

# FCC BT LE REPORT

## FCC Certification

**Applicant Name:**

LG Electronics MobileComm U.S.A., Inc.

**Address:**

1000 Sylvan Avenue, Englewood Cliffs NJ 07632

**Date of Issue:**

November 25, 2015

**Test Site/Location:**

HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

**Report No.:** HCT-R-1511-F017**HCT FRN:** 0005866421**IC Recognition No.:** 5944A-5**FCC ID : ZNFK410F****APPLICANT : LG Electronics MobileComm U.S.A., Inc.****FCC Model(s):** LG-K410f**Additional Model(s):** LGK410f, K410f**EUT Type:** GSM/WCDMA Phone with Bluetooth4.1LE, WIFI802.11b/g/n(2.4GHz\_HT20&40), VoIP, Hotspot support**Peak RF Output Power:** -3.507 dBm (0.446mW)**Frequency Range:** 2402 MHz -2480 MHz**Modulation type** GFSK**FCC Classification:** Digital Transmission System(DTS)**FCC Rule Part(s):** Part 15.247**Engineering Statement:**

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C.853(a)



**Report prepared by**  
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**Test Engineer of RF Team**



**Approved by**  
**: Sang Jun Lee**  
**Manager of RF Team**

## Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1511-F017	November 25, 2015	- First Approval Report

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## 1. GENERAL INFORMATION

**Applicant:** LG Electronics MobileComm U.S.A., Inc  
**Address:** 1000 Sylvan Avenue, Englewood Cliffs NJ 07632  
**FCC ID:** ZNFK410F  
**EUT Type:** GSM/WCDMA Phone with Bluetooth4.1LE, WIFI802.11b/g/n(2.4GHz\_HT20&40), VoIP, Hotspot support  
**Model name(s):** LG-K410f  
**Additional Model name(s):** LGK410f, K410f  
**Date(s) of Tests:** November 10, 2015 ~ November 23, 2015  
**Place of Tests:** HCT Co., Ltd.  
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea  
(IC Recognition No. : 5944A-5)

## 2. EUT DESCRIPTION

<b>FCC Model Name</b>	LG-K410f	
<b>FCC Additional Model Name</b>	LGK410f, K410f	
<b>EUT Type</b>	GSM/WCDMA Phone with Bluetooth4.1LE, WIFI802.11b/g/n(2.4GHz_HT20&40), VoIP, Hotspot support	
<b>Power Supply</b>	DC 3.8 V	
<b>Battery Infomation</b>	Model: BL-45A1H Type: Li-ion Battery	
<b>Frequency Range</b>	TX: 2402 MHz ~ 2480 MHz RX: 2402 MHz ~ 2480 MHz	
<b>Max. RF Output Power</b>	Peak	-3.507 dBm (0.446 mW)
	Average	-3.828dBm (0.414 mW)
<b>BT Operating Mode</b>	BT _Low Energy Mode	
<b>Modulation Type</b>	GFSK	
<b>Number of Channels</b>	40 Channels	
<b>Antenna Specification</b>	Manufacturer: KOMATECH Co.,Ltd. Antenna type: INTERNAL ANTENNA Peak Gain : -0.67 dBi	

### 3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v03r03 dated June 09, 2015 entitled "Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) Operating Under §15.247" were used in the measurement.

#### 3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

#### 3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

#### 3.3 GENERAL TEST PROCEDURES

##### Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

##### Conducted Antenna Terminal

See Section from 9.1 to 9.2.(KDB 558074)

#### 3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

## 4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

## 5. FACILITIES AND ACCREDITATIONS

### 5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661)

### 5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

## 6. ANTENNA REQUIREMENTS

### According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

\* The antennas of this E.U.T are permanently attached.

\*The E.U.T Complies with the requirement of §15.203

## 7. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	CONDUCTED	PASS
Conducted Maximum Peak Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	§15.247(d)	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 8.7		PASS
Radiated Spurious Emissions	§15.205, 15.209	cf. Section 8.6.1	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.6.2		PASS

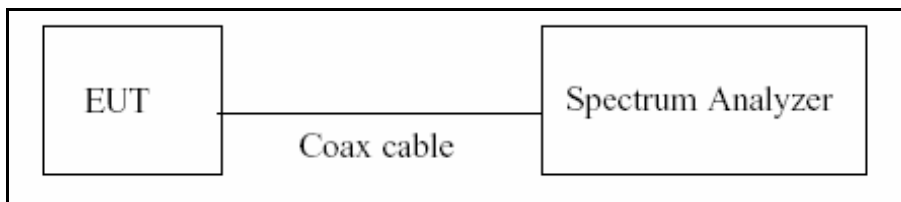
## 8. TEST RESULT

### 8.1 DUTY CYCLE

#### ■ TEST PROCEDURE

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW  $\geq$  OBW if possible; otherwise, set RBW to the largest available value. Set VBW  $\geq$  RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are  $> 50/T$  and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if  $T \leq 16.7$  microseconds.)

#### ■ TEST CONFIGURATION



#### ■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, 6.0)b) in KDB 558074(issued 06/09/2015)

The largest available value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if  $T \leq 6.25$  microseconds. ( $50/6.25 = 8$ )

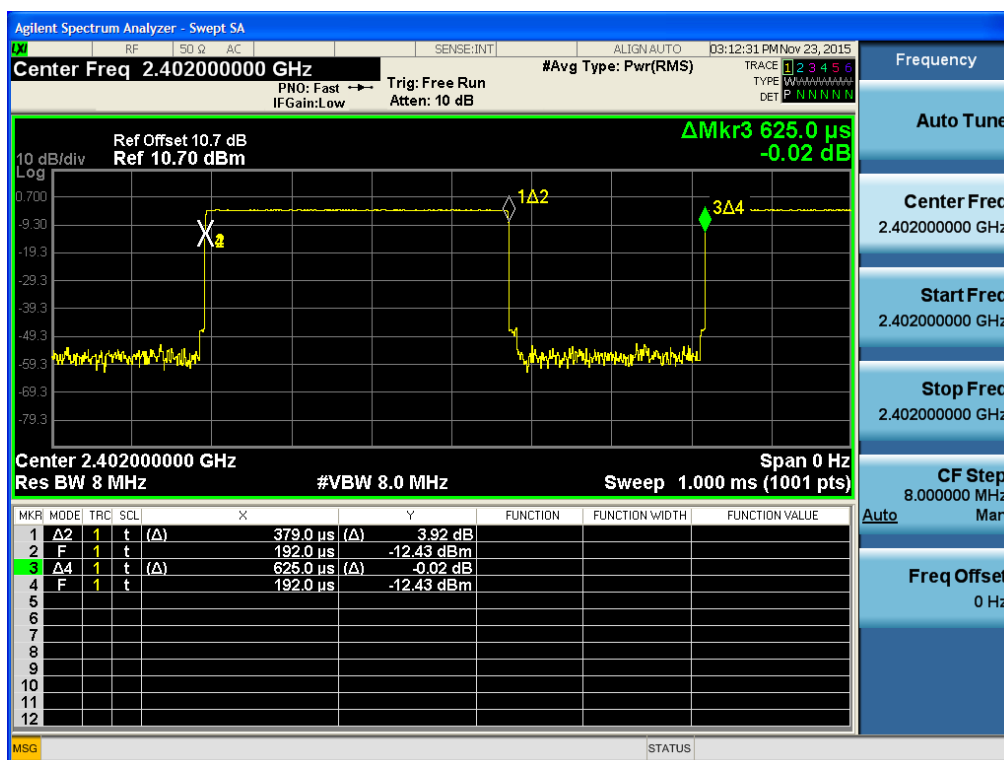
The zero-span method was used because all measured T data are  $> 6.25$  microseconds and both RBW and VBW are  $> 50/T$ .

1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz ( $\geq$  RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep  $> 100$
6. Trace mode = Clear write
7. Measure  $T_{total}$  and  $T_{on}$
8. Calculate Duty Cycle =  $T_{on} / T_{total}$  and Duty Cycle Factor =  $10 \cdot \log(1/\text{Duty Cycle})$

LE Mode	$T_{on}$ (ms)	$T_{total}$ (ms)	Duty Cycle	Duty Cycle Factor
	0.3790	0.6250	0.6064	2.17



## RESULT PLOTS



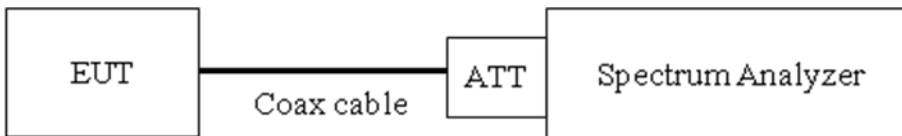
## 8.2 6dB BANDWIDTH MEASUREMENT

### Test Requirements and limit, §15.247(a)(2)

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

**The minimum permissible 6dB bandwidth is 500 kHz.**

### ■ TEST CONFIGURATION



### ■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 8.1 in KDB 558074, issued 06/09/2015)

RBW = 100 kHz

VBW  $\geq 3 \times$  RBW

Detector = Peak

Trace mode = max hold

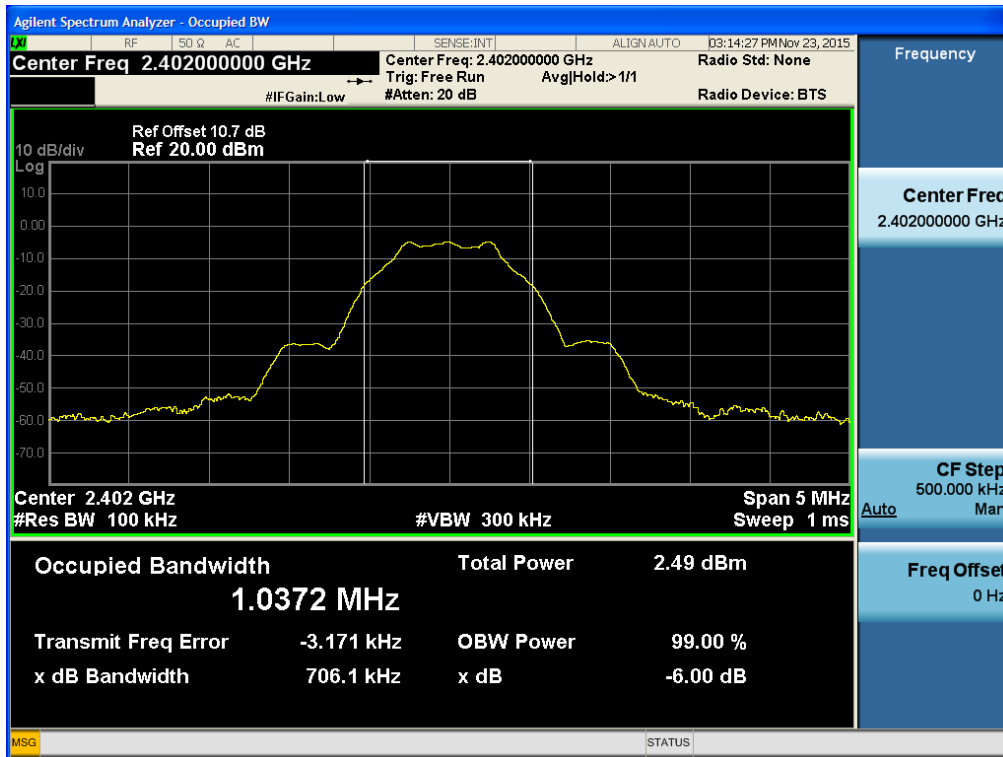
Sweep = auto couple

Allow the trace to stabilize

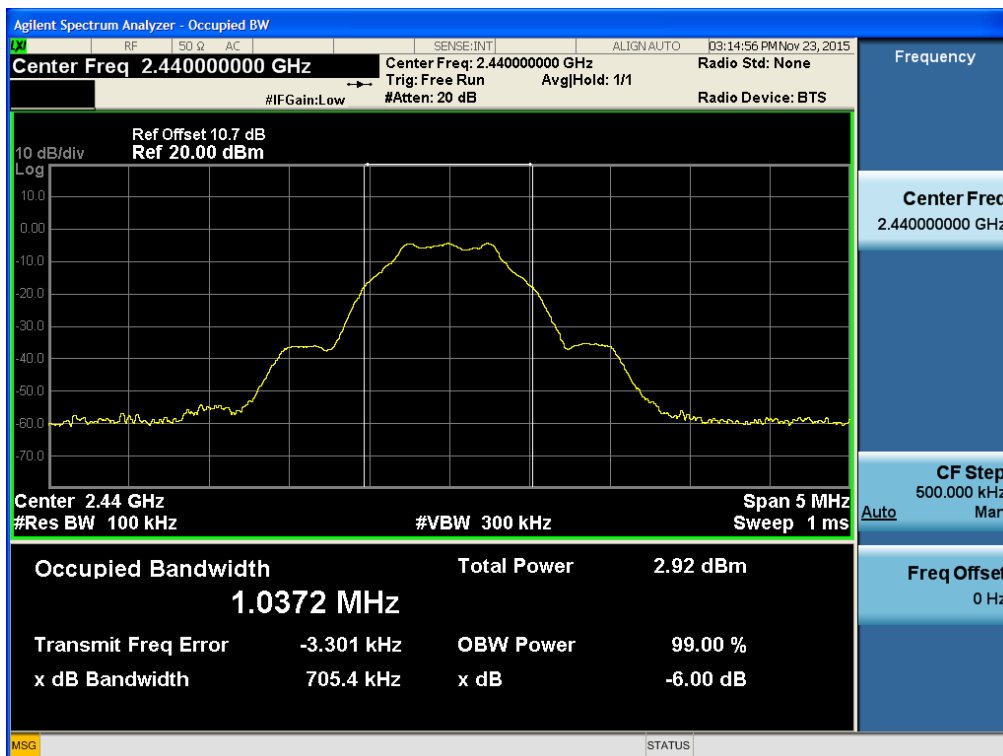
Note : We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

