

TEST REPORT



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Report No.:
CTK-2020-03970
Page (1) / (51) Pages

1. Client

- Name : EVERINT Co.,Ltd.
- Address : (Yongtan-dong), 129, Chungjusandan1-ro, Chungju-si, Chungcheongbuk-do, Korea 27326
- Date of Receipt : 2020-09-02

2. Manufacturer

- Name : 1. EVERINT Co.,Ltd.
2. BIXOLON Co.,Ltd.
3. IDRO CO.,Ltd.
- Address : 1. (Yongtan-dong), 129, Chungjusandan1-ro, Chungju-si, Chungcheongbuk-do, Korea 27326
2. 7th~8th FL, MiraeAsset Venture Tower, 20, Pangyoyeok-ro 241beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea
3. 219-Ho, Acegwanggyotower-1Cha, Daehak 4-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model: UHF RFID Reader Module / IDRO900MI-m

5. Date of Test : 2020-09-14 to 2020-10-08

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.247 ISED RSS-247 & RSS-Gen

7. Testing Environment: Temp.: (23 ± 1) °C, Humidity: (48 ± 3) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by	Technical Manager
	Ji-Hye, Kim: (Signature)	Won-Jae, Hwang: (Signature)

2020-10-12

Republic of KOREA **CTK Co., Ltd.**

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REPORT REVISION HISTORY

Date	Revision	Page No
2020-10-12	Issued (CTK-2020-03970)	all

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1. General Product Description

1.1 Client Information

Company	EVERINT Co.,Ltd.
Contact Point	(Yongtan-dong), 129, Chungjusandan1-ro, Chungju-si, Chungcheongbuk-do, Korea 27326
Contact Person	Name : Ji-Sung Shin E-mail : jsshin@bixolon.com Tel : +82-31-218-5582 Fax : +82-31-218-5589

1.2 Product Information

FCC ID	2AKMF-IDRO900MI
ISED	22266-IDRO900MI
Product Description	UHF RFID Reader Module
Model name	IDRO900MI-m
Operating Band	902 MHz - 928 MHz
Frequency Range	902.75 MHz - 927.25 MHz
RF Output Power	28.03 dBm (0.635 W)
Antenna Specification	Antenna1 type : PCB Antenna Gain1 : -39.50 dBi
	Antenna1 type : PCB Antenna Gain1 : -10.68 dBi
Number of channels	50
Channel Spacing	500 kHz
Type of Modulation	ASK
Power Source	DC 4 V
Hardware Rev	V06
Software Rev	V20031900

1.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
Note Computer	HP	15-bs563TU	CND7253R6N
AC/DC Adapter	HP	HSTNN-CA40	-

2. Facility and Accreditations

2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A-2
KOREA	NRRA	KR0025

2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

3. Test Specifications

3.1 Standards

FCC Part Section(s)	ISED Part Section(s)	Requirement(s)	Status (Note 1)	Test Condition
15.247(a)(1)	RSS-247 5.1(b)	Carrier Frequency Separation	C	Conducted
15.247(a)(1)(i)	RSS-247 5.1(d)	Number of Hopping Frequencies	C	
15.247(a)	RSS-247 5.1(a)	20 dB Bandwidth	C	
15.247(a)(1)(i)	RSS-247 5.1(d)	Time of occupancy (Dwell Time)	C	
15.247(b)(2)	RSS-247 5.4(b)	Maximum peak conducted output power	C	
15.247(d)	RSS-247 5.5	Unwanted emission	C	
15.209	RSS-Gen 6.13	Transmitter emission	C	Radiated
15.207(a)	RSS-Gen 8.8	AC Conducted Emission	C	Line Conducted
<u>Note 1:</u> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable				
<u>Note 2:</u> The data in this test report are traceable to the national or international standards.				
<u>Note 3:</u> The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013, RSS-247, RSS-GEN				

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.
During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.
The results are only attached worst cases.

Test Frequency

Lowest frequency	Middle frequency	Highest frequency
902.75 MHz	914.75 MHz	927.25 MHz

Test mode

Hopping mode
Modulated single hop mode

3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.
Coverage factor $k = 2$, Confidence levels of 95 %

Description	Uncertainty
Conducted RF Output Power	± 1.5 dB
Occupied Bandwidth	± 0.1 MHz
Unwanted Emission(conducted)	± 3.0 dB
Radiated Emissions ($f \leq 1$ GHz)	± 4.0 dB
Radiated Emissions ($f > 1$ GHz)	± 5.0 dB

3.4 Test Software

Conducted Test	Ics Pro Ver. 6.0.3
Radiated Test	TOYO EMI software EP5RE Ver. 6.0.1.0
Line Conducted Test	ESC17, ESC13 : EMC32 Ver. 8.50.0 ESR7 : EMC32 Ver. 8.53.0

4. Technical Characteristic Test

4.1 Carrier Frequency Separation

Test Procedures

ANSI C63.10-2013 - Section 7.8.2

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled.
After the trace being stable, the reading value between the peaks of the adjacent channels using the marker-delta function was recorded as the measurement results.

The spectrum analyzer is set to:

- a) Span = 2 MHz (wide enough to capture the peaks of two adjacent channels)
- b) RBW = 100 kHz (Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel)
- c) VBW = 100 kHz ($\geq$ RBW)
- d) Sweep = auto
- e) Detector function = peak
- f) Trace = max hold

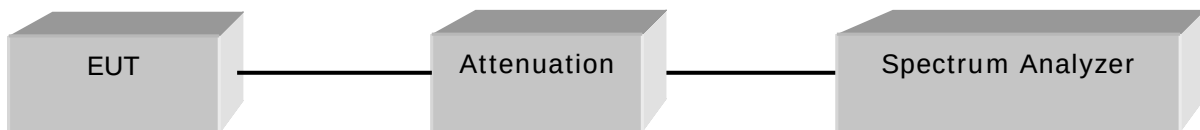


Figure 1 : Measurement setup for the carrier frequency separation

Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

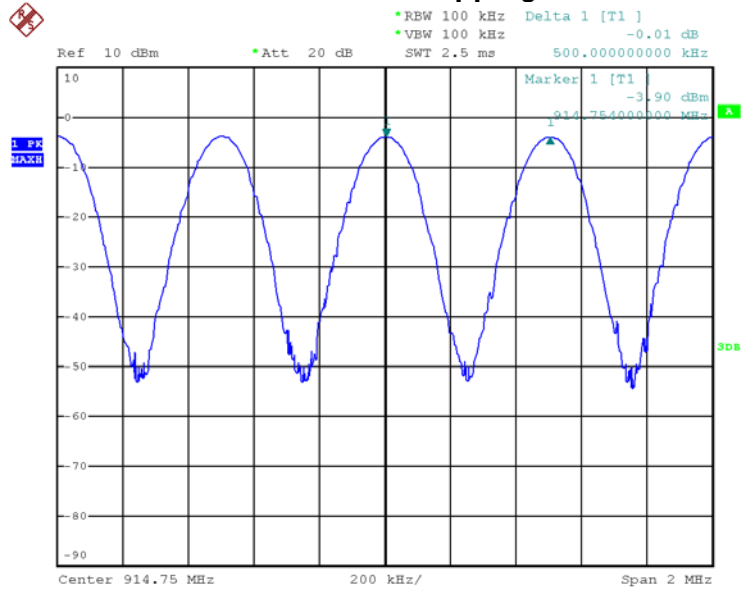
Test Results

Test mode : Hopping mode

Channel	Adjacent Hopping Channel Separation [kHz]	20dB bandwidth [kHz]	Minimum Bandwidth [kHz]	Result
Middle	500	51.2	25	Complies

See follow for actual measured spectrum plots.

Test mode : Hopping Mode



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4.2 Number of Hopping Frequencies

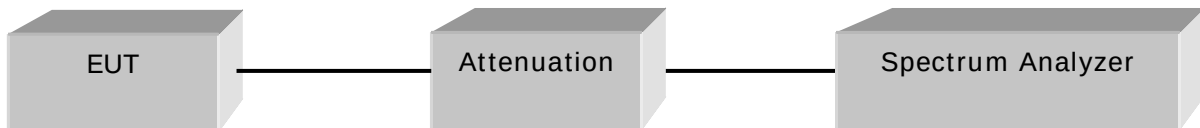
Test Procedures

ANSI C63.10-2013 - Section 7.8.3

The number of hopping frequencies was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

- a) RBW = 100 kHz (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)
- b) VBW = 100 kHz ($\geq$ RBW)
- c) Sweep = auto
- d) Detector function = peak
- e) Trace = max hold



Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

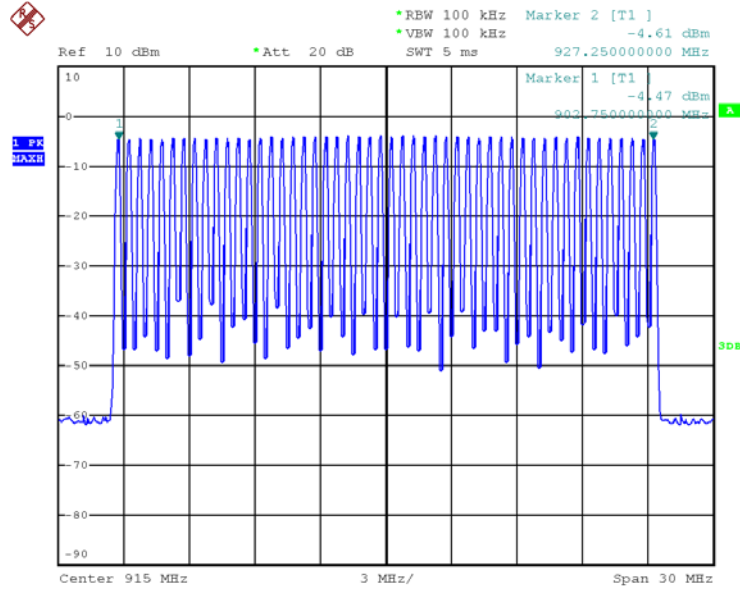
Test Results

Test mode : Hopping Mode

Total number of Hopping Channels	Result
50	Complies

See follow for actual measured spectrum plots.

Test Mode : Hopping Mode



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4.3 20 dB bandwidth & 99 % Bandwidth

Test Procedures

ANSI C63.10-2013 - Section 6.9.2
RSS-GEN Issue 5 - Section 6.7

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

Test Procedures

ANSI C63.10-2013 - Section 6.9.3
RSS-GEN Issue 5 - Section 6.7

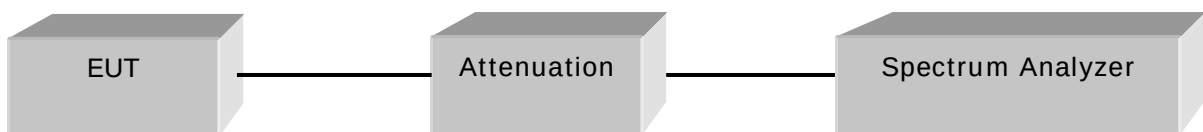
The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

- a) Span = 200 kHz (between 2 times and 5 times the OBW)
- b) RBW = 3 kHz (1% to 5% of the OBW)
- c) VBW = 10 kHz (approximately 3 times RBW)
- d) Sweep = auto
- e) Detector function = peak
- f) Trace = max hold



Limit

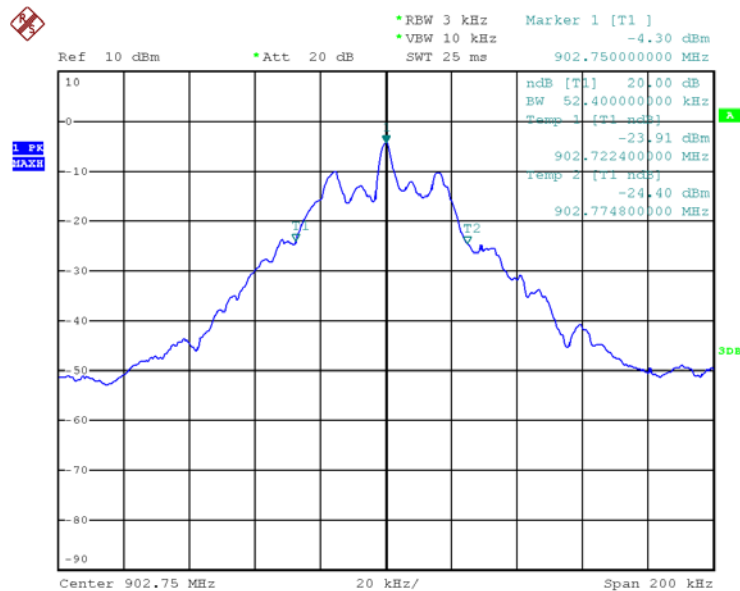
Limit : N/A

Test Results

Channel	Frequency [MHz]	20 dB Bandwidth [KHz]	99 % Bandwidth [KHz]	Result
Lowest	902.75	52.40	65.60	Complies
Middle	914.75	51.20	66.40	Complies
Highest	927.25	5120	64.00	Complies

See follow for actual measured spectrum plots.

