



FCC CFR47 PART 15 SUBPART C

**ANT+
CERTIFICATION TEST REPORT
FOR**

GSM/WCDMA/LTE Phone + Bluetooth, WLAN 2.4GHz b/g/n & ANT+

MODEL NUMBER: SM-A3000

FCC ID: A3LSMA3000

REPORT NUMBER: 14I18652-E5 Revision A

ISSUE DATE: SEPTEMBER 30, 2014

**Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	9/9/14	Initial Issue	P. Zhang
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: GSM/WCDMA/LTE Phone + Bluetooth, WLAN 2.4 GHz
b/g/n & ANT+

MODEL: SM-A3000

SERIAL NUMBER: FL-345-A (RADIATED), FL-345-C (CONDUCTED)

DATE TESTED: AUGUST 28 - SEPTEMBER 9, 2014

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

UL Verification Services Inc. 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 Verification Services Inc. 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 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 any government.

Approved & Released For

UL Verification Services Inc. By:



PENG ZHANG
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UL Verification Services Inc.

Tested By:



CHARLES VERGONIO
CONSUMER TECHNOLOGY DIVISION
LAB ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, 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
☐ Chamber A(IC: 2324B-1)	☐ Chamber D(IC: 2324B-4)
☐ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 2324B-5)
☒ Chamber C(IC: 2324B-3)	☒ Chamber F(IC: 2324B-6)
	☐ Chamber G(IC: 2324B-7)
	☐ Chamber H(IC: 2324B-8)

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

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:

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

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	3.52 dB
Radiated Disturbance, 30 to 26000 MHz	4.94 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 + Bluetooth, WLAN 2.4GHz b/g/n & ANT+

5.2. MAXIMUM OUTPUT FUNDAMENTAL FIELD STRENGTH

The ANT+ mode has maximum output 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 +	74.96	69.53	3.00

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -1.85 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

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

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

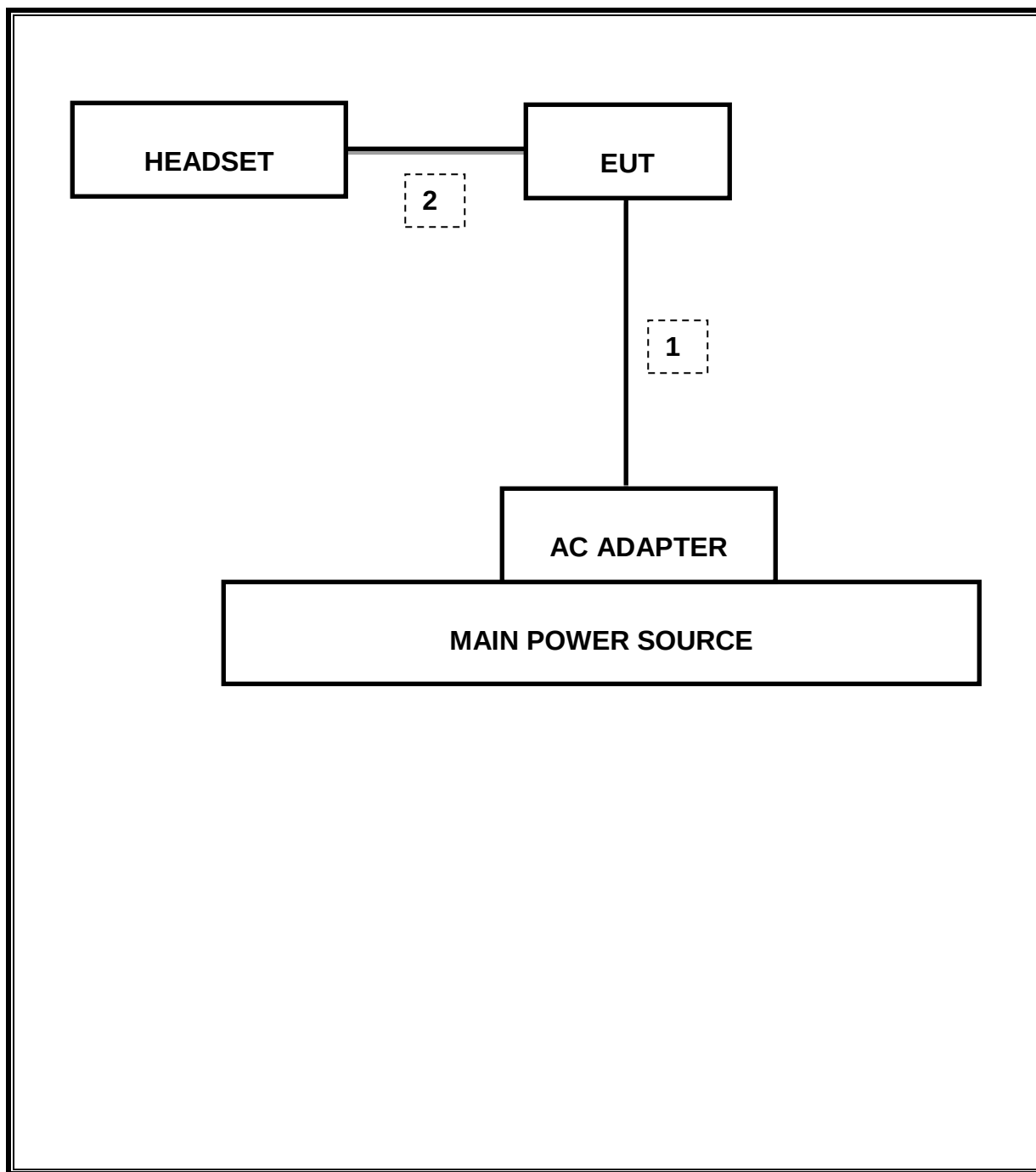
Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter	SAMSUNG	ETA0U83CBC	N/A	N/A
Earphone	SAMSUNG	EHS64AVFWE	N/A	N/A

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	1.2m	N/A
2	Audio	1	Mini-Jack	Unshielded	1m	N/A

TEST SETUP

The EUT is set to continuously transmit in ANT + test mode



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	Asset	Cal Due
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	C01171	02/13/15
Antenna, Horn, 18GHz	EMCO	3115	C00783	10/25/14
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/14/14
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/28/15
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	10/22/14
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/14
CBT Bluetooth Tester	R & S	CBT	None	07/12/15
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/14
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/14
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/15
Reject Filter, 2.4GHz	Micro-Tronics	BRM50702	N02684	CNR

