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 : DRTFCC1901-0001
2. Customer
   - Name : Phychips Inc.
   - Address : (Yongsan-dong), Migun Technoworld 2, A-104, 187, Techno 2-ro, Yuseong-gu, Daejeon, Korea
3. Use of Report : Class II Permissive Change
4. Product Name / Model Name : RFID Module / RED4S

   FCC ID : Y3D-RED4S
5. Test Method Used : ANSI C63.10-2013

   Test Specification : FCC Part 15.247
6. Date of Test : 2018.12.05 ~ 2018.12.21
7. Testing Environment : See appended test report.
8. Test Result : Refer to the attached test result.

Affirmation	Tested by Name : MyungHoon Lee (Signature)	Reviewed by Name : GeunKi Son (Signature)

2019 . 01 . 08 .

DT&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description
DRTFCC1901-0001	Jan. 08, 2019	Initial issue

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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**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
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1.2 Details of Applicant

Applicant	:	Phychips Inc.
Address	:	(Yongsan-dong), Migun Technoworld 2, A-104, 187, Techno 2-ro, Yuseong-gu, Daejeon, South Korea
Contact person	:	Khyungjoo Min

1.3 Description of EUT

EUT	RFID Module
Model Name	RED4S
Add Model Name	NA
Serial Number	Identical prototype
Hardware version	Rev10
Software version	v2.0.2_E
Power Supply	DC 3.6 V
Frequency Range	917.10 ~ 926.90 MHz
Modulation Technique	ASK
Number of Channels	50(Channel Spacing: 200kHz)
Antenna Type	External Antenna (Max. PK 3.72 dBi)

1.4 Declaration by the manufacturer

- N/A

1.5 Test conditions

Ambient Condition	
▪ Temperature	+22 ℃ ~ +25 ℃
▪ Relative Humidity	38 % ~ 48 %

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	17/12/28	18/12/28	MY50410357
DC Power Supply	Agilent Technologies	66332A	17/12/27	18/12/27	US37476998
DC Power Supply	Agilent Technologies	SDP30-5D	18/07/03	19/07/03	305DMG305
Multimeter	FLUKE	17B	17/12/26	18/12/26	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	17/12/27	18/12/27	255571
Signal Generator	ANRITSU	MG3695C	18/02/12	19/02/12	173501
Band Pass Filter	Wainwright Instruments	WRCT800/960.0-2/40-8SSK	18/07/05	19/07/05	32
Network Analyzer	Agilent Technologies	E5071C	18/07/04	19/07/04	MY46106970
Highpass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	18/07/05	19/07/05	7
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
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 Antenna	ETS-Lindgren	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
Attenuator	SMAJK	SMAJK-50-10	18/07/04	19/07/04	15081903
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2495A MA2490A	18/07/04	19/07/04	1338003 1249304
EMI Test Receiver	Rohde Schwarz	ESR7	18/02/13	19/02/13	101061
EMI Test Receiver	Rohde Schwarz	ESCI7	18/02/12	19/02/12	100910
PULSE LIMITER	Rohde Schwarz	ESH3-Z2	18/09/27	19/09/27	101333
LISN	SCHWARZBECK	NNLK 8121	18/03/20	19/03/20	06183
Cable	Radiall	TESTPRO3	18/07/06	19/07/06	M-01
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
Cable	DT&C	CABLE	18/06/25	19/06/25	RF-20

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 902-928 MHz)	Test Condition	Status Note 1
15.247(a) RSS-247(5.1)	Carrier Frequency Separation	>= 25 kHz or >= 20 dB BW, whichever is greater.	Conducted	C
	Number of Hopping Frequencies	>= 50 hops, if 20 dB BW < 250kHz >= 25 hops, if 20 dB BW >= 250kHz		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		NA
15.247(d) 15.205 & 209 RSS-247(5.5) RSS-Gen (8.9 & 8.10)	Radiated Spurious Emissions	FCC 15.209 Limits	Radiated	C Note 3
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	917.10 ~ 926.90 MHz	917.10 ~ 926.90 MHz

- Hopping Function: Disable

Channel	TX Frequency (MHz)	RX Frequency (MHz)
Lowest Channel	917.10	917.10
Middle Channel	921.90	921.90
Highest Channel	926.90	926.90

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)(a), 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 peak output power 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

