TEST REPORT

of

FCC Part 15 Subpart C §15.247

FCC ID : SS4I1F4

Equipment Under Test	:	Bluetooth Barcode Scanner
Model Name	:	BI-500
Serial No.	:	N/A
Applicant	:	Bluebird Soft, Inc.
Manufacturer	:	Bluebird Soft, Inc.
Date of Test(s)	:	2010.10.06 ~ 2010.10.12
Date of Issue	:	2010.10.14

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

Tested By: Grant Lee **Date** 2010.10.14

Approved By Charles Kim **Date** 2010.10.14

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1. General Information

1.1. Testing Laboratory

SGS Testing Korea Co., Ltd.
- 705, Dongchun-Dong Sooji-Gu, Yongin-Shi, Kyungki-Do, South Korea.
- Wireless Div. 2FL, 18-34, Sanbon-dong, Gunpo-si, Gyeonggi-do, Korea 435-040

www.electrolab.kr.sgs.com
Telephone : +82 +31 428 5700
FAX : +82 +31 427 2371

1.2. Details of Applicant

Applicant : Bluebird Soft, Inc.
Address : 1242, Gaepo-dong, Kangnam-gu, Seoul, Korea
Contact Person : Kim In-Gu
Phone No. : +82 70 7730 8252

1.3. Description of EUT

Kind of Product	Bluetooth Barcode Scanner
Model Name	BI-500
Serial Number	N / A
Power Supply	DC 3.7 V
Frequency Range	2 402 ㎒ ~ 2 480 ㎒
Modulation Technique	GFSK only
Number of Channels	79
Antenna Type	Fixed Type
Antenna Gain	0 dBi

1.4. Declaration by the manufacturer

- 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 1 600 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 ㎒

1.6. Test Equipment List

Equipment	Manufacturer	Model	Cal Due.
Signal Generator	Agilent	E4438C	Mar. 31, 2011
Signal Generator	Rohde & Schwarz	SMR40	Jul. 15, 2011
Spectrum Analyzer	Agilent	E4440A	Mar. 31, 2011
Spectrum Analyzer	Rohde & Schwarz	FSV30	May 15, 2011
Bluetooth Tester	TESOM	TC-3000C	Jan. 11, 2011
Directional Coupler	KRYTAR	152661	Jun. 01, 2011
High Pass Filter	Wainwright	WHK3.0/18G-10SS	Sep. 29, 2011
DC power Supply	Agilent	U8002A	Jan. 06, 2011
Preamplifier	H.P.	8447F	Jul. 05, 2011
Preamplifier	Rohde & Schwarz	8449B	Mar. 31, 2011
Test Receiver	R & S	ESU26	Apr. 08, 2011
Bilog Antenna	SCHWARZBECK MESSELEKTRONIK	396	Jul. 22, 2011
Horn Antenna	SCHWARZBECK MESSELEKTRONIK	BBHA9170	Mar. 17, 2012
Horn Antenna	Rohde & Schwarz	HF 906	Oct. 08, 2011
Antenna Master	EMCO	1050	N/A
Turn Table	Daeil EMC	DI-1500	N/A
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	Jan. 27, 2011
Two-Line V-Network	R & S	ENV216	Jan. 06, 2011
Test Receiver	R & S	ESHS10	Jul. 13, 2011
Anechoic Chamber	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A

1.7. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD:FCC Part15		
Section	**Test Item**	**Result**
15.205(a) 15.209 15.247(d)	Transmitter Radiated Spurious Emissions Conducted Spurious Emission	Complied
15.247(a)(1)	20 dB Bandwidth	Complied
15.247(b)(1)	Maximum Peak Output Power	Complied
15.247(a)(1)	Frequency Separation	Complied
15.247(b)(1)	Number of Hopping Frequency	Complied
15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Complied
15.207	Transmitter AC Power Line Conducted Emission	Complied
15.247(i) 1.1307(b)(1)	Maximum Permissible Exposure (Exposure of Humans to RF Fields)	Complied

1.8 Test report revision

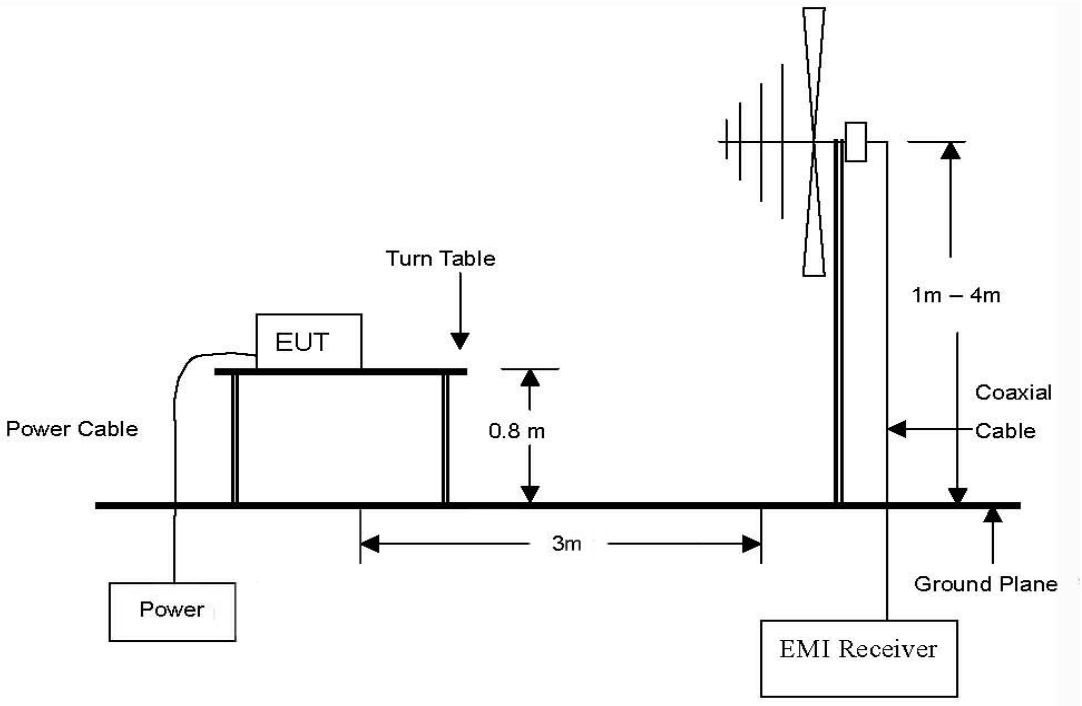
Revision	Report number	Description
0	F690501/RF-RTL004228	Initial

2. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

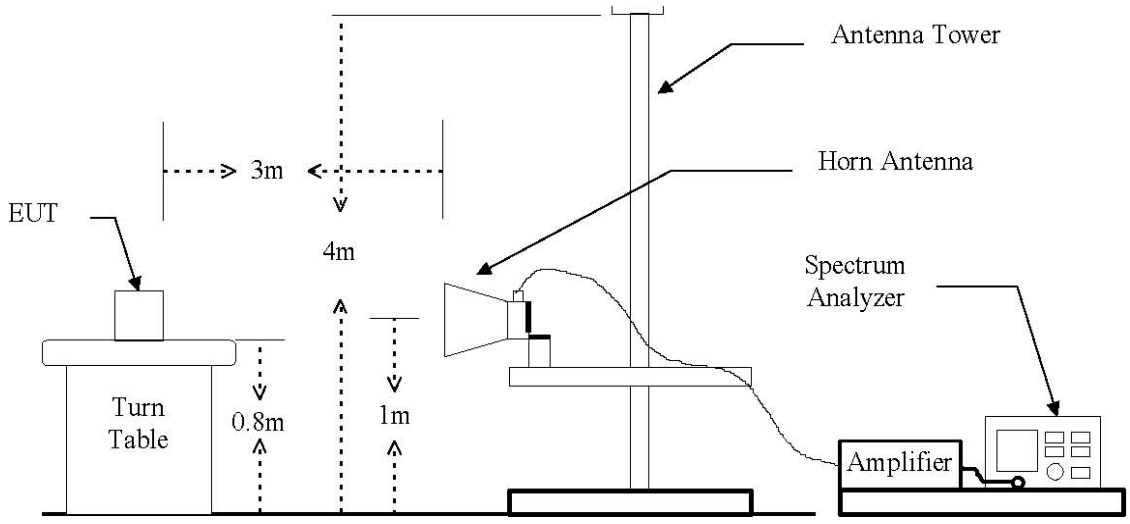
2.1. Test Setup

2.1.1. Transmitter Radiated Spurious Emissions

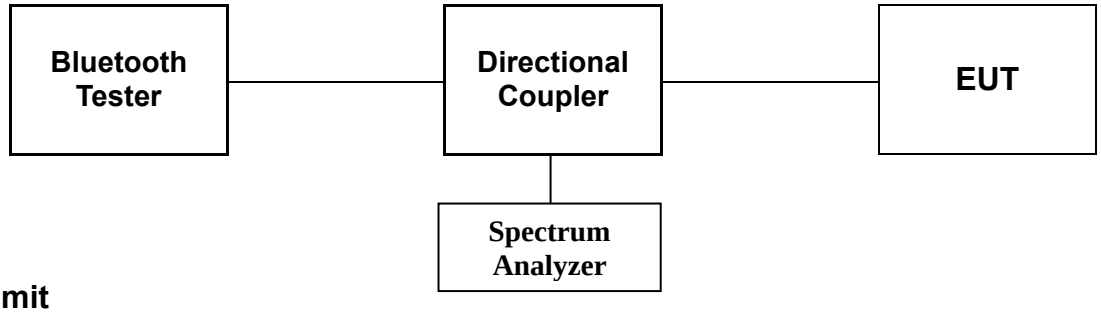
The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



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



2.1.2. Conducted Spurious Emissions



2.2. Limit

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. 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 § 15.209(a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table：

Frequency (㎒)	Distance (Meters)	Field Strength (㏈μV/m)	Field Strength (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

2.3. Test Procedures

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

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

2.3.2. Test Procedures for Conducted Spurious Emissions

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

2.4. Test Results

Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

2.4.1. Spurious Radiated Emission

The frequency spectrum from 30 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 30 ㏈. All reading values are peak values.