7. LIMITS AND RESULTS

7.1. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

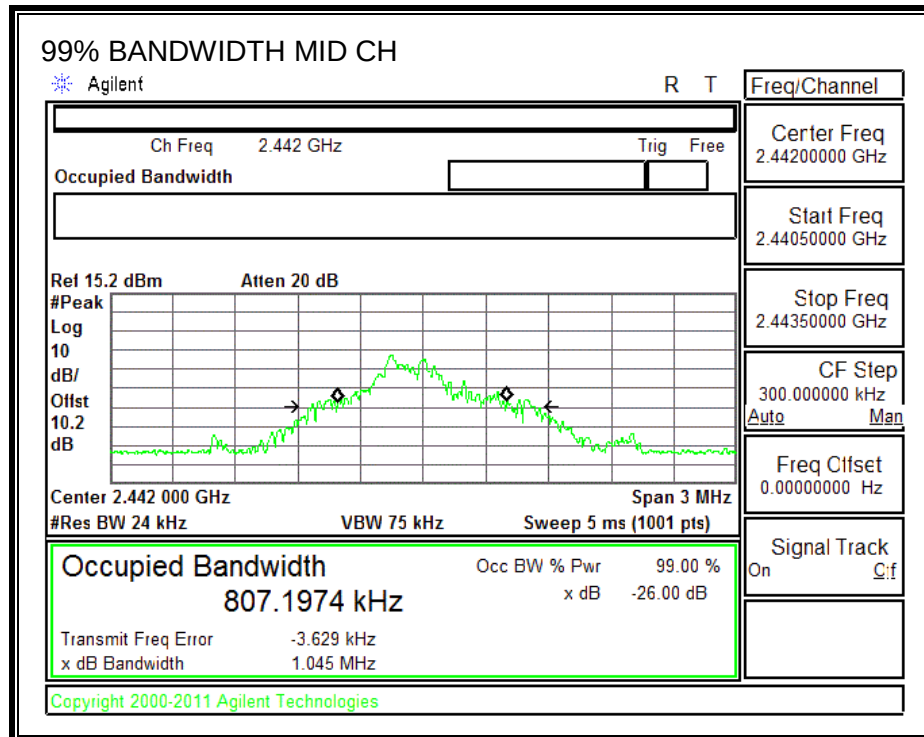
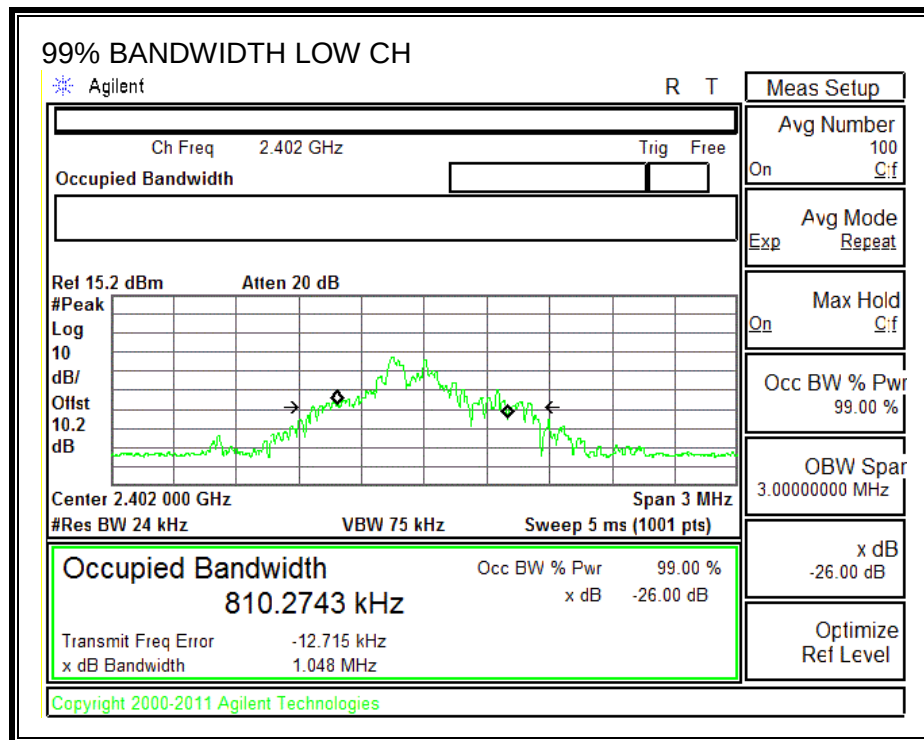
TEST PROCEDURE

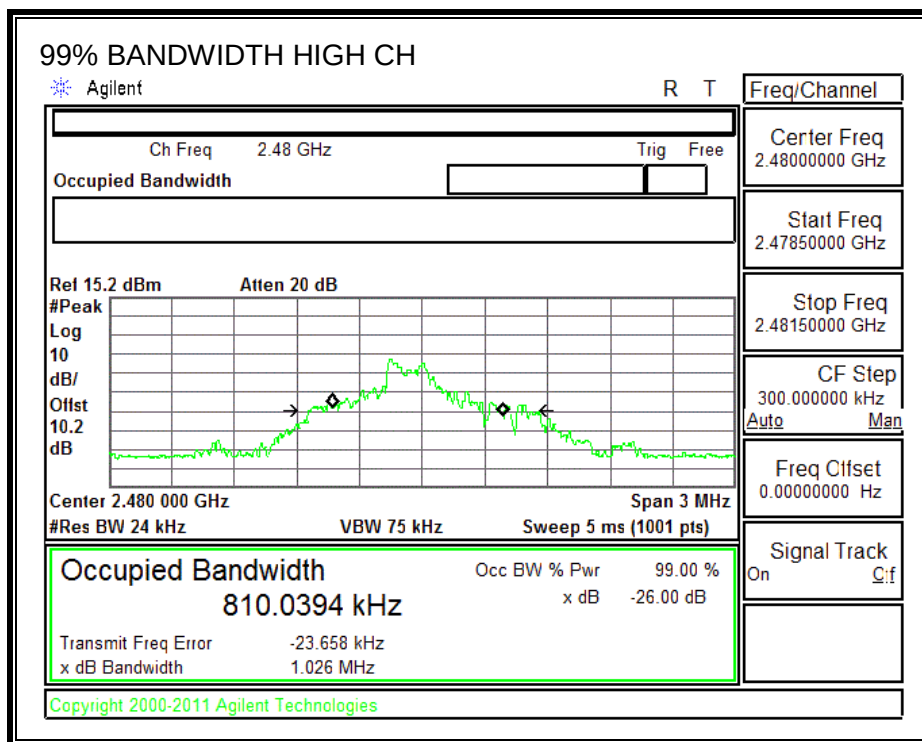
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Frequency (MHz)	99% Bandwidth (MHz)
2402	0.810
2442	0.807
2480	0.810

