TEST REPORT

KCTL Inc.
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Suwon-si, Gyeonggi-do, 443-390, Korea
TEL: 82 70 5008 1021
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http://www.kctl.co.kr

1. Applicant

Name:	Starnex Co., Ltd.
Address:	#710, Kolon Digital Tower Aston Bldg., 212, Gasan Digital 1-ro Geumcheon-gu, Seoul 153-708, KOREA

2. Sample Description:

FCC ID:	TN9DOMINOE1
Type of equipment:	Wireless Radio Device
Basic Model:	DOMINO E1

3. Date of Test: May 20 ~ May 24, 2016

4. Test standard used: FCC Part 15 Subpart C, 15.247
RSS-247 Issue 1 May 2015
RSS GEN Issue 4 November 2014

5. Test Results:

Test Item:	Refer to page 7
Result:	Refer to page 8 ~ page 65
Measurement Uncertainty:	Refer to page 7

This result shown in this report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name: EUI JUNG, KIM	Technical Manager Name: CHANG MIN, KIM

2016. 06. 29

KCTL Inc.

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1. Client information

Applicant:	Starnex Co., Ltd.
Address:	#710, Kolon Digital Tower Aston Bldg., 212, Gasan Digital 1-ro Geumcheon-gu, Seoul 153-708, KOREA
Telephone number:	+82-2-837-9700
Facsimile number:	+82-2-2082-8585
Contact person:	Seok-Woo Choi / csw324@starnex.co.kr

Manufacturer:	Starnex Co., Ltd.
Address:	#710, Kolon Digital Tower Aston Bldg., 212, Gasan Digital 1-ro Geumcheon-gu, Seoul 153-708, KOREA

2. Laboratory information

Address

KCTL Inc.
65 Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
Telephone Number: 82-70-5008-1016 Facsimile Number: 82-505-299-8311

Certificate

KOLAS No.: KT231
FCC Site Designation No.: KR0040
FCC Site Registration No.: 687132
VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849
IC Site Registration No.:8035A-2

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant	Starnex Co., Ltd.
Address of Applicant	#710, Kolon Digital Tower Aston Bldg., 212, Gasan Digital 1-ro Geumcheon-gu, Seoul 153-708, KOREA
Manufacturer	Starnex Co., Ltd.
Address of Manufacturer	#710, Kolon Digital Tower Aston Bldg., 212, Gasan Digital 1-ro Geumcheon-gu, Seoul 153-708, KOREA
Type of equipment	Wireless Radio Device
Basic Model	DOMINO E1
Serial number	N/A

3.2 General description

Frequency Range	902.6 ㎒ ~ 927.5 ㎒ (Half mode), 903.0 ㎒ ~ 927.5 ㎒ (Hi-fi mode)
Type of Modulation	FHSS
The number of channels	Half mode (250 ch), Hi-fi mode (50 ch)
Type of Antenna	Internal Antenna
Antenna Gain	-0.95 dBi
Transmit Power	19.78 dBm
Power supply	DC 3.7 V
Product SW/HW version	01-02-04 / V07
Radio SW/HW version	01-02-04 / V07
Test SW Version	1.0
RF power setting in TEST SW	82

Note : The above EUT information was declared by the manufacturer.

3.3 Test frequency

	Half mode	Hi-fi mode
Lowest frequency	902.6 ㎒	903.0 ㎒
Middle frequency	915.0 ㎒	915.0 ㎒
Highest frequency	927.5 ㎒	927.5 ㎒

3.4 Test Voltage

Mode	Voltage
Nominal voltage	DC 3.7 V

Hopping group channel list

HG(1)		HG(2)		HG(3)		HG(4)		HG(5)	
Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel
902.6	1	902.7	2	902.8	3	902.9	4	903	5
903.1	6	903.2	7	903.3	8	903.4	9	903.5	10
903.6	11	903.7	12	903.8	13	903.9	14	904	15
904.1	16	904.2	17	904.3	18	904.4	19	904.5	20
904.6	21	904.7	22	904.8	23	904.9	24	905	25
905.1	26	905.2	27	905.3	28	905.4	29	905.5	30
905.6	31	905.7	32	905.8	33	905.9	34	906	35
906.1	36	906.2	37	906.3	38	906.4	39	906.5	40
906.6	41	906.7	42	906.8	43	906.9	44	907	45
907.1	46	907.2	47	907.3	48	907.4	49	907.5	50
907.6	51	907.7	52	907.8	53	907.9	54	908	55
908.1	56	908.2	57	908.3	58	908.4	59	908.5	60
908.6	61	908.7	62	908.8	63	908.9	64	909	65
909.1	66	909.2	67	909.3	68	909.4	69	909.5	70
909.6	71	909.7	72	909.8	73	909.9	74	910	75
910.1	76	910.2	77	910.3	78	910.4	79	910.5	80
910.6	81	910.7	82	910.8	83	910.9	84	911	85
911.1	86	911.2	87	911.3	88	911.4	89	911.5	90
911.6	91	911.7	92	911.8	93	911.9	94	912	95
912.1	96	912.2	97	912.3	98	912.4	99	912.5	100
912.6	101	912.7	102	912.8	103	912.9	104	913	105
913.1	106	913.2	107	913.3	108	913.4	109	913.5	110
913.6	111	913.7	112	913.8	113	913.9	114	914	115
914.1	116	914.2	117	914.3	118	914.4	119	914.5	120
914.6	121	914.7	122	914.8	123	914.9	124	915	125
915.1	126	915.2	127	915.3	128	915.4	129	915.5	130
915.6	131	915.7	132	915.8	133	915.9	134	916	135
916.1	136	916.2	137	916.3	138	916.4	139	916.5	140
916.6	141	916.7	142	916.8	143	916.9	144	917	145
917.1	146	917.2	147	917.3	148	917.4	149	917.5	150
917.6	151	917.7	152	917.8	153	917.9	154	918	155
918.1	156	918.2	157	918.3	158	918.4	159	918.5	160
918.6	161	918.7	162	918.8	163	918.9	164	919	165
919.1	166	919.2	167	919.3	168	919.4	169	919.5	170
919.6	171	919.7	172	919.8	173	919.9	174	920	175
920.1	176	920.2	177	920.3	178	920.4	179	920.5	180
920.6	181	920.7	182	920.8	183	920.9	184	921	185
921.1	186	921.2	187	921.3	188	921.4	189	921.5	190
921.6	191	921.7	192	921.8	193	921.9	194	922	195
922.1	196	922.2	197	922.3	198	922.4	199	922.5	200
922.6	201	922.7	202	922.8	203	922.9	204	923	205
923.1	206	923.2	207	923.3	208	923.4	209	923.5	210
923.6	211	923.7	212	923.8	213	923.9	214	924	215
924.1	216	924.2	217	924.3	218	924.4	219	924.5	220
924.6	221	924.7	222	924.8	223	924.9	224	925	225
925.1	226	925.2	227	925.3	228	925.4	229	925.5	230
925.6	231	925.7	232	925.8	233	925.9	234	926	235
926.1	236	926.2	237	926.3	238	926.4	239	926.5	240
926.6	241	926.7	242	926.8	243	926.9	244	927	245
927.1	246	927.2	247	927.3	248	927.4	249	927.5	250

- Note: Half mode uses HG(1)~(5) and Hi-fi mode uses only HG(5)

4. Summary of test results

4.1 Standards & results

FCC Rule	IC Rule	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	-	Antenna Requirement	5.1	C
15.247(b)(1), (4)	RSS-247, 5.4 (2)	Maximum Peak Output Power	5.2	C
15.247(a)(1)	RSS-247, 5.1 (2)	Carrier Frequency Separation	5.3	C
15.247(a)(1)	RSS-247, 5.1 (1)	20dB Channel Bandwidth	5.4	C
-	RSS-GEN, 6.6	Occupied Bandwidth	5.4	C
15.247(a)(iii) 15.247(b)(1)	RSS-247, 5.1	Nunber of Hopping Channel	5.5	C
15.247(a) (iii)	RSS-247, 5.1 (4)	Time of Occupancy(Dwell Time)	5.6	C
15.247(d), 15.205(a), 15.209(a)	RSS-247, 5.5 RSS-GEN, 8.9, 10	Spurious Emission, BandEdge, Restricted Band	5.7	C
15.207(a)	RSS-GEN, 8.8	Conducted Emissions	5.8	C
Note: C=complies NC= Not complies NT=Not tested NA=Not Applicable				

- The method of measurement used to test this FHSS device is ANSI C63.10-2013.

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = *k*Uc (*k* = 2)	
Conducted RF power	1.44 dB	
Conducted Spurious Emissions	1.52 dB	
Radiated Spurious Emissions	30 ㎒ ~ 300 ㎒:	+ 4.94 dB, - 5.06 dB
		+ 4.93 dB, - 5.05 dB
	300 ㎒ ~ 1 000 ㎒:	+ 4.97 dB, - 5.08 dB
		+ 4.84 dB, - 4.96 dB
	1 ㎓ ~ 25 ㎓:	+ 6.03 dB, - 6.05 dB
Conducted Emissions	9 ㎑ ~ 150 ㎑:	3.75 dB
	150 ㎑ ~ 30 ㎒:	3.36 dB

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result

-Complied

The transmitter has permanently attached antenna(internal antenna).

5.2 Maximum Peak Output Power

5.2.1 Regulation

According to §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. Alternatively, frequency hopping systems operating in the 2400-2483.5 ㎒ band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-thirds of the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

According to §15.247(b)(2), for frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

According to §15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 ㏈i. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 ㏈i are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.

5.2.2 Measurement Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation.

The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:
   1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
   2) RBW > 20 dB bandwidth of the emission being measured.
   3) VBW ≥ RBW.
   4) Sweep: Auto.
   5) Detector function: Peak.
   6) Trace: Max hold.
b) Allow trace to stabilize.
c) Use the marker-to-peak function to set the marker to the peak of the emission.
d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
e) A plot of the test results and setup description shall be included in the test report.

NOTE:
A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

5.2.3 Test Result

- Complied

- Half mode

Channel	Frequency [㎒]	Result [dBm]	Limit [dBm]	Margin [dB]	Avarage Power [dBm]
Lowest	902.6	19.68	30.00	10.32	19.57
Middle	915.0	19.78	30.00	10.22	19.65
Highest	927.5	19.68	30.00	10.32	19.52

- Hi-fi mode

Channel	Frequency [㎒]	Result [dBm]	Limit [dBm]	Margin [dB]	Avarage Power [dBm]
Lowest	903.0	19.68	30.00	10.32	18.49
Middle	915.0	19.78	30.00	10.22	18.52
Highest	927.5	19.68	30.00	10.32	18.40

NOTE:
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.
2. It was measured by power sensor.

5.3 Carrier Frequency Separation

5.3.1 Regulation

According to §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. Alternatively, frequency hopping systems operating in the 2 400-2 483.5 ㎒ band may have hopping channel carrier frequencies that are separated by 25 ㎑ or two-thirds of the 20 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽.

5.3.2 Measurement Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Wide enough to capture the peaks of two adjacent channels.
b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
c) Video (or average) bandwidth (VBW) ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

5.3.3 Test Result

- Complied

- Half mode

Frequency [㎒]	Carrier frequency separation [㎒]	Limit
902.6	0.100	≥25 ㎑ or 20 dBbandwidth
915.0	0.100	≥25 ㎑ or 20 dBbandwidth
927.5	0.100	≥25 ㎑ or 20 dBbandwidth

- Hi-fi mode

Frequency [㎒]	Carrier frequency separation [㎒]	Limit
903.0	0.502	≥25 ㎑ or 20 dBbandwidth
915.0	0.502	≥25 ㎑ or 20 dBbandwidth
927.5	0.502	≥25 ㎑ or 20 dBbandwidth

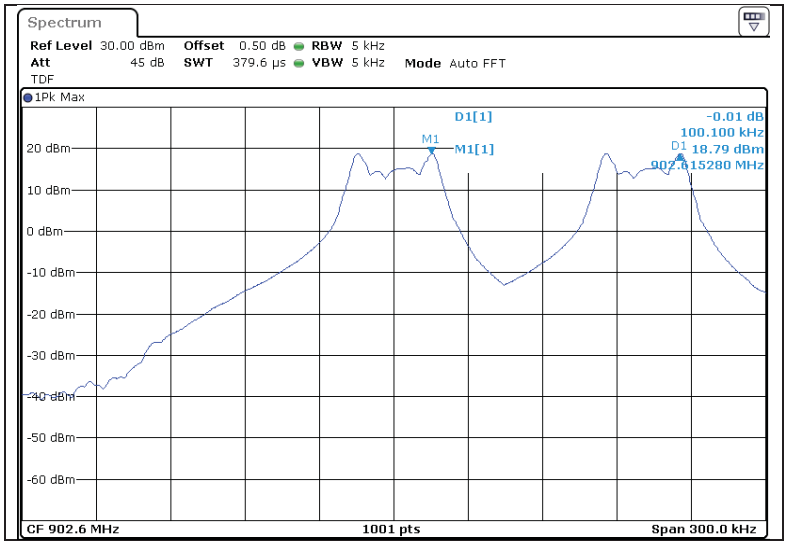
NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.3.4 Test Plot

