

EMC Test Report

Application for Grant of Equipment Authorization

FCC Part 15 Subpart C

Model: HR54-200

FCC ID: A3LHR54200

APPLICANT: Samsung Electronics Co., Ltd.
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IC SITE REGISTRATION #: 2845B-3; 2845B-4, 2845B-5, 2845B-7

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	July 15, 2015	Initial release	
1	August 27, 2015	Revised to correct length of A/V cable listed on page 9, tests for which an HP 8563E analyzer was used, EIRP value for b/g modes, results for both chains for 802.11b mode, note about chain used for signal bandwidth tests, notation of method used for testing on pages 55 and 56 and added notes about change in disk drive on pages 67, 71 and 76	dwb
2	September 17, 2015	Revised for new test data for WiFi with higher powers	dwb
3	September 21, 2015	Revised to correct EIRP value on page 6 and add note about measurement method on pages 52-55	dwb
4	October 8, 2015	Revised to add band edge test data for channels 2 and 10	dwb
5	October 9, 2015	clarified notes for g mode band edge measurements.	dwb

TABLE OF CONTENTS

REVISION HISTORY	2
TABLE OF CONTENTS	3
SCOPE.....	4
OBJECTIVE	4
STATEMENT OF COMPLIANCE.....	5
DEVIATIONS FROM THE STANDARDS.....	5
TEST RESULTS SUMMARY	6
DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHZ)	6
GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS.....	6
MEASUREMENT UNCERTAINTIES.....	7
EQUIPMENT UNDER TEST (EUT) DETAILS.....	8
GENERAL.....	8
OTHER EUT DETAILS.....	8
ENCLOSURE.....	8
MODIFICATIONS.....	8
SUPPORT EQUIPMENT.....	8
EUT INTERFACE PORTS	9
EUT OPERATION	10
TEST SITE.....	11
GENERAL INFORMATION.....	11
CONDUCTED EMISSIONS CONSIDERATIONS	11
RADIATED EMISSIONS CONSIDERATIONS	11
MEASUREMENT INSTRUMENTATION	12
RECEIVER SYSTEM	12
INSTRUMENT CONTROL COMPUTER	12
LINE IMPEDANCE STABILIZATION NETWORK (LISN).....	12
FILTERS/ATTENUATORS	13
ANTENNAS.....	13
ANTENNA MAST AND EQUIPMENT TURNABLE.....	13
INSTRUMENT CALIBRATION.....	13
TEST PROCEDURES	14
EUT AND CABLE PLACEMENT	14
CONDUCTED EMISSIONS.....	14
RADIATED EMISSIONS.....	15
CONDUCTED EMISSIONS FROM ANTENNA PORT	18
BANDWIDTH MEASUREMENTS	18
SPECIFICATION LIMITS AND SAMPLE CALCULATIONS.....	19
CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(A), RSS GEN	19
GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS	20
OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS	20
TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS AND DTS SYSTEMS.....	20
SAMPLE CALCULATIONS - RADIATED EMISSIONS.....	21
SAMPLE CALCULATIONS - CONDUCTED EMISSIONS	21
SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION.....	22
APPENDIX A TEST EQUIPMENT CALIBRATION DATA	23
APPENDIX B TEST DATA	25
END OF REPORT	118

SCOPE

An electromagnetic emissions test has been performed on the Samsung Electronics Co., Ltd. model HR54-200, pursuant to the following rules:

FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems - Silicon Valley test procedures:

ANSI C63.10-2009

FCC DTS Measurement Guidance KDB558074

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested samples of Samsung Electronics Co., Ltd. model HR54-200 complied with the requirements of the following regulations:

FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Samsung Electronics Co., Ltd. model HR54-200 and therefore apply only to the tested samples. The samples were selected and prepared by Cho Minhyung of Samsung Electronics Co., Ltd..

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)		Digital Modulation	Systems uses OFDM / DSSS / GFSK modulations	System must utilize a digital transmission technology	Complies
15.247 (a) (2)		6dB Bandwidth	RF4CE: 1.56 MHz All Modes: 8.07 MHz	>500kHz	Complies
15.247 (b) (3)		Output Power (multipoint systems)	RF4CE: 1.5 dBm 802.11b: 23.4 dBm 802.11g: 22.3 dBm 802.11n20: 25.4 dBm 802.11n40: 19.8 dBm Max EIRP: 0.710 W ^{Note 1}	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)		Power Spectral Density	RF4CE: -6.6 dBm/30kHz 802.11b: 7.1 dBm/10kHz 802.11g: 2.6 dBm/10kHz 802.11n20: 5.8 dBm/10kHz 802.11n40: -3.0 dBm/10kHz	8dBm/3kHz	Complies
15.247(c)		Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions < -30 dBc	< -30dBc ^{Note 2}	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 25 GHz	53.8 dBμV/m @ 2390.0 MHz (-0.2 dB)	15.207 in restricted bands, all others <-30dBc ^{Note 2}	Complies
Note 1: EIRP calculated using antenna gain of 2.1 or 3.1 dBi for the highest EIRP system. Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antennas are integral to the product	Unique or integral antenna required	Complies
15.207	RSS GEN Table 3	AC Conducted Emissions	42.0 dBμV @ 0.443 MHz (-5.0 dB)	Refer to page 19	Complies
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in separate exhibit and User Manual statements.	Refer to OET 65, FCC Part 1	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dB μ V/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dB μ V	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Samsung Electronics Co., Ltd. model HR54-200 is a set-top DVR that incorporates 802.11abgn Wi-Fi and RF4CE radios. Since the EUT would be placed on a tabletop during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 12V DC, 4.0 Amps. The electrical rating of the AC/DC adapter is 120V, 60Hz, 1.3 Amps.

The samples were received on March 25, 2015 and tested on March 25, 26, 27, April 6, 7, 9, August 14, 18, 20, September 2, 4 and October 7, 2015. The following samples were used for testing:

Company	Model	Description	Serial Number	FCC ID
Samsung Electronics	HR54-200	Settop Box	PV1056150225013	A3LHR54200
Samsung Electronics	HR54-200	Settop Box	PV1056150225002	A3LHR54200
Samsung Electronics	HR54-200	Settop Box	PV1056150225025	A3LHR54200
Samsung Electronics	HR54-200	Settop Box	PV1056150225012	A3LHR54200
DirecTV	EPS44R3-08	AC/DC Adapter	LA44D1505D0297	-

OTHER EUT DETAILS

The following EUT details should be noted: The RF4CE antennas are integral PCB traces (Diversity is employed). The Wi-Fi antennas are N2415-D2 (connected to chain 1) and N2520DS (connected to chain 2).

ENCLOSURE

The EUT enclosure is primarily constructed of plastic with a metal sub chassis. It measures approximately 33.5 cm wide by 25 cm deep by 5.5 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Dynex	DX-LCD19-09	Television	H8984JA055002	-
Memorette	FMR-MEMORTTE(8)	USB Memory Stick	None	-
Sabrent	None	Sata Drive Enclosure	None	-
Lacie	d2 Quadra	Sata Drive Enclosure	16551411120974GH B	-
Changed Sabrent Sata Drive Enclosure to Lacie Sata Drive Enclosure on 3/27/15				

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
DirecTV	P129R1-03	SWM Power Inserter	YG29B1046A6729	-
DirecTV	SWM8R2-03	8 Channel SWM	49001052	-
DirecTV	MSPLIT8R1-03	8-Way Splitter	YG8WB1030C0141	-
Radyme	DM240XR	Satellite Modulator	6382	-
HP	Z600 Workstation	Tower Computer	2UA0170J62	-
HP	KB-0316	Keyboard	BC2AA0FLUVYM3E	-
Genius	NetScroll 120	Mouse	146721101760	-
Samsung	SyncMaster 720N	Display	MJ17H9FM229414V	-
Linksys	BEFSR41	Cable/DSL Router	687F749FC378	-

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Power Input	AC Adapter	2 wire with ferrite	Shielded	0.7
SATA	Sata Drive	Multiwire	Shielded	1.2
USB	USB Memory Stick	4 wire	Shielded	1.2
Ethernet	Remote Switch	Cat 5	Unshielded	7
HDMI	Television	Multiwire with ferrite	Shielded	1.2
Coaxial	Television	Coax	Shielded	1.2
Digital Audio Out	Not connected (optical)	-	-	-
A/V Out	Television	Multiwire	Shielded	1.2
Satellite In	SWM	Coax	Shielded	7
Temporary Serial Programming box	CN1510 connection on PCB	Multiwire	Unshielded	0.3
Temporary Serial Programming box	Laptop	Multiwire	Shielded	1.5

Additional on Support Equipment

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
SWM Adapter	SWM1/PWR	Coax	Shielded	0.4
SWM (x4)	Splitter	Coax	Shielded	0.4
Splitter	Satellite Modulator Out	Coax	Shielded	0.8
Satellite Modulator Ethernet	Workstation Ethernet	Cat 5	Unshielded	1.2
Satellite Modulator Com	Workstation Com	Multiwire	Unshielded	1
Workstation Video	Display	Multiwire with ferrite	Shielded	1.2
Workstation PS/2	Keyboard	Multiwire	Shielded	1.2
Workstation PS/2	Mouse	Multiwire	Shielded	1.2

EUT OPERATION

During emissions testing the EUT was set to transmit continuously on the selected frequency, data rate, bandwidth, number of chains, power level and modulation as noted for each test using the serial port. The image generated by the remote system was displayed on the Television. The Ethernet port was in link state.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 3	US0027	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	US0027	2845B-4	
Chamber 5	US0027	2845B-5	
Chamber 7	US0027	2845B-7	

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.10. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.10 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor as specified in ANSI C63.4. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

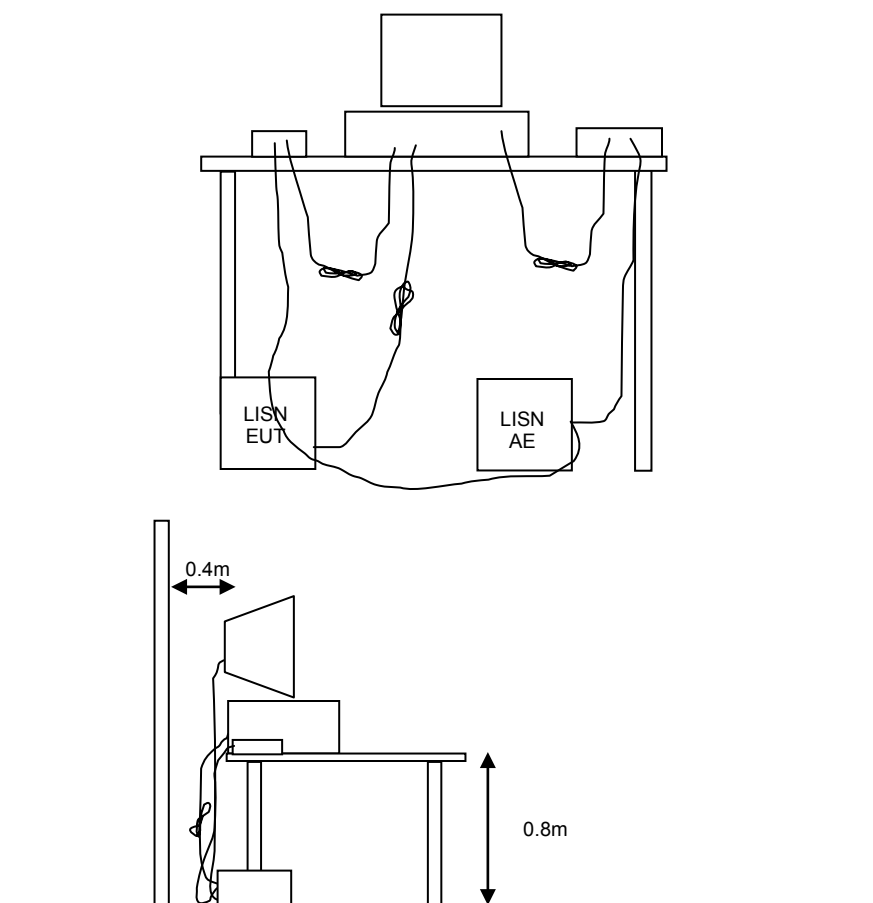


Figure 1 Typical Conducted Emissions Test Configuration

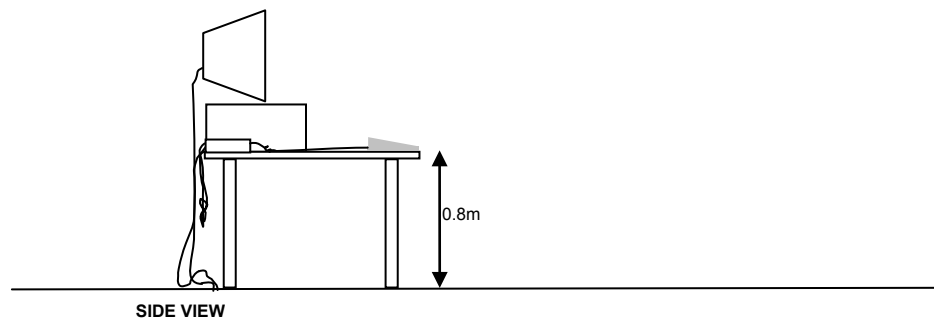
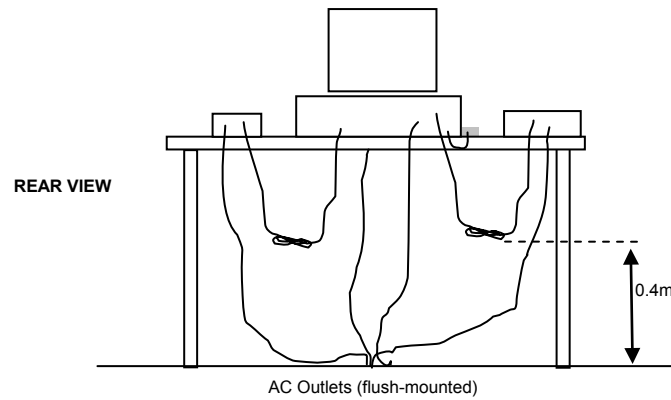
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

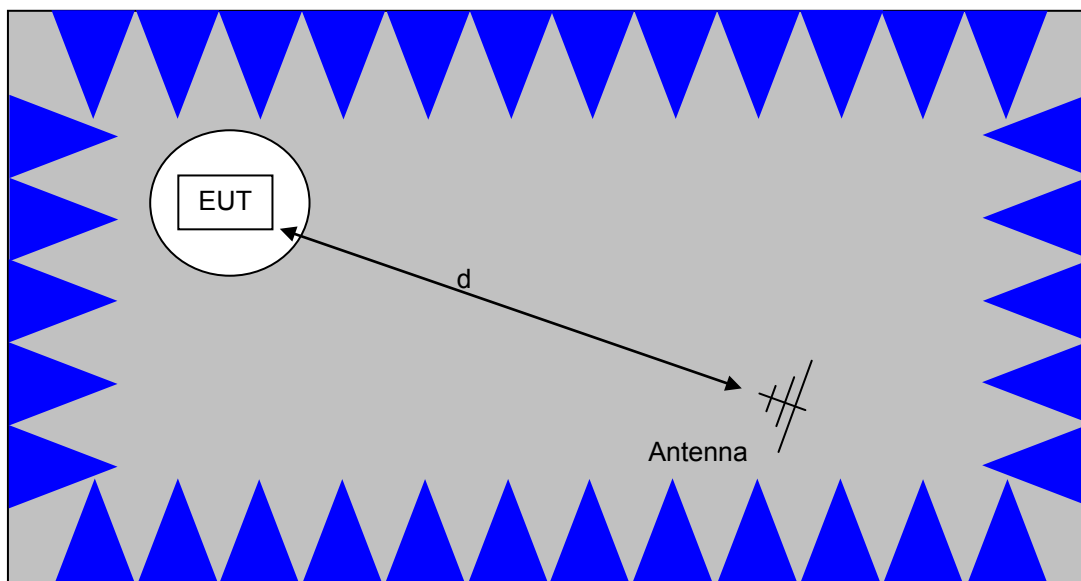
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

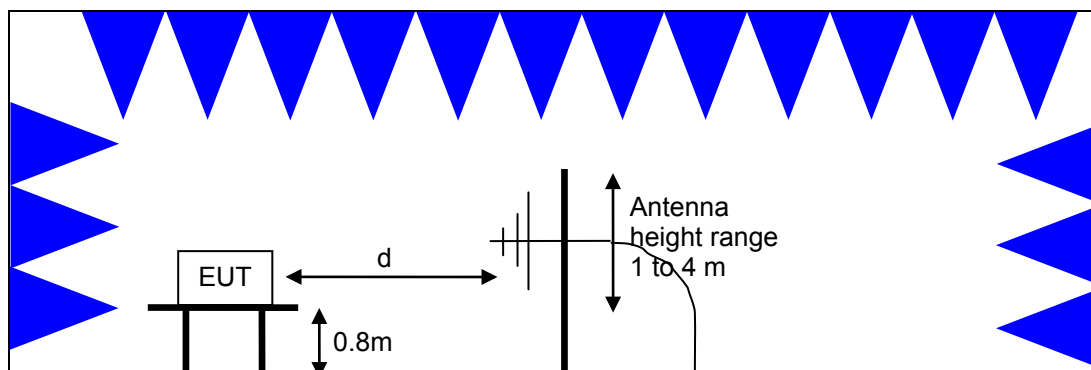


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

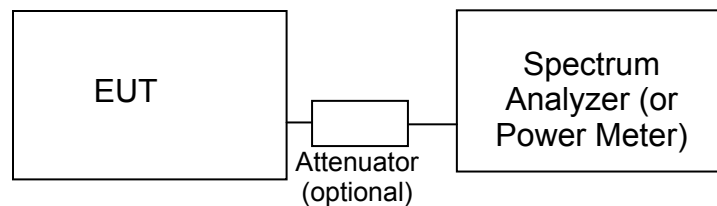
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

**Test Configuration for Antenna Port Measurements**

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Silicon Valley's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹ and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	2400/F _{KHz} @ 300m	67.6-20*log ₁₀ (F _{KHz}) @ 300m
0.490-1.705	24000/F _{KHz} @ 30m	87.6-20*log ₁₀ (F _{KHz}) @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

¹ The restricted bands are detailed in FCC 15.205

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Radiated Emissions (Band Edge), 1,000 - 6,500 MHz, 25-Mar-15					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Radio Antenna Port (Power VS Data Rate), 25-Mar-15					
Agilent Technologies	USB Average Power Sensor	U2001A	2442	12/19/2014	12/19/2015
Radiated Emissions, BE, 30 - 6,000 MHz, 26-Mar-15					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Radiated Emissions, 1,000 - 6000 MHz, 27-Mar-15					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Radiated Emissions, 1,000 - 12,000 MHz, 27-Mar-15					
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/20/2015	2/20/2016
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2014	9/16/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	3/7/2015	3/7/2016
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/20/2013	8/20/2015
Radiated Emissions, 1,000 - 25,000 MHz, 27-Mar-15					
Hewlett Packard	Head (Inc W1-W4, 1946 , 1947) Purple	84125C	1772	1/20/2015	1/20/2016
A. H. Systems	Purple System Horn, 18-40GHz	SAS-574, p/n: 2581	2160	8/11/2014	8/11/2015
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/20/2015	2/20/2016
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2014	9/16/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	3/7/2015	3/7/2016
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/20/2013	8/20/2015
Radio Antenna Port (Power and Spurious Emissions), 07-Apr-15					
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	3/31/2015	3/31/2016
Conducted Emissions - AC Power Ports, 09-Apr-15					
EMCO	LISN, 10 kHz-100 MHz	3825/2	1293	2/13/2014	4/13/2015
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	5/15/2014	5/15/2015
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
Com-Power	9KHz-30MHz, 50uH, 15Aac, 10Adc, max	LI-215A	2671	5/24/2014	5/24/2015

Radiated Emissions, 1,000 - 12,000 MHz, 14&18-Aug-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/31/2014	10/31/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, FT (SA40) Blue	8564E (84125C)	1393	5/2/2015	5/2/2016
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	7/13/2015	7/13/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	1/23/2015	1/23/2016

Radiated Emissions, 1000 - 25000 MHz, 20-Aug-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/31/2014	10/31/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, FT (SA40) Blue	8564E (84125C)	1393	5/2/2015	5/2/2016
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	6/27/2014	6/27/2016
Hewlett Packard	Head (Inc flex cable, (1742,1743) Blue)	84125C	1620	6/5/2015	6/5/2016
A. H. Systems	Red System Horn, 18-40GHz	SAS-574, p/n: 2581	2161	7/16/2015	7/16/2017
Micro-Tronics	Band Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2014	9/16/2015
Micro-Tronics	Band Filter, 5150-5350 MHz	BRC50703-02	2239	9/16/2014	9/16/2015

Radiated Emissions, 30 - 1,000 MHz, 02-Sep-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 G	ESIB7	1630	7/6/2015	7/6/2016
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	2237	8/29/2014	8/29/2016
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	2885	10/22/2014	10/22/2015

Radiated Emissions, 1000 - 40,000 MHz, 02-Sep-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/26/2014	6/26/2016
Micro-Tronics	Band Filter, 5150-5350 MHz	BRC50703-02	1729	7/8/2015	7/8/2016
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	11/14/2014	11/14/2015
Hewlett Packard	Head (Inc 3136 Miteq + cable) Purple		1772	6/19/2015	6/19/2016
A. H. Systems	Spare System Horn, 18-40G	SAS-574	2162	7/29/2015	7/29/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/20/2015	2/20/2016
Micro-Tronics	Band Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2014	9/16/2015

Radio Antenna Port (Power and Spurious Emissions), 04-Sep-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	3/31/2015	3/31/2016

Radiated Emissions, 1000 - 5,000 MHz, 07-Oct-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
EMCO	Antenna, Horn, 1-18GHz	3115	487	7/29/14	7/29/16
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40GHz	ESIB40	2493	1/23/15	1/23/16

Appendix B Test Data

T97510 Pages 26 – 117

Client:	Samsung Electronics	Job Number:	J97349
Product	HR54-200	T-Log Number:	T97510
		Project Manager:	Irene Radamacher
Contact:	Cho Minhyung	Project Coordinator:	
Emissions Standard(s):	FCC 15.247/15.407	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Samsung Electronics

Product

HR54-200

Date of Last Test: 10/7/2015

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Power vs. Data Rate

In normal operating modes the card uses power settings stored on EEPROM to set the output power. For a given nominal output power the actual transmit power normally is reduced as the data rate increases, therefore testing was performed at the data rate in the mode with highest power to determine compliance with the requirements.

The following power measurements were made using a GATED average power meter and with the device configured in a continuous transmit mode on Chain 1 at the various data rates in each mode to verify the highest power mode:

CN3110-A0-Chain 1

CN3210-A1-Chain 2

Sample Notes

Sample S/N: PV1056150225013

Driver: 5.99 RC188.12

Date of Test: 3/25/2015

Test Engineer: Jack Liu

Test Location: FT Chamber#7

Mode	Data Rate	Power (dBm)	Chain	Power setting
802.11b	1	17.9	1	18
	2	17.8	1	
	5.5	17.6	1	
	11	17.7	1	
	worse case rate	17.8	2	
802.11g	6	15.9	1	16
	9	15.8	1	
	12	15.7	1	
	18	15.6	1	
	24	15.7	1	
	36	15.6	1	
	48	15.6	1	
	54	15.5	1	
	worse case rate	15.2	2	

Use highest power for single chain measurements

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

Mode	Data Rate	Power (dBm)	Chain	Power setting
802.11n 20MHz	6.5	17.7	1	18
	13	17.7	1	
	19.5	17.6	1	
	26	17.6	1	
	39	17.5	1	
	52	17.4	1	
	58.5	17.5	1	
	65	17.5	1	
	worse case rate	17.5	2	

Mode	Data Rate	Power (dBm)	Chain	Power setting
802.11n 40MHz	13.5	15.4	1	16
	27	15.3	1	
	40.5	15.0	1	
	54	14.9	1	
	81	14.8	1	
	108	14.7	1	
	121.5	14.7	1	
	135	14.6	1	
	worse case rate	14.9	2	

Note : Power setting - the software power setting used during testing, included for reference only.

RF4CE has only one rate

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements MIMO and Smart Antenna Systems Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 22.7 °C
Rel. Humidity: 34 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1Tx Modes						
1			Output Power	15.247(b)	Pass	23.4 dBm
2			Power spectral Density (PSD)	15.247(d)	Pass	7.1 dBm/10kHz
2Tx Modes						
1			Output Power	15.247(b)	Pass	25.4 dBm
2			Power spectral Density (PSD)	15.247(d)	Pass	5.8 dBm/10kHz
All Modes						
3			Minimum 6dB Bandwidth	15.247(a)	Pass	8.07 MHz
3			99% Bandwidth	RSS GEN	-	35.3 MHz
4			Spurious emissions	15.247(b)	Pass	Signals all below -30dBc

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	0.94	Yes	144	0.3	0.6	7
11a/g	6 Mbps	0.99	Yes	103.55	0	0	10
n20	MCS 0	0.99	Yes	95.85	0	0	10
n40	MCS 0	0.99	Yes	94.3	0	0	10

Sample Notes

Sample S/N: PV1056150225013 & PV1056150225002

Driver: 5.99 RC188.12

Antenna Gain Information

Freq	Antenna Gain (dBi) / Chain				BF	MultiChain Legacy	CDD	Sectorized / Xpol	Dir G (PWR)	Dir G (PSD)
	1	2	3	4						
2.4 GHz	2.1	3.1			No	No	Yes	No	3.1	6.1

For devices that support CDD modes

Min # of spatial streams: 1

Max # of spatial streams: 2

Notes:	BF = beamforming mode supported, Multichain Legacy = 802.11 legacy data rates supported for multichain transmissions, CDD = Cyclic Delay Diversity (or Cyclic Shift Diversity) modes supported, Sectorized / Xpol = antennas are sectorized or cross polarized
Notes:	Dir G (PWR) = total gain (Gant + Array Gain) for power calculations; Dir G (PSD) = total gain for PSD calculations based on FCC KDB 662911. Depending on the modes supported, the Array Gain value for power could be different from the PSD value.
Notes:	Array gain for power/psd calculated per KDB 662911 D01, v01r02.

Notes

For 802.11b and g, testing performed on the worse case chain 1 (highest power) based on preliminary measurements.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Output Power

Date of Test: 9/4/2015

Test Engineer: Rafael Varelas

Test Location: FT Lab#4B

Config. Used: 1

Config Change: none

EUT Voltage: 120V/60Hz

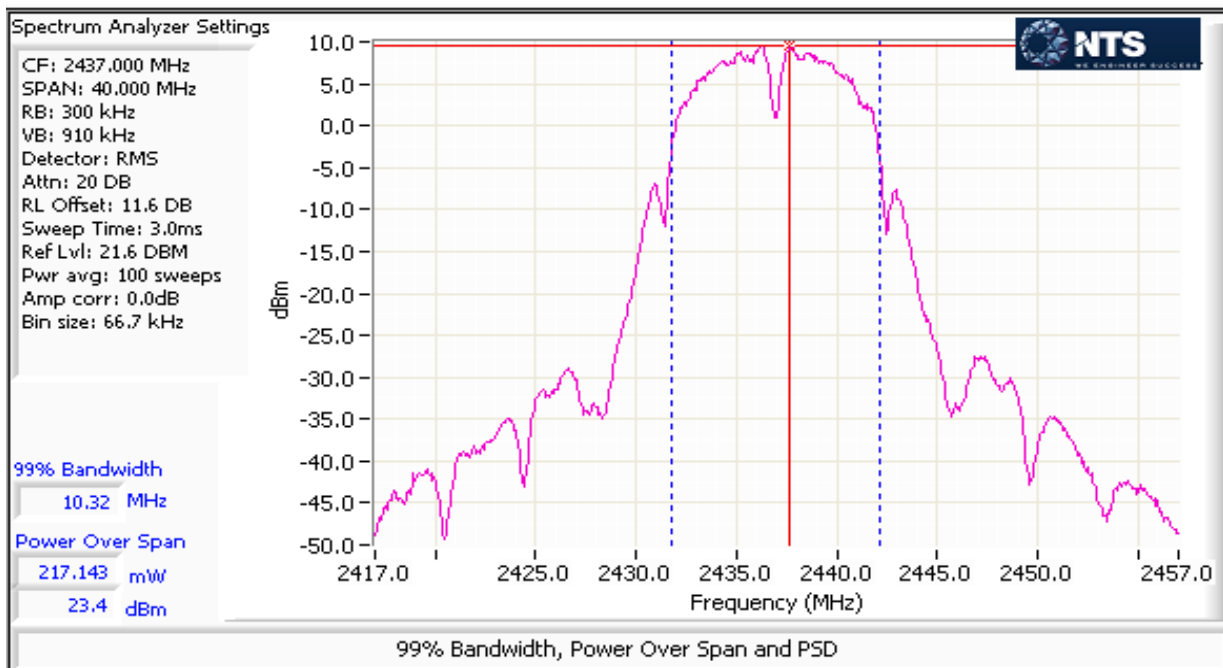
Operating Mode: 11b

Directional Gain (dBi): 2.1

Max EIRP (mW): 354.8

Frequency (MHz)	Chain	Software Setting	Power ¹		Total		Max Power (W)	Limit dBm	Result	Power (dBm) ³
			dBm	mW	mW	dBm				
2412	1	q89	22.9	195.0	197.0	22.9	0.219	30.0	Pass	
	2			2.0						
2437	1	q90	23.4	218.8	218.8	23.4		30.0	Pass	
	2			0.0						
2462	1	q90	23.3	213.8	213.8	23.3		30.0	Pass	
	2			0.0						

Note 1: Duty Cycle < 98%, constant duty cycle. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Measurement corrected by Pwr Cor Factor. Spurious limit becomes -30dBc.



