TEST REPORT

Part 15 C & RSS-247 (Issue 2)

Equipment under test	Wireless Video Baby Camera
Model name	SEP-102CRW
FCC ID	NLMSEP102CRW
IC	21482-SEP102CRW
Applicant	Hanwha Techwin Co., Ltd.
Manufacturer	Hanwha Techwin (Tianjin) Co.,Ltd. Hanwha Techwin Security Vietnam Co.,Ltd. D-TECH Co.,Ltd.
Date of test(s)	2018.11.12 ~ 2018.11.16
Date of issue	2019.01.02

Issued to
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Revision history

Revision	Date of issue	Test report No.	Description
-	2019.01.02	KES-RF-19T0001	Initial

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1. General information

Applicant:	Hanwha Techwin Co., Ltd.
Applicant address:	6, Pangyo-ro 319 Beon-gil, Bundang-gu Seongnam-si, Gyeonggi-do, 13488, Korea
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.: 23298
FCC rule part(s):	15.247
IC rule part(s):	RSS-247
FCC ID:	NLMSEP102CRW
IC:	21482-SEP102CRW
Test device serial No.:	☒ Production ☐ Pre-production ☐ Engineering

1.1. EUT description

Equipment under test	Wireless Video Baby Camera
Frequency range	2 409.5 ㎒ ~ 2 476 ㎒
Model	SEP-102CRW
Modulation technique	GFSK
Number of channels	20 ch
Antenna specification	Antenna type : Dipole antenna, Peak gain : 1.2 ㏈i
Power source	AC 120 V (AC/DC Adapter)

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

15.247(g): 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): 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.

Pseudorandom frequency hopping sequence
The channel is represented by a pseudo-random hopping sequence hopping through the 20 RF channels.

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

Example of a 20 hopping sequence in data mode:
12, 14, 03,17, 16, 02, 18, 05, 19, 10, 06, 20, 09, 01, 13, 07, 11, 08, 15, 04

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1.2. Test configuration

The **Hanwha Techwin Co., Ltd. Wireless Baby Monitor FCC ID: NLMSEP102CRW, IC: 21482-SEP102CRW** 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
ANSI C63.10-2013

1.3. Frequency/channel operations

Ch.	Frequency (MHz)
01	2409.5
. .	. .
10	2441
. .	. .
20	2476

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 version 1.0

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).
= 0.72 + 20 = 20.72 (dB)

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)	Carrier frequency 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
15.207(a)	RSS-Gen 8.8	AC conducted emissions	Pass

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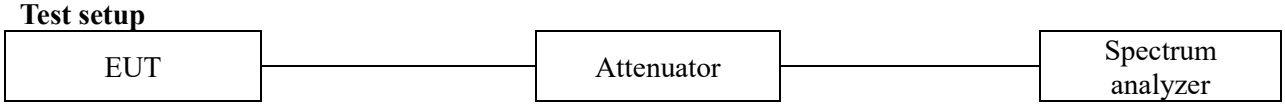
3. Test results

3.1. 99% Occupied Bandwidth

Test procedure

ANSI C63.10-2013 clause 7.8.7

Test setup



Test setting

1. Span = approximately 1.5 to 5 times the OBW, centered on a hopping channel
2. RBW = range of 1% to 5 % of the OBW
3. VBW = approximately 3 times RBW
4. Sweep = auto
5. Detector function = Peak
6. Trace = Max hold

Limit

Not applicable

Test results

Frequency(㎒)	99% occupied bandwidth(㎒)	Limit(㎒)
2 409.5	2.569	-
2 441	2.569	
2 476	2.554	

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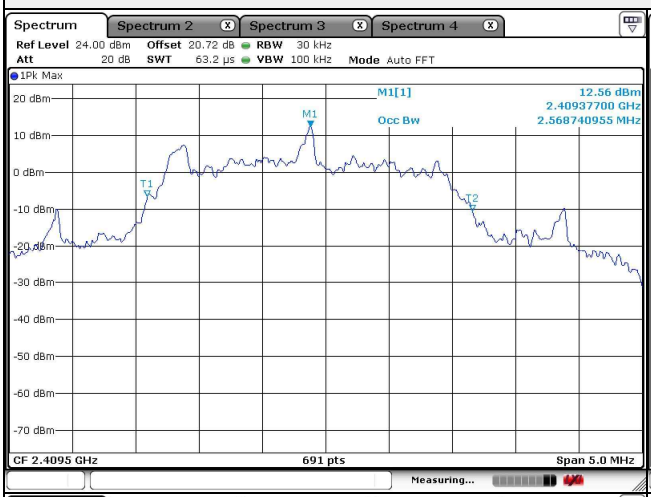
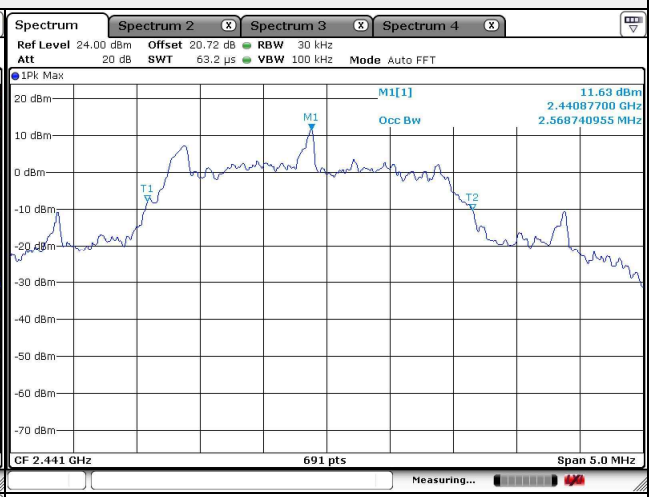
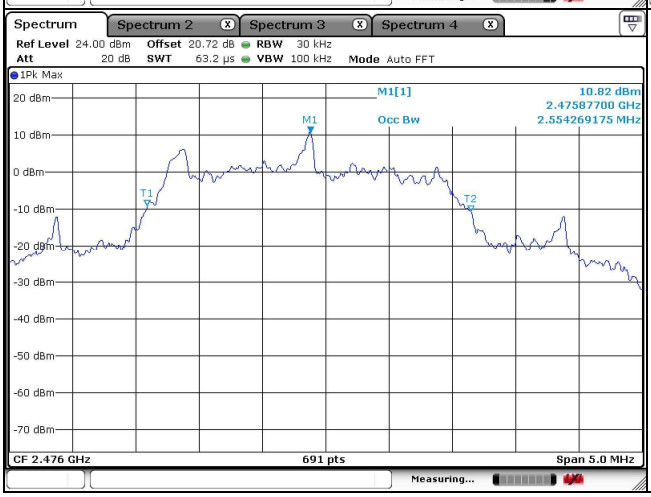
Test plots

GFSK







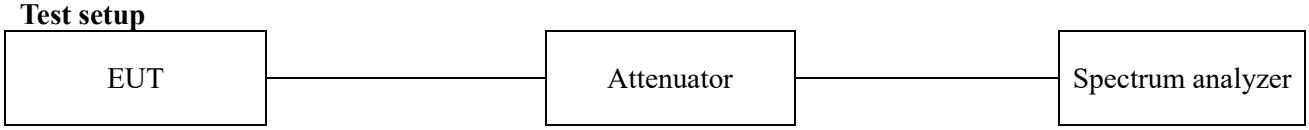
N/A

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 = approximately 2 to 5 times the OBW, centered on a hopping channel
2. RBW = range of 1% to 5 % of the OBW
3. VBW = approximately 3 times RBW
4. Sweep = auto
5. Detector function = peak
6. Trace mode = max hold

Limit

Not applicable

Test results

Frequency(㎒)	20 dB bandwidth(㎒)	Limit(㎒)
2 409.5	2.533	-
2 441	2.504	
2 476	2.518	

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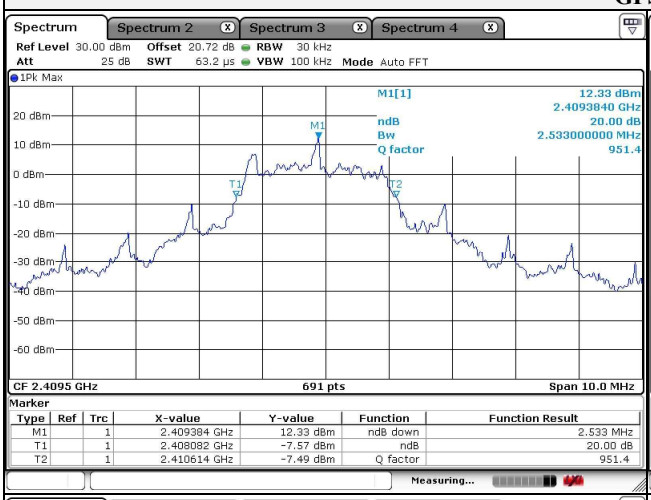
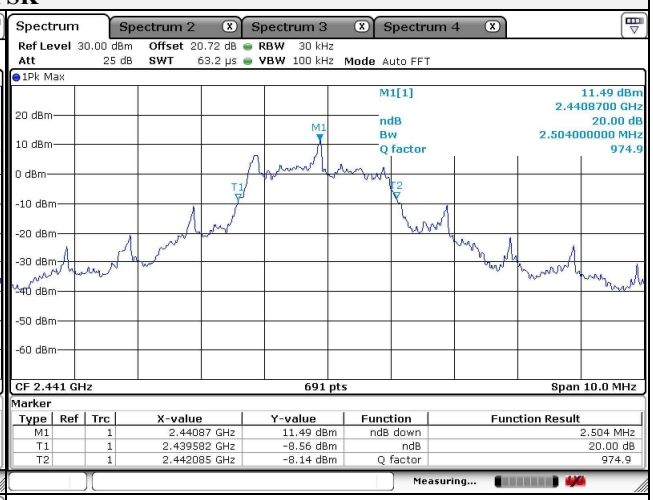
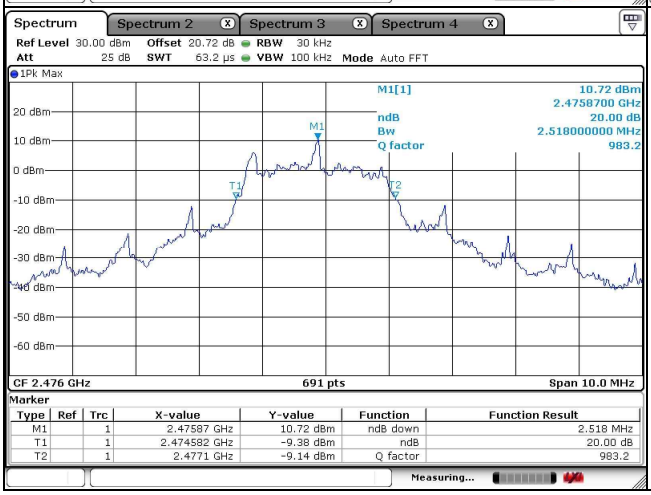
Test plots

