

FCC BT REPORT

FCC Certification

Applicant Name:

LG Electronics MobileComm U.S.A., Inc

Address:

1000 SYLVAN AVENUE ENGLEWOOD CLIFFS, NJ 07632

Date of Issue: June 29, 2015 Test Site/Location: HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea Report No.: HCT-R-1506-F068 HCT FRN: 0005866421

FCC ID

: **ZNFKBB700**

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

FCC Model(s):	KBB-700
EUT Type:	Bluetooth keyboard
Max. RF Output Power:	0.175 dBm (1.041 mW)
Frequency Range:	2402 MHz - 2480 MHz (Bluetooth)
Modulation type	GFSK(Normal), π /4DQPSK and 8DPSK(EDR)
FCC Classification:	FCC Part 15 Spread Spectrum Transmitter
FCC Rule Part(s):	Part 15 subpart C 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 : Kyung Soo Kang Test Engineer of RF Team

Approved by : Sang Jun Lee Manager of RF Team

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1506-F68	June 29, 2015	- First Approval Report



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Model: KBB-700

1. GENERAL INFORMATION

Applicant:	LG Electronics MobileComm U.S.A., Inc			
Address:	1000 SYLVAN AVENUE ENGLEWOOD CLIFFS, NJ 07632			
FCC ID:	ZNFKBB700			
EUT Type:	Bluetooth keyboard			
Model name(s):	KBB-700			
Date(s) of Tests:	June 05, 2015 ~ June 22, 2015			
Place of Tests:	HCT Co., Ltd. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea			
	(IC Recognition No. : 5944A-3)			

2. EUT DESCRIPTION

FCC Model Name	KBB-700	
EUT Type	Bluetooth keyboard	
Power Supply	DC 1.5 V	
Battery type	Li-ion Battery(Standard)	
Frequency Range	2402 MHz - 2480 MHz (Bluetooth)	
Transmit Power	0.175 dBm (1.041 mW)	
BT Operating Mode	Normal, EDR, AFH	
Modulation Type	GFSK(Normal), π /4DQPSK and 8DPSK(EDR)	
Modulation Technique	FHSS	
Number of Channels	79Channels, Minimum 20 Channels(AFH)	
	Manufacturer: Chicony Electronics(Dongguan) Co., Ltd.	
Antenna Specification	Antenna type: Invert F Antenna	
	Peak Gain : -0.47 dBi	

💥 15.247 Requirements for Bluetooth transmitter

• This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:

- 1) This system is hopping pseudo-randomly.
- 2) Each frequency is used equally on the average by each transmitter.
- 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
- 4) The receiver shifts frequencies in synchronization with the transmitted signals.

• 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.

• 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.



3. TEST METHODOLOGY

The measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.4-2003) and FCC Public Notice DA 00-705 dated March 30, 2000 entitled "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" were used in the measurement of the LG Electronics MobileComm U.S.A., Inc

. Bluetooth keyboard FCC ID: ZNFKBB700

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 13.1.4.1 of ANSI C63.4. (Version :2003) 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. 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 13.1.4.1 of ANSI C63.4. (Version: 2003). To record the final measurements, the analyzer detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 120 kHz for frequencies below 1 GHz or 1 MHz for frequencies above 1 GHz. For average measurements above 1 GHz, the analyzer was set to peak detector with a reduced VBW setting(RBW = 1 MHz, VBW = 1/T Hz, where T = Pulse width).

Conducted Antenna Terminal

See Section from 8.1 to 8.6.1.(DA 00-705)



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 :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated February 28, 2014 (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 OF TEST RESULTS

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
20 dB Bandwidth	§15.247(a)(1)(ii) or (iii)	N/A		PASS
Occupied Bandwidth	N/A	N/A	-	N/A
Conducted Maximum Peak Output Power	§15.247(b)(1)	< 1 Watts if ≥ 75 non- overlapping hopping channels used < 125 Milliwatts if < 75 non- overlapping hopping channels used		PASS
Carrier Frequency Separation	§15.247(a)(1)	>25 kHz or >2/3 of the 20dB BW	CONDUCTED	PASS
Number of Hopping Frequencies	§15.247(a)(1)(iii)	>15		PASS
Time of Occupancy	§15.247(a)(1)(iii)	<400 ms		PASS
Conducted Spurious Emissions	§15.247(d)	> 20 dB for all out-of band emissions		PASS
Band Edge(Out of Band Emissions)	§15.247(d)	> 20 dB for all out-of band emissions		PASS
AC Power line Conducted Emissions	§15.207(a)	cf. Section 8.7		PASS
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 8.6.2	DADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.6.3		PASS



8. FCC PART 15.247 REQUIREMENTS

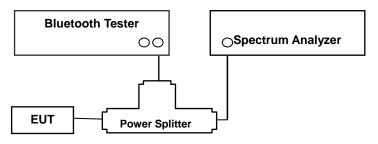
8.1 PEAK POWER

LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

- For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 W. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 W.
- 2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

The Spectrum Analyzer is set to (DA 00-705)

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = Auto Detector = Peak Trace = Max hold

SAMPLE CALCULATION

Output Power = Spectrum Reading Power + Power Splitter loss + Cable loss(2 ea)

= 10 dBm + 6 dB + 1.5 dB = 17.5 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 splitter and cable combination.



- 2. Spectrum offset = Power Splitter loss + Cable loss
- 3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 6.51 dB at 2402 MHz and is 6.54 dB at 2480 MHz. So, 6.5 dB is offset. And the offset gap in the 2.4 GHz range do not affect the conducted peak power final result

TEST RESULTS

No non-compliance noted

Test Data

Channel	Frequency	•	t Power SK)	Limit	Result
	(MHz)	(dBm)	(mW)	(mW)	
Low	2402	-0.738	0.844		PASS
Mid	2441	-0.117	0.973	125	PASS
High	2480	0.175	1.041		PASS



Model: KBB-700

Test Plots (GFSK) Peak Power (Low-CH)



Test Plots (GFSK) Peak Power (Mid-CH)





Model: KBB-700

Test Plots (GFSK) Peak Power (High-CH)

