



**FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8**

CERTIFICATION TEST REPORT

FOR

RF MODULE

MODEL NUMBER: SCWK240

FCC ID: A3LSCWK240

IC ID: 649E-SCWK240

REPORT NUMBER: 14U18038-2 Revision C

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Prepared for

SAMSUNG ELECTRONICS CO., LTD.

416, MAETAN 3-DONG, YEONGTONG-GU

SUWON-CITY, GYEONGGI-DO 443-742, SOUTH KOREA

Prepared by

UL VERIFICATION SERVICES INC.

47173 BENICIA STREET

FREMONT, CA 94538, U.S.A.

TEL: (510) 771-1000

FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	7/7/14	Initial Issue	P. Zhang
A	9/25/14	Added AC line data	P. Zhang
B	10/14/14	Add Industry Canada Standards reference Retested and Revised 99% Bandwidth Data	P. Zhang
C	11/17/14	Add Swept Signal 99% Bandwidth Plot	P. Zhang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: RF MODULE

MODEL: SCWK240

SERIAL NUMBER: 1903671-VS

DATE TESTED: June 24th – July 7th, 2014

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	Pass
INDUSTRY CANADA RSS-210 ISSUE 8	Pass
INDUSTRY CANADA RSS-GEN ISSUE 3	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
CONSUMER TECHNOLOGY DIVISION
PROJECT LEAD
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 C63.10-2009, 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	☐ Chamber D
☒ Chamber B	☐ Chamber E
☐ Chamber C	☐ Chamber F

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 1000 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 DC powered 24 GHz sensor for SMART TV.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak field strength @3m distance as follows:

Frequency Range (GHz)	Mode	Output Power (dBuV/m)
24.075 -24.175	Modulator	96.80

5.3. WORST-CASE CONFIGURATION AND MODE

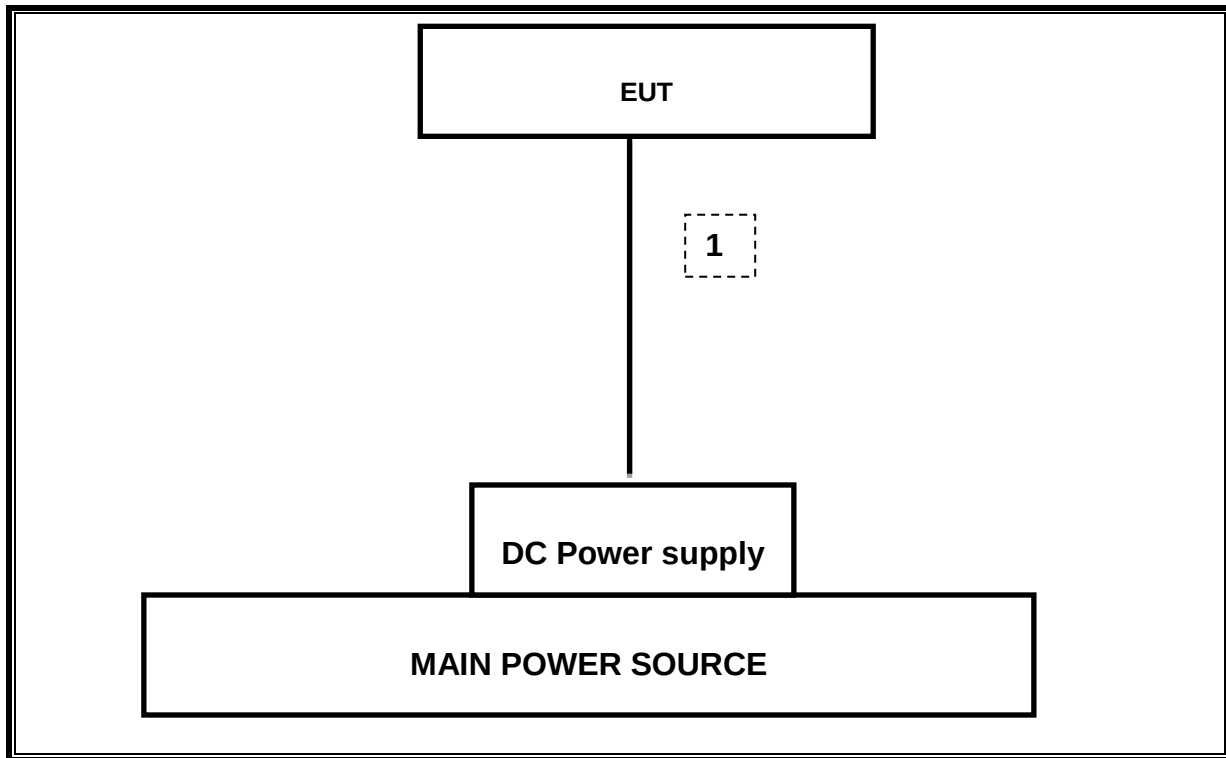
The EUT only has single channel, and it is determined as the worst case configuration and mode was in the Y orientation.

5.4. DESCRIPTION OF TEST SETUP

TEST SETUP

The EUT is placed on the table with power on and continuous Tx and Rx.

SETUP DIAGRAM FOR TESTS



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	JB3	F00168	03/07/15
Antenna, Horn, 1-18GHz	ETS Lindgren	3117	F00131	02/18/15
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/26/14
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	06/28/15
Harmonic Mixer, 110 GHz	Agilent	11970W	C00770	02/13/15
Harmonic Mixer, 140 to 220 GHz	OML	M05HWA	C00867	03/01/16
Harmonic Mixer, 220 to 325 GHz	OML	M03HW/A	C01153	03/01/16
Harmonic Mixer, 50 GHz	Agilent	11970Q	C00769	09/25/14
Harmonic Mixer, 75 GHz	Agilent	11970V	C00768	02/05/15
Harmonic Mixer, 90 to 140 GHz	OML	M08HWA	C00868	03/01/16
RF Amplifier	Sonoma	310	F00008	05/27/15
RF PreAmplifier, 1-18GHz	Miteq	AFS42-00101800-25-S-42	F00353	08/24/14
RF PreAmplifier, 1-26.5GHz	Agilent	8449B	F00165	08/24/14
RF PreAmplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/20/14
Spectrum Analyzer, 40 GHz	Agilent	8564E	C00951	07/29/14
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	F00129	02/22/15
Spectrum Analyzer, PXA, 3Hz to 50GHz	Agilent	N9030A	F00112	01/21/15

