

# 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: August 22, 2016 Test Site/Location: HCT CO., LTD., 74,Seoicheon-ro 578beon-gil,Majangmyeo,Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA Report No.: HCT-R-1608-F023 HCT FRN: 0005866421

IC Recognition No.: 5944A-5

# FCC ID : ZNFH990

# APPLICANT : LG Electronics MobileComm U.S.A., Inc.

Model(s):	LG-H990
Additional Model(s):	LG-H990TR, LG-H990ds
EUT Type:	GSM/WCDMA/LTE Phone with Bluetooth, WLAN, NFC
<b>RF Peak Output Power:</b>	4.39 dBm (2.748 mW)
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 : Seul Ki Lee Test Engineer of RF Team

Approved by : Kyoung Houn Seo Manager of RF Team

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# **Version**

TEST REPORT NO.	DATE	DESCRIPTION		
HCT-R-1608-F023	August 22, 2016	- 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:	ZNFH990				
EUT Type:	GSM/WCDMA/LTE Phone with Bluetooth, WLAN, NFC				
Model (s):	LG-H990				
Date(s) of Tests:	July 20, 2016 ~ August 18, 2016				
Place of Tests:	HCT Co., Ltd.				
	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea				

Model	LG-H990			
Additional Model(s):	LG-H990 <sup>-</sup>	TR, LG-H990ds		
EUT Type	GSM/WC	DMA/LTE Phone with Bluetooth, WLAN, NFC		
Power Supply	DC 3.85 \	/		
Battery Information	Model: BL-44E1F Type: Li-ion Battery			
Frequency Range	TX: 2402 MHz ~ 2480 MHz RX: 2402 MHz ~ 2480 MHz			
Max. RF Output Power	Peak	Data packet length (Min)_4.39 dBm (2.748 mW) / Data packet length (Max)_4.24 dBm (2.655 mW)		
	Average	Data packet length (Min)_4.19 dBm (2.624 mW) / Data packet length (Max)_3.94 dBm (2.477 mW)		
BT Operating Mode	BT_Low Energy Mode			
Modulation Type	GFSK			
Number of Channels	40 Channels			
Antenna Specification	Antenna t	urer: Ace technology ype: INTERNAL ANTENNA n : -2.2 dBi		

## 2. EUT DESCRIPTION



# 3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v03r05 dated April 8, 2016 entitled "Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in ANSI C63.10(Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

# **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 3.75 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 v03r05)

## 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.

Espectially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2006).

# 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. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the  $U_{CISPR}$  measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	6.07



# 8. SUMMARY TEST OF RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	§15.247(a)(2) > 500 kHz		PASS
Conducted Maximum Peak Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band	CONDUCTED	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	RADIATED	PASS

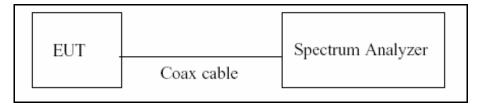


# 9. TEST RESULT 9.1 DUTY CYCLE

#### 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 accroding to the zerospan measurement method, 6.0)b) in KDB 558074 v03r05.

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  $T \le 6.25$  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 (≥ 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\*log(1/Duty Cycle)



Model: LG-H990

Data packet length (Min)

LE Mode	T <sub>on</sub> (ms)	T <sub>total</sub> (ms)	Duty Cycle	Duty Cycle Factor (dB)				
	0.3901	0.6257	0.6235	2.05				
Data packet length (Max)	Data packet length (Max)							
LE Mode	T <sub>on</sub> (ms)	T <sub>total</sub> (ms)	Duty Cycle	Duty Cycle Factor				
	2.1350	2.5000	0.8540	0.69				

#### RESULT PLOTS\_Data packet length (Min)

Center Fre	q 2.402000000	PNO: Fast	Trig: Free Run Atten: 20 dB	#Avg Type: RMS	06:53:10 PM Jul 21, 2016 TRACE 1 2 3 4 5 0 TYPE DET P N N N N	Frequency
	Ref Offset 10.7 dB Ref 20.00 dBm			L	∆Mkr3 625.7 µs 1.91 dB	Auto Tui
10.0 0.00		X			3∆4	Center Fr 2.402000000 G
-20.0						Start Fr 2.402000000 G
-50.0 -60.0 -70.0	hanaquri	have a stal		lather was a start	whit	Stop Fr 2.402000000 G
Res BW 8 N		#VBW	8.0 MHz		Span 0 Hz .267 ms (1001 pts)	CF St 8.000000 M Auto M
MKR MODE TRC 1 Δ2 1 2 F 1 3 Δ4 1 4 F 1 5 6		390.1 μs (Δ) 447.1 μs 625.7 μs (Δ) 447.1 μs	Y 2.19 dB 0.81 dBm 1.91 dB 0.81 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offs 0
7						
8 9 10 11					×	

#### RESULT PLOTS\_ Data packet length (Max)

Center F			NO: Fast	SENSE:INT Trig: Free Run Atten: 20 dB	#Avg 1	ALIGNAUTO Type: RMS	06:44:45 PM Jul 21, 2016 TRACE 2 2 3 4 5 0 TYPE W000000000 Det P NNNNN	Frequency
0 dB/div	Ref Offset Ref 20.0	10.7 dB 0 dBm				Δ	Mkr3 2.500 ms -0.01 dB	Auto Tun
0.00		X.				1∆2		Center Fre 2.402000000 GF
10.0 10.0 10.0						ndan uju		Start Fre 2.402000000 G
50.0 50.0 70.0		Spiellynner I				and the second sec		Stop Fre 2.402000000 GF
enter 2. es BW 8		×	#VBW	8.0 MHz V 0.19 dB	FUNCTION	Sweep 5.	Span 0 Hz 000 ms (1001 pts) FUNCTION VALUE	CF Ste 8.000000 MH Auto Ma
2 F 3 Δ4 4 F 6 6 7	t t (Δ) t	1.3	345 ms 500 ms (Δ) 345 ms	2.60 dBm -0.01 dB 2.60 dBm				Freq Offs 0 F
8								



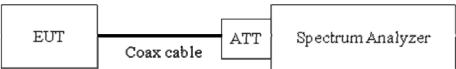
## 9.2 6 dB BANDWIDTH MEASUREMENT

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

The bandwidth at 6 dB 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 6 dB 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 v03r05)

RBW = 100 kHz VBW  $\geq$  3 x 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.

#### TEST RESULT\_Data packet length (Min)

Mode	Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Pass/Fail
BT LE	0	715.7		Pass
	19	724.9	> 500	Pass
	39	725.4		Pass

#### TEST RESULT\_ Data packet length (Max)

Mode	Channel	6 dB Bandwidth	Limit	Pass/Fail
	Channel	(kHz)	(kHz)	Pass/Fail
BT LE	0	670.7		Pass
	19	670.0	> 500	Pass
	39	670.6		Pass



#### RESULT PLOTS\_Min



#### 6 dB Bandwidth plot (Mid-CH 19)

Agilent Spectrum Analyzer - Occupied BW	SENSE:INT ALIGN A	AUTO 06:17:29 PM Jul 21, 2016	
Center Freq 2.440000000 GHz	Center Freq: 2.440000000 GHz	Radio Std: None	Frequency
#IFGain:Low	#Atten: 10 dB	Radio Device: BTS	
Ref Offset 10.7 dB 10 dB/div Ref 20.00 dBm			
Log 10.0			Center Freq
0.00			2.440000000 GHz
-10.0			
-20.0			
-40.0		<b>*</b>	
-50.0		Mark Marked and Marked	
-60.0		Viet UP Yoyaja.	
Center 2.44 GHz #Res BW 100 kHz	#VBW 300 kHz	Span 5 MHz Sweep   2.533 ms	CF Step 500.000 kHz
Occupied Bandwidth	Total Power	10.8 dBm	<u>Auto</u> Man
1.0880 Mi	Ηz		Freq Offset
Transmit Freg Error -4.776		99.00 %	0 Hz
x dB Bandwidth 724.9 l	(Hz x dB	-6.00 dB	
MSG JPoints changed; all traces cleared		STATUS	

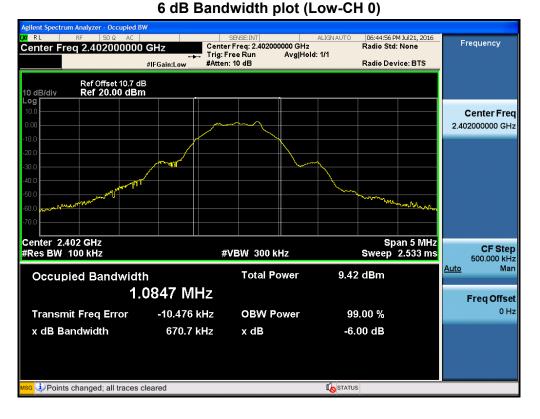


Agilent Spectrum Analyzer - Occupied BW           LXI         RF         50 Ω         AC           Center Freq 2.480000000	GHz Cente	sense:INT er Freq: 2.480000000 GHz Free Run Avg Hol	Ra	6:21:15 PM Jul 21, 2016 adio Std: None	Frequency
		n: 10 dB		adio Device: BTS	
Ref Offset 10.7 dB 10 dB/div Ref 20.00 dBm Log					
0.00					<b>Center Freq</b> 2.480000000 GHz
-20.0			-		
-40.0				white a star	
-60.0				and a start of the	
Center 2.48 GHz #Res BW 100 kHz	#	VBW 300 kHz	SI	Span 5 MHz weep   2.533 ms	CF Step 500.000 kHz
Occupied Bandwidth	1	Total Power	8.46 d	Bm	<u>Auto</u> Man
	0884 MHz				Freq Offset
Transmit Freq Error	-2.049 kHz	OBW Power	99.00	0 %	0 Hz
x dB Bandwidth	725.4 kHz	x dB	-6.00	dB	
мsg Points changed; all traces cl	eared				