Agilent S	pectrum Analyzer - Swept SA						
Cente	RF 50Ω AC er Freq 2.48000000	GHz	NSE:INT #Av	ALIGNAUTO g Type: Pwr(RMS)	TRACE	4 Jun 09, 2015	Frequency
		PNO: Fast +++ Trig: Free IFGain:Low #Atten: 20		[Hold: 1/1	TYP	E M WWWWW T P N N N N N	
	Ref Offset 6.5 dB liv Ref 15.00 dBm			Mkr	0.17	86 GHz 75 dBm	Auto Tune
10 dB/d	av Rei 15.00 dBm				0.11	o abiii	
5.00							Center Freq
5.00							2.480000000 GHz
-5.00							
							Start Freq
-15.0							2.475000000 GHz
-25.0							
×							Stop Freq 2.48500000 GHz
-35.0							2.483000000 GHz
							CF Step
-45.0							1.000000 MHz
-55.0							<u>Auto</u> Man
							Freq Offset
-65.0							0 Hz
-75.0							
Center	r 2.480000 GHz				Snan 1).00 MHz	
	BW 3.0 MHz	#VBW 50 MHz		Sweep	1.00 ms (′	1001 pts)	
MSG				STATUS	5		

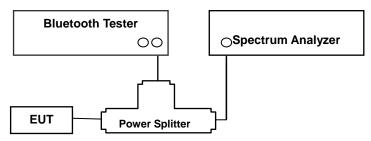


8.2 BAND EDGES

LIMIT

According to §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.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off and hopping on.

The Spectrum Analyzer is set to (DA 00-705)

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW \geq 1% of the span

VBW ≥ RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

TEST RESULTS

See attached.

Note :

- 1. The results in plot is already including the actual values of loss for the splitter and cable combination.
- 2. Spectrum offset = Power Splitter loss + Cable loss
- 3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 6.51 dB at 2402 MHz and is 6.54 dB at 2480 MHz. So, 6.5 dB is offset. And the offset gap in the 2.4 GHz range do not affect the band edge measurement final result.



Test Data

- Without hopping

Outside	GFSK	Limit	Margin	
Frequency Band	(dB)	(dBc)	GFSK (dBc)	Result
Lower	43.502	20	23.502	PASS
Upper	57.643	20	37.643	PASS

- With hopping

Outside	GFSK	Limit	Margin	
Frequency Band	(dB)	(dBc)	GFSK	Result
			(dBc)	
Lower	48.401	20	28.401	PASS
Upper	59.824	20	39.824	PASS

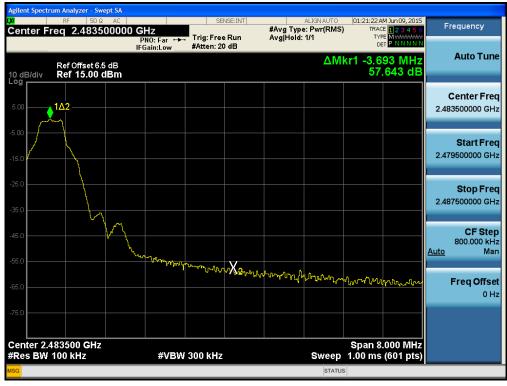


Model: KBB-700

Test Plots without hopping (GFSK) Band Edges (Low-CH)



Test Plots without hopping (GFSK) Band Edges (High-CH)



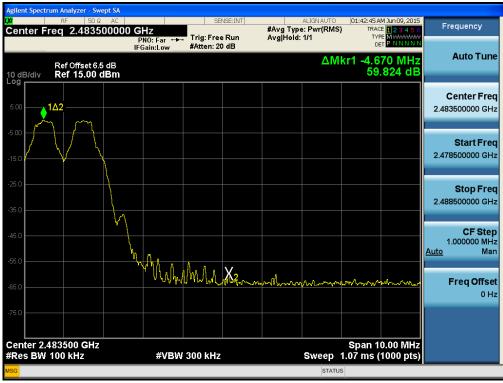


Model: KBB-700

Test Plots with hopping (GFSK) Band Edges (Low-CH)



Test Plots with hopping (GFSK) Band Edges (High-CH)

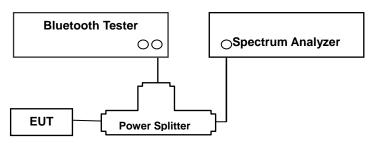




8.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW) LIMIT

According to §15.247(a)(1), Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Configuration



TEST PROCEDURE

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The Spectrum Analyzer is set to (DA 00-705)

Span = wide enough to capture the peaks of two adjacent channels

RBW ≥ 1% of the span

 $VBW \ge RBW$

Sweep = Auto

Detector = Peak

Trace = Max hold

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

TEST RESULTS

No non-compliance noted



Model: KBB-700

Test Data

Channel Separation (kHz)	20dB Band	width (kHz)	Limit	Result
GFSK	Channel	GFSK	(kHz)	
	Low CH	1025.00	>25 or	
1000	Middle CH	1023.00	>2/3 of the	Pass
	High CH	1017.00	20dB BW	

Occupied Bandwidth (99% BW)

99% BW (kHz)				
Channel	GFSK			
Low CH	959.07			
Middle CH	955.05			
High CH	945.58			

Note : We can not know what use channel in AFH mode. So, we can not test in AFH mode. Also, if the test performs some channel in AFH mode, the test result is not different with normal mode.



Model: KBB-700

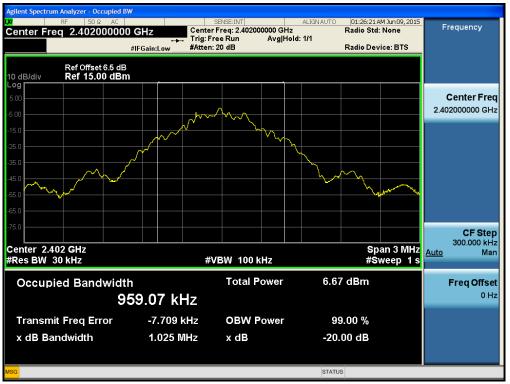
Test Plots (GFSK) Channel Separation





Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (Low-CH)



Test Plots (GFSK)

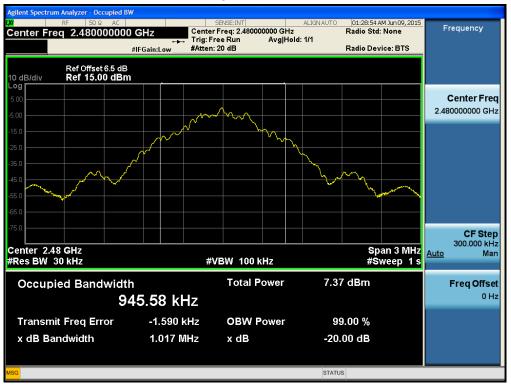
20 dB Bandwidth & Occupied Bandwidth (Mid-CH)





Test Plots (GFSK)

20 dB Bandwidth & Occupied Bandwidth (High-CH)



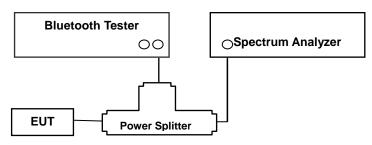


8.4 NUMBER OF HOPPING FREQUENCY

LIMIT

According to 15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands shall use at least 15 hopping frequencies.