7. DUTY CYCLE

7.1. ON TIME AND DUTY CYCLE RESULTS

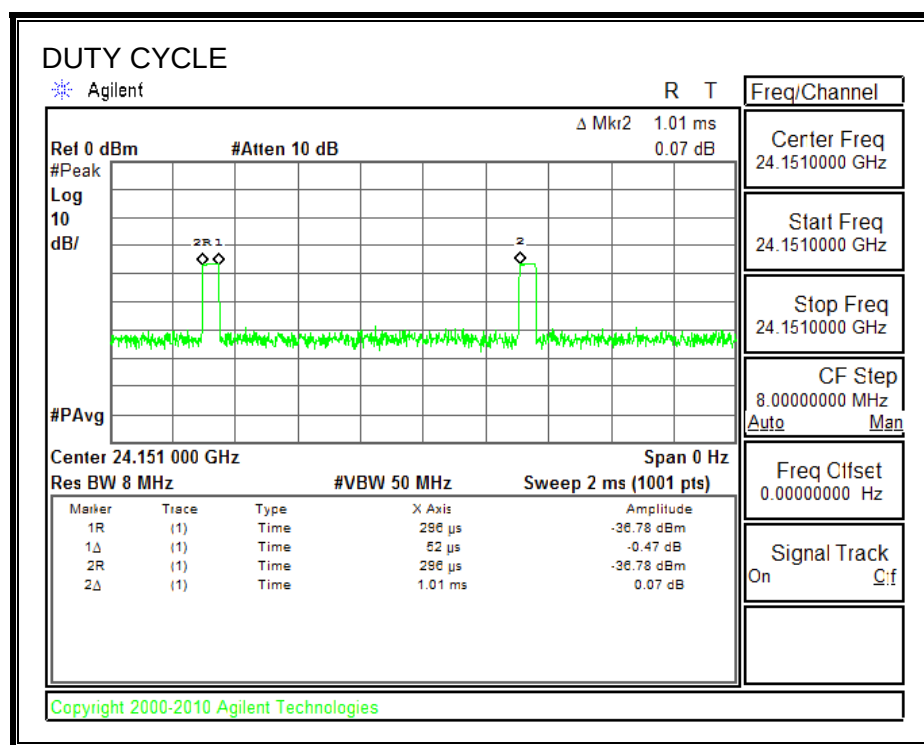
LIMITS

None; for reporting purposes only.

RESULTS

Tx on (usec)	Tx on + Tx off (usec)	Duty Cycle (%)	Correction Factor (dB)
52	1010	5.15	12.88

7.2. DUTY CYCLE PLOT



8. ANTENNA PORT TEST RESULTS

8.1. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

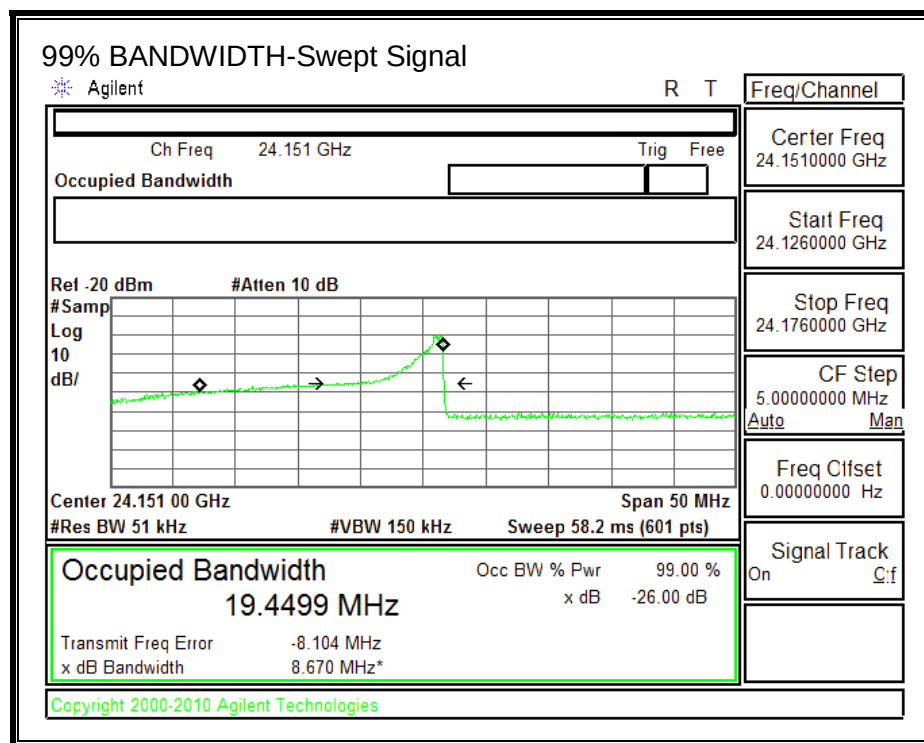
TEST PROCEDURE

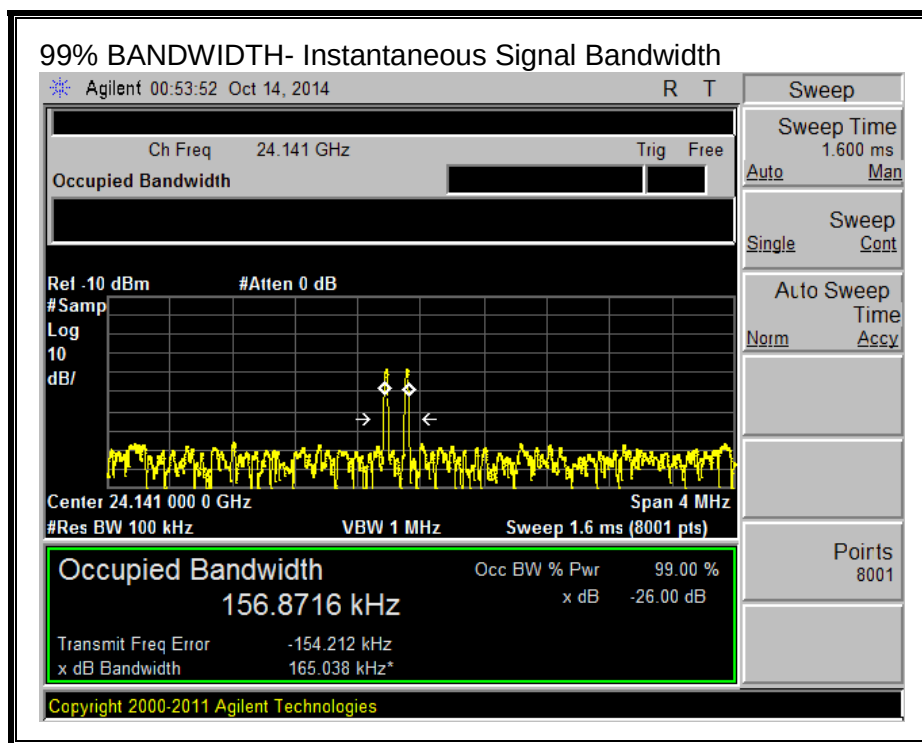
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Frequency (GHz)	99% Bandwidth (MHz)
24.151	19.4499

99% BANDWIDTH





9. RADIATED EMISSION TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMIT

§15.245

RSS 210 Annex 7 (1)

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Limits for radiated disturbance of an intentional radiator		
Fundamental Frequency (MHz)	Field Strength of fundamental (millivolts / meter)	Field Strength of harmonic (millivolts / meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25
24075-24175	2500	25

§15.245 (1) Radiated emissions in the restricted bands below 17.7 GHz, as specified in **§15.205**, shall not exceed the general limits in §15.209.

