TEST REPORT

Dt&C

DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1812-0281(1)

2. Customer

   • Name : Star Systems International Limited

   • Address (FCC) : Unit04, 12/F Vanta Industrial Centre 21-33 Tai Lin Pai Road, Kwai Chung, New Territories, Hong Kong

   • Address (IC) : Unit 04, 12/F Vanta Industrial Centre, 21-33 Tai Lin Pai Road Kwai Chung IP 999077 Hongkong

3. Use of Report : FCC & IC Original Grant

4. Product Name / Model Name : CARINA / HRD0800F
   FCC ID : 2AA7K-CARINA0800F / IC : 20068-CARINA0800F

5. Test Method Used : ANSI C63.10-2013, RSS-GEN Issue 5 (2018-04)
   Test Specification : FCC Part 15 Subpart C 247,
   RSS-247 Issue 2 (2017-02), RSS-GEN Issue 5 (2018-04)

6. Date of Test : 2018.12.10 ~ 2018.12.21

7. Testing Environment : See appended test report

8. Test Result : Refer to the attached Test Result

Affirmation	Tested by Name : JaeHyeok Bang (Signature)	Technical Manager Name : Geunki Son (Signature)

2018 . 12 . 31 .

DT&C Co., Ltd.

Test Report Version

Test Report No.	Date	Description
DRTFCC1812-0281	Dec. 21, 2018	Initial issue
DRTFCC1812-0281	Dec. 31, 2018	Updated the page 1, 10, 34

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1.General Information

1.1 Testing Laboratory

DT&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014. **- FCC MRA Accredited Test Firm No. : KR0034** **- IC Test site No. : 5740A-4**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
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1.2 Details of Applicant

Applicant	:	Star Systems International Limited
Address (FCC)	:	Unit04, 12/F Vanta Industrial Centre 21-33 Tai Lin Pai Road, Kwai Chung, New Territories, Hong Kong
Address (IC)	:	Unit 04, 12/F Vanta Industrial Centre, 21-33 Tai Lin Pai Road Kwai Chung IP 999077 Hongkong
Contact person(FCC)	:	Robert W. Karr
Contact person(IC)	:	Stephen Lockhart

1.3 Description of EUT

Product	CARINA
Model Name	HRD0800F
Serial Number	Identical prototype
Hardware version	0.3
Software version	V18091800
Power Supply	DC 12 V
Frequency Range	902.75 ~ 927.25 MHz
Modulation Technique	ASK
Number of Channels	50(Channel Spacing 500kHz)
Antenna Type	Internal Antenna
Antenna Gain	Max. PK: 6.12 dBi

1.4 Declaration by the manufacturer

- N/A

1.5 Test conditions

Ambient Condition	
▪ Temperature	+22 ℃ ~ +24 ℃
▪ Relative Humidity	43 % ~ 45 %

1.6 Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/07/09	19/07/09	MY46471251
Spectrum Analyzer	Agilent Technologies	N9020A	18/07/09	19/07/09	MY53310140
PXA Signal Analyzer	Agilent Technologies	N9030A	18/07/09	19/07/09	MY53310140
DC Power Supply	Agilent	66332A	18/07/02	19/07/02	MY43001172
Multimeter	FLUKE	17B+	17/12/26	18/12/26	36390701WS
Signal Generator	R&S	SMBV100A	17/12/27	18/12/27	255571
Signal Generator	Rohde Schwarz	SMF100A	18/06/07	19/06/07	102341
Attenuator(10dB)	Aeroflex/Weinschel	23-10-34	18/07/04	19/07/04	BP4386
Thermohygrometer	BODYCOM	BJ5478	18/01/03	19/01/03	120612-1
Thermohygrometer	BODYCOM	BJ5478	18/01/03	19/01/03	120612-2
HYGROMETER	TESTO	608-H1	18/02/10	19/02/10	34862883
Band Pass Filter	Wainwright Instruments	WRCT800/960.0-2/40-8SSK	18/07/05	19/07/05	32
Highpass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	18/07/05	19/07/05	7
Network Analyzer	Agilent Technologies	E5071C	18/07/04	19/07/04	MY46106970
Loop Antenna	Schwarzbeck	FMZB1513	18/01/30	20/01/30	1513-128
Bilog Antenna	Schwarzbeck	VULB 9160	18/07/13	20/07/13	3359
HORN ANT	ETS	3117	18/05/10	20/05/10	00140394
PreAmplifier	Agilent Technologies	8449B	18/07/05	19/07/05	3008A02108
PreAmplifier	H.P	8447D	17/12/26	18/12/26	2944A07774
EMI Test Receiver	Rohde Schwarz	ESCI7	18/02/12	19/02/12	100910
EMI Test Receiver	Rohde Schwarz	ESR7	18/02/13	19/02/13	101061
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	18/09/27	19/09/27	101333
LISN	SCHWARZBECK	NNLK 8121	18/03/20	19/03/20	06183
LISN	KYORITSU	KNW-407	17/12/26	18/12/26	8-317-8
Cable	Radiall	TESTPRO3	18/07/06	19/07/06	M-01
Cable	HUBER+SUHNER	SUCOFLEX 104	18/07/06	19/07/06	M-03
Cable	Junkosha	MWX315	18/11/19	19/11/19	M-05
Cable	Junkosha	MWX221	18/11/19	19/11/19	M-06
Cable	Junkosha	MWX221	18/11/19	19/11/19	M-07
Cable	DT&C	CABLE	18/07/05	19/07/05	RF-82

Note 1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017
Note 2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

1.7 Summary of Test Results

FCC Part RSS Std.	Parameter	Limit (Using in 2400~ 2483.5 MHz)	Test Condition	Status Note 1
15.247(a) RSS-247(5.1)	Carrier Frequency Separation	>= 25 kHz or >= Two thirds of the 20 dB BW, whichever is greater.	Conducted	C
	Number of Hopping Frequencies	>= 25 hops		C
	20 dB Bandwidth	< 500 kHz		C
	Dwell Time	=< 0.4 seconds		C
15.247(b) RSS-247(5.4)	Transmitter Output Power	**For FCC** =< 1 Watt , if CHs >= 50 =< 0.25 W, if CHs >= 25, < 50 **For IC** if CHs >= 50 =< 1 Watt For Conducted Power =< 4 Watt For e.i.r.p, if CHs >= 25, < 50 =< 0.25 W For Conducted Power. =< 1 Watt For e.i.r.p		C
15.247(d) RSS-247(5.5)	Conducted Spurious Emissions	The radiated emission to any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density.		C
RSS Gen(6.6)	Occupied Bandwidth (99 %)	N/A		C
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	Radiated Spurious Emissions	FCC 15.209 Limits RSS-Gen 8.9	Radiated	C Note3
15.207 RSS-Gen(8.8)	AC Conducted Emissions	FCC 15.207 Limits	AC Line Conducted	C
15.203 RSS-Gen(8.3)	Antenna Requirements	FCC 15.203	-	C

Note 1: **C** = Comply **NC** = Not Comply **NT** = Not Tested **NA** = Not Applicable

Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.

Note 3 : This test item was performed in each axis and the worst case data was reported.

1.8 Conclusion of worst-case and operation mode

The field strength of spurious emission was measured in three orthogonal EUT positions(X-axis, Y-axis and Z-axis).

Tested frequency information,

- Hopping Function: Enable

	TX Frequency (MHz)	RX Frequency (MHz)
Hopping Band	902.75 ~ 927.25 MHz	902.75 ~ 927.25 MHz

- Hopping Function: Disable

Channel	TX Frequency (MHz)	RX Frequency (MHz)
Lowest Channel	902.75	902.75
Middle Channel	915.25	915.25
Highest Channel	927.25	927.25

2. Test Methodology

Generally the tests were performed according to the ANSI C63.10-2013.

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The EUT was operated in the test mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

2.3 General Test Procedures

Conducted Emissions

The power-line conducted emission tests were performed with ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

The radiated tests were performed with ANSI C63.10-2013.

The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axes.

3. Maximum Peak Output Power Measurement

3.1 Test Setup

Refer to the APPENDIX I.