99% BANDWIDTH





7.2. TRANSMITTER RADIATED EMISSIONS

TEST PROCEDURE

ANSI C63.4

LIMIT

IC RSS-210, A2.9
FCC 15.249

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.

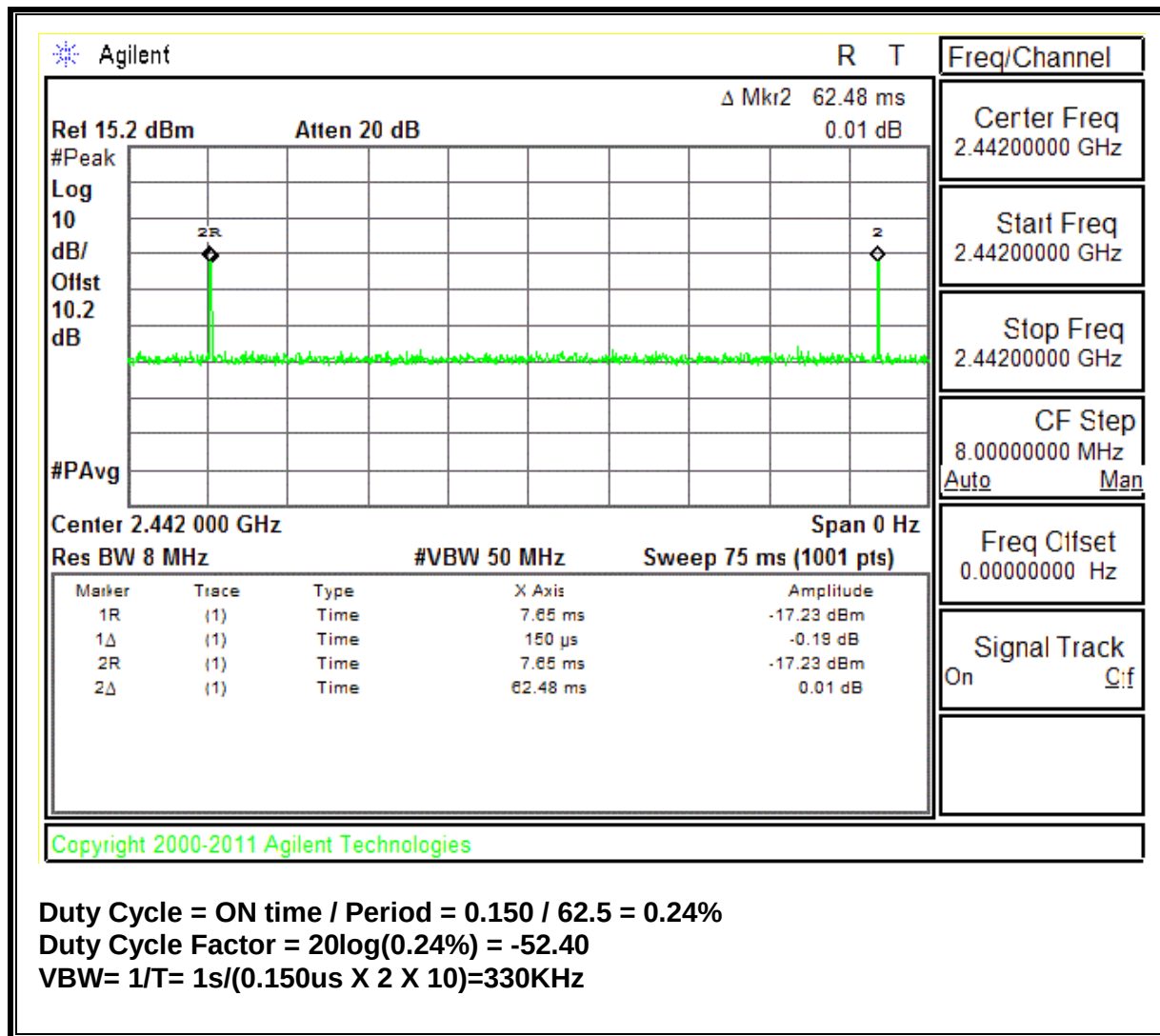
(e) As shown in Sec. 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under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

Frequency (MHz)	Field strength (microvolts/meter)	Measure- ment dis- tance (meters)
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.

RESULTS

7.2.1. DUTY CYCLE



7.2.2. FUNDAMENTAL FREQUENCY RADIATED EMISSION

	FCC, VCCI, CISPR, CE, AUSTEL, NZ	Project #: 14I18652
	UL, CSA, TUV, BSMI, DHHS, NVLAP	Report #: 14I18652
47173 BENICIA STREET, FREMONT, CA 94538, USA		Date & Time: 09/08/14
		Test Engr: Jude Semana

Company:	Samsung
EUT Description:	GSM/WCDMA + BLUETOOTH & WLAN (2.4 & 5 GHZ) PHONE
Test Configuration :	X POSITION
Type of Test:	FCC
Mode of Operation:	Transmitting : ANT+ mode