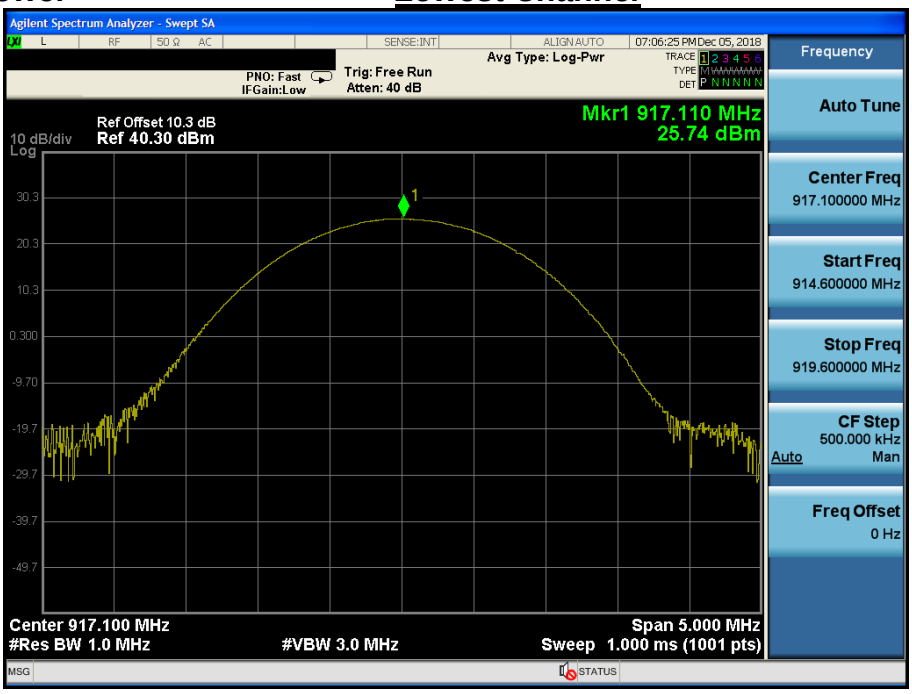
3.4 Test Results

Tested Channel	Frame Average Output Power		Peak Output Power	
	dBm	mW	dBm	mW
Lowest	24.21	263.63	25.740	374.97
Middle	**24.28**	**267.92**	**25.810**	**381.07**
Highest	24.17	261.22	25.700	371.54

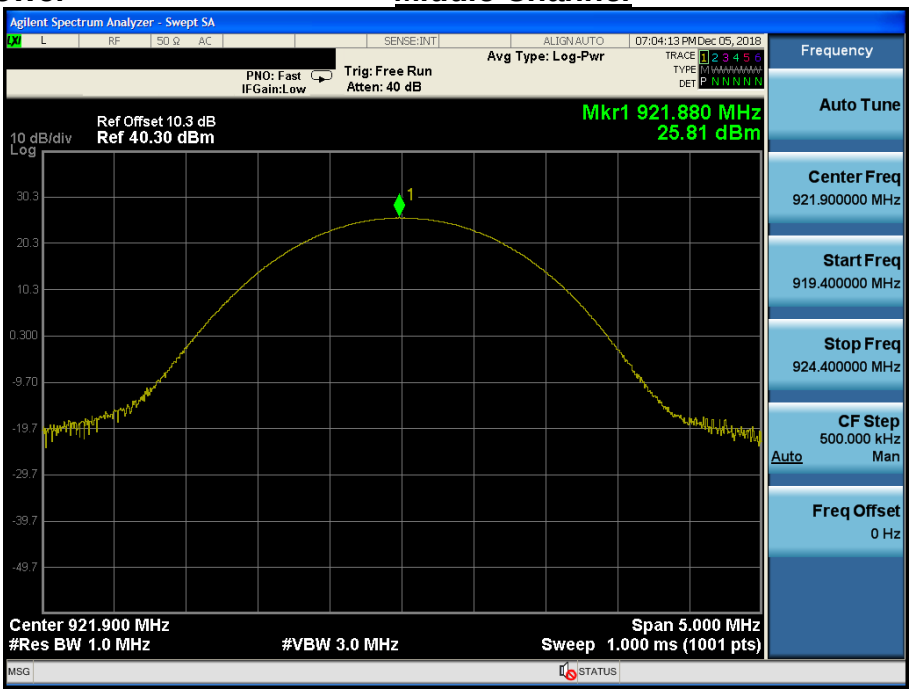
Note 1 : The frame average output power was tested using an average power meter for reference only.

Note 2 : See next pages for actual measured spectrum plots.