GFSK







N/A

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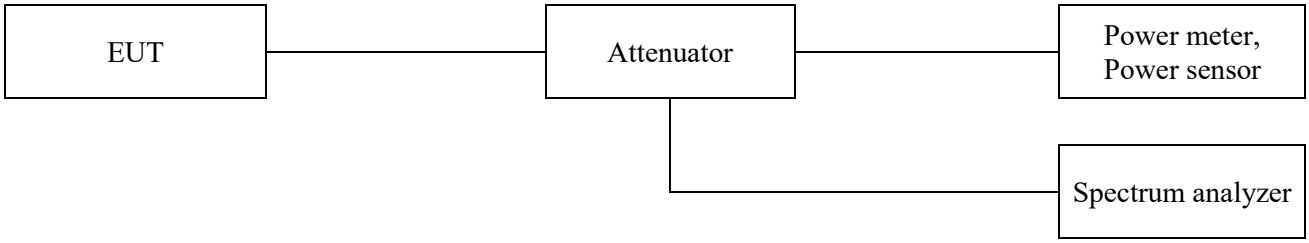
3.3. Output power

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
7. Allow the trace to stabilize.

Limit

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequenci es 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 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 ㎾ if the hopset uses 75 or more hopping channls; the maximum peak conducted output power shall not exceed 0.125 ㎾ if the hopset uses less than 75 hopping channls. The e.i.r.p shall not exceed 0.4 ㎾, except as provided in section 5.4(e).

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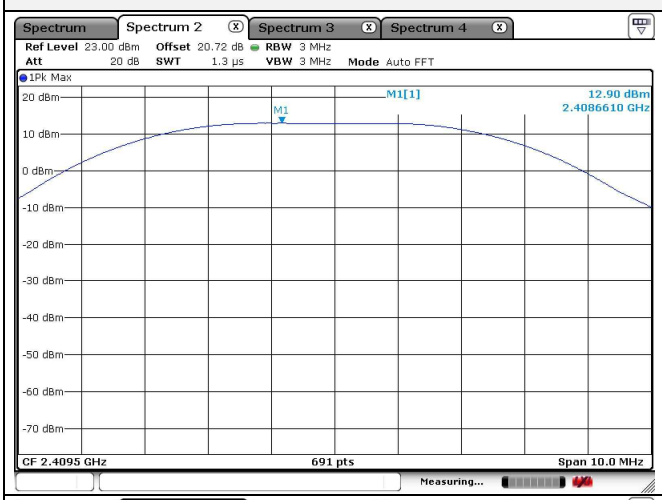
Test results

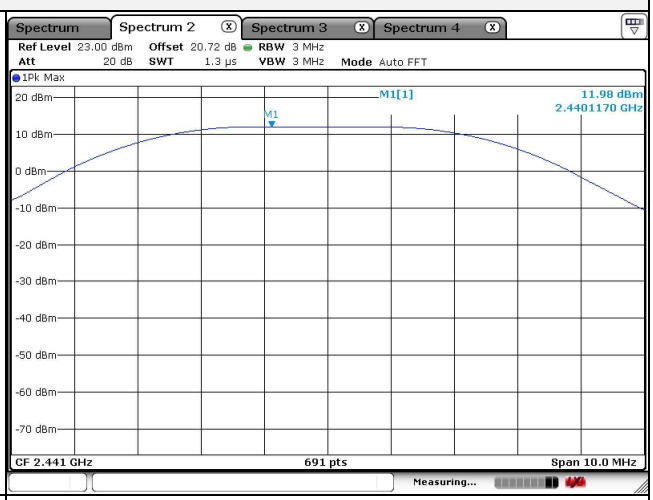
Frequency(㎒)	Channel no.	Peak Power (dBm)	Average Power (dBm) Note1	Power Limit (dBm)
2 409.5	01	12.90	12.49	20.97
2 441	10	11.98	11.46	20.97
2 476	20	11.15	10.72	20.97

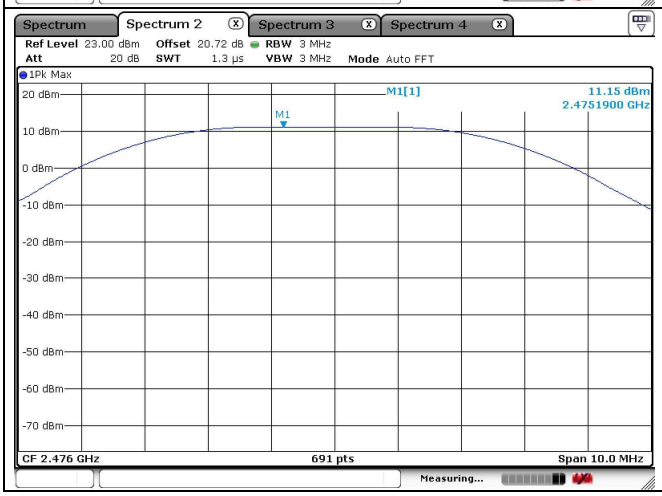
Note.
1. The average power was tested using an average power meter.

Test plots

GFSK







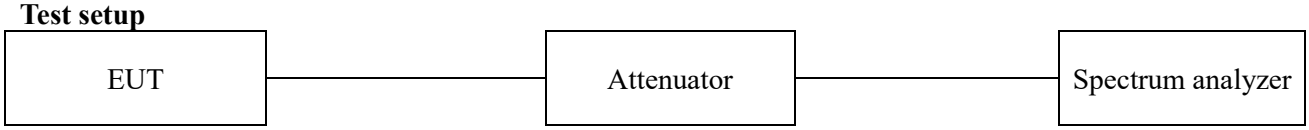
N/A

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. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

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 �W.

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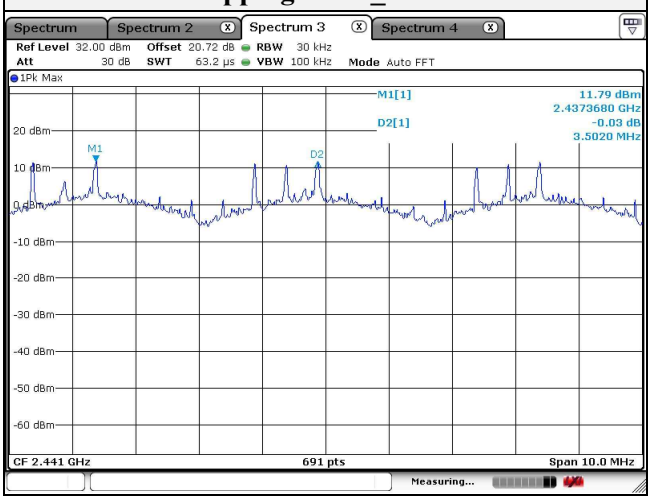
Test results

Frequency(㎒)	Channel no.	Channel Separation (㎒)
2 441	10	3.502

Test plots

Hopping mode_GFSK



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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.
2. 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.
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. Allow the trace to stabilize.

All the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

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(4), 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.

Test results

Frequency	Number of hopping frequency	Limit
2 409.5 ~ 2 476 ㎒	20	≥ 15

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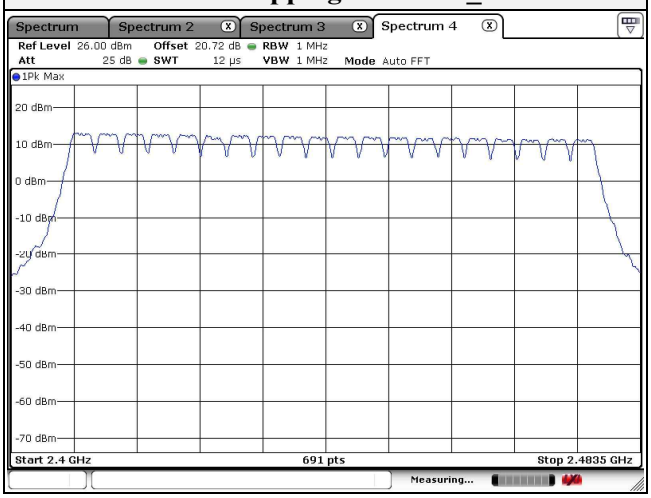
Test plots

Number of Hopping Channels_GFSK



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.
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. 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.
5. Detector function = peak
6. Trace = max hold

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 8 second period.

