CERTIFICATION TEST REPORT

Report Number. : 12563734-E7V3

Applicant	:	Samsung Electronics Co., Ltd. 129 Samsung-Ro, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, 16677, Korea
Model	:	SM-G970F/DS and SM-G970F
FCC ID	:	A3LSMG970F
EUT Description	:	GSM/WCDMA/LTE phone with BT, DTS/UNII a/b/g/n/ac/11ax HE 20/40/80, ANT+ and NFC
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C

Date Of Issue:
January 17, 2019

Prepared by:
UL Verification Services Inc.
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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	12/20/2018	Initial Issue	
V2	1/15/2019	Updated per reviewer's comments	Steven Tran
V3	1/17/2019	Removed KDB from Section 2	Steven Tran

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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 phone with BT, DTS/UNII a/b/g/n/ac/11ax HE 20/40/80, ANT+ and NFC

MODEL: SM-G970F/DS and SM-G970F

SERIAL NUMBER: Conducted: R38KA0H49TL
Radiated: R38KB05BJQB

DATE TESTED: NOVEMBER 19 – JANUARY 07, 2018

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.

Approved & Released For
UL Verification Services Inc. By:

DAN CORONIA
Operations Leader
Consumer Technology Division
UL Verification Services Inc.

Reviewed By:

STEVEN TRAN
Project Engineer
Consumer Technology Division
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, and ANSI C63.10-2013.

3. 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 (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☐ Chamber I (ISED:2324A-5)
☐ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☐ Chamber J (ISED:2324A-6)
☒ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	☐ Chamber K (ISED:2324A-1)
	☐ Chamber G (ISED:22541-4)	☐ Chamber L (ISED:2324A-3)
	☐ Chamber H (ISED:22541-5)	

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

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

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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

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

4.3. MEASUREMENT UNCERTAINTY

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	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a GSM/WCDMA/LTE phone with BT, DTS/UNII a/b/g/n/ac/11ax HE 20/40/80, ANT+ and NFC. The model SM-G970F was used for final testing and is representative of the test results in this report.

5.2. 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)
2405 - 2475	ANT +	100.40	73.93	3.00

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -1.21 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was G970F.001

5.5. 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 Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y 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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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC Adapter	Samsung	EP-TA300	R3KB5B01S1SE3	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

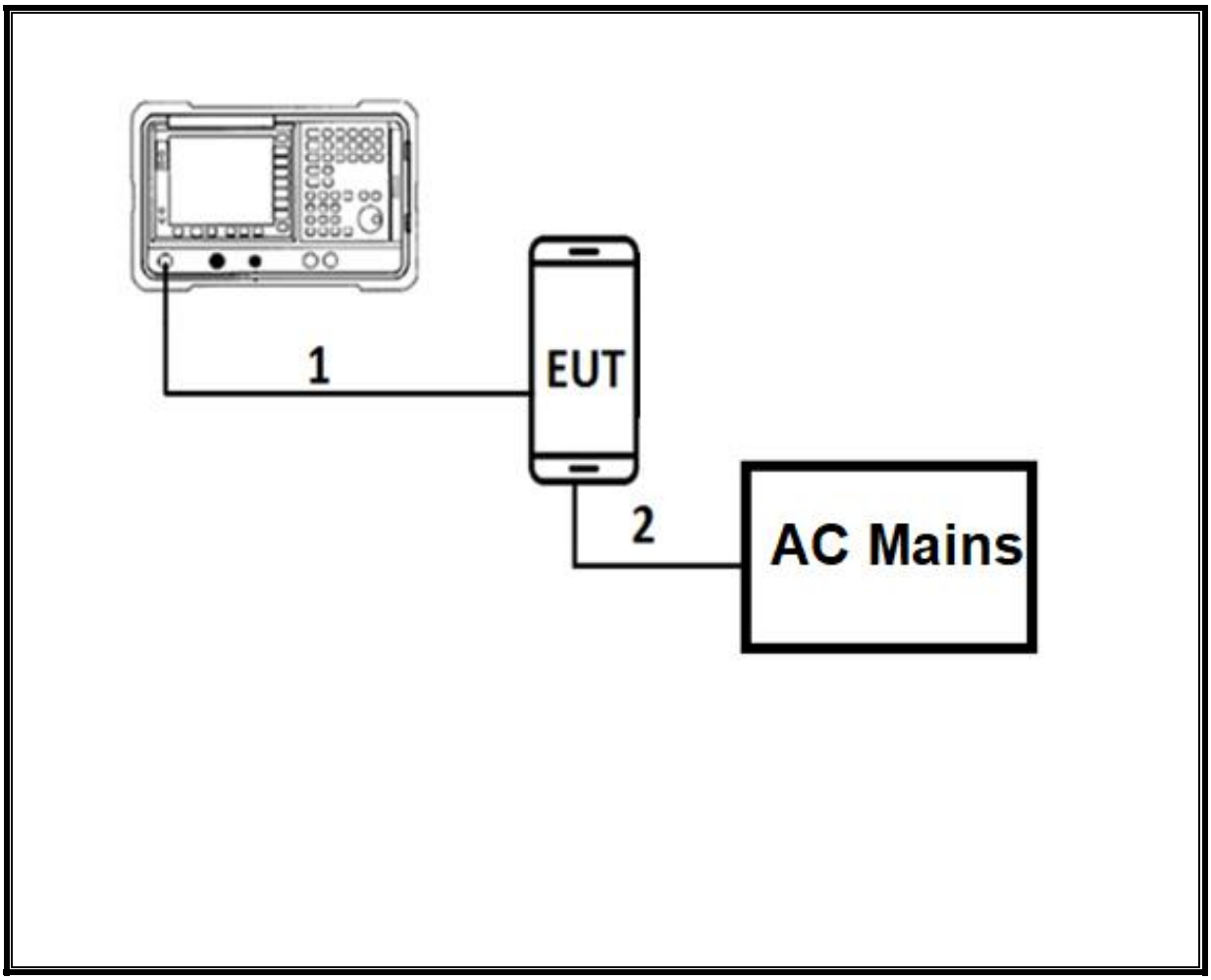
I/O CABLES (RADIATED AND CONDUCTED EMISSIONS)

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

TEST SETUP

The EUT is a stand alone. Test software exercised the radio card.

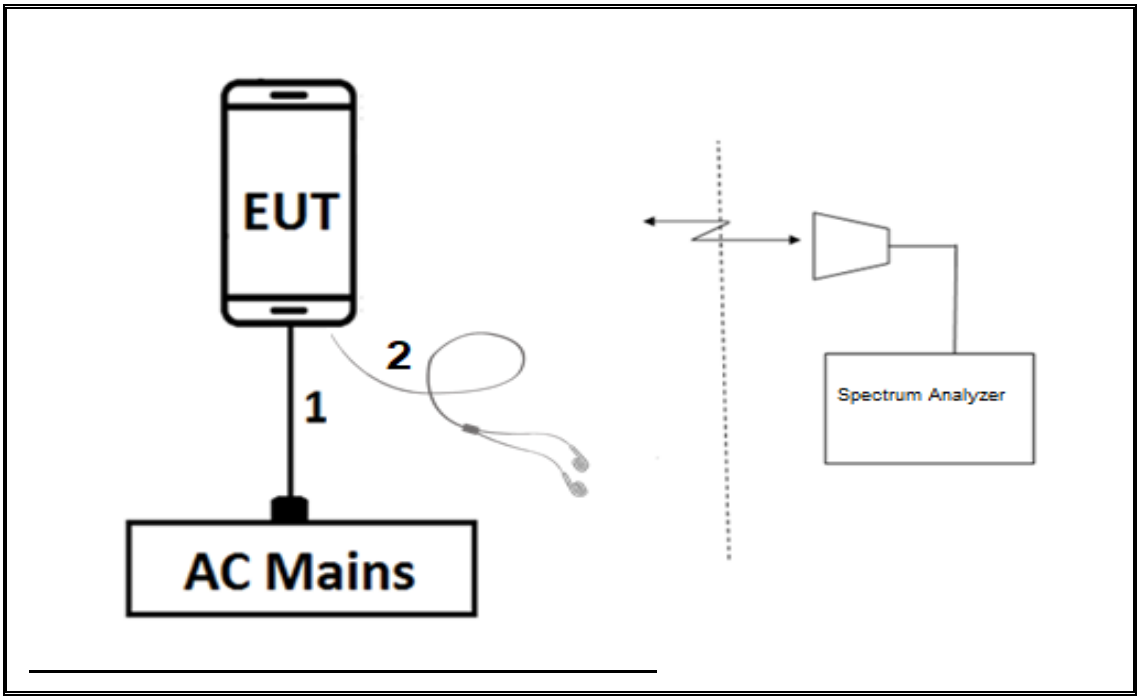
CONDUCTED TEST SETUP DIAGRAM



TEST SETUP

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

RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated tests: EUT has support equipment (AC Adapter and Headset). The test software exercises the radio.