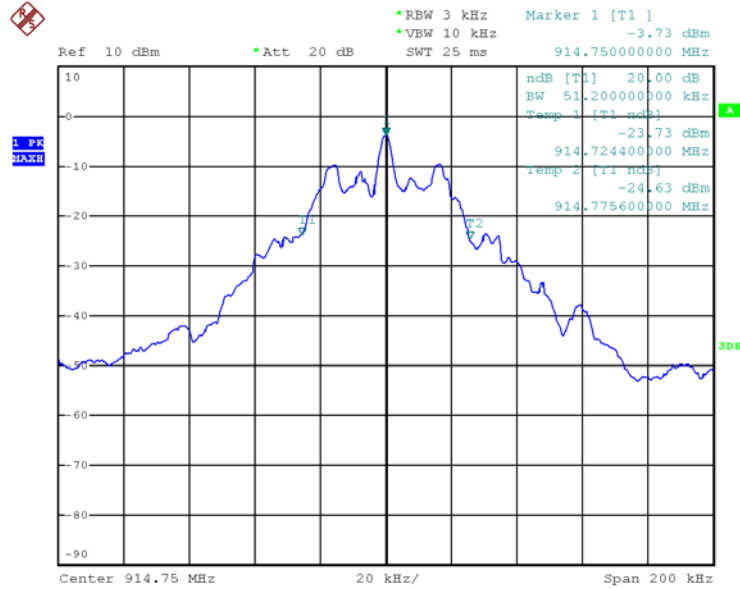
20 dB Bandwidth - Lowest Frequency



CAC-5500

Date: 14.SEP.2020 19:50:40

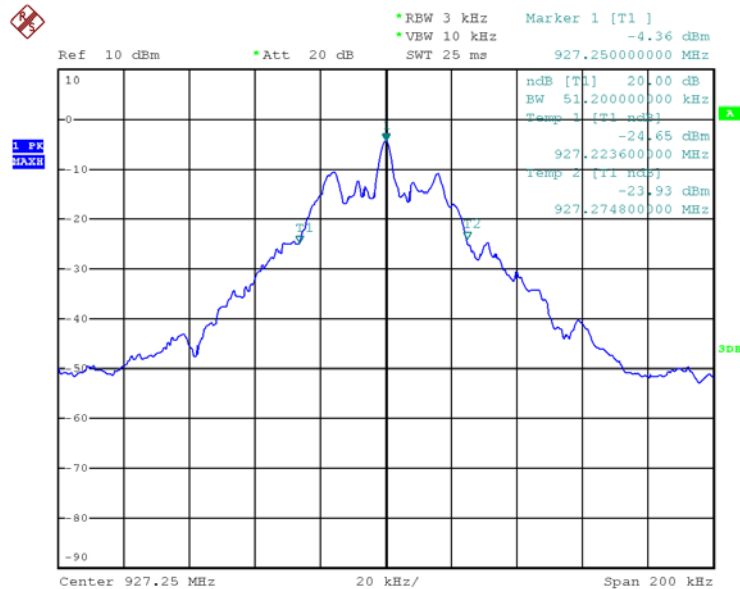
20 dB Bandwidth - Middle Frequency



CAC-5500

Date: 14.SEP.2020 19:51:39

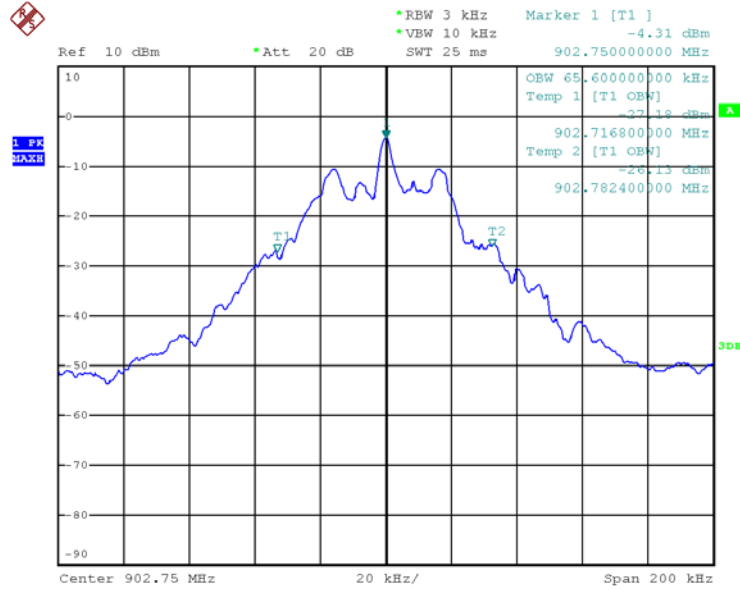
20 dB Bandwidth - Highest Frequency



CAC-5500

Date: 14.SEP.2020 19:52:18

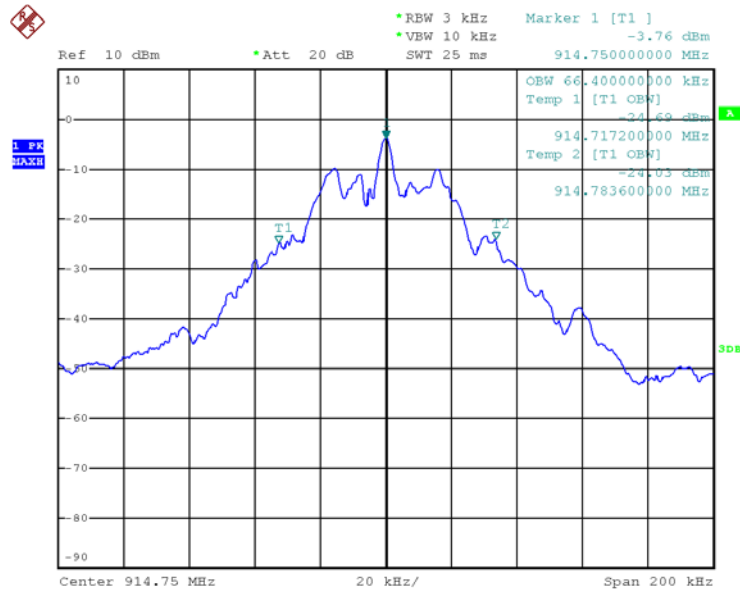
99 % Bandwidth - Lowest Frequency



CAC-5500

Date: 14.SEP.2020 19:50:54

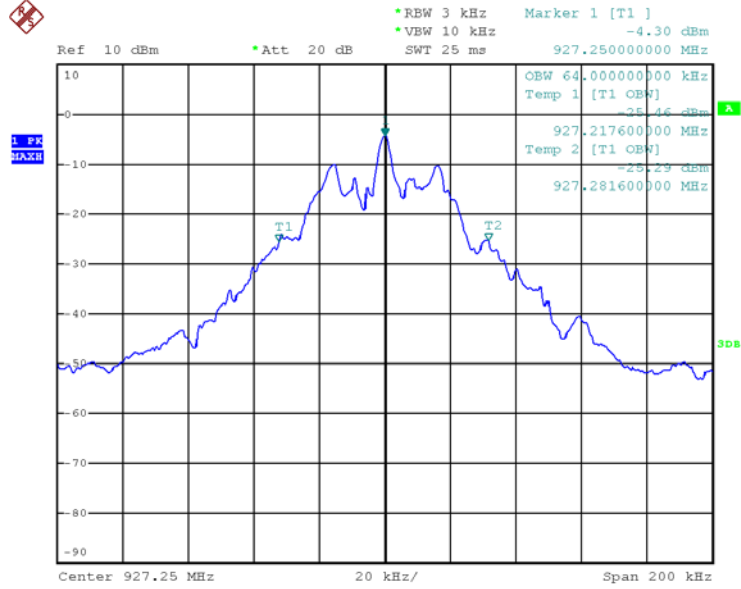
99 % Bandwidth - Middle Frequency



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Date: 14.SEP.2020 19:51:52

99 % Bandwidth - Highest Frequency



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Date: 14.SEP.2020 19:52:31

4.4 Time of Occupancy

Test Procedures

ANSI C63.10-2013 - Section 7.8.4

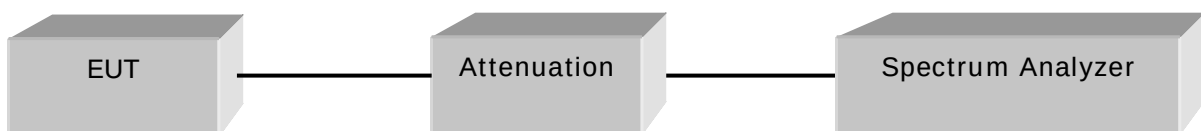
The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function enabled.

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

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

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



Limit

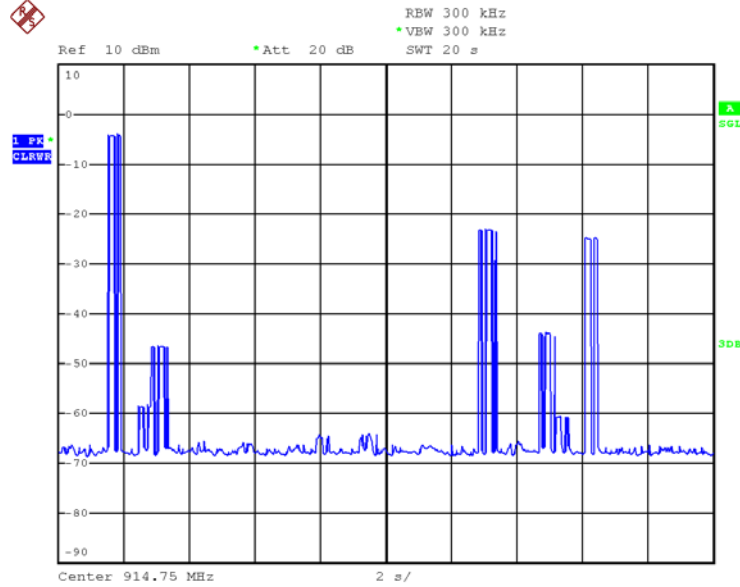
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Test Results

Number of hops channels within a 20 second period	Transmit time per hop(msec)	Result (msec)	Limit (msec)
1	198.4	198.4	400

See follow for actual measured spectrum plots.

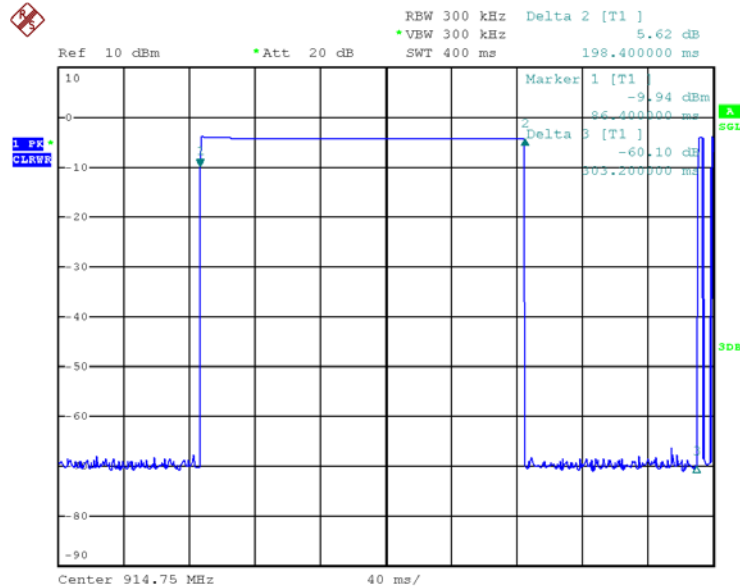
Number of hops channels within a 20 second period



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Transmit time per hop



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4.5 Maximum peak Conducted Output Power

Test Procedures

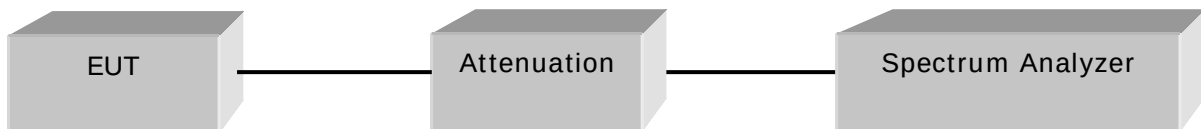
ANSI C63.10-2013 - Section 7.8.5

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

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

- a) Span = 400 kHz (approximately 5 times of the 20 dB bandwidth)
- b) RBW = 1 MHz (greater than the 20 dB bandwidth of the emission being measured)
- c) VBW = 1 MHz ($\geq$ RBW)
- d) Detector = peak
- e) Trace = max hold
- f) Sweep = auto



Limit

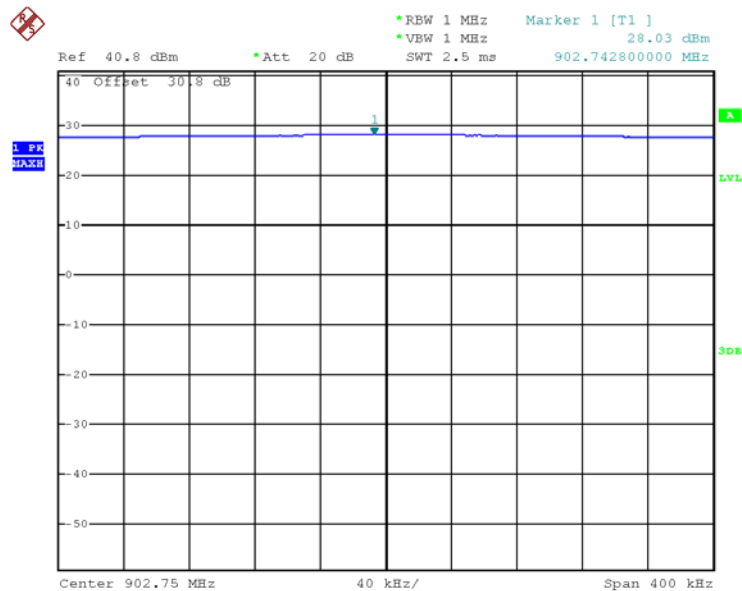
For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels

Test Results

Channel	Frequency [MHz]	Output Power [dBm]	Output power [mW]	Result
Lowest	902.75	28.03	635.33	Complies
Middle	914.75	27.09	511.68	Complies
Highest	927.25	26.30	426.58	Complies

See follow for actual measured spectrum plots.

