TEST REPORT

Report Number. : 13211873-E8V1

Applicant	:	Samsung Electronics Co., Ltd. 129 Samsung-Ro, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, 16677, Korea
Model	:	SM-A715W
FCC ID	:	A3LSMA715W
EUT Description	:	GSM/WCDMA/LTE Phablet with BT/BLE, DTS/UNII a/b/g/n/ac, NFC and ANT+
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C

Date Of Issue:
February 25, 2020

Prepared by:
UL Verification Services Inc.
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NVLAP TESTING

NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2/25/2020	Initial Issue	

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Samsung Electronics Co., Ltd.
129 Samsung-Ro, Yeongtong-Gu,
Suwon-Si, Gyeonggi-Do, 16677, Korea

EUT DESCRIPTION: GSM/WCDMA/LTE Phablet with BT/BLE, DTS/UNII a/b/g/n/ac, NFC and ANT+

MODEL: SM-A715W

SERIAL NUMBER: Conducted (Original): R38M60J9VBM
Radiated (Original): R38M808E5AH
Radiated (Spot Check): R38N108PFHB

DATE TESTED: November 26 – December 4, 2019 (Original)
February 19, 2020 (Spot Check)

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

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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2. INTRODUCTION OF TEST DATA REUSE

2.1. INTRODUCTION

According to the manufacturer, FCC ID: A3LSMA715F and FCC ID: A3LSMA715W non-licensed are electrically identical. The FCC ID: A3LSMA715F test data shall remain representative of FCC ID: A3LSMA715W.

The applicant takes full responsibility that the test data as referenced in this section represents compliance for this FCC ID.

2.2. DIFFERENCES

The FCC ID: A3LSMA715F, shares the same enclosure and circuit board as FCC ID: A3LSMA715W. The ANT+ antennas and surrounding circuitry and layout are identical between two models.

After confirming through preliminary radiated emissions that the performance of the FCC ID: A3LSMG715F remains representative of FCC ID: A3LSMA715W. The test data of FCC ID: A3LSMG715F being submitted for this application to cover ANT+ features.

2.3. SPOT CHECK VERIFICATION RESULTS SUMMARY

Spot check verification has been done on device A3LSMA715W for radiated harmonic spurious and radiated band-edge. The data from the application has been verified through appropriate spot checks to demonstrate compliance for this device in accordance to FCC public KDB 484596 D01 as shown in the summary below.

A3LSMA705W SPOT CHECK RESULTS									
Technology	Test Item	Channel	Measured	Original model		Spot check model		Delta (dB)	
				SM-A715F		SM-A715W			
				A3LSMA715F		A3LSMA715W			
			Frequency	Peak	Ave	Peak	Ave	Peak	Ave
ANT+	Fundamental	41	2441MHz	88.06	54.33	87.7	53.97	-0.36	-0.36
	RBE	80	2549MHz	52.14	18.41	51.47	17.17	-0.67	-1.24
	RSE	02	4929MHz	42.18	29.74	44.01	28.8	1.83	-0.94

Comparison of the models, upper deviation is within 3dB range and all tests are under FCC Technical Limits.

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SPOT CHECK DATA

FUNDAMENTAL FREQUENCY RADIATED EMISSION

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.44098	81.1	Pk	32.1	-25.5	0	87.7	-	-	114	-26.3	140	154	H
	2.44098	81.1	Pk	32.1	-25.5	-33.73	53.97	94	-40.03	-	-	140	154	H
2	2.44098	72.73	Pk	32.1	-25.5	0	79.33	-	-	114	-34.67	72	138	V
	2.44098	72.73	Pk	32.1	-25.5	-33.73	45.6	94	-48.4	-	-	140	154	H

PKFH - FHSS: RB=1MHz VB=3 x RB, Peak
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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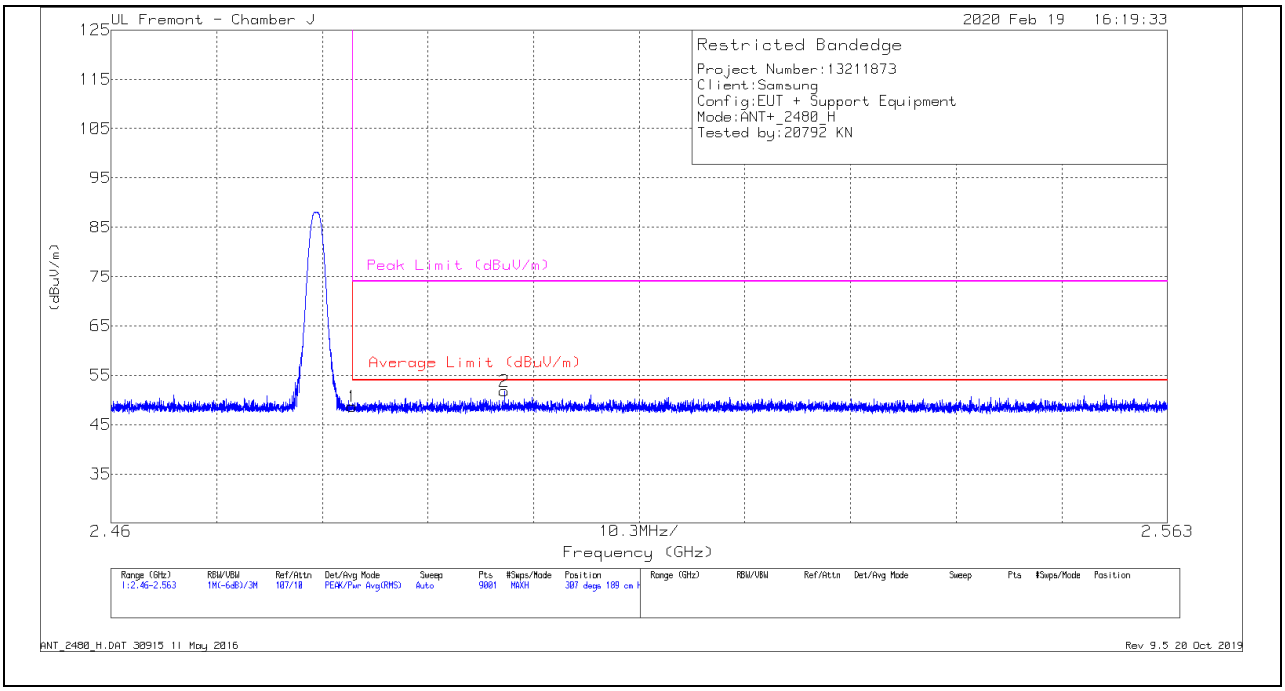
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	41.92	Pk	32.3	-25.5	0	48.72	-	-	74	-25.28	307	189	H
	* 2.48351	41.92	AVG	32.3	-25.5	-33.73	14.99	54	-39.01	-	-	307	189	H
2	* 2.49835	44.9	Pk	32.4	-25.5	0	51.8	-	-	74	-22.2	307	189	H
	* 2.49835	44.9	AVG	32.4	-25.5	-33.73	18.07	54	-35.93	-	-	307	189	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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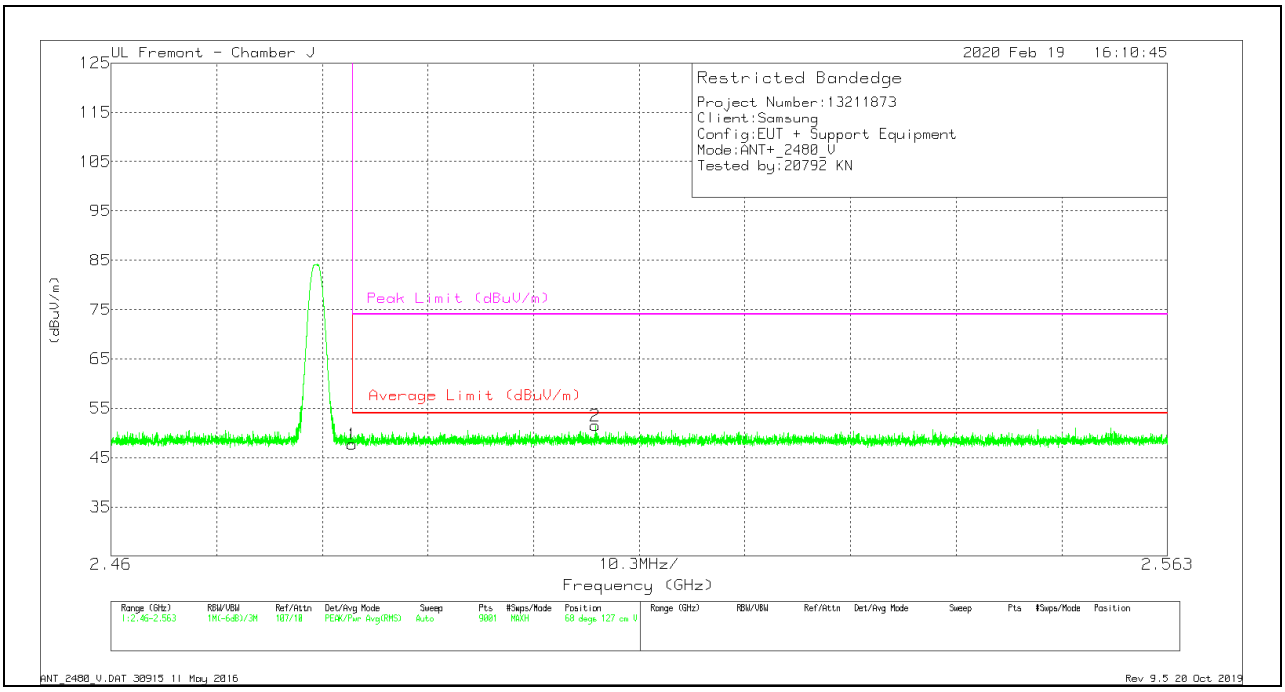
VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	40.89	Pk	32.3	-25.5	0	47.69	-	-	74	-26.31	68	127	V
	* 2.48351	40.89	AVG	32.3	-25.5	-33.73	13.96	54	-40.04	-	-	68	127	V
2	2.5072	44.57	Pk	32.4	-25.5	0	51.47	-	-	74	-22.53	68	127	V
	2.5072	44.57	AVG	32.4	-25.5	-33.73	17.74	54	-36.26	-	-	68	127	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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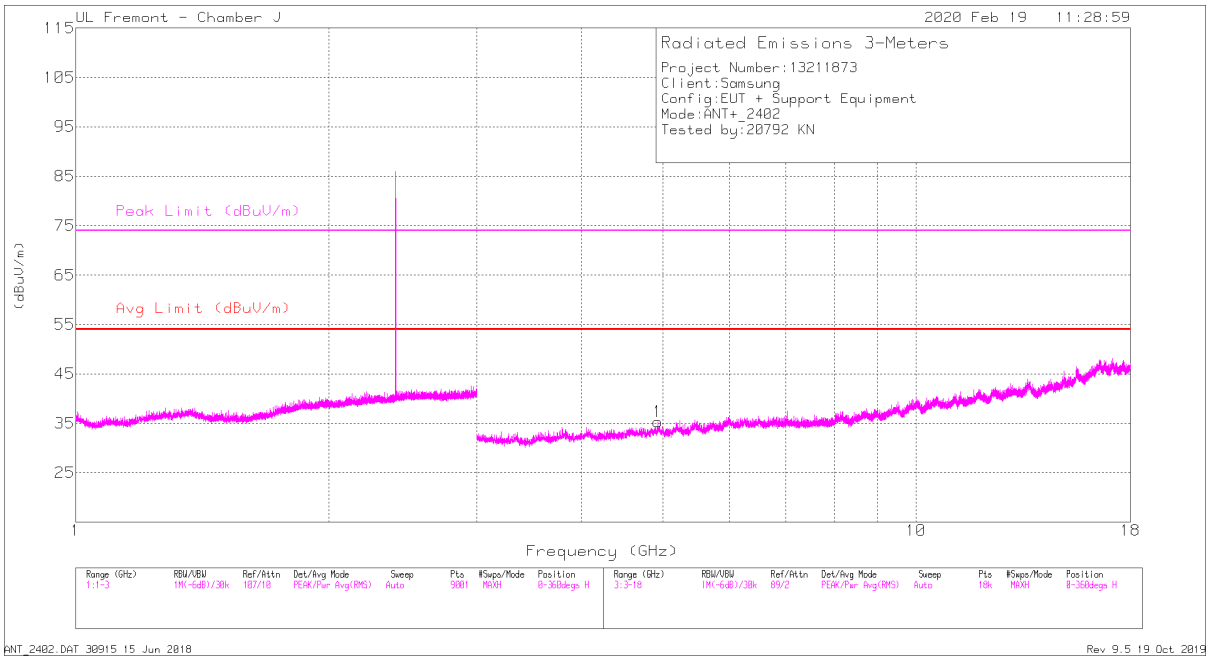
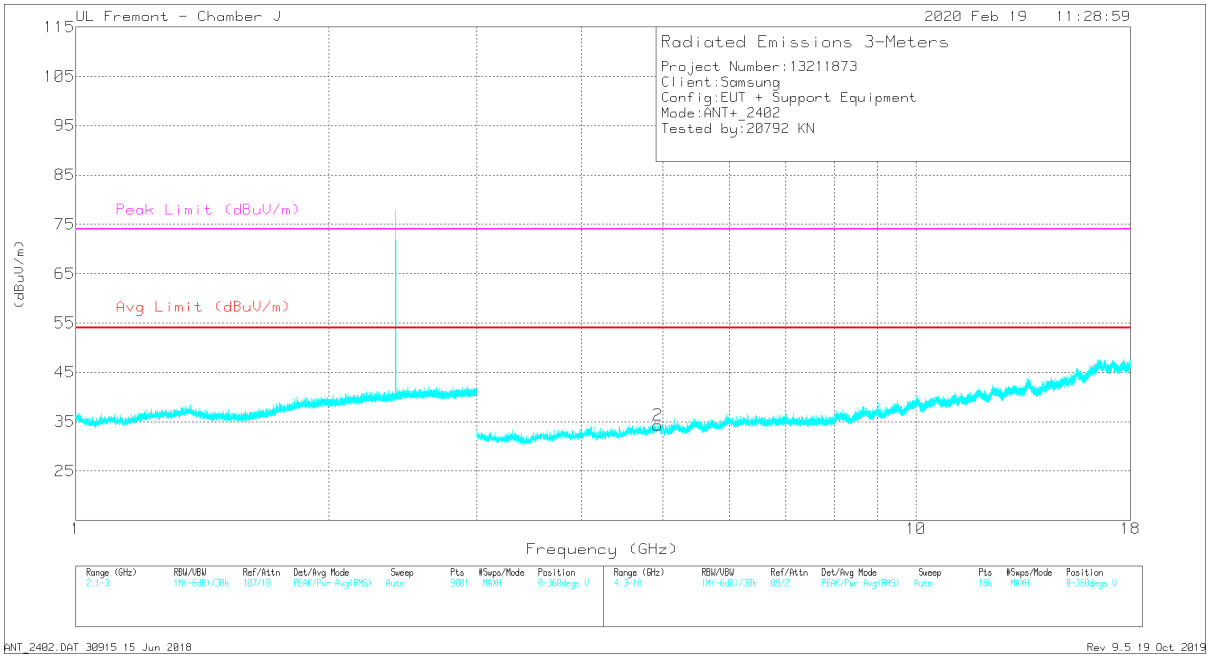
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.92569	39.96	PKFH	34.1	-30.5	43.56	-	-	74	-30.44	81	210	H
	* 4.92679	25.01	VA1T	34.1	-30.5	28.61	54	-25.39	-	-	81	210	H
2	* 4.9291	40.31	PKFH	34.1	-30.4	44.01	-	-	74	-29.99	232	108	V
	* 4.93248	25	VA1T	34.1	-30.3	28.8	54	-25.2	-	-	232	108	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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2.4. REFERENCE DETAIL

