TEST REPORT

of

FCC Part 15 Subpart B&C §15.247/RSS-210 Issue 7, RSS-Gen Issue 2

FCC ID/IC Certification: A3LSBH650/649E-SBH650

Equipment Under Test	:	Bluetooth Stereo Headset
Model Name	:	SBH650
Serial No.	:	N/A
Applicant	:	SAMSUNG ELECTRONICS CO.,LTD.
Manufacturer	:	SAMSUNG ELECTRONICS CO.,LTD.
Date of Test(s)	:	2008-04-10 ~ 2008-04-18
Date of Issue	:	2008-04-22

In the configuration tested, the EUT complied with the standards specified above.

Tested By: **Date** **2008-04-22**

Feel Jeong

Approved By **Date** **2008-04-22**

Denny Ham

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1. General Information

1.1. Testing Laboratory

SGS Testing Korea Co., Ltd.
-Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040
- 705, Dongchun-Dong Sooji-Gu, Yongin-Shi, Kyungki-Do, South Korea.
www.electrolab.kr.sgs.com
Telephone : +82 +31 428 5700
FAX : +82 +31 427 2371

1.2. Details of Applicant

Applicant : SAMSUNG ELECTRONICS CO.,LTD.
Address : 416, Maetan-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
Contact Person : Jung-Heon, Yoo
Phone No. : 82-31-301-4179
Fax No. : 82-31-301-5998

1.3. Description of EUT

Kind of Product	Bluetooth Stereo Headset
Model Name	SBH650
Serial Number	N/A
Power Supply	DC 3.7 V
Frequency Range	2402 ~ 2480 MHz
Modulation Technique	GFSK
Number of Channels	79
Operating Conditions	-20 ℃ ~ 50 ℃
H/W Version	Rev 1.0
S/W Version	SBH650-SW01
Antenna Type	Chip Type
Antenna Gain	3.11 dBi

* The field strength of spurious emission was measured in three orthogonal EUT positions (X-axis, Y-axis and Z-axis). Worst case is Z-axis

1.4. Details of modification

N/A

1.5. Information about the FHSS characteristics:

1.5.1. Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1600 hops/s.

1.5.2. Equal Hopping Frequency Use

All Bluetooth units participating in the piconet are time and hop-synchronized to the channel.

1.5.3. System Receiver Input Bandwidth

Each channel bandwidth is 1 MHz

1.6. Test Equipment List

EQUIPMENT	MANUFACTURER	MODEL	CAL DUE.
Signal Generator	Agilent	E4438C	May 11 2008
Spectrum Analyzer	Agilent	8565E	Dec. 31 2008
Bluetooth Tester	TESOM	TC-3000B	Dec. 11 2008
Two-Line V-Network	Rohde & Schwarz	ENV216	Jan. 17 2009
Test Receiver	Rohde & Schwarz	ESVS10	Mar. 21 2009
Test Receiver	Rohde & Schwarz	ESHS10	Sep. 04 2008
Ultra-Broadband Antenna	Rohde & Schwarz	HL562	Oct. 02 2009
High Pass Filter	Wainwright Instrument GmbH	WHK3.0/18G-11SS	Dec. 06 2008
Preamplifier	Agilent	8449B	May 11 2008
Horn Antenna	Rohde & Schwarz	HF906	Nov. 13 2009
Anechoic Chamber	SY Corporation	L x W x H 6.5m x 3.5m x 3.5m	Feb. 15 2009

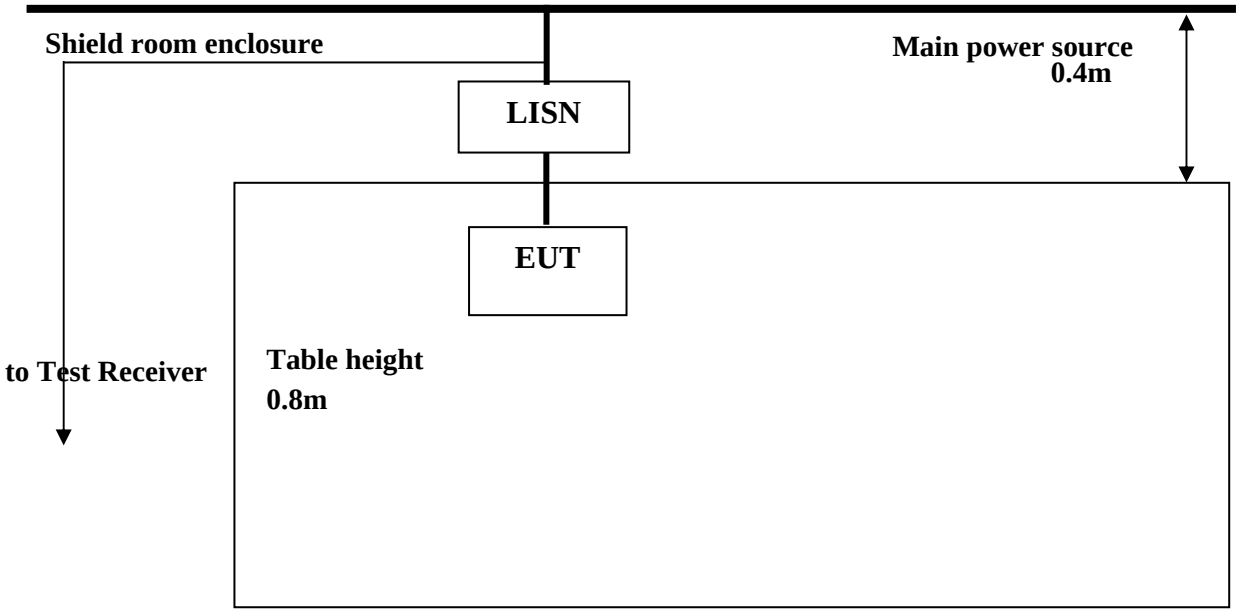
1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15, RSS-210,RSS-Gen			
Section in FCC 15	**Section in RSS-210 RSS-Gen**	**Test Item**	**Result**
15.207	RSS-Gen 7.2.2	Transmitter AC Power Line Conducted Emission	Complied
15.107	RSS-Gen 7.2.2	Receiver AC Power Line Conducted Emission	Complied
15.205(a) 15.209 15.247(d)	A8.5	Transmitter Radiated Spurious Emissions Conducted Spurious Emission	Complied
15.109(a)	RSS-Gen 6	Receiver Radiated Spurious Emission	Complied
15.247(a)(1)	A8.1(1)	20 dB Bandwidth and 99% BW	Complied
15.247(b)(1)	A8.4(2)	Maximum Peak Output Power	Complied
15.247(a)(1)	A8.1(2)	Frequency Separation	Complied
15.247(a)(1)(iii)	A8.1(4)	Number of Hopping Frequency	Complied
15.247(a)(1)(iii)	A8.1(4)	Time of Occupancy (Dwell Time)	Complied
15.247(f)	A8.3(2)	Power Spectral Density	Complied
15.247(i) 1.1307(b)(1)	RSS-Gen 5.5/ RSS-102	Maximum Permissible Exposure (Exposure of Humans to RF Fields)	Complied

2. Transmitter AC Power Line Conducted Emission

2.1. Test Setup



2.2. Limit

According to §15.207(a) for an intentional radiator that 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 the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.50	66-56*	56-46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

* Decreases with the logarithm of the frequency.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

1. The test procedure is performed in a 6.5m × 3.6m× 3.6m (L×W×H) shielded room. The EUT along with its peripherals were placed on a 1.0m(W)× 1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

2.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

Ambient temperature : 21 ℃ Relative humidity : 44 %

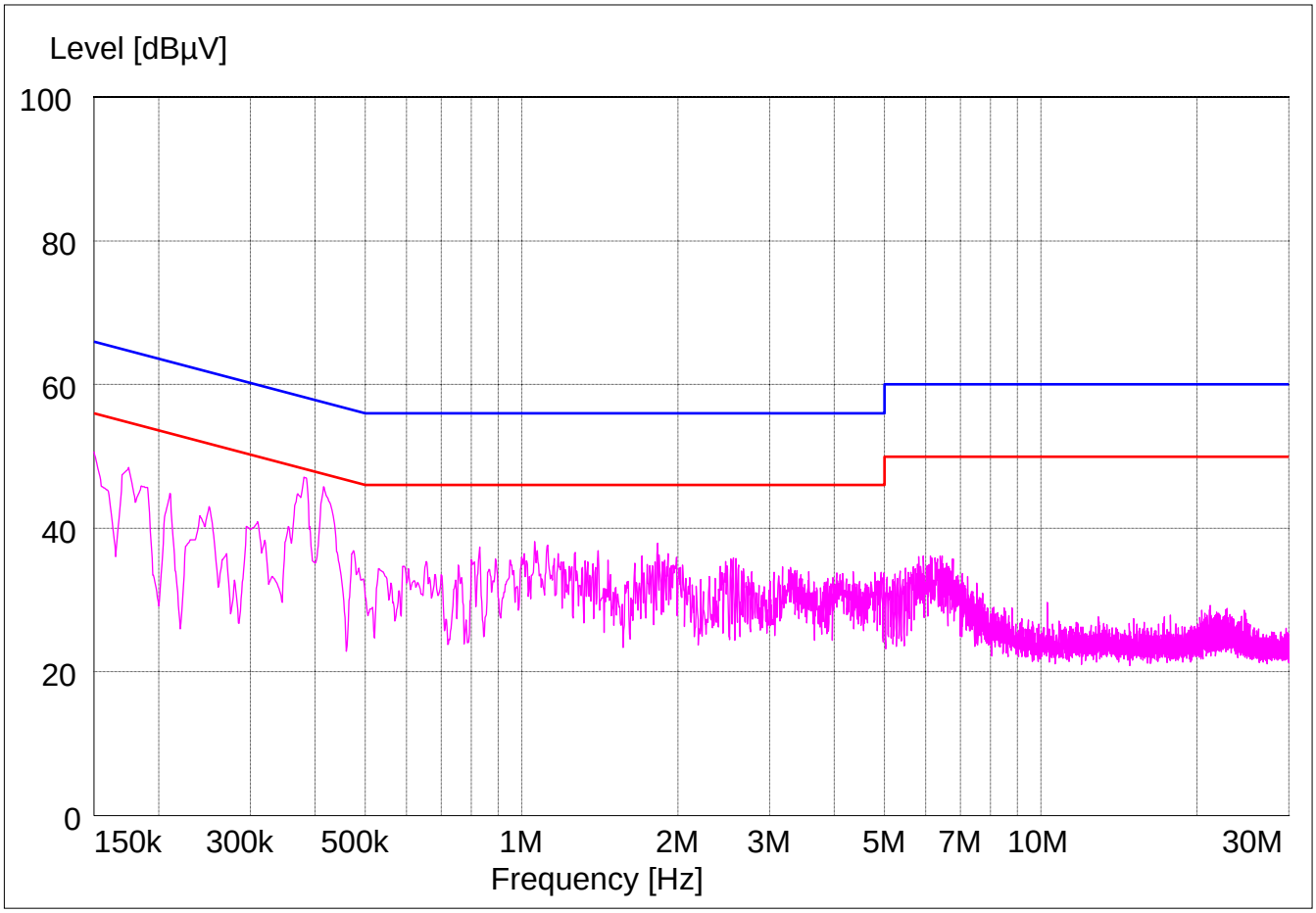
Frequency range : 0.15 MHz – 30 MHz
Measured Bandwidth : 9 kHz

FREQ.	LEVEL(dBuV)		LINE	LIMIT(dBuV)		MARGIN(dB)	
(MHz)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.15	40.20	16.30	N	66.00	56.00	25.80	39.70
0.17	38.40	24.30	N	64.96	54.96	26.56	30.66
0.38	43.50	43.20	N	58.28	48.28	14.78	5.08
1.06	31.30	21.50	N	56.00	46.00	24.70	24.50
2.55	30.20	29.60	N	56.00	46.00	25.80	16.40
5.04	28.50	20.80	N	60.00	50.00	31.50	29.20
0.15	45.30	19.80	H	66.00	56.00	20.70	36.20
0.17	42.50	18.90	H	64.96	54.96	22.46	36.06
0.38	39.00	27.40	H	58.28	48.28	19.28	20.88
1.06	29.30	17.70	H	56.00	46.00	26.70	28.30
2.55	26.20	17.90	H	56.00	46.00	29.80	28.10
5.04	25.90	17.80	H	60.00	50.00	34.10	32.20

