TEST REPORT

Part 15 C & RSS-247 (Issue 2)

Equipment under test	mFC Bluetooth Remote GEN1
Model name	mFC-BTR-01
FCC ID	2AVO6-MFCBTR01
IC	26009-MFCBTR01
Applicant	Senior Group LLC
Manufacturer	Hyun Seung I&C Co., Ltd
Date of test(s)	2020.04.08 ~ 2020.04.17
Date of issue	2020.04.21

Issued to
Senior Group LLC
1300 West Main Street Louisville KY 40203
Tel: 855-993-2323

Issued by
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Test and report completed by :	**Report approval by :**
Jang-yeon, Hwang Test engineer	Young-Jin, Lee Technical manager

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Revision history

Revision	Date of issue	Test report No.	Description
-	2020.04.21	KES-RF-20T0080	Initial

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1. General information

Applicant:	Senior Group LLC
Applicant address:	1300 West Main Street Louisville KY 40203
Test site:	KES Co., Ltd.
Test site address:	3701, 40, Simin-daero 365beon-gil, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea 473-21, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Test Facility	FCC Accreditation Designation No.: KR0100, Registration No.: 444148 ISED Registration No.: 4769B
FCC rule part(s):	15.247
IC rule part(s):	RSS-247
FCC ID:	2AVO6-MFCBTR01
IC Certification	26009-MFCBTR01
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	mFC Bluetooth Remote GEN1
Frequency range	2 402 ㎒ ~ 2 480 ㎒ (BDR) 2 402 ㎒ ~ 2 480 ㎒ (BLE)
Model	mFC-BTR-01
Modulation technique	GFSK
Number of channels	2 402 ㎒ ~ 2 480 ㎒ (BDR) : 79 ch 2 402 ㎒ ~ 2 480 ㎒ (BLE) : 40 ch
Antenna specification	Antenna type : PCB antenna, Peak gain : 3.3 ㏈i
Power source	DC 3.0 V (Battery)

15.247(a)(1) that the rx input bandwidths shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate it channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

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Pseudorandom frequency hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

Equal hopping frequency use

The channels of this system will be used equally over the long-term distribution of the hopsets.

System receiver input bandwidth

Each channel bandwidth is 1 ㎒.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.2. Test configuration

The **Senior Group LLC mFC-BTR-01 FCC ID: 2AVO6-MFCBTR01, IC: 26009-MFCBTR01**was tested according to the specification of EUT, the EUT must comply with following standards and KDB documents.

FCC Part 15.247
ISED RSS-247 Issue 2 and RSS-Gen Issue 5
KDB 558074 D01 v05 r02
ANSI C63.10-2013

1.3. Frequency/channel operations

Ch.	Frequency (㎒)	Rate(Mbps)
00	2 402	1
⋮	⋮	⋮
39	2 441	1
⋮	⋮	⋮
78	2 480	1

1.4. Accessory information

Equipment	Manufacturer	Model	Serial No.	Power source
-	-	-	-	-

1.5. Software and Firmware description

The software and firmware installed in the EUT is 01B

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1.6. Measurement results explanation example

For all conducted test items :

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).
= 1.53 + 10 = 11.53

1.7. Measurement Uncertainty

Test Item		Uncertainty
Uncertainty for Conduction emission test		2.62 dB
Uncertainty for Radiation emission test (include Fundamental emission)	9kHz - 30MHz	4.54 dB
	30MHz - 1GHz	4.36 dB
	Above 1GHz	5.00 dB
Note. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.		

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2. Summary of tests

Section in FCC Part 15	Section in RSS-247 & Gen	Parameter	Test results
-	RSS-Gen 6.7	99% occupied bandwidth	Pass
15.247(a)(1)	RSS-247 5.1(a)	20 dB bandwidth	Pass
15.247(b)(1)	RSS-247 5.4(b)	Output power	Pass
15.247(a)(1)	RSS-247 5.1(b)	Channel separation	Pass
15.247(a)(1)(iii)	RSS-247 5.1(d)	Number of channels	Pass
15.247(a)(1)(iii)	RSS-247 5.1(d)	Time of occupancy	Pass
15.205 15.209	RSS-247 5.5 RSS-Gen 8.9, 8.10	Radiated restricted band and emission	Pass
15.247(d)	RSS-247 5.5	Conducted spurious emission and band edge	Pass

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3. Test results

3.1. 99% Occupied Bandwidth

Test procedure

ANSI C63.10-2013 clause 6.9.2 and 6.9.3

Test setup

EUT	—	Attenuator	—	Spectrum analyzer

Test setting

1. Span = The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
2. RBW = The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW
3. VBW = shall be approximately three times the RBW
4. Sweep = auto
5. Detector function = Peak
6. Trace = Max hold

Limit

Not applicable

Test results

Frequency(㎒)	99% occupied bandwidth(㎒)	Limit(㎒)
2 402	0.926	-
2 441	0.933	
2 480	0.919	

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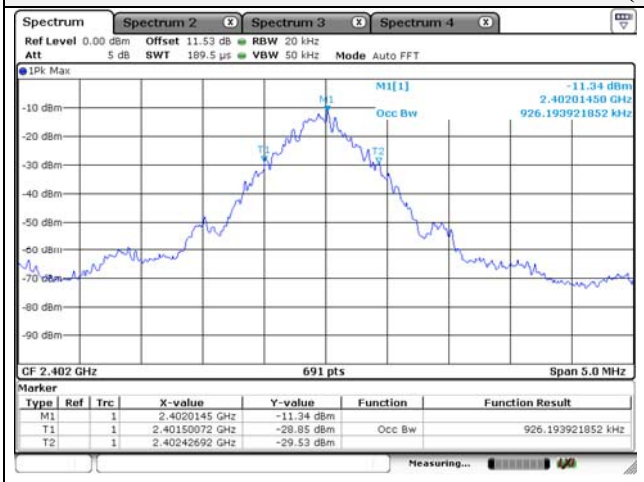
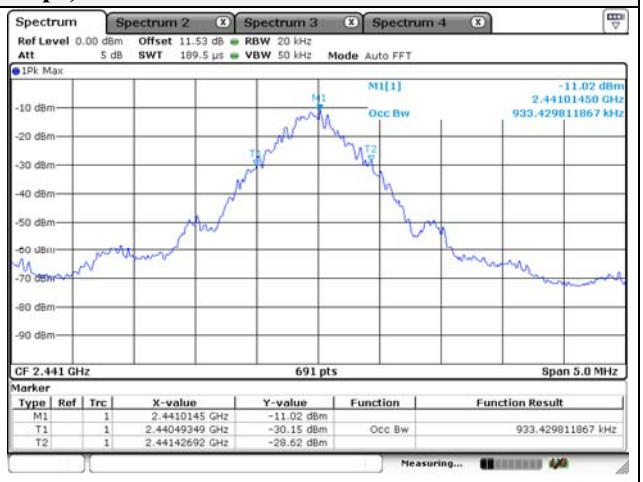
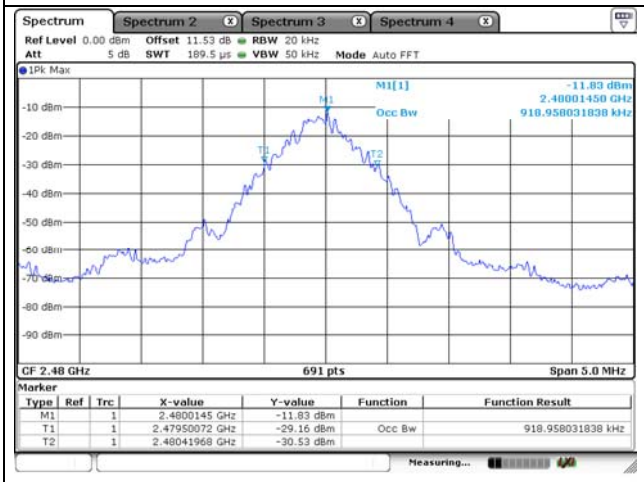
Test plots

BDR(1Mbps)







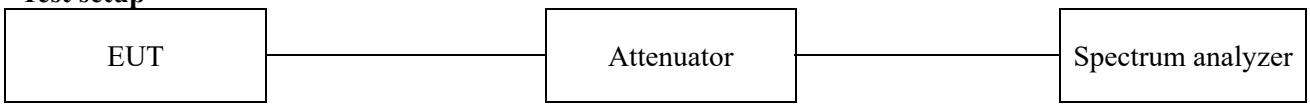
N/A

3.2. 20 dB bandwidth

Test procedure

ANSI C63.10-2013 clause 6.9.2 and 6.9.3

Test setup



Test setting

1. Span = 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.
2. RBW = The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW.
3. VBW = Shall be approximately three times the RBW.
4. Sweep = auto
5. Detector function = peak
6. Trace mode = max hold