■ RESULT PLOTS

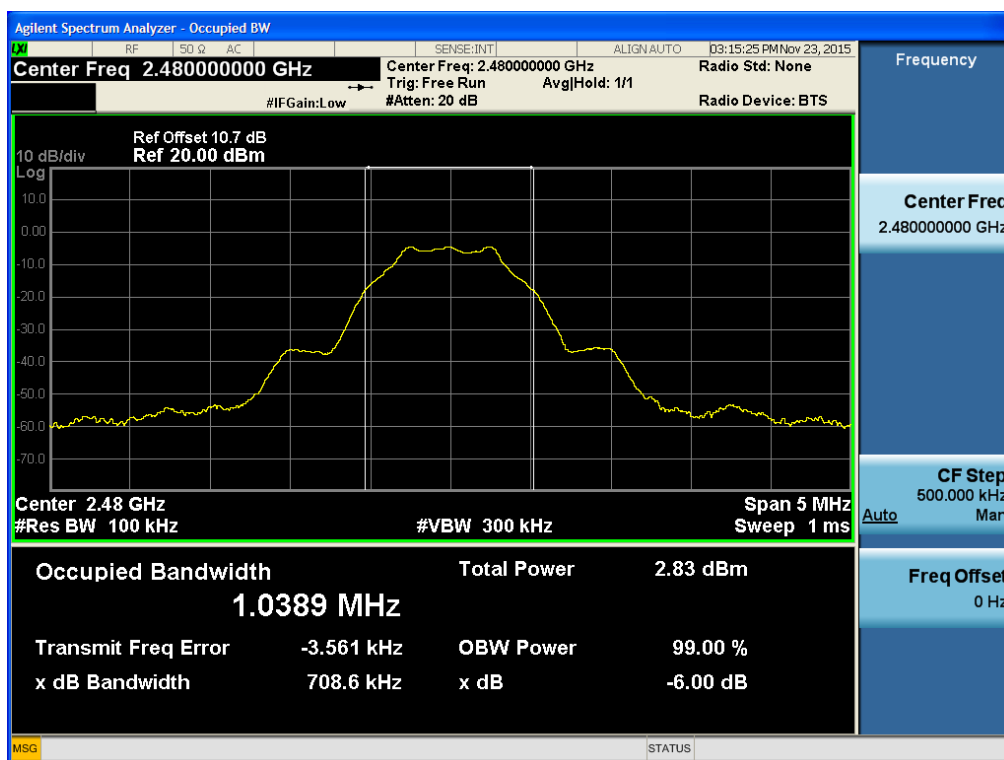
6dB Bandwidth plot (Low-CH 0)



6dB Bandwidth plot (Mid-CH 19)



### 6dB Bandwidth plot (High-CH 39)



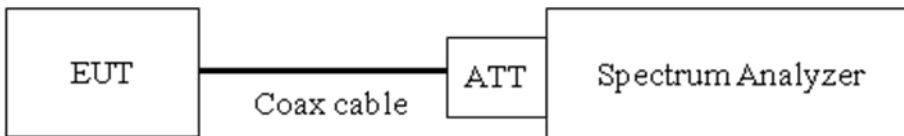
### 8.3 OUTPUT POWER MEASUREMENT

#### Test Requirements and limit, §15.247(b)(3)

A transmitter antenna terminal of EUT is connected to the input of a Spectrum Analyzer. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

**The maximum permissible conducted output power is 1 Watt.**

#### ■ TEST CONFIGURATION



#### ■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We use the spectrum analyzer's integrated band power measurement function.

This EUT TX condition is actual operating mode by BT LE mode test program.

The Spectrum Analyzer is set to

- Peak Power ( Procedure 9.1.1 in KDB 558074, issued 06/09/2015)

RBW  $\geq$  DTS Bandwidth

VBW  $\geq 3 \times$  RBW

SPAN  $\geq 3 \times$  RBW

Detector Mode = Peak

Sweep = auto couple

Trace Mode = max hold

Allow trace to fully stabilize.

Use peak marker function to determine the peak amplitude level

- Average Power ( Procedure 9.2.2.4 in KDB 558074, issued 06/09/2015)

Measure the duty cycle

Set span to at least 1.5 times the OBW

RBW = 1-5 % of the OBW, not to exceed 1 MHz.

VBW  $\geq 3 \times$  RBW.

Number of points in sweep  $\geq 2 \times$  span / RBW. (This gives bin-to-bin spacing  $\leq$  RBW/2, so that narrowband signals are not lost between frequency bins.)

Sweep time = auto.

Detector = RMS(i.e., power averaging)

Do not use sweep triggering. Allow the sweep to "free run".

Trace average at least 100 traces in power averaging(RMS) mode.

Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.

Add  $10 \log (1/x)$ , where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

### ■ Sample Calculation

Output Power = Reading Value + ATT loss + Cable loss(1 ea) + Duty Cycle Factor

Output Power = 10 dBm + 10 dB + 0.8 dB + 0.2 dB = 21.0 dBm

Note :

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest 10.7 dB. So, 10.7 dB is offset for 2.4 GHz Band.

## ■ TEST RESULTS-Peak

### Conducted Output Power Measurements

LE Mode		Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.		
2402	0	-3.963	30
2440	19	-3.507	30
2480	39	-3.605	30

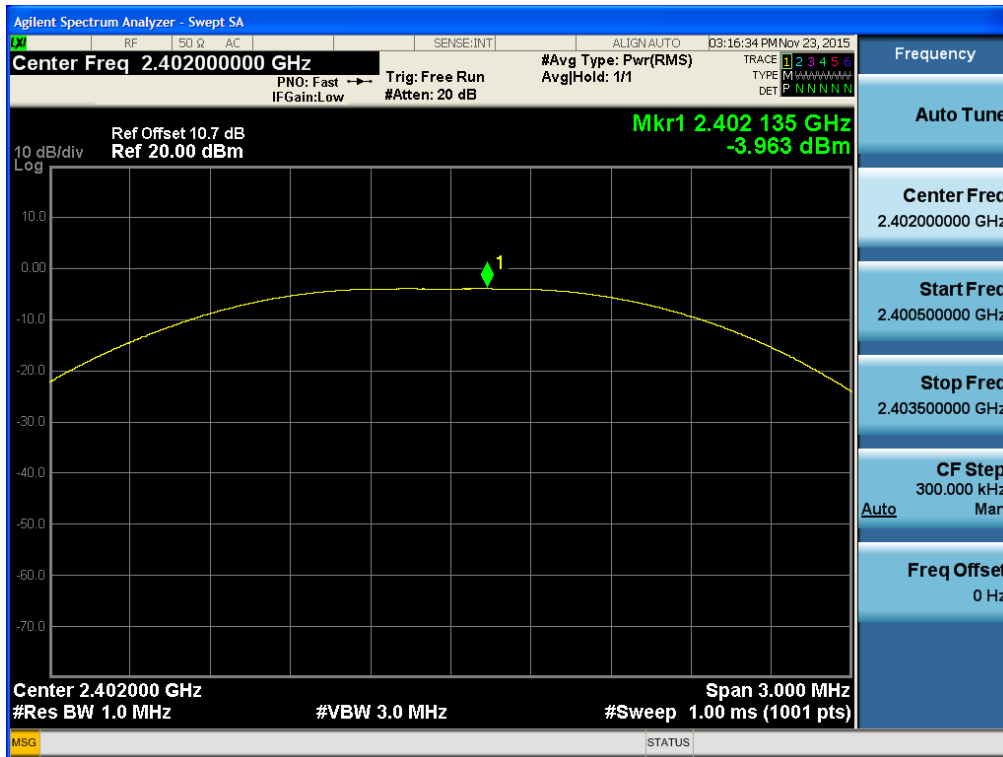
## ■ TEST RESULTS-Average

### Conducted Output Power Measurements

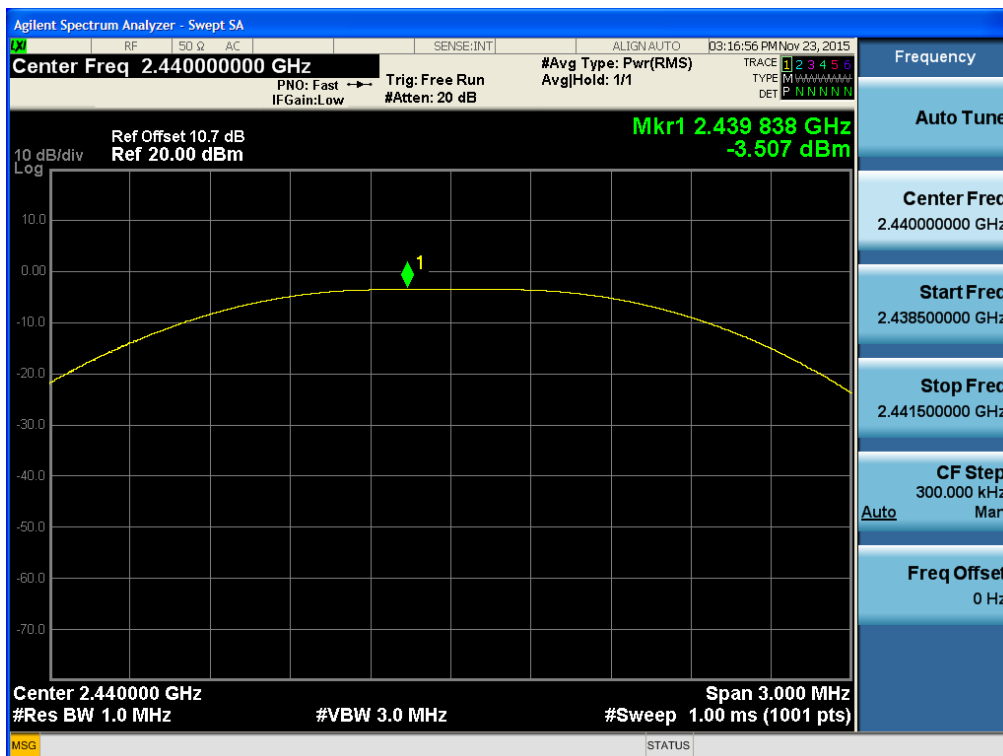
LE Mode		Measured Power(dBm)	Duty Cycle Factor	Measured Power(dBm) + Duty Cycle Factor	Limit (dBm)
Frequency[MHz]	Channel No.				
2402	0	-6.420	2.17	-4.248	30
2440	19	-6.000	2.17	-3.828	30
2480	39	-6.080	2.17	-3.908	30

■ RESULT PLOTS-Peak

Conducted Output Power (Low-CH 0)

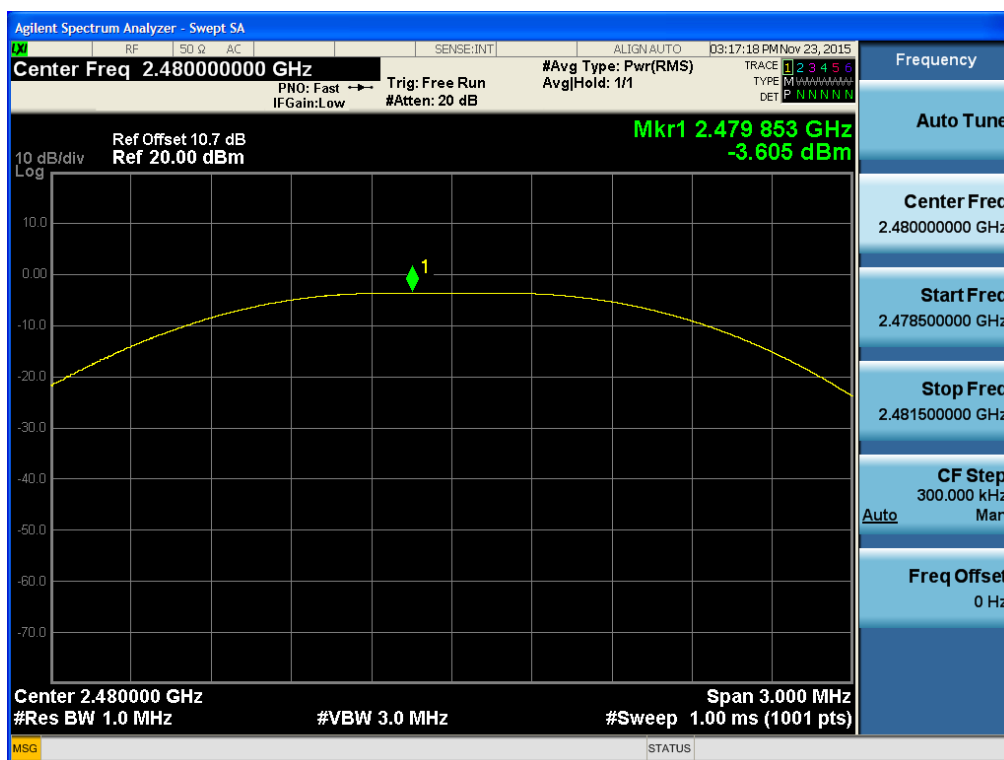


Conducted Output Power (Mid-CH 19)





