



FCC CFR47 PART 15 SUBPART C

NFC

CERTIFICATION TEST REPORT

FOR

GSM/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n, ANT+ and NFC

MODEL NUMBER : SM-C701F/DS

FCC ID: A3LSMC701F

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	03/10/17	Initial issue	Junwhan Lee
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TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	4
2. TEST METHODOLOGY	5
3. FACILITIES AND ACCREDITATION	5
4. CALIBRATION AND UNCERTAINTY	5
4.1. MEASURING INSTRUMENT CALIBRATION	5
4.2. SAMPLE CALCULATION	5
4.3. MEASUREMENT UNCERTAINTY	5
5. EQUIPMENT UNDER TEST	6
5.1. DESCRIPTION OF EUT	6
5.2. MAXIMUM OUTPUT POWER	6
5.3. WORST-CASE CONFIGURATION AND MODE	6
5.4. DESCRIPTION OF TEST SETUP	7
6. TEST AND MEASUREMENT EQUIPMENT	10
7. 20dB BANDWIDTH	11
8. RADIATED EMISSION TEST RESULTS	12
8.1. LIMITS AND PROCEDURE	12
8.1.1. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 – 30 MHz)	14
8.1.2. TX SPURIOUS EMISSION 30 TO 1000 MHz	15
9. AC MAINS LINE CONDUCTED EMISSIONS	17
10. FREQUENCY STABILITY	22
11. SETUP PHOTOS	23

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

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

MODEL NUMBER: SM-C701F/DS

SERIAL NUMBER: R38J10TDQXT (RADIATED);
R38J10TDSMA (CONDUCTED)

DATE TESTED: MAR 07, 2017 - MAR 20, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass

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.

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Tested By:



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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.

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
☐	Chamber 2

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637. The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

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	2.32 dB
Radiated Disturbance, Below 1GHz	4.14 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

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

5.2. MAXIMUM OUTPUT POWER

The testing was performed at 1 meter. The transmitter maximum E-field at 30m distance is 19.03 dBuV/m which convert from 1 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 fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that the Z orientation was the worst-case orientation; therefore all final radiated testing was performed with the EUT in the Z orientation while generating continuous emissions.

5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Charger	SAMSUNG	EP-TA20IWE	R37H7JNHYW1SE3	N/A
Data Cable	SAMSUNG	EP-DN930CWE	N/A	N/A
Earphone	SAMSUNG	EHS64AVFWE	N/A	N/A

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC Power	1	Mini-USB	Shielded	1.0m	N/A
2	Audio	2	Mini-Jack	Unshielded	1.0m	N/A

