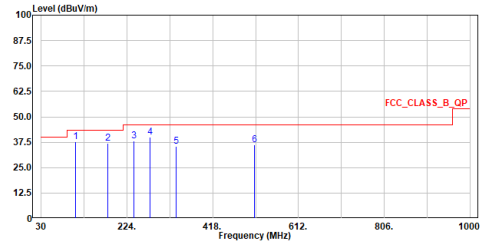
4.5. Test Result of Radiated Emissions (30 MHz ~ 1 GHz)

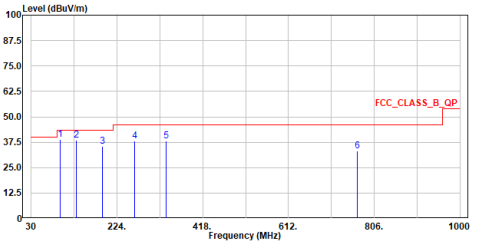
Site :HC-CB04
Condition :3m Horizontal
Mode :LF_BT_GFSK_TX_2402MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	108.085	37.57	43.50	-5.93	44.06	-6.49	QP
2	180.350	37.11	43.50	-6.39	41.53	-4.42	QP
3	240.490	37.94	46.00	-8.06	42.48	-4.54	QP
4	275.895	39.93	46.00	-6.07	42.89	-2.96	QP
5	335.550	35.30	46.00	-10.70	36.69	-1.39	QP
6	512.090	36.39	46.00	-9.61	33.45	2.94	QP

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission under 30MHz was not included since the emission levels are very low against the limit.
5. The other emission levels were very low against the limit.

Site :HC-CB04
Condition :3m Vertical
Mode :LF_BT_GFSK_TX_2402MHz
Test By :Scott

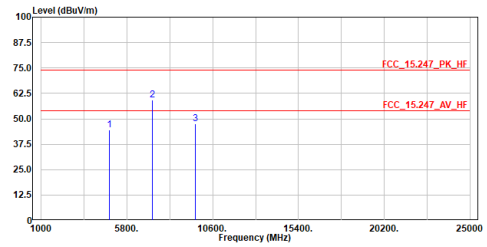


No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	95.960	38.98	43.50	-4.52	47.32	-8.34	QP
2	132.335	38.41	43.50	-5.09	42.47	-4.06	QP
3	191.505	35.62	43.50	-7.88	41.53	-5.91	QP
4	263.770	38.30	46.00	-7.70	41.89	-3.59	QP
5	335.550	37.97	46.00	-8.03	39.36	-1.39	QP
6	768.170	33.22	46.00	-12.78	25.45	7.77	QP

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The emission under 30MHz was not included since the emission levels are very low against the limit.
5. The other emission levels were very low against the limit.

4.6. Test Result of Radiated Emissions (1 GHz ~ 10th Harmonic)

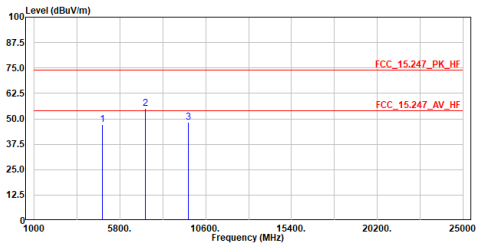
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_2402MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4804.000	44.50	74.00	-29.50	60.43	-15.93	Peak
2	7206.000	59.26	74.00	-14.74	69.74	-10.48	Peak
3	9608.000	47.52	74.00	-26.48	53.99	-6.47	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

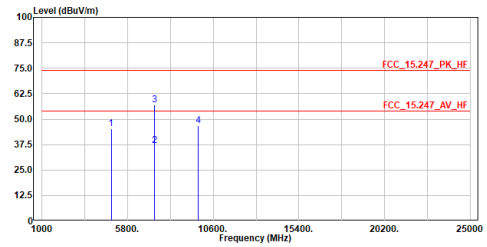
Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_2402MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4804.000	47.14	74.00	-26.86	63.07	-15.93	Peak
2	7206.000	55.09	74.00	-18.91	65.57	-10.48	Peak
3	9608.000	48.47	74.00	-25.53	54.94	-6.47	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

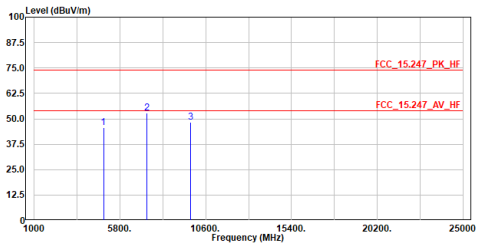
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_2441MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4882.000	45.32	74.00	-28.68	60.97	-15.65	Peak
2	7323.000	36.99	54.00	-17.01	47.24	-10.25	Average
3	7323.000	56.99	74.00	-17.01	67.24	-10.25	Peak
4	9764.000	46.64	74.00	-27.36	52.89	-6.25	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.
6. The calculation of average value :
   Average value = Peak value + Duty cycle correction factor (The duty cycle correction factor refer to section "Duty Cycle")

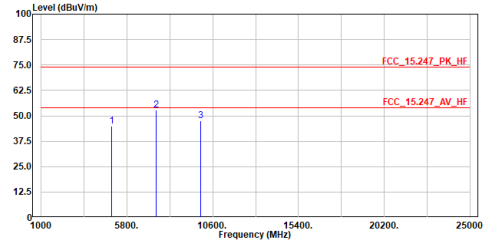
Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_2441MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4882.000	45.70	74.00	-28.30	61.35	-15.65	Peak
2	7323.000	52.95	74.00	-21.05	63.20	-10.25	Peak
3	9764.000	48.33	74.00	-25.67	54.58	-6.25	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

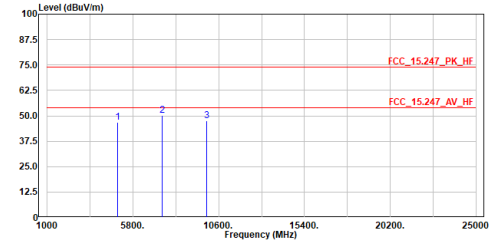
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_2480MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	44.80	74.00	-29.20	60.17	-15.37	Peak
2	7440.000	52.73	74.00	-21.27	62.76	-10.03	Peak
3	9920.000	47.41	74.00	-26.59	53.43	-6.02	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_2480MHz
Test By :Scott