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



#### RESULT PLOTS\_Max



# 6 dB Bandwidth plot (Mid-CH 19)

Agilent Spectrum Analyzer - Occupied BW	V				
M RL RF 50Ω AC Center Freq 2.440000000	CH7 Cent	SENSE:INT er Freg: 2.440000000 GHz	ALIGNAUTO	06:33:54 PM Jul 21, 2016 Radio Std: None	Frequency
	HIZ →→ Trig:	Free Run Avg Hol	d: 1/1		
	#IFGain:Low #Atte	n: 10 dB		Radio Device: BTS	
Ref Offset 10.7 dB 10 dB/div Ref 20.00 dBm					
Log 10.0					Center Freq
0.00					2.440000000 GHz
-10.0					2.44000000 GHZ
-20.0					
-30.0	Mar and Mar		-		
-40.0			mon		
-60.0 mmm/~lunnamm~~~				where west when we	
-70.0					
-70.0					
Center 2.44 GHz				Span 5 MHz	CF Step
#Res BW 100 kHz	7	#VBW 300 kHz		Sweep 2.533 ms	500.000 kHz
Occupied Bandwidth	ı	Total Power	10.9	dBm	<u>Auto</u> Man
1.0	0864 MHz				Freq Offset
Transmit Freq Error	-7.939 kHz	OBW Power	99.	00 %	0 Hz
x dB Bandwidth	670.0 kHz	x dB	-6.0	0 dB	
мsg 🧼 Points changed; all traces cl	leared		STATUS		



Agilent Spectrum Analyzer - Occupied BW		SENSE:INT	ALIGN AUTO	06:42:28 PM Jul 21, 20	716
Center Freq 2.480000000		r Freq: 2.480000000 GHz		Radio Std: None	Frequency
,		FreeRun Avg Ho n:10 dB	IG: 1/1	Radio Device: BTS	;
Ref Offset 10.7 dB 10 dB/div Ref 20.00 dBm					
Log 10.0 0.00					Center Freq 2.480000000 GHz
-20.0	mon				
-40.0 -50.0				and	
Center 2.48 GHz					
#Res BW 100 kHz	#	VBW 300 kHz		Span 5 N Sweep 2.533	
Occupied Bandwidth		Total Power	8.54	dBm	<u>Auto</u> Man
1.0	857 MHz				Freq Offset
Transmit Freq Error	-4.300 kHz	OBW Power	99.	00 %	0 Hz
x dB Bandwidth	670.6 kHz	x dB	-6.0	0 dB	
мsg Points changed; all traces cle	eared		<b>I</b> STATUS		

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



# 9.3 OUTPUT POWER MEASUREMENT

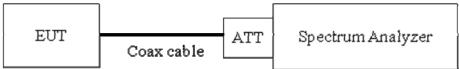
### Test Requirements and limit, §15.247(b)(3)

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 v03r05)
  - RBW ≥ DTS Bandwidth
  - $VBW \ge 3 \times RBW$
  - SPAN ≥ 3 x 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 v03r05)

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 x RBW.

Number of points in sweep  $\ge 2 x \text{ span} / \text{RBW}$ . (This gives bin-to-bin spacing  $\le \text{RBW}/2$ ,

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 tenth dB. So, 10.7 dB is offset for 2.4 GHz Band.



#### TEST RESULTS-Peak

#### Conducted Output Power Measurements\_Data packet length (Min)

LE Me	ode	Measured	Limit
Frequency[MHz]	Channel No.	Power(dBm)	(dBm)
2402	0	3.139	30
2440	19	4.391	30
2480	39	2.086	30

#### Conducted Output Power Measurements\_ Data packet length (Max)

LE M	ode	Measured	Limit
Frequency[MHz]	Channel No.	Power(dBm)	(dBm)
2402	0	2.905	30
2440	19	4.242	30
2480	39	1.899	30

#### TEST RESULTS-Average

#### Conducted Output Power Measurements\_ Data packet length (Min)

LE Mode			Duty Cycle	Measured		
Frequency[MHz]	Channel No.	Measured Power(dBm)	Duty Cycle Factor (dB)	Power(dBm) + Duty Cycle Factor(dB)	Limit (dBm)	
2402	0	0.80	2.05	2.85	30	
2440	19	2.14	2.05	4.19	30	
2480	39	-0.24	2.05	1.81	30	

#### Conducted Output Power Measurements\_ Data packet length (Max)

LE Mode			Duty Cycle	Measured	
Frequency[MHz]	Channel No.	Measured Power(dBm)	Duty Cycle Factor (dB)	Power(dBm) + Duty Cycle Factor(dB)	Limit (dBm)
2402	0	1.96	0.69	2.65	30
2440	19	3.26	0.69	3.94	30
2480	39	1.09	0.69	1.77	30



### RESULT PLOTS-Peak\_Data packet length (Min) Conducted Output Power (Low-CH 0)

Agilent Spectr	um Analyzer - Swept SA RF 50 Ω AC		SENSE:INT	ALIGNAUTO	06:54:22 PM Jul 21, 2016	
	req 2.402000000	GHz PNO: Wide ↔		#Avg Type: RMS Avg Hold: 1/1	TRACE 123456 TYPE MUMANANA	Frequency
		IFGain:Low	Atten: 20 dB	Mkr1	DET P P P P P P	Auto Tune
10 dB/div Log	Ref Offset 10.7 dB Ref 20.00 dBm				3.139 dBm	
						Center Freq
10.0						2.402000000 GHz
0.00						Start Freq
-10.0	A Contraction					2.400500000 GHz
-20.0						
						Stop Freq 2.403500000 GHz
-30.0						
-40.0						CF Step 300.000 kHz
-50.0						<u>Auto</u> Man
-60.0						Freq Offset
-80.0						0 Hz
-70.0						
Center 24	102000 GHz				Span 3.000 MHz	
#Res BW	1.0 MHz		3.0 MHz		.532 ms (1000 pts)	
MSG 🗼 Point	s changed; all traces o	cleared			S	

## Conducted Output Power (Mid-CH 19)





Agilent Spectrum Analyzer - Swept SA					
Center Freq 2.480000000	PNO: Wide +++ TI	rig: Free Run tten: 10 dB	ALIGN AUTO #Avg Type: RMS Avg Hold: 1/1	06:21:25 PM Jul 21, 2016 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P P	Frequency
Ref Offset 10.7 dB 10 dB/div Ref 10.70 dBm			Mkr1	2.479 764 GHz 2.086 dBm	Auto Tune
0.700	<b>_</b>	1			Center Freq 2.480000000 GHz
-9.30 -19.3					Start Freq 2.478500000 GHz
-29.3					Stop Fred 2.481500000 GH;
-49.3					CF Step 300.000 kH <u>Auto</u> Mar
-69.3					Freq Offse 0 Ha
-79.3 Center 2.480000 GHz #Res BW 1.0 MHz	#VBW 3.0	) MHz	Sweep 1	Span 3.000 MHz .532 ms (1000 pts)	
<sup>usg</sup> ↓Points changed; all traces o	cleared				

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



## RESULT PLOTS-Peak\_Data packet length (Max) Conducted Output Power (Low-CH 0)

Agilent Spectr	r <mark>um Analyzer - Swept SA</mark> RF 50 Ω AC		SENSE:INT		06:47:17 PM Jul 21, 2016	
	req 2.402000000	GHz		ALIGNAUTO #Avg Type: RMS	UB:47:17 PM JUI21, 2016 TRACE 1 2 3 4 5 6 TYPE M WWWWW	Frequency
		PNO: Wide ↔→ IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Hold: 1/1	DETPPPPP	
10 dB/div Log	Ref Offset 10.7 dB Ref 20.00 dBm			Mkr	1 2.402 239 GHz 2.905 dBm	Auto Tune
10.0						Center Freq 2.402000000 GHz
-10.0	L ALVAL ALLAND					<b>Start Freq</b> 2.400500000 GHz
-20.0						<b>Stop Freq</b> 2.403500000 GHz
-40.0						CF Step 300.000 kHz <u>Auto</u> Man
-60.0						Freq Offset 0 Hz
	402000 GHz				Span 3.000 MHz	
#Res BW	1.0 MHz ts changed; all traces of		3.0 MHz	Sweep	1.532 ms (1000 pts) Is	
	to onlanged, un traces (	, ou ou				

## Conducted Output Power (Mid-CH 19)

	um Analyzer - Swept S						
Center F	RF 50Ω A req 2.4400000		SENSE:IN	#Avg Type	RMS	06:34:04 PM Jul 21, 2016 TRACE 1 2 3 4 5 6	Frequency
		PNO: Wide ↔ IFGain:Low	Trig: Free Rur Atten: 10 dB	n Avg Hold:	1/1	DET PPPP	
10 dB/div	Ref Offset 10.7 d Ref 10.70 dBr	в			Mkr1 2	.439 752 GHz 4.242 dBm	Auto Tune
0.700			<b>↓</b> 1				Center Freq 2.440000000 GHz
-9.30							Start Freq
-19.3							2.438500000 GHz
-39.3							<b>Stop Freq</b> 2.441500000 GHz
-49.3							CF Step 300.000 kHz <u>Auto</u> Man
-69.3							Freq Offset 0 Hz
-79.3							
Center 2.4 #Res BW	140000 GHz 1.0 MHz	#VB\	V 3.0 MHz	ş	Sweep 1.5	Span 3.000 MHz 32 ms (1000 pts)	
<mark>мsg</mark> 🔱 Point	ts changed; all trac	es cleared			<b>K</b> STATUS		



Agilent Spectrum Analyzer - Swept SA           VM         RL         RF         50.0         AC         SENSE:INT         ALIGNAUTO         06:42:37 PM Jul/21, 2016									
	req 2.48000000	OGHz PNO: Wide ↔ IFGain:Low		e Run	#Avg Typ Avg Hold:	e: RMS	TRAC		Frequency
10 dB/div	Ref Offset 10.7 dB Ref 10.70 dBm	II Gam.Low				Mkr1	2.479 7 1.8	'49 GHz 99 dBm	Auto Tune
Log			<b>∳</b> <sup>1</sup>						Center Freq 2.480000000 GHz
-9.30 -19.3									<b>Start Freq</b> 2.478500000 GHz
-29.3									<b>Stop Freq</b> 2.481500000 GHz
-49.3									CF Step 300.000 kHz <u>Auto</u> Man
-69.3									Freq Offset 0 Hz
-79.3 Center 2.4 #Res BW	180000 GHz 1.0 MHz	#VBM	/ 3.0 MHz			Sweep_1	Span 3 .532 ms (	.000 MHz 1000 pts)	
	MSG UPoints changed; all traces cleared								