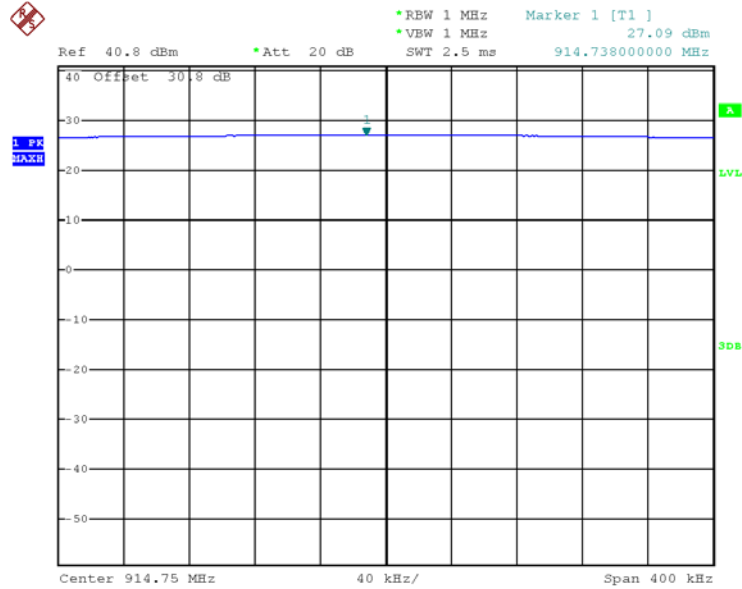
Output Power - Lowest Frequency



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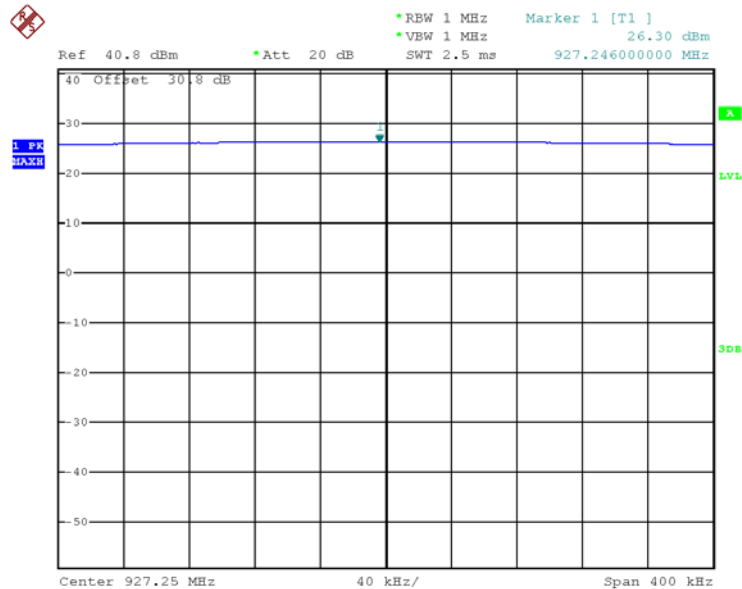
Output Power - Middle frequency



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Date: 14.SEP.2020 19:13:55

Output Power - Highest frequency



CAC-5500

Date: 14.SEP.2020 19:32:39

4.6 Unwanted Emissions (Conducted)

Test Procedures

ANSI C63.10-2013 - Section 7.8.6, 7.8.8

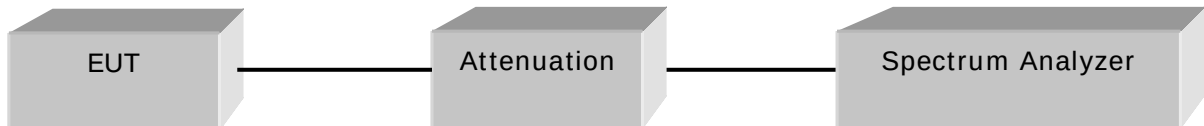
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either 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(4), the attenuation required shall be 30 dB instead of 20 dB.

The bandwidth at 20 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT has its hopping function disabled at the highest, middle and the lowest available channels.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW = 300 kHz ($\geq$ RBW)
- c) Span = 10 MHz
- d) Detector = peak
- e) Trace = max hold
- f) Sweep = auto



Limit

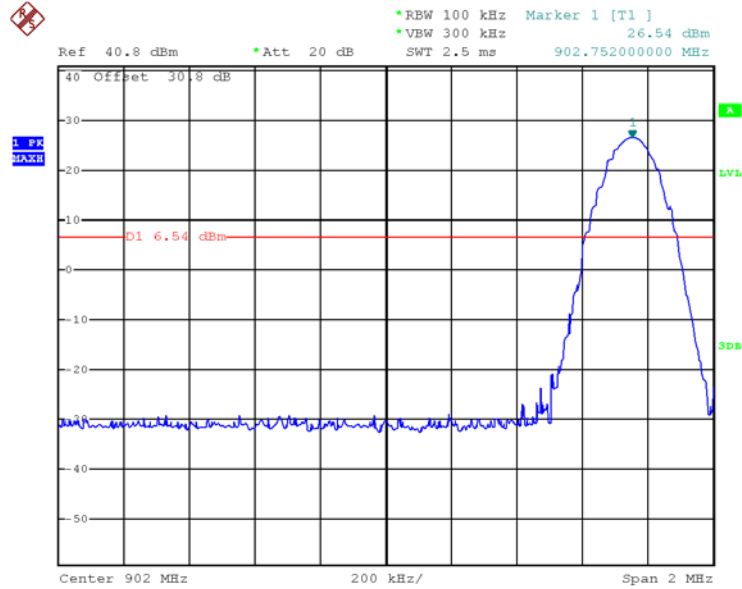
> 20 dBc

Test Results

All conducted emission in any 100 kHz bandwidth outside of the spectrum band was at least 20 dB lower than the highest level of the in-band spectral density. Therefore the applying equipment meets the requirement.

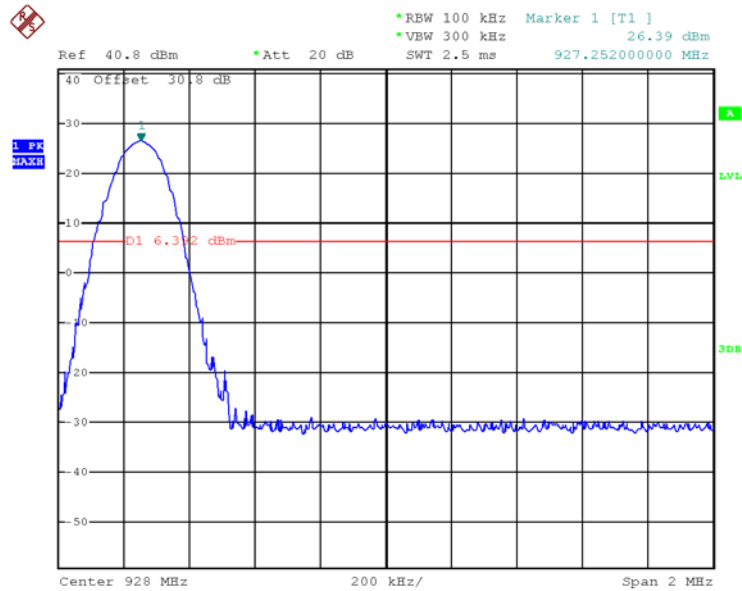
See follow for actual measured spectrum plots.