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP + CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
202.66	54.94	Peak	H	7.51	-25.85	36.60	43.50	6.90
304.025	53.45	Peak	H	11.00	-25.25	39.20	46.00	6.80
912.053	39.65	Peak	V	21.08	-24.43	36.30	46.00	9.70
Above 1 000.000	Not detected							

Remark:

1. All spurious emission at channels are almost the same below 1 ㎓, so that middle channel was chosen at representative in final test.
2. Actual = Reading + AF + AMP + CL
3. The field strength of spurious emission was measured in three orthogonal EUT positions (x-axis, y-axis and z-axis). Worst case is y-axis.

2.4.2. Spurious Radiated Emission

The frequency spectrum above 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 30 ㏈.

Operating Mode: GFSK

A. Low Channel (2 402 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
*2 390.000	24.12	Peak	V	28.09	4.84	57.05	74.00	16.95
*2 390.000	11.48	Average	V	28.09	4.84	44.41	54.00	9.59

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP+CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4 804.230	43.16	Peak	V	32.59	-27.78	47.97	74.00	26.03
Above 4 900.000	Not detected	-	-	-	-	-	-	-

B. Middle Channel (2 441 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (㏈㎶)	Detect Mode	Pol.	AF (㏈/m)	AMP+CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4 882.020	43.86	Peak	V	32.90	-27.56	49.20	74.00	24.80
Above 4 900.000	Not detected	-	-	-	-	-	-	-

C. High Channel (2 480 ㎒)

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
*2 483.500	26.19	Peak	V	28.09	4.78	59.06	74.00	14.94
*2 483.500	10.13	Average	V	28.09	4.78	43.00	54.00	11.00

Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4 949.850	42.15	Peak	V	33.22	-27.41	47.96	74.00	26.04
Above 5 000.000	Not detected	-	-	-	-	-	-	-

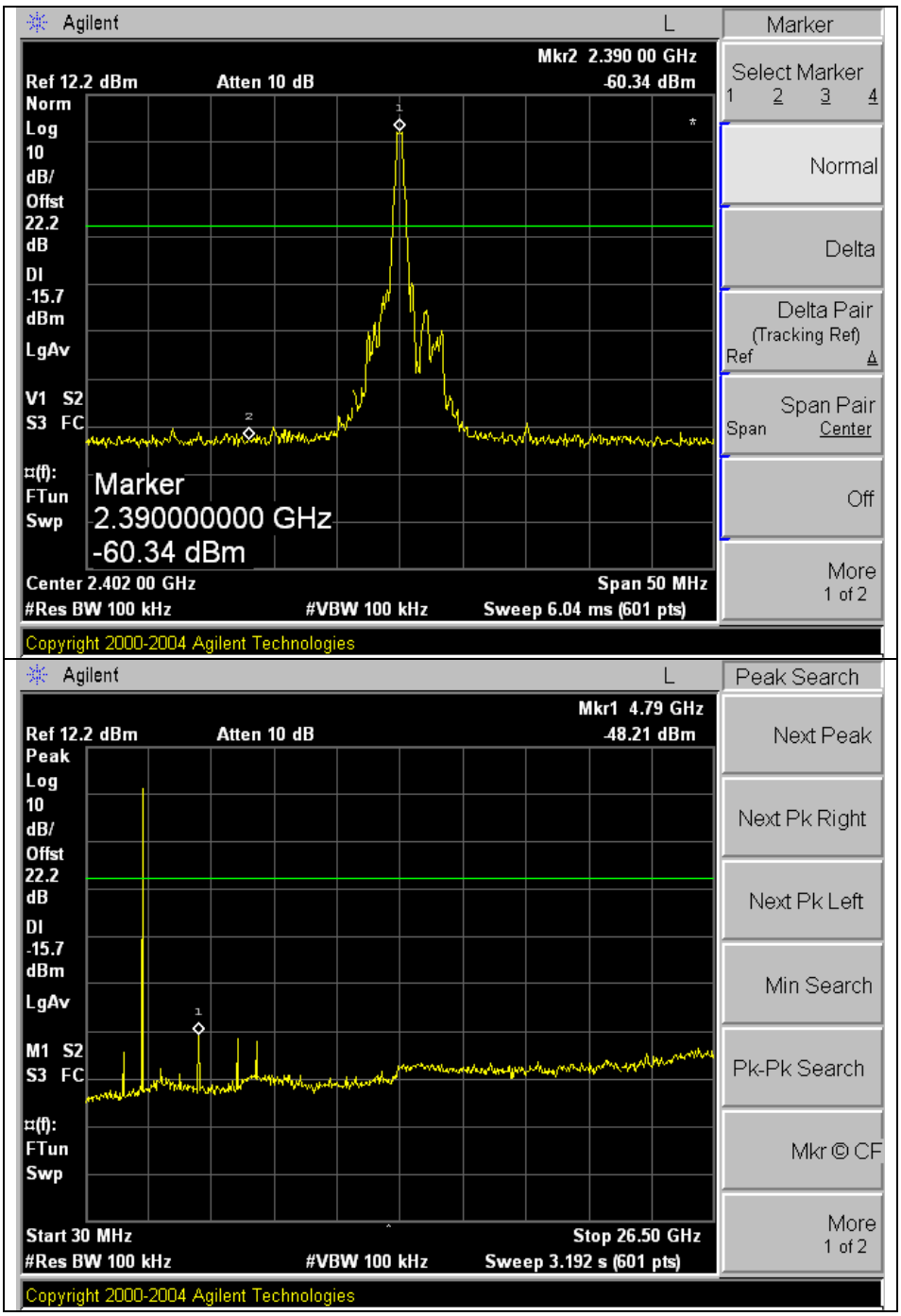
Remarks ;

1. "*" means the restricted band.
2. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental Frequency.
3. Radiated emissions measured in frequency above 1 000 ㎒ 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 + CL
6. The field strength of spurious emission was measured in three orthogonal EUT positions (x-axis, y-axis and z-axis). Worst case is y-axis.

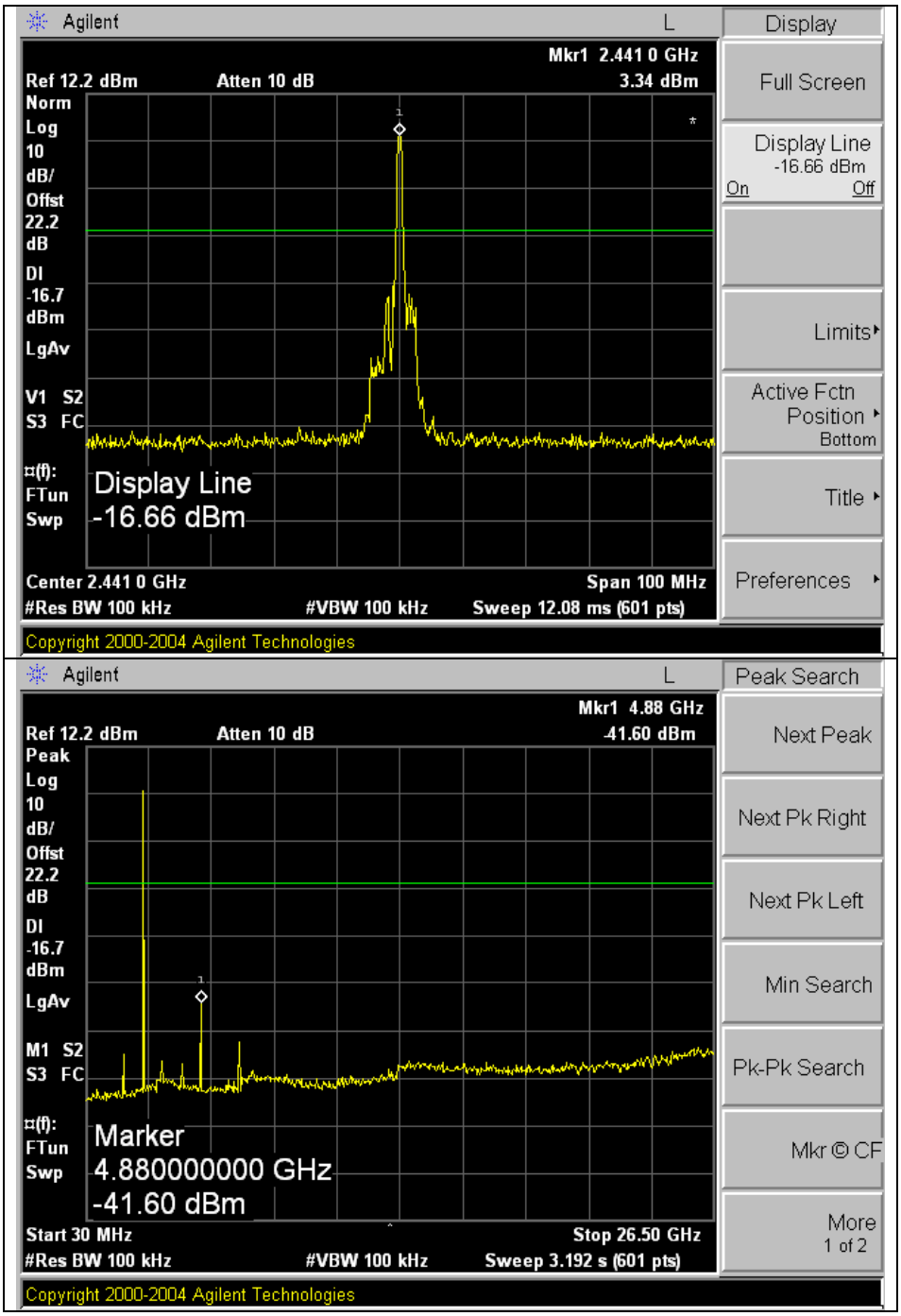
2.4.3. Spurious RF Conducted Emissions: Plot of Spurious RF Conducted Emission