RSS 210 Annex 7 (2) Additionally, harmonic emissions falling into a restricted band of RSS-Gen and below 17.7 GHz shall meet the general field strength limits of RSS-Gen.

Those falling into restricted bands above 17.7 GHz shall not exceed the following field strength limits measured at a distance of 3 metres:

- (i) 25 mV/m for the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for devices designed for use only within buildings or for intermittent use, such as to open building doors;
- (ii) 7.5 mV/m for all other devices.

RSS 210 Annex 7 (3) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands of RSS-Gen, other than the second and third harmonics from devices operating in the band 24075-24175 MHz, comply with the general field strength limits specified in RSS-Gen. Continuous operation of field disturbance sensors designed to be used in farm equipment (i.e. vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations), or railroad locomotives, railroad cars, and other equipment which travels on fixed tracks, is permitted. A field disturbance sensor is considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g. putting a vehicle into reverse gear, activating a turn signal, etc.).

§15.245 (1) (ii) The second and third harmonics emissions shall not be exceed 7.5mV/m equivalent to 77.5dBuV/m at a distance of 3 meters.

RSS 210 Annex 7 (3) 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 field strength limits specified in RSS-Gen, whichever is less stringent.

§15.245 (3) Radiated emissions 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 limit in §15.209, whichever is the lesser attenuation.

TEST PROCEDURE

ANSI C63.4

The EUT is an intentional radiator that incorporates a digital device, the highest fundamental frequency generated or used in the device is 24.150 GHz; therefore, the frequency range was investigated from 30 MHz to the 5th harmonic of the highest fundamental frequency, or 100GHz, whichever is lower.

PROCEDURE FOR 30 MHz TO 40 GHz

Measurements are made with the antenna feeding a spectrum analyzer via a preamplifier and cables.

PROCEDURE FOR 40 TO 100 GHz

External harmonic mixers are utilized.

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations, at a maximum distance of 10 cm from the EUT.

A final test is made at any frequencies at which emissions are found. During this final scan, the antenna is kept no further from the EUT than the maximum distance calculated for each mixer band that yields a minimum system noise floor at least 6 dB below the spurious emissions limit.

RESULTS

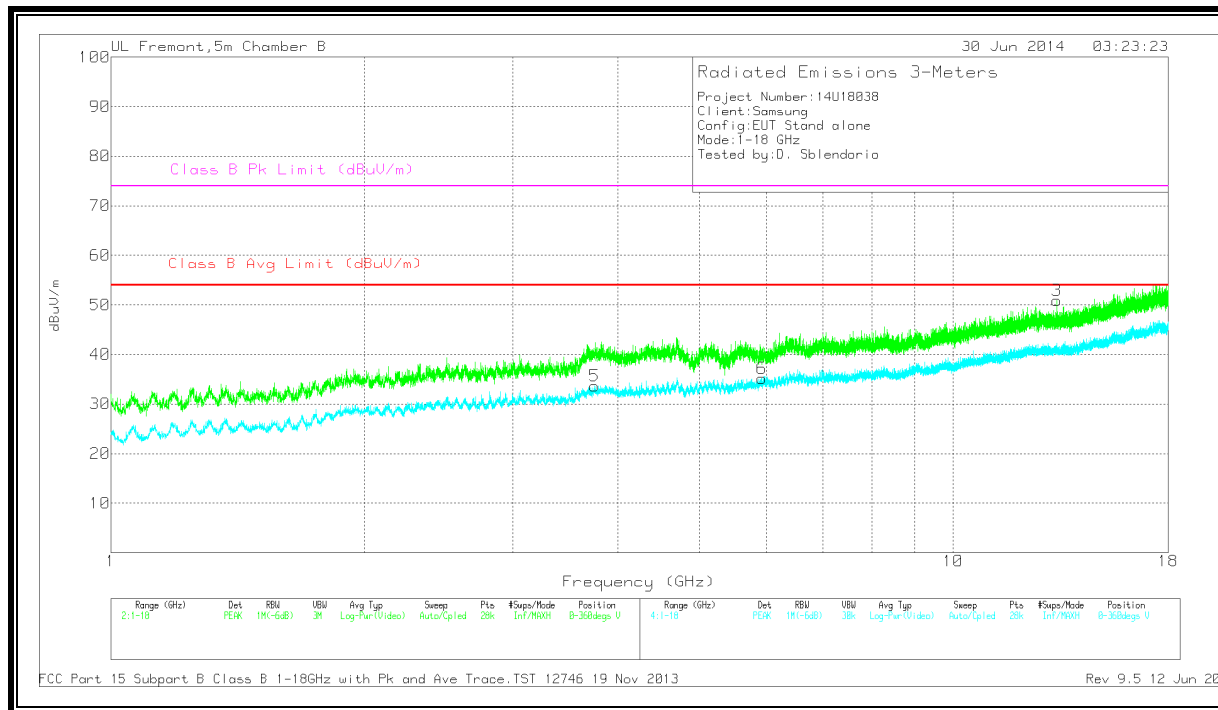
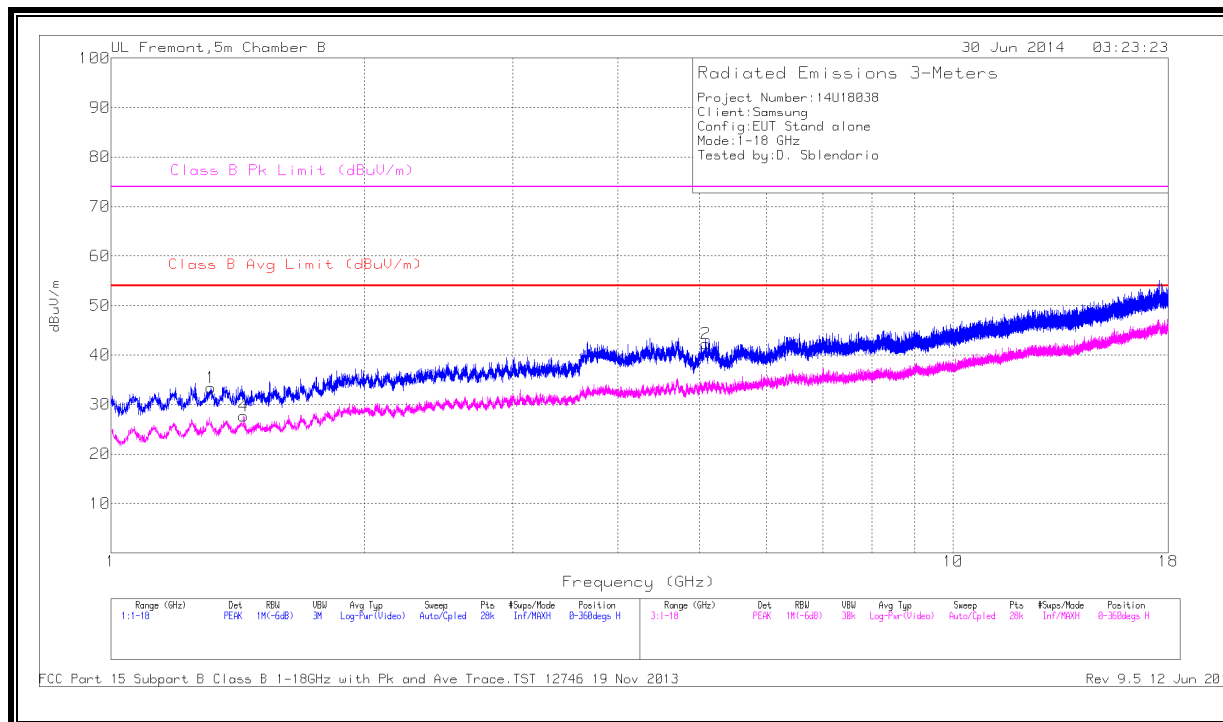
9.2. FUNDAMENTAL RADIATED EMISSION