M% = ((t1+t2+t3+...)/T) * 66.83% = 0.24%

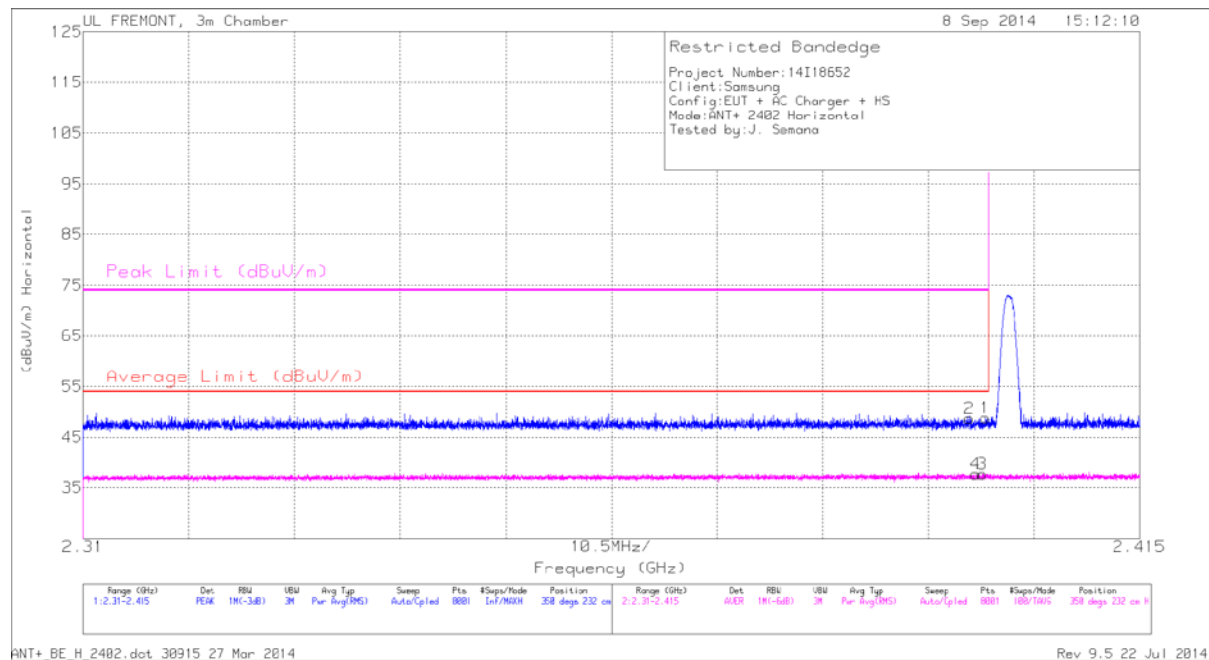
Av Reading = Pk Reading + 20*log(M%)
20 * log (M%) = -52.40

Freq. (MHz)	Pk Rdg (dBuV)	Av Rdg (dBuV)	AF (dB)	Closs (dB)	Pre-amp (dB)	Pk Level (dBuV/m)	Av Level (dBuV/m)	Pk Limit FCC_B	Av Limit FCC_B	Pk Margin (dB)	Av Margin (dB)	Pol (H/V)	Az (Deg)	Height (Meter)
Low channel														
2402.00	75.05	68.81	32.10	-34.00	0.00	73.15	66.91	114.00	94.00	-40.85	-27.09	3mV	0.00	1.00
2402.00	76.86	70.42	32.10	-34.00	0.00	74.96	68.52	114.00	94.00	-39.04	-25.48	3mH	0.00	2.00
Mid channel														
2442.00	74.04	68.06	32.10	-34.00	0.00	72.14	66.16	114.00	94.00	-41.86	-27.84	3mV	0.00	1.00
2442.00	74.63	71.43	32.10	-34.00	0.00	72.73	69.53	114.00	94.00	-41.27	-24.47	3mH	0.00	2.00
High channel														
2480.00	72.58	71.03	32.10	-34.00	0.00	70.68	69.13	114.00	94.00	-43.32	-24.87	3mV	0.00	1.00
2480.00	74.24	71.28	32.10	-34.00	0.00	72.34	69.38	114.00	94.00	-41.66	-24.62	3mH	0.00	2.00

AVG VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

7.2.3. TRANSMITTER RESTRICTED BAND EDGES

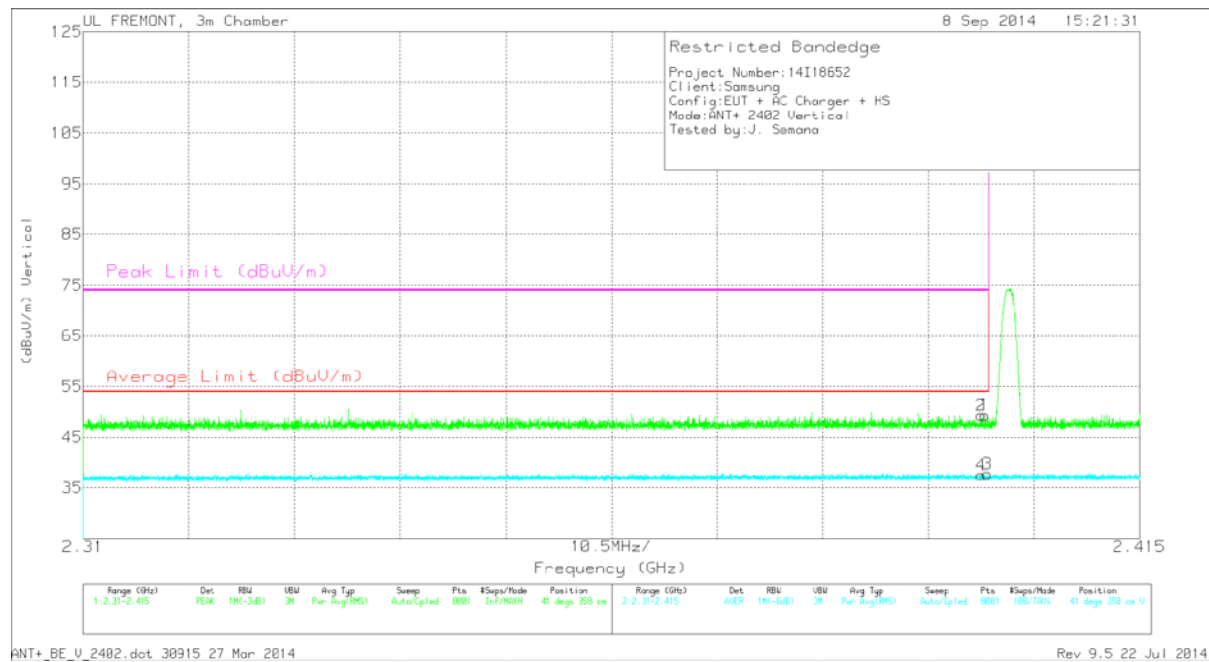
BANDEDGE (LOW CHANNEL, HORIZONTAL)