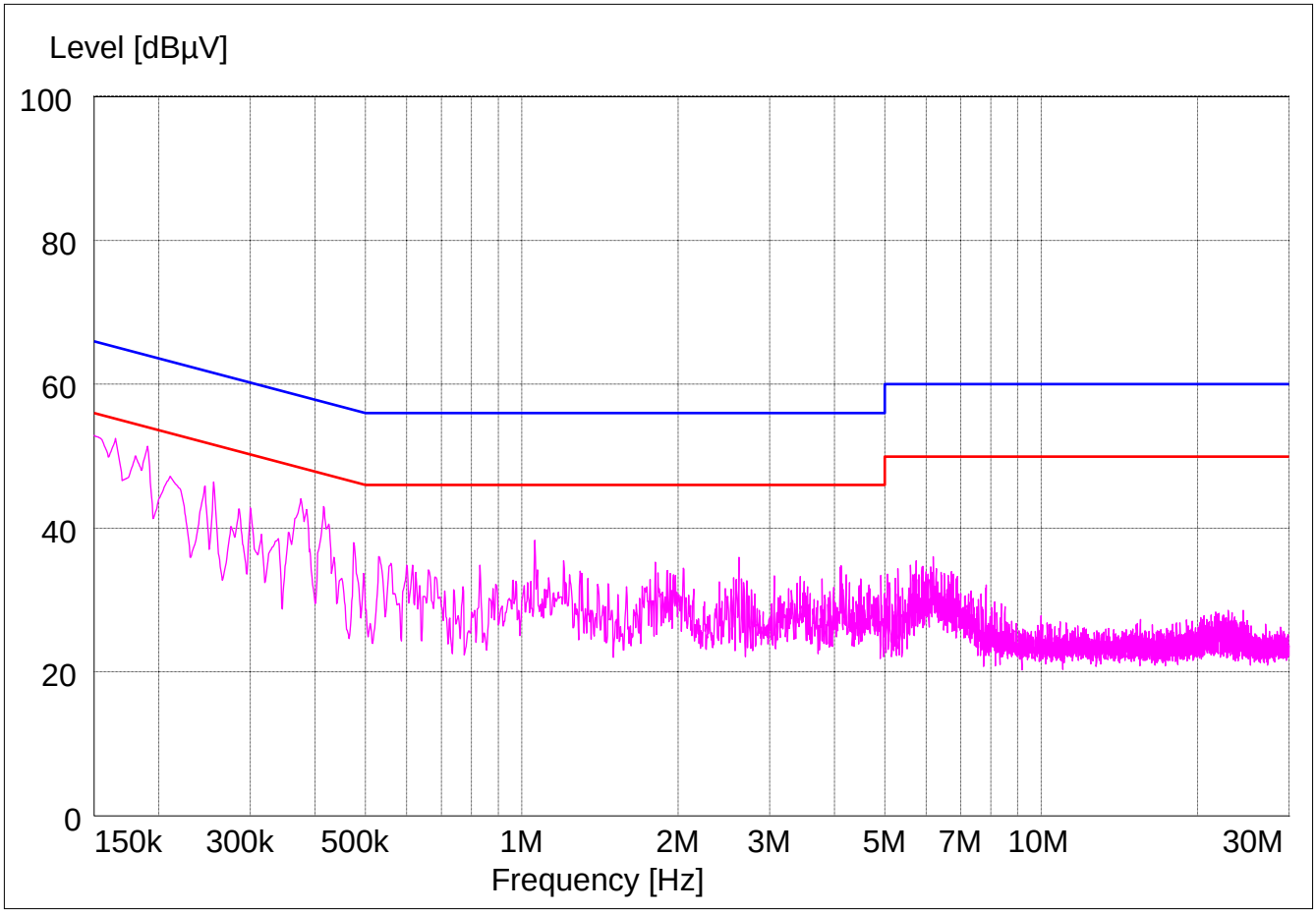
Note ;
Line (H) : Hot
Line (N) : Neutral

Plot of Conducted Power line

Test mode: (Hot)



Test mode: (Neutral)



3. Receiver AC Power Line Conducted Emission

3.1. Test Setup- Same as clause 2.1.

3.2. Limit

According to §15.107(a) Except for Class A digital devices, for equipment that 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 the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of Emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.50	66-56*	56-46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

* Decreases with the logarithm of the frequency.

3.3. Test Procedures- Same as clause 2.3.

3.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line;
Addition,
Ambient temperature : 21 ℃ Relative humidity : 44 %

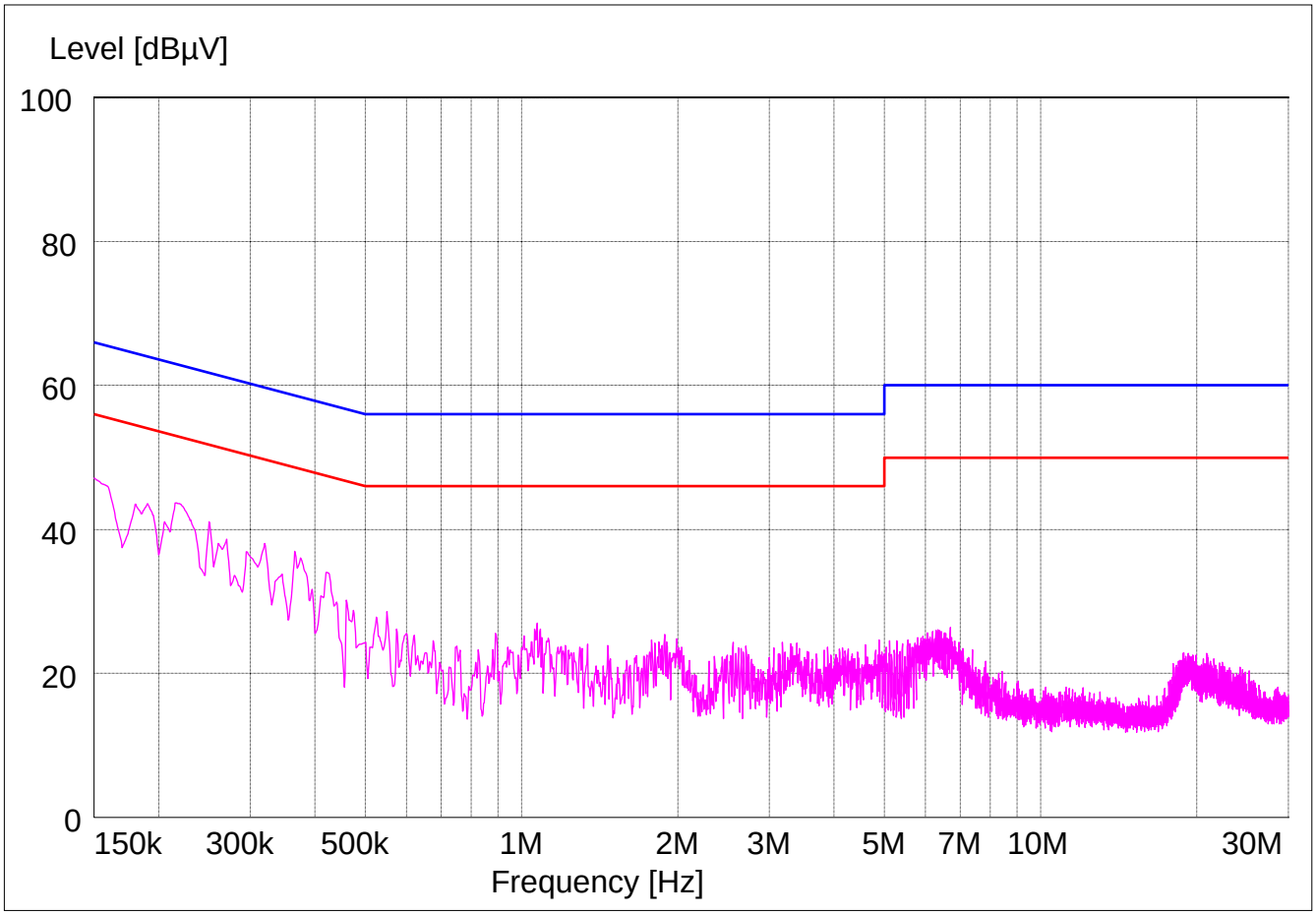
Frequency range : 0.15 MHz – 30 MHz
Measured Bandwidth : 9 kHz

FREQ.	LEVEL(dBuV)		LINE	LIMIT(dBuV)		MARGIN(dB)	
(MHz)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.15	43.20	16.20	N	66.00	56.00	22.80	39.80
0.22	35.20	11.20	N	62.82	52.82	27.62	41.62
0.37	30.20	18.50	N	58.50	48.50	28.30	30.00
0.42	27.40	15.60	N	57.45	47.45	30.05	31.85
6.32	28.90	17.50	N	60.00	50.00	31.10	32.50
19.30	20.10	11.10	N	60.00	50.00	39.90	38.90
0.15	42.50	15.60	H	66.00	56.00	23.50	40.40
0.22	36.20	10.50	H	62.82	52.82	26.62	42.32
0.37	30.80	18.50	H	58.50	48.50	27.70	30.00
0.42	28.20	16.90	H	57.45	47.45	29.25	30.55
6.32	29.30	16.50	H	60.00	50.00	30.70	33.50
19.30	19.50	10.20	H	60.00	50.00	40.50	39.80

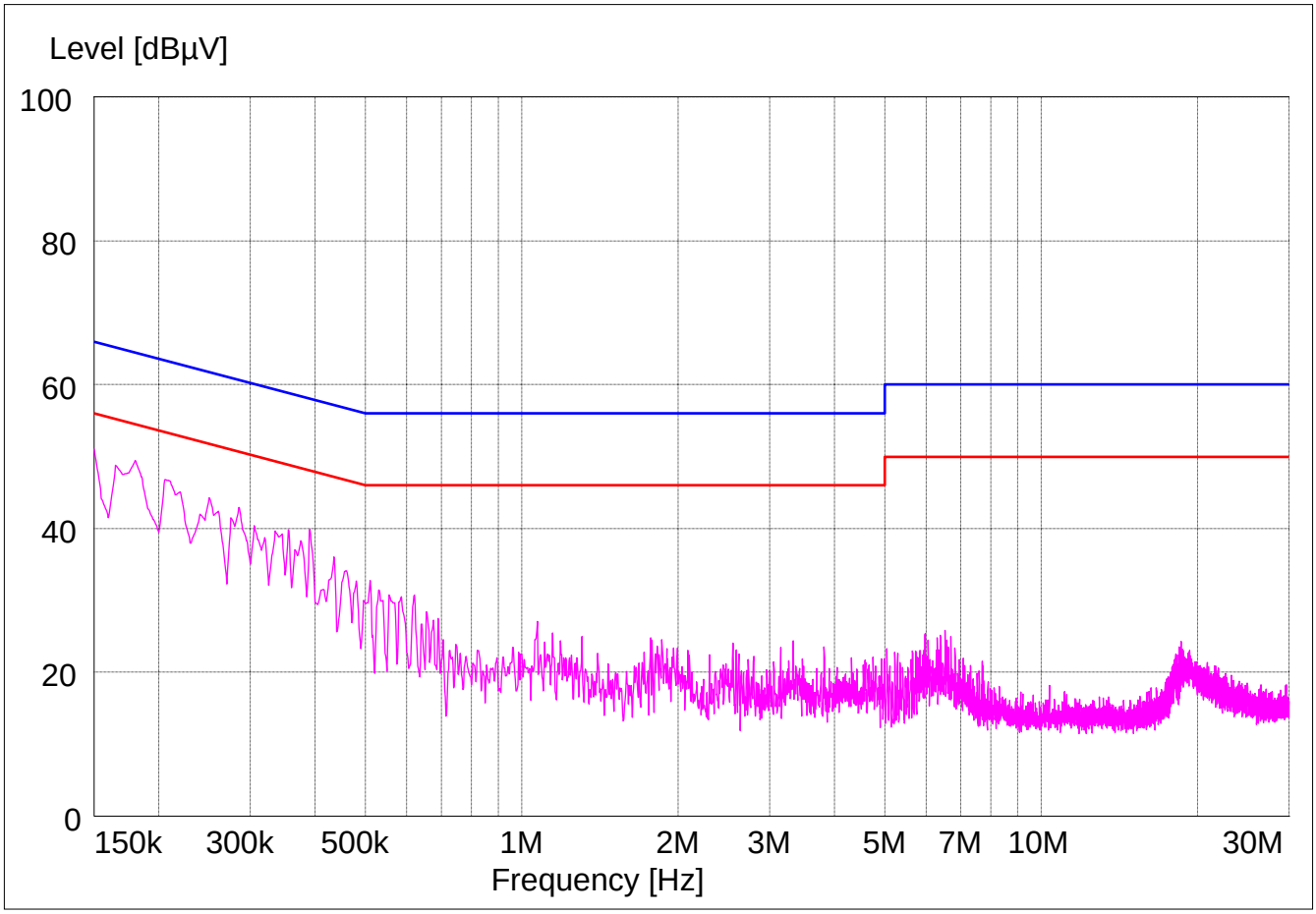
Note ;
Line (H) : Hot
Line (N) : Neutral

Plot of Conducted Power line

Test mode: (Hot)



Test mode: (Neutral)