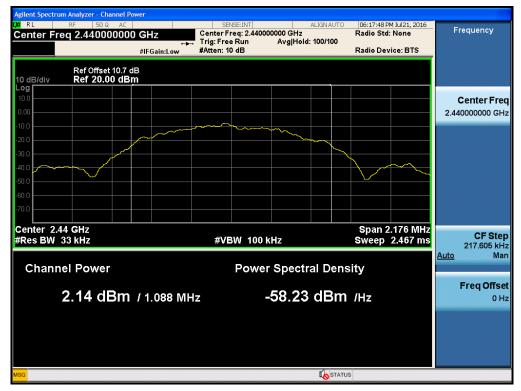
### Conducted Output Power (High-CH 39)



### RESULT PLOTS-Average\_Data packet length (Min) Conducted Output Power (Low-CH 0)



#### Conducted Output Power (Mid-CH 19)







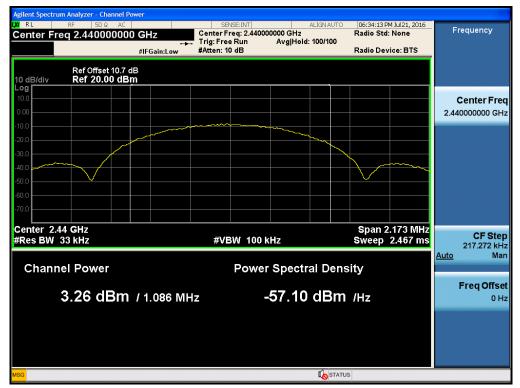
#### **Conducted Output Power (High-CH 39)**



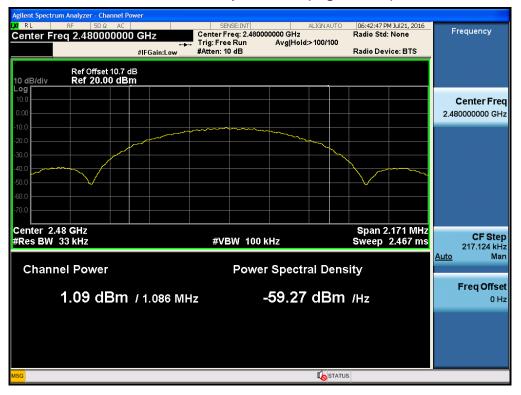
### RESULT PLOTS-Average\_Data packet length (Max) Conducted Output Power (Low-CH 0)

gilent Spectrum Analyzer - Channel Powe RL 06:47:27 PM Jul 21, 2016 Radio Std: None ALIGN A Center Freq: 2.402000000 GHz Trig: Free Run Avg|Hold #Atten: 10 dB Frequency Center Freq 2.402000000 GHz Avg|Hold: 100/100 Radio Device: BTS #IFGain:Low Ref Offset 10.7 dB Ref 20.00 dBm 0 dB/div og **Center Freq** 2.402000000 GHz Center 2.402 GHz #Res BW 33 kHz Span 2.169 MHz Sweep 2.467 ms CF Step 216.942 kHz #VBW 100 kHz Man Auto **Channel Power Power Spectral Density** Freq Offset -58.39 dBm /Hz 1.96 dBm / 1.085 MHz 0 Hz **STATUS** 

#### Conducted Output Power (Mid-CH 19)







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



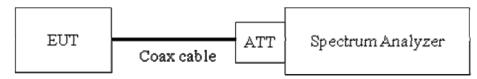
# 9.4 POWER SPECTRAL DENSITY

#### 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 01/07/2016

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

 $RBW = 3 kHz \le RBW \le 100 kHz.$ 

VBW  $\geq$  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 tenth dB. So,10.7 dB is offset for 2.4 GHz Band.



Model: LG-H990

### TEST RESULTS

#### Conducted Power Density Measurements\_Data packet length (Min)

Frequency (MHz)	Channel No.	Mode	Test Result				
			PSD	Limit	Pass/		
			(dBm)	(dBm)	Fail		
2402	0		-11.091	8	Pass		
2440	19	LE	-9.682	8	Pass		
2480	39		-12.127	8	Pass		

#### Conducted Power Density Measurements\_ Data packet length (Max)

Frequency (MHz)	Channel No.	Mode	Test Result				
			PSD	Limit	Pass/		
			(dBm)	(dBm)	Fail		
2402	0		-12.768	8	Pass		
2440	19	LE	-11.864	8	Pass		
2480	39		-13.843	8	Pass		



#### RESULT PLOTS\_Data packet length (Min) Power Spectral Density (Low-CH 0)



## Power Spectral Density (Mid-CH 19)







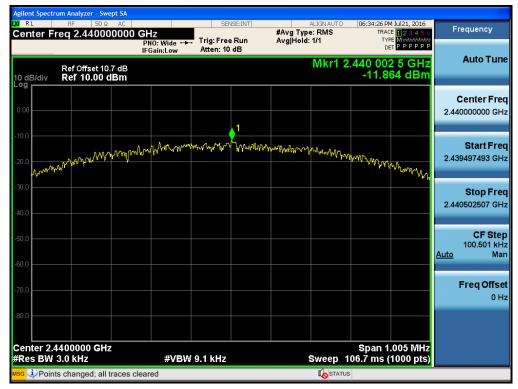
#### **Power Spectral Density (High-CH 39)**



### RESULT PLOTS\_Data packet length (Max) Power Spectral Density (Low-CH 0)

gilent Spectrum Analyzer - Swept SA 40 PM Jul 21, 2016 #Avg Type: RMS Avg|Hold: 1/1 Frequency Center Freq 2.402000000 GHz TRACE TYPE MUNANNA DET PPPPP Trig: Free Run Atten: 10 dB PNO: Wide IFGain:Low Auto Tune Mkr1 2.401 968 3 GHz -12.768 dBm Ref Offset 10.7 dB Ref 10.00 dBm 10 dB/div Center Frea 2.402000000 GHz mmmm manna mar hand Start Freq MANA 2.401496967 GHz m man m  $\gamma \sim$ Stop Freq 2.402503033 GHz CF Step 100.607 kHz Man Auto Freq Offset 0 Hz Span 1.006 MHz Sweep 106.8 ms (1000 pts) Center 2.4020000 GHz #Res BW 3.0 kHz #VBW 9.1 kHz Points changed; all traces cleared **I**STATUS

## Power Spectral Density (Mid-CH 19)







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

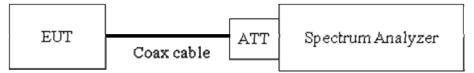


# 9.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS Test Requirements and limit, §15.247(d)

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 § 15.205(c)).

#### Limit : 20 dBc

#### **TEST CONFIGURATION**



#### TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074, issued 01/07/2016)

RBW = 100 kHz

 $VBW \ge 3 \times RBW$ 

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  $\geq 2^{*}$ Span/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 maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1(KDB558074 v03r05), so the peak output power measured in any 100 kHz bandwidth outside



of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

- 2. The band edge results in plot is already including the actual values of loss for the attenuator and cable combination.
- 3. Spectrum offset = Attenuator loss + Cable loss
- 4. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.7 dB is offset for 2.4 GHz Band.
- 5. In case of conducted spurious emissions test, please check factors blow table.
- 6. In order to simplify the report, attached plots were only the worst case channel and data rate.

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			

#### **FACTORS FOR FREQUENCY**

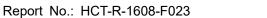


Model: LG-H990

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.

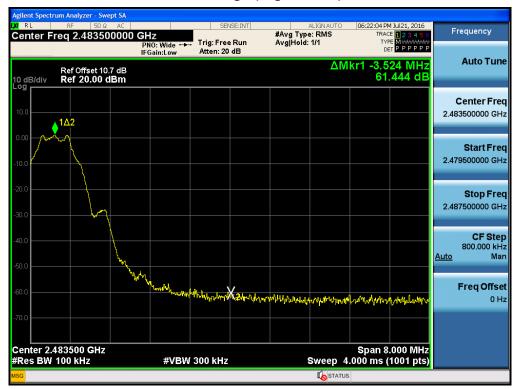
2. Factor = Cable loss + Attenuator loss



### RESULT PLOTS\_ Data packet length (Min) BandEdge (Low-CH 0)

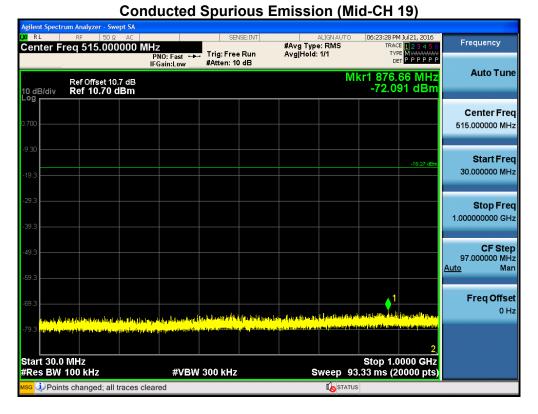


#### BandEdge (High-CH 39)



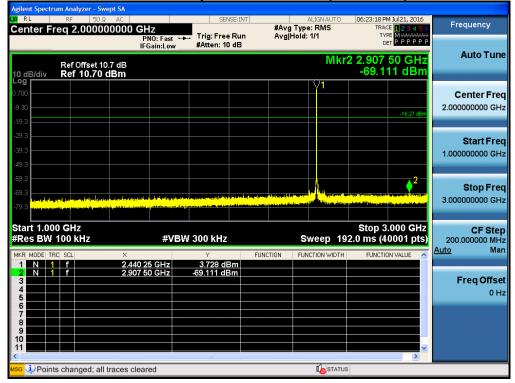


## 30 MHz ~ 1 GHz



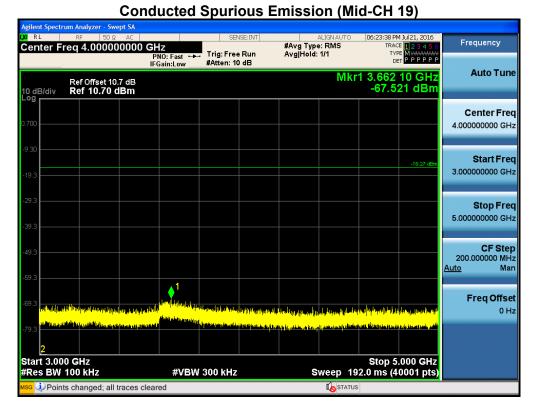
#### 1 GHz ~ 3 GHz







## 3 GHz ~ 5 GHz



#### 5 GHz ~ 7 GHz

XI RL	rum Analyzer - Swept SA RF 50 Ω AC Teq 6.000000000	GHz	#Avg Type	: RMS TRAC	1 Jul 21, 2016 E <mark>1 2 3 4 5 6</mark>	Frequency
10 dB/div	Ref Offset 10.7 dB Ref 10.70 dBm	PNO: Fast +++ Trig: Free I IFGain:Low #Atten: 10		Mkr1 6.168	70 GHz 27 dBm	Auto Tune
0.700						<b>Center Fred</b> 6.000000000 GH:
-9.30					-16.27 dBm	Start Free 5.000000000 GH
-29.3						<b>Stop Fre</b> 7.000000000 GH
-49.3						CF Ste 200.000000 MH Auto Ma
		ligy for a factor of the factor of the sector				<b>Freq Offse</b> 0 H
-79.3 2 Start 5.00 #Res BW	00 GHz	#VBW 300 kHz			.000 GHz	
	<aaa.png> saved</aaa.png>	#VEW 500 KH2	51	STATUS	ooor pis)	

