	21.7	170.0	0.0	63.1	0.0	53.0	105.1	-52.2
0.681	23.5	281.0	0.0	49.3	0.1	41.5	70.9	-29.5
0.798	30.0	60.0	0.0	48.1	0.1	46.8	69.6	-22.8
13.560	54.4	328.0	0.0	34.1	0.2	57.8	69.5	-11.7
Level + AF + CL - Amp								
Margin = QP Value - Limit								

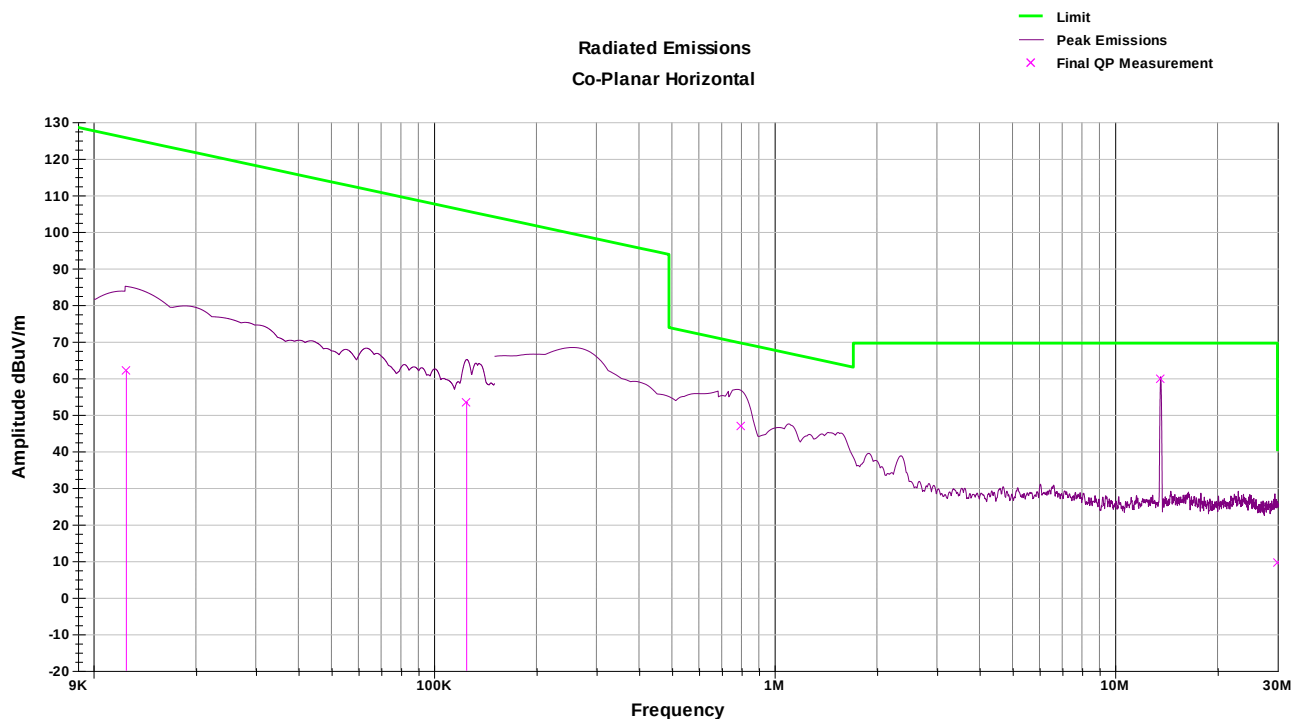
Vertical Co-Planar Plot



Vertical Co-Planar Data

Frequency MHz	Raw QP dBuV	Azimuth degrees	Height cm	AF dB	CL dB	QP Value dBuV/m	Limit dBuV/m	Margin dB
0.013	9.0	360.0	0.0	82.4	0.0	59.6	125.0	-65.5
0.135	21.5	155.0	0.0	62.9	0.0	52.6	105.0	-52.4
0.783	28.0	194.0	0.0	48.2	0.1	44.9	69.7	-24.8
1.46	17.9	-1.0	0.0	43.9	0.1	30.8	64.3	-33.6
30.00	6.7	175.0	0.0	33.8	0.3	9.8	40.0	-30.2
QP Value = Level + AF + CL - Amp								
Margin = QP Value - Limit								