Reference application that contains the reused reference data

Equipment Class	Reference FCC ID	Type Grant/ Permissive Change	Reference Application	Folder Test/RF Exposure	Report Title/Section
DXX	A3LSMA715F	Grant	13096868-E8	Test	FCC Report ANT+ / All sections

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3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, and KDB 484596 D01 Referencing Test Data v01.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 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.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd
☐ Chamber A	☐ Chamber D	☐ Chamber I
☐ Chamber B	☐ Chamber E	☒ Chamber J
☐ Chamber C	☐ Chamber F	☐ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	☐ Chamber M

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code: 2324A.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

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5. CALIBRATION AND UNCERTAINTY

5.1. 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.

5.2. SAMPLE CALCULATION

RADIATED EMISSIONS
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

MAINS CONDUCTED EMISSIONS
Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

5.3. MEASUREMENT UNCERTAINTY

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.).

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

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a GSM/WCDMA/LTE Phablet with BT/BLE, DTS/UNII a/b/g/n/ac, NFC and ANT+. The test report addresses the ANT+ operational mode.

6.2. MAXIMUM FUNDAMENTAL FIELD STRENGTH

The transmitter has a maximum peak fundamental field strength as follows:

Frequency Range (MHz)	Mode	Peak E-field Strength (dBuV/m)	Avg E-field Strength (dBuV/m)	Distance (m)
2402 - 2480	ANT +	88.06	54.33	3.00

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal antenna, with a maximum gain of -7.52 dBi.

6.4. SOFTWARE

The test utility software used during testing was A715F.001.

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

All radios that can be transmitted simultaneously have been evaluated for radiated for all possible combinations of transmission and found to be in compliance.

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6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC Adapter	Samsung	EP-TA800	R37M8PH3JN2SE3	N/A
Earphone	Samsung	N/A	N/A	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Antenna	1	RF	Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Un-shielded	1	EUT to AC Mains

I/O CABLES (RADIATED AND CONDUCTED EMISSIONS)

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	USB	Shielded	1	N/A
2	Earphone	1	3.5mm	Un-shielded	1	N/A

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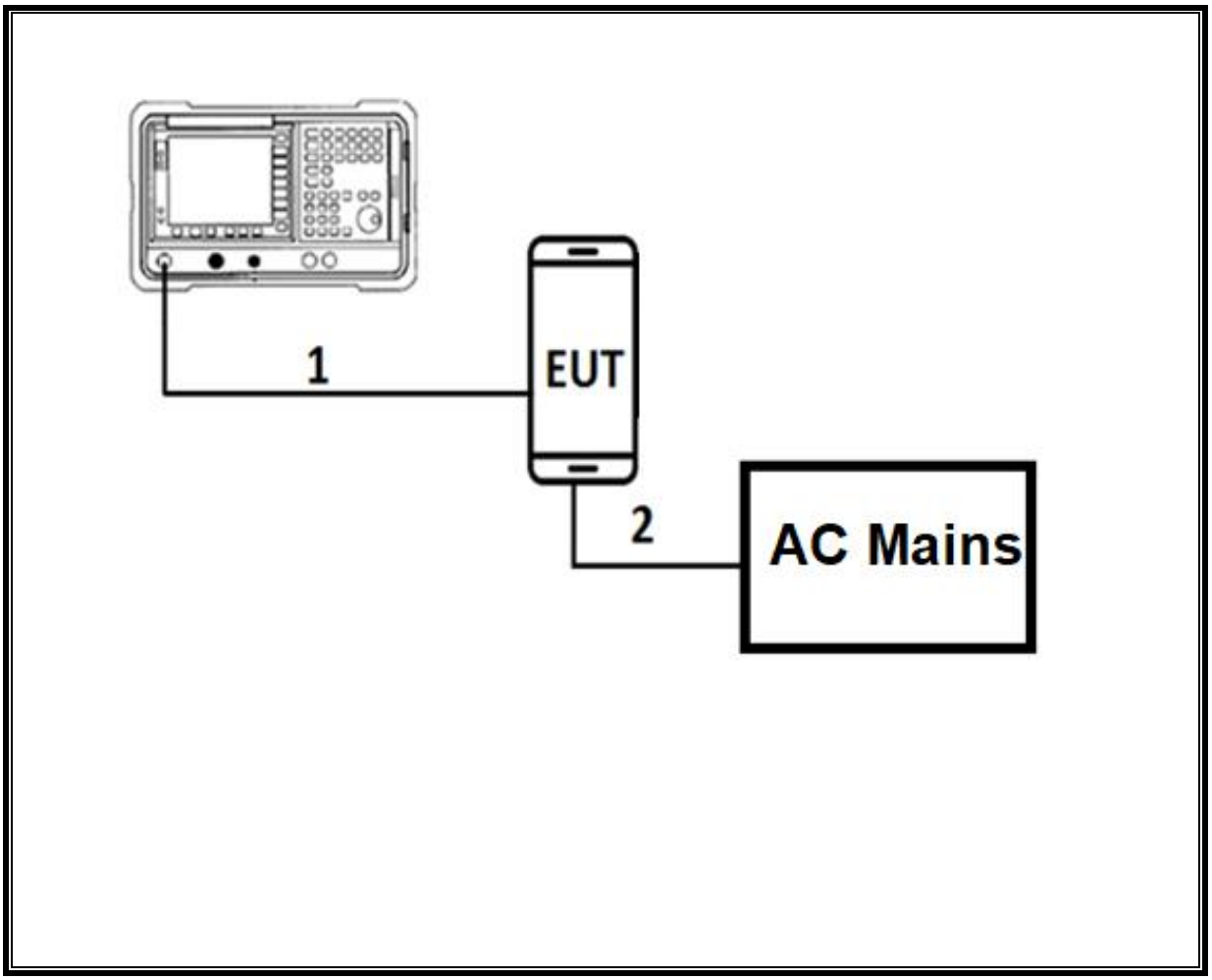
CONDUCTED TEST SETUP DIAGRAM



TEST SETUP

For conducted tests: the EUT was stand alone. The test software exercises the radio.