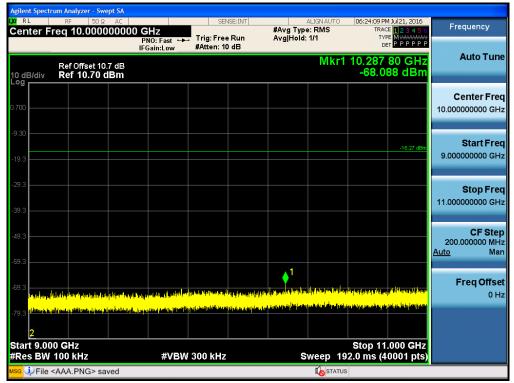


## 7 GHz ~ 9 GHz

06:23:59 PM Jul 21, 2016 RL Frequency Center Freq 8.000000000 GHz #Avg Type: RMS Avg|Hold:>1/1 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET PPPPP PNO: Fast +++ IFGain:Low Trig: Free Run #Atten: 10 dB Auto Tune Mkr1 7.502 10 GHz -68.622 dBm Ref Offset 10.7 dB Ref 10.70 dBm 10 dB/div **Center Freq** 8.00000000 GHz Start Freq 7.000000000 GHz Stop Freq 9.00000000 GHz CF Step 200.000000 MHz <u>Auto</u> Man 1 **Freq Offset** 0 Hz Stop 9.000 GHz Sweep 192.0 ms (40001 pts) Start 7.000 GHz #Res BW 100 kHz #VBW 300 kHz File <AAA.PNG> saved **I**STATUS

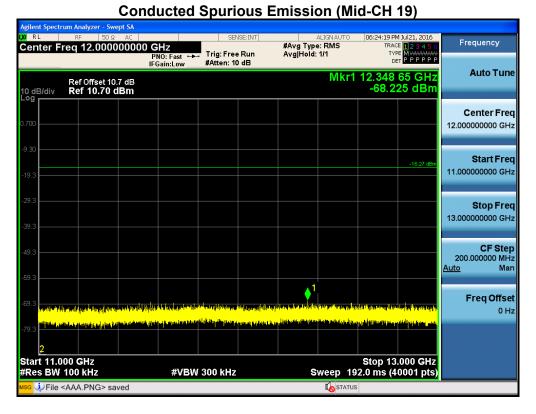
#### **Conducted Spurious Emission (Mid-CH 19)**

#### 9 GHz ~ 11 GHz





## 11 GHz ~ 13 GHz

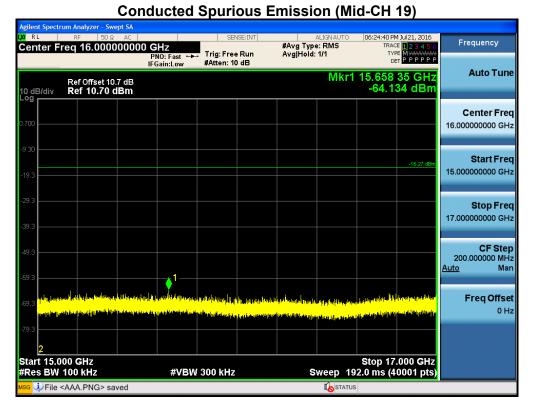


## 13 GHz ~ 15 GHz

	rum Analyzer - Swept SA							
Center F	RF 50Ω AC reg 14.00000000	0 GHz	SENSE:	#Avg	ALIGNAUTO	TRACE	123456	Frequency
	•	PNO: Fast ↔↔ IFGain:Low	Trig: Free Ru #Atten: 10 dB		old: 1/1	TYPE DE	P P P P P P	
10 dB/div Log	Ref Offset 10.7 dB Ref 10.70 dBm				Mk	r1 14.954 ( -65.92	65 GHz 26 dBm	Auto Tune
0.700								Center Freq 14.00000000 GHz
-9.30							-16.27 dBm	<b>Start Freq</b> 13.000000000 GHz
-29.3								<b>Stop Freq</b> 15.000000000 GHz
-49.3								CF Step 200.000000 MHz <u>Auto</u> Man
-59.3 -69.3 <mark>Marijudu</mark>	la <mark>n aran da mana mana mana para para ana mana ba</mark>		an ann an ann an an an an an an an an an		elejin beriji on elejin ma o de outor troch	yay manganakan ( ) malaka malakan kunanakan dalah	1 Matel Associated	<b>Freq Offset</b> 0 Hz
2	an a sharan ta fara an	n an	in the second	International Contraction of the second s				
Start 13.0 #Res BW		#VBW 3	300 kHz		Sweep	Stop 15. 192.0 ms (40	000 GHz )001 pts)	
	<aaa.png> saved</aaa.png>				I STA			



## 15 GHz ~ 17 GHz

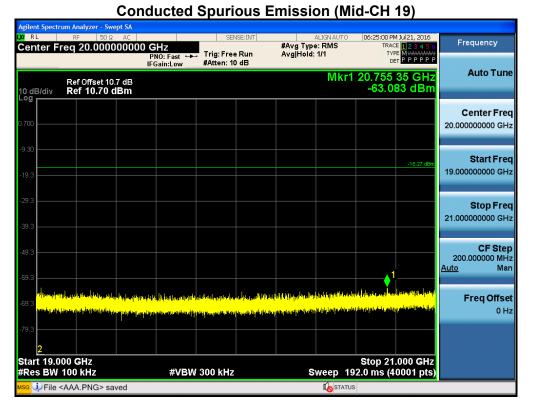


#### 17 GHz ~ 19 GHz

Agilent Spectr	BE 50.9	e <mark>pt SA</mark> AC		055	VSE:INT		ALIGNAUTO	00:24-50.5	M Jul 21, 2016	
	req 18.0000	00000 G				#Avg Type Avg Hold:	e: RMS	TRAC	CE 123456 PE MAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	Frequency
10 dB/div Log	Ref Offset 10 Ref 10.70 c	IFC .7 dB	NO: Fast 🔸 Gain:Low	#Atten: 10				DE 17.932	85 GHz 41 dBm	Auto Tune
0.700										Center Fred 18.000000000 GH:
-9.30									-16.27 dBm	Start Free 17.000000000 GH
-29.3										<b>Stop Fre</b> 19.000000000 GH
-49.3				1						CF Ste 200.000000 MH <u>Auto</u> Ma
.69 3	n is policited between and harmonic programming power	1.1		a station and a station of the stati	1.11				Alabiatika di mediangta <sup>Ala</sup> ng menorika di di peri	Freq Offse 0 H
-79.3 2 Start 17.0	00 GHz							Stop <u>19</u>	.000 GHz	
#Res BW			#VBW	/ 300 kHz		s	weep 19	2.0 ms (4	0001 pts)	
Pile ·	<aaa.png> sa</aaa.png>	veu					STATUS			



## 19 GHz ~ 21 GHz



## 21 GHz ~ 23 GHz

Agilent Spectr	r <mark>um Analyzer - Swept SA</mark> RF 50 Ω AC		SENS	SE:INT		ALIGN AUTO	06:25:11 Pf	4 Jul 21, 2016	_
Center F	req 22.0000000	PNO: Fast ↔	Trig: Free		#Avg Type Avg Hold:		TYP	E 1 2 3 4 5 6 MWWWWW T P P P P P P	Frequency
10 dB/div	Ref Offset 10.7 dB Ref 10.70 dBm	IFGain:Low	#Atten: 10	dB		Mkr	1 22.667		Auto Tune
0.700									Center Fred 22.000000000 GH2
-9.30								-16.27 dBm	Start Free 21.000000000 GH:
-29.3									Stop Free 23.000000000 GH
-49.3							1		CF Stej 200.000000 MH <u>Auto</u> Ma
and a second	l Normal and Article and Ar							Hanna Marana Androis Maran	Freq Offse 0 H:
-79.3 2								.000 GHz	
#Res BW	<pre>400 kHz 400 kHz 400 kHz</pre>	#VBW	/ 300 kHz		S	weep 1	92.0 ms (4 <sup>JS</sup>	0001 pts)	



## 23 GHz ~ 25 GHz

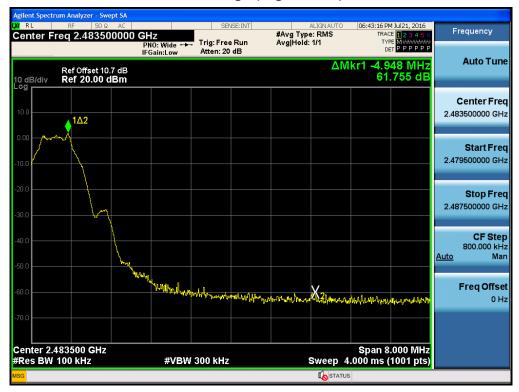
Agilent Spectrum Analyzer - Swept SA #Avg Type: RMS Avg|Hold: 1/1 21 PM Jul 21, 2016 Frequency Center Freq 24.000000000 GHz TRACE 1 2 3 4 5 6 TYPE M Trig: Free Run #Atten: 10 dB PNO: Fast + IFGain:Low Auto Tune Mkr1 24.978 00 GHz -58.320 dBm Ref Offset 10.7 dB Ref 10.70 dBm 10 dB/div Log **Center Freq** 24.00000000 GHz Start Freq 23.00000000 GHz Stop Freq 25.00000000 GHz CF Step 200.000000 MHz to Man <u>Auto</u> a la familia da ang a da kanang kalang na na kaning kan ka مراجاة بالمشرفين فالأشار وبرو at ut the **Freq Offset** 0 Hz Start 23.000 GHz #Res BW 100 kHz Stop 25.000 GHz Sweep 192.0 ms (40001 pts) #VBW 300 kHz File <AAA.PNG> saved **I**STATUS