Limit

Not applicable

Test results

Frequency(㎒)	20 dB bandwidth(㎒)	Limit(㎒)
2 402	0.905	-
2 441	0.912	
2 480	0.854	

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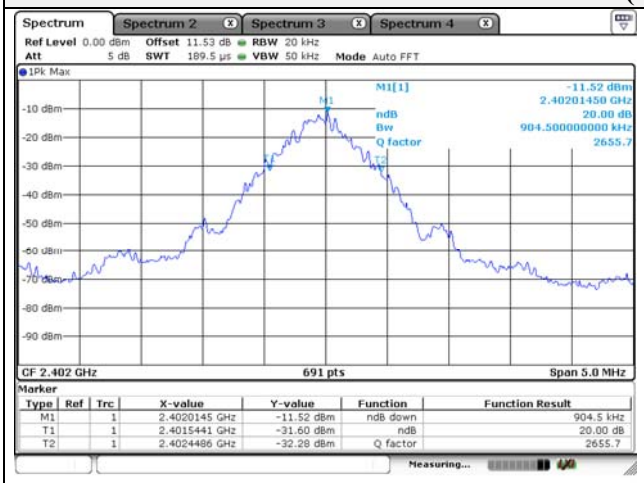
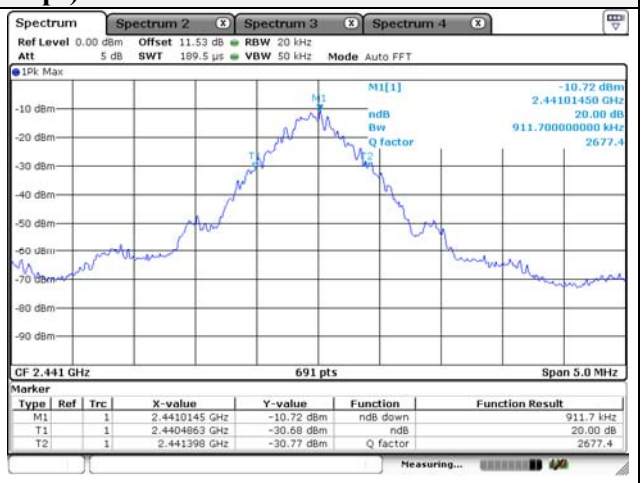
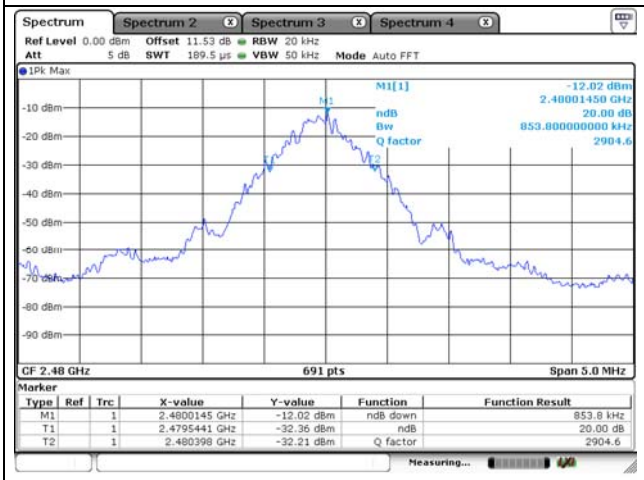
Test plots

BDR(1Mbps)







N/A

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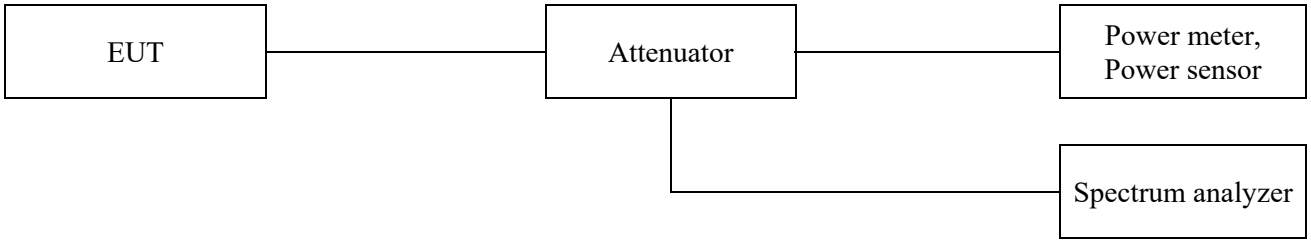
3.3. Output power

Test procedure

ANSI C63.10-2013 - Section 7.8.5

Test setup



Test setting

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

Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emiss ion. The indicated level is the peak output power, after any corrections for external attenuators and cables. A plot of the test results and setup description shall be included in the test report.

Limit

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, provided the systems operate with an output power no greater than 125 ㎽.

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

According to RSS-247 Issue 2 5.4(b), For FHSs operating in the band 2 400 - 2 483.5 ㎒, the maximum peak conducted output power shall not exceed 1.0 �W if the hopset uses 75 or more hopping channls; the maximum peak conducted output power shall not exceed 0.125 �W if the hopset uses less than 75 hopping channls. The e.i.r.p shall not exceed 0.4 �W, except as provided in section 5.4(e).

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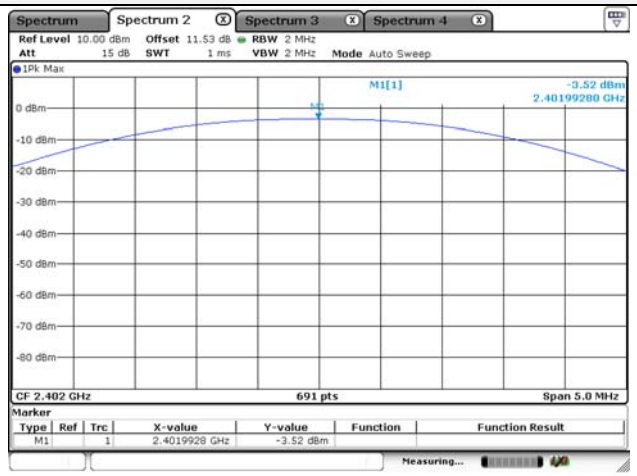
Test results

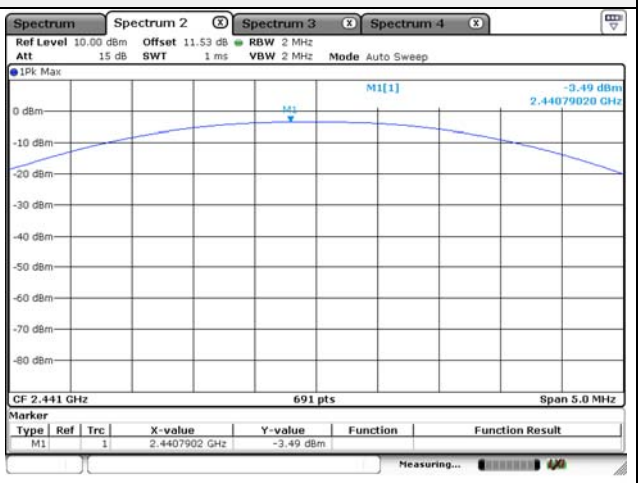
Frequency(㎒)	Peak Power (dBm)	Average Power (dBm) Note1	PK E.I.R.P (dBm)	Power Limit (dBm)	E.I.R.P Limit for ISED(dBm)
2 402	-3.52	-4.50	-0.22	20.97	36.02
2 441	-3.49	-4.65	-0.19	20.97	36.02
2 480	-4.43	-5.55	-1.13	20.97	36.02

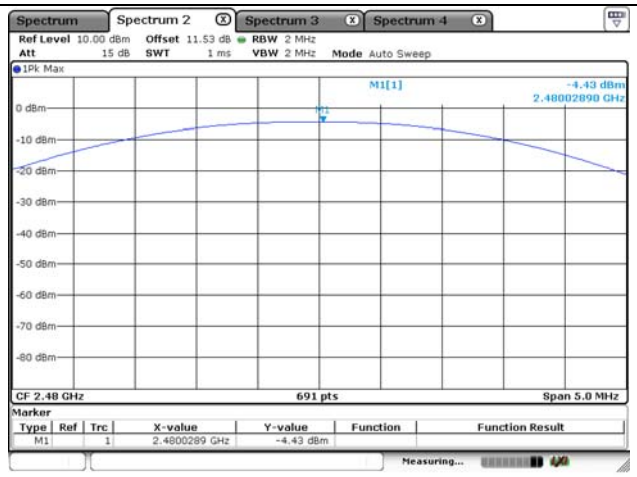
Note.
1. Antenna gain : 3.3 dBi
2. The average power was tested using an average power meter.

Test plots

GFSK







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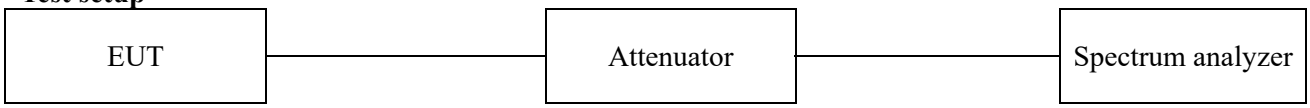
3.4. Carrier frequency separation

Test procedure

ANSI C63.10-2013 - Section 7.8.2

Test setup



Test Setting

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = wide enough to capture the peaks of two adjacent channels
3. 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.
4. Video (or Average) Bandwidth (VBW) ≥ RBW
5. Sweep = auto
6. Detector function = peak
7. Trace = max hold

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.

Limit

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

According to RSS-247 Issue 2, 5.1(b), FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 20 ㏈ bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 ㎒ 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 that the systems operate with an output power no greater than 0.125 ㎡.

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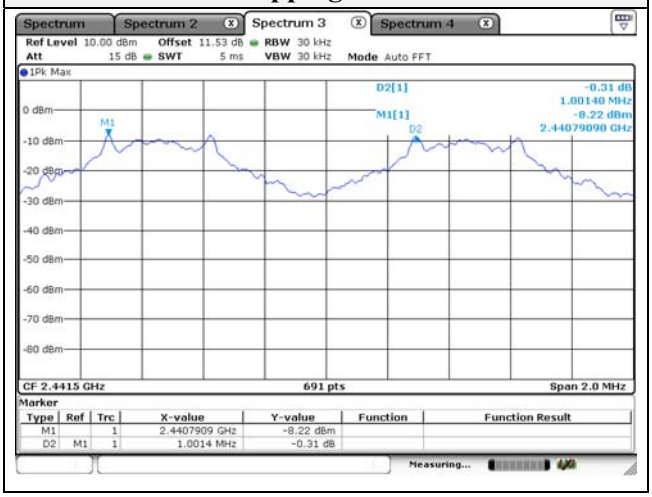
Test results

Frequency(㎒)	Channel no.	Data rate(Mbps)	Channel Separation (㎒)	Minimum limit (㎒)
2 441	39	1	1.001	0.607

Test plots

Hopping mode



3.5. Number of hopping frequency

Test procedure

ANSI C63.10-2013 - Section 7.8.3

Test setting

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Frequency range: 2 400 ㎒ ~ 2 441.5 ㎒, 2 441.5 ㎒ ~ 2 483.5 ㎒
3. Span = the frequency band of operation
4. 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.
5. VBW ≥ RBW
6. Sweep = auto
7. Detector function = peak
8. Trace = max hold

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.

Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 ㎒ bands shall use at least 15 hopping frequencies.

According to RSS-247 Issue 2, 5.1(d), FHSs operating in the band 2400-2483.5 ㎒ shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

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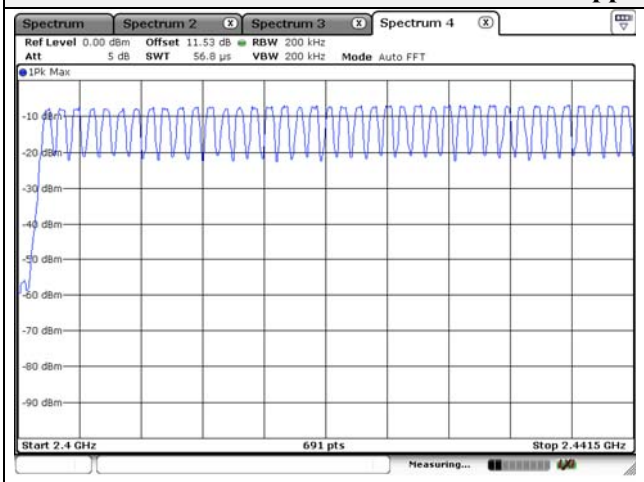
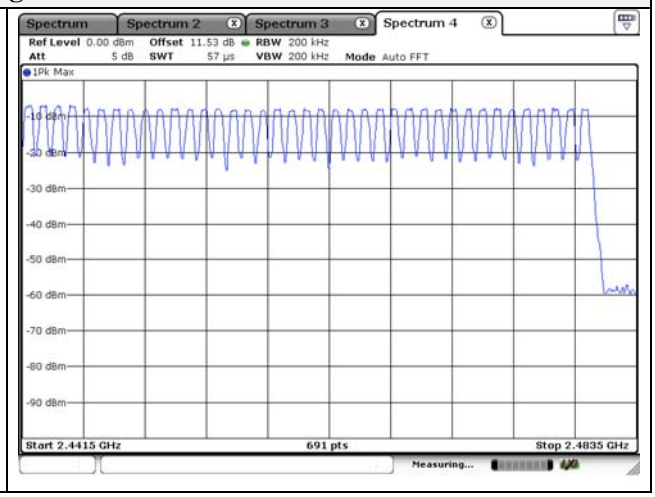
Test results

Hopping mode





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3.6. Time of occupancy

Test procedure

ANSI C63.10-2013 - Section 7.8.4

Test setting

1. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
2. Span = zero span, centered on a hopping channel
3. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
4. VBW = 1 ㎒ (≥ RBW)
5. Sweep = as necessary to capture the entire dwell time per hopping channel
6. Detector function = peak
7. 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.

Limit

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2 400 ~ 2 483.5 ㎒ band, the average time of occupancy on any frequency shall not be greater than 0.4 second within a period of 0.4 seconds multiplied by the number of hopping channels employed.

According to RSS-247 Issue 2, 5.1(d), FHSs operating in the band 2 400 - 2 483.5 ㎒ shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

A period time = 0.4(s) × 79 = 31.6(s)

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

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Test results

Packet type	Frequency (㎒)	Dwell time (ms)	A period time (s)	Time of occupancy on the Tx channel	Limit for time of occupancy on the Tx channel
DH1	2 441	0.380	31.6	121.60	400
DH3	2 441	1.636	31.6	261.76	400
DH5	2 441	2.883	31.6	307.52	400

Note:
DH1: Dwell time (ms) × [(1 600 ÷ 2) ÷ 79] × 31.6(s) = 121.60 (ms)
DH3: Dwell time (ms) × [(1 600 ÷ 4) ÷ 79] × 31.6(s) = 261.76 (ms)
DH5: Dwell time (ms) × [(1 600 ÷ 6) ÷ 79] × 31.6(s) = 307.52 (ms)

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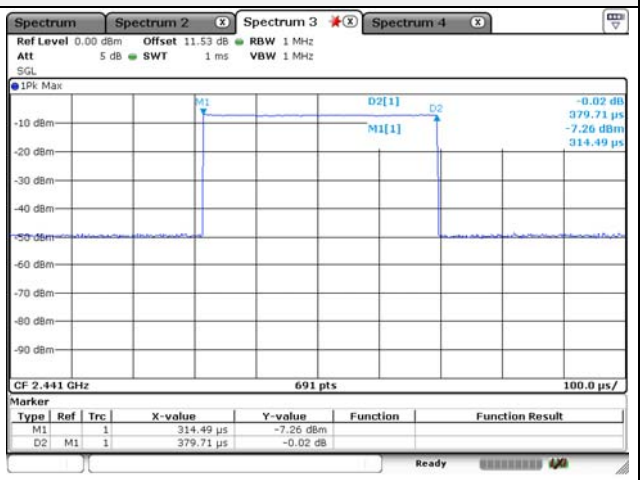
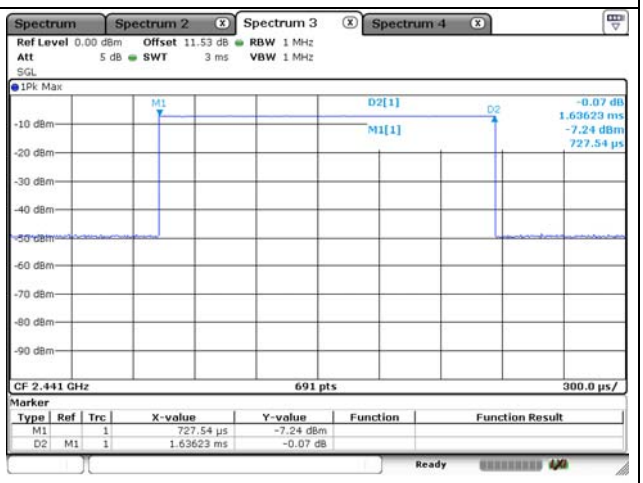
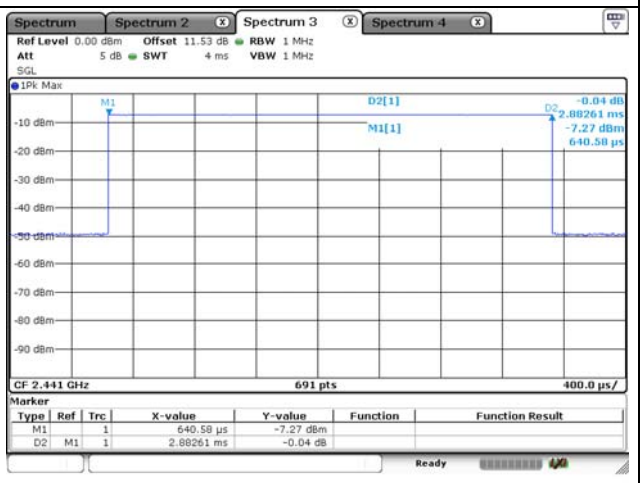
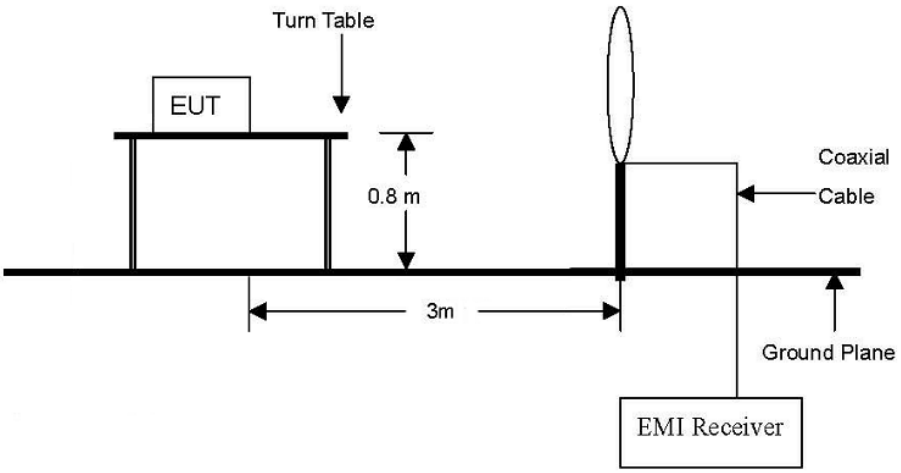
Packet type	BDR(1Mbps)
DH1	
DH3	
DH5	

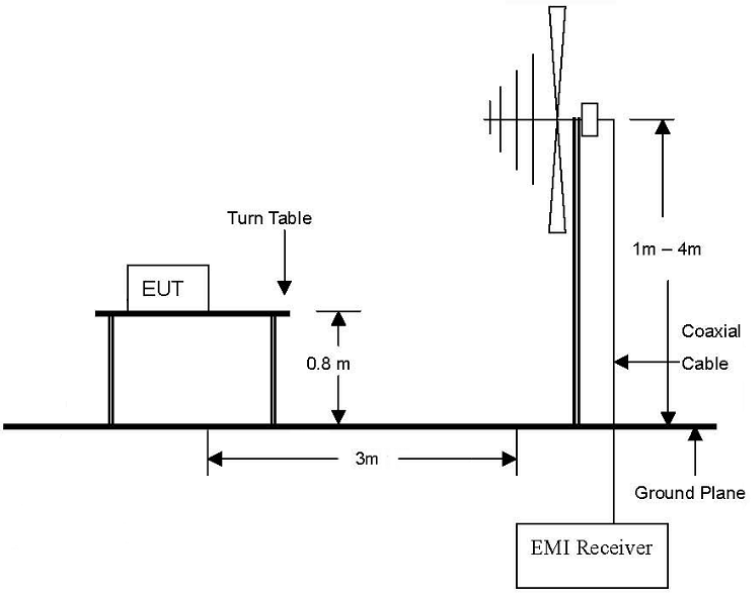
3.7. Radiated restricted band and emissions

Test setup

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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