Test Configuration



TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled.

The Spectrum Analyzer is set to (DA 00-705)

Span = the frequency band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = Auto

Detector = Peak

Trace = Max hold

The trace was allowed to stabilize.

TEST RESULTS

No non-compliance noted

Test Data

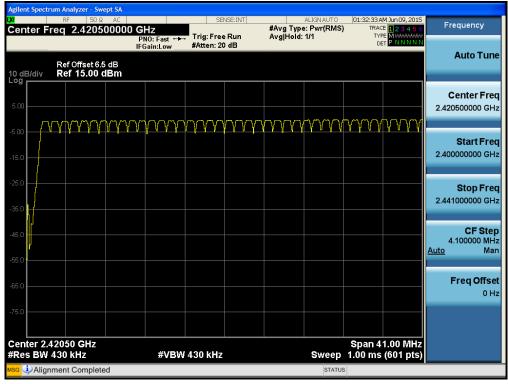
Result (No. of CH)	Lingit	Popult	
GFSK	Limit	Result	
79	>15	Pass	

Note : In case of AFH mode, minimum number of hopping channels is 20.



Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots (GFSK) Number of Channels (2.441 GHz - 2.4835 GHz)

Agiler	nt Spectru	ım Analyze										
Cen	nter Fr	^{RF} eq 2.4	50 Ω AC		Hz		NSE:INT		ALIGNAUTO e: Pwr(RMS)	TRAC	M Jun 09, 2015	Frequency
				Pl	NO: Fast 🔸	Trig: Free #Atten: 20		Avg Hold:	1/1	DI		
		Ref Offs	et 6.5 dB									Auto Tune
10 di Log	B/div		00 dBn									
0												Center Freq
5.00												2.462250000 GHz
-5.00	$\gamma\gamma\gamma$	$\gamma\gamma\gamma\gamma$	muu	$\gamma\gamma\gamma$	$\gamma\gamma\gamma\gamma\gamma$	$\gamma\gamma\gamma\gamma\gamma$	m	mm	MMM	$\gamma\gamma\gamma\gamma\gamma$	٧٦	
-3.00												Start Freq
-15.0												2.441000000 GHz
-25.0												Stop Freq
-35.0												2.483500000 GHz
-45.0												CF Step 4.250000 MHz
-55.0											հլո	<u>Auto</u> Man
-39.0											P In	
-65.0												Freq Offset
												0 Hz
-75.0												
		6225 GI 130 kHz			#VRM	430 kHz			Sween		2.50 MHz (601 pts)	
MSG	5 8 1 1	700 AT 12			<i></i> V D V V	-700 MHZ			STATUS		(oor proj	

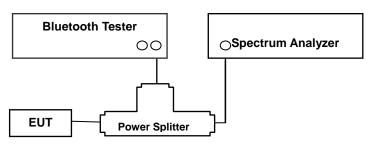


8.5 TIME OF OCCUPANCY (DWELL TIME)

LIMIT

According to \$15.247(a)(1)(iii), Frequency hopping systems operating in the 2400 MHz ~ 2483.5 MHz bands. The average time of occupancy on any channels shall not greater than 0.4 s within a period 0.4 s multiplied by the number of hopping channels employed.

Test Configuration



TEST PROCEDURE

This test is performed with hopping off.

EUT was set to transmit the longest packet type (DH5)

The Spectrum Analyzer is set to (DA 00-705)

Span = Zero span, Centered on a hopping channel

RBW = 1 MHz

VBW ≥ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector = Peak

Trace = Max hold

The marker-delta function was used to determine the dwell time.

Normal Mode / EDR Mode

DH 5(The longest packet type for GFSK) CH Mid : 2.942 * (1600/6)/79 * 31.6 = 313.81 (ms)

AFH Mode

DH 5(The longest packet type for GFSK) CH Mid : 2.942 * (800/6)/20 * 8.0 = 156.91 (ms)



Model: KBB-700

Note :

A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.7 times of appearance. Each tx-time per appearance of DH5 is 2.892 ms.

Dwell time = Tx-time * 106.7

TEST RESULTS

See the table.

	Channel	GFSK
Pulse	Low	2.942
Time	Mid	2.942
(ms)	High	2.942

	Channel	GFSK	Period Time (s)	Limit (ms)	Result
Total of	Low	313.8	31.6		PASS
Dwell	Mid	313.8	31.6	400	PASS
(ms)	High	313.8	31.6		PASS



Model: KBB-700

Test Plots (GFSK) Dwell Time (Low-CH)

Agilent Spect	rum Analyzer - Swe								
	RF 50 Ω			SEN	SE:INT	#Aug Typ	ALIGNAUTO e: Pwr(RMS)	01:58:00 AM Jun 09, 201 TRACE 1 2 3 4 5	
Center F	req 2.40200	PN	IO East ↔	Trig: Free #Atten: 20		*****	e. F wi (RM3)		N
10 dB/div Log	Ref Offset 6.5 Ref 15.00 d	dB IBm						/lkr1 2.942 m -8.68 dB	
5.00									Center Freq 2.402000000 GHz
-5.00	X ₂						1Δ2		Start Freq 2.402000000 GHz
-25.0									Stop Freq 2.402000000 GHz
-45.0							. La stato Ja		CF Step 1.000000 MHz <u>Auto</u> Man
-65.0	4/vn,1						\. \. \. \. \. \. \. \. \. \. \. \. \. \	⁴ UJu ₁₁	Freq Offset 0 Hz
-75.0	402000000 G	H7						Span 0 H	
Res BW 1			#VBW 1	1.0 MHz			Sweep 5	.000 ms (601 pts	
mag							STATUS		

Test Plots (GFSK) Dwell Time (Mid-CH)