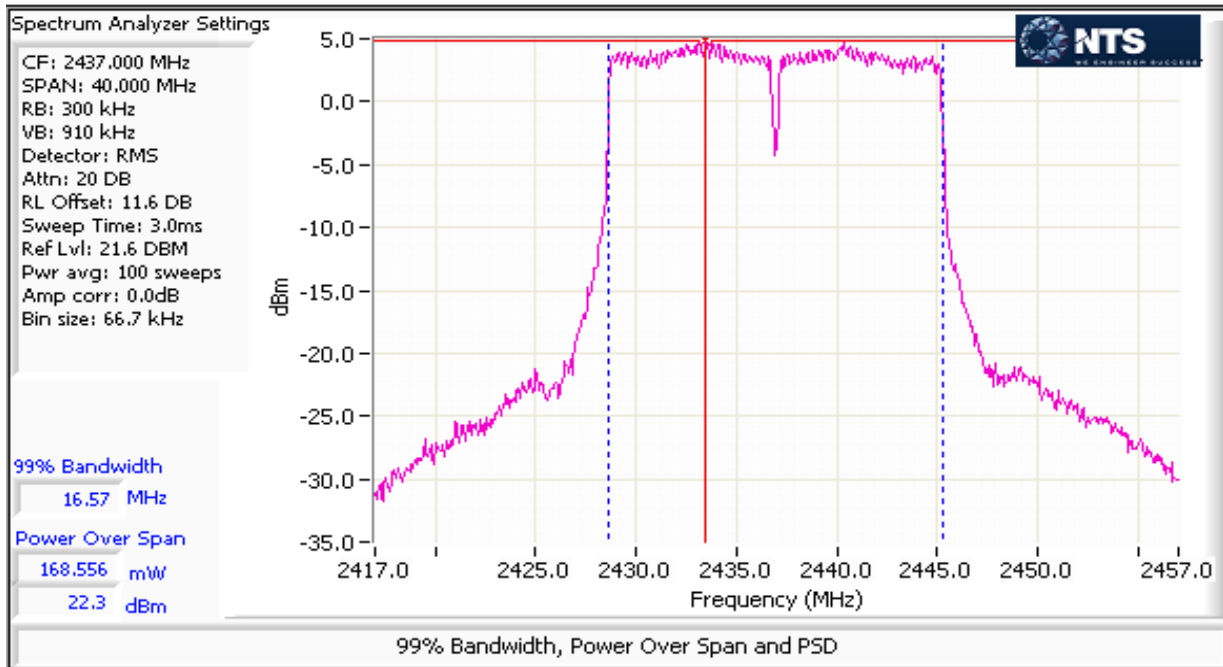
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Operating Mode: 11g

Directional Gain (dBi): 2.1

Max EIRP (mW): 275.4

Frequency (MHz)	Chain	Software Setting	Power ¹		Total		Max Power (W)	Limit dBm	Result	Power (dBm) ³
			dBm	mW	mW	dBm				
2412	1	17	17.2	52.5	52.5	17.2	0.170	30.0	Pass	
	2			0.0						
2437	1	22.5	22.3	169.8	169.8	22.3		30.0	Pass	
	2			0.0						
2462	1	17	17.3	53.7	53.7	17.3		30.0	Pass	
	2			0.0						



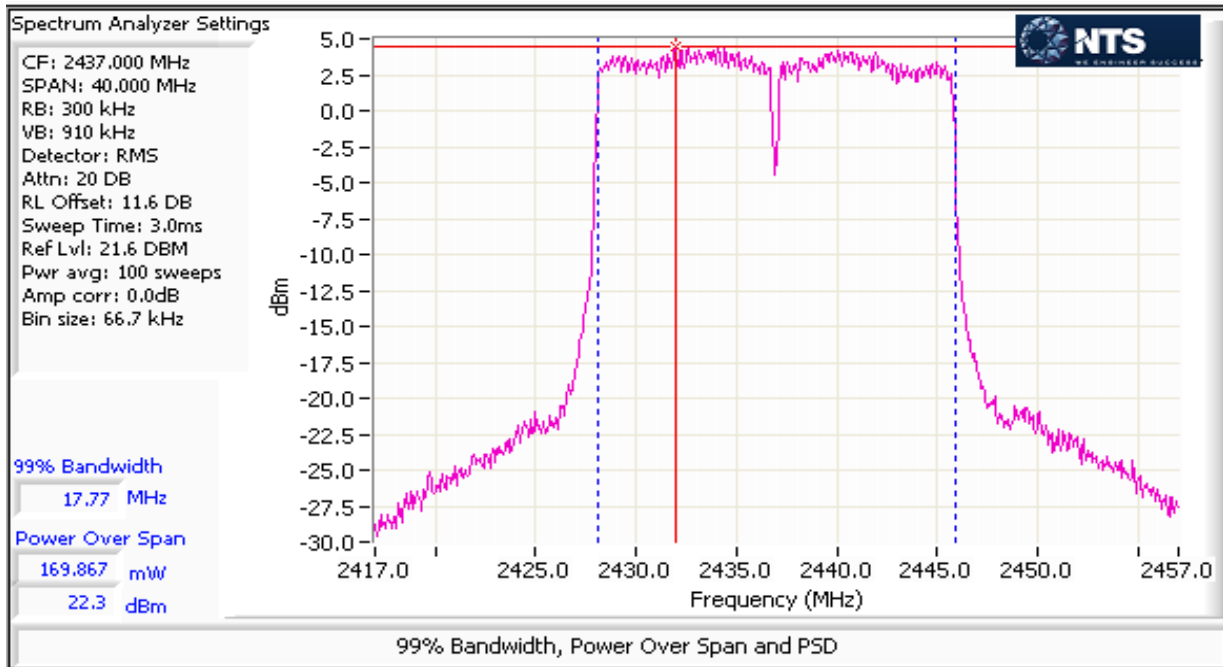
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Operating Mode: n20

Directional Gain (dBi): 3.1

Max EIRP (mW): 709.8

Frequency (MHz)	Chain	Software Setting	Power ¹		Total		Max Power (W)	Limit dBm	Result	Power (dBm) ³
			dBm	mW	mW	dBm				
2412	1	q66	17.0	50.1	101.4	20.1	0.348	30.0	Pass	
	2		17.1	51.3						
2437	1	22.5	22.3	169.8	347.7	25.4		30.0	Pass	
	2		22.5	177.8						
2462	1	q62	16.0	39.8	80.5	19.1		30.0	Pass	
	2		16.1	40.7						

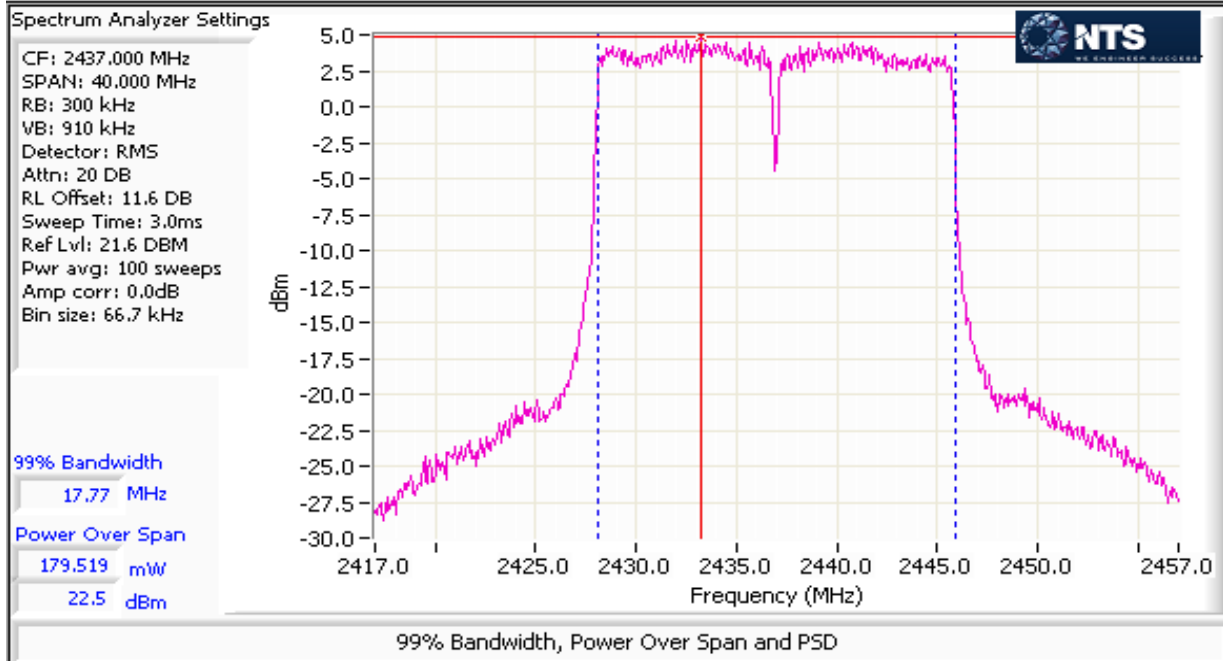


**NTS**

WE ENGINEER SUCCESS

EMC Test Data

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Operating Mode: n40

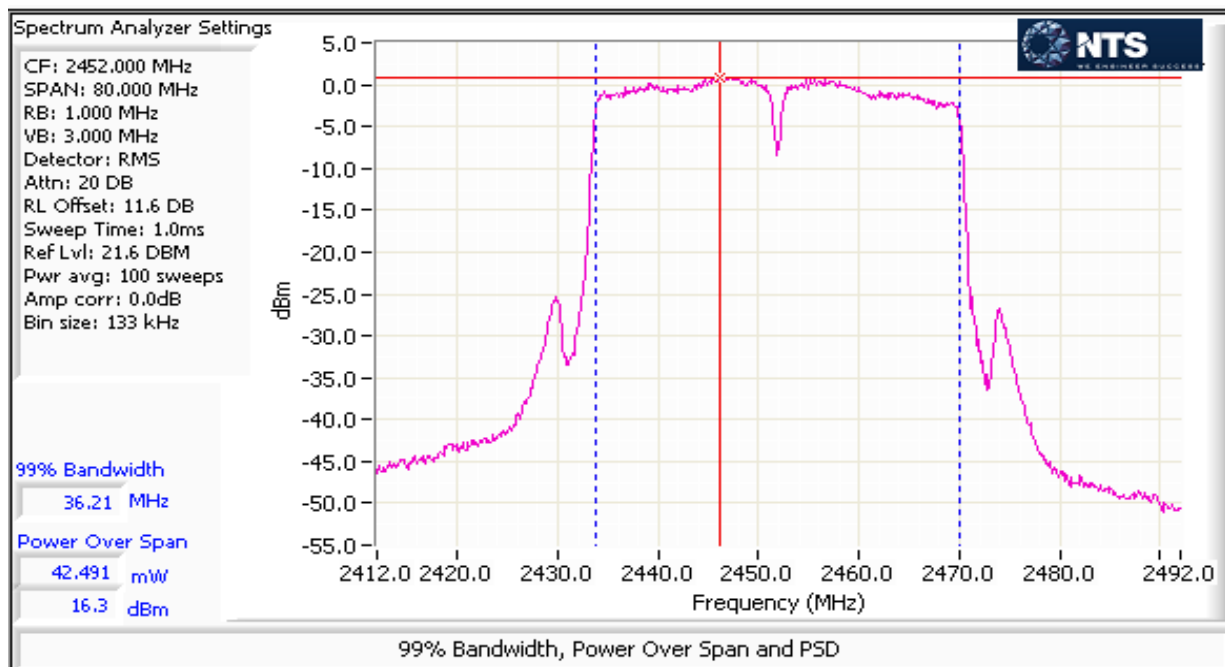
Directional Gain (dBi): 3.1

Max EIRP (mW): 194.2

Frequency (MHz)	Chain	Software Setting	Power ¹		Total		Max Power (W)	Limit dBm	Result	Power (dBm) ³
			dBm	mW	mW	dBm				
2422	1	15	16.2	41.7	91.8	19.6	0.095	30.0	Pass	
	2		17.0	50.1						
2437	1	15	15.9	38.9	90.2	19.6		30.0	Pass	
	2		17.1	51.3						
2452	1	15	16.3	42.7	95.1	19.8		30.0	Pass	
	2		17.2	52.5						

Note 1: Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Spurious limit becomes -30dBc.

Note 2: Power setting - if a single number the same power setting was used for each chain. If multiple numbers the power setting for each chain is separated by a comma (e.g. x,y would indicate power setting x for chain 1, power setting y for chain 2).



**NTS**

WE ENGINEER SUCCESS

EMC Test Data

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Spectrum Analyzer Settings

CF: 2452.000 MHz
SPAN: 80.000 MHz
RB: 1.000 MHz
VB: 3.000 MHz
Detector: RMS
Attn: 20 DB
RL Offset: 11.6 DB
Sweep Time: 1.0ms
Ref Lvl: 21.6 DBM
Pwr avg: 100 sweeps
Amp corr: 0.0dB
Bin size: 133 kHz

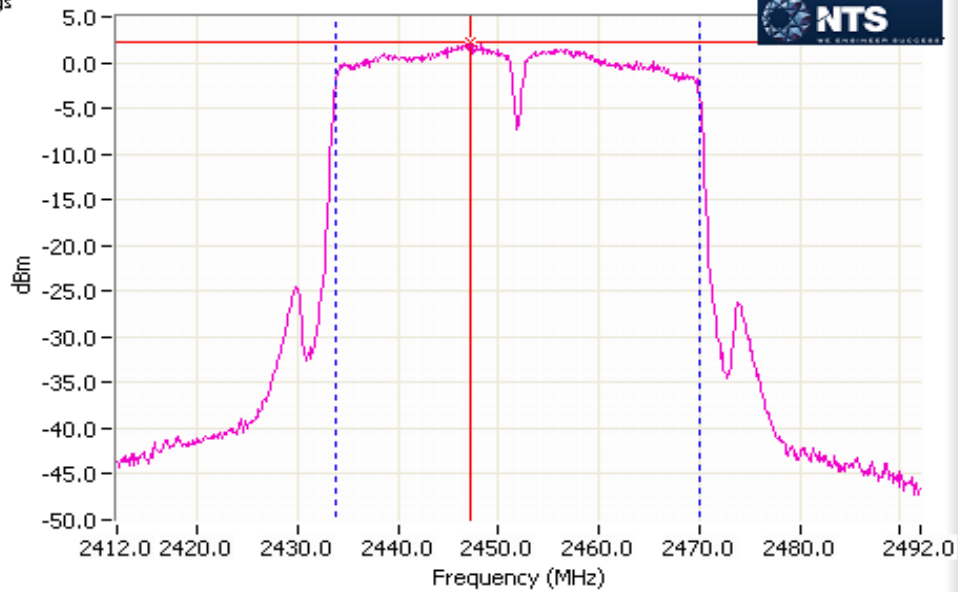
99% Bandwidth

36.21 MHz

Power Over Span

52.995 mW

17.2 dBm



99% Bandwidth, Power Over Span and PSD

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #2: Power spectral Density

Mode: 11b

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) ^{Note 1}				Total	Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4			
23	2412	6.0				6.0	8.0	Pass
23	2437	7.1				7.1	8.0	Pass
23	2462	6.0				6.0	8.0	Pass

Mode: 11g

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) ^{Note 1}				Total	Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4			
17.0	2412	-1.9				-1.9	8.0	Pass
22.5	2437	2.6				2.6	8.0	Pass
18.0	2462	-2.7				-2.7	8.0	Pass

Mode: n20

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) ^{Note 1}				Total	Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4			
17.0	2412	-2.7	-2.1			0.6	8.0	Pass
22.5	2437	2.4	3.1			5.8	8.0	Pass
18.0	2462	-1.9	-2.3			0.9	8.0	Pass

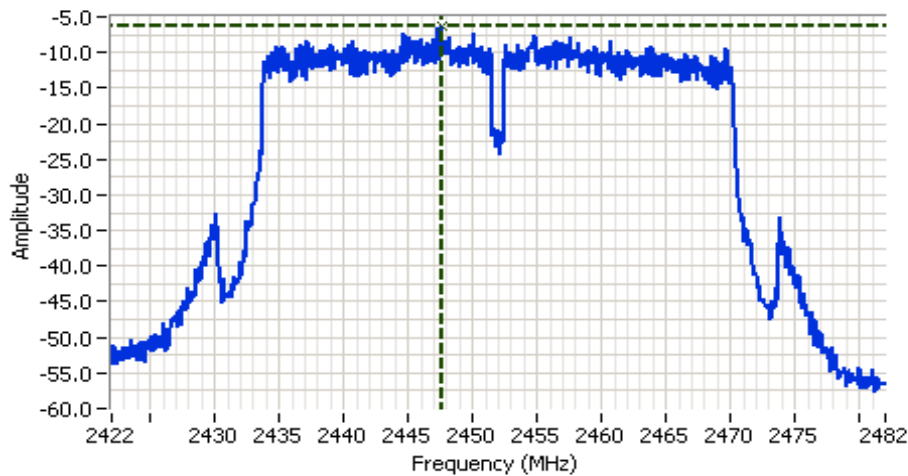
Mode: n40

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) ^{Note 1}				Total	Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4			
15	2422	-7.6	-5.7			-3.5	8.0	Pass
14	2437	-8.5	-6.8			-4.5	8.0	Pass
15	2452	-6.4	-5.7			-3.0	8.0	Pass

Note 1:

Test performed per method PKPSD, in KDB 558074. Power spectral density measured using: $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$, $\text{VBW}=3*\text{RBW}$, peak detector, span = $1.5*\text{DTS BW}$, auto sweep time, max hold.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

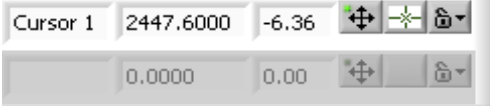


Analyzer Settings

Agilent Technologies, E4446A
 CF: 2452.000 MHz
 SPAN: 60.000 MHz
 RB: 10.0 kHz
 VB: 30.0 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 11.1 DB
 Sweep Time: 0.6s
 Ref Lvl: 0.0 DBM

Comments

PSD = -6.36 dBm/10kHz
 n40 chain 1



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #3: Signal Bandwidth

Mode: 11b

Power Setting	Frequency (MHz)	Bandwidth (MHz) 6dB 99%	RBW Setting (kHz) 6dB 99%
23.0	2412	8.07 10.3	100 300
23.0	2437	8.07 10.3	
23.0	2462	8.07 10.3	

Mode: 11g

Power Setting	Frequency (MHz)	Bandwidth (MHz) 6dB 99%	RBW Setting (kHz) 6dB 99%
17.0	2412	16.4 17.0	100 300
22.5	2437	16.5 17.0	
18.0	2462	16.4 17.0	

Mode: n20

Power Setting	Frequency (MHz)	Bandwidth (MHz) 6dB 99%	RBW Setting (kHz) 6dB 99%
17.0	2412	17.6 18.6	100 300
22.5	2437	17.7 17.9	
18.0	2462	17.7 17.8	

Mode: n40

Power Setting	Frequency (MHz)	Bandwidth (MHz) 6dB 99%	RBW Setting (kHz) 6dB 99%
15.0	2422	35.2 36.5	100 1000
14.0	2437	35.3 36.3	
15.0	2452	35.3 36.6	

Note 1:	DTS BW: RBW=100kHz, VBW $\geq 3 \times$ RBW, peak detector, max hold, auto sweep time. 99% BW: RBW=1-5% of 99%BW, VBW $\geq 3 \times$ RBW, peak detector, max hold, auto sweep time.
Note 2:	Measurements performed on chain 2, except for 11b/g modes, which can transmit only on chain 1.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2412.000 MHz
 SPAN: 40.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 3.8ms
 Ref Lvl: 10.0 DBM

Comments

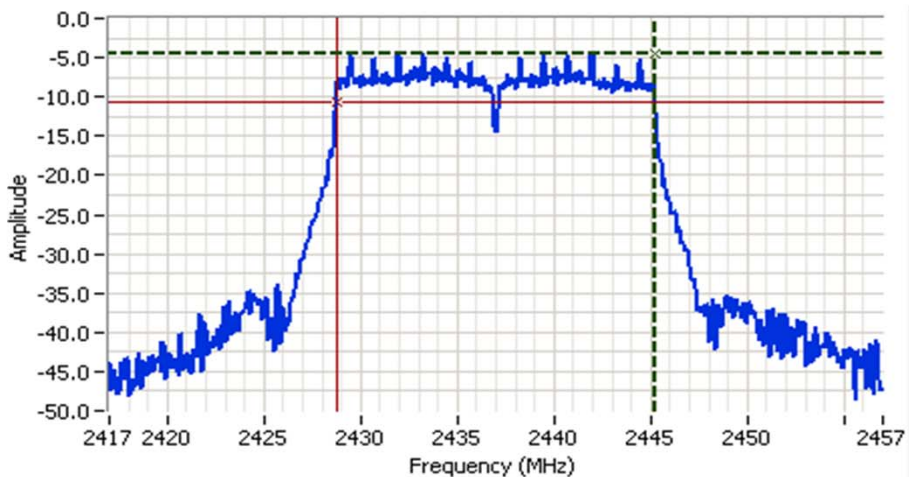
6dB BW: 8.067 MHz
 11b chain 1

Cursor 1 2416.0000 -1.2

Cursor 2 2407.9333 -7.2

Delta Freq. 8.067

Delta Amplitude 6.0



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2437.000 MHz
 SPAN: 40.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 3.8ms
 Ref Lvl: 10.0 DBM

Comments

6dB BW: 16.467 MHz
 11g chain 1

Cursor 1 2445.2000 -4.6

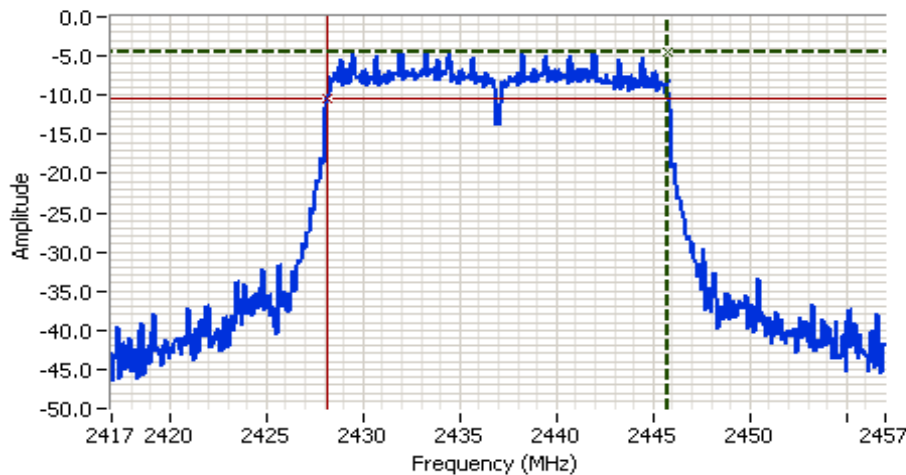
Cursor 2 2428.7333 -10.6

Delta Freq. 16.467

Delta Amplitude 6.0



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

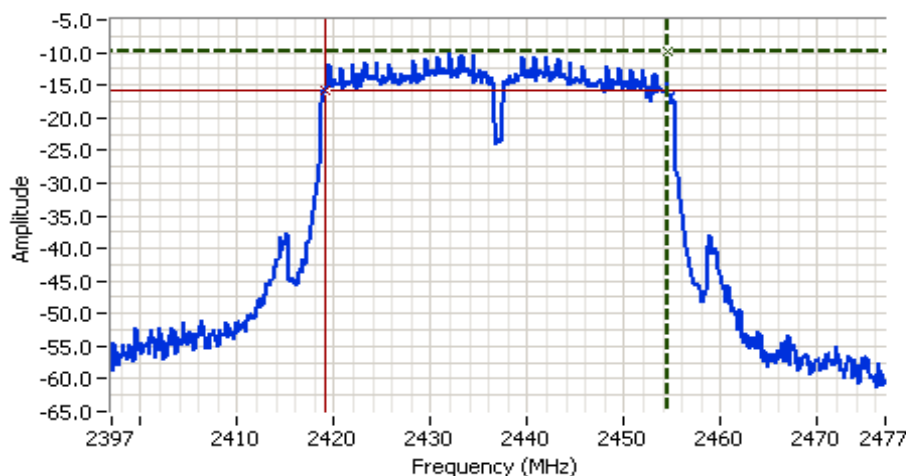


Analyzer Settings

Agilent Technologies, E4446A
 CF: 2437.000 MHz
 SPAN: 40.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 3.8ms
 Ref Lvl: 10.0 DBM

Comments

6dB BW: 17.667 MHz
 n20 chain 2



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2437.000 MHz
 SPAN: 80.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 7.7ms
 Ref Lvl: 10.0 DBM

Comments

6dB BW: 35.333 MHz
 n40 chain 2



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

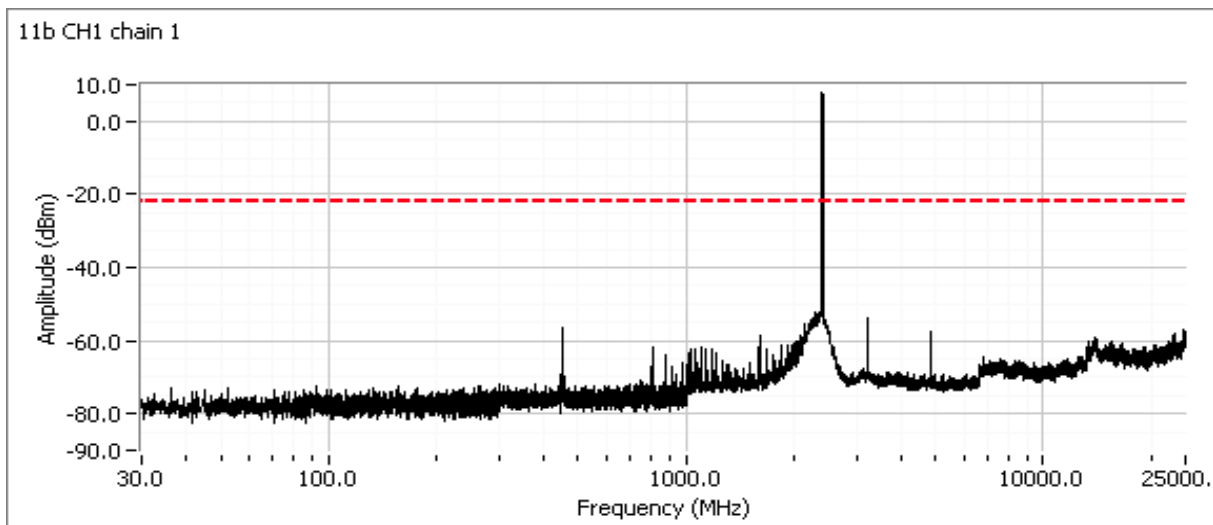
Run #4: Out of Band Spurious Emissions

Test center channel for all three OFDM modes and high and low channel for worst case OFDM mode only.

Power Setting Per Chain				Mode	Frequency (MHz)	Limit	Result
#1	#2	#3	#4				
23				11b	2412	-30 dBc	Pass
23				11b	2437	-30 dBc	Pass
23				11b	2462	-30 dBc	Pass
22.5				11g	2437	-30 dBc	Pass
17	22.5			11n20	2437	-30 dBc	Pass
14	14			11n40	2437	-30 dBc	Pass
17				11g	2412	-30 dBc	Pass
18				11g	2462	-30 dBc	Pass

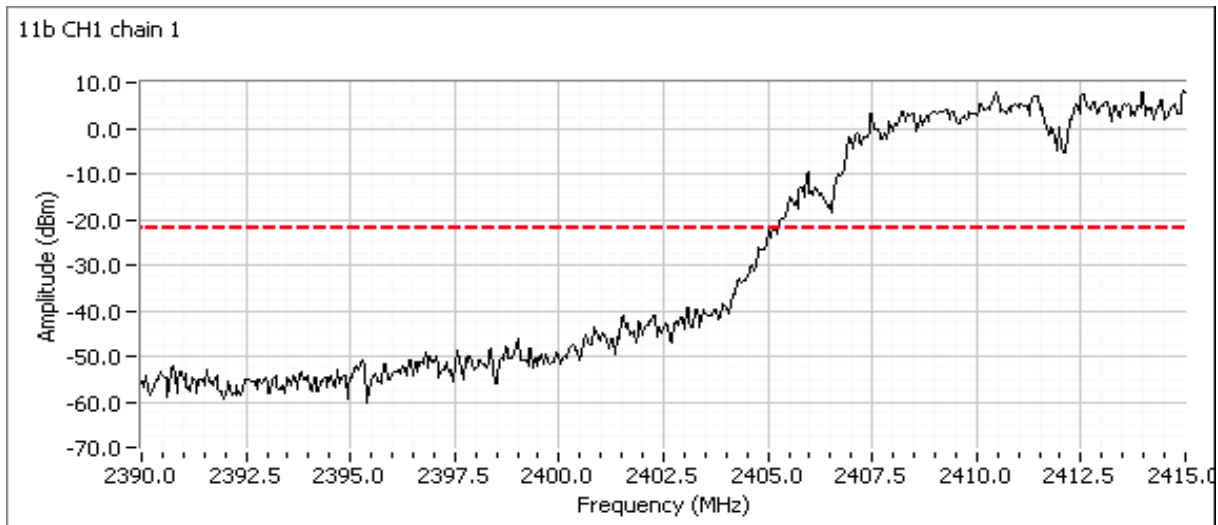
Note 1: Measured on each chain individually, RBW = 100 kHz, VBW = 300 kHz

Plots for low channel

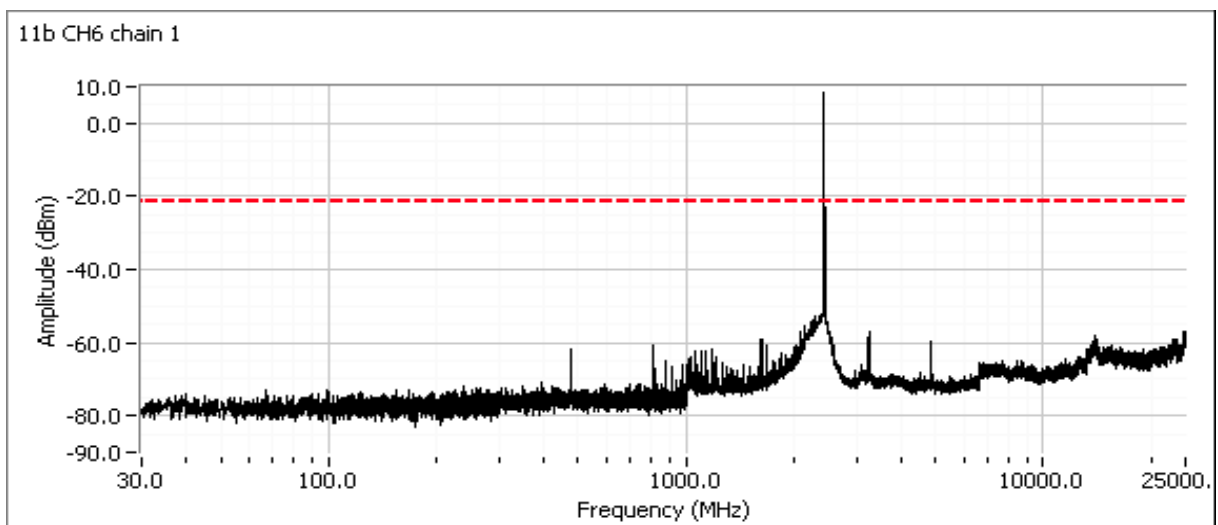


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz and above 2483.5 MHz.