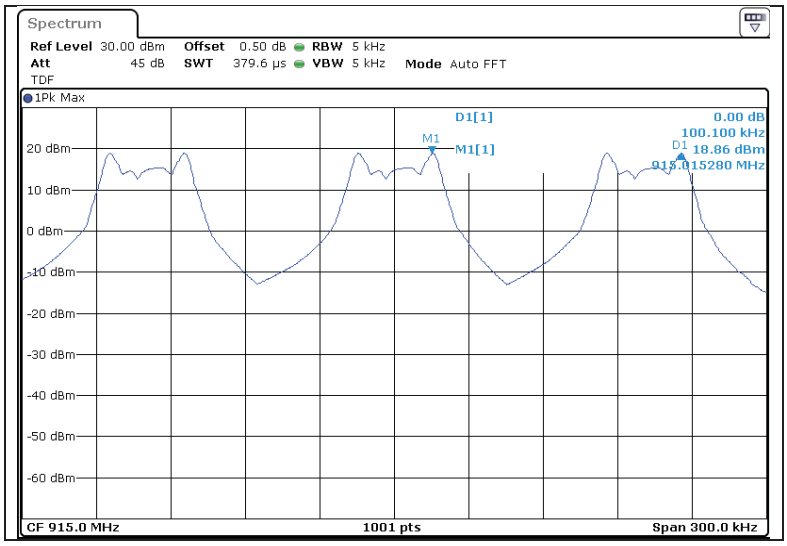
Figure 2.Plot of the Carrier Frequency Separation (Conducted)

- Half mode

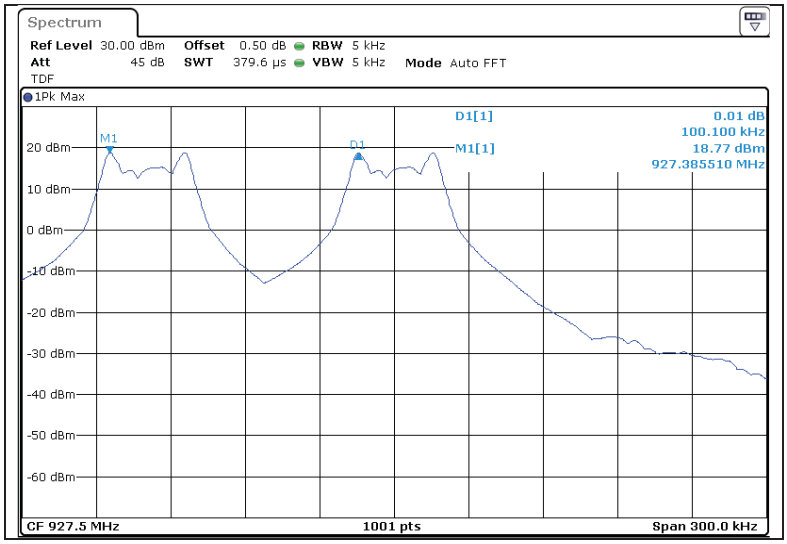
Lowest Channel (902.6 ㎒)



Middle Channel (915.0 ㎒)

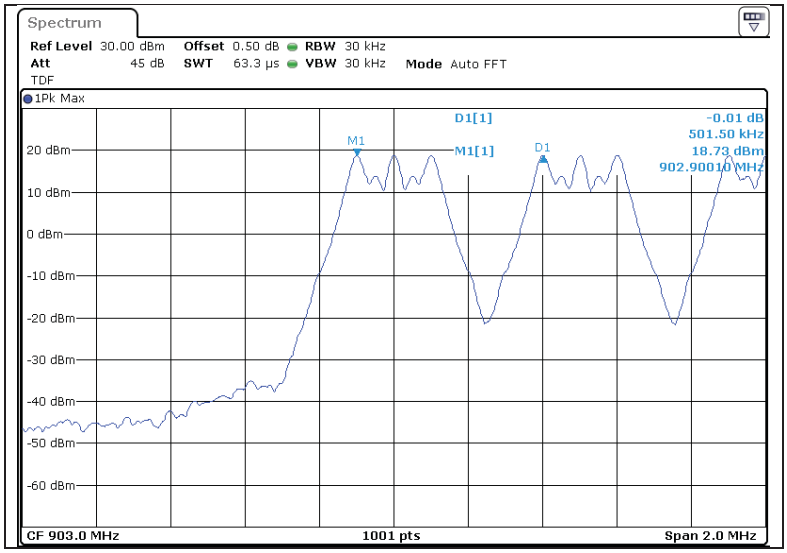


Highest Channel (927.5 ㎒)

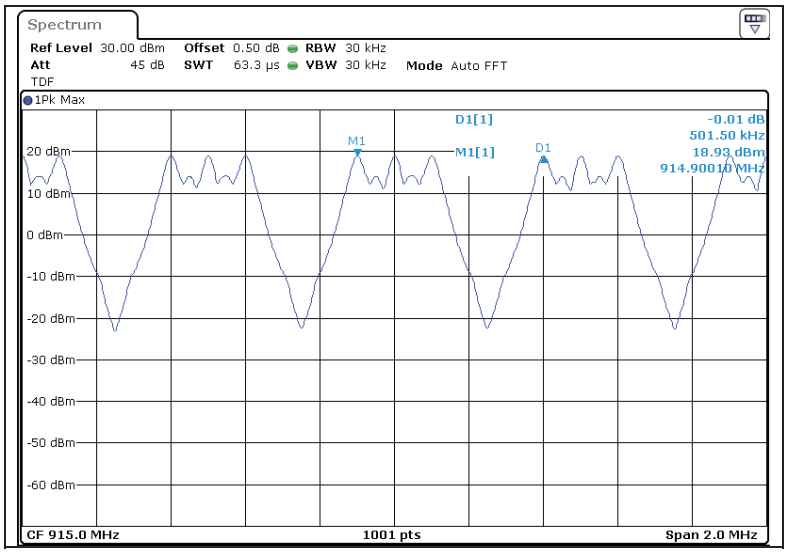


- Hi-fi mode

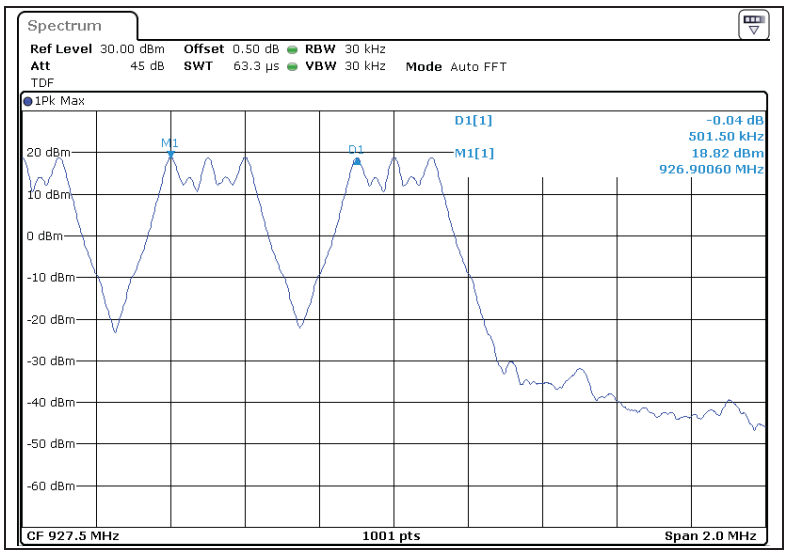
Lowest Channel (903.0 ㎒)



Middle Channel (915.0 ㎒)



Highest Channel (927.5 ㎒)



5.4 20 dB Channel Bandwidth

5.4.1 Regulation

According to §15.247(a)(1)(i), 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.

5.4.2 Measurement Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

The occupied bandwidth is measured as the width of the spectral envelope of the modulated signal, at an amplitude level reduced from a reference value by a specified ratio (or in decibels, a specified number of dB down from the reference value). Typical ratios, expressed in dB, are −6 dB, −20 dB, and −26 dB, corresponding to 6 dB BW, 20 dB BW, and 26 dB BW, respectively. In this subclause, the ratio is designated by "−xx dB." The reference value is either the level of the unmodulated carrier or the highest level of the spectral envelope of the modulated signal, as stated by the applicable requirement. Some requirements might specify a specific maximum or minimum value for the "−xx dB" bandwidth; other requirements might specify that the "−xx dB" bandwidth be entirely contained within the authorized or designated frequency band.

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
d) Steps a) through c) might require iteration to adjust within the specified tolerances.
e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target "−xx dB down" requirement; that is, if the requirement calls for measuring the −20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
f) Set detection mode to peak and trace mode to max hold.

g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
h) Determine the "−xx dB down amplitude" using [(reference value) − xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).
j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "−xx dB down amplitude" determined in step h). If a marker is below this "−xx dB down amplitude" value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "−xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.
k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

5.4.3 Test Result

- Complied

Mode	Channel	20 dB Channel Bandwidth [㎒]	Occupied Bandwidth (99 % BW) [㎒]
Half mode	Lowest	0.040	0.038
	Middle	0.040	0.038
	Highest	0.040	0.038
Hi-fi mode	Lowest	0.311	0.293
	Middle	0.311	0.293
	Highest	0.311	0.293

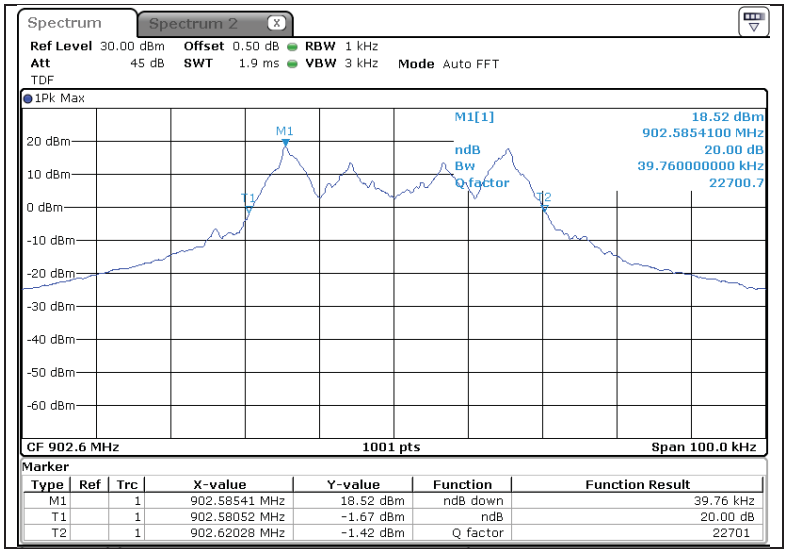
NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.4.4 Test Plot

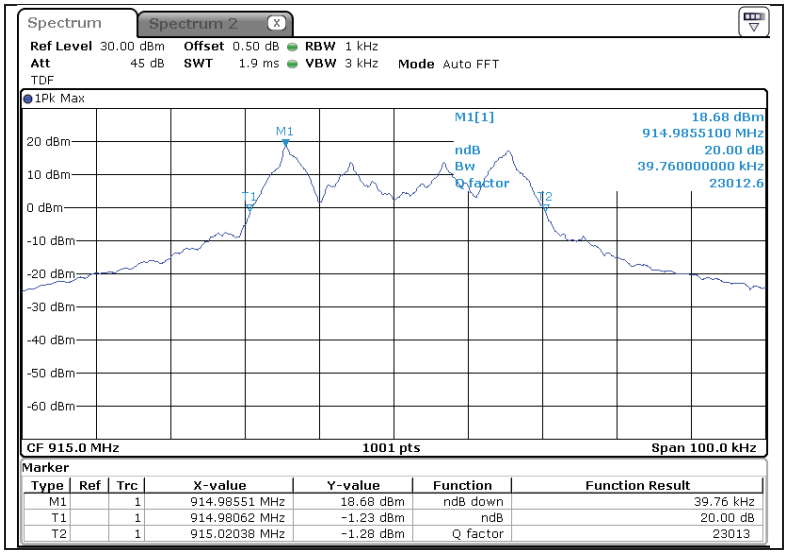
Figure 3.Plot of the 20 dB Channel Bandwidth / Occupied Bandwidth (Conducted)

- Half mode (20 dB Channel Bandwidth)

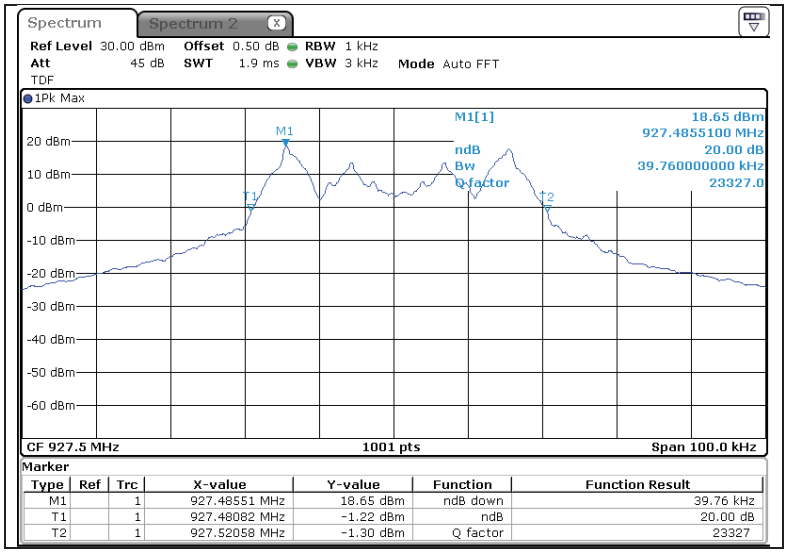
Lowest Channel (902.6 ㎒)



Middle Channel (915.0 ㎒)