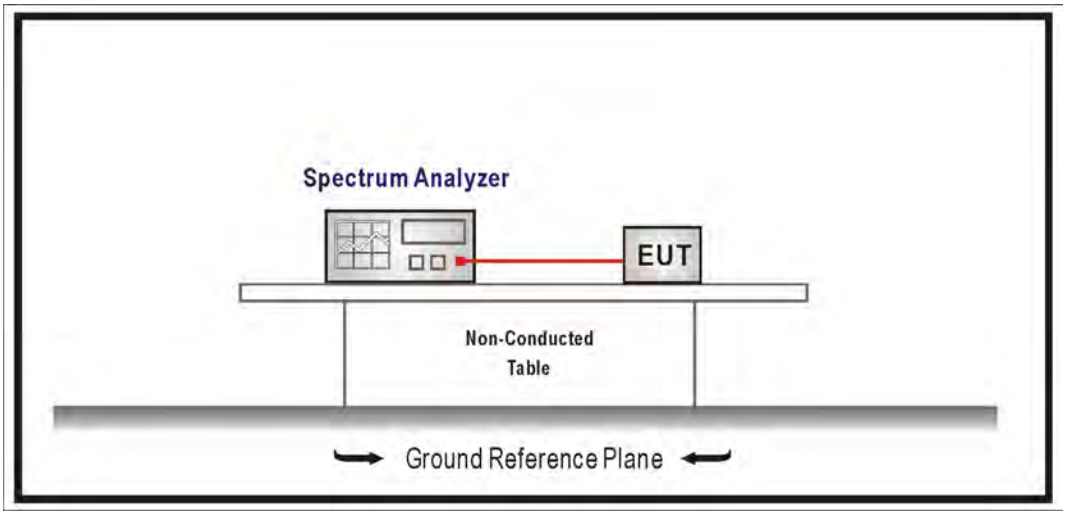


No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	4960.000	46.62	74.00	-27.38	61.99	-15.37	Peak
2	7440.000	50.21	74.00	-23.79	60.24	-10.03	Peak
3	9920.000	47.46	74.00	-26.54	53.48	-6.02	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

5. Antenna Port Conducted Emission

5.1. Test Setup



5.2. Test Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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 an RF conducted or radiated measurement. Attenuation below the general limit 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 limit specified in Section 15.209(a) (see Section 15.205(c)).

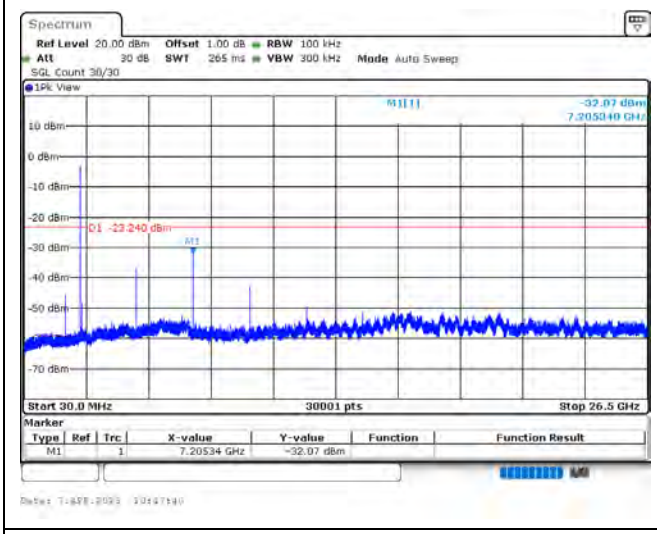
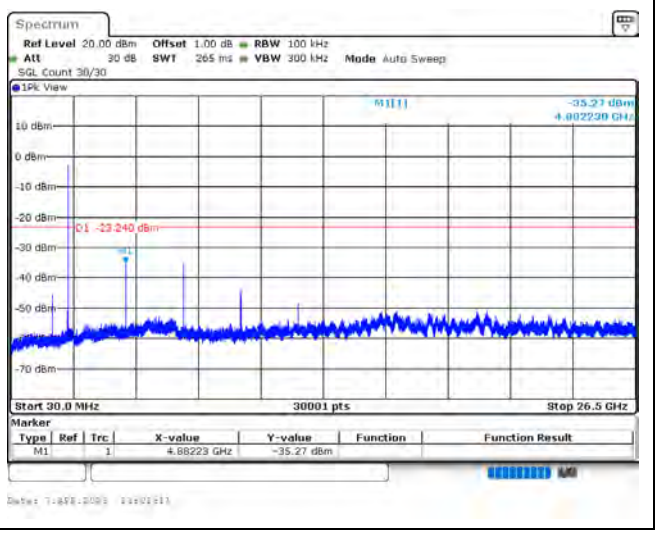
5.3. Test Procedure

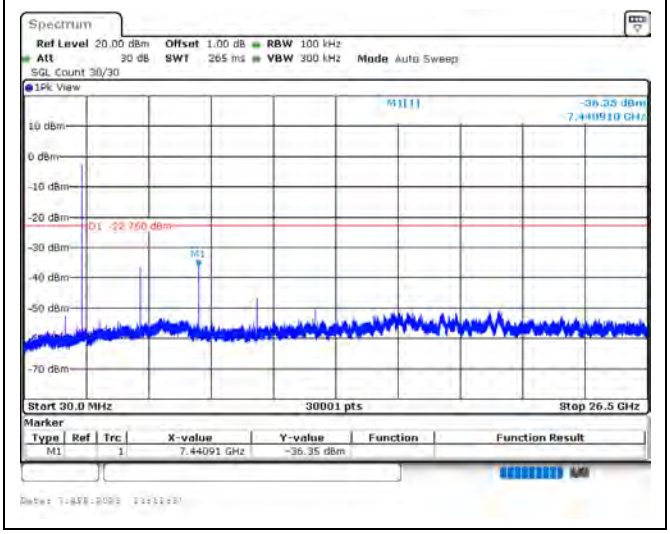
The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247

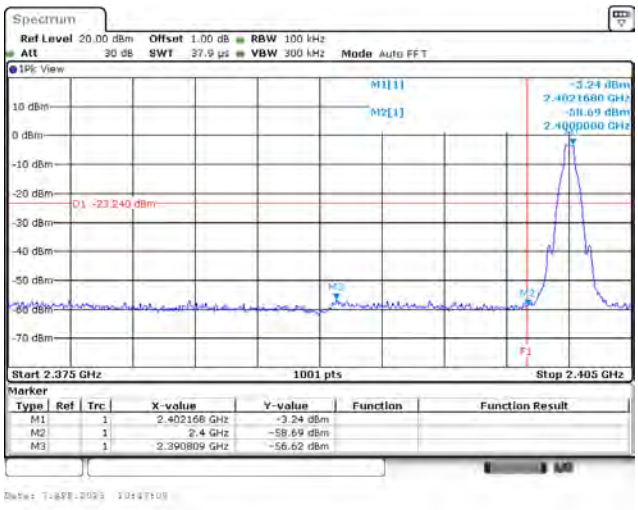
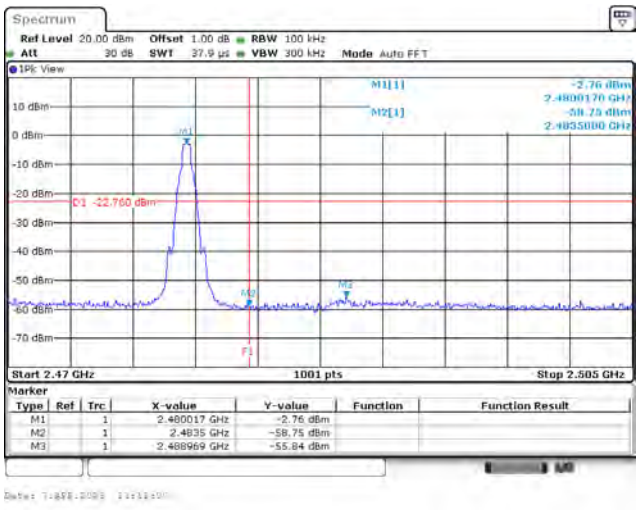
5.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