### Conducted Output Power (High-CH 39)

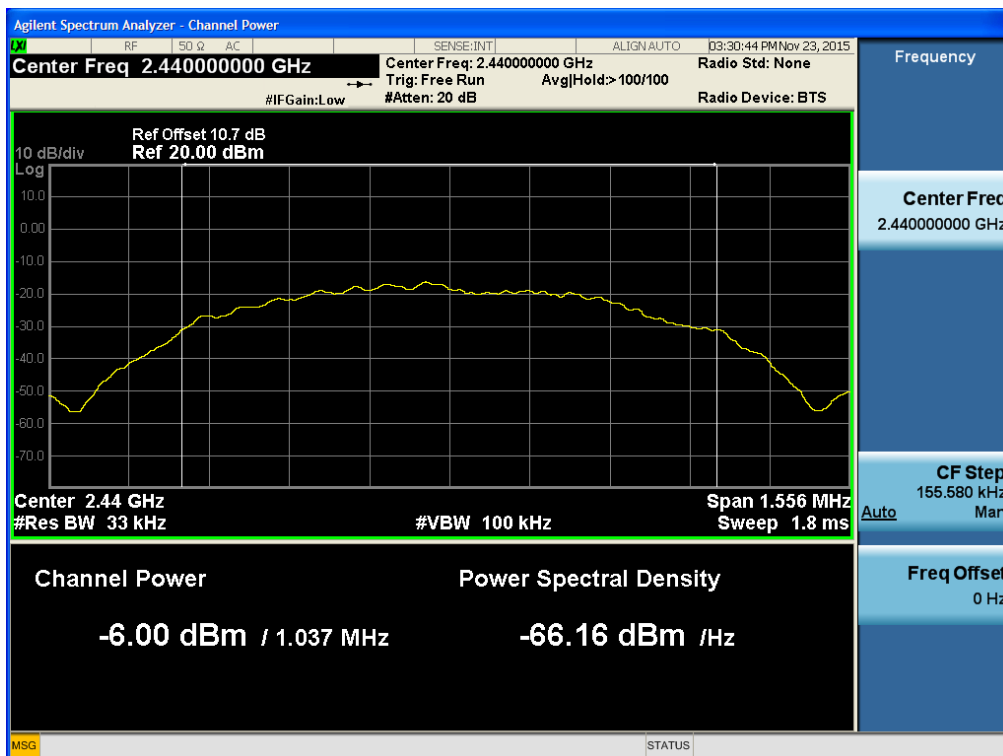


■ RESULT PLOTS-Average

Conducted Output Power (Low-CH 0)



Conducted Output Power (Mid-CH 19)



### Conducted Output Power (High-CH 39)



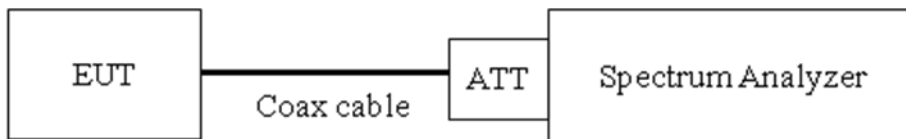
## 8.4 POWER SPECTRAL DENSITY

### Test Requirements and limit, §15.247(e)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

**Minimum Standard – The transmitter power density average over 1-second interval shall not be greater than 8dBm in any 3kHz BW.**

### ■ TEST CONFIGURATION



### ■ TEST PROCEDURE

We tested according to Procedure 10.2 in KDB 558074, issued 06/09/2015

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 x RBW.

Sweep = auto couple

Detector = peak

Trace Mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### ■ Sample Calculation

PSD = Reading Value + ATT loss + Cable loss(1 ea)

Output Power = -5 dBm + 10 dB + 0.8 dB = 5.8 dBm

Note :

1. Spectrum reading values are not plot data. The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest 10.7 dB. So, 10.7 dB is offset for 2.4 GHz Band.

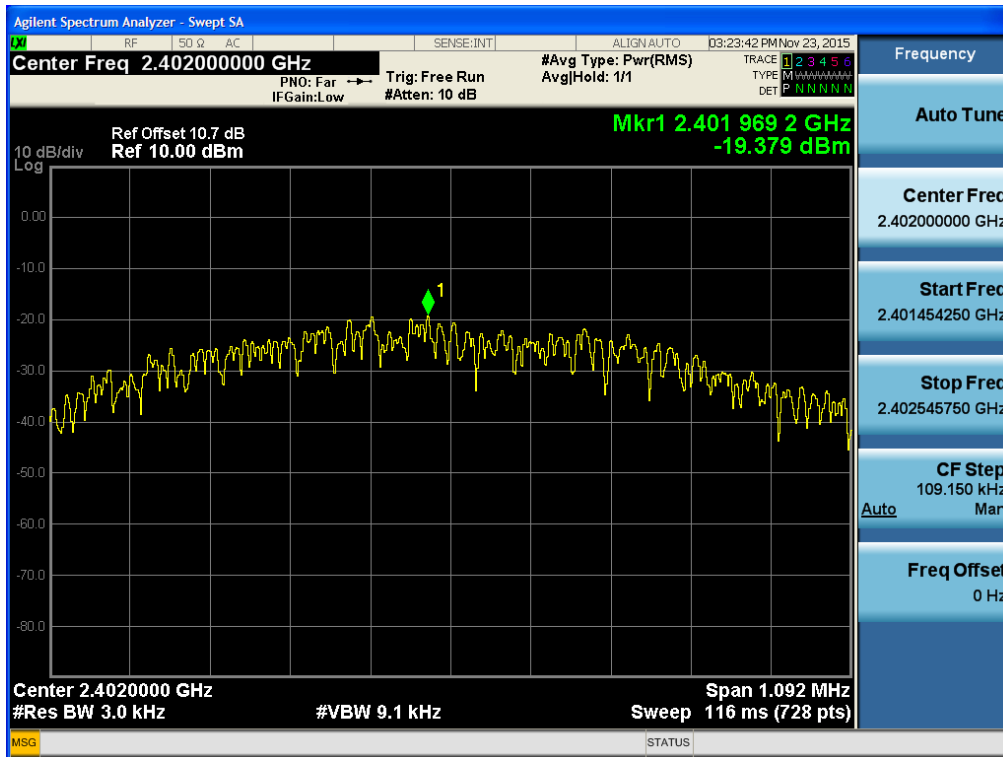
## ■ TEST RESULTS

### Conducted Power Density Measurements

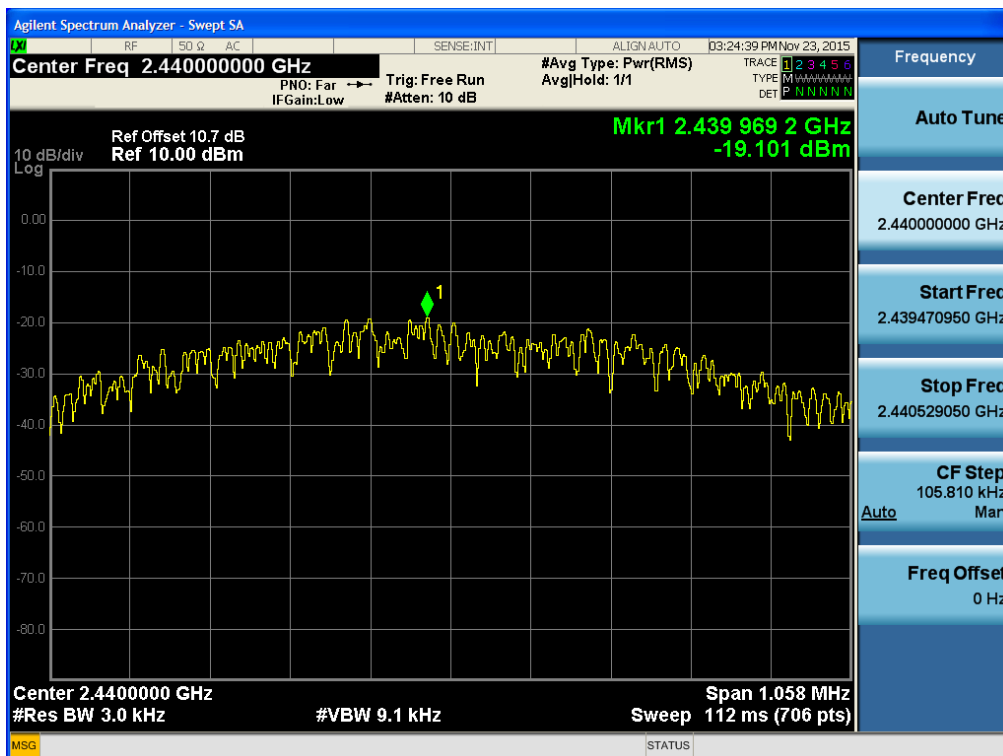
Frequency (MHz)	Channel No.	Mode	Test Result		
			PSD (dBm)	Limit (dBm)	Pass/ Fail
2402	0	LE	-19.379	8	Pass
2440	19		-19.101	8	Pass
2480	39		-19.047	8	Pass

■ RESULT PLOTS

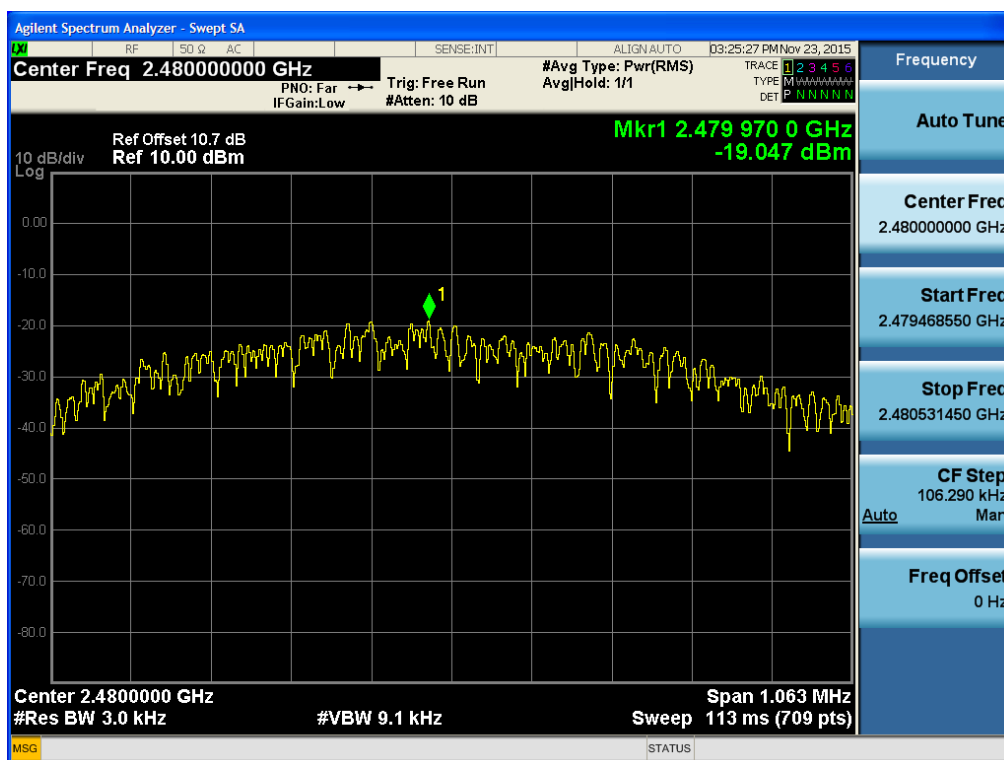
Power Spectral Density (Low-CH 0)



Power Spectral Density (Mid-CH 19)

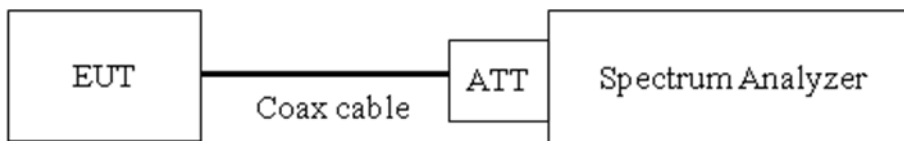


### Power Spectral Density (High-CH 39)



**8.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS****Test Requirements and limit, §15.247(d)**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

**Limit : 20 dBc****■ TEST CONFIGURATION****■ TEST PROCEDURE**

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074, issued 06/09/2015)

RBW = 100 kHz

VBW  $\geq 3 \times$  RBW

Set span to encompass the spectrum to be examined

Detector = Peak

Trace Mode = max hold

Sweep time = auto couple

Ensure that the number of measurement points  $\geq 2 \times \text{Span} / \text{RBW}$

Allow trace to fully stabilize.

Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10<sup>th</sup> harmonic range with the transmitter set to the lowest, middle, and highest channels.

Note :

1. The band edge results in plot is already including the actual values of loss for the attenuator and cable combination.



2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest 10.7 dB. So, 10.7 dB is offset for 2.4 GHz Band.
4. In case of conducted spurious emissions test, please check factors blow table.
5. In order to simplify the report, attached plots were only the worst case channel and data rate.

#### **■ FACTORS FOR FREQUENCY**

Freq(MHz)	Factor(dB)
30	11.30
100	9.83
200	10.19
300	10.13
400	10.23
500	10.25
600	10.32
700	10.35
800	10.35
900	10.34
1000	10.39
2000	10.64
2400*	10.65
2500*	10.67
3000	10.68
4000	10.89
5000	11.07
6000	11.06
7000	11.35
8000	11.32
9000	11.48
10000	11.56
11000	11.56
12000	11.68
13000	11.83
14000	11.90
15000	11.98
16000	12.04

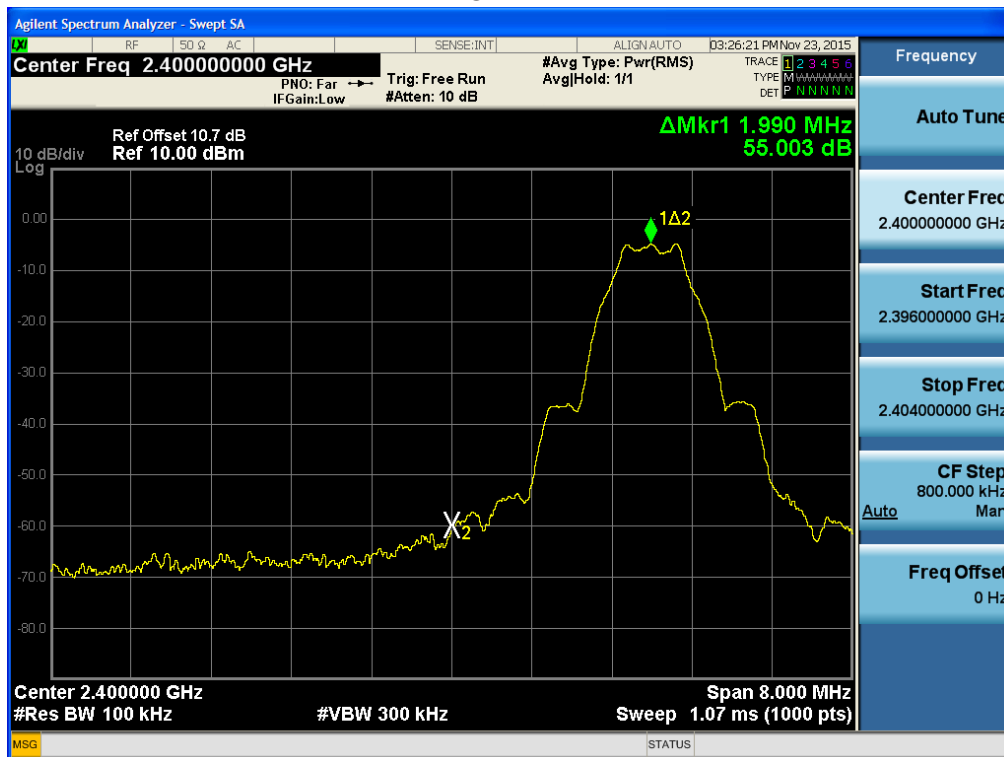
17000	12.02
18000	12.08
19000	12.07
20000	12.14
21000	12.17
22000	12.31
23000	12.60
24000	12.34
25000	12.53

Note : 1. '\*\*' is fundamental frequency range.