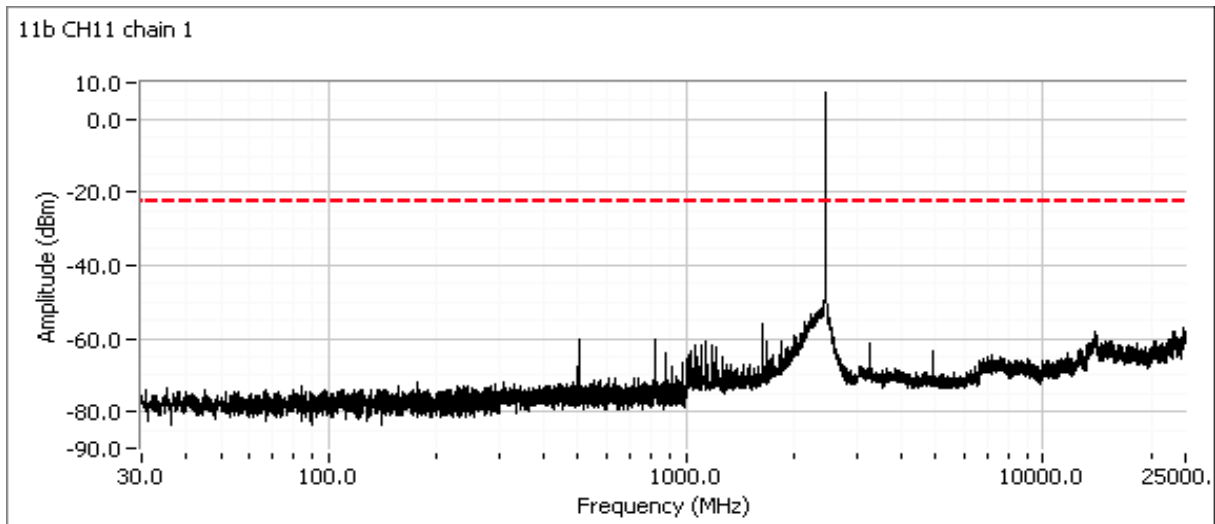


Plots for center channel



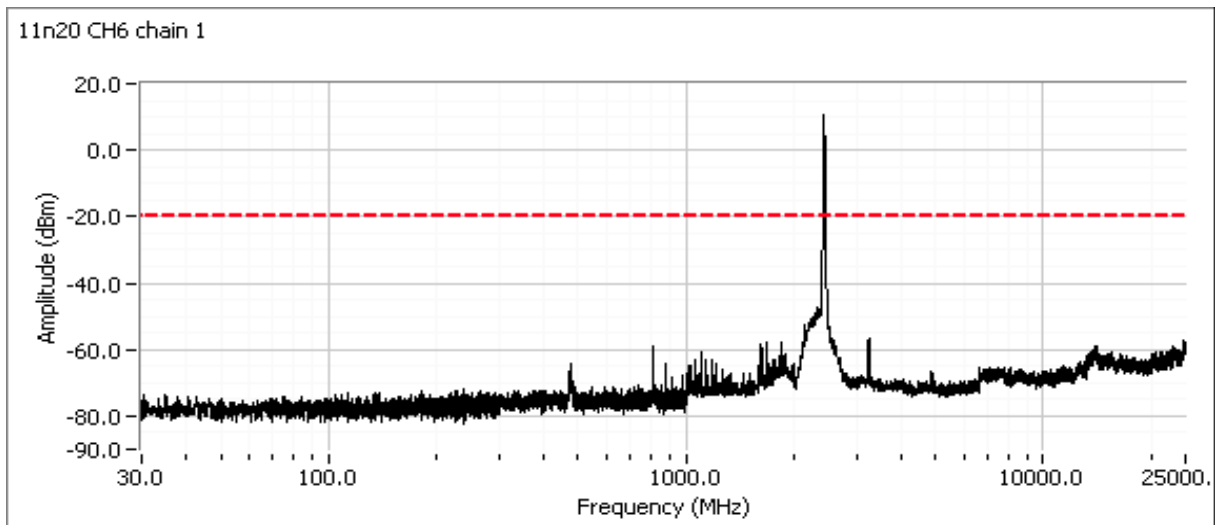
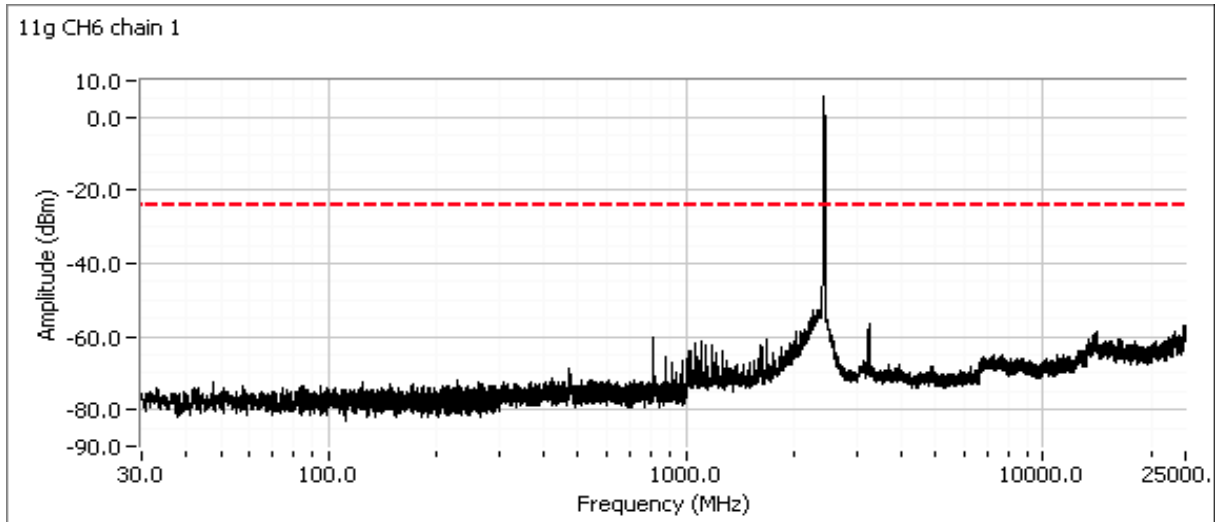
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Plots for high channel

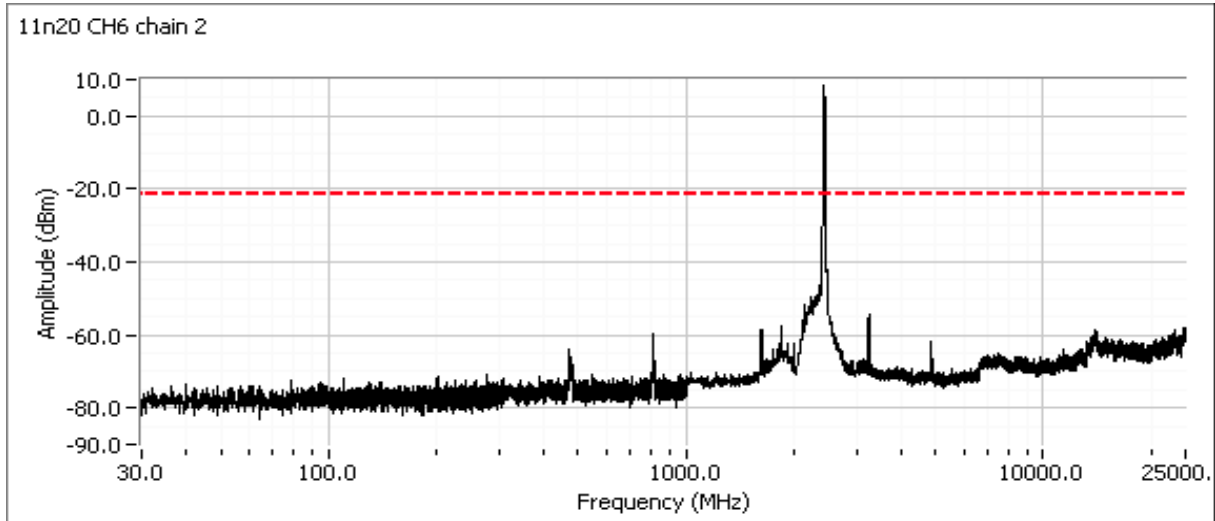


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

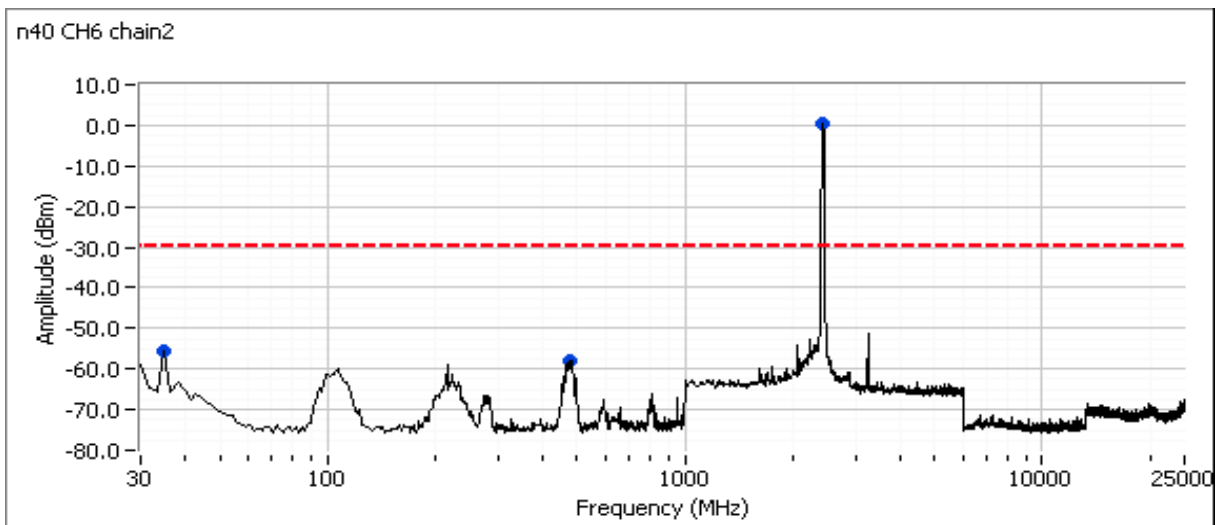
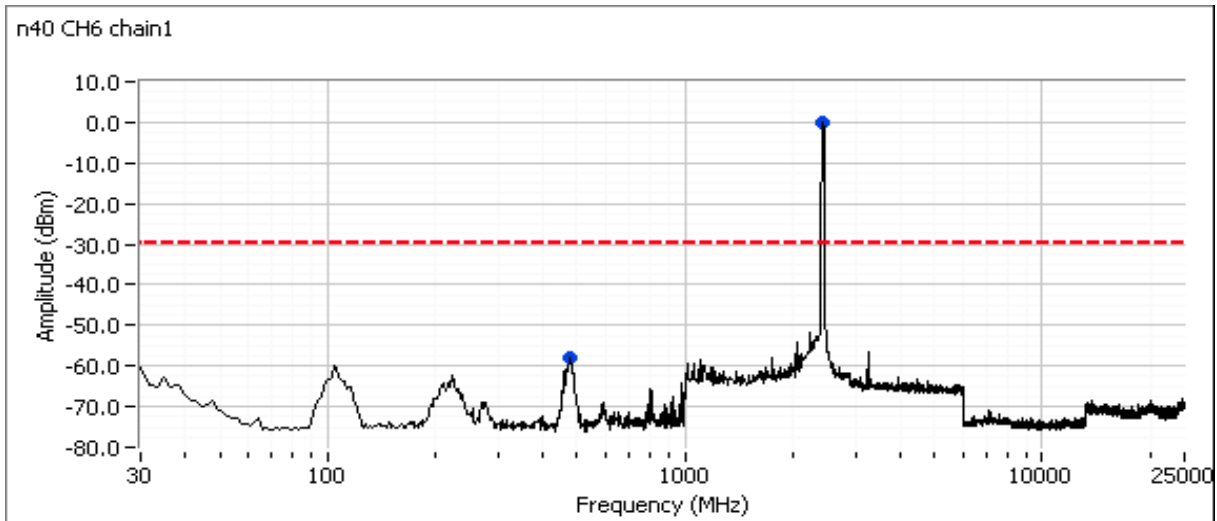
Center channel scans to determin worst case OFDM mode



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radmacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



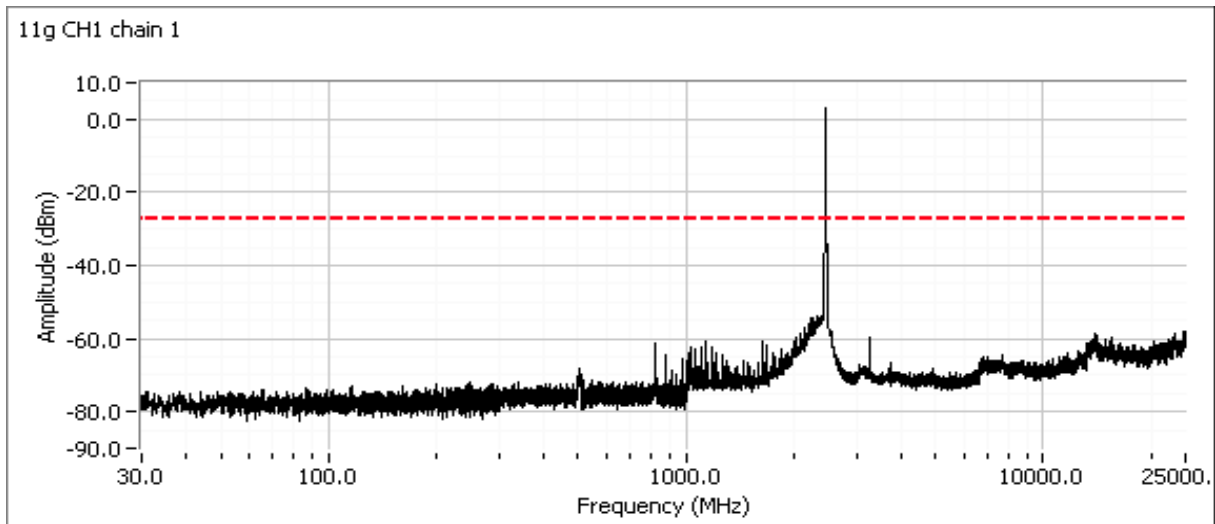
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



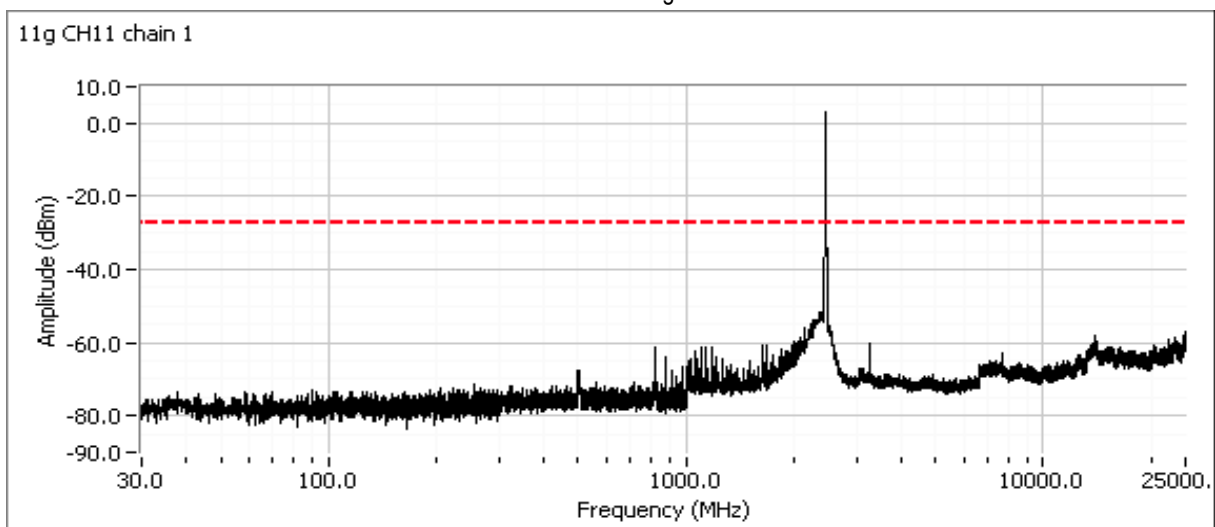
11g is worst case mode

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Plots for low channel



Plots for high channel



Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: °C

Rel. Humidity: %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Passing Power Setting	Test Performed	Limit	Result / Margin
1	b (Chain 1)	1 - 2412MHz	23 (q92)	q90	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	53.4 dBµV/m @ 2387.4 MHz (-0.6 dB)
	b (Chain 2)	1 - 2412MHz	23 (q92)	q89	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	53.4 dBµV/m @ 2387.2 MHz (-0.6 dB)
	b (Chain 1)	11 - 2462MHz	23 (q92)	q90	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	53.6 dBµV/m @ 2486.8 MHz (-0.4 dB)
	b (Chain 2)	11 - 2462MHz	23 (q92)	q90	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	53.4 dBµV/m @ 2486.8 MHz (-0.6 dB)
	g (Chain 2)	1 - 2412MHz	17 (q68)	q70	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	73.2 dBµV/m @ 2388.2 MHz (-0.8 dB)
2	g (Chain 1)	11 - 2462MHz	18 (q72)	q68	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	73.6 dBµV/m @ 2485.0 MHz (-0.4 dB)
	n20 (2x2)	1 - 2412MHz	17 (q68)	q66	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	73.8 dBµV/m @ 2389.1 MHz (-0.2 dB)
3	n20 (2x2)	11 - 2462MHz	18 (q72)	q62	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	73.7 dBµV/m @ 2483.7 MHz (-0.3 dB)
	n40 (2x2)	3 - 2422MHz	15.0	16.0	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	45.1 dBµV/m @ 2390.0 MHz (-8.9 dB)
4	n40 (2x2)	9 - 2452MHz	15.0	16.0	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	45.2 dBµV/m @ 2483.5 MHz (-8.8 dB)



EMC Test Data

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: PV1056150225025

Driver: 5.99 RC 188.12

Antenna: Airgain N2420DS and N2415D2

CN3110-A0-Chain 1

CN3210-A1-Chain 2

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1	0.94	Yes	144	0.3	0.6	7
11a/g	6	0.99	Yes	103.55	0	0	10
n20	MCS 0	0.99	Yes	95.85	0	0	10
n40	MCS 0	0.99	Yes	94.3	0	0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle $< 98\%$ and is NOT constant, average measurement performed: RBW=1MHz, VBW $> 1/T$, peak detector, linear average mode, sweep time auto, max hold. Max hold for $50 \times (1/DC)$ traces
Note 5:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Notes:

11g performed using worse case mode based on preliminary tests (chain 1 for lowest channels and chain 2 for highest channels)

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Radiated Bandedge Measurements

Date of Test: 08/14/15

Test Engineer: Eddie Mariscal

Test Location: FT Chamber #5

Config. Used: 1

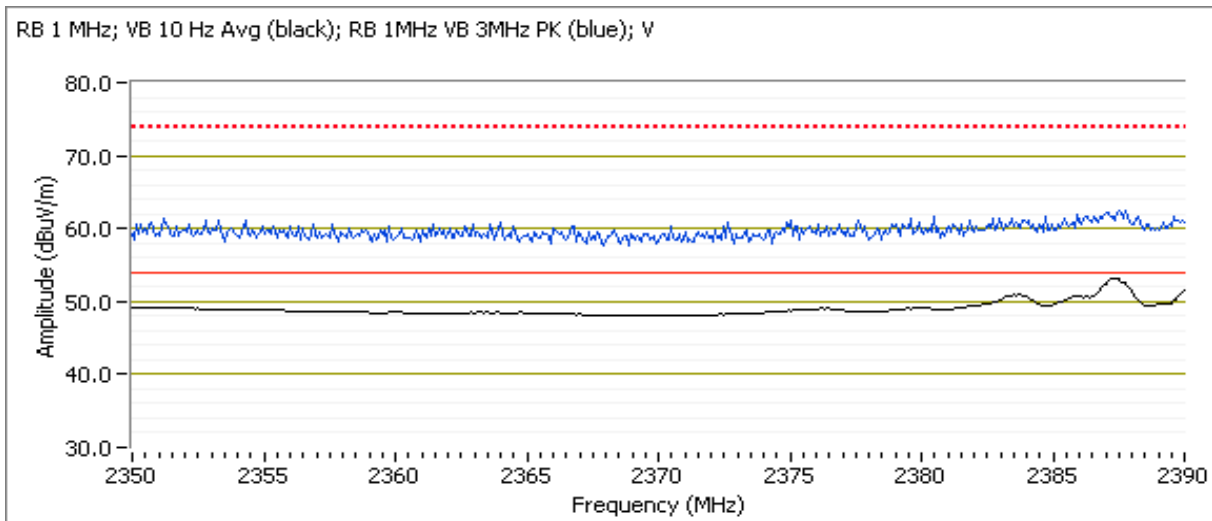
Config Change: none

EUT Voltage: 120V/60Hz

Channel: 1 Mode: b
 Tx Chain: 1 Data Rate: 1

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2387.390	53.4	V	54.0	-0.6	AVG	9	1.0	POS; RB 1 MHz; VB: 10 Hz, Note 3
2389.920	63.0	V	74.0	-11.0	PK	9	1.0	POS; RB 1 MHz; VB: 3 MHz

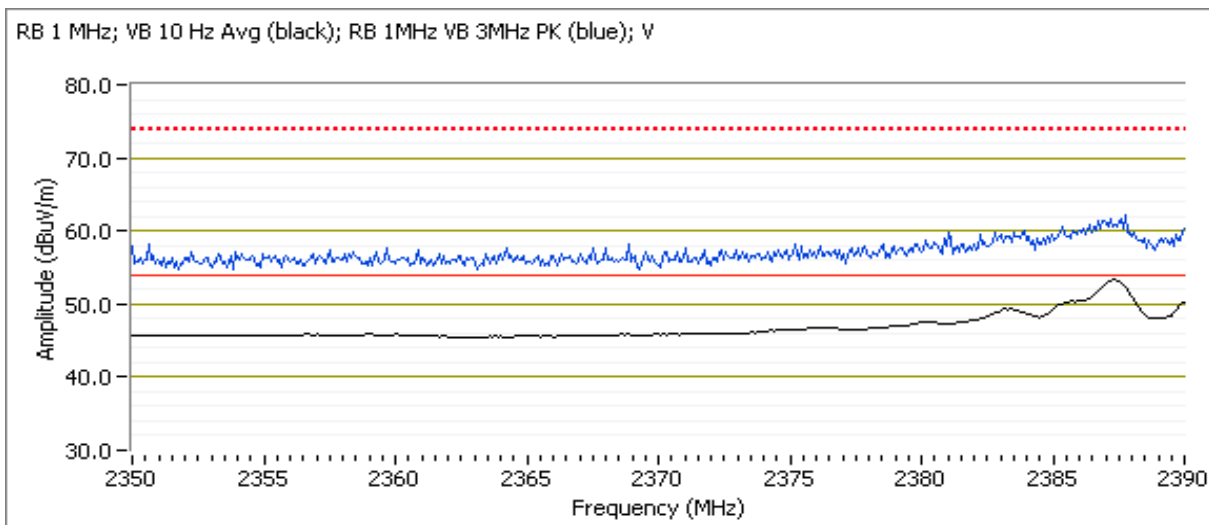


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 1 Mode: b
 Tx Chain: 2 Data Rate: 1

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
2387.220	53.4	H	54.0	-0.6	AVG	311	1.5	POS; RB 1 MHz; VB: 10 Hz, Note 3
2387.550	62.1	H	74.0	-11.9	PK	311	1.5	POS; RB 1 MHz; VB: 3 MHz

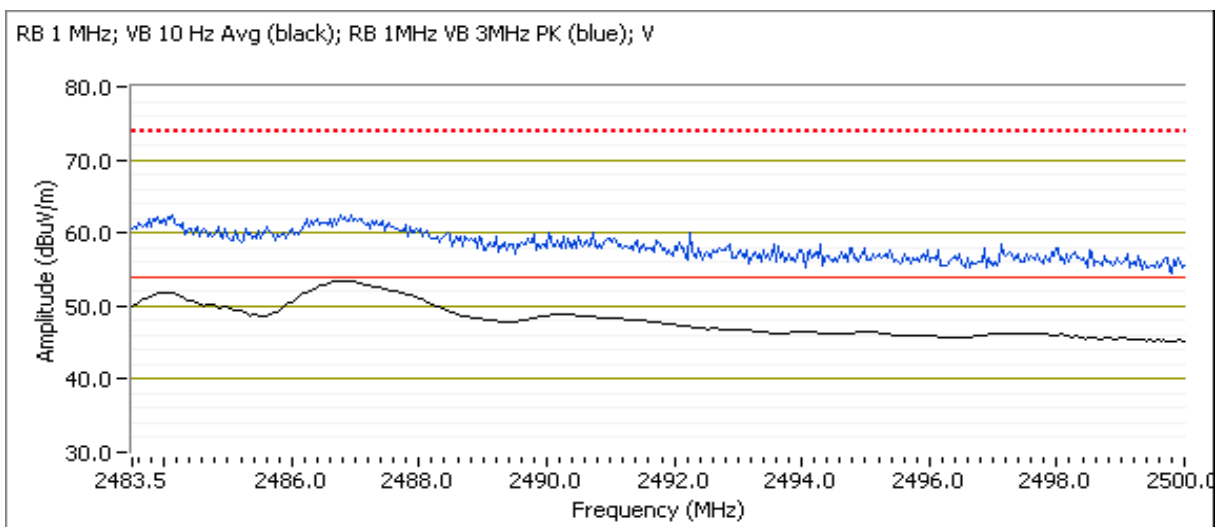


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 11 Mode: b
 Tx Chain: 1 Data Rate: 1

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
2486.810	53.6	V	54.0	-0.4	AVG	360	1.2	POS; RB 1 MHz; VB: 10 Hz, Note 3
2484.000	62.8	V	74.0	-11.2	PK	360	1.2	POS; RB 1 MHz; VB: 3 MHz

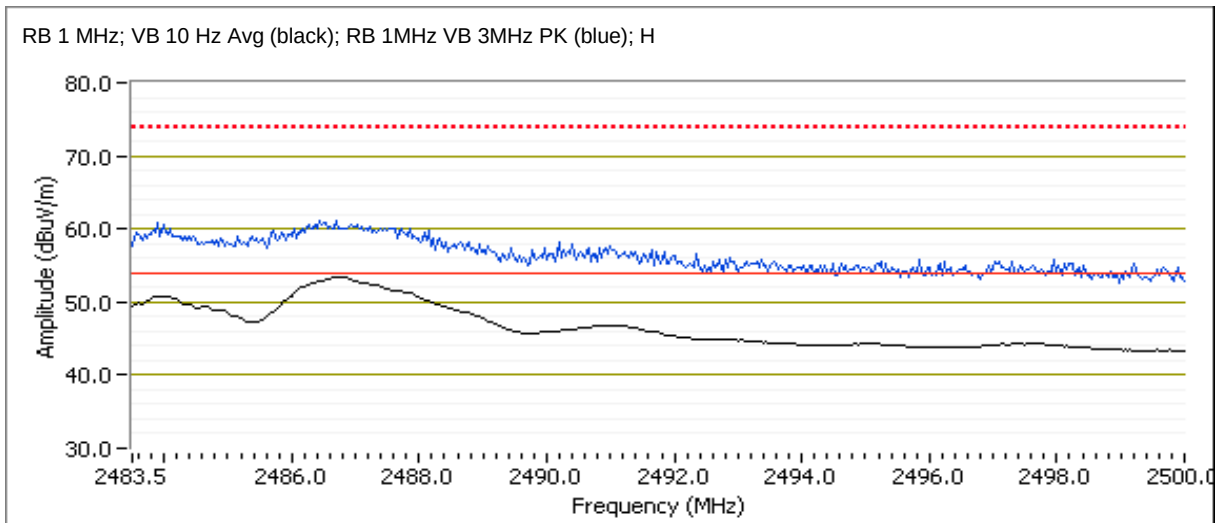


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 11 Mode: b
 Tx Chain: 2 Data Rate: 1

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2486.770	53.4	H	54.0	-0.6	AVG	288	1.2	POS; RB 1 MHz; VB: 10 Hz, Note 3
2486.990	61.8	H	74.0	-12.2	PK	288	1.2	POS; RB 1 MHz; VB: 3 MHz



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #2: Radiated Bandedge Measurements

Date of Test: 08/14/15

Test Engineer: Eddie Mariscal

Test Location: FT Chamber #5

Config. Used: 1

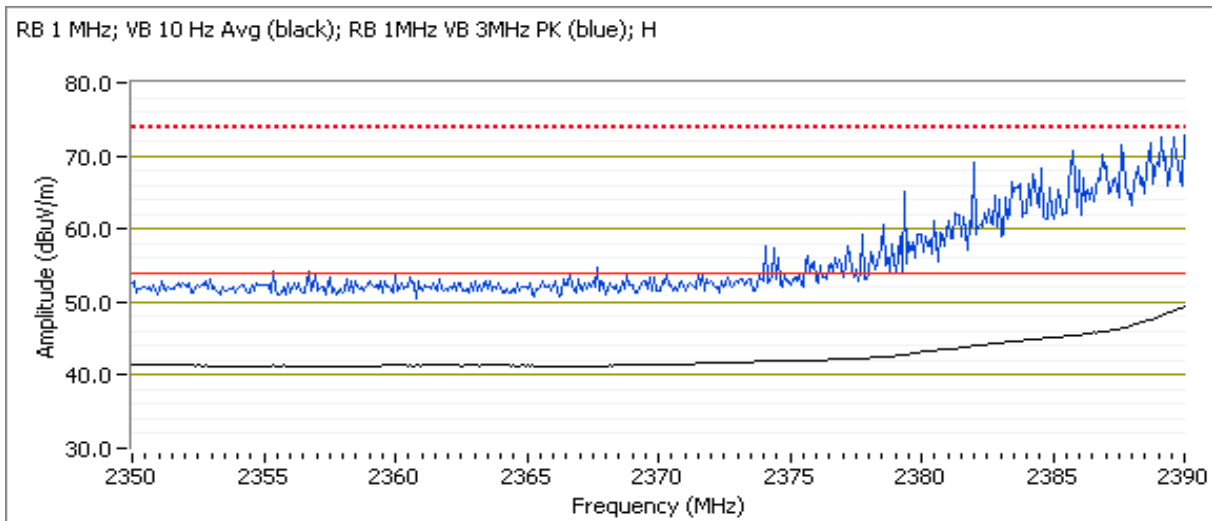
Config Change: none

EUT Voltage: 120V/60Hz

Channel: 1 Mode: g
 Tx Chain: 2 Data Rate: 6Mbps

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.920	50.9	V	54.0	-3.1	AVG	255	1.8	POS; RB 1 MHz; VB: 10 Hz
2389.200	73.4	V	74.0	-0.6	PK	255	1.8	POS; RB 1 MHz; VB: 3 MHz
2390.000	49.4	H	54.0	-4.6	AVG	79	1.7	POS; RB 1 MHz; VB: 10 Hz
2388.240	73.2	H	74.0	-0.8	PK	79	1.7	POS; RB 1 MHz; VB: 3 MHz