5.5. Test Result of Antenna Port Conducted Emission

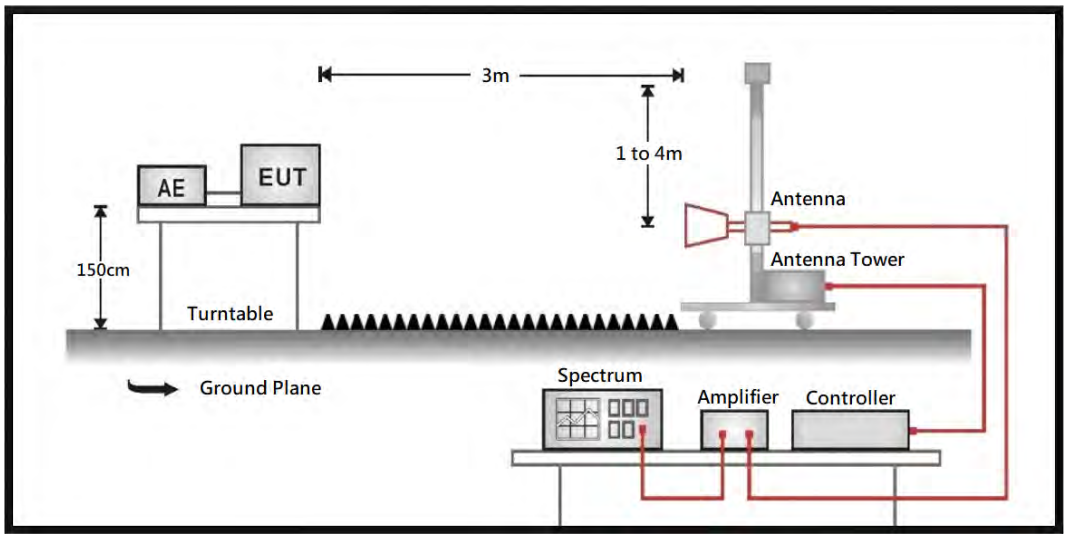
GFSK / 2402 MHz	GFSK / 2441 MHz
	

GFSK / 2480 MHz


GFSK / 2402 MHz (Band Edge)	GFSK / 2480 MHz (Band Edge)
	

6. Radiated Emission Band Edge

6.1. Test Setup



6.2. Test Limit

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general radiated emission limit in paragraph 15.209, whichever is the lesser attenuation.

Frequency (MHz)	Field strength (uV/m)	Field strength (dBuV/m)	Measurement distance (m)
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

Remarks:

1. Field strength (dBuV/m) = 20 log Field strength (uV/m)
2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

6.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to the FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements.

The EUT and its simulators are placed on a turn table which is 1.5 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

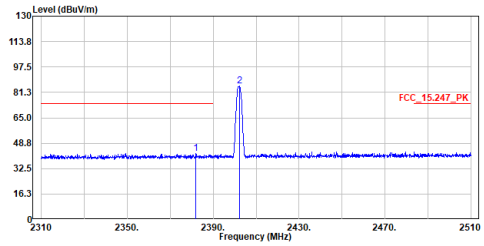
6.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

6.5. Test Result of Radiated Emission Band Edge

Band Edge

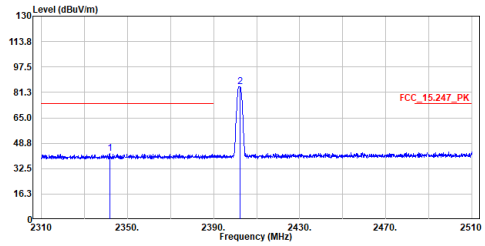
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_2402MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2382.000	42.24	74.00	-31.76	30.24	12.00	Peak
2	2402.300	85.11	------	------	73.02	12.09	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

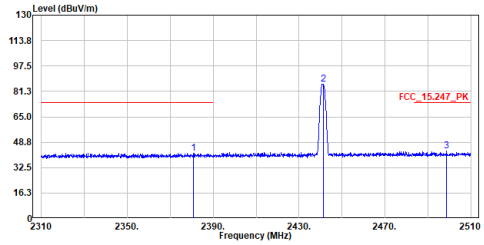
Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_2402MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2341.800	42.07	74.00	-31.93	30.25	11.82	Peak
2	2402.200	85.03	------	------	72.94	12.09	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

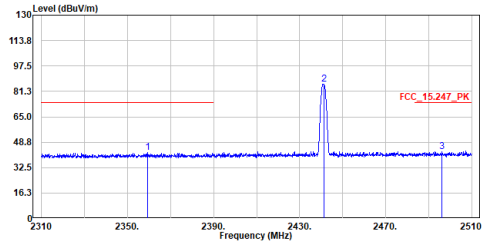
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_2441MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2381.000	41.86	74.00	-32.14	29.86	12.00	Peak
2	2441.300	85.89	------	------	73.61	12.28	Peak
3	2498.600	42.95	74.00	-31.05	30.40	12.55	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

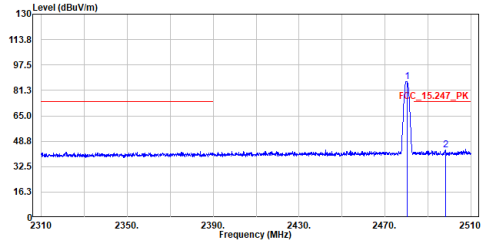
Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_2441MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2359.300	42.29	74.00	-31.71	30.39	11.90	Peak
2	2441.300	86.05	------	------	73.77	12.28	Peak
3	2496.100	42.90	74.00	-31.10	30.37	12.53	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