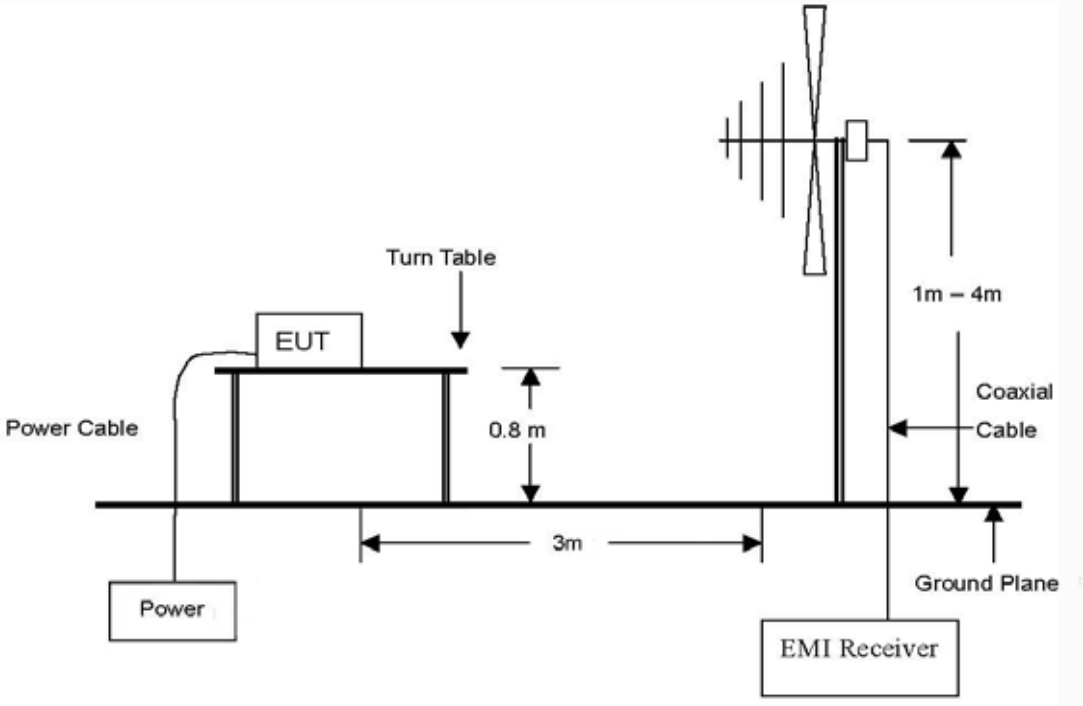


4. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

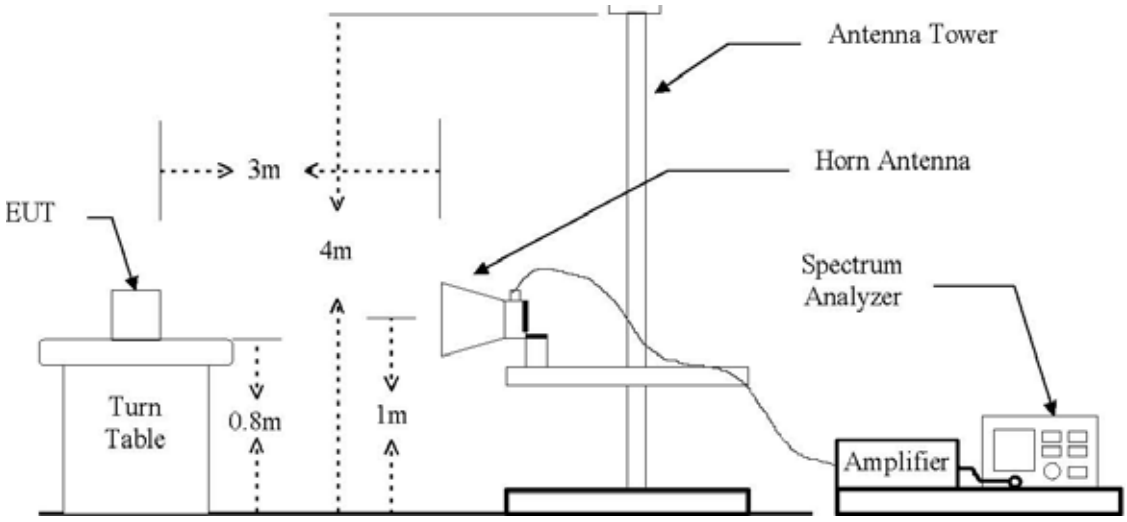
4.1. Test Setup

4.1.1. Transmitter Radiated Spurious Emissions

The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz Emissions.



4.1.2. Conducted Spurious Emissions

4.2. 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. 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 section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))
According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emission from unintentional radiators at a distance of 3 meters shall not exceed the above table.

4.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

4.3.1. Test Procedures for Radiated Spurious Emissions

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE ;

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz for Peak detection and frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

4.3.2. Test Procedures for Conducted Spurious Emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=100 kHz, VBW=100 kHz.

4.4. Test Results

Ambient temperature : 22 ℃ Relative humidity : 45 %

4.4.1. Spurious Radiated Emission

The frequency spectrum from 30 MHz to 1000 MHz was investigated. All emissions are not reported much lower than the prescribed limits. All reading values are quasi-peak values.

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
80.925	12.31	Q.P.	H	8.14	1.14	21.59	40.00	18.41
88.200	16.84	Q.P.	V	8.43	1.20	26.47	43.50	17.03
168.225	15.56	Q.P.	V	7.52	1.67	24.75	43.50	18.745
Above 170.00	Not Detected	-	-	-	-	-	-	-

Remark:

1. All spurious emission at channels are almost the same below 1 GHz, so that the channel was chosen at representative in final test.
2. "*" means the restricted band.
3. Actual = Reading + AF + CL

4.4.2. Spurious Radiated Emission

The frequency spectrum above 1000 MHz was investigated. All emissions are not reported much lower than the prescribed limits. Reading values are both peak and average values.

Operating Mode: GFSK

A. Low Channel (2402 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF (dB/m)	Amp Gain+CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2390.00*	47.63	Peak	V	28.05	-28.19	47.49	74.00	26.51
Above 2400.00	Not Detected	-	-	-	-	-	-	-

B. Middle Channel (2441 MHz)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF (dB/m)	Amp Gain+CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4882.11	49.15	Peak	V	33.17	-25.07	57.25	74.00	16.75
4882.11	34.62	Average	V	33.17	-25.07	42.72	54.00	11.28
Above 4900.00	Not Detected	-	-	-	-	-	-	-

C. High Channel (2480 MHz)

Radiated Emissions			Ant	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF (dB/m)	Amp Gain+CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.50*	59.22	Peak	V	28.18	-28.14	59.26	74.00	14.74
2483.50*	43.69	Average	V	28.18	-28.14	43.73	54.00	10.27
4960.25	50.41	Peak	V	33.39	-24.95	58.85	74.00	15.15
4960.25	36.14	Average	V	33.39	-24.95	44.58	54.00	9.42
Above 5000.00	Not Detected	-	-	-	-	-	-	-

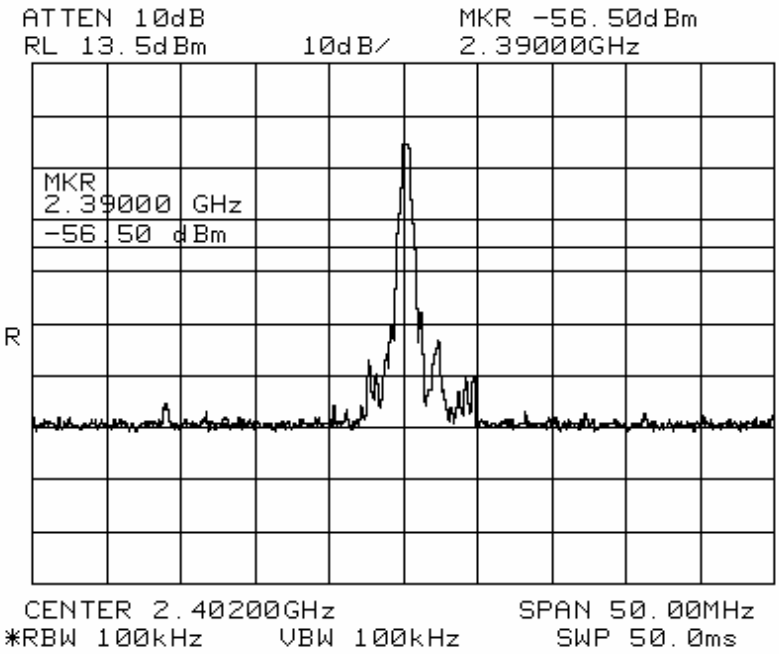
Remarks;

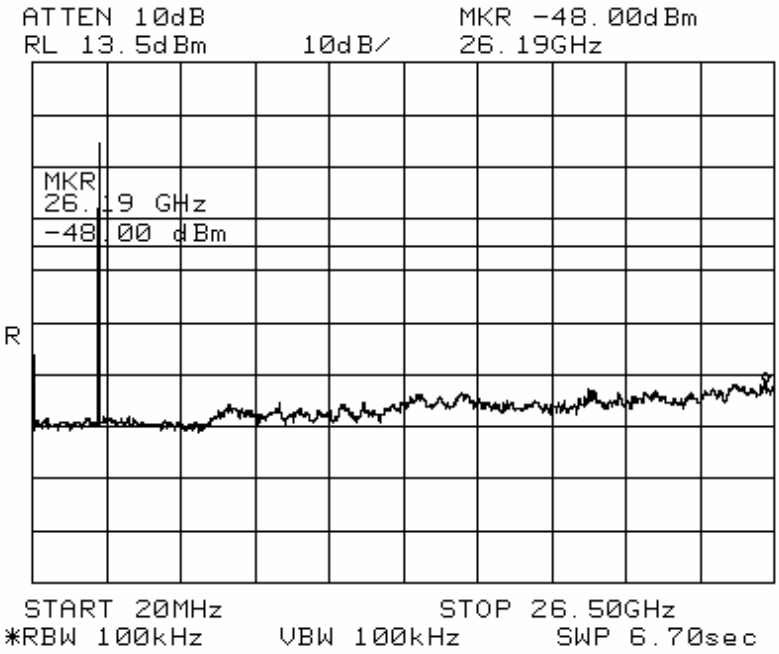
1. "*" means the restricted band.
2. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
3. Radiated emissions measured in frequency above 1000 MHz were made with an instrument using peak/average detector mode.
4. Average test would be performed if the peak result were greater than the average limit.
5. Actual = Reading + AF - Amp Gain + CL