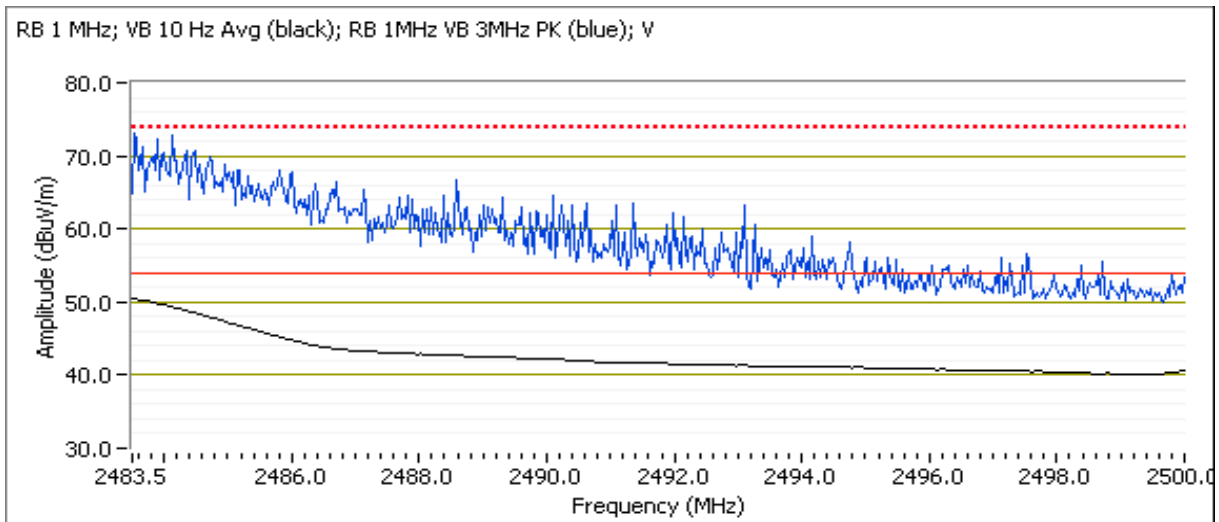


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 11 Mode: g
 Tx Chain: 1 Data Rate: MCS 0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	50.5	V	54.0	-3.5	AVG	23	1.2	POS; RB 1 MHz; VB: 10 Hz
2485.020	73.6	V	74.0	-0.4	PK	23	1.2	POS; RB 1 MHz; VB: 3 MHz
2483.510	43.6	H	54.0	-10.4	AVG	302	1.1	POS; RB 1 MHz; VB: 10 Hz
2483.540	66.6	H	74.0	-7.4	PK	302	1.1	POS; RB 1 MHz; VB: 3 MHz



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #3: Radiated Bandedge Measurements

Date of Test: 08/14/15

Test Engineer: Eddie Mariscal

Test Location: FT Chamber #5

Config. Used: 1

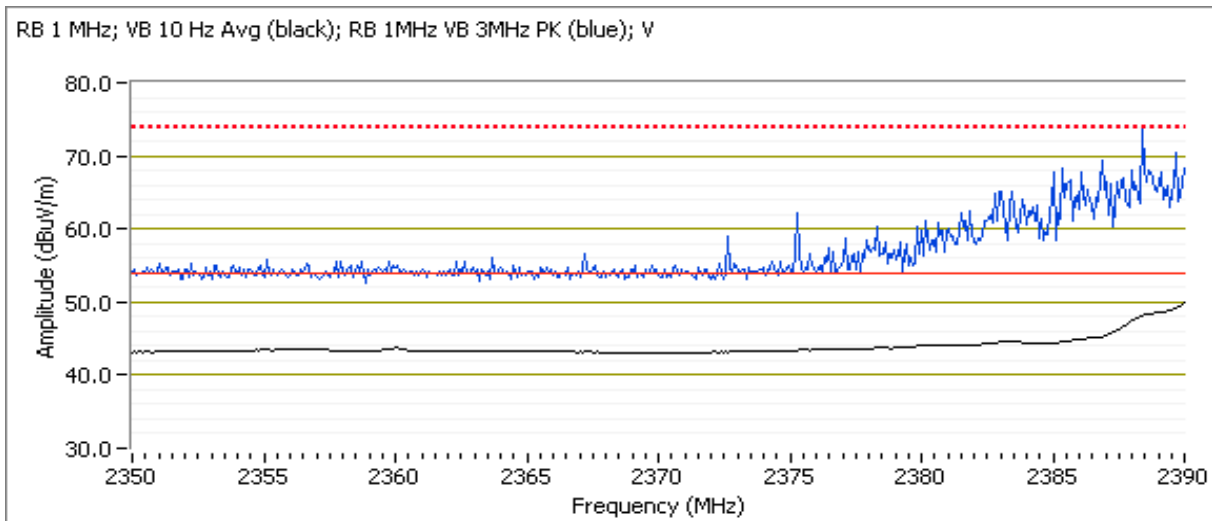
Config Change: none

EUT Voltage: 120V/60Hz

Channel: 1 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS 0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.000	50.0	V	54.0	-4.0	AVG	17	1.3	POS; RB 1 MHz; VB: 10 Hz
2389.100	73.8	V	74.0	-0.2	PK	17	1.3	POS; RB 1 MHz; VB: 3 MHz
2389.890	48.7	H	54.0	-5.3	AVG	242	1.8	POS; RB 1 MHz; VB: 10 Hz
2389.530	69.4	H	74.0	-4.6	PK	242	1.8	POS; RB 1 MHz; VB: 3 MHz

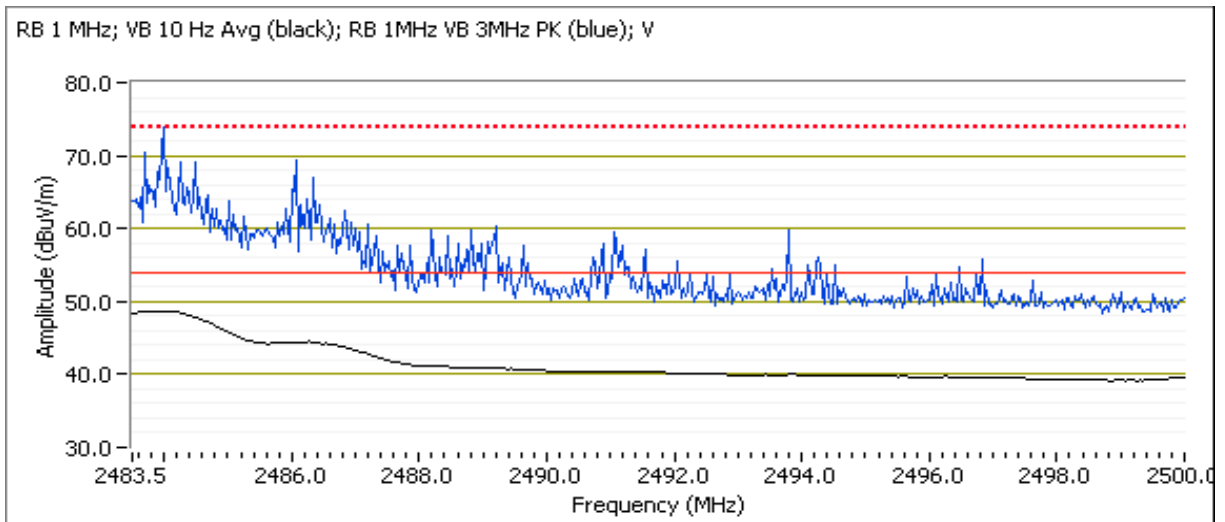


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 11 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS 0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2484.000	48.8	V	54.0	-5.2	AVG	256	1.4	POS; RB 1 MHz; VB: 10 Hz
2483.730	73.7	V	74.0	-0.3	PK	256	1.4	POS; RB 1 MHz; VB: 3 MHz
2484.190	46.4	H	54.0	-7.6	AVG	290	1.1	POS; RB 1 MHz; VB: 10 Hz
2483.860	70.6	H	74.0	-3.4	PK	290	1.1	POS; RB 1 MHz; VB: 3 MHz



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #4: Radiated Bandedge Measurements

Date of Test: 03/25/15

Test Engineer: Joseph Cadigal

Test Location: FT Chamber#7

Config. Used: 1

Config Change: none

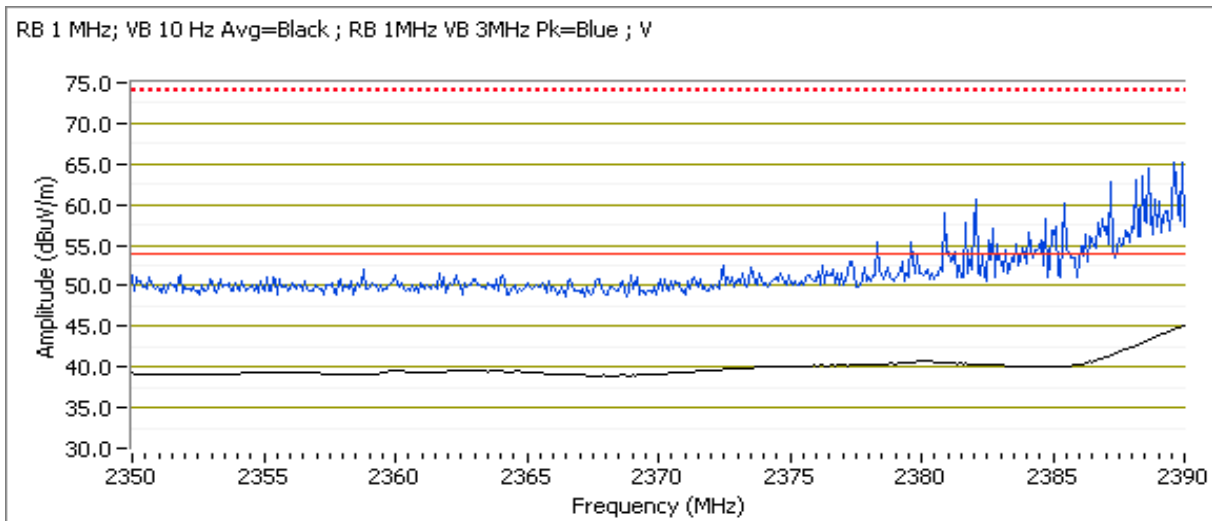
EUT Voltage: 120V/60Hz

Channel: 1 Mode: n40 Power Setting: 16.0

Tx Chain: 2x2 Data Rate: MCS 0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.000	45.1	V	54.0	-8.9	AVG	360	1.0	POS; RB 1 MHz; VB: 10 Hz
2389.920	58.5	V	74.0	-15.5	PK	360	1.0	POS; RB 1 MHz; VB: 3 MHz
2390.000	45.0	H	54.0	-9.0	AVG	300	1.3	POS; RB 1 MHz; VB: 10 Hz
2389.920	63.5	H	74.0	-10.5	PK	300	1.3	POS; RB 1 MHz; VB: 3 MHz



**NTS**

WE ENGINEER SUCCESS

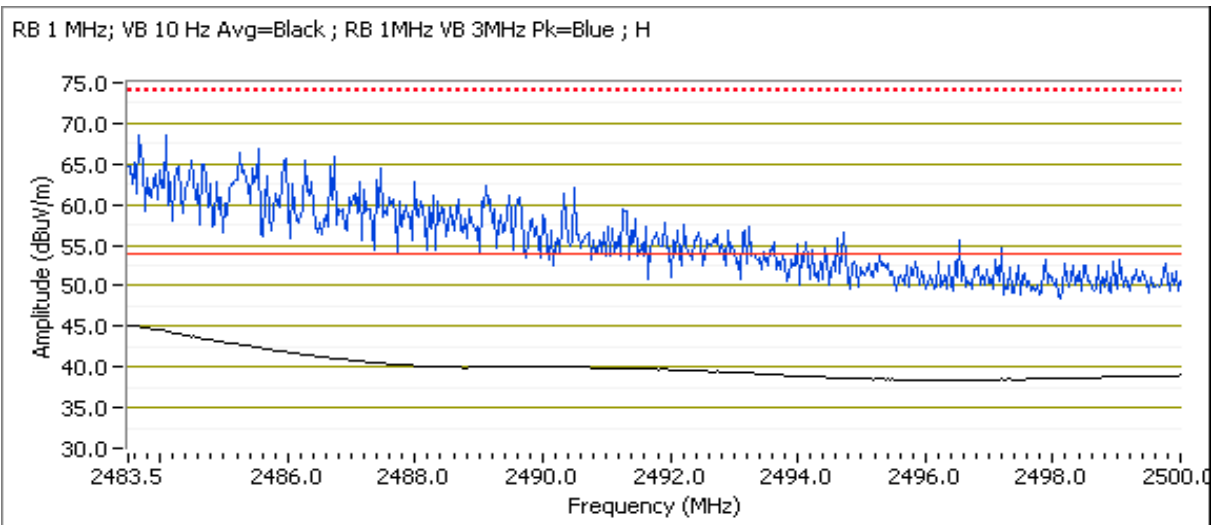
EMC Test Data

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

Channel: 11 Mode: n40 Power Setting: 16.0
Tx Chain: 2x2 Data Rate: MCS 0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.530	45.2	H	54.0	-8.8	AVG	290	1.9	POS; RB 1 MHz; VB: 10 Hz
2484.330	69.5	H	74.0	-4.5	PK	290	1.9	POS; RB 1 MHz; VB: 3 MHz
2483.600	44.5	V	54.0	-9.5	AVG	0	1.0	POS; RB 1 MHz; VB: 10 Hz
2485.620	64.6	V	74.0	-9.4	PK	0	1.0	POS; RB 1 MHz; VB: 3 MHz



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 25 °C
 Rel. Humidity: 30 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Passing Power Setting	Test Performed	Limit	Result / Margin
1	g (Chain 2)	2 - 2417MHz	22.5	21.0	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	53.9 dBµV/m @ 2389.8 MHz (-0.1 dB)
	g (Chain 1)	10 - 2457MHz	22.5	22.5	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	53.6 dBµV/m @ 2483.5 MHz (-0.4 dB)
2	n20 (2x2)	2 - 2462MHz	22.5	20.5	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	53.5 dBµV/m @ 2390.0 MHz (-0.5 dB)
	n20 (2x2)	10 - 2457MHz	22.5	21.5	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	52.6 dBµV/m @ 2483.6 MHz (-1.4 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: PV1056150225025

Driver: 5.99 RC 188.12

Antenna: Airgain N2420DS and N2415D2

CN3110-A0-Chain 1

CN3210-A1-Chain 2

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1	0.94	Yes	144	0.3	0.6	7
11a/g	6	0.99	Yes	103.55	0	0	10
n20	MCS 0	0.99	Yes	95.85	0	0	10
n40	MCS 0	0.99	Yes	94.3	0	0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle $< 98\%$ and is NOT constant, average measurement performed: RBW=1MHz, VBW $> 1/T$, peak detector, linear average mode, sweep time auto, max hold. Max hold for $50 \cdot (1/DC)$ traces
Note 5:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Notes:

11g performed using worse case mode based on preliminary tests (chain 1 for lowest channels and chain 2 for highest channels)

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Radiated Bandedge Measurements

Date of Test: 10/07/15

Test Engineer: Joseph Cadigal

Test Location: FT Chamber #4

Config. Used: 1

Config Change: none

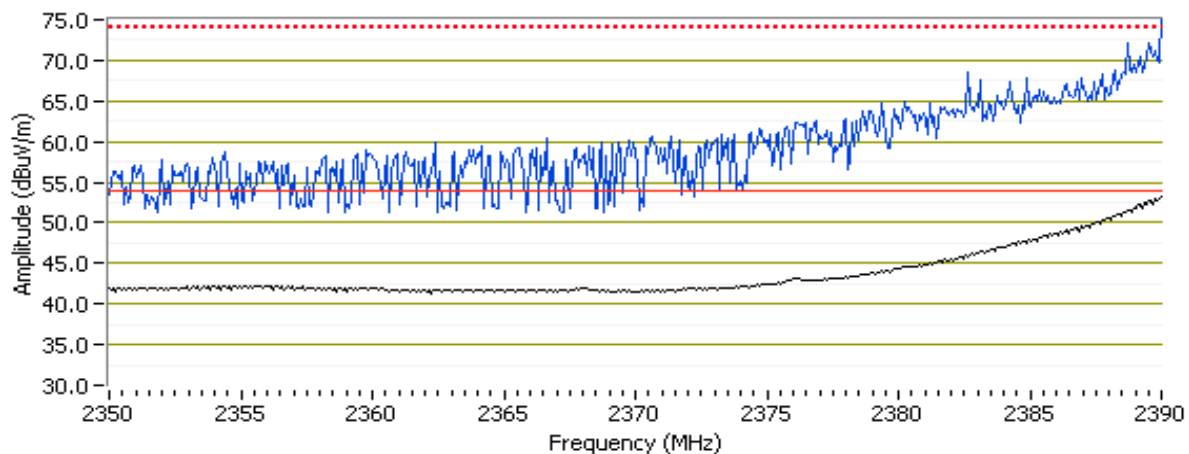
EUT Voltage: 120V/60Hz

Channel: 2 Mode: g
 Tx Chain: 2 Data Rate: 6

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.840	53.9	H	54.0	-0.1	AVG	247	1.6	POS; RB 1 MHz; VB: 10 Hz, 21
2389.040	70.9	H	74.0	-3.1	PK	247	1.6	POS; RB 1 MHz; VB: 3 MHz, 21
2390.000	52.9	V	54.0	-1.1	AVG	350	1.0	POS; RB 1 MHz; VB: 10 Hz, 21
2390.000	69.1	V	74.0	-4.9	PK	350	1.0	POS; RB 1 MHz; VB: 3 MHz, 21

RB 1 MHz; VB 10 Hz = avg (black) , 1MHz 3MHz = Pk (blue), Horizontal



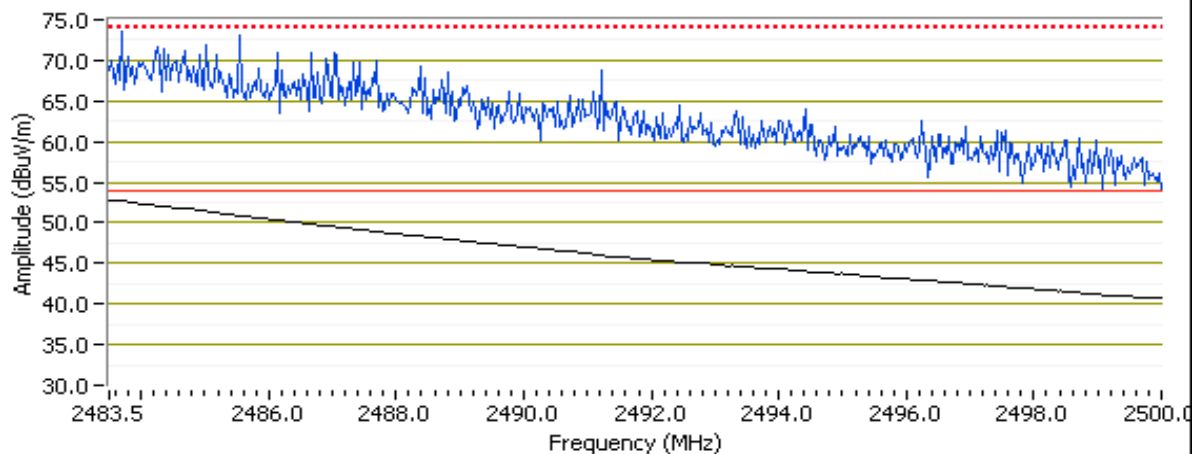
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 10 Mode: g
 Tx Chain: 1 Data Rate: 6

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.530	53.6	H	54.0	-0.4	AVG	345	1.4	POS; RB 1 MHz; VB: 10 Hz, 22.5
2488.230	69.3	H	74.0	-4.7	PK	345	1.4	POS; RB 1 MHz; VB: 3 MHz, 22.5
2483.530	52.5	V	54.0	-1.5	AVG	0	1.0	POS; RB 1 MHz; VB: 10 Hz, 22.5
2484.760	67.4	V	74.0	-6.6	PK	0	1.0	POS; RB 1 MHz; VB: 3 MHz, 22.5

RB 1 MHz; VB 10 Hz= avg (black) , 1MHz 3MHz = Pk (blue), Horizontal



**NTS**

WE ENGINEER SUCCESS

EMC Test Data

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

Run #2: Radiated Bandedge Measurements

Date of Test: 10/07/15

Test Engineer: Joseph Cadigal

Test Location: FT Chamber #4

Config. Used: 1

Config Change: none

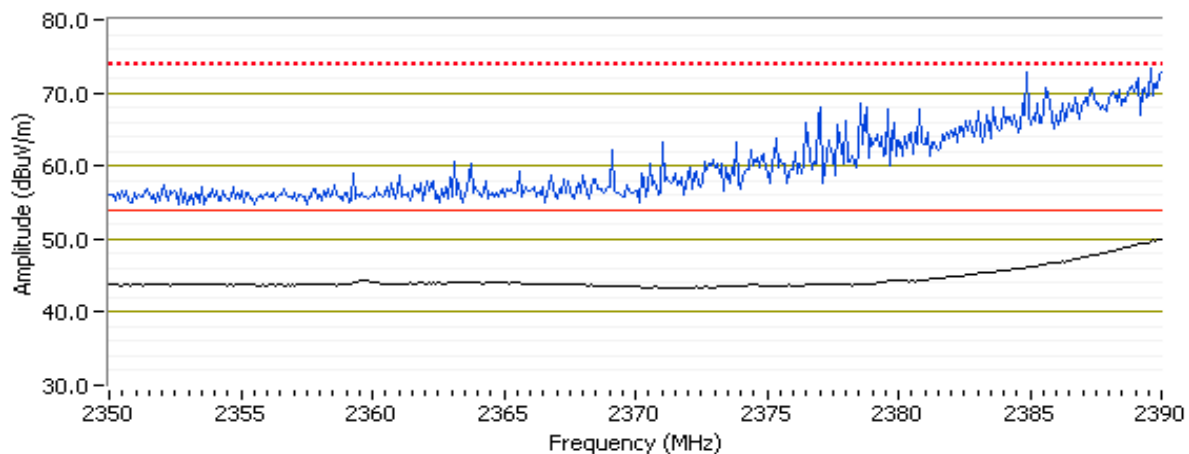
EUT Voltage: 120V/60Hz

Channel: 2 Mode: n20
Tx Chain: 1 Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.000	53.5	H	54.0	-0.5	AVG	80	1.1	POS; RB 1 MHz; VB: 10 Hz, 20.5
2387.760	69.9	H	74.0	-4.1	PK	80	1.1	POS; RB 1 MHz; VB: 3 MHz, 20.5
2390.000	48.6	V	54.0	-5.4	AVG	124	1.0	POS; RB 1 MHz; VB: 10 Hz, 20.5
2386.870	63.2	V	74.0	-10.8	PK	124	1.0	POS; RB 1 MHz; VB: 3 MHz, 20.5

RB 1 MHz; VB 10 Hz= avg (black) , 1MHz 3MHz = Pk (blue), Horizontal



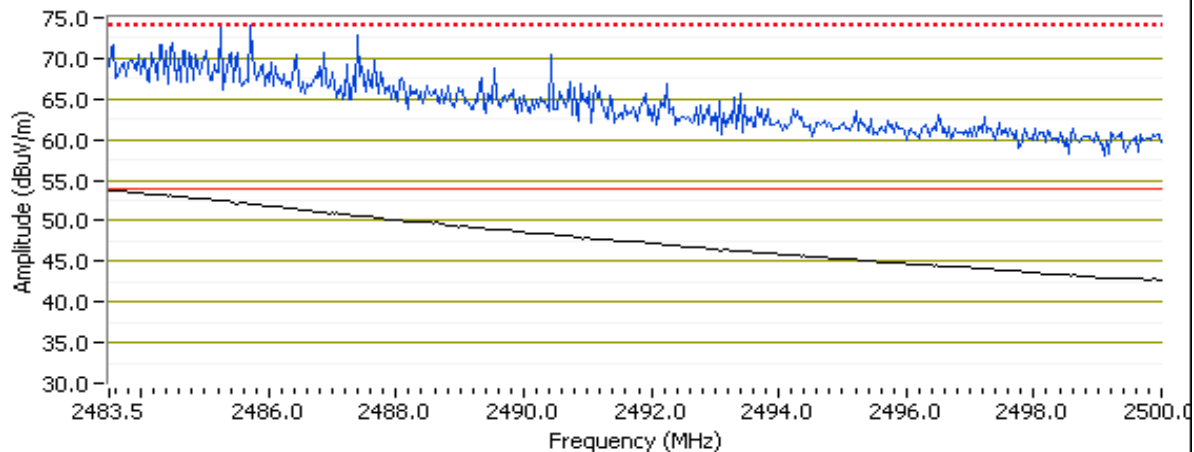
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 10 Mode: n20
 Tx Chain: 2 Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.570	52.6	H	54.0	-1.4	AVG	35	1.0	POS; RB 1 MHz; VB: 10 Hz, 21.5
2484.000	69.8	H	74.0	-4.2	PK	35	1.0	POS; RB 1 MHz; VB: 3 MHz, 21.5
2483.530	51.1	V	54.0	-2.9	AVG	77	1.0	POS; RB 1 MHz; VB: 10 Hz, 21.5
2489.820	68.6	V	74.0	-5.4	PK	77	1.0	POS; RB 1 MHz; VB: 3 MHz, 21.5

RB 1 MHz; VB 10 Hz= avg (black) , 1MHz 3MHz = Pk (blue), Horizontal



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions: Temperature: 28 °C
Rel. Humidity: 33.4 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Passing Power Setting	Test Performed	Limit	Result / Margin
1	b (chain 1)	1 - 2412MHz	23.0	23.0	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	64.0 dBµV/m @ 7235.1 MHz (-6.0 dB)
	b (chain 1)	6 - 2437MHz	23.0	22.5			53.5 dBµV/m @ 7310.2 MHz (-0.5 dB)
	b (chain 1)	11 - 2462MHz	23.0	22.5			52.7 dBµV/m @ 7385.2 MHz (-1.3 dB)

Scans on center channel in all three OFDM modes to determine the worst case mode.

2	g (chain 1)	6 - 2437MHz	23.0	23	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	49.1 dBµV/m @ 2200.0 MHz (-4.9 dB)
	g (chain 2)	6 - 2437MHz	23.0	23			46.8 dBµV/m @ 7309.3 MHz (-7.2 dB)
	n20 (2x2)	6 - 2437MHz	23.0	23			51.6 dBµV/m @ 7310.4 MHz (-2.4 dB)
	n40 (2x2)	6 - 2437MHz	14.0	14			49.7 dBµV/m @ 1050.0 MHz (-4.3 dB)

Measurements on low and high channels in worst-case OFDM mode.

3	n20 (2x2)	1 - 2412MHz	23	23	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	48.9 dBµV/m @ 7251.0 MHz (-5.1 dB)
	n20 (2x2)	11 - 2462MHz	23	23			52.8 dBµV/m @ 7388.1 MHz (-1.2 dB)

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: PV1056150225025

Driver: 5.99 RC 188.12

Antenna: Airgain N2420DS and N2415D2

CN3110-A0-Chain 1

CN3210-A1-Chain 2

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mbps	0.94	Yes	144	0.3	0.6	7
11a/g	6 Mbps	0.99	Yes	103.55	0	0	10
n20	MCS 0	0.99	Yes	95.85	0	0	10
n40	MCS 0	0.99	Yes	94.3	0	0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 3:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=10Hz or value in above table if higher, peak detector, linear averaging, auto sweep, trace average 100 traces

Notes:

11b performed using worse case chain from 11g

2.4GHz band reject filter used except above 18 GHz

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

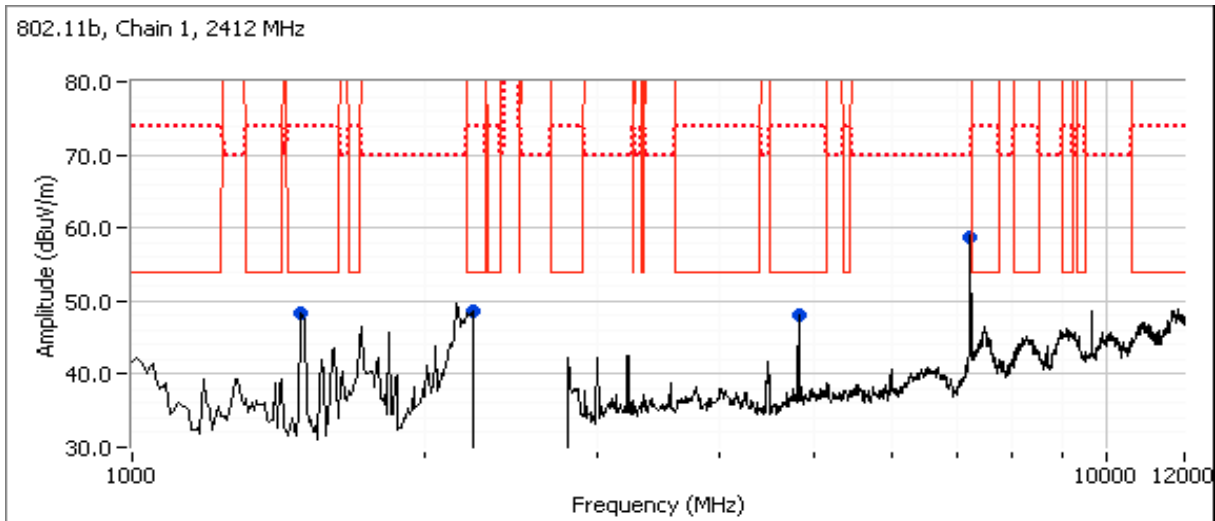
Run #1: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: 802.11b
 Date of Test: 8/18/2015 0:00 Config. Used: 1
 Test Engineer: Eddie Mariscal / R. Varelas Config Change: none
 Test Location: Chamber #5 EUT Voltage: 120V / 60Hz

Run #1a: Low Channel

Channel: 1 Mode: b
 Tx Chain: 1 Data Rate: 1 Mbps

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7235.100	64.0	V	82.8	-18.8	PK	87	1.5	RB 100 kHz;VB 100 kHz;Peak
4823.950	45.5	V	54.0	-8.5	AVG	325	2.0	RB 1 MHz;VB 10 Hz;Peak, Note 3
4823.910	50.2	V	74.0	-23.8	PK	325	2.0	RB 1 MHz;VB 3 MHz;Peak
2209.550	46.2	H	54.0	-7.8	AVG	101	1.2	RB 1 MHz;VB 10 Hz;Peak, Note 3
2209.550	58.6	H	74.0	-15.4	PK	101	1.2	RB 1 MHz;VB 3 MHz;Peak
1496.900	33.8	V	54.0	-20.2	AVG	360	2.1	RB 1 MHz;VB 10 Hz;Peak, Note 3
1499.840	53.5	V	74.0	-20.5	PK	360	2.1	RB 1 MHz;VB 3 MHz;Peak
2411.570	112.8	V	-	-	PK	360	1.0	RB 100 kHz;VB 100 kHz;Peak
2411.570	111.7	H	-	-	PK	287	1.0	RB 100 kHz;VB 100 kHz;Peak

Note: As there were no significant emissions observed above 12 GHz on the center channel, scans of this channel were only performed up to 12 GHz.