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) × 20 = 8(s)

Frequency (㎒)	Burst time (ms)	Burst number	Time of occupancy (ms)	Limit (ms)
2 441	11.594	25	289.85	400

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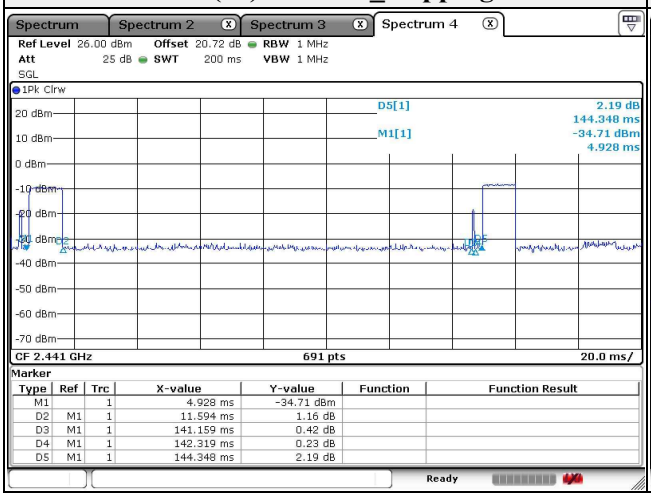
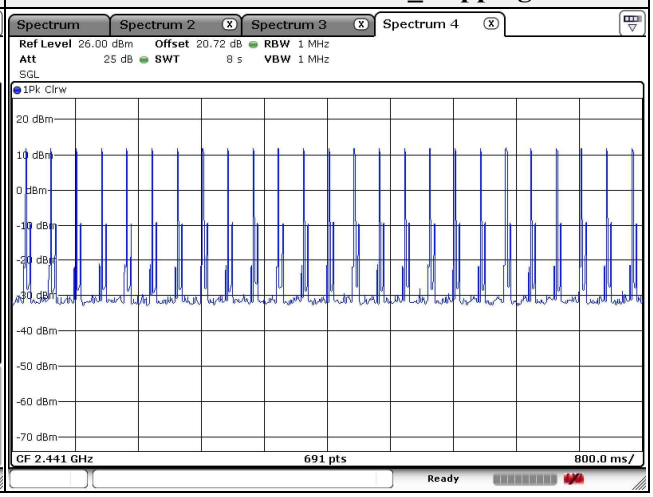
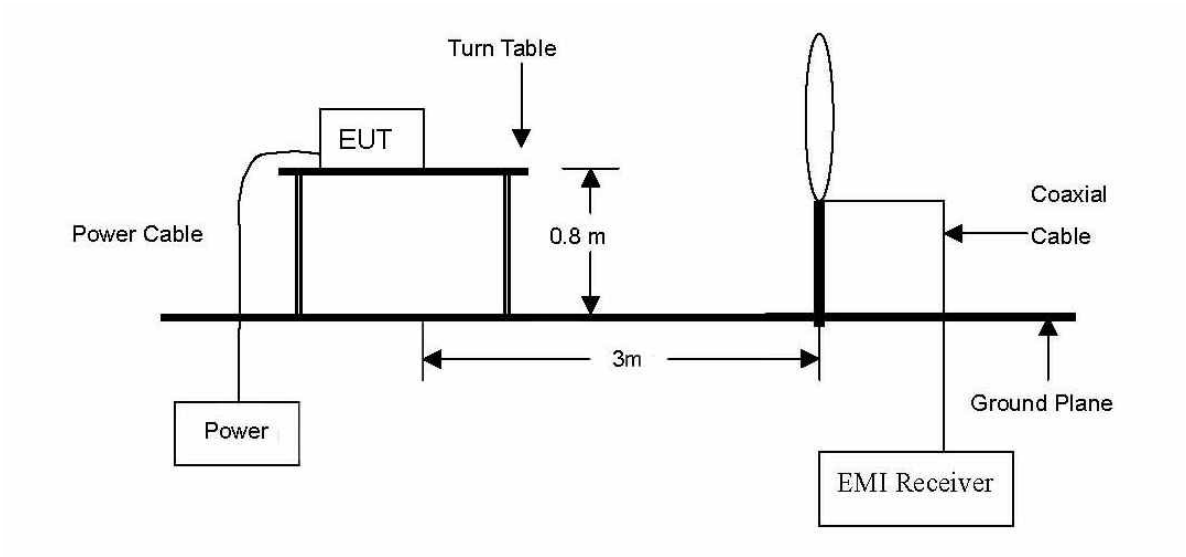
Burst time(㎳) = 11.594_Hopping Mode	Burst number within 8 s =25 _Hopping Mode
	

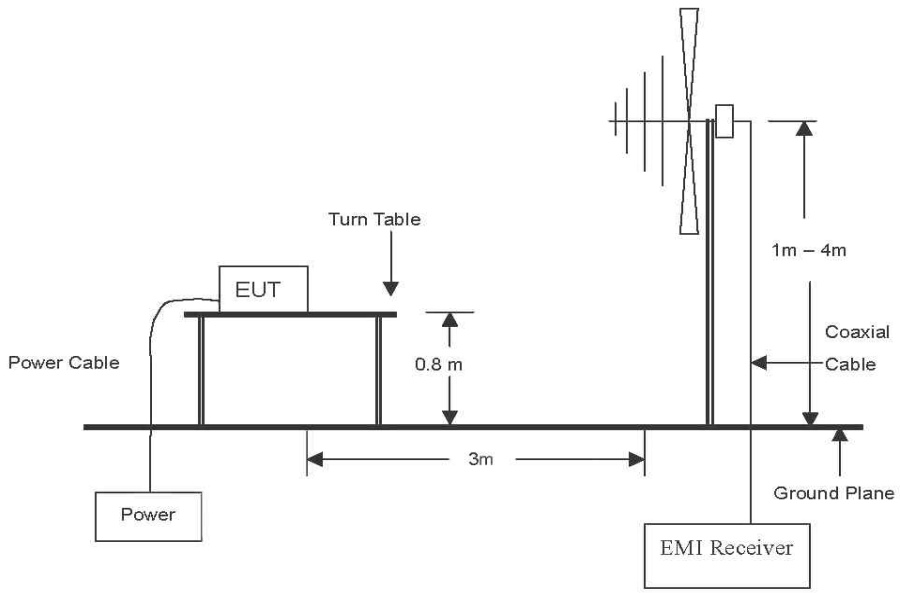
3.7. Radiated restricted band and emissions

Test setup

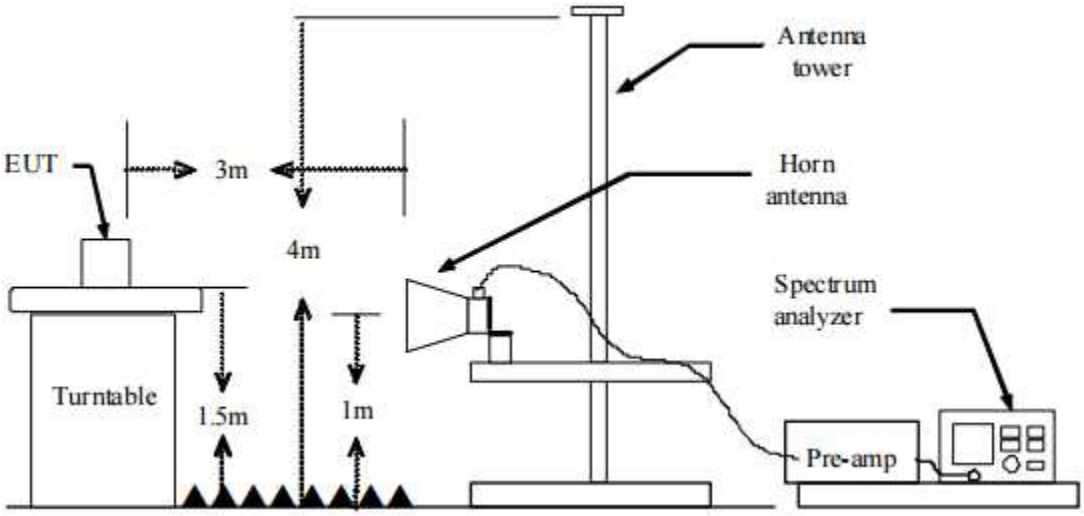
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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



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 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 $f \geq 1$ ㎓: 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 $f \geq 1$ ㎓: Average
   ① Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
   ② RBW = 1 ㎒
   ③ VBW ≥ 3 × RBW
   ④ Detector = RMS, if span/(# of points in sweep) ≤ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
   ⑤ Averaging type = power(i.e., RMS)
      1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
      2) Some instruments require linear display mode in order to use linear voltage averaging. Log or ㏈ averaging shall not be used.
   ⑥ Sweep = auto
   ⑦ Trace = max hold
   ⑧ Perform a trace average of at least 100 traces.
   ⑨ A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

      1) If power averaging (RMS) mode was used in step ⑤, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
      2) If linear voltage averaging mode was used in step ⑤, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
      3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

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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. 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.
3. Average test would be performed if the peak result were greater than the average limit.
4. Field strength(㏈㎶/m) = Level(㏈㎶) + Correction factors(㏈/m) + or F_d(㏈) + or DCF(㏈)
5. CF(Correction factors(㏈)) = Antenna factor(㏈/m) + Cable loss(㏈) + or Amp. gain(㏈)
6. Margin(㏈) = Limit(㏈㎶/m) - Field strength(㏈㎶/m)
7. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.
8. 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
   DCF = duty cycle correction factor
9. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are 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.