Operating Mode:

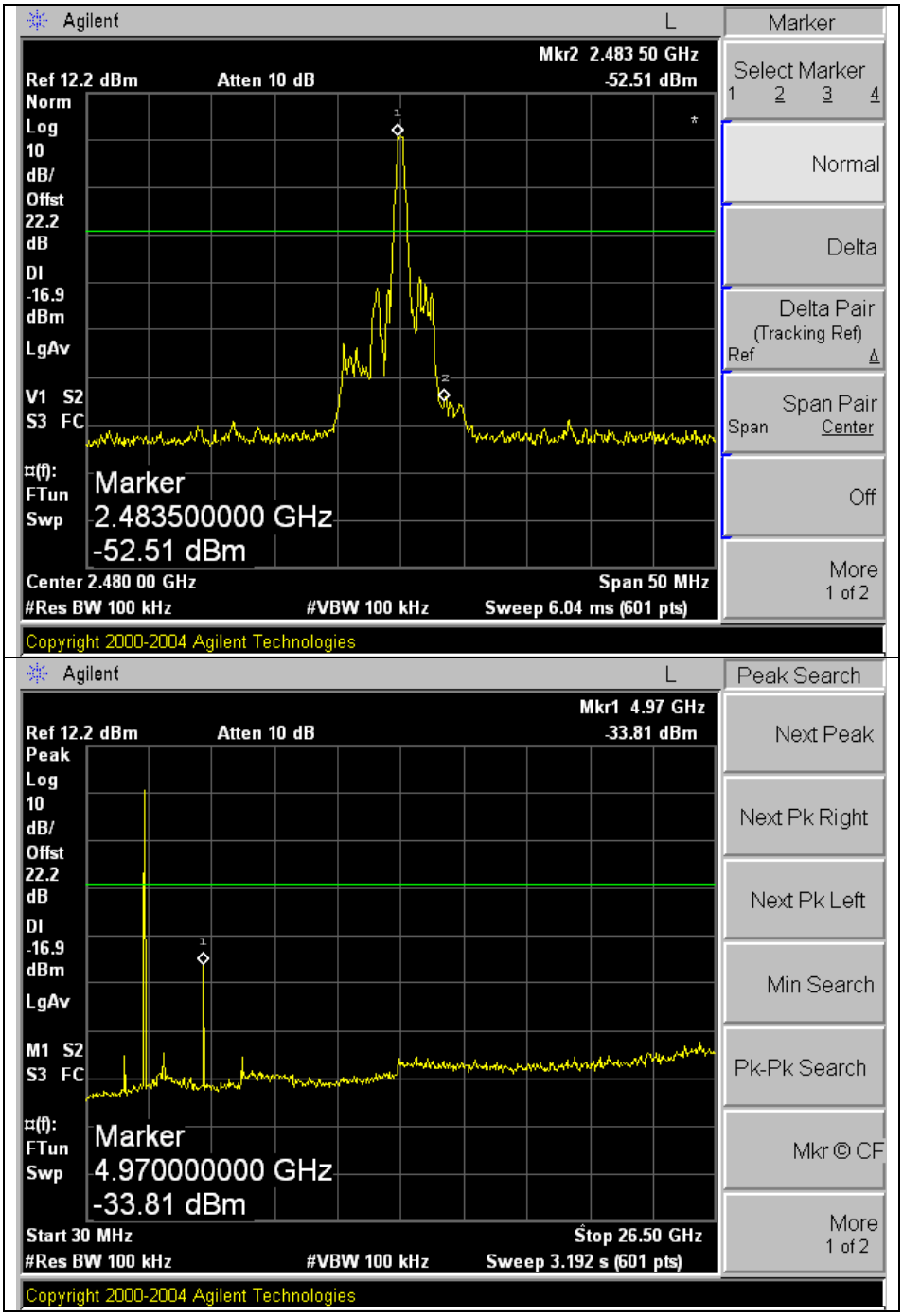
Low Channel



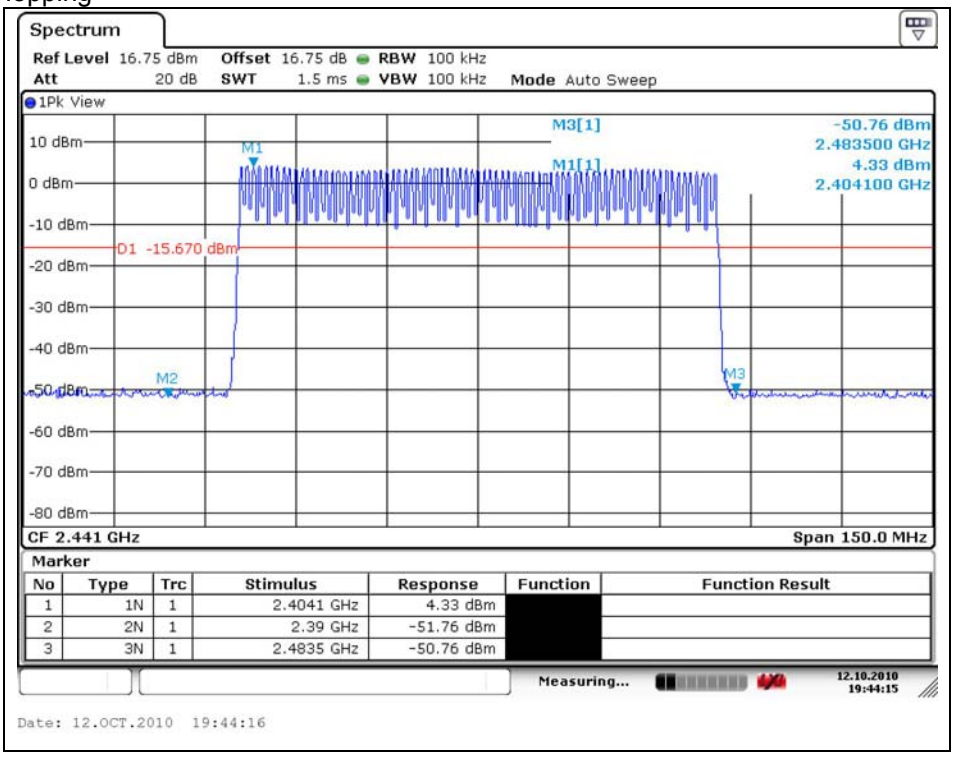
Middle Channel



High Channel

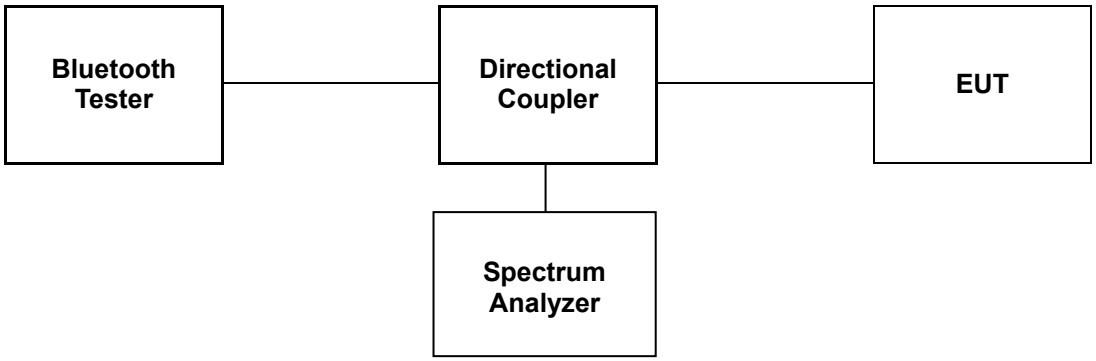


Bandedge at Hopping



3. 20 dB Bandwidth Measurement

3.1. Test Setup



3.2. Limit

Limit: Not Applicable

3.3. Test Procedure

1. The 20 dB 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 20 dB band width of the emission was determined.

2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 30 ㎑, VBW =30 ㎑, Span = 10 ㎒.