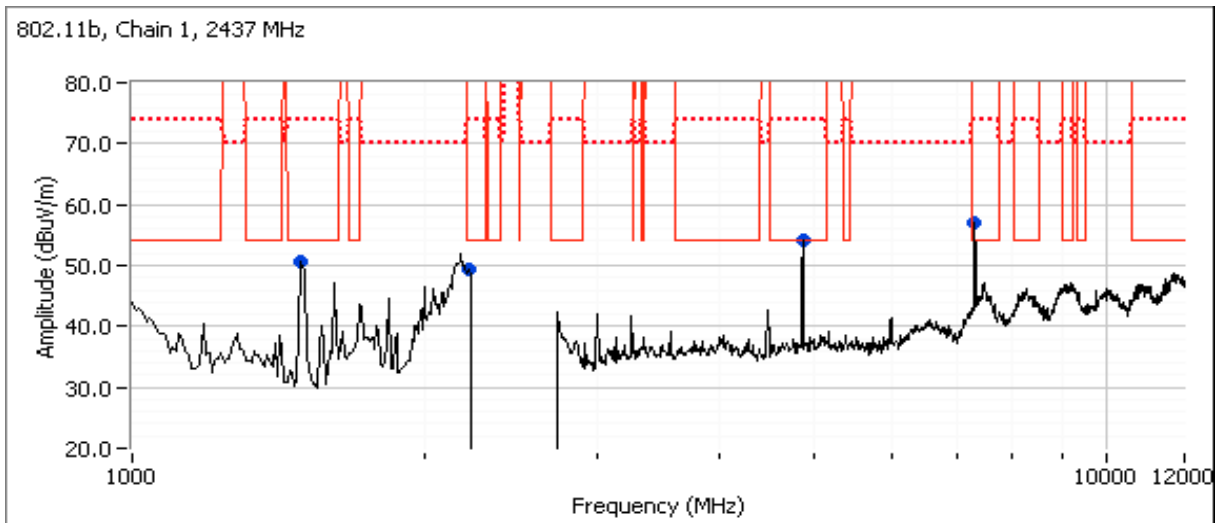


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

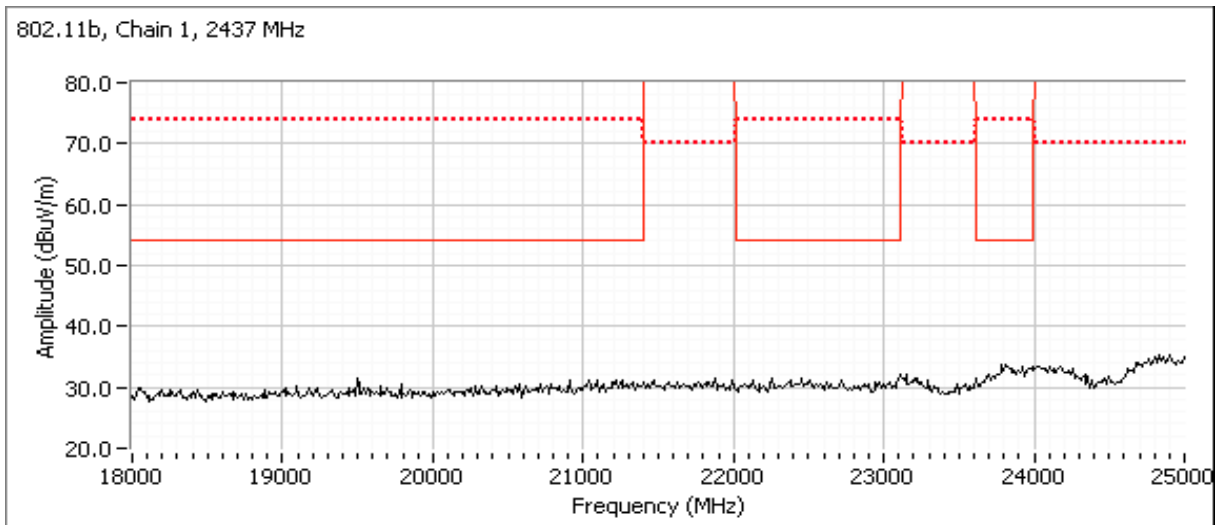
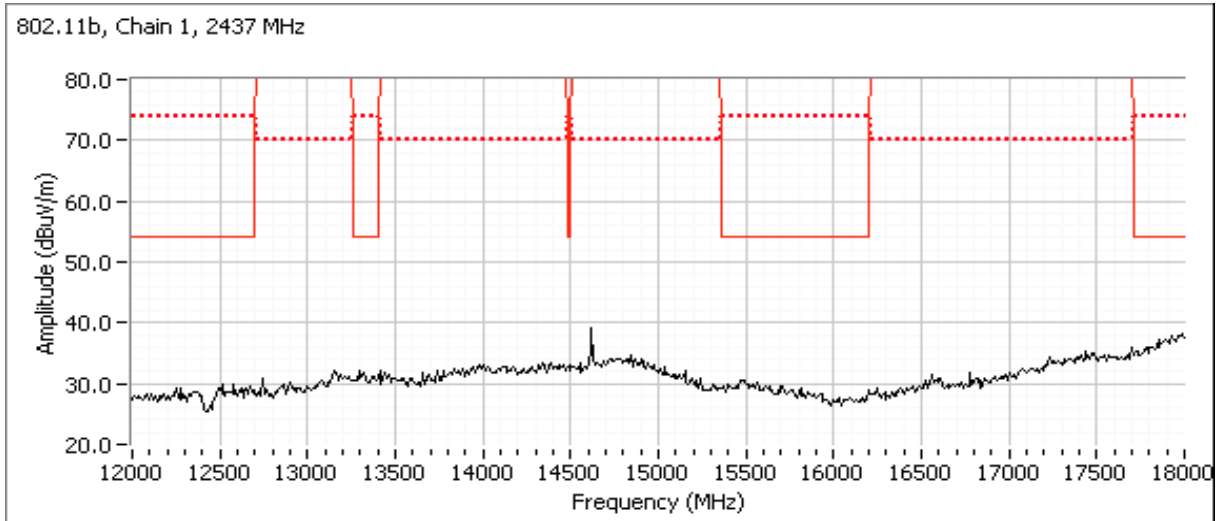
Run #1b: Center Channel

Channel: 6 Mode: b
 Tx Chain: 1 Data Rate: 1 Mbps

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
1500.080	36.4	V	54.0	-17.6	AVG	343	2.1	RB 1 MHz;VB 10 Hz;Peak, 3, q92
1492.910	57.3	V	74.0	-16.7	PK	343	2.1	RB 1 MHz;VB 3 MHz;Peak, q92
2200.030	45.4	V	54.0	-8.6	AVG	259	2.0	RB 1 MHz;VB 10 Hz;Peak, 3, q92
2200.060	57.1	V	74.0	-16.9	PK	259	2.0	RB 1 MHz;VB 3 MHz;Peak, q92
4873.960	52.0	V	54.0	-2.0	AVG	337	1.6	RB 1 MHz;VB 10 Hz;Peak, 3, q92
4873.870	54.5	V	74.0	-19.5	PK	337	1.6	RB 1 MHz;VB 3 MHz;Peak, q92
7310.190	53.5	V	54.0	-0.5	AVG	15	1.6	RB 1 MHz;VB 10 Hz;Peak, 3, q90
7311.060	59.5	V	74.0	-14.5	PK	15	1.6	RB 1 MHz;VB 3 MHz;Peak, q90



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Note: Scans made between 12 - 25 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range

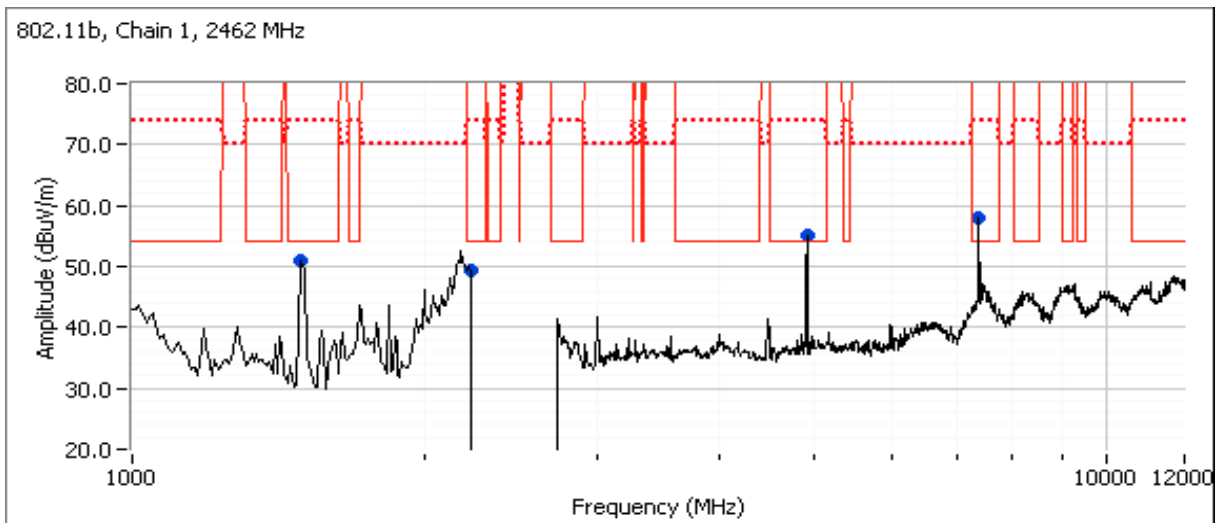
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1c: High Channel

Channel: 11 Mode: b
 Tx Chain: 1 Data Rate: 1 Mbps

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
1499.990	36.8	V	54.0	-17.2	AVG	343	2.1	RB 1 MHz;VB 10 Hz;Peak, 3, q92
1499.800	56.9	V	74.0	-17.1	PK	343	2.1	RB 1 MHz;VB 3 MHz;Peak, q92
2200.030	47.0	H	54.0	-7.0	AVG	303	1.6	RB 1 MHz;VB 10 Hz;Peak, 3, q92
2205.730	58.4	H	74.0	-15.6	PK	303	1.6	RB 1 MHz;VB 3 MHz;Peak, q92
7385.150	52.7	V	54.0	-1.3	AVG	161	2.2	RB 1 MHz;VB 10 Hz;Peak, 3, q90
7386.190	59.8	V	74.0	-14.2	PK	161	2.2	RB 1 MHz;VB 3 MHz;Peak, q90
4923.980	46.8	V	54.0	-7.2	AVG	342	1.7	RB 1 MHz;VB 10 Hz;Peak, 3, q90
4923.940	50.4	V	74.0	-23.6	PK	342	1.7	RB 1 MHz;VB 3 MHz;Peak, q90

Note: As there were no emissions observed above 12 GHz on the center channel, scans of this channel were only performed up to 12 GHz.





EMC Test Data

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

Run #2: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: OFDM
 Date of Test: 8/18/2015 0:00 Config. Used: 1
 Test Engineer: Eddie Mariscal Config Change: none
 Test Location: FT Chamber #5 EUT Voltage: 120V/60Hz

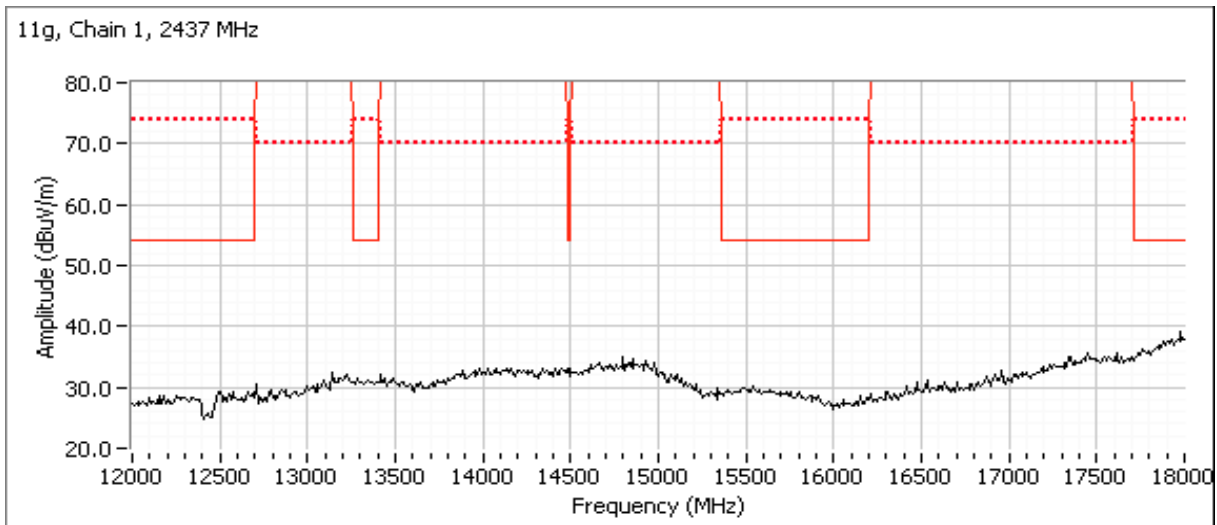
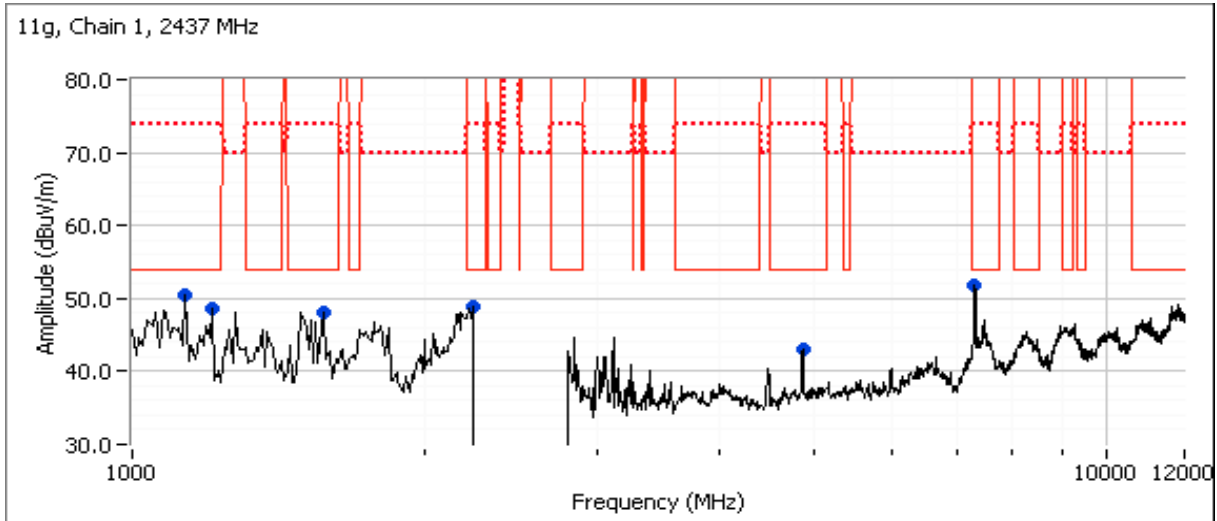
Run #2a: Center Channel

Channel: 6 Mode: g
 Tx Chain: 1 Data Rate: 6 Mbps

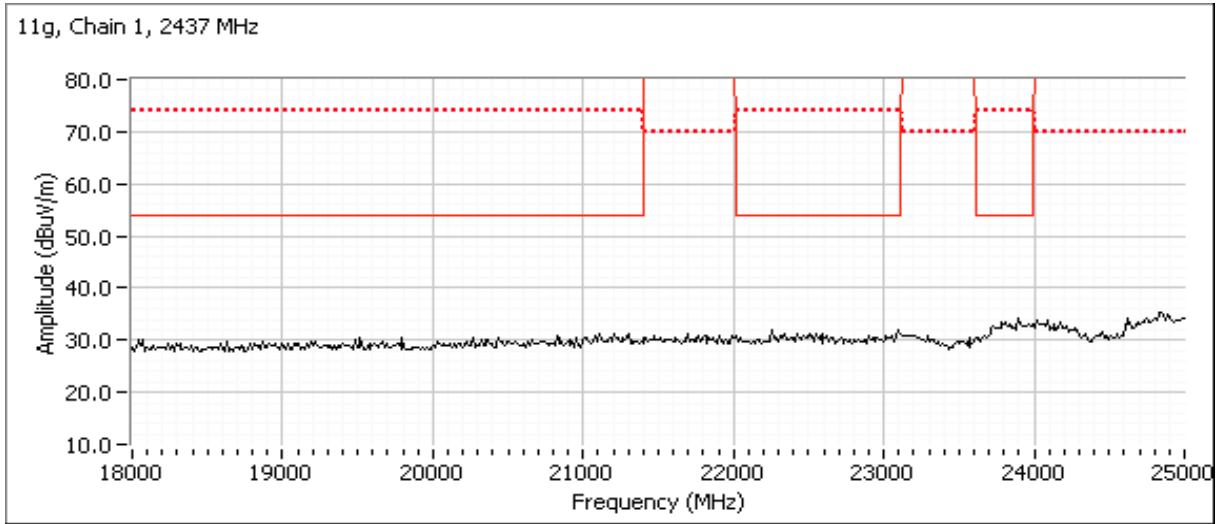
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2200.000	49.1	H	54.0	-4.9	AVG	301	1.3	RB 1 MHz;VB 10 Hz;Peak
2215.640	61.1	H	74.0	-12.9	PK	301	1.3	RB 1 MHz;VB 3 MHz;Peak
4874.210	38.4	V	54.0	-15.6	AVG	339	1.7	RB 1 MHz;VB 10 Hz;Peak
4873.370	52.7	V	74.0	-21.3	PK	339	1.7	RB 1 MHz;VB 3 MHz;Peak
1199.400	31.3	V	54.0	-22.7	AVG	12	1.0	RB 1 MHz;VB 10 Hz;Peak
1199.630	58.0	V	74.0	-16.0	PK	12	1.0	RB 1 MHz;VB 3 MHz;Peak
7311.230	47.7	V	54.0	-6.3	AVG	173	1.9	RB 1 MHz;VB 10 Hz;Peak
7312.650	62.5	V	74.0	-11.5	PK	173	1.9	RB 1 MHz;VB 3 MHz;Peak
1139.970	33.0	H	54.0	-21.0	AVG	26	1.5	RB 1 MHz;VB 10 Hz;Peak
1142.320	60.3	H	74.0	-13.7	PK	26	1.5	RB 1 MHz;VB 3 MHz;Peak
1571.490	32.1	V	54.0	-21.9	AVG	355	1.5	RB 1 MHz;VB 10 Hz;Peak
1573.470	54.7	V	74.0	-19.3	PK	355	1.5	RB 1 MHz;VB 3 MHz;Peak

Note: Scans made between 12 - 25 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

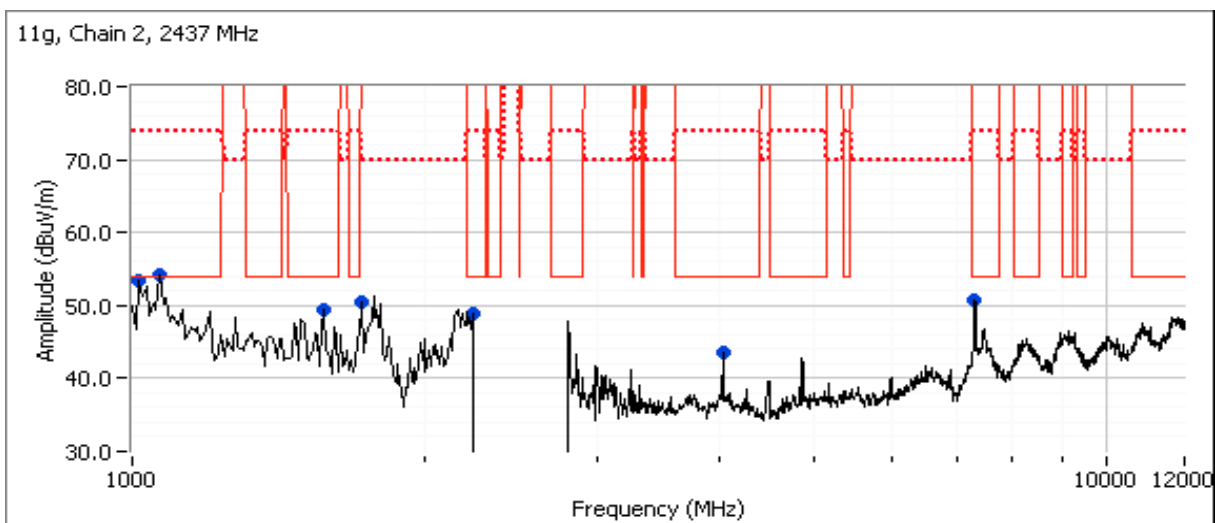


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Channel: 6 Mode: g
 Tx Chain: 2 Data Rate: 6 Mbps

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1600.160	36.8	V	54.0	-17.2	AVG	1	1.1	RB 1 MHz;VB 10 Hz;Peak
1599.430	54.1	V	74.0	-19.9	PK	1	1.1	RB 1 MHz;VB 3 MHz;Peak
1019.850	39.5	V	54.0	-14.5	AVG	357	1.1	RB 1 MHz;VB 10 Hz;Peak
1014.820	66.9	V	74.0	-7.1	PK	357	1.1	RB 1 MHz;VB 3 MHz;Peak
3996.000	34.0	V	54.0	-20.0	AVG	58	2.1	RB 1 MHz;VB 10 Hz;Peak
3995.950	44.9	V	74.0	-29.1	PK	58	2.1	RB 1 MHz;VB 3 MHz;Peak
7309.300	46.8	V	54.0	-7.2	AVG	62	1.9	RB 1 MHz;VB 10 Hz;Peak
7306.930	60.7	V	74.0	-13.3	PK	62	1.9	RB 1 MHz;VB 3 MHz;Peak
1064.140	26.1	H	54.0	-27.9	AVG	65	1.9	RB 1 MHz;VB 10 Hz;Peak
1065.190	55.3	H	74.0	-18.7	PK	65	1.9	RB 1 MHz;VB 3 MHz;Peak
2200.100	45.2	V	54.0	-8.8	AVG	263	1.5	RB 1 MHz;VB 10 Hz;Peak
2218.150	56.8	V	74.0	-17.2	PK	263	1.5	RB 1 MHz;VB 3 MHz;Peak
1719.830	39.1	V	54.0	-14.9	AVG	0	1.8	RB 1 MHz;VB 10 Hz;Peak
1718.750	59.7	V	70.0	-10.3	PK	0	1.8	RB 1 MHz;VB 3 MHz;Peak

Note: As there were no significant emissions observed above 12 GHz on the Chain 1, scans of this chain were only performed up to 12 GHz.



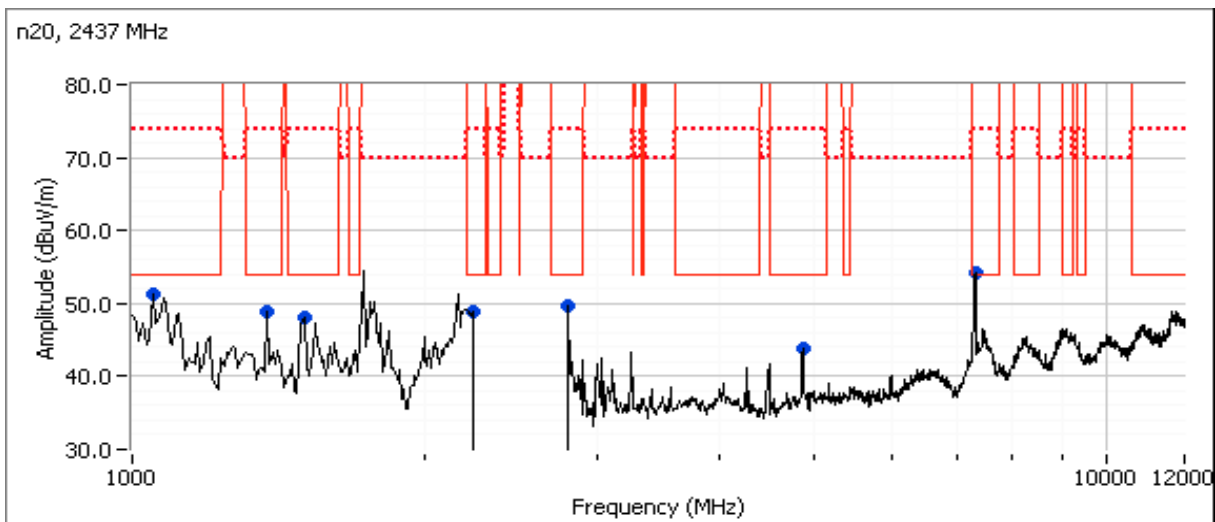
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #2b: Center Channel

Channel: 6 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS 0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4873.890	38.7	V	54.0	-15.3	AVG	337	1.6	RB 1 MHz;VB 10 Hz;Peak
4873.190	53.1	V	74.0	-20.9	PK	337	1.6	RB 1 MHz;VB 3 MHz;Peak
2223.380	46.6	H	54.0	-7.4	AVG	297	1.3	RB 1 MHz;VB 10 Hz;Peak
2225.310	58.4	H	74.0	-15.6	PK	297	1.3	RB 1 MHz;VB 3 MHz;Peak
1049.600	38.4	V	54.0	-15.6	AVG	11	1.8	RB 1 MHz;VB 10 Hz;Peak
1048.200	69.5	V	74.0	-4.5	PK	11	1.8	RB 1 MHz;VB 3 MHz;Peak
1373.870	33.8	V	54.0	-20.2	AVG	136	1.2	RB 1 MHz;VB 10 Hz;Peak
1379.670	53.5	V	74.0	-20.5	PK	136	1.2	RB 1 MHz;VB 3 MHz;Peak
2790.070	37.0	V	54.0	-17.0	AVG	218	1.8	RB 1 MHz;VB 10 Hz;Peak
2802.070	51.6	V	74.0	-22.4	PK	218	1.8	RB 1 MHz;VB 3 MHz;Peak
7310.420	51.6	V	54.0	-2.4	AVG	177	1.9	RB 1 MHz;VB 10 Hz;Peak
7310.380	65.0	V	74.0	-9.0	PK	177	1.9	RB 1 MHz;VB 3 MHz;Peak
1498.540	33.8	V	54.0	-20.2	AVG	0	1.6	RB 1 MHz;VB 10 Hz;Peak
1499.910	55.5	V	74.0	-18.5	PK	0	1.6	RB 1 MHz;VB 3 MHz;Peak

Note: As there were no significant emissions observed above 12 GHz on the center channel in g mode, scans of this channel were only performed up to 12 GHz.



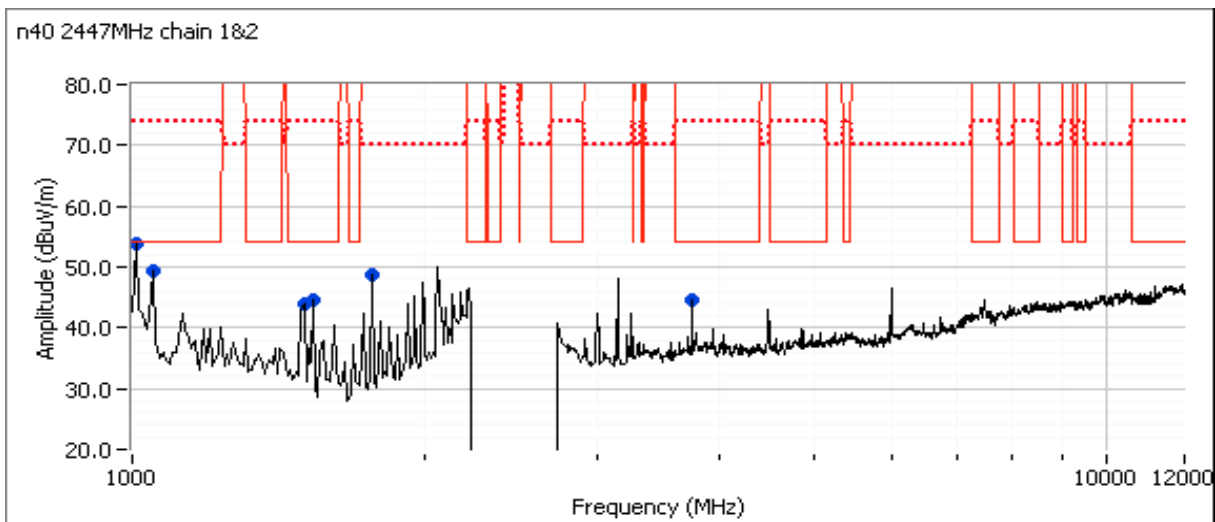
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #2d: Center Channel

Channel: 6 Mode: n40
 Tx Chain: 2x2 Data Rate: MCS 0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
1012.550	53.1	H	54.0	-0.9	AVG	243	1.6	RB 1 MHz;VB 10 Hz;Peak, Note 1
1012.660	54.3	H	74.0	-19.7	PK	243	1.6	RB 1 MHz;VB 3 MHz;Peak, Note 1
1050.030	49.7	V	54.0	-4.3	AVG	135	2.12	RB 1 MHz;VB 10 Hz;Peak
1050.020	51.9	V	74.0	-22.1	PK	135	2.12	RB 1 MHz;VB 3 MHz;Peak
1500.170	38.8	H	54.0	-15.2	AVG	234	1.6	RB 1 MHz;VB 10 Hz;Peak
1500.040	47.7	H	74.0	-26.3	PK	234	1.6	RB 1 MHz;VB 3 MHz;Peak
1533.300	44.4	H	54.0	-9.6	AVG	171	1.00	RB 1 MHz;VB 10 Hz;Peak
1533.200	49.7	H	74.0	-24.3	PK	171	1.00	RB 1 MHz;VB 3 MHz;Peak
1762.530	46.1	V	54.0	-7.9	AVG	188	1.00	RB 1 MHz;VB 10 Hz;Peak, Note 2
1762.650	47.9	V	74.0	-26.1	PK	188	1.00	RB 1 MHz;VB 3 MHz;Peak, Note 2
3750.260	47.7	V	54.0	-6.3	AVG	189	1.6	RB 1 MHz;VB 10 Hz;Peak
3750.140	50.3	V	74.0	-23.7	PK	189	1.6	RB 1 MHz;VB 3 MHz;Peak

Note 1:	Confirmed that the emission was not related to the EUT.
Note 2:	Emission in non-restricted band, but limit of 15.209 used.
Note 3:	As there were no significant emissions observed above 12 GHz on the center channel in g mode, scans of this channel were only performed up to 12 GHz.