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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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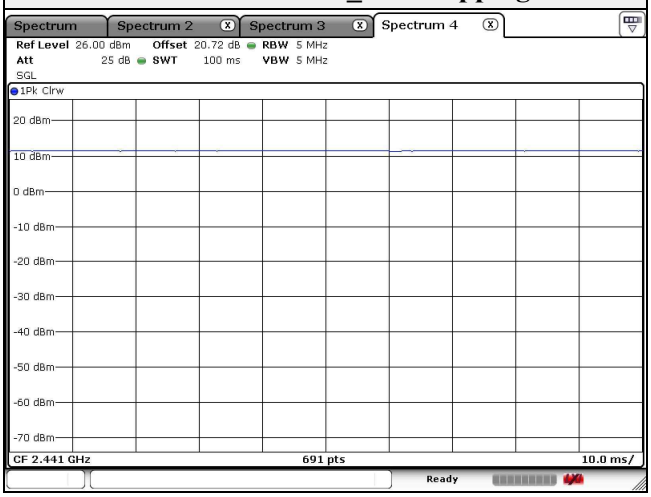
Duty cycle

Test mode	T_{on} time (㎳)	Period (㎳)	Duty cycle (Linear)	Duty cycle (%)	Duty cycle correction factor (dB)
GFSK	100.00	100.00	1	100	0

Duty cycle (Linear) = T_{on} time/Period

GFSK // Middle channel_Non Hopping Mode



Note.

1. Radiated test is performed with Non hopping Mode

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Test results (Below 30 ㎒)

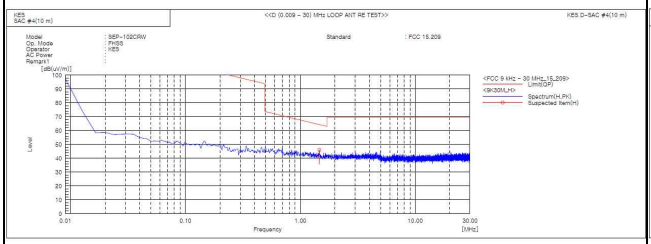
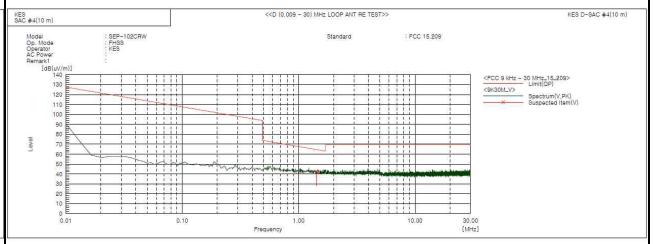
Mode: GFSK

Distance of measurement: 3 meter

Channel: 01 (Worst case)

- **Spurious**

Frequency (㎒)	Reading (dBμV)	Ant. Pol. (H/V)	CF (dB)	Distance factor (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1.464	25.60	H	20.40	- 40.00	6.00	24.29	18.29
1.426	21.90	V	20.40	- 40.00	2.30	24.52	22.22

Horizontal	Vertical
	
Spectrum Selection No. Frequency (P) Reading c.f Result PK Limit QP Margin QP Height Angle Remark [MHz] [dB(uV)] [dB(1/m)] [dB(uV/m)] [dB(uV/m)] [dB] [cm] [deg] 1 1.464 H 25.6 20.4 46.0 64.3 18.3 100.0 295.0	Spectrum Selection No. Frequency (P) Reading c.f Result PK Limit QP Margin QP Height Angle Remark [MHz] [dB(uV)] [dB(1/m)] [dB(uV/m)] [dB(uV/m)] [dB] [cm] [deg] 1 1.426 V 21.9 20.4 42.3 64.5 22.2 100.0 191.0

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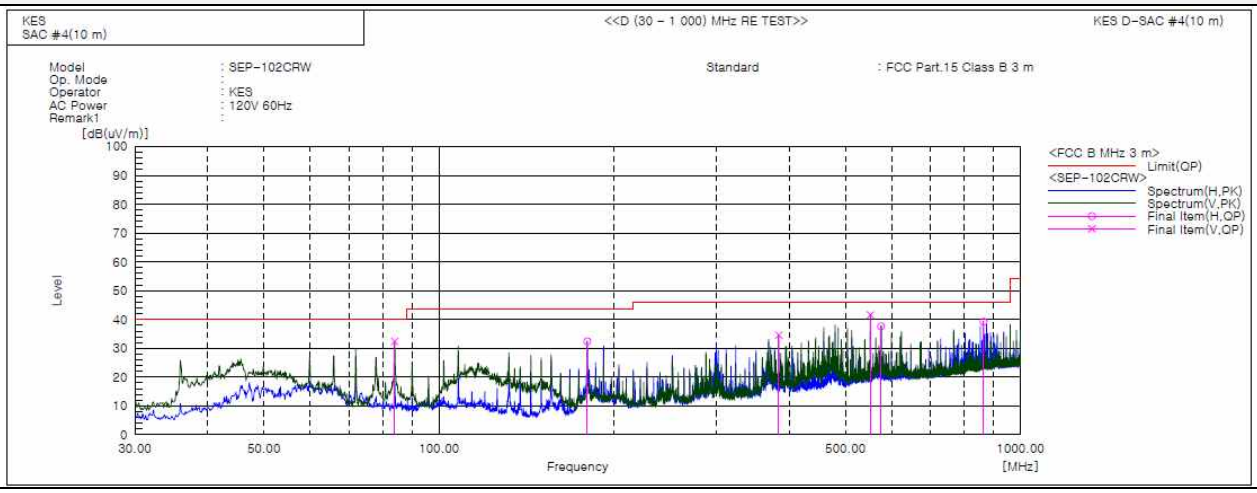
Test results (Below 1 000 ㎒)

Mode: GFSK

Distance of measurement: 3 meter

Channel: 01 (Worst case)

Horizontal // Vertical



No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	83.956	V	66.5	-34.1	32.4	40.0	7.6	162.0	31.0	
2	179.986	H	63.1	-30.7	32.4	43.5	11.1	207.0	88.0	
3	384.050	V	57.7	-23.1	34.6	46.0	11.4	169.0	154.0	
4	552.103	V	60.0	-18.4	41.6	46.0	4.4	104.0	91.0	
5	575.989	H	55.4	-17.8	37.6	46.0	8.4	215.0	175.0	
6	864.079	H	53.4	-14.2	39.2	46.0	6.8	100.0	128.0	

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Test results (Above 1 000 ㎒)

Mode: GFSK

Distance of measurement: 3 meter

Channel: 01

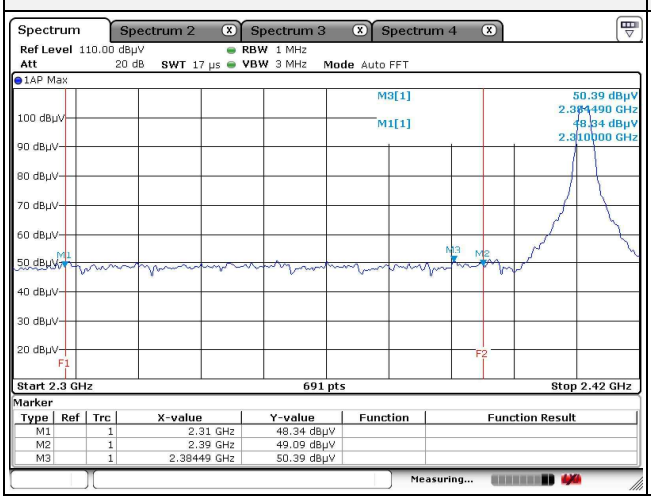
- **Spurious**

Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
1 369.00	52.76	Peak	H	-6.77	-	45.99	74.00	28.01
1 725.00	54.57	Peak	V	-3.79	-	50.78	74.00	23.22
4 813.00	45.90	Peak	H	7.66	-	53.56	74.00	20.44
4 813.00	51.97	Peak	V	7.66	-	59.63	74.00	14.37
4 813.00	38.31	Average	V	7.66	-	45.97	54.00	8.03

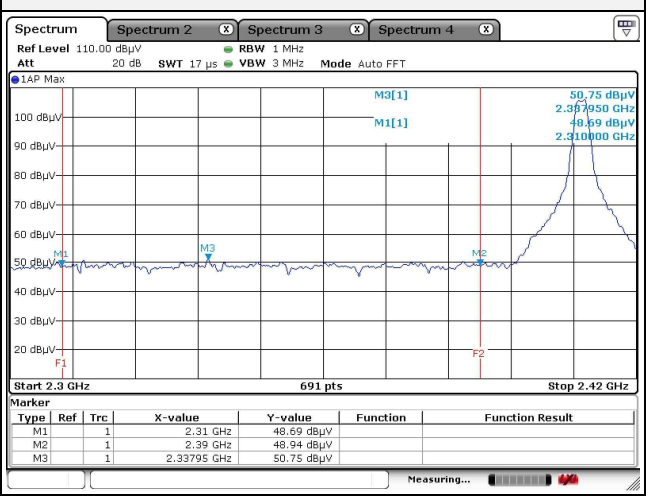
- **Band edge**

Frequency (㎒)	Level (dB㎶)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
2 384.49	50.39	Peak	H	-0.23	-	50.16	74.00	23.84
2 337.95	50.75	Peak	V	-0.32	-	50.75	74.00	23.57