3.2 Limit

▣ FCC Requirements

The maximum peak output power of the intentional radiator shall not exceed the following :

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

▣ IC Requirements

1. RSS-247(5.4)(1), For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

3.3 Test Procedure

1. The RF output power was measured with a spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ;
   Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 20 dB BW
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold

3.4 Test Results

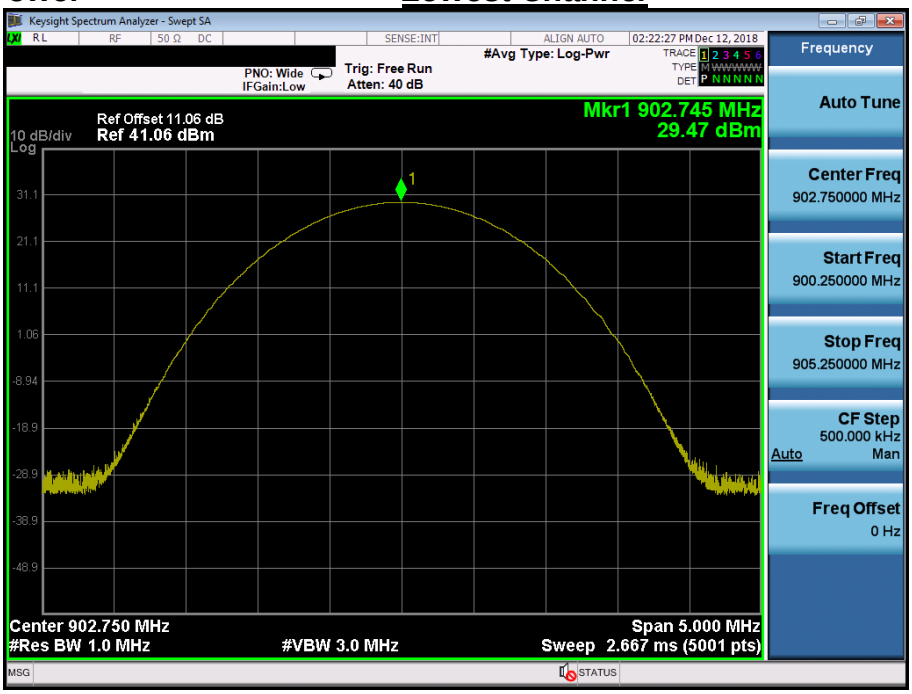
Tested Channel	Frame Average Output Power		Peak Output Power		Limit (Peak Output Power)
	dBm	mW	dBm	mW	mW
Lowest	22.27	168.66	29.47	885.12	**972.75**[Note1]
Middle	22.64	183.65	29.59	909.91	
Highest	**22.70**	1**86.21**	**29.64**	**920.45**	

Note 1: The directional gain(6.12dBi) of antenna is greater than 6dBi. Thus, Peak output power limit was reduced by the amount in 0.12dB.

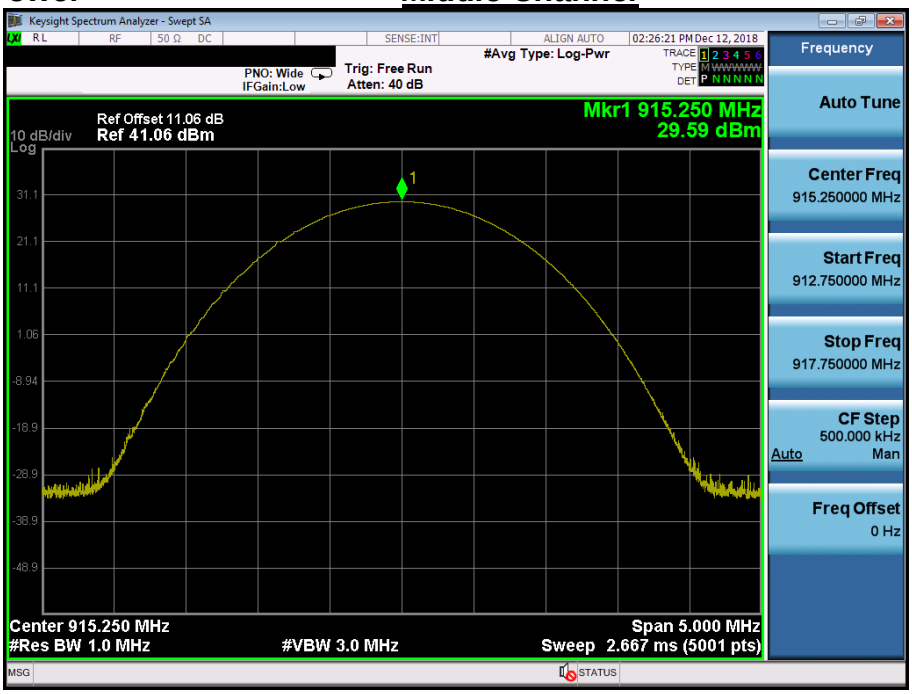
Note 2: The frmae average output power was tested using an average power meter for reference only.

Note 3: See next pages for actual measured spectrum plots.

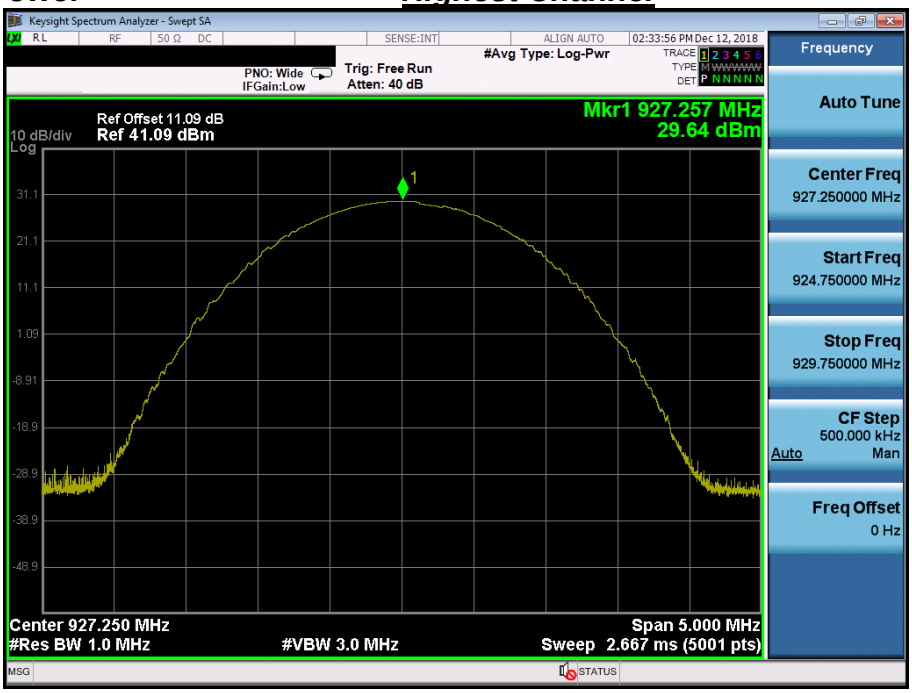
Peak Output Power *Lowest Channel*



Peak Output Power *Middle Channel*



Peak Output Power ***Highest Channel***



4. 20dBc BW & Occupied BW

4.1 Test Setup

Refer to the APPENDIX I.