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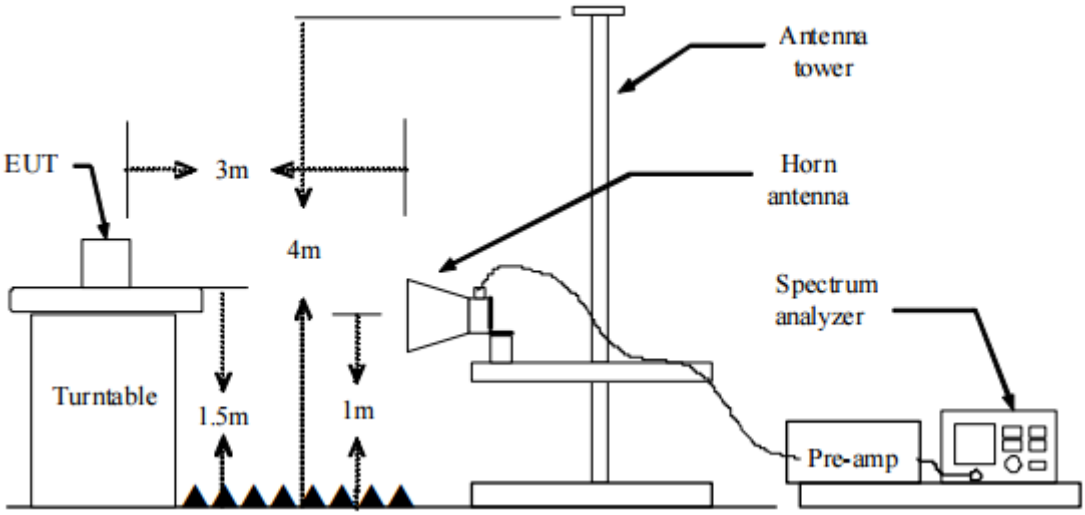
The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to the tenth harmonic of the highest fundamental frequency or to 40 ㎓ emissions, whichever is lower.



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Test procedure

1. The EUT is placed on a turntable, which is 0.8 m (below 1 ㎓) and 1.5 m (above 1 ㎓) above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum analyzer settings for f < 1 ㎓:
   Span = wide enough to fully capture the emission being measured
   RBW = 100 ㎑
   VBW ≥ RBW
   Sweep = auto
   Detector function = quasi peak
   Trace = max hold
8. Spectrum analyzer settings for f ≥1 ㎓: Peak
   Span = wide enough to fully capture the emission being measured
   RBW = 1 ㎒
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
9. Spectrum analyzer settings for f ≥1 ㎓: Average
   Average value of pulsed emissions.
   Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determined from the peak field strength after correcting for the worst-case duty cycle as described in 7.5 in ANSI 63.10-2013 & Procedure 9(b) in the KDB 558074 v05r02.
10. Duty Cycle Correction Factor
    a. Time to cycle through all channels = Δt=τ[㎳] × 79 channels = 227.76 ㎳, where τ = pulse width
    b. 100 ㎳/ Δt[㎳] = H → Round up to next highest integer, H =1, where H = number of hops
    c. Worst Case Dwell Time = τ[㎳] × H = 2.883 ㎳
    d. Duty Cycle Correction = 20log (Worst Case Dwell Time/ 100㎳) ㏈ = -30.80 ㏈

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Note:

1. The spectrum is measured from 9 ㎑ to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1 ㎓. Above 1 ㎓, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of the respective limits were not reported.
2. The loop antenna was investigated with three polarizations, and horizontal and vertical polarizations were reported as the worst case**.**
3. According to 15.35 (c), as a "duty cycle correction factor", pulse averaging with 20 log(duty cycle) has to be used.
   Duty cycle correction factor = 20log(dwell time/100 ㎳)
4. Emissions below 18 ㎓ were measured at a 3 meter test distance while emissions above 18 ㎓ were measured at a 1 meter test distance with the application of a distance correction factor.
5. Average test would be performed if the peak result were greater than the average limit.
6. Field strength(㏈㎶/m) = Level(㏈㎶) + Correction factors(㏈/m) + Cable loss(㏈) + or F_d(㏈)
7. Correction factors(㏈/m) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈)
8. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
9. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z, it was determined that **X** orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in **X** orientation.
10. The worst-case emissions are reported however emissions whose levels were not within 20 ㏈ of respective limits were not reported.
11. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open field test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
12. f < 30 ㎒, extrapolation factor of 40 ㏈/decade of distance. $F_d = 40\log(D_m / Ds)$
    $f \geq$ 30 ㎒, extrapolation factor of 20 ㏈/decade of distance. $F_d = 20\log(D_m / Ds)$

Where:

F_d = Distance factor in ㏈
D_m = Measurement distance in meters
D_s = Specification distance in meters

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Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2400/F(㎑)
0.490 ~ 1.705	30	24000/F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**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., Sections 15.231 and 15.241.

According to RSS-Gen, Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2 400 / F(㎑)
0.490 ~ 1.705	30	24 000 / F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960*	3	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

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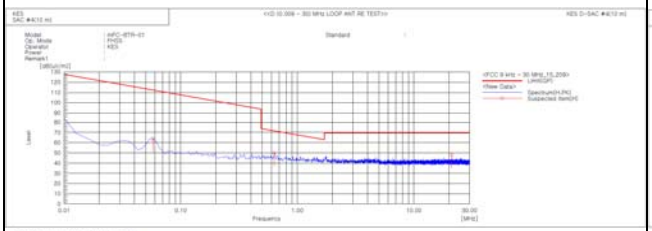
Test results (Below 30 ㎒)

Mode:	BDR
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Channel:	39 (Worst case)

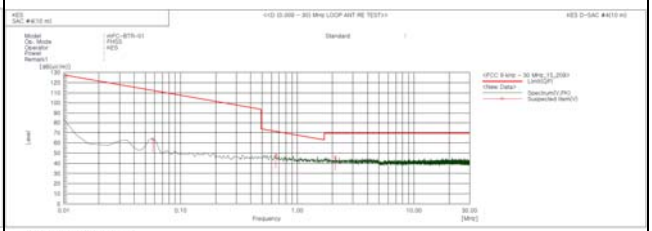
Horizontal



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	0.058	H	44.0	19.9	63.9	112.4	48.5	100.0	341.0	
2	0.635	H	29.1	21.0	50.1	71.6	21.5	100.0	191.0	
3	21.100	H	27.0	21.2	48.2	69.5	21.3	100.0	89.0	

Vertical



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	0.058	V	44.0	19.9	63.9	112.4	48.5	100.0	90.0	
2	0.658	V	27.3	21.0	48.3	71.3	23.0	100.0	35.0	
3	2.120	V	26.2	20.1	46.3	69.5	23.2	100.0	192.0	

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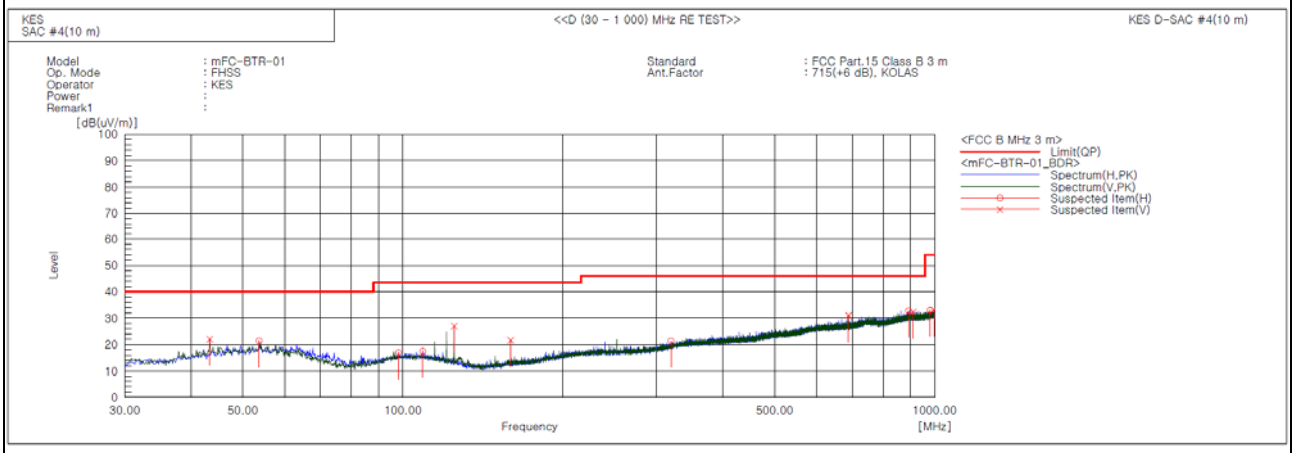
Test results (Below 1 000 ㎒)

Mode:	BDR
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Channel:	39 (Worst case)

Horizontal // Vertical



No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	53.644	H	43.4	-22.0	21.4	40.0	18.6	200.0	257.0	
2	98.143	H	40.1	-23.2	16.9	43.5	26.6	100.0	117.0	
3	108.934	H	40.7	-23.2	17.5	43.5	26.0	200.0	133.0	
4	319.060	H	40.1	-18.7	21.4	46.0	24.6	100.0	153.0	
5	892.330	H	40.1	-7.3	32.8	46.0	13.2	200.0	257.0	
6	979.509	H	39.8	-6.8	33.0	54.0	21.0	100.0	17.0	
7	43.338	V	44.6	-22.5	22.1	40.0	17.9	400.0	79.0	
8	124.818	V	52.4	-25.4	27.0	43.5	16.5	100.0	350.0	
9	159.374	V	47.6	-25.9	21.7	43.5	21.8	100.0	350.0	
10	688.266	V	41.2	-10.2	31.0	46.0	15.0	150.0	310.0	
11	910.518	V	39.6	-7.2	32.4	46.0	13.6	150.0	76.0	
12	997.211	V	39.7	-6.5	33.2	54.0	20.8	150.0	48.0	

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Test results (Above 1 000 ㎒)

Mode: BDR

Transfer rate: 1 Mbps

Distance of measurement: 3 meter

Channel: 00

- **Spurious**

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 195.40	54.06	Peak	H	-5.92	-	48.14	74.00	25.86
1 398.00	56.21	Peak	H	-5.36	-	50.85	74.00	23.15
1 195.40	59.77	Peak	V	-5.92	-	53.85	74.00	20.15
1 398.00	54.51	Peak	V	-5.36	-	49.15	74.00	24.85