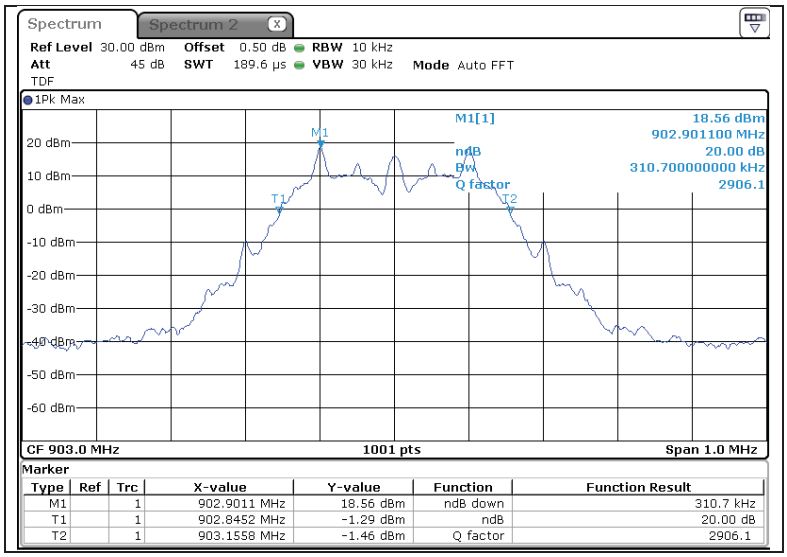


Highest Channel (927.5 ㎒)

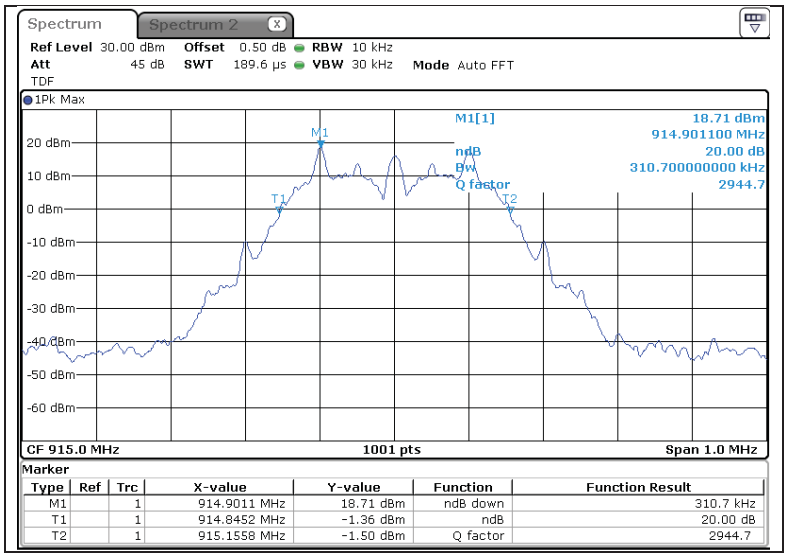


- Hi-fi mode (20 ㏈ Channel Bandwidth)

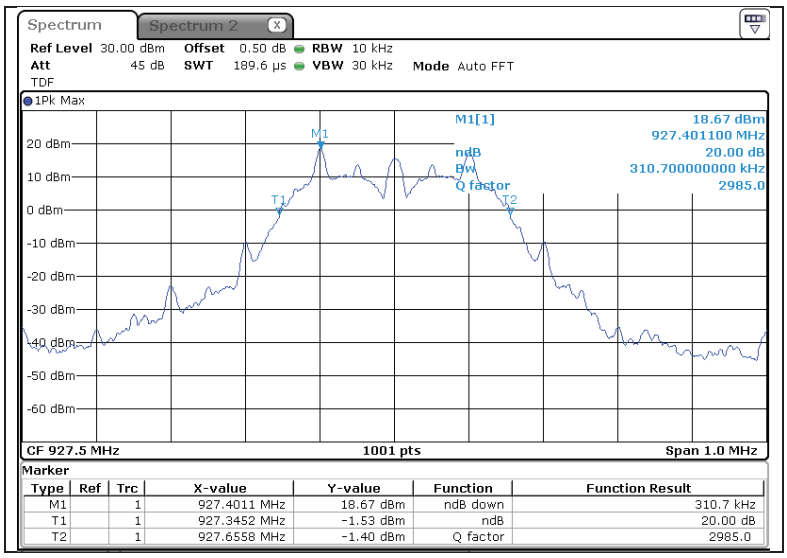
Lowest Channel (903.0 ㎒)



Middle Channel (915.0 ㎒)

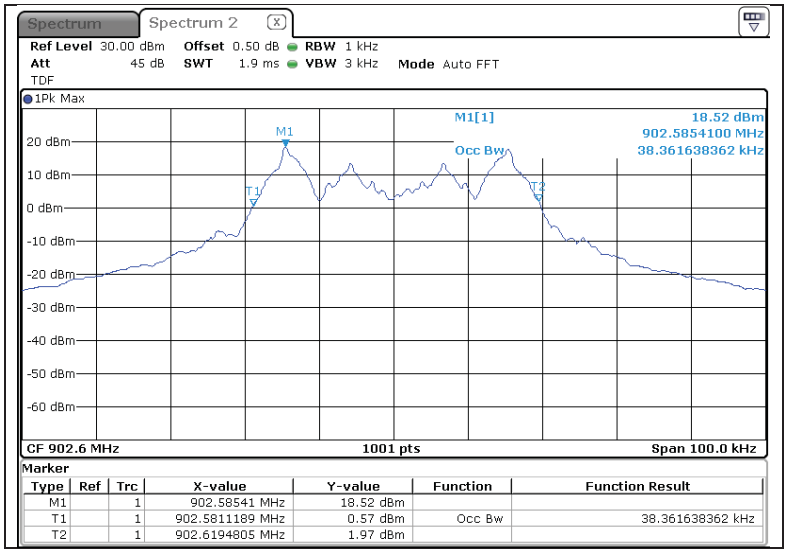


Highest Channel (927.5 ㎒)

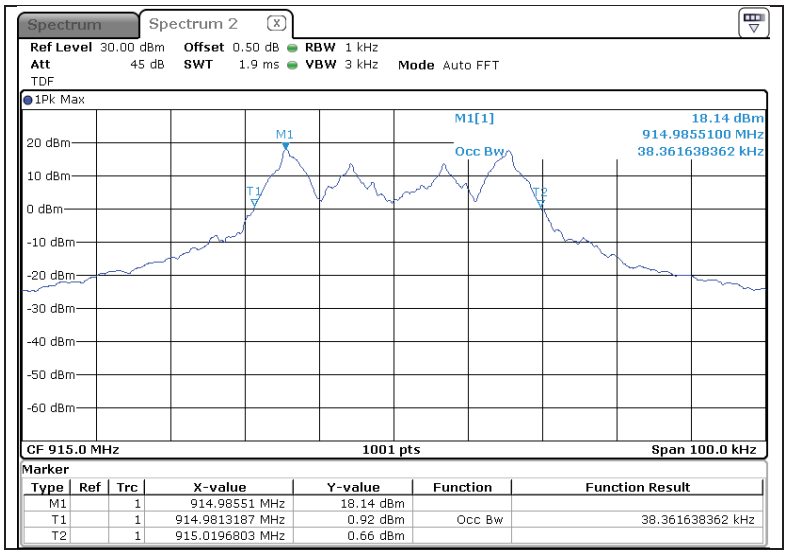


- Half mode (Occupied Bandwidth)

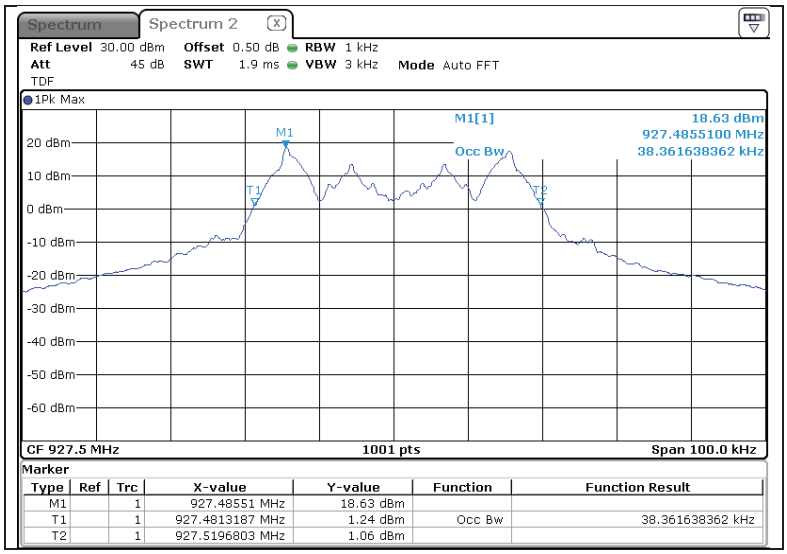
Lowest Channel (902.6 ㎒)



Middle Channel (915.0 ㎒)

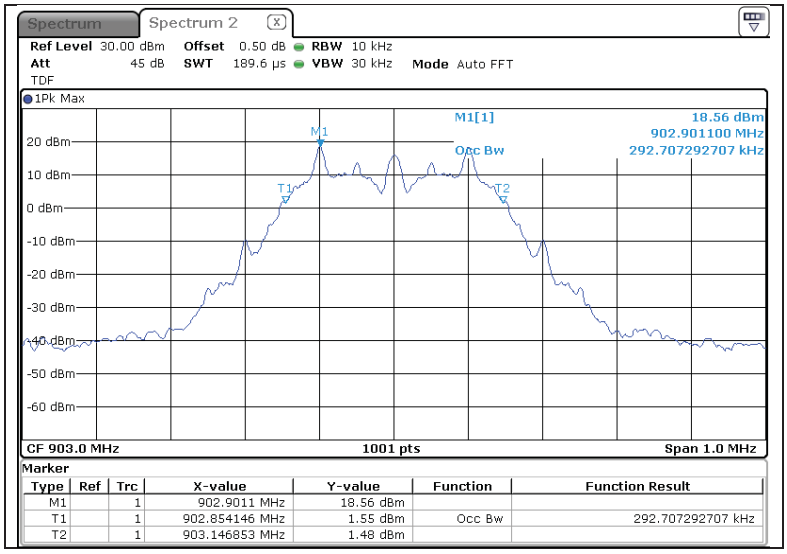


Highest Channel (927.5 ㎒)

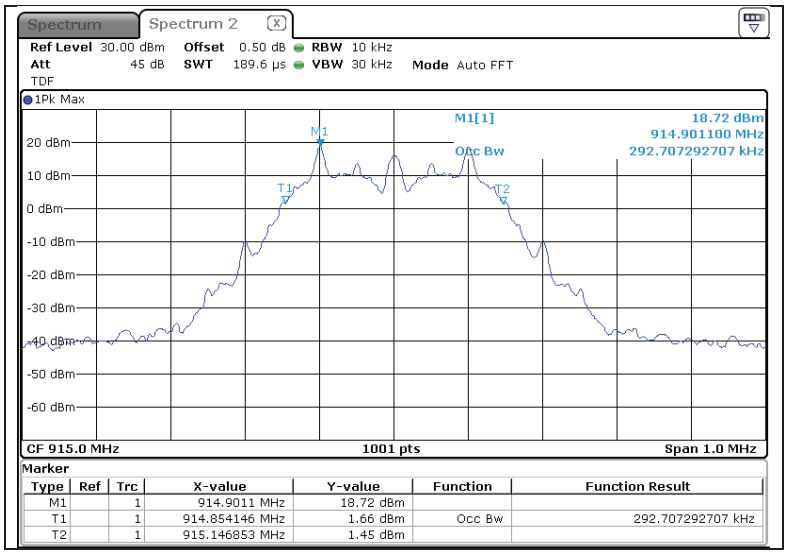


- Hi-fi mode (Occupied Bandwidth)

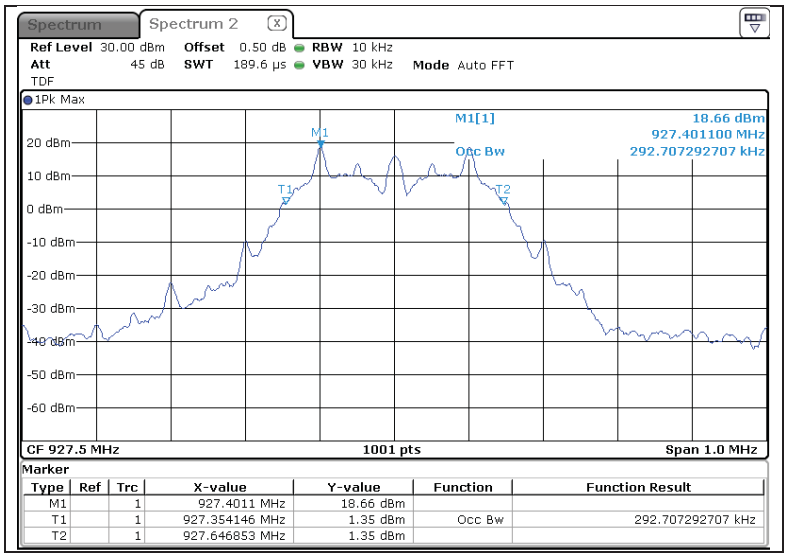
Lowest Channel (903.0 ㎒)



Middle Channel (915.0 ㎒)



Highest Channel (927.5 ㎒)



5.5 Number of Hopping Channels

5.5.1 Regulation

According to §15.247(a)(1)(i), 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.
According to §15.247(b)(2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

5.5.2 Measurement Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
c) VBW ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

5.5.3 Test Result

- Complied

Mode	Hopping Group	Frequency	Number of hopping channel	Limit
Half mode	(1)	902.6 ㎒ – 927.5 ㎒	50	≥50
	(2)		50	≥50
	(3)		50	≥50
	(4)		50	≥50
	(5)		50	≥50
Hi-fi mode	(5)	903.0 ㎒ – 927.5 ㎒	50	≥25