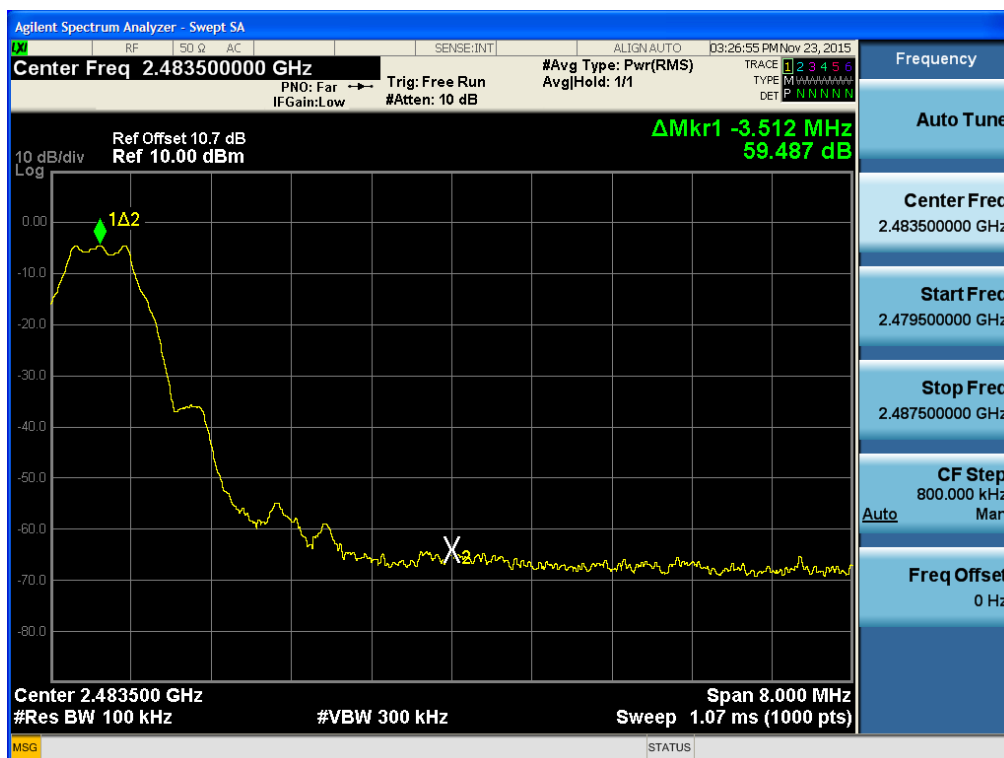
2. Factor = Cable loss + Attenuator loss

■ RESULT PLOTS

BandEdge (Low-CH 0)

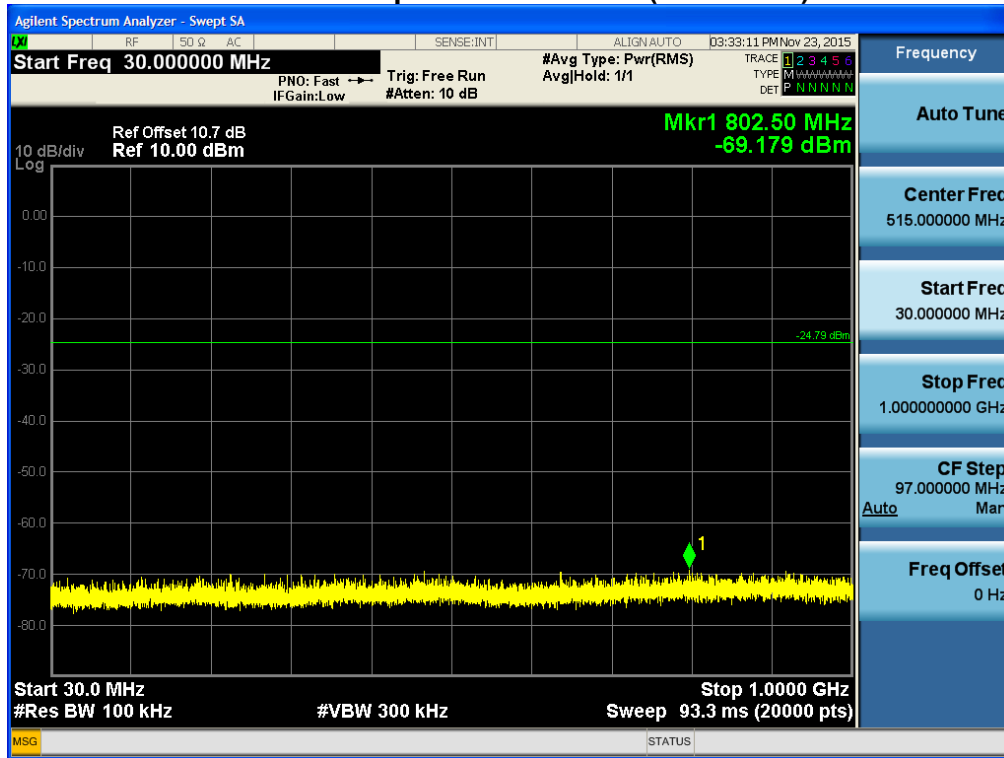


BandEdge (High-CH 39)