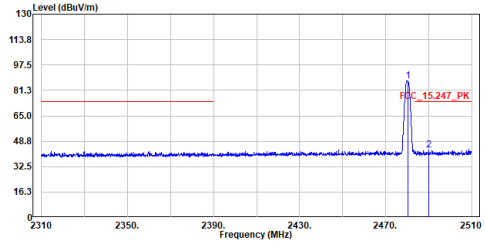
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_2480MHz
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2480.200	86.73	------	------	74.27	12.46	Peak
2	2498.200	42.94	74.00	-31.06	30.39	12.55	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_2480MHz
Test By :Scott

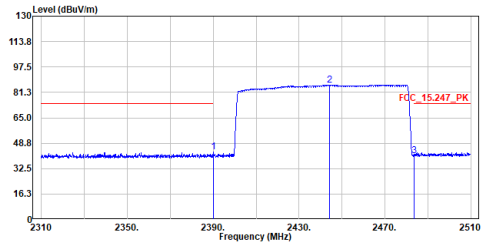


No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2480.300	87.18	------	------	74.72	12.46	Peak
2	2490.000	43.02	74.00	-30.98	30.52	12.50	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Band Edge – Hopping

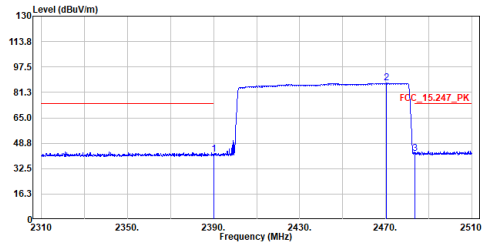
Site :HC-CB04
Condition :3m ,Horizontal
Mode :BT_GFSK_TX_Hopping
Test By :Scott



No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2390.000	43.09	74.00	-30.91	31.06	12.03	Peak
2	2444.300	85.95	------	------	73.66	12.29	Peak
3	2483.500	40.77	74.00	-33.23	28.30	12.47	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

Site :HC-CB04
Condition :3m ,Vertical
Mode :BT_GFSK_TX_Hopping
Test By :Scott

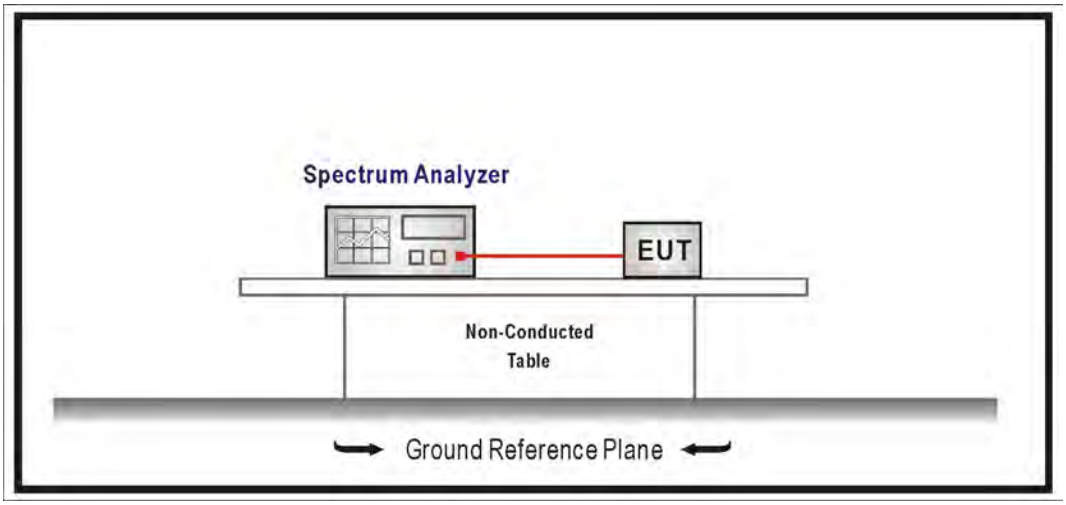


No.	Frequency	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	
1	2390.000	41.57	74.00	-32.43	29.54	12.03	Peak
2	2470.300	87.08	------	------	74.67	12.41	Peak
3	2483.500	42.15	74.00	-31.85	29.68	12.47	Peak

Note:
1. Level = Read Level + Factor
2. Factor = Antenna Factor + Cable Loss - Preamp Factor
3. Over Limit = Level - Limit Line
4. The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
5. The other emission levels were very low against the limit.

7. Number of Hopping Frequency

7.1. Test Setup



7.2. Test Limit

For frequency hopping systems operating in the 902 ~ 928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Frequency hopping systems in the 2400 ~ 2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Frequency hopping systems operating in the 5725 ~ 5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

7.3. Test Procedures

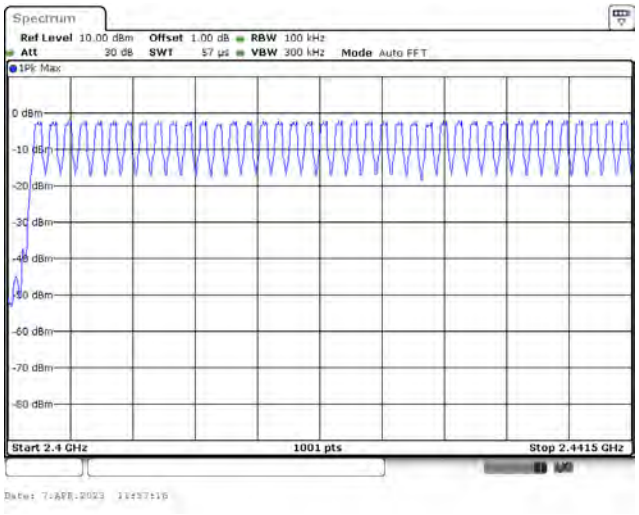
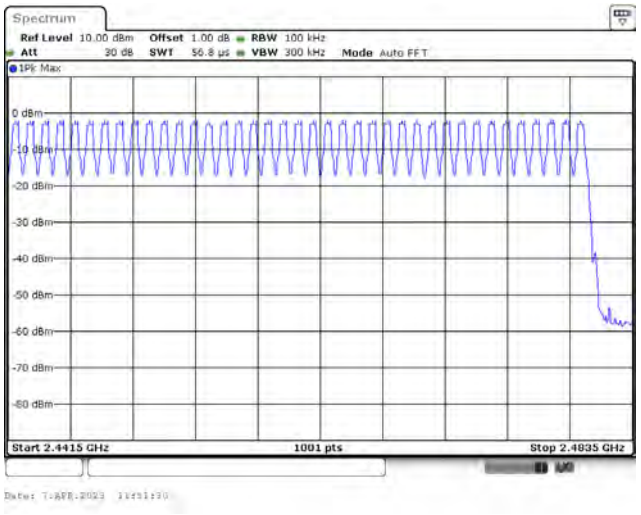
The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements.