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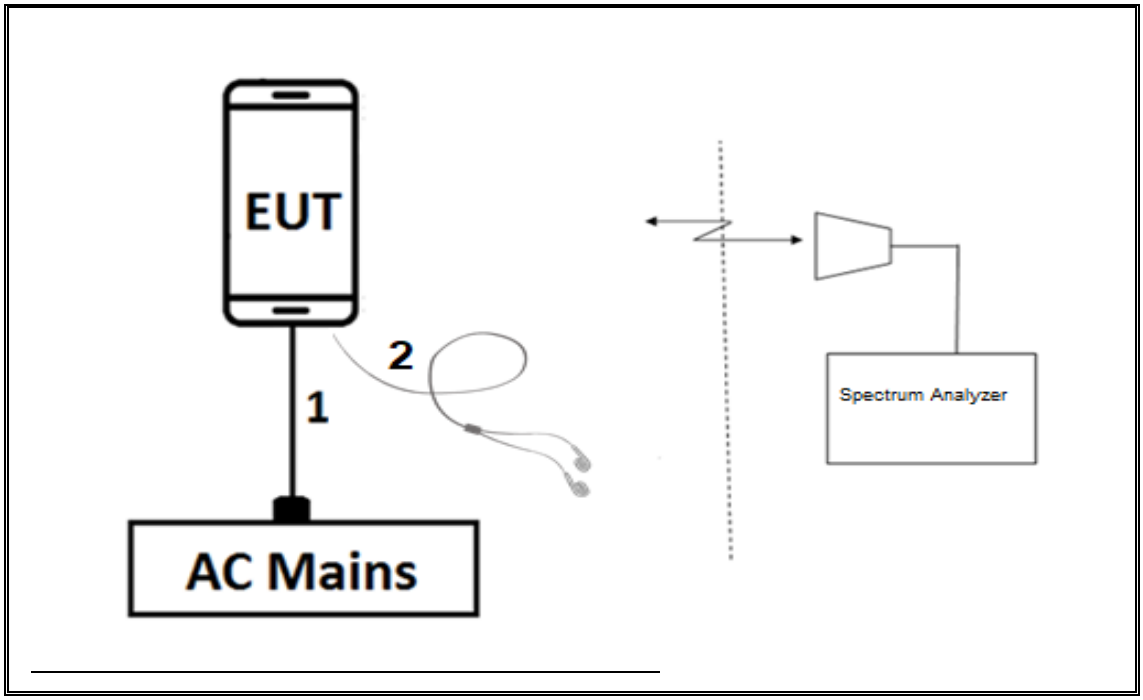
RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated tests: EUT is connected to earphone. The test software exercises the radio.

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7. 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**	**Asset**	**Cal Due**
Antenna, Passive Loop 30Hz to 1MHz	ELETRO METRICS	EM-6871	PRE0179466	05/31/2020
Antenna, Passive Loop 100KHz to 30MHz	ELETRO METRICS	EM-6872	PRE0179468	05/31/2020
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T344	05/07/2020
Amplifier, 1 to 18GHz	Amplical	AMP1G18-35	T1571	05/28/2020
Antenna, Broadband Hybrid, 30MHz to 2GHz	Sunol Sciences	JB3	T899	08/23/2020
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0180174	06/01/2020
Spectrum Analyzer, PSA, 3Hz to 44GHz	Keysight	E4446A	T146	01/28/2020
Antenna Horn, 18 to 26.5GHz	ARA	MWH-1826/B	T447	08/13/2020
Pre-Amp 1-26.5 GHz	AMPLICAL	AMP18G26.5-60	PRE0181238	05/01/2020
EMI Test Receiver	Rohde&Schwarz	ESW44	PRE0179367	05/16/2020
Filter, HPF 3.0GHz	MICRO-TRONICS	HPM17543	171901	05/28/2020
AC Line Conducted				
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/14/2020
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	01/24/2020
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, June 15, 2019	
Antenna Port Software	UL	UL RF	Ver 11.13, Nov 13, 2019	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

NOTES:
1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

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SPOTCHECK TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Asset**	**Cal Due**
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T344	05/07/2020
Amplifier, 1 to 18GHz	Amplical	AMP1G18-35	T1571	05/28/2020
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	05/16/2020
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, June 15, 2019	

NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

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8. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Occupied BW (20dB): ANSI C63.10-2013 Section 6.9.2

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3 and 6.5

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3 and 6.6

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

AC Power-line conducted emissions: ANSI C63.10-2013, Section 6.2.

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9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

NOTE: For ON TIME measurement:
ON Time over 1msec period x No. of pulses over 100msec period = ON TIME
158.3us x 13 pulses = 2.058msec

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor for Average Measurements (dB)	1/B Minimum VBW (kHz)
ANT+	2.058	100.00	0.021	2.06	-33.73	0.486

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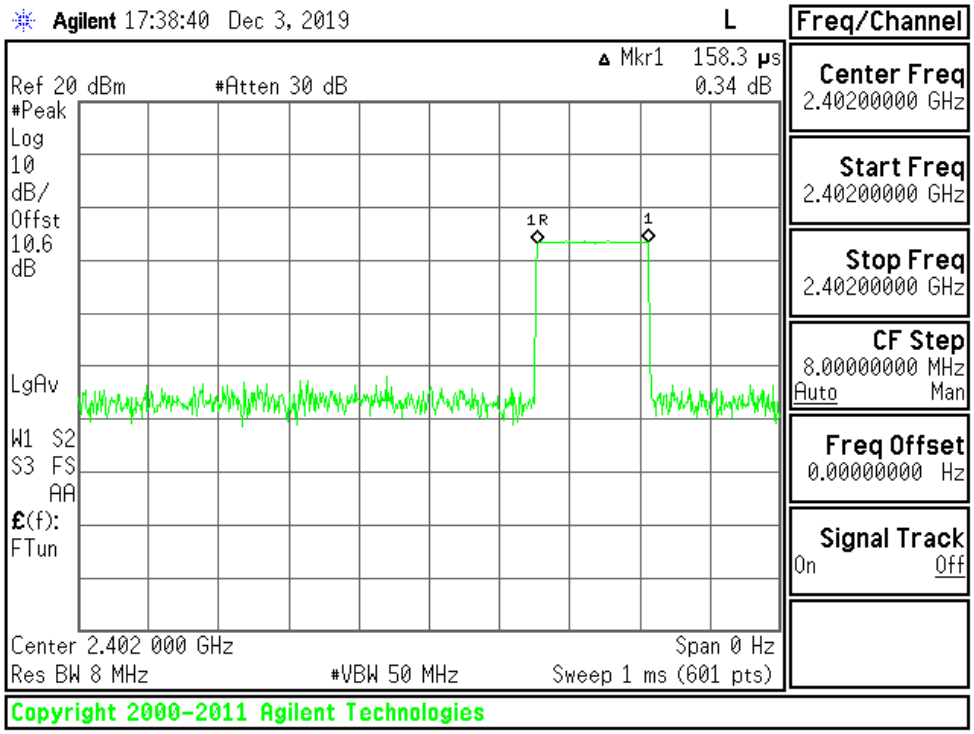
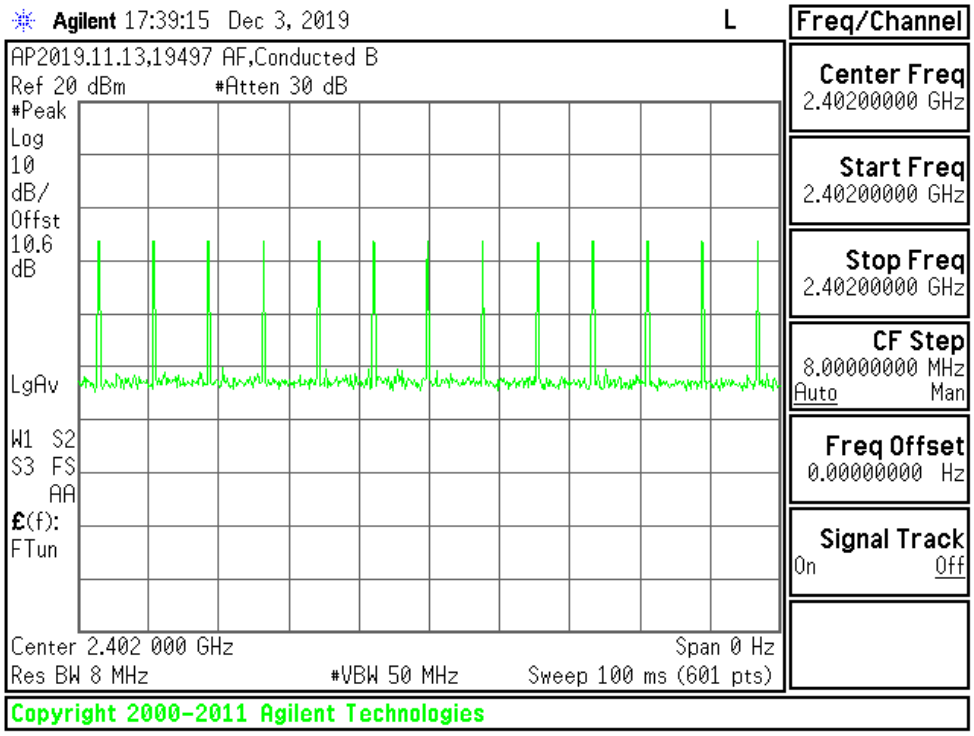
DUTY CYCLE PLOTS



ANT+ ON TIME



ANT+ 100ms PERIOD

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9.2. 20dB BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 5% of the 20 dB bandwidth. The VBW is set to approximately three times RBW. The sweep time is coupled

RESULTS

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Frequency Edge (MHz)	Limit (MHz)	Margin (MHz)
Low	2402	0.718	2401.6410	2400	-1.64
Mid	2441	0.706	N/A	N/A	N/A
High	2480	0.752	2480.3760	2483.5	-3.12

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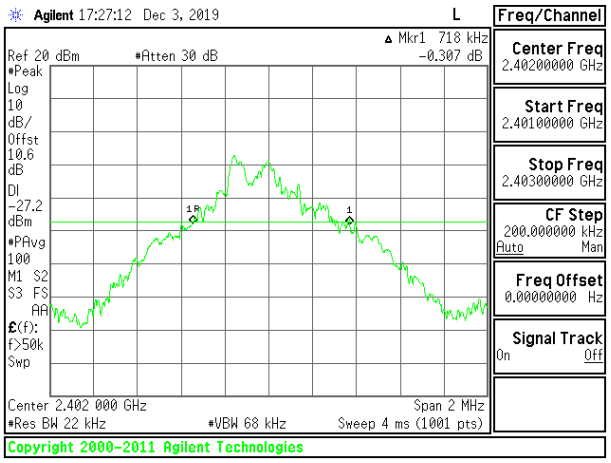
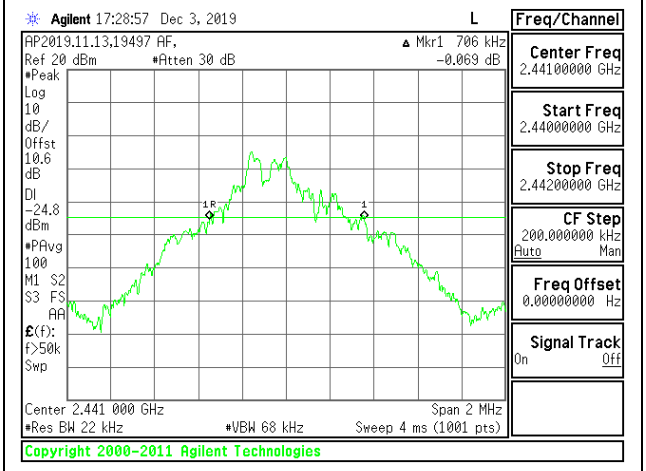
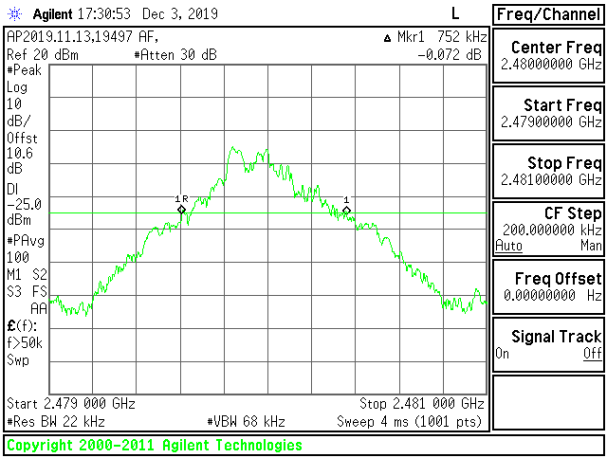


LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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10. RADIATED TEST RESULTS

LIMITS

FCC §15.249

FCC §15.205 and §15.209

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.
(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(e) As shown in Sec. 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