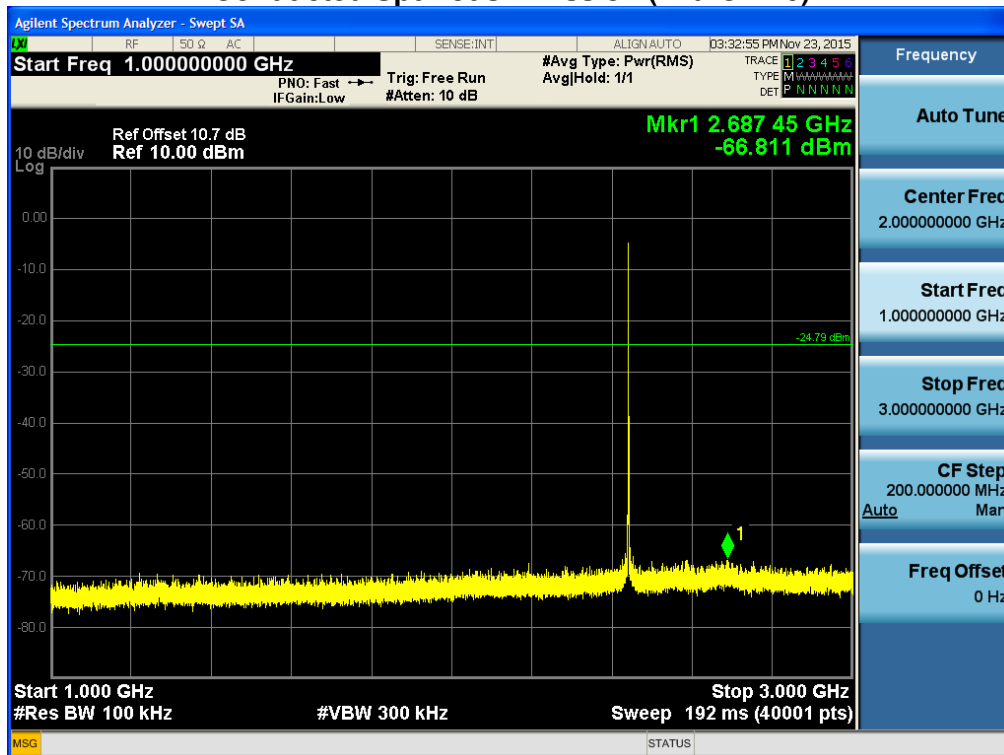
### 30 MHz ~ 1 GHz

#### Conducted Spurious Emission (Mid-CH 19)



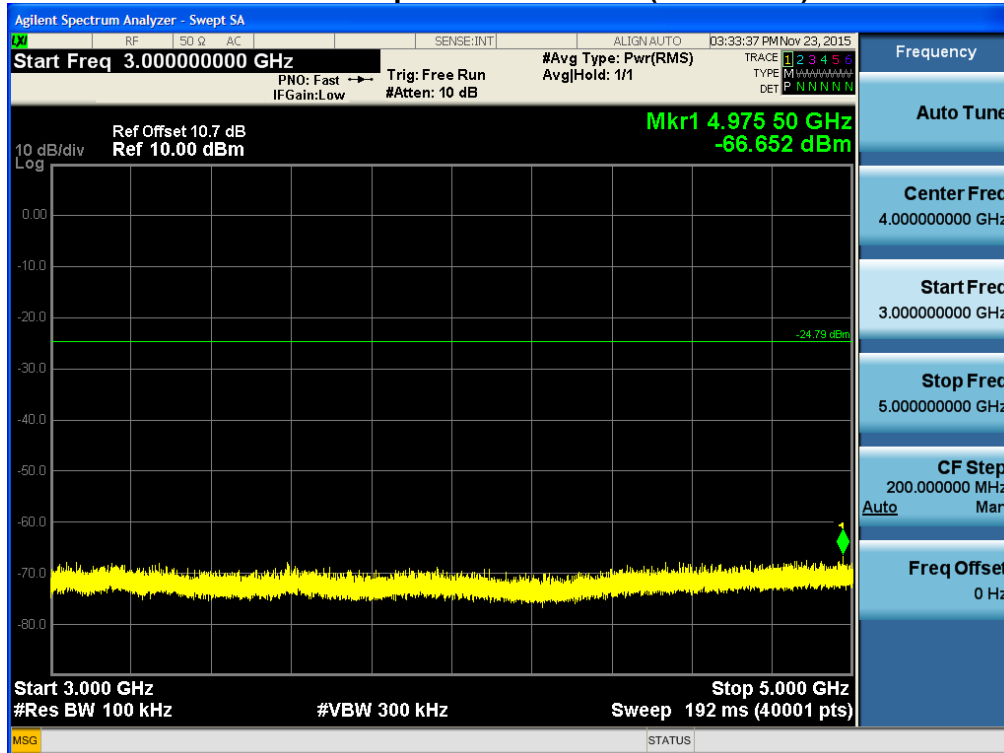
### 1 GHz ~ 3 GHz

#### Conducted Spurious Emission (Mid-CH 19)



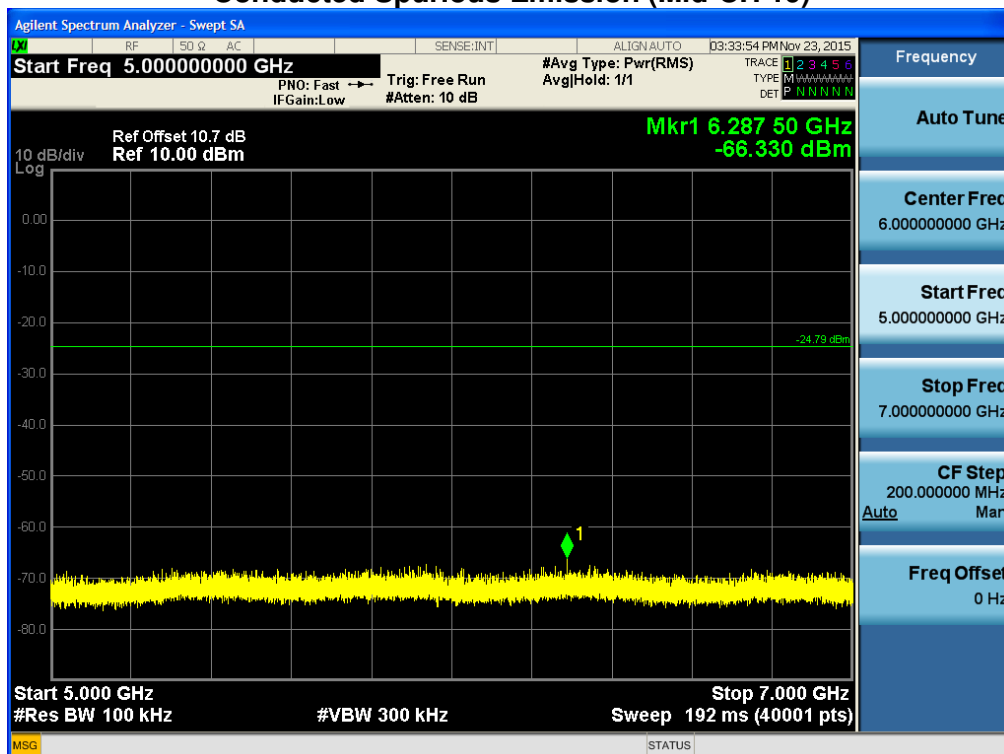
### 3 GHz ~ 5 GHz

### Conducted Spurious Emission (Mid-CH 19)



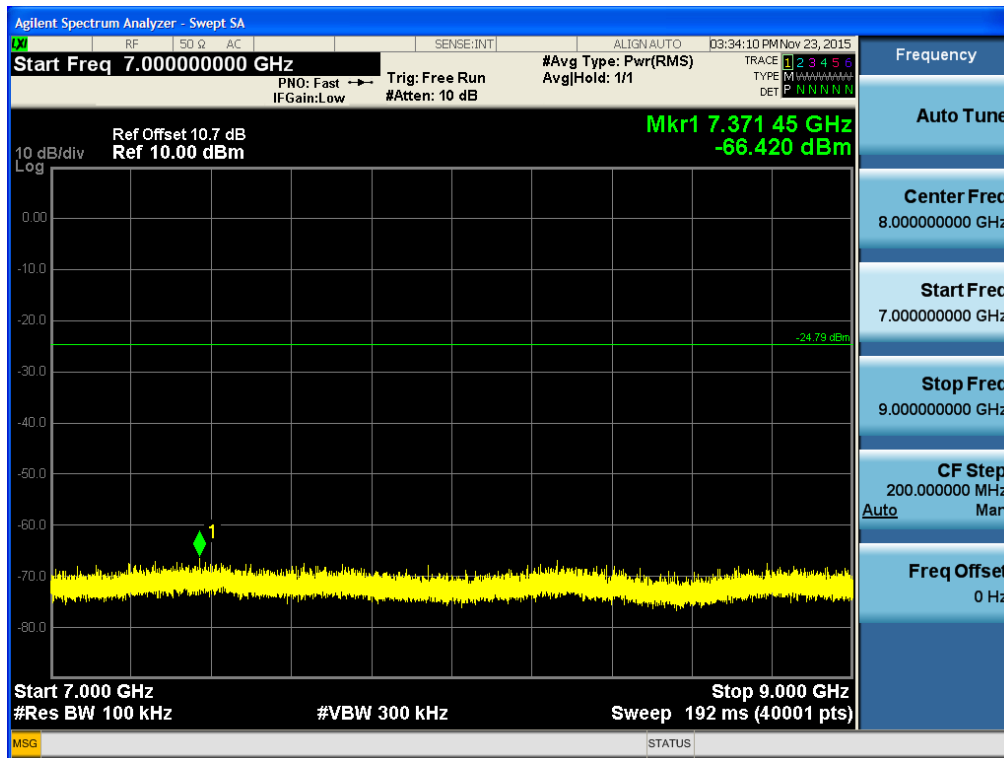
5 GHz ~ 7 GHz

### Conducted Spurious Emission (Mid-CH 19)



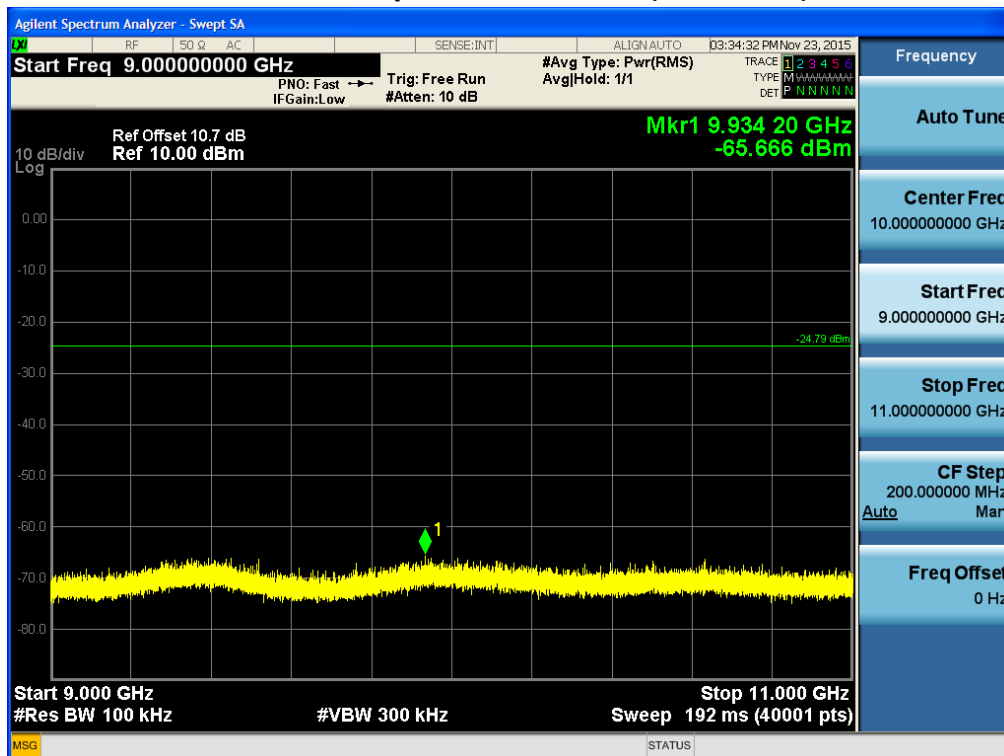
7 GHz ~ 9 GHz

### Conducted Spurious Emission (Mid-CH 19)



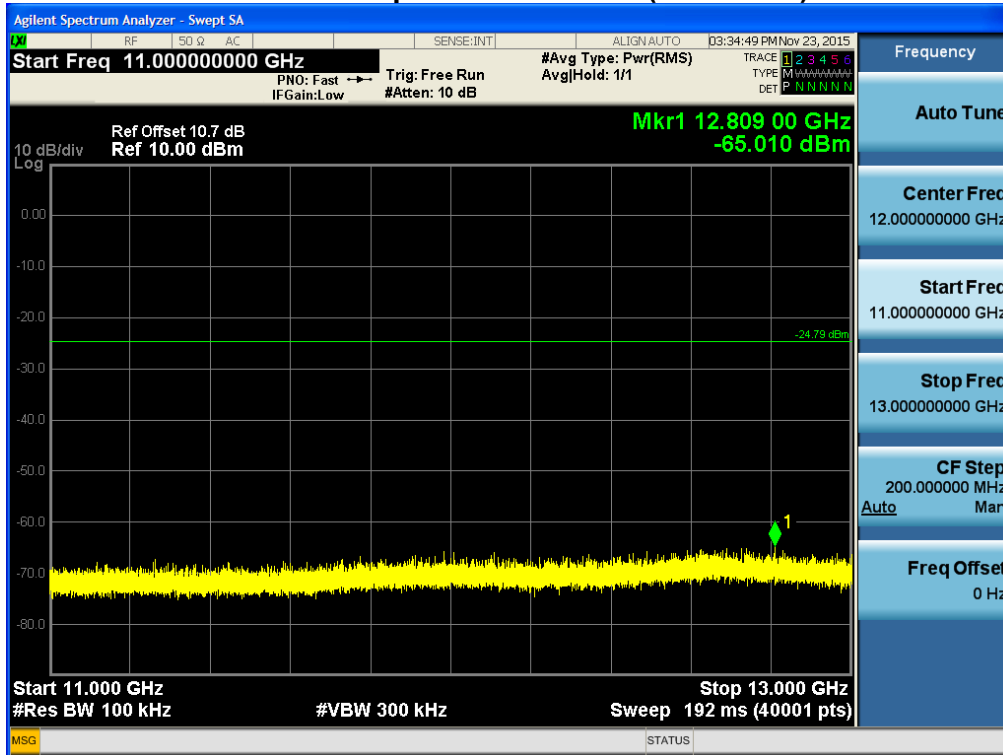
9 GHz ~ 11 GHz

### Conducted Spurious Emission (Mid-CH 19)



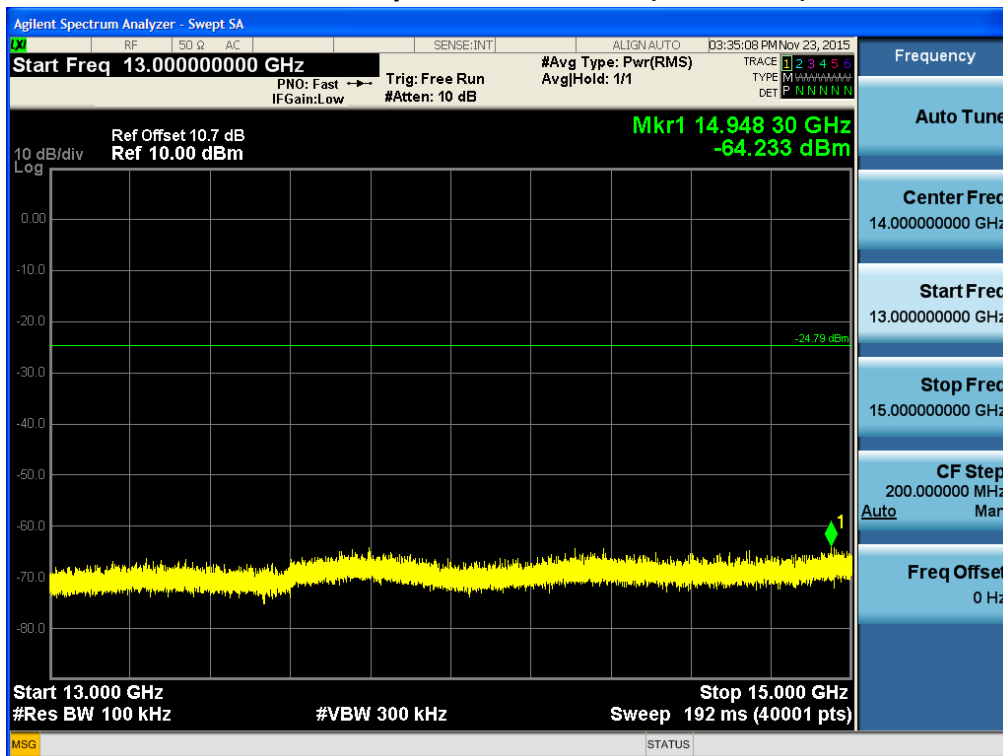
11 GHz ~ 13 GHz

### Conducted Spurious Emission (Mid-CH 19)



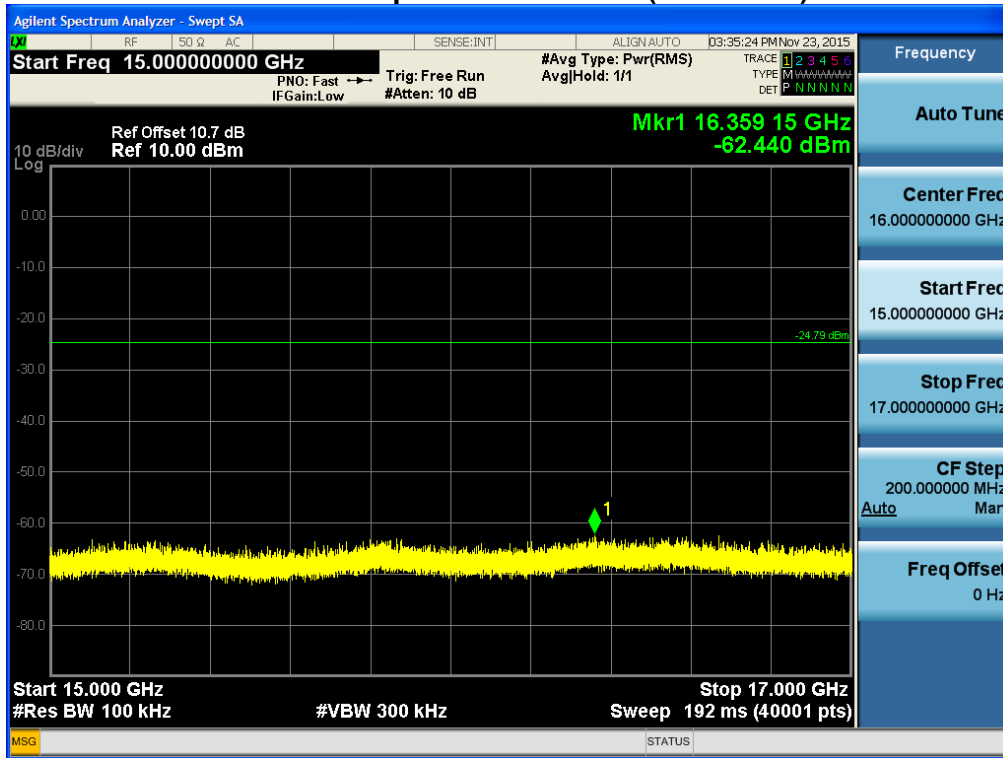
13 GHz ~ 15 GHz

### Conducted Spurious Emission (Mid-CH 19)



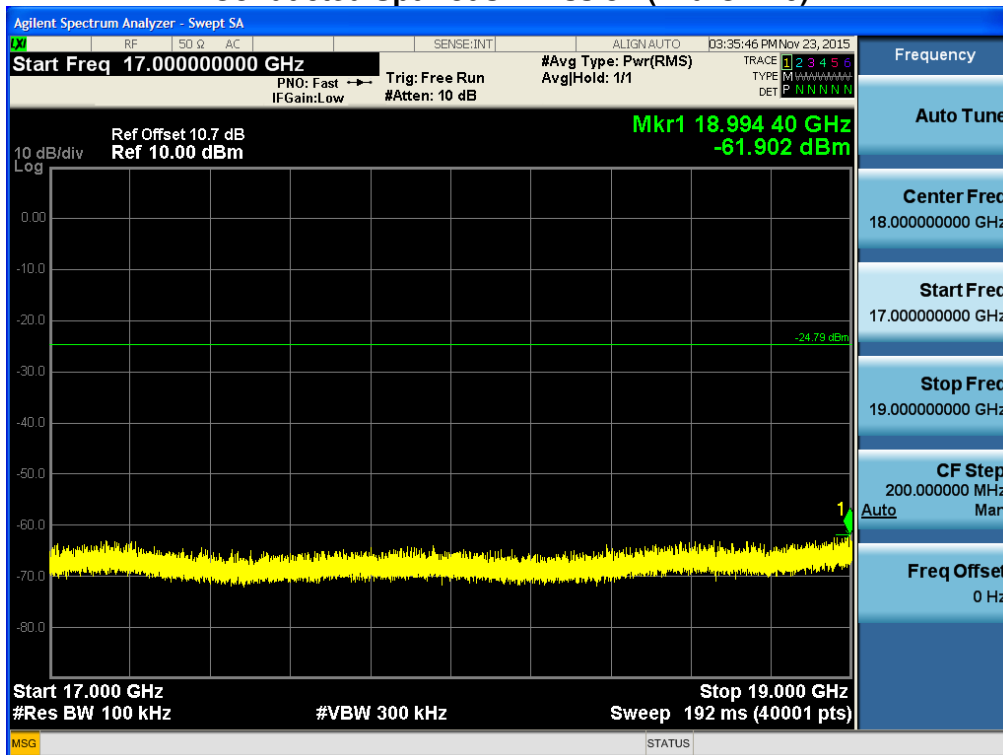
15 GHz ~ 17 GHz

Conducted Spurious Emission (Mid-CH 19)