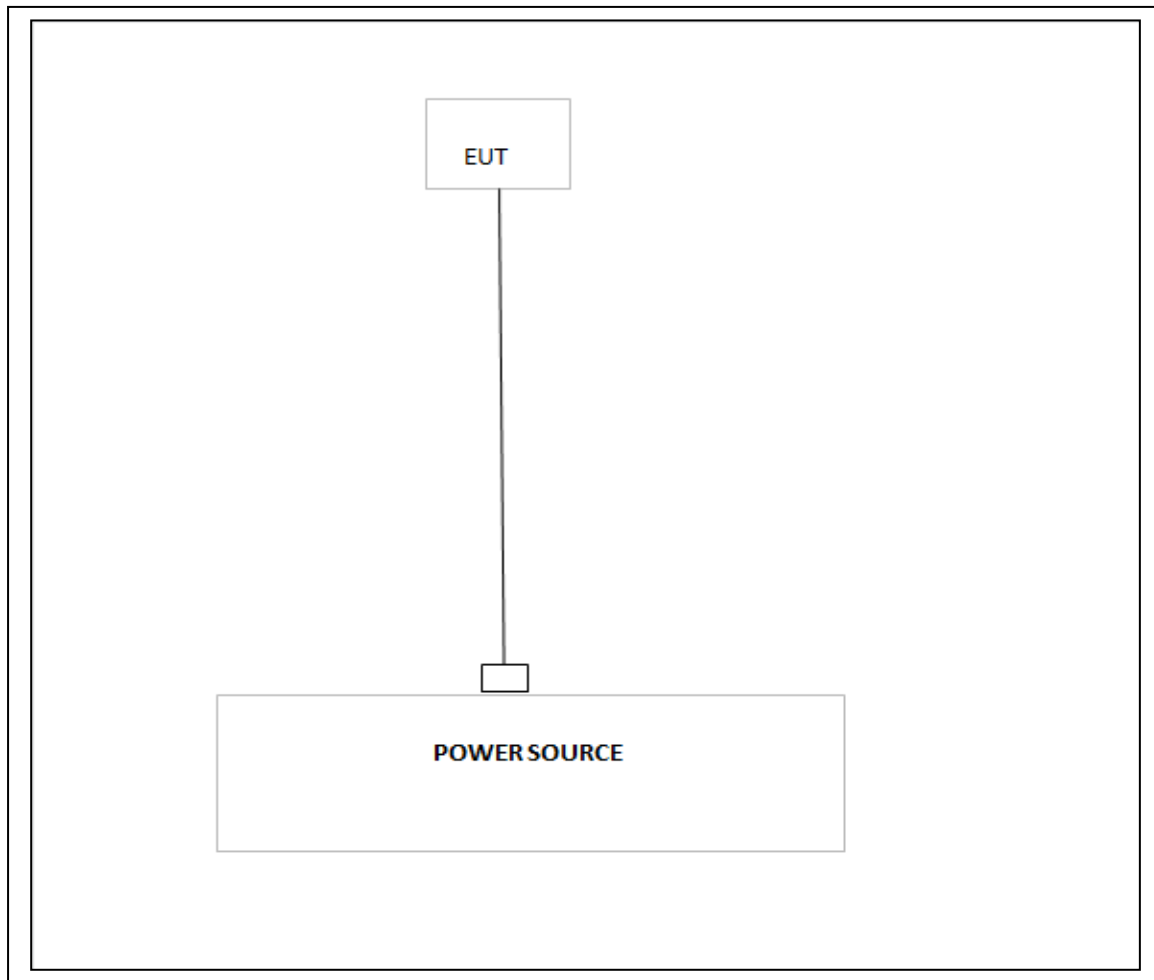
TEST SETUP

The EUT is a stand-alone device configured and tested in a worst-case setup.