Agilent Sp	pectrum Analyzer - Swept					
l <mark>XI</mark> Cente	RF 50 Ω A r Freq 2.441000		SENSE:INT	ALIGNA #Avg Type: Pwr(RMS) TRACE 12345 (Frequency
conto		PNO: Fast ← IFGain:Low	 Trig: Free Run #Atten: 20 dB 		TYPE WWWWWW DET P N N N N	
10 dB/d Log	Ref Offset 6.5 dE liv Ref 15.00 dBi	3 m			ΔMkr1 2.942 ms 0.21 dB	
5.00					<u>1</u> Δ2	Center Freq 2.441000000 GHz
-5.00		X	2			Start Freq 2.441000000 GHz
-25.0						Stop Freq 2.441000000 GHz
-45.0						CF Step 1.000000 MHz <u>Auto</u> Man
-65.0	ι μ	\m ^{puty} whullwer ^u			լու Մորդու	Freq Offset 0 Hz
-75.0						
	r 2.441000000 GHz W 1.0 MHz		N 1.0 MHz	Swe	Span 0 Hz ep 5.000 ms (601 pts)	
MSG				5	STATUS	



Model: KBB-700

Test Plots (GFSK) Dwell Time (High-CH)

Agilent Spectr	rum Analyzer - Swept SA				
Center F	RF 50 Ω AC req 2.480000000 GH	Z SENSE:	#Avg Type: F	wr(RMS) TRAC	M Jun 09, 2015 E 1 2 3 4 5 6 WWWWWW
		: Fast ↔ Trig: Free Ru in:Low #Atten: 20 dB		Di	
10 dB/div Log	Ref Offset 6.5 dB Ref 15.00 dBm			ΔMkr1 2.	942 ms Auto Tune 2.90 dB
5.00					Center Freq 2.480000000 GHz
-5.00	X ₂			14	
-15.0					2.480000000 GHz
-25.0					Stop Freq 2,480000000 GHz
-35.0					
-45.0					CF Step 1.000000 MHz <u>Auto</u> Man
	Www. Mr Walay Magain			14m	ա ^{լա} իկութի Freq Offset
-65.0					0 Hz
-75.0					
Center 2.4 Res BW 1	480000000 GHz	#VBW 1.0 MHz	s	Sweep 5.000 ms	pan 0 Hz (601 pts)
MSG			×	STATUS	



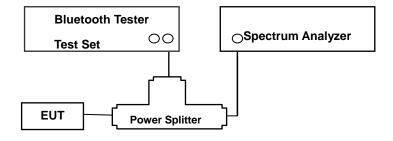
8.6 SPURIOUS EMISSIONS

8.6.1 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

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer.

The Spectrum Analyzer is set to (DA 00-705)

- Span = wide enough to capture the peak level of the in-band emission and all spurious emissions(e.g.,harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
- 2. RBW = 100 kHz
- 3. VBW ≥ 300 kHz
- 4. Sweep = auto
- 5. Sweep point \geq 2*span/RBW



5. Detector function = peak

6. Trace = max hold

Measurements are made over the 30 MHz to 26 GHz range with the transmitter set to the lowest,

middle, and highest channels.

This test is performed with hopping off.

TEST RESULTS

No non-compliance noted.

Note : In order to simplify the report, attached plots were only the worst case channel and data rate.

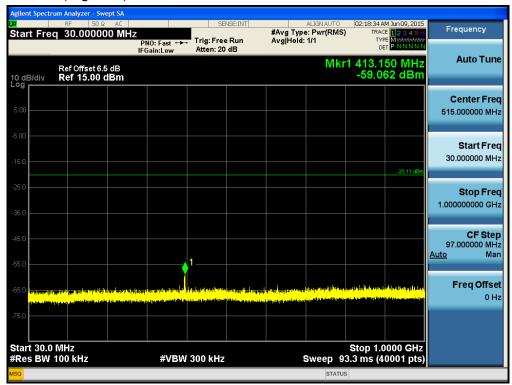
FACTORS F	
Freq(MHz)	Factor(dB)
30	10.01
100	10.02
200	10.10
300	10.09
400	10.13
500	10.21
600	10.13
700	10.31
800	10.18
900	10.30
1000	10.17
2000	8.53
2400*	6.51
2500*	6.54
3000	8.59
4000	10.02
5000	9.88
6000	5.70
7000	10.21
8000	6.13
9000	8.79
10000	12.46
11000	8.11
12000	9.52
13000	8.98
14000	8.13
15000	11.82
16000	6.92
17000	13.23
18000	10.25
19000	10.28
20000	9.10
21000	10.94
22000	11.54
23000	8.81
24000	11.71
25000	9.37
26000	9.34

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

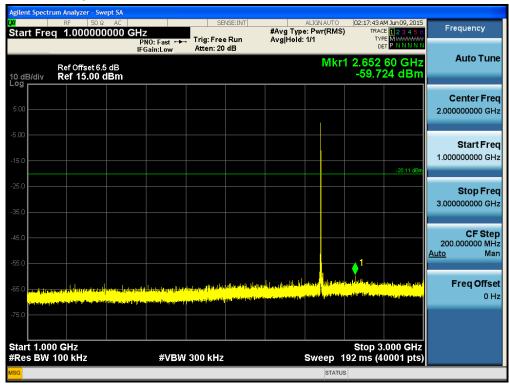
2. Factor = Cable loss + Splitter loss



Test Plots (GFSK)- 30 MHz - 1 GHz Spurious Emission (High-CH)

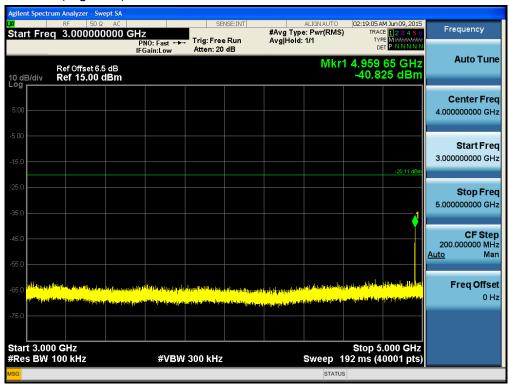


Test Plots (GFSK)-- 1 GHz – 3 GHz Spurious Emission (High-CH)





Test Plots (GFSK)-- 3 GHz - 5 GHz Spurious Emission (High-CH)



Test Plots(GFSK)-- 5 GHz - 7 GHz Spurious Emission (High-CH)