7.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

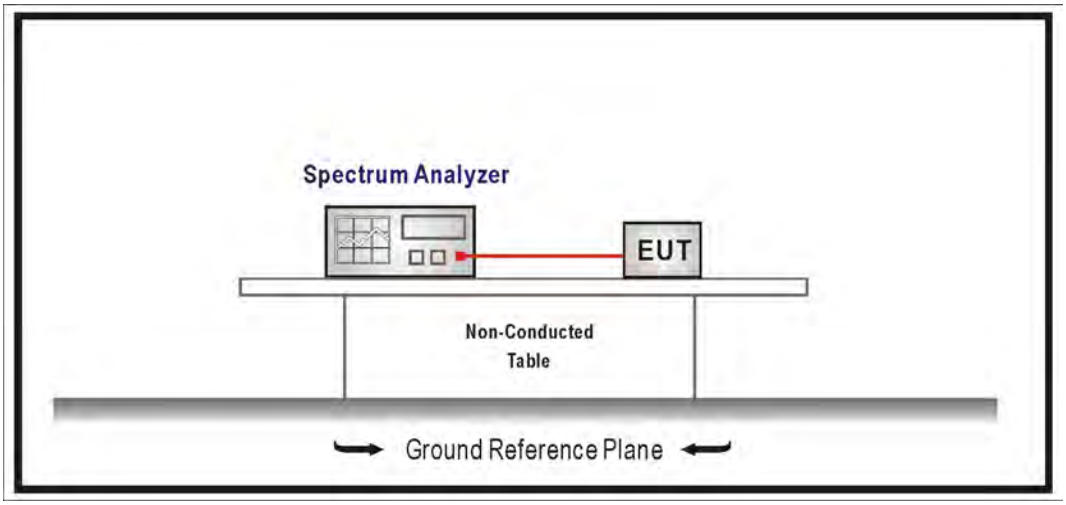
7.5. Test Result of Number of Hopping Frequency

Frequency Range (MHz)	Measure Level (Channels)	Limit (Channels)
2402 ~ 2480	79	≧ 75

2400 ~ 2441.5 MHz	2441.5 ~ 2483.5 MHz
	

8. Carrier Frequency Separation

8.1. Test Setup



8.2. Test Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, 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, provided the systems operate with an Maximum Conducted Output Power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

8.3. Test Procedures

The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements.

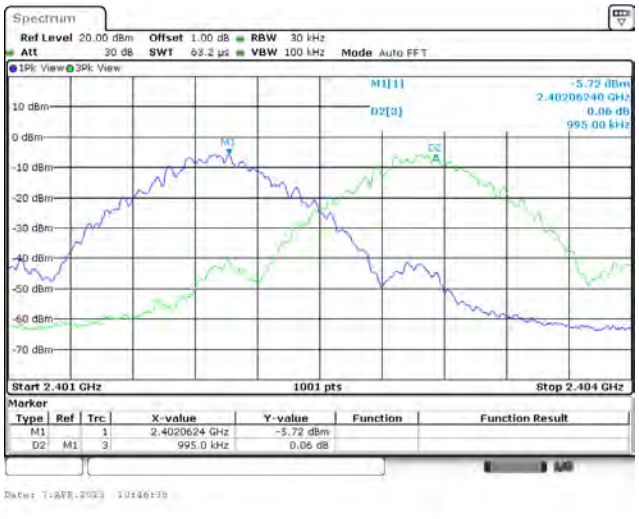
8.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

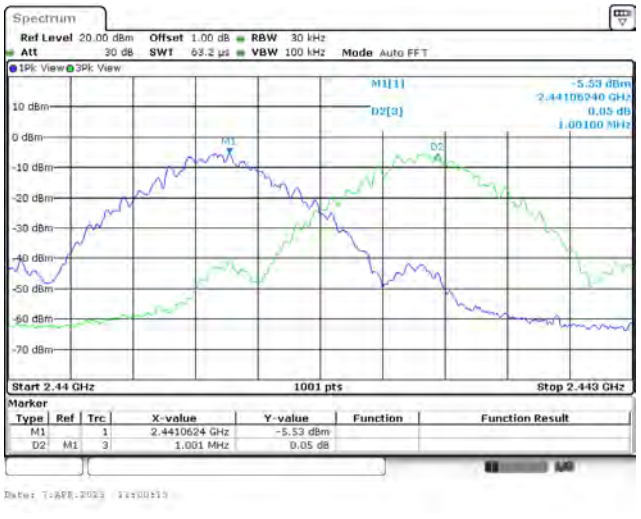
8.5. Test Result of Carrier Frequency Separation

Modulation	Channel	Frequency (MHz)	Measure Level (MHz)	Limit (MHz)	Result
GFSK	00	2402	0.995	≧0.730	Pass
	39	2441	1.001	≧0.730	Pass
	78	2480	0.998	≧0.730	Pass