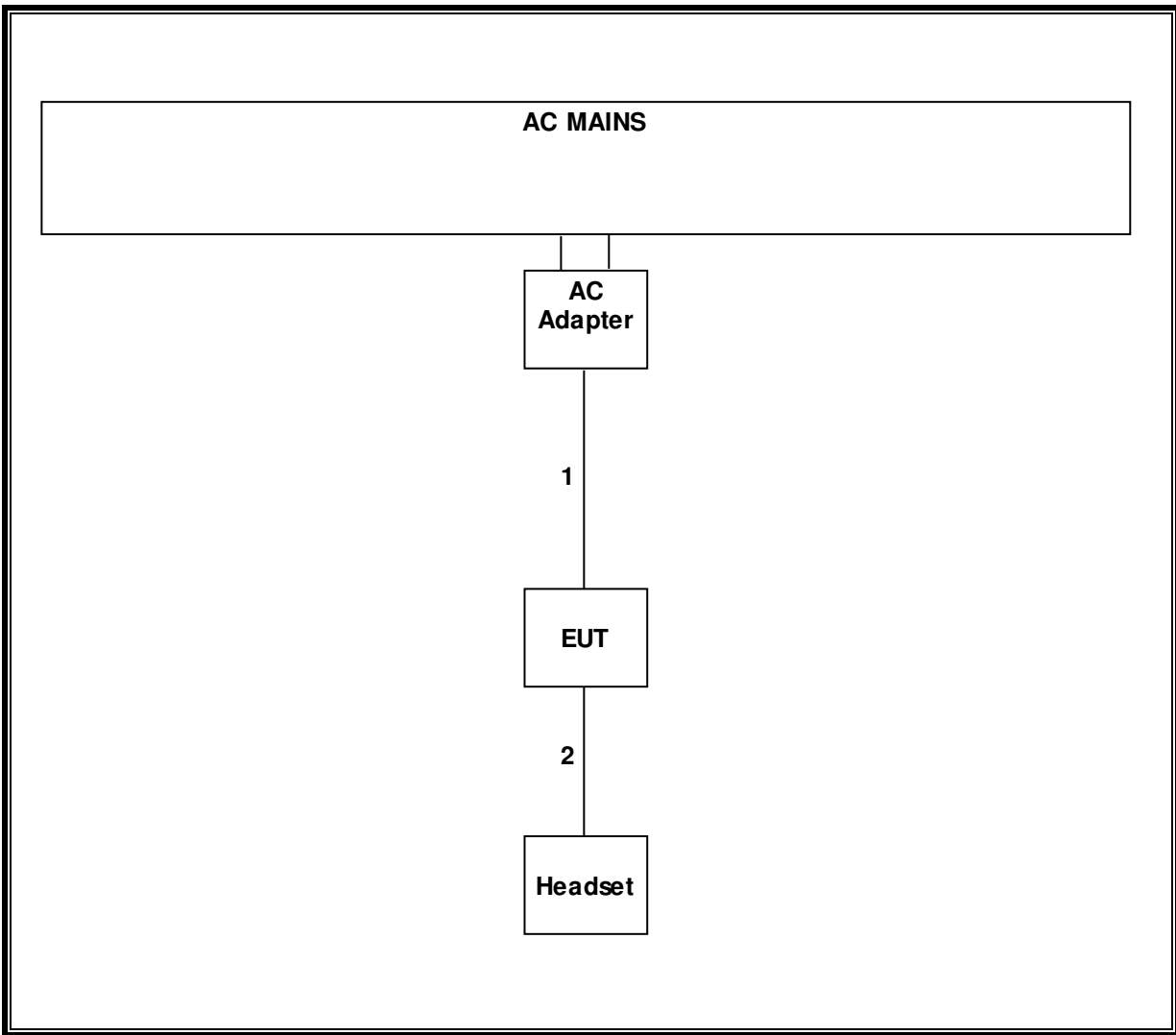
Note: Worst case is using worst case orientation with AC charger and headset attached to the EUT with NFC signal continuously transmitting.

SETUP DIAGRAM FOR TESTS

Radiated Emissions Below 30 MHz:



Radiated Emissions Above 30 MHz, AC Line Conducted Emissions:



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	750	10-14-18
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-17
Antenna, Loop, 9kHz-30MHz	R&S	HFH2-Z2	100418	11-25-17
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-17-17
Preamplifier, 1000 MHz	Sonoma	310N	251741	08-16-17
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-17-17
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-16-17
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-16-17
DC Power Supply	Agilent / HP	E3640A	MY54226395	08-16-17
Temperature Chamber	ESPEC	SH-642	93001109	08-17-17
LISN	R&S	ENV216	101836	08-16-17
LISN	R&S	ENV216	101837	08-16-17
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]	20dB Bandwidth [KHz]
13.56	435.2

Note : Because the intentional signal is very narrowband (almost CW) adjusting the RBW per RSS-GEN / ANSI C63.10 to be a value of between 1 – 5% of the OBW is impractical. Measurements were made using RBW sufficient to show that the 99% bandwidth is contained within the 14kHz range between 13.553-13.567 MHz.