4.2 Limit

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

4.3 Test Procedure

1. The 20 dB bandwidth were measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting:
   RBW = 1% to 5% of the 20 dB BW & Occupied BW
   VBW ≥ 3 × RBW
   Span = between two times and five times the 20 dB bandwidth & Occupied BW
   Sweep = auto
   Detector function = peak
   Trace = max hold

4.4 Test Results

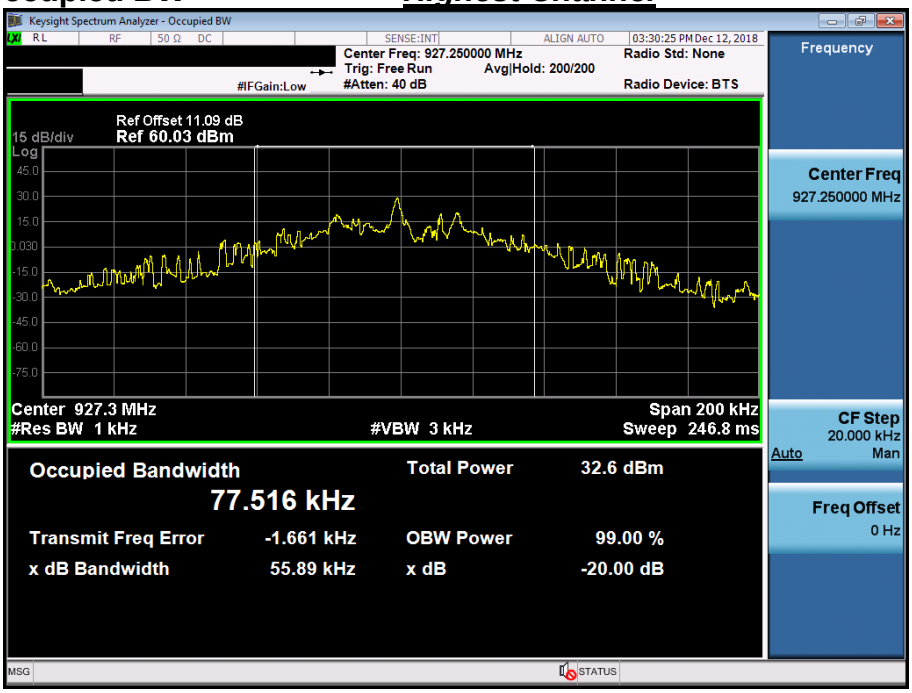
Frequency (MHz)	Tested Channel	20dBc BW(kHz)	Occupied BW (kHz)
902.75	**Lowest**	43.92	54.54
915.25	**Middle**	43.73	53.46
927.25	**Highest**	55.89	77.52

Note 1: See next pages for actual measured spectrum plots.

20 dB BW & Occupied BW *Lowest Channel*

20 dB BW & Occupied BW *Middle Channel*

20 dB BW & Occupied BW ***Highest Channel***



5. Carrier Frequency Separation

5.1 Test Setup

Refer to the APPENDIX I.

5.2 Limit

Limit : ≥ 25 kHz or ≥ Two-Thirds of the 20 dB BW whichever is greater.

5.3 Procedure

The carrier frequency separation was measured with a spectrum analyzer connected to the antenna terminal, while EUT had 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.

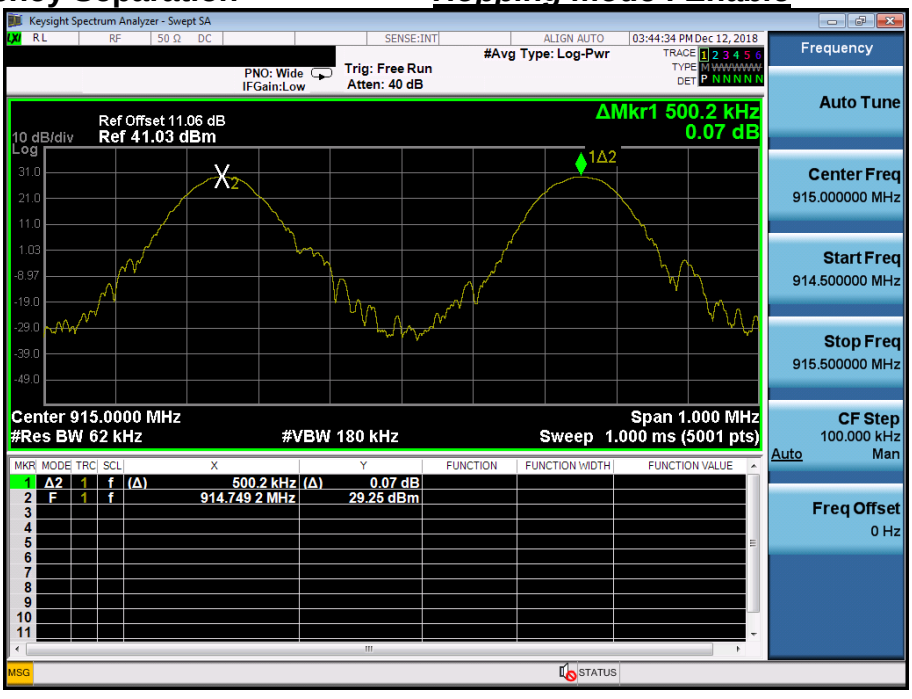
The spectrum analyzer is set to :

Span = wide enough to capture the peaks of two adjacent channels
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.
VBW ≥ RBW Sweep = auto
Detector function = peak Trace = max hold

5.4 Test Results

Hopping Mode	Peak of center channel (MHz)	Peak of adjacent Channel (MHz)	Test Result (kHz)
Enable	914.749	915.249	500.2

Carrier Frequency Separation ***Hopping mode : Enable***



6. Number of Hopping Frequencies

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

Limit: >= 50 hops

6.3 Procedure

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

To get higher resolution, two frequency ranges for FH mode within the 902 ~ 928 MHz were examined.

The spectrum analyzer is set to :

Span for FH mode = 40 MHz Start Frequency = 895.25 MHz, Stop Frequency = 935.25 MHz

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.

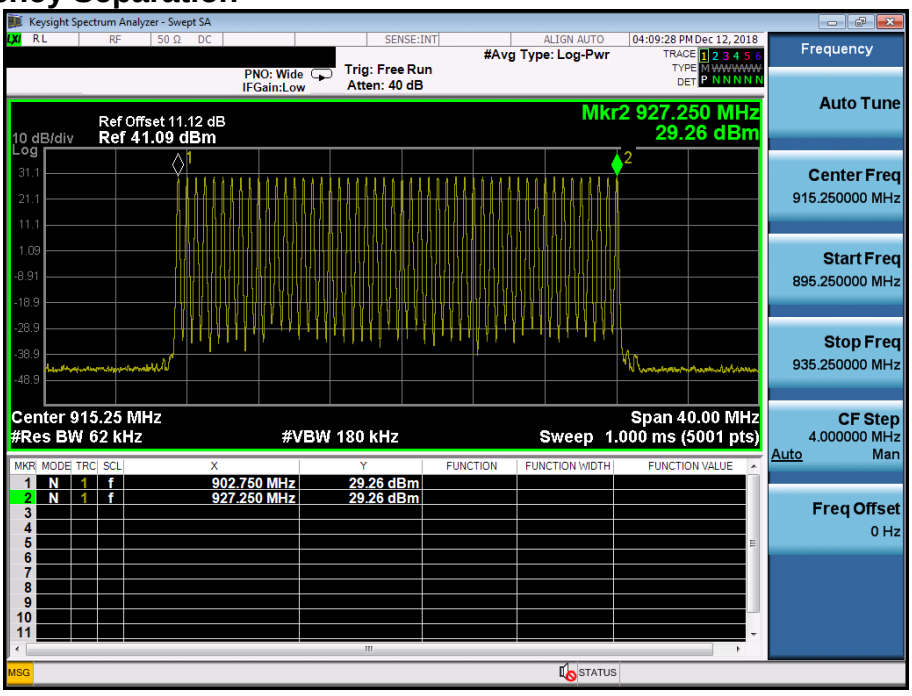
VBW ≥ RBW Sweep = auto

Detector function = peak Trace = max hold

6.4 Test Results

Hopping mode	Test Result (Total Hops)
Enable	50

Carrier Frequency Separation ***Hopping mode : Enable***



7. Time of Occupancy (Dwell Time)

7.1 Test Setup

Refer to the APPENDIX I.

