CERTIFICATION TEST REPORT

Report Number. : 4790632108-E7V1

Applicant	:	SAMSUNG ELECTRONICS CO., LTD. 129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI, GYEONGGI-DO, 16677, KOREA
Model	:	SM-A546U, SM-A546U1, SM-S546VL
FCC ID	:	A3LSMA546U
EUT Description	:	GSM/WCDMA/LTE 5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax and NFC
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C

Date Of Issue:
2023-01-20

Prepared by:
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IAS ACCREDITED Testing Laboratory TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2023-01-20	Initial issue	Dexter(Hyunsik) Yun

UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C(04)
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SAMSUNG ELECTRONICS CO., LTD.
EUT DESCRIPTION:	GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax and NFC.
MODEL NUMBER:	SM-A546U, SM-A546U1, SM-S546VL
SERIAL NUMBER:	R3CTA0AXNHR(Radiated, Original); 'R3CTB0F5SJF(Radiated, Spot-check);
DATE TESTED:	2022-12-16 ~ 2023-01-17(Original); 2023-01-10(Spot-check);

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

Seokhwan Hong
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Dexter(Hyunsik) Yun
Suwon Lab Engineer
UL Korea, Ltd.

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1.1. INTRODUCTION OF TEST DATA REUSE

This report referenced from the FCC ID: A3LSMA546V DXX NFC(FCC CFR 47 Part 15C).
And the applicant takes full responsibility that the test data as referenced in this report represent compliance for this FCC ID.

1.2. DIFFERENCE

The A3LSMA546U model shares the same enclosure and circuit board as A3LSMA546V. The NFC antennas and surrounding circuitry and layout are identical between these two units.

After confirming through preliminary radiated emissions that the performance of the A3LSMA546V remains representative of A3LSMA546U. The test data of A3LSMA546V being submitted for this application to cover NFC features.

1.3. SPOT CHECK VERIFICATION DATA

(Worst case of the radiated fundamental and radiated spurious emissions)

Band	Test Item	Mode	Frequency	Test Limit	Original model	Spot check model	Deviation	Remark
					SM-A546V Results	SM-A546U Results		
					FCC ID : A3LSMA546V	FCC ID : A3LSMA546U		
NFC	NFC Fund	NFC_FUND_Y_Position	13.56 MHz	84.00 dBuV/m	17.40 dBuV/m	19.31 dBuV/m	1.91 dB	
	NFC RSE	NFC_RSE_Y position	13.56 MHz	29.50 dBuV/m(QP)	17.20 dBuV/m	17.60 dBuV/m	0.40 dB	

Comparison of two models, upper deviation is within 3 dB range and all test results are under FCC Technical Limits.

1.4. REFERENCE DETAIL

Reference application that contains the reused reference data in the individual test reports:

Equipment Class	Reference FCC ID (Parent)	Application Type	Reference Test report number	Exhibit Type	Variant Test Report Number	Data Re-used
PCE	A3LSMA546V	Original Grant	4790632299-E2 (WWAN)	Test Report	4790632108-E2 (WWAN)	Partial
DTS	A3LSMA546V	Original Grant	4790632299-E3 (802.11b/g/n/ax)	Test Report	4790632108-E3 (802.11b/g/n/ax)	All
			4790632299-E4 (Bluetooth LE)	Test Report	4790632108-E4 (Bluetooth LE)	All
DSS	A3LSMA546V	Original Grant	4790632299-E5 (Bluetooth)	Test Report	4790632108-E5 (Bluetooth)	All
NII	A3LSMA546V	Original Grant	4790632299-E6 (802.11a/n/ac/ax)	Test Report	4790632108-E6 (802.11a/n/ac/ax)	All
DXX	A3LSMA546V	Original Grant	4790632299-E7 (NFC)	Test Report	4790632108-E7 (NFC)	All
CBE	A3LSMA546V	Original Grant	4790632299-E8 (CBRS)	Test Report	4790632108-E8 (CBRS)	All

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. ANSI C63.10-2013.
4. KDB 414788 D01 Radiated Test Site v01r01
5. KDB 484596 D01 Referencing Test Data v01

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

218 Maeyeong-ro
☐ Chamber 1(3m semi-anechoic chamber)
☒ Chamber 2(3m semi-anechoic chamber)
☐ Chamber 3(3m semi-anechoic chamber)
☐ Chamber 4(3m Full-anechoic chamber)
☐ Chamber 5(3m Full-anechoic chamber)

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at https://www.iasonline.org/wp-content/uploads/2017/05/TL-637-cert-New.pdf.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

Corrected Reading (dBuV) = Meter Reading (dBuV) + External Cable (dB) + Cableloss (dB)
46.62 dBuV + 9.8 dB + 0.1 dB = 56.52 dBuV

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	2.80 dB
Radiated Disturbance, 9 kHz to 30 MHz	1.69 dB
Radiated Disturbance, 30 MHz to 1 GHz	3.92 dB

Uncertainty figures are valid to a confidence level of 95%.

4.4. DECISION RULE

Decision rule for statement(s) of conformity is based on Procedure 2, Clause 4.4.3 in IEC Guide 115:2021.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE/5G NR Phone + BT/BLE, DTS/UNII a/b/g/n/ac/ax and NFC. This test report addresses the DXX (NFC) operational mode.

Representative model	Difference	Derivative model	
		SM-A546U1	SM-S546VL
SM-A546U	Hardware	Same as SM-A546U	Same as SM-A546U
	Software	Same as SM-A546U	Different from SM-A546U (Exclude some of the main band)

Thus, SM-A546U was set for final test.

5.2. MAXIMUM E-FIELD STRENGTH

The testing was performed at 3 meter. The transmitter maximum E-field at 30m distance is 17.4 dBuV/m which convert from 3 meter data.

5.3. WORST-CASE CONFIGURATION AND MODE

The NFC function was tested at its' fundamental and only operational frequency of 13.56 MHz.

The NFC with tag mode's fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that the Y orientation was the worst-case orientation; therefore radiated testing was reported with the EUT in the Y orientation while generating continuous emissions.

The NFC without tag mode's fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that the Y orientation was the worst-case orientation; therefore radiated testing was reported with the EUT in the Y orientation while generating continuous emissions.

The fundamental level of the EUT was investigated each type and bitrate.
All test was performed worst case condition(type A and bit rate 106 kbps).

Radiated(fundamental level and spurious emissions) tests were performed both without reading a passive tag condition[test mode] and with reading a passive tag condition.

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5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