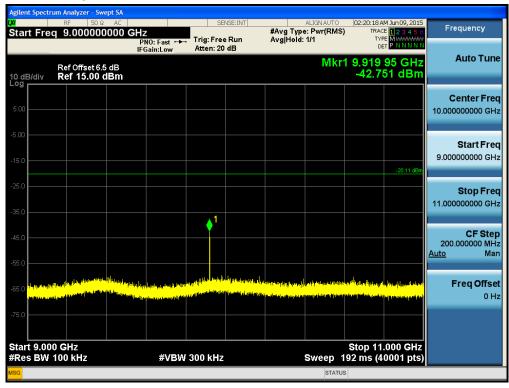
Agilen	nt Spectru											
star	t Fred	RF 1 5.00		AC	z		NSE:INT		ALIGNAUTO e: Pwr(RMS)) TRAC	M Jun 09, 2015	Frequency
					PNO: Fast ↔ FGain:Low	Trig: Free Atten: 20		Avg Hold:	1/1	TYI Di		
		Pof Of	fset 6.5		odilizon				Mkr		15 GHz	Auto Tune
10 dł Log	3/div		5.00 c							-60.6	61 dBm	
LUG												Center Freq
5.00												6.000000000 GHz
-5.00												Start Freq
-15.0												5.00000000 GHz
											-20.11 dBm	
-25.0	<u> </u>											Stop Freq
05.0												7.000000000 GHz
-35.0												
-45.0												CF Step
												200.00000 MHz <u>Auto</u> Man
-55.0						1						
-65.0	بالمعاملة ال	العنول العرد ا) na la sa	Acolatication	and the state of the	a dan dati se can	Station Balling		واردينا وقدرته أزا الأواه	فيلوا ومعتقره والراوية و	Mahanadhhanadh	Freq Offset
-05.0	la filekte finst	neer joordi	an a	plasta spor	upa makanan pikatakan kataka	a sector la sector de sector d	and the second	<mark>a de son de la </mark>	Million parameter	(and constraints)	intenting formation	0 Hz
-75.0												
	t 5.00										.000 GHz	
#Re	s BW	100 kH	z		#VBW	/ 300 kHz			Sweep 1	92 ms (4	0001 pts)	
MSG									STATU	S		



Test Plots (GFSK)-- 7 GHz - 9 GHz Spurious Emission (High-CH)

LXI	um Analyzer - Swept SA RF 50 Ω AC Q 7.0000000000 C	GHz PNO: Fast ↔→→ IFGain:Low	SENS Trig: Free R Atten: 20 dl	lun	ALIGN AUTO : Pwr(RMS) 1/1	TRAC	M Jun 09, 2015 E 1 2 3 4 5 6 E M WWWWW T P N N N N N	Frequency
10 dB/div Log	Ref Offset 6.5 dB Ref 15.00 dBm	IFGam.Low	Theen 20 an		Mkr1		95 GHz 15 dBm	Auto Tune
5.00								Center Freq 8.00000000 GHz
-5.00							-20.11 dBm	Start Freq 7.000000000 GHz
-25.0	1							Stop Freq 9.000000000 GHz
-45.0								CF Step 200.000000 MHz <u>Auto</u> Man
-33.0 -65.0 <mark>-114/-41</mark> 4 -65.0 -	and the state of the	spansformet Holdsstein formali name and the spirit of a large	ing the state of the part		alalah dari dalaman ^{New J} aciman dari dari dari dari dari dari dari dari		hyhilige synthia Mariaethymiae	Freq Offset 0 Hz
-75.0	0 GHz					Stop 9	.000 GHz	
#Res BW ^{MSG}	100 kHz	#VBW	300 kHz		Sweep 19 STATUS	92 ms (4	0001 pts)	

Test Plots (GFSK)- 9 GHz - 11 GHz Spurious Emission (High-CH)





Test Plots (GFSK)-11 GHz - 13 GHz Spurious Emission (High-CH)

	RF 50 Ω	AC		SEI	NSE:INT		ALIGN AUTO	02:20:40 A	M Jun 09, 2015	_
tart Fre	q 11.00000		Hz PNO: Fast ↔ FGain:Low	Trig: Free Atten: 20		#Avg Typ Avg Hold:	e: Pwr(RMS) 1/1	TYP	E 1 2 3 4 5 6 E MWWWWW T P N N N N N	Frequency
) dB/div	Ref Offset 6.5 Ref 15.00 d	dB Bm					Mkr1	12.613 -57.4	70 GHz 28 dBm	Auto Tun
.00										Center Fre 12.000000000 GH
5.0									-20.11 dBm	Start Fre 11.000000000 GH
5.0										Stop Fre 13.000000000 G⊦
5.0								<u>1</u>		CF Ste 200.000000 MH <u>Auto</u> Ma
5.0 5.0 <mark>- 1949-0</mark>	a construction of the state					a para di si di subbata Ngana na mangana pa	l <mark>e ang sa </mark>	lihatsika dun du mentaikap operatu		Freq Offse 0 H
5.0										
tart 11.0 Res BW	00 GHz 100 kHz		#VBW	300 kHz			Sweep 1		.000 GHz 0001 pts)	

Test Plots (GFSK)-- 13 GHz – 15 GHz Spurious Emission (High-CH)

Agiler	nt Spectru	m Analyzer - S									
sta	rt Fred	RF 50	Ω AC	Hz		NSE:INT		ALIGNAUTO : Pwr(RMS) TRAC	M Jun 09, 2015	Frequency
		Ref Offset 6		PNO: Fast ↔ Gain:Low	Trig: Free Atten: 20		Avg Hold:		DI 14.881	15 GHz	Auto Tune
10 dl Log	B/div	Ref 15.00							-54.3	78 dBm	
5.00											Center Freq 14.000000000 GHz
-5.00											Start Freq 13.000000000 GHz
-25.0										-20.11 dBm	Stop Freq
-35.0 -45.0											CF Step
-55.0				. Juliu patentit	Martin and		وروان المراجع المراجع المراجع	atta sasta a tr.a	an watatata da da kababara		200.000000 MHz <u>Auto</u> Man
-65.0	delan bis hiteri	gelitika Terring Materialian Terring Materialian		n in <u>statestings Justa a Walte</u> n	ر بند <u>و معروف (المحمد و معروف) المحمد و معروف (المحمد و معروف) المحمد و معروف (المحمد و معروف) المحمد و</u>					iya (bilin) ka antifatar	Freq Offset 0 Hz
Star	t 13.00	00 GHz							Stop 15	.000 GHz	
#Re ^{MSG}	s BW ′	00 kHz		#VBN	300 kHz			Sweep 1		0001 pts)	



Test Plots (GFSK)--- 15 GHz - 17 GHz Spurious Emission (High-CH)