Company: Samsung Project #: Date: 6/24/2014 Test Engineer: Charles Configuration: EUT Alone Mode: TX											
Freq. GHz	Distance (m)	Read Pk dBuV	Ant factor	CL dB	D Factor dB	Peak dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Pol (V/H)
X Position											
24.149	1.0	95.6	33.6	-22.9	-9.5	96.8	148.0	128.0	-51.2	-31.2	H
24.149	1.0	80.0	33.6	-22.9	-9.5	81.1	148.0	128.0	-66.9	-46.9	V
Y Position											
24.149	1.0	80.0	33.6	-22.9	-9.5	81.1	148.0	128.0	-66.9	-46.9	H
24.149	1.0	93.0	33.6	-22.9	-9.5	94.1	148.0	128.0	-53.9	-33.9	V

Measurement performed at 1meter and data convert to 3meters

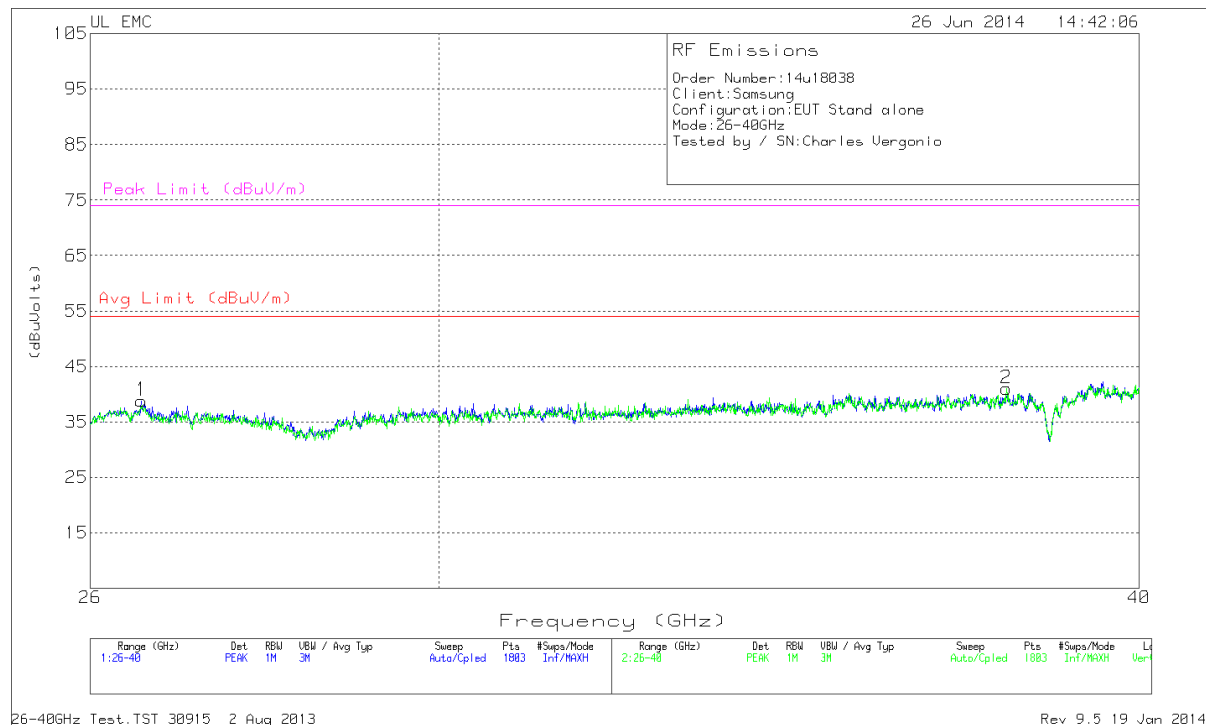
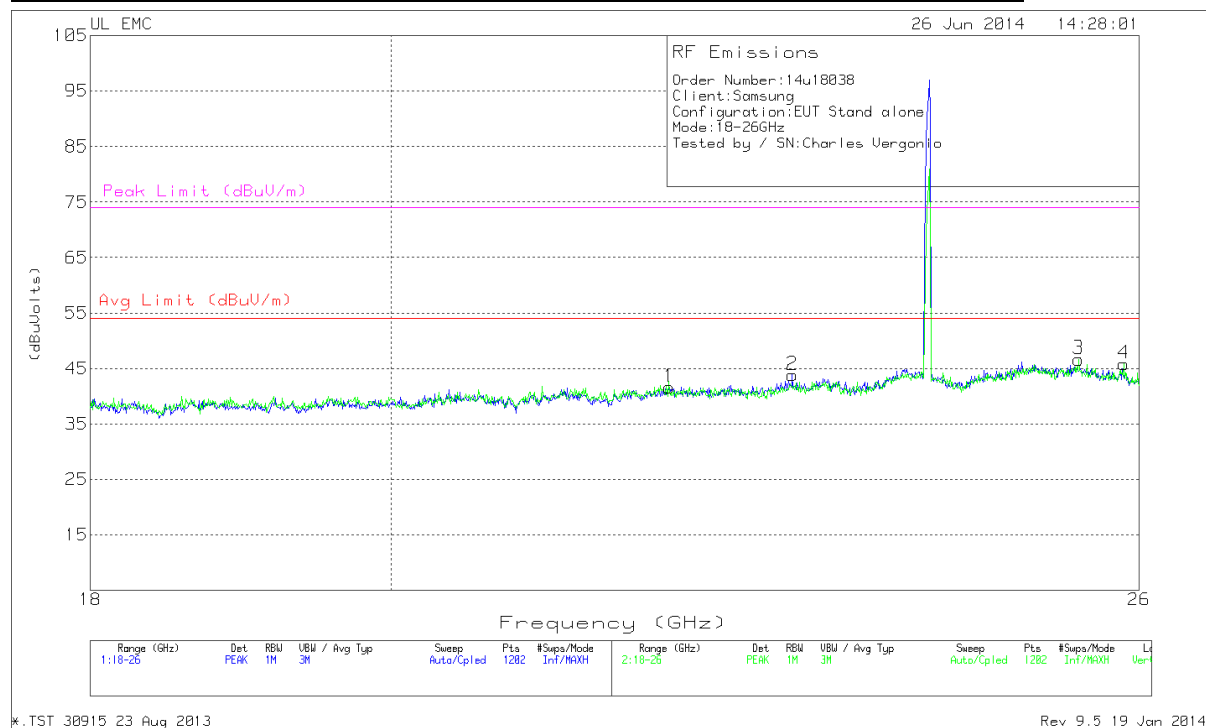
9.3. TX SPURIOUS RADIATED EMISSIONS ABOVE 1GHz