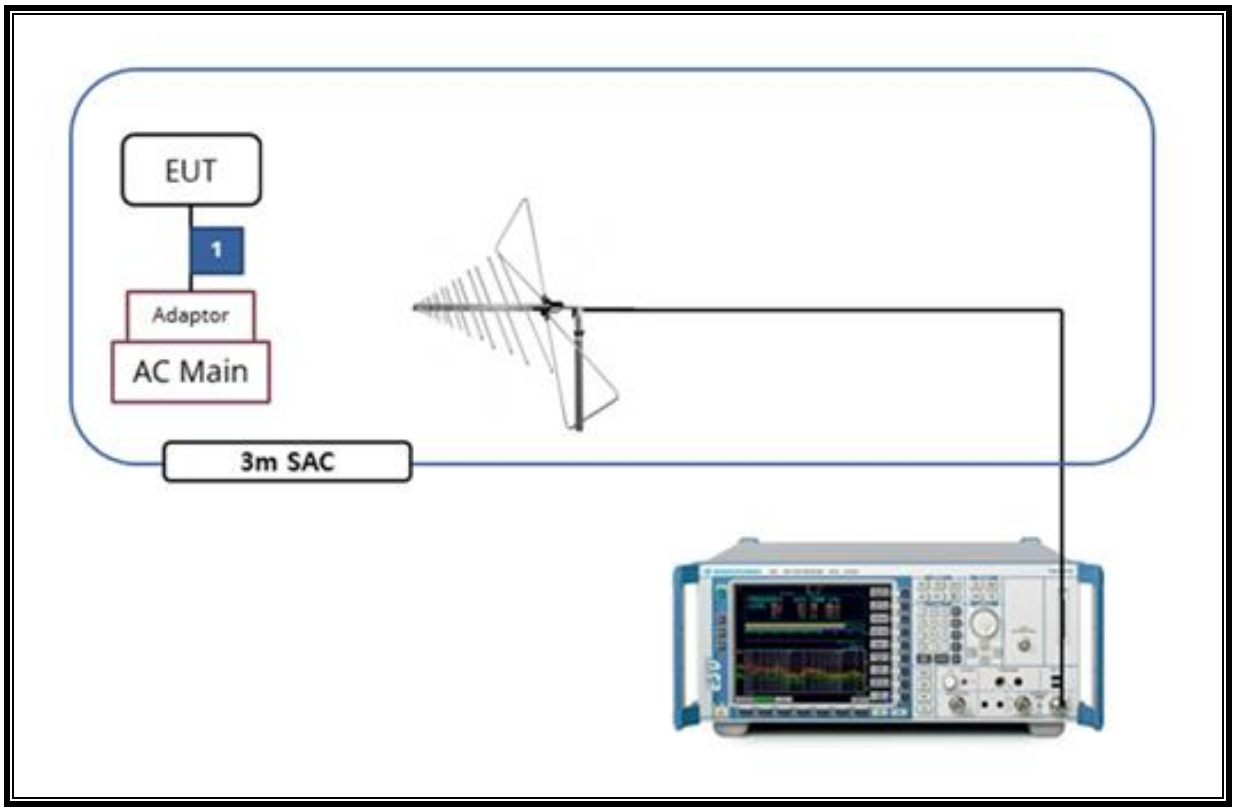
Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Charger	SAMSUNG	EP-TA800	R37T7WW84Y9SEA	N/A
Data Cable	SAMSUNG	EP-DN980	GH39-02116A	N/A

I/O CABLE

I/O Cable List						
Cable No.	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC Power	1	C Type	Shielded	1.0 m	N/A

The EUT is a stand-alone device configured and tested in a worst-case setup.
Note: Worst case is using worst case orientation with AC charger attached to the EUT with NFC signal continuously transmitting.

SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	**Manufacturer**	**Model**	**S/N**	**Cal Due**
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	845	2024-08-15
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	2024-08-15
Preamplifier, 1000 MHz	Sonoma	310N	341282	2023-08-02
Preamplifier, 1000 MHz	Sonoma	310N	351741	2023-08-02
Spectrum Analyzer, 7 GHz	Agilent / HP	N9010A	MY54200580	2023-08-01
EMI Test Receive, 3 GHz	R&S	ESR3	101832	2023-08-01
DC Power Supply	Agilent / HP	E3640A	MY54226395	2023-08-02
Temperature Chamber	ESPEC	SH-642	93001109	2023-08-01
LISN	R&S	ENV216	101837	2023-08-04
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	2023-10-06
UL Software				
Description	**Manufacturer**	**Model**	**Version**	
Radiated software	UL	UL EMC	Ver 9.5	
AC Line Conducted software	UL	UL EMC	Ver 9.5	

7. 20dB BANDWIDTH

LIMITS

§15.215

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated

§15.225

Operation within the band 13.110 – 14.010MHz

TEST PROCEDURE

The spectrum analyzer connected receive antenna and the EUT placed on near the receive antenna. The RBW is set to 10kHz. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

Frequency [MHz]	20 dB Bandwidth [kHz]
13.56	437.05

20dB Bandwidth Plot

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8. RADIATED EMISSION TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMIT

§15.225

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/ meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110– 14.010 MHz and shall not exceed the general radiated emission limits in § 15.209 as follows:
§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Limits for radiated disturbance of an intentional radiator		
Frequency range (MHz)	Limits (µV/m)	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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.
§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

Formula for converting the filed strength from uV/m to dBuV/m is:
Limit (dBuV/m) = 20 log limit (uV/m)

In addition:

§15.209 (d) The emission limits shown the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

§15.209 (d) The provisions in §§ 15.225, measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

TEST PROCEDURE

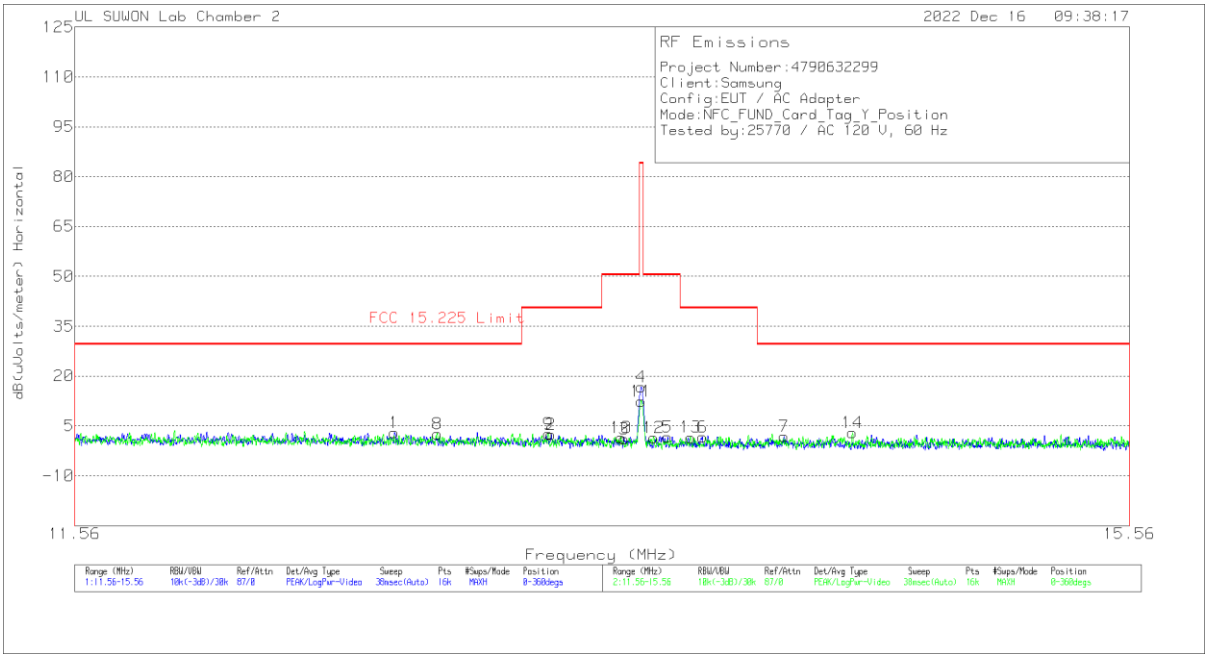
ANSI C63.10-2013

The EUT is an intentional radiator that incorporates a digital device. The highest fundamental frequency generated or used in the device is 13.56 MHz. The frequency range was investigated from 0.15 MHz to the 10th harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater (1000MHz)

RESULTS

No non-compliance noted:

8.1.1. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 – 30 MHz) [EUT with passive TAG mode]



Trace Markers

Face On

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Dist Corr 30m	Cable Loss	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	Margin (dB)	Azimuth (Degs)
1	12.65	22.46	Pk	20	-40	.5	2.96	29.54	-26.58	0-360
2	13.221	21.83	Pk	20	-40	.5	2.33	40.51	-38.18	0-360
3	13.49575	20.56	Pk	20	-40	.5	1.06	50.5	-49.44	0-360
**4	13.561	36.23	Pk	20	-40	.5	16.73	84	-67.27	0-360
5	13.66225	21	Pk	20	-40	.6	1.6	50.5	-48.9	0-360
6	13.79625	21.01	Pk	20	-40	.6	1.61	40.51	-38.9	0-360
7	14.11725	21.18	Pk	20	-40	.6	1.78	29.54	-27.76	0-360