20dB Bandwidth Plot



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 field strength from µV/m to dBuV/m is:

Limit (dBuV/m) = 20 log limit (µV/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

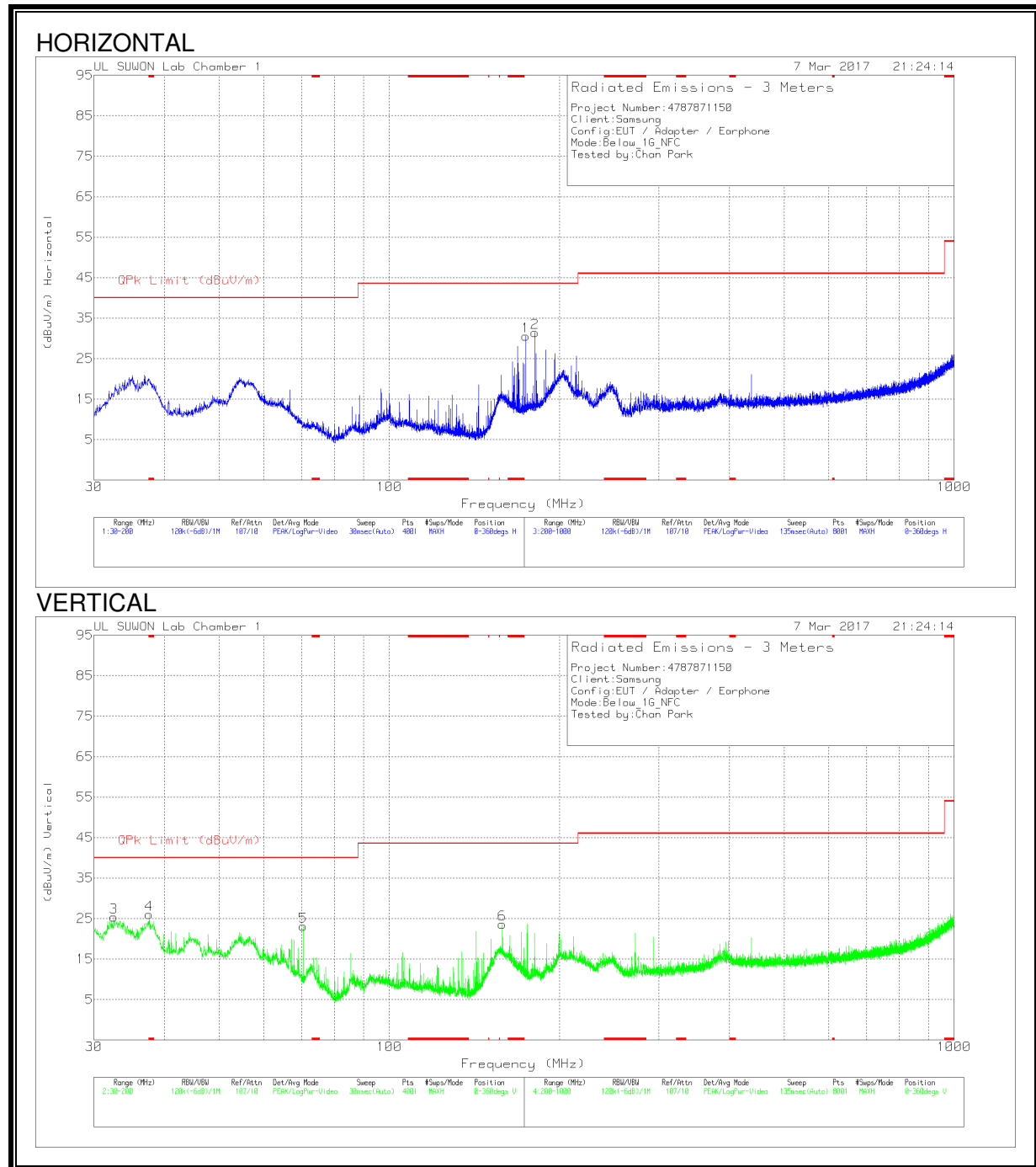
No non-compliance noted:

8.1.1. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 – 30 MHz)