		AC AC		SEI	VSE:INT		ALIGN AUTO		M Jun 09, 2015	Frequency
tart Fre	q 15.0000		HZ PNO: Fast ↔ Gain:Low	. Trig: Free Atten: 20		#Avg Typ Avg Hold:	e: Pwr(RMS) : 1/1	TYF	E 1 2 3 4 5 6 E MWWWWWW T P N N N N N	
) dB/div	Ref Offset 6. Ref 15.00						Mkr1	16.715 -54.74	05 GHz 46 dBm	Auto Tun
5.00 										Center Fre 16.000000000 GH
5.0									-20.11 dBm	Start Fre 15.000000000 GH
5.0										Stop Fre 17.000000000 GH
5.0								↓ ¹		CF Ste 200.000000 M⊢ <u>Auto</u> Ma
5.0 0-0-0 5.0	ali ang Alilla kalendan ani bas ng mbanan ang Alilan ng Ang	a discrete to	na a tradicitativa da financia Na antica patrici da finanti			an kura balabalika Ingenation seria dalah			hand ala in the provident The monotone alarmatic	FreqOffse
5.0										
art 15.0	00 GHz 100 kHz		#VBW	300 kHz			Sweep 1		.000 GHz	

Test Plots (GFSK)-- 17 GHz - 19 GHz Spurious Emission (High-CH)

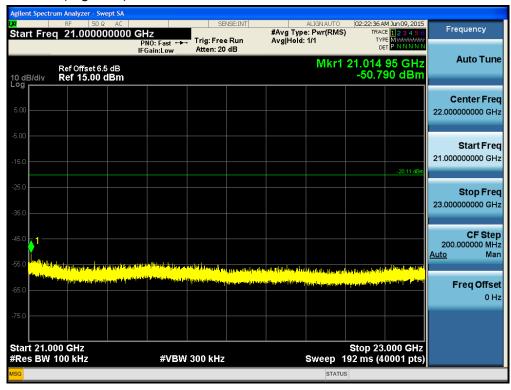
Agiler	nt Spectru	ım Analyzer - Sv									
<mark>IXI</mark>			AC AC		SEI	VSE:INT	#Aug Typ	ALIGNAUTO e: Pwr(RMS)		M Jun 09, 2015	Frequency
Sta	π Fred	ן 17.0000 17.0000	F	TZ 'NO: Fast ↔ Gain:Low	- Trig: Free Atten: 20		Avg Hold:		TYE		
10 di Log	B/div	Ref Offset 6 Ref 15.00						Mkr1	18.958 -56.4	50 GHz 55 dBm	Auto Tune
5.00											Center Freq 18.00000000 GHz
-5.00 -15.0										-20.11 dBm	Start Freq 17.000000000 GHz
-25.0 -35.0											Stop Freq 19.000000000 GHz
-45.0											CF Step 200.000000 MHz <u>Auto</u> Man
-55.0 -65.0	a si ka Musik Tara sa si ka si	tinda balasin (da _{baran}) ^{Ing} alari inggang _{dabaran}	Nebaalaa ka kapaala ^{ka k} asa _{ne} menera kat	a lagit (ping salatan ayan salan dari man	il (destation of the second	genedalistic di pice distanti patri pice		and a standard and a standard a s			Freq Offset 0 Hz
-75.0											
		00 GHz 100 kHz		#VBW	/ 300 kHz			Sweep 1	Stop 19 92 ms (4	.000 GHz 0001 pts)	
MSG								STATUS	5		



Test Plots (GFSK)-- 19 GHz - 21 GHz Spurious Emission (High-CH)

Agilent	t Spectru	ım Analyzer	- Swept SA								
XI		RF	50Ω AC			SENSE:INT		ALIGN AUTO		4 Jun 09, 2015	-
Star	t Frec	19.00	0000000) GHz PNO: Fas IFGain:Lo		: Free Run en: 20 dB	#Avg Tyj Avg Hold	be: Pwr(RMS) 1: 1/1) TRACI TYP DE	123456 MWWWWW PNNNNN	Frequency
10 dB _0g r	3/div	Ref Offse Ref 15.	et 6.5 dB 00 dBm					Mkr1	20.970 -52.28	30 GHz 32 dBm	Auto Tune
5.00											Center Free 20.000000000 GH
5.00 15.0										-20.11 dBm	Start Free 19.000000000 GH
25.0 - 35.0 -											Stop Fre 21.000000000 GH
45.0 55.0										1	CF Ste 200.000000 MH <u>Auto</u> Ma
1	institution assistanti	alla ana ang ang ang ang ang ang ang ang an	n an the second s	ndal of the distribution water population distribution	dis players in districts patronomic log para pub	Difter (Die Ander ^{Di} fter ^{Die} Natur (der Geschachter) ^{en .}	an a	n a geographic an ann an Anna a Anna an Anna an	<mark>. soluti stanta rapia</mark> .	and an	Freq Offse
75.0											
		00 GHz 100 kHz		#\	VBW 300	kHz		Sweep 1	Stop 21. 192 ms (41		
SG								STATU	s		

Test Plots (GFSK)-- 21 GHz - 23 GHz Spurious Emission (High-CH)





Model: KBB-700

Test Plots(GFSK)- 23 GHz - 25 GHz Spurious Emission(High-CH)

<mark>u</mark>	RF 50 Ω A		SEN	VSE:INT		ALIGN AUTO		M Jun 09, 2015	Frequency
Start Fre	q 23.0000000	00 GHz PNO: Fast ↔ IFGain:Low	. Trig: Free Atten: 20		#Avg Type Avg Hold:	e: Pwr(RMS) 1/1	TYP	E 123456 E MWWWWW T P N N N N N	
0 dB/div	Ref Offset 6.5 dB Ref 15.00 dBn					Mkr1	24.944 -49.84	70 GHz 45 dBm	Auto Tune
5.00									Center Fred 24.000000000 GHz
15.0								-20.11 dBm	Start Fred 23.000000000 GH;
25.0 <u> </u>									Stop Fred 25.000000000 GH;
45.0	The public of the state of the	photo publication and a start of a start of a start of a start of the	_{Boord} o Iss _{in} to Middle by P	ul dimme a da t	u salas kasta tila salas	a halbestarren fignadio.	n fillen bene beforen	1	CF Stej 200.000000 MH <u>Auto</u> Ma
65.0	Josef and Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio Antonio	An a china a fellari pate parti da	n algegelen om Ministry giver	ala internation and a state	h har a sund children and a	Alliand Room (Source) .	^{ind} aks pologijos, iks birgilijo osa.	a para di kaci da da kati kati kati kati kati kati kati kat	Freq Offse 0 H
75.0									
tart 23.0 Res BW	00 GHz 100 kHz	#VBV	/ 300 kHz			Sweep_1	Stop 25 92 ms <u>(</u> 4	.000 GHz 0001 pts)	