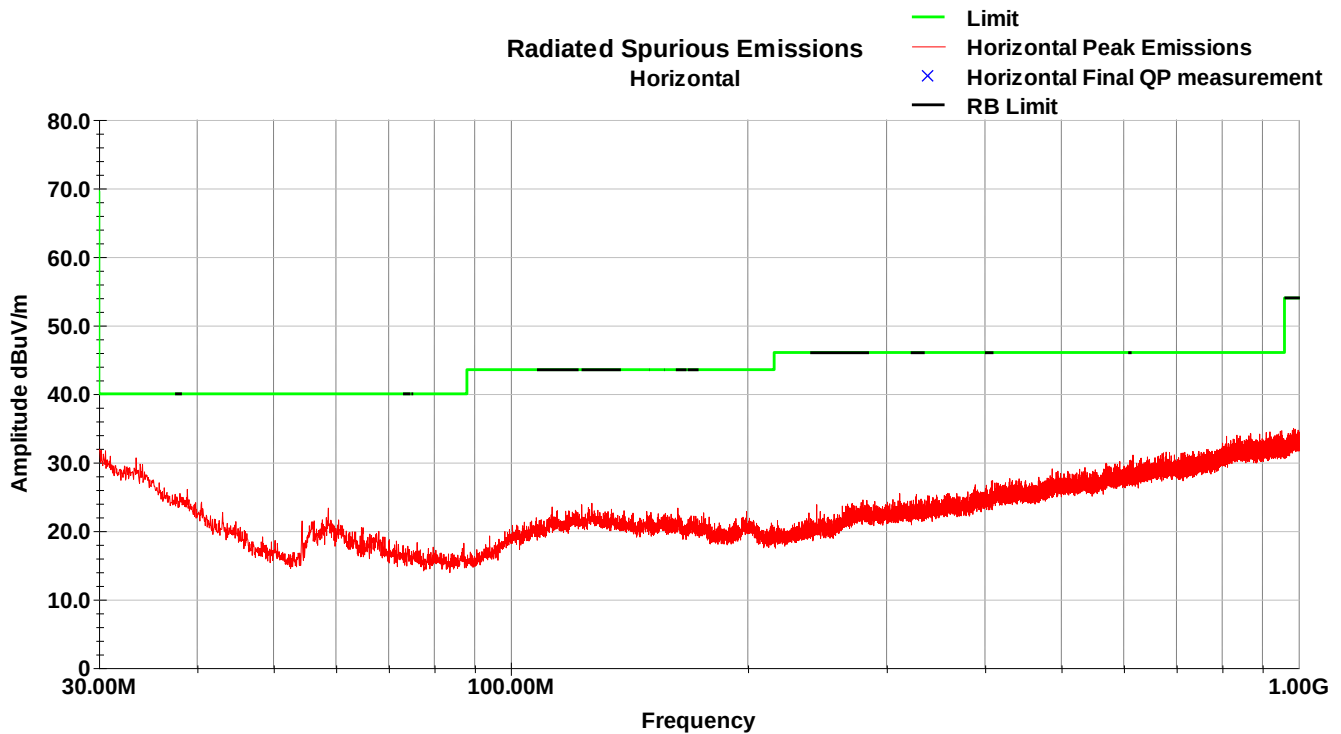
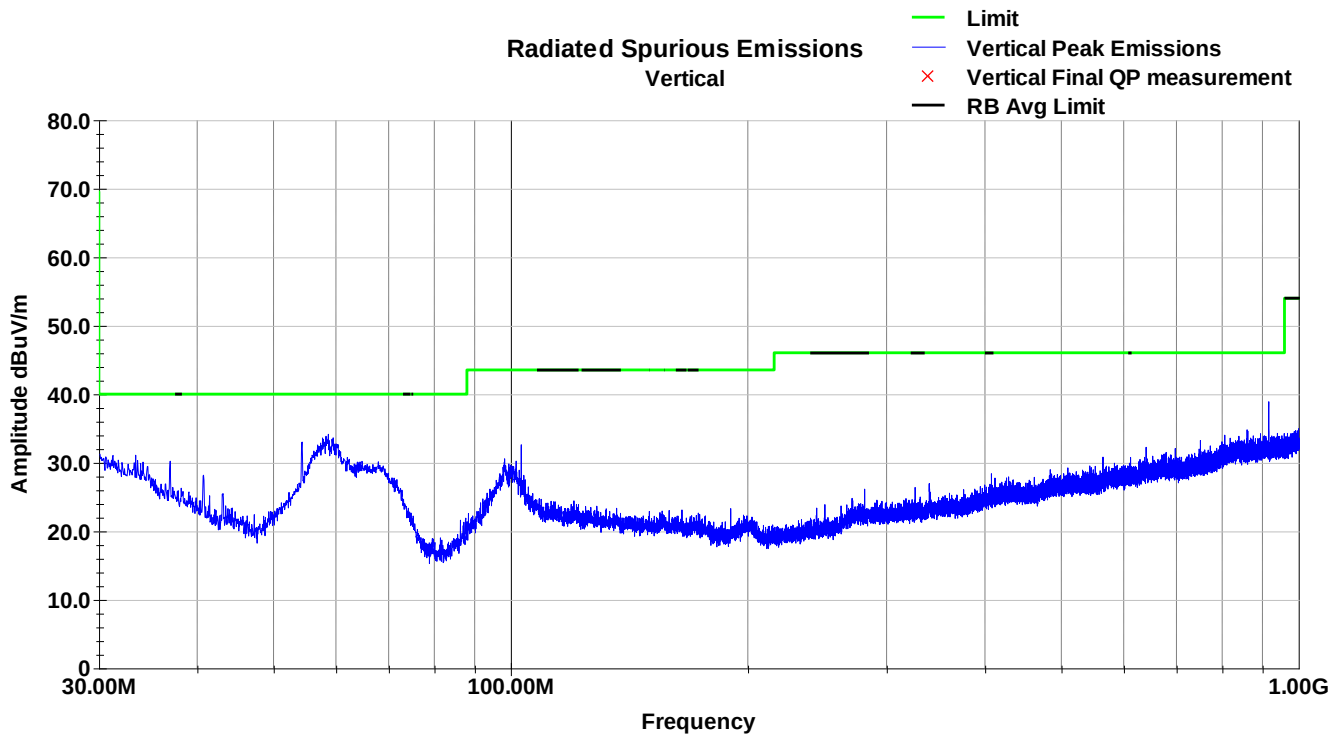
Horizontal Co-Planar Plot