Trace Markers

Marker	Frequen cy (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Correcte d Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.398	41.18	PK	32	-24.5	48.68	-	-	74	-25.32	350	232	H
3	2.399	30.35	VB1 T	32	-24.6	37.75	54	-16.25	-	-	350	232	H
4	2.399	30.37	VB1 T	32	-24.6	37.77	54	-16.23	-	-	350	232	H
1	2.4	41.4	PK	32	-24.6	48.8	-	-	74	-25.2	350	232	H

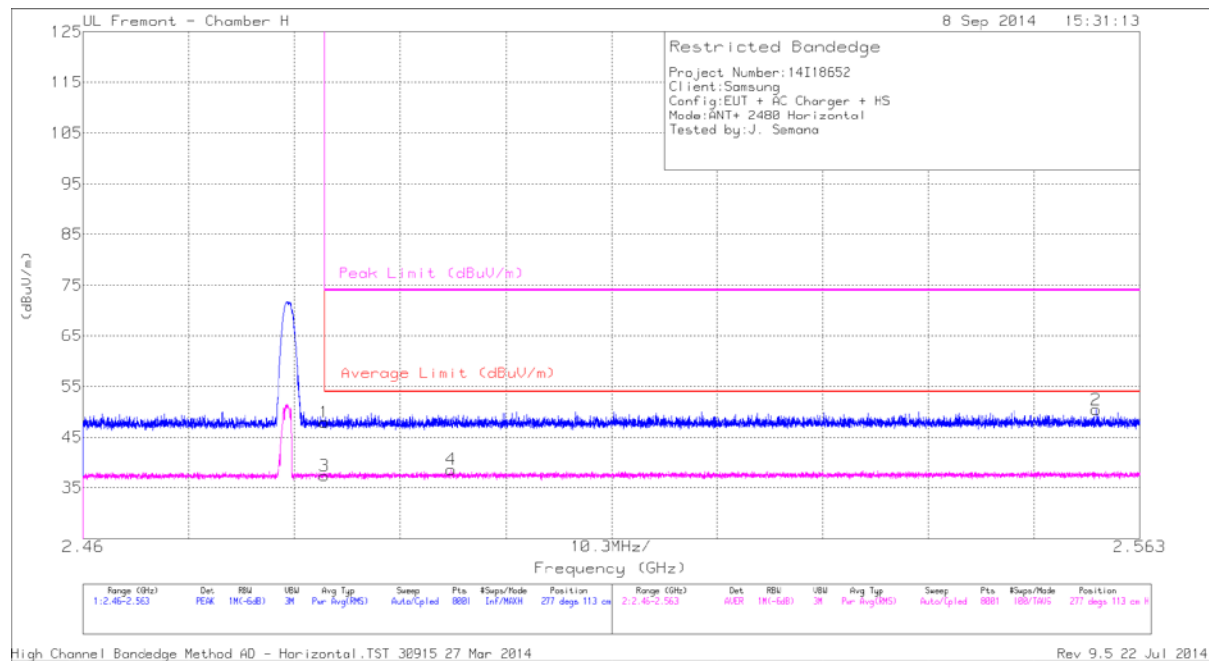
BANDEDGE (LOW CHANNEL, VERTICAL)



Trace Markers

Marker	Frequen cy (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Correcte d Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.399	41.95	PK	32	-24.6	49.35	-	-	74	-24.65	41	358	V
4	2.399	30.06	VB1 T	32	-24.6	37.46	54	-16.54	-	-	41	358	V
1	2.4	41.96	PK	32	-24.6	49.36	-	-	74	-24.64	41	358	V
3	2.4	30.35	VB1 T	32	-24.6	37.75	54	-16.25	-	-	41	358	V

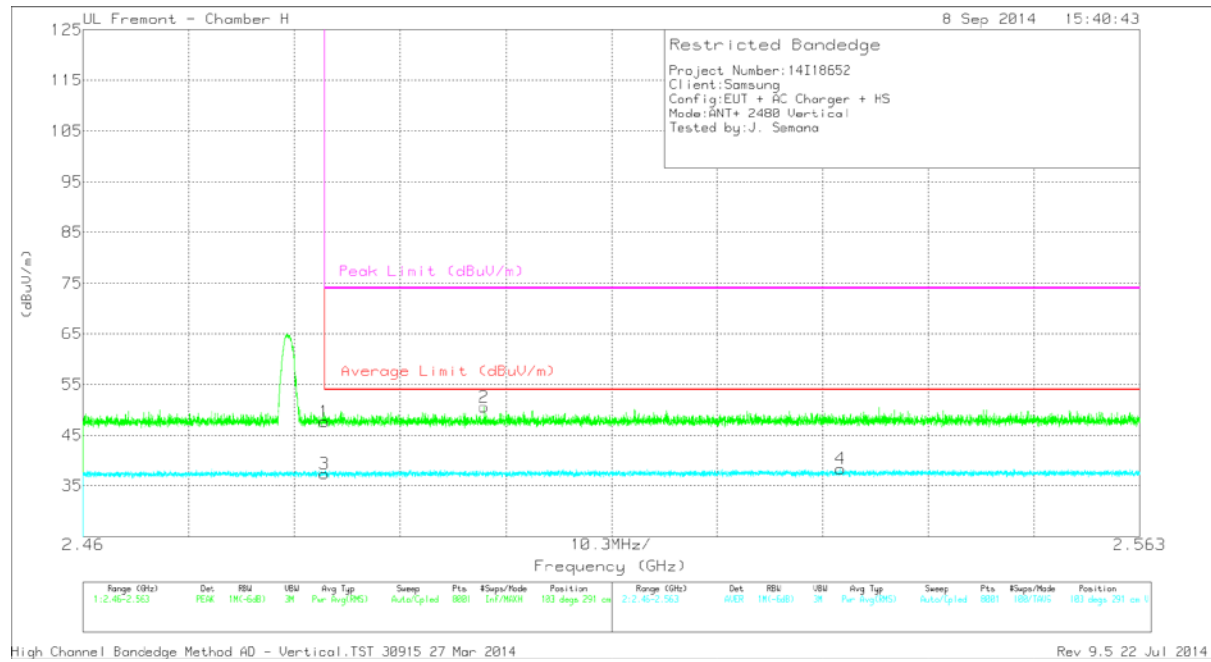
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