Restricted band // Horizontal // Peak



Restricted band // Vertical // Peak



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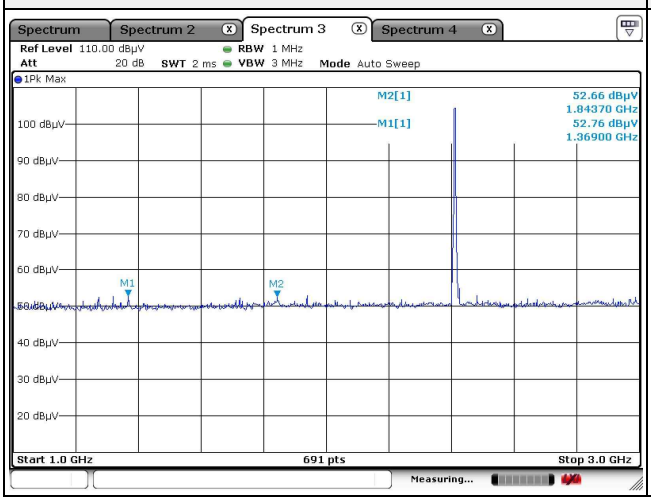
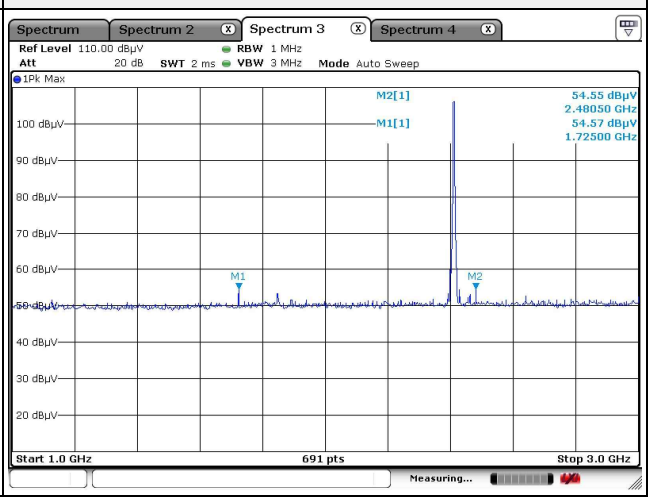
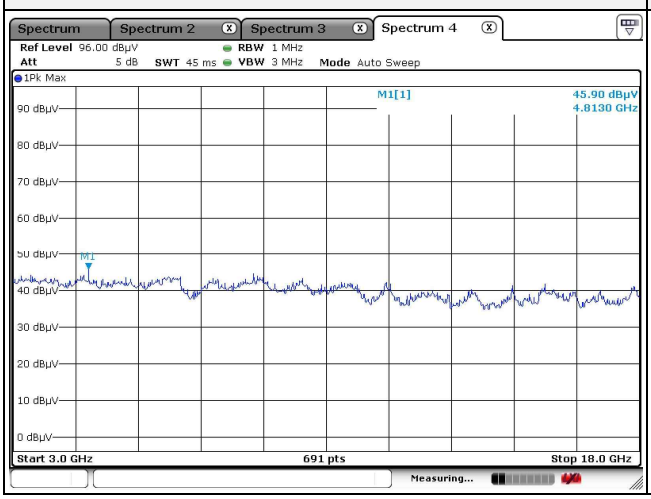
Horizontal // Peak for 1 ㎓ to 3 ㎓



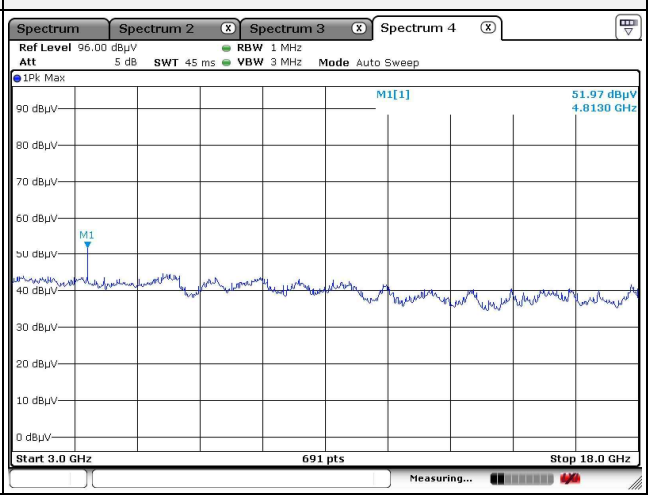
Vertical // Peak for 1 ㎓ to 3 ㎓



Horizontal // Peak for 3 ㎓ to 18 ㎓



Vertical // Peak for 3 ㎓ to 18 ㎓



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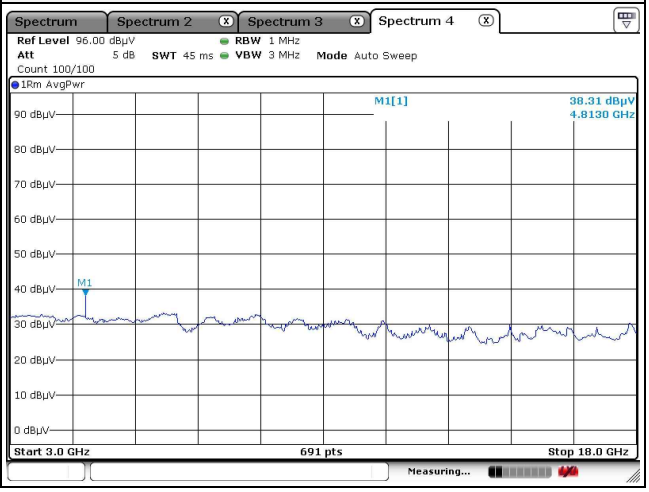
Horizontal // Average for 3 ㎓ to 18 ㎓	Vertical // Average for 3 ㎓ to 18 ㎓
N/A	

Note.

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

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Mode: GFSK

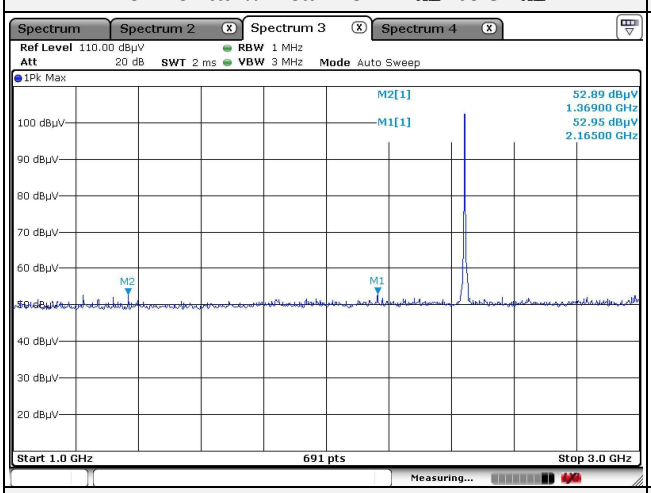
Distance of measurement: 3 meter

Channel: 10

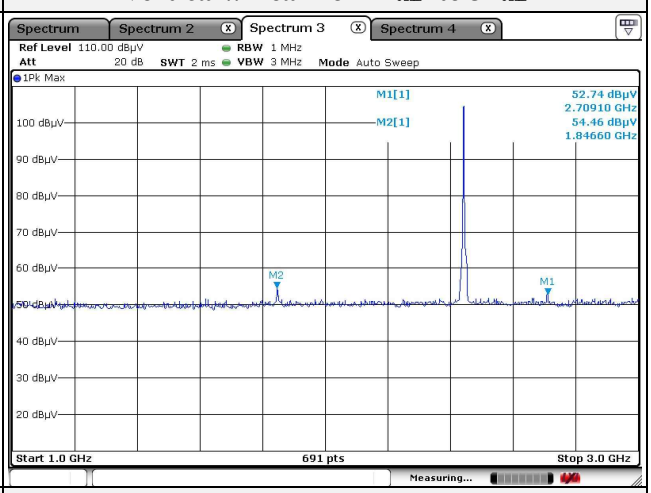
- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 165.00	52.95	Peak	H	-0.64	-	52.31	74.00	21.69
1 846.60	54.46	Peak	V	-2.59	-	51.87	74.00	22.13
8 872.00	44.50	Peak	H	13.38	-	57.88	74.00	16.12
8 894.00	32.42	Average	H	13.33	-	45.75	54.00	8.25
4 878.00	47.29	Peak	V	8.17	-	55.46	74.00	18.54
4 878.00	33.86	Average	V	8.17	-	42.03	54.00	11.97