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TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T (500 Hz) video bandwidth with peak detector for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

2D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

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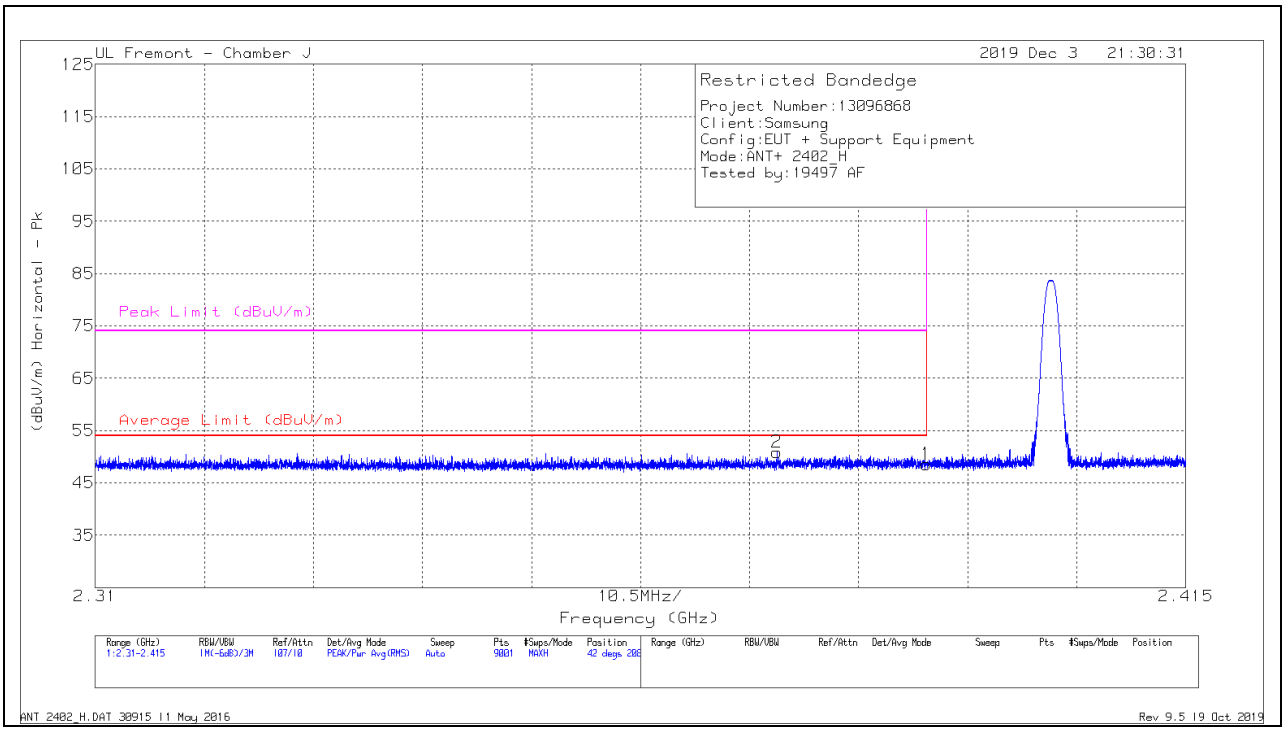
10.1. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	42.17	Pk	31.9	-25.5	0	48.57	-	-	74	-25.43	42	208	H
	* 2.38999	42.17	AVG	31.9	-25.5	-33.73	14.84	54	-39.16	-	-	42	208	H
2	* 2.37562	44.57	Pk	31.8	-25.5	0	50.87	-	-	74	-23.13	42	208	H
	* 2.37562	44.57	AVG	31.8	-25.5	-33.73	17.14	54	-36.86	-	-	42	208	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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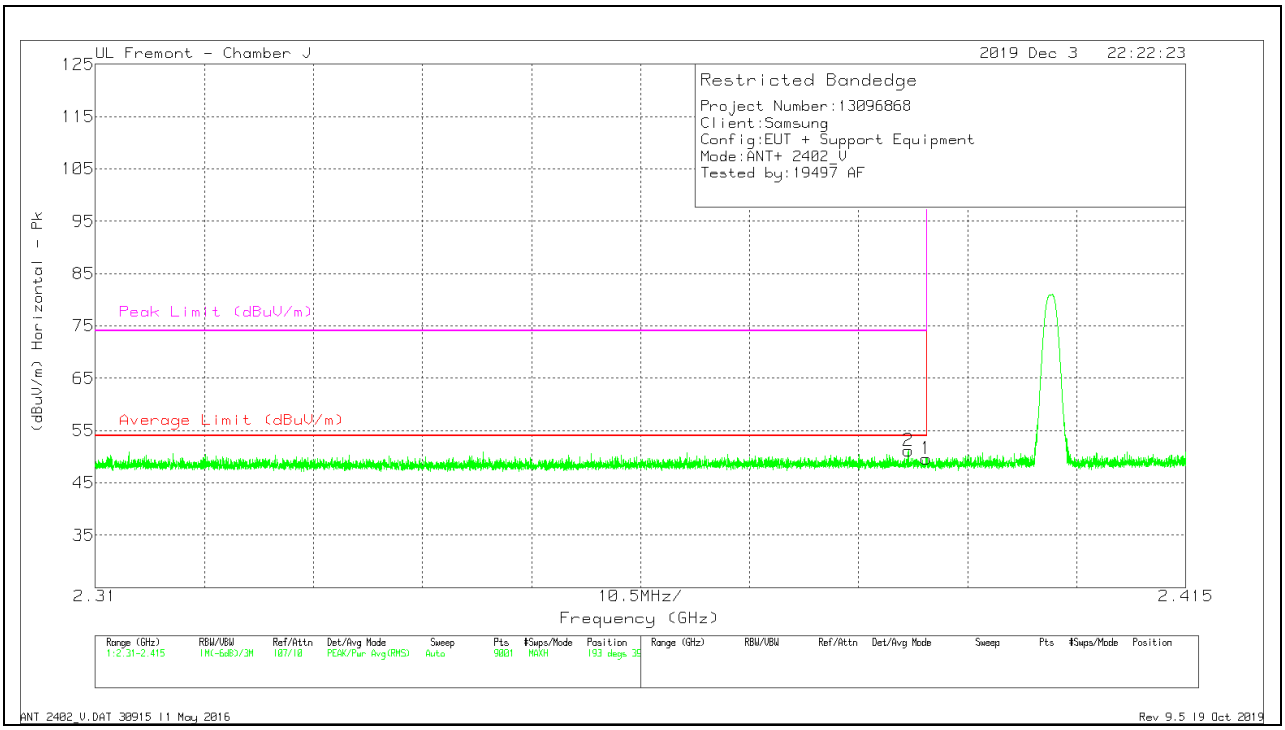
VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	43.23	Pk	31.9	-25.5	0	49.63	-	-	74	-24.37	193	395	V
	* 2.38999	43.23	AVG	31.9	-25.5	-33.73	15.9	54	-38.1	-	-	193	395	V
2	* 2.38827	44.8	Pk	31.9	-25.5	0	51.2	-	-	74	-22.8	193	395	V
	* 2.38827	44.8	AVG	31.9	-25.5	-33.73	17.47	54	-36.53	-	-	193	395	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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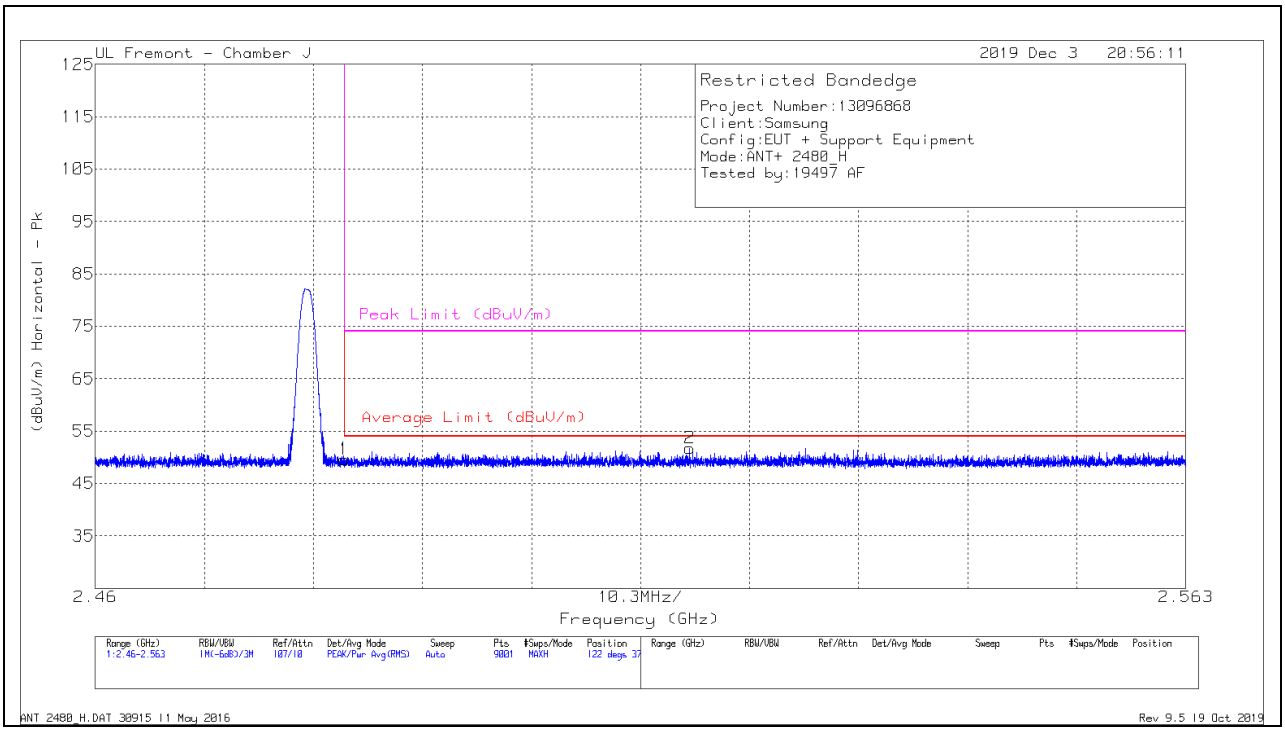
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	42.8	Pk	32.3	-25.5	0	49.6	-	-	74	-24.4	122	372	H
	* 2.48351	42.8	AVG	32.3	-25.5	-33.73	15.87	54	-38.13	-	-	122	372	H
2	2.51613	44.73	Pk	32.4	-25.4	0	51.73	-	-	74	-22.27	122	372	H
	2.51613	44.73	AVG	32.4	-25.4	-33.73	18	54	-36	-	-	122	372	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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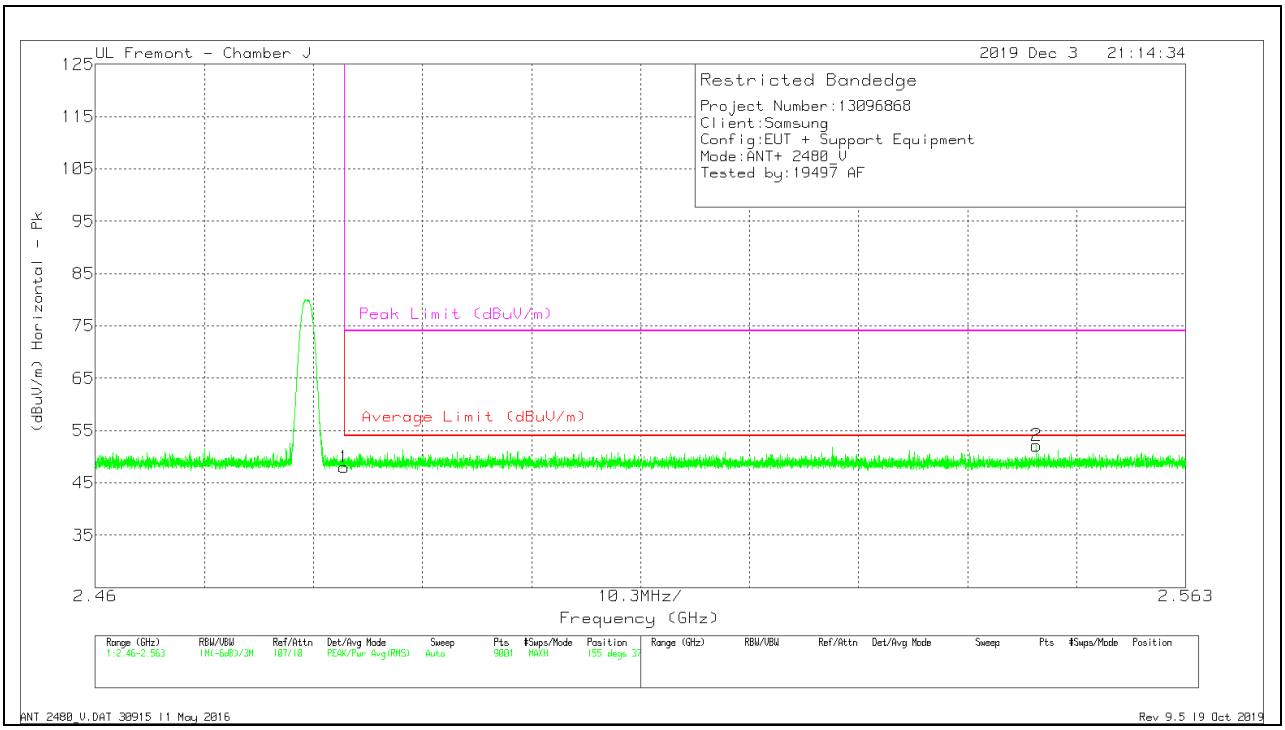
VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	41.17	Pk	32.3	-25.5	0	47.97	-	-	74	-26.03	155	373	V
	* 2.48351	41.17	Pk	32.3	-25.5	-33.73	14.24	54	-39.76	-	-	155	373	V
2	2.54889	45.24	Pk	32.3	-25.4	0	52.14	-	-	74	-21.86	155	373	V
	2.54889	45.24	Pk	32.3	-25.4	-33.73	18.41	54	-35.59	-	-	155	373	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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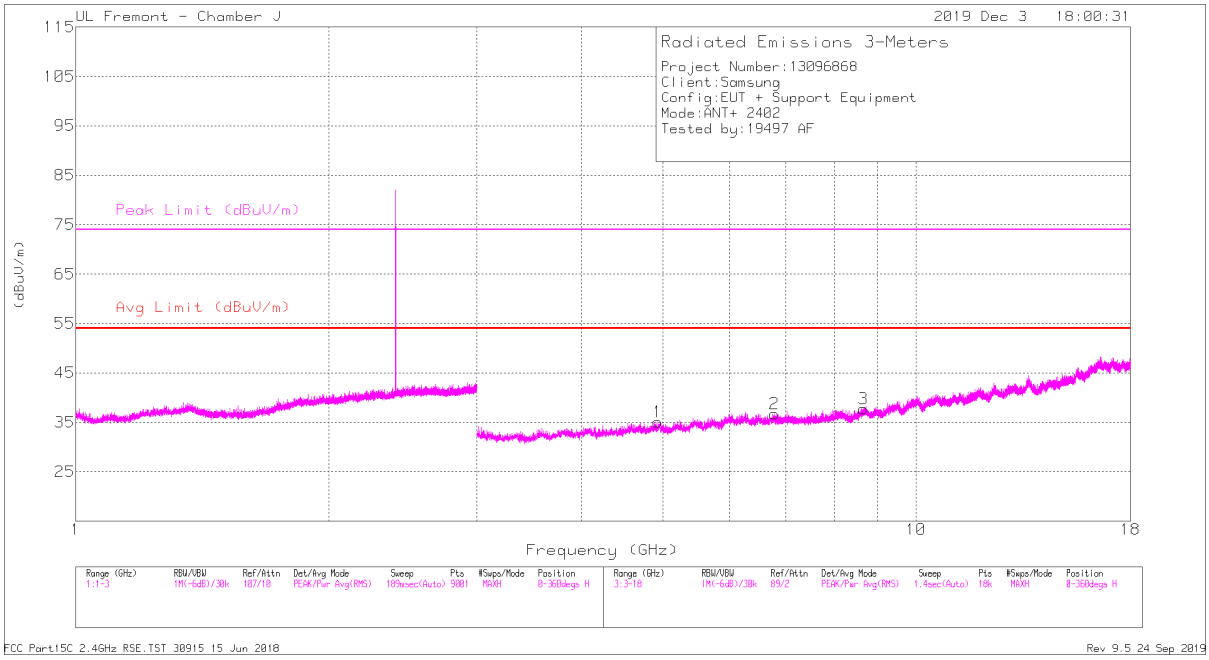
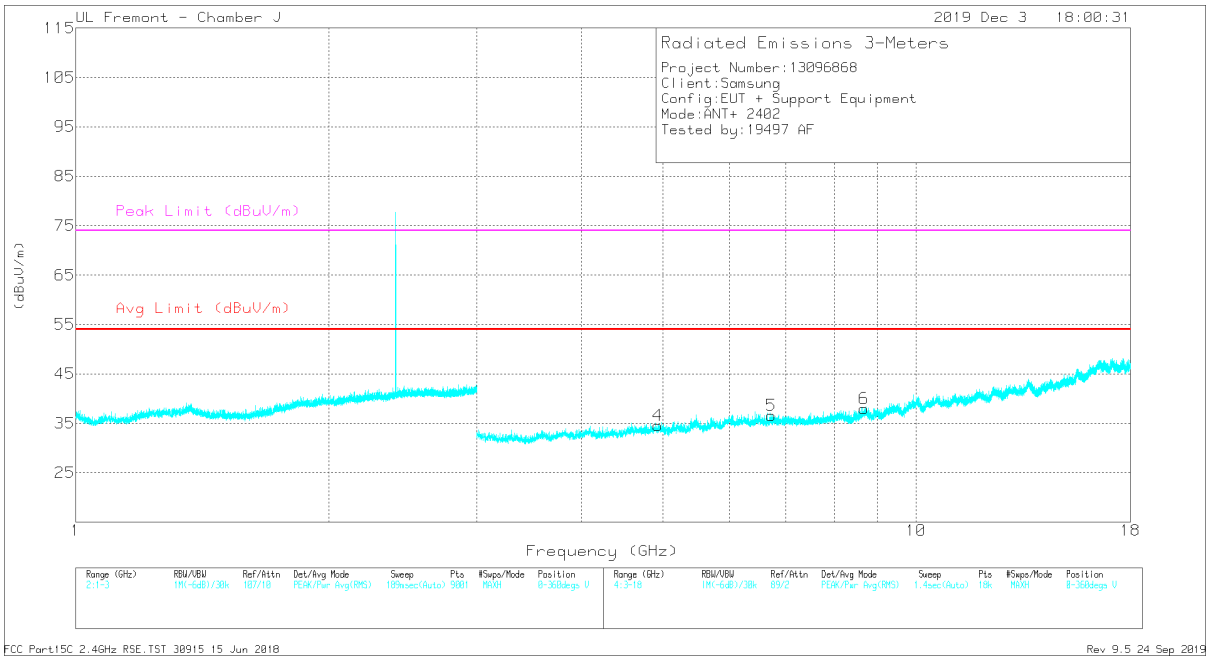
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.92844	39.57	PKFH	34.1	-30.4	43.27	-	-	74	-30.73	160	200	H
	* 4.92847	25.96	VA1T	34.1	-30.4	29.66	54	-24.34	-	-	160	200	H
2	6.78355	28.14	Pk	35.6	-27	36.74	-	-	-	-	0-360	199	H
3	8.65782	27.07	Pk	35.9	-25.2	37.77	-	-	-	-	0-360	199	H
4	* 4.92699	38.58	PKFH	34.1	-30.5	42.18	-	-	74	-31.82	150	312	V
	* 4.92949	26.04	VA1T	34.1	-30.4	29.74	54	-24.26	-	-	150	312	V
5	6.72854	28.34	Pk	35.6	-27.3	36.64	-	-	-	-	0-360	101	V
6	8.66865	27.14	Pk	36	-25.1	38.04	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton (in Hz) where Ton is the transmit duration