7.2 Limit

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

7.3 Test Procedure

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

The spectrum analyzer is set to :

Center frequency = 915.25 MHz Span = zero

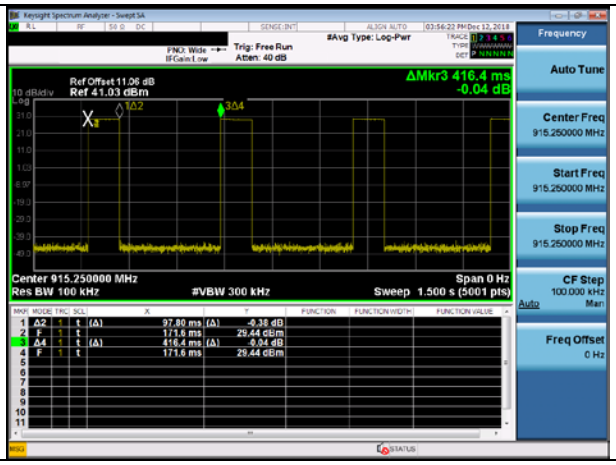
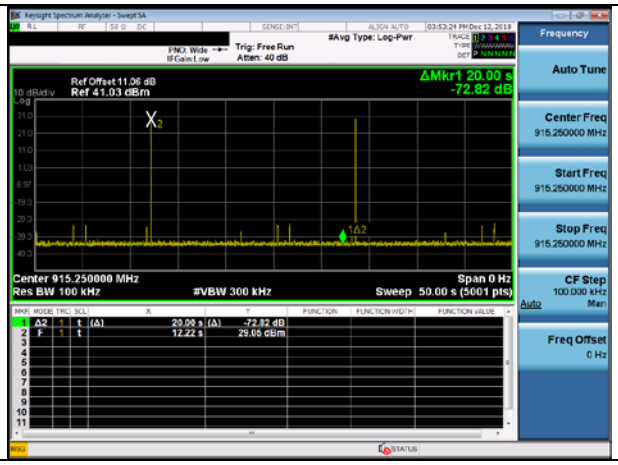
RBW = 100 kHz (RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel)

VBW ≥ RBW Detector function = peak

Trace = max hold

7.4 Test Results

Channel Frequency (MHz)	Length (ms)	Number	Dwell Time (ms)
915.25	97.8	1	97.8

Length	Period
	

8. Transmitter Radiated Spurious Emissions and Conducted Spurious Emission

8.1 Test Setup

Refer to the APPENDIX I.

8.2 Limit

According to §15.247(d), in any 100 kHz 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 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 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 dB instead of 20 dB. 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 § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	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 - 72 MHz, 76 - 88 MHz, 174 - 216 MHz or 470 - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

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

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2655 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		
			3600 ~ 4400		

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

8.3 Test Procedures

8.3.1 Test Procedures for Radiated Spurious Emissions

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
   The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
3. For measurements above 1GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
4. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
5. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
6. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
7. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.

NOTE 2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.

NOTE 3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10Hz for Average detection (AV) at frequency above 1 GHz.

8.3.2 Test Procedures for Conducted Spurious Emissions

1. The transmitter output was connected to the spectrum analyzer.
2. The **reference level** of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
3. The conducted spurious emission was tested each ranges were set as below.

Frequency range : 9 kHz ~ 30 MHz
RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

Frequency range : 30 MHz ~ 10 GHz
RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

8.4 Test Results

8.4.1 Radiated Emission

Note 1: Attached plot of worst data, refer to the APPENDIX II.

9kHz ~ 10GHz Data

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
103.102	H	Z	QP	44.00	-9.60	N/A	34.40	43.50	9.10
136.700	H	Z	QP	41.40	-6.50	N/A	34.90	43.50	8.60
138.640	H	Z	QP	48.30	-6.30	N/A	42.00	43.50	1.50
929.178	V	Z	QP	34.60	7.60	N/A	42.20	46.00	3.80
933.058	H	Z	QP	32.50	7.70	N/A	40.20	46.00	5.80
933.058	H	Z	QP	32.70	7.70	N/A	40.40	46.00	5.60
1805.368	H	Z	PK	51.87	-0.35	N/A	51.52	74.00	22.48
1805.522	H	Z	AV	46.90	-0.35	N/A	46.55	54.00	7.45
2708.200	H	Z	PK	48.30	2.19	N/A	50.49	74.00	23.51
2708.250	H	Z	AV	39.52	2.19	N/A	41.71	54.00	12.29
3611.148	V	Y	PK	55.52	2.71	N/A	58.23	74.00	15.77
3610.969	V	Y	AV	48.16	2.71	N/A	50.87	54.00	3.13
4513.836	H	Z	PK	45.72	4.62	N/A	50.34	74.00	23.66
4513.769	H	Z	AV	36.75	4.62	N/A	41.37	54.00	12.63

Note.

1. No other spurious and harmonic emissions were reported greater than listed emissions above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCF = Duty Cycle Correction Factor

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
135.730	H	Z	QP	41.40	-6.50	N/A	34.90	43.50	8.60
138.640	H	Z	QP	42.50	-6.30	N/A	36.20	43.50	7.30
140.580	H	Z	QP	41.00	-6.40	N/A	34.60	43.50	8.90
898.139	V	Z	QP	34.50	6.70	N/A	41.20	46.00	4.80
901.049	H	Z	QP	34.50	6.70	N/A	41.20	46.00	4.80
928.208	H	Z	QP	34.00	7.60	N/A	41.60	46.00	4.40
929.178	V	Z	QP	34.00	7.60	N/A	41.60	46.00	4.40
930.148	V	Z	QP	33.60	7.70	N/A	41.30	46.00	4.70
1830.690	H	Z	PK	50.44	-0.14	N/A	50.30	74.00	23.70
1830.507	H	Z	AV	44.82	-0.14	N/A	44.68	54.00	9.32
2745.835	H	Z	PK	47.63	2.20	N/A	49.83	74.00	24.17
2745.765	H	Z	AV	39.37	2.20	N/A	41.57	54.00	12.43
3660.900	V	Y	PK	54.56	2.69	N/A	57.25	74.00	16.75
3660.980	V	Y	AV	49.16	2.69	N/A	51.85	54.00	2.15
4576.219	H	Z	PK	47.92	4.89	N/A	52.81	74.00	21.19
4576.273	H	Z	AV	38.46	4.89	N/A	43.35	54.00	10.65

Note.

1. No other spurious and harmonic emissions were reported greater than listed emissions above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCF = Duty Cycle Correction Factor

▪ Highest Channel

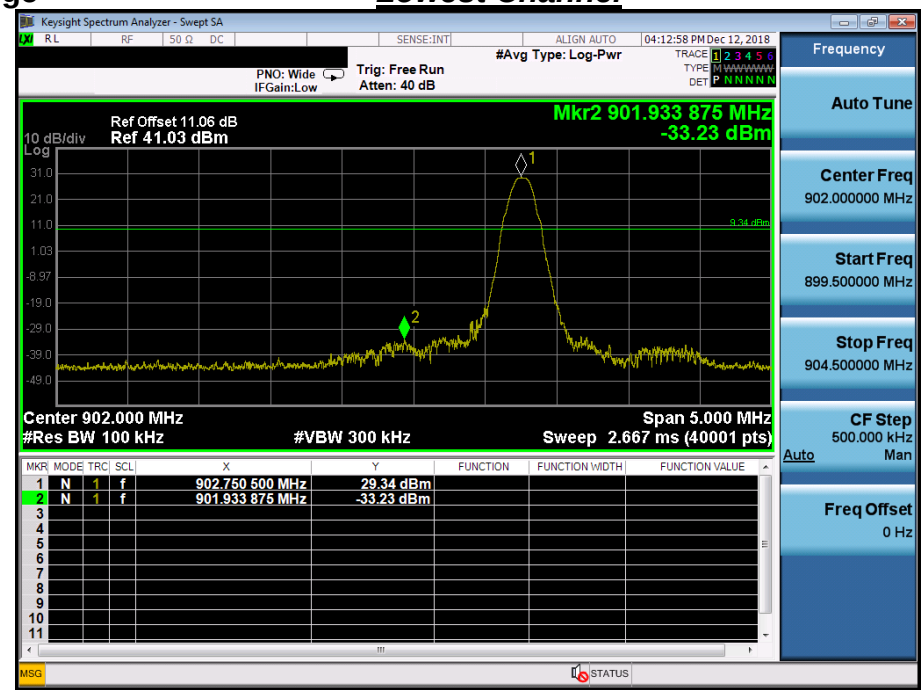
Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
105.042	H	Z	QP	43.10	-9.30	N/A	33.80	43.50	9.70
138.640	H	Z	QP	41.30	-6.30	N/A	35.00	43.50	8.50
138.640	V	Z	QP	39.90	-6.30	N/A	33.60	43.50	9.90
898.139	V	Z	QP	34.80	6.70	N/A	41.50	46.00	4.50
901.000	H	Z	QP	36.00	6.70	N/A	42.70	46.00	3.30
901.049	V	Z	QP	37.60	6.70	N/A	44.30	46.00	1.70
1854.475	H	Z	PK	50.61	0.04	N/A	50.65	74.00	23.35
1854.503	H	Z	AV	44.56	0.40	N/A	44.96	54.00	9.04
2781.527	H	Z	PK	48.14	2.09	N/A	50.23	74.00	23.77
2781.753	H	Z	AV	39.14	2.09	N/A	41.23	54.00	12.77
3708.957	V	Y	PK	54.39	2.76	N/A	57.15	74.00	16.85
3709.009	V	Y	AV	49.86	2.76	N/A	52.62	54.00	1.38
4636.144	H	Z	PK	47.21	4.90	N/A	52.11	74.00	21.89
4636.275	H	Z	AV	38.65	4.90	N/A	43.55	54.00	10.45

Note.