FCC Part 15, Subpart B & C 1 Meter Distance Measurement At Chamber 1												
Company: Samsung Project #: 4787871150 Model #: SM-C701F_DS Tester: Chan Park Date: 2017/03/07												
Frequency (MHz)	PK (dBu/V)	QP (dBu/V)	AV (dBu/V)	AF (dB/m)	Distance Correction (dB)	PK Corrected Reading (dBuV/m)	AV Corrected Reading (dBuV/m)	QP Limit (dBuV/m)	AV Limit (dBuV/m)	PK Margin (dB)	AV Margin (dB)	Notes
Loop Antenna Face on: Z position worst												
13.56	63.97		N/A	19.03	-59.08	23.92	N/A	84.00	N/A	-60.1	N/A	Fundamental @ 1m Dist
13.55	53.42		N/A	19.032	-59.08	13.37	N/A	50.48	N/A	-37.1	N/A	13.41MHz-13.553MHz
13.57	51.55		N/A	19.029	-59.08	11.49	N/A	50.48	N/A	-39.0	N/A	13.567MHz-13.71MHz
13.35	45.15		N/A	19.064	-59.08	5.13	N/A	40.51	N/A	-35.4	N/A	13.110-13.410MHz
13.77	42.85		N/A	18.997	-59.08	2.76	N/A	40.51	N/A	-37.7	N/A	13.71-14.01MHz
12.88	14.64		N/A	19.139	-59.08	-25.31	N/A	29.54	N/A	-54.8	N/A	9k-13.11MHz
14.09	20.63		N/A	18.946	-59.08	-19.51	N/A	29.54	N/A	-49.0	N/A	14.01MHz-30MHz
Loop Antenna Face off: Z position worst												
13.56	54.93		N/A	19.03	-59.08	14.88	N/A	84.00	N/A	-69.1	N/A	Fundamental @ 1m Dist
13.55	43.78		N/A	19.032	-59.08	3.73	N/A	50.48	N/A	-46.8	N/A	13.41MHz-13.553MHz
13.57	42.08		N/A	19.029	-59.08	2.02	N/A	50.48	N/A	-48.5	N/A	13.567MHz-13.71MHz
13.41	26.55		N/A	19.054	-59.08	-13.48	N/A	40.51	N/A	-54.0	N/A	13.110-13.410MHz
13.77	29.64		N/A	18.997	-59.08	-10.45	N/A	40.51	N/A	-51.0	N/A	13.71-14.01MHz
8.24	11.55		N/A	19.671	-59.08	-27.86	N/A	29.54	N/A	-57.4	N/A	9k-13.11MHz
20.13	11.2		N/A	18.905	-59.08	-28.98	N/A	29.54	N/A	-58.5	N/A	14.01MHz-30MHz
* No more emissions were found up to 30MHz												
Note: The emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.												
P.K. = Peak Q.P. = Quasi Peak Readings A.F. = Antenna factor												
Rev. 10.23.09												

Note : Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area 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 937606.

8.1.2. TX SPURIOUS EMISSION 30 TO 1000 MHz



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	VULB9163-749	30-1000MHz[dB]	Corrected Reading (dBUV/m)	QPk Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	174.2875	52	Pk	9.2	-30.6	30.6	43.52	-12.92	0-360	100	H
2	181.1725	52.46	Pk	9.6	-30.6	31.46	43.52	-12.06	0-360	300	H
3	32.55	46.41	Pk	10.5	-31.6	25.31	40	-14.69	0-360	100	V
4	* 37.6075	45.8	Pk	11.8	-31.6	26	40	-14	0-360	100	V
5	70.375	44.9	Pk	9.5	-31.3	23.1	40	-16.9	0-360	100	V
6	158.605	45.78	Pk	8.5	-30.7	23.58	43.52	-19.94	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 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 50 μ H/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 (dB μ V)	
	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.