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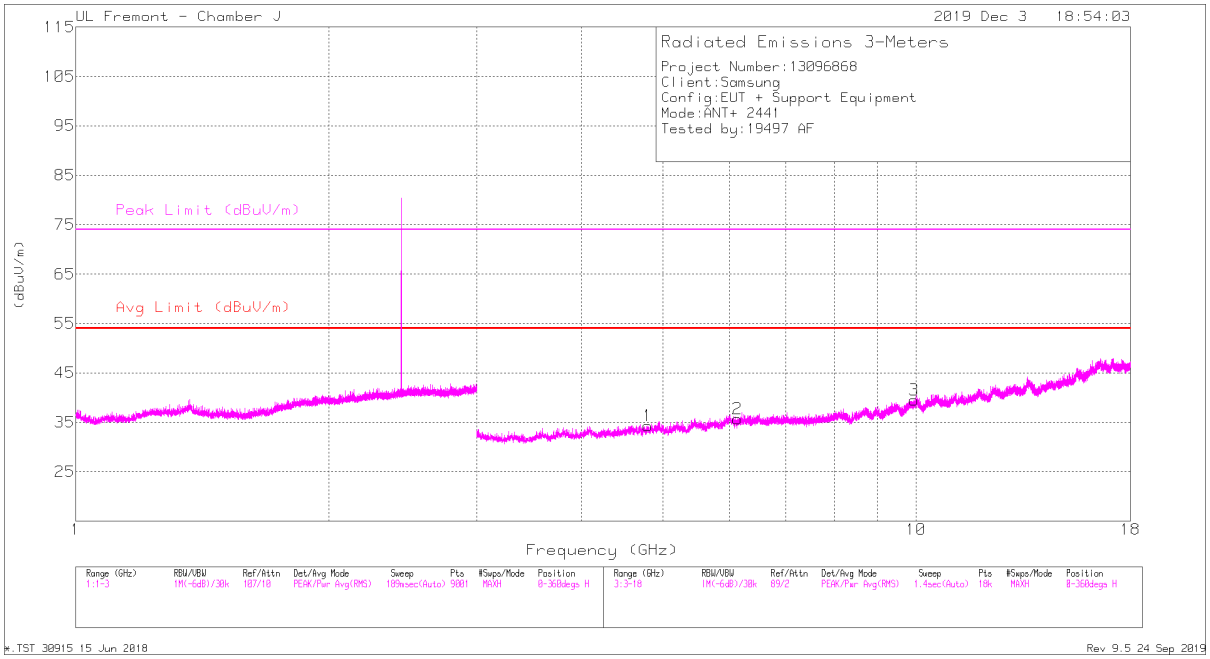
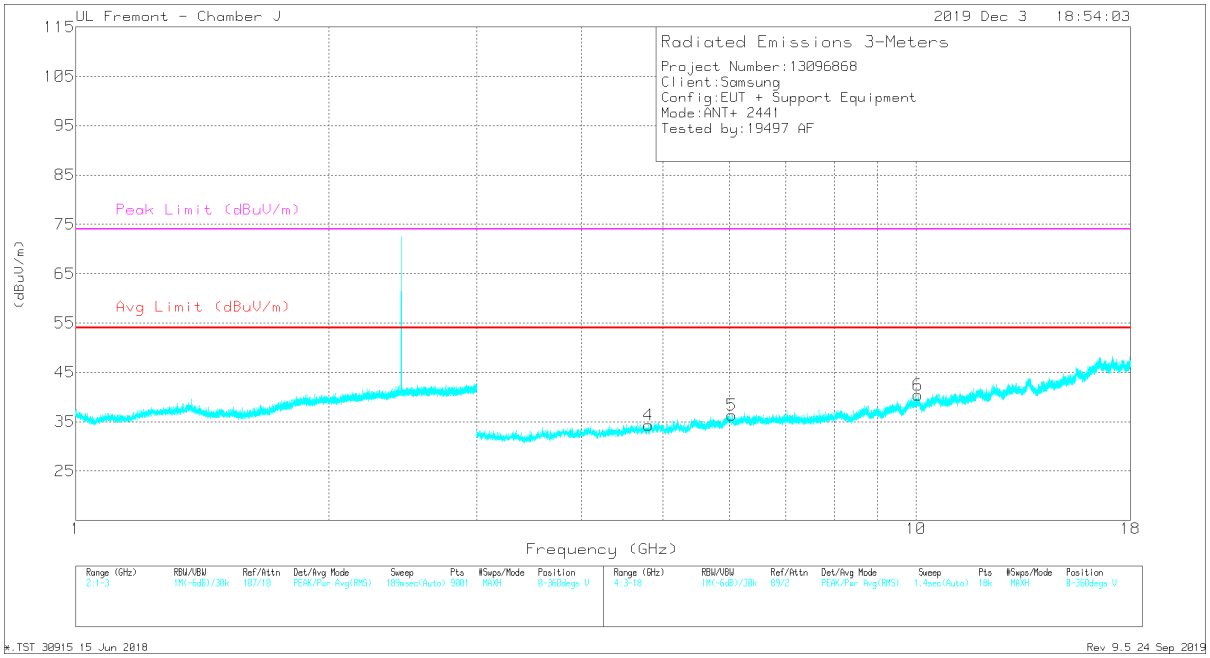
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.79574	38.99	PKFH	34.1	-30.8	42.29	-	-	74	-31.71	201	297	H
	* 4.79325	26.07	VA1T	34.1	-30.8	29.37	54	-24.63	-	-	201	297	H
2	6.13434	29	Pk	35.7	-29	35.7	-	-	-	-	0-360	100	H
3	9.95039	26.92	Pk	37	-24.4	39.52	-	-	-	-	0-360	100	H
4	* 4.80452	38.69	PKFH	34.2	-30.8	42.09	-	-	74	-31.91	201	356	V
	* 4.8053	25.85	VA1T	34.3	-30.8	29.35	54	-24.65	-	-	201	356	V
5	6.041	29.06	Pk	35.4	-28.1	36.36	-	-	-	-	0-360	101	V
6	10.0629	26.42	Pk	37.2	-23.2	40.42	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton (in Hz) where Ton is the transmit duration