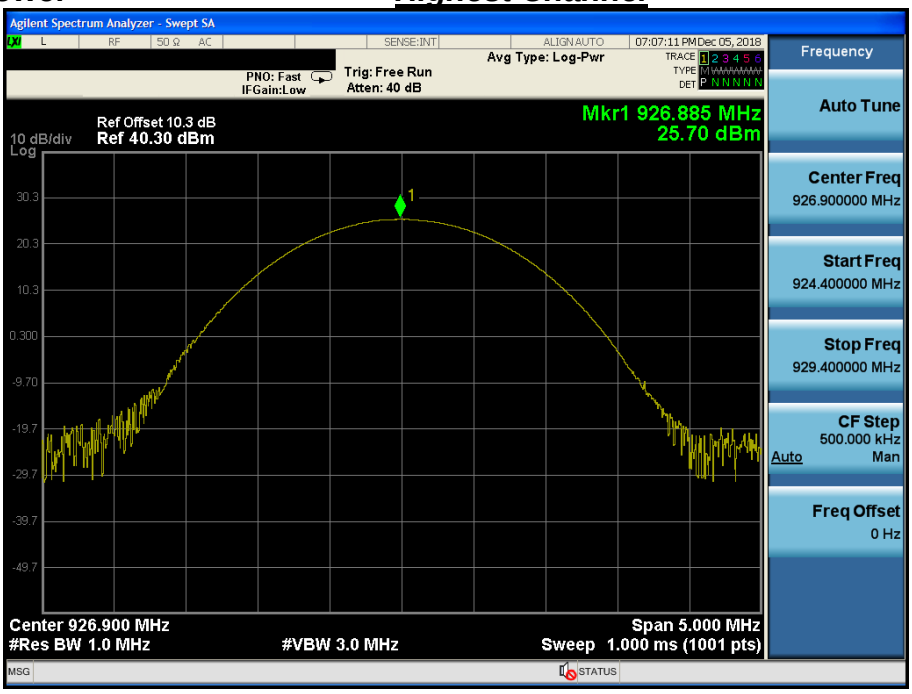
Peak Output Power ***Lowest Channel***



Peak Output Power ***Middle Channel***



Peak Output Power ***Highest Channel***



4. 20dBc BW

4.1 Test Setup

Refer to the APPENDIX I.

4.2 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.

4.3 Test Procedure

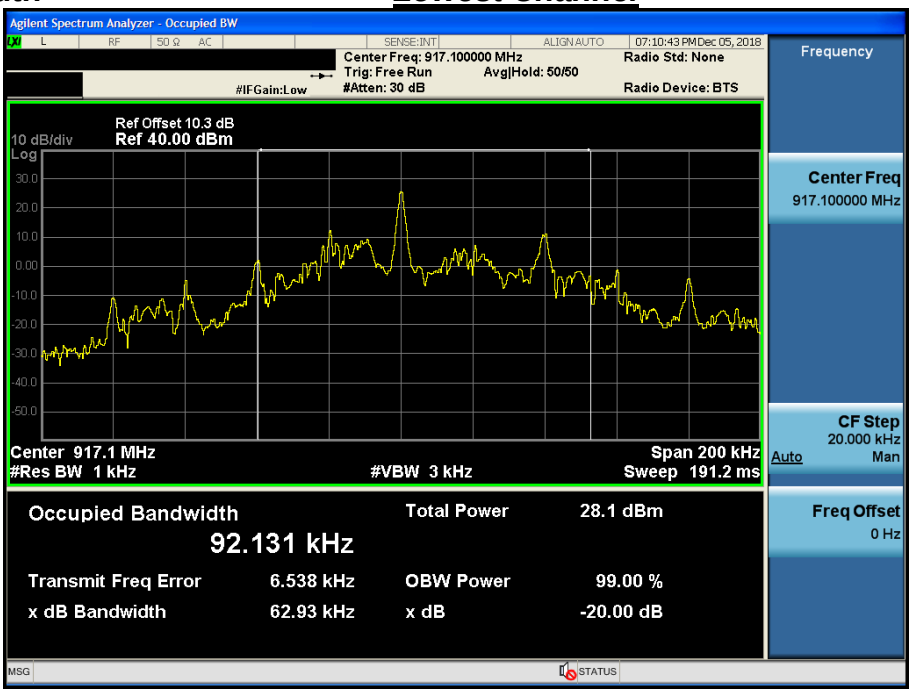
1. The 20 dB bandwidth were measured with a spectrum analyzer connected to RF antenna Connector (conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using below setting: RBW shall be in the range of 1% to 5% of the 20 dB bandwidth and VBW ≥ 3 × RBW, Span = between two times and five times the 20 dB bandwidth.