17 GHz ~ 19 GHz

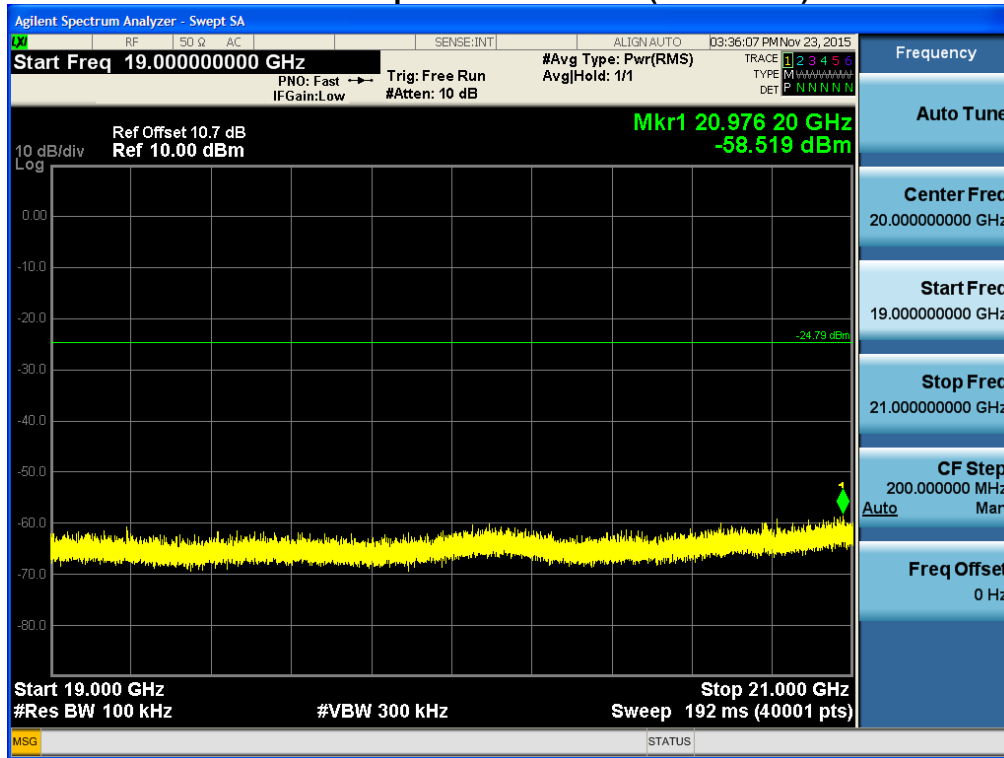
Conducted Spurious Emission (Mid-CH 19)





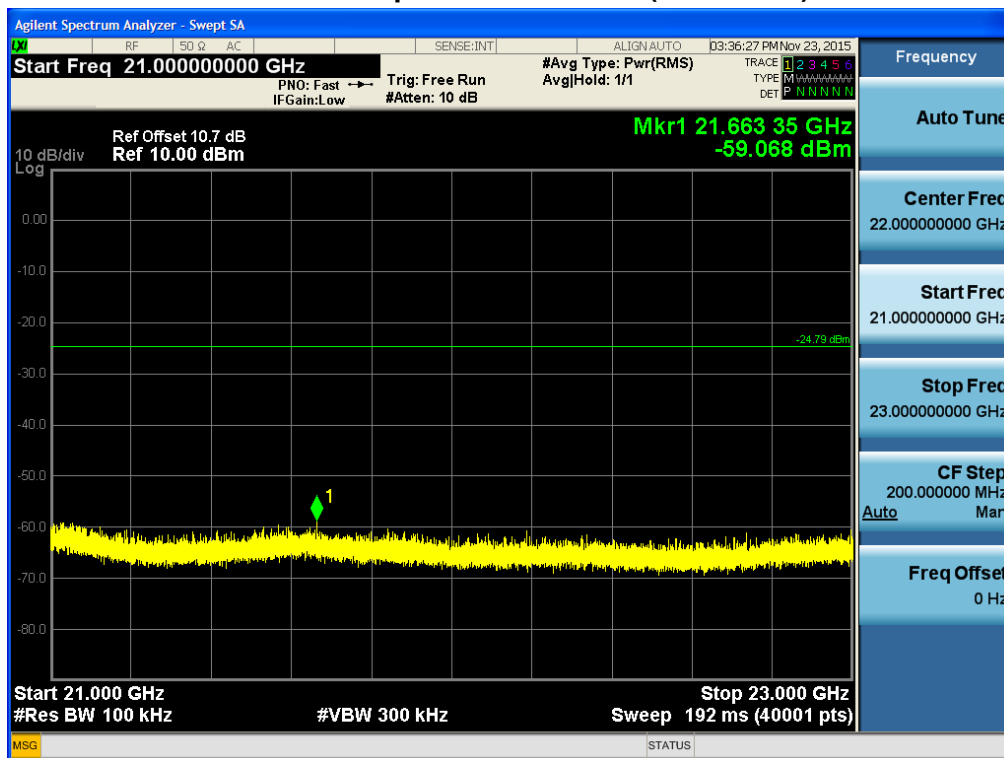
19 GHz ~ 21 GHz

Conducted Spurious Emission (Mid-CH 19)



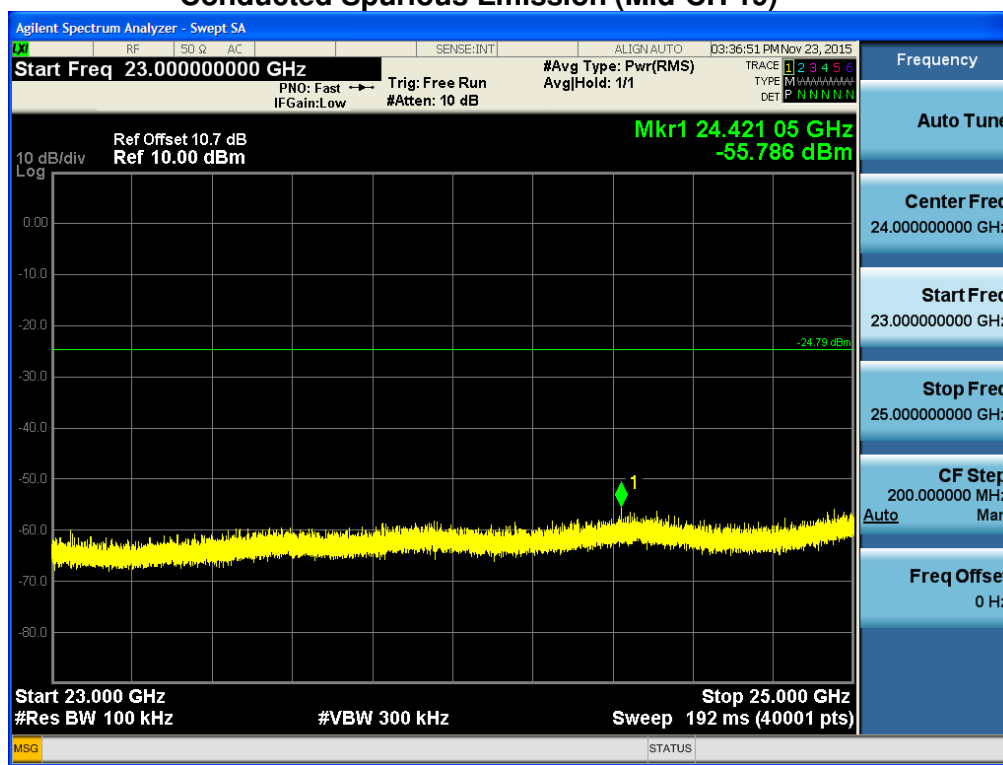
21 GHz ~ 23 GHz

Conducted Spurious Emission (Mid-CH 19)



23 GHz ~ 25 GHz

### Conducted Spurious Emission (Mid-CH 19)

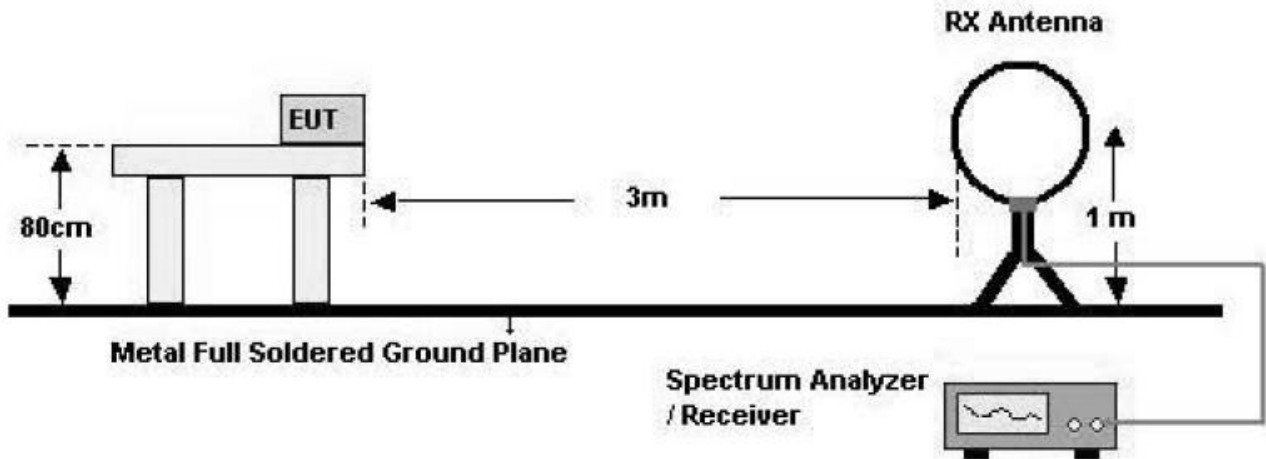


**8.6 RADIATED MEASUREMENT.****8.6.1 RADIATED SPURIOUS EMISSIONS.****Test Requirements and limit, §15.205, §15.209**

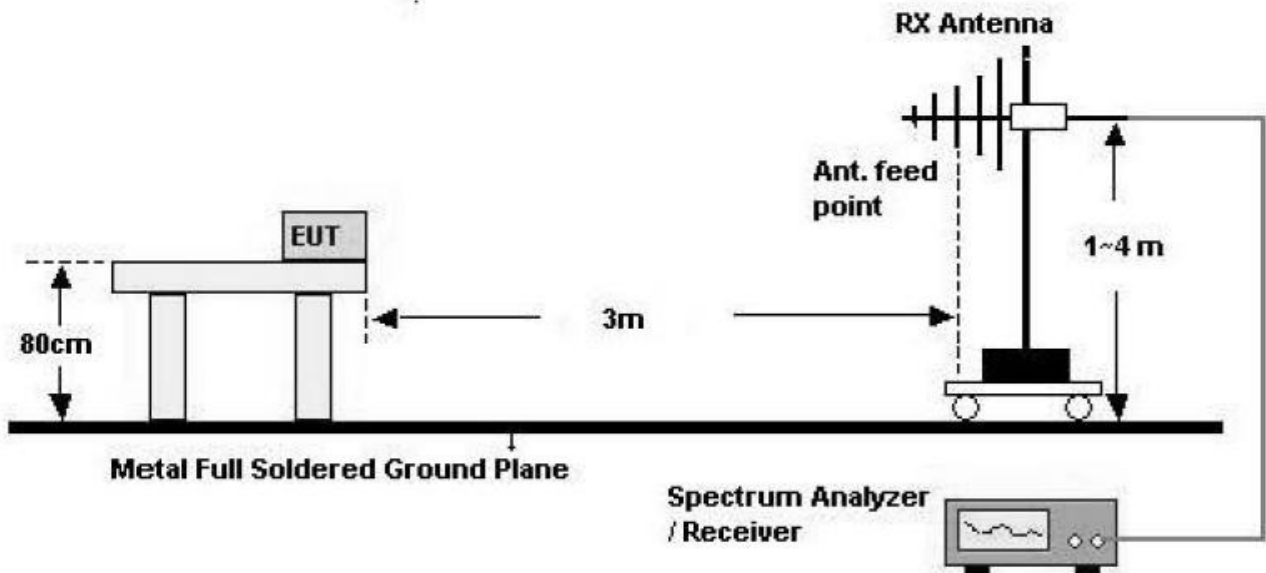
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

## Test Configuration

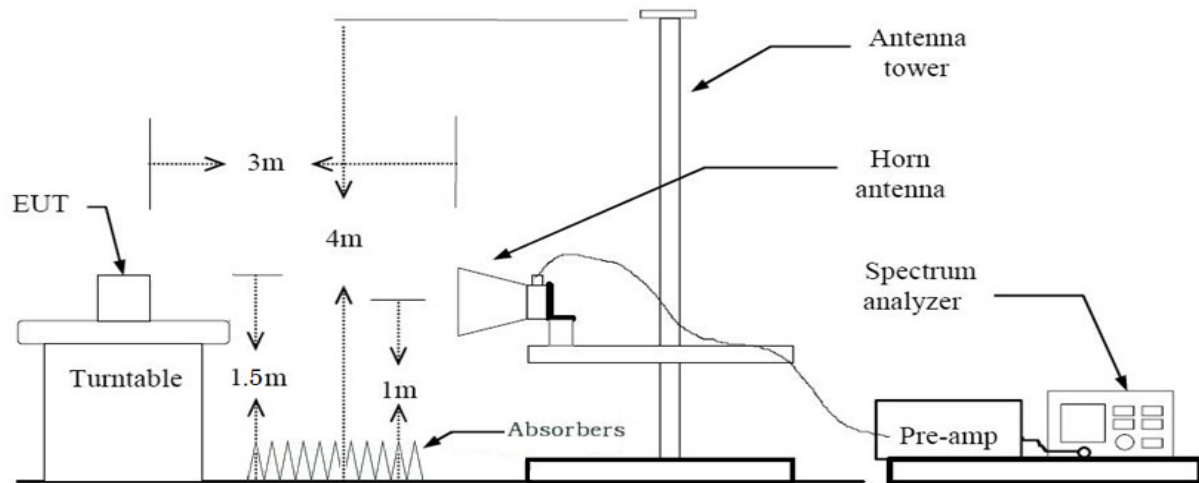
### Below 30 MHz



### 30 MHz - 1 GHz



## Above 1 GHz



## TEST PROCEDURE USED

Method 12.1 in KDB 558074, issued 06/09/2015

### Spectrum Setting

#### - Peak

Peak emission levels are measured by setting the instrument as follows:

RBW = cf. Table 1.