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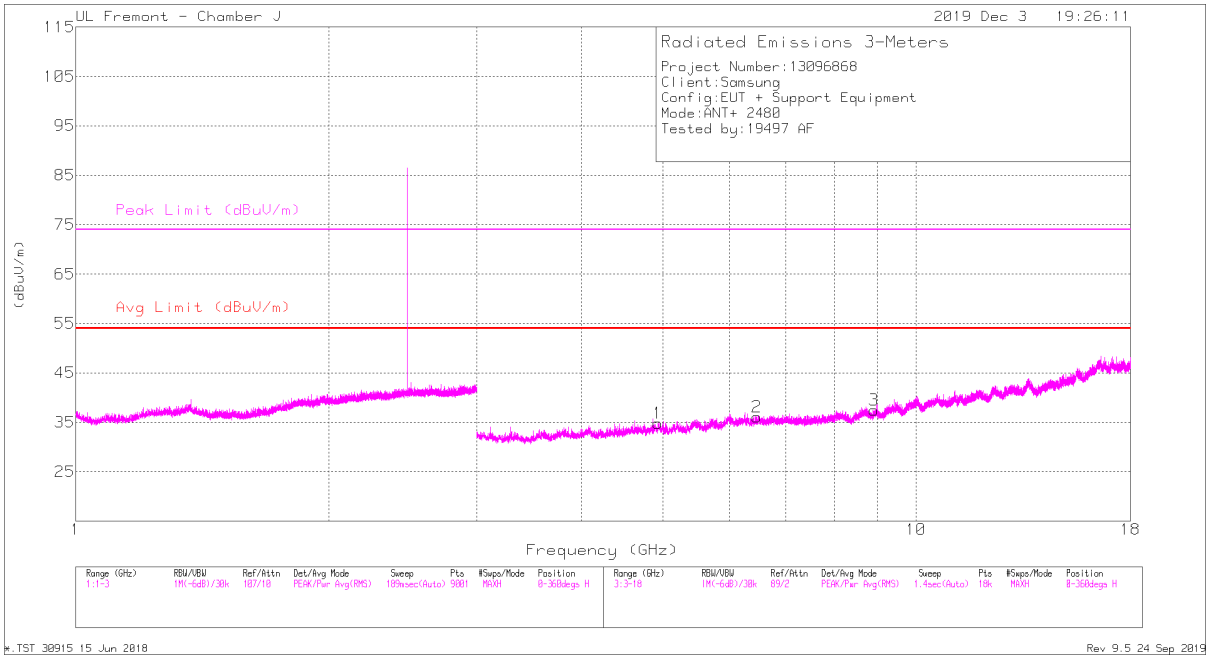
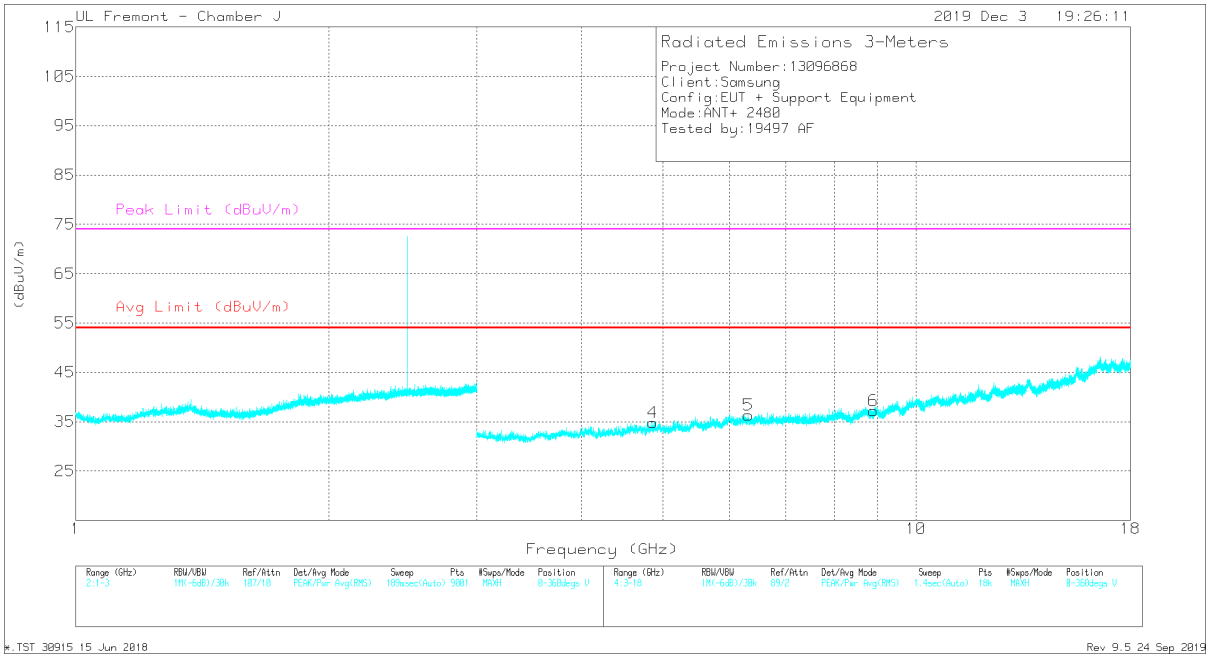
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.92976	38.58	PKFH	34.1	-30.4	42.28	-	-	74	-31.72	282	307	H
	* 4.92648	25.97	VA1T	34.1	-30.5	29.57	54	-24.43	-	-	282	307	H
2	6.46686	28.22	Pk	35.6	-27.7	36.12	-	-	-	-	0-360	199	H
3	8.92033	25.45	Pk	36.1	-24.1	37.45	-	-	-	-	0-360	199	H
4	* 4.86367	39.74	PKFH	34.1	-31.1	42.74	-	-	74	-31.26	28	389	V
	* 4.8642	26.21	VA1T	34.1	-31.1	29.21	54	-24.79	-	-	28	389	V
5	6.31852	28.59	Pk	35.6	-27.9	36.29	-	-	-	-	0-360	199	V
6	8.90116	25.74	Pk	36.1	-24.6	37.24	-	-	-	-	0-360	199	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton (in Hz) where Ton is the transmit duration

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10.2. FUNDAMENTAL FREQUENCY RADIATED EMISSION

Tested By:	19497 AF
Date:	12/03/2019

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.402	75.76	PKFH	31.9	-25.5	0	82.16	-	-	114	-31.84	74	118	H
	75.76	AVG	31.9	-25.5	-33.73	48.43	94	-45.57	-	-	74	118	H
	73.05	PKFH	31.9	-25.5	0	79.45	-	-	114	-34.55	236	347	V
	73.05	AVG	31.9	-25.5	-33.73	45.72	94	-48.28	-	-	236	347	V
2.441	79.09	PKFH	31.9	-25.5	0	85.49	-	-	114	-28.51	246	397	H
	79.09	AVG	31.9	-25.5	-33.73	51.76	94	-42.24	-	-	246	397	H
	74.35	PKFH	31.9	-25.5	0	80.75	-	-	114	-33.25	193	395	V
	74.35	AVG	31.9	-25.5	-33.73	47.02	94	-46.98	-	-	193	395	V
2.480	81.16	PKFH	32.4	-25.5	0	88.06	-	-	114	-25.94	83	252	H
	81.16	AVG	32.4	-25.5	-33.73	54.33	94	-39.67	-	-	83	252	H
	74.92	PKFH	32.4	-25.5	0	81.82	-	-	114	-32.18	234	373	V
	74.92	AVG	32.4	-25.5	-33.73	48.09	94	-45.91	-	-	234	373	V

PKFH - FHSS: RB=1MHz VB=3 x RB, Peak
AVG = Peak Reading + Duty Cycle Correction Factor
Duty Cycle Correction Factor = -33.73 dB