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #3: Radiated Spurious Emissions, 1,000 - 12000 MHz. Operating Mode: Worse case from Run #2

Date of Test: 8/20/2015 0:00

Config. Used: 1

Test Engineer: Eddie Mariscal

Config Change: None

Test Location: FT Chamber #5

EUT Voltage: 120V/60Hz

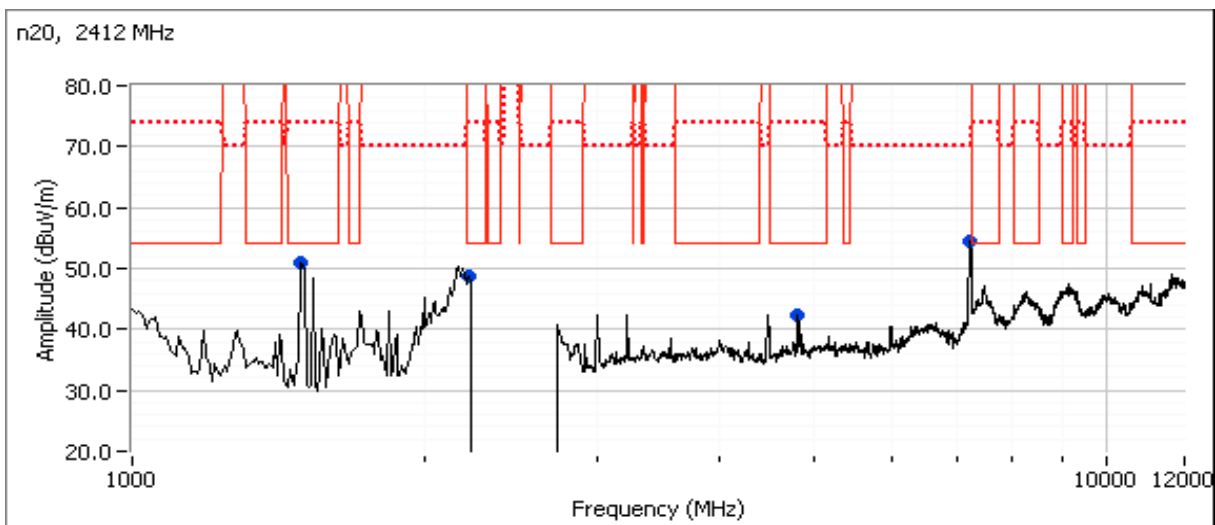
Run #3a: Low Channel

Channel: 1 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4823.500	35.4	V	54.0	-18.6	AVG	22	1.3	RB 1 MHz;VB 10 Hz;Peak
4823.430	49.9	V	74.0	-24.1	PK	22	1.3	RB 1 MHz;VB 3 MHz;Peak
7250.980	48.9	V	54.0	-5.1	AVG	153	1.8	RB 1 MHz;VB 10 Hz;Peak
7256.080	63.9	V	74.0	-10.1	PK	153	1.8	RB 1 MHz;VB 3 MHz;Peak
2200.500	46.5	H	54.0	-7.5	AVG	101	1.2	RB 1 MHz;VB 10 Hz;Peak
2200.500	58.2	H	74.0	-15.8	PK	101	1.2	RB 1 MHz;VB 3 MHz;Peak
1496.190	37.0	V	54.0	-17.0	AVG	344	2.1	RB 1 MHz;VB 10 Hz;Peak
1499.840	57.0	V	74.0	-17.0	PK	344	2.1	RB 1 MHz;VB 3 MHz;Peak

Note:

As there were no significant emissions observed above 12 GHz on the center channel in g mode, scans of this channel were only performed up to 12 GHz.

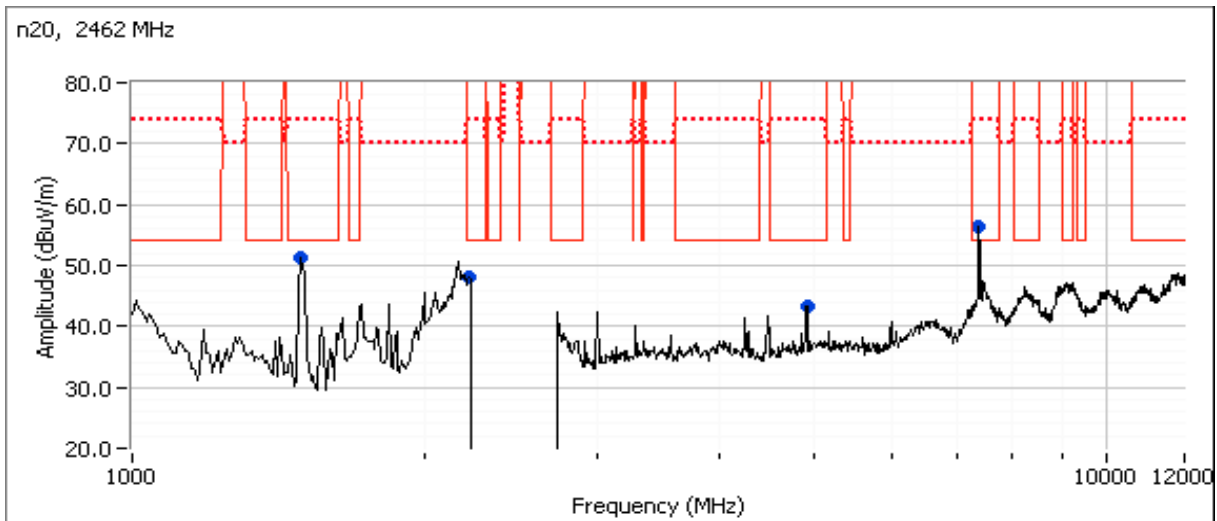


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #3b: High Channel

Channel: 11 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
1500.020	35.8	V	54.0	-18.2	AVG	0	1.6	RB 1 MHz;VB 10 Hz;Peak
1500.010	56.3	V	74.0	-17.7	PK	0	1.6	RB 1 MHz;VB 3 MHz;Peak
2214.530	45.1	H	54.0	-8.9	AVG	304	1.6	RB 1 MHz;VB 10 Hz;Peak
2213.960	57.6	H	74.0	-16.4	PK	304	1.6	RB 1 MHz;VB 3 MHz;Peak
4923.630	39.6	V	54.0	-14.4	AVG	331	1.6	RB 1 MHz;VB 10 Hz;Peak
4923.550	53.9	V	74.0	-20.1	PK	331	1.6	RB 1 MHz;VB 3 MHz;Peak
7388.070	52.8	V	54.0	-1.2	AVG	178	1.8	RB 1 MHz;VB 10 Hz;Peak
7377.670	66.0	V	74.0	-8.0	PK	178	1.8	RB 1 MHz;VB 3 MHz;Peak



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 4/6/2015 & 4/7/2015
 Test Engineer: John Caizzi
 Test Location: Chamber 7

Config. Used:
 Config Change: none
 EUT Voltage: 120V/60Hz

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 23 °C
 Rel. Humidity: 40 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	3		Output Power	15.247(b)	Pass	1.5 dBm
2			Power spectral Density (PSD)	15.247(d)	Pass	-6.6 dBm/30kHz
3			Minimum 6dB Bandwidth	15.247(a)	Pass	1.56 MHz
3			99% Bandwidth	RSS GEN	-	2.40 MHz
4			Spurious emissions	15.247(b)	Pass	All emissions < -30 dBc

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
RF4CE	-	1.00	Yes	100	0	0	10

Sample Notes

Sample S/N: PV1056150225013

Driver: 5.99 RC 188.12

Antenna: Integral PCB trace antennas (Diversity)

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Output Power

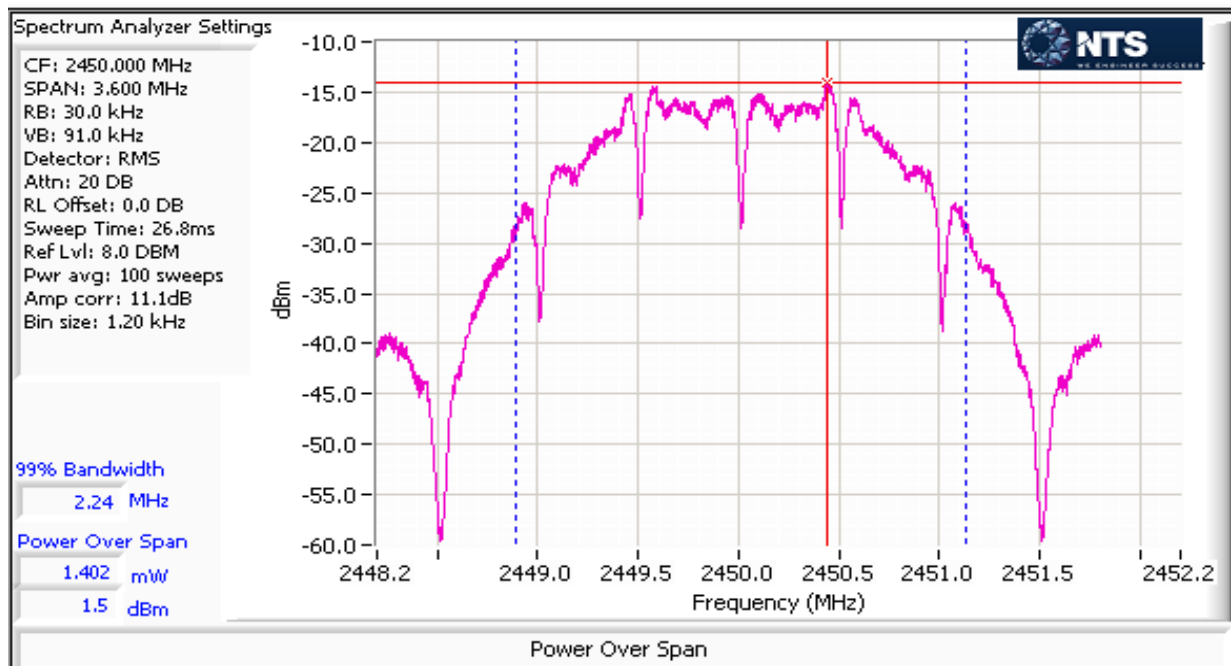
Mode: RF4CE

All measurements made on chain 1, which had higher output than chain 2

Max EIRP (mW): 0.003

Power Setting ²	Frequency (MHz)	Output Power		Antenna Gain (dBi)	Result	EIRP		Output Power	
		(dBm) ¹	mW			dBm	W	(dBm) ³	mW
3	2425	1.1	1.3	3.1	Pass	4.2	0.003		
	2450	1.5	1.4	3.1	Pass	4.6	0.003		
	2475	1.1	1.3	3.1	Pass	4.2	0.003		

Note 1:	Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Spurious limit becomes -30dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.



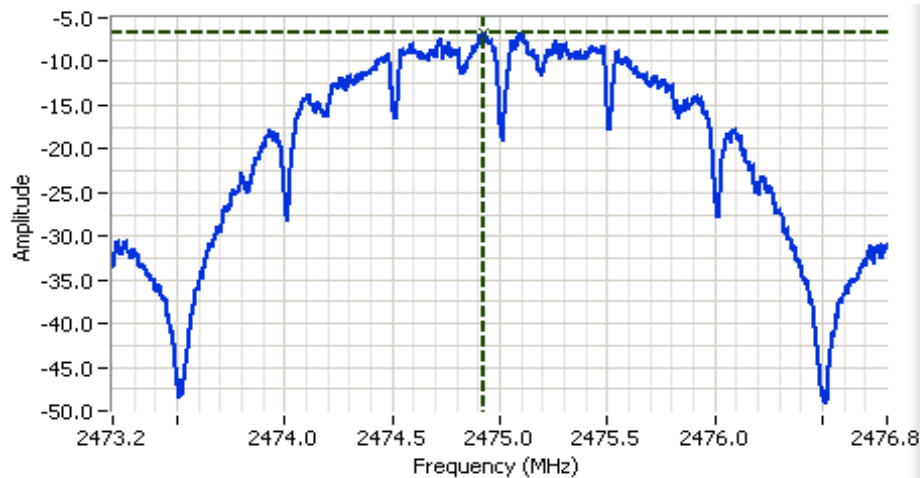
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #2: Power spectral Density

All measurements made on chain 1, which had higher output than chain 2

Power Setting	Frequency (MHz)	PSD (dBm/30kHz) ^{Note 1}	Limit dBm/3kHz	Result
3	2425	-7.3	8.0	Pass
	2450	-6.7	8.0	Pass
	2475	-6.6	8.0	Pass

Note 1: Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: $3\text{kHz} \leq \text{RBW} \leq 100\text{kHz}$, $\text{VBW}=3*\text{RBW}$, peak detector, span = $1.5*\text{DTS BW}$, auto sweep time, max hold.



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 2475.000 MHz
 SPAN: 3.600 MHz
 RB: 30.0 kHz
 VB: 91.0 kHz
 Detector: PK (CISPR)
 Attn: 10 DB
 RL Offset: 11.1 DB
 Sweep Time: 8.6ms
 Ref Lvl: 0.0 DBM

Comments
 PSD = -6.6 dBm/30kHz
 Chain 1 CH25

Cursor 1 2474.9262 -6.6
 0.0000 0.0

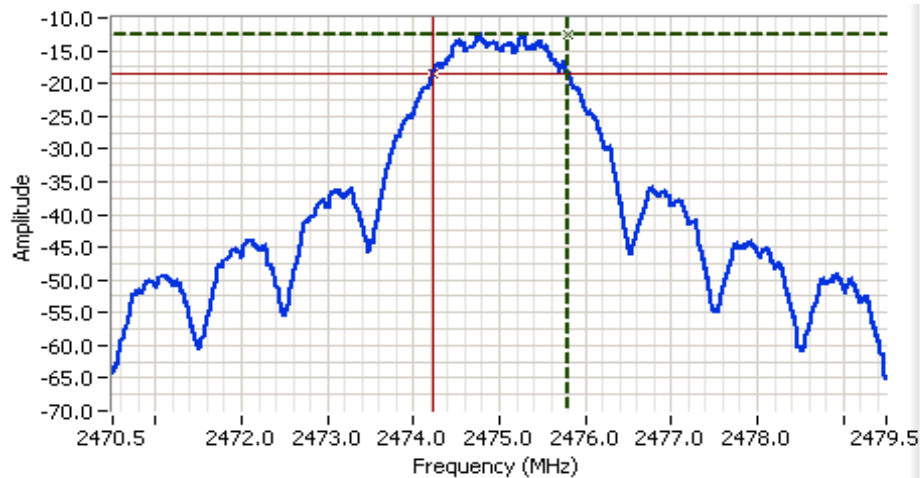
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #3: Signal Bandwidth

All measurements made on chain 1, which had higher output than chain 2

Power Setting	Frequency (MHz)	Bandwidth (kHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
3	2425	1.60	2.39	100	30
	2450	1.57	2.40		
	2475	1.56	2.39		

Note 1: DTS BW: RBW=100kHz, VBW $\geq 3 \times$ RBW, peak detector, max hold, auto sweep time.
 99% BW: RBW=1-5% of 99%BW, VBW $\geq 3 \times$ RBW, peak detector, max hold, auto sweep time.



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2475.000 MHz
 SPAN: 9.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 1.0ms
 Ref Lvl: 8.0 DBM

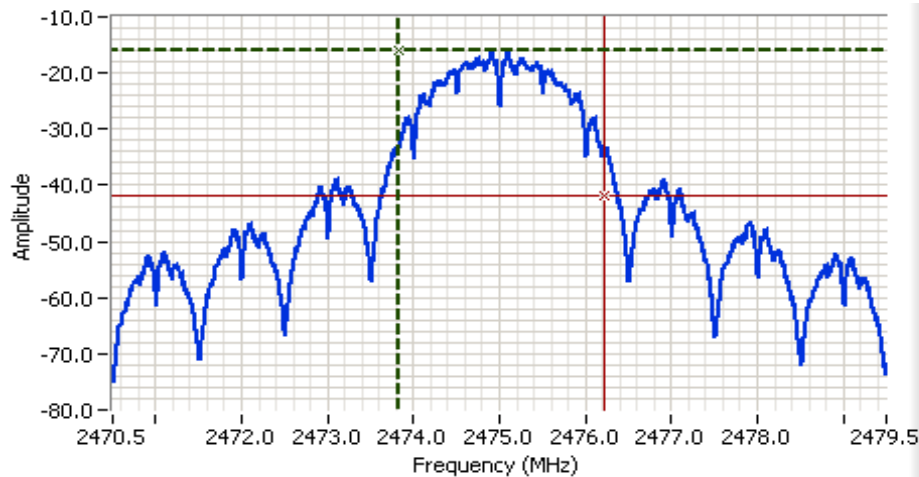
Comments

6dB BW: 1.564 MHz
 Chain 1 CH25

Cursor 1	2475.7968	-12.5	
Cursor 2	2474.2332	-18.5	

Delta Freq. 1.564
 Delta Amplitude 6.0

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Analyzer Settings

Agilent Technologies, E4446A
 CF: 2475.000 MHz
 SPAN: 9.000 MHz
 RB: 30.0 kHz
 VB: 91.0 kHz
 Detector: POS
 Attn: 20 DB
 RL Offset: 0.0 DB
 Sweep Time: 9.6ms
 Ref Lvl: 8.0 DBM

Comments

99% power BW: 2.388 MHz
 Chain 1 CH25

Cursor 1	2473.8210	-16.0			
Cursor 2	2476.2090	-42.0			

Delta Freq. 2.388

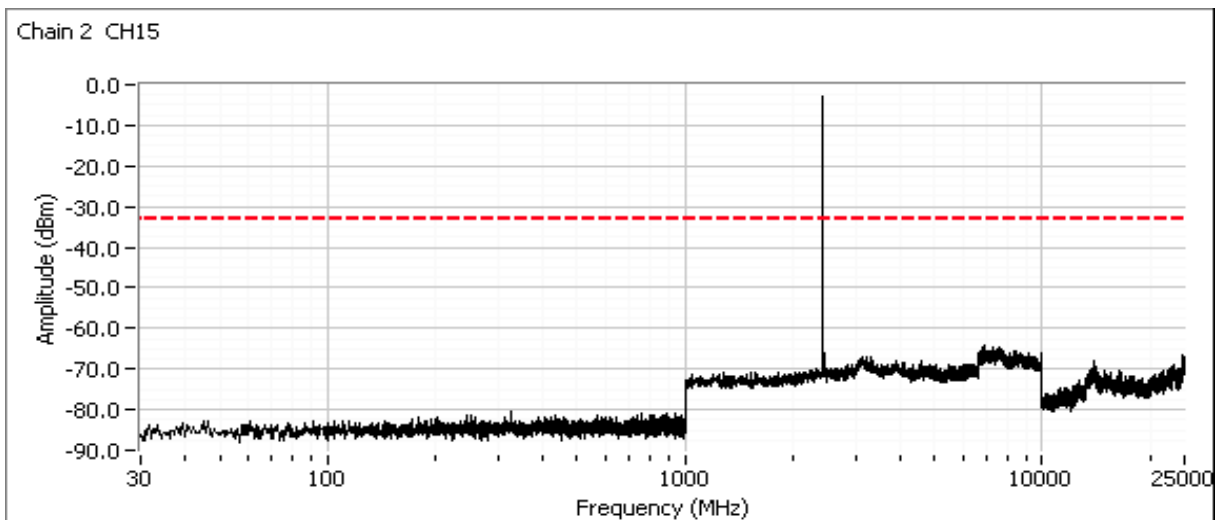
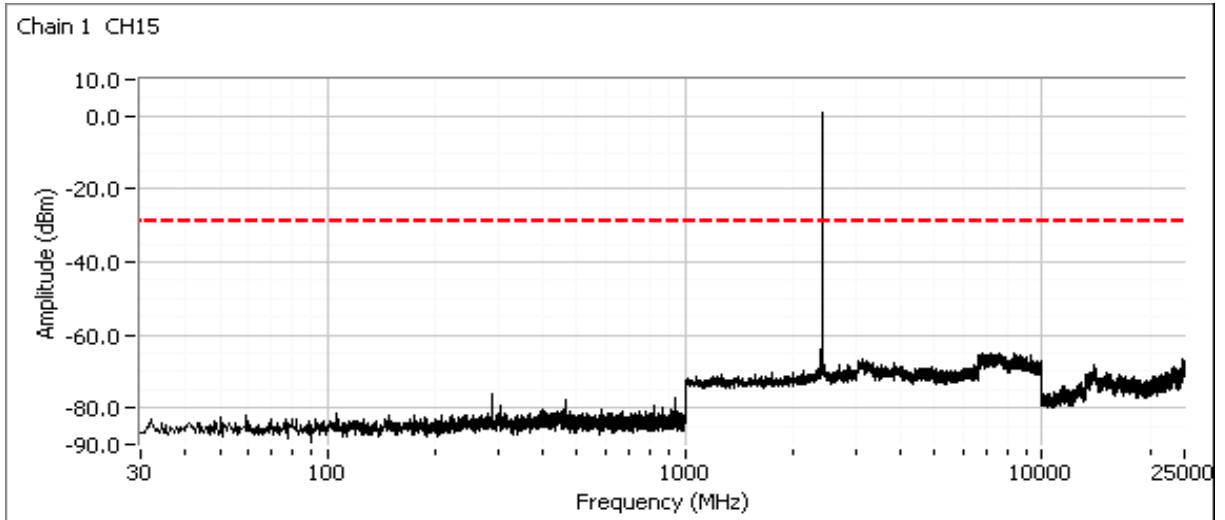
Delta Amplitude 26.0

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #4a: Out of Band Spurious Emissions

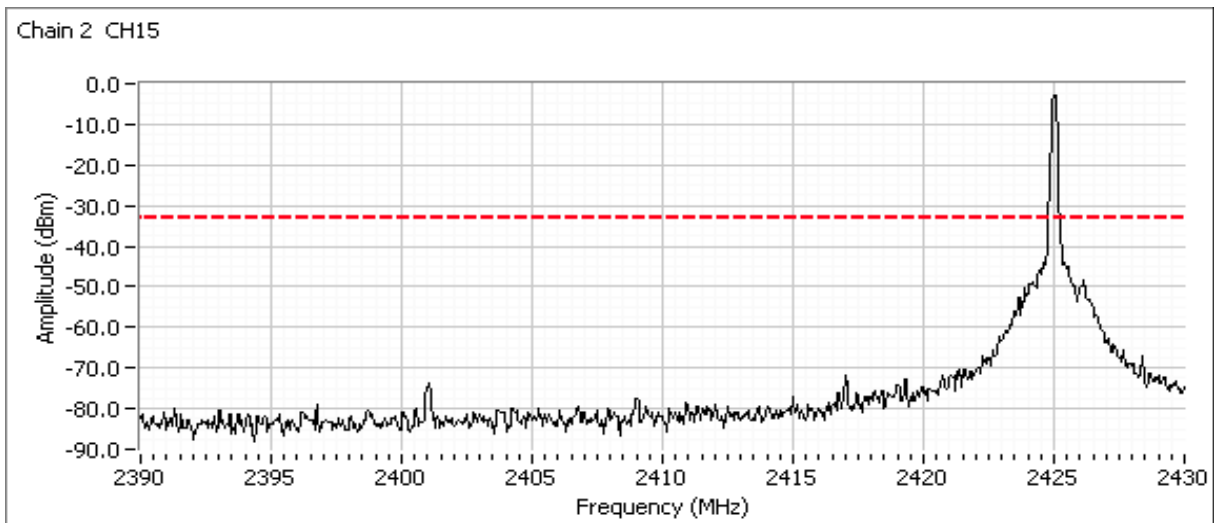
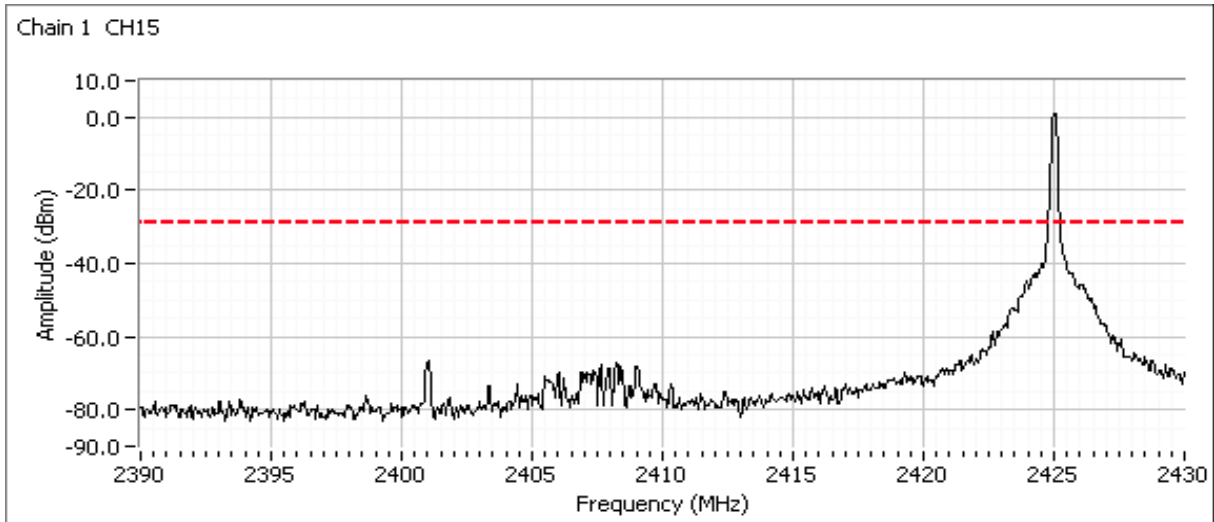
Power Setting Per Chain				Mode	Frequency (MHz)	Limit	Result
#1	#2	#3	#4				
3	3			RF4CE	2425	-30 dBc	Pass
					2450		Pass
					2475		Pass

Plots for low channel



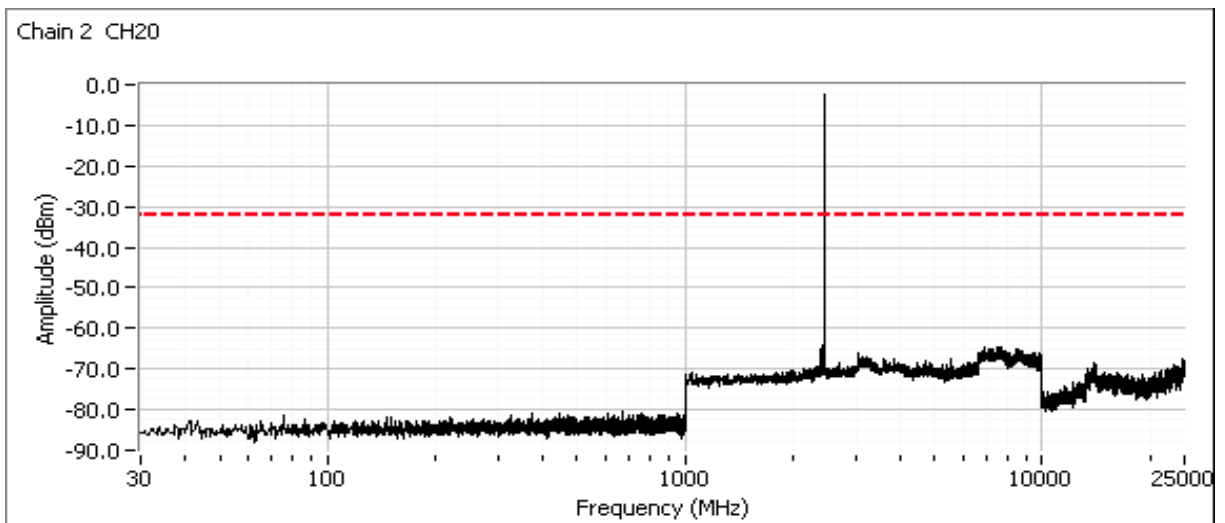
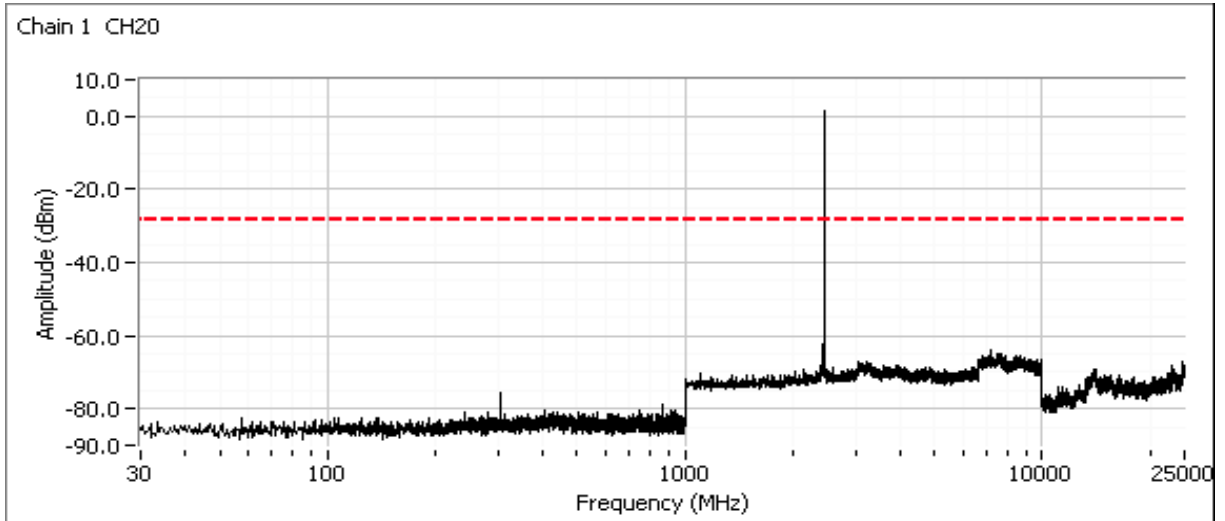
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.