Trace Markers

Marker	Frequen cy (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Correcte d Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.22	PK	32.2	-24.5	47.92	-	-	74	-26.08	277	113	H
3	* 2.484	29.73	VB1 T	32.2	-24.5	37.43	54	-16.57	-	-	277	113	H
4	* 2.496	30.87	VB1 T	32.2	-24.5	38.57	54	-15.43	-	-	277	113	H
2	2.559	42.53	PK	32.2	-24.3	50.43	-	-	74	-23.57	277	113	H

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Ampl/Cbl/ Filt/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	40	PK	32.2	-24.5	47.7	-	-	74	-26.3	103	291	V
2	* 2.499	42.82	PK	32.2	-24.5	50.52	-	-	74	-23.48	103	291	V
3	* 2.484	29.65	VB1 T	32.2	-24.5	37.35	54	-16.65	-	-	103	291	V
4	2.534	30.55	VB1 T	32.2	-24.4	38.35	54	-15.65	-	-	103	291	V

HARMONICS AND SPURIOUS EMISSIONS ABOVE 1GHz

HARMONICS



FCC, VCCI, CISPR, CE, AUSTEL, NZ
UL, CSA, TUV, BSMI, DHHS, NVLAP

47173 BENICIA STREET, FREMONT, CA 94538, USA

Company: Samsung
EUT Description: GSM/WCDMA + BLUETOOTH & WLAN (2.4 & 5 GHZ) PHONE
Test Configuration: X POSITION
Type of Test: FCC
Mode of Operation: Transmitting : ANT+ mode

Project #: 14I18652
Report #: 14I18652
Date & Time: 09/08/14
Test Engr: Jude Semana

M% = ((t1+t2+t3+...)/T) * 66.83% = 0.24%

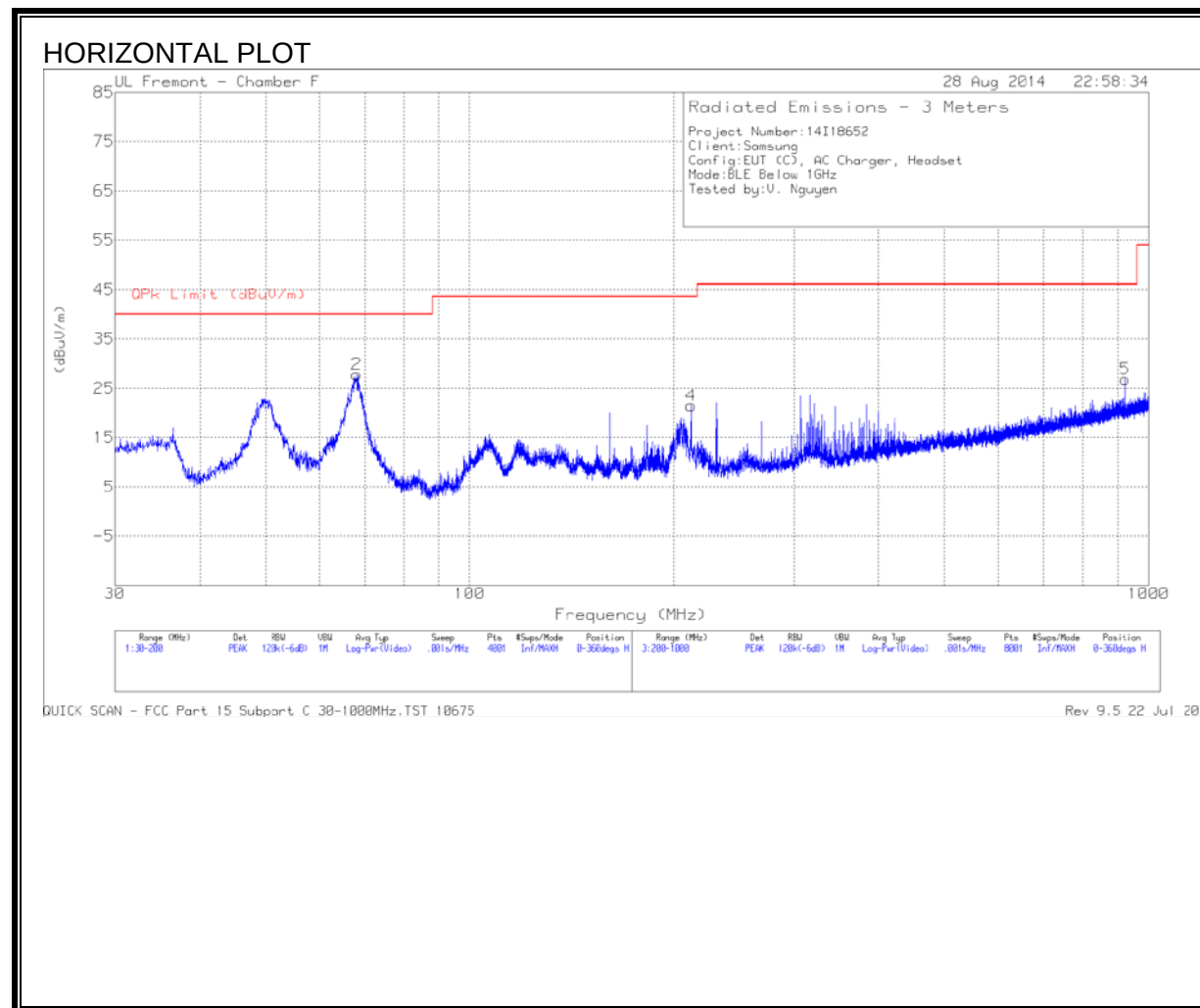
Av Reading = Pk Reading + 20*log(M%)
20 * log (M%) = -52.40