- **Band edge**

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 361.92	50.94	Peak	H	0.53	-	51.47	74.00	22.53
2 389.42	47.47	Peak	V	0.46	-	47.93	74.00	26.07

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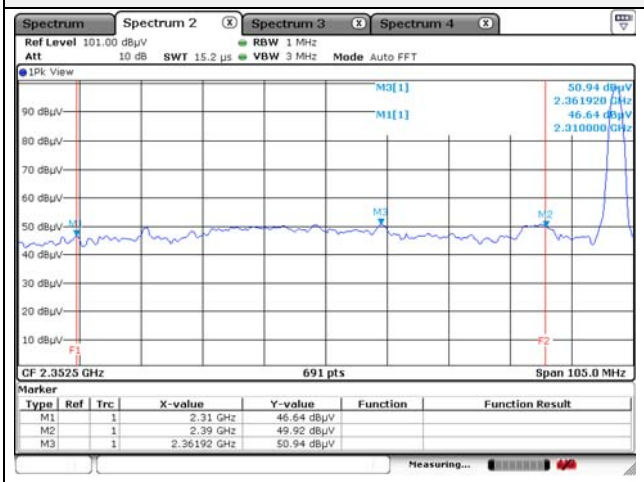
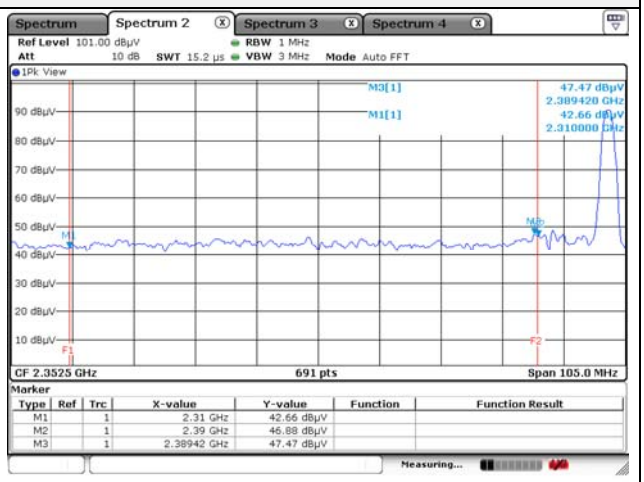
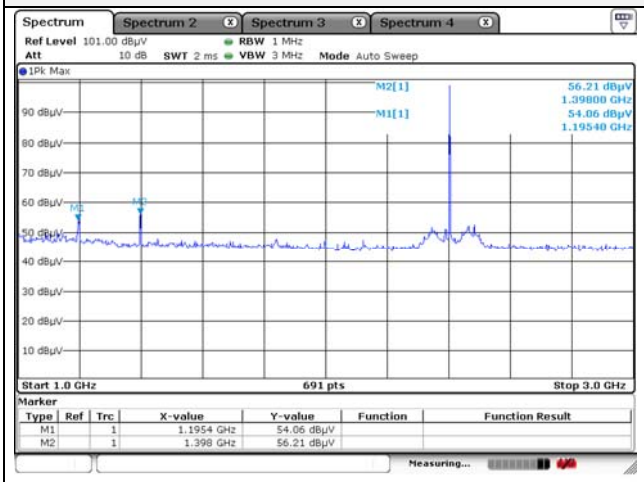
Restricted band // Horizontal // Peak



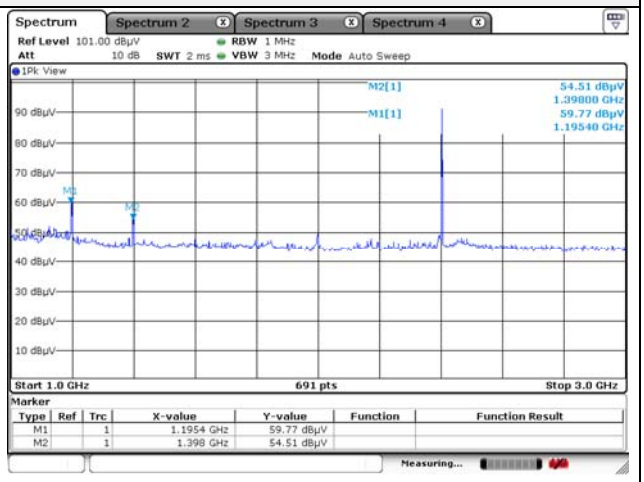
Restricted band // Vertical // Peak



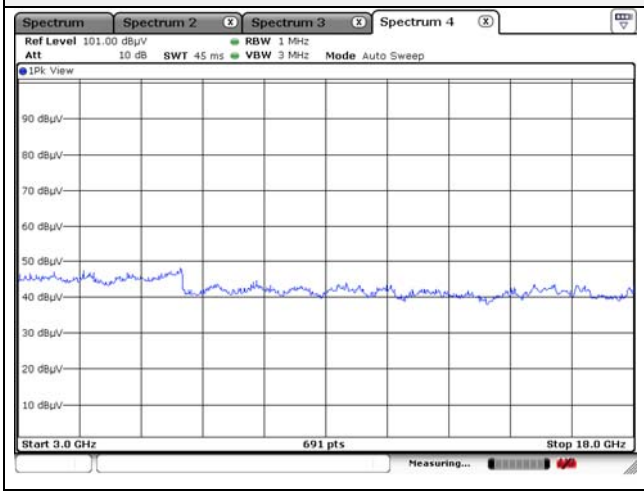
Horizontal // Peak for 1 ㎓ to 3 ㎓



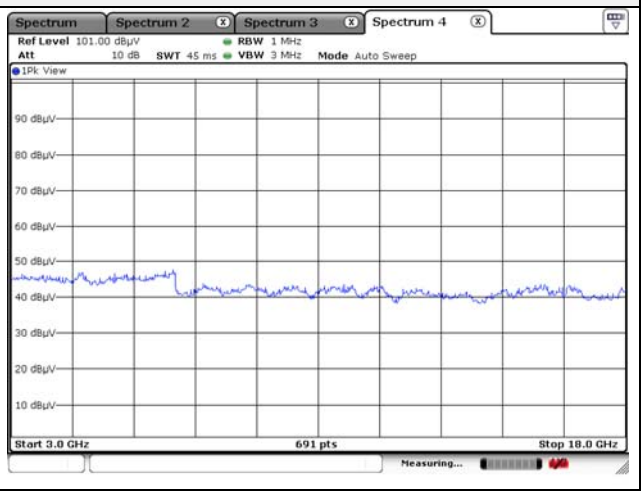
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



Note.
1. Average test would be performed if the peak result were greater than the average limit.
2. No spurious emission were detected above 3 ㎓.

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Mode: BDR

Transfer rate: 1 Mbps

Distance of measurement: 3 meter

Channel: 39

- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 195.40	51.94	Peak	H	-5.92	-	46.02	74.00	27.98
1 395.10	50.17	Peak	H	-5.37	-	44.80	74.00	29.20
1 198.30	57.62	Peak	V	-5.91	-	51.71	74.00	22.29
1 395.10	58.83	Peak	V	-5.37	-	53.46	74.00	20.54

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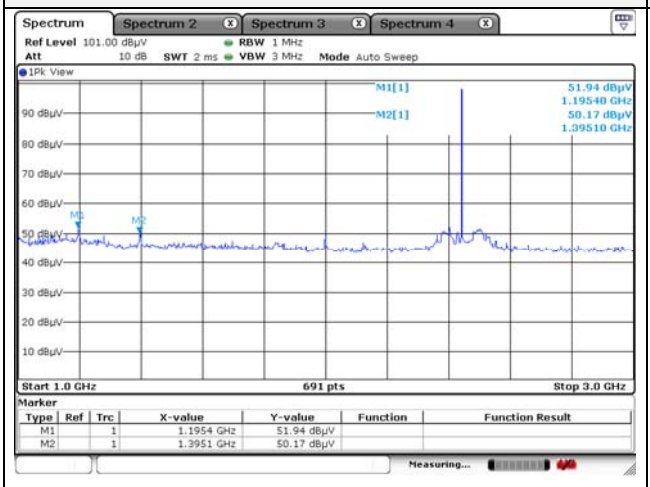
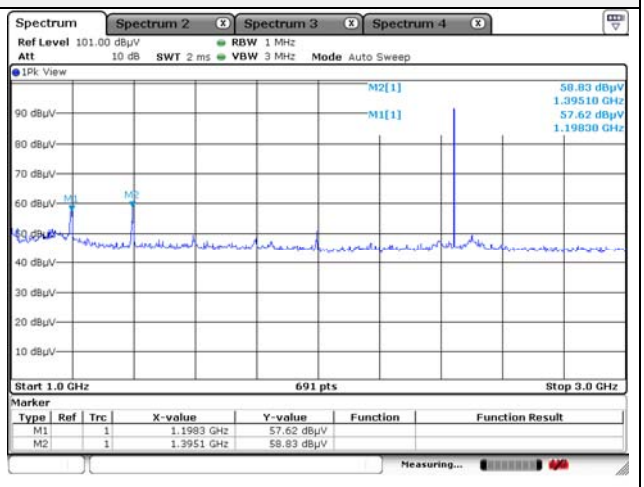
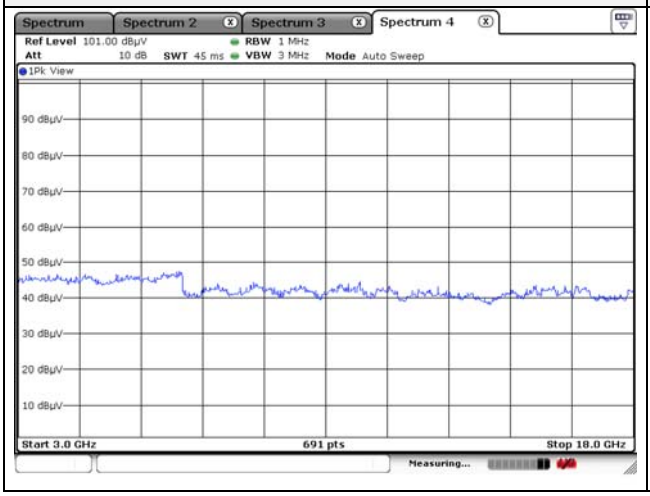
Horizontal // Peak for 1 ㎓ to 3 ㎓