Band Edge - Hopping mode



CAC-5500

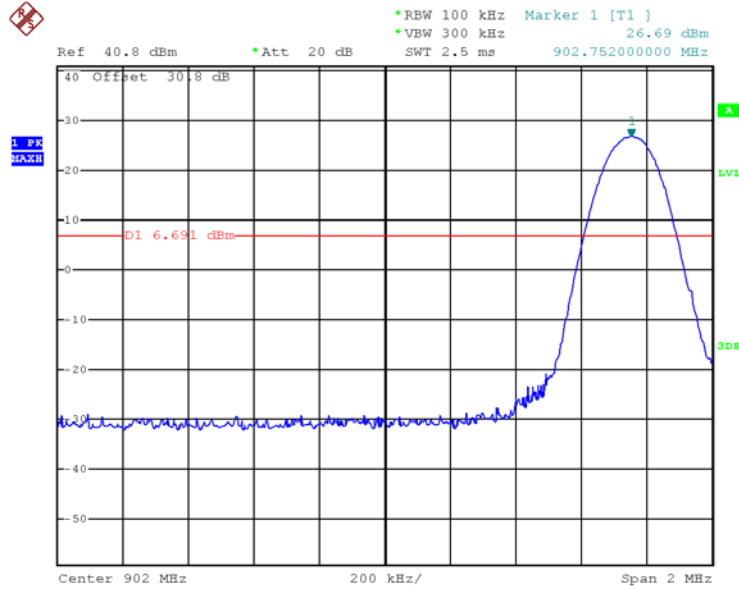
Date: 14.SEP.2020 19:40:52



CAC-5500

Date: 14.SEP.2020 19:41:13

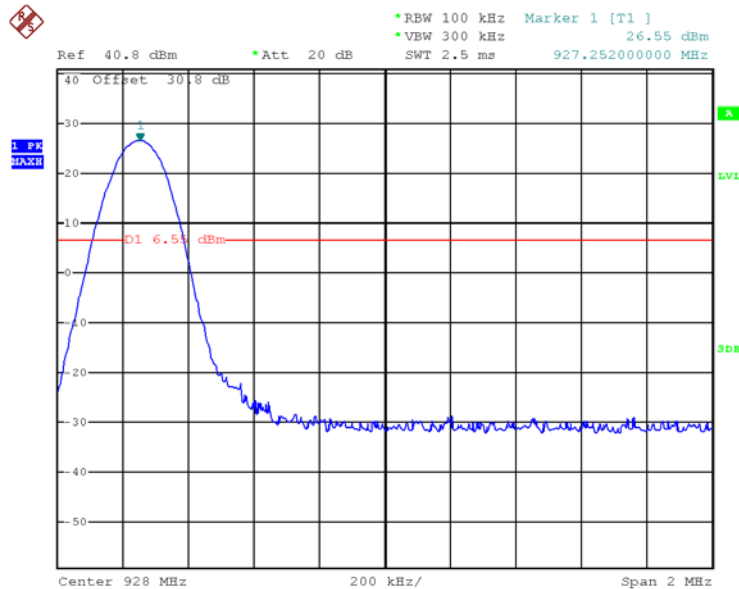
Band Edge - Lowest frequency



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Date: 14.SEP.2020 19:12:43

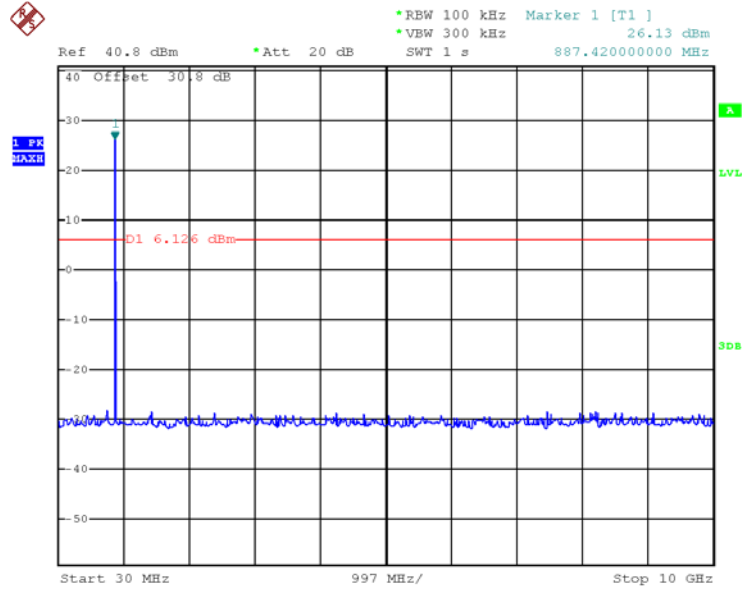
Band Edge - Highest frequency



CAC-5500

Date: 14.SEP.2020 19:34:05

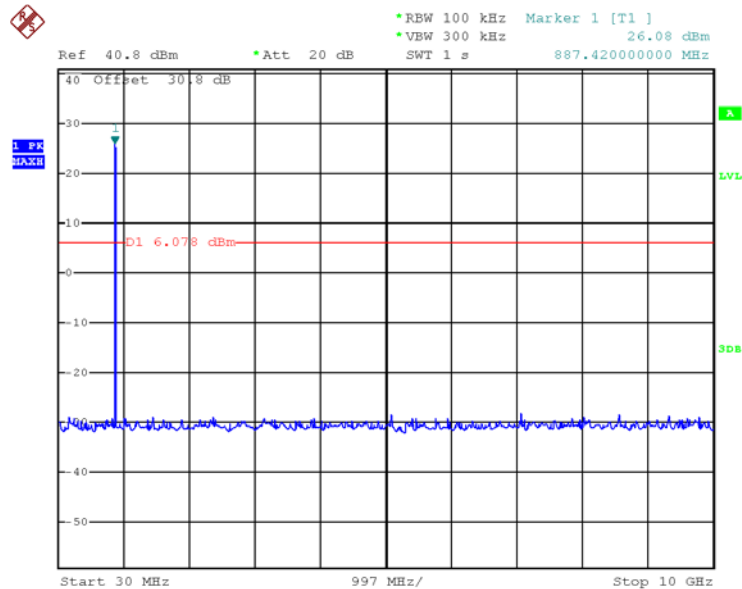
Spurious Emission - Lowest frequency



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Date: 14.SEP.2020 19:13:00

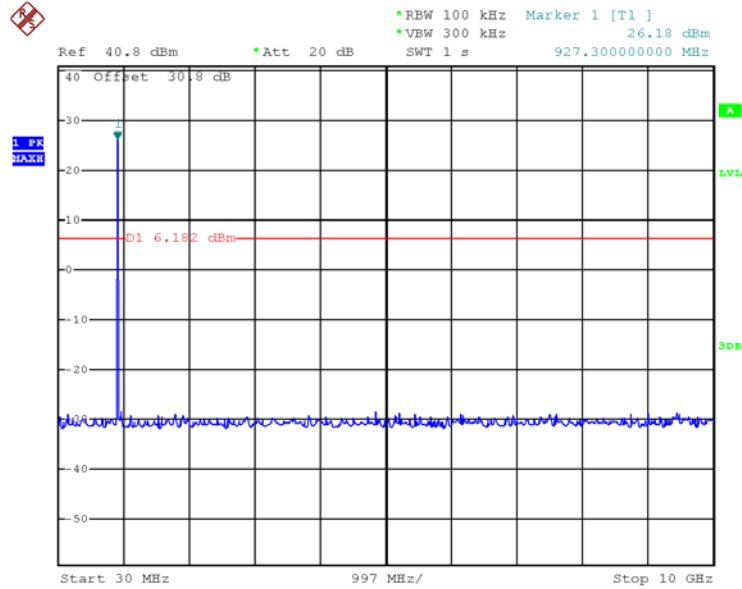
Spurious Emission - Middle frequency



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Date: 14.SEP.2020 19:31:46

Spurious Emission - Highest frequency



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Date: 14.SEP.2020 19:34:22

 CTK Co., Ltd. The Prime Leader of Global Regulatory Compliance	CTK Co., Ltd. (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea Tel: +82-31-339-9970 Fax: +82-31-624-9501	Report No.: CTK-2020-03970 Page (28) / (51) Pages	
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4.7 Radiated Emission

Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)
☒ 3 m SAC (test distance : 3 m)

Test Procedures

ANSI C63.10-2013 - Section 6.5, 6.6

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

Instrument Settings

Frequency Range = 9 kHz ~ 10 GHz (900 MHz 10th harmonic)

- a) RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz, 9 kHz for $f < 30$ MHz
- b) VBW $\geq$ RBW
- c) Sweep time = auto couple

Limit :

Unwanted emissions that do not fall within the restricted frequency bands of Table 1 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

Table 1. Restricted Frequency Bands

MHz	MHz	MHz	MHz	MHz	GHz
0.09-0.11	8.37626-8.38675	73-74.6	399.9-410	2690-2900	10.6-12.7
¹ 0.495-0.505	8.41425-8.41475	74.8-75.2	608-614	3260-3267	13.25-13.4
2.1735-2.1905	12.29-12.293	108-121.94	960-1240	3332-3339	14.47-14.5
4.125-4.128	12.51975-12.52025	123-138	1300-1427	3345.8-3358	15.35-16.2
4.17725-4.17775	12.57675-12.57725	149.9-150.05	1435-1626.5	3600-4400	17.7-21.4
4.20725-4.20775	13.36-13.41	156.52475-156.52525	1645.5-1646.5	4500-5150	22.01-23.12
6.215-6.218	16.42-16.423	156.7-156.9	1660-1710	5350-5460	23.6-24
6.26775-6.26825	16.69475-16.69525	162.0125-167.17	1718.8-1722.2	7250-7750	31.2-31.8
6.31175-6.31225	16.80425-16.80475	167.72-173.2	2200-2300	8025-8500	36.43-36.5
8.291-8.294	25.5-25.67	240-285	2310-2390	9000-9200	² Above 38.6
8.362-8.366	37.5-38.25	322-335.4	2483.5-2500	9300-9500	

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 2. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 2. General Field Strength Limits for Licence-Exempt Transmitters

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705-30	30	-	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46	3
Above 960	500	54	3

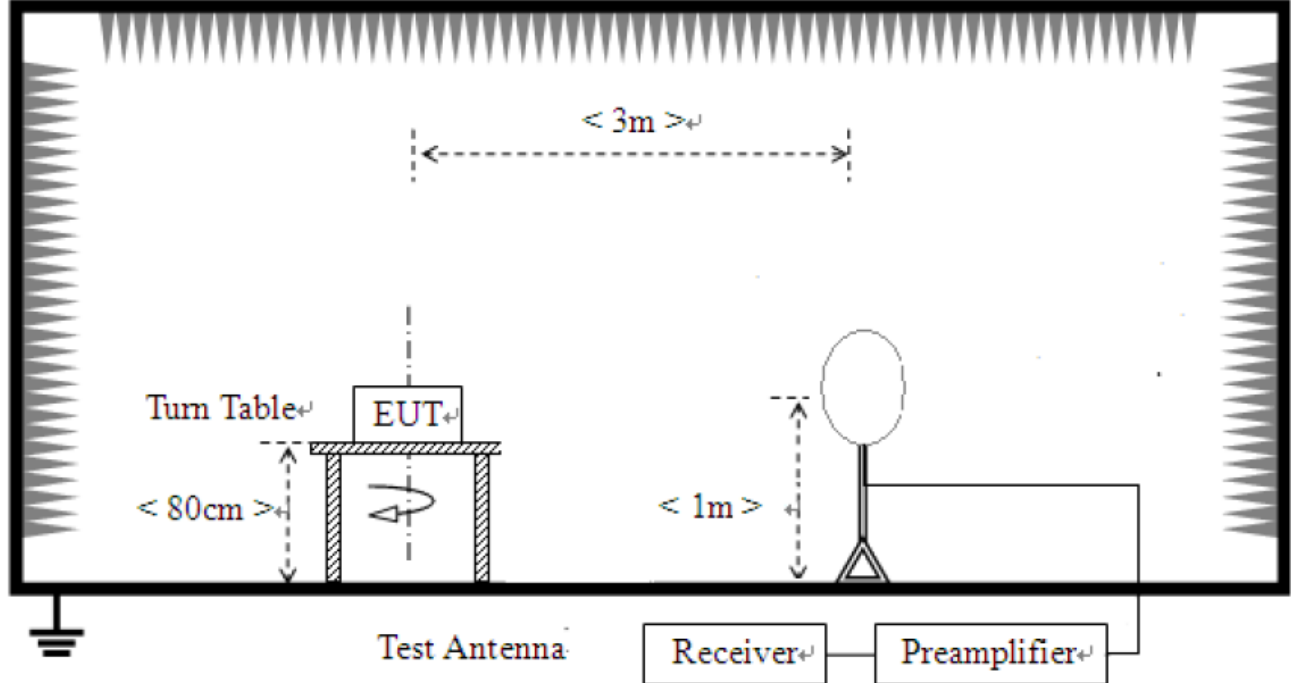
** Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

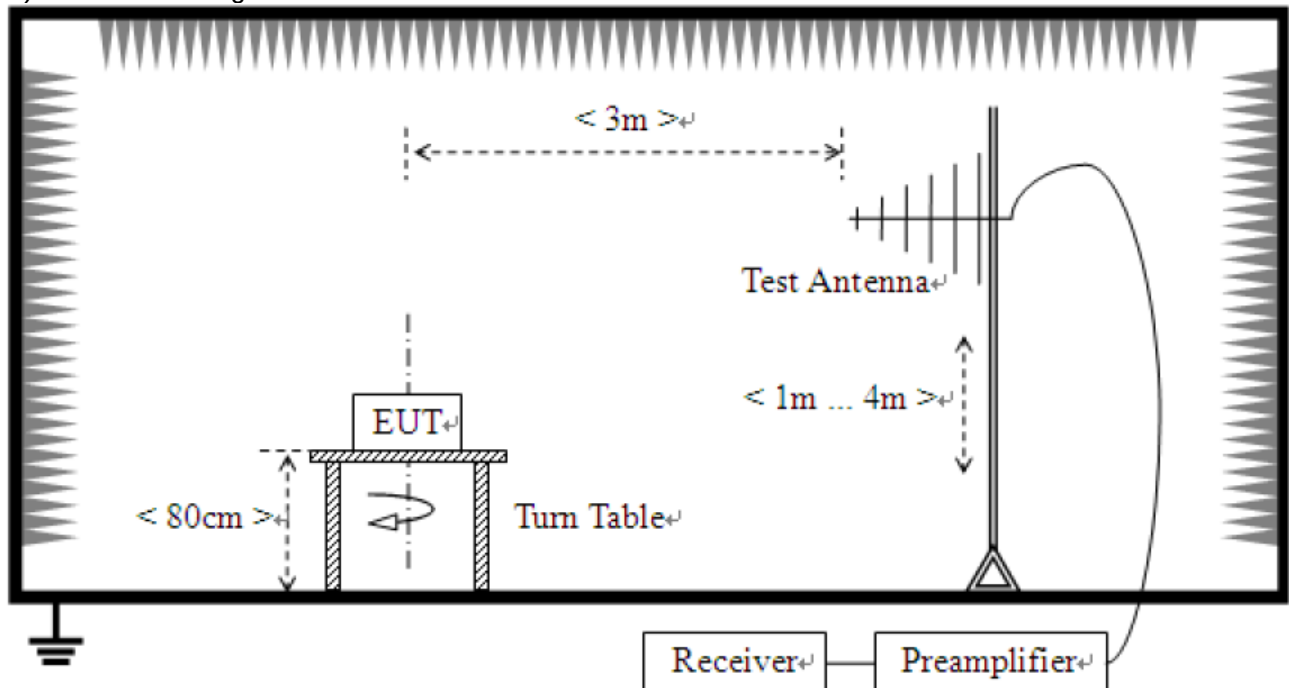
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- 3) For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement.(Duty Cycle is > 98%,)
- 4) Duty Cycle is < 98%, VBW setting will need to > 1/T.

Test Setup:

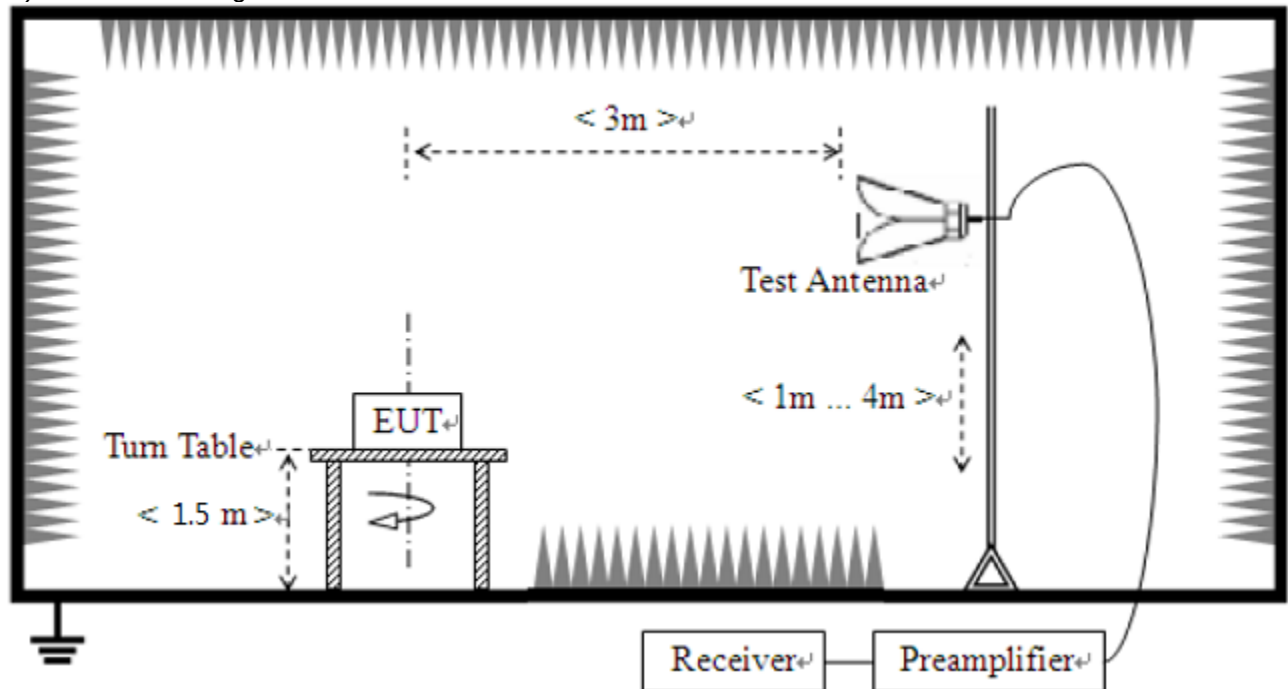
1) For field strength of emissions from 9 kHz to 30 MHz