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**	**ID Num**	**Cal Due**	**Last Cal**
Amplifier, 100KHz to 1GHz,32dB	SONOMA INSTRUMENT	310N	T300	12/11/2018	12/11/2017
RF Amplifier, 1-18GHz	MITEQ	AFS42-00101800-25-S-42	T1165	10/20/2019	10/20/2018
Pre-Amp 1-26.5 GHz	Agilent	8449B	T404	03/09/2019	023/09/2018
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T900	06/18/2019	06/18/2018
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T345	04/25/2019	04/25/2018
Antenna, Active Loop 9kHz-30MHz	Com-Power Corp.	AL-130R	PRE0165308	12/13/2018	12/13/2017
18 - 26.5 GHz Horn Antenna	ARA	MWH-1826/B	T447	06/16/2019	06/16/2018
EMI Reciever	Rohde & Schwarz	ESR	T1436	02/21/2019	02/21/2018
L.I.S.N.	FCC INC.	FCC LISN 50/250	T1310	06/15/2019	06/15/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1113	12/21/2018	12/21/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1466	04/16/2019	04/16/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T1454	01/08/2019	01/08/2018

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5, Dec 01, 2016
Antenna Port Software	UL	UL RF	Ver 9.0, Oct 31, 2018

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7. 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

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

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 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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8. ANTENNA PORT TEST RESULTS

8.1. 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
226us x 21 pulses = 4.746msec

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor For Average Measurements (dB)
ANT+	4.75	100.00	0.047	4.7%	26.47

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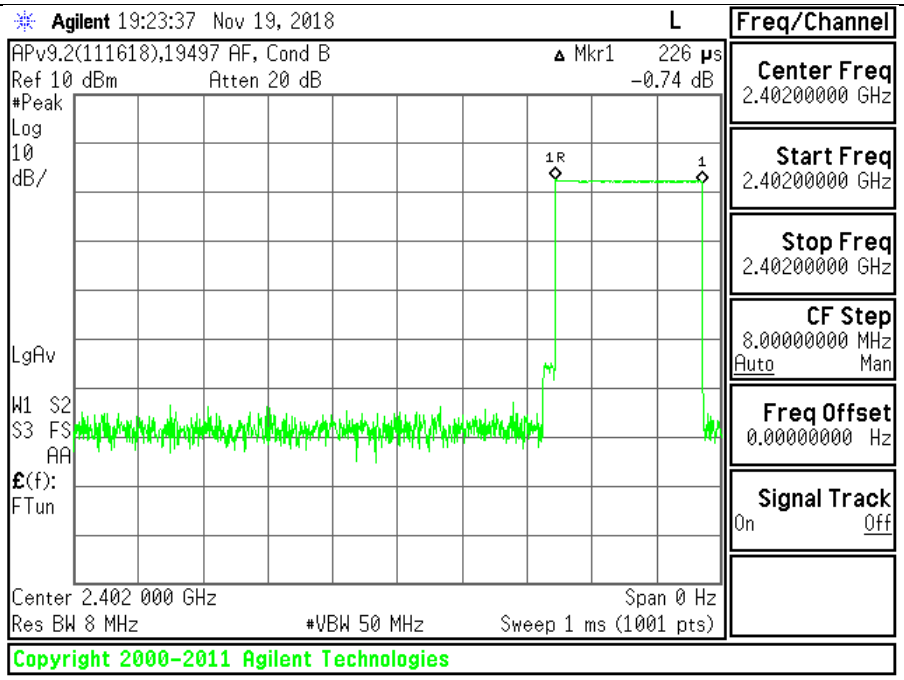
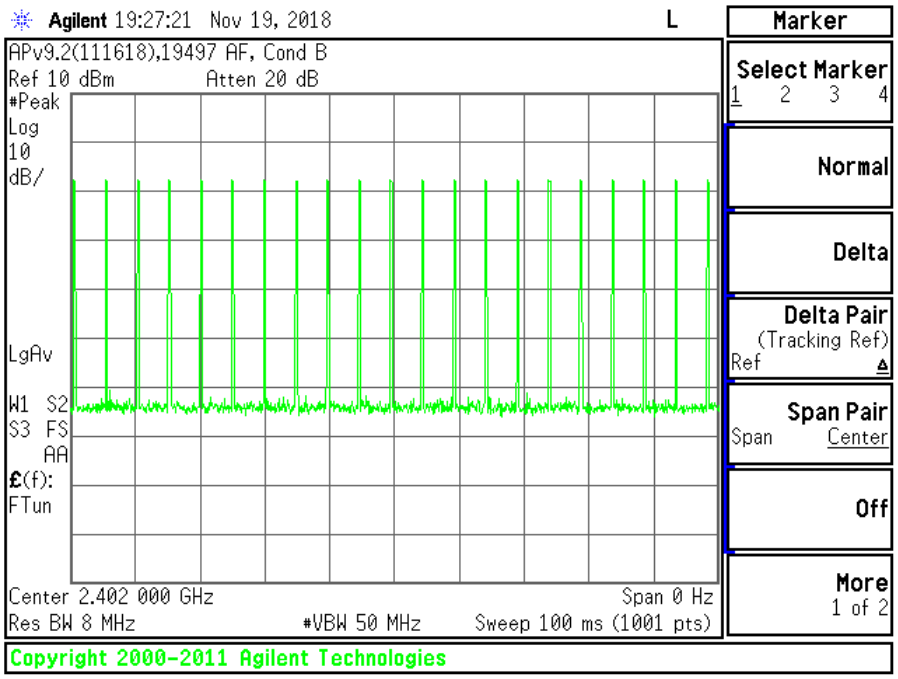
DUTY CYCLE PLOTS



ANT+ ON TIME



ANT+ 100ms PERIOD

8.2. 99% BANDWIDTH

LIMITS

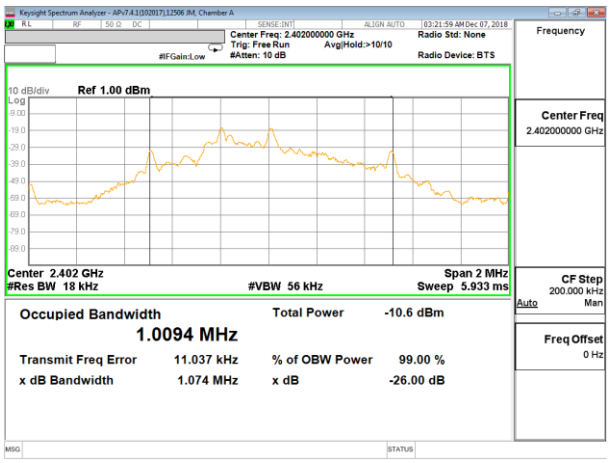
None; for reporting purposes only.

TEST PROCEDURE

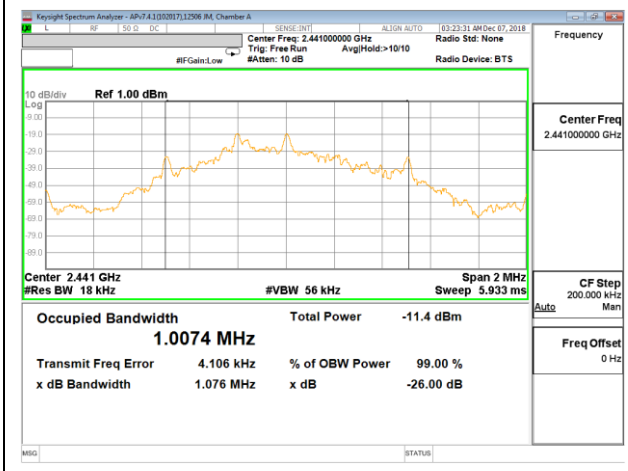
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

RESULTS

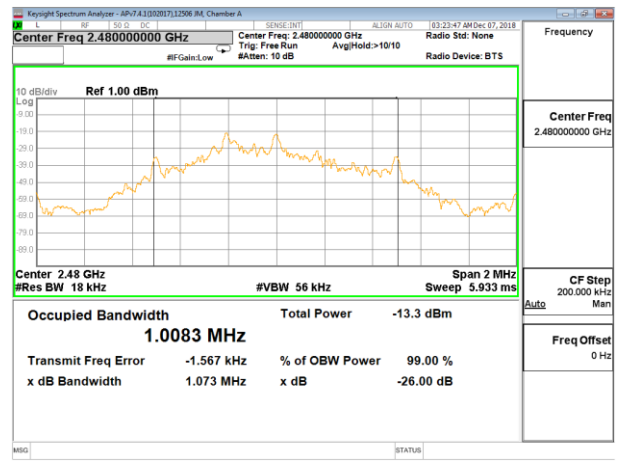
Channel	Frequency (MHz)	99% Bandwidth (KHz)
Low	2402	1.0094
Mid	2441	1.0074
High	2480	1.0083



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.3. 20dB BANDWIDTH

LIMITS

None; for reporting purposes only.

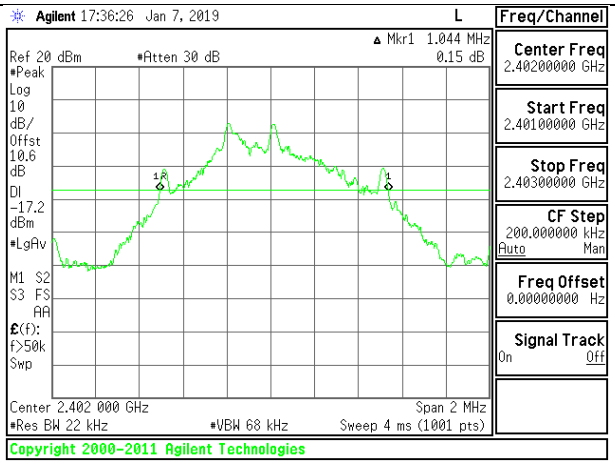
TEST PROCEDURE

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

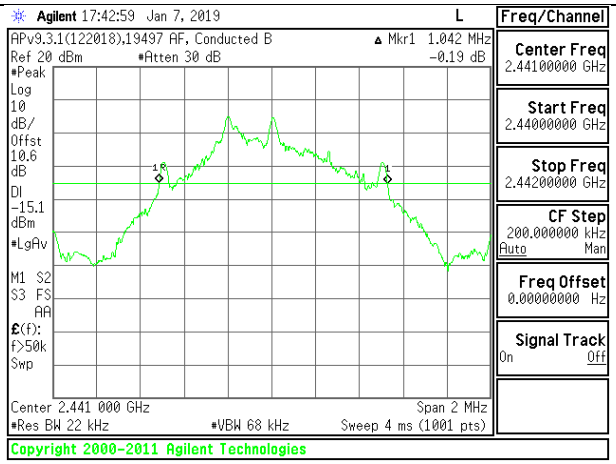
RESULTS

Test table results for FCC Rule Part15.215(c): Compliant.

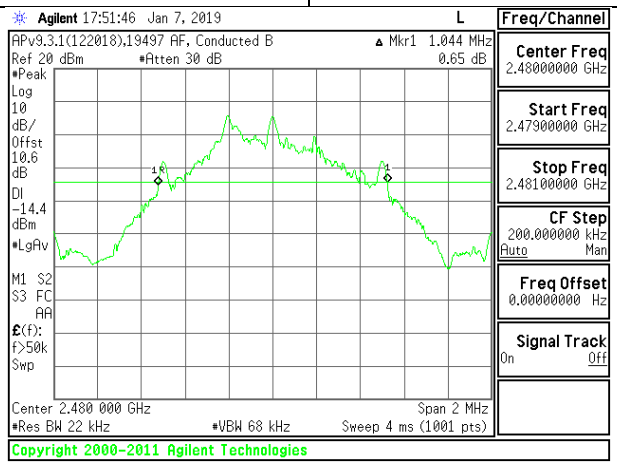
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Frequency Edge (MHz)	Limit (MHz)	Margin (MHz)
Low	2402	1.044	2401.4780	2400	-1.48
Mid	2441	1.042	N/A	N/A	N/A
High	2480	1.044	2480.5220	2483.5	-2.98



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9. 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 measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T 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.