Model: LG-H990

## RESULT PLOTS\_ Data packet length (Max) BandEdge (Low-CH 0)

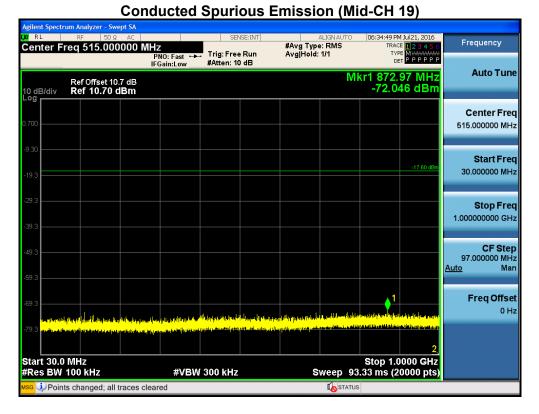


## BandEdge (High-CH 39)





## 30 MHz ~ 1 GHz



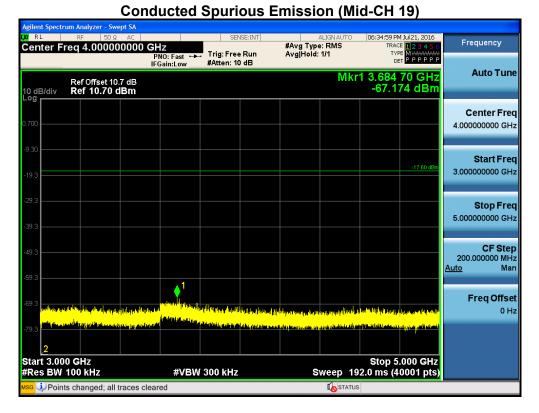
#### 1 GHz ~ 3 GHz



XI RL		vept SA 2 AC 00000 GHz PNO: Fast IEGain: Low	SENSE:INT → Trig: Free Run #Atten: 10 dB	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	06:34:39 PM Jul 21, 2016 TRACE 1 2 3 4 5 6 TYPE M WAAAAAAAA DET P P P P P P	Frequency
10 dB/div	Ref Offset 1 Ref 10.70	0.7 dB	Materia To de		2 2.997 55 GHz -69.137 dBm	Auto Tune
Log 0.700 -9.30 -19.3					-17.60 dBm	Center Fred 2.000000000 GH:
-29.3 -39.3 -49.3						Start Free 1.000000000 GH:
-59.3 -69.3 -79.3	(Der jord 1) 200 a Velder av J.		n se an			Stop Free 3.000000000 GH
Start 1.00 #Res BW	100 kHz	#VB	W 300 kHz	Sweep 19	Stop 3.000 GHz 2.0 ms (40001 pts)	CF Step 200.000000 MH Auto Mar
MKR         MODE         TH           1         N         1           2         N         1           3         -         -           4         -         -           5         -         -           6         -         -           7         -         -           8         -         -           9         -         -           10         -         -	f	× 2.440 25 GHz 2.997 55 GHz	2.396 dBm -69.137 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offse
s <mark>g</mark> 🗘 Point	s changed; all	I traces cleared		STATU		



## 3 GHz ~ 5 GHz



#### 5 GHz ~ 7 GHz

	um Analyzer - Swej								
Center Fr	RF 50Ω req 6.00000	0000 GH		<b>.</b>	#Avg Type		TRAC	1 Jul 21, 2016 E <mark>1 2 3 4 5 6</mark> E M <del>11 1 1 1 1 1 1 1 1 1</del> 1	Frequency
10 dB/div Log	Ref Offset 10.7 Ref 10.70 d	IFC 7 dB	NO: Fast ↔ Gain:Low	. Trig: Free #Atten: 10	Avg Hold:		1 6.941	т <mark>РРРРР</mark>	Auto Tune
0.700									Center Freq 6.000000000 GHz
-9.30								-17.60 dBm	Start Freq 5.000000000 GHz
-29.3									<b>Stop Freq</b> 7.000000000 GHz
-49.3									CF Step 200.000000 MHz <u>Auto</u> Mar
-69.3 <mark>-69.3</mark>	lee for Northernetone		· · ·						Freq Offset 0 Hz
-79.3 2								.000 GHz	
#Res BW	100 kHz		#VBW	300 kHz	s		92.0 ms (4		
MSG 🔱 File <	<aaa.png> sav</aaa.png>	ved			 	<b>I</b> STATU	S		

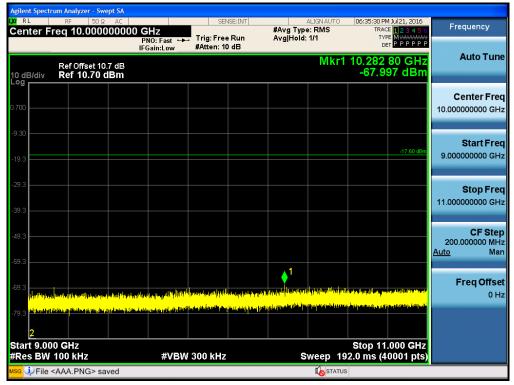


## 7 GHz ~ 9 GHz

06:35:20 PM Jul 21, 2016 RL Frequency Center Freq 8.000000000 GHz #Avg Type: RMS Avg|Hold: 1/1 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET PPPPP PNO: Fast +++ IFGain:Low Trig: Free Run #Atten: 10 dB Auto Tune Mkr1 7.610 00 GHz -68.191 dBm Ref Offset 10.7 dB Ref 10.70 dBm 10 dB/div **Center Freq** 8.00000000 GHz Start Freq 7.00000000 GHz Stop Freq 9.00000000 GHz CF Step 200.000000 MHz <u>Auto</u> Man 1 Freq Offset 0 Hz Stop 9.000 GHz Sweep 192.0 ms (40001 pts) Start 7.000 GHz #Res BW 100 kHz #VBW 300 kHz File <AAA.PNG> saved **I**STATUS

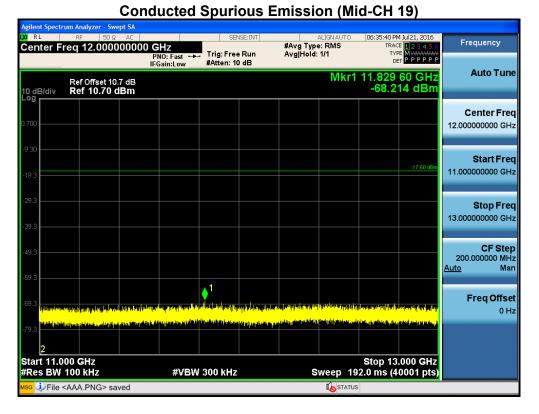
#### **Conducted Spurious Emission (Mid-CH 19)**

#### 9 GHz ~ 11 GHz





## 11 GHz ~ 13 GHz

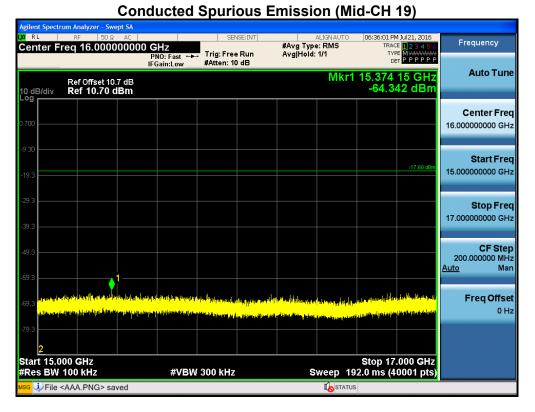


# 13 GHz ~ 15 GHz

			- Swept S/									
LXI R Cen		RF ea 14.0	50Ω AC		Hz		ISE:INT	#Avg Type		TRA	M Jul 21, 2016 CE <mark>1 2 3 4 5 6</mark>	Frequency
				PN	IO:Fast ↔ ain:Low	Trig: Free #Atten: 10		Avg Hold:	1/1			
		Ref Offs	et 10.7 dE		dini.cow				Mk	r1 14.885		Auto Tune
10 di Log	3/div		70 dBm							-65.8	35 dBm	
9												Center Freq
0.700	<u> </u>											14.00000000 GHz
-9.30												
-9.30												Start Freq
-19.3											-17.60 dBm	13.00000000 GHz
-29.3												Stop Freq
-39.3												15.00000000 GHz
-49.3												CF Step 200.000000 MHz
-59.3												<u>Auto</u> Man
30.5											♦ <sup>1</sup>	
-69.3	مراريم . مراجع	e d thi cardalardh	n di sinan bi	under bei bei b	the strange of the state	THE PARTY OF THE P	alalah merikak kela	. yaliya asila Ni	ala di tan	Aladi (gen Kolonia) Da en anti dalla far	Abel a filler	Freq Offset 0 Hz
	the state of the	a atili a juli dha hiti	ر الماليكور (1999) والسرالة	ومقادعته حوار	nepartition til plante	The state of the second se	with a firm	<mark>) a pakatan dari karata</mark>	added <sub>Co</sub> randes	allean na Hipkeleidether i	a alabanah an liat	0 112
-79.3												
	2											
		00 GHz 100 kHz			#VBW	/ 300 kHz		s	weep	192.0 ms (4	5.000 GHz 10001 pts)	
		AAA.PNC							<b>I</b> o STA	<u> </u>		