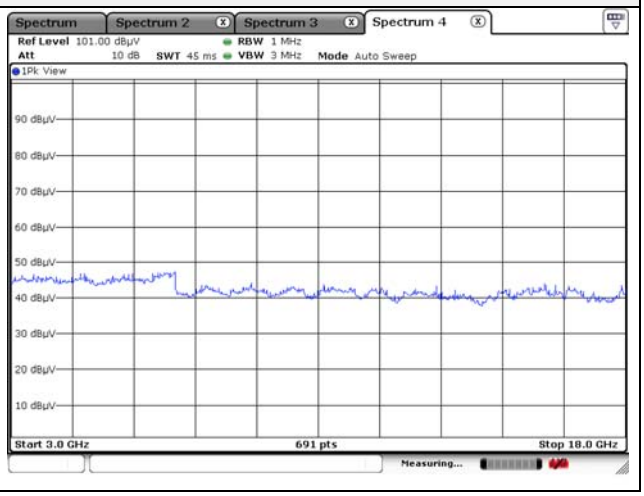
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



Note.
1. Average test would be performed if the peak result were greater than the average limit.
2. No spurious emission were detected above 3 ㎓.

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Mode: BDR

Transfer rate: 1 Mbps

Distance of measurement: 3 meter

Channel: 78

- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 198.30	53.84	Peak	H	-5.91	-	47.93	74.00	26.07
1 400.90	54.16	Peak	H	-5.36	-	48.80	74.00	25.20
1 198.30	55.73	Peak	V	-5.91	-	49.82	74.00	24.18
1 395.10	56.35	Peak	V	-5.37	-	50.98	74.00	23.02

- **Band edge**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 486.32	48.59	Peak	H	0.17	-	48.76	74.00	25.24
2 487.16	45.88	Peak	V	0.16	-	46.04	74.00	27.96

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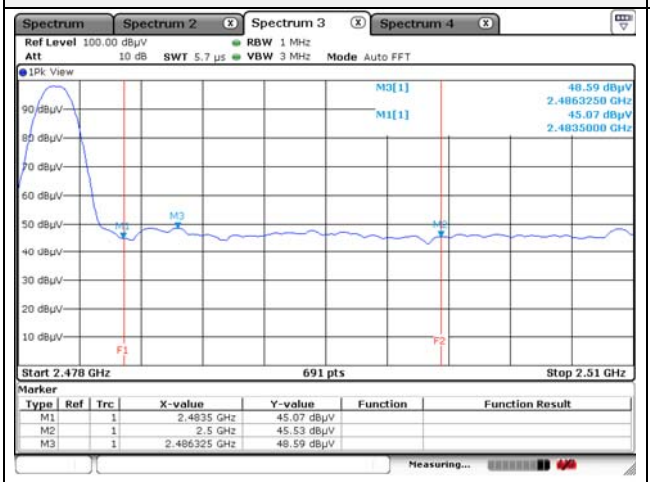
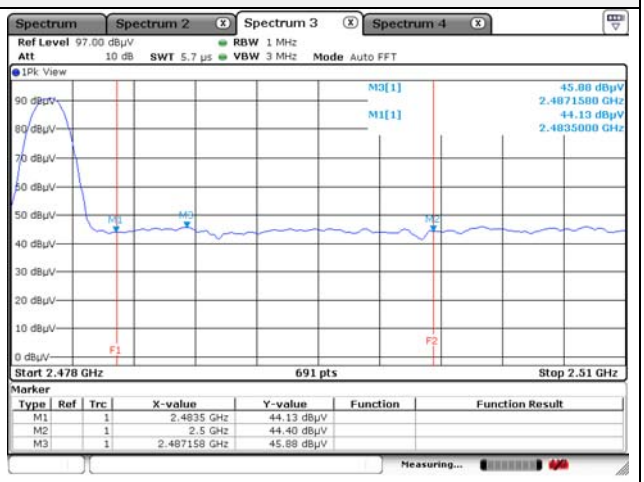
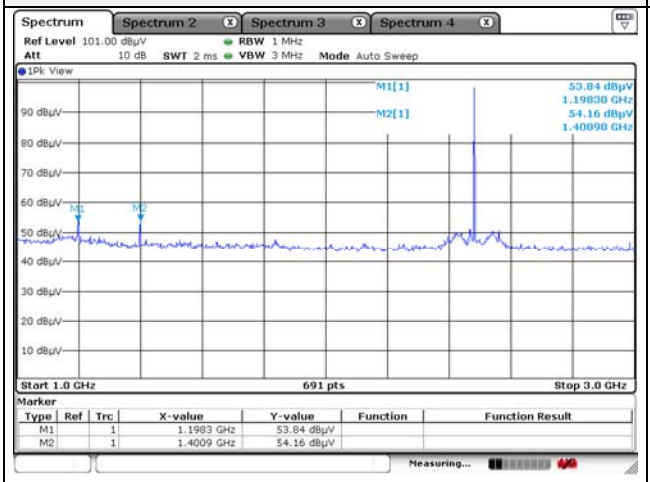
Restricted band // Horizontal // Peak



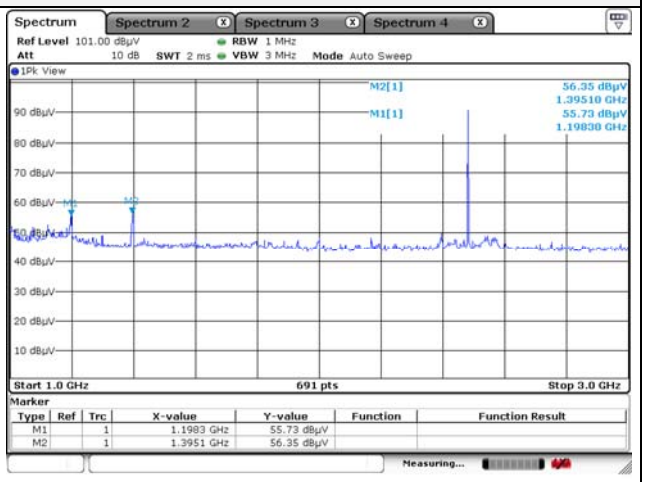
Restricted band // Vertical // Peak



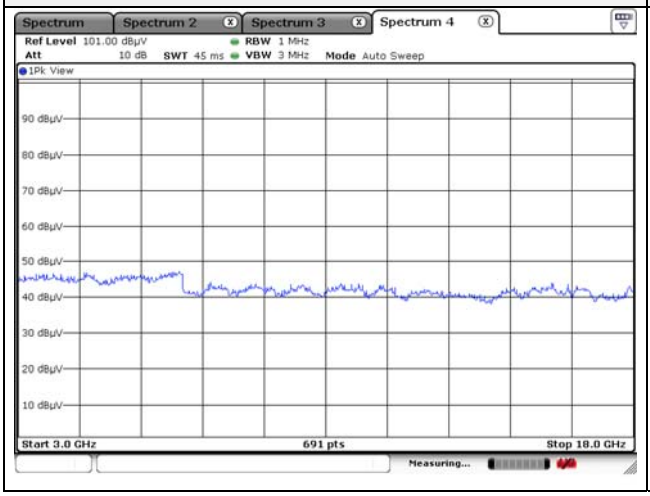
Horizontal // Peak for 1 ㎓ to 3 ㎓



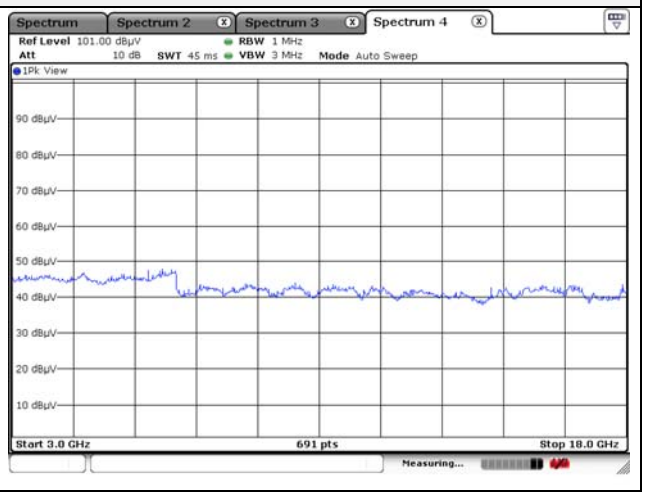
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



Note.
1. Average test would be performed if the peak result were greater than the average limit.
2. No spurious emission were detected above 3 ㎓.