Face OFF

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Dist Corr 30m	Cable Loss	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	Margin (dB)	Azimuth (Degs)
8	12.80375	22.16	Pk	20	-40	.5	2.66	29.54	-26.88	0-360
9	13.211	22.02	Pk	20	-40	.5	2.52	40.51	-37.99	0-360
10	13.4835	20.98	Pk	20	-40	.5	1.48	50.5	-49.02	0-360
**11	13.56025	31.98	Pk	20	-40	.5	12.48	84	-71.52	0-360
12	13.60925	20.85	Pk	20	-40	.6	1.45	50.5	-49.05	0-360
13	13.75025	20.97	Pk	20	-40	.6	1.57	40.51	-38.94	0-360
14	14.3915	22.32	Pk	20	-40	.6	2.92	29.54	-26.62	0-360

Pk - Peak detector

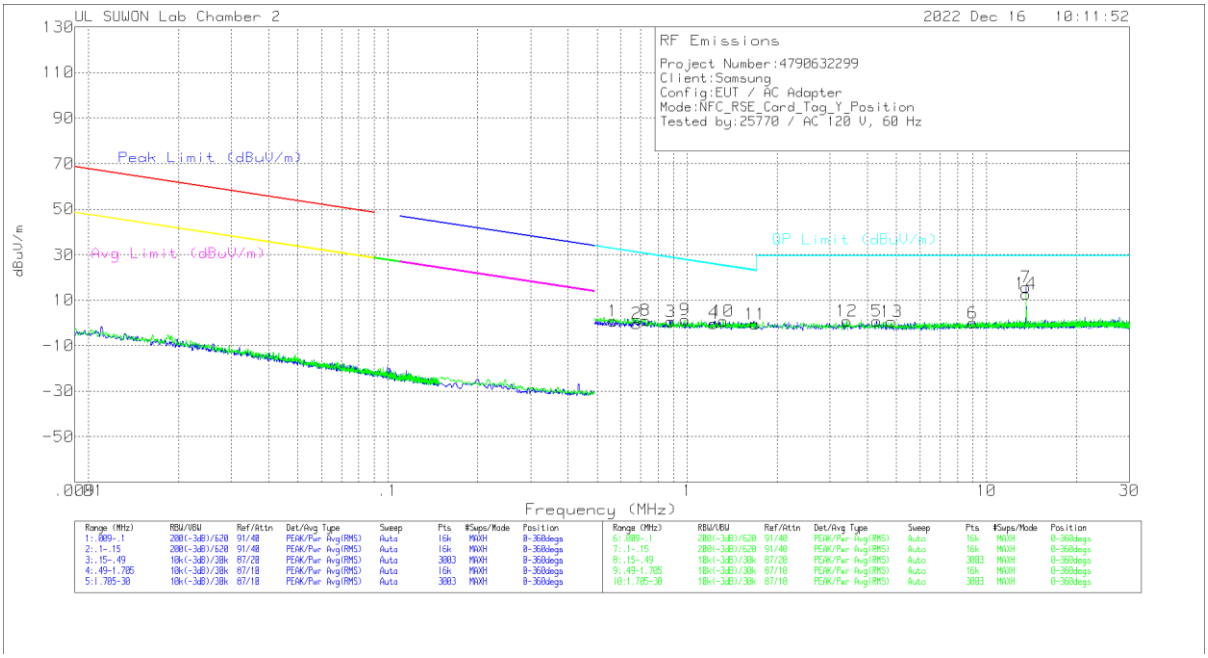
**Fundamental

Note 1 : Although these tests were performed other than open filed test site, adequate comparison measurements were confirmed against 30 m open are test site.

Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Note 2: Radiated test were investigated with three receiving antenna axes: Face-on, Face-off and horizontal (parallel to the ground plane) and the worse orientations of Face-on and Face-off were set for final test.

8.1.2. SPURIOUS EMISSION 0.009 TO 30 MHz
[EUT with passive TAG mode]



Trace Markers
Face ON

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Cable Loss	Dist Corr 30m	Corrected Reading dBuV/m	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.56497	20.93	Pk	19.7	.1	-40	.73	32.57	-31.84	0-360
2	.67719	19.93	Pk	19.7	.1	-40	-.27	31	-31.27	0-360
3	.88015	20.44	Pk	19.8	.2	-40	.44	28.73	-28.29	0-360
4	1.22925	19.86	Pk	19.8	.2	-40	-.14	25.83	-25.97	0-360
5	4.29688	20.69	Pk	19.8	.3	-40	.79	29.5	-28.71	0-360
6	9.00938	19.49	Pk	20	.5	-40	-.01	29.5	-29.51	0-360
7	13.56165	35.33	Pk	20	.5	-40	15.83	29.5	-13.67	0-360

Face OFF

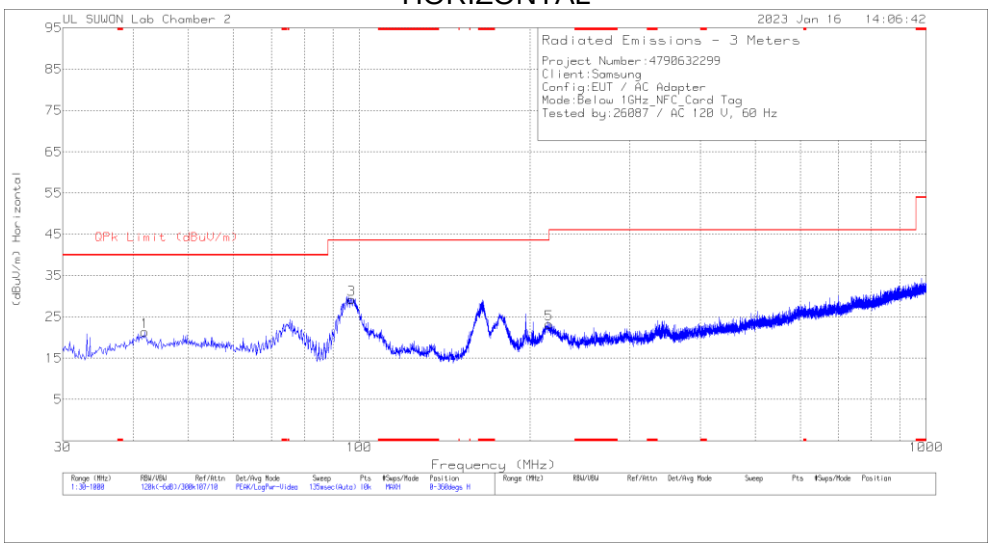
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Cable Loss	Dist Corr 30m	Corrected Reading dBuV/m	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
9	.98271	21.3	Pk	19.8	.2	-40	1.3	27.77	-26.47	0-360
10	1.31893	20.75	Pk	19.8	.2	-40	.75	25.22	-24.47	0-360
11	1.68909	19.46	Pk	19.8	.2	-40	-.54	23.08	-23.62	0-360
12	3.41564	20.7	Pk	19.9	.3	-40	.9	29.5	-28.6	0-360
13	4.81525	20.42	Pk	19.8	.3	-40	.52	29.5	-28.98	0-360
14	13.56165	32.31	Pk	20	.5	-40	12.81	29.5	-16.69	0-360
9	.98271	21.3	Pk	19.8	.2	-40	1.3	27.77	-26.47	0-360