Freq. (MHz)	Pk Rdg (dBuV)	Av Rdg (dBuV)	AF (dB)	Closs (dB)	Pre-amp (dB)	Pk Level (dBuV/m)	Av Level (dBuV/m)	Pk Limit FCC_B	Av Limit FCC_B	Pk Margin (dB)	Avg Margin (dB)	Pol (H/V)	Az (Deg)	Height (Meter)
Low channel														
4804.00	39.49	32.58	32.10	-31.00	0.00	40.59	33.68	74.00	54.00	-33.41	-20.32	3mV	0.00	1.00
4804.00	39.10	32.37	32.10	-31.00	0.00	40.20	33.47	74.00	54.00	-33.81	-20.53	3mH	0.00	2.00
Mid channel														
4884.00	37.96	31.78	32.10	-31.00	0.00	39.06	32.88	74.00	54.00	-34.94	-21.12	3mV	0.00	1.00
4884.00	38.97	31.99	32.10	-31.00	0.00	40.07	33.09	74.00	54.00	-33.93	-20.91	3mH	0.00	2.00
High channel														
4960.00	39.28	32.65	32.10	-31.00	0.00	40.38	33.75	74.00	54.00	-33.62	-20.25	3mV	0.00	1.00
4960.00	39.03	32.41	32.10	-31.00	0.00	40.13	33.51	74.00	54.00	-33.88	-20.49	3mH	0.00	2.00

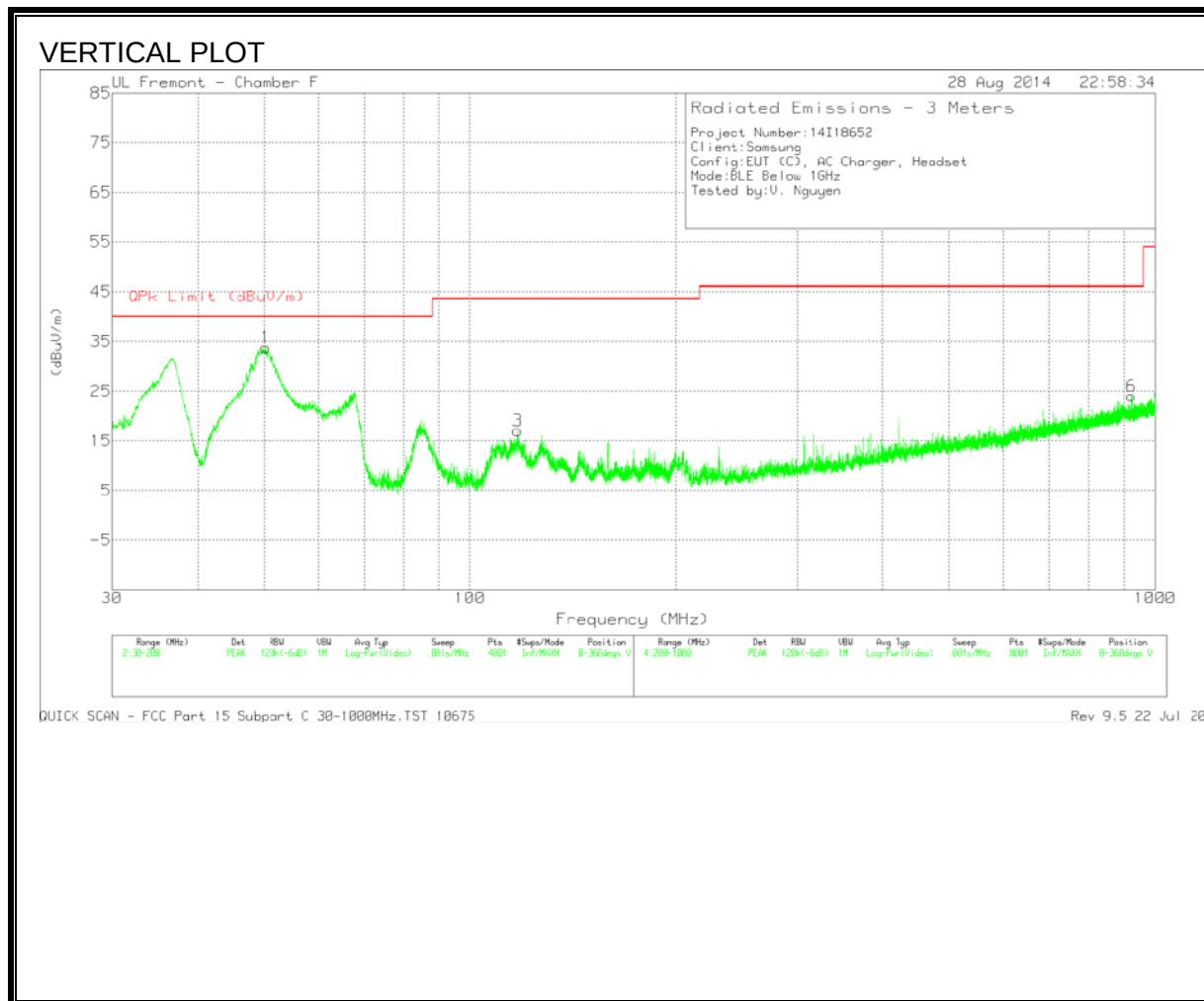
AVG VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

7.2.4. SPURIOUS BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (HORIZONTAL)



SPURIOUS EMISSIONS 30 TO 1000 MHz (VERTICAL)



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	68.1225	51.3	PK	8.1	-31.6	0	27.8	40	-12.2	0-360	100	H
1	50.23	57.62	PK	8	-31.8	0	33.82	40	-6.18	0-360	100	V
3	* 117.2525	34.77	PK	13.8	-31.5	0	17.07	43.52	-26.45	0-360	100	V
4	211.7	42.08	PK	10.5	-31.1	0	21.48	43.52	-22.04	0-360	100	H
5	923.8	32.84	PK	22.4	-28.4	0	26.84	46.02	-19.18	0-360	100	H
6	923.8	29.99	PK	22.4	-28.4	0	23.99	46.02	-22.03	0-360	100	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 117.1925	27.67	QP	13.8	-31.5	0	9.97	43.52	-33.55	148	108	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