4.4 Test Results

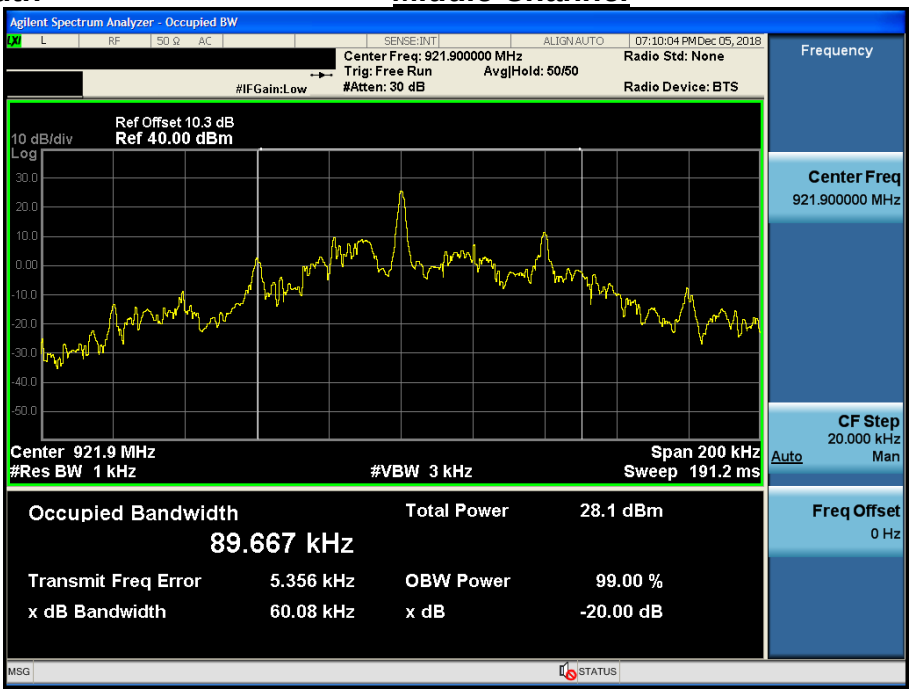
Frequency (MHz)	Tested Channel	20dBc BW (kHz)
917.10	**Lowest**	62.93
921.90	**Middle**	60.08
926.90	**Highest**	66.25

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

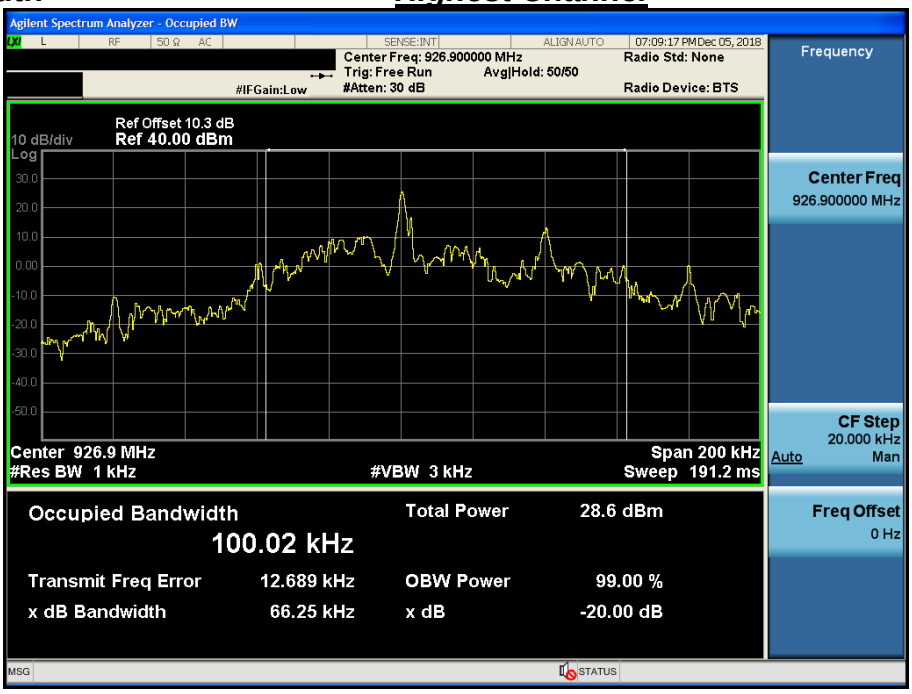
20dBc Bandwidth ***Lowest Channel***



20dBc Bandwidth ***Middle Channel***



20dBc Bandwidth ***Highest Channel***



5. Carrier Frequency Separation

5.1 Test Setup

Refer to the APPENDIX I.

5.2 Limit

Limit : ≥ 25 kHz or ≥ 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.