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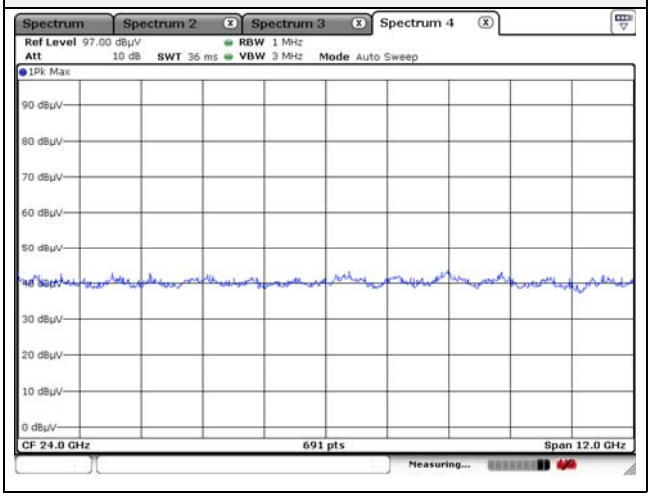
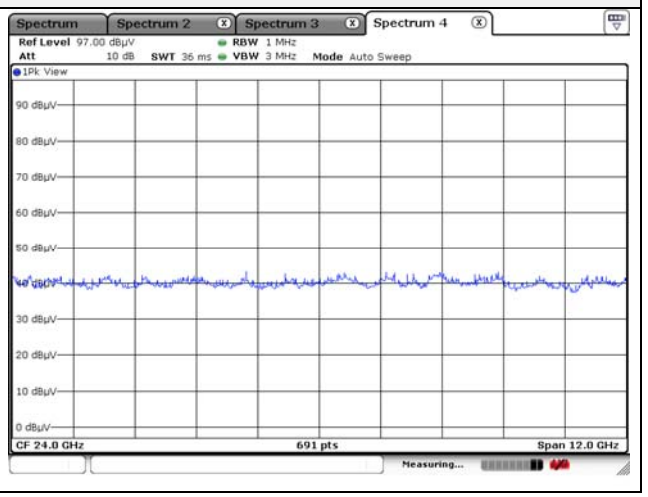
Test results (18 ㎓ to 30 ㎓)

Mode:	BDR
Transfer rate:	1 Mbps
Distance of measurement:	3 meter
Channel:	39(Worst case)

Horizontal	Vertical
	

Note.
1. No spurious emission were detected above 18 ㎓.

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Test results (Above 1 000 ㎒)

Mode: BLE, BDR

Distance of measurement: 3 meter

Channel: BLE:39, BDR:39 (Worst case)

- **Spurious**

Frequency (㎒)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 198.30	53.77	Peak	H	-5.91	-	47.86	74.00	26.14
1 395.10	50.33	Peak	H	-5.37	-	44.96	74.00	29.04
1 198.30	56.27	Peak	V	-5.91	-	50.36	74.00	23.64
1 398.00	55.06	Peak	V	-5.36	-	49.70	74.00	24.30
*4 965.00	45.72	Peak	H	16.05	-	61.77	74.00	12.23
*4 965.00	31.41	Average	H	16.05	0.67	48.13	54.00	5.87

Note.
1. “ * ” is emission by BLE.
2. DCF of BLE = 0.67 dB.

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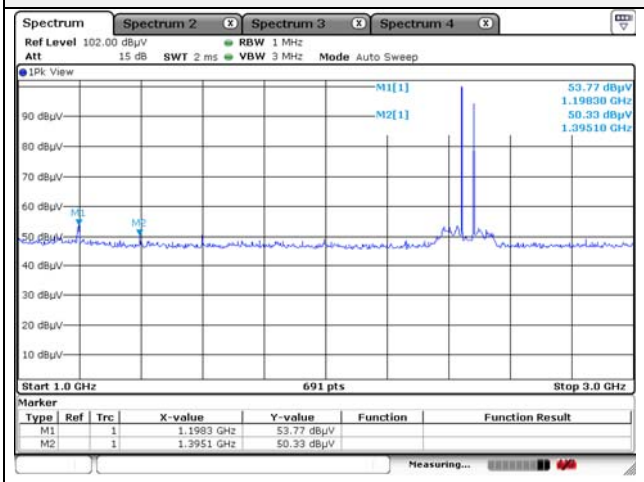
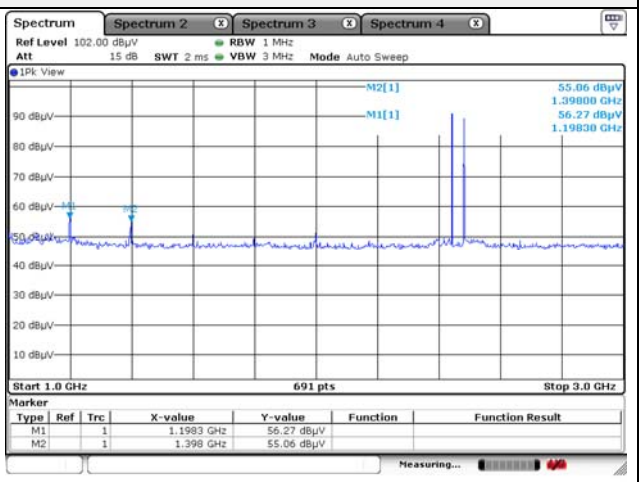
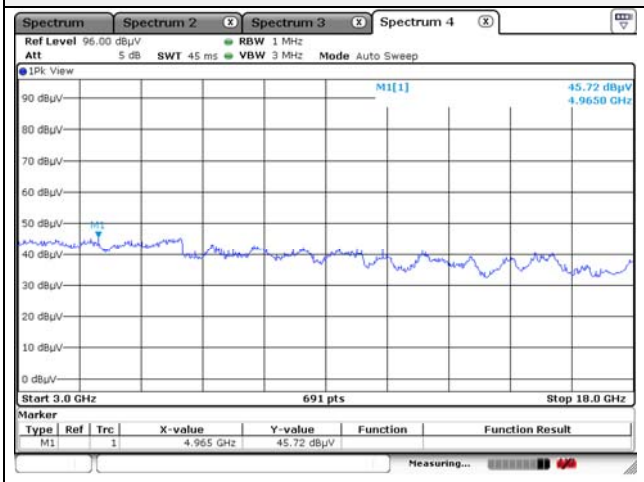
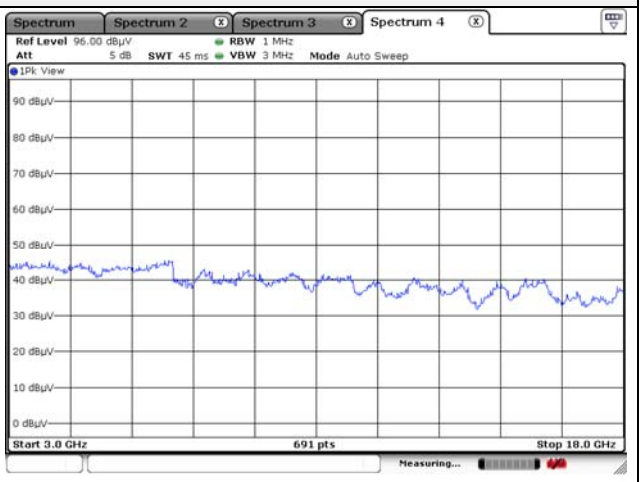
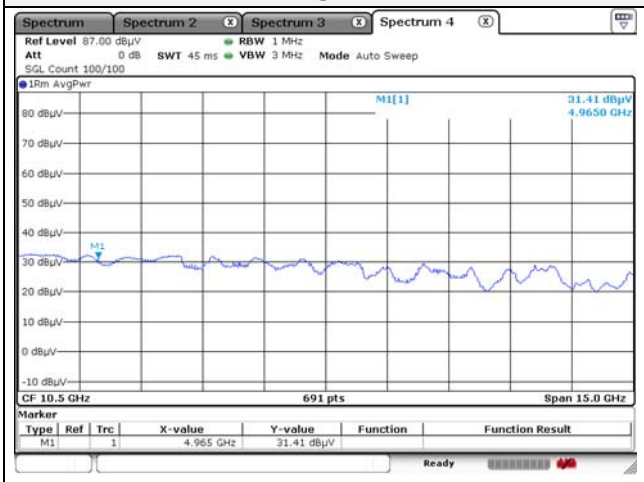
Horizontal // Peak for 1 ㎓ to 3 ㎓	Vertical // Peak for 1 ㎓ to 3 ㎓
	
Horizontal // Peak for 3 ㎓ to 18 ㎓	**Vertical // Peak for 3 ㎓ to 18 ㎓**
	
Horizontal // Average for 3 ㎓ to 18 ㎓	**Vertical // Average for 3 ㎓ to 18 ㎓**
	Blank

Note.
1. Average test would be performed if the peak result were greater than the average limit.

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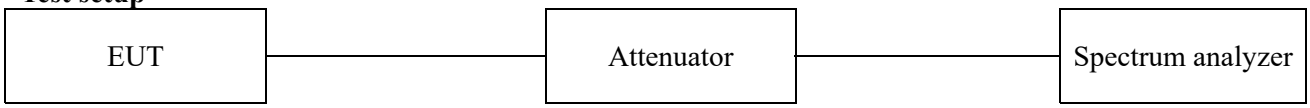
3.8 Conducted spurious emissions & band edge

Test setup



Test procedure

ANSI C63.10-2013 - Section 7.8.6 and 7.8.8

Test setting

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 opera tion.
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.
3. Attenuation: Auto (at least 10 dB preferred).
4. RBW = 100 ㎑
5. VBW ≥ 300 ㎑
6. Detector = Peak
7. Sweep time = auto couple
8. Allow the trace to stabilize.

Limit

According to 15.247(d), in any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval , as permitted under paragraph(b)(3) of this section , the attenuation required under this paragraph shall be 30 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in section 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section 15.205(a), must also comply the radiated emission limits specified in section 15.209(a) (see section 15.205(c))