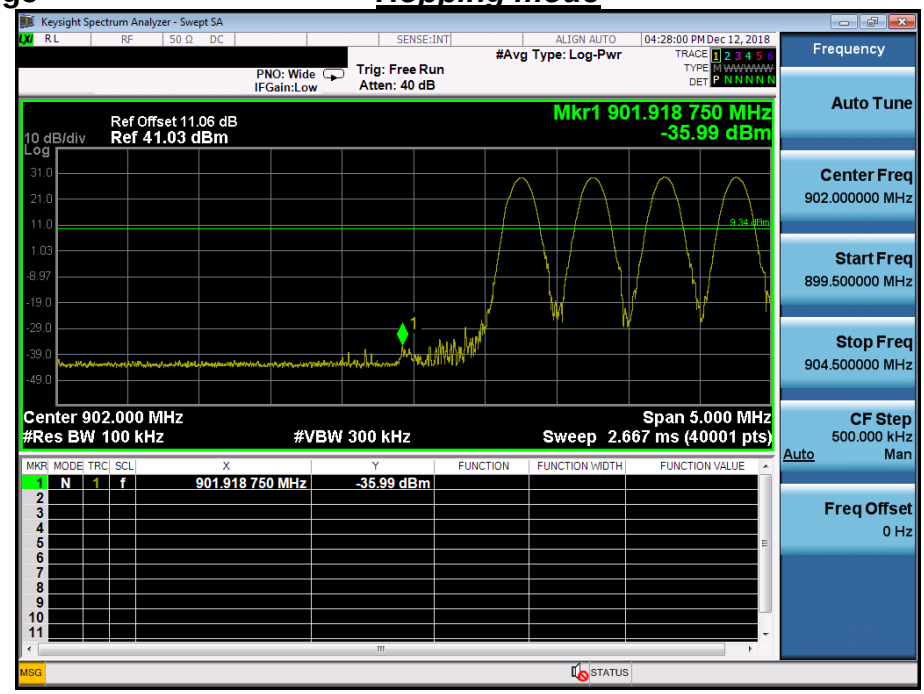
1. No other spurious and harmonic emissions were reported greater than listed emissions above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,
   DCF = Duty Cycle Correction Factor