## 15 GHz ~ 17 GHz

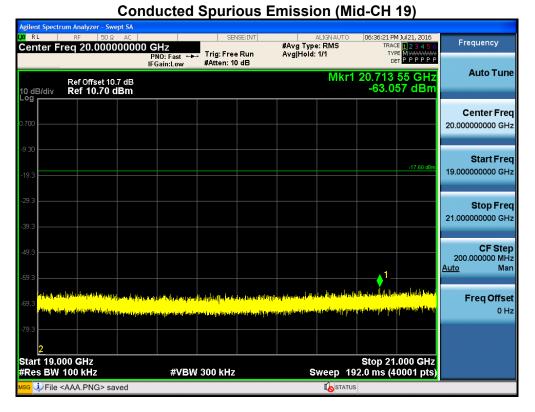


#### 17 GHz ~ 19 GHz

Agilent Spectrum Analyzer - Swe	AC				
Center Freq 18.0000		SENSE:INT	ALIGNAUTO #Avg Type: RMS Avg Hold: 1/1	06:36:11 PM Jul 21, 2016 TRACE 1 2 3 4 5 6 TYPE M	Frequency
Ref Offset 10. 10 dB/div Ref 10.70 d	IFGain:Low	#Atten: 10 dB	<b>.</b> .	ост РРРРРР 17.886 50 GHz -63.149 dBm	Auto Tune
0.700					<b>Center Freq</b> 18.000000000 GHz
-9.30				-17.60 dBm	Start Freq 17.000000000 GHz
-29.3					Stop Fred 19.000000000 GHz
-49.3					<b>CF Step</b> 200.000000 MH: <u>Auto</u> Mar
.co.2			nden ha transferiðin den sam þeifur þegalandi. Ananger eilli finnsku stærðin stærðinska þjór sjún		Freq Offset 0 Hz
-79.3 2 Start 17.000 GHz				Stop 19.000 GHz	
#Res BW 100 kHz <sup>MSG</sup> ①File <aaa.png> sa</aaa.png>		3W 300 kHz	Sweep 19	92.0 ms (40001 pts)	



## 19 GHz ~ 21 GHz



#### 21 GHz ~ 23 GHz

Agilent Spectrum Analyzer - Swept SA					
Center Freq 22.0000000	0 GHz	#Avg Typ	e: RMS	32 PM Jul 21, 2016 TRACE 2 3 4 5 6	Frequency
	PNO: Fast ↔→ Trig: Fre IFGain:Low #Atten: 1		. 171		
Ref Offset 10.7 dB 10 dB/div Ref 10.70 dBm			Mkr1 22.9 -62	88 50 GHz 2.537 dBm	Auto Tune
					Center Freq
0.700					22.000000000 GHz
-9.30					Otherst France
-19.3				-17.60 dBm	Start Freq 21.00000000 GHz
-29.3					Stop Freq
-39.3					23.000000000 GHz
-49.3					CF Step
				1.	200.000000 MHz <u>Auto</u> Mar
-59.3		n. En ans a la forta da adale da	un se de la la constanti de la constante de la	al a dell' state ta anna de al	
-69.3 Helenard particular the second					Freq Offset 0 Hz
-79.3					0112
2					
Start 21.000 GHz	#) (B)# 000 LU		Stop	23.000 GHz	
#Res BW 100 kHz	#VBW 300 kH		weep 192.0 ms	5 (40001 pts)	



## 23 GHz ~ 25 GHz

Agilent Spectrum Analyzer - Swept SA #Avg Type: RMS Avg|Hold: 1/1 42 PM Jul 21, 2016 Frequency Center Freq 24.000000000 GHz TRACE 1 2 3 4 5 6 TYPE M Trig: Free Run #Atten: 10 dB PNO: Fast + IFGain:Low Auto Tune Mkr1 24.519 80 GHz -58.287 dBm Ref Offset 10.7 dB Ref 10.70 dBm 10 dB/div Log **Center Freq** 24.00000000 GHz Start Freq 23.00000000 GHz Stop Freq 25.00000000 GHz CF Step 200.000000 MHz to Man 1 <u>Auto</u> teres feines feines feines auto andre la complete auto al prime de contracte de la casta de la casta de par pap **Freq Offset** 0 Hz Start 23.000 GHz #Res BW 100 kHz Stop 25.000 GHz Sweep 192.0 ms (40001 pts) #VBW 300 kHz File <AAA.PNG> saved **I**STATUS



# 9.6 RADIATED MEASUREMENT.9.6.1 RADIATED SPURIOUS EMISSIONS.

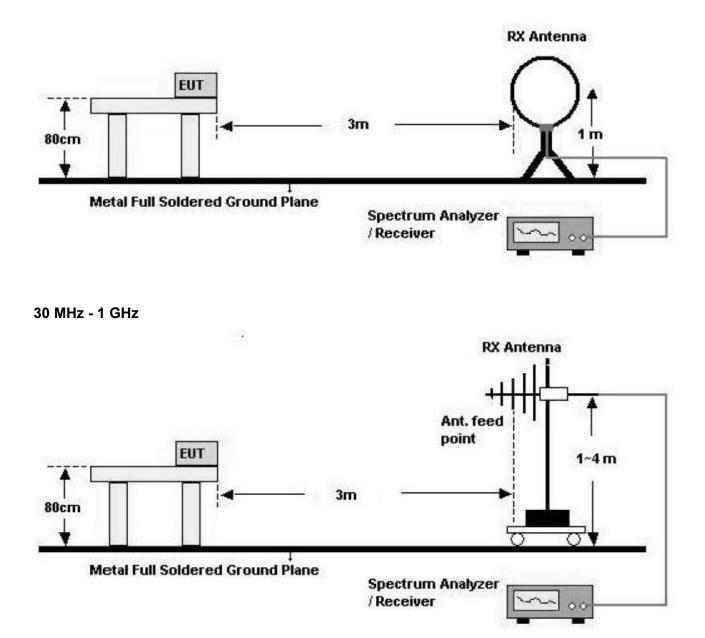
Test Requirements and limit, §15.205, §15.209

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		



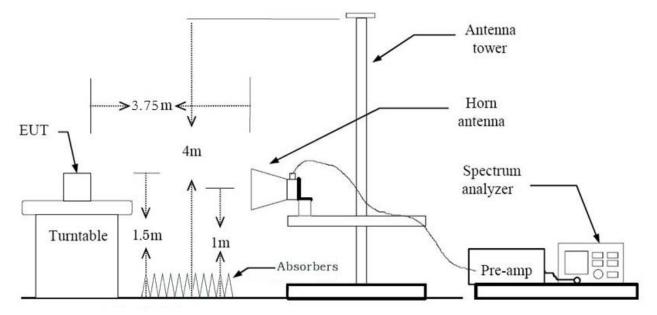
## **Test Configuration**

#### Below 30 MHz





## Above 1 GHz



#### TEST PROCEDURE USED

Method 12.1 in KDB 558074 v03r05

#### Spectrum Setting

- Peak

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

RBW = cf. Table 1.

VBW  $\geq$  3 x 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).

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

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



Average (duty cycle < 98%, duty cycle variations are less than ±2%)</li>
Set RBW = 1 MHz
Set VBW ≥ 3 x 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.

#### Note :

1. We are performed the RSE and radiated band edge using standard radiated method(RMS).

2. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor( reference distance : 3 m).

3. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

#### Data packet length (Min)

LE Mode	T <sub>on</sub> (ms)	T <sub>total</sub> (ms)	Duty Cycle	Duty Cycle Factor (dB)
	0.3901	0.6257	0.6235	2.05

#### Data packet length (Max)

LE Mode	T <sub>on</sub> (ms)	T <sub>total</sub> (ms)	Duty Cycle	Duty Cycle Factor (dB)
	2.1350	2.5000	0.8540	0.69



## **TEST RESULTS**

#### 9 kHz – 30MHz

## Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

- 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 (specific distance / 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	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

- 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.



Model: LG-H990

## Above 1 GHz

Frequency	Reading	Duty Cycle Factor	A.F.+C.LA.G.+D.F.	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dBm]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4804	48.65	0.00	-0.61	V	48.04	73.98	25.94	PK
4804	37.26	2.05	-0.61	V	38.7	53.98	15.28	AV
7206	45.12	0.00	8.78	V	53.9	73.98	20.08	PK
7206	33.51	2.05	8.78	V	44.34	53.98	9.64	AV
4804	49.09	0.00	-0.61	Н	48.48	73.98	25.50	PK
4804	37.41	2.05	-0.61	Н	38.85	53.98	15.13	AV
7206	45.45	0.00	8.78	Н	54.23	73.98	19.75	PK
7206	33.52	2.05	8.78	Н	44.35	53.98	9.63	AV

Operation Mode: CH.0\_ Data packet length (Min)

\*A.F. : Antenna Factor / C.L. : Cable Loss / A.G. : Amplifier Gain / D.F. : Distance Factor

- 1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- 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 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- 4. Total = Reading Value + Antenna Factor + Cable Loss Amp Gain + Distance Factor
   + Duty Cycle Factor
- 5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



Frequency	Reading	Duty Cycle Factor	A.F.+C.LA.G.+D.F.	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dBm]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4880	49.72	0.00	0.19	V	49.91	73.98	24.07	PK
4880	37.61	2.05	0.19	V	39.85	53.98	14.13	AV
7320	45.85	0.00	8.85	V	54.70	73.98	19.28	PK
7320	34.28	2.05	8.85	V	45.18	53.98	8.80	AV
4880	49.54	0.00	0.19	Н	49.73	73.98	24.25	PK
4880	37.73	2.05	0.19	Н	39.97	53.98	14.01	AV
7320	46.30	0.00	8.85	Н	55.15	73.98	18.83	PK
7320	34.34	2.05	8.85	Н	45.24	53.98	8.74	AV

## Operation Mode: CH.19\_ Data packet length (Min)

- 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. Total = Reading Value + Antenna Factor + Cable Loss Amp Gain + Distance Factor + Duty Cycle Factor
- 5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



Frequency	Reading	Duty Cycle Factor	A.F.+C.LA.G.+D.F.	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dBm]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4960	49.18	0.00	0.92	V	50.10	73.98	23.88	PK
4960	37.45	2.05	0.92	V	40.42	53.98	13.56	AV
7440	45.37	0.00	9.03	V	54.40	73.98	19.58	PK
7440	33.78	2.05	9.03	V	44.86	53.98	9.12	AV
4960	49.34	0.00	0.92	Н	50.26	73.98	23.72	PK
4960	37.53	2.05	0.92	Н	40.50	53.98	13.48	AV
7440	46.21	0.00	9.03	Н	55.24	73.98	18.74	PK
7440	33.84	2.05	9.03	Н	44.92	53.98	9.06	AV