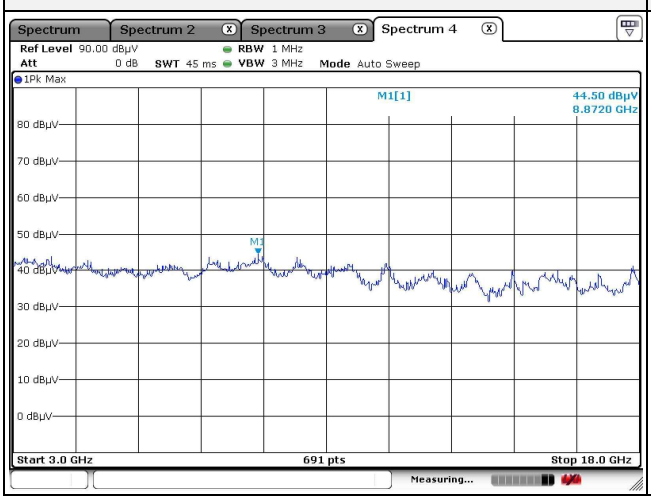
Horizontal // Peak for 1 GHz to 3 GHz



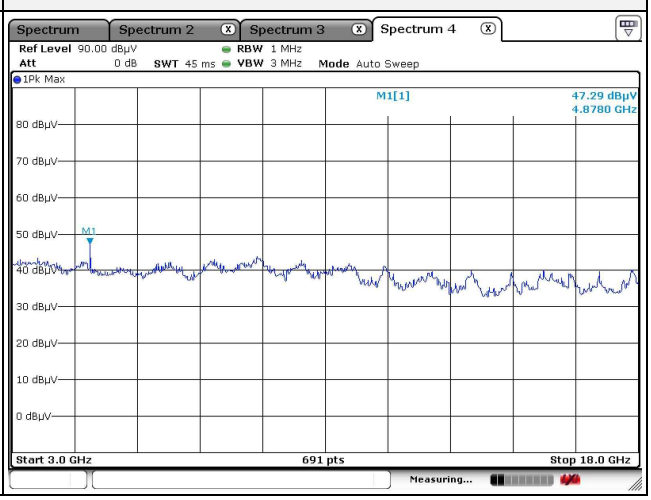
Vertical // Peak for 1 GHz to 3 GHz



Horizontal // Peak for 3 GHz to 18 GHz



Vertical // Peak for 3 GHz to 18 GHz



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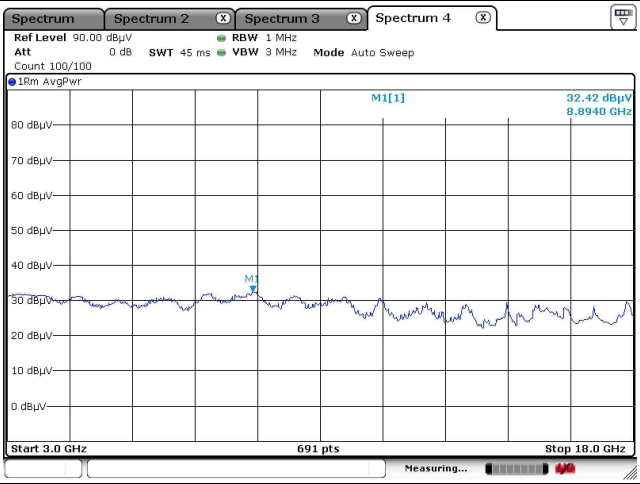
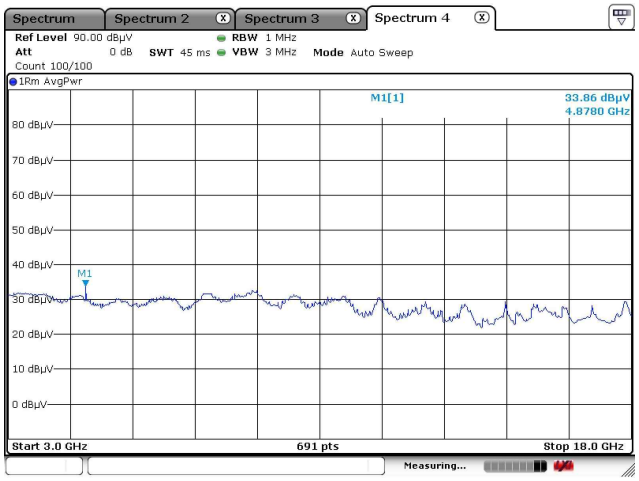
Horizontal // Average for 3 ㎓ to 18 ㎓	Vertical // Average for 3 ㎓ to 18 ㎓
	

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

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Mode: GFSK

Distance of measurement: 3 meter

Channel: 20

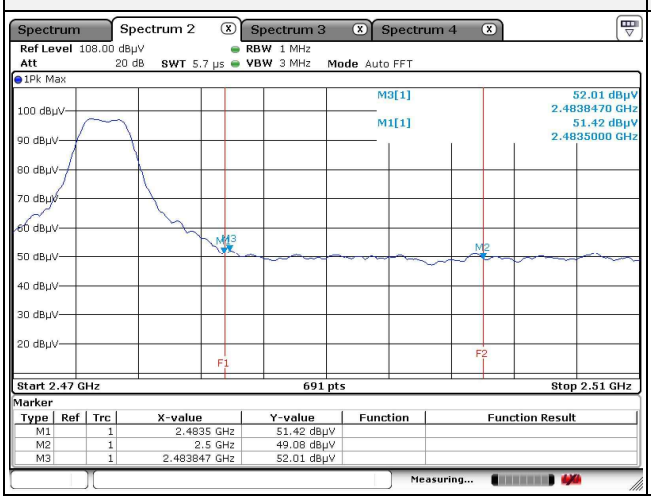
- **Spurious**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1 369.00	52.35	Peak	H	-6.77	-	45.58	74.00	28.42
1 846.60	53.58	Peak	V	-2.59	-	50.99	74.00	23.01
8 459.00	43.67	Peak	H	13.91	-	57.58	74.00	16.42
8 894.00	32.32	Average	H	13.33	-	45.65	54.00	8.35
8 915.00	43.24	Peak	V	13.29	-	56.53	74.00	17.47
8 894.00	32.42	Average	V	13.33	-	45.75	54.00	8.25

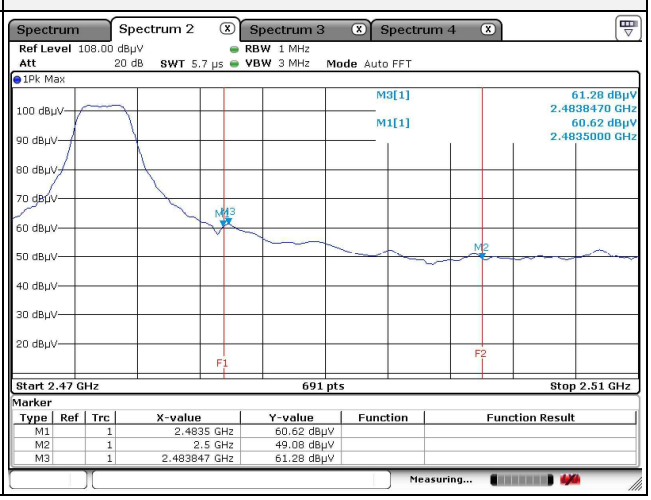
- **Band edge**

Frequency (MHz)	Level (dBμV)	Detect mode	Ant. Pol. (H/V)	CF (dB)	DCF (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 483.85	52.01	Peak	H	-0.05	-	51.96	74.00	22.04
2 483.85	61.28	Peak	V	-0.05	-	61.23	74.00	12.77
2 483.50	48.14	Average	V	-0.05	-	48.09	54.00	5.91

Restricted band // Horizontal // Peak



Restricted band // Vertical // Peak



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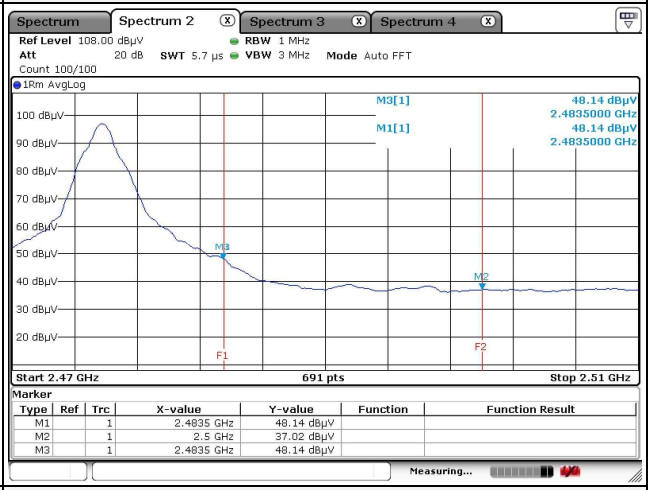
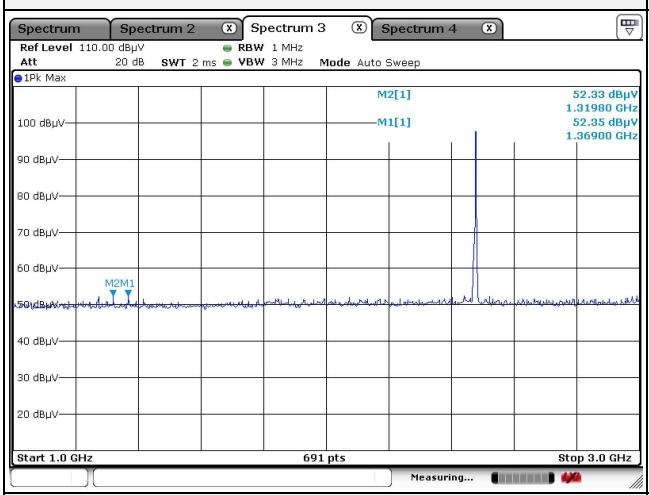
Restricted band // Horizontal // Average