NOTE:

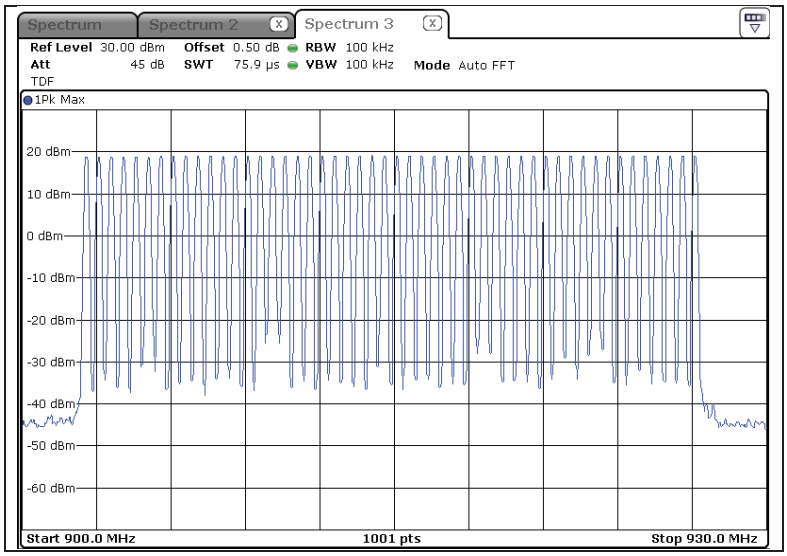
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

5.5.4 Test Plot

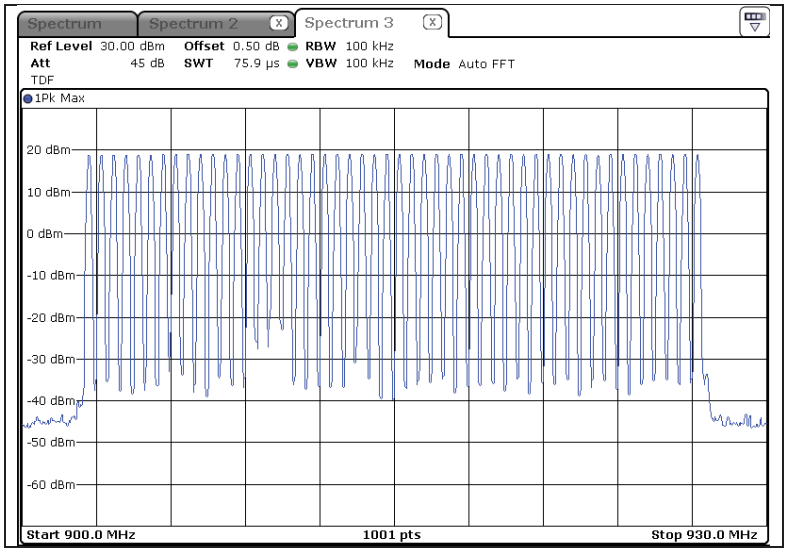
Figure 4. Plot of the Number of Hopping Channels (Conducted)

- Half mode

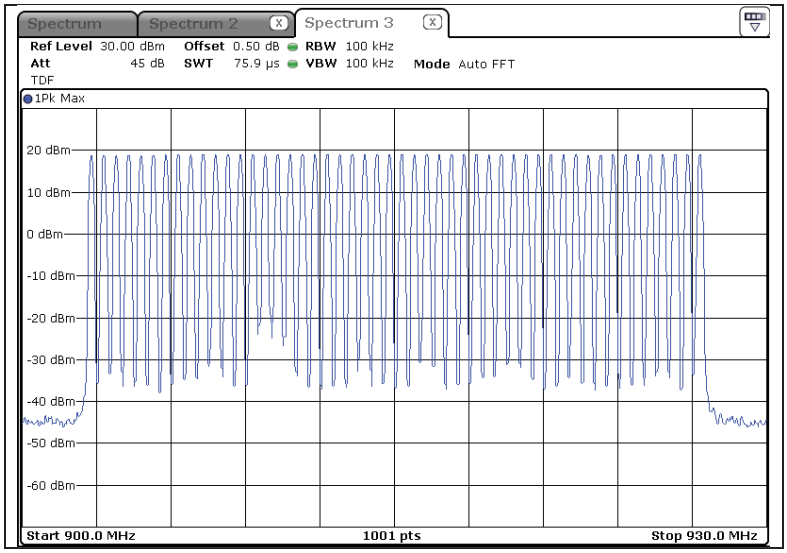
Hopping Group (1)



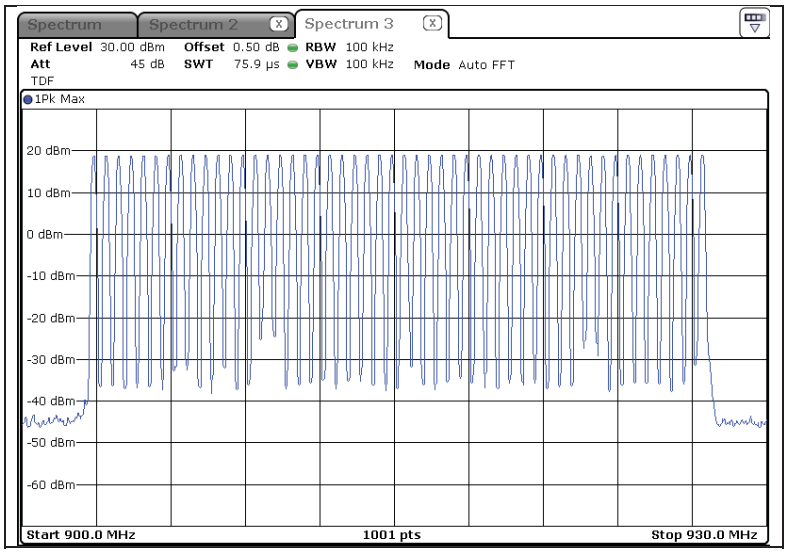
Hopping Group (2)



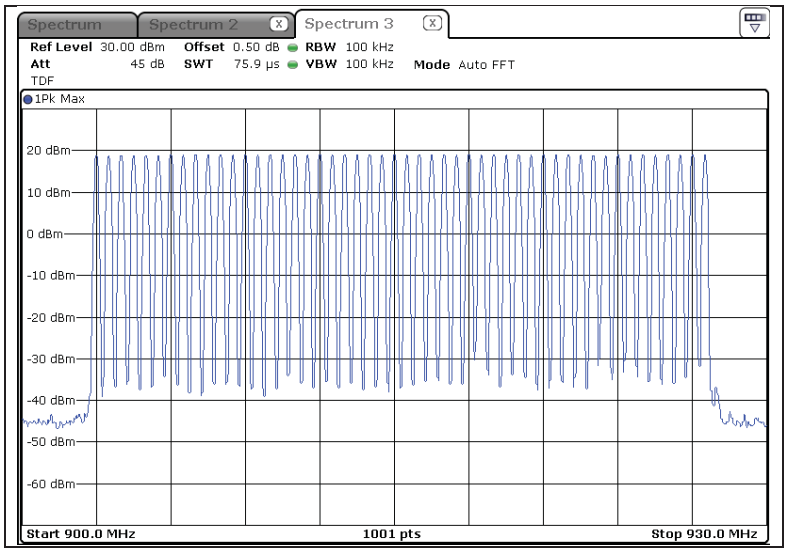
Hopping Group (3)



Hopping Group (4)



Hopping Group (5)



- Hi-fi mode

Hopping Group (5)

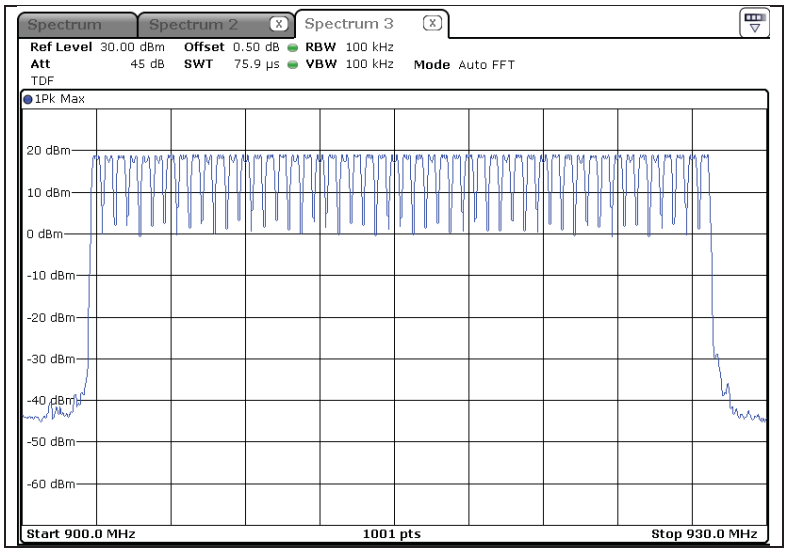
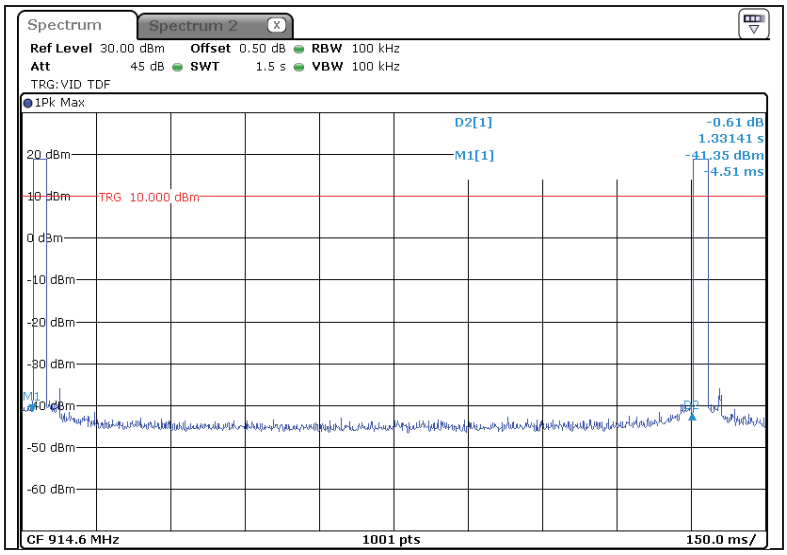


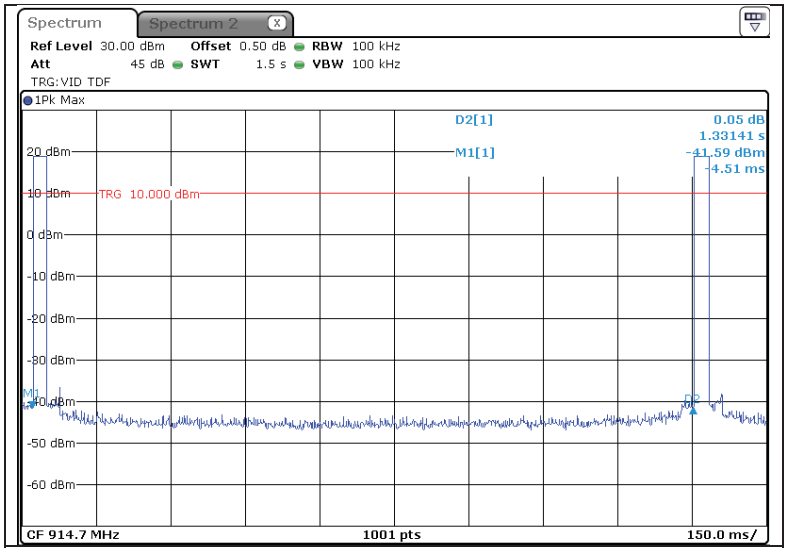
Figure 5. Plot of each individual hopping frequency sequence. (Conducted)

- Half mode

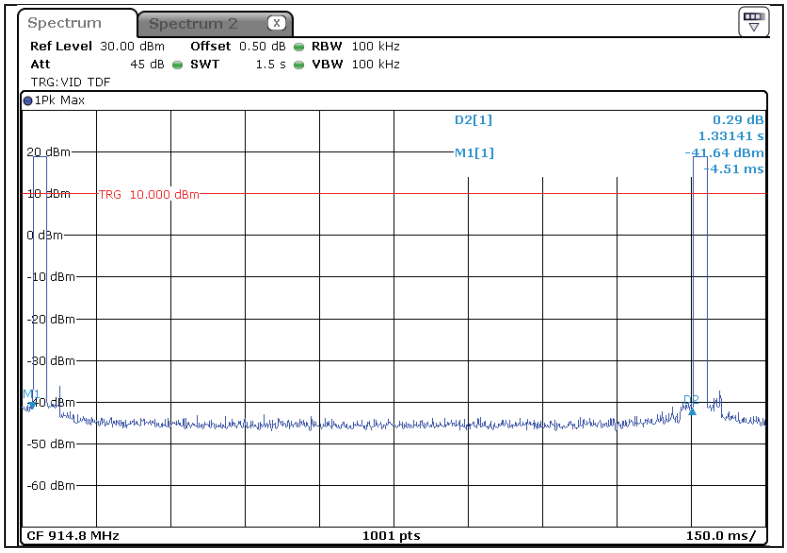
Hopping Group (1)