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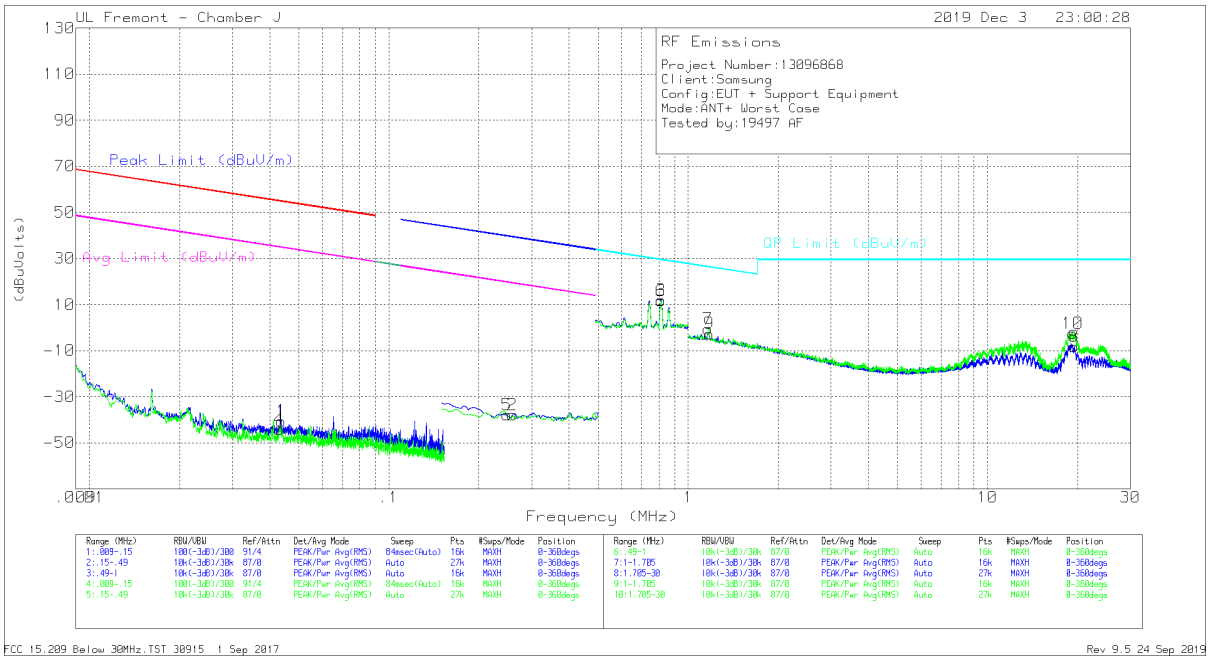
10.3. WORST CASE BELOW 30 MHz

SPURIOUS EMISSIONS 9 kHz TO 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30 MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.04367	10.85	Pk	57	-28.5	-80	-40.65	54.78	-95.43	34.78	-75.43	-	-	-	-	0-360
2	.2592	14.65	Pk	56.1	-28.6	-80	-37.85	-	-	-	-	39.34	-77.19	19.34	-57.19	0-360
4	.04302	7.43	Pk	57	-28.5	-80	-44.07	54.91	-98.98	34.91	-78.98	-	-	-	-	0-360
5	.24757	14.73	Pk	56.1	-28.6	-80	-37.77	-	-	-	-	39.74	-77.51	19.74	-57.51	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.81091	24.48	Pk	56.1	-28.5	-40	12.08	29.44	-17.36	0-360
6	.81101	24	Pk	56.1	-28.5	-40	11.6	29.44	-17.84	0-360
7	1.16676	22.01	Pk	45.9	-28.4	-40	-.49	26.29	-26.78	0-360
8	19.43192	25.62	Pk	34	-27.8	-40	-8.18	29.5	-37.68	0-360
9	1.17719	19.91	Pk	45.9	-28.4	-40	-2.59	26.21	-28.8	0-360
10	19.2569	31.45	Pk	34	-27.8	-40	-2.35	29.5	-31.85	0-360

Pk - Peak detector

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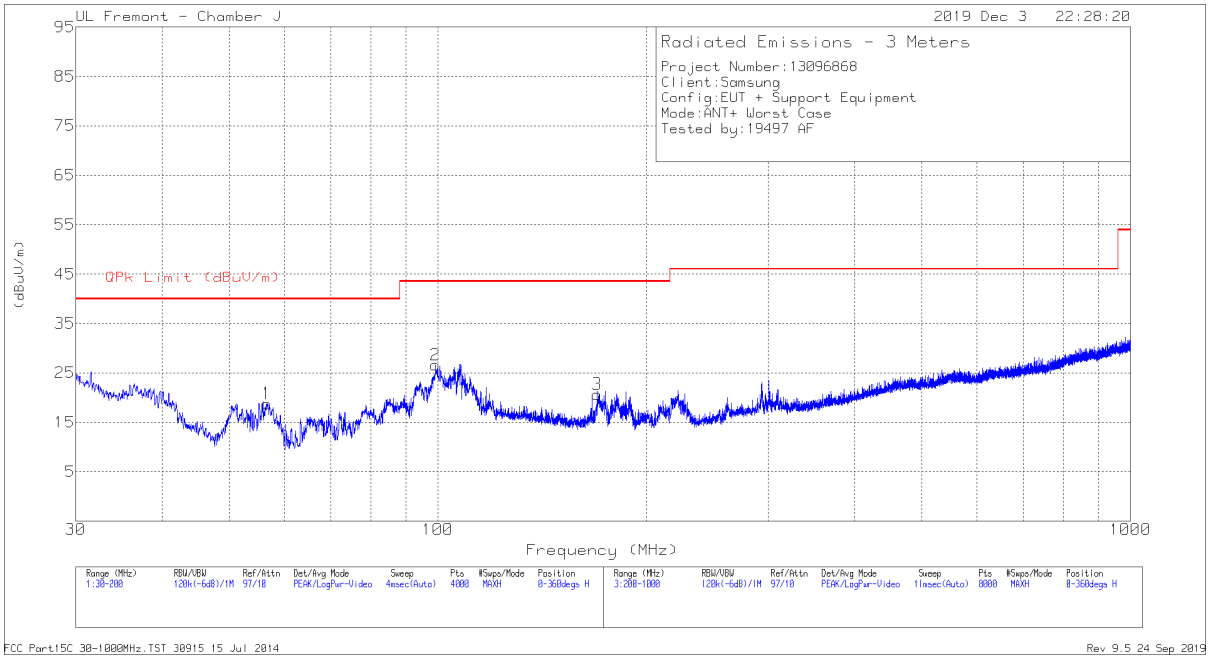
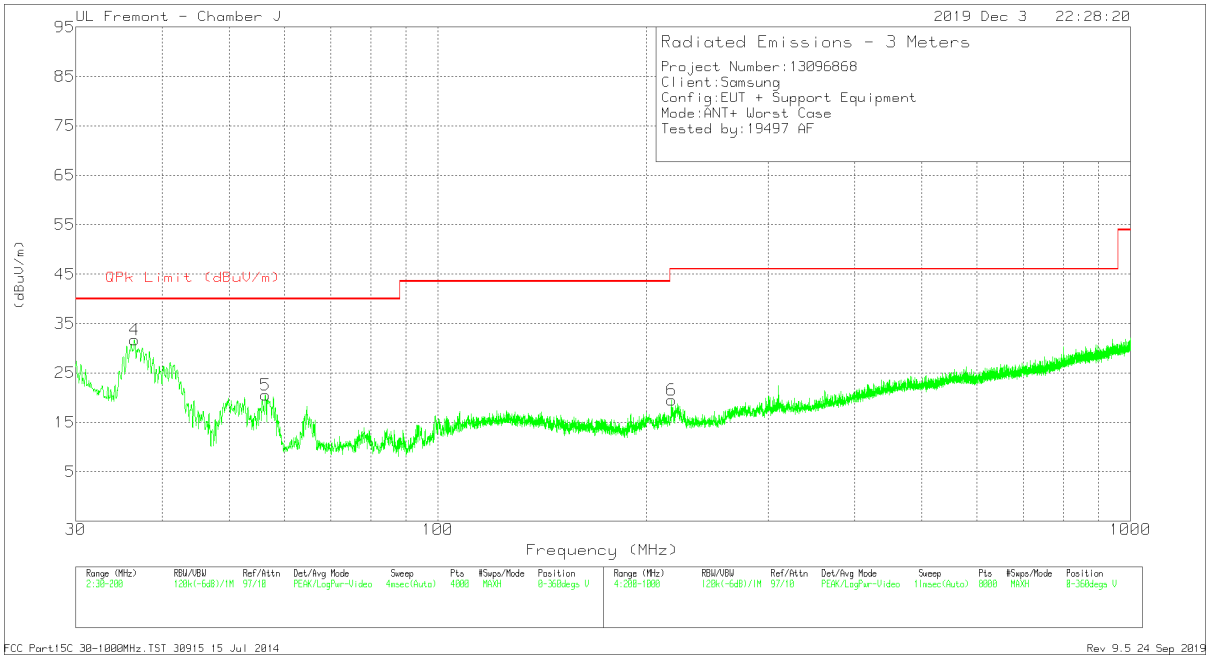
10.4. WORST CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

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Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	56.5694	36.91	Pk	13.3	-31.4	18.81	40	-21.19	0-360	398	H
2	99.1654	41.75	Pk	15.9	-31	26.65	43.52	-16.87	0-360	198	H
3	* 169.9462	33.61	Pk	17.7	-30.6	20.71	43.52	-22.81	0-360	98	H
4	36.6204	41.53	Pk	22.8	-31.5	32.83	40	-7.17	221	105	V
	36.6204	2.01	Qp	22.8	-31.5	-6.69	40	-46.69	221	105	V
5	56.3568	38.68	Pk	13.2	-31.4	20.48	40	-19.52	0-360	101	V
6	217.5023	33.49	Pk	16.4	-30.4	19.49	46.02	-26.53	0-360	299	V