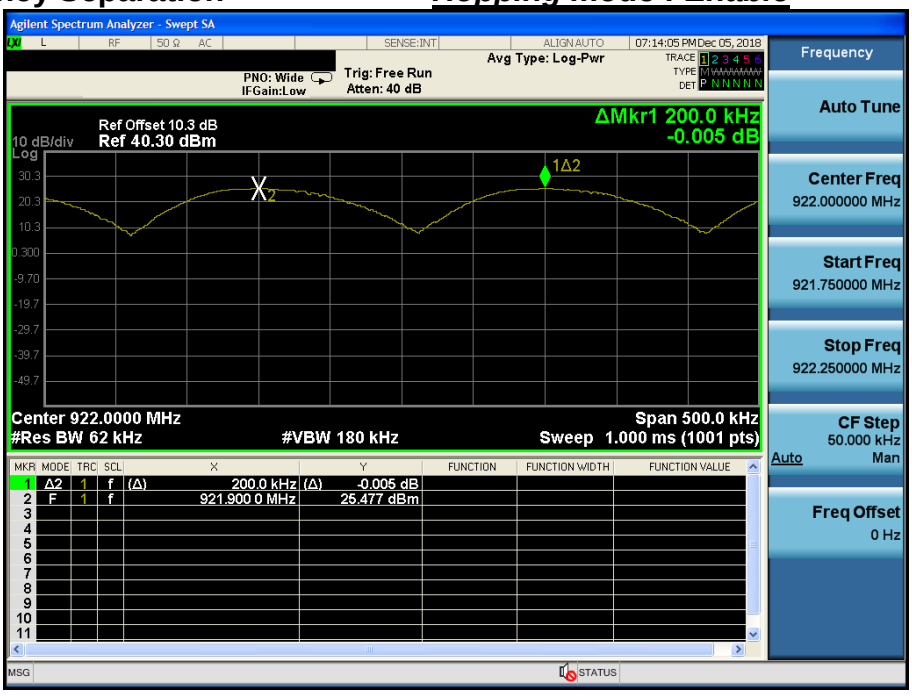
VBW ≥ RBW Sweep = auto

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	921.90	922.10	200

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 = 20 MHz Start Frequency = 911.90 MHz, Stop Frequency = 931.9 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

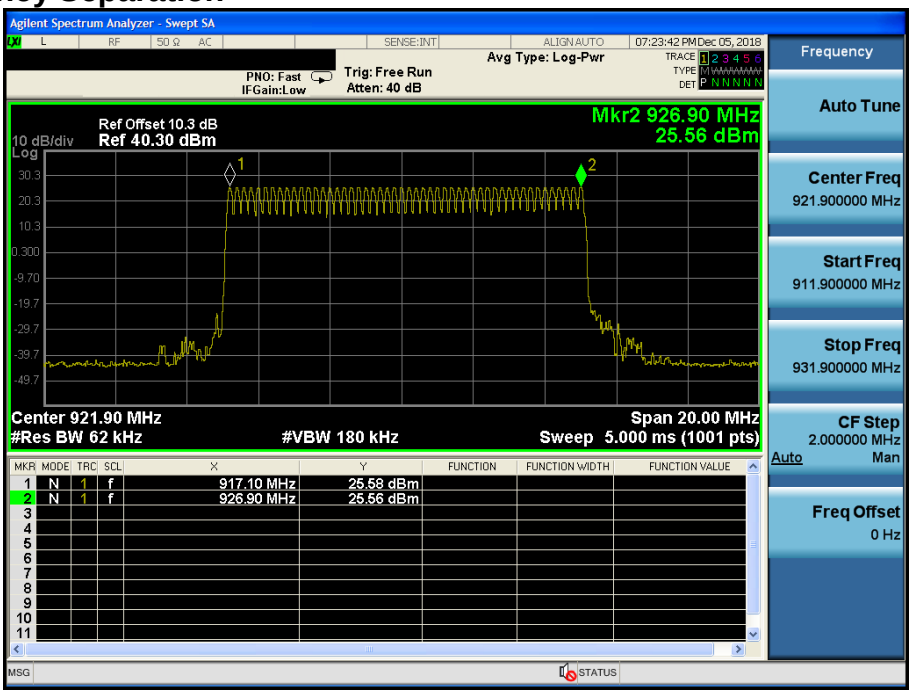
Detector function = peak Trace = max hold

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 = 921.90 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)