Pk - Peak detector
**FUNDAMENTAL

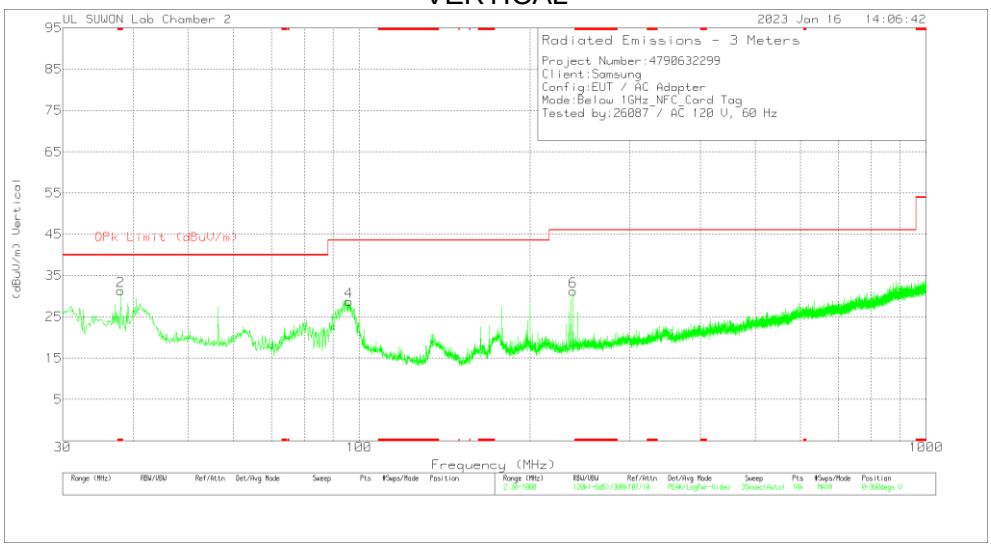
Note 1: The data for marker number 7 and 14 are the fundamental signal.
Please refer to section 8.1.1 about the fundamental level.
Frequency range 0.009MHz ~ 0.490MHz, only noise floor level and more than 20dB margin.
Note 2: Radiated test were investigated with three receiving antenna axes: Face-on, Face-off and horizontal (parallel to the ground plane) and the worse orientations of Face-on and Face-off were set for final test.

8.1.3. TX SPURIOUS EMISSION 30 TO 1000 MHz [EUT with passive TAG mode]

HORIZONTAL



VERTICAL

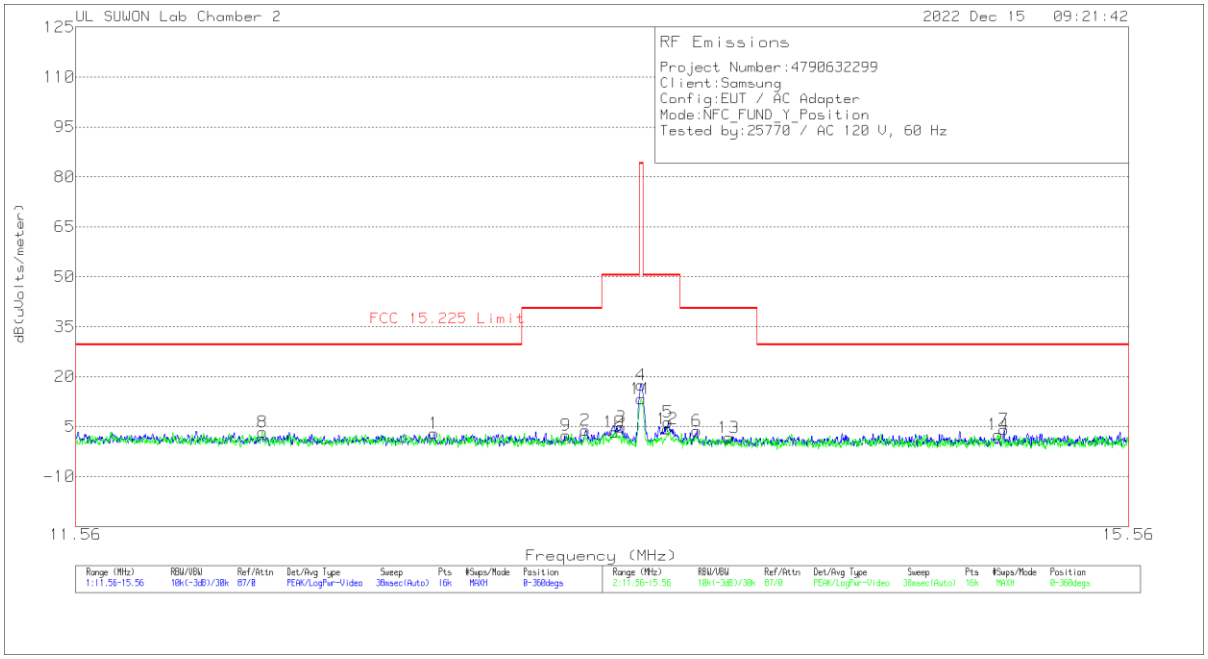


Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163_749	Below 1G[dB]	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	41.834	33.45	Pk	19.3	-31.4	21.35	40	-18.65	0-360	200	H
3	97.027	43.06	Pk	16.9	-30.7	29.26	43.52	-14.26	0-360	200	H
5	216.337	35.8	Pk	17	-29.6	23.2	46.02	-22.82	0-360	100	H
2	* 37.954	44.78	Pk	18	-31.4	31.38	40	-8.62	0-360	100	V
4	95.96	42.68	Pk	16.8	-30.8	28.68	43.52	-14.84	0-360	100	V
6	238.356	42.61	Pk	18.1	-29.5	31.21	46.02	-14.81	0-360	100	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

8.1.4. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 – 30 MHz) [EUT without passive TAG mode]



Trace Markers

Face on

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Dist Corr 30m	Cable Loss	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	Margin (dB)	Azimuth (Degs)
1	12.79088	22.56	Pk	20	-40	.5	3.06	29.54	-26.48	0-360
2	13.34963	23.49	Pk	20	-40	.5	3.99	40.51	-36.52	0-360
3	13.48413	24.42	Pk	20	-40	.5	4.92	50.5	-45.58	0-360
**4	13.5605	36.9	Pk	20	-40	.5	17.4	84	-66.6	0-360
5	13.66425	25.7	Pk	20	-40	.6	6.3	50.5	-44.2	0-360
6	13.77625	23.13	Pk	20	-40	.6	3.73	40.51	-36.78	0-360
7	15.02325	23.45	Pk	20	-40	.6	4.05	29.54	-25.49	0-360

Face off

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Dist Corr 30m	Cable Loss	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	Margin (dB)	Azimuth (Degs)
8	12.186	22.85	Pk	20	-40	.5	3.35	29.54	-26.19	0-360
9	13.276	21.93	Pk	20	-40	.5	2.43	40.51	-38.08	0-360
10	13.45825	22.94	Pk	20	-40	.5	3.44	50.5	-47.06	0-360
**11	13.56	32.83	Pk	20	-40	.5	13.33	84	-70.67	0-360
12	13.6615	23.68	Pk	20	-40	.6	4.28	50.5	-46.22	0-360
13	13.89925	21.06	Pk	20	-40	.6	1.66	40.51	-38.85	0-360
14	14.998	22.03	Pk	20	-40	.6	2.63	29.54	-26.91	0-360