8.6.2 RADIATED SPURIOUS EMISSIONS

LIMIT : §15.205, §15.209

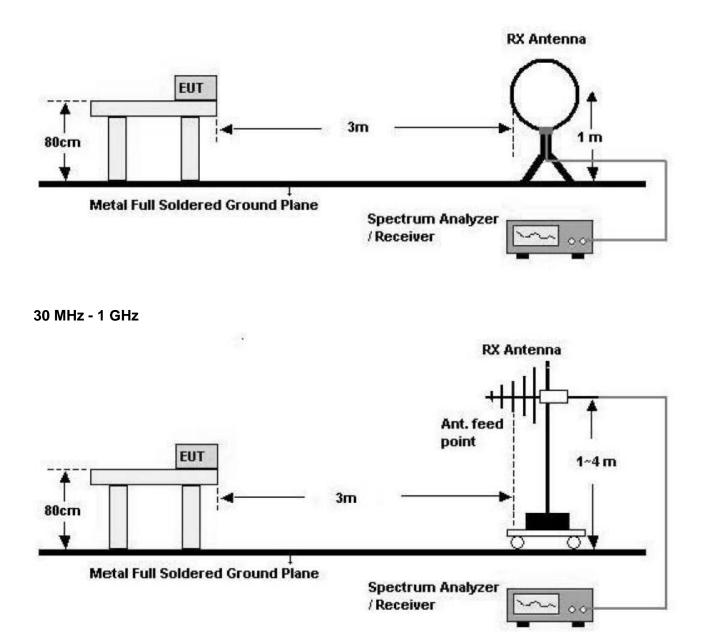
1. 20dBc in any 100kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

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

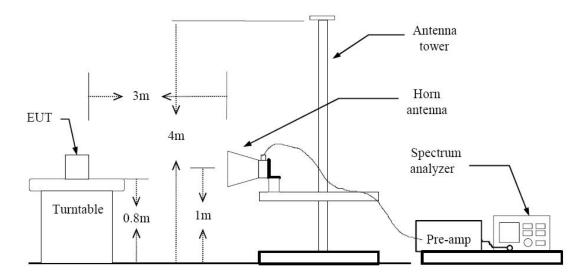
Below 30 MHz





Model: KBB-700

Above 1 GHz



TEST PROCEDURE

- 1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
- 2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
- 4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 6. Repeat above procedures until the measurements for all frequencies are complete.
- 7. Spectrum Setting
 - a. Peak: 1 GHz 25 GHz, RBW = 1 MHz, VBW ≥3*RBW
 - b. Average: 1 GHz 25 GHz, RBW = 1 MHz, VBW \geq 1/T Hz, where T = pulse width in seconds.



TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin	
MHz	dBμN	dB /m	dB	(H/V)	dBµN/m	dBµN/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. This test is performed with hopping off.
- 6. 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	dBμN	dB /m	dB	(H/V)	dBµN/m	dBµN/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. This test is performed with hopping off.
- 4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



Model: KBB-700

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Above 1 GHz

Operation Mode: CH Low(GFSK)

Frequency	Reading	* A.F+CL-AMP GAIN	ANT. POL	Total	Limit	Margin	Measurement
[MHz]	DBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре
4804	52.43	-2.16	V	50.27	73.98	23.71	PK
4804	44.39	-2.16	V	42.23	53.98	11.75	AV
7206	48.16	7.31	V	55.47	73.98	18.51	PK
7206	36.26	7.31	V	43.57	53.98	10.41	AV
4804	51.66	-2.16	Н	49.50	73.98	24.48	PK
4804	42.83	-2.16	н	40.67	53.98	13.31	AV
7206	46.82	7.31	Н	54.13	73.98	19.85	PK
7206	33.06	7.31	Н	40.37	53.98	13.61	AV

* A·F: ANTENNA FACTOR

C·L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

- 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.
- 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
- 5. Spectrum setting:
 - a. Peak: 1 GHz 25 GHz, RBW = 1 MHz, VBW ≥3*RBW
 - b. Average: 1 GHz 25 GHz, RBW = 1 MHz, VBW \ge 1/T Hz, where T = pulse width in seconds. We performed using a reduced video BW method was done with the analyzer in linear mode.
- 6. FYI : Duty Cycle Correction Factor (79 channel hopping)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H '=1
 - c. Worst Case Dwell Time = T [ms] x H ' = 2.900 ms
 - d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
- 7. Duty Cycle Correction Factor(AFH mode minimum channel number case 20 channels)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H' = 2



- c. Worst Case Dwell Time = τ [ms] x H ' = 5.800 ms
- d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
- e. We applied DCCF in the test result which hopping channel number is 20.
- 8. We have done Normal Mode and EDR Mode test.
- 9. This test is performed with hopping off.

10. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



÷.										
	Frequency	Reading	* A.F+CL-AMP GAIN	ANT. POL	Total	Limit	Margin	Measurement		
	[MHz]	DBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре		
	4882	54.28	-1.95	V	52.33	73.98	21.65	PK		
	4882	46.74	-1.95	V	44.79	53.98	9.19	AV		
	7323	47.04	7.34	V	54.38	73.98	19.60	PK		
	7323	34.03	7.34	V	41.37	53.98	12.61	AV		
	4882	53.15	-1.95	Н	51.20	73.98	22.78	PK		
	4882	44.47	-1.95	н	42.52	53.98	11.46	AV		
	7323	46.54	7.34	Н	53.88	73.98	20.10	PK		
	7323	33.43	7.34	Н	40.77	53.98	13.21	AV		

Operation Mode: CH Mid(GFSK)

* A·F: ANTENNA FACTOR

C·L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

- 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.
- 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
- 5. Spectrum setting:
 - a. Peak: 1 GHz 25 GHz, RBW = 1 MHz, VBW ≥3*RBW
 - b. Average: 1 GHz 25 GHz, RBW = 1 MHz, VBW \geq 1/T Hz, where T = pulse width in seconds. We performed using a reduced video BW method was done with the analyzer in linear mode.
- 6. FYI : Duty Cycle Correction Factor (79 channel hopping)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H '=1
 - c. Worst Case Dwell Time = T [ms] x H ' = 2.900 ms
 - d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
- 7. Duty Cycle Correction Factor(AFH mode minimum channel number case 20 channels)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H' = 2
 - c. Worst Case Dwell Time = τ [ms] x H ' = 5.800 ms
 - d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB



- e. We applied DCCF in the test result which hopping channel number is 20.
- 8. We have done Normal Mode and EDR Mode test.
- 9. This test is performed with hopping off.
- 10. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