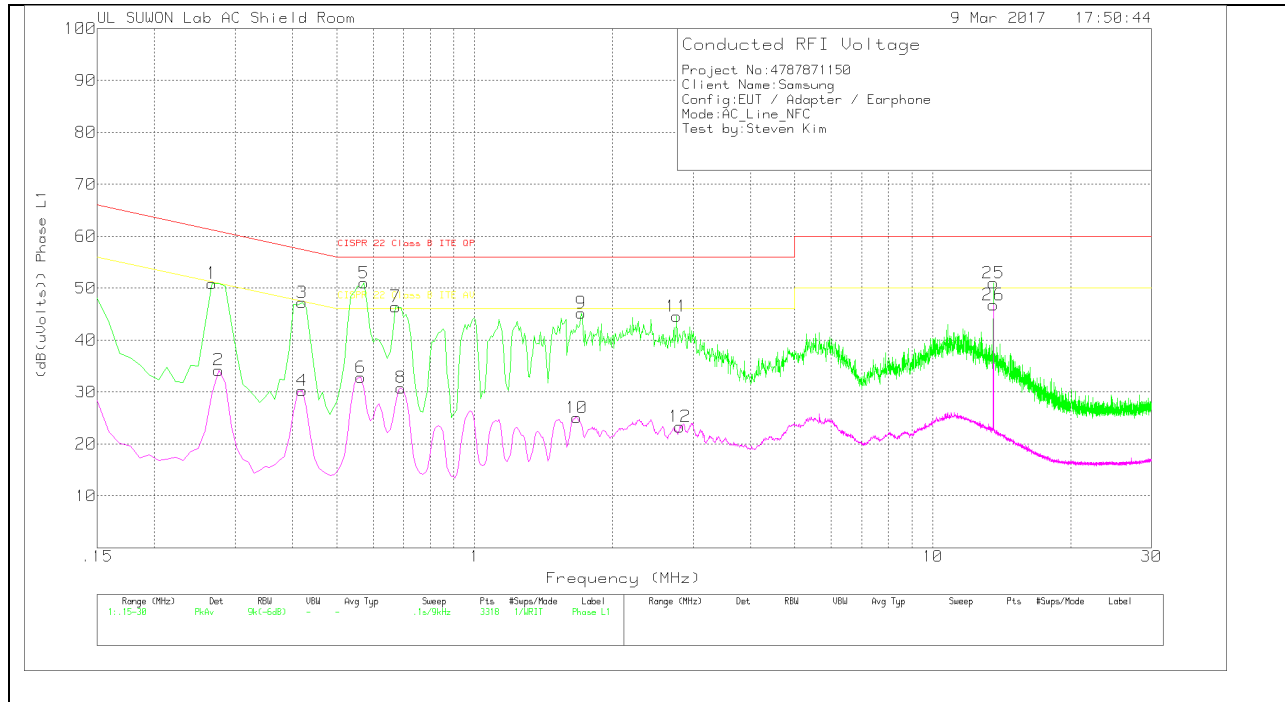
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

No non-compliance noted:

WORST EMISSIONS

LINE 1 PLOT



LINE 1 RESULTS

Trace Markers

Phase L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_w ith ex- cord_L1	CABLELOS S(dB)	Corrected Reading (dB(uVolts)	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
1	.267	41.01	Pk	9.7	.2	50.91	61.21	-10.3	-	-
2	.276	24.32	Av	9.7	.2	34.22	-	-	50.94	-16.72
3	.42	37.14	Pk	9.9	.2	47.24	57.45	-10.21	-	-
4	.42	20.18	Av	9.9	.2	30.28	-	-	47.45	-17.17
5	.573	40.9	Pk	9.9	.2	51	56	-5	-	-
6	.564	22.71	Av	9.9	.2	32.81	-	-	46	-13.19
7	.672	36.34	Pk	9.9	.2	46.44	56	-9.56	-	-
8	.69	20.73	Av	9.9	.2	30.83	-	-	46	-15.17
9	1.707	35.2	Pk	9.7	.3	45.2	56	-10.8	-	-
10	1.671	15.05	Av	9.7	.3	25.05	-	-	46	-20.95
11	2.76	34.58	Pk	9.7	.3	44.58	56	-11.42	-	-
12	2.805	13.33	Av	9.7	.3	23.33	-	-	46	-22.67
25	13.56	40.51	Pk	10.1	.4	51.01	60	-8.99	-	-
26	13.56	36.27	Av	10.1	.4	46.77	-	-	50	-3.23