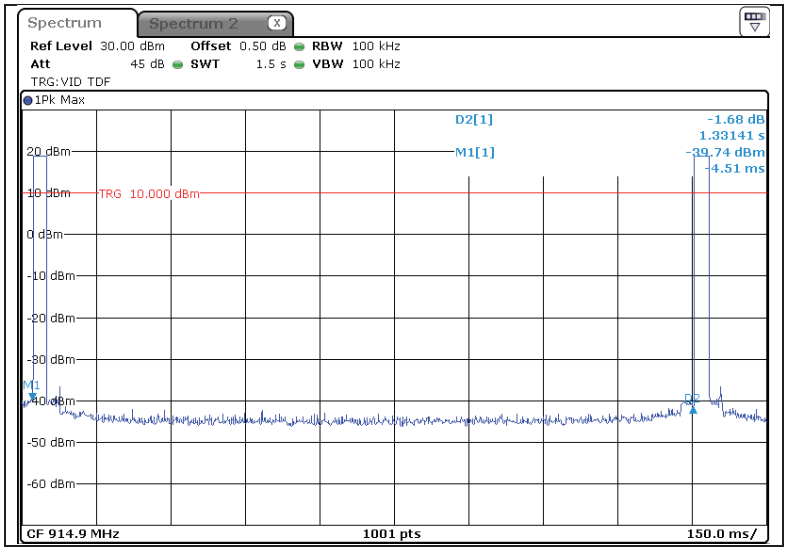
Hopping Group (2)



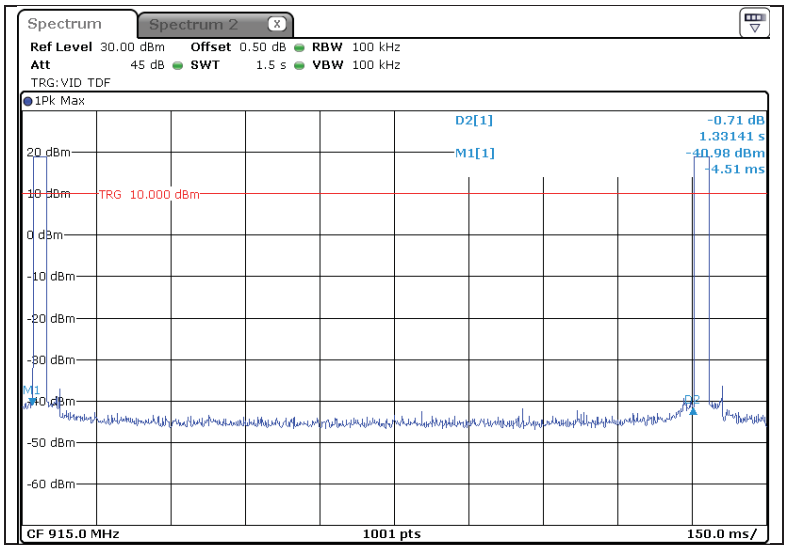
Hopping Group (3)



Hopping Group (4)

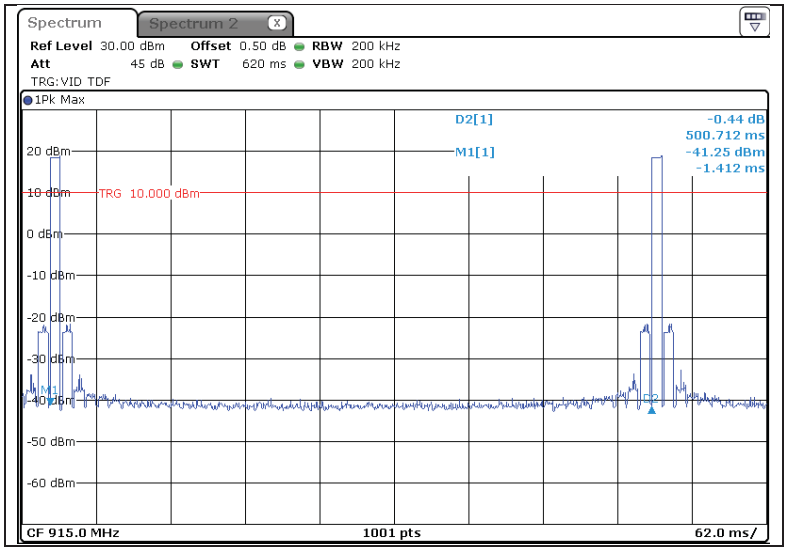


Hopping Group (5)



- Hi-fi mode

Hopping Group (5)



5.6 Time of Occupancy(Dwell Time)

5.6.1 Regulation

According to §15.247(a)(1)(i), 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.

5.6.2 Measurement Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function: Peak.
e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.
Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

5.6.3 Test Result

- Complied

Hopping mode	Hopping Group	Frequency [㎒]	Reading[㎳]	Hopping rate [hop/s]	Number of Channels	Actual[s]	Limit[s]
Half mode	(1)	914.6	26.478	37.554	50	0.398	0.40
	(2)	914.7	26.478	37.554	50	0.398	0.40
	(3)	914.8	26.478	37.554	50	0.398	0.40
	(4)	914.9	26.478	37.554	50	0.398	0.40
	(5)	915.0	26.478	37.554	50	0.398	0.40

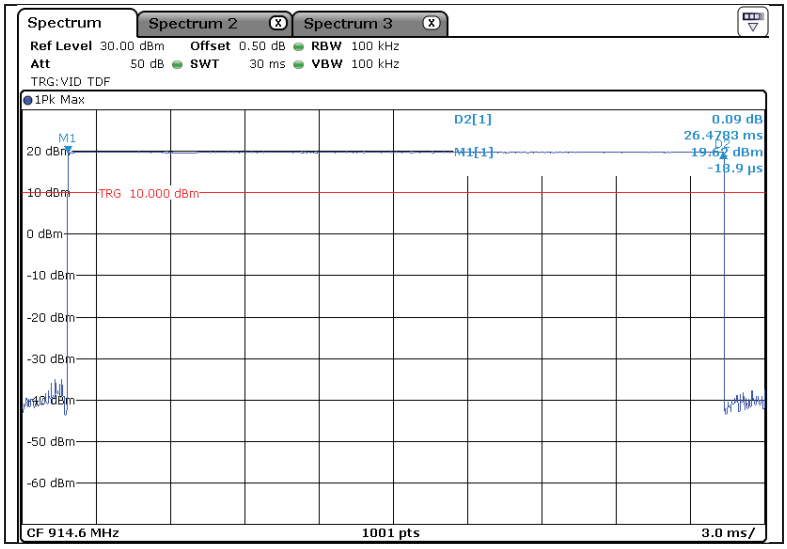
Hopping mode	Hopping Group	Frequency [㎒]	Reading[㎳]	Hopping rate [hop/s]	Number of Channels	Actual[s]	Limit[s]
Hi-fi mode	(5)	915.0	7.760	99.858	50	0.155	0.40

5.6.4 Test Plot

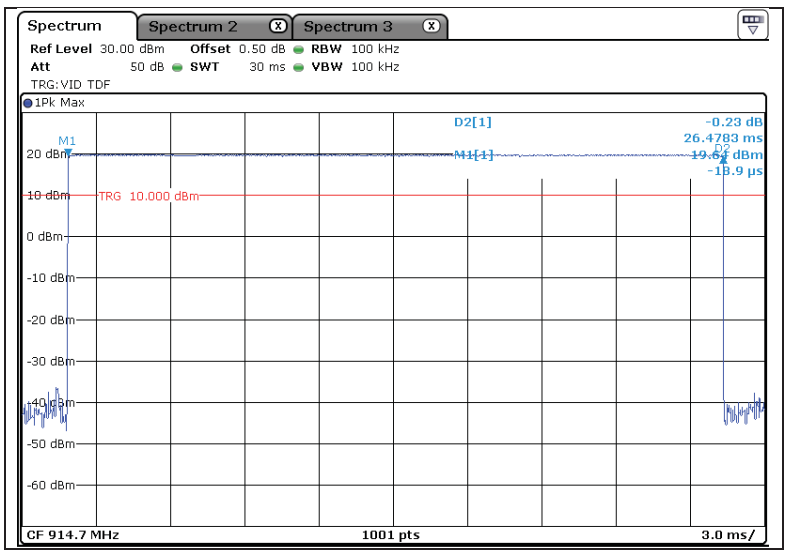
Figure 5. Plot of the Time of Occupancy (Conducted)

- Half mode

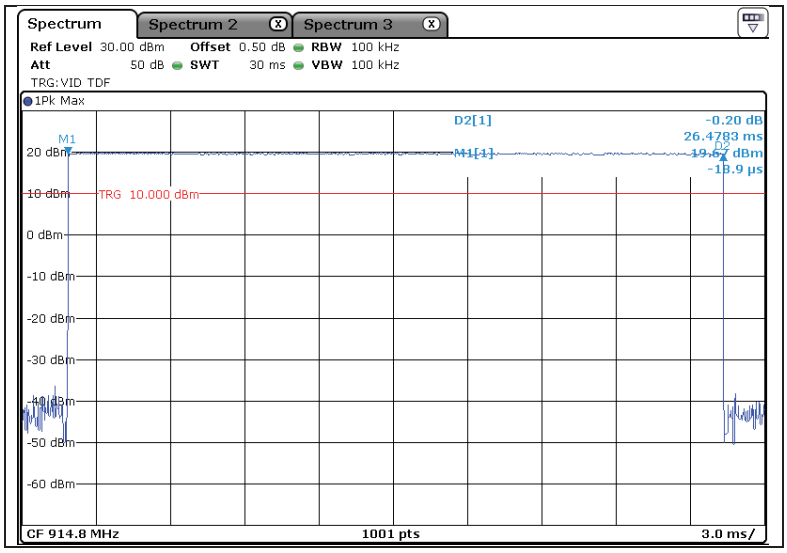
Hopping Group(1) (914.6 ㎒)



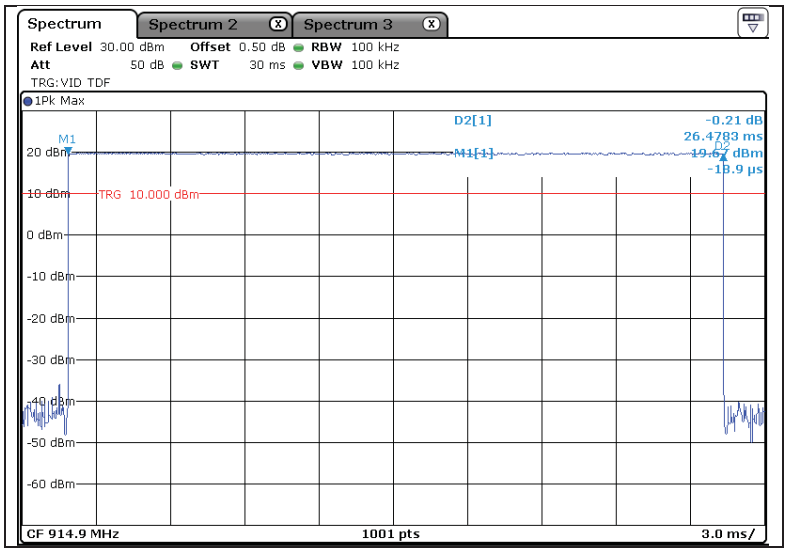
Hopping Group(2) (914.7 ㎒)



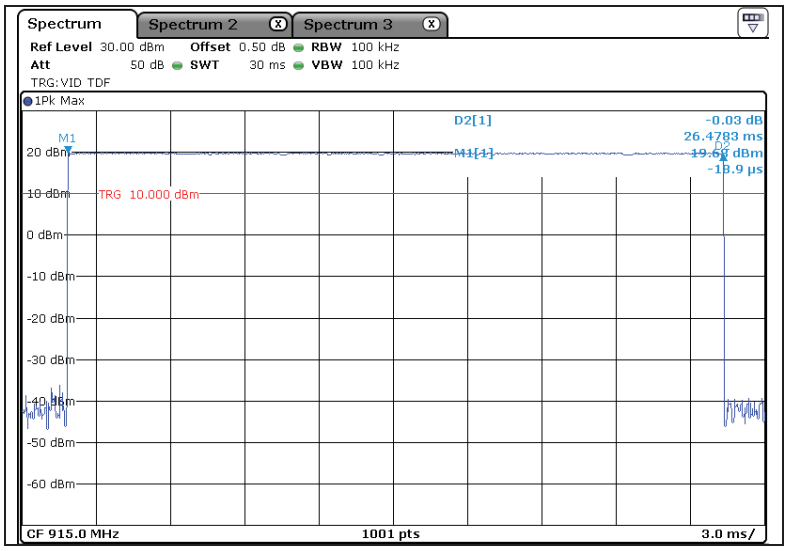
Hopping Group(3) (914.8 ㎒)



Hopping Group(4) (914.9 ㎒)

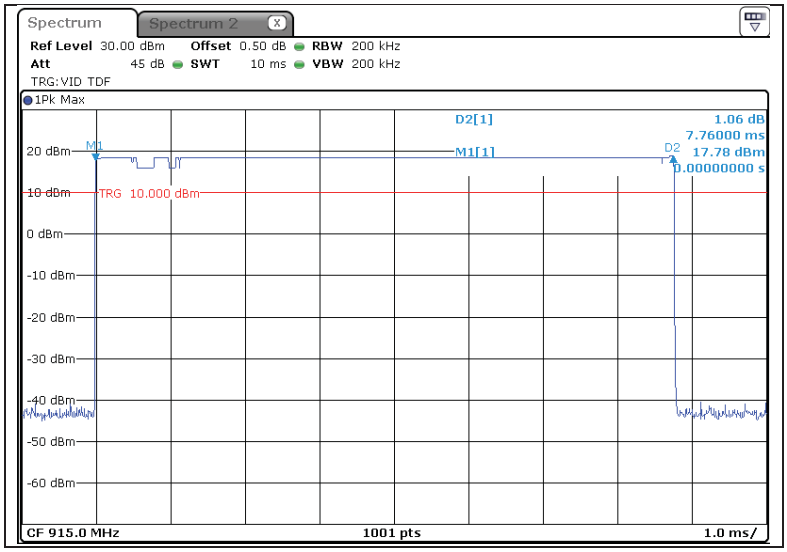


Hopping Group(5) (915.0 ㎒)



- Hi-fi mode

Hopping Group(5) (915.0 ㎒)



5.7 Spurious Emission, Band edge and Restricted bands

5.7.1 Regulation

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 emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

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 (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 -1.705	24 000/F(㎑)	30
1.705 – 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 ㎒, 76–88 ㎒, 174–216 ㎒ or 470–806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	Above 38.6
13.36 - 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1 000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

5.7.2 Measurement Procedure

The method of measurement used to test this FHSS device is ANSI C63.10-2013.