QP - Quasi-Peak detector

8. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

ANSI C63.4 - 2009

RESULTS

6 WORST EMISSIONS

Line-L1 .15 - 30MHz

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin to Limit (dB)	CISPR 22 Class B Avg	Margin to Limit (dB)
1	.1635	44.17	PK	1.2	0	45.37	65.3	-19.93	-	-
2	.1635	30.72	Av	1.2	0	31.92	-	-	55.3	-23.38
3	.3975	52.45	PK	.4	0	52.85	57.9	-5.05	-	-
4	.3975	44.23	Av	.4	0	44.63	-	-	47.9	-3.27
7	.5595	45.13	PK	.3	0	45.43	56	-10.57	-	-
8	.5595	37.71	Av	.3	0	38.01	-	-	46	-7.99
5	.7935	45.34	PK	.3	0	45.64	56	-10.36	-	-
6	.7935	24.88	Av	.3	0	25.18	-	-	46	-20.82
9	3.417	41.9	PK	.2	.1	42.2	56	-13.8	-	-
10	3.417	26.63	Av	.2	.1	26.93	-	-	46	-19.07
11	6.9405	39.2	PK	.2	.1	39.5	60	-20.5	-	-
12	6.9405	23.78	Av	.2	.1	24.08	-	-	50	-25.92

Line-L2 .15 - 30MHz

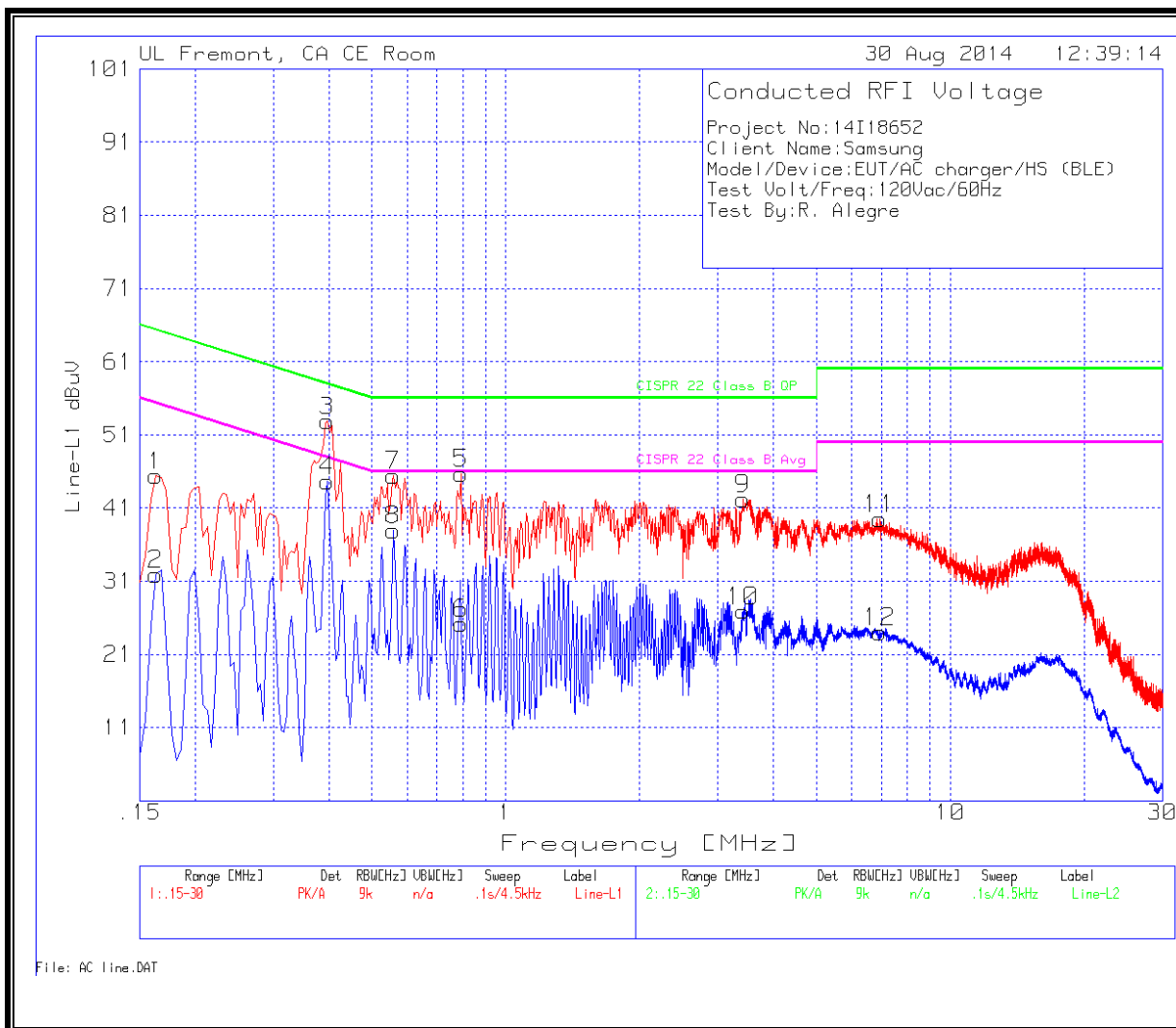
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin to Limit (dB)	CISPR 22 Class B Avg	Margin to Limit (dB)
13	.1725	44.77	PK	1.2	0	45.97	64.8	-18.83	-	-
14	.1725	20.63	Av	1.2	0	21.83	-	-	54.8	-32.97
15	.402	51.86	PK	.4	0	52.26	57.8	-5.54	-	-
16	.402	40.39	Av	.4	0	40.79	-	-	47.8	-7.01
17	.564	43.17	PK	.3	0	43.47	56	-12.53	-	-
18	.564	29.64	Av	.3	0	29.94	-	-	46	-16.06
19	.9375	40.46	PK	.3	0	40.76	56	-15.24	-	-
20	.9375	28	Av	.3	0	28.3	-	-	46	-17.7
21	3.6375	39.64	PK	.2	.1	39.94	56	-16.06	-	-
22	3.6375	18.96	Av	.2	.1	19.26	-	-	46	-26.74
23	5.865	37.46	PK	.2	.1	37.76	60	-22.24	-	-
24	5.865	18.97	Av	.2	.1	19.27	-	-	50	-30.73

PK - Peak detector

Av - average detection

LINE 1 RESULTS



LINE 2 RESULTS