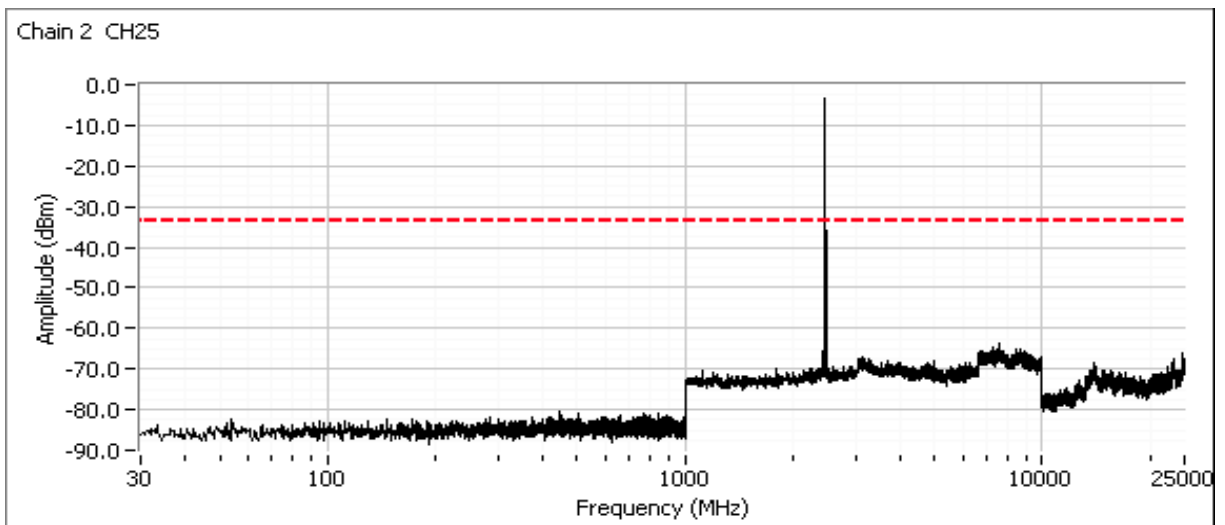
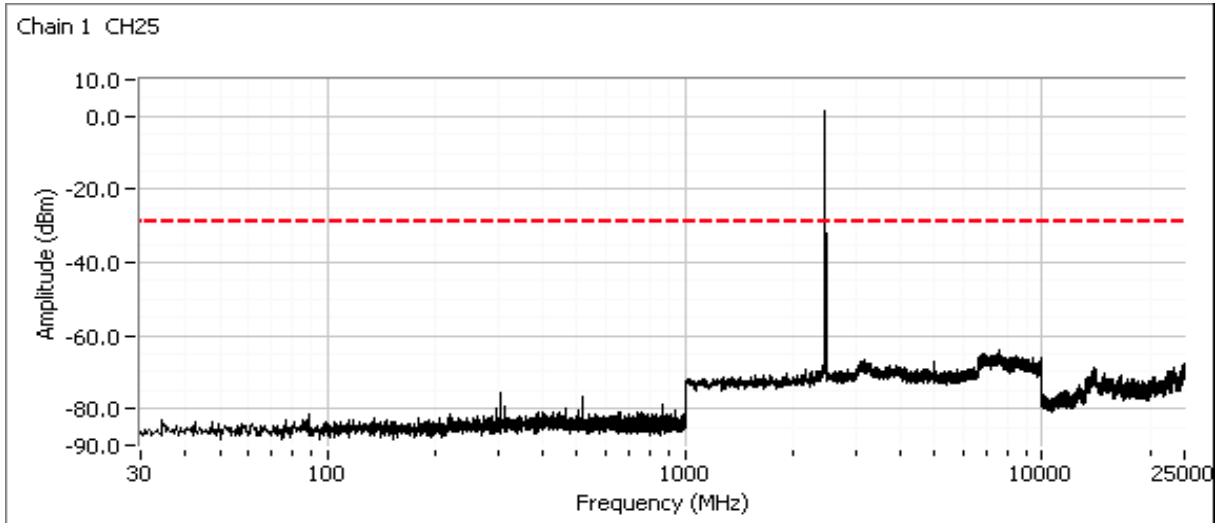
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Plots for center channel



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Plots for high channel



Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
 For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 28 °C
 Rel. Humidity: 31 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	RF4CE	2425MHz	W 3	W 3	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	38.4 dBμV/m @ 2362.6 MHz (-15.6 dB)
	RF4CE	2475MHz	W 3	W 3	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	35.2 dBμV/m @ 2484.0 MHz (-18.8 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: PV1056150225025
 Driver: 5.99 RC 188.12
 Antenna: Integral PCB trace antennas (Diversity)

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
RF4CE	-	1.00	Yes	100	0	0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle $< 98\%$ and is NOT constant, average measurement performed: RBW=1MHz, VBW $> 1/T$, peak detector, linear average mode, sweep time auto, max hold. Max hold for $50 \cdot (1/DC)$ traces
Note 5:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Radiated Bandedge Measurements

Date of Test: 03/26/15

Test Engineer: Joseph Cadigal

Test Location: Fremont Chamber #7

Test Location: Chamber 7

EUT Voltage: 120V / 60Hz

Channel: 2405MHz

Mode:

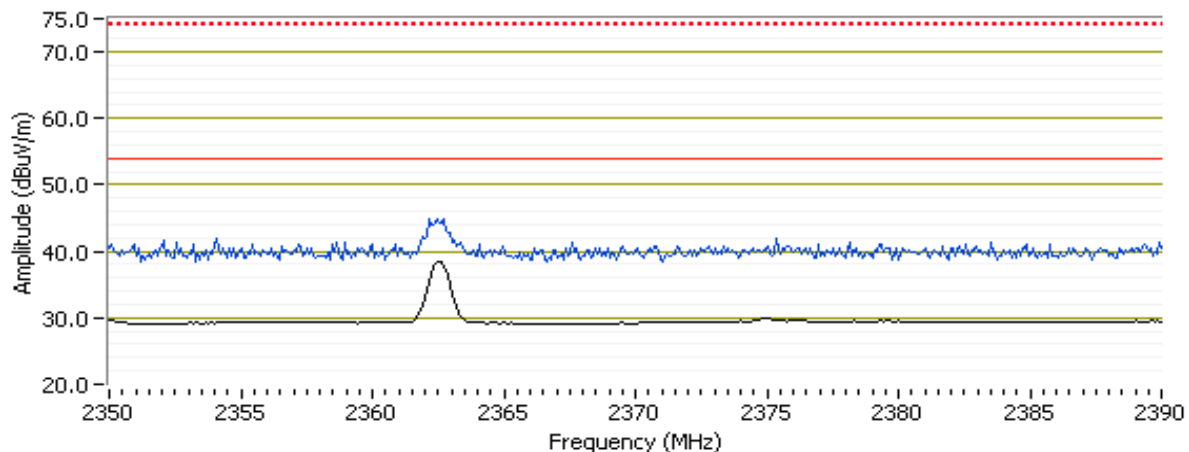
RF4CE

Highest of either Chain 0 or 1

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2362.590	38.4	H	54.0	-15.6	AVG	225	1.0	POS; RB 1 MHz; VB: 10 Hz
2362.750	41.3	H	74.0	-32.7	PK	225	1.0	POS; RB 1 MHz; VB: 3 MHz
2362.510	37.1	V	54.0	-16.9	AVG	194	1.0	POS; RB 1 MHz; VB: 10 Hz
2362.590	44.0	V	74.0	-30.0	PK	194	1.0	POS; RB 1 MHz; VB: 3 MHz

RB 1 MHz; VB 10 Hz= Avg=Black; 1MHz 3MHz Pk=Blue, H



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

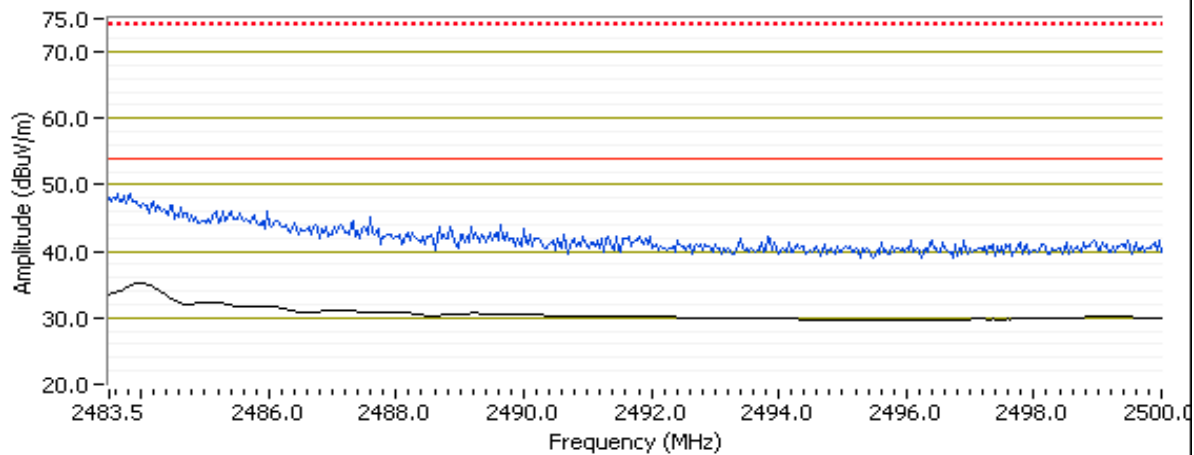
Channel: 2475MHz Mode: RF4CE

Highest of either Chain 0 or 1

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2484.000	35.2	V	54.0	-18.8	AVG	38	1.0	POS; RB 1 MHz; VB: 10 Hz
2484.390	46.5	V	74.0	-27.5	PK	38	1.0	POS; RB 1 MHz; VB: 3 MHz
2483.960	34.1	H	54.0	-19.9	AVG	338	1.6	POS; RB 1 MHz; VB: 10 Hz
2485.450	46.1	H	74.0	-27.9	PK	338	1.6	POS; RB 1 MHz; VB: 3 MHz

RB 1 MHz; VB 10 Hz= Avg=Black; 1MHz 3MHz Pk=Blue, V



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 25 °C
 Rel. Humidity: 31 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	RF4CE	2425MHz	W 3	W 3	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	45.5 dBµV/m @ 3750.1 MHz (-8.5 dB)
	RF4CE	2450MHz	W 3	W 3	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	36.4 dBµV/m @ 4901.1 MHz (-17.6 dB)
	RF4CE	2475MHz	W 3	W 3	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	46.3 dBµV/m @ 3750.0 MHz (-7.7 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: PV1056150225025

Driver: 5.99 RC 188.12

Antenna: Integral PCB trace antennas (Diversity)

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

2.4GHz band reject filter used

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
RF4CE	-	1.00	Yes	100	0	0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle $< 98\%$ and is NOT constant, average measurement performed: RBW=1MHz, VBW $> 1/T$, peak detector, linear average mode, sweep time auto, max hold. Max hold for $50 \cdot (1/DC)$ traces
Note 5:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Notes:

2.4GHz band reject filter used except above 18 GHz



EMC Test Data

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Radiated Spurious Emissions, 1,000 - 25000 MHz

Date of Test: 3/27/2015 20:00

Test Engineer: Joseph Cadigal

Test Location: FT Chamber#7

Config. Used: 1

Config Change: none

EUT Voltage: 120V/60Hz

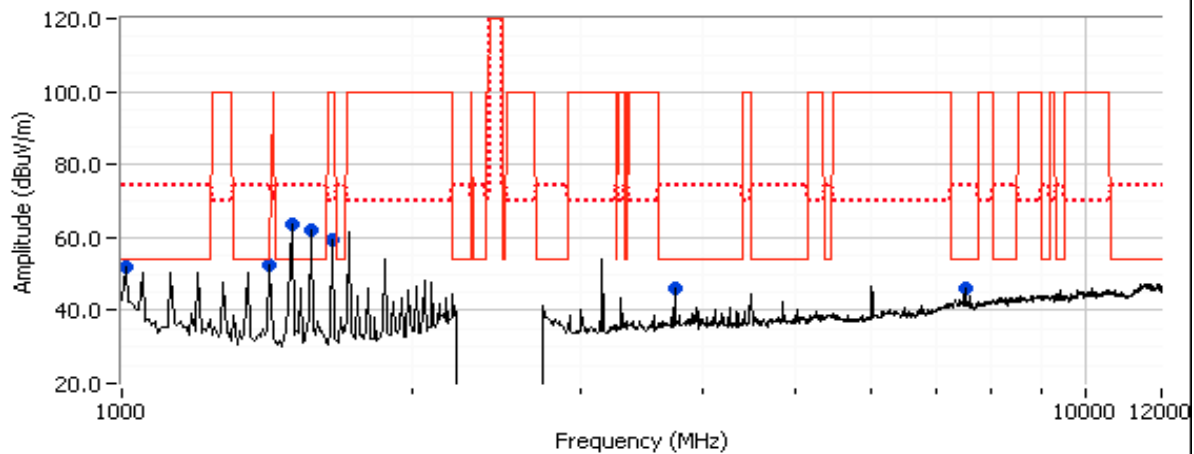
Run #1a: Low Channel

Channel: 2425MHz Mode: RF4CE

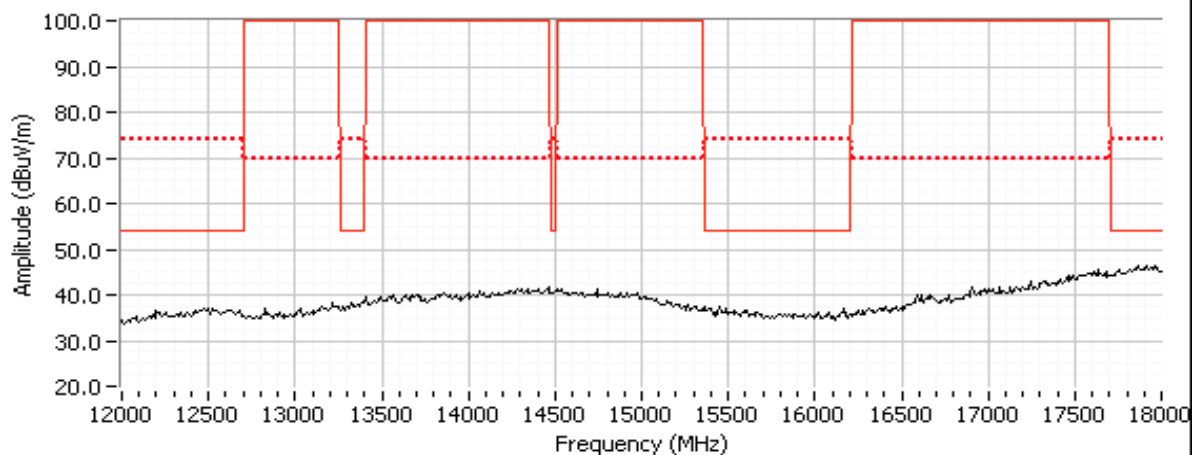
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3750.060	45.5	V	54.0	-8.5	AVG	192	1.0	RB 1 MHz;VB 10 Hz;Peak
3750.060	48.3	V	74.0	-25.7	PK	192	1.0	RB 1 MHz;VB 3 MHz;Peak
7502.120	39.8	V	54.0	-14.2	AVG	67	2.0	RB 1 MHz;VB 10 Hz;Peak
7502.720	51.2	V	74.0	-22.8	PK	67	2.0	RB 1 MHz;VB 3 MHz;Peak
1014.780	29.7	V	54.0	-24.3	AVG	192	1.0	RB 1 MHz;VB 10 Hz;Peak
1016.900	40.8	V	74.0	-33.2	PK	192	1.0	RB 1 MHz;VB 3 MHz;Peak
1500.010	41.0	V	54.0	-13.0	AVG	214	2.5	RB 1 MHz;VB 10 Hz;Peak
1500.100	49.5	V	74.0	-24.5	PK	214	2.5	RB 1 MHz;VB 3 MHz;Peak
1575.000	32.8	V	54.0	-21.2	AVG	321	2.0	RB 1 MHz;VB 10 Hz;Peak
1575.350	46.0	V	74.0	-28.0	PK	321	2.0	RB 1 MHz;VB 3 MHz;Peak
1424.920	31.4	V	54.0	-22.6	AVG	327	2.0	RB 1 MHz;VB 10 Hz;Peak
1424.050	41.0	V	74.0	-33.0	PK	327	2.0	RB 1 MHz;VB 3 MHz;Peak
7510.000	45.9	V	54.0	-8.1	Peak	67	2.0	Peak scan reading
7510.000	45.9	V	54.0	-8.1	Peak	67	2.0	Peak scan reading
3750.000	46.0	V	54.0	-8.0	Peak	192	1.0	Peak scan reading
1650.000	56.5	V	70.0	-13.5	Peak	302	2.5	Peak scan reading
1575.000	57.8	V	54.0	3.8	Peak	321	2.0	Peak scan reading
1500.000	63.0	V	54.0	9.0	Peak	214	2.5	Peak scan reading
1425.000	50.8	V	54.0	-3.2	Peak	327	2.0	Peak scan reading
1008.330	51.6	V	54.0	-2.4	Peak	192	1.0	Peak scan reading

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

RF4CE 2425 MHz



RF4CE 2425 MHz



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

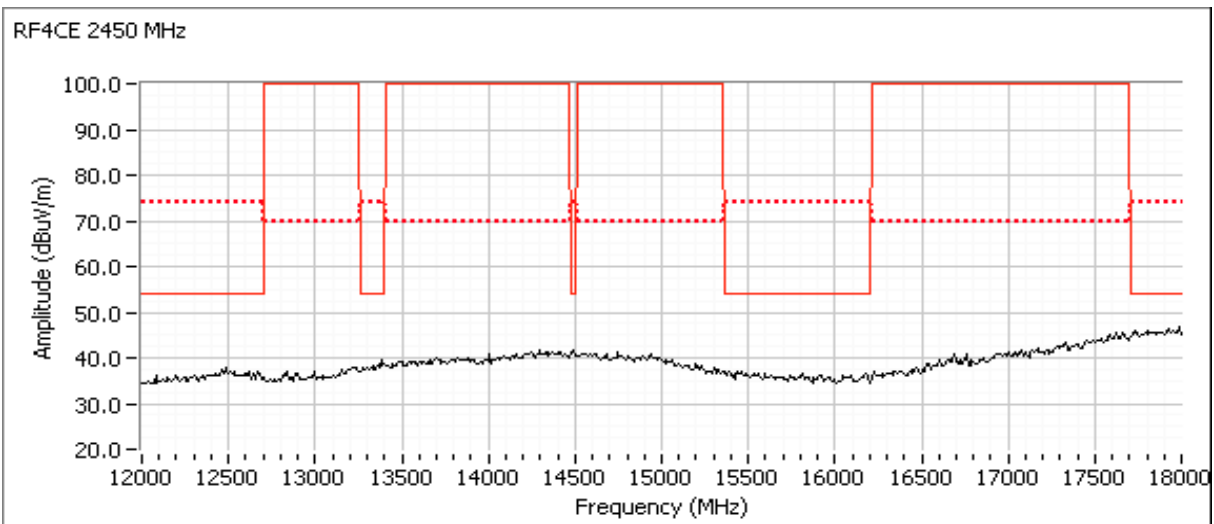
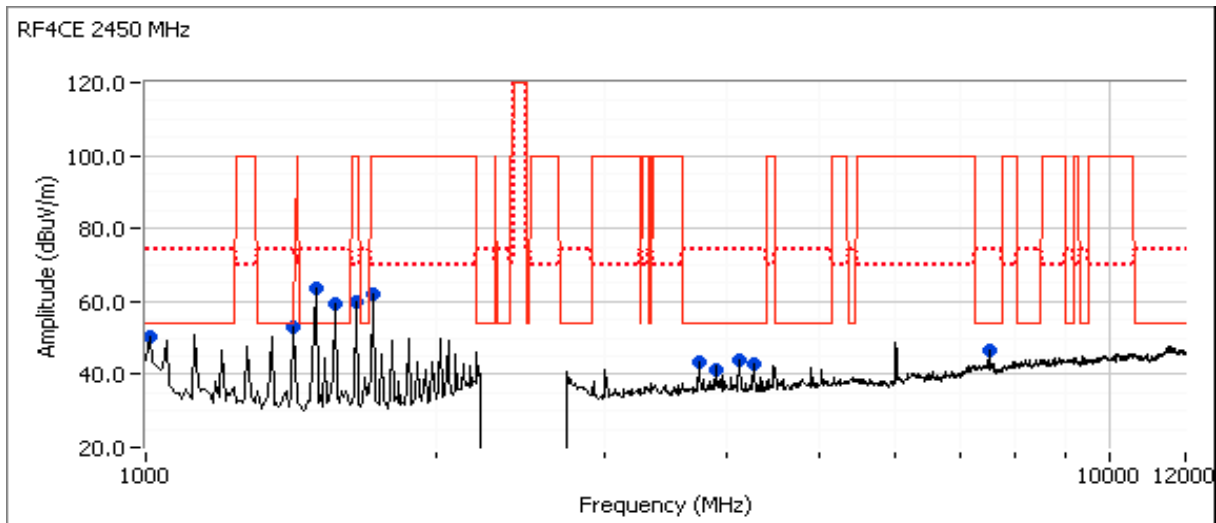
Run #1b: Center Channel

Channel: 2450MHz Mode: RF4CE

Highest of either Chain 0 or 1

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4901.050	36.4	V	54.0	-17.6	AVG	305	1.0	RB 1 MHz;VB 10 Hz;Peak
4898.730	46.1	V	74.0	-27.9	PK	305	1.0	RB 1 MHz;VB 3 MHz;Peak
1500.050	38.0	V	54.0	-16.0	AVG	31	2.0	RB 1 MHz;VB 10 Hz;Peak
1499.970	48.7	V	74.0	-25.3	PK	31	2.0	RB 1 MHz;VB 3 MHz;Peak
7499.940	39.9	V	54.0	-14.1	AVG	55	2.0	RB 1 MHz;VB 10 Hz;Peak
7499.120	51.5	V	74.0	-22.5	PK	55	2.0	RB 1 MHz;VB 3 MHz;Peak
3750.070	43.5	H	54.0	-10.5	AVG	138	2.0	RB 1 MHz;VB 10 Hz;Peak
3750.080	48.1	H	74.0	-25.9	PK	138	2.0	RB 1 MHz;VB 3 MHz;Peak
1574.820	34.2	V	54.0	-19.8	AVG	164	1.0	RB 1 MHz;VB 10 Hz;Peak
1574.890	40.8	V	74.0	-33.2	PK	164	1.0	RB 1 MHz;VB 3 MHz;Peak
4128.520	32.2	V	54.0	-21.8	AVG	172	1.0	RB 1 MHz;VB 10 Hz;Peak
4128.970	43.2	V	74.0	-30.8	PK	172	1.0	RB 1 MHz;VB 3 MHz;Peak
1725.030	60.8	V	100.0	-39.2	AVG	226	2.0	RB 1 MHz;VB 10 Hz;Peak
1725.030	61.9	V	70.0	-8.1	PK	226	2.0	RB 1 MHz;VB 3 MHz;Peak
4267.120	32.1	V	54.0	-21.9	AVG	235	1.0	RB 1 MHz;VB 10 Hz;Peak
4266.270	43.1	V	74.0	-30.9	PK	235	1.0	RB 1 MHz;VB 3 MHz;Peak
3895.990	32.0	V	54.0	-22.0	AVG	237	2.0	RB 1 MHz;VB 10 Hz;Peak
3896.230	43.6	V	74.0	-30.4	PK	237	2.0	RB 1 MHz;VB 3 MHz;Peak
1498.670	63.5	V	54.0	9.5	Peak	31	2.0	Peak scan reading
7500.120	46.7	V	54.0	-7.3	Peak	55	2.0	Peak scan reading
3750.110	43.4	H	54.0	-10.6	Peak	138	2.0	Peak scan reading
1574.780	59.4	V	54.0	5.4	Peak	164	1.0	Peak scan reading
4129.330	43.8	V	54.0	-10.2	Peak	172	1.0	Peak scan reading
1650.060	60.0	V	70.0	-10.0	Peak	178	1.0	Peak scan reading
1424.330	53.0	V	54.0	-1.0	Peak	226	2.0	Peak scan reading
1725.060	61.8	V	70.0	-8.2	Peak	226	2.0	Peak scan reading
1012.600	50.3	V	54.0	-3.7	Peak	229	2.5	Peak scan reading
4266.790	43.0	V	54.0	-11.0	Peak	235	1.0	Peak scan reading
3896.530	41.4	V	54.0	-12.6	Peak	237	2.0	Peak scan reading

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



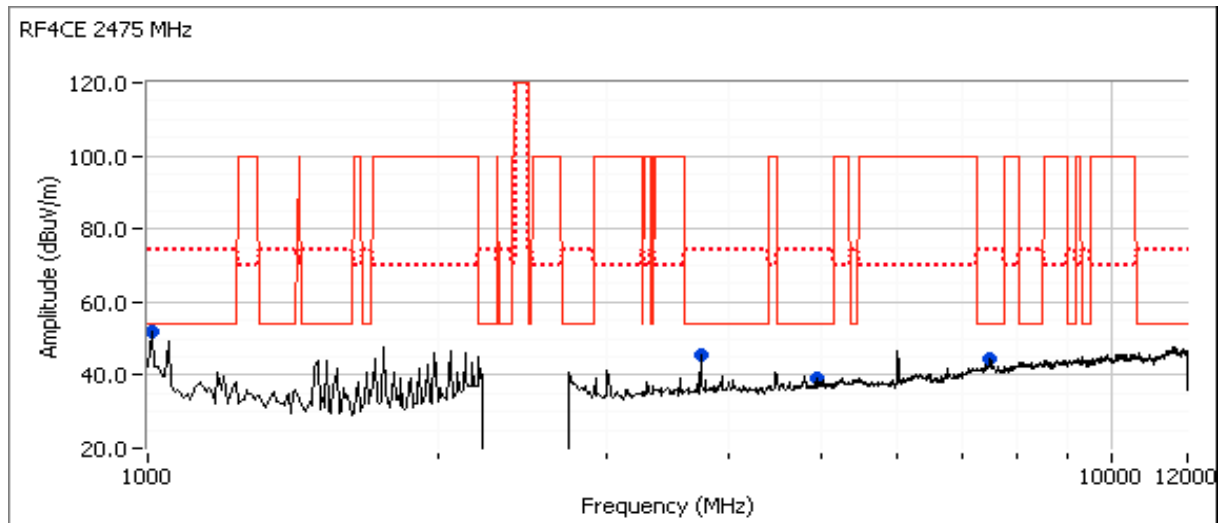
Note: Scans made between 18 - 25 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1c: High Channel

Channel: 2475MHz Mode: RF4CE

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3749.990	46.3	V	54.0	-7.7	AVG	196	1.5	RB 1 MHz;VB 10 Hz;Peak
3750.140	49.4	V	74.0	-24.6	PK	196	1.5	RB 1 MHz;VB 3 MHz;Peak
4950.980	36.2	V	54.0	-17.8	AVG	325	2.0	RB 1 MHz;VB 10 Hz;Peak
4949.700	46.2	V	74.0	-27.8	PK	325	2.0	RB 1 MHz;VB 3 MHz;Peak
7506.370	39.7	V	54.0	-14.3	AVG	60	2.0	RB 1 MHz;VB 10 Hz;Peak
7505.540	51.6	V	74.0	-22.4	PK	60	2.0	RB 1 MHz;VB 3 MHz;Peak
1012.500	48.8	H	54.0	-5.2	AVG	230	1.5	RB 1 MHz;VB 10 Hz;Peak
1012.700	50.6	H	74.0	-23.4	PK	230	1.5	RB 1 MHz;VB 3 MHz;Peak
9003.910	40.7	V	54.0	-13.3	AVG	284	1.0	RB 1 MHz;VB 10 Hz;Peak
9004.540	51.5	V	74.0	-22.5	PK	284	1.0	RB 1 MHz;VB 3 MHz;Peak
7506.710	38.1	V	54.0	-15.9	Peak	60	2.0	Peak scan reading
3750.080	36.7	V	54.0	-17.3	Peak	196	1.5	Peak scan reading
1012.570	43.1	H	54.0	-10.9	Peak	230	1.5	Peak scan reading
9005.210	40.7	V	54.0	-13.3	Peak	284	1.0	Peak scan reading
4951.060	32.1	V	54.0	-21.9	Peak	325	2.0	Peak scan reading



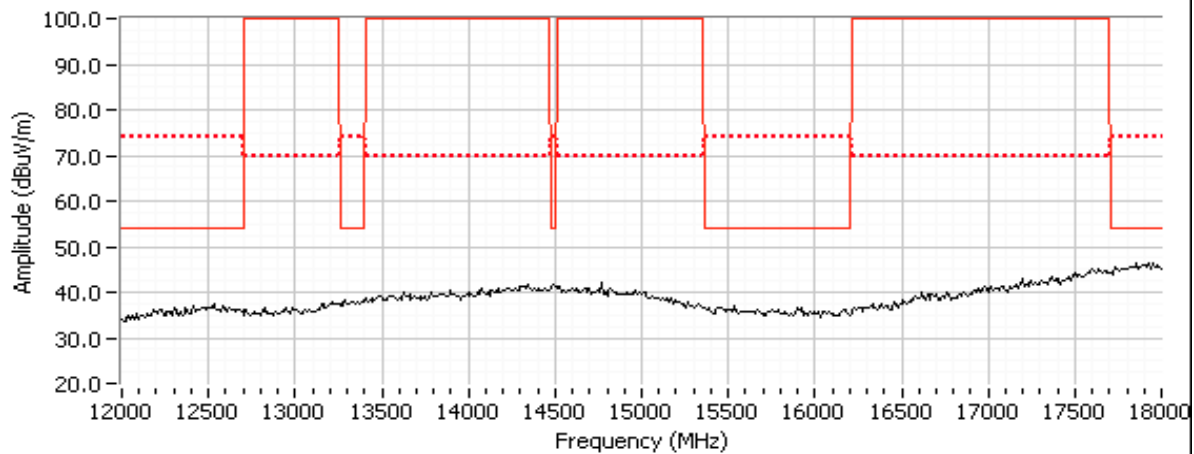
**NTS**

WE ENGINEER SUCCESS

EMC Test Data

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

RF4CE 2475 MHz



Client:	Samsung Electronics	Job Number:	J97349
Model:	HR54-200	T-Log Number:	T97510
Contact:	Cho Minhyung	Project Manager:	Irene Radamacher
Standard:	FCC 15.247/15.407	Project Coordinator:	-
		Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
 For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions: Temperature: 22.8 °C
 Rel. Humidity: 39 %

Summary of Results - Intermodulation

Run #	Mode	Channel	Power Setting		Test Performed	Limit	Result / Margin
Simultaneous Tx - RF4CE + Wifi - using the worse case 2.4GHz wifi channel and the center channel for RF4CE							
1	RF4CE + Worse case Wifi	6 - 2437 MHz & RF4CE CH20	22.5 & Max	-	Radiated Emissions 30MHz - 1000MHz	FCC 15.209 / 15.247	44.2 dBµV/m @ 256.51 MHz (-1.8 dB)
				-	Radiated Emissions 1 - 25 GHz	FCC 15.209 / 15.247	49.7 dBµV/m @ 4873.5 MHz (-4.3 dB)
Simultaneous Tx - RF4CE + Wifi - using the worse case 5GHz wifi channel and the center channel for RF4CE							
2	RF4CE + Worse case Wifi	64 - 5320MHz & RF4CE CH20	q82 & Max	-	Radiated Emissions 30MHz - 1000MHz	FCC 15.209 / 15 E	44.5 dBµV/m @ 256.51 MHz (-1.5 dB)
				-	Radiated Emissions 1 - 40 GHz	FCC 15.209 / 15 E	53.1 dBµV/m @ 5024.8 MHz (-0.9 dB)

As the emisisions without the ferrite bead on the HDMI cable from Run 1 and 2 show no difference below 1 GHz and no intermodultion products, additional testing of different modes and frequencies was not required.