N/A

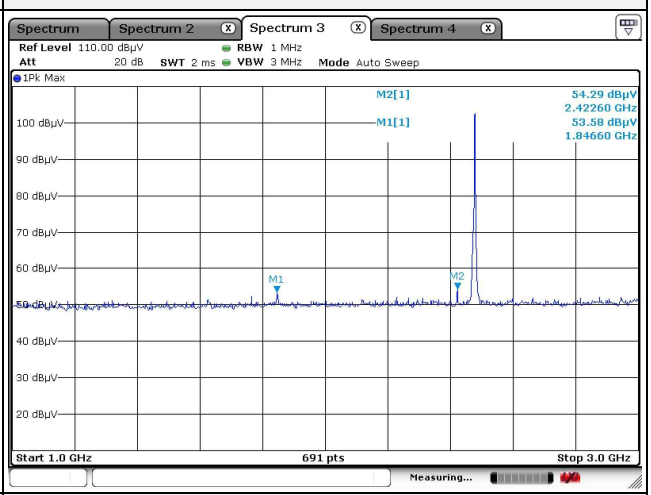
Restricted band // Vertical // Average



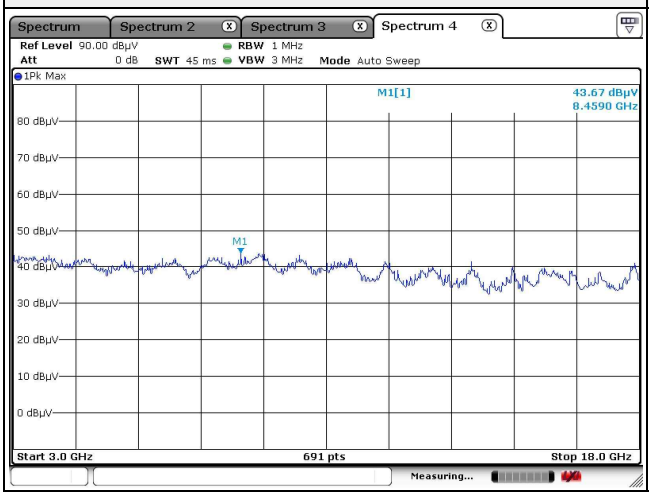
Horizontal // Peak for 1 GHz to 3 GHz



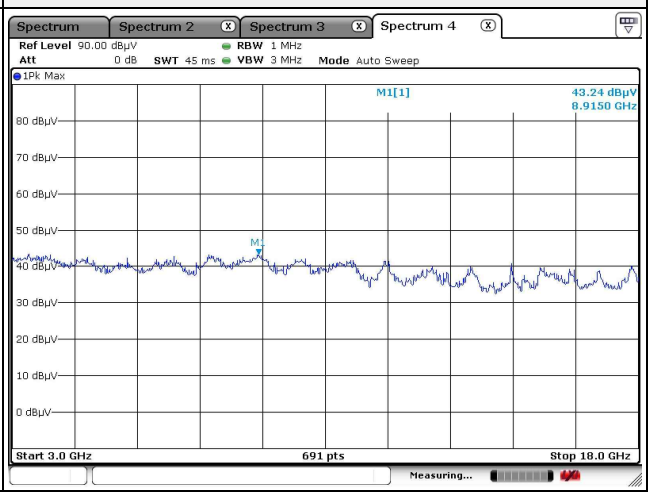
Vertical // Peak for 1 GHz to 3 GHz



Horizontal // Peak for 3 GHz to 18 GHz



Vertical // Peak for 3 GHz to 18 GHz



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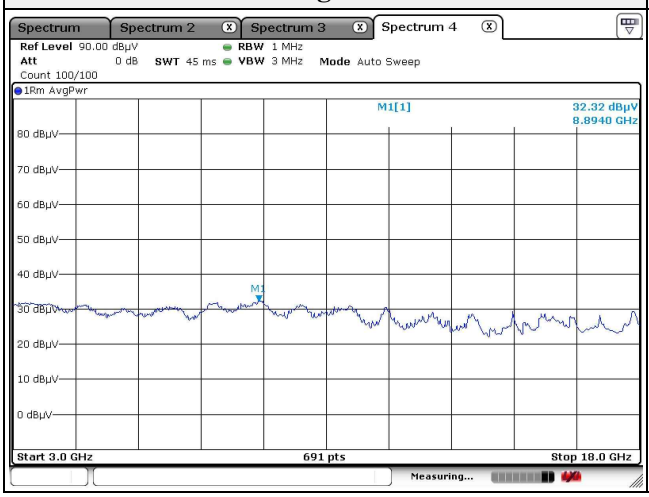
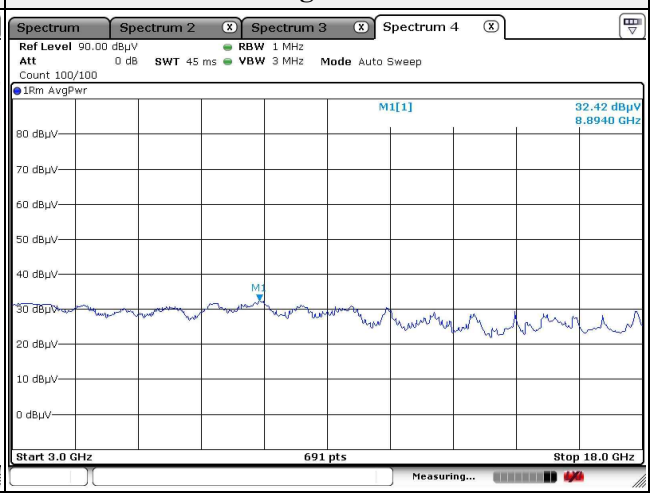
Horizontal // Average for 3 ㎓ to 18 ㎓	Vertical // Average for 3 ㎓ to 18 ㎓
	

Note.

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

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Test results (18 ㎓ to 30 ㎓)

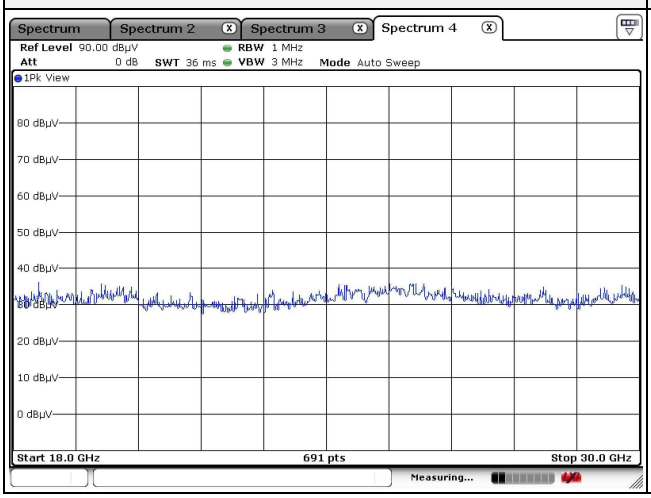
Mode: GFSK

Distance of measurement: 3 meter

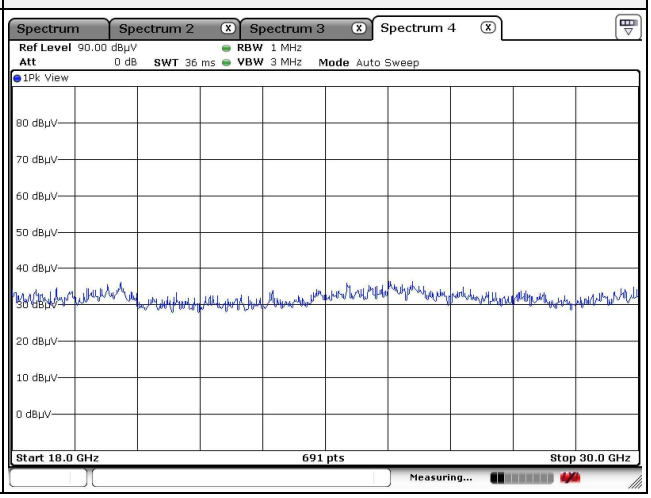
Channel: 01(Worst case)

Frequency (㎒)	Level (dBμV)	Ant. Pol. (H/V)	CF (dB)	F_d (dB)	Field strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No spurious emissions were detected within 20 ㏈ of the limit							

Horizontal



Vertical



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

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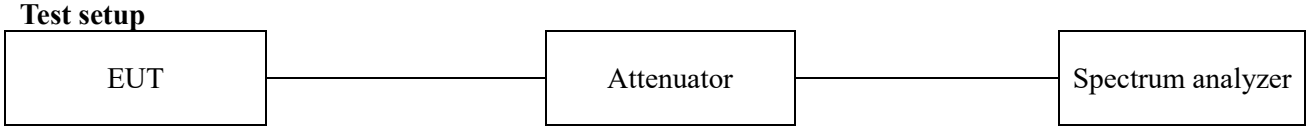
3.8 Conducted spurious emissions & band edge

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 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.
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 shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided 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 time interval, as permitted under Section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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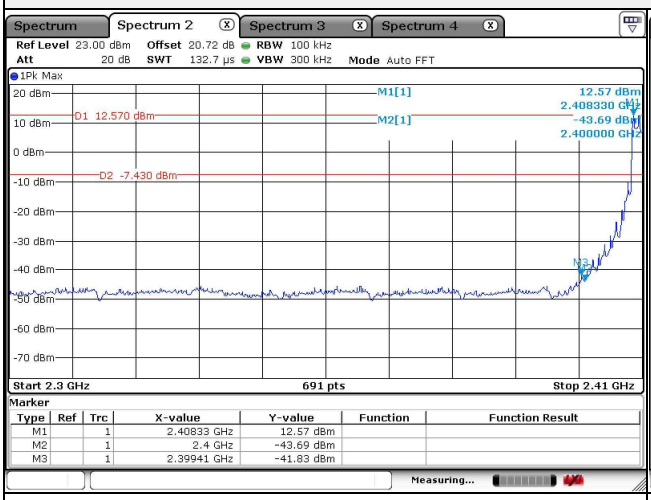
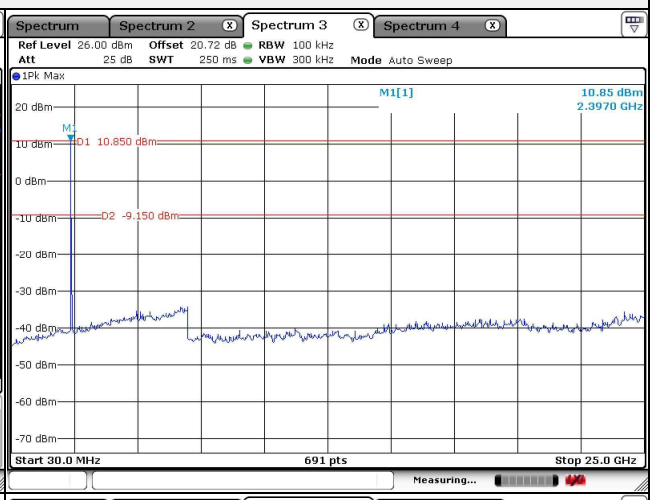
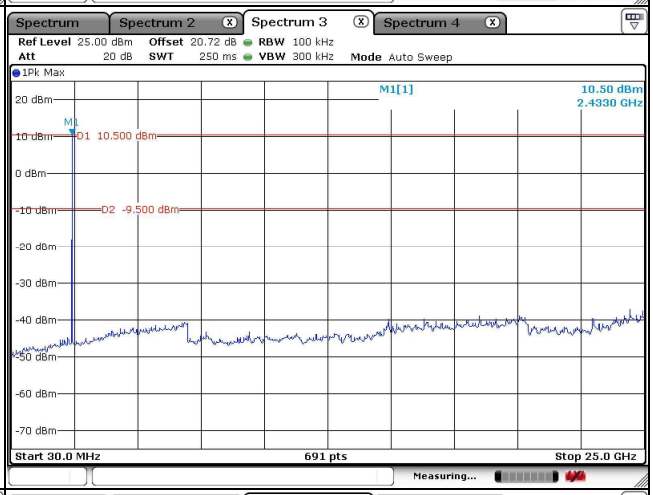
Test results