Horizontal Co-Planar Data

Frequency MHz	Raw QP dBuV	Azimuth degrees	Height cm	AF dB	CL dB	QP Value dBuV/m	Limit dBuV/m	Margin dB
0.013	11.1	62.0	0.0	82.7	0.0	62.0	125.7	-63.6
0.125	21.8	90.0	0.0	63.5	0.0	53.5	105.7	-52.2
0.798	30.1	142.0	0.0	48.1	0.1	46.9	69.6	-22.7
13.56	56.6	-1.0	0.0	34.1	0.2	60.0	69.5	-9.6
29.99	6.5	146.0	0.0	33.8	0.3	9.6	69.5	-59.9
Level + AF + CL - Amp								
Margin = QP Value - Limit								

7.7 30 MHz - 1000 MHz



8 Frequency Stability

8.1 Test Result

Test Description	Basic Standards	Test Result
Frequency Stability	FCC 15.225(e) RSS-210 B.6(b) ANSI C63.10	Compliant

8.2 Test Method

The EUT was placed inside the Environmental Chamber and allowed to stabilize to each set temperature for a minimum of thirty minutes before any measurements were made. The EUT fundamental transmission was coupled to the spectrum analyzer using a near field probe.

8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 24.49

Relative Humidity: 39.8%

Atmospheric Pressure: 98.08 kPa

8.4 Test Equipment

Test End Date: 8-Apr-2025

Tester: SGM

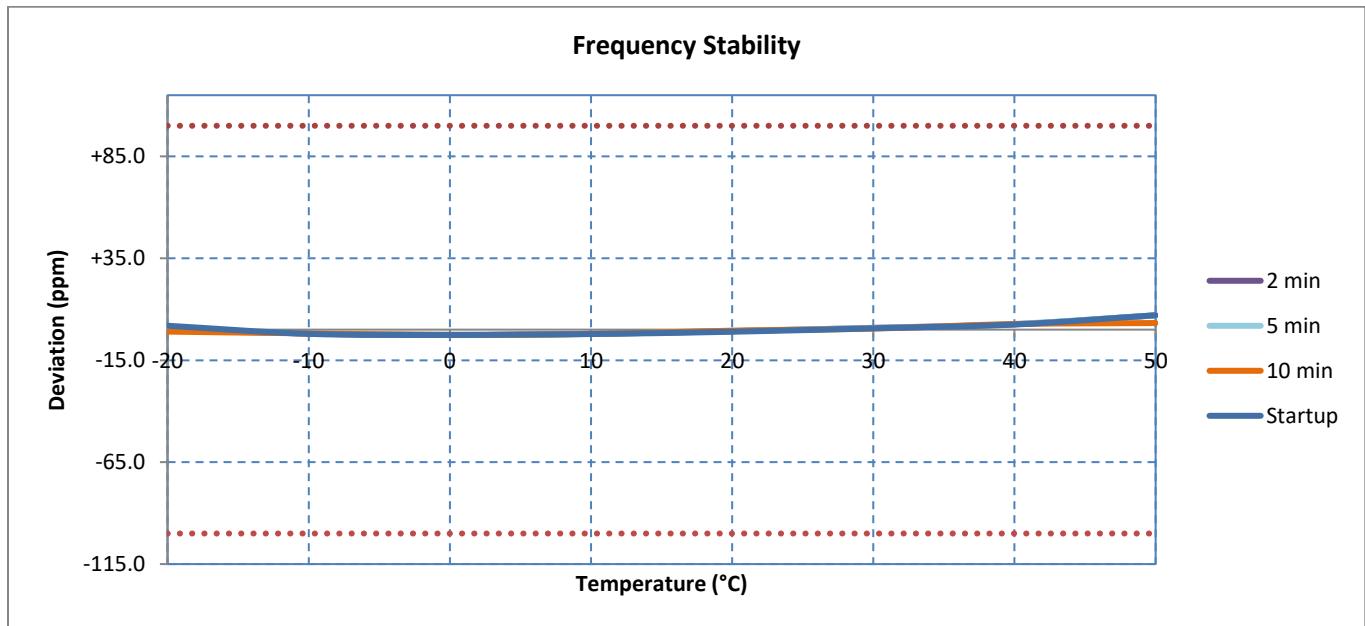
Equipment	Manufacturer	Model	Asset Number	Cal Date	Cal Due Date
RF CABLE (TS8997)	HUBER & SUHNER	141	B095585	8-Jul-2024	8-Jul-2025
NEAR FIELD PROBES	COM-POWER CORPORATION	N/A	16016	CNR	CNR
SIGNAL ANALYZER (TS8997)	ROHDE & SCHWARZ	FSV30	B085749	4-Mar-2025	4-Mar-2026
MULTIMETER	FLUKE	87V	23014	20-Aug-2024	20-Aug-2025

8.5 Test Data

The carrier frequency shall not depart from the reference frequency by more than ± 100 ppm.

RFID 13.56 MHz

Voltage %	Power V_{DC}	Temp $^{\circ}C$	Frequency MHz				Freq Dev ppm			
			Startup	2 min	5 min	10 min	Startup	2 min	5 min	10 min