2) For field strength of emissions from 30 MHz to 1 GHz



3) For field strength of emissions above 1 GHz



Test results

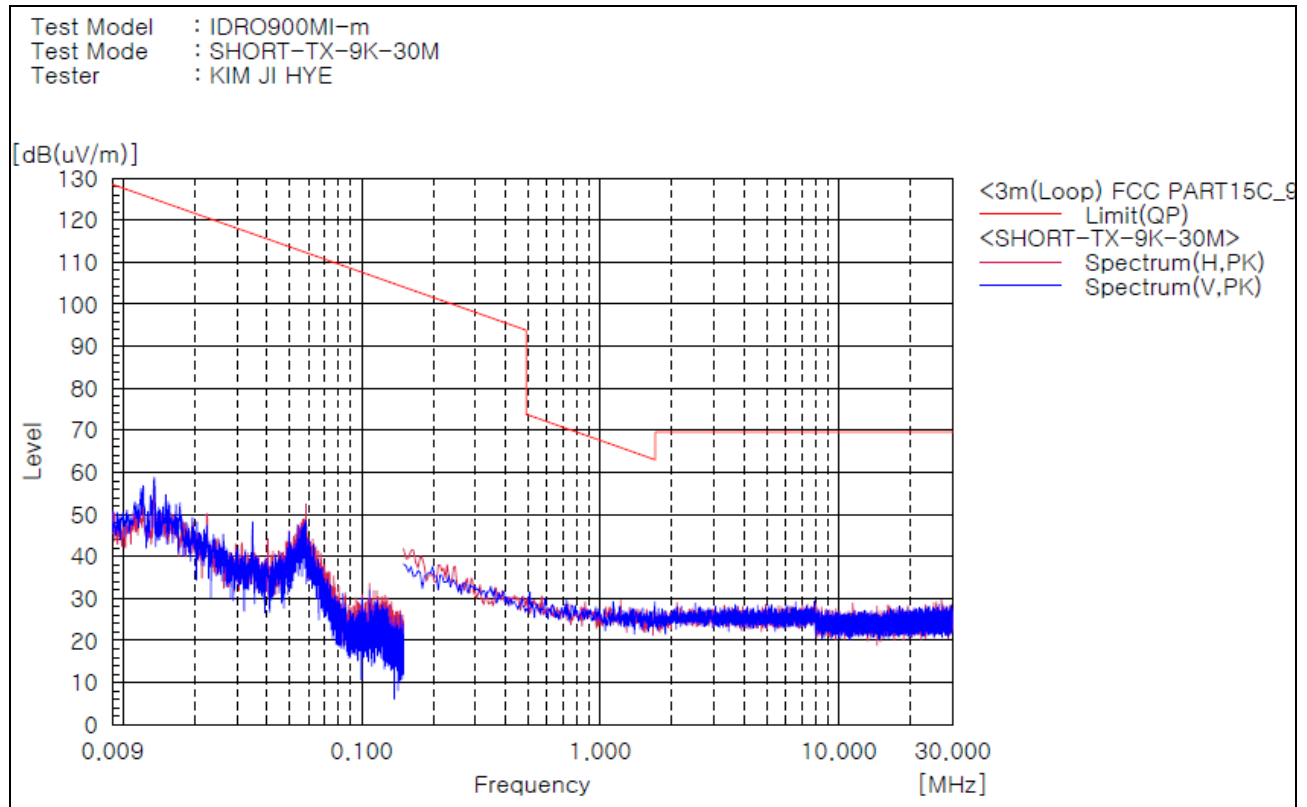
1) 9 kHz to 30 MHz

Test mode : Antenna1_Transmitter(Worst Case)

The requirements are:

☒ Complies

Test Data



Frequency [MHz]	(P)	Reading QP [dBuV]	dB [1 / m]	Result QP [dBuV / m]	Limit QP [dBuV / m]	Margin QP [dB]
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The emissions 9 kHz to 30MHz were 20 dB lower than the limit.

Remark :

- The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.
- Result = Reading + c.f(Correction factor)
- Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

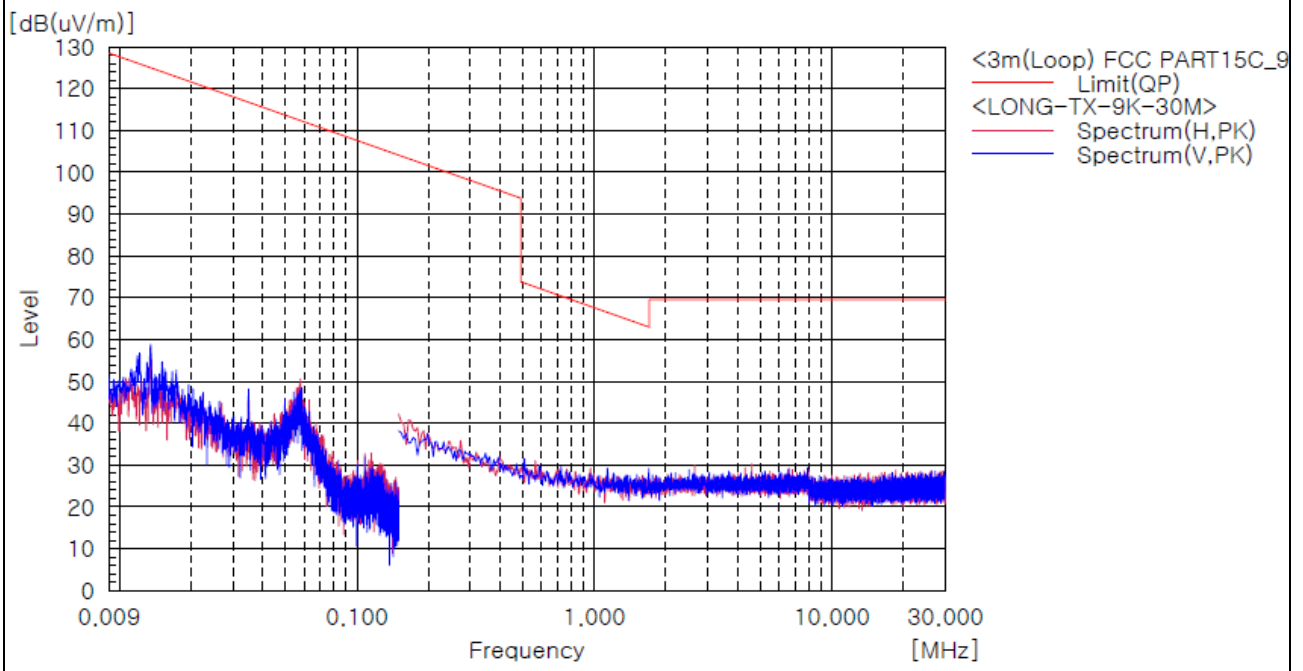
Test mode : Antenna2_Transmitter(Worst Case)

The requirements are:

☒ Complies

Test Data

Test Model : IDRO900MI-m
Test Mode : LONG-TX-9K-30M
Tester : KIM JI HYE



Frequency [MHz]	(P)	Reading QP [dBuV]	dB [1 / m]	Result QP [dBuV / m]	Limit QP [dBuV / m]	Margin QP [dB]
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The emissions 9 kHz to 30MHz were 20 dB lower than the limit.

Remark :

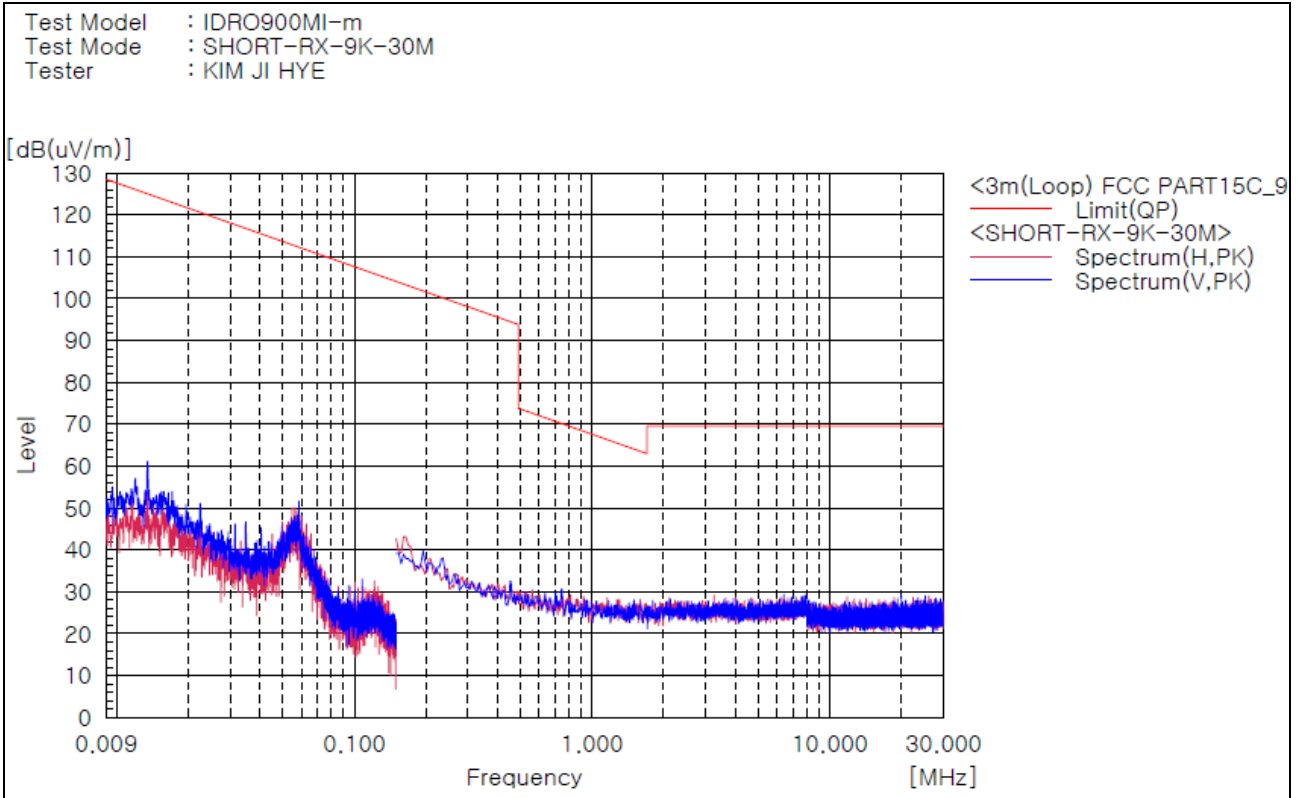
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Antenna1_ Receiver (Worst Case)

The requirements are:

☒ Complies

Test Data



Frequency [MHz]	(P)	Reading QP [dBuV]	dB [1/m]	Result QP [dBuV/m]	Limit QP [dBuV/m]	Margin QP [dB]
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The emissions 9 kHz to 30MHz were 20 dB lower than the limit.

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

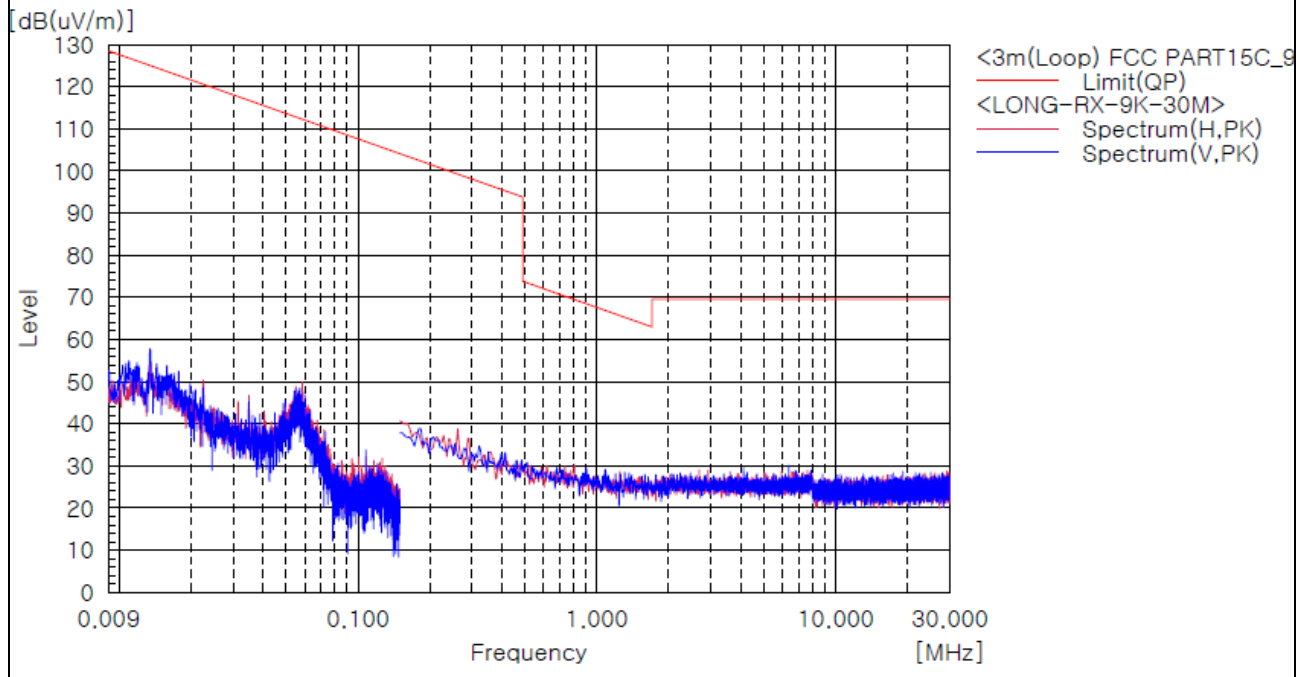
Test mode : Antenna2_ Receiver (Worst Case)

The requirements are:

☒ Complies

Test Data

Test Model : IDRO900MI-m
Test Mode : LONG-RX-9K-30M
Tester : KIM JI HYE



Frequency [MHz]	(P)	Reading QP [dBuV]	dB [1 / m]	Result QP [dBuV / m]	Limit QP [dBuV / m]	Margin QP [dB]
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The emissions 9 kHz to 30MHz were 20 dB lower than the limit.