4.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission

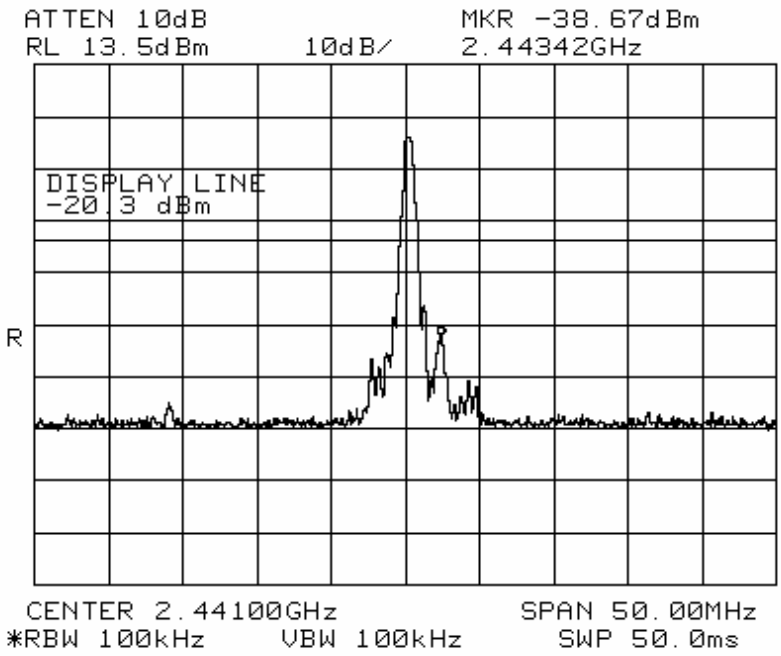
Operating Mode: GFSK

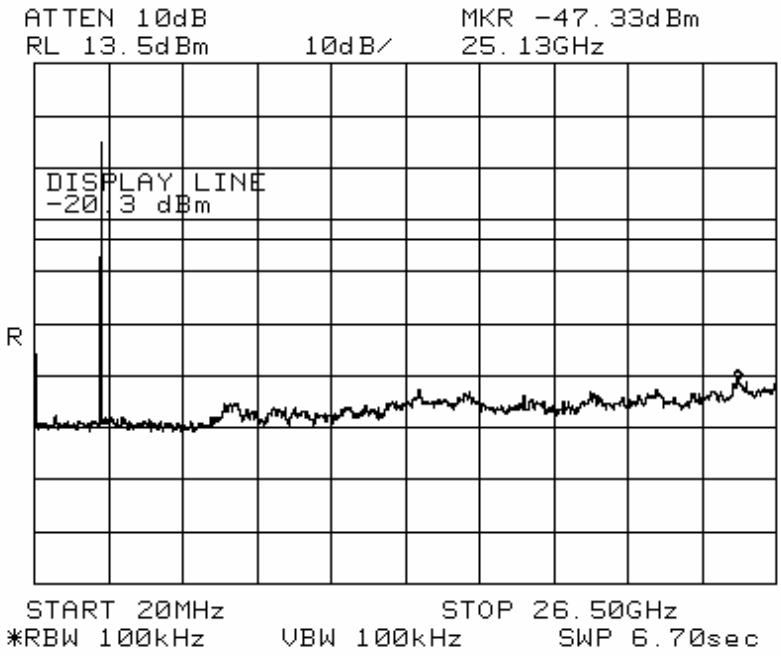
Low Channel



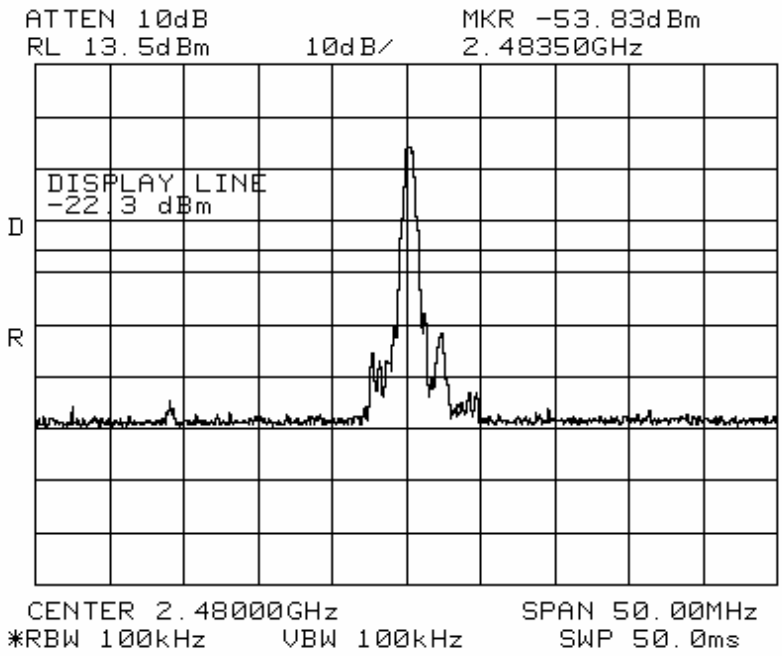


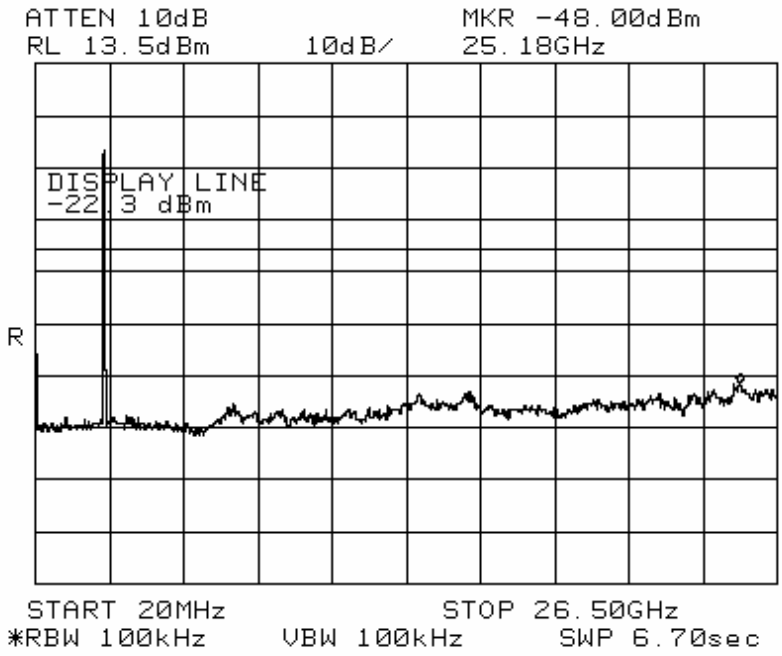
Middle Channel





High Channel





5. Receiver Radiated Spurious Emissions

5.1. Test setup - Same as clause 4.1.

5.1.1. Receiver Radiated Spurious Emissions - Same as clause 4.1.1.

5.2. Limit

According to §15.109(a), Except for Class A digital devices, the field strength of radiated emission from unintentional radiator at a distance of 3 m shall not exceed the following values:

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

5.3. Test Procedures - Same as clause 4.3.

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

5.3.1. Test Procedures for Radiated Spurious Emissions- Same as clause 4.3.1.

5.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 43 %

5.4.1. Spurious Radiated Emission

All emissions are not reported much lower than the prescribed limits. All reading values are quasi-peak values.

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dBuV/m)	Limit (dBuV/m)	Margin (dB)
71.225	18.18	Q.P.	V	6.78	1.07	26.03	40.00	13.97
90.625	15.72	Q.P.	V	8.53	1.22	25.47	43.50	18.03
160.950	15.98	Q.P.	V	7.41	1.64	25.03	43.50	18.47
294.325	12.37	Q.P.	V	10.82	2.24	25.43	46.00	20.57
284.625	13.29	Q.P.	H	10.51	2.20	26.00	46.00	20.00
Above 290.00	Not Detected	-	-	-	-	-	-	-

Remark:

1. All spurious emission at channels are almost the same below 1 GHz, so that the channel was chosen at representative in final test.
2. "*" means the restricted band.
3. Actual = Reading + AF + CL

6. 20 dB Bandwidth Measurement and 99 % BW

6.1. Test Setup

6.2. Limit

Limit: Not Applicable

6.3. Test Procedure

1. The 20dB band width was measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 20dB band width of the emission was determined.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=10 kHz, VBW=10 kHz, Span=2 MHz.

6.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 42 %

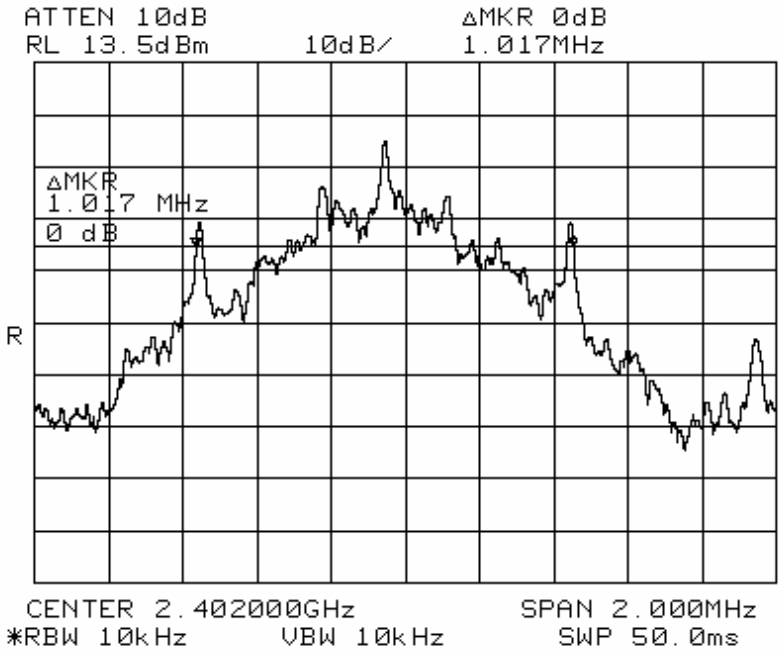
Operation Mode	Channel	Channel Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	Low	2402	1.017
	Middle	2441	1.017
	High	2480	1.020

Operation Mode	Channel	Channel Frequency (MHz)	99% Bandwidth (MHz)
GFSK	Low	2402	1.003
	Middle	2441	1.007
	High	2480	1.007