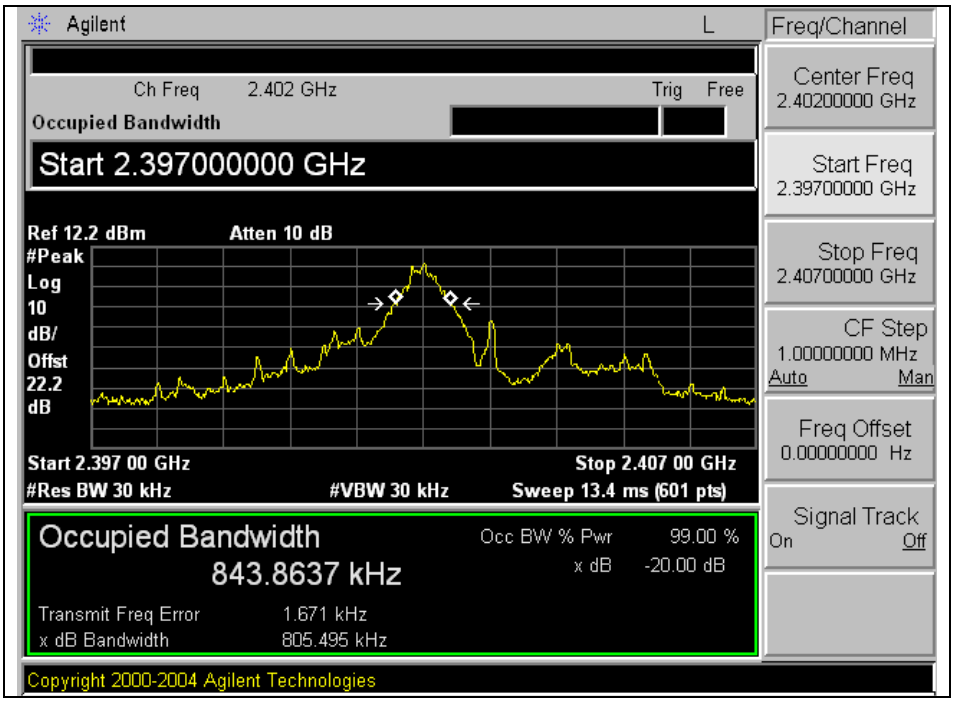
3.4. Test Results

Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

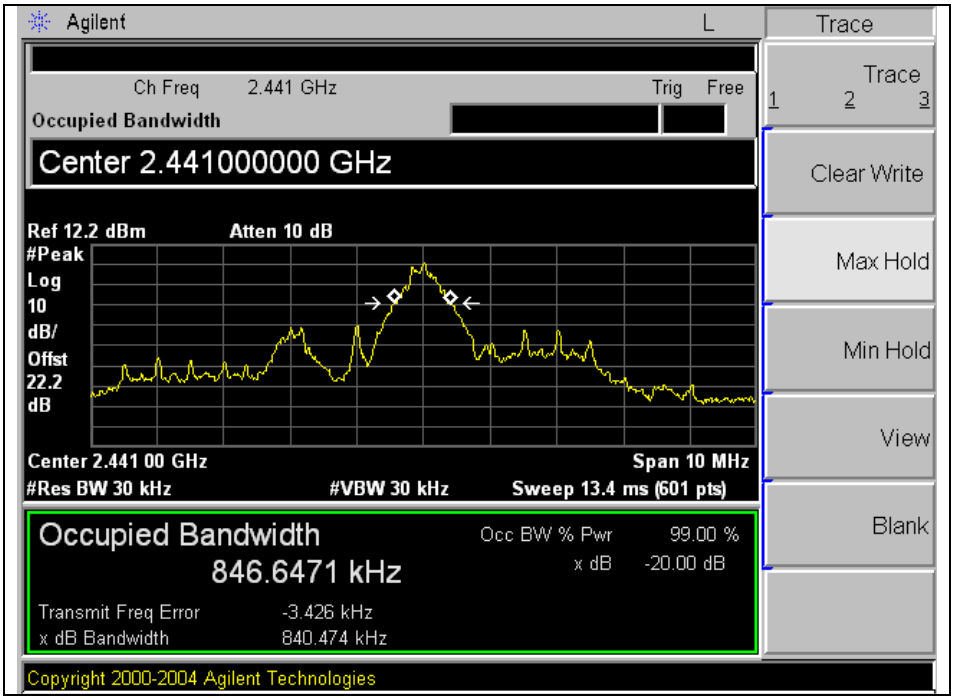
Operation Mode	Channel	Channel Frequency (㎒)	20 dB Bandwidth (㎒)
GFSK	Low	2 402	0.805
	Middle	2 441	0.840
	High	2 480	0.842

20 dB Bandwidth

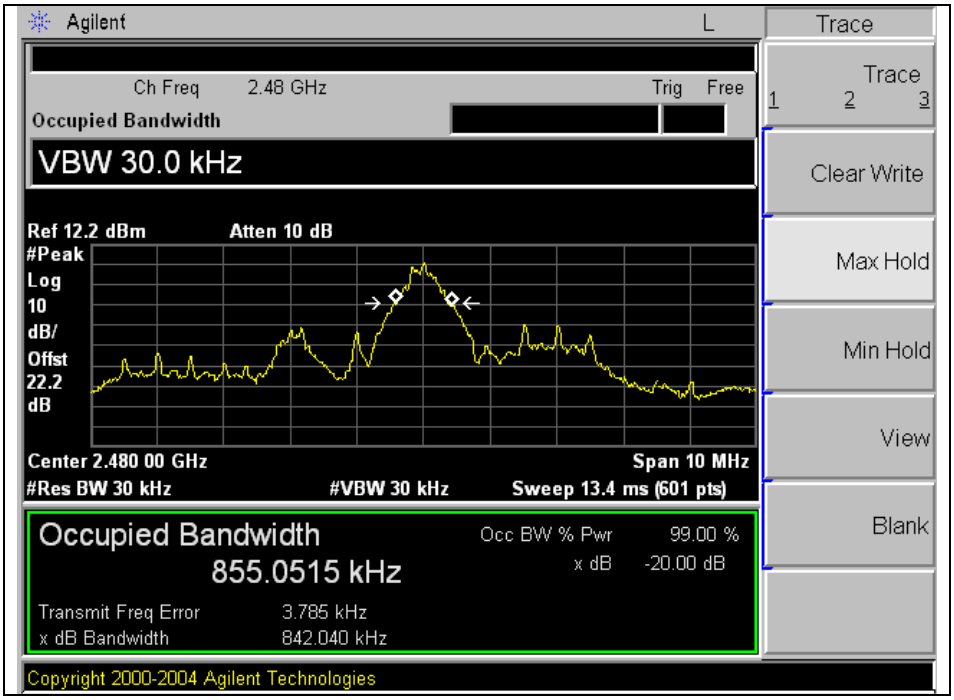
Operating Mode: GFSK
Low Channel



Middle Channel

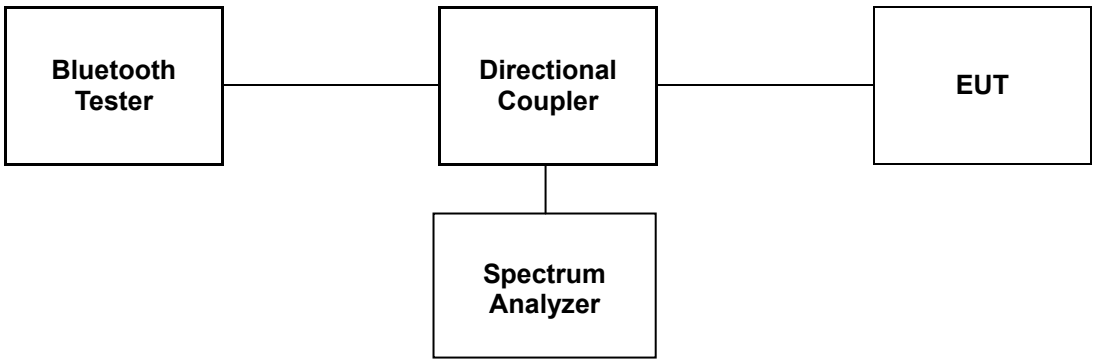


High Channel



4. Maximum Peak Output Power Measurement

4.1. Test Setup



4.2. Limit

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

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.
2. §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 ㎒ band: 1 Watt.

4.3. 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.

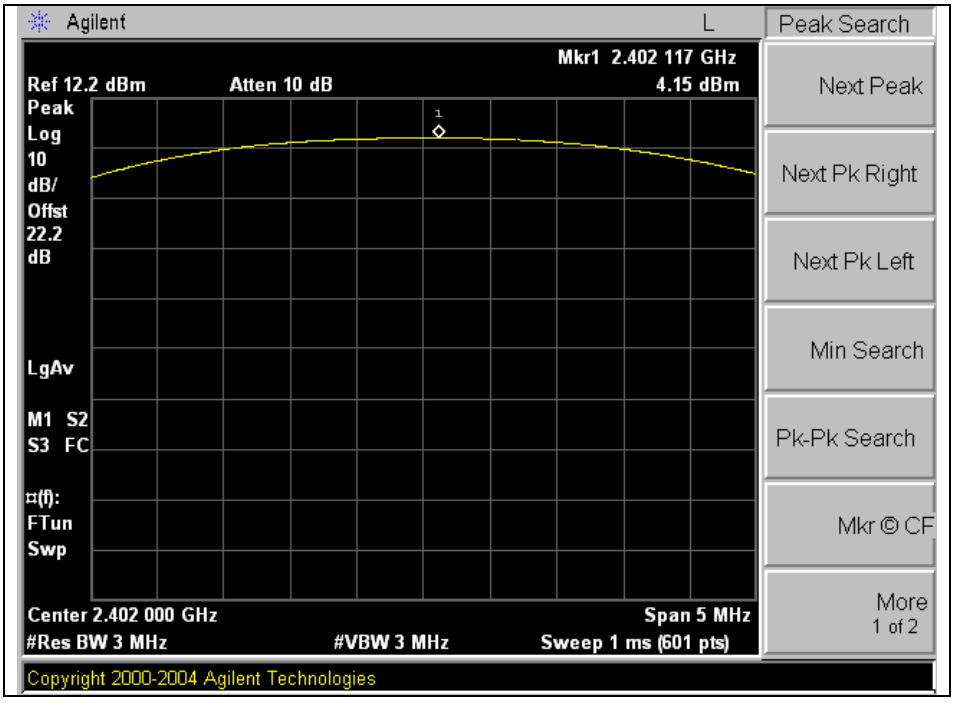
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ;
   Span = approximately 5 times the 20 ㏈ bandwidth, centered on a hopping channel
   RBW ≥ 20㏈ BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