Pk - Peak detector

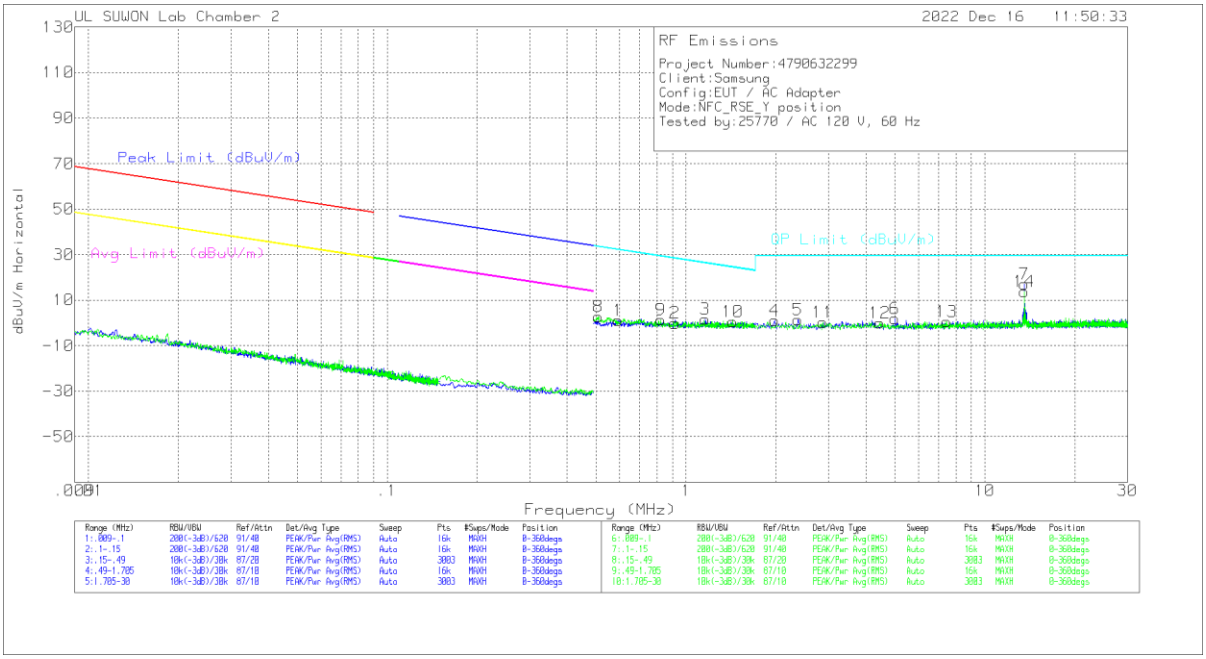
**Fundamental

Note 1: Although these tests were performed other than open filed test site, adequate comparison measurements were confirmed against 30 m open are test site.
Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Note 2: Radiated test were investigated with three receiving antenna axes: Face-on, Face-off and horizontal (parallel to the ground plane) and the worse orientations of Face-on and Face-off were set for final test.

UL Korea, Ltd. Suwon Laboratory FORM ID: FCC_15C(04)
218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea TEL: (031) 337-9902 FAX: (031) 213-5433

8.1.5. SPURIOUS EMISSION 0.09 TO 30 MHz [EUT without passive TAG mode]



Trace Markers

Face ON

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Cable Loss	Dist Corr 30m	Corrected Reading dBuV/m	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.59173	21.24	Pk	19.7	.1	-40	1.04	32.17	-31.13	0-360
2	.91735	19.87	Pk	19.8	.2	-40	-.13	28.37	-28.5	0-360
3	1.1599	21.73	Pk	19.8	.2	-40	1.73	26.34	-24.61	0-360
4	1.97833	21.08	Pk	19.8	.2	-40	1.08	29.5	-28.42	0-360
5	2.36475	21.4	Pk	19.9	.2	-40	1.5	29.5	-28	0-360
6	4.99433	21.95	Pk	19.8	.3	-40	2.05	29.5	-27.45	0-360
7	13.56165	36.7	Pk	20	.5	-40	17.2	29.5	-12.3	0-360

Face OFF

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Cable Loss	Dist Corr 30m	Corrected Reading dBuV/m	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
8	.50942	23.08	Pk	19.7	.1	-40	2.88	33.46	-30.58	0-360
9	.82315	21.27	Pk	19.8	.2	-40	1.27	29.31	-28.04	0-360
10	1.4327	20.47	Pk	19.8	.2	-40	.47	24.51	-24.04	0-360
11	2.86428	20.11	Pk	19.9	.3	-40	.31	29.5	-29.19	0-360
12	4.43825	19.98	Pk	19.8	.3	-40	.08	29.5	-29.42	0-360
13	7.44483	20.3	Pk	19.9	.4	-40	.6	29.5	-28.9	0-360
14	13.56165	33.36	Pk	20	.5	-40	13.86	29.5	-15.64	0-360

Pk - Peak detector
**FUNDAMENTAL

Note 1: The data for marker number 7 and 14 are the fundamental signal.
Please refer to section 8.1.4 about the fundamental level.
Frequency range 0.009MHz ~ 0.490MHz, only noise floor level and more than 20dB margin.

Note 2: Radiated test were investigated with three receiving antenna axes: Face-on, Face-off and horizontal (parallel to the ground plane) and the worse orientations of Face-on and Face-off were set for final test.

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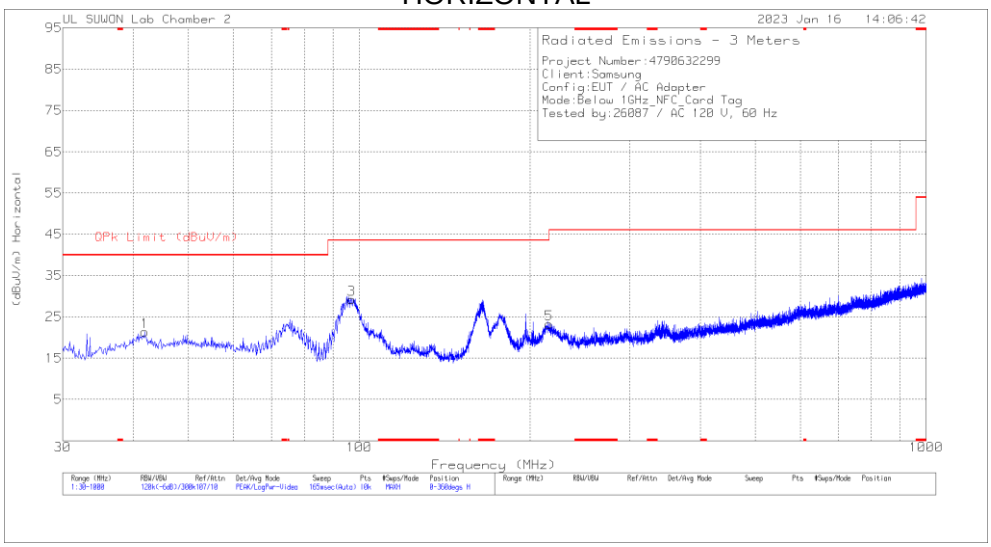
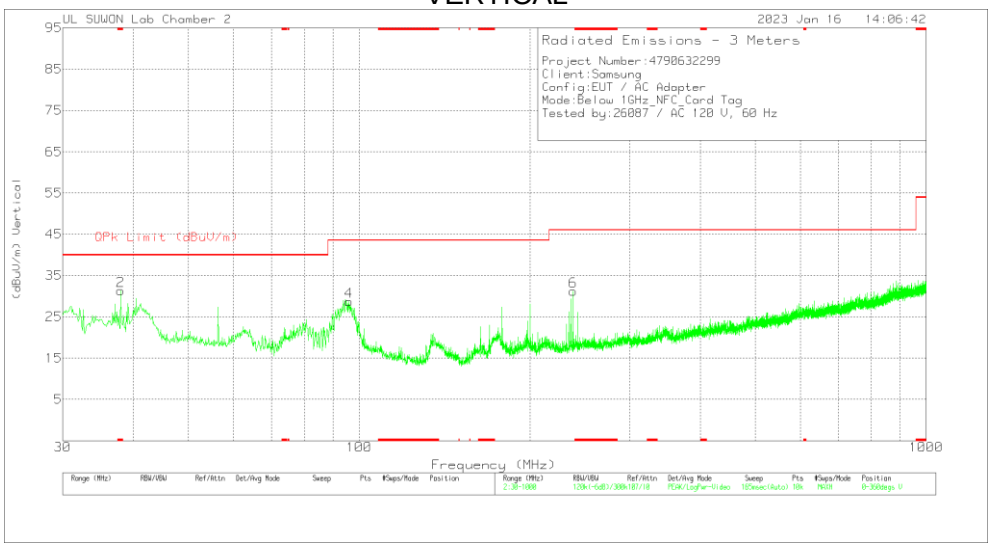
8.1.6. TX SPURIOUS EMISSION 30 TO 1000 MHz
[EUT without passive TAG mode]