EMISSIONS FROM 1 TO 18GHz AT 3 METER

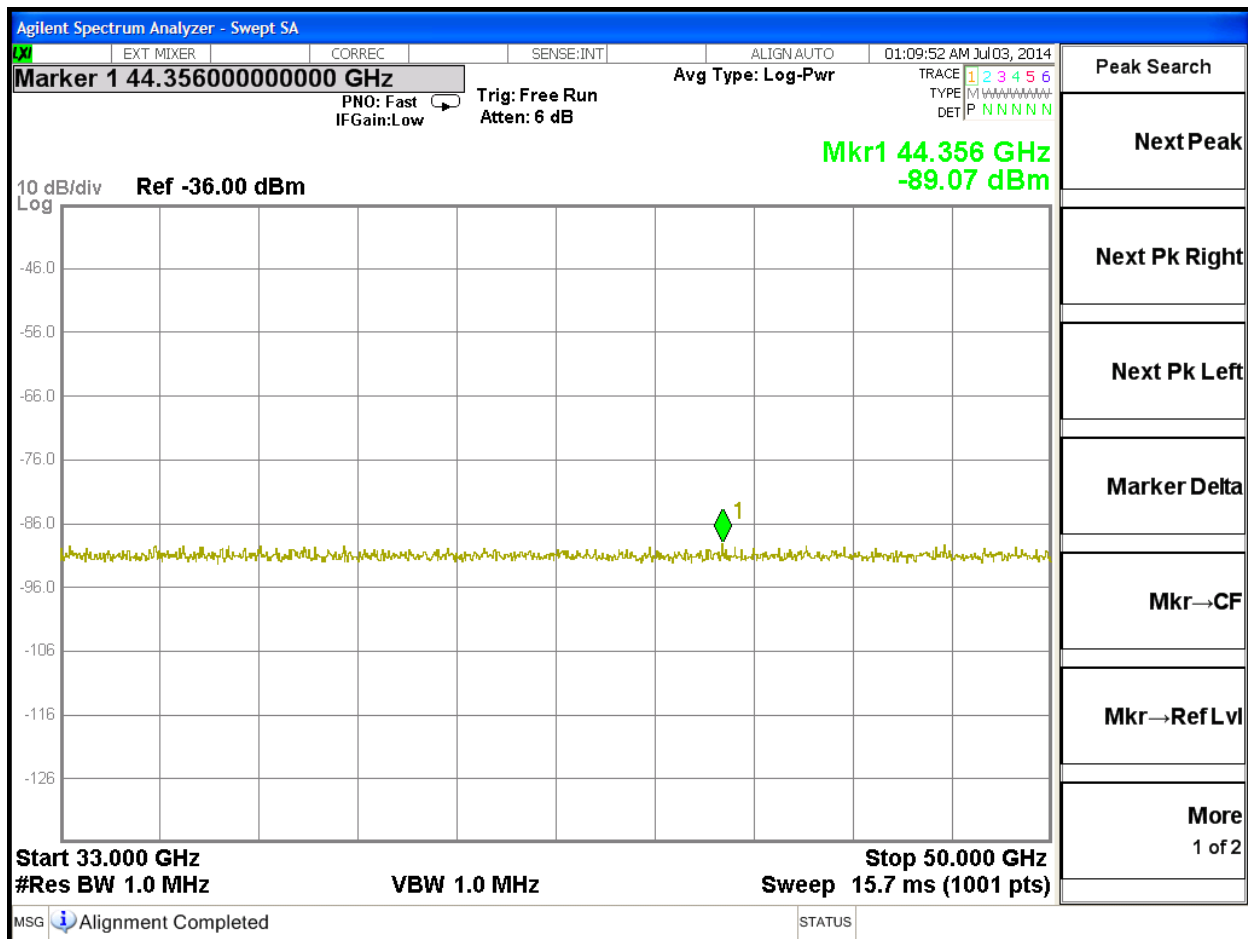


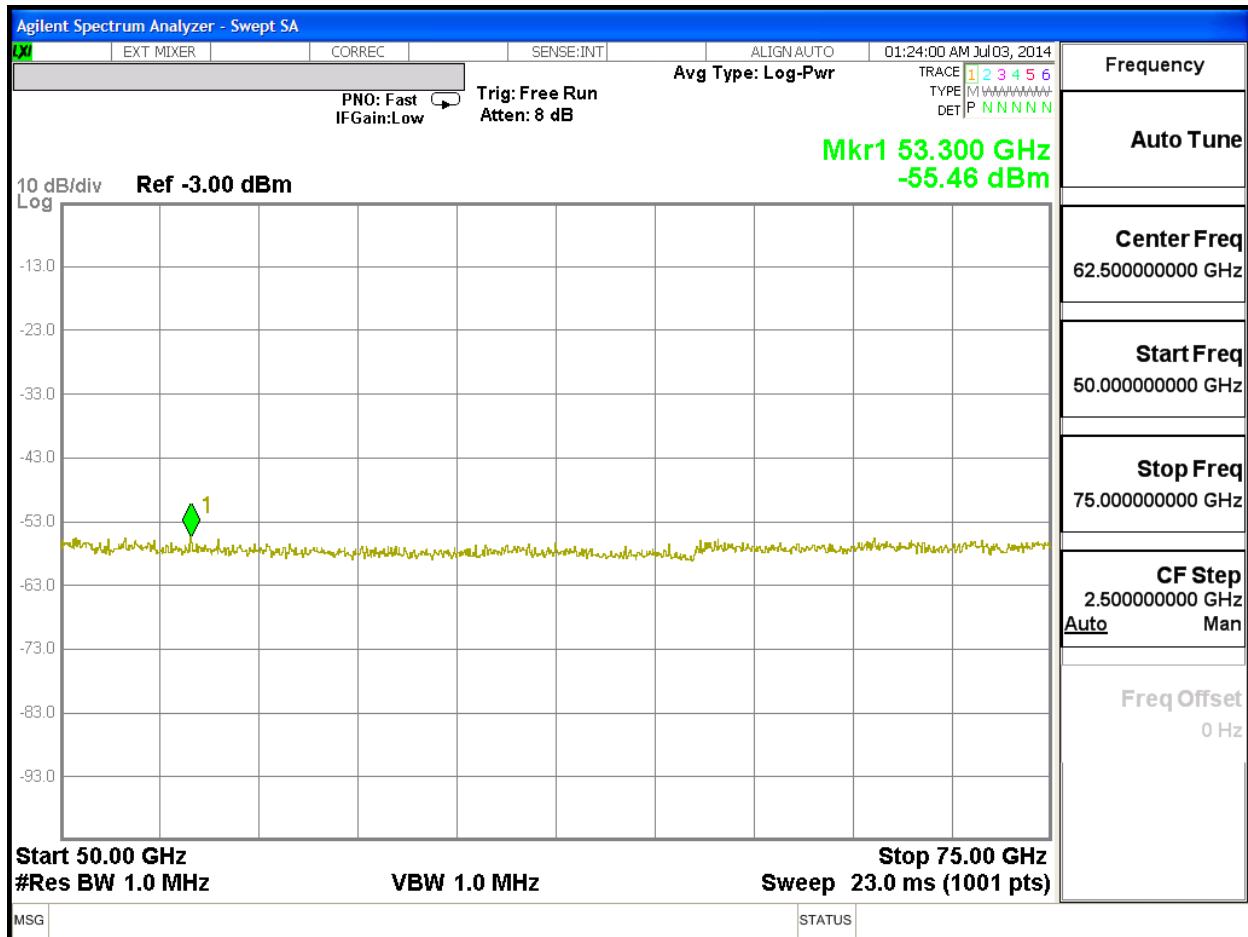
NOTE: there are no emissions found from EUT above the system noise floor level from 1GHz to 18GHz.