4.4. Test Results

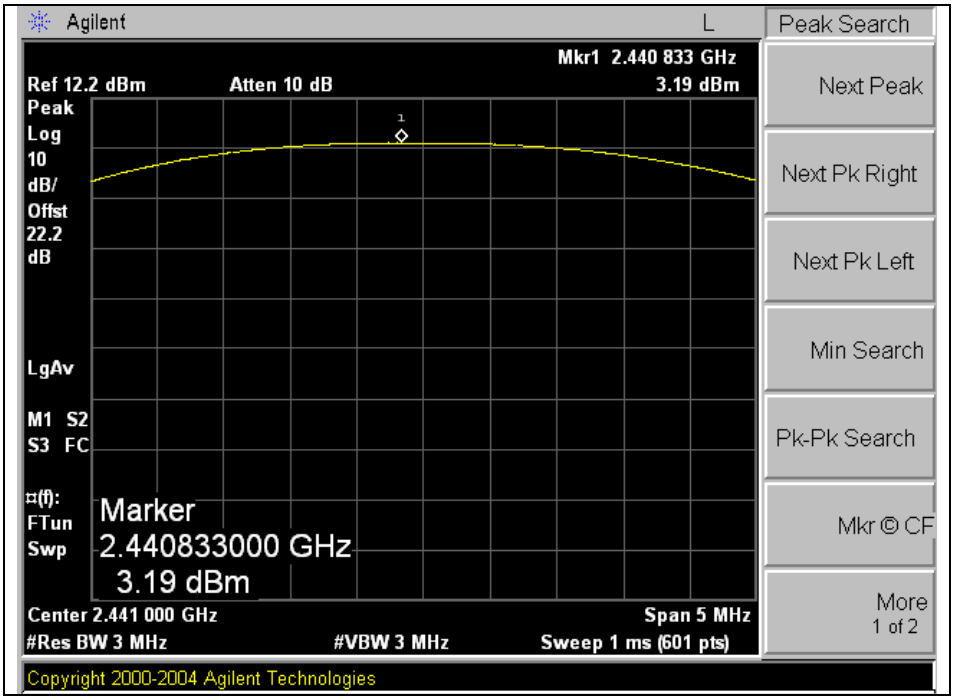
Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Operation Mode	Channel	Channel Frequency (㎒)	Peak Power Output (dB m)	Peak Power Limit (dB m)
GFSK	Low	2 402	4.15	30.00
	Middle	2 441	3.19	30.00
	High	2 480	3.13	30.00

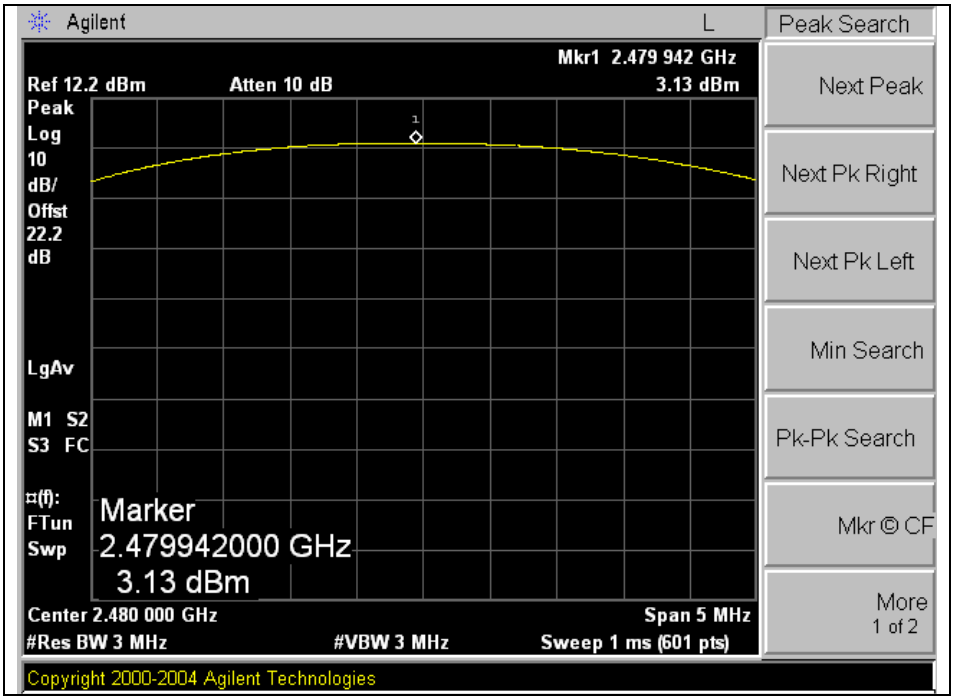
Operating Mode: GFSK
Low Channel



Middle Channel

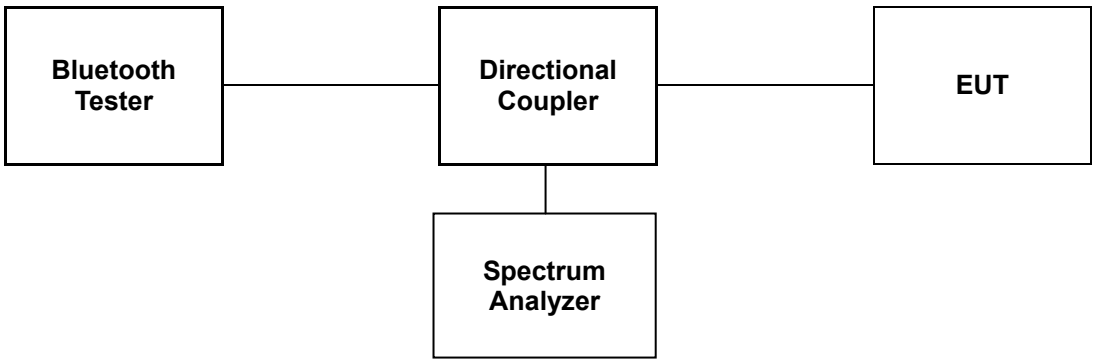


High Channel



5. Hopping Channel Separation

5.1. Test Setup



5.2. Limit

§15.247(a)(1) Frequency hopping system operating in 2 400 – 2 483.5 ㎒. Band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-third of 20 ㏈ bandwidth of the hopping channel, whichever is is greater, provided the systems operate with an output power no greater than 125 ㎽.

5.3. 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 ㎑, VBW = 100 ㎑, Span = 5 ㎒ and Sweep = auto.

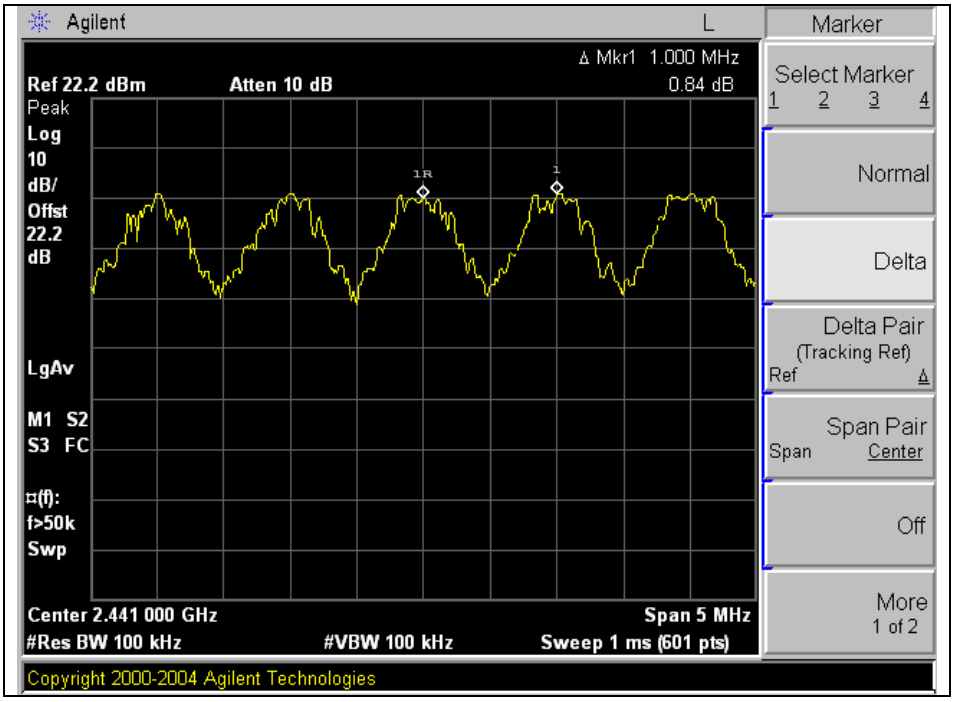
5.4. Test Results

Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Operation Mode	Channel (Middle)	Adjacent Hopping Channel Separation (㎑)	Two-third of 20 ㏈ Bandwidth (㎑)	Minimum Bandwidth (㎑)
GFSK	2 441 ㎒	1 000	560	25

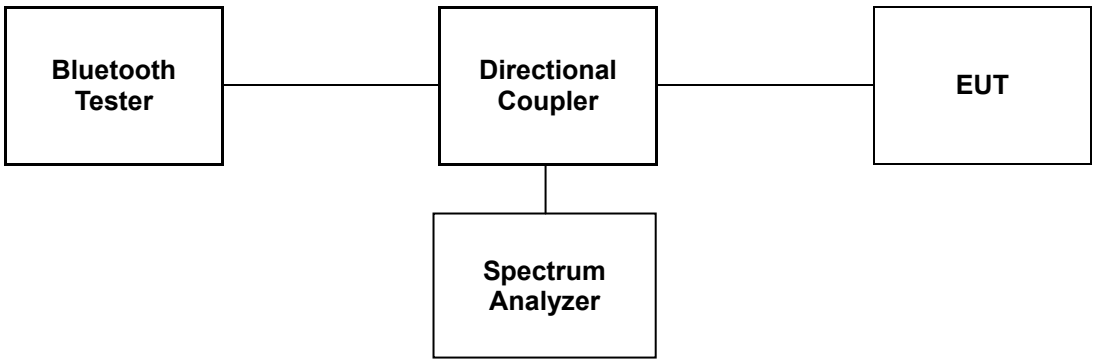
Note ;
20 ㏈ bandwidth measurement, the measured channel separation should be greater than two-third of 20 ㏈ bandwidth or Minimum bandwidth.