HORIZONTAL



VERTICAL



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	VULB9163_749	Below 1G[dB]	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	41.834	33.45	Pk	19.3	-31.4	21.35	40	-18.65	0-360	200	H
3	97.027	43.06	Pk	16.9	-30.7	29.26	43.52	-14.26	0-360	200	H
5	216.337	35.8	Pk	17	-29.6	23.2	46.02	-22.82	0-360	100	H
2	* 37.954	44.78	Pk	18	-31.4	31.38	40	-8.62	0-360	100	V
4	95.96	42.68	Pk	16.8	-30.8	28.68	43.52	-14.84	0-360	100	V
6	238.356	42.61	Pk	18.1	-29.5	31.21	46.02	-14.81	0-360	100	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

9. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

§15.207

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Notes: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

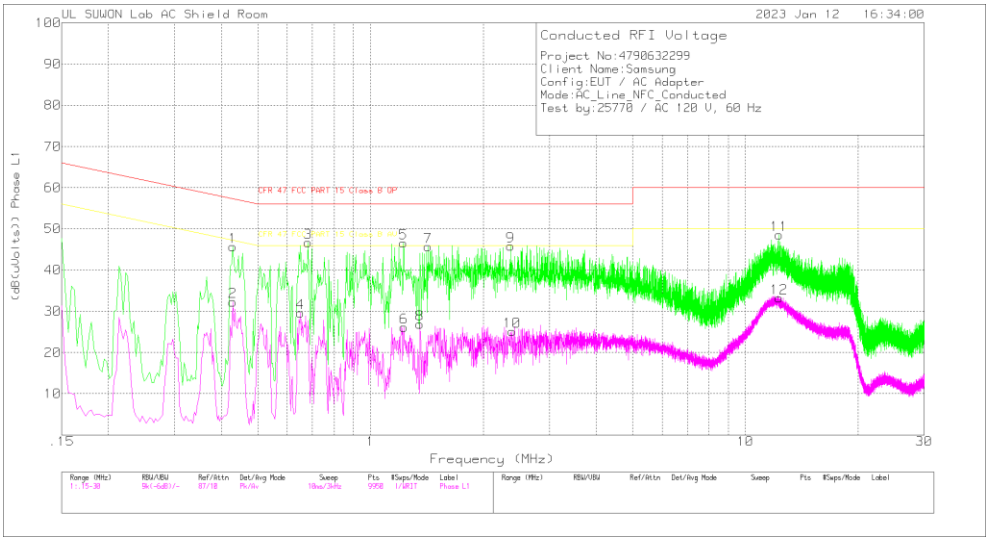
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

No non-compliance noted:

WORST EMISSIONS(Terminated)

LINE 1 PLOT



LINE 1 RESULTS

Trace Markers

Range 1: Phase L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_L1[dB]	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
1	.429	35.71	Pk	9.8	.2	45.71	57.27	-11.56	-	-
2	.429	22.3	Av	9.8	.2	32.3	-	-	47.27	-14.97
3	.681	36.72	Pk	9.8	.2	46.72	56	-9.28	-	-
4	.651	19.62	Av	9.8	.2	29.62	-	-	46	-16.38
5	1.224	36.59	Pk	9.7	.3	46.59	56	-9.41	-	-
6	1.227	16.17	Av	9.7	.3	26.17	-	-	46	-19.83
7	1.422	35.66	Pk	9.7	.3	45.66	56	-10.34	-	-
8	1.356	16.87	Av	9.7	.3	26.87	-	-	46	-19.13
9	2.367	35.81	Pk	9.7	.3	45.81	56	-10.19	-	-
10	2.388	15.11	Av	9.7	.3	25.11	-	-	46	-20.89
11	12.318	38.33	Pk	9.9	.3	48.53	60	-11.47	-	-
12	12.318	23.06	Av	9.9	.3	33.26	-	-	50	-16.74

Pk - Peak detector
Av - Average detection

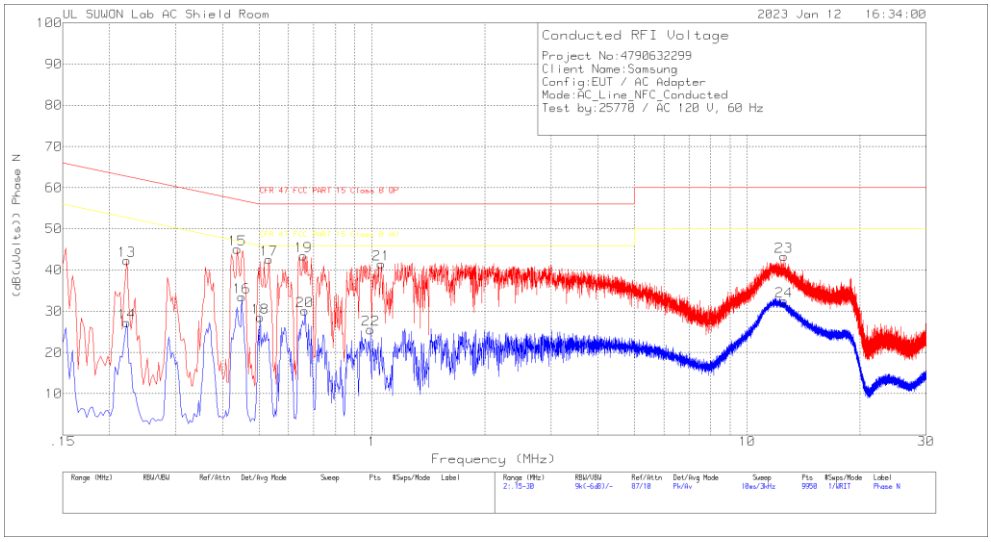
Quasi-Peak Emissions

Range 1: Phase L1 .15 - 30MHz

Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_L1[dB]	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
.68025	30.46	Qp	9.8	.2	40.46	56	-15.54	-	-
1.22325	29.03	Qp	9.7	.3	39.03	56	-16.97	-	-

Qp - Quasi-Peak detector

LINE 2 PLOT



LINE 2 RESULTS

Trace Markers

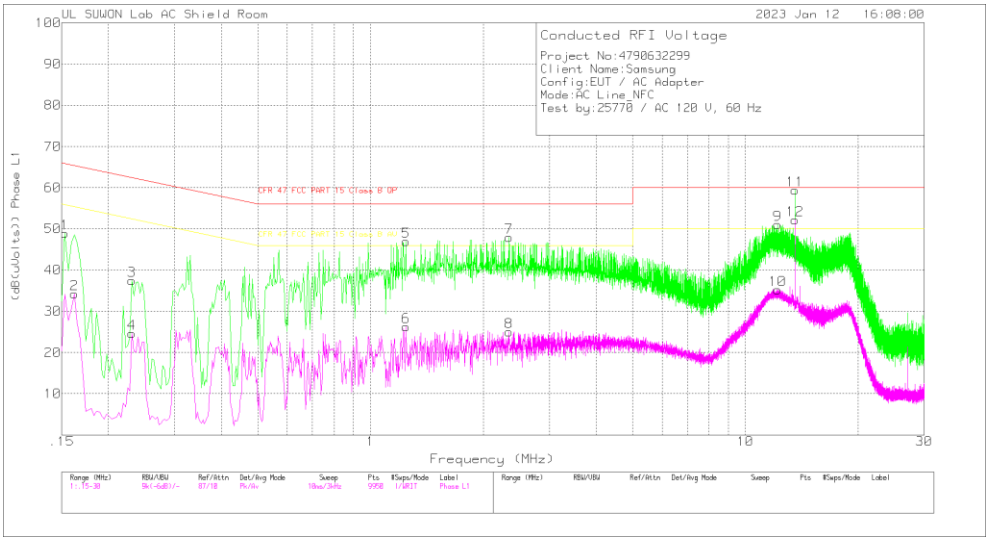
Range 2: Phase N .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_N[dB]	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
13	.222	32.38	Pk	9.7	.2	42.28	62.74	-20.46	-	-
14	.222	17.33	Av	9.7	.2	27.23	-	-	52.74	-25.51
15	.438	35.02	Pk	9.9	.2	45.12	57.1	-11.98	-	-
16	.45	23.33	Av	9.9	.2	33.43	-	-	46.88	-13.45
17	.531	32.51	Pk	9.9	.2	42.61	56	-13.39	-	-
18	.504	18.43	Av	9.9	.2	28.53	-	-	46	-17.47
19	.657	33.44	Pk	9.8	.2	43.44	56	-12.56	-	-
20	.663	20.09	Av	9.8	.2	30.09	-	-	46	-15.91
21	1.059	31.51	Pk	9.7	.3	41.51	56	-14.49	-	-
22	.993	15.57	Av	9.7	.3	25.57	-	-	46	-20.43
23	12.522	32.99	Pk	10	.3	43.29	60	-16.71	-	-
24	12.534	22.17	Av	10	.3	32.47	-	-	50	-17.53