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

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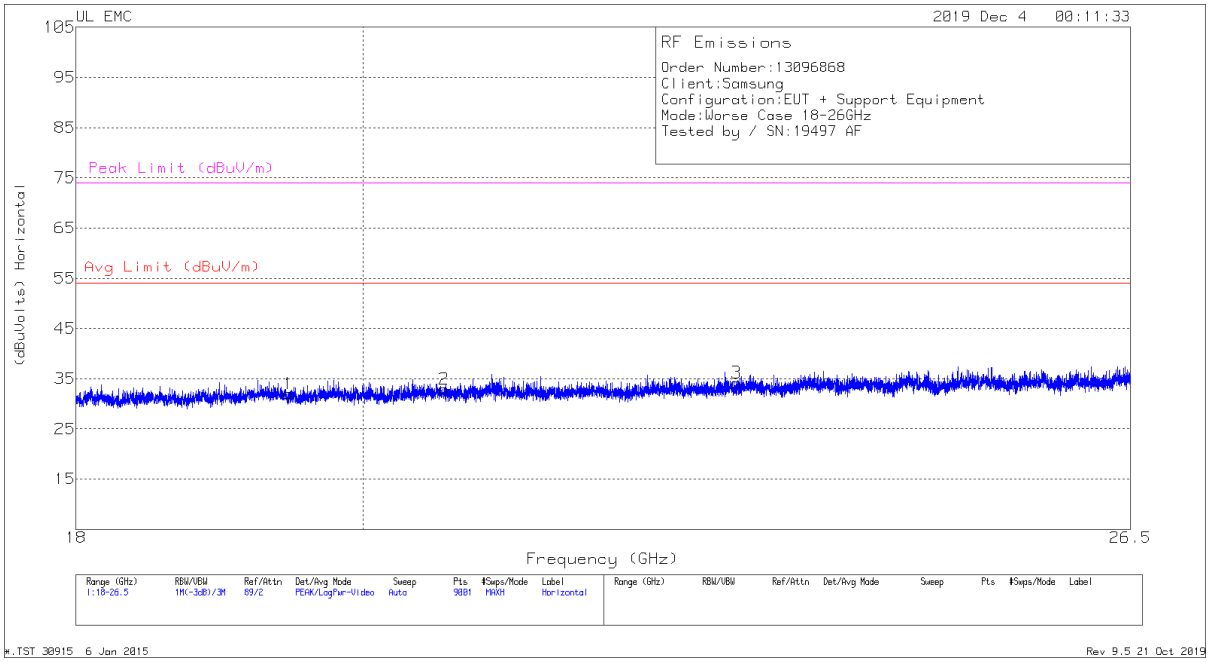
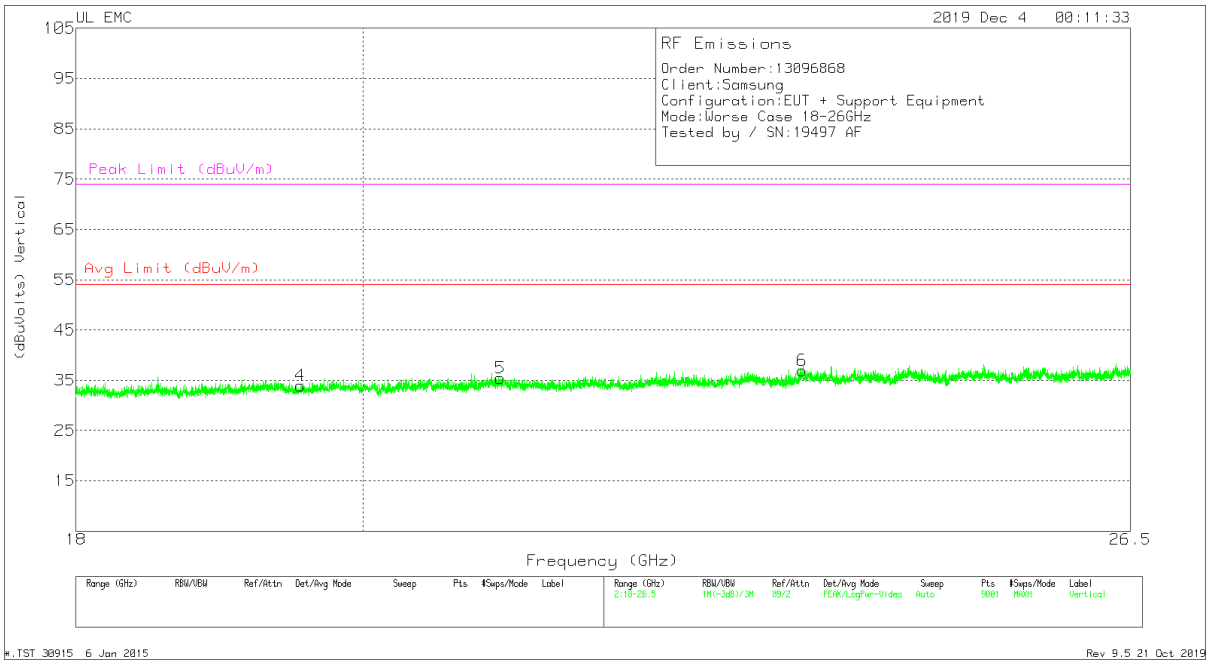
10.5. WORST CASE 18-26 GHz

SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

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18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T447 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	19.45917	65.96	Pk	32.8	-57.2	-9.5	32.06	54	-21.94	74	-41.94
2	20.60289	66.65	Pk	33.1	-57.3	-9.5	32.95	54	-21.05	74	-41.05
3	22.93378	67.48	Pk	33.7	-57.5	-9.5	34.18	54	-19.82	74	-39.82
4	19.54417	67.85	Pk	32.8	-57.2	-9.5	33.95	54	-20.05	74	-40.05
5	21.03072	68.51	Pk	33.3	-56.9	-9.5	35.41	54	-18.59	74	-38.59
6	23.49289	69.4	Pk	34.2	-57.2	-9.5	36.9	54	-17.1	74	-37.1

Pk - Peak detector

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11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

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

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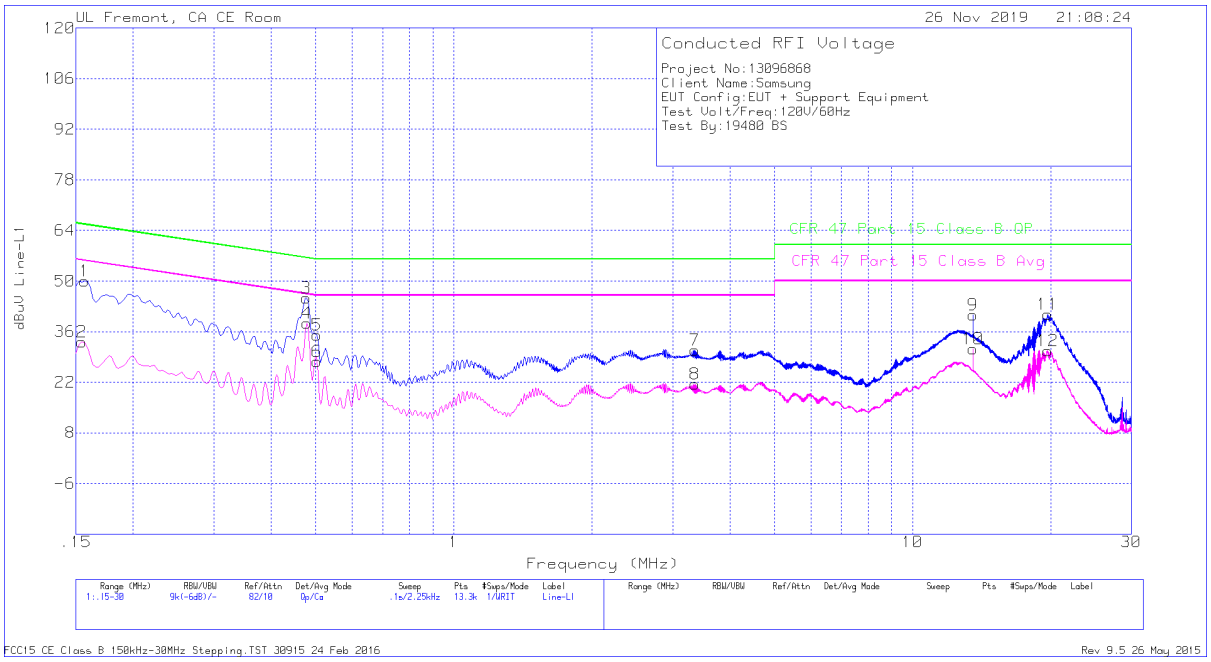
AC Power Line Norm

LINE 1 RESULTS



Trace Markers

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.15675	39.85	Qp	.1	0	10.1	50.05	65.63	-15.58	-	-
2	.1545	22.89	Ca	.1	0	10.1	33.09	-	-	55.75	-22.66
3	.47625	35.18	Qp	0	0	10.1	45.28	56.4	-11.12	-	-
4	.4785	28.24	Ca	0	0	10.1	38.34	-	-	46.37	-8.03
5	.50325	24.9	Qp	0	0	10.1	35	56	-21	-	-
6	.50325	17.63	Ca	0	0	10.1	27.73	-	-	46	-18.27
7	3.3495	20.69	Qp	0	.1	10.1	30.89	56	-25.11	-	-
8	3.3495	11.25	Ca	0	.1	10.1	21.45	-	-	46	-24.55
9	13.56	30.13	Qp	.1	.2	10.2	40.63	60	-19.37	-	-
10	13.56	20.74	Ca	.1	.2	10.2	31.24	-	-	50	-18.76
11	19.72725	30.02	Qp	.1	.3	10.3	40.72	60	-19.28	-	-
12	19.70475	20.06	Ca	.1	.3	10.3	30.76	-	-	50	-19.24

Qp - Quasi-Peak detector
Ca - CISPR average detection
NOTE**:** Markers 9 and 10, 13.56MHz is an external NFC signal unrelated to the EUT.

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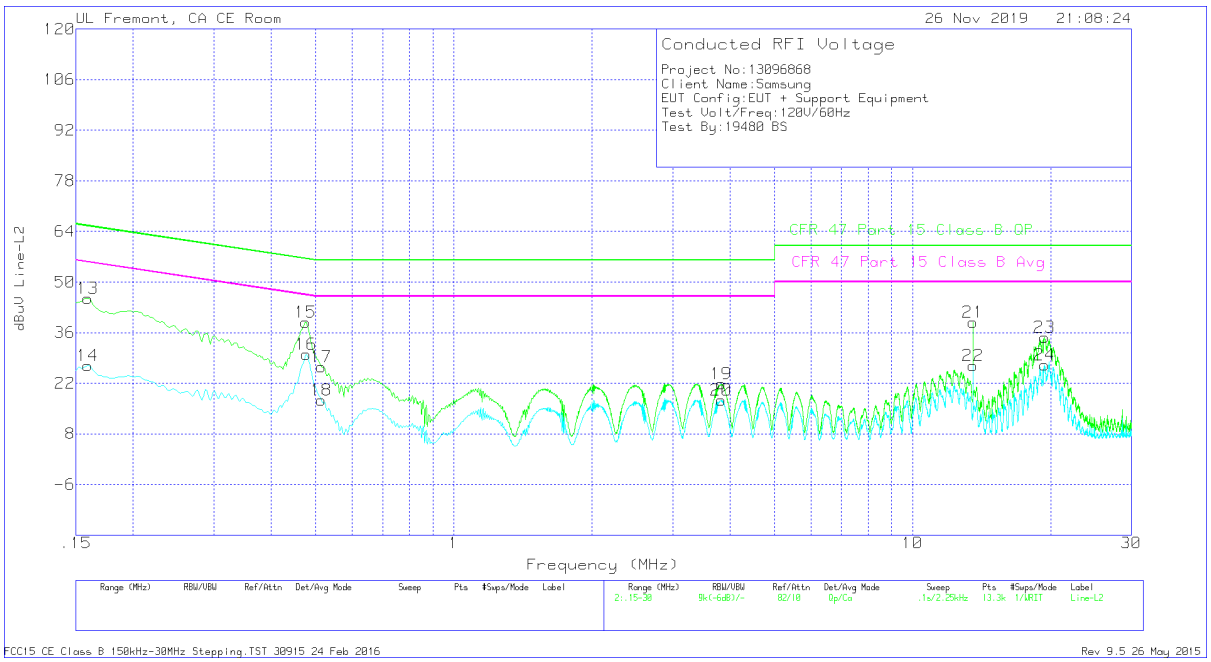
LINE 2 RESULTS



Trace Markers

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
13	.159	35.28	Qp	.1	0	10.1	45.48	65.52	-20.04	-	-
14	.159	16.73	Ca	.1	0	10.1	26.93	-	-	55.52	-28.59
15	.47512	28.73	Qp	0	0	10.1	38.83	56.42	-17.59	-	-
16	.47625	19.89	Ca	0	0	10.1	29.99	-	-	46.4	-16.41
17	.5145	16.51	Qp	0	0	10.1	26.61	56	-29.39	-	-
18	.5145	7.26	Ca	0	0	10.1	17.36	-	-	46	-28.64
19	3.83325	11.59	Qp	0	.1	10.1	21.79	56	-34.21	-	-
20	3.83325	7.19	Ca	0	.1	10.1	17.39	-	-	46	-28.61
21	13.56	28.33	Qp	.1	.2	10.2	38.83	60	-21.17	-	-
22	13.56	16.4	Ca	.1	.2	10.2	26.9	-	-	50	-23.1
23	19.39425	24.05	Qp	.1	.3	10.3	34.75	60	-25.25	-	-
24	19.39425	16.29	Ca	.1	.3	10.3	26.99	-	-	50	-23.01

Qp - Quasi-Peak detector
Ca - CISPR average detection
NOTE**:** Markers 21 and 22, 13.56MHz is an external NFC signal unrelated to the EUT.

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