8.4.2 Conducted Spurious Emissions

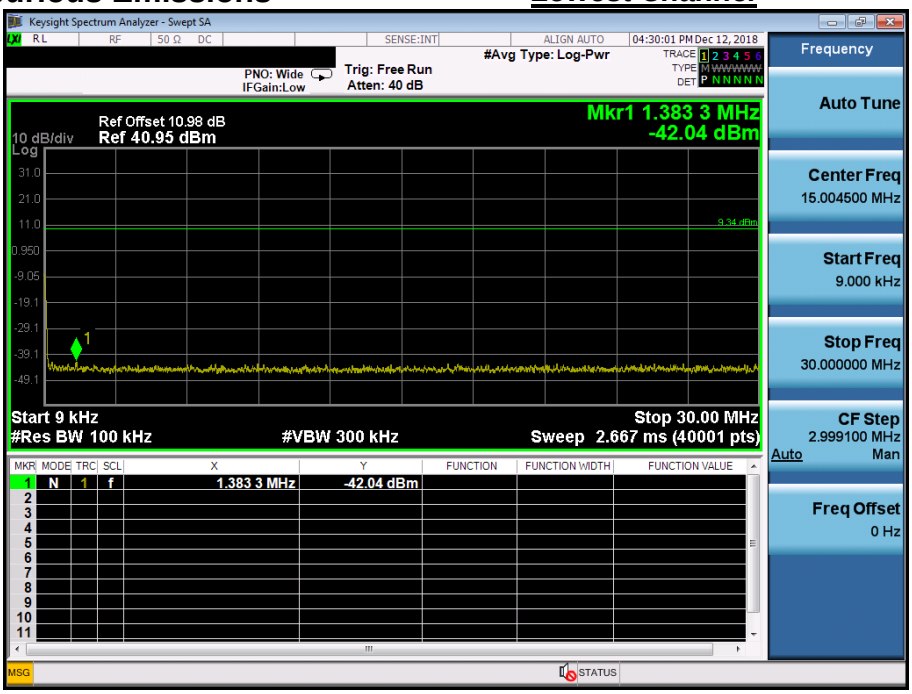
Low Band-edge *Lowest Channel*

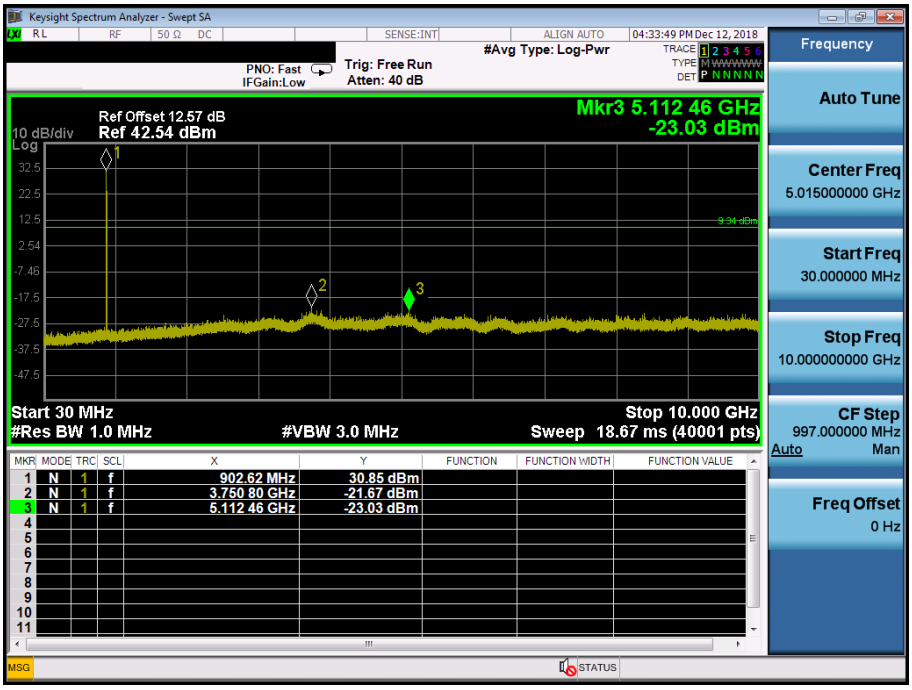


Low Band-edge *Hopping mode*



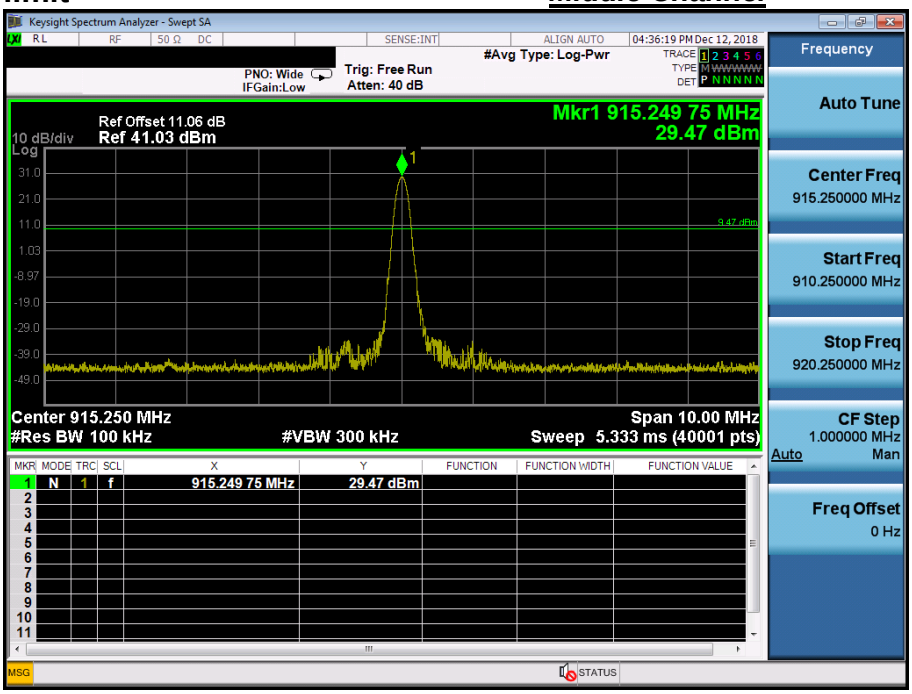
Conducted Spurious Emissions ***Lowest Channel***