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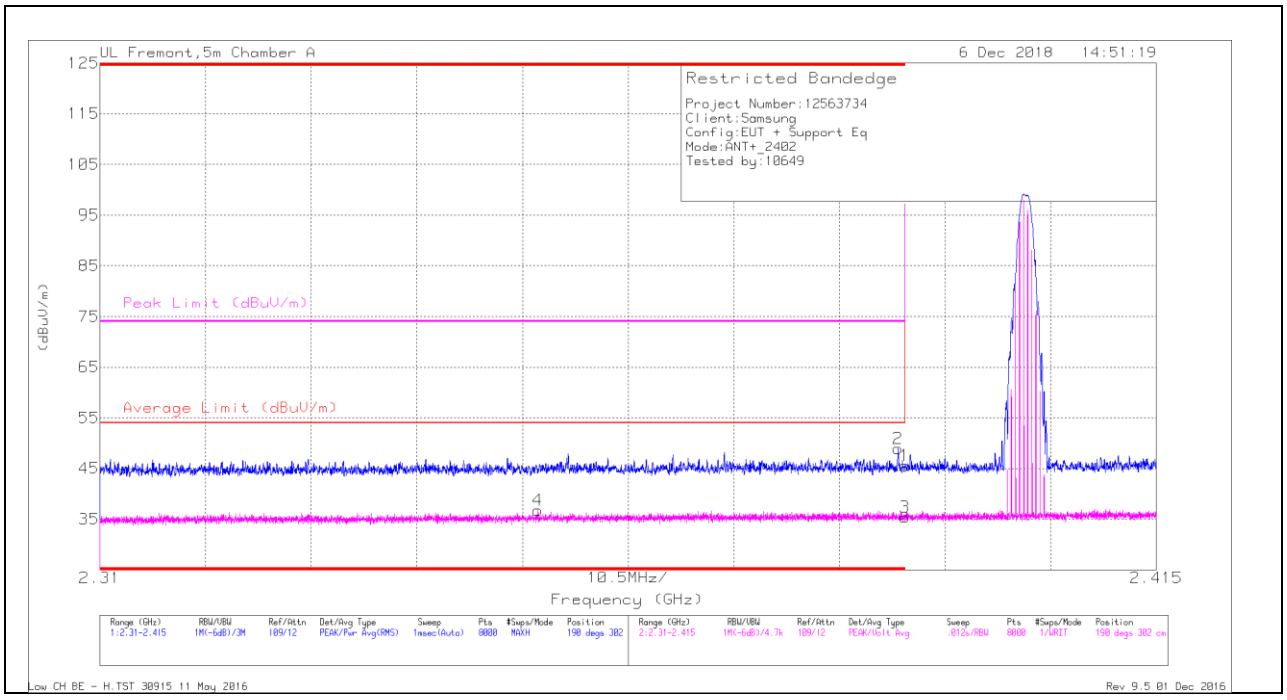
9.1. TRANSMITTER ABOVE 1 GHz

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT

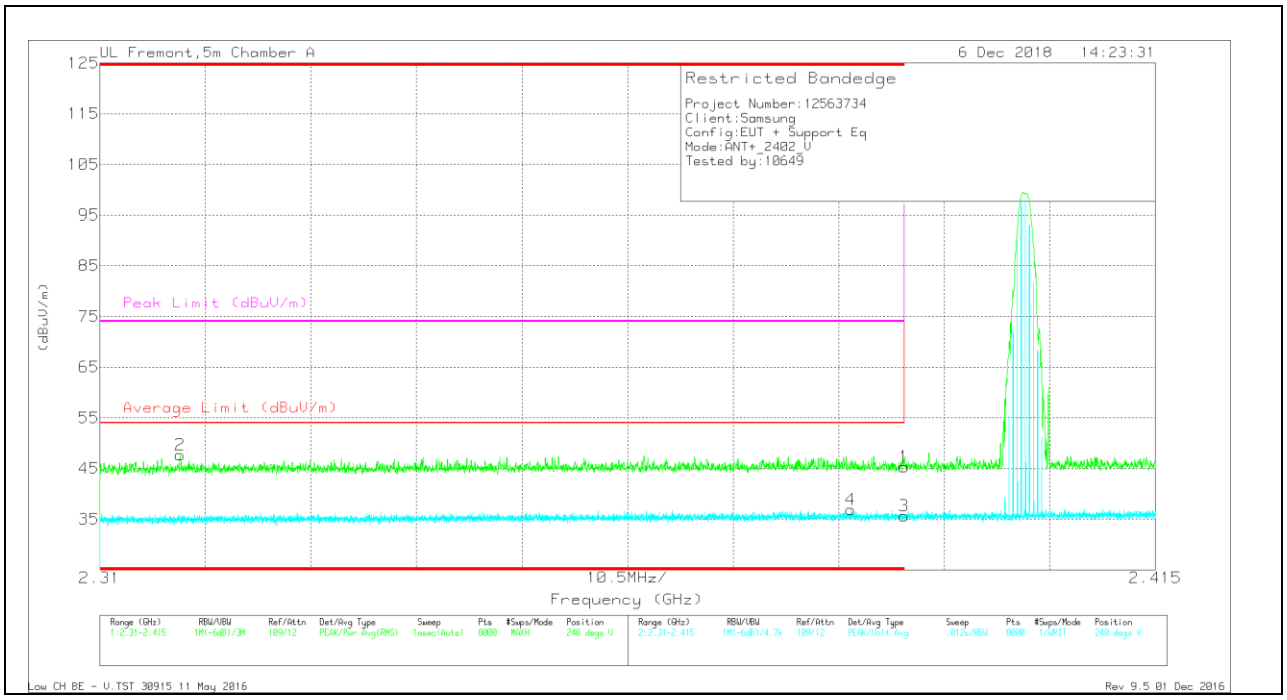


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 2.354	27.94	VA1T	31.8	-23	36.74	54	-17.26	-	-	190	302	H
2	* 2.389	39.94	Pk	32	-23	48.94	-	-	74	-25.06	190	302	H
1	* 2.39	36.58	Pk	32	-23	45.58	-	-	74	-28.42	190	302	H
3	* 2.39	26.44	VA1T	32	-23	35.44	54	-18.56	-	-	190	302	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	36.28	Pk	32	-23	45.28	-	-	74	-28.72	248	235	V
2	* 2.318	38.96	Pk	31.8	-23.1	47.66	-	-	74	-26.34	248	235	V
3	* 2.39	26.67	VA1T	32	-23	35.67	54	-18.33	-	-	248	235	V
4	* 2.385	27.83	VA1T	32	-23	36.83	54	-17.17	-	-	248	235	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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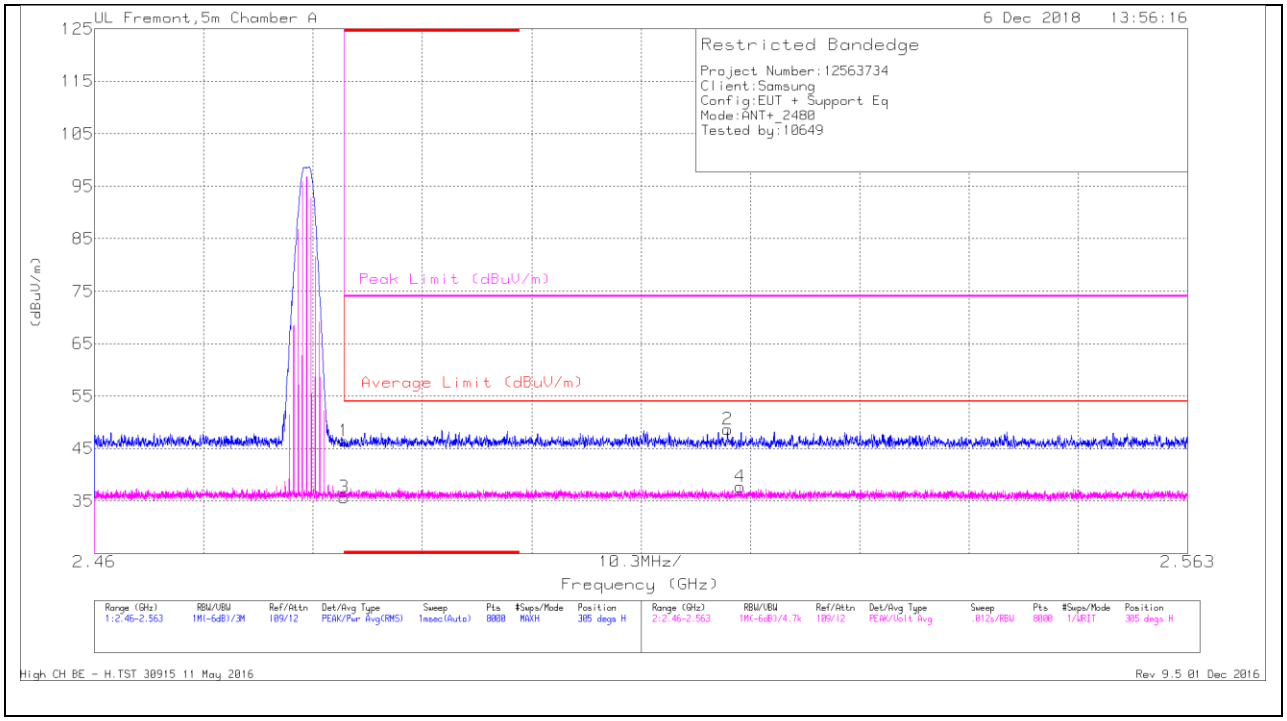
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT