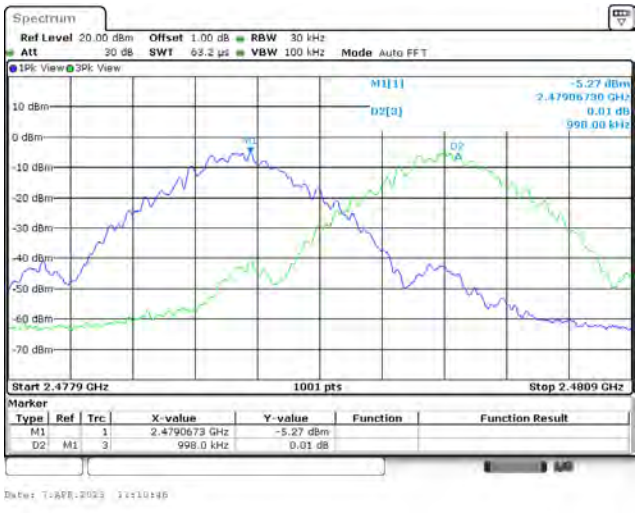
GFSK / 2402 MHz



GFSK / 2441 MHz

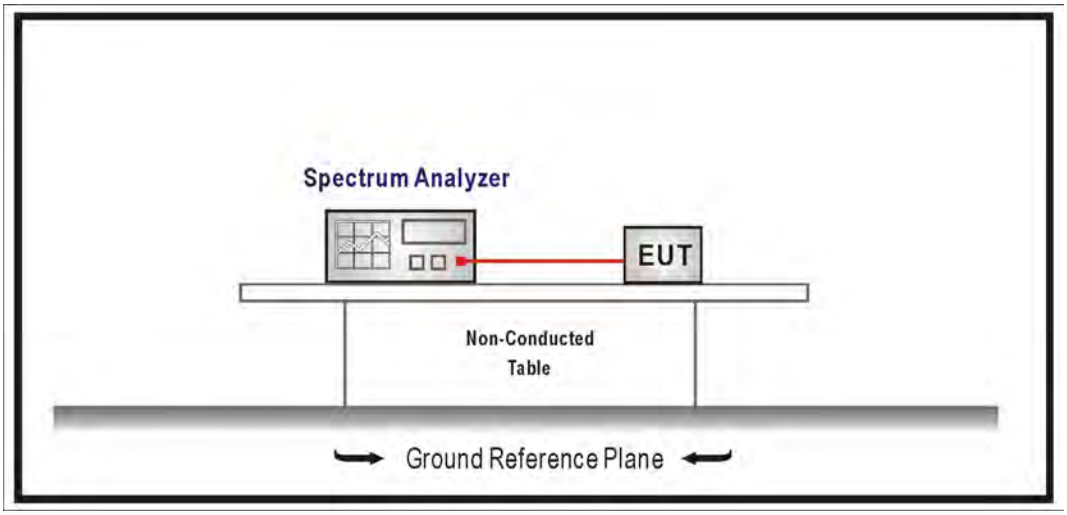


GFSK / 2480 MHz



9. 20dB Bandwidth

9.1. Test Setup



9.2. Test Limit

N/A

9.3. Test Procedures

The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW ≥ 1% of the 20 dB bandwidth, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold,

The EUT should be transmitting at its maximum data rate.

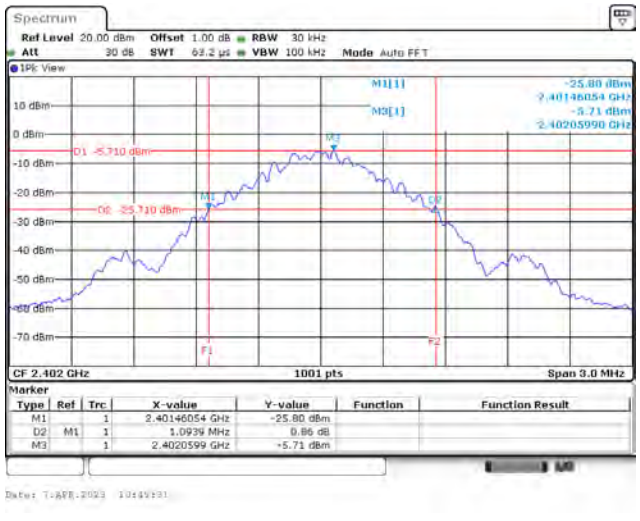
9.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

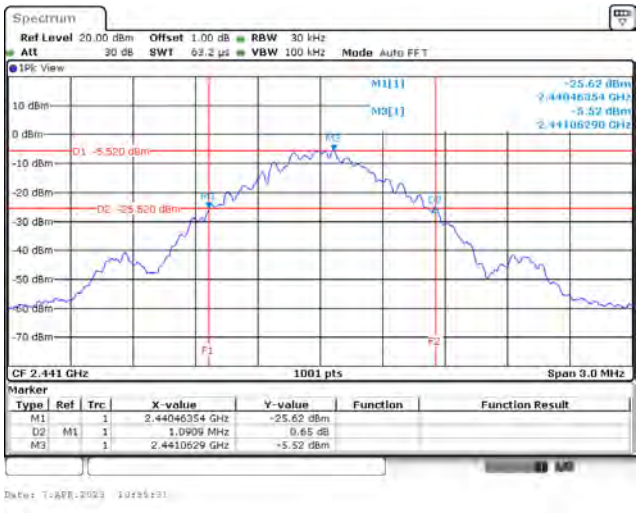
9.5. Test Result of 20dB Bandwidth

Modulation	Channel	Frequency (MHz)	Measure Level (MHz)	Limit (MHz)
GFSK	00	2402	1.093	-
	39	2441	1.090	-
	78	2480	1.090	-

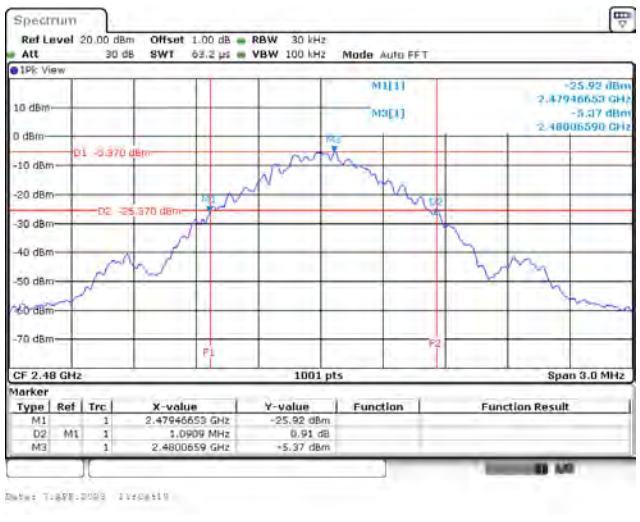
GFSK / 2402 MHz



GFSK / 2441 MHz

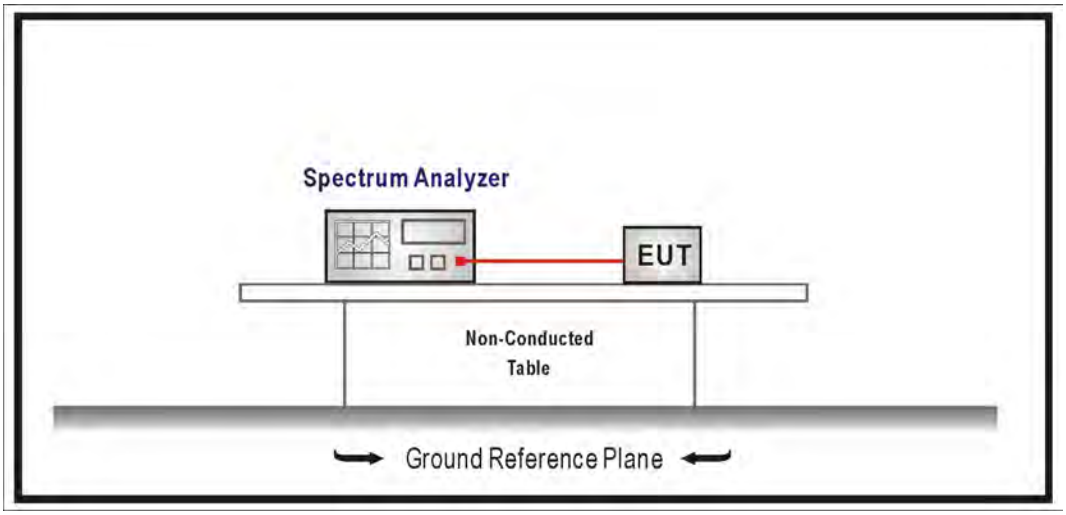


GFSK / 2480 MHz



10. Dwell Time

10.1. Test Setup



10.2. Test Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

For frequency hopping systems operating in the 2400-2483.5 MHz bands. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

For frequency hopping systems operating in the 5725-5850 MHz bands. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

10.3. Test Procedures

The EUT was setup according to ANSI C63.10: 2013 and tested according to FHSS test procedure of FCC KDB 558074 D01 v05r02 for compliance to FCC 47CFR 15.247 requirements

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 function = peak, Trace = max hold.