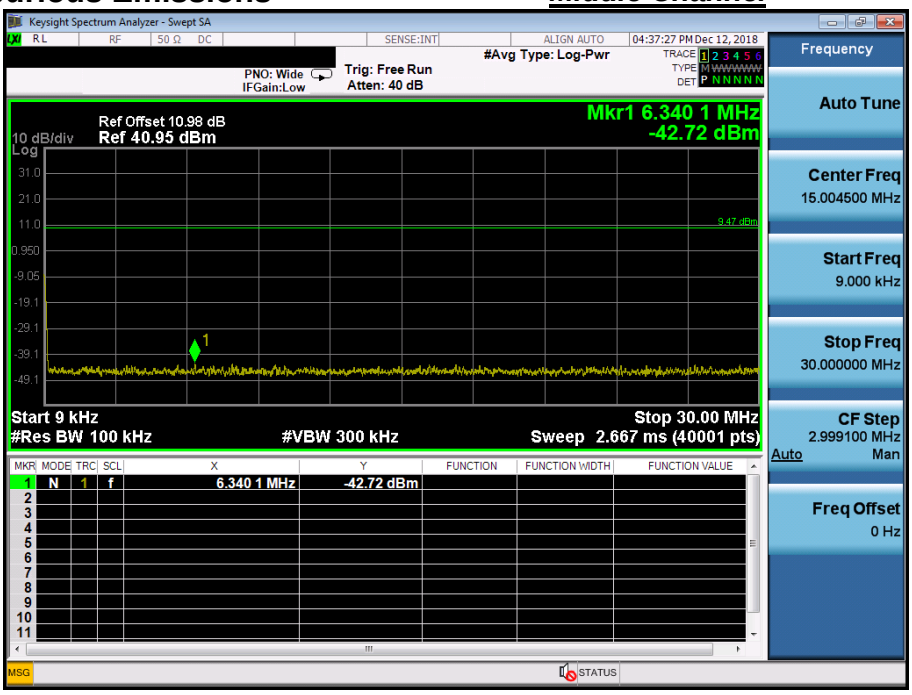


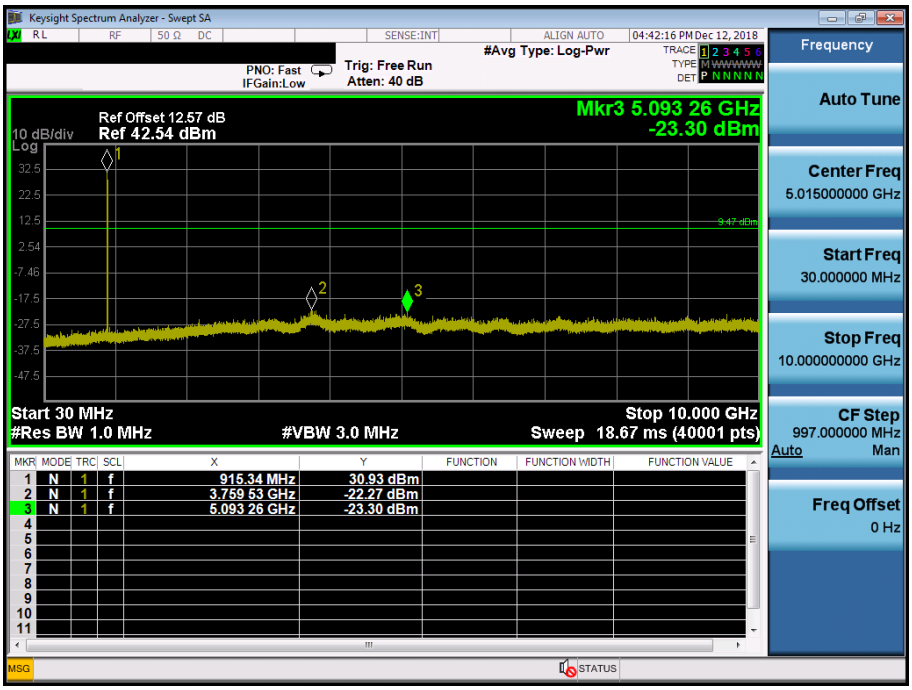
Reference for limit

Middle Channel

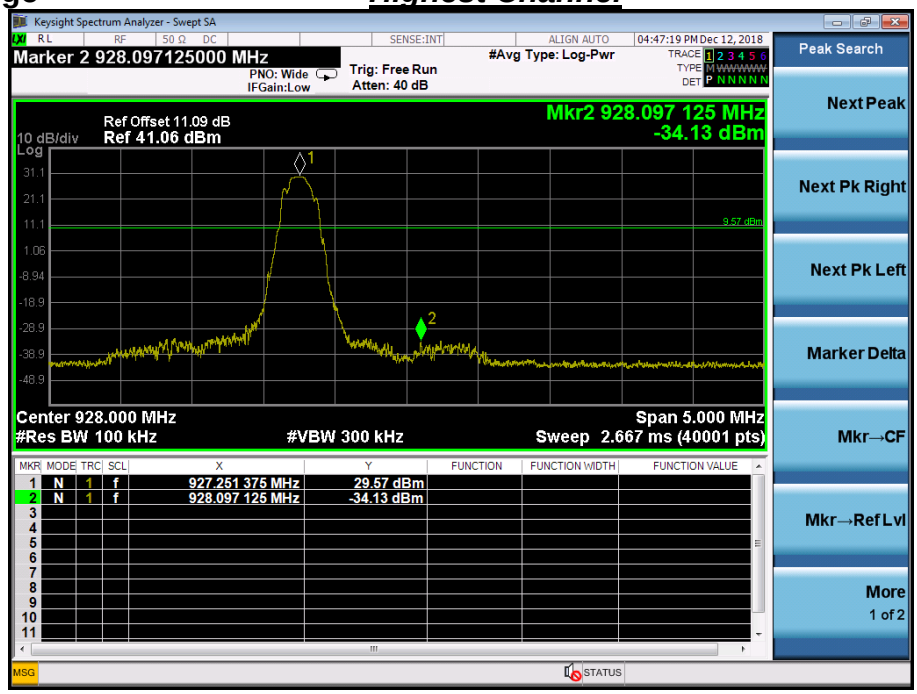


Conducted Spurious Emissions ***Middle Channel***

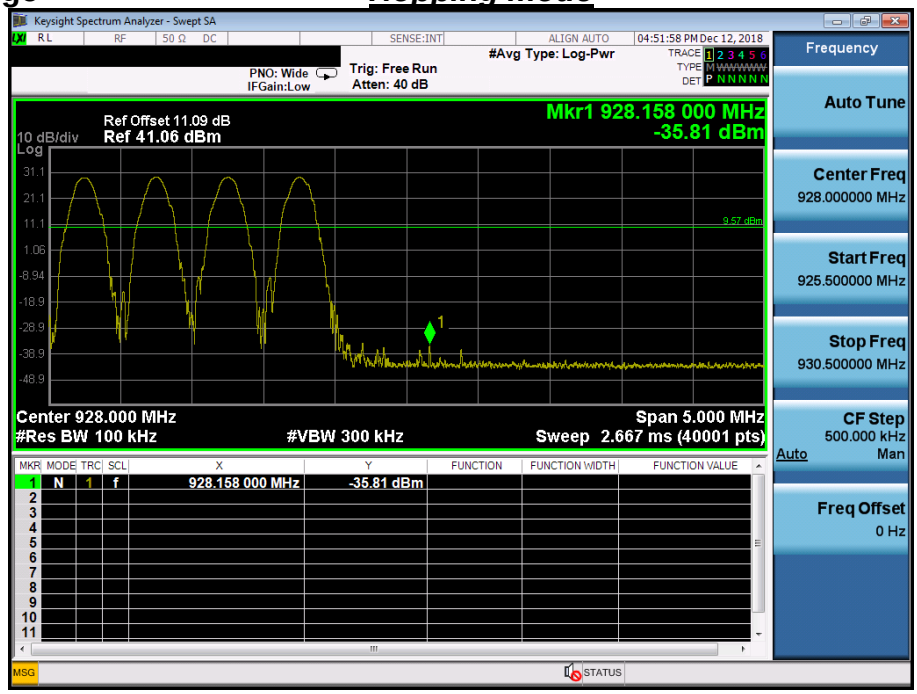




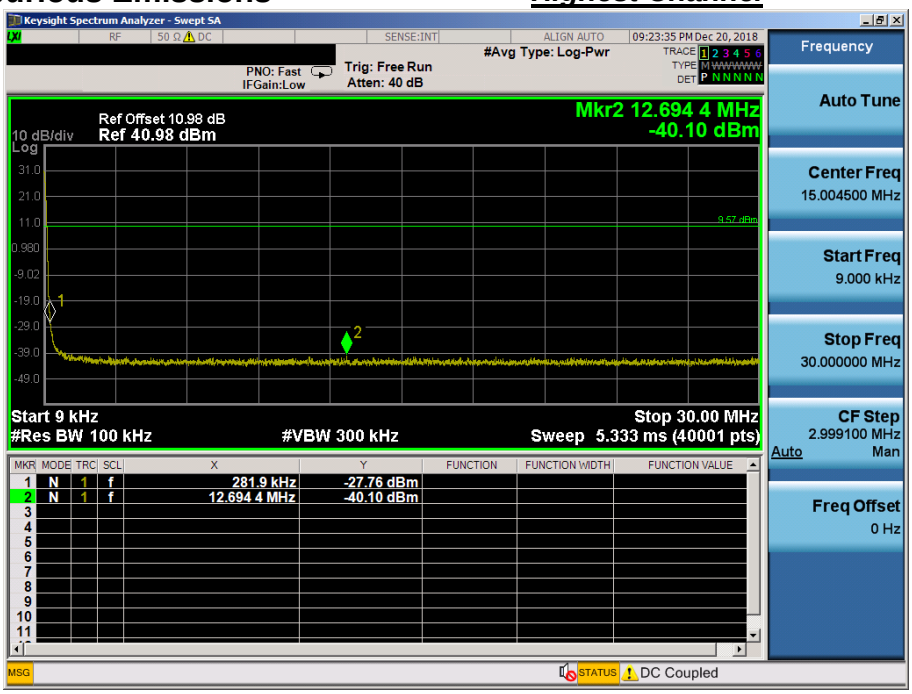
High Band-edge *Highest Channel*

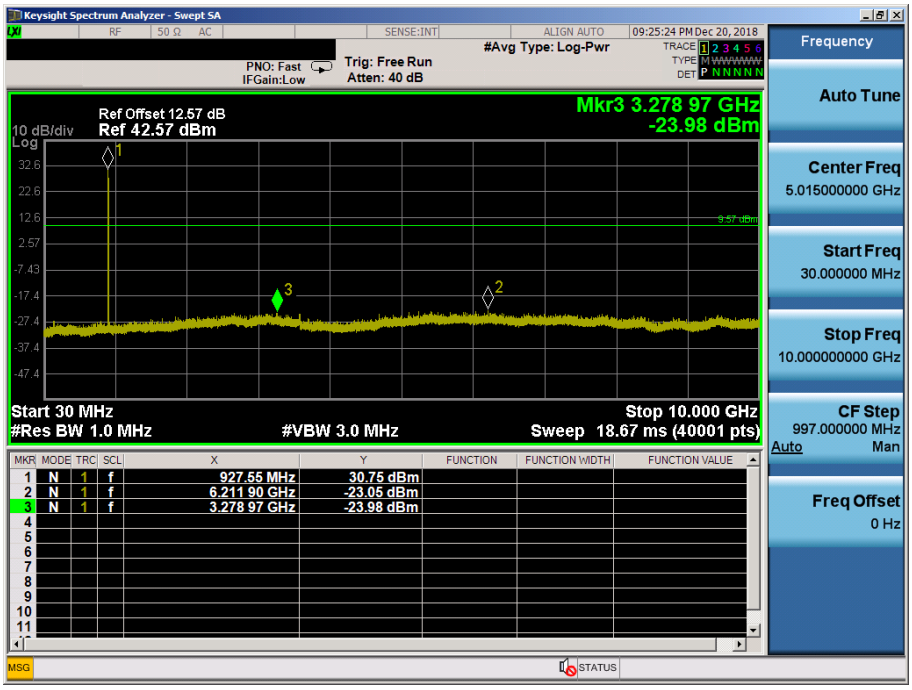


High Band-edge *Hopping mode*



Conducted Spurious Emissions ***Highest Channel***





9. Transmitter AC Power Line Conducted Emission

9.1 Test Setup

See test photo graphs for the actual connections between EUT and support equipment.

9.2 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 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 uH/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 frequency ranges.