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11a/g	6	0.99	Yes	103.55	0	0	10
n20	MCS 0	0.99	Yes	95.85	0	0	10
n40	MCS 0	0.99	Yes	94.3	0	0	10

Sample Notes

Sample S/N: PV1056150225002

Driver: 5.99 RC 188.12

Antenna: Airgain N2420DS and N2415D2

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle $\geq 98\%$, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle $< 98\%$ and is NOT constant, average measurement performed: RBW=1MHz, VBW $> 1/T$, peak detector, linear average mode, sweep time auto, max hold. Max hold for $50 \cdot (1/DC)$ traces
Note 5:	Emission has duty cycle $< 98\%$, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #1: Radiated Spurious Emissions, 30 - 25,000 MHz.

Date of Test: 09/02/15

Test Engineer: Rafael Varelas

Test Location: FT Chamber #4

EUT Voltage: 120V/60Hz

Channel: 6 Mode: g Power Setting: 22.5
 Tx Chain: 1 Data Rate: 6Mbps

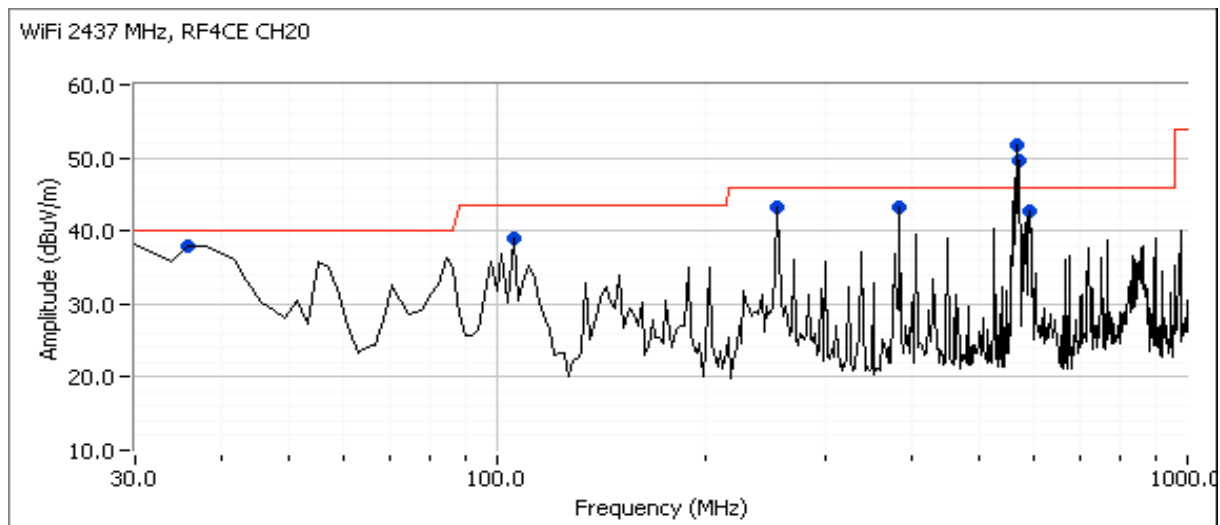
RF4CE: 20 Power Setting: Max
 Tx Chain: 1

30-1000MHz

HDMI cable w/o ferrite

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
256.510	44.2	H	46.0	-1.8	QP	246	1.2	QP (1.00s)
573.018	39.5	H	46.0	-6.5	QP	319	1.8	QP (1.00s)
105.731	37.5	V	43.5	-6.0	QP	305	1.0	QP (1.00s)
565.737	27.7	H	46.0	-18.3	QP	230	1.0	QP (1.00s)
589.836	34.4	V	46.0	-11.6	QP	230	1.7	QP (1.00s)
36.147	31.7	V	40.0	-8.3	QP	216	1.0	QP (1.00s)
383.992	30.7	H	46.0	-15.3	QP	205	1.0	QP (1.00s)

WiFi 2437 MHz, RF4CE CH20



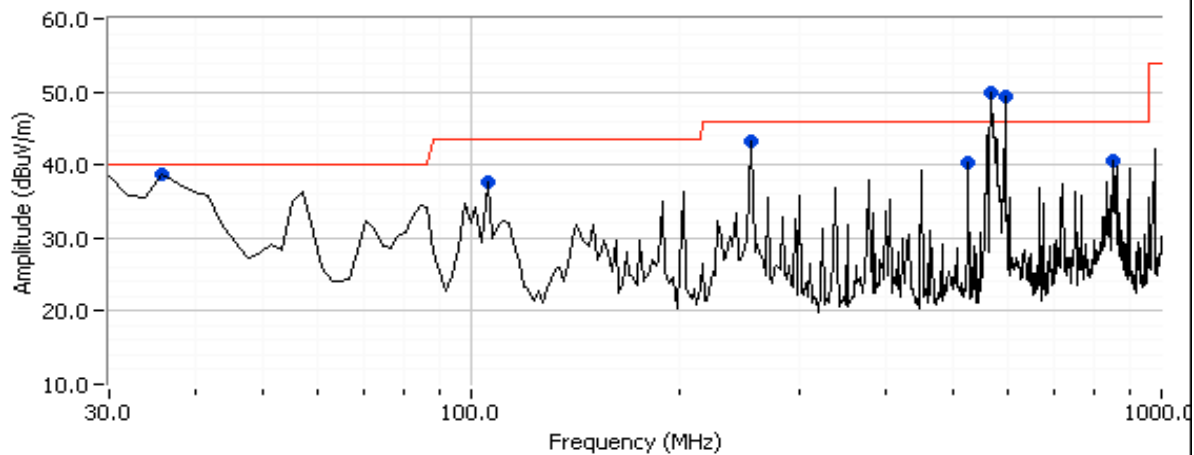
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

30-1000MHz

HDMI cable w/ ferrite

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
256.508	43.8	H	46.0	-2.2	QP	249	1.2	QP (1.00s)
105.696	37.0	V	43.5	-6.5	QP	296	1.0	QP (1.00s)
525.001	40.8	V	46.0	-5.2	QP	243	1.2	QP (1.00s)
590.568	39.7	H	46.0	-6.3	QP	195	1.0	QP (1.00s)
36.744	32.2	V	40.0	-7.8	QP	140	1.0	QP (1.00s)
566.348	40.1	H	46.0	-5.9	QP	116	1.9	QP (1.00s)
852.586	32.0	V	46.0	-14.0	QP	45	1.4	QP (1.00s)

WiFi 2437 MHz, RF4CE CH20

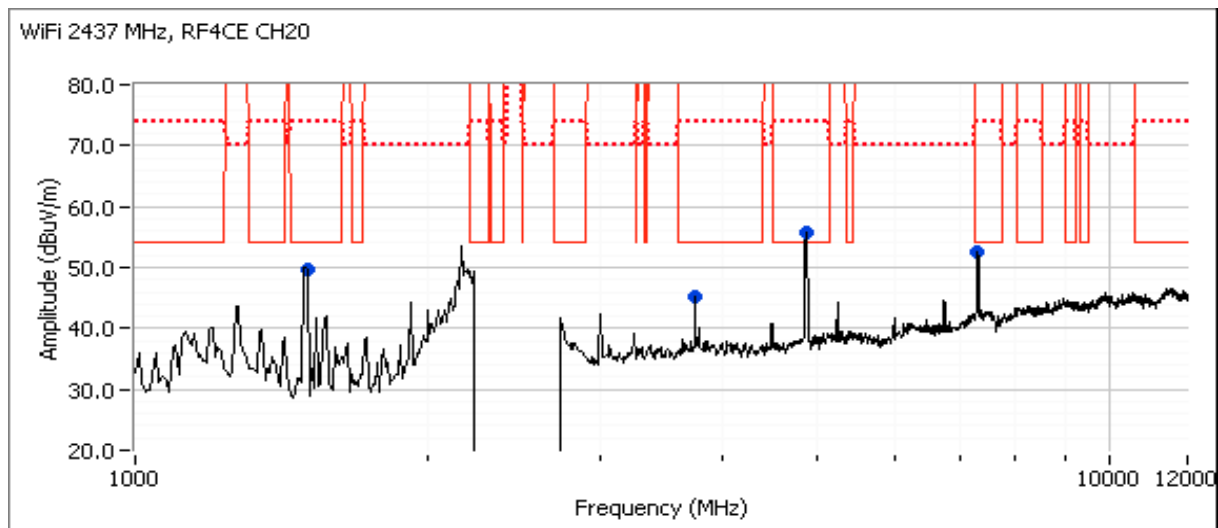


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

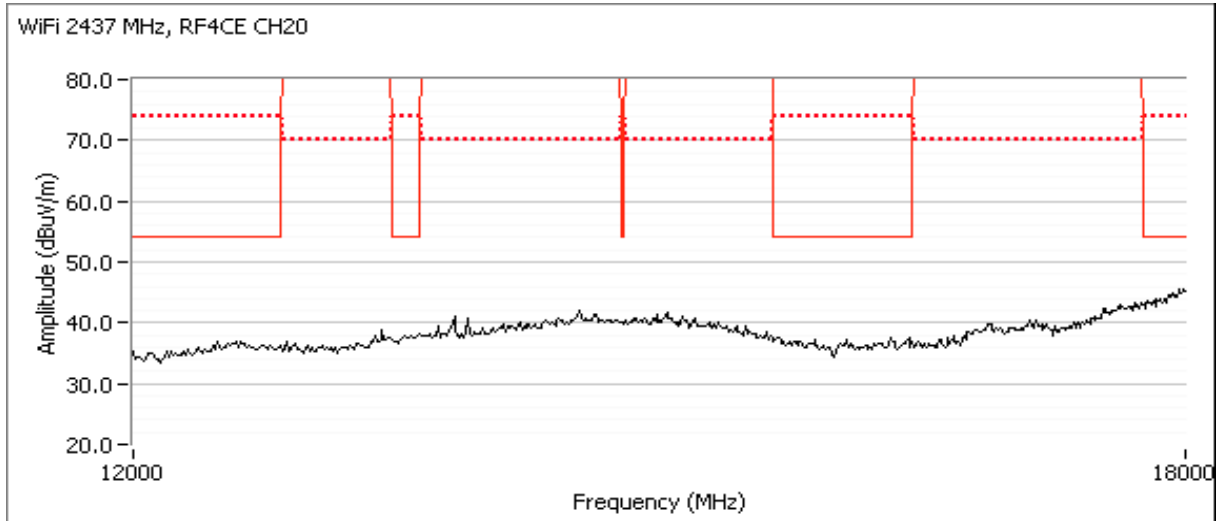
1000-25,000MHz
 HDMI cable w/o ferrite

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
4873.460	49.7	V	54.0	-4.3	AVG	145	1.6	RB 1 MHz;VB 10 Hz;Peak
4877.760	60.7	V	74.0	-13.3	PK	145	1.6	RB 1 MHz;VB 3 MHz;Peak
7310.010	48.0	V	54.0	-6.0	AVG	134	1.5	RB 1 MHz;VB 10 Hz;Peak
7314.410	60.1	V	74.0	-13.9	PK	134	1.5	RB 1 MHz;VB 3 MHz;Peak
1494.190	37.4	V	54.0	-16.6	AVG	183	1.5	RB 1 MHz;VB 10 Hz;Peak
1493.540	56.2	V	74.0	-17.8	PK	183	1.5	RB 1 MHz;VB 3 MHz;Peak
3750.050	42.7	H	54.0	-11.3	AVG	226	1.0	RB 1 MHz;VB 10 Hz;Peak
3750.090	48.4	H	74.0	-25.6	PK	226	1.0	RB 1 MHz;VB 3 MHz;Peak

Note: Scans between 18 - 40 GHz were made with the measurement antenna moved around the EUT at a distance of 20-50cm.
 Scans indicated that there were no significant emissions in this frequency range



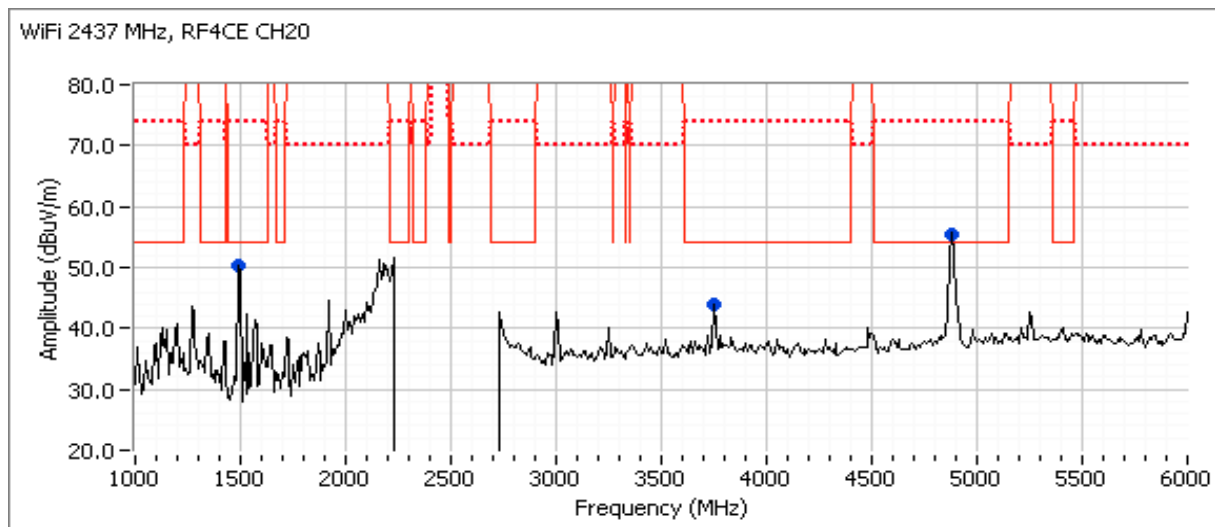
Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

1000-6,000MHz
 HDMI cable w/ ferrite

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
3750.070	44.1	H	54.0	-9.9	AVG	226	1.3	RB 1 MHz;VB 10 Hz;Peak
3749.940	47.8	H	74.0	-26.2	PK	226	1.3	RB 1 MHz;VB 3 MHz;Peak
1494.300	37.6	V	54.0	-16.4	AVG	159	1.0	RB 1 MHz;VB 10 Hz;Peak
1494.060	56.9	V	74.0	-17.1	PK	159	1.0	RB 1 MHz;VB 3 MHz;Peak
4873.500	50.1	V	54.0	-3.9	AVG	147	1.0	RB 1 MHz;VB 10 Hz;Peak
4872.870	61.9	V	74.0	-12.1	PK	147	1.0	RB 1 MHz;VB 3 MHz;Peak



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

Run #2: Radiated Spurious Emissions, 30 - 40,000 MHz.

Date of Test: 09/02/15

Test Engineer: Rafael Varelas

Test Location: FT Chamber #4

EUT Voltage: 120V/60Hz

Channel: 64 Mode: a Power Setting: q82
 Tx Chain: 1 Data Rate: 6Mbps

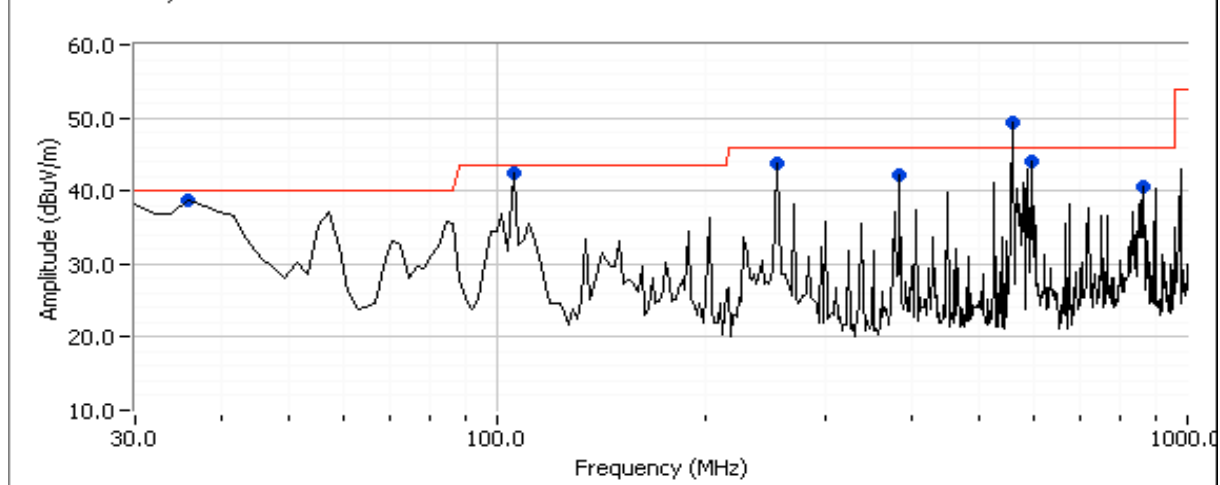
RF4CE: 20 Power Setting: Max
 Tx Chain: 1

30-1000MHz

HDMI cable w/o ferrite

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
256.511	44.5	H	46.0	-1.5	QP	247	1.2	QP (1.00s)
860.788	28.0	H	46.0	-18.0	QP	8	3.7	QP (1.00s)
36.500	32.7	V	40.0	-7.3	QP	106	1.0	QP (1.00s)
384.012	30.1	H	46.0	-15.9	QP	203	1.0	QP (1.00s)
595.933	40.3	H	46.0	-5.7	QP	231	1.0	QP (1.00s)
105.717	40.4	V	43.5	-3.1	QP	249	1.0	QP (1.00s)
559.738	41.1	H	46.0	-4.9	QP	340	1.7	QP (1.00s)

WiFi 5320 MHz, RF4CE CH20

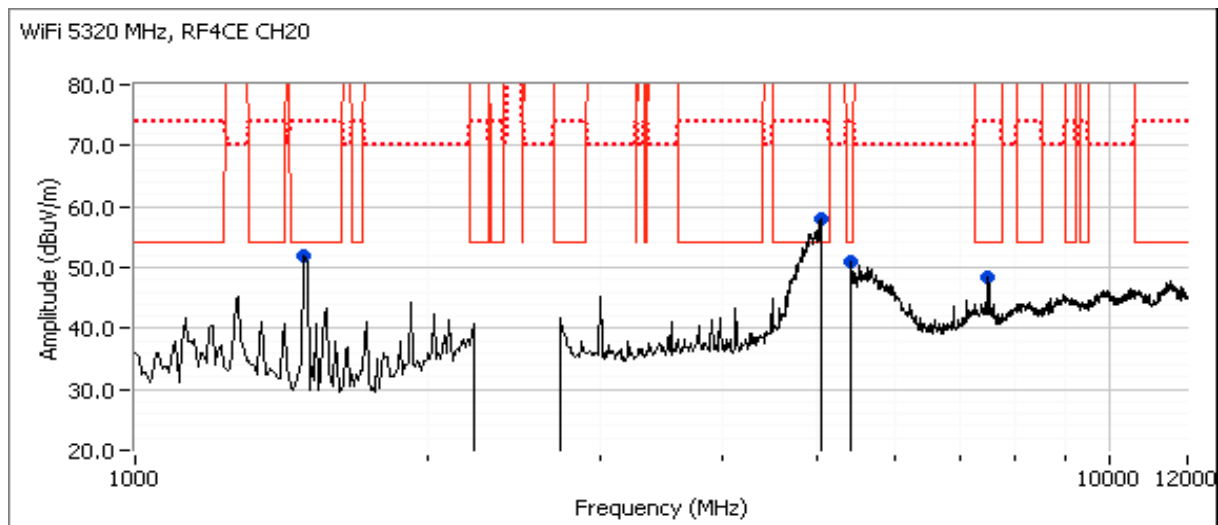


Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A

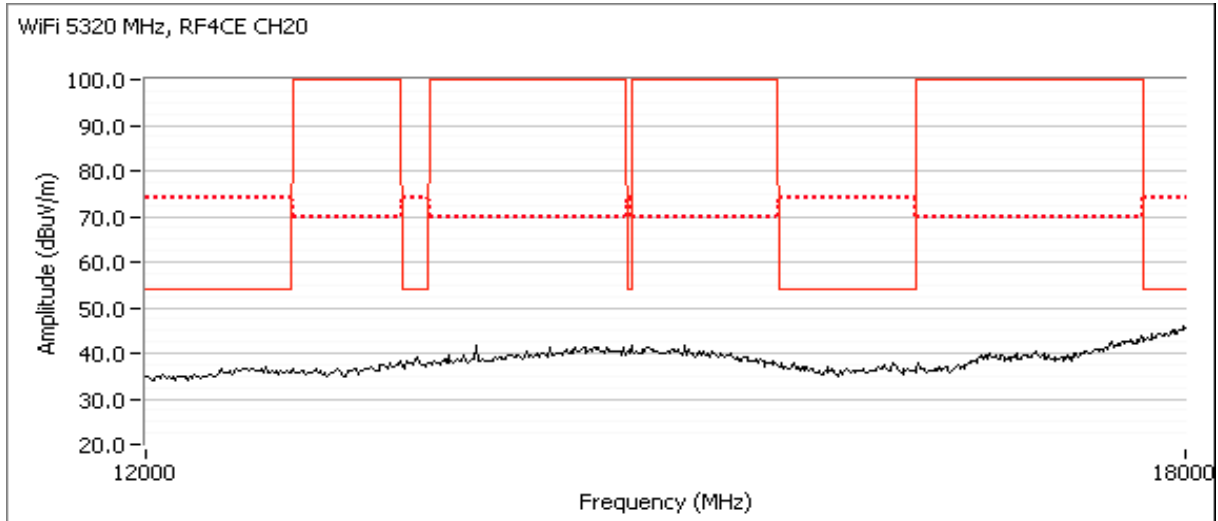
1000-40,000MHz
 HDMI cable w/o ferrite

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
5024.840	53.1	V	54.0	-0.9	AVG	31	1.0	RB 1 MHz;VB 10 Hz;Peak
5024.770	65.0	V	74.0	-9.0	PK	31	1.0	RB 1 MHz;VB 3 MHz;Peak
5412.070	48.3	V	54.0	-5.7	AVG	74	1.0	RB 1 MHz;VB 10 Hz;Peak
5411.620	59.1	V	74.0	-14.9	PK	74	1.0	RB 1 MHz;VB 3 MHz;Peak
1500.020	48.7	V	54.0	-5.3	AVG	188	1.0	RB 1 MHz;VB 10 Hz;Peak
1499.940	58.5	V	74.0	-15.5	PK	188	1.0	RB 1 MHz;VB 3 MHz;Peak
7500.120	44.0	V	54.0	-10.0	AVG	360	1.3	RB 1 MHz;VB 10 Hz;Peak
7499.860	53.0	V	74.0	-21.0	PK	360	1.3	RB 1 MHz;VB 3 MHz;Peak

Note: Scans between 18 - 40 GHz were made with the measurement antenna moved around the EUT at a distance of 20-50cm.
 Scans indicated that there were no significant emissions in this frequency range



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radmacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: N/A



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: B

Conducted Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 4/9/2015
 Test Engineer: John Caizzi
 Test Location: Fremont Chamber #7

Config. Used: 1
 Config Change: none
 EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN. A second LISN was used for all local support equipment. Remote support equipment was located outside of the semi-anechoic chamber. Any cables running to remote support equipment were routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Ambient Conditions: Temperature: 23 °C
 Rel. Humidity: 37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	CE, AC Power, 120V/60Hz	Class B	Pass	42.0 dBµV @ 0.443 MHz (-5.0 dB)

Modifications Made During Testing

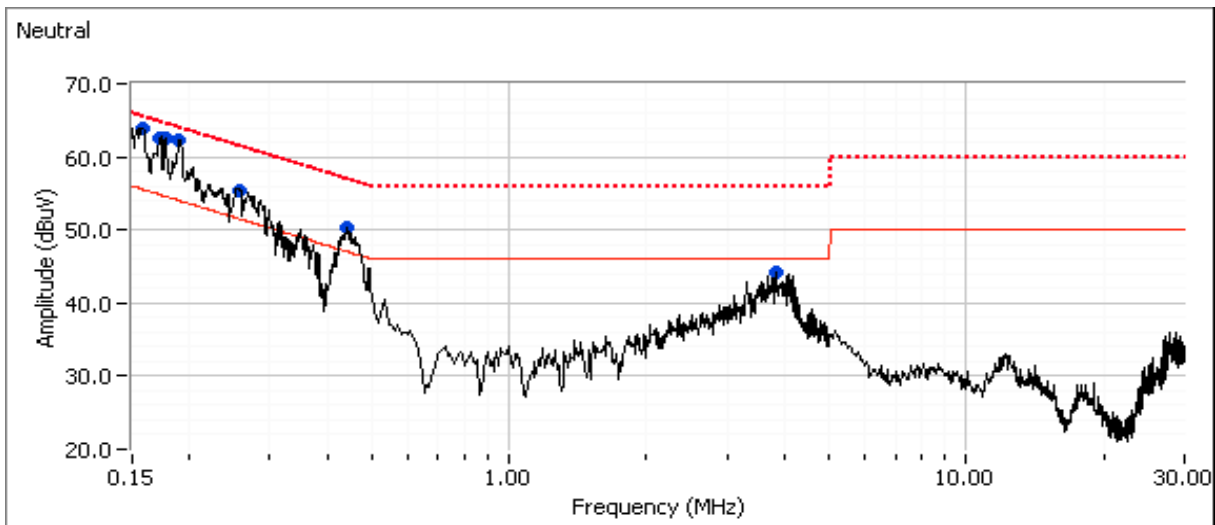
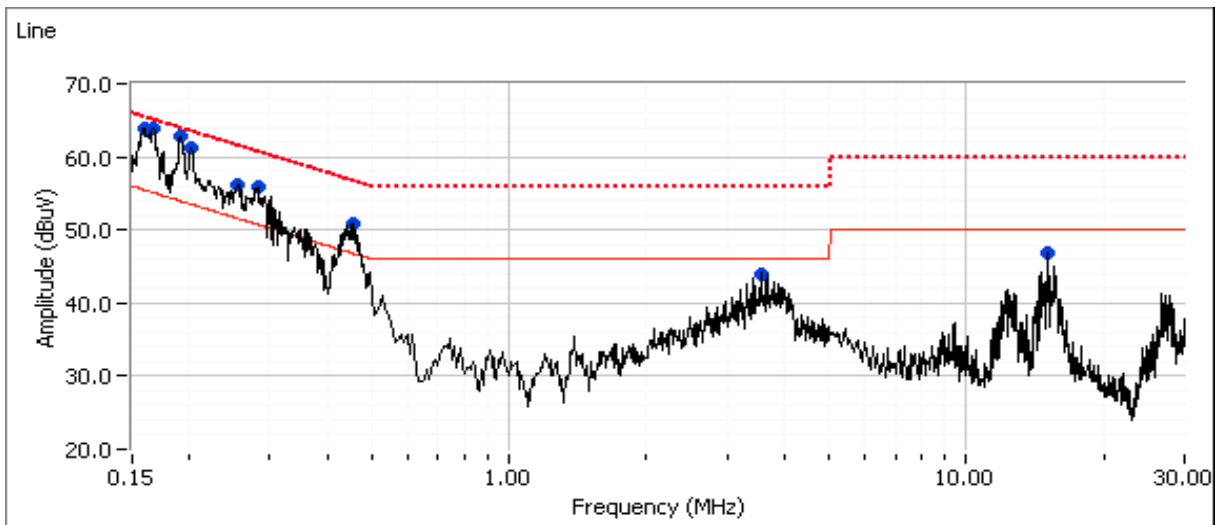
No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radmacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: B

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz. Radios transmitting.



Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: B

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency MHz	Level dB μ V	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.154	64.0	Line	55.5	8.5	Peak	
0.169	63.9	Line	55.1	8.8	Peak	
0.189	62.8	Line	54.0	8.8	Peak	
0.202	61.3	Line	53.5	7.8	Peak	
0.253	56.2	Line	51.6	4.6	Peak	
0.280	55.8	Line	50.7	5.1	Peak	
0.456	50.9	Line	46.8	4.1	Peak	
3.553	44.0	Line	46.0	-2.0	Peak	
15.037	46.9	Line	50.0	-3.1	Peak	
0.155	63.9	Neutral	55.6	8.3	Peak	
0.172	62.5	Neutral	54.8	7.7	Peak	
0.181	62.5	Neutral	54.6	7.9	Peak	
0.189	62.2	Neutral	54.1	8.1	Peak	
0.252	55.5	Neutral	51.5	4.0	Peak	
0.443	50.2	Neutral	47.0	3.2	Peak	
3.807	44.3	Neutral	46.0	-1.7	Peak	

Client: Samsung Electronics	Job Number: J97349
Model: HR54-200	T-Log Number: T97510
Contact: Cho Minhyung	Project Manager: Irene Radamacher
Standard: FCC 15.247/15.407	Project Coordinator: -
	Class: B

Final quasi-peak and average readings

Frequency MHz	Level dB μ V	AC Line	Class B		Detector QP/Ave	Comments
			Limit	Margin		
0.154	47.0	Line	55.8	-8.8	AVG	
0.154	59.5	Line	65.8	-6.3	QP	
0.169	47.1	Line	55.0	-7.9	AVG	
0.169	59.2	Line	65.0	-5.8	QP	
0.189	45.3	Line	54.1	-8.8	AVG	
0.189	58.2	Line	64.1	-5.9	QP	
0.202	42.5	Line	53.5	-11.0	AVG	
0.202	57.0	Line	63.5	-6.5	QP	
0.253	44.4	Line	51.7	-7.3	AVG	
0.253	53.2	Line	61.7	-8.5	QP	
0.280	43.4	Line	50.8	-7.4	AVG	
0.280	52.5	Line	60.8	-8.3	QP	
0.456	40.5	Line	46.8	-6.3	AVG	
0.456	47.9	Line	56.8	-8.9	QP	
3.553	36.7	Line	46.0	-9.3	AVG	
3.553	41.6	Line	56.0	-14.4	QP	
15.037	38.4	Line	50.0	-11.6	AVG	
15.037	44.3	Line	60.0	-15.7	QP	
0.155	47.7	Neutral	55.7	-8.0	AVG	
0.155	59.8	Neutral	65.7	-5.9	QP	
0.172	44.7	Neutral	54.9	-10.2	AVG	
0.172	58.0	Neutral	64.9	-6.9	QP	
0.181	41.5	Neutral	54.4	-12.9	AVG	
0.181	57.5	Neutral	64.4	-6.9	QP	
0.189	46.0	Neutral	54.1	-8.1	AVG	
0.189	58.0	Neutral	64.1	-6.1	QP	
0.252	43.7	Neutral	51.7	-8.0	AVG	
0.252	53.2	Neutral	61.7	-8.5	QP	
0.443	42.0	Neutral	47.0	-5.0	AVG	
0.443	48.1	Neutral	57.0	-8.9	QP	
3.807	30.9	Neutral	46.0	-15.1	AVG	
3.807	38.7	Neutral	56.0	-17.3	QP	

End of Report

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