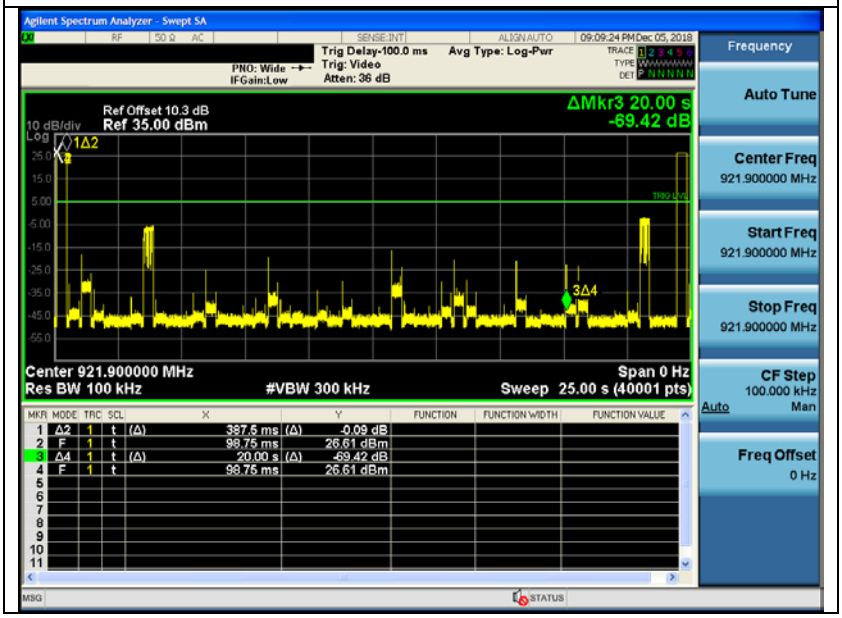
VBW ≥ RBW Detector function = peak

Trace = max hold

7.4 Test Results

Channel Frequency (MHz)	Length (ms)	Number	Dwell Time (ms)
921.90	387.5	1	387.5

Dwell Time



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 1 kHz 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)
2751.327	H	X	PK	51.60	1.49	N/A	53.09	74.00	20.91
2751.307	H	X	AV	48.29	1.49	N/A	49.78	54.00	4.22
3668.268	H	Y	PK	50.48	2.41	N/A	52.89	74.00	21.11
3668.418	H	Y	AV	45.81	2.41	N/A	48.22	54.00	5.78

▪ 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)
2765.757	H	X	PK	52.12	1.44	N/A	53.56	74.00	20.44
2765.725	H	X	AV	48.87	1.44	N/A	50.31	54.00	3.69
3687.803	H	Y	PK	49.86	2.42	N/A	52.28	74.00	21.72
3687.667	H	Y	AV	44.84	2.42	N/A	47.26	54.00	6.74

▪ Highest Channel

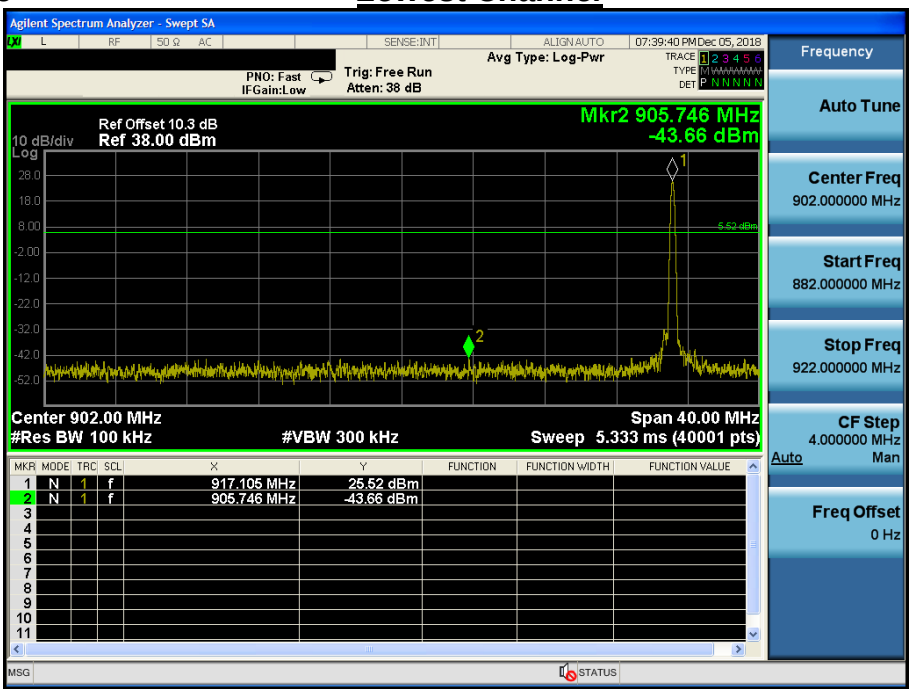
Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F. (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2780.508	H	X	PK	51.28	1.39	N/A	52.67	74.00	21.33
2780.728	H	X	AV	47.71	1.39	N/A	49.10	54.00	4.90
3707.575	H	Y	PK	49.62	2.42	N/A	52.04	74.00	21.96
3707.597	H	Y	AV	44.57	2.42	N/A	46.99	54.00	7.01

Note.