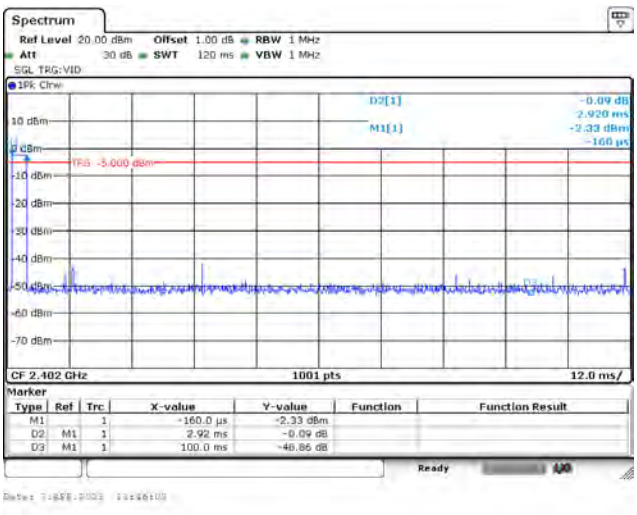
10.4. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247.

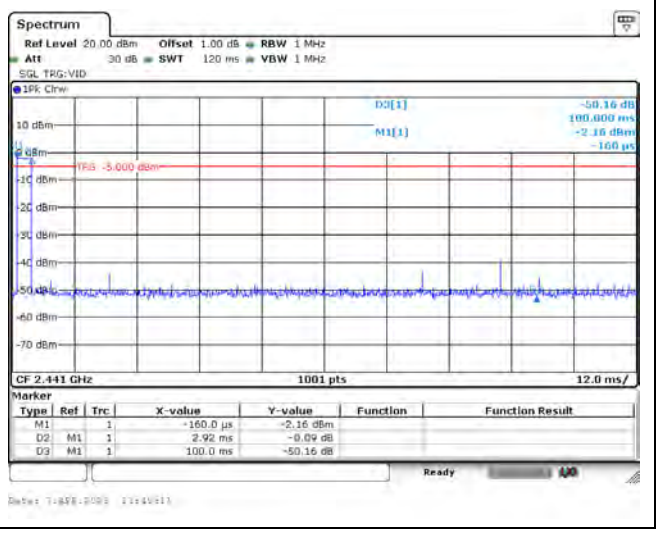
10.5. Test Result of Dwell Time

Modulation	Occupancy Time of Frequency Hopping System
GFSK	A) 2402 MHz Test Time Period: 0.4*79=31.60 sec, Time slot length : 2.920 ms = 0.002920 sec
	Dwell Time : 0.002920 *(266.67/79)*31.60 = 0.3115 sec
	B) 2441 MHz Test Time Period: 0.4*79=31.60 sec, Time slot length : 2.920 ms = 0.002920 sec
	Dwell Time : 0.002920 *(266.67/79)*31.60 = 0.3115 sec
	C) 2480 MHz Test Time Period: 0.4*79=31.60 sec, Time slot length : 3.000 ms = 0.003000 sec
	Dwell Time : 0.003000 *(266.67/79)*31.60 = 0.3200 sec
Test Result: The Average Occupancy Time of Each Highest, Middle and Lowest Channel Is Less Than 0.4 sec, And Corresponds to The Standard。	

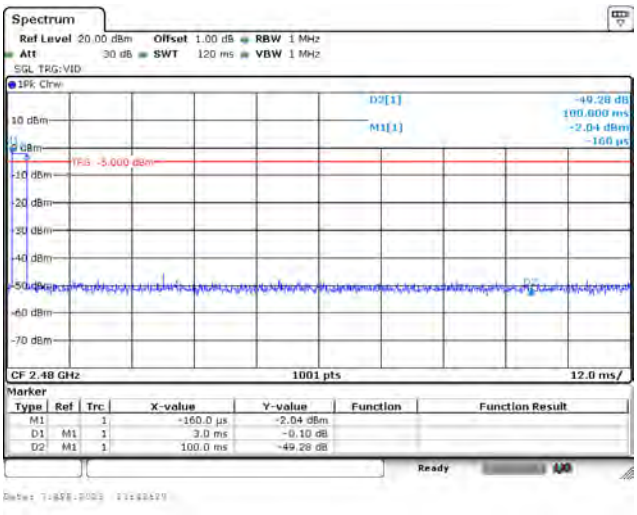
Hop rate / GFSK / 2402 MHz



Hop rate / GFSK / 2441 MHz



Hop rate / GFSK / 2480 MHz



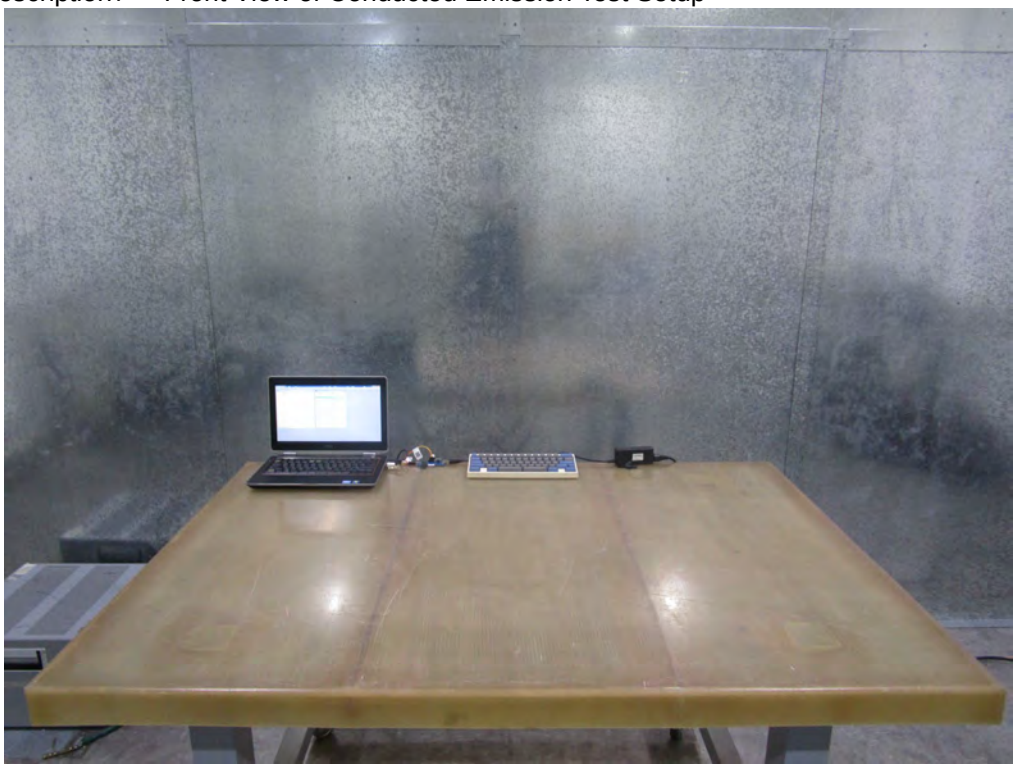
Note: Dwell time＝time slot length * hop rate / number of hopping channels * period.