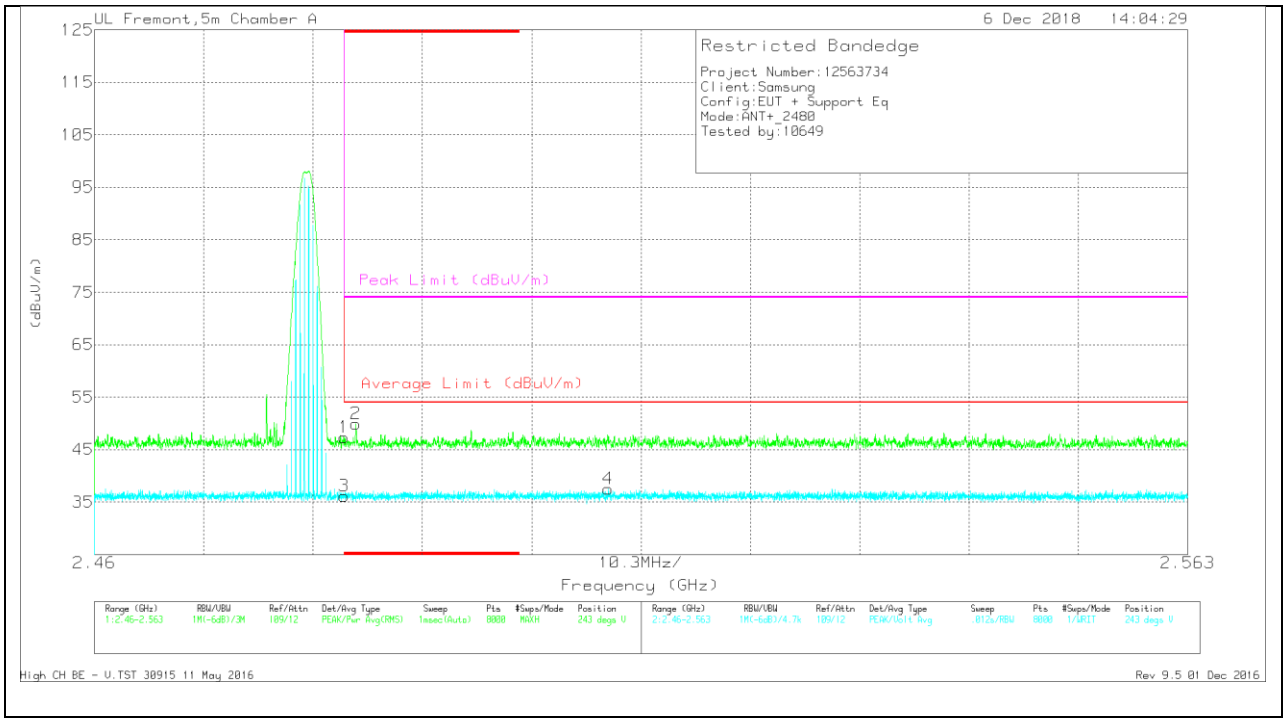


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	36.95	Pk	32.4	-22.9	46.45	-	-	74	-27.55	305	269	H
3	* 2.484	26.2	VA1T	32.4	-22.9	35.7	54	-18.3	-	-	305	269	H
2	2.52	39.23	Pk	32.3	-22.9	48.63	-	-	74	-25.37	305	269	H
4	2.521	28.34	VA1T	32.3	-22.9	37.74	54	-16.26	-	-	305	269	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT



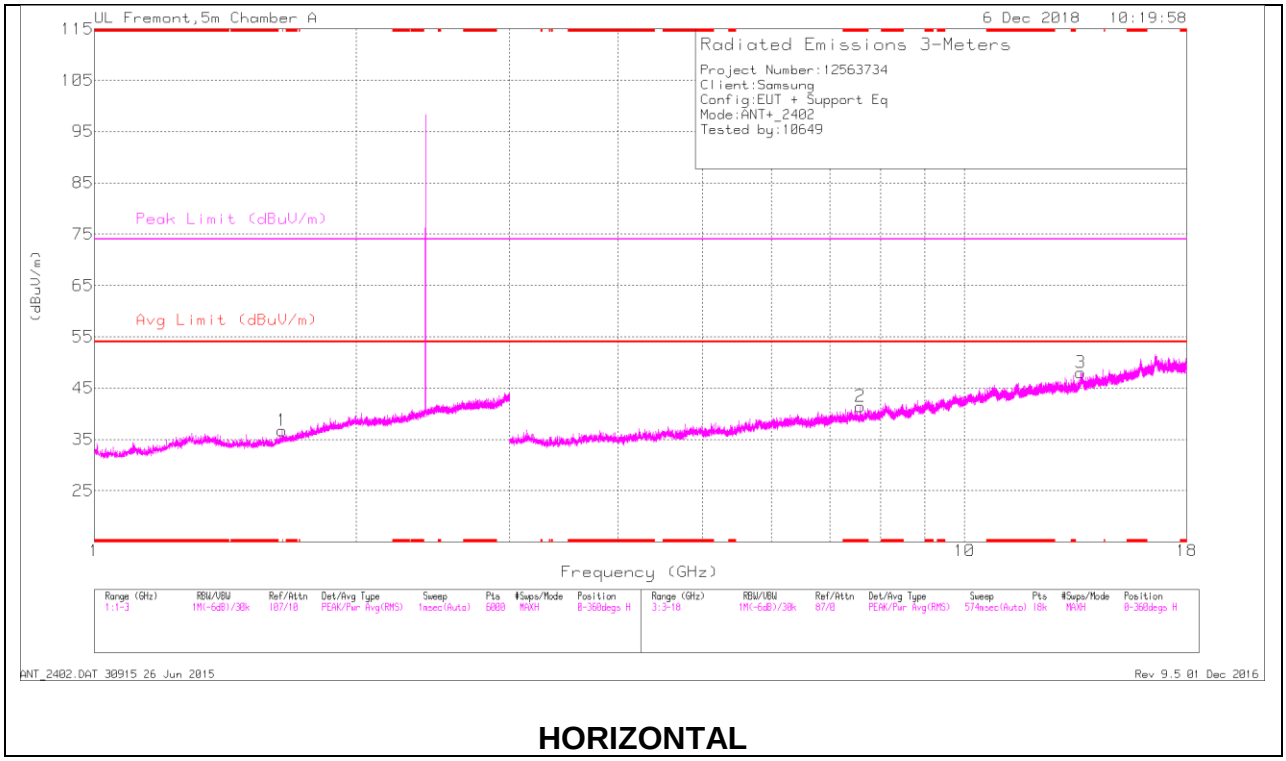
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	37.85	Pk	32.4	-22.9	47.35	-	-	74	-26.65	243	275	V
3	* 2.484	26.66	VA1T	32.4	-22.9	36.16	54	-17.84	-	-	243	275	V
2	* 2.485	40.47	Pk	32.4	-22.9	49.97	-	-	74	-24.03	243	275	V
4	2.508	28.02	VA1T	32.4	-22.9	37.52	54	-16.48	-	-	243	275	V

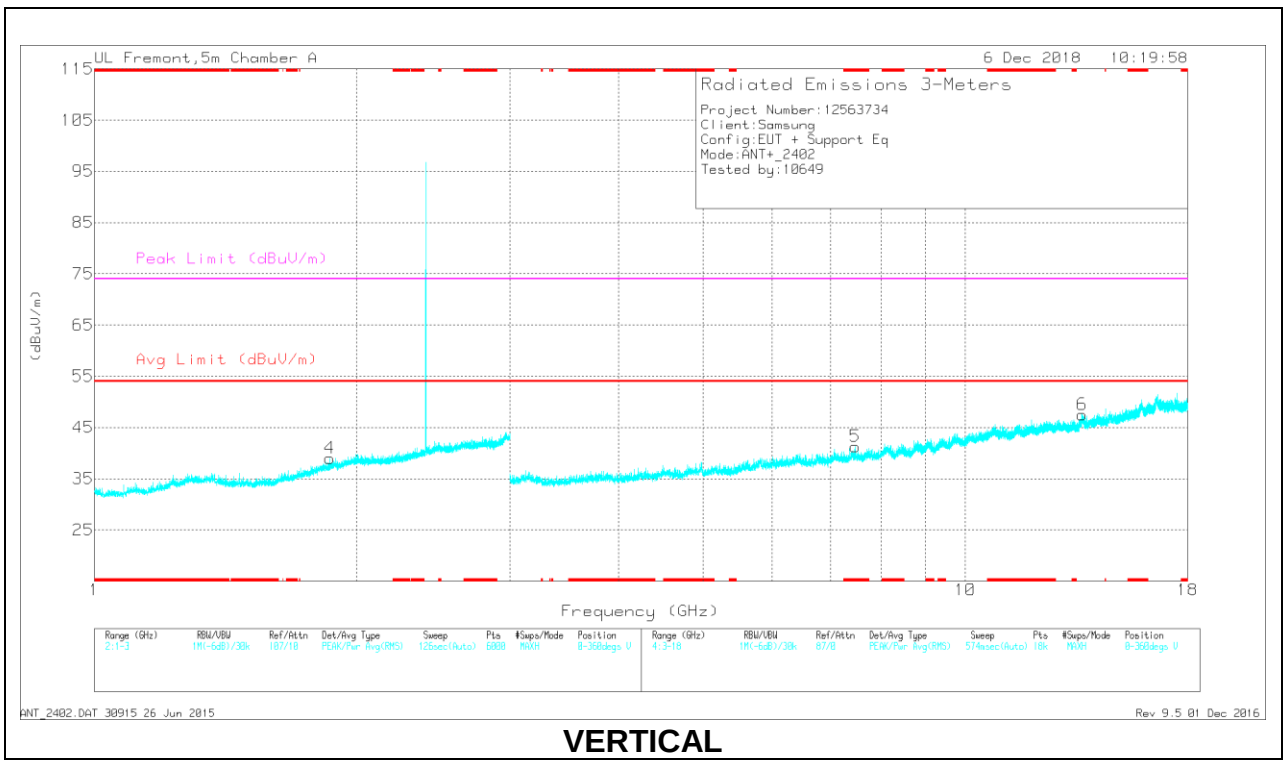
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (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	* 1.494	34.5	PKFH	28	-23.1	39.4	-	-	74	-34.6	21	388	H
	* 1.497	22.83	VA1T	28	-23	27.83	54	-26.17	-	-	21	388	H
4	* 1.467	34.36	PKFH	28.2	-23.1	39.46	-	-	74	-34.54	0	147	V
	* 1.465	22.86	VA1T	28.2	-23.1	27.96	54	-26.04	-	-	0	147	V
2	* 7.595	32.11	PKFH	35.7	-22.5	45.31	-	-	74	-28.69	116	298	H
	* 7.596	20.06	VA1T	35.7	-22.5	33.26	54	-20.74	-	-	116	298	H
3	* 11.513	30.63	PKFH	38.2	-18.2	50.63	-	-	74	-23.37	24	266	H
	* 11.513	18.75	VA1T	38.2	-18.2	38.75	54	-15.25	-	-	24	266	H
5	* 7.472	31.46	PKFH	35.7	-21.7	45.46	-	-	74	-28.54	327	164	V
	* 7.472	19.66	VA1T	35.7	-21.7	33.66	54	-20.34	-	-	327	164	V
6	* 8.451	31.67	PKFH	35.9	-20.9	46.67	-	-	74	-27.33	46	244	V
	* 8.448	19.85	VA1T	35.9	-20.9	34.85	54	-19.15	-	-	46	244	V