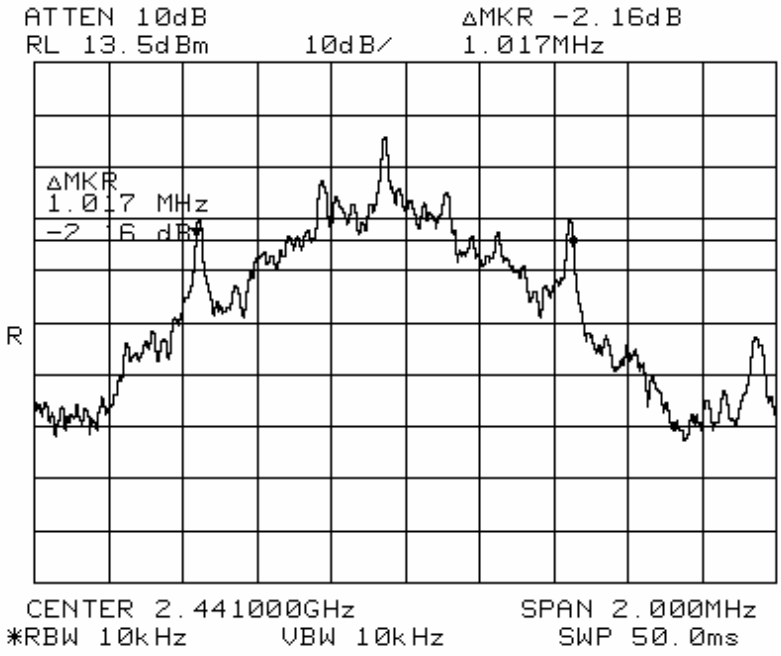
20 dB Bandwidth

Operating Mode: GFSK

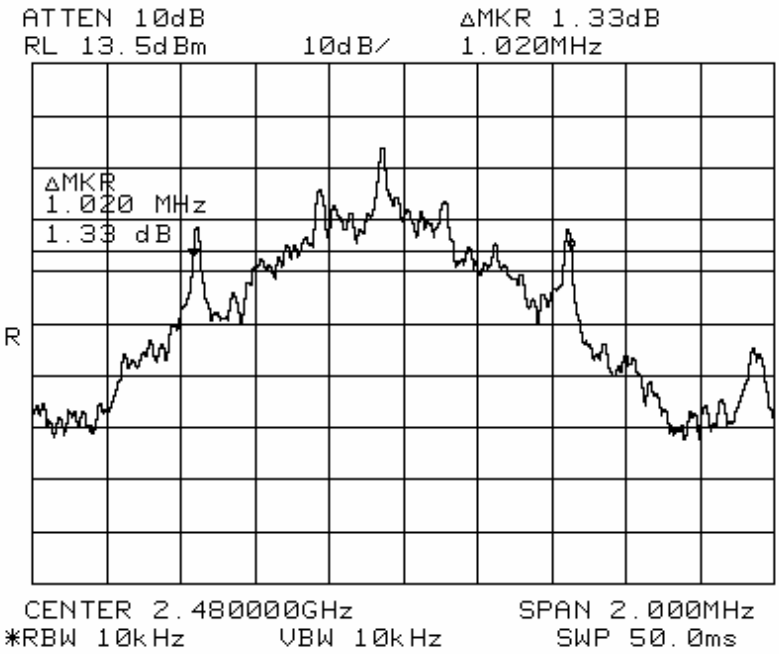
Low Channel



Middle Channel



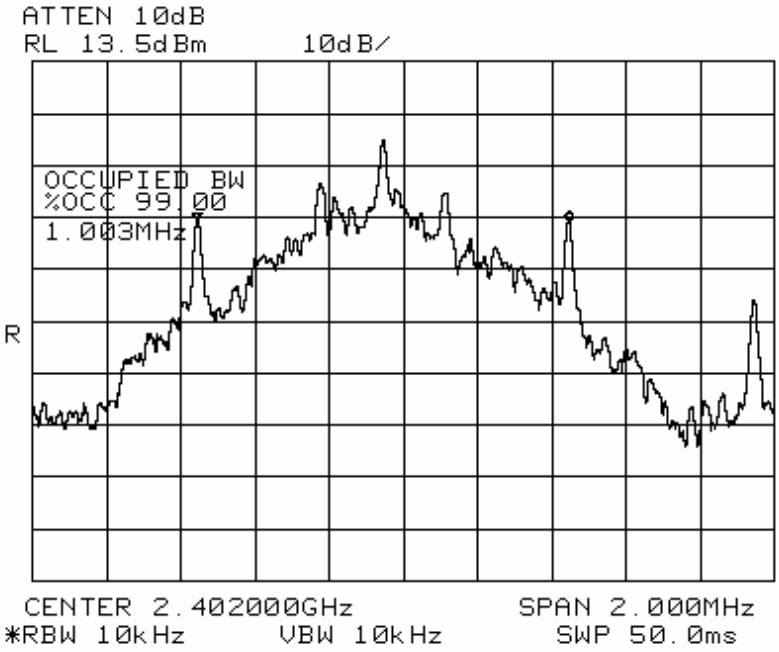
High Channel



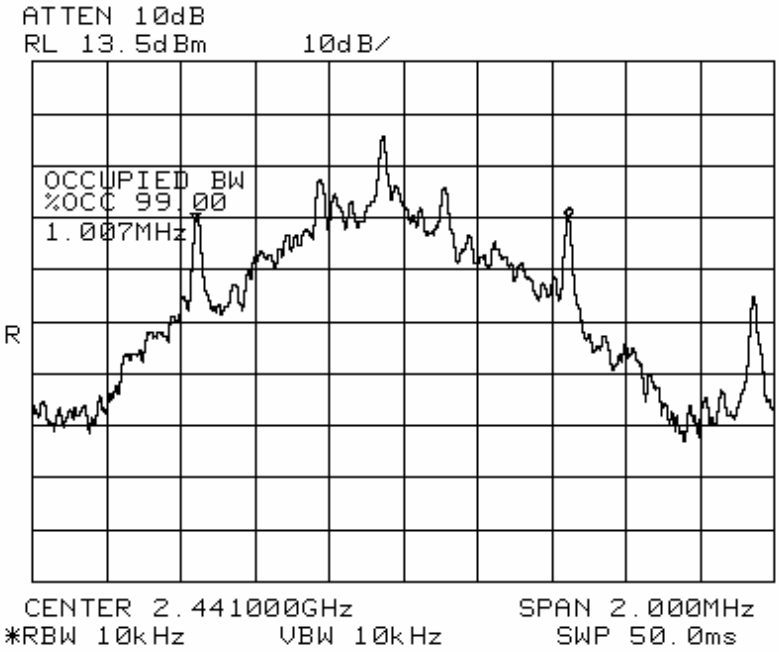
99 % Bandwidth

Operating Mode: GFSK

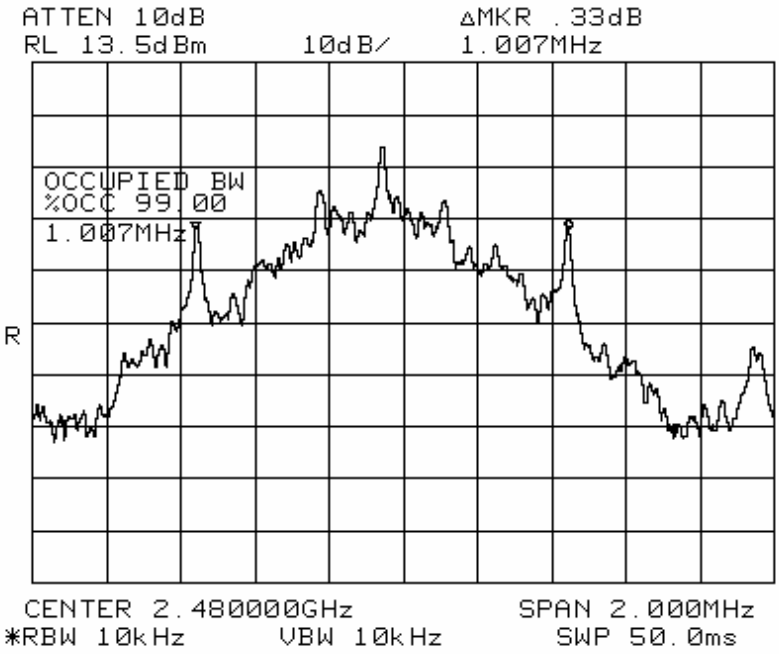
Low Channel



Middle Channel

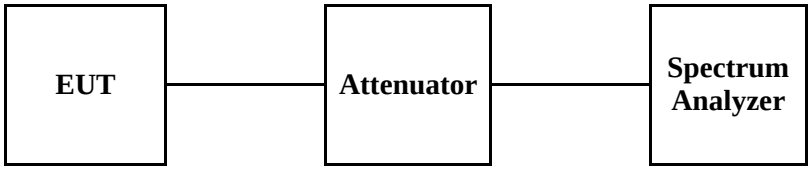


High Channel



7. Maximum Peak Output Power Measurement

7.1. Test Setup



7.2. Limit

§15.247(b)(3) For systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz band: 1 Watt.

7.3. Test Procedure

1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ;
   Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
   RBW = 1 MHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

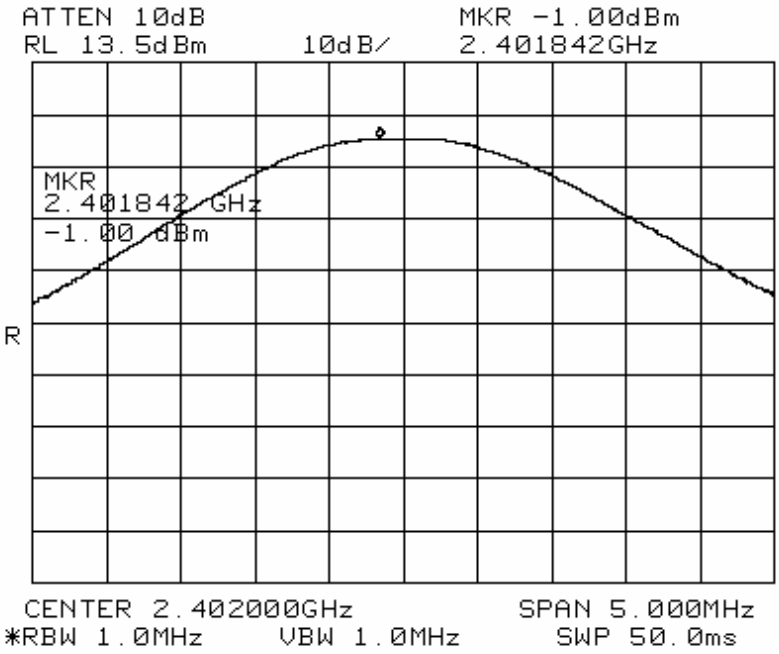
7.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 42 %

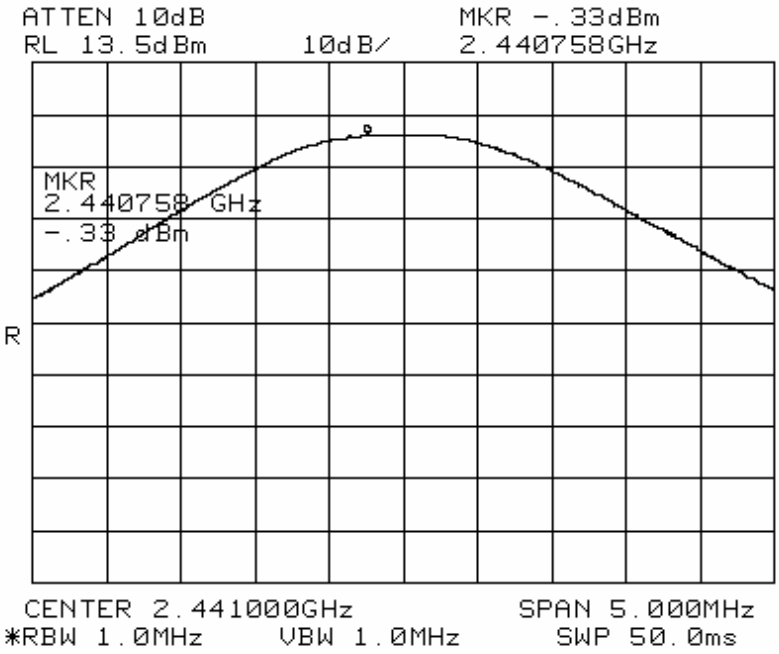
Operation Mode	Channel	Channel Frequency (MHz)	Peak Power Output (dBm)	Peak Power Limit (dBm)
GFSK	Low	2402	-1.00	21
	Middle	2441	-0.33	21
	High	2480	-2.17	21

Operating Mode: GFSK

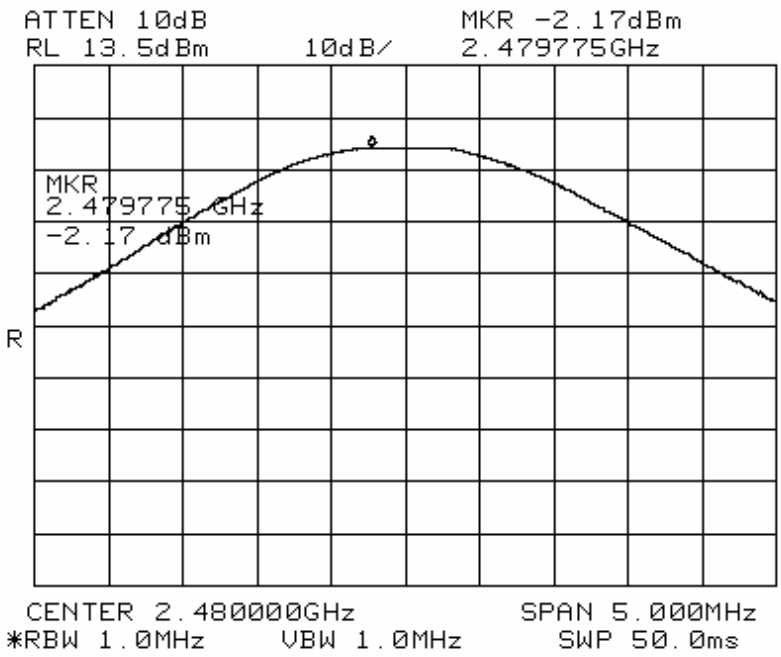
Low Channel



Middle Channel

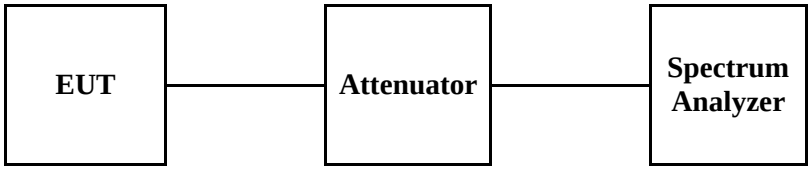


High Channel



8. Hopping Channel Separation

8.1. Test Setup



8.2. Limit

§15.247(a)(1) Frequency hopping system operating in 2400-2483.5MHz. Band may have hopping channel carrier frequencies that are separated by 25kHz or two-third of 20dB bandwidth of the hopping channel, whichever is is greater, provided the systems operate with an output power no greater than 125mW.

8.3. Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of adjacent channels.
4. Measure the frequency difference of these two adjacent channels by spectrum analyzer MARK function. And then plot the result on spectrum analyzer screen.
5. Repeat above procedures until all frequencies measured were complete.
6. Set center frequency of spectrum analyzer = middle of hopping channel.
7. Set the spectrum analyzer as RBW=100 kHz, VBW=100 kHz, Span=5 MHz and Sweep = auto.

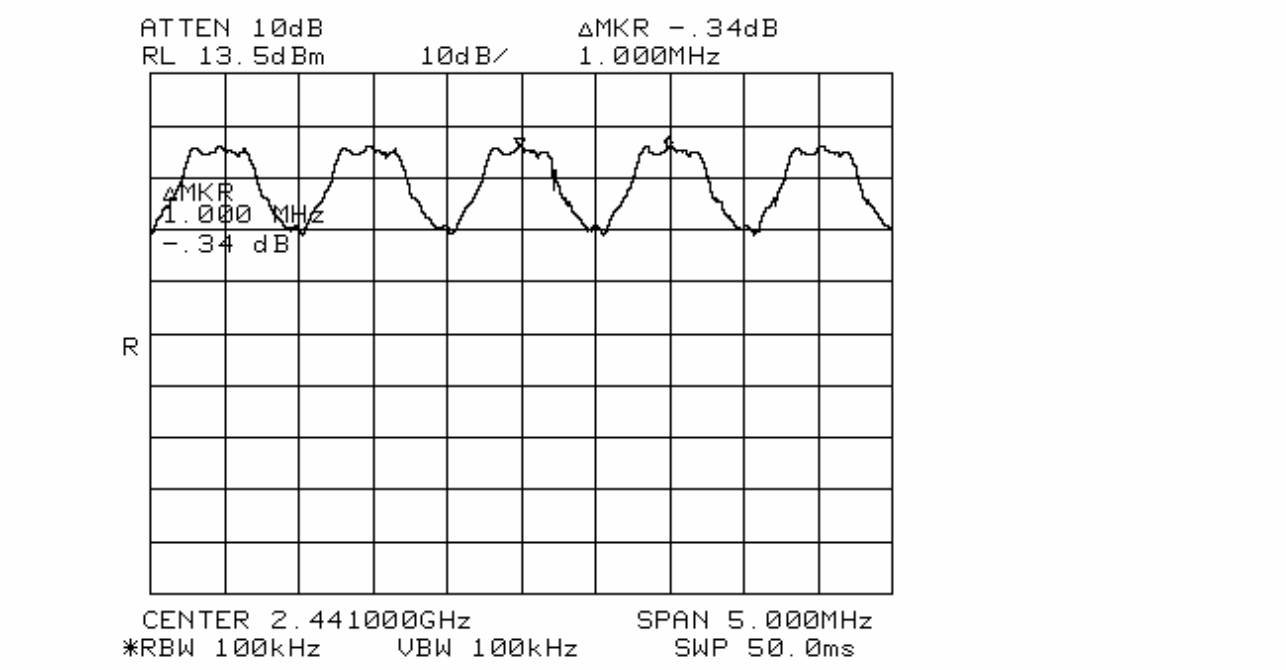
8.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 43 %

Operation Mode	Channel (Middle)	Adjacent Hopping Channel Separation (kHz)	Two-third of 20 dB Bandwidth (kHz)	Minimum Bandwidth (kHz)
GFSK	2441 MHz	1000	680	25

Note ;
20 dB bandwidth measurement, the measured channel separation should be greater than two-third of 20dB bandwidth or Minimum bandwidth.