VBW  $\geq 3 \times$  RBW.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweeps to continue until the trace stabilizes.

(Note that the required measurement time may be longer for low duty cycle applications).

**Table 1 —RBW as a function of frequency**

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

- Average (duty cycle  $\geq 98\%$ )

Set RBW = 1 MHz

Set VBW  $\geq 3 \times$  RBW

Detector = RMS

Averaging type = power (*i.e.*, RMS).

Sweep time = auto.

Trace mode = average (at least 100 traces).

- Average (duty cycle  $< 98\%$ , duty cycle variations are less than  $\pm 2\%$ )

Set RBW = 1 MHz

Set VBW  $\geq 3 \times$  RBW

Detector = RMS.

Averaging type = power (*i.e.*, RMS).

Sweep time = auto.

Trace mode = average (at least 100 traces).

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.

- Average (duty cycle  $< 98\%$ )

Set RBW = 1 MHz

Set VBW  $\geq 1/T$ . (at least 100 times less than the resolution bandwidth, but no less than 10 Hz.)

Select spectrum analyzer linear display mode.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Note :

1. We are performed the RSE and radiated band edge using standard radiated method.
2. The duty cycle factor for BT LE mode.

BT LE Mode	$T_{on}$ (ms)	$T_{total}$ (ms)	Duty Cycle (%)	Duty Cycle Factor	VBW(1/T) (Hz)
	0.3790	0.6250	60.64	2.17	2639

## TEST RESULTS

### 9 kHz – 30MHz

**Operation Mode:** Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	$\text{dB}\mu\text{V}/\text{m}$	$\text{dBm}/\text{m}$	$\text{dBm}$	(H/V)	$\text{dB}\mu\text{V}/\text{m}$	$\text{dB}\mu\text{V}/\text{m}$	$\text{dB}$
No Critical peaks found							

### Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

## TEST RESULTS

### Below 1 GHz

**Operation Mode:** Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	$\text{dB}\mu\text{V}/\text{m}$	$\text{dBm}/\text{m}$	$\text{dBm}$	(H/V)	$\text{dB}\mu\text{V}/\text{m}$	$\text{dB}\mu\text{V}/\text{m}$	$\text{dB}$
No Critical peaks found							

### Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



## Above 1 GHz

Operation Mode: CH Low(LE Mode)

Frequency [MHz]	Reading [dBuV/m]	A.F.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4804	48.53	-2.96	V	45.57	73.98	28.41	PK
4804	35.86	-2.96	V	32.9	53.98	21.08	AV
7206	45.84	6.88	V	52.72	73.98	21.26	PK
7206	32.53	6.88	V	39.41	53.98	14.57	AV
4804	48.68	-2.96	H	45.72	73.98	28.26	PK
4804	35.92	-2.96	H	32.96	53.98	21.02	AV
7206	45.85	6.88	H	52.73	73.98	21.25	PK
7206	32.98	6.88	H	39.86	53.98	14.12	AV

### Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. The Reading values are already added value of the duty cycle factor.
5. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

## Operation Mode: CH Mid(LE Mode)

Frequency [MHz]	Reading [dBuV/m]	A.F.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4882	49.37	-2.60	V	46.77	73.98	27.21	PK
4882	36.55	-2.60	V	33.95	53.98	20.03	AV
7323	45.54	6.11	V	51.65	73.98	22.33	PK
7323	32.70	6.11	V	38.81	53.98	15.17	AV
4882	49.47	-2.60	H	46.87	73.98	27.11	PK
4882	36.61	-2.60	H	34.01	53.98	19.97	AV
7323	45.65	6.11	H	51.76	73.98	22.22	PK
7323	32.75	6.11	H	38.86	53.98	15.12	AV

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. The Reading values are already added value of the duty cycle factor.
5. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

## Operation Mode: CH High(LE Mode)

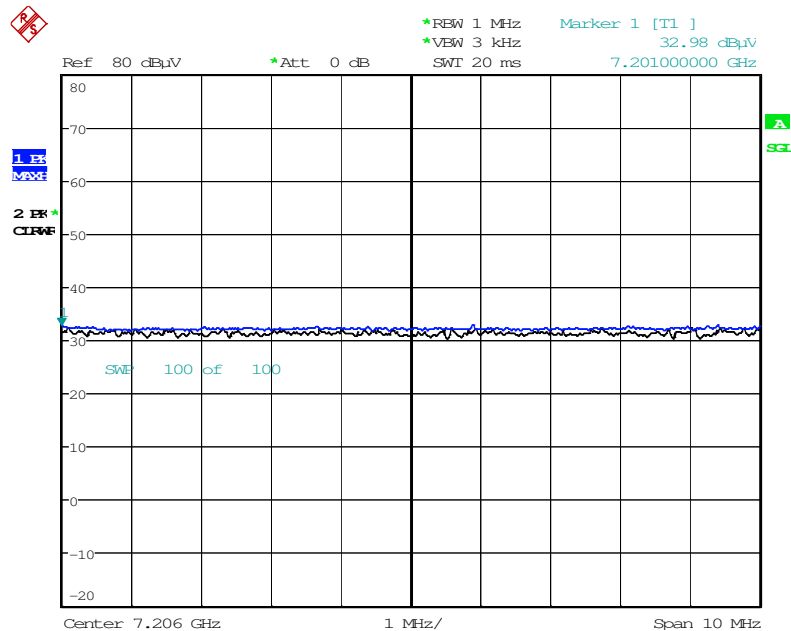
Frequency [MHz]	Reading [dBuV/m]	A.F.+CL-AMP G [dBm]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4960	48.90	-2.53	V	46.37	73.98	27.61	PK
4960	36.12	-2.53	V	33.59	53.98	20.39	AV
7440	45.40	5.73	V	51.13	73.98	22.85	PK
7440	31.76	5.73	V	37.49	53.98	16.49	AV
4960	49.03	-2.53	H	46.5	73.98	27.48	PK
4960	36.21	-2.53	H	33.68	53.98	20.30	AV
7440	45.55	5.73	H	51.28	73.98	22.70	PK
7440	32.82	5.73	H	38.55	53.98	15.43	AV

**Notes:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. The Reading values are already added value of the duty cycle factor.
5. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

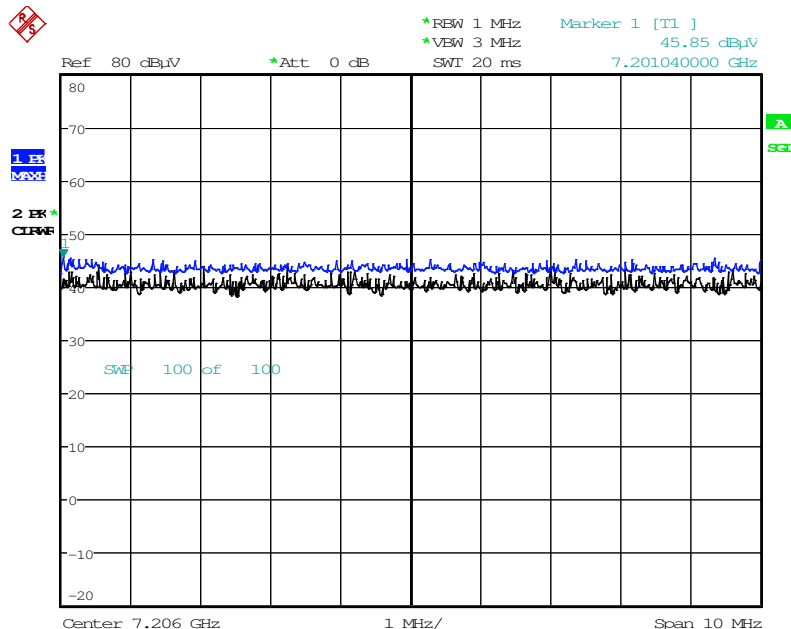
## RESULT PLOTS

### Radiated Spurious Emissions plot – Average Reading (LE, Ch. Low 3rd Harmonic)



Date: 18.NOV.2015 04:27:52

### Radiated Spurious Emissions plot – Peak Reading (LE, Ch. Low 3rd Harmonic)



Date: 18.NOV.2015 04:28:37

**Note : Only the worst case plots for Radiated Spurious Emissions.**

## 8.6.2 RADIATED RESTRICTED BAND EDGES

### Test Requirements and limit, §15.247(d) §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

Operation Mode	BT_LE
Operating Frequency	2402 MHz
Channel No	0 Ch

Frequency [MHz]	Reading [dBuV/m]	A.F.+CL [dBm]	Ant. Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	27.05	31.31	H	58.36	73.98	15.62	PK
2390.0	16.26	31.31	H	47.57	53.98	6.41	AV
2390.0	27.11	31.31	V	58.42	73.98	15.56	PK
2390.0	16.30	31.31	V	47.61	53.98	6.37	AV

### Notes:

1. Frequency range of measurement = 2310 MHz ~ 2390 MHz
2. The Reading values are already added value of the duty cycle factor.
3. Total = Reading Value + Antenna Factor + Cable Loss
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The radiated restricted band edge measurements are measured with a spectrum analyzer connected to the receive antenna while the EUT is transmitting.

Operation Mode	BT_LE
Operating Frequency	2480 MHz
Channel No	39 Ch

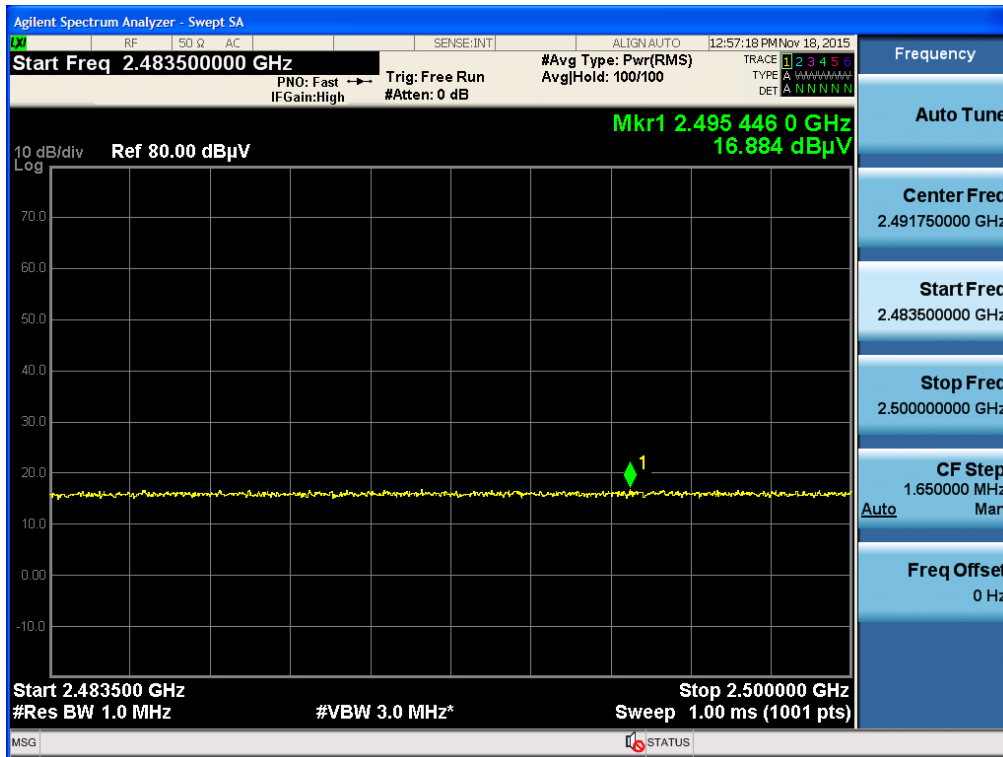
Frequency [MHz]	Reading [dBuV/m]	A.F.+CL [dBm]	Ant. Pol. [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	27.89	31.37	H	59.26	73.98	14.72	PK
2483.5	16.75	31.37	H	48.12	53.98	5.86	AV
2483.5	28.30	31.37	V	59.67	73.98	14.31	PK
2483.5	16.89	31.37	V	48.26	53.98	5.72	AV