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

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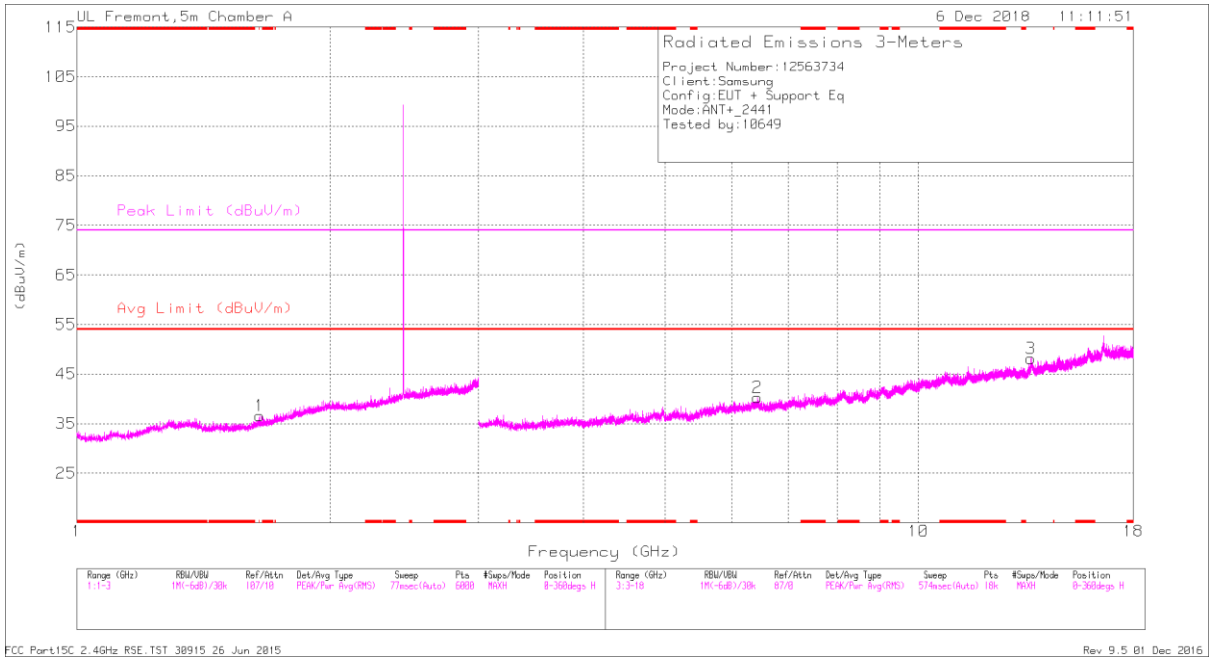
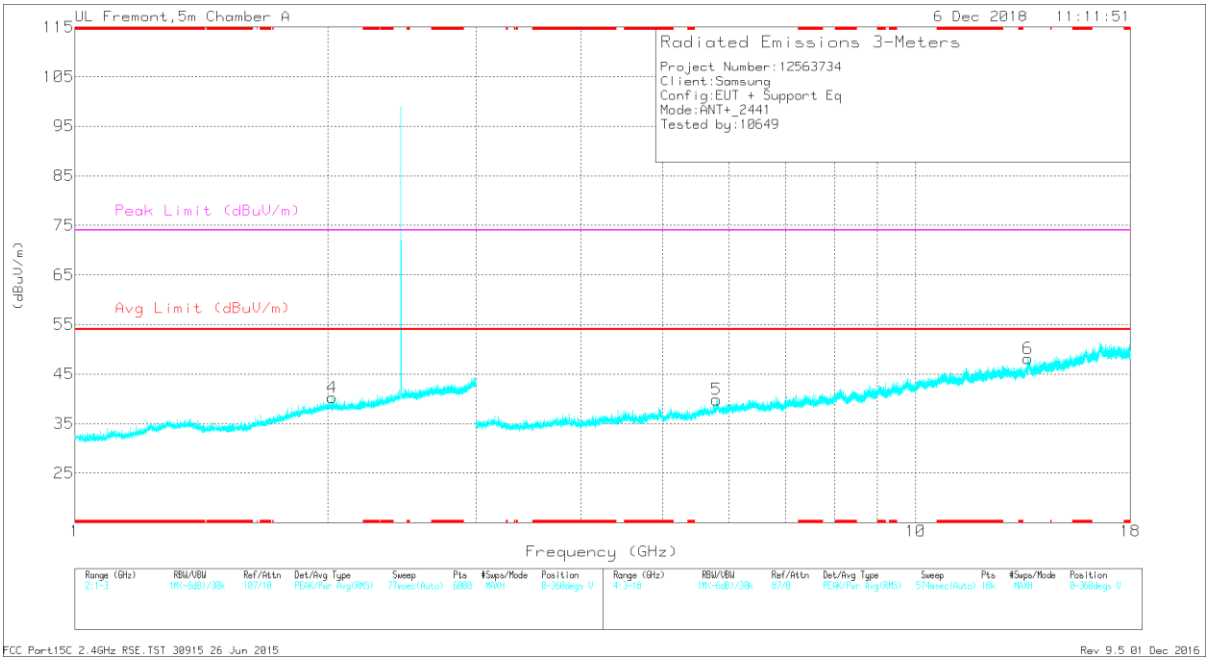
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (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	* 1.382	35.06	PKFH	28.9	-23.3	40.66	-	-	74	-33.34	307	297	H
	* 1.382	24.58	VA1T	28.9	-23.3	30.18	54	-23.82	-	-	307	297	H
2	* 1.664	35.02	PKFH	28.8	-23.1	40.72	-	-	74	-33.28	213	173	H
	* 1.663	24.85	VA1T	28.8	-23.2	30.45	54	-23.55	-	-	213	173	H
4	* 1.481	34.98	PKFH	28.1	-23.1	39.98	-	-	74	-34.02	0	291	V
	* 1.48	24.64	VA1T	28.2	-23.1	29.74	54	-24.26	-	-	0	291	V
5	* 1.575	34.28	PKFH	28.1	-23.1	39.28	-	-	74	-34.72	22	192	V
	* 1.574	24.9	VA1T	28.1	-23.1	29.9	54	-24.1	-	-	22	192	V
3	* 11.45	30.31	PKFH	38.2	-18.1	50.41	-	-	74	-23.59	222	137	H
	* 11.448	20.73	VA1T	38.2	-18.1	40.83	54	-13.17	-	-	222	137	H
6	* 11.494	30.32	PKFH	38.2	-18.1	50.42	-	-	74	-23.58	3	139	V
	* 11.494	20.53	VA1T	38.2	-18.1	40.63	54	-13.37	-	-	3	139	V