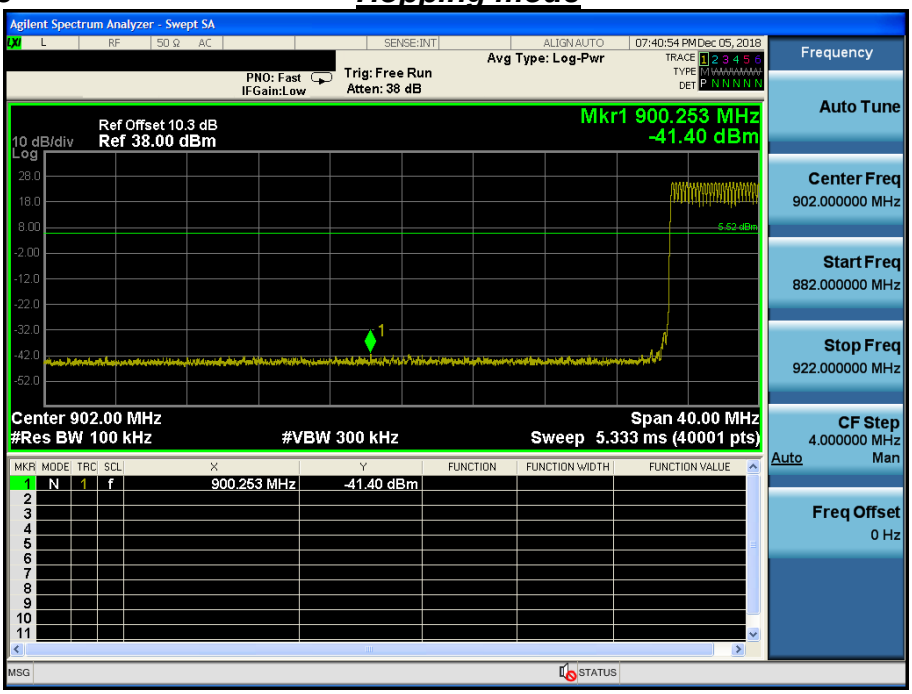
1. No other spurious and harmonic emissions were reported greater than listed emissions above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F+ DCF / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor,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