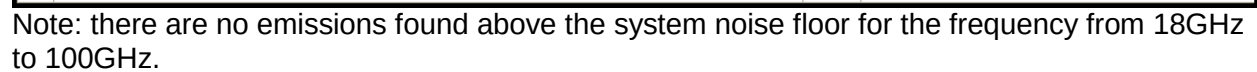
EMISSIONS FROM 18 TO 26 GHz AT 1 METER AND COVERT DATA TO 3 METER



EMISSIONS FROM 33 TO 100 GHz AT 10 CENTIMETER







PEAK MEASUREMENT

Note: The peak density is less than the average limit

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
44.356	0.100	-89.07	20.00	-63.7
EIRP (W)	Specification Distance (m)	Power Density (W/m ²)	Power Density (pW/cm ²)	Limit (pW/cm ²)
4.27E-10	3.0	3.78E-12	0.00	90

field strenght is -18.47 @3meter

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
53.3	0.100	-55.46	20.00	-28.5
EIRP (W)	Specification Distance (m)	Power Density (W/m ²)	Power Density (pW/cm ²)	Limit (pW/cm ²)
1.42E-06	3.0	1.25E-08	1.25	90

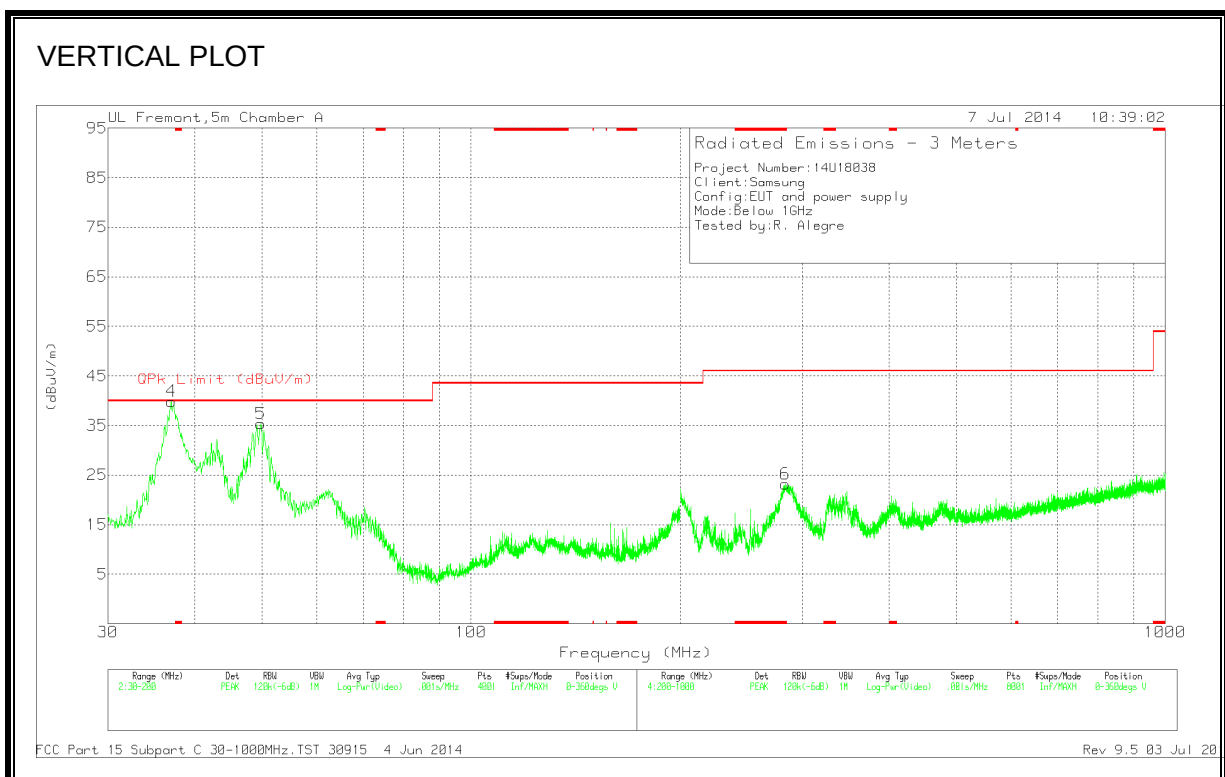
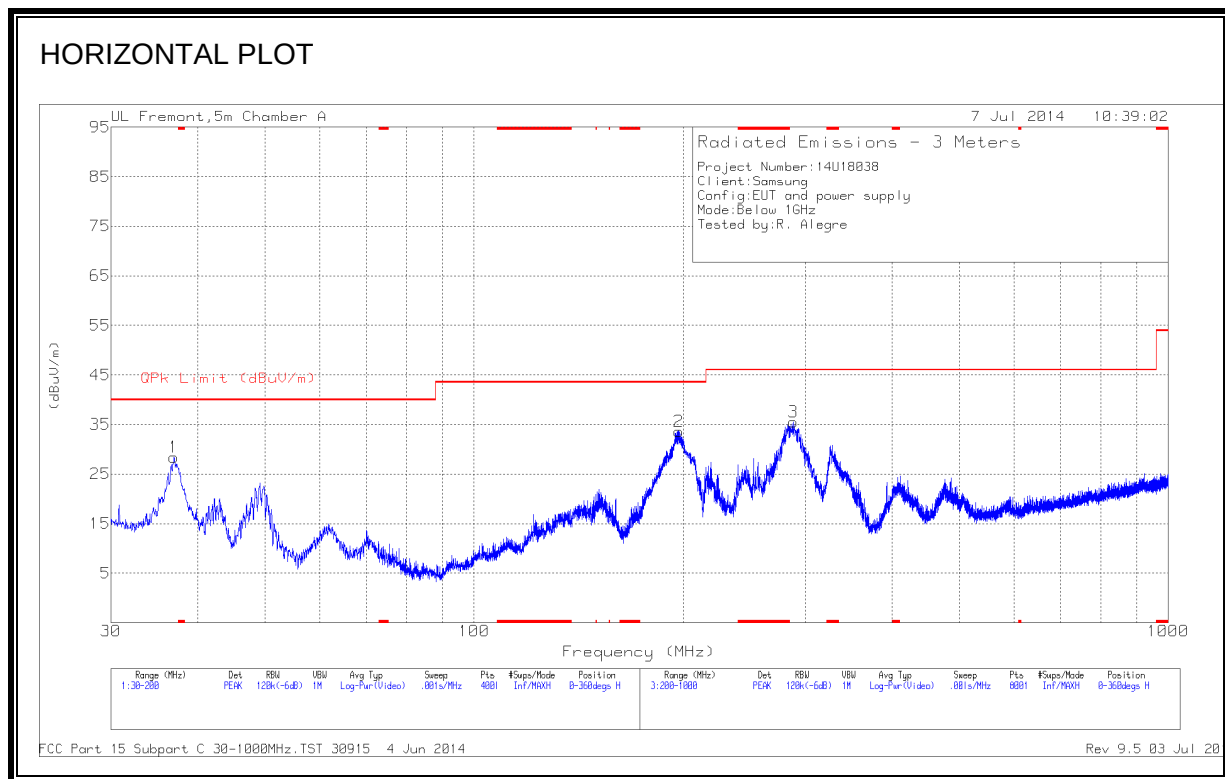
field strenght is 16.73 @3meter