Pk - Peak detector
Av - Average detection

WORST EMISSIONS(non-Terminated)

LINE 1 PLOT



LINE 1 RESULTS

Trace Markers

Range 1: Phase L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_L1[dB]	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
1	.153	39.05	Pk	9.8	.1	48.95	65.84	-16.89	-	-
2	.162	24.27	Av	9.9	.1	34.27	-	-	55.36	-21.09
3	.231	27.59	Pk	9.7	.2	37.49	62.41	-24.92	-	-
4	.231	14.74	Av	9.7	.2	24.64	-	-	52.41	-27.77
5	1.242	36.96	Pk	9.7	.3	46.96	56	-9.04	-	-
6	1.242	16.25	Av	9.7	.3	26.25	-	-	46	-19.75
7	2.34	37.89	Pk	9.7	.3	47.89	56	-8.11	-	-
8	2.34	15.03	Av	9.7	.3	25.03	-	-	46	-20.97
9	12.201	40.89	Pk	9.9	.3	51.09	60	-8.91	-	-
10	12.195	25	Av	9.9	.3	35.2	-	-	50	-14.8
11	13.56	49.01	Pk	10	.4	59.41	60	-.59	-	-
12	13.56	41.73	Av	10	.4	52.13	-	-	**50**	**2.13**

Pk - Peak detector
Av - Average detection

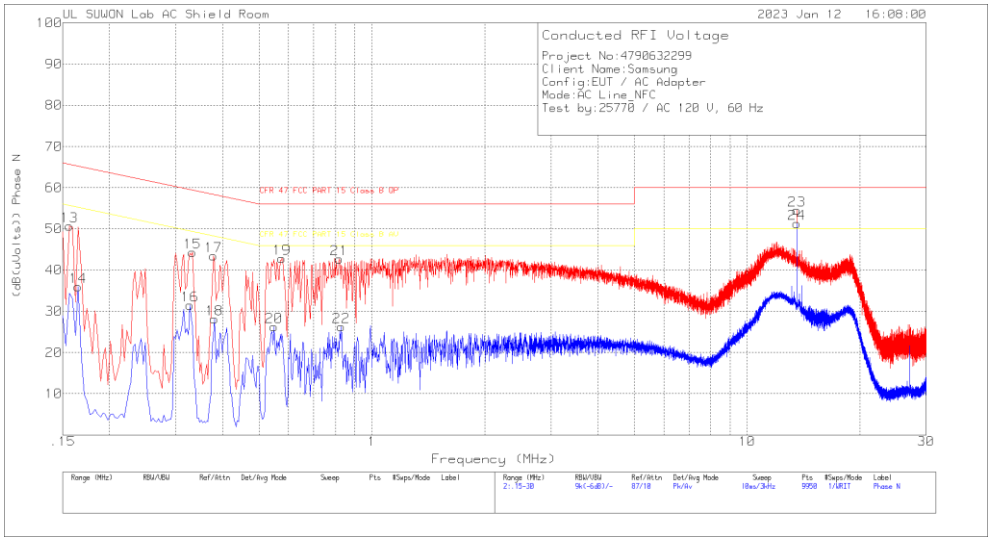
Quasi-Peak Emissions

Range 1: Phase L1 .15 - 30MHz

Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_L1[dB]	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
1.24125	30.78	Qp	9.7	.3	40.78	56	-15.22	-	-
2.33925	29.65	Qp	9.7	.3	39.65	56	-16.35	-	-
12.2003	30.2	Qp	9.9	.3	40.4	60	-19.6	-	-
13.5608	45.63	Qp	10	.4	56.03	60	-3.97	-	-

Qp - Quasi-Peak detector

LINE 2 PLOT



LINE 2 RESULTS

Trace Markers

Range 2: Phase N .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_N[dB]	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
13	.156	40.8	Pk	9.8	.1	50.7	65.67	-14.97	-	-
14	.165	25.96	Av	9.9	.1	35.96	-	-	55.21	-19.25
15	.333	34.35	Pk	9.8	.2	44.35	59.38	-15.03	-	-
16	.327	21.63	Av	9.7	.2	31.53	-	-	49.53	-18
17	.378	33.4	Pk	9.8	.2	43.4	58.32	-14.92	-	-
18	.381	18.1	Av	9.8	.2	28.1	-	-	48.26	-20.16
19	.576	32.72	Pk	9.9	.2	42.82	56	-13.18	-	-
20	.549	16.14	Av	9.9	.2	26.24	-	-	46	-19.76
21	.819	32.76	Pk	9.8	.2	42.76	56	-13.24	-	-
22	.828	16.15	Av	9.8	.3	26.25	-	-	46	-19.75
23	13.56	44.2	Pk	10	.4	54.6	60	-5.4	-	-
24	13.56	40.93	Av	10	.4	51.33	-	-	**50**	**1.33**

Pk - Peak detector
Av - Average detection

Quasi-Peak Emissions

Range 2: Phase N .15 - 30MHz

Frequency (MHz)	Meter Reading (dBuV)	Det	101836_With EX_N[dB]	CABLELOSS (dB)	Corrected Reading (dB(uVolts))	CFR 47 FCC PART 15 Class B QP	Margin (dB)	CFR 47 FCC PART 15 Class B AV	Margin (dB)
13.5608	42.28	Qp	10	.4	52.68	60	-7.32	-	-

Qp - Quasi-Peak detector

10. FREQUENCY STABILITY

LIMIT

§15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency, over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

TEST PROCEDURE

ANSI C63.10 §6.8

RESULTS

Test Date	2023-1-10
Test Engineer	25910

Reference Frequency: EUT Channel 13.56 MHz @ 20ºC Limit: ± 100 ppm = 1.356 kHz										
Power Supply	Envir.	Frequency Deviation Measureed with Time Elapse								
(Vdc)	Temp (°C)	Start up (MHz)	Delta (ppm)	@ 2mins (MHz)	Delta (ppm)	@ 5mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.86	50	13.560574761	-3.664	13.560573484	-3.759	13.560573406	-3.764	13.560573374	-3.767	100
3.86	40	13.560592286	-2.372	13.560587576	-2.719	13.560581236	-3.187	13.560580510	-3.240	100
3.86	30	13.560612032	-0.916	13.560610238	-1.048	13.560604712	-1.456	13.560601252	-1.711	100
3.86	***20***	***13.560624452***	***0***	***13.560623266***	-0.087	***13.560623269***	-0.087	***13.560624192***	-0.019	***100***
3.86	10	13.560628364	0.288	13.560634528	0.743	13.560641717	1.273	13.560646505	1.626	100
3.86	0	13.560656632	2.373	13.560661783	2.753	13.560665685	3.041	13.560667349	3.163	100
3.86	-10	13.560673822	3.641	13.560673884	3.645	13.560673899	3.646	13.560673925	3.648	100
3.86	-20	13.560659834	2.609	13.560659701	3.000	13.560657946	2.470	13.560657205	2.415	100
3.86	-30	13.560604466	-1.474	13.560599782	-1.819	13.560592314	-2.370	13.560590375	-2.513	100