8.4.2 Conducted Spurious Emissions

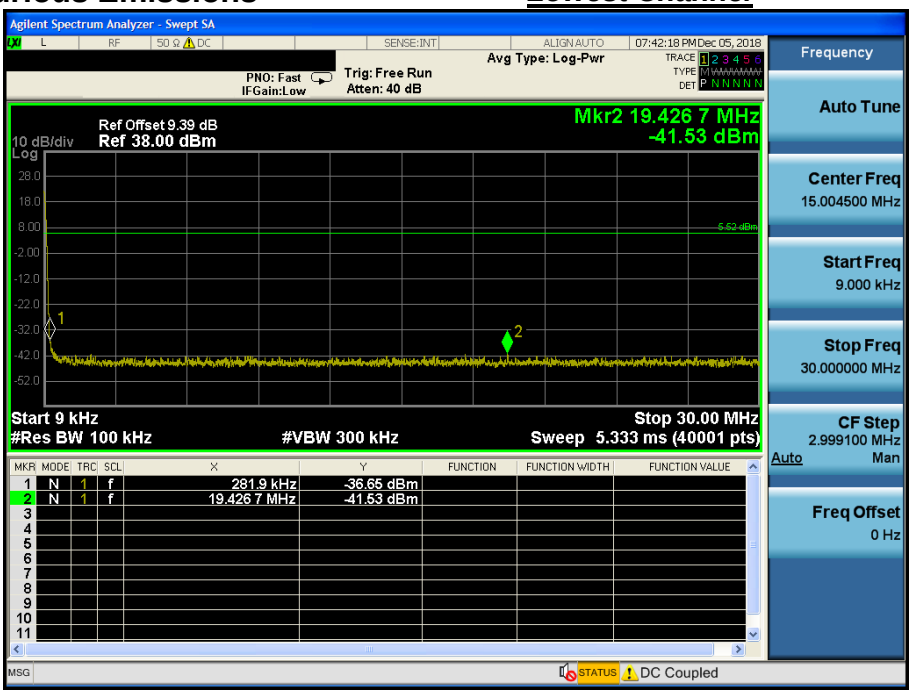
Low Band-edge ***Lowest Channel***

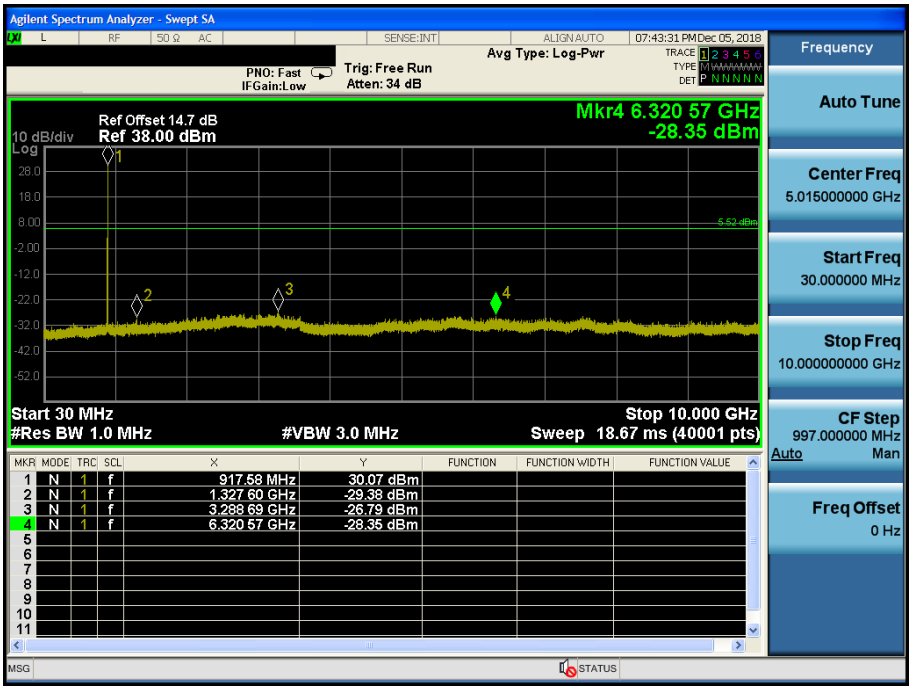


Low Band-edge ***Hopping mode***

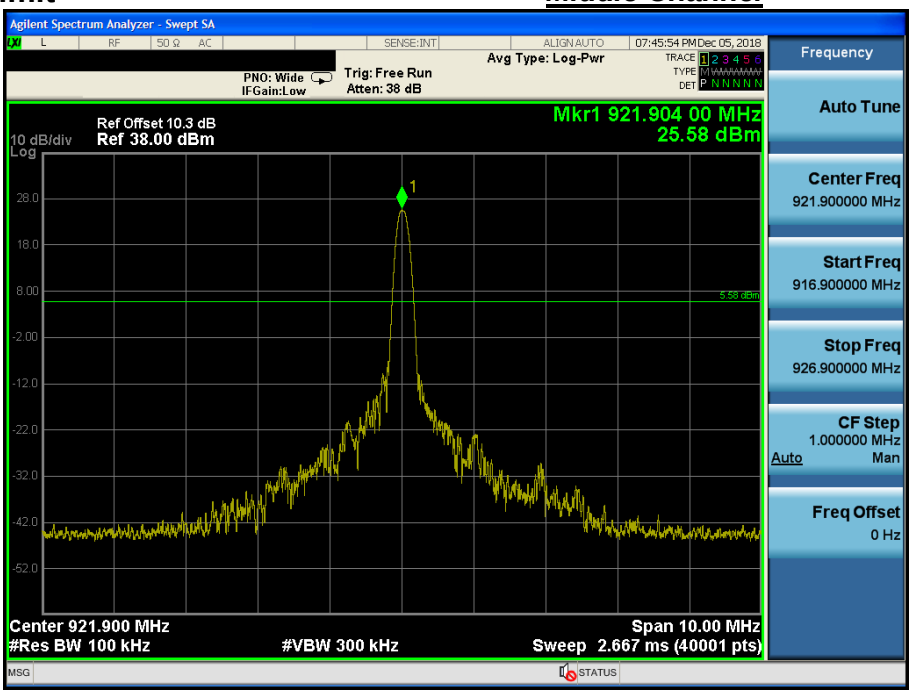


Conducted Spurious Emissions ***Lowest Channel***

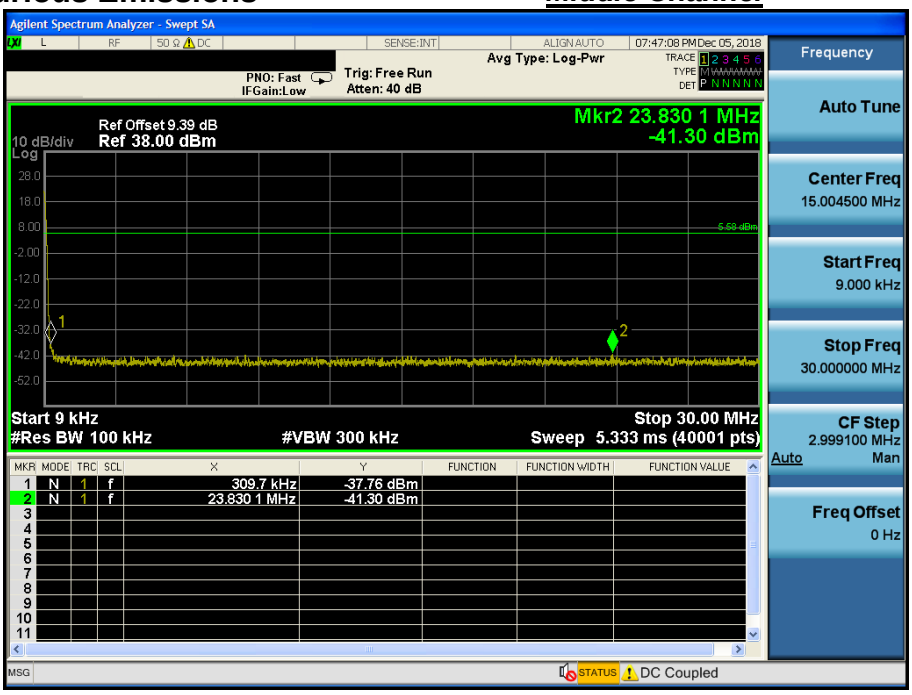