Operating Mode: GFSK



9. Number of Hopping Frequency

9.1. Test Setup

9.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2400-2483.5MHz bands shall use at least 15 hopping frequencies.

9.3. Test Procedure

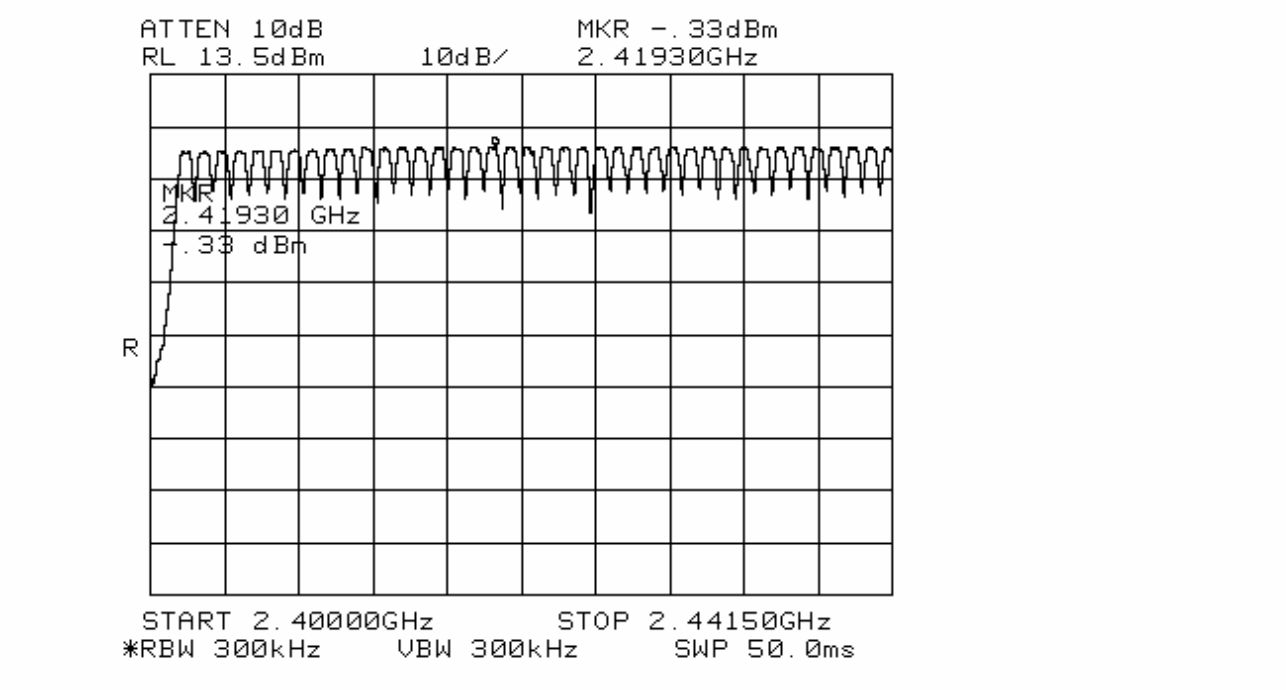
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna the port to the Spectrum analyzer
3. Set spectrum analyzer Start=2400 MHz, Stop=2441.5 MHz, Sweep=auto and Start=2441.5 MHz, Stop= 2483.5 MHz, Sweep=auto.
4. Set the spectrum analyzer as RBW, VBW=300 kHz.
5. Max hold, view and count how many channel in the band.

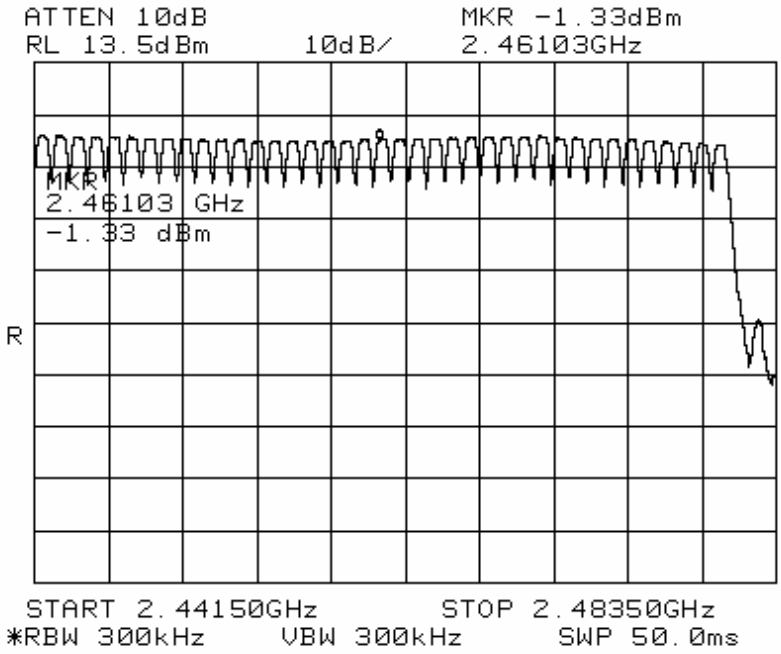
9.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 43 %

Operation Mode	Number of Hopping Frequency	Limit
GFSK	79	>= 15

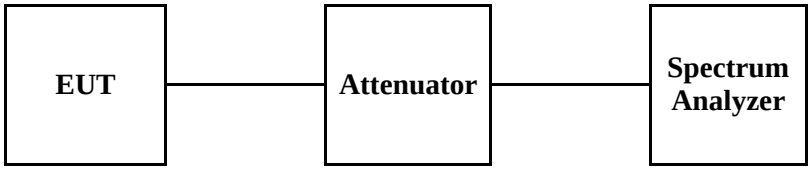
Operating Mode: GFSK




ATTEN 10dB
RL 13.5dBm
10dB/
MKR -1.33dBm
2.46103GHz
MKR
2.46103 GHz
-1.33 dBm
R
START 2.44150GHz
STOP 2.48350GHz
*RBW 300kHz
VBW 300kHz
SWP 50.0ms

10. Time of Occupancy (Dwell Time)

10.1. Test Set up



10.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2400-2483.5MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a 31.6 second period.

A period time=0.4(s)*79=31.6(s)

10.3. Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable.
3. Adjust the center frequency of spectrum analyzer on any frequency be measured and set spectrum analyzer to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.
6. The Bluetooth has 3 type of payload, DH1, DH3, DH5.The hopping rate is 1600 per second.

10.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 43 %

Time of occupancy on the TX channel in 31.6sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 31.6

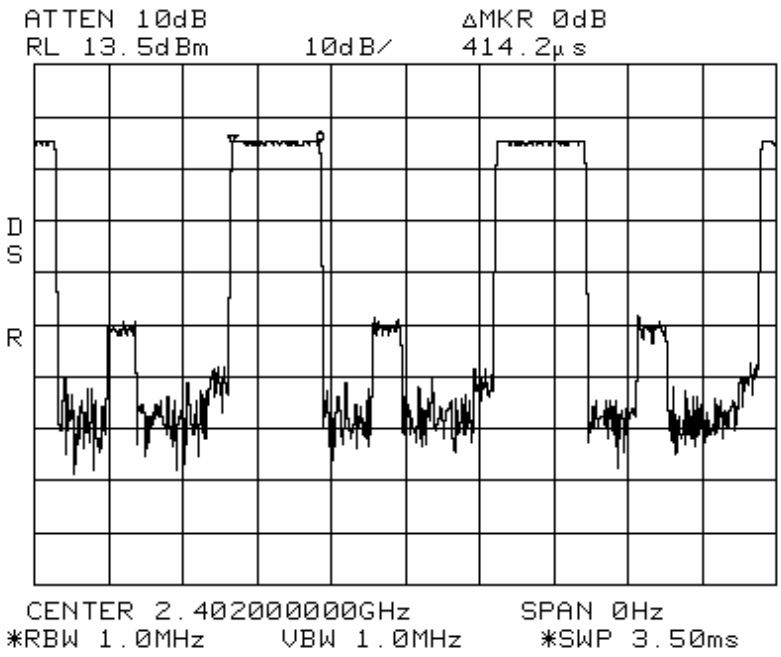
10.4.1. Packet Type: DH1

Operation Mode	Frequency	Dwell Time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2402 MHz	0.414	132.48	400
	2441 MHz	0.414	132.48	400
	2480 MHz	0.414	132.48	400

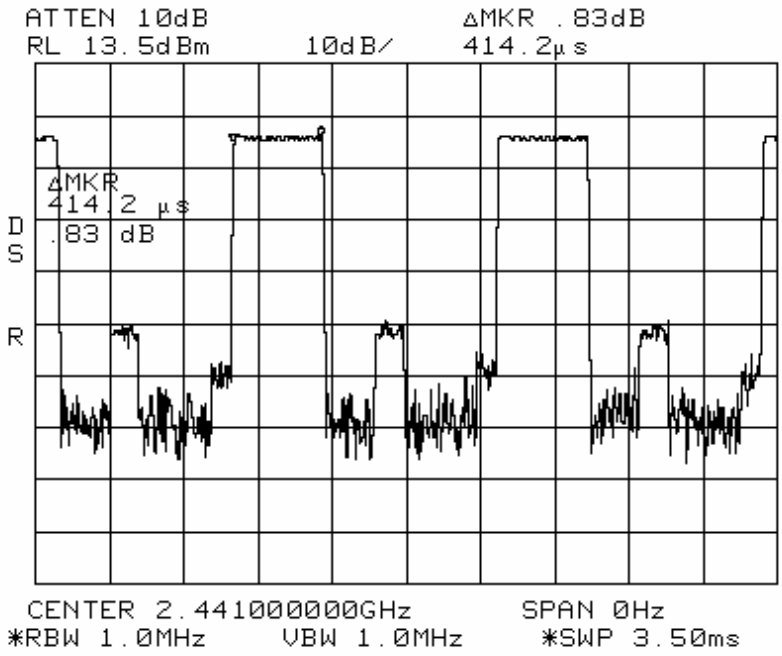
2402 MHz: 0.414(ms) × [(1600÷2) ÷79] ×31.6(s) = 132.48(ms)
2441 MHz: 0.414(ms) × [(1600÷2) ÷79] ×31.6(s) = 132.48(ms)
2480 MHz: 0.414(ms) × [(1600÷2) ÷79] ×31.6(s) = 132.48(ms)