Appendix A

➢ Test Setup Photograph

<AC Power Line Conducted Emission>

Description： Front View of Conducted Emission Test Setup

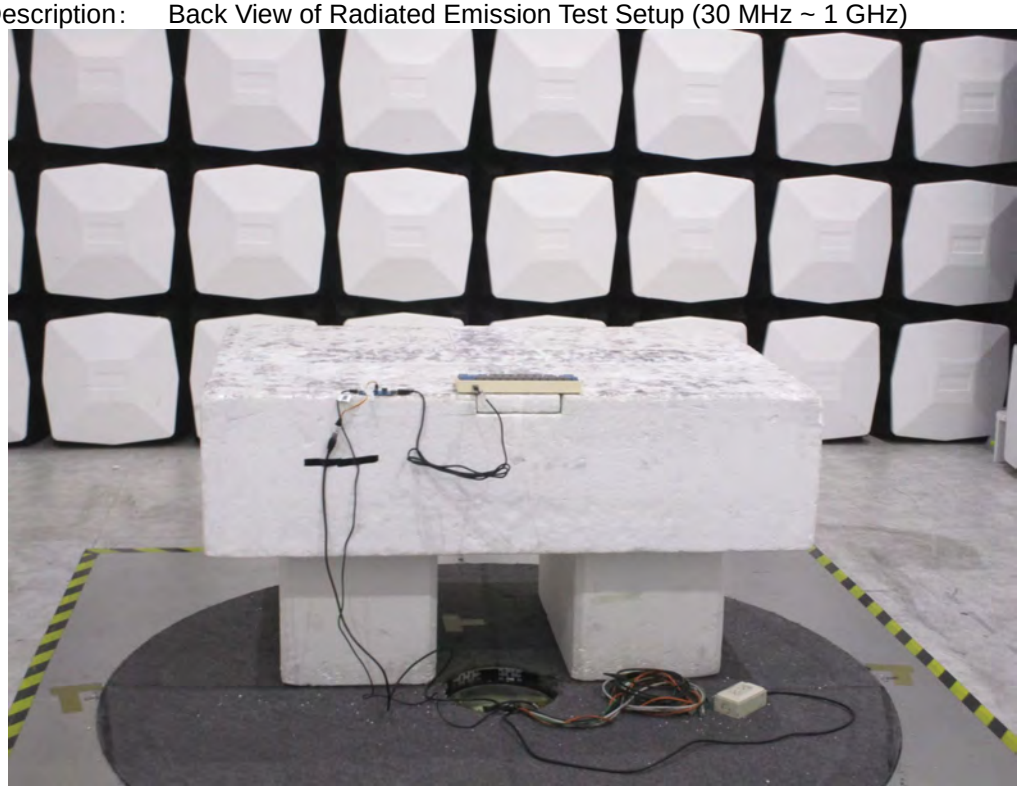


Description： Back View of Conducted Emission Test Setup

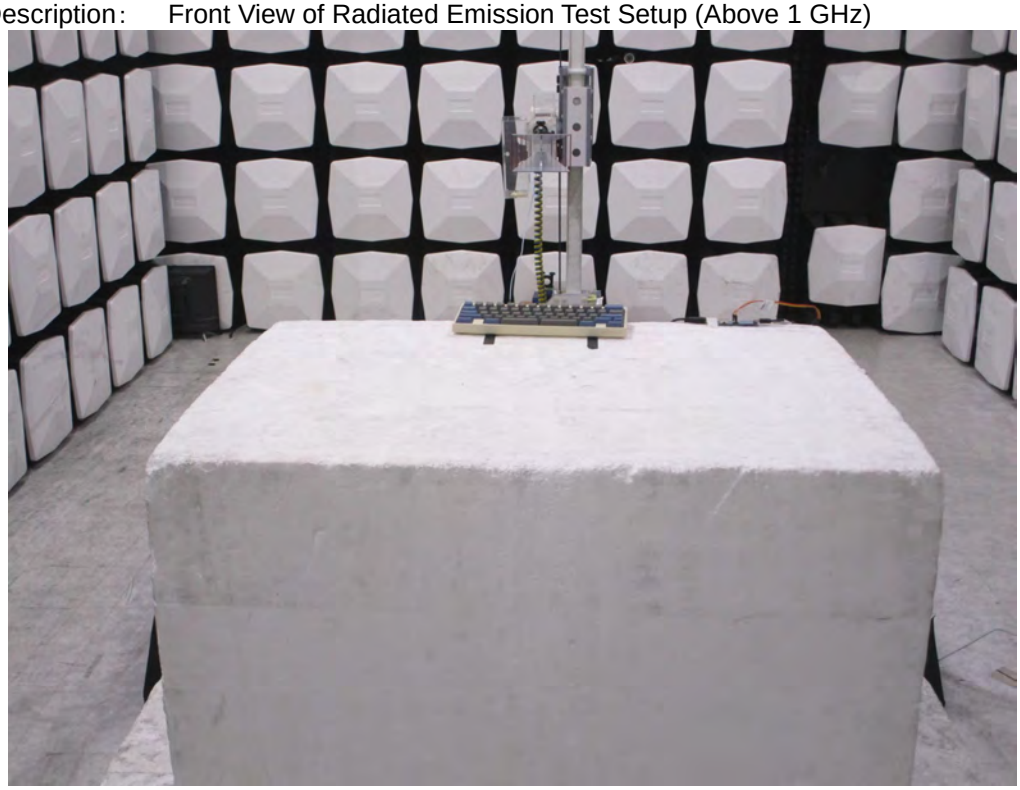
<Radiated Emission>

Description： Front View of Radiated Emission Test Setup (30 MHz ~ 1 GHz)

Description： Back View of Radiated Emission Test Setup (30 MHz ~ 1 GHz)



Description： Front View of Radiated Emission Test Setup (Above 1 GHz)



Description： Back View of Radiated Emission Test Setup (Above 1 GHz)