Pk - Peak detector

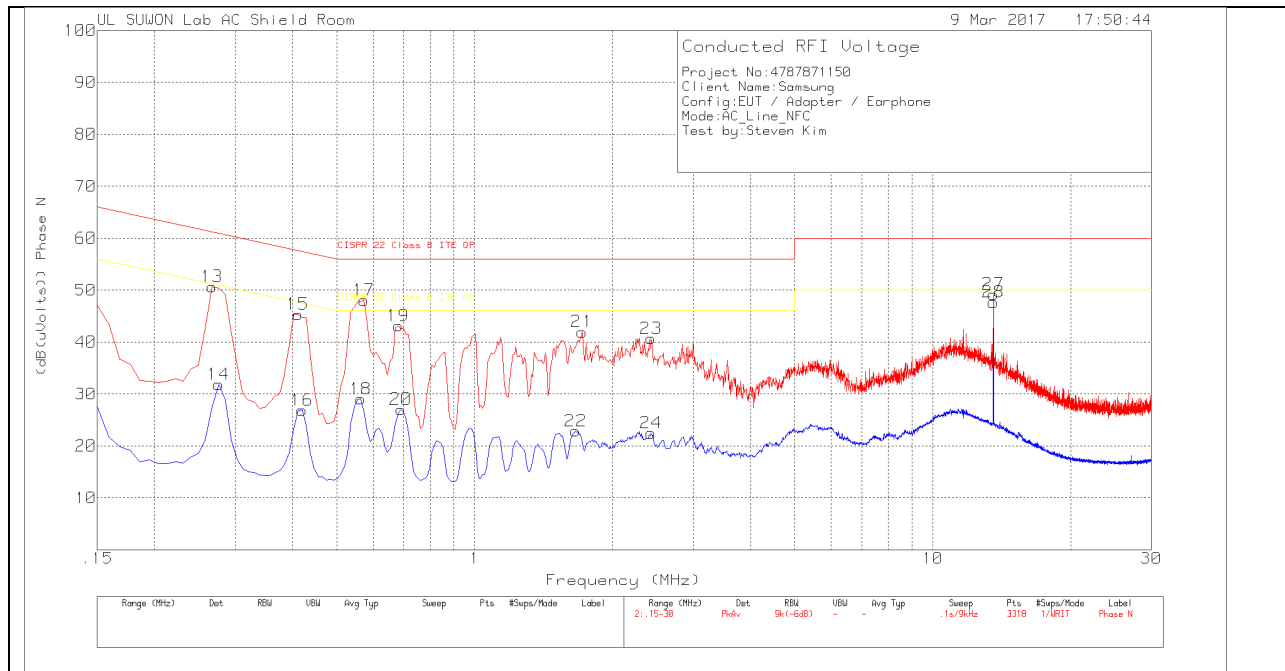
Av - Average detection

Phase L1 .15 - 30MHz

Frequency (MHz)	Meter Reading (dBuV)	Det	101837_wit h ex-cord_L1	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
.2715	36.93	Qp	9.7	.2	46.83	61.07	-14.24	-	-
.4164	31.39	Qp	9.9	.2	41.49	57.52	-16.03	-	-
.5685	34.75	Qp	9.9	.2	44.85	56	-11.15	-	-
.6765	31.71	Qp	9.9	.2	41.81	56	-14.19	-	-
13.5591	43.45	Qp	10.1	.4	53.95	60	-6.05	-	-