1) Band-edge Compliance of RF Conducted Emissions

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

Band-edge tests are typically performed as a conducted test but may be performed as radiated measurements on a test site meeting the specifications in 5.2, at the measurement distances specified in 5.3. The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors Specified in 4.1.4.2.

When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3.

For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods. Particular attention to the hopping sequence requirements specified below is needed in the case of adaptive frequency-hopping devices:

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.

d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.

e) Perform the test as follows:

1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

3) Attenuation: Auto (at least 10 dB preferred).

4) Sweep time: Coupled.

5) Resolution bandwidth: 100 kHz.

6) Video bandwidth: 300 kHz.

7) Detector: Peak.

8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

g) Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

h) Repeat step c) through step e) for every applicable modulation.

i) Set the EUT to the highest frequency channel (for the hopping on test, the hopping sequence shall include the highest frequency channel) and repeat step c) through step d).

j) The band-edge measurement shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

2) Spurious RF Conducted Emissions:

Conducted spurious emissions shall be measured for the transmit frequency, per 5.5 and 5.6, and at the maximum transmit powers.
Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer.
The instrument shall span 30 MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100 kHz, video bandwidth of 300 kHz, and a coupled sweep time with a peak detector. The band 30 MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an semi-anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 ㎑ to 30 ㎒ using the loop antenna, and from 30 to 1000 ㎒ using the Bi-Log antenna, and from 1000 ㎒ to 10000 ㎒ using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter in an semi-anechoic chamber. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The 0.8m height is for below 1 G testing, and 1.5m is for above 1G testing.

- Procedure for unwanted emissions measurements below 1000 MHz

The procedure for unwanted emissions measurements below 1000 MHz is as follows:

a) Follow the requirements in 12.7.4.

b) Compliance shall be determined using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- Procedure for peak unwanted emissions measurements above 1000 MHz

The procedure for peak unwanted emissions measurements above 1000 MHz is as follows:

a) Follow the requirements in 12.7.4.

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

1) RBW = 1 MHz.

2) VBW ≥ [3 · RBW].

3) Detector = peak.

4) Sweep time = auto.

5) Trace mode = max hold.

6) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not continuous, then the time required for the trace to stabilize will increase by a factor of approximately 1 / D, where *D* is the duty cycle. For example, at 50% duty cycle, the measurement time will increase by a factor of two, relative to measurement time for continuous transmission.

- Procedures for average unwanted emissions measurements above 1000 MHz

Method VB-A is averaging using reduced video bandwidth. The procedure for this method is as follows:

a) RBW = 1 MHz.

b) Video bandwidth:

1) If the EUT is configured to transmit with D ≥ 98%, then set VBW ≤ RBW / 100 (i.e., 10 kHz), but not less than 10 Hz.

2) If the EUT D is < 98%, then set VBW ≥ 1 / T, where T is defined in item a1) of 12.2.

c) Video bandwidth mode or display mode:

1) The instrument shall be set with video filtering applied in the power domain. Typically, this requires setting the detector mode to RMS (power averaging) and setting the average-VBW type to power (rms).

2) As an alternative, the instrument may be set to linear detector mode. Video filtering shall be applied in linear voltage domain (rather than in a log or dB domain). Some instruments require linear display mode to accomplish this. Others have a setting for average-VBW type, which can be set to “voltage” regardless of the display mode.

d) Detector = peak.

e) Sweep time = auto.

f) Trace mode = max hold.

g) Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98% duty cycle. For lower duty cycles, increase the minimum number of traces by a factor of 1/x, where D is the duty cycle. For example, use at least 200 traces if the duty cycle is 25%. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 50 traces should be averaged.)

5.7.3 Test Result

- Complied

1. Band edge compliance of RF Conducted Emissions was shown in figure 6.
2. Measured value of the Field strength of spurious Emissions (Radiated)
3. It tested x,y and z – 3 axis each, mentioned only worst case data at this report.

- 9 ㎑ ~ 30 ㎒ data (Worst-case: Half mode)

Half mode_Middle Channel (915.0 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 30 ㎒							
Below 30.00	Not Detected	-	-	-	-	-	-

- 30 ㎒ ~ 1 ㎓ data

Half mode_Lowest Channel (902.6 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 1 ㎓							
※999.15	120	H	20.90	4.10	25.00	54.00	29.00
Above 1 000.00	**Not Detected**	**-**	-	-	-	-	-

※ This sign means restricted band.

Half mode_Middle Channel (915.0 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 1 ㎓							
※980.48	120	H	21.30	3.70	25.00	54.00	29.00
Above 1 000.00	**Not Detected**	-	-	-	-	-	-

※ This sign means restricted band.

Half mode_Highest Channel (927.5 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 1 ㎓							
※985.57	120	H	20.60	3.80	24.40	54.00	29.60
Above 1 000.00	**Not Detected**	-	-	-	-	-	-

※ This sign means restricted band.

Hi-fi mode_Lowest Channel (903.0 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 1 ㎓							
※982.06	120	H	21.20	3.80	25.00	54.00	29.00
Above 1 000.00	**Not Detected**	-	-	-	-	-	-

※ This sign means restricted band.

Hi-fi mode_Middle Channel (915.0 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 1 ㎓							
※998.42	120	H	21.10	4.10	25.20	54.00	28.80
Above 1 000.00	**Not Detected**	-	-	-	-	-	-

※ This sign means restricted band.

Hi-fi mode_Highest Channel (927.5 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Quasi-Peak DATA. Emissions below 1 ㎓							
※998.06	120	H	20.80	4.10	24.90	54.00	29.10
Above 1 000.00	**Not Detected**	-	-	-	-	-	-

※ This sign means restricted band.

- 1 ㎓ ~ 10 ㎓ data

Half mode_Lowest channel (902.6 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak DATA. Emissions above 1 ㎓							
#1 804.38	1 000	H	48.90	0.40	49.30	74.00	24.70
3 426.63	1 000	V	37.20	5.30	42.50	74.00	31.50
4 721.50	1 000	H	35.90	9.50	45.40	74.00	28.60
6 504.63	1 000	V	35.20	12.60	47.80	74.00	26.20
8 076.25	1 000	V	34.30	15.20	49.50	74.00	24.50
9 016.75	1 000	H	33.30	16.90	50.20	74.00	23.80
Above 9 500.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
#1 804.38	1 000	H	46.70	0.40	47.10	54.00	6.90
3 426.63	1 000	V	27.30	5.30	32.60	54.00	21.40
4 721.50	1 000	H	26.10	9.50	35.60	54.00	18.40
6 504.63	1 000	V	26.90	12.60	39.50	54.00	14.50
8 076.25	1 000	V	25.30	15.20	40.50	54.00	13.50
9 016.75	1 000	H	24.60	16.90	41.50	54.00	12.50
Above 9 500.00	**Not Detected**	-	-	-	-	-	-

NOTE 1. Factor = Cable loss – Amp gain + Antenna factor
This Hash means harmonic components.

Half mode_Middle channel (915.0 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak DATA. Emissions above 1 ㎓							
#1 829.13	1 000	H	47.70	0.70	48.40	74.00	25.60
#2 744.88	1 000	H	39.60	4.40	44.00	74.00	30.00
4 780.00	1 000	V	35.70	9.40	45.10	74.00	28.90
6 519.25	1 000	V	34.50	12.60	47.10	74.00	26.90
7 552.00	1 000	H	34.20	14.90	49.10	74.00	24.90
9 166.38	1 000	V	35.20	16.70	51.90	74.00	22.10
Above 9 500.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
#1 829.13	1 000	H	46.40	0.70	47.10	54.00	6.90
#2 744.88	1 000	H	30.20	4.40	34.60	54.00	19.40
4 780.00	1 000	V	26.10	9.40	35.50	54.00	18.50
6 519.25	1 000	V	24.90	12.60	37.50	54.00	16.50
7 552.00	1 000	H	25.30	14.90	40.20	54.00	13.80
9 166.38	1 000	V	26.80	16.70	43.50	54.00	10.50
Above 9 500.00	**Not Detected**	-	-	-	-	-	-

NOTE 1. Factor = Cable loss – Amp gain + Antenna factor
This Hash means harmonic components.

Half mode_Highest channel (927.5 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak DATA. Emissions above 1 ㎓							
#1 855.00	1 000	H	48.90	1.00	49.90	74.00	24.10
3 329.88	1 000	V	36.60	5.30	41.90	74.00	32.10
4 474.00	1 000	H	35.30	8.40	43.70	74.00	30.30
5 968.00	1 000	V	34.10	11.80	45.90	74.00	28.10
7 420.38	1 000	H	34.80	14.70	49.50	74.00	24.50
9 212.50	1 000	V	35.20	16.60	51.80	74.00	22.20
Above 9 500.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
#1 855.00	1 000	H	47.60	1.00	48.60	54.00	5.40
3 329.88	1 000	V	26.80	5.30	32.10	54.00	21.90
4 474.00	1 000	H	25.70	8.40	34.10	54.00	19.90
5 968.00	1 000	V	26.30	11.80	38.10	54.00	15.90
7 420.38	1 000	H	25.10	14.70	39.80	54.00	14.20
9 212.50	1 000	V	25.80	16.60	42.40	54.00	11.60
Above 9 500.00	**Not Detected**	-	-	-	-	-	-

NOTE 1. Factor = Cable loss – Amp gain + Antenna factor
This Hash means harmonic components.

Hi-fi mode_Lowest channel (903.0 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
#1 805.50	1 000	H	50.40	0.40	50.80	74.00	23.20
3 283.75	1 000	H	37.50	5.20	42.70	74.00	31.30
4 552.75	1 000	V	34.90	9.00	43.90	74.00	30.10
6 280.75	1 000	V	35.40	12.30	47.70	74.00	26.30
7 752.25	1 000	V	33.90	15.10	49.00	74.00	25.00
8 398.00	1 000	H	34.30	15.70	50.00	74.00	24.00
Above 9 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
#1 805.50	1 000	H	44.60	0.40	45.00	54.00	9.00
3 283.75	1 000	H	27.10	5.20	32.30	54.00	21.70
4 552.75	1 000	V	25.80	9.00	34.80	54.00	19.20
6 280.75	1 000	V	26.10	12.30	38.40	54.00	15.60
7 752.25	1 000	V	24.50	15.10	39.60	54.00	14.40
8 398.00	1 000	H	25.30	15.70	41.00	54.00	13.00
Above 9 000.00	**Not Detected**	-	-	-	-	-	-

NOTE 1. Factor = Cable loss – Amp gain + Antenna factor
This Hash means harmonic components.

Hi-fi mode_Middle channel (915.0 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
#1 829.13	1 000	H	48.80	0.70	49.50	74.00	24.50
#2 744.88	1 000	H	40.00	4.40	44.40	74.00	29.60
4 010.50	1 000	V	36.60	6.60	43.20	74.00	30.80
5 124.25	1 000	H	34.80	10.00	44.80	74.00	29.20
7 414.75	1 000	V	34.30	14.60	48.90	74.00	25.10
8 234.88	1 000	V	35.20	15.40	50.60	74.00	23.40
Above 9 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
#1 829.13	1 000	H	42.80	0.70	43.50	54.00	10.50
#2 744.88	1 000	H	31.70	4.40	36.10	54.00	17.90
4 010.50	1 000	V	26.90	6.60	33.50	54.00	20.50
5 124.25	1 000	H	25.30	10.00	35.30	54.00	18.70
7 414.75	1 000	V	24.80	14.60	39.40	54.00	14.60
8 234.88	1 000	V	25.40	15.40	40.80	54.00	13.20
Above 9 000.00	**Not Detected**	-	-	-	-	-	-

NOTE 1. Factor = Cable loss – Amp gain + Antenna factor
This Hash means harmonic components.