· '.									
	Frequency	Reading	* A.F+CL-AMP GAIN	ANT. POL	Total	Limit	Margin	Measurement	
	[MHz]	DBuV	[dB]	[H/V]	[dBuV/m]	[dBuV/m]	[dB]	Туре	
	4960	54.55	-1.84	V	52.71	73.98	21.27	PK	
	4960	47.97	-1.84	V	46.13	53.98	7.85	AV	
	7440	47.18	7.13	V	54.31	73.98	19.67	PK	
	7440	33.78	7.13	V	40.91	53.98	13.07	AV	
	4960	53.46	-1.84	Н	51.62	73.98	22.36	PK	
	4960	46.54	-1.84	н	44.70	53.98	9.28	AV	
	7440	46.52	7.13	Н	53.65	73.98	20.33	PK	
	7440	35.26	7.13	Н	42.39	53.98	11.59	AV	

Operation Mode: CH High(GFSK)

* A·F: ANTENNA FACTOR

C·L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

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.
- 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
- 5. Spectrum setting:
 - a. Peak: 1 GHz 25 GHz, RBW = 1 MHz, VBW ≥3*RBW
 - b. Average: 1 GHz 25 GHz, RBW = 1 MHz, VBW \geq 1/T Hz, where T = pulse width in seconds.

We performed using a reduced video BW method was done with the analyzer in linear mode.

- 6. FYI : Duty Cycle Correction Factor (79 channel hopping)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H '=1
 - c. Worst Case Dwell Time = T [ms] x H ' = 2.900 ms
 - d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
- 7. Duty Cycle Correction Factor(AFH mode minimum channel number case 20 channels)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H' = 2
 - c. Worst Case Dwell Time = τ [ms] x H ' = 5.800 ms
 - d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
 - e. We applied DCCF in the test result which hopping channel number is 20.



- 8. We have done Normal Mode and EDR Mode test.
- 9. This test is performed with hopping off.
- 10. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



8.6.3 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 Normal(GFSK)

2402 MHz, 2480 MHz CH 0, CH 78

Frequency	Reading	* A.F.+CL	Ant. Pol.	Duty Cycle Correction	Total	Limit	Margin	Measurement
[MHz]	dBuV	[dB]	[H/V]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	Туре
2390.0	25.44	31.47	Н	0	56.91	73.98	17.07	PK
2390.0	12.23	31.47	Н	-24.73	18.96	53.98	35.02	AV
2390.0	24.98	31.47	V	0	56.45	73.98	17.53	PK
2390.0	12.19	31.47	V	-24.73	18.92	53.98	35.06	AV
2483.5	27.39	31.46	Н	0	58.85	73.98	15.13	PK
2483.5	22.46	31.46	Н	-24.73	29.19	53.98	24.79	AV
2483.5	25.73	31.46	V	0	57.19	73.98	16.79	PK
2483.5	18.74	31.46	V	-24.73	25.47	53.98	28.51	AV

* A·F: ANTENNA FACTOR

C·L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

Notes:

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

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

3. Spectrum setting:

a. Peak: 1 GHz – 25 GHz, RBW = 1 MHz, VBW ≥3*RBW

b. Average: 1 GHz – 25 GHz, RBW = 1 MHz, VBW \geq 1/T Hz, where T = pulse width in seconds.

We performed using a reduced video BW method was done with the analyzer in linear mode.



- 4. FYI : Duty Cycle Correction Factor (79 channel hopping)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 79 channels = 229.100 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H'=1
 - c. Worst Case Dwell Time = T [ms] x H ' = 2.900 ms
 - d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100ms) dB = -30.752 dB
- 5. Duty Cycle Correction Factor(AFH mode minimum channel number case 20 channels)
 - a. Time to cycle through all channels= Δ t= τ [ms] x 20 channels = 58.00 ms, where τ = pulse width
 - b. 100 ms/ Δt [ms] = $H \rightarrow$ Round up to next highest integer, H' = 2
 - c. Worst Case Dwell Time = τ [ms] x H ' = 5.800 ms
 - d. Duty Cycle Correction(AFH) = 20log (Worst Case Dwell Time/ 100ms) dB = -24.7314 dB
 - e. We applied DCCF in the test result which hopping channel number is 20.
- 6. We have done Normal Mode, EDR Mode.
- 7. This test is performed with hopping off.
- 8. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.



8.7 POWERLINE CONDUCTED EMISSIONS

LIMIT

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 microvolt (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.

Note: We don't perform powerline conducted emission test. Because this EUT is DC voltage.



9. LIST OF TEST EQUIPMENT

9.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration	Serial No.
				100070
Rohde & Schwarz	ENV216/ LISN	01/13/2015	Annual	100073
Agilent	E4440A/ Spectrum Analyzer	03/18/2015	Annual	US45303008
Agilent	N9020A/ SIGNAL ANALYZER	04/29/2015	Annual	MY51110063
Agilent	N1911A/Power Meter	01/15/2015	Annual	MY45100523
Agilent	N1921A /POWER SENSOR	07/09/2014	Annual	MY45241059
Agilent	87300B/Directional Coupler	12/08/2014	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	04/30/2015	Annual	11275
ITECH	IT6720 / DC POWER SUPPLY	11/04/2014	Annual	010002156287001199
Rohde & Schwarz	CBT / BLUETOOTH TESTER	03/13/2015	Annual	100808
Agilent	8493C / Attenuator(10 dB)	07/21/2014	Annual	76649



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
Rohde & Schwarz	SCU-18/ Signal Conditioning Unit	09/04/2014	Annual	10094
CERNEX	CBL18265035 / POWER AMP	07/23/2014	Annual	22966
Schwarzbeck	BBHA 9120D/ Horn Antenna	07/05/2013	Biennial	1151
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	07/05/2013	Biennial	BBHA9170541
Rohde & Schwarz	FSP / Spectrum Analyzer	10/23/2014	Annual	836650/016
Wainwright Instrument	WHF3.0/18G-10EF / High Pass Filter	06/23/2014	Annual	8
Wainwright Instrument	WRCJ2400/2483.5-2370/2520-60/14SS / Band Reject Filter	06/23/2014	Annual	2
Rohde & Schwarz	CBT / BLUETOOTH TESTER	03/13/2015	Annual	100808
Rohde & Schwarz	LOOP ANTENNA	09/03/2014	Biennial	1513-175
CERNEX	CBL06185030 / POWER AMP	07/21/2014	Annual	22965
CERNEX	CBLU1183540 / POWER AMP	07/21/2014	Annual	22964