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

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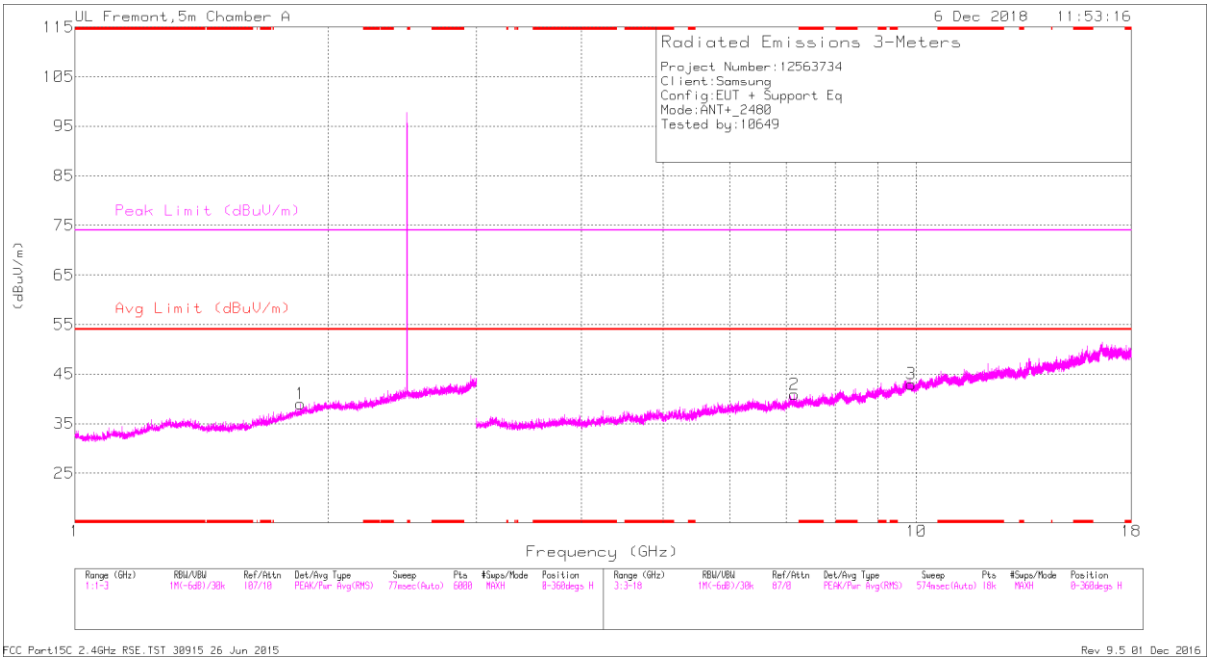
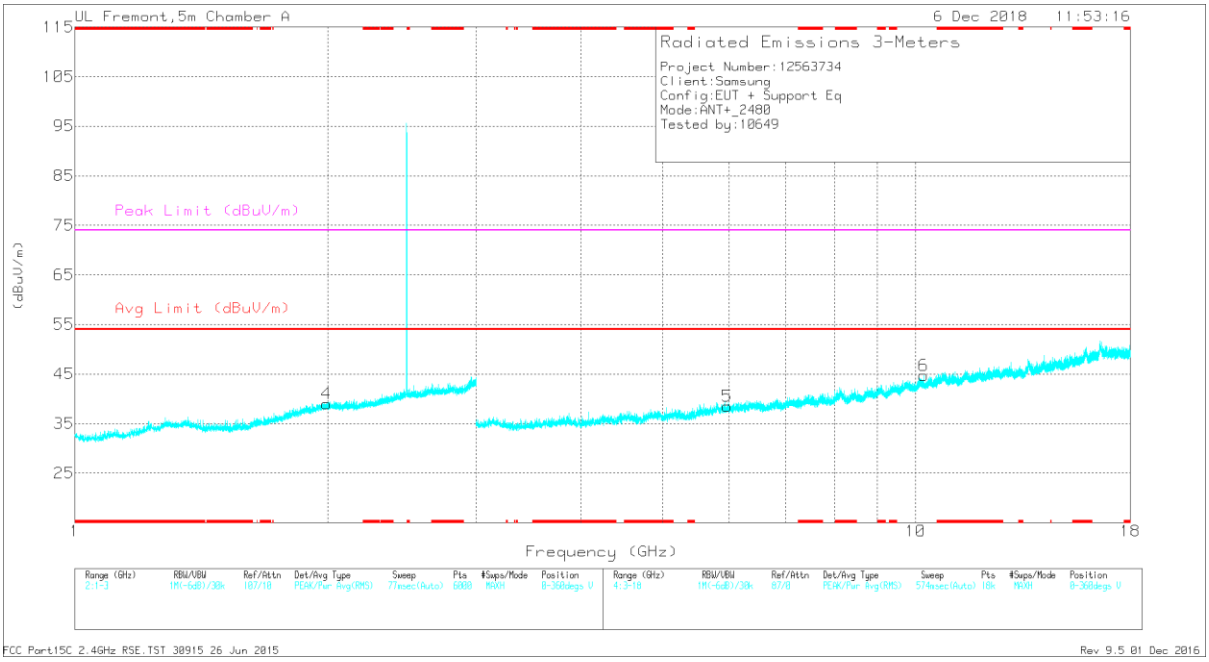
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (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	* 1.583	35.23	PKFH	28.1	-23.1	40.23	-	-	74	-33.77	214	356	H
	* 1.585	24.88	VA1T	28.1	-23.1	29.88	54	-24.12	-	-	214	356	H
2	* 1.7	35.72	PKFH	28.9	-23	41.62	-	-	74	-32.38	130	299	H
	* 1.699	24.93	VA1T	28.9	-23	30.83	54	-23.17	-	-	130	299	H
4	* 1.511	34.76	PKFH	27.8	-23	39.56	-	-	74	-34.44	97	318	V
	* 1.51	24.94	VA1T	27.8	-23	29.74	54	-24.26	-	-	97	318	V
5	* 2.232	35.06	PKFH	31.7	-23.3	43.46	-	-	74	-30.54	91	150	V
	* 2.23	25.55	VA1T	31.7	-23.3	33.95	54	-20.05	-	-	91	150	V
3	* 11.43	30.64	PKFH	38.1	-18.2	50.54	-	-	74	-23.46	5	110	H
	* 11.429	20.34	VA1T	38.1	-18.2	40.24	54	-13.76	-	-	5	110	H
6	* 11.912	30.18	PKFH	38.6	-18.5	50.28	-	-	74	-23.72	250	165	V
	* 11.911	20.74	VA1T	38.6	-18.5	40.84	54	-13.16	-	-	250	165	V

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

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9.2. FUNDAMENTAL FREQUENCY RADIATED EMISSION

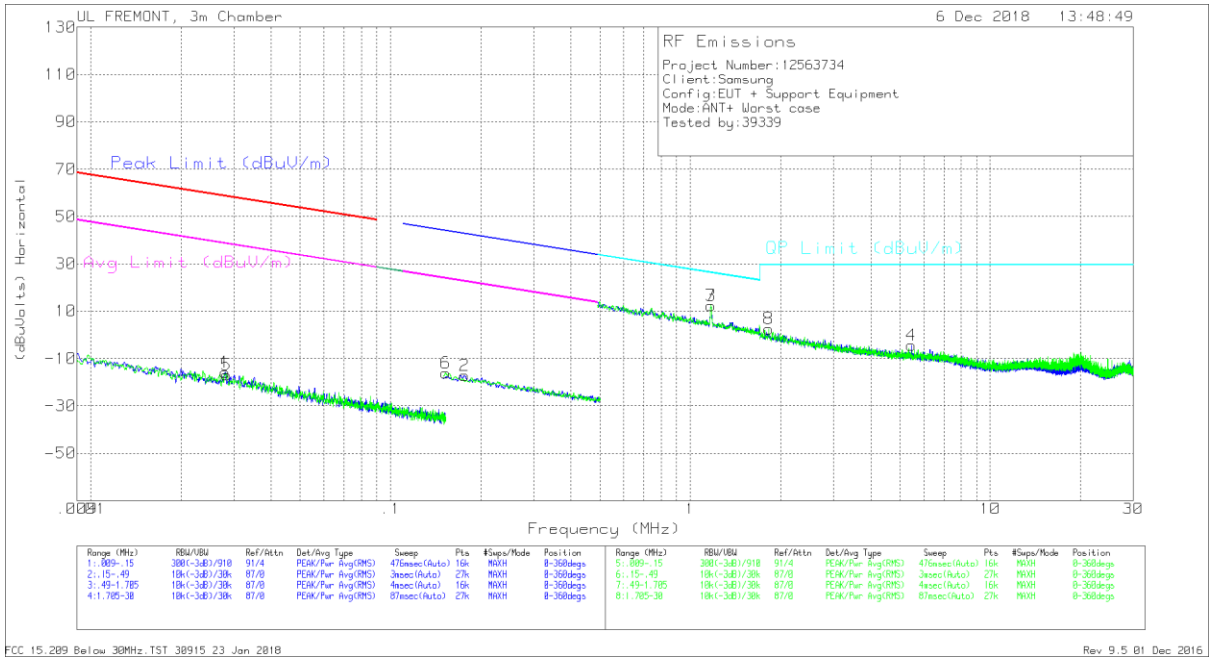
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.402	90.32	PKFH	32	-22.1	0	100.22	-	-	114	-13.78	306	285	H
	90.32	AVG	32	-22.1	26.47	73.75	94	-20.25	-	-	306	285	H
	88.63	PKFH	32.1	-22.1	0	98.63	-	-	114	-15.37	248	234	V
	88.63	AVG	32.1	-22.1	26.47	72.16	94	-21.84	-	-	248	234	V
2.441	89.6	PKFH	32.4	-22	0	100	-	-	114	-14	312	275	H
	89.6	AVG	32.4	-22	26.47	73.53	94	-20.47	-	-	312	275	H
	90	PKFH	32.4	-22	0	100.4	-	-	114	-13.6	256	234	V
	90	AVG	32.4	-22	26.47	73.93	94	-20.07	-	-	256	234	V
2.480	87.88	PKFH	32.4	-21.8	0	98.48	-	-	114	-15.52	304	276	H
	87.88	AVG	32.4	-21.8	26.47	72.01	94	-21.99	-	-	304	276	H
	87.08	PKFH	32.4	-21.8	0	97.68	-	-	114	-16.32	255	223	V
	87.08	AVG	32.4	-21.8	26.47	71.21	94	-22.79	-	-	255	223	V

PKFH - FHSS: RB=1MHz VB=3 x RB, Peak
AVG = Peak Reading - Duty Cycle Correction Factor
Duty Cycle Correction Factor = -26.47 dB

9.3. Worst Case Below 30 MHz

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

HORIZONTAL AND VERTICAL PLOT



NOTE: KDB 414788 OATS and Chamber Correlation Justification

- Based 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.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Below 30 MHz Data

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	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	.02813	47.57	Pk	15.2	1.4	-80	-15.83	58.6	-74.43	38.6	-54.43	-	-	-	-	0-360
5	.02832	46.48	Pk	15.2	1.4	-80	-16.92	58.54	-75.46	38.54	-55.46	-	-	-	-	0-360
6	.15283	48.49	Pk	13.8	1.5	-80	-16.21	-	-	-	-	43.94	-60.15	23.94	-40.15	0-360
2	.17698	47.43	Pk	13.8	1.5	-80	-17.27	-	-	-	-	42.66	-59.93	22.66	-39.93	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	1.17157	36.64	Pk	14.2	1.5	-40	12.34	26.25	-13.91	0-360
7	1.17286	36.56	Pk	14.2	1.5	-40	12.26	26.24	-13.98	0-360
8	1.825	26.93	Pk	14.2	1.5	-40	2.63	29.5	-26.87	0-360
4	5.46051	19.82	Pk	14.3	1.5	-40	-4.38	29.5	-33.88	0-360