Operating Mode: GFSK



6. Number of Hopping Frequency

6.1. Test Setup



6.2. Limit

§15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 ㎒ band: 1 Watt.

6.3. Test Procedure

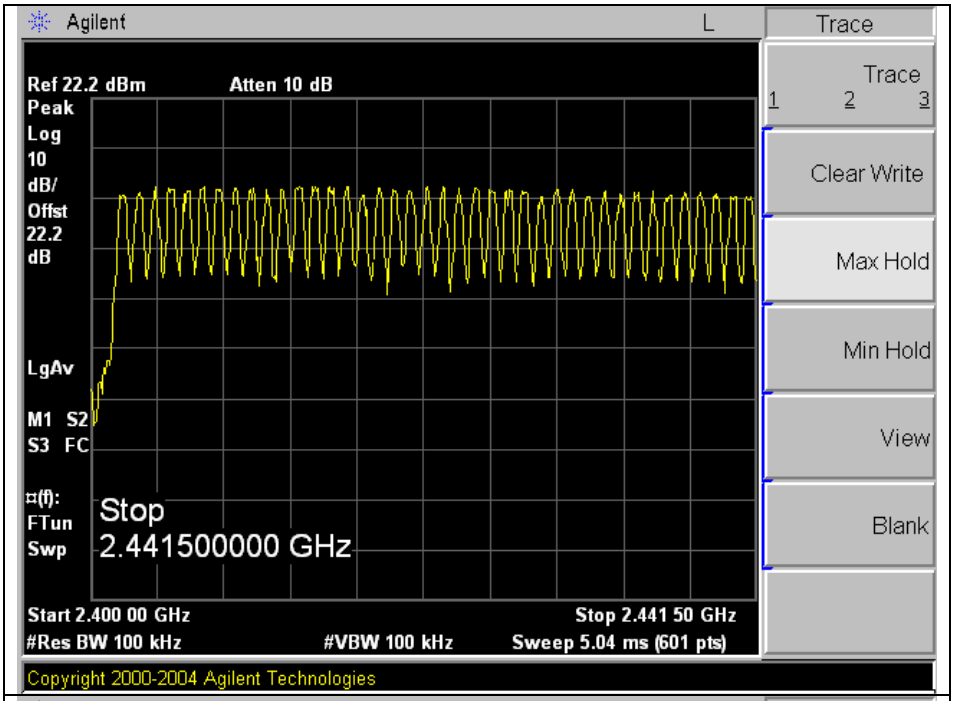
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna the port to the Spectrum analyzer
3. Set spectrum analyzer Start = 2400 ㎒, Stop = 2 441.5 ㎒, Sweep=auto and Start = 2 441.5 ㎒, Stop = 2483.5 ㎒, Sweep = auto.
4. Set the spectrum analyzer as RBW, VBW=100 ㎑.
5. Max hold, view and count how many channel in the band.

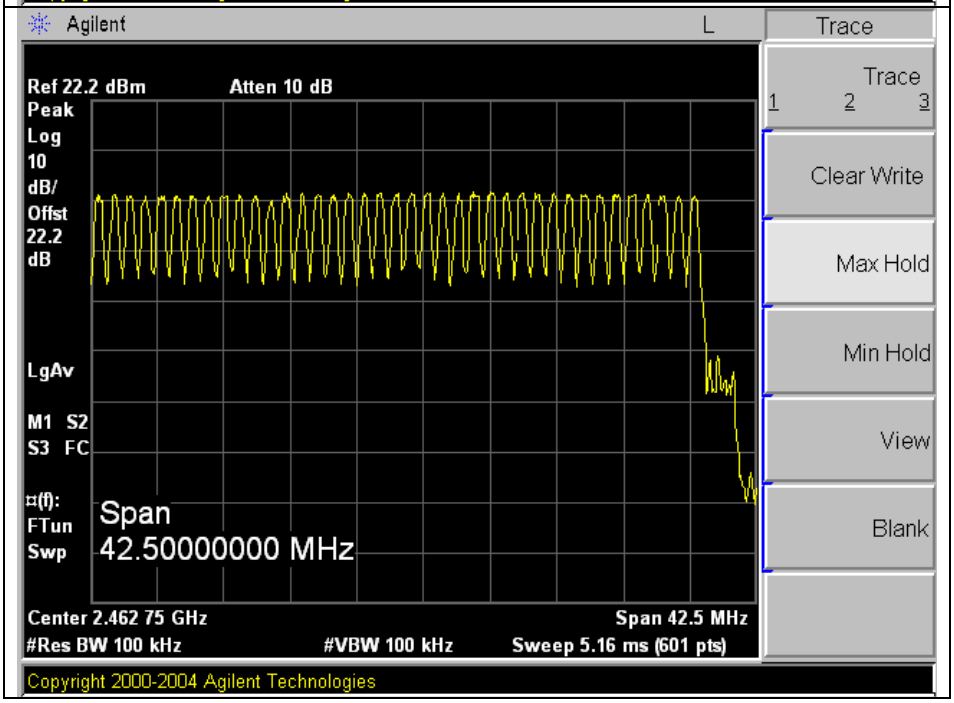
6.4. Test Results

Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

Operation Mode	Number of Hopping Frequency	Limit
GFSK	79	≥ 75

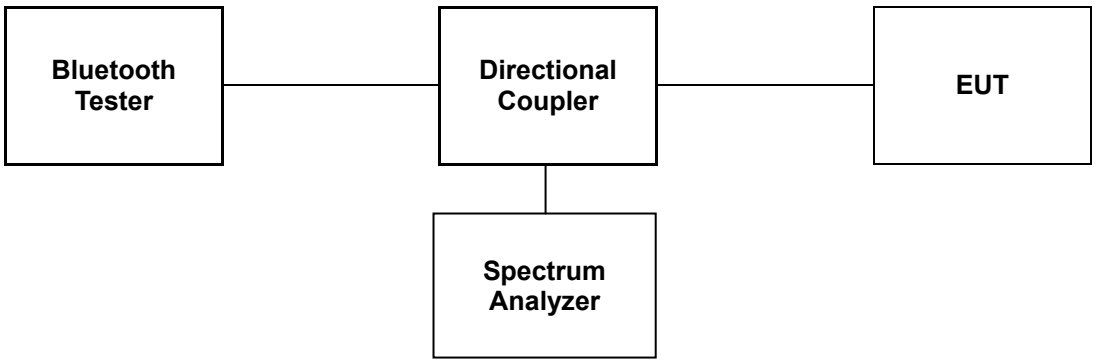
Operating Mode: GFSK





7. Time Of Occupancy (Dwell Time)

7.1. Test Set up



7.2. Limit

§15.247(a)(1)(iii) For frequency hopping system operating in the 2 400 – 2 483.5 ㎒ 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)

7.3. 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 and 3-DH1, 3-DH3, 3-DH5.The hopping rate is 1 600 per second.

7.4. Test Results

Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.

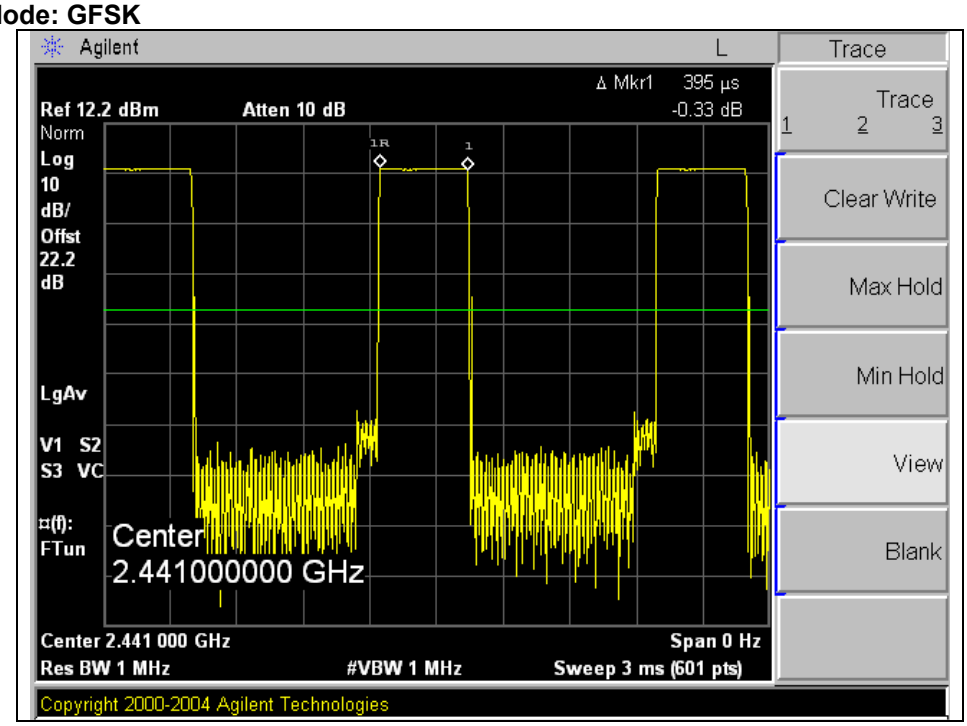
Time of occupancy on the TX channel in 31.6sec
= time domain slot length × (hop rate ÷ number of hop per channel) × 31.6