According to RSS-247 issue 2 5.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shal l be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a t ime interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 2 0 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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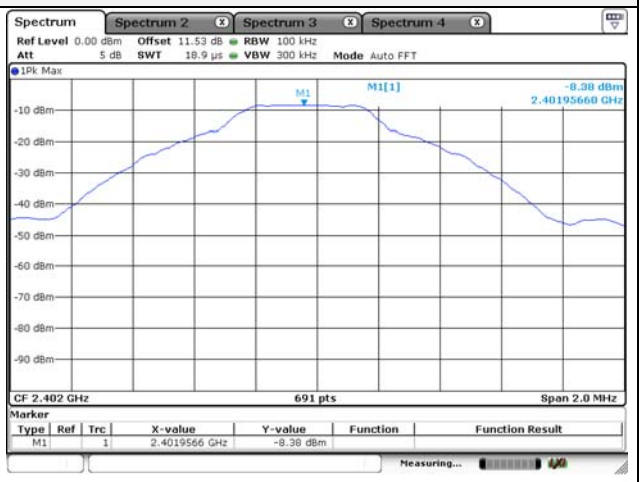
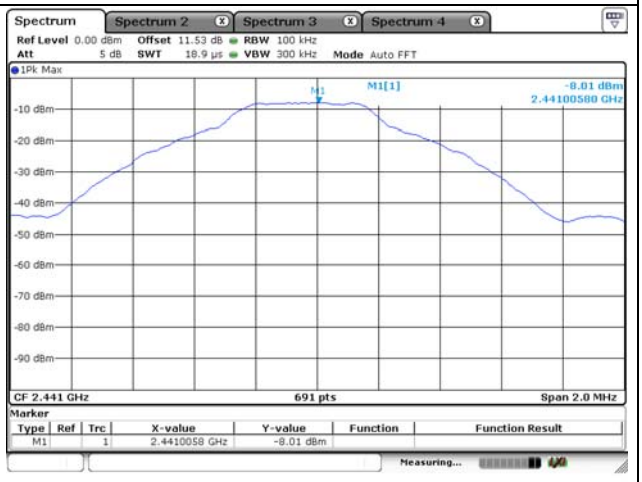
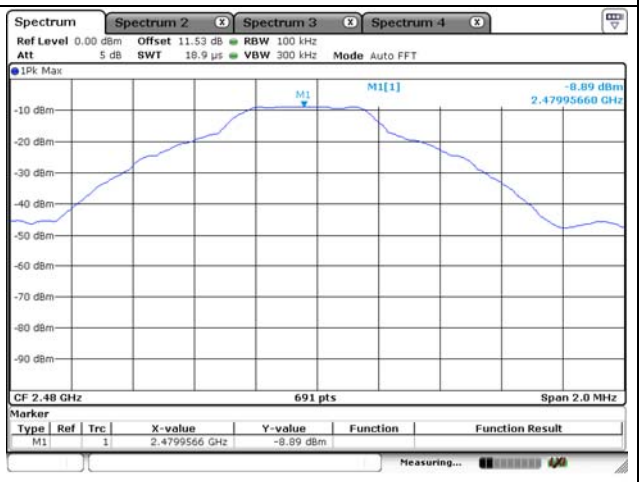
Test results

CH	Reference level
00	
39	
78	

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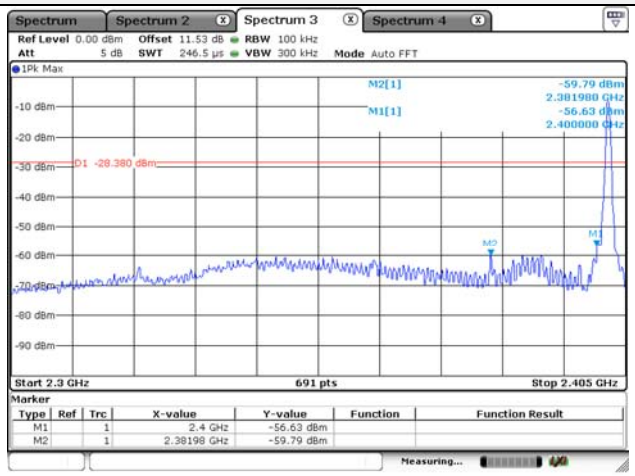
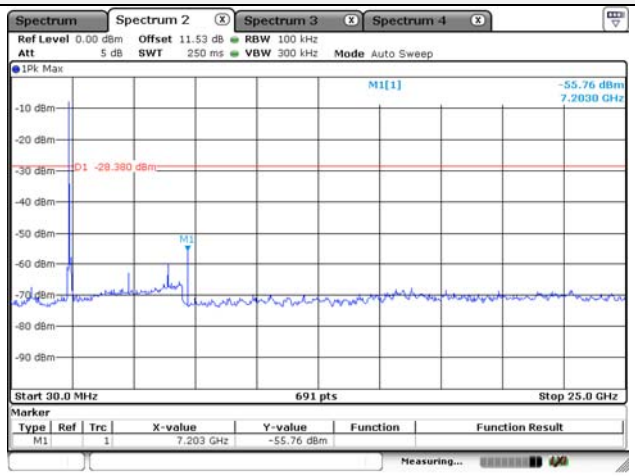
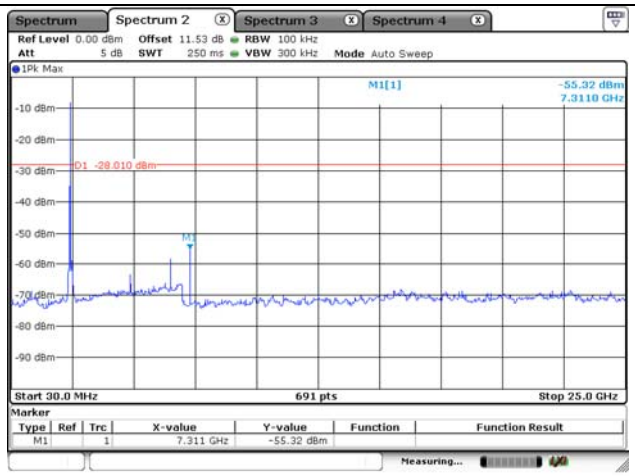
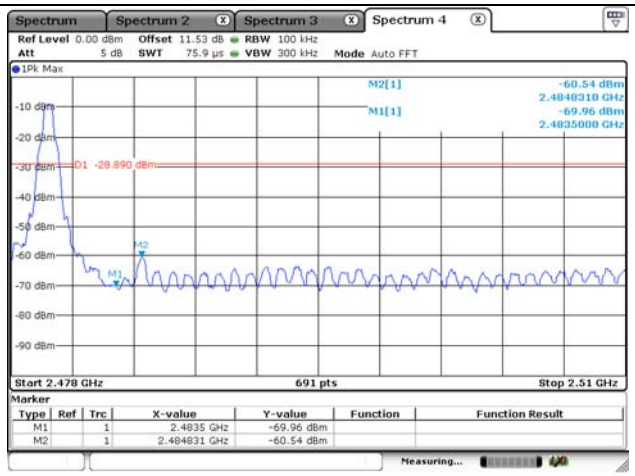
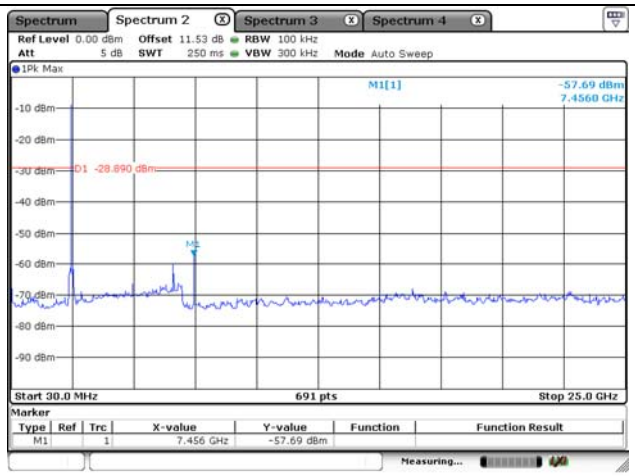
CH	BDR	
00		
39	Blank	
78		

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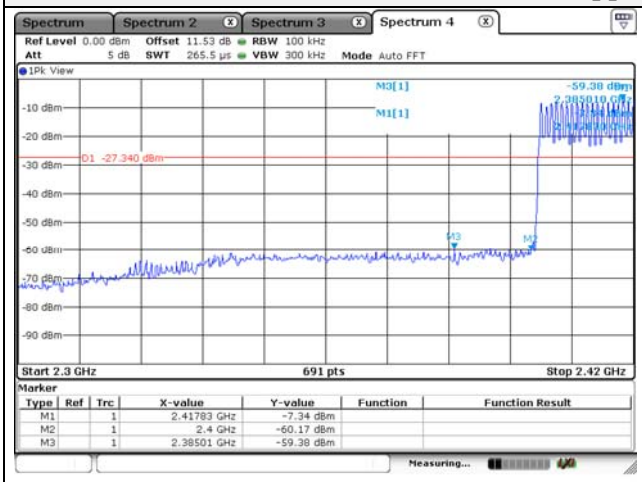
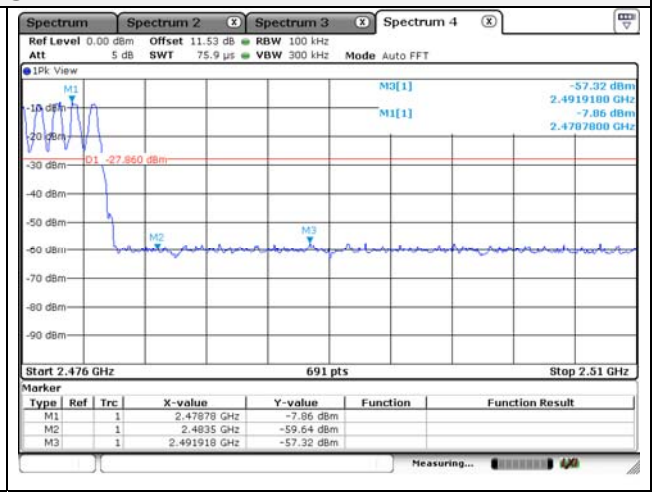
Hopping mode





Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV40	101002	1 year	2020.06.24
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2021.01.15
DC Power Supply	Agilent	6632B	US36351824	1 year	2021.01.14
Power Meter	Anritsu	ML2495A	1438001	1 year	2021.01.14
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2021.01.14
Attenuator	KEYSIGHT	8493C	82506	1 year	2021.01.14
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2021.02.15
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	715	2 years	2020.09.20
Horn Antenna	A.H	SAS-571	414	2 years	2021.02.11
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	2 years	2021.02.19
High Pass Filter	Wainwright Instrument Gmbh	WHJS3000-10TT	1	1 year	2020.06.25
Preamplifier	R&S	SCU01	100603	1 year	2020.11.25
Preamplifier	AGILENT	8449B	3008A01742	1 year	2021.01.02
EMI Test Receiver	R&S	ESU26	100551	1 year	2021.04.01
EMI TEST RECEIVER	R & S	ESR3	101781	1 year	2020.04.22
PULSE LIMITER	R & S	ESH3-Z2	101915	1 year	2021.01.02

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
Notebook computer	LG Electronics Inc.,	LGS53	306QCZP560949

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