## Operation Mode: CH.39\_ Data packet length (Min)

- 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. Total = Reading Value + Antenna Factor + Cable Loss Amp Gain + Distance Factor + Duty Cycle Factor
- 5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



Frequency	Reading	Duty Cycle Factor	A.F.+C.LA.G.+D.F.	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dBm]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4804	48.55	0.00	-0.61	V	47.94	73.98	26.04	PK
4804	37.38	0.69	-0.61	V	37.46	53.98	16.52	AV
7206	45.39	0.00	8.78	V	54.17	73.98	19.81	PK
7206	33.56	0.69	8.78	V	43.03	53.98	10.95	AV
4804	48.89	0.00	-0.61	Н	48.28	73.98	25.70	PK
4804	37.45	0.69	-0.61	Н	37.53	53.98	16.45	AV
7206	45.61	0.00	8.78	Н	54.39	73.98	19.59	PK
7206	33.58	0.69	8.78	Н	43.05	53.98	10.93	AV

Operation Mode: CH.0\_ Data packet length (Max)

\*A.F. : Antenna Factor / C.L. : Cable Loss / A.G. : Amplifier Gain / D.F. : Distance Factor

- 1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- 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 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- 4. Total = Reading Value + Antenna Factor + Cable Loss Amp Gain + Distance Factor
   + Duty Cycle Factor
- 5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



Frequency	Reading	Duty Cycle Factor	A.F.+C.LA.G.+D.F.	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dBm]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4880	49.14	0.00	0.19	V	49.33	73.98	24.65	PK
4880	37.65	0.69	0.19	V	38.53	53.98	15.45	AV
7320	46.28	0.00	8.85	V	55.13	73.98	18.85	PK
7320	34.27	0.69	8.85	V	43.81	53.98	10.17	AV
4880	49.56	0.00	0.19	Н	49.75	73.98	24.23	PK
4880	37.71	0.69	0.19	Н	38.59	53.98	15.39	AV
7320	46.51	0.00	8.85	Н	55.36	73.98	18.62	PK
7320	34.38	0.69	8.85	Н	43.92	53.98	10.06	AV

## Operation Mode: CH.19\_ Data packet length (Max)

- 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. Total = Reading Value + Antenna Factor + Cable Loss Amp Gain + Distance Factor + Duty Cycle Factor
- 5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



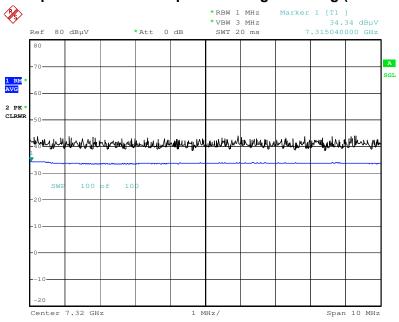
Frequency	Reading	Duty Cycle Factor	A.F.+C.LA.G.+D.F.	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dBm]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4960	49.36	0.00	0.92	V	50.28	73.98	23.70	PK
4960	37.51	0.69	0.92	V	39.12	53.98	14.86	AV
7440	45.94	0.00	9.03	V	54.97	73.98	19.01	PK
7440	33.70	0.69	9.03	V	43.42	53.98	10.56	AV
4960	49.20	0.00	0.92	Н	50.12	73.98	23.86	PK
4960	37.46	0.69	0.92	Н	39.07	53.98	14.91	AV
7440	46.33	0.00	9.03	Н	55.36	73.98	18.62	PK
7440	33.79	0.69	9.03	Н	43.51	53.98	10.47	AV

## Operation Mode: CH.39\_ Data packet length (Max)

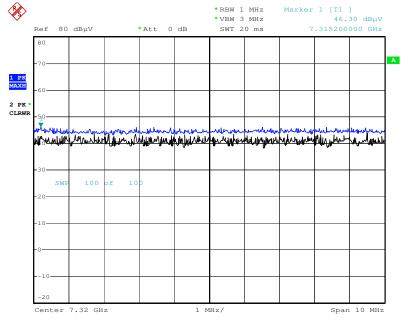
- 1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- 2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already 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. Total = Reading Value + Antenna Factor + Cable Loss Amp Gain + Distance Factor + Duty Cycle Factor
- 5. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



## RESULT PLOTS\_Data packet length (Min) (Worst case : x-H) Radiated Spurious Emissions plot – Average Reading (Ch.19 3rd Harmonic)



Date: 9.AUG.2016 17:27:48



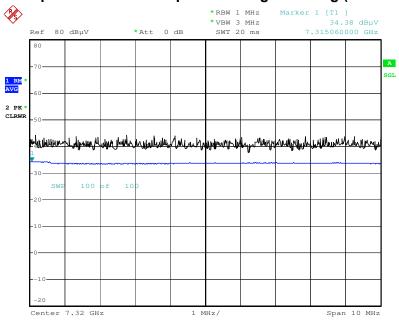
## Radiated Spurious Emissions plot – Peak Reading (Ch.19 3rd Harmonic)

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

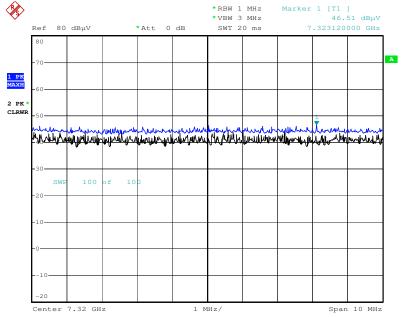
Date: 9.AUG.2016 17:29:07



## RESULT PLOTS\_Data packet length (Max) (Worst case : x-H) Radiated Spurious Emissions plot – Average Reading (Ch.19 3rd Harmonic)



Date: 9.AUG.2016 17:28:14



## Radiated Spurious Emissions plot – Peak Reading (Ch.19 3rd Harmonic)

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

Date: 9.AUG.2016 17:28:34



## 9.6.2 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 Operating Frequency

Channel No.

BT LE Data packet length (Min)

2402 MHz

2102	 12	
0		

Frequency	Reading	Duty Cycle Factor	A.F.+C.L.+D.F.	Ant. Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
2390.0	14.73	0.00	32.68	Н	47.41	73.98	26.58	PK
2390.0	3.08	2.05	32.68	Н	37.81	53.98	16.17	AV
2390.0	14.93	0.00	32.68	V	47.61	73.98	26.37	PK
2390.0	3.32	2.05	32.68	V	38.05	53.98	15.93	AV

Operation Mode Operating Frequency Channel No.

## BT\_LE Data packet length (Max)

2402 MHz		
0		

Frequency	Reading	Duty Cycle Factor	A.F.+C.L.+D.F.	Ant. Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
2390.0	14.47	0.00	32.68	Н	47.15	73.98	26.83	PK
2390.0	3.34	0.69	32.68	Н	36.71	53.98	17.28	AV
2390.0	14.85	0.00	32.68	V	47.53	73.98	26.45	PK
2390.0	3.25	0.69	32.68	V	36.62	53.98	17.36	AV



- 1. Frequency range of measurement = 2310 MHz ~ 2390 MHz
- 2. Total = Reading Value + Antenna Factor + Cable Loss + Duty Cycle Factor + Distance Factor
- 3. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



**Operation Mode Operating Frequency**  BT\_LE Data packet length (Min)

Model: LG-H990

2480 MHz

Channel No.

39

Frequency	Reading	Duty Cycle Factor	A.F.+C.L.+D.F.	Ant. Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
2483.5	15.29	0.00	33.05	Н	48.34	73.98	25.64	PK
2483.5	3.73	2.05	33.05	Н	38.83	53.98	15.15	AV
2483.5	15.77	0.00	33.05	V	48.82	73.98	25.16	PK
2483.5	3.85	2.05	33.05	V	38.95	53.98	15.03	AV

**Operation Mode Operating Frequency** Channel No.

BT\_LE Data packet length (Max)

2480 MHz		
39		

Frequency	Reading	Duty Cycle Factor	A.F.+C.L.+D.F.	Ant. Pol.	Total	Limit	Margin	Measurement
[MHz]	[dBuV/m]	[dB]	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
2483.5	14.67	0.00	33.05	Н	47.72	73.98	26.26	PK
2483.5	4.15	0.69	33.05	Н	37.89	53.98	16.09	AV
2483.5	14.80	0.00	33.05	V	47.85	73.98	26.13	PK
2483.5	4.33	0.69	33.05	V	38.07	53.98	15.91	AV

## Notes:

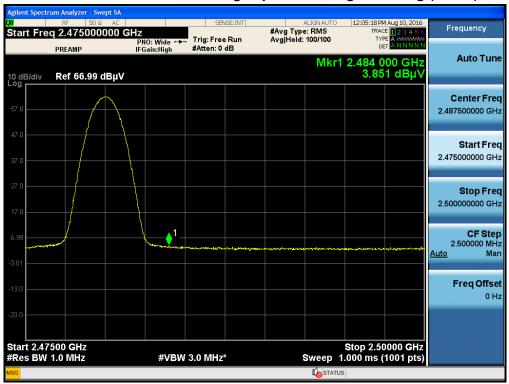
1. Frequency range of measurement = 2483.5 MHz ~ 2500 MHz

2. Total = Reading Value + Antenna Factor + Cable Loss + Duty Cycle Factor + Distance Factor

- 3. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)
- 4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



## RESULT PLOTS\_Data packet length (Min) (Worst case : z-V) Radiated Restricted Band Edges plot – Average Reading (Ch.39)



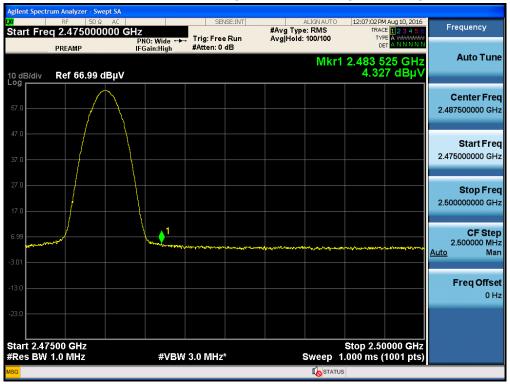
## Radiated Restricted Band Edges plot - Peak Reading (Ch.39)



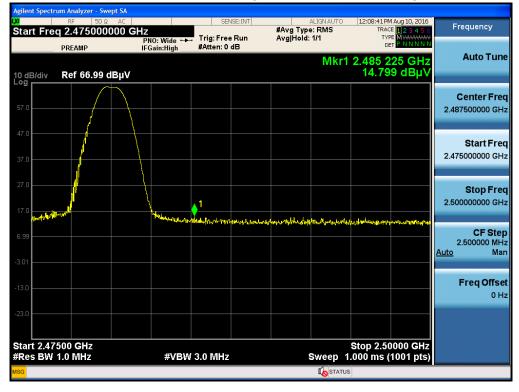
Note : Only the worst case plots for Radiated Restricted Band Edges.