Qp – Quasi-peak detector

LINE 2 PLOT



LINE 2 RESULTS

Trace Markers

Phase N .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	101837_w ith ex- cord_N	CABLELOS S(dB)	Corrected Reading (dB(uVolts)	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
13	.267	40.75	Pk	9.7	.2	50.65	61.21	-10.56	-	-
14	.276	21.94	Av	9.7	.2	31.84	-	-	50.94	-19.1
15	.411	35.25	Pk	9.9	.2	45.35	57.63	-12.28	-	-
16	.42	16.77	Av	9.9	.2	26.87	-	-	47.45	-20.58
17	.573	37.96	Pk	9.9	.2	48.06	56	-7.94	-	-
18	.564	18.96	Av	9.9	.2	29.06	-	-	46	-16.94
19	.681	33.01	Pk	9.9	.2	43.11	56	-12.89	-	-
20	.69	16.94	Av	9.9	.2	27.04	-	-	46	-18.96
21	1.716	31.97	Pk	9.7	.3	41.97	56	-14.03	-	-
22	1.662	12.88	Av	9.7	.3	22.88	-	-	46	-23.12
23	2.427	30.68	Pk	9.7	.3	40.68	56	-15.32	-	-
24	2.427	12.48	Av	9.7	.3	22.48	-	-	46	-23.52
27	13.56	38.53	Pk	10.3	.4	49.23	60	-10.77	-	-
28	13.56	37	Av	10.3	.4	47.7	-	-	50	-2.3

Pk - Peak detector

Av - Average detection

Phase N .15 - 30MHz

Frequency (MHz)	Meter Reading (dBuV)	Det	101837_wit h ex-cord_N	CABLELOSS(dB)	Corrected Reading (dB(uVolts))	CISPR 22 Class B ITE QP	Margin (dB)	CISPR 22 Class B ITE AV	Margin (dB)
.2715	36.15	Qp	9.7	.2	46.05	61.07	-15.02	-	-
.4101	29.9	Qp	9.9	.2	40	57.65	-17.65	-	-
.5685	32.08	Qp	9.9	.2	42.18	56	-13.82	-	-
.6783	28	Qp	9.9	.2	38.1	56	-17.9	-	-
13.56	44.85	Qp	10.3	.4	55.55	60	-4.45	-	-

Qp – Quasi-peak detector

10. FREQUENCY STABILITY

LIMIT

§15.225 (e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ 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

Reference Frequency: EUT Channel 13.56 MHz @ 20°C Limit: ± 100 ppm = 1.356 kHz										
Power Supply (Vdc)	Envir. Temp (°C)	Frequency Deviation Measured with Time Elapse								
		Start up (MHz)	Delta (ppm)	@ 2mins (MHz)	Delta (ppm)	@ 5mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.559940182	5.188	13.559939852	5.212	13.559937210	5.407	13.559936252	5.478	100
3.80	40	13.559968462	3.103	13.559966582	3.241	13.559964215	3.416	13.559960986	3.654	100
3.80	30	13.559991730	1.387	13.559990217	1.498	13.559989824	1.527	13.559988449	1.629	100
3.80	20	13.560010532	0	13.560009824	0.052	13.560008438	0.154	13.560008125	0.178	100
3.80	10	13.560044532	-2.507	13.560042111	-2.329	13.560040842	-2.235	13.560038824	-2.086	100
3.80	0	13.560046752	-2.671	13.560046483	-2.651	13.560045725	-2.595	13.560045124	-2.551	100
3.80	-10	13.560049552	-2.878	13.560049284	-2.858	13.560048884	-2.828	13.560048108	-2.771	100
3.80	-20	13.560051064	-2.989	13.560051002	-2.985	13.560050825	-2.971	13.560050432	-2.942	100
3.80	-30	13.560051524	-3.023	13.560050982	-2.983	13.560050524	-2.949	13.560050013	-2.912	100

Reference Frequency: EUT Channel 13.56 MHz @ 20°C Limit: ± 100 ppm = 1.356 kHz										
Power Supply (Vdc)	Envir. Temp (°C)	Frequency Deviation Measured with Time Elapse								
		Start up (MHz)	Delta (ppm)	@ 2mins (MHz)	Delta (ppm)	@ 5mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.85	20	13.560010532	0	13.560009824	0.052	13.560008438	0.154	13.560008125	0.178	100
4.43	20	13.560010425	0.008	13.560009924	0.045	13.560008106	0.024	13.560008014	0.186	100
3.40	20	13.560010482	0.004	13.560009857	0.050	13.560008239	0.015	13.560007959	0.190	100

No non-compliance noted.