Frequency (GHz)	Measurement Distance (m)	Peak Power (dBm)	Rx Antenna Gain (dBi)	EIRP (dBm)
108.565	0.100	-46.66	23.00	-16.5
EIRP (W)	Specification Distance (m)	Power Density (W/m ²)	Power Density (pW/cm ²)	Limit (pW/cm ²)
2.23E-05	3.0	1.98E-07	19.77	90

field strenght is 28.73 @3meter

Distance factor from 10cm to 3 meter is 50dB

9.4. TX SPURIOUS RADIATED EMISSIONS BELOW 1 GHz



HORIZONTAL AND VERTICAL DATA

Marker	Frequenc y (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Correcte d Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
6	* 283.7	39.23	PK	13.4	-29.4	23.23	46.02	-22.79	0-360	200	V
1	36.97	43.03	PK	16.5	-31.1	28.43	40	-11.57	0-360	200	H
4	37.0125	54.48	PK	16.5	-31.1	39.88	40	-.12	0-360	101	V
5	49.7625	58.23	PK	8.1	-30.9	35.43	40	-4.57	0-360	101	V
2	197.45	51.25	PK	12.3	-29.9	33.65	43.52	-9.87	0-360	101	H
3	288.4	51.43	PK	13.3	-29.2	35.53	46.02	-10.49	0-360	101	H

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

Radiated Emissions

Frequen cy (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Correcte d Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
36.8756	51.54	QP	16.6	-31.1	37.04	40	-2.96	299	104	V

* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band
QP - Quasi-Peak detector

10. 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

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 C63.4.

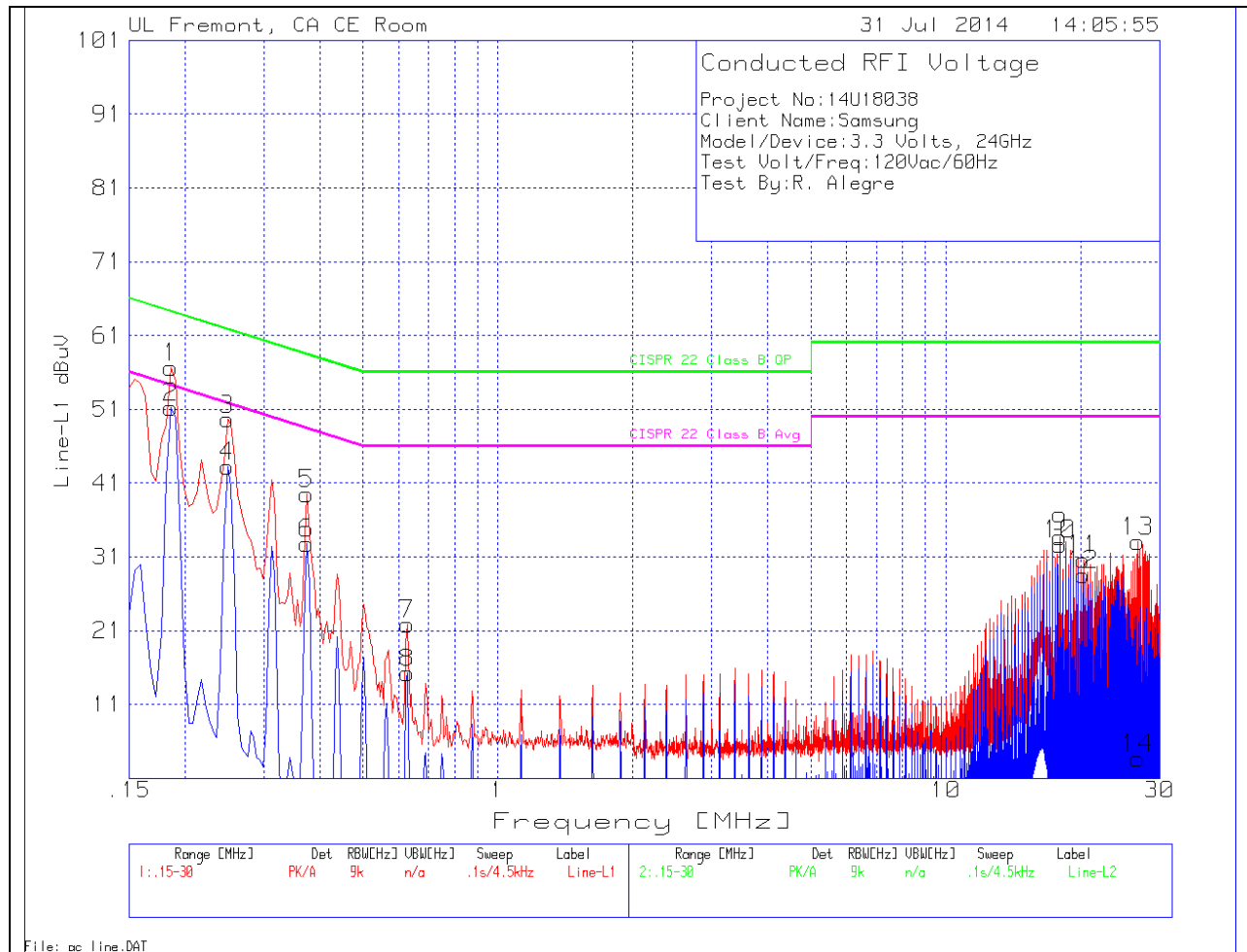
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