**Notes:**

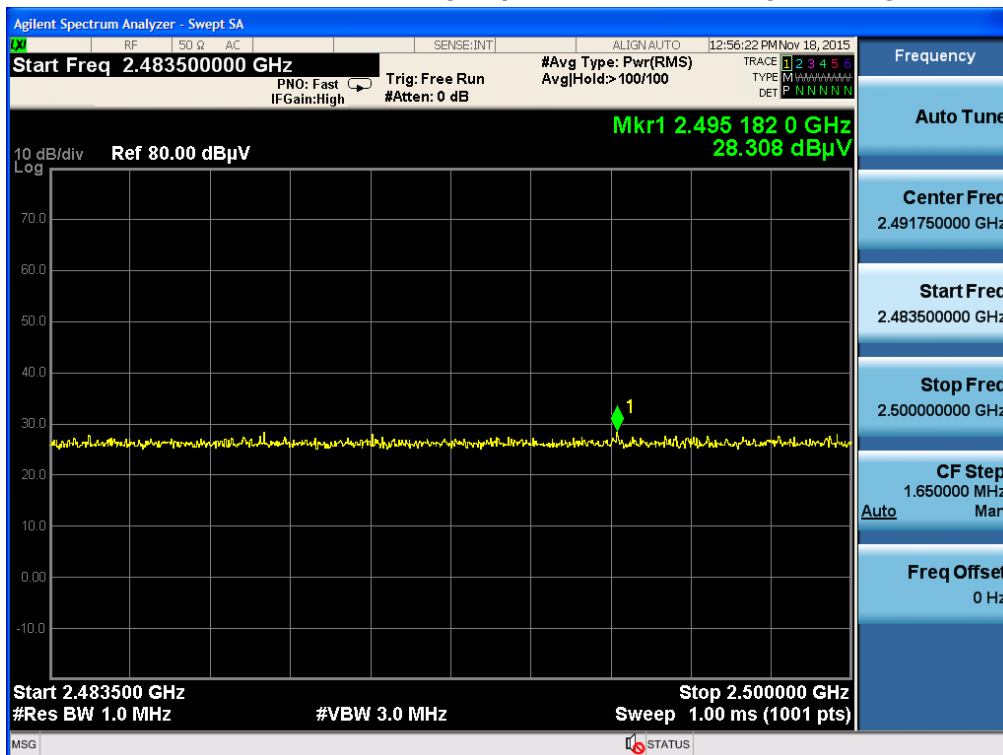
1. Frequency range of measurement = 2483.5 MHz ~ 2500 MHz
2. The Reading values are already added value of the duty cycle factor.
3. Total = Reading Value + Antenna Factor + Cable Loss
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The radiated restricted band edge measurements are measured with a spectrum analyzer connected to the receive antenna while the EUT is transmitting.

## RESULT PLOTS

### Radiated Restricted Band Edges plot – Average Reading (LE, High Ch.)



### Radiated Restricted Band Edges plot – Peak Reading (LE, High Ch.)



Note : Only the worst case plots for Radiated Restricted Band Edges.

## 8.7 POWERLINE CONDUCTED EMISSIONS

### Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

### Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor



## RESULT PLOTS

### Conducted Emissions (Line 1)

EMI Auto Test(12)

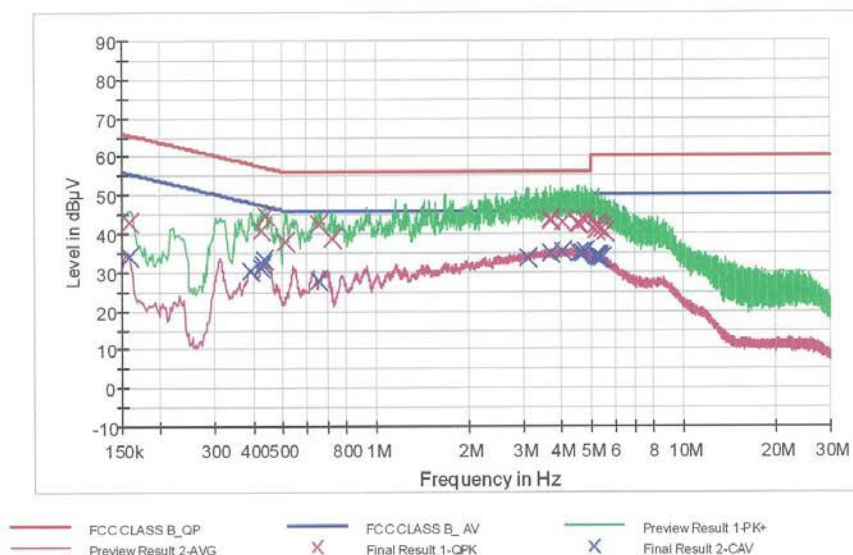
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## HCT TEST Report

### Common Information

EUT: LG-K410f  
Manufacturer: LG  
Test Site: SHIELD ROOM  
Operating Conditions: BT LE MODE  
Operator Name: KS KANG

FCC CLASS B



### Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	42.9	9.000	Off	N	9.6	22.7	65.6
0.424000	40.7	9.000	Off	N	9.6	16.7	57.4
0.438000	44.8	9.000	Off	N	9.6	12.3	57.1
0.512000	37.9	9.000	Off	N	9.6	18.1	56.0
0.654000	42.3	9.000	Off	N	9.6	13.7	56.0
0.722000	38.8	9.000	Off	N	9.7	17.2	56.0
3.694000	43.8	9.000	Off	N	9.8	12.2	56.0
3.700000	43.3	9.000	Off	N	9.8	12.7	56.0
4.026000	43.0	9.000	Off	N	9.8	13.0	56.0
4.520000	42.7	9.000	Off	N	9.8	13.3	56.0
4.582000	42.4	9.000	Off	N	9.8	13.6	56.0
4.800000	43.4	9.000	Off	N	9.8	12.6	56.0
5.174000	42.1	9.000	Off	N	9.8	17.9	60.0
5.198000	41.0	9.000	Off	N	9.8	19.0	60.0
5.236000	42.4	9.000	Off	N	9.8	17.6	60.0
5.312000	41.5	9.000	Off	N	9.8	18.5	60.0

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EMI Auto Test(12)

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Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
5.454000	41.2	9.000	Off	N	9.8	18.8	60.0
5.566000	40.3	9.000	Off	N	9.8	19.7	60.0

### Final Result 2

Frequency (MHz)	CAverage (dBμV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.158000	34.2	9.000	Off	N	9.6	21.4	55.6
0.394000	30.5	9.000	Off	N	9.6	17.5	48.0
0.424000	31.2	9.000	Off	N	9.6	16.2	47.4
0.432000	32.1	9.000	Off	N	9.6	15.1	47.2
0.436000	33.2	9.000	Off	N	9.6	13.9	47.1
0.654000	27.7	9.000	Off	N	9.6	18.3	46.0
3.112000	33.9	9.000	Off	N	9.8	12.1	46.0
3.694000	34.9	9.000	Off	N	9.8	11.1	46.0
4.026000	35.4	9.000	Off	N	9.8	10.6	46.0
4.580000	35.0	9.000	Off	N	9.8	11.0	46.0
4.690000	35.1	9.000	Off	N	9.8	10.9	46.0
4.800000	35.3	9.000	Off	N	9.8	10.7	46.0
5.198000	34.1	9.000	Off	N	9.8	15.9	50.0
5.236000	34.3	9.000	Off	N	9.8	15.7	50.0
5.312000	33.9	9.000	Off	N	9.8	16.1	50.0
5.320000	34.0	9.000	Off	N	9.8	16.0	50.0
5.336000	33.8	9.000	Off	N	9.8	16.2	50.0
5.454000	33.6	9.000	Off	N	9.8	16.4	50.0

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## Conducted Emissions (Line 2)

EMI Auto Test(12)

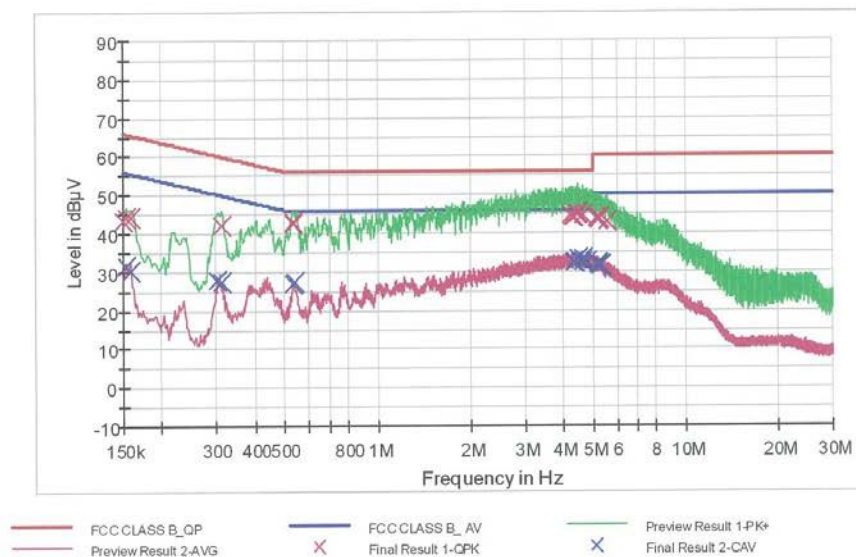
1 / 2

# HCT TEST Report

## Common Information

EUT: LG-K410f  
Manufacturer: LG  
Test Site: SHIELD ROOM  
Operating Conditions: BT LE MODE  
Operator Name: KS KANG

FCC CLASS B



## Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	43.3	9.000	Off	L1	9.6	22.7	66.0
0.154000	44.2	9.000	Off	L1	9.6	21.6	65.8
0.158000	44.1	9.000	Off	L1	9.6	21.5	65.6
0.314000	42.1	9.000	Off	L1	9.6	17.8	59.9
0.532000	42.5	9.000	Off	L1	9.7	13.5	56.0
0.536000	43.0	9.000	Off	L1	9.7	13.0	56.0
4.250000	44.8	9.000	Off	L1	9.8	11.2	56.0
4.288000	44.1	9.000	Off	L1	9.8	11.9	56.0
4.340000	44.1	9.000	Off	L1	9.8	11.9	56.0
4.404000	45.0	9.000	Off	L1	9.8	11.0	56.0
4.478000	45.0	9.000	Off	L1	9.8	11.0	56.0
4.642000	44.4	9.000	Off	L1	9.8	11.6	56.0
5.146000	43.9	9.000	Off	L1	9.8	16.1	60.0
5.162000	43.4	9.000	Off	L1	9.8	16.6	60.0
5.184000	43.3	9.000	Off	L1	9.8	16.7	60.0
5.188000	43.7	9.000	Off	L1	9.8	16.3	60.0

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## EMI Auto Test(12)

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Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
5.218000	43.7	9.000	Off	L1	9.8	16.3	60.0
5.584000	43.0	9.000	Off	L1	9.9	17.0	60.0

## Final Result 2

Frequency (MHz)	CAverage (dBμV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154000	31.7	9.000	Off	L1	9.6	24.1	55.8
0.158000	30.2	9.000	Off	L1	9.6	25.4	55.6
0.304000	27.6	9.000	Off	L1	9.6	22.5	50.1
0.312000	27.6	9.000	Off	L1	9.6	22.3	49.9
0.532000	26.9	9.000	Off	L1	9.7	19.1	46.0
0.538000	27.3	9.000	Off	L1	9.7	18.7	46.0
4.340000	32.2	9.000	Off	L1	9.8	13.8	46.0
4.362000	32.3	9.000	Off	L1	9.8	13.7	46.0
4.478000	33.2	9.000	Off	L1	9.8	12.8	46.0
4.630000	33.2	9.000	Off	L1	9.8	12.8	46.0
4.642000	32.6	9.000	Off	L1	9.8	13.4	46.0
4.798000	32.4	9.000	Off	L1	9.8	13.6	46.0
5.184000	31.8	9.000	Off	L1	9.8	18.2	50.0
5.188000	32.0	9.000	Off	L1	9.8	18.0	50.0
5.192000	31.8	9.000	Off	L1	9.8	18.2	50.0
5.214000	31.6	9.000	Off	L1	9.8	18.4	50.0
5.256000	31.8	9.000	Off	L1	9.8	18.2	50.0
5.280000	31.5	9.000	Off	L1	9.8	18.5	50.0

11/12/2015

5:58:47

## 9. LIST OF TEST EQUIPMENT

### 9.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216/ LISN	01/13/2015	Annual	100073
Agilent	E4440A/ Spectrum Analyzer	03/18/2015	Annual	US45303008
Agilent	N9020A / SIGNAL ANALYZER	06/30/2015	Annual	MY51110085
Agilent	N9020A / SIGNAL ANALYZER	07/02/2015	Annual	MY50510304
Agilent	N1911A/Power Meter	07/09/2015	Annual	MY45100523
Agilent	N1921A /POWER SENSOR	07/09/2015	Annual	MY45241059
Agilent	87300B/Directional Coupler	12/08/2014	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/15/2015	Annual	5001
Hewlett Packard	E3632A / DC POWER SUPPLY	03/11/2015	Annual	KR75303962
Agilent	8493C / Attenuator(10 dB)	07/23/2015	Annual	07560

## 9.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Schwarzbeck	VULB 9160/ TRILOG Antenna	10/10/2014	Biennial	3368
HD	MA240/ Antenna Position Tower	N/A	N/A	556
EMCO	1050/ Turn Table	N/A	N/A	114
HD GmbH	HD 100/ Controller	N/A	N/A	13
HD GmbH	KMS 560/ SlideBar	N/A	N/A	12
Schwarzbeck	BBHA 9120D/ Horn Antenna	05/07/2015	Biennial	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	04/30/2015	Biennial	BBHA9170124
Rohde & Schwarz	FSP / Spectrum Analyzer	01/22/2015	Annual	839117/011
Wainwright Instrument	WHF3.0/18G-10EF / High Pass Filter	06/29/2015	Annual	8
Wainwright Instrument	WRCJ2400/2483.5-2370/2520-60/14SS / Band Reject Filter	06/15/2015	Annual	1
Rohde & Schwarz	LOOP ANTENNA	09/03/2014	Biennial	1513-175
CERNEX	CBL18265035 / POWER AMP	07/27/2015	Annual	22966
CERNEX	CBL06185030 / POWER AMP	07/21/2015	Annual	22965
CERNEX	CBLU1183540 / POWER AMP	07/21/2015	Annual	22964