Frequency Range (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

* Decreases with the logarithm of the frequency

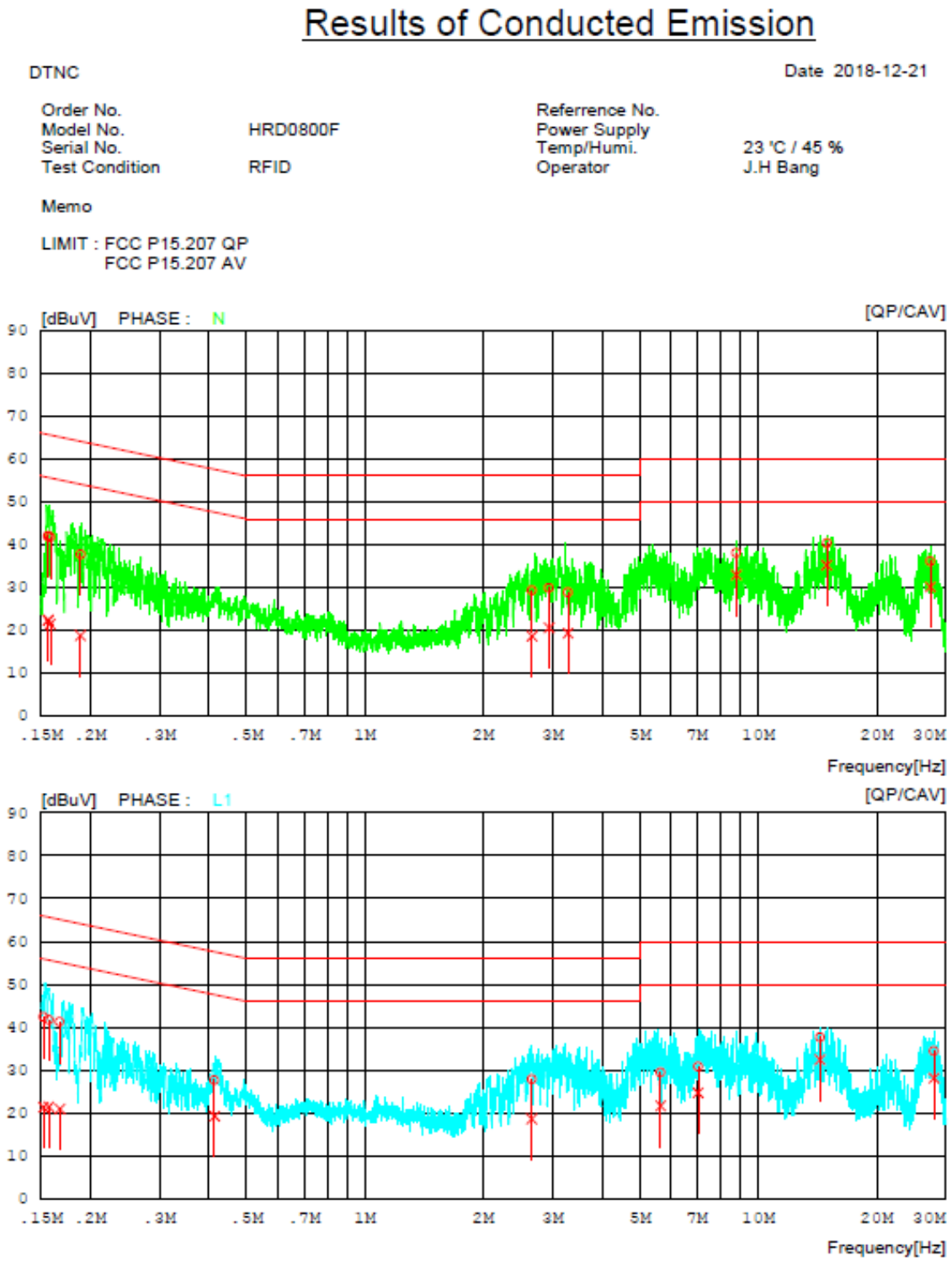
9.3 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

9.4. Test Results

AC Line Conducted Emissions (Graph)



AC Line Conducted Emissions (List)

Results of Conducted Emission

DTNC Date 2018-12-21

Order No.		Referrence No.	
Model No.	HRD0800F	Power Supply	
Serial No.		Temp/Humi.	23 ℃ / 45 %
Test Condition	RFID	Operator	J.H Bang

Memo

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ	READING QP	READING CAV	C.FACTOR	RESULT QP	RESULT CAV	LIMIT QP	LIMIT CAV	MARGIN QP	MARGIN CAV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.15651	31.85	12.07	10.25	42.10	22.32	65.65	55.65	23.55	33.33	N
2	0.15619	31.69	12.14	10.26	41.95	22.40	65.66	55.66	23.71	33.26	N
3	0.15814	31.43	11.26	10.24	41.67	21.50	65.56	55.56	23.89	34.06	N
4	0.18889	27.65	8.80	10.06	37.71	18.86	64.09	54.09	26.38	35.23	N
5	2.65760	19.16	8.60	10.13	29.29	18.73	56.00	46.00	26.71	27.27	N
6	2.93800	19.72	10.50	10.15	29.87	20.65	56.00	46.00	26.13	25.35	N
7	3.27840	18.75	9.27	10.15	28.90	19.42	56.00	46.00	27.10	26.58	N
8	8.78600	27.70	22.62	10.34	38.04	32.96	60.00	50.00	21.96	17.04	N
9	14.92960	29.87	24.72	10.52	40.39	35.24	60.00	50.00	19.61	14.76	N
10	27.36640	25.47	19.45	10.68	36.15	30.13	60.00	50.00	23.85	19.87	N
11	0.15218	32.10	11.05	10.25	42.35	21.30	65.88	55.88	23.53	34.58	L1
12	0.15707	31.50	11.15	10.22	41.72	21.37	65.62	55.62	23.90	34.25	L1
13	0.16726	31.00	10.79	10.16	41.16	20.95	65.10	55.10	23.94	34.15	L1
14	0.41385	17.58	9.23	9.99	27.57	19.22	57.57	47.57	30.00	28.35	L1
15	2.65400	17.72	8.46	10.10	27.82	18.56	56.00	46.00	28.18	27.44	L1
16	5.64380	19.17	11.36	10.21	29.38	21.57	60.00	50.00	30.62	28.43	L1
17	7.02940	20.46	14.43	10.25	30.71	24.68	60.00	50.00	29.29	25.32	L1
18	14.34680	27.15	21.93	10.46	37.61	32.39	60.00	50.00	22.39	17.61	L1
19	27.95020	23.77	17.44	10.63	34.40	28.07	60.00	50.00	25.60	21.93	L1

10. Antenna Requirement

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

10.1 Conclusion

The antenna is connected on the device by means of unique connector.

Therefore this E.U.T Complies with the requirement of §15.203

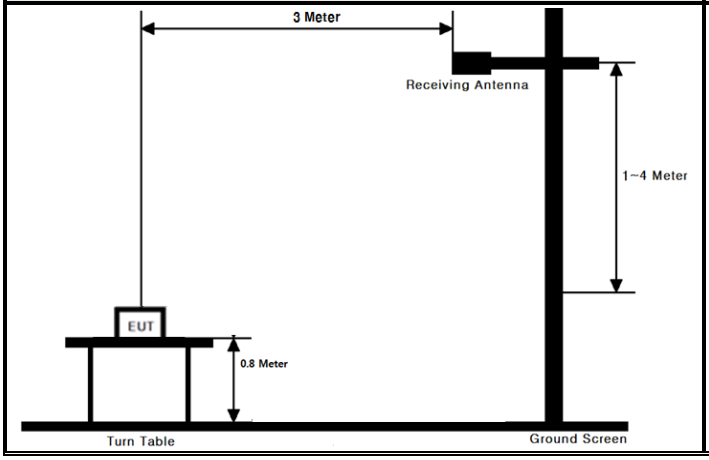
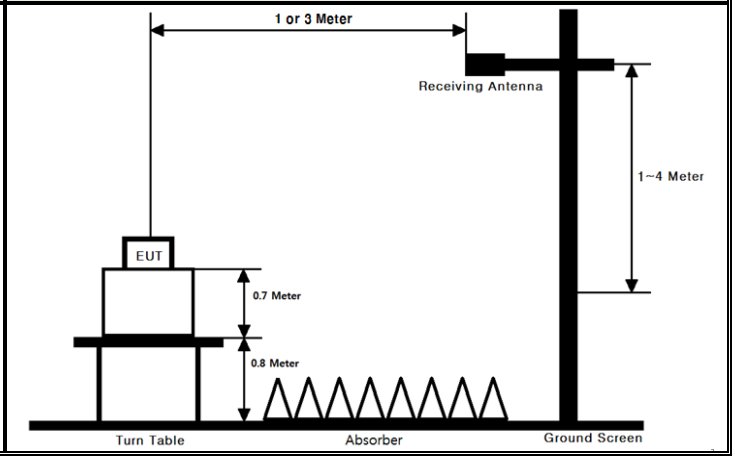
Minimum Standard:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.

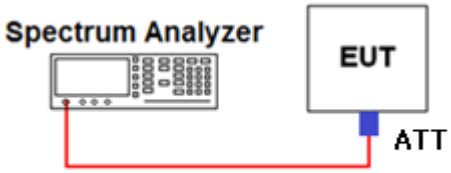
APPENDIX I

Test set up diagrams

- **Radiated Measurement**

Below 1GHz	Above 1GHz
	

- **Conducted Measurement**



Path loss information

Frequency (MHz)	Path Loss (dB)	Frequency (MHz)	Path Loss (dB)
30	10.98	927.25	11.09
500	11.02	1000	11.13
902.75	11.06	5000	11.76
915.25	11.06	10000	12.57

Note 1 : The path loss from EUT to Spectrum analyzer were measured and used for test.

Path loss (S/A's Correction factor) = Cable A + Attenuator

APPENDIX II

Unwanted Emissions (Radiated) Test Plot

Hightest & Y & Ver **Detector Mode : AV**