100%	5.00	+20 (Ref)	13.5610260	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100%	5.00	-20	+13.561000000	+13.56102000	+13.5610310	+13.5610390	+1.92	+0.44	-0.37	-0.96
100%	5.00	-10	+13.561054000	+13.56105200	+13.5610510	+13.56105100	-2.06	-1.92	-1.84	-1.84
100%	5.00	0	+13.561061000	+13.5610610	+13.5610620	+13.5610610	-2.58	-2.58	-2.65	-2.58
100%	5.00	+10	+13.561055000	+13.5610540	+13.5610550	+13.5610540	-2.14	-2.06	-2.14	-2.06
100%	5.00	+20	+13.561040000	+13.5610360	+13.5610340	+13.5610330	-1.03	-0.74	-0.59	-0.52
100%	5.00	+30	+13.561017000	+13.5610140	+13.5610150	+13.561019	+0.66	+0.88	+0.81	+0.52
100%	5.00	+40	+13.560992000	+13.5609900	+13.5609880	+13.5609890	+2.51	+2.65	+2.80	+2.73
100%	5.00	+50	+13.560930100	+13.5609311	+13.5609311	+13.5609820	+7.07	+7.00	+7.00	+3.24
115%	5.75	+20	+13.561038000	N/A	N/A	N/A	-0.88	N/A	N/A	N/A
85%	4.25	+20	+13.561018000	N/A	N/A	N/A	+0.59	N/A	N/A	N/A



9 Measurement Uncertainty

Measurement uncertainty is not used to adjust the measurements to determine compliance.

Measurement uncertainty values in the table below comply with CISPR 16-4-2.

Parameter	Uncertainty
Conducted emissions	± 0.8 dB
Radiated emissions, 9 kHz to 30 MHz	± 3.5 dB
Radiated emissions, 30 to 200 MHz	± 3.1 dB
Radiated emissions, 200 to 1000 MHz	± 4.6 dB
Radiated emissions, 1 to 18 GHz	± 5.4 dB
Radiated emissions, 18 to 40 GHz	± 4.0 dB
Note: The uncertainties provided in this table represent an expanded uncertainty expressed at the ~95% confidence level using a coverage factor of K=2.	

10 Revision History

Revision Level	Description of changes	Revision Date
Draft	Draft Release	09 October 2024
0	Initial Release	30 October 2024
1	Updated cover page and sections: 2.3, 4.1, 5.1; addition of OBW & Frequency Stability data.	02 April 2025
2	Updated Model/HVIN number	10 April 2025