7.4.1. Packet Type: DH1

Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 31.6 sec (㎳)	Limit for time of occupancy on the Tx Channel in 31.6 sec (㎳)
GFSK	2 441 ㎒	0.395	126.40	400

2 441 ㎒ : 0.395 (㎳) × [(1 600 ÷ 2) ÷79] ×31.6(s) = 126.40 (㎳)

Operating Mode: GFSK

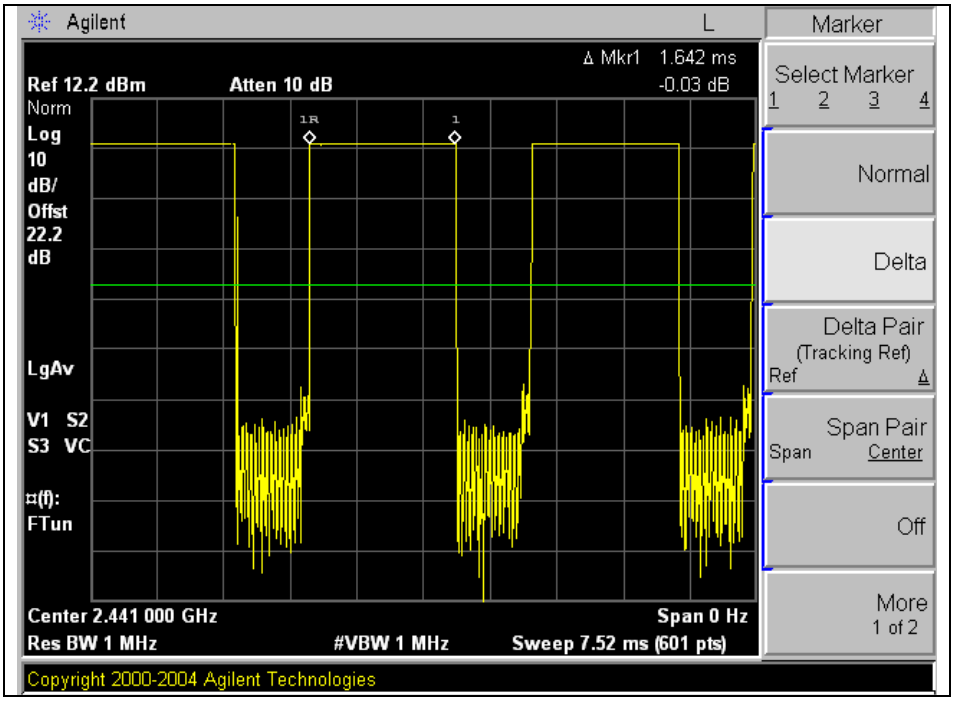


7.4.2. Packet Type: DH3

Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 31.6 sec (㎳)	Limit for time of occupancy on the Tx Channel in 31.6 sec (㎳)
GFSK	2 441 ㎒	1.642	262.72	400

2 441 ㎒ : 1.642 (㎳) × [(1 600 ÷ 4) ÷ 79] ×31.6(s) = 262.72 (㎳)

Operating Mode: GFSK

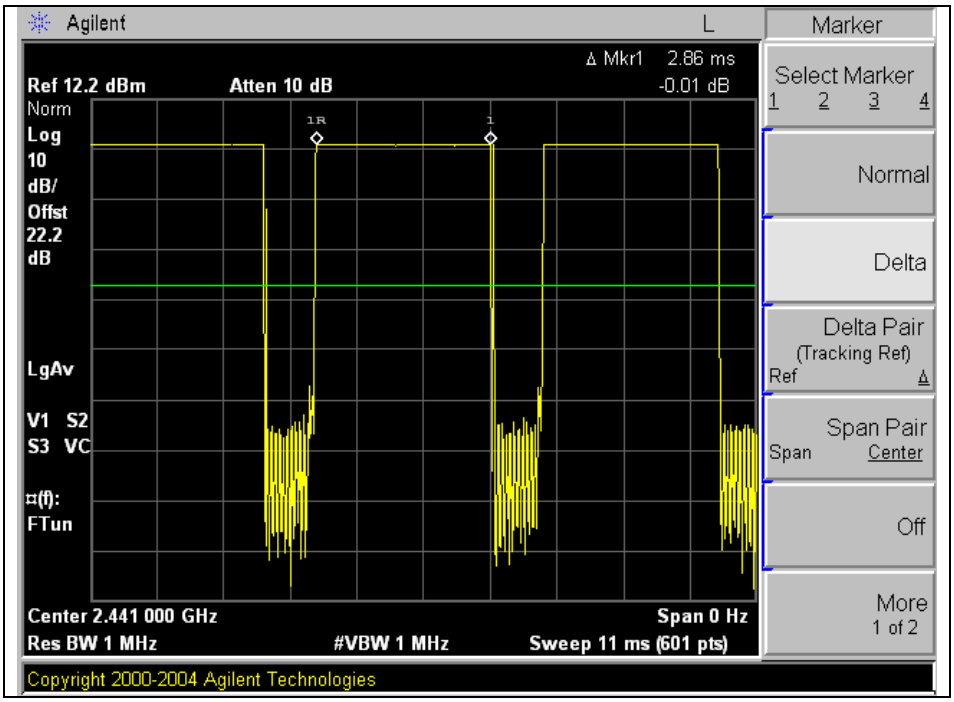


7.4.3. Packet Type: DH5

Operation Mode	Frequency	Dwell Time (㎳)	Time of occupancy on the Tx Channel in 31.6 sec (㎳)	Limit for time of occupancy on the Tx Channel in 31.6 sec (㎳)
GFSK	2 441 ㎒	2.860	305.07	400

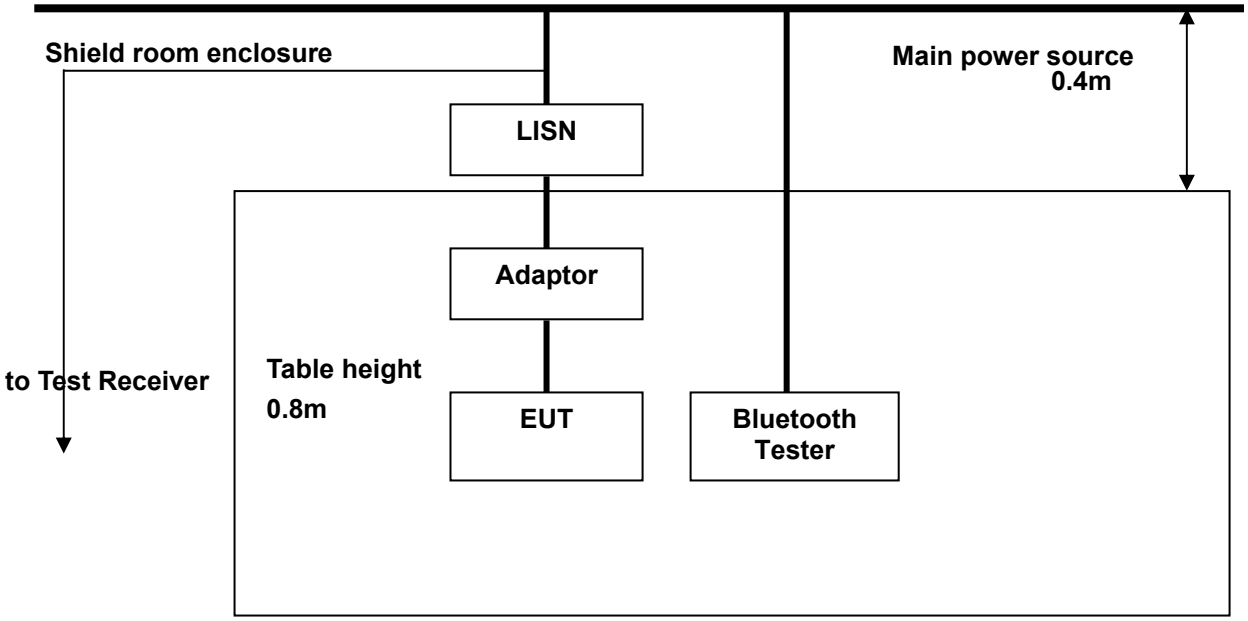
2 441 ㎒ : 2.860 (㎳) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 305.07 (㎳)

Operating Mode: GFSK



8. Transmitter AC Power Line Conducted Emission

8.1. Test Setup



8.2. 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 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 μH/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 (㎒)	Conducted limit (㏈μV)	
	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.

8.3. 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.