6 WORST EMISSIONS

LINE 1 PLOT



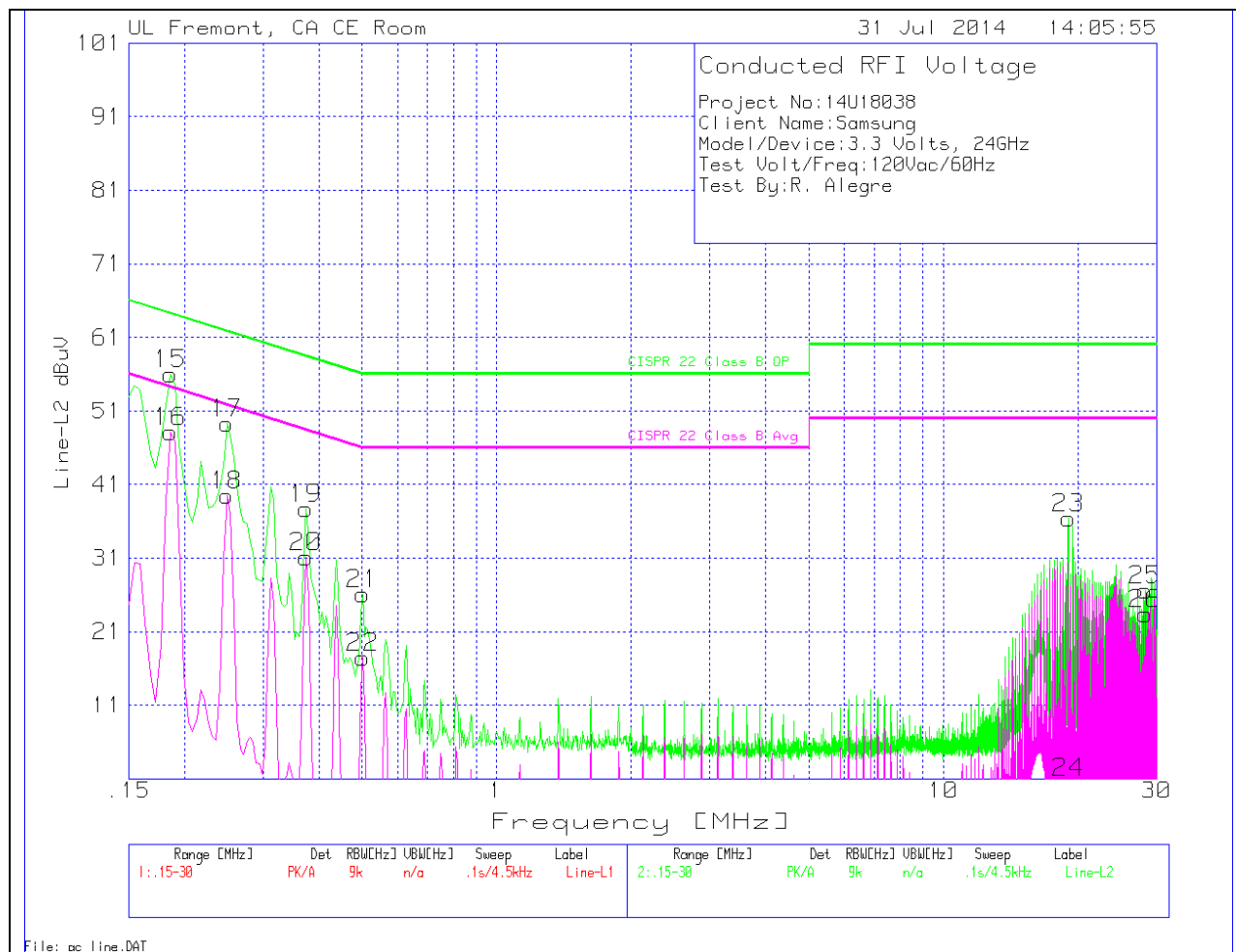
LINE 1 RESULTS

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	.186	55.68	PK	1	0	56.68	64.2	-7.52	-	-
2	.186	50.24	Av	1	0	51.24	-	-	54.2	-2.96
3	.249	48.92	PK	.7	0	49.62	61.8	-12.18	-	-
4	.249	42.49	Av	.7	0	43.19	-	-	51.8	-8.61
5	.375	39.06	PK	.4	0	39.46	58.4	-18.94	-	-
6	.375	32.38	Av	.4	0	32.78	-	-	48.4	-15.62
7	.627	21.52	PK	.3	0	21.82	56	-34.18	-	-
8	.627	14.91	Av	.3	0	15.21	-	-	46	-30.79
9	18.006	33.26	PK	.3	.2	33.76	60	-26.24	-	-
10	18.006	32.12	Av	.3	.2	32.62	-	-	50	-17.38
11	20.256	30.08	PK	.3	.2	30.58	60	-29.42	-	-
12	20.256	28.03	Av	.3	.2	28.53	-	-	50	-21.47
13	26.8125	32.44	PK	.3	.3	33.04	60	-26.96	-	-
14	26.8125	3.01	Av	.3	.3	3.61	-	-	50	-46.39

LINE 2 PLOT



LINE 2 RESULTS

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)
15	.186	54.91	PK	1.1	0	56.01	64.2	-8.19	-	-
16	.186	47.07	Av	1.1	0	48.17	-	-	54.2	-6.03
17	.249	48.58	PK	.7	0	49.28	61.8	-12.52	-	-
18	.249	38.83	Av	.7	0	39.53	-	-	51.8	-12.27
19	.375	37.25	PK	.5	0	37.75	58.4	-20.65	-	-
20	.375	30.58	Av	.5	0	31.08	-	-	48.4	-17.32
21	.501	25.65	PK	.4	0	26.05	56	-29.95	-	-
22	.501	17.01	Av	.4	0	17.41	-	-	46	-28.59
23	19.086	35.95	PK	.3	.2	36.45	60	-23.55	-	-
24	19.086	-.05	Av	.3	.2	.45	-	-	50	-49.55
25	28.257	25.98	PK	.3	.3	26.58	60	-33.42	-	-
26	28.257	22.77	Av	.3	.3	23.37	-	-	50	-26.63

PK - Peak detector

Av - average detection