Hi-fi mode_Highest channel (927.5 ㎒)

Frequency	Receiver Bandwidth	Pol.	Reading	Factor	Result	Limit	Margin
[㎒]	[㎑]	[V/H]	[dB(㎶)]	[dB]	[dB(㎶/m)]	[dB(㎶/m)]	[dB]
Peak DATA. Emissions above 1 ㎓							
#1 855.00	1 000	H	49.00	1.00	50.00	74.00	24.00
3 806.88	1 000	V	36.20	6.40	42.60	74.00	31.40
4 738.38	1 000	H	35.60	9.50	45.10	74.00	28.90
6 980.50	1 000	V	35.10	13.50	48.60	74.00	25.40
7 688.13	1 000	H	34.50	15.00	49.50	74.00	24.50
8 347.38	1 000	V	34.20	15.60	49.80	74.00	24.20
Above 9 000.00	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
#1 855.00	1 000	H	43.40	1.00	44.40	54.00	9.60
3 806.88	1 000	V	26.80	6.40	33.20	54.00	20.80
4 738.38	1 000	H	26.30	9.50	35.80	54.00	18.20
6 980.50	1 000	V	25.30	13.50	38.80	54.00	15.20
7 688.13	1 000	H	24.70	15.00	39.70	54.00	14.30
8 347.38	1 000	V	24.90	15.60	40.50	54.00	13.50
Above 9 000.00	**Not Detected**	-	-	-	-	-	-

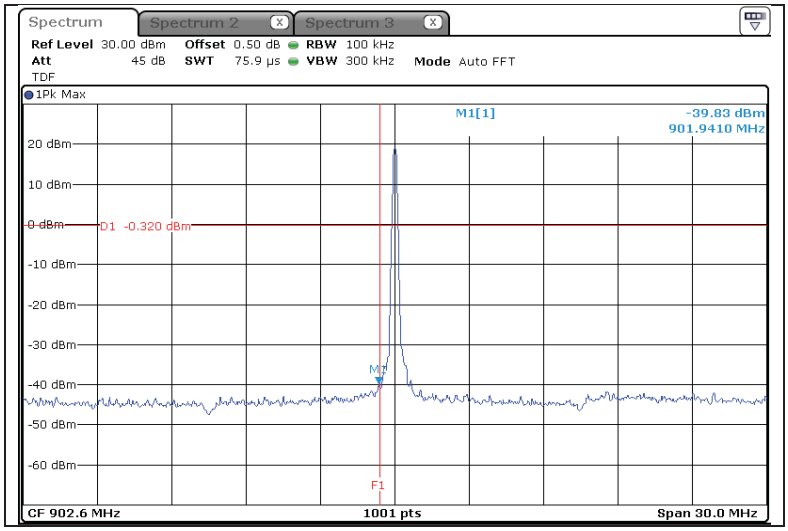
NOTE 1. Factor = Cable loss – Amp gain + Antenna fact
This Hash means harmonic components.

5.7.5 Test Plot

Figure 6. Plot of the Band Edge (Conducted)

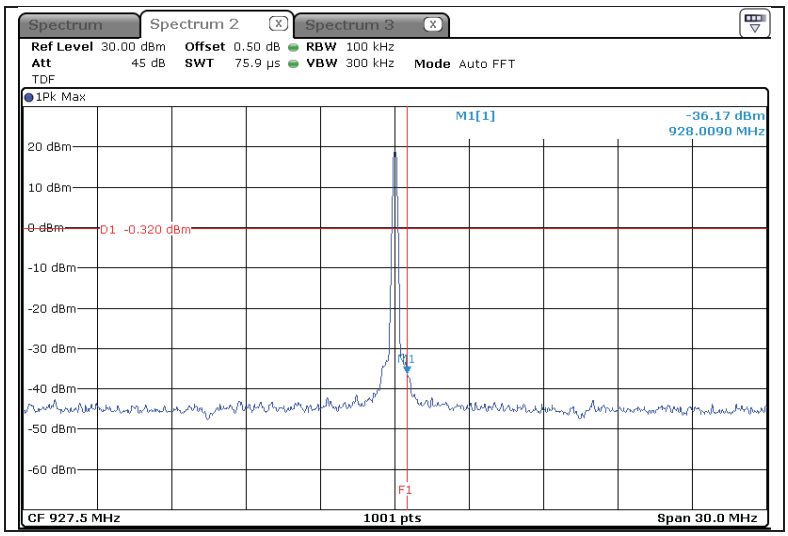
- Half mode (Without hopping)

Lowest Channel (902.6 ㎒)



- Result of 902.6 ㎒

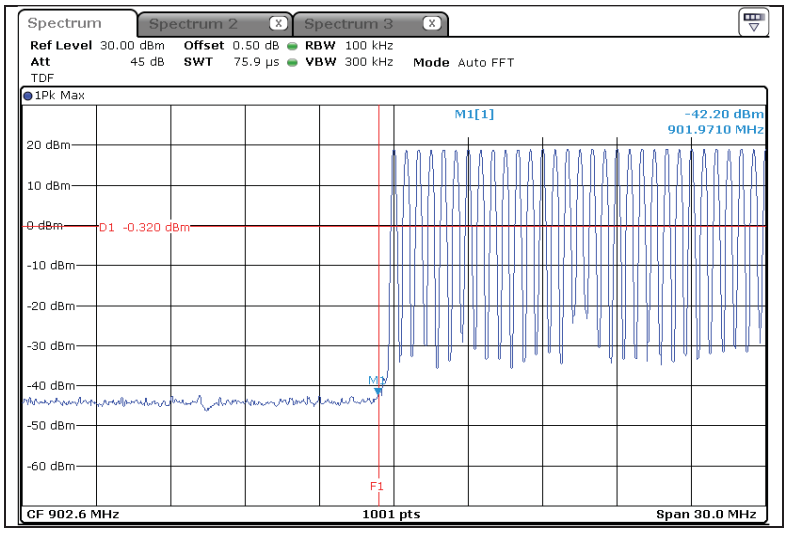
Highest Channel (927.5 ㎒)



- Result of 927.5 ㎒

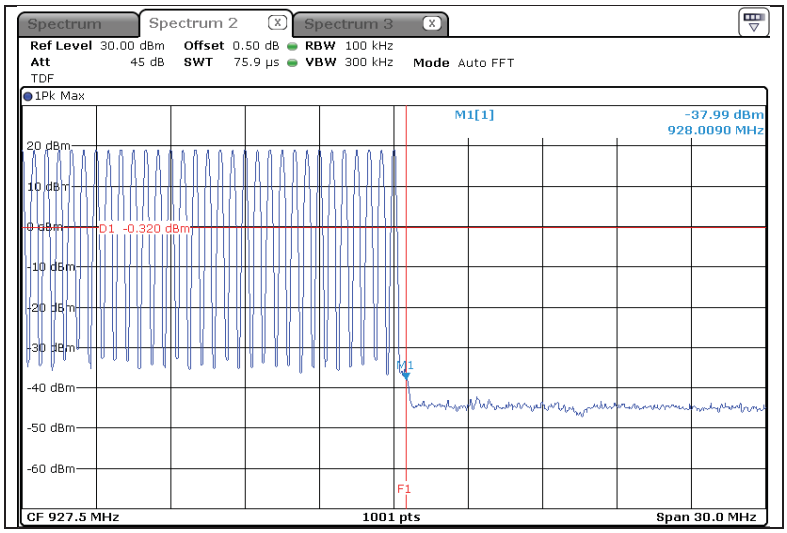
- Half mode (With hopping)

Lowest Channel (902.6 ㎒)



- Result of 902.6 ㎒

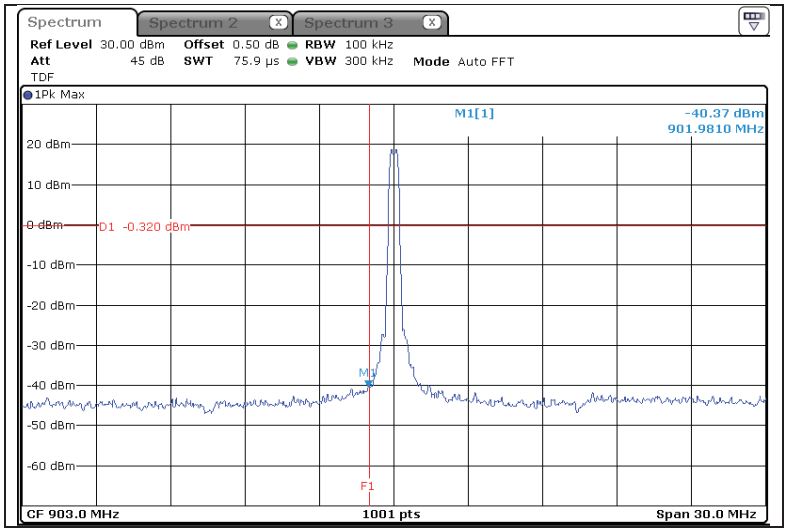
Highest Channel (927.5 ㎒)



- Result of 927.5 ㎒

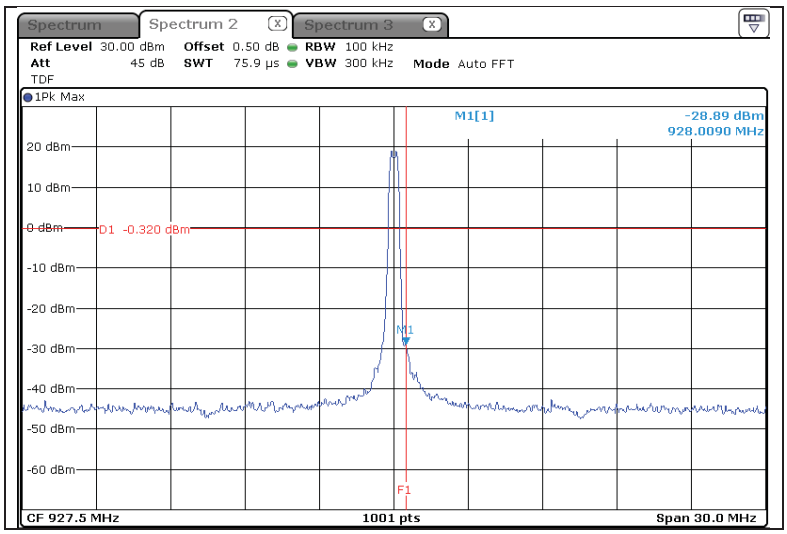
- Hi-fi mode (Without hopping)

Lowest Channel (903.0 ㎒)



- Result of 903.0 ㎒

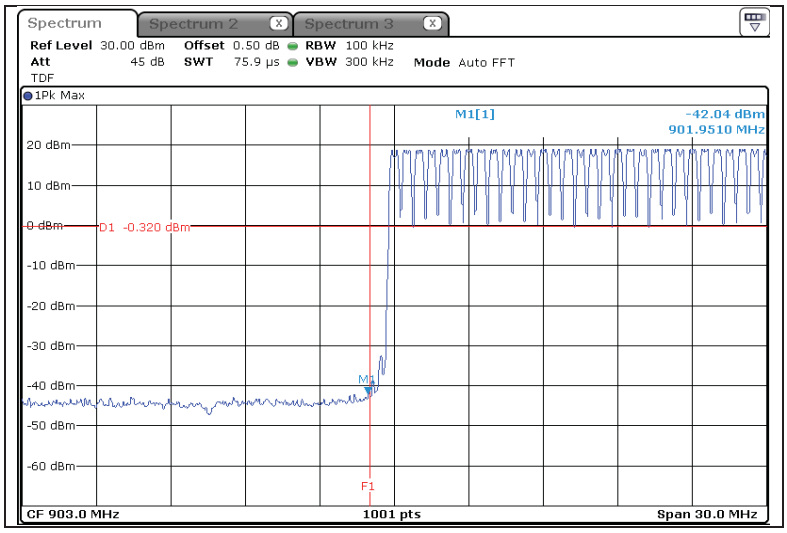
Highest Channel (927.5 ㎒)



- Result of 927.5 ㎒

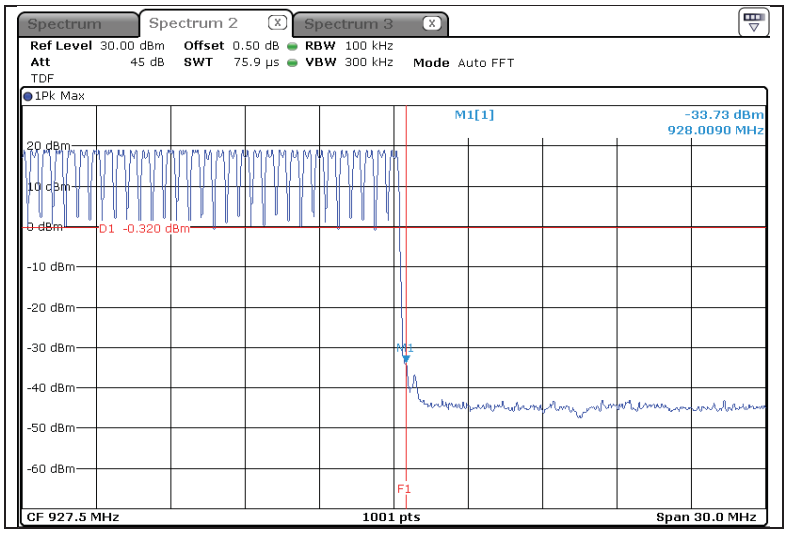
- Hi-fi mode (With hopping)

Lowest Channel (903.0 ㎒)



- Result of 903.0 ㎒

Highest Channel (927.5 ㎒)