8.4. Test Results

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

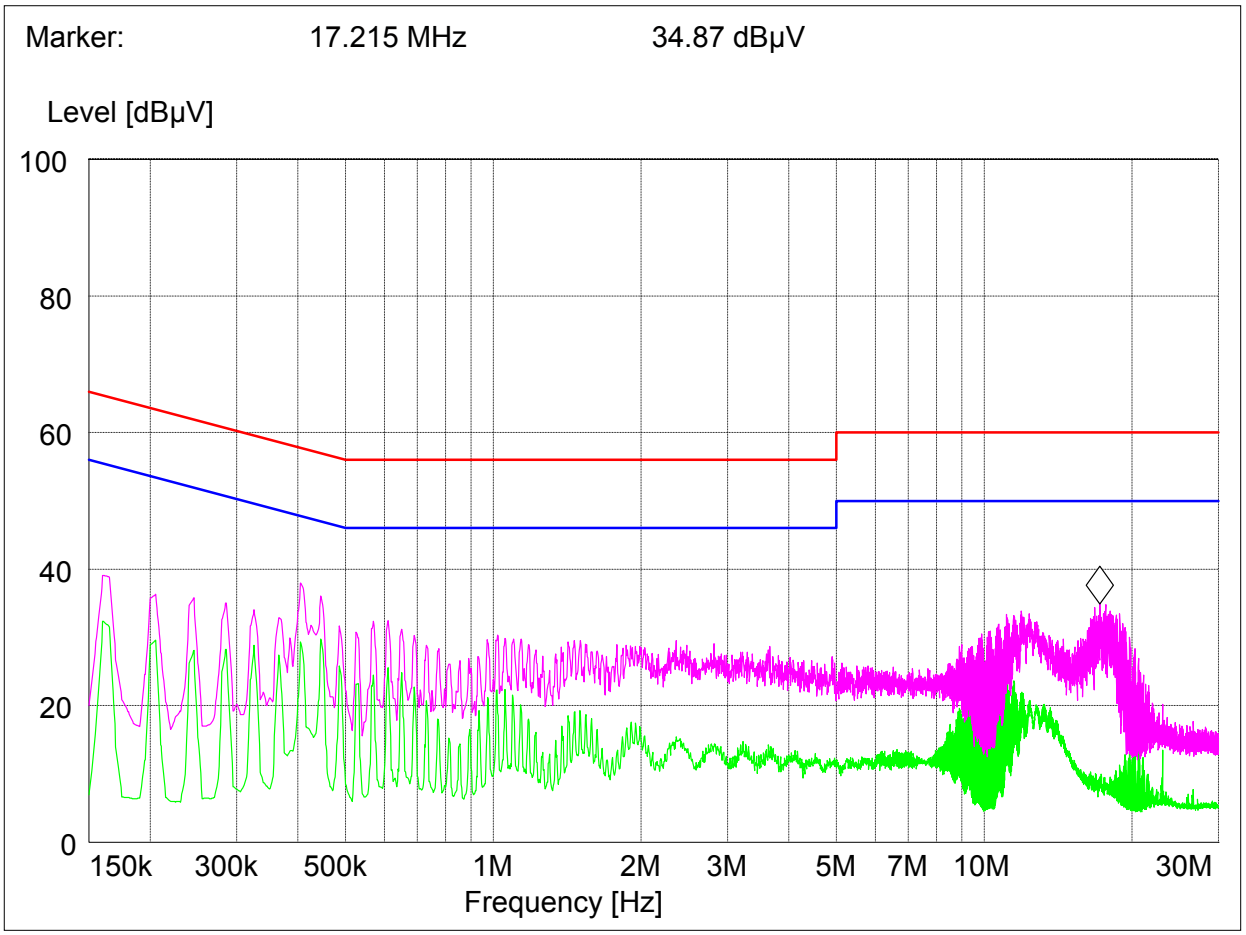
Ambient temperature : (24 ± 2) ℃
Relative humidity : 47 % R.H.
Frequency range : 0.15 ㎒ – 30 ㎒
Measured Bandwidth : 9 ㎑

FREQ.	LEVEL(dBμV)		LINE	LIMIT(dBμV)		MARGIN(dB)	
(㎒)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.160	38.60	32.90	H	65.46	55.46	26.86	22.56
0.205	35.40	30.00	H	63.41	53.41	28.01	23.41
0.245	34.10	28.20	H	61.92	51.92	27.82	23.72
0.405	36.30	29.30	H	57.75	47.75	21.45	18.45
0.445	33.90	30.10	H	56.97	46.97	23.07	16.87
17.215	24.80	9.00	H	60.00	50.00	35.20	41.00
0.160	38.70	30.10	N	65.46	55.46	26.76	25.36
0.200	34.50	25.50	N	63.61	53.61	29.11	28.11
0.405	34.70	30.00	N	57.75	47.75	23.05	17.75
12.400	19.80	12.00	N	60.00	50.00	40.20	38.00
17.235	18.20	6.10	N	60.00	50.00	41.80	43.90
17.940	18.60	5.40	N	60.00	50.00	41.40	44.60

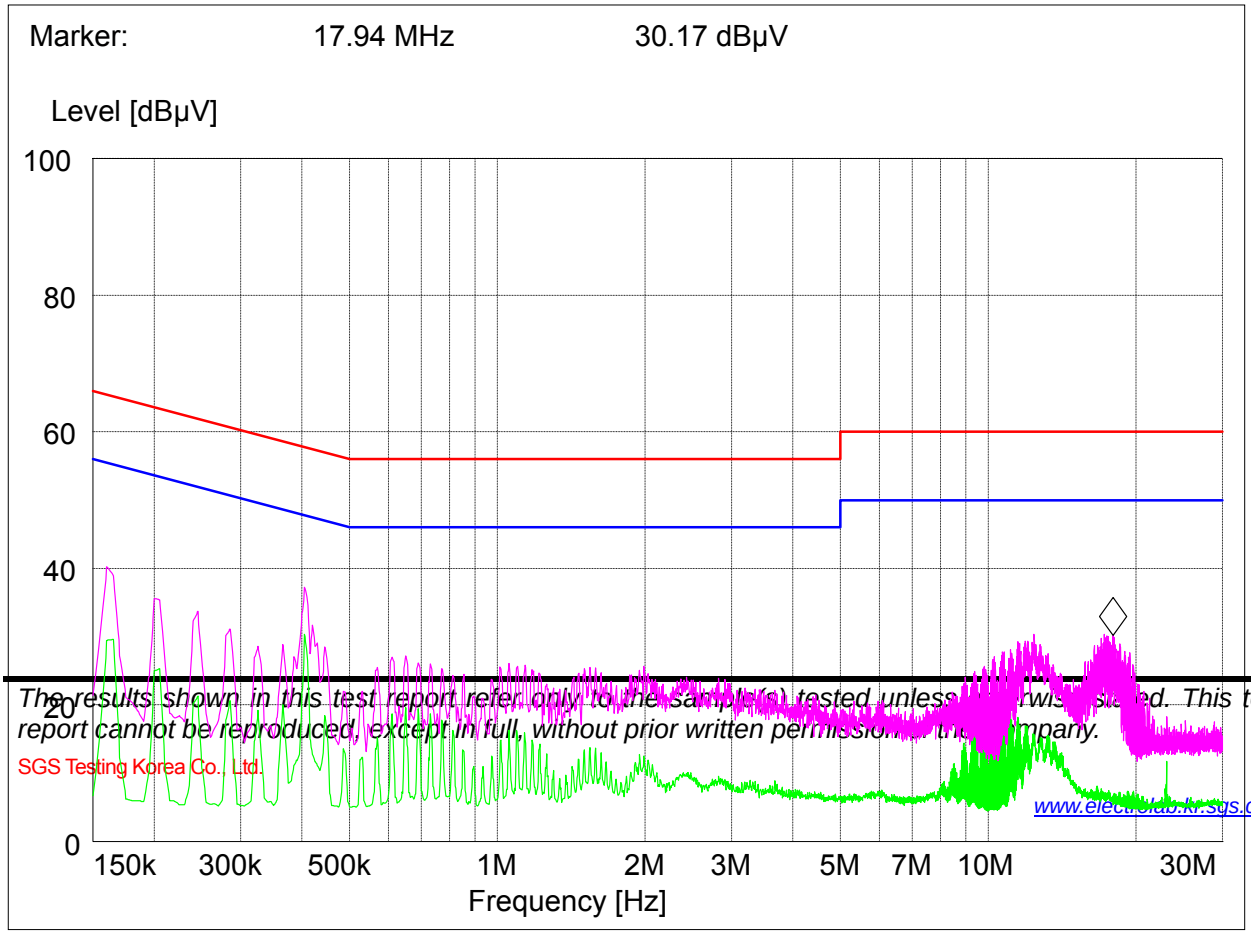
Note ;
Line (H) : Hot
Line (N) : Neutral

Plot of Conducted Power line

Test mode : (Hot)



Test mode : (Neutral)



9. Antenna Requirement

9.1. 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 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

9.2. Antenna Connected Construction

Antenna used in this product is Integral type (Chip Antenna) gain of 0 dBi.

10. RF Exposure Evaluation

10.1 Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310

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
1 500 – 100 000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300 – 1 500	--	--	F/1 500	6
1 500 – 100 000	**--**	**--**	**1**	**30**

10.1.1. 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.

10.1.2. Test Result of RF Exposure Evaluation

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

10.1.3. Output Power into Antenna & RF Exposure Evaluation Distance

Channel	Channel Frequency (MHz)	Output Avg Power to Antenna (dBm)	Antenna Gain (dBi)	Power Density at 20cm (mW/cm^2)	Limits (mW/cm^2)
Low	2 402	-1.07	0	0.000 16	1
Middle	2 441	-1.36	0	0.000 15	
High	2 480	-1.65	0	0.000 14	

Note :
1. For GFSK mode.
2. The power density Pd (5th column) at a distance of 20cm calculated from the friis transmission formula is far below the limit of 1 mW/cm^2 .