Pk - Peak detector

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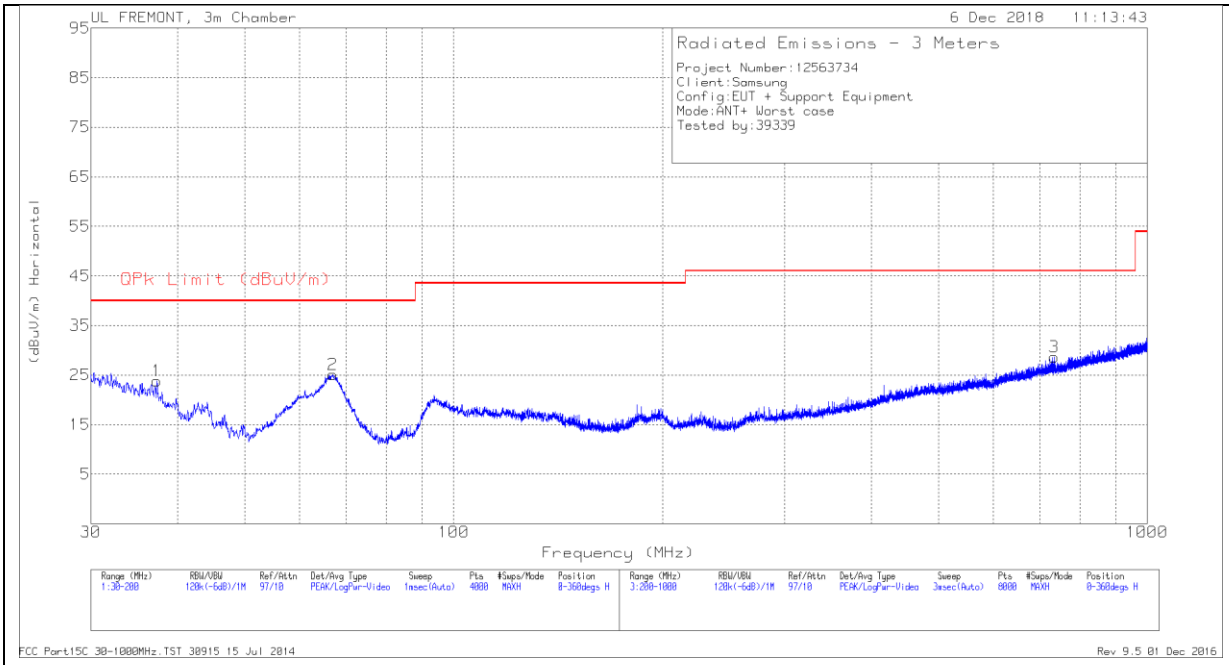
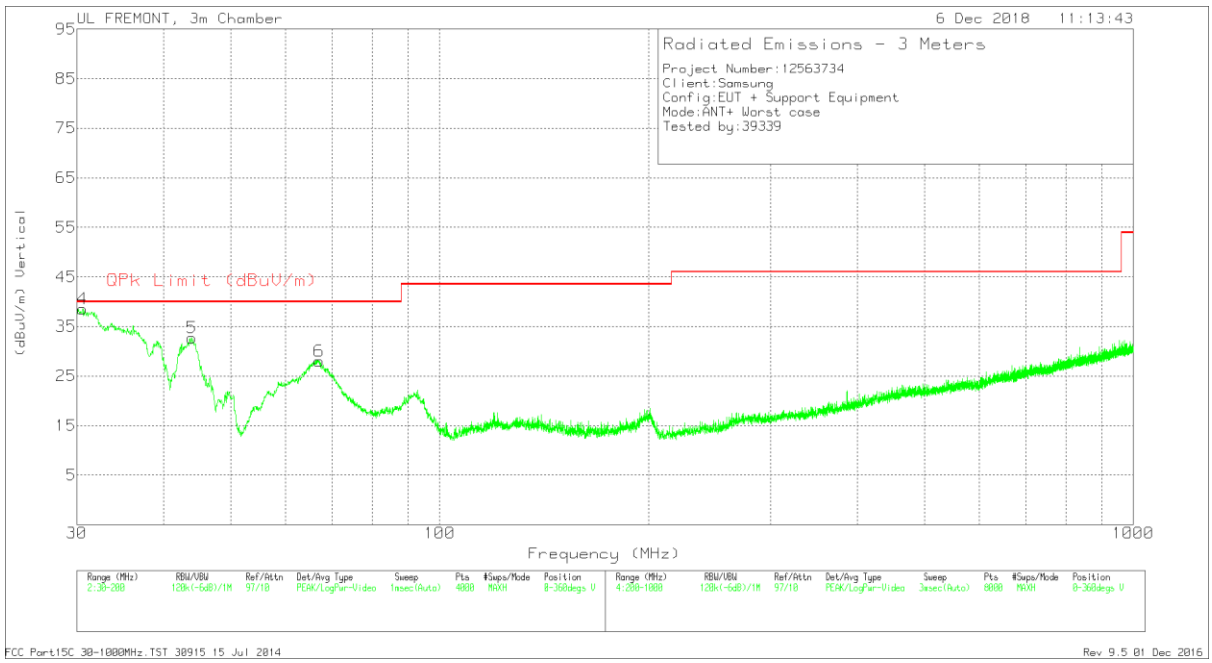
9.4. Worst Case Below 1 GHz

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



HORIZONTAL



VERTICAL

Below 1GHz Data

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T900 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	30.5526	44.99	Pk	24.7	-31.1	38.59	40	-1.41	0-360	100	V
1	37.3544	34.47	Pk	20.3	-31	23.77	40	-16.23	0-360	300	H
5	43.9011	48.23	Pk	15.4	-30.9	32.73	40	-7.27	0-360	100	V
2	66.9846	43.54	Pk	12.2	-30.6	25.14	40	-14.86	0-360	300	H
6	67.0271	46.47	Pk	12.2	-30.6	28.07	40	-11.93	0-360	100	V
3	733.4693	31	Pk	24.5	-26.8	28.7	46.02	-17.32	0-360	400	H

Pk - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T900 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
30.3966	40.22	Qp	24.8	-31.1	33.92	40	-6.08	227	100	V
43.6832	40.69	Qp	15.5	-30.9	25.29	40	-14.71	114	133	V
66.7643	39.66	Qp	12.2	-30.6	21.26	40	-18.74	332	291	H
67.1173	42.69	Qp	12.2	-30.6	24.29	40	-15.71	266	255	V

Qp - Quasi-Peak detector

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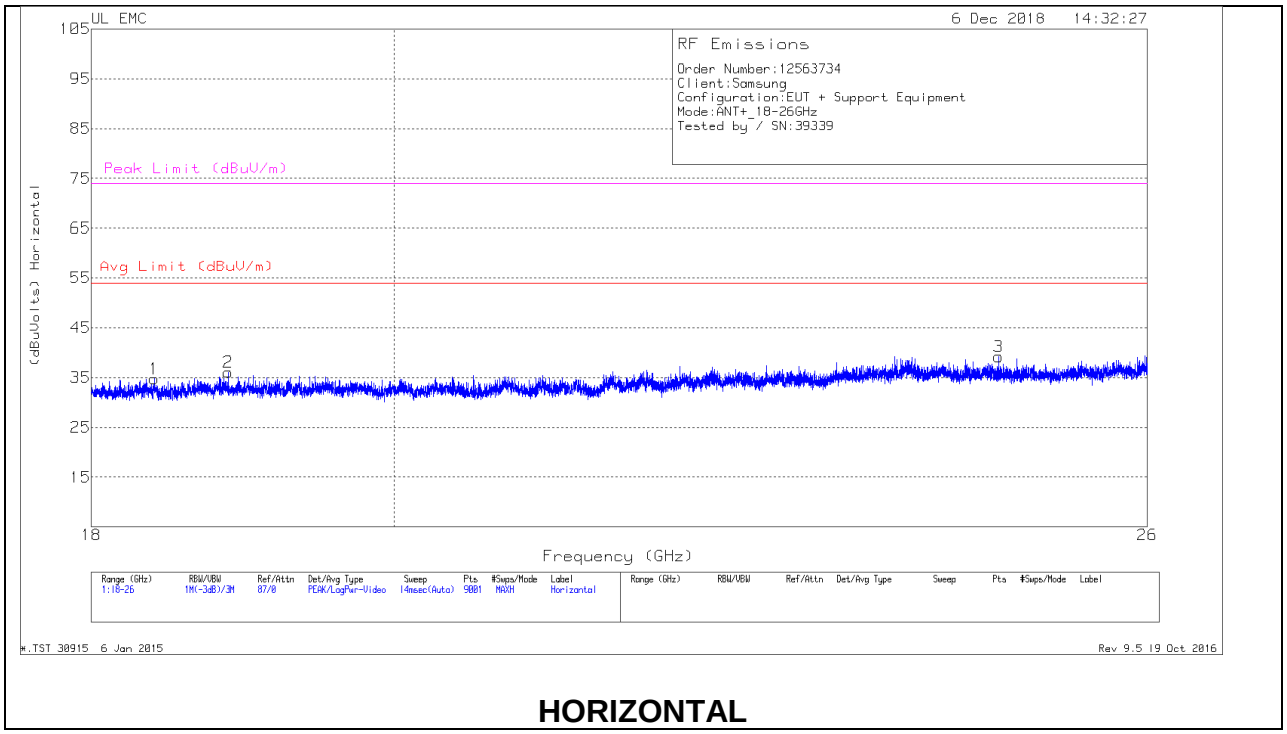
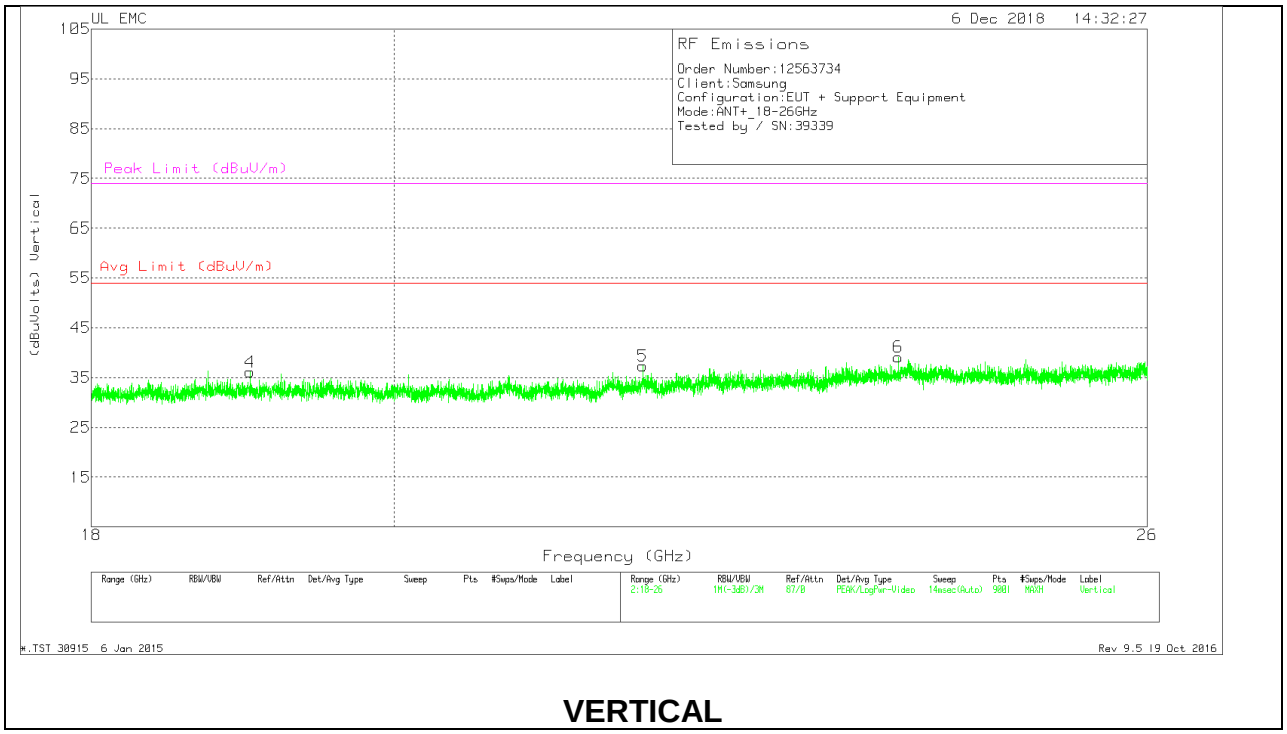
9.5. Worst Case 18-26 GHz