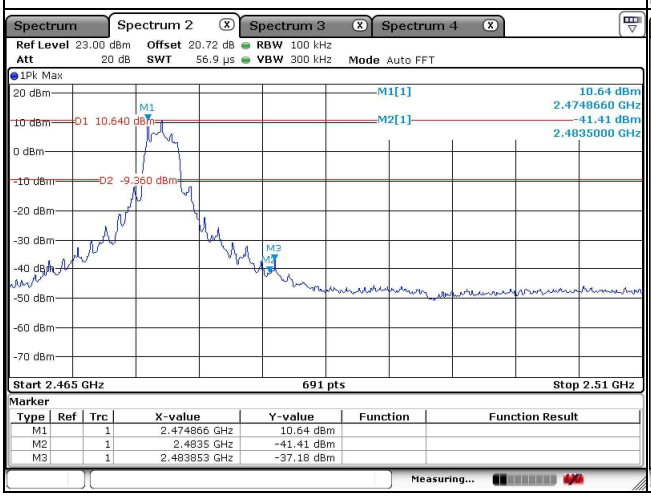
GFSK

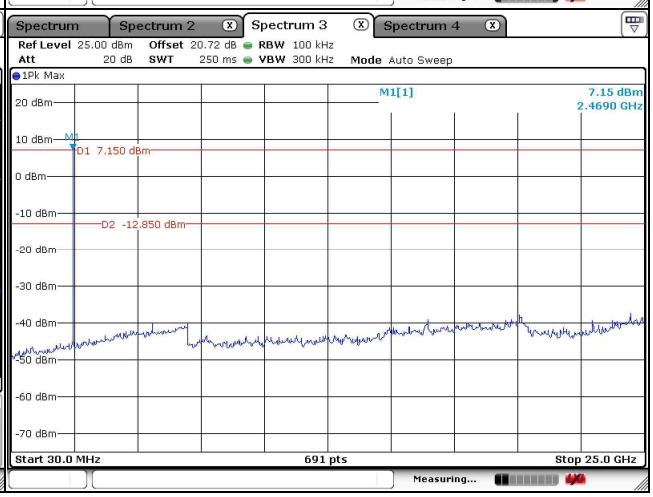




N/A







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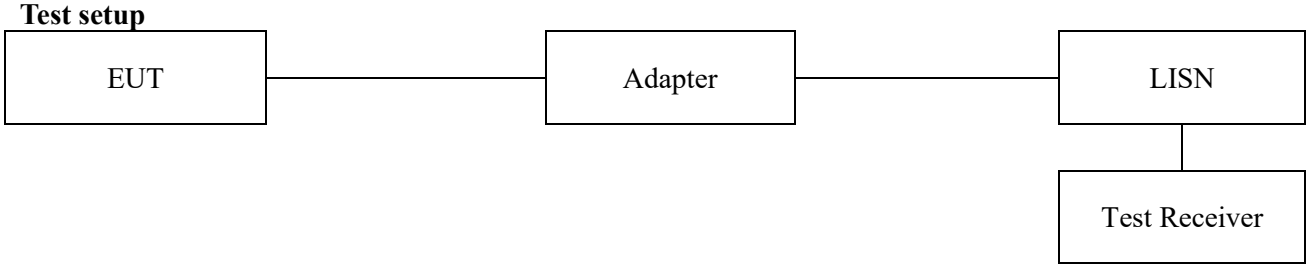
3.9. AC conducted emissions

Test setup



Limit

According to 15.207(a), for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

According to RSS-Gen Issue 5, 8.8, a radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which 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 Table 3. Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 ㎒ to 30 ㎒ shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.
The conducted emissions shall be measured in accordance with the reference publication mentioned in Section 3.

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

Note:
1. All AC line conducted spurious emission are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and the appropriate frequencies. All data rates and modes were investigated for conducted spurious emission. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.
3. Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

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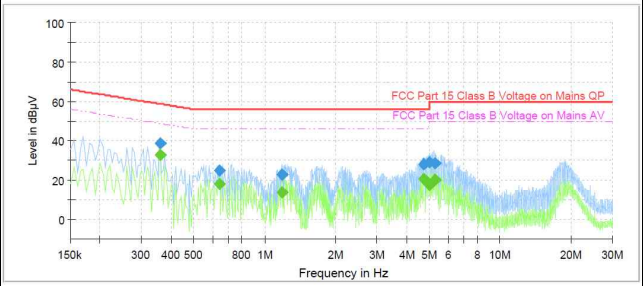
Test results

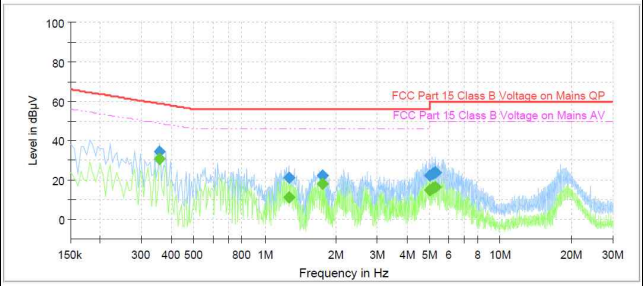
Hot Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.360000	38.61	---	58.73	20.12	1000.0	9.000	L1	9.7
0.360000	---	33.07	48.73	15.66	1000.0	9.000	L1	9.7
0.640000	---	17.80	46.00	28.20	1000.0	9.000	L1	9.8
0.640000	24.68	---	56.00	31.32	1000.0	9.000	L1	9.8
1.180000	22.71	---	56.00	33.29	1000.0	9.000	L1	10.0
1.180000	---	13.92	46.00	32.08	1000.0	9.000	L1	10.0
4.720000	---	20.44	46.00	25.56	1000.0	9.000	L1	10.1
4.720000	28.25	---	56.00	27.75	1000.0	9.000	L1	10.1
4.990000	29.36	---	56.00	26.64	1000.0	9.000	L1	10.0
4.990000	---	17.33	46.00	28.67	1000.0	9.000	L1	10.0
5.265000	28.79	---	60.00	31.21	1000.0	9.000	L1	10.0
5.265000	---	20.23	50.00	29.77	1000.0	9.000	L1	10.0

Neutral Line



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.355000	34.42	---	58.84	24.42	1000.0	9.000	N	9.7
0.355000	---	30.73	48.84	18.11	1000.0	9.000	N	9.7
1.260000	---	11.34	46.00	34.66	1000.0	9.000	N	10.1
1.260000	21.39	---	56.00	34.61	1000.0	9.000	N	10.1
1.750000	---	18.08	46.00	27.92	1000.0	9.000	N	10.1
1.750000	22.49	---	56.00	33.51	1000.0	9.000	N	10.1
4.980000	---	14.61	46.00	31.39	1000.0	9.000	N	10.1
4.980000	22.48	---	56.00	33.52	1000.0	9.000	N	10.1
5.190000	---	15.88	50.00	34.12	1000.0	9.000	N	10.0
5.190000	23.54	---	60.00	36.46	1000.0	9.000	N	10.0
5.310000	---	16.20	50.00	33.80	1000.0	9.000	N	10.0
5.310000	24.03	---	60.00	35.97	1000.0	9.000	N	10.0

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Appendix A. Measurement equipment

Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum Analyzer	R&S	FSV30	100736	1 year	2019.06.28
Spectrum Analyzer	R&S	FSV40	101002	1 year	2019.06.29
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2019.01.22
Power Meter	Anritsu	ML2495A	1438001	1 year	2019.01.25
Pulse Power Sensor	Anritsu	MA2411B	1339205	1 year	2019.01.25
Attenuator	KEYSIGHT	8493C	82506	1 year	2019.01.22
Loop Antenna	Schwarzbeck	FMZB1513	225	2 years	2019.05.10
Trilog-broadband antenna	SCHWARZBECK	VULB 9163	9168-714	2 years	2020.11.26
Horn Antenna	A.H	SAS-571	414	2 years	2019.02.15
Horn Antenna	SCHWARZBECK	BBHA9170	BBHA 9170550	2 years	2019.02.15
High Pass Filter	Wainwright Instrument Gmbh	WHJS3000-10TT	1	1 year	2019.06.29
Low Pass Filter	Wainwright Instrument Gmbh	WLK1.0/18G-10TT	1	1 year	2019.06.29
Preamplifier	R&S	SCU01	100603	1 year	2019.11.26
Preamplifier	AGILENT	8449B	3008A01742	1 year	2019.01.11
EMI Test Receiver	R&S	ESR3	101783	1 year	2019.04.25
EMI Test Receiver	R&S	ESU26	100551	1 year	2019.04.11
LISN	R&S	ENV216	101137	1 year	2019.01.31

Peripheral devices

Device	Manufacturer	Model No.	Serial No.
-	-	-	-

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