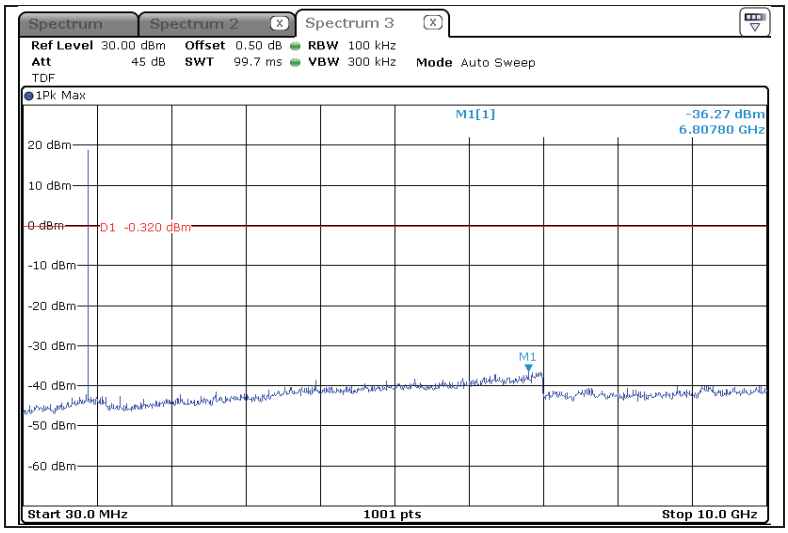


- Result of 927.5 ㎒

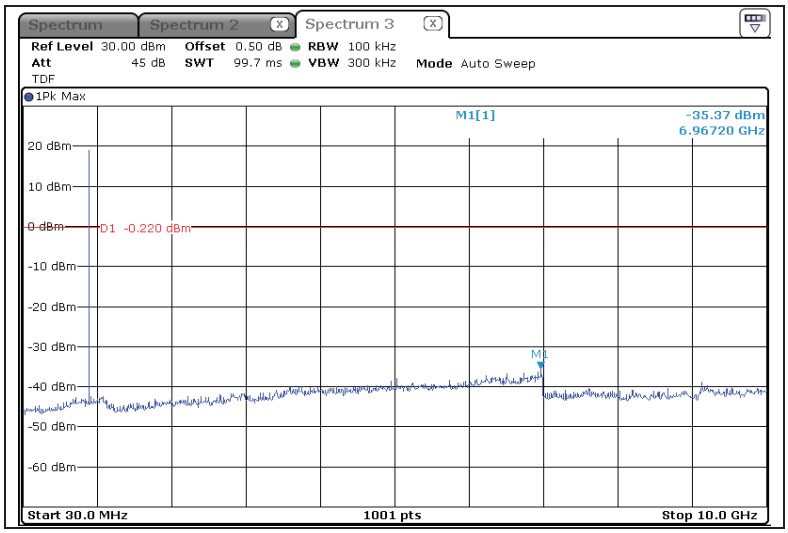
Figure 7 . Plot of the Spurious RF conducted emissions

- Half mode

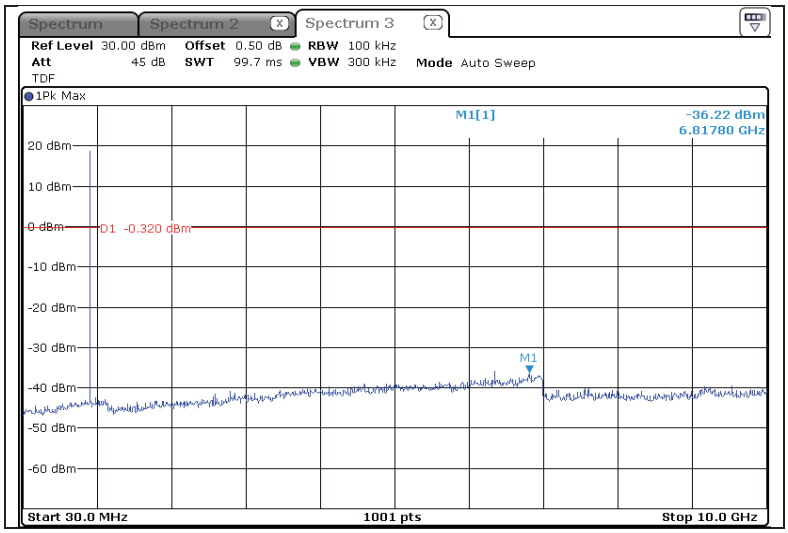
Lowest Channel (902.6 ㎒)



Middle Channel (915.0 ㎒)

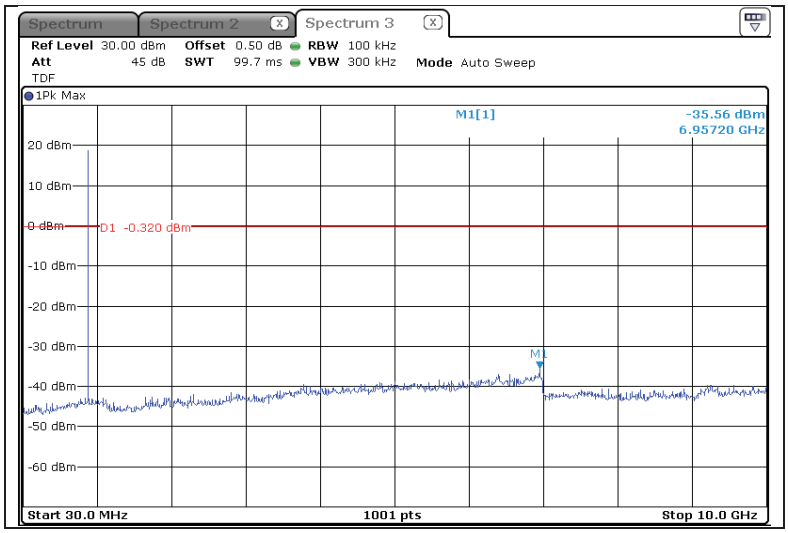


Highest Channel (927.5 ㎒)

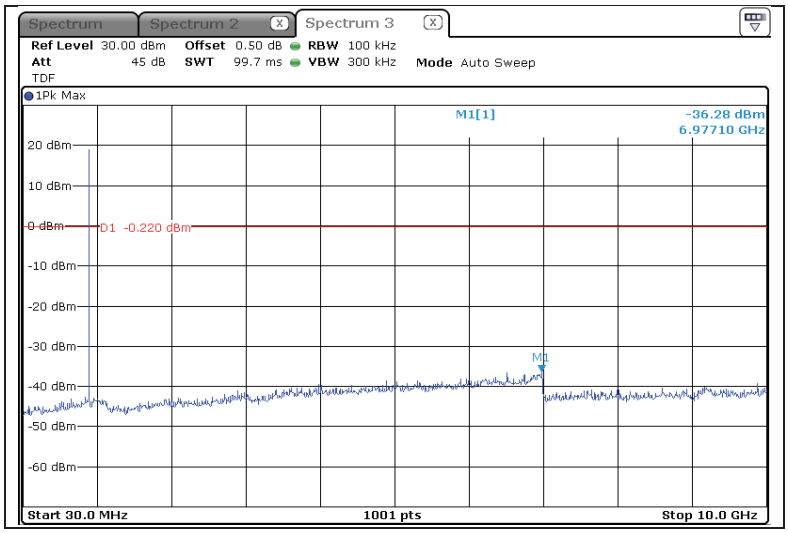


- Hi-fi mode

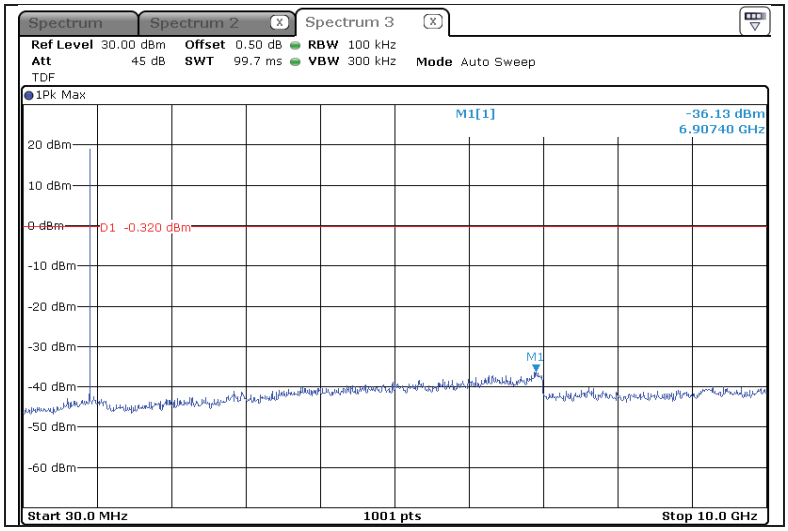
Lowest Channel (903.0 ㎒)



Middle Channel (915.0 ㎒)



Highest Channel (927.5 ㎒)



5.8 Conducted Emission

5.8.1 Regulation

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 Ω 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 boundary between the frequency ranges.

Frequency of emission (㎒)	Conducted limit (dB㎶)	
	Qausi-peak	Average
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.8.2 Measurement Procedure

1) The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 ㎝ in which is located 40 ㎝ away from the vertical wall and 1.5m away from the side wall of the shielded room.

2) Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.

3) Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.

4) The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 ㎒ to 30 ㎒.

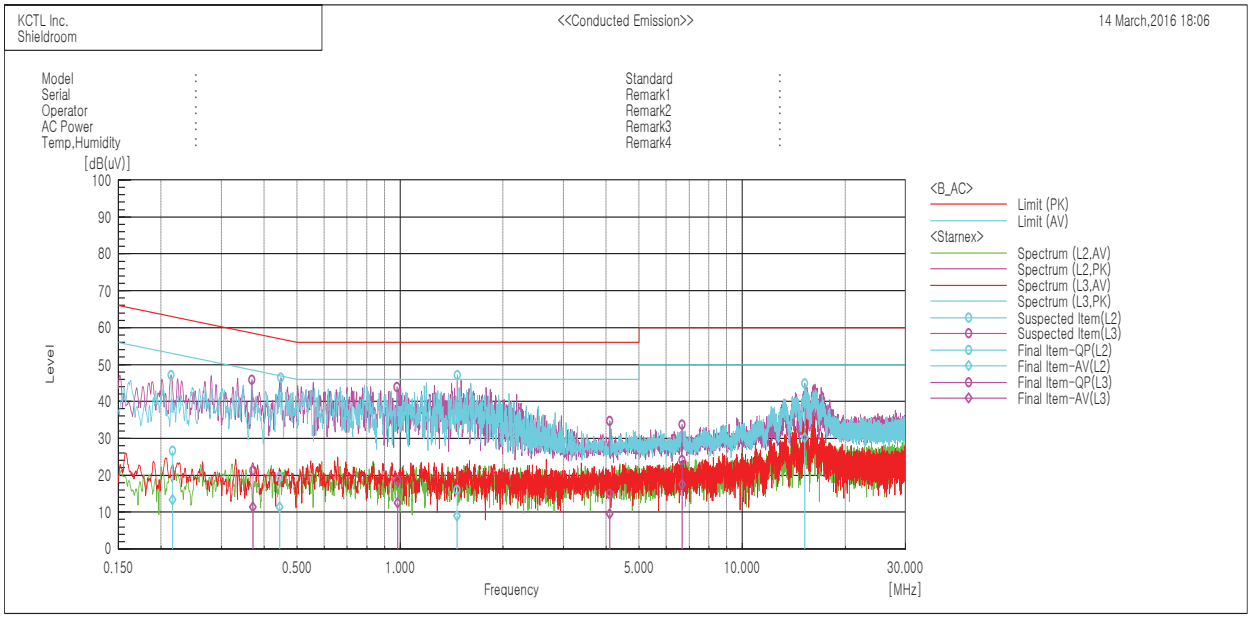
5) The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 ㎑ or to QUASI-PEAK and AVERAGE within a bandwidth of 9 ㎑. The EUT was in transmitting mode during the measurements.

5.8.3 Test Result

- Complied

Figure 8. plot of Conducted Emission

- Conducted worst-case data : Half mode_Middle Channel (915.0 ㎒)



Final Result

--- L2 Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.216	16.4	3.1	10.2	26.6	13.3	63.0	53.0	36.4	39.7
2	0.44501	9.3	1.1	10.2	19.5	11.3	57.0	47.0	37.5	35.7
3	1.46644	5.6	-1.5	10.4	16.0	8.9	56.0	46.0	40.0	37.1
4	15.25133	24.7	14.8	15.3	40.0	30.1	60.0	50.0	20.0	19.9

--- L3 Phase ---

No.	Frequency [MHz]	Reading QP [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB]	Result QP [dB(uV)]	Result CAV [dB(uV)]	Limit QP [dB(uV)]	Limit AV [dB(uV)]	Margin QP [dB]	Margin CAV [dB]
1	0.37125	11.2	1.3	10.1	21.3	11.4	58.5	48.5	37.2	37.1
2	0.98409	8.3	2.1	10.3	18.6	12.4	56.0	46.0	37.4	33.6
3	4.09967	3.2	-2.1	11.6	14.8	9.5	56.0	46.0	41.2	36.5
4	6.67728	11.6	5.0	12.4	24.0	17.4	60.0	50.0	36.0	32.6

6. Test equipment used for test

	Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
■	Spectrum Analyzer	R & S	FSV40	100989	17.01.07
■	DC Power Supply	Agilent	E3632A	MY40017108	16.07.15
■	Signal Generator	R & S	SMR40	100007	16.06.15
■	Wideband Power Sensor	R & S	NRP-Z81	100677	17.01.08
■	EMI TEST RECEIVER	R & S	ESCI	100710	17.02.26
■	Bi-Log Antenna	SCHWARZBECK	VULB 9163	583	16.06.19
■	Amplifier	SONOMA INSTRUMENT	310N	344922	16.09.02
■	Attenuator	SCHWARZBECK	DGA9552N	BU2404	17.04.08
■	Horn Antenna	ETS.lindgren	3117	155787	16.11.25
■	Broadband Preamplifier	SCHWARZBECK	BBV9718	9718-233	17.01.09
■	LOOP Antenna	R & S	HFH2-Z2	100355	18.03.03
■	Antenna Mast	MATURO	AM4.0	079/3440509	-
■	Turn Table	MATURO	CO2000-SOFT	-	-
■	Highpass Filter	Wainwright InstrumentsGmbH	WHKX1.0/1.5S-10SS	14	17.02.04
■	TWO-LINE V-NETWORK	R & S	ENV216	101352	16.09.02
■	Vector Signal Generator	R & S	SMBV100A	257566	17.01.07