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



HORIZONTAL



VERTICAL

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	18.397	37.16	Pk	32.4	-25.3	-9.5	34.76	54	-19.24	74	-39.24
2	18.879	38.49	Pk	32.5	-25.4	-9.5	36.09	54	-17.91	74	-37.91
3	24.688	38.8	Pk	34.4	-24.5	-9.5	39.2	54	-14.8	74	-34.8
4	19.023	37.73	Pk	32.6	-24.7	-9.5	36.13	54	-17.87	74	-37.87
5	21.811	38.05	Pk	33.2	-24.4	-9.5	37.35	54	-16.65	74	-36.65
6	23.839	38.73	Pk	34.2	-24.3	-9.5	39.13	54	-14.87	74	-34.87

Pk - Peak detector

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10. 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

UL VERIFICATION SERVICES INC.
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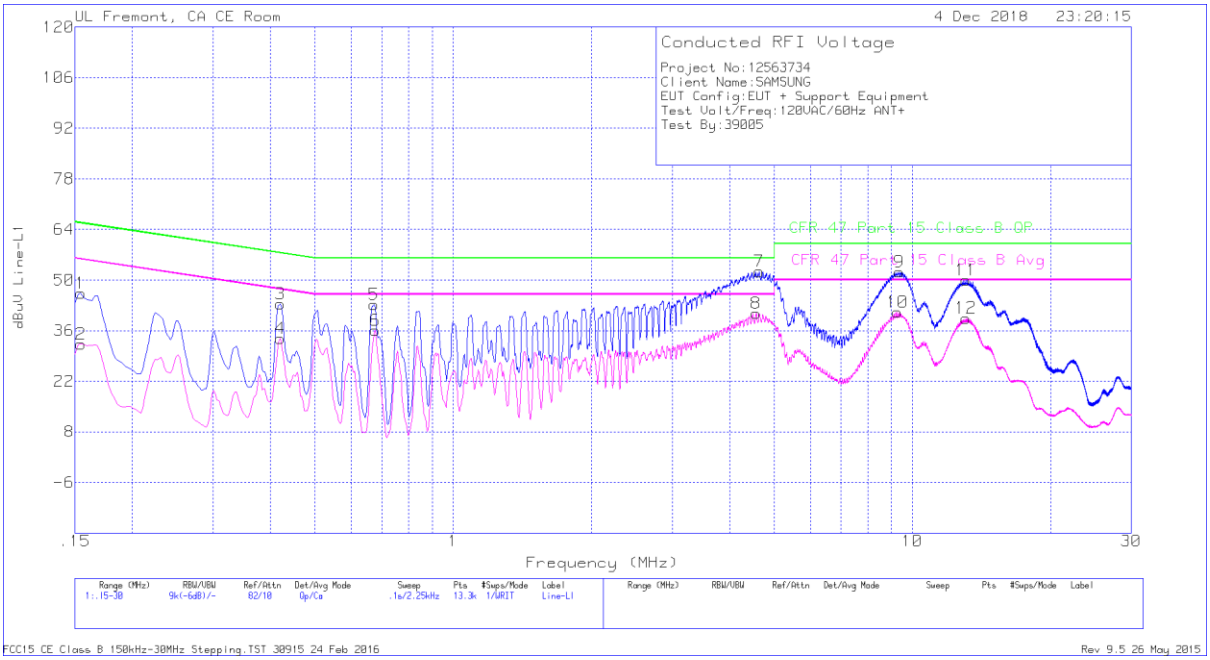
10.1.1. AC Power Line Norm

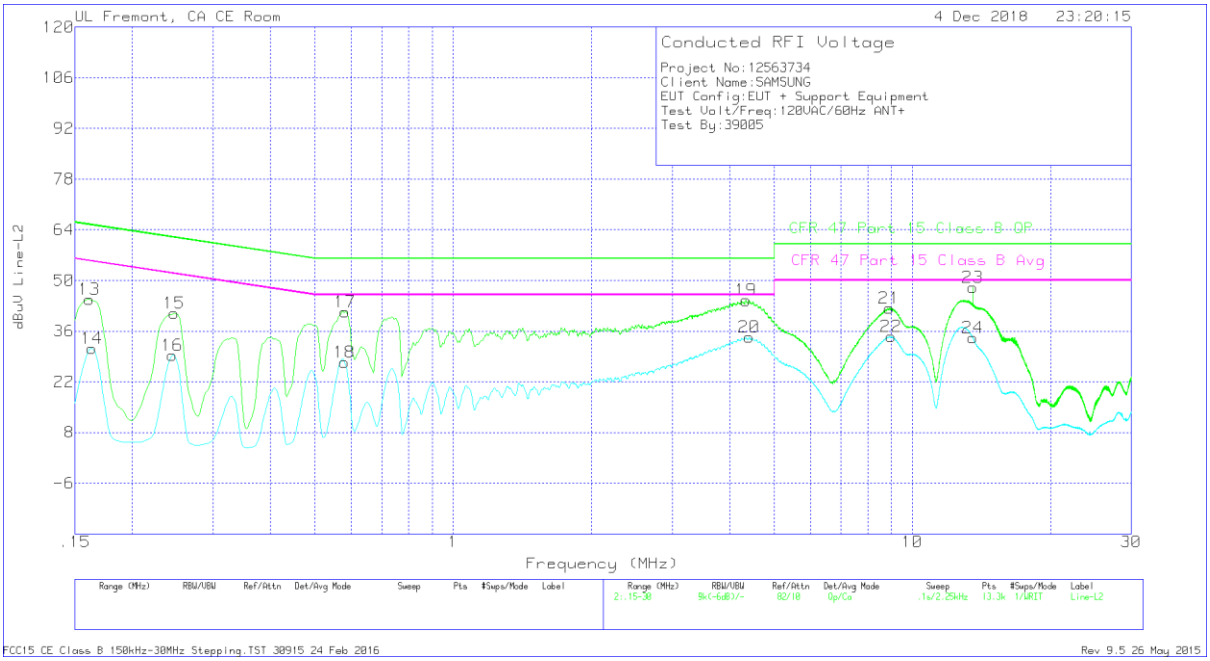
LINE 1 RESULTS



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	.1545	36.18	Qp	.1	0	10.1	46.38	65.75	-19.37	-	-
2	.1545	22.12	Ca	.1	0	10.1	32.32	-	-	55.75	-23.43
3	.42	33.28	Qp	0	0	10.1	43.38	57.45	-14.07	-	-
4	.42	23.75	Ca	0	0	10.1	33.85	-	-	47.45	-13.6
5	.672	33.07	Qp	0	0	10.1	43.17	56	-12.83	-	-
6	.6765	25.95	Ca	0	0	10.1	36.05	-	-	46	-9.95
7	4.641	42.15	Qp	0	.1	10.1	52.35	56	-3.65	-	-
8	4.5735	30.62	Ca	0	.1	10.1	40.82	-	-	46	-5.18
9	9.37275	41.78	Qp	0	.2	10.2	52.18	60	-7.82	-	-
10	9.29175	30.66	Ca	0	.2	10.2	41.06	-	-	50	-8.94
11	13.08525	39.45	Qp	.1	.2	10.2	49.95	60	-10.05	-	-
12	13.083	28.98	Ca	.1	.2	10.2	39.48	-	-	50	-10.52

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



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	.16125	34.58	Qp	.1	0	10.1	44.78	65.4	-20.62	-	-
14	.1635	21.07	Ca	.1	0	10.1	31.27	-	-	55.28	-24.01
15	.24675	30.79	Qp	0	0	10.1	40.89	61.87	-20.98	-	-
16	.2445	19.26	Ca	0	0	10.1	29.36	-	-	51.94	-22.58
17	.582	31.28	Qp	0	0	10.1	41.38	56	-14.62	-	-
18	.57975	17.29	Ca	0	0	10.1	27.39	-	-	46	-18.61
19	4.33725	34.33	Qp	0	.1	10.1	44.53	56	-11.47	-	-
20	4.41375	24.1	Ca	0	.1	10.1	34.3	-	-	46	-11.7
21	8.91825	31.97	Qp	0	.2	10.2	42.37	60	-17.63	-	-
22	8.98575	24.09	Ca	0	.2	10.2	34.49	-	-	50	-15.51
23	13.56	37.53	Qp	.1	.2	10.2	48.03	60	-11.97	-	-
24	13.5465	23.64	Ca	.1	.2	10.2	34.14	-	-	50	-15.86

Qp - Quasi-Peak detector
Ca - CISPR average detection