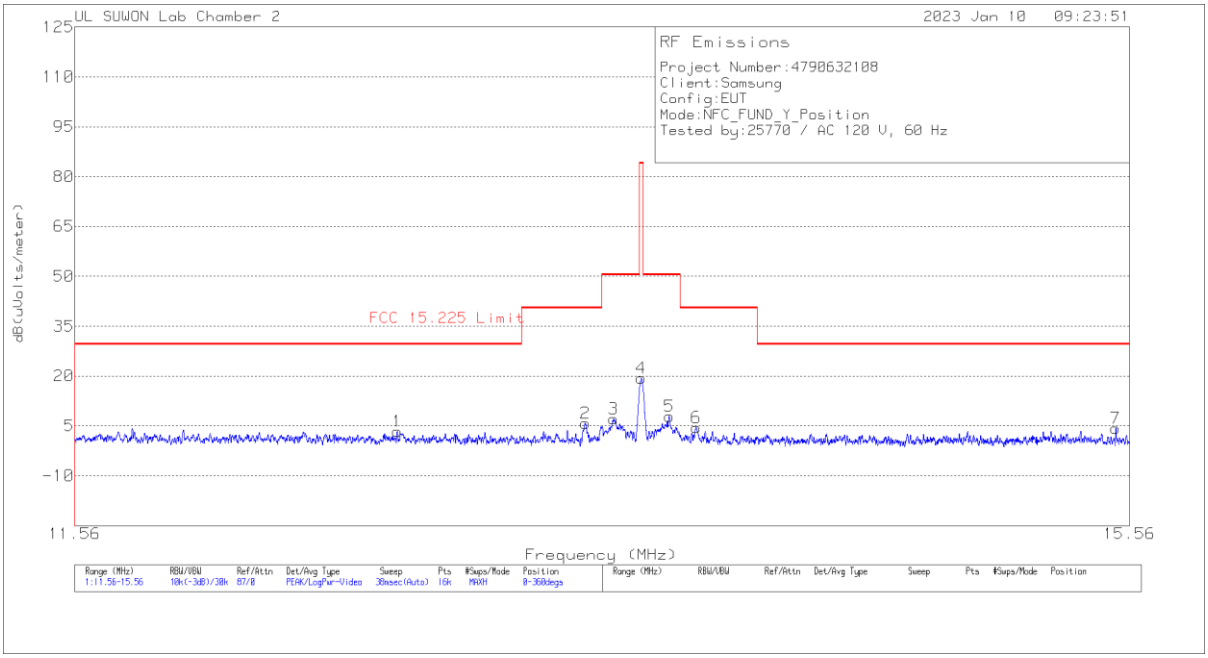
Reference Frequency: EUT Channel 13.56 MHz @ 20ºC Limit: ± 100 ppm = 1.356 kHz										
Power Supply	Envir.	Frequency Deviation Measureed with Time Elapse								
(Vdc)	Temp (°C)	Start up (MHz)	Delta (ppm)	@ 2mins (MHz)	Delta (ppm)	@ 5mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.86	***20***	***13.560624452***	***0***	***13.560623266***	-0.087	***13.560623269***	-0.087	***13.560624192***	-0.019	***100***
4.20	20	13.560632104	0.564	*13.560630207*	0.424	*13.560626903*	0.181	*13.560624132*	-0.024	100
3.75	20	13.560614433	-0.739	*13.560612949*	-0.848	*13.560611040*	-0.989	*13.560609344*	-1.114	100

No non-compliance noted.

11. SPOT-CHECK TEST RESULT

BANDEDGE (WORST CASE: Without Card tag / Face on)

FUNDAMENTAL EMISSION DATA



Trace Markers

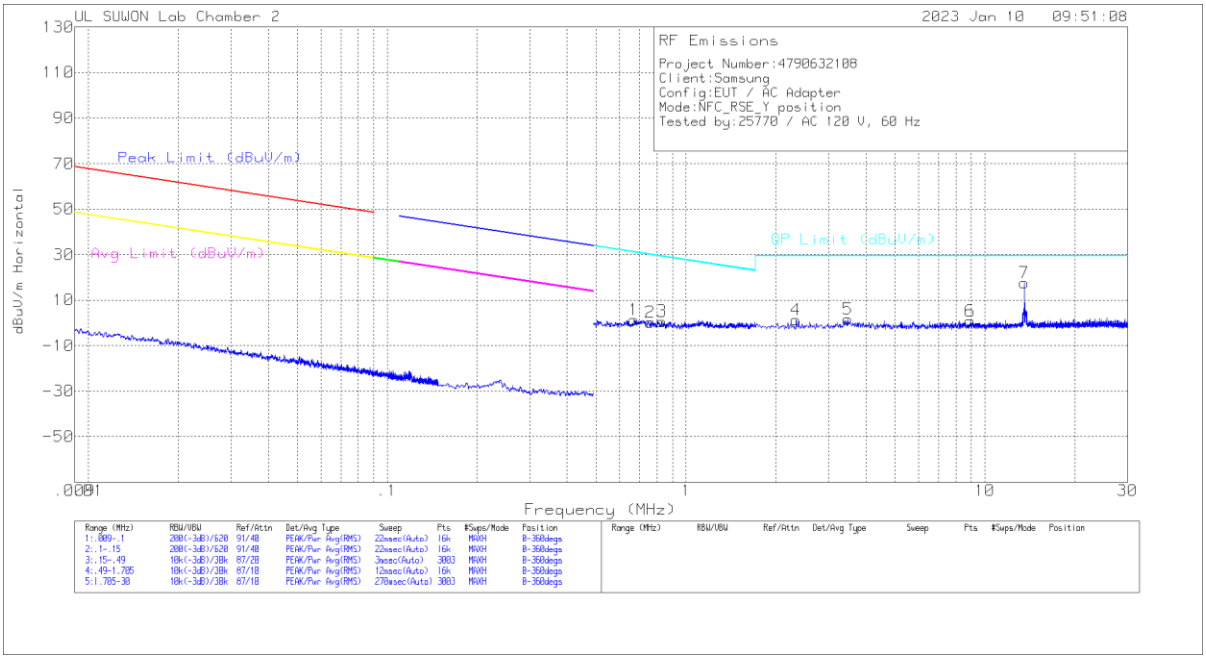
Face on

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Dist Corr 30m	Cable Loss	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	Margin (dB)	Azimuth (Degs)
1	12.65975	22.81	Pk	20	-40	.5	3.31	29.54	-26.23	0-360
2	13.34813	25.28	Pk	20	-40	.5	5.78	40.51	-34.73	0-360
3	13.45563	26.59	Pk	20	-40	.5	7.09	50.5	-43.41	0-360
**4	13.56063	38.81	Pk	20	-40	.5	19.31	84	-64.69	0-360
5	13.66738	27.28	Pk	20	-40	.6	7.88	50.5	-42.62	0-360
6	13.77263	23.96	Pk	20	-40	.6	4.56	40.51	-35.95	0-360
7	15.50075	23.7	Pk	20	-40	.6	4.3	29.54	-25.24	0-360

Pk - Peak detector
**Fundamental

HARMONICS AND SPURIOUS EMISSIONS(Without Card tag / Face off)

SPURIOUS EMISSION DATA



Trace Markers

Face ON

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	HFH2-Z2_Loop Antenna	Cable Loss	Dist Corr 30m	Corrected Reading dBuV/m	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.66963	21.7	Pk	19.7	.1	-40	1.5	31.09	-29.59	0-360
2	.75969	20.38	Pk	19.8	.2	-40	.38	30	-29.62	0-360
3	.83006	20.69	Pk	19.8	.2	-40	.69	29.23	-28.54	0-360
4	2.33648	21.4	Pk	19.9	.2	-40	1.5	29.5	-28	0-360
5	3.4769	21.55	Pk	19.9	.3	-40	1.75	29.5	-27.75	0-360
6	8.92455	20.34	Pk	20	.5	-40	.84	29.5	-28.66	0-360
**7	13.56165	37.1	Pk	20	.5	-40	17.6	29.5	-11.9	0-360

Pk - Peak detector
**Fundamental

END OF TEST REPORT