Operating Mode: GFSK

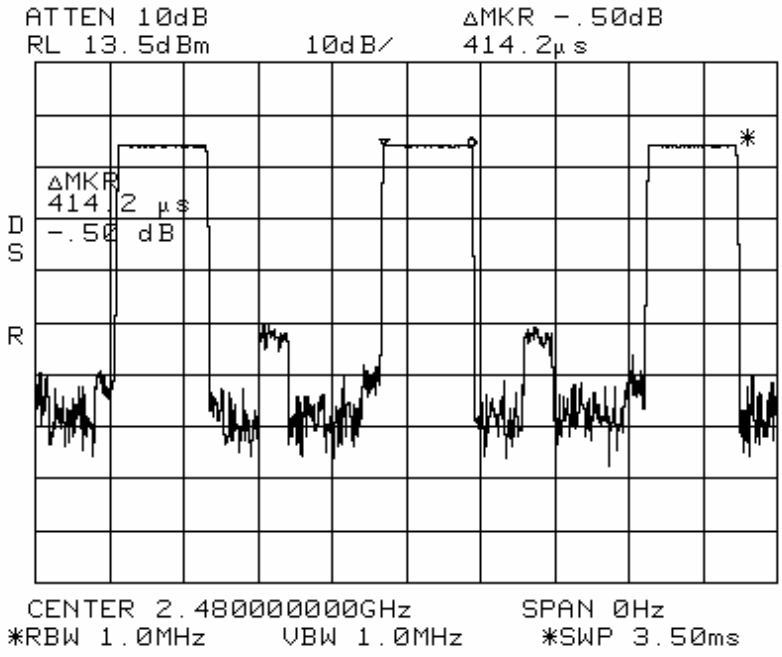
Low Channel



Middle Channel



High Channel



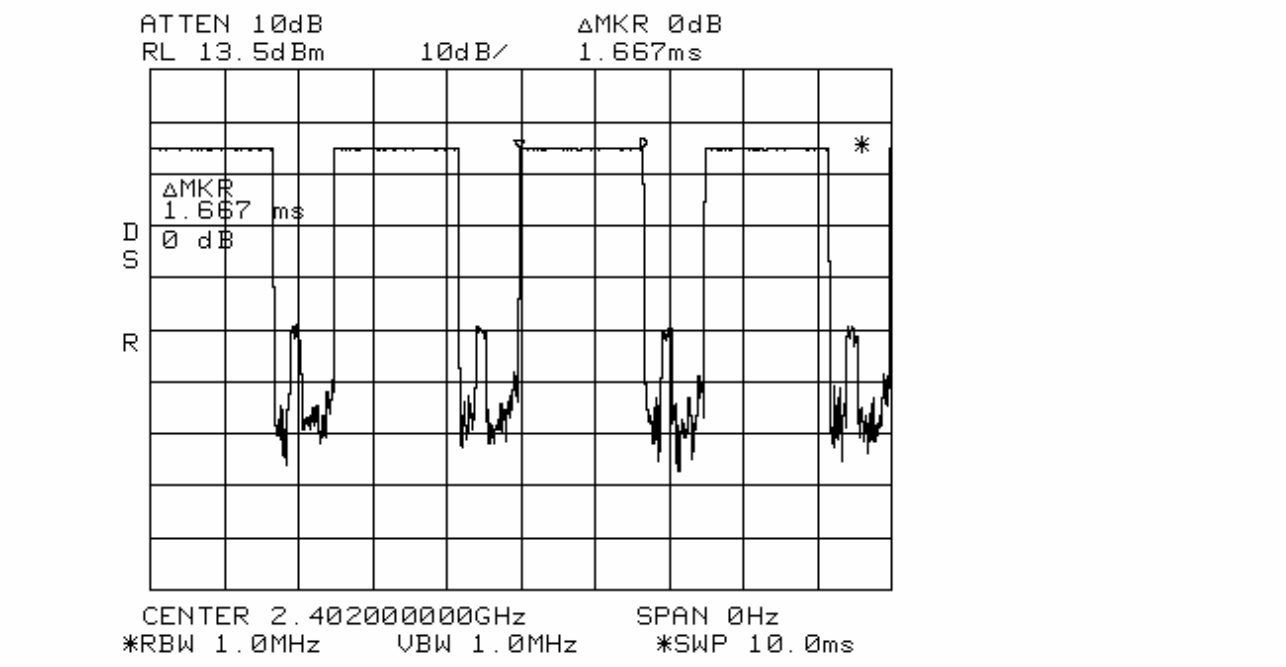
10.4.2. Packet Type: DH3

Operation Mode	Frequency	Dwell Time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2402 MHz	1.667	266.72	400
	2441 MHz	1.667	266.72	400
	2480 MHz	1.667	266.72	400

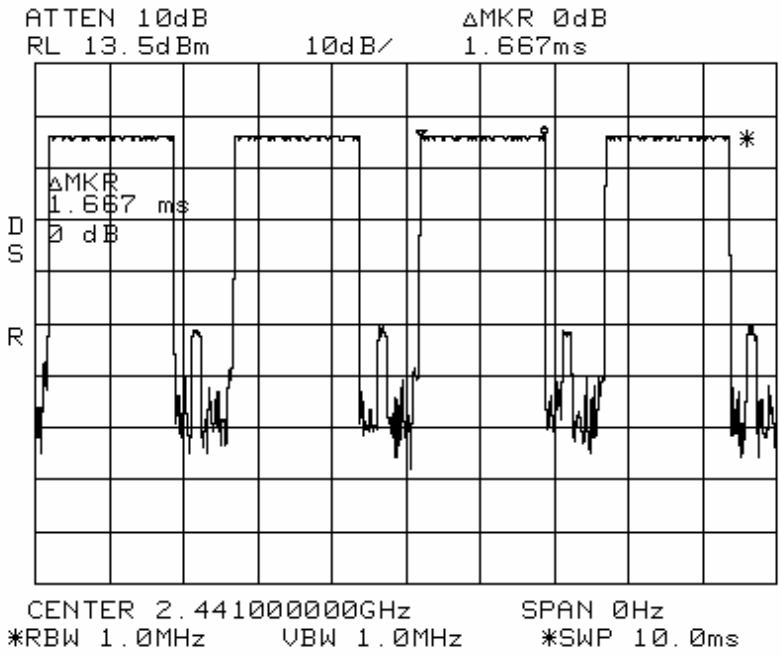
2402 MHz: 1.667 (ms) × [(1600÷4) ÷79] ×31.6(s) = 266.72(ms)
2441 MHz: 1.667 (ms) × [(1600÷4) ÷79] ×31.6(s) = 266.72(ms)
2480 MHz: 1.667 (ms) × [(1600÷4) ÷79] ×31.6(s) = 266.72(ms)

Operating Mode: GFSK

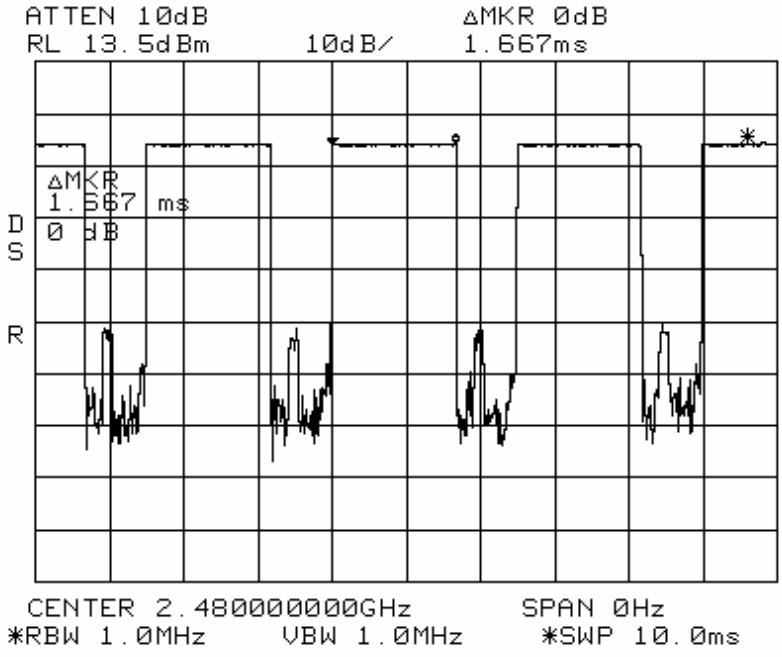
Low Channel



Middle Channel



High Channel



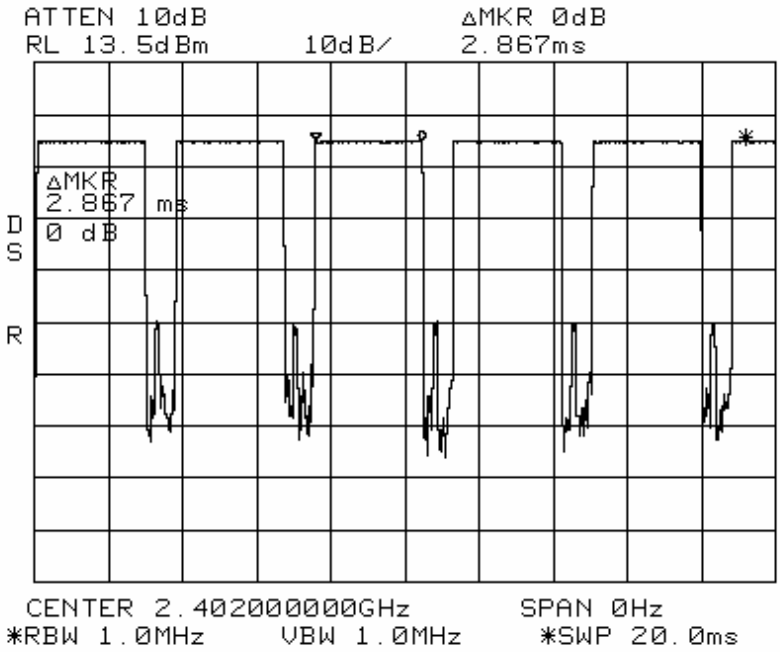
10.4.3. Packet Type: DH5

Operation Mode	Frequency	Dwell Time (ms)	Time of occupancy on the Tx Channel in 31.6 sec (ms)	Limit for time of occupancy on the Tx Channel in 31.6 sec (ms)
GFSK	2402 MHz	2.867	305.81	400
	2441 MHz	2.867	305.81	400
	2480 MHz	2.867	305.81	400

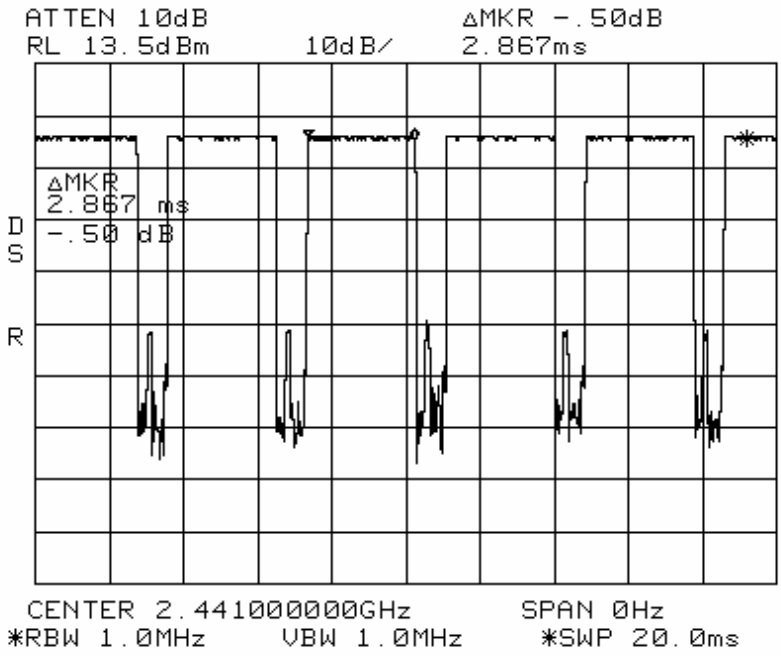
2402 MHz: 2.867 (ms) × [(1600÷6) ÷79] ×31.6(s) = 305.81(ms)
2441 MHz: 2.867 (ms) × [(1600÷6) ÷79] ×31.6(s) = 305.81(ms)
2480 MHz: 2.867 (ms) × [(1600÷6) ÷79] ×31.6(s) = 305.81(ms)

Operating Mode: GFSK

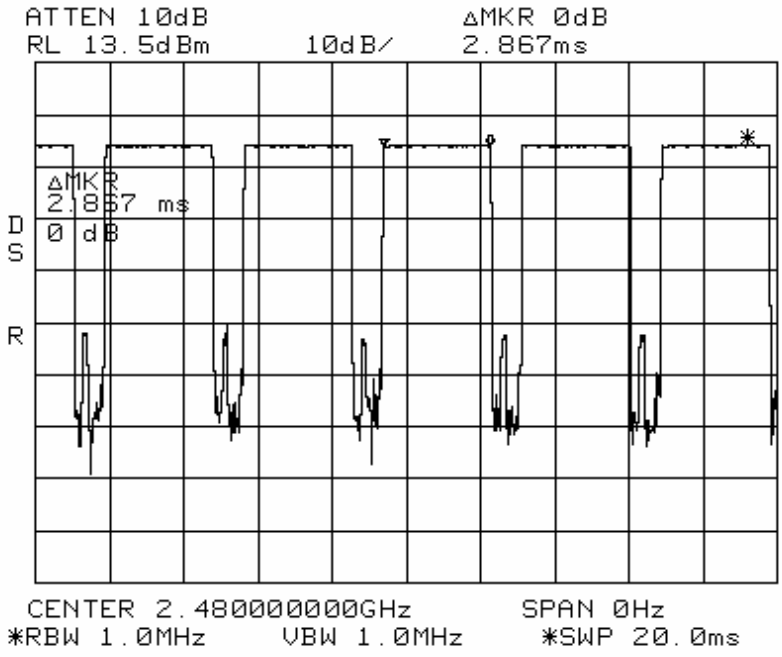
Low Channel



Middle Channel

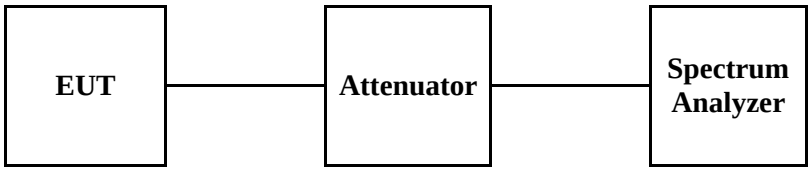


High Channel



11. Power Spectral Density Measurement

11.1. Test Setup



11.2. Limit

§15.247(e) For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

11.3. Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in test setup without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the Max Hold function record the separation of adjacent channels.
4. Repeat above procedures until all frequencies measured were complete.
5. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ; RBW=3 kHz, VBW=10 kHz, Span=300 kHz and Sweep=100 s.