## RESULT PLOTS\_Data packet length (Max) (Worst case : z-V) Radiated Restricted Band Edges plot – Average Reading (Ch.39)



## Radiated Restricted Band Edges plot - Peak Reading (Ch.39)



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



# 9.7 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:

	Limits (dBµV)				
Frequency Range (MHz)	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**

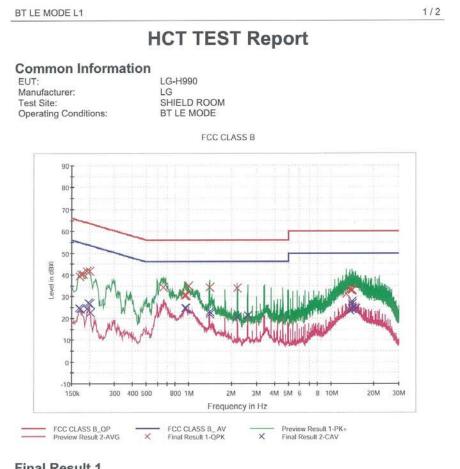
- 1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
- 2. The EUT is connected via LISN to a test power supply.
- 3. The measurement results are obtained as described below:
- 4. Detectors Quasi Peak and Average Detector.

## Sample Calculation

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



## RESULT PLOTS **Conducted Emissions (Line 1)**



#### **Final Result 1**

Frequency (MHz)	QuasiPeak (dB¥i V)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB¥i V)
0.170000	39.4	9.000	Off	L1	9.7	25.6	65.0
0.174000	40.5	9.000	Off	L1	9.7	24.3	64.8
0.180000	40.4	9.000	Off	L1	9.7	24.1	64.5
0.192000	41.7	9.000	Off	L1	9.7	22.2	63.9
0.200000	41.8	9.000	Off	L1	9.7	21.8	63.6
0.660000	34.1	9.000	Off	L1	9.7	21.9	56.0
0.934000	30.3	9.000	Off	L1	9.8	25.7	56.0
0.948000	30.9	9.000	Off	L1	9.8	25.1	56.0
0.954000	30.5	9.000	Off	L1	9.8	25.5	56.0
0.996000	34.9	9.000	Off	L1	9.8	21.1	56.0
1.394000	34.3	9.000	Off	L1	9.8	21.7	56.0
2.194000	33.8	9.000	Off	L1	9.8	22.2	56.0
12.714000	31.3	9.000	Off	L1	10.1	28.7	60.0
13.498000	33.2	9.000	Off	L1	10.2	26.8	60.0
14.032000	33.1	9.000	Off	L1	10.2	26.9	60.0
14.038000	32.9	9.000	Off	L1	10.2	27.1	60.0
14.056000	33.1	9.000	Off	L1	10.2	26.9	60.0
14.096000	32.9	9.000	Off	L1	10.2	27.1	60.0

#### **Final Result 2**



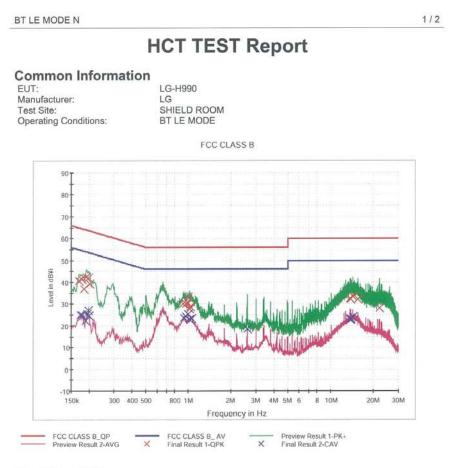
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#### BT LE MODE L1

Frequency (MHz)	CAverage (dB¥iV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB¥iV)
0.168000	24.7	9.000	Off	L1	9.7	30.3	55.1
0.172000	24.3	9.000	Off	L1	9.7	30.5	54.9
0.192000	24.4	9.000	Off	L1	9.7	29.5	53.9
0.196000	27.2	9.000	Off	L1	9.7	26.6	53.8
0.200000	26.7	9.000	Off	L1	9.7	26.9	53.6
0.204000	22.5	9.000	Off	L1	9.7	30.9	53.4
0.936000	24.6	9.000	Off	L1	9.8	21.4	46.0
0.948000	24.8	9.000	Off	L1	9.8	21.2	46.0
1.394000	22.9	9.000	Off	L1	9.8	23.1	46.0
1.398000	22.1	9.000	Off	L1	9.8	23.9	46.0
2.194000	20.7	9.000	Off	L1	9.8	25.3	46.0
2.590000	21.2	9.000	Off	L1	9.8	24.8	46.0
13.498000	23.6	9.000	Off	L1	10.2	26.4	50.0
14.032000	24.4	9.000	Off	L1	10.2	25.6	50.0
14.048000	24.4	9.000	Off	L1	10.2	25.6	50.0
14.056000	27.8	9.000	Off	L1	10.2	22.2	50.0
14.096000	26.6	9.000	Off	L1	10.2	23.4	50.0
14,792000	24.2	9.000	Off	L1	10.2	25.8	50.0



#### **Conducted Emissions (Line 2)**



#### **Final Result 1**

Frequency (MHz)	QuasiPeak (dB¥i V)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB¥i V)
0.170000	40.6	9.000	Off	N	9.7	24.3	65.0
0.178000	41.3	9.000	Off	N	9.7	23.3	64.6
0.186000	37.0	9.000	Off	N	9.7	27.2	64.2
0.192000	42.4	9.000	Off	N	9.7	21.5	63.9
0.198000	41.9	9.000	Off	N	9.7	21.8	63.7
0.204000	39.2	9.000	Off	N	9.7	24.2	63.4
0.924000	30.2	9.000	Off	N	9.7	25.8	56.0
0.964000	30.1	9.000	Off	N	9.7	25.9	56.0
0.996000	33.3	9.000	Off	N	9.7	22.7	56.0
1.000000	30.6	9.000	Off	N	9.7	25.4	56.0
1.020000	27.6	9.000	Off	N	9.7	28.4	56.0
1.036000	28.7	9.000	Off	N	9.7	27.3	56.0
13.644000	32.5	9.000	Off	N	10.2	27.5	60.0
13.824000	32.2	9.000	Off	N	10.2	27.8	60.0
14.344000	33.4	9.000	Off	N	10.2	26.6	60.0
15.518000	32.2	9.000	Off	N	10.2	27.8	60.0
15.596000	32.3	9.000	Off	N	10.2	27.7	60.0
22.138000	28.2	9.000	Off	N	10.4	31.8	60.0

#### Final Result 2



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#### BT LE MODE N

Frequency (MHz)	CAverage (dB¥iV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB¥iV)
0.174000	24.9	9.000	Off	N	9.7	29.9	54.8
0.178000	25.0	9.000	Off	N	9.7	29.6	54.6
0.190000	22.2	9.000	Off	N	9.7	31.9	54.0
0.194000	25.4	9.000	Off	N	9.7	28.5	53.9
0.198000	26.9	9.000	Off	N	9.7	26.8	53.7
0.202000	24.6	9.000	Off	N	9.7	28.9	53.5
0.926000	23.7	9.000	Off	N	9.7	22.3	46.0
0.958000	24.2	9.000	Off	N	9.7	21.8	46.0
0.996000	25.2	9.000	Off	N	9.7	20.8	46.0
1.022000	22.9	9.000	Off	N	9.7	23.1	46.0
1.054000	23.4	9.000	Off	N	9.7	22.6	46.0
2.590000	18.5	9.000	Off	N	9.8	27.5	46.0
13.640000	23.1	9.000	Off	N	10.2	26.9	50.0
13,644000	23.3	9.000	Off	N	10.2	26.7	50.0
13.794000	23.1	9.000	Off	N	10.2	26.9	50.0
13.806000	23.3	9.000	Off	N	10.2	26.7	50.0
14.334000	23.9	9.000	Off	N	10.2	26.1	50.0
14.358000	24.0	9.000	Off	N	10.2	26.0	50.0



# 10. LIST OF TEST EQUIPMENT 10.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	12/28/2015	Annual	100073
Rohde & Schwarz	ESCI / Test Receiver	12/28/2015	Annual	100584
Agilent	N9020A / Signal Analyzer	06/24/2016	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	11/24/2015	Annual	MY49431210
Agilent	N1911A / Power Meter	03/11/2016	Annual	MY45100523
Agilent	N1921A / Power Sensor	03/11/2016	Annual	MY52260025
Agilent	87300B / Directional Coupler	11/30/2015	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/14/2016	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	03/09/2016	Annual	KR75303962
Agilent	8493C / Attenuator(10 dB)	07/15/2016	Annual	07560
Rohde & Schwarz	CBT / Bluetooth Tester	05/16/2016	Annual	100422



## 10.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Audix	AM4000 / Antenna Position Tower	N/A	N/A	N/A
Audix	Turn Table	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Rohde & Schwarz	Loop Antenna	02/23/2016	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/15/2015	Biennial	255
Schwarzbeck	BBHA 9120D / Horn Antenna	05/07/2015	Biennial	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	09/03/2015	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	09/24/2015	Annual	100688
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/23/2015	Annual	101068-SZ
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	06/24/2016	Annual	8
Wainwright Instruments	WHFX7.0/18G-8SS / High Pass Filter	05/13/2016	Annual	29
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	07/06/2016	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/26/2016	Annual	2
Agilent	8493C-10 / Attenuator(10 dB)	08/11/2016	Annual	76649
CERNEX	CBLU1183540 / Power Amplifier	07/15/2016	Annual	22964
CERNEX	CBL06185030 / Power Amplifier	07/15/2016	Annual	22965
CERNEX	CBL18265035 / Power Amplifier	07/11/2016	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	07/11/2016	Annual	25956
TESCOM	TC-3000C / Bluetooth Tester	04/01/2016	Annual	3000C000276