Remark :

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

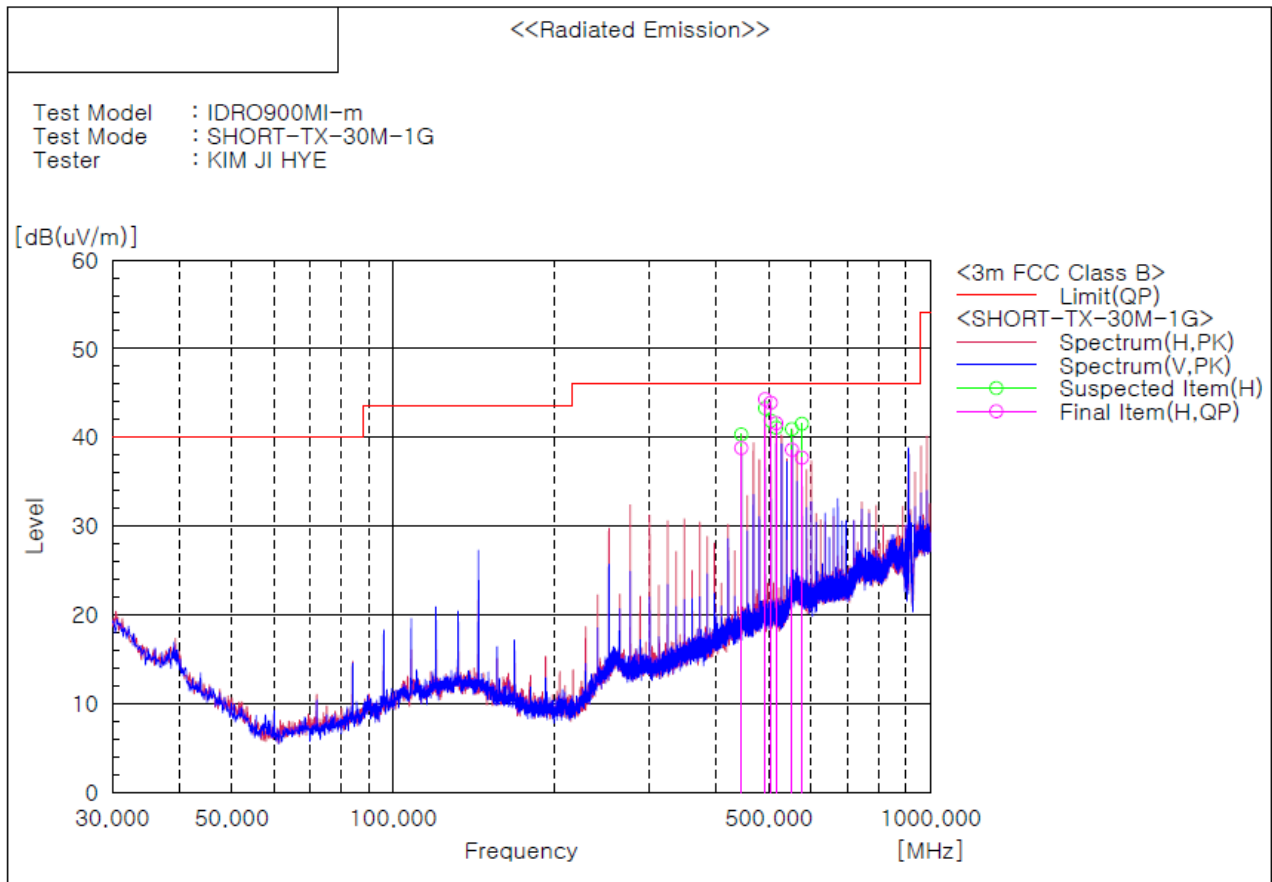
2) 30 MHz to 1 GHz

Test mode : Antenna1_Hopping Mode

The requirements are:

☒ Complies

Test Data



Final Result

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]
1	444.520	H	42.4	-3.6	38.8	46.0	7.2	101.0	205.0
2	492.551	H	46.7	-2.4	44.3	46.0	1.7	205.0	187.0
3	504.575	H	46.1	-2.2	43.9	46.0	2.1	205.0	194.0
4	516.584	H	43.8	-2.2	41.6	46.0	4.4	205.0	194.0
5	552.634	H	38.6	0.0	38.6	46.0	7.4	101.0	145.0
6	576.674	H	37.8	-0.1	37.7	46.0	8.3	101.0	128.0

Remark :

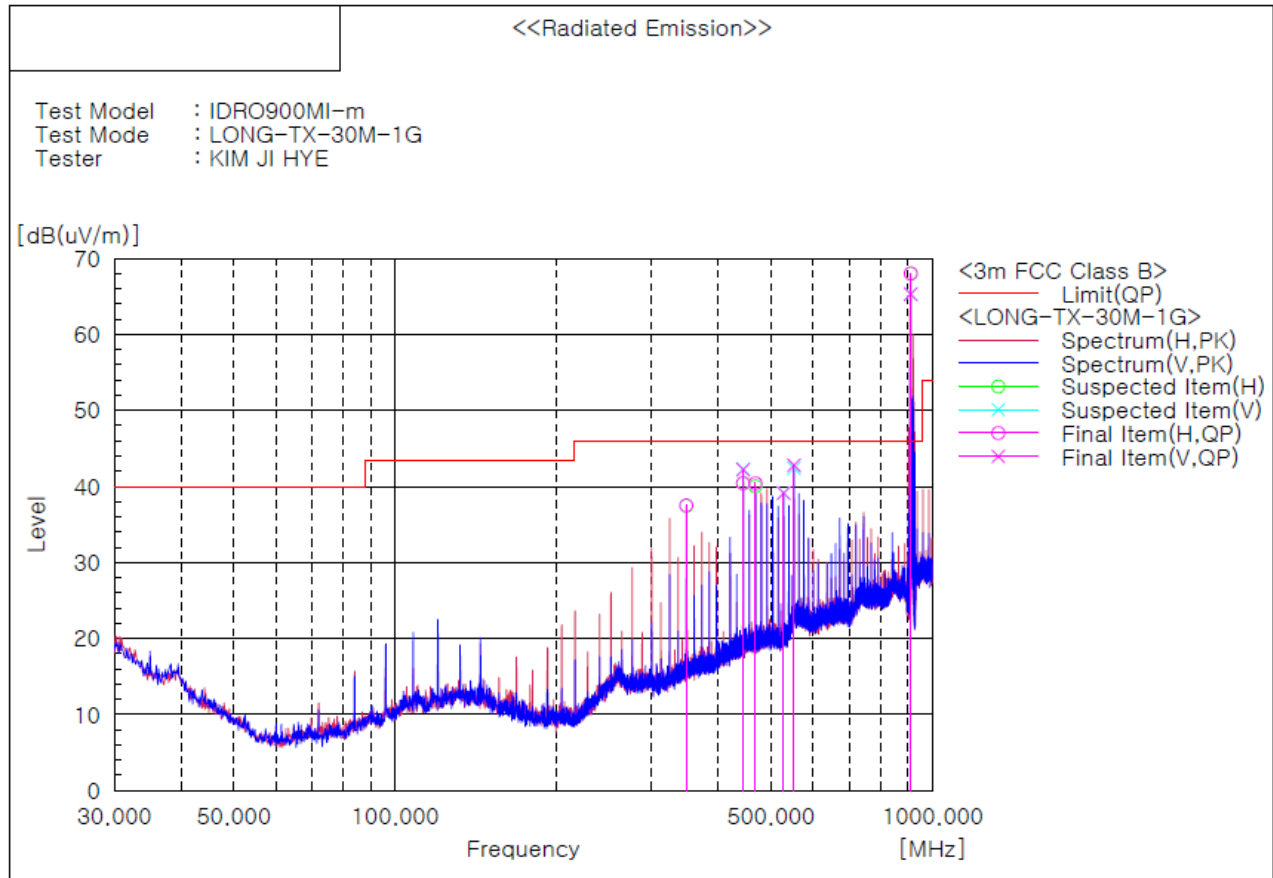
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Antenna2_Hopping Mode

The requirements are:

☒ Complies

Test Data



Final Result

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]
1	348.405	H	44.6	-7.1	37.5	46.0	8.5	100.0	337.0
2	444.493	V	45.8	-3.6	42.2	46.0	3.8	101.0	266.0
3	444.510	H	44.0	-3.6	40.4	46.0	5.6	208.0	233.0
4	468.536	H	43.6	-3.2	40.4	46.0	5.6	208.0	223.0
5	528.610	V	41.3	-2.2	39.1	46.0	6.9	101.0	272.0
6	552.617	V	42.8	0.0	42.8	46.0	3.2	101.0	272.0
7	911.366	V	59.1	6.2	65.3	46.0	-19.3	101.0	78.0
8	911.851	H	61.7	6.3	68.0	46.0	-22.0	100.0	357.0

Remark :

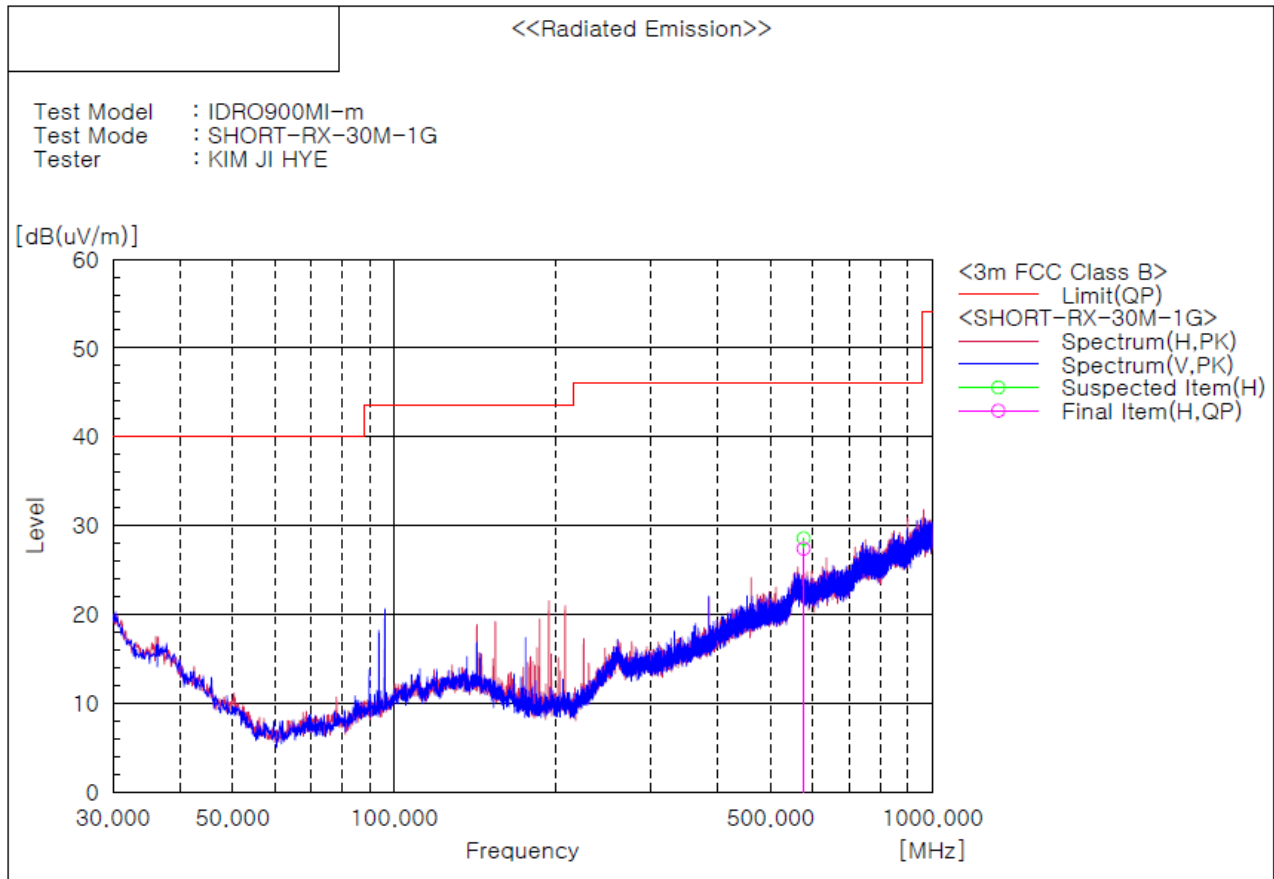
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. No.7 and No.8 are the carrier frequencies.

Test mode : Antenna1_Receiver

The requirements are:

☒ Complies

Test Data



Frequency [MHz]	(P)	Reading QP [dBuV]	dB [1 / m]	Result QP [dBuV / m]	Limit QP [dBuV / m]	Margin QP [dB]
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The emissions 30 MHz to 1GHz were 20 dB lower than the limit.

Remark :

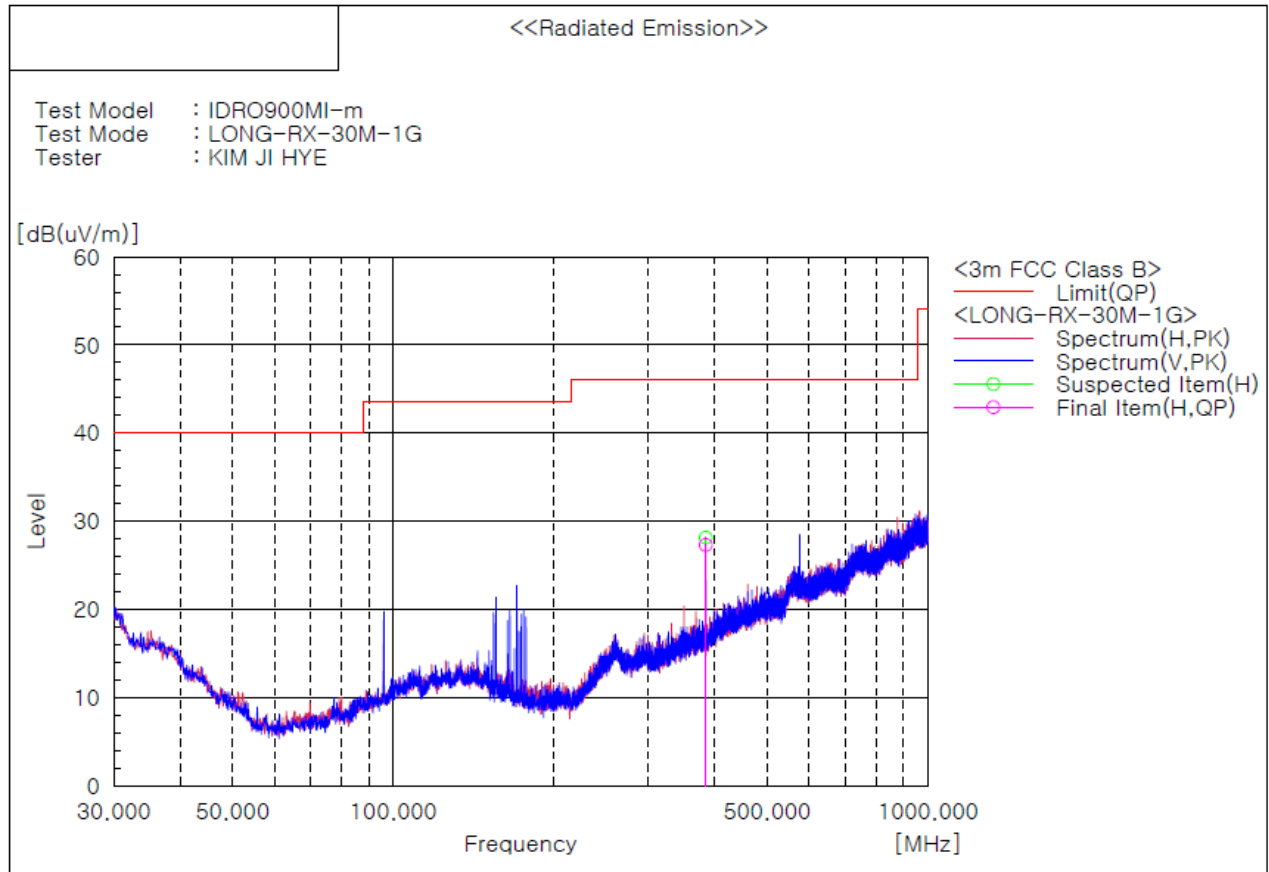
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in in lie-down position (X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

Test mode : Antenna2_Receiver

The requirements are:

☒ Complies

Test Data



Frequency [MHz]	(P)	Reading QP [dBuV]	dB [1/m]	Result QP [dBuV/m]	Limit QP [dBuV/m]	Margin QP [dB]
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The emissions 30 MHz to 1GHz were 20 dB lower than the limit.

Remark :

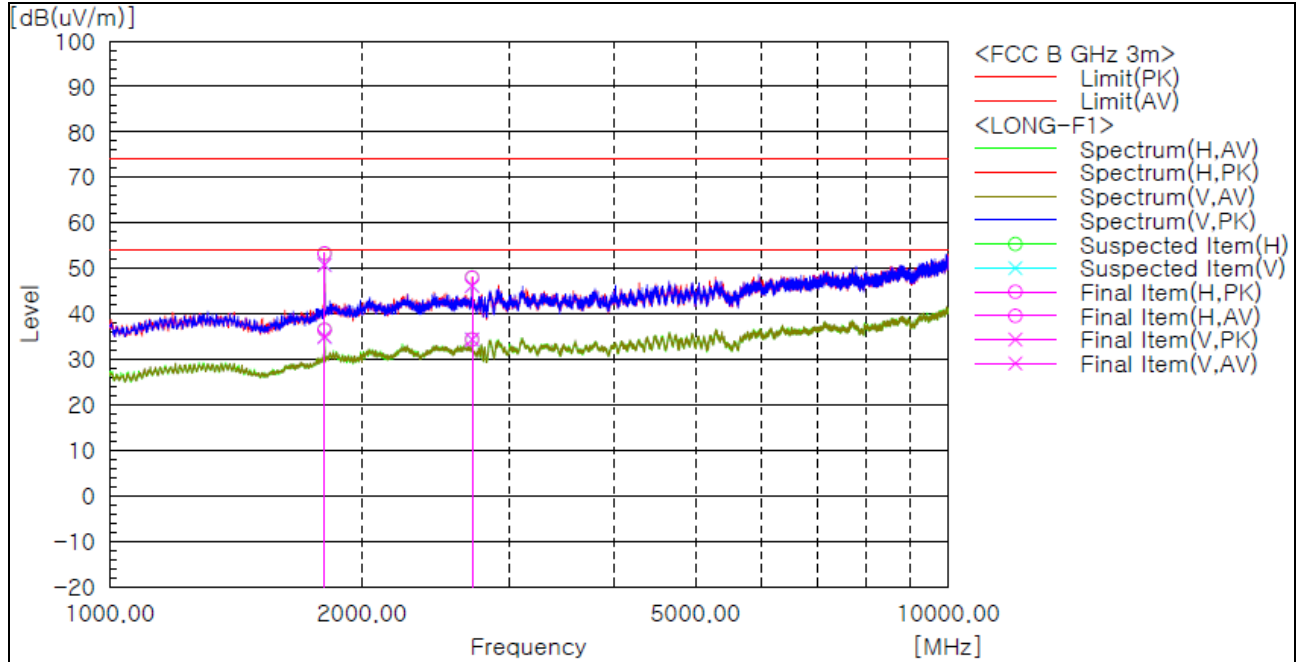
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in in lie-down position (X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain

3) above 1 GHz

The requirements are:

☒ Complies

Test Data



[Antenna1]

Test mode : Lowest frequency(902.75 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
1 805.50	H	62.0	-4.4	57.6	74.0	16.4	Peak
1 805.50	V	57.8	-4.4	53.4	74.0	20.6	Peak
2 707.75	H	49.6	-1.9	47.7	54.0	6.3	Peak
2 707.75	V	47.5	-1.9	45.6	54.0	8.4	Peak

Test mode : Middle frequency(914.75 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
1 829.13	H	60.5	-4.0	56.5	74.0	17.5	Peak
1 829.13	V	56.6	-4.0	52.6	74.0	21.4	Peak
2 743.75	H	48.4	-2.2	46.2	54.0	7.8	Peak
2 743.75	V	45.1	-2.2	42.9	54.0	11.1	Peak

Test mode : Highest frequency(927.25 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
1 853.88	H	59.2	-3.9	55.3	74.0	18.7	Peak
1 853.88	V	55.7	-3.9	51.8	74.0	22.2	Peak
3 709.00	H	46.7	-0.3	46.4	54.0	7.6	Peak
3 709.00	V	46.5	-0.3	46.2	54.0	7.8	Peak

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
 2. Result = Reading + c.f(correction factor)
 3. Correction factor = Antenna factor + Cable loss - Amp Gain
- * Reading data is the peak value.

[Antenna2]

Test mode : Lowest frequency(902.75 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
1 805.50	H	57.7	-4.4	53.3	74.0	20.7	Peak
1 805.50	V	55.2	-4.4	50.8	74.0	23.2	Peak
2 707.75	H	49.9	-1.9	48.0	54.0	6.0	Peak
2 707.75	V	48.1	-1.9	46.2	54.0	7.8	Peak

Test mode : Middle frequency(914.75 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
1 829.13	H	54.4	-4.0	50.4	54.0	3.6	Peak
1 829.13	V	50.1	-4.0	46.1	54.0	7.9	Peak
2 743.75	H	55.5	-2.2	53.3	54.0	0.7	Peak
2 743.75	V	55.1	-2.2	52.9	54.0	1.1	Peak
3 658.38	H	48.1	-0.3	47.8	54.0	6.2	Peak
3 658.38	V	50.7	-0.3	50.4	54.0	3.6	Peak

Test mode : Highest frequency(927.25 MHz)

Frequency [MHz]	Ant. Pol. (V/H)	Reading* [dBuV/m]	c.f [dB/m]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
1 853.88	H	52.7	-3.9	48.8	54.0	5.2	Peak
1 853.88	V	50.3	-3.9	46.4	54.0	7.6	Peak
3 709.00	H	59.2	-0.3	58.9	74.0	15.1	Peak
3 709.00	V	62.0	-0.3	61.7	74.0	12.3	Peak

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
 2. Result = Reading + c.f(correction factor)
 3. Correction factor = Antenna factor + Cable loss - Amp Gain
- * Reading data is the peak value.

Test mode : Receiver

Frequency [MHz]	(P)	Limit AV [dBuV / m]	Limit PK [dBuV / m]	Result AV [dBuV / m]	Result PK [dBuV / m]	Margin AV [dB]	Margin PK [dB]
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The emissions above 1 GHz were 20 dB lower than the limit.

Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position (x axis) and the worst case was recorded.
2. Correction factor = Antenna factor + Cable loss - Amp Gain

4.8 AC Power Line Conducted Emissions

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 kHz-30 MHz, shall not exceed the limits.

Instrument Settings

IF Band Width: 9 kHz

Test Procedures

RSS-Gen - Section 8.8

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average**
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* The level decreases linearly with the logarithm of the frequency.

** A linear average detector is required.

Test Results

The requirements are:

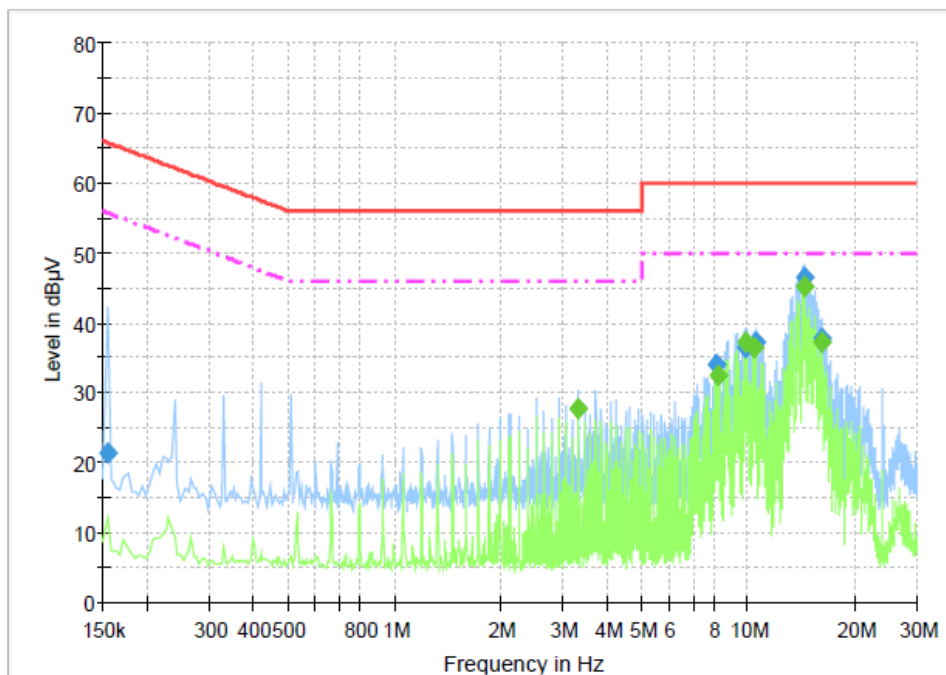
☒ Complies

Test Data

Test mode : Antenna1

[L1]

3CE_Class B_L1



Final Result 1

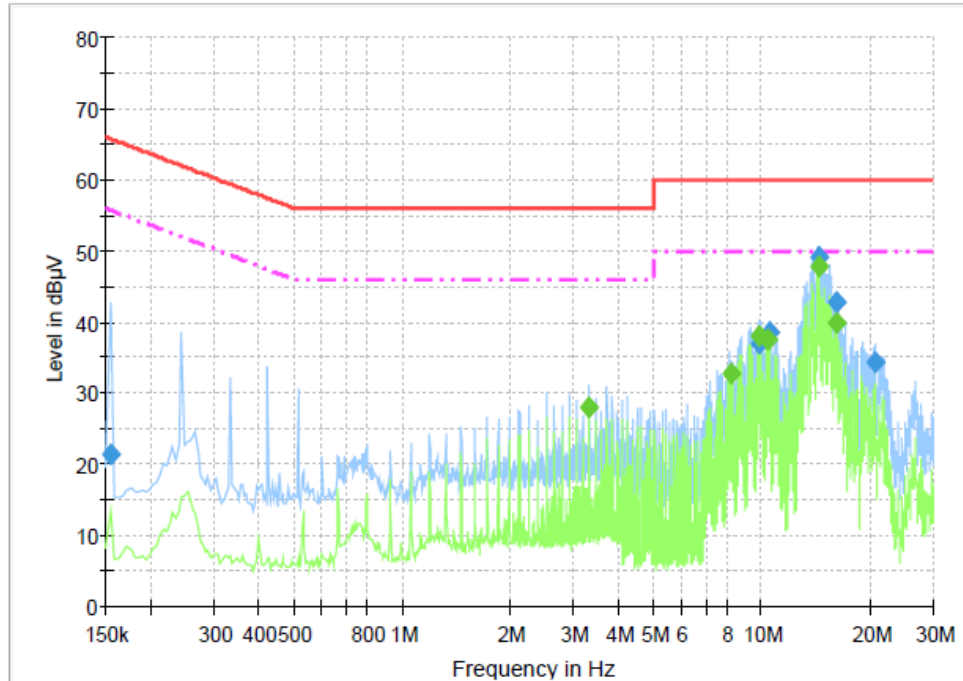
Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	21.4	1000.0	9.000	On	L1	9.8	44.3	65.8
8.160000	34.1	1000.0	9.000	On	L1	9.8	25.9	60.0
9.883500	36.4	1000.0	9.000	On	L1	9.9	23.6	60.0
10.482000	37.2	1000.0	9.000	On	L1	9.9	22.8	60.0
14.361000	46.4	1000.0	9.000	On	L1	9.9	13.6	60.0
16.201500	37.9	1000.0	9.000	On	L1	10.0	22.1	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
3.318000	27.6	1000.0	9.000	On	L1	9.8	18.4	46.0
8.200500	32.4	1000.0	9.000	On	L1	9.8	17.6	50.0
9.879000	37.3	1000.0	9.000	On	L1	9.9	12.7	50.0
10.401000	36.4	1000.0	9.000	On	L1	9.9	13.6	50.0
14.361000	45.2	1000.0	9.000	On	L1	9.9	4.8	50.0
16.120500	37.3	1000.0	9.000	On	L1	10.0	12.7	50.0

[NEUTRAL]

3CE_Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	21.5	1000.0	9.000	On	N	9.8	44.3	65.8
9.883500	37.1	1000.0	9.000	On	N	9.9	22.9	60.0
10.482000	38.6	1000.0	9.000	On	N	9.9	21.4	60.0
14.401500	49.0	1000.0	9.000	On	N	9.9	11.0	60.0
16.120500	42.8	1000.0	9.000	On	N	10.0	17.2	60.0
20.679000	34.4	1000.0	9.000	On	N	10.1	25.6	60.0

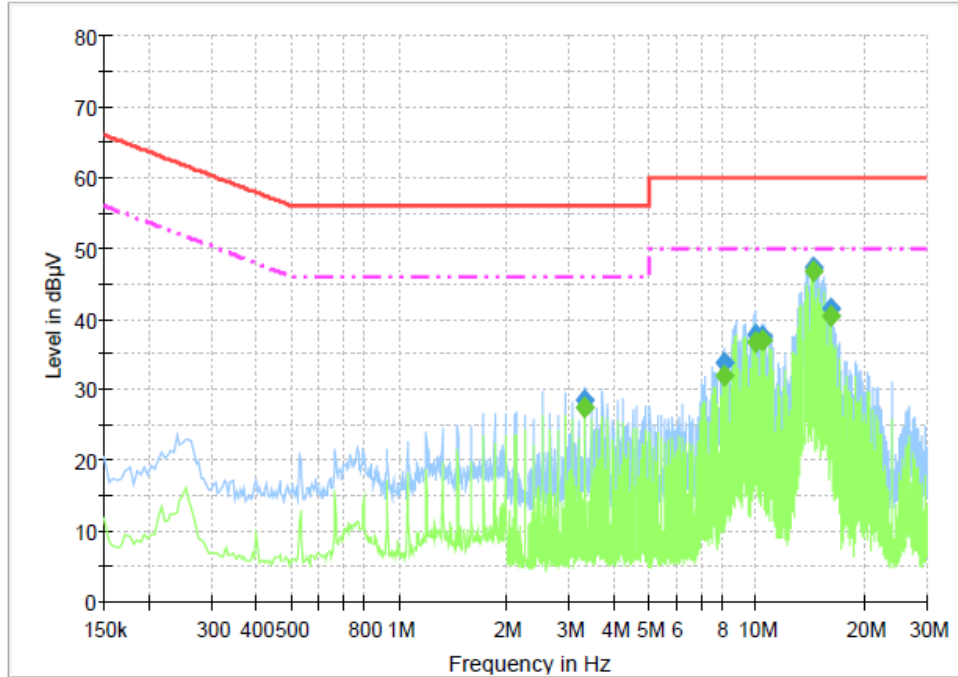
Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
3.318000	27.9	1000.0	9.000	On	N	9.8	18.1	46.0
8.241000	32.7	1000.0	9.000	On	N	9.8	17.3	50.0
9.879000	38.1	1000.0	9.000	On	N	9.9	11.9	50.0
10.441500	37.5	1000.0	9.000	On	N	9.9	12.5	50.0
14.361000	47.7	1000.0	9.000	On	N	9.9	2.3	50.0
16.161000	40.0	1000.0	9.000	On	N	10.0	10.0	50.0

Test mode : Antenna2

[L1]

3CE_Class B_L1



Final Result 1

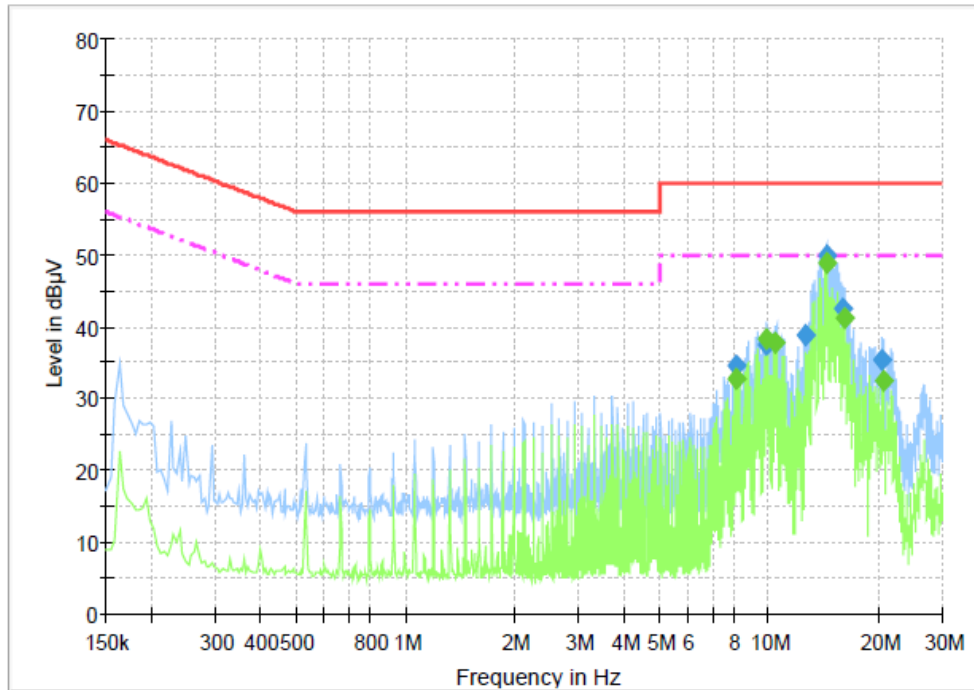
Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
3.318000	28.5	1000.0	9.000	On	L1	9.8	27.5	56.0
8.160000	33.7	1000.0	9.000	On	L1	9.8	26.3	60.0
9.919500	37.7	1000.0	9.000	On	L1	9.9	22.3	60.0
10.441500	37.5	1000.0	9.000	On	L1	9.9	22.5	60.0
14.361000	47.3	1000.0	9.000	On	L1	9.9	12.7	60.0
16.120500	41.4	1000.0	9.000	On	L1	10.0	18.6	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
3.318000	27.4	1000.0	9.000	On	L1	9.8	18.6	46.0
8.160000	32.0	1000.0	9.000	On	L1	9.8	18.0	50.0
9.919500	36.7	1000.0	9.000	On	L1	9.9	13.3	50.0
10.401000	37.0	1000.0	9.000	On	L1	9.9	13.0	50.0
14.361000	46.7	1000.0	9.000	On	L1	9.9	3.3	50.0
16.161000	40.4	1000.0	9.000	On	L1	10.0	9.6	50.0

[NEUTRAL]

3CE_Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
8.160000	34.7	1000.0	9.000	On	N	9.8	25.4	60.0
9.883500	37.4	1000.0	9.000	On	N	9.9	22.6	60.0
12.678000	38.8	1000.0	9.000	On	N	9.9	21.2	60.0
14.401500	50.0	1000.0	9.000	On	N	9.9	10.0	60.0
15.958500	42.6	1000.0	9.000	On	N	10.0	17.4	60.0
20.562000	35.3	1000.0	9.000	On	N	10.1	24.7	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
8.160000	32.8	1000.0	9.000	On	N	9.8	17.2	50.0
9.879000	38.4	1000.0	9.000	On	N	9.9	11.6	50.0
10.401000	37.8	1000.0	9.000	On	N	9.9	12.2	50.0
14.361000	48.7	1000.0	9.000	On	N	9.9	1.3	50.0
16.120500	41.2	1000.0	9.000	On	N	10.0	8.8	50.0
20.598000	32.4	1000.0	9.000	On	N	10.1	17.6	50.0

4.9 Frequency Hopping System Requirements

Requirements

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

Frequency Hopping System

This transmitter device is frequency hopping device, and complies with FCC part 15.247 rule.

This device uses RFID radio which operates in 902-928 MHz band. It uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it on up to 50 bands (0.5 MHz each; centered from 902.75 to 927.25 MHz) in the range 902-928 MHz.

EUT Pseudo random Frequency Hopping Sequence

Pseudo random Frequency Hopping Sequence Table as below:
Channel:

27,26,2,49,48,4,50,36,34,14,33,31,6,5,46,39,25,9,23,40,18,19,3,13,7,20,8,30,24,10,32,
28,16,17,11,45,15,35,29,22,43,12,47,21,44,38,37,41,1,42

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

APPENDIX A – Test Equipment Used For Tests

	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	Spectrum Analyzer	Rohde & Schwarz	FSP	100401	2020-01-17	2021-01-17
2	Signal Generator	Rohde & Schwarz	SMB100A	175528	2020-04-28	2021-04-28
3	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2019-10-22	2020-10-22
4	Bilog Antenna	Schaffner	CBL6111C	2551	2020-05-26	2022-05-26
5	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2020-04-16	2022-04-16
6	6dB Attenuator	R&S	DNF	272.4110.50-2	2019-10-25	2020-10-25
7	6dB Attenuator	BIRD	5W 6dB	1744	2020-01-03	2021-01-03
8	AMPLIFIER	SONOMA	310	291721	2020-01-22	2021-01-22
9	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2020-01-17	2021-01-17
10	Preamplifier	Agilent	8449B	3008A01504	2019-12-17	2020-12-17
11	Double Ridged Guide Antenna	ETS-Lindgren	3117	00154525	2019-02-22	2021-02-22
12	LISN	Rohde & Schwarz	ENV216	101235	2020-01-17	2021-01-17
13	Band Reject Filter	Wainwright Instruments GmbH	WRCG902/930-894/938-50/12SS	SN1	2020-04-03	2021-04-03
14	RF Coaxial Attenuator	BIRD	300-WA-FFN-30	0205340	2020-04-03	2021-04-03
15	Dual-Tracking DC Power Supply	Topward Electric Instruments	6303D	711196	2020-01-16	2021-01-16

	Cable	Manufacturer	Model No.	Serial No.	Check Date
1	RF Cable	Canare Corporation	L-5D2W	N/A	2020-04-06
2	RF Cable	Junkosha Inc.	MWX221	1512S149	2020-09-14
3	RF Cable	HUBER+SUHNER	SUCOFLEX 102	MY073/2	2020-05-07
4	RF Cable	HUBER+SUHNER	SUCOFLEX 102	MY4728/2	2020-05-07
5	RF Cable	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2020-05-07
6	RF Cable	HUBER+SUHNER	SUCOFLEX 104	N/A	2020-05-07
7	RF Cable	HUBER+SUHNER	SUCOFLEX 104	MY27573/4	2020-05-07
8	RF Cable	HUBER+SUHNER	SUCOFLEX 106	N/A	2020-05-07