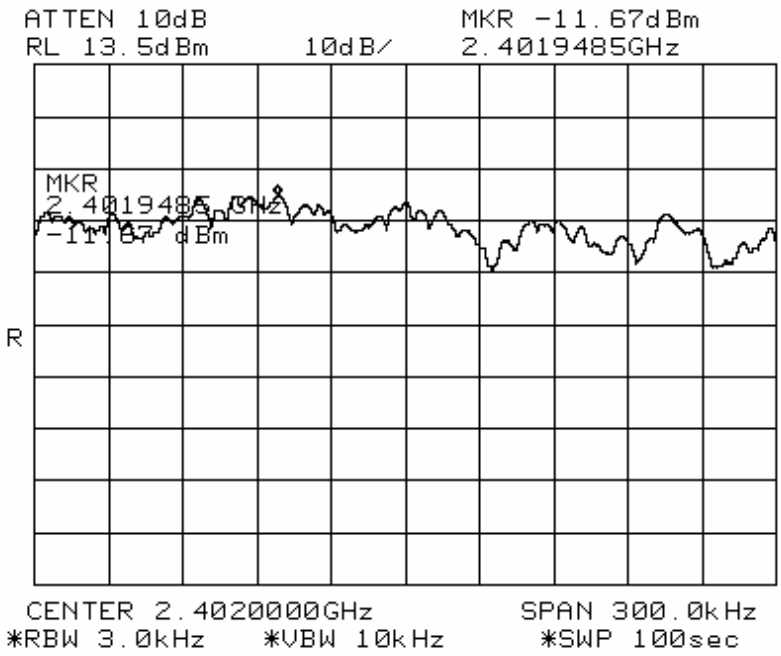
11.4. Test Results

Ambient temperature : 21 ℃ Relative humidity : 42 %

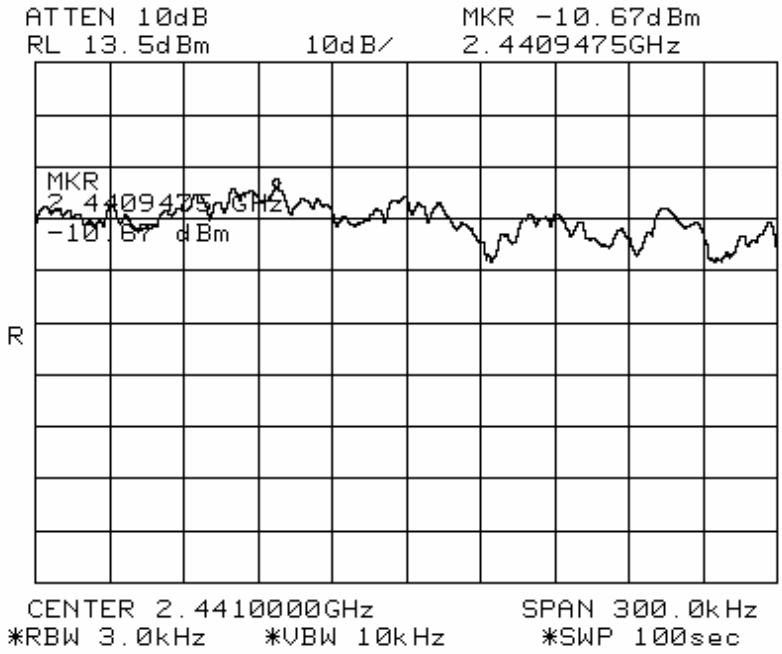
Operation Mode	Frequency	Final RF Power Level in 3 kHz BW (dBm)	Maximum Limit (dBm)
GFSK	2402 MHz	-11.67	8
	2441 MHz	-10.67	8
	2480 MHz	-12.50	8

Operating Mode: GFSK

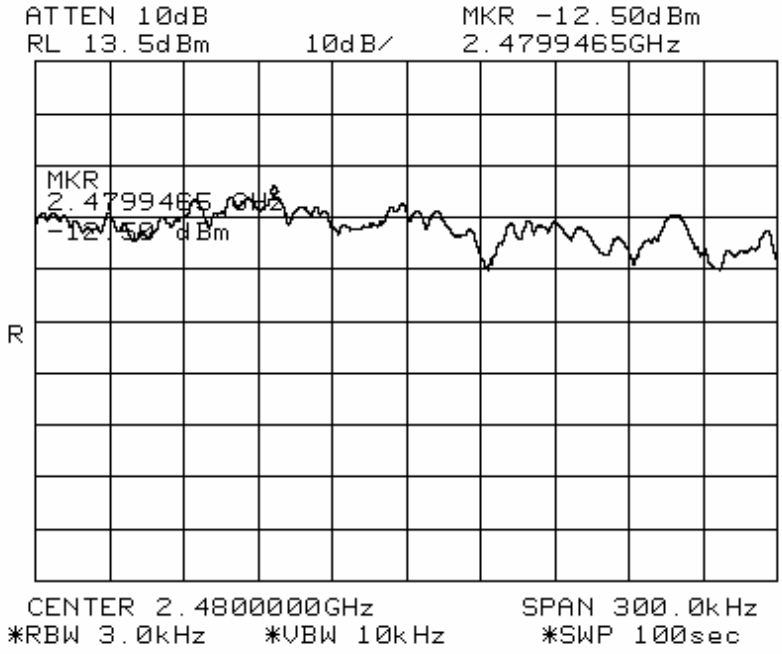
Low Channel



Middle Channel



High Channel



12. Antenna Requirement

12.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section §15.247 (b) if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6dBi.

12.2. Antenna Connected Construction

Antenna used in this product is Fixed type (Chip antenna) gain of 3.11 dBi

13. RF Exposure Evaluation

According to FCC 1.1310 : The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in § 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time
(A) Limits for Occupational /Control Exposures				
300 – 1500	--	--	**F/300**	**6**
1500 - 100000	--	--	**5**	**6**
(B) Limits for General Population/Uncontrol Exposures				
300 – 1500	--	--	**F/1500**	**6**
1500 - 100000	--	--	**1**	**30**

13.1 Friis transmission formula : Pd = (Pout*G)/(4*pi*R^2)

Where
Pd = power density in mW/cm^2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
Pi = 3.1416
R = distance between observation point and center of the radiator in cm
Pd the limit of MPE, 1 mW/cm^2. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

13.1 Test Result of RF Exposure Evaluation

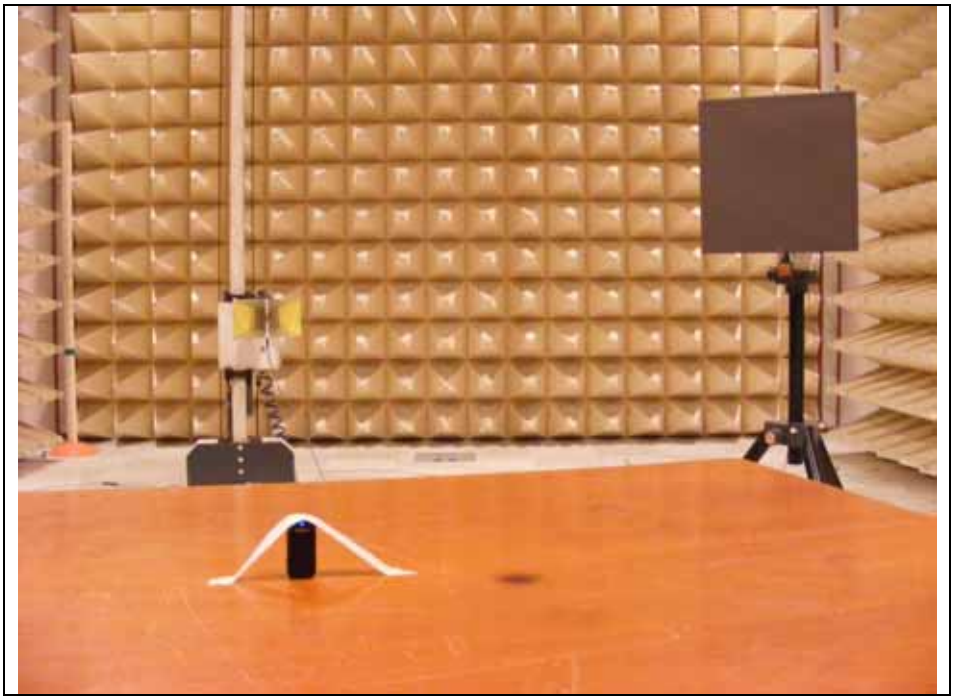
Test Item : RF Exposure Evaluation Data
Test Mode : Normal Operation

13.1.1 Output Power into Antenna & RF Exposure Evaluation Distance

Operating Mode: GFSK

Channel	Channel Frequency (MHz)	Output Peak Power to Antenna (dBm)	Antenna Gain (dBi)	Power Density at 20cm (mW/cm^2)	Limits (mW/cm^2)
Low	2402	-1.00	3.11	0.00032	1
Middle	2441	-0.33	3.11	0.00038	1
High	2480	-2.17	3.11	0.00025	1

Appendix A-1. Photo of Field Strength Test



Appendix A -2. Photos of Conducted Power Line Test

Appendix B. Photos of the EUT

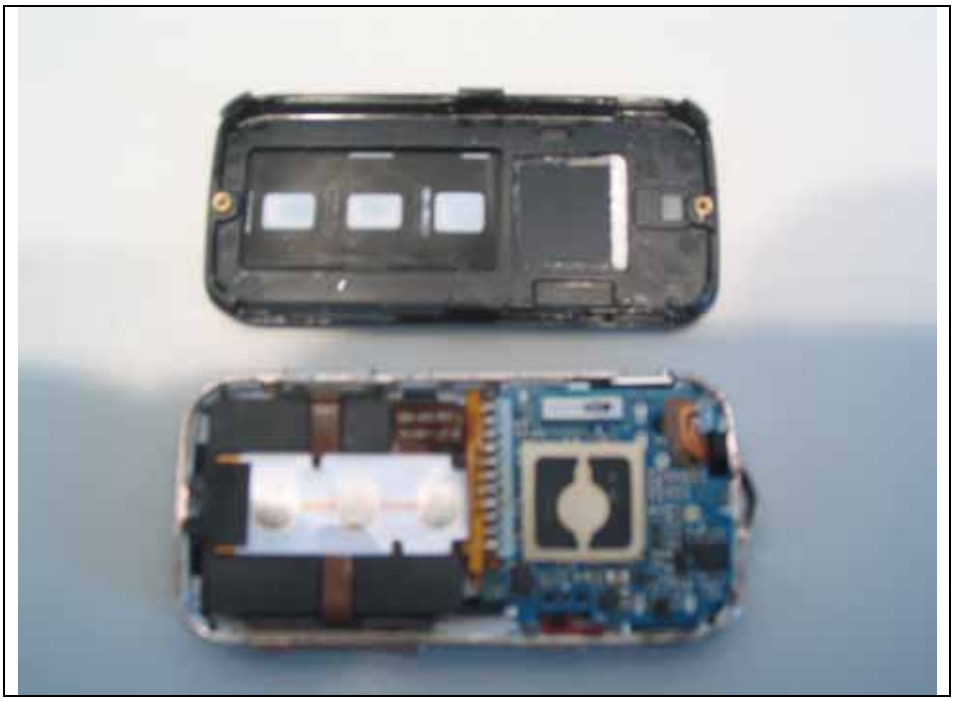
Front View of EUT

Rear View of EUT

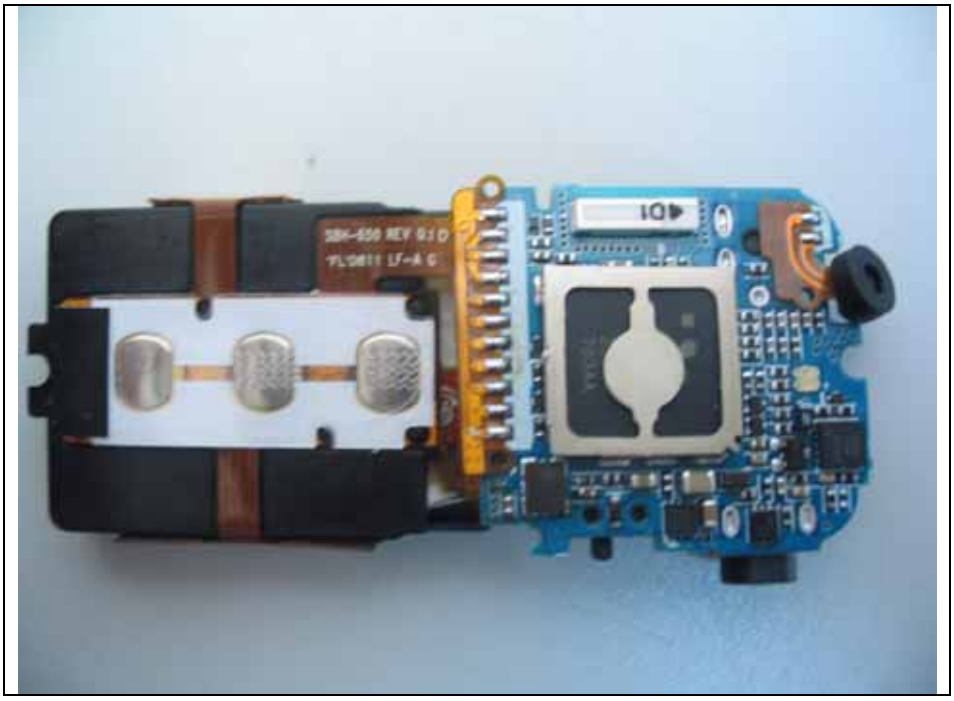
Right View of EUT

Left View of EUT

Inner View of EUT



Front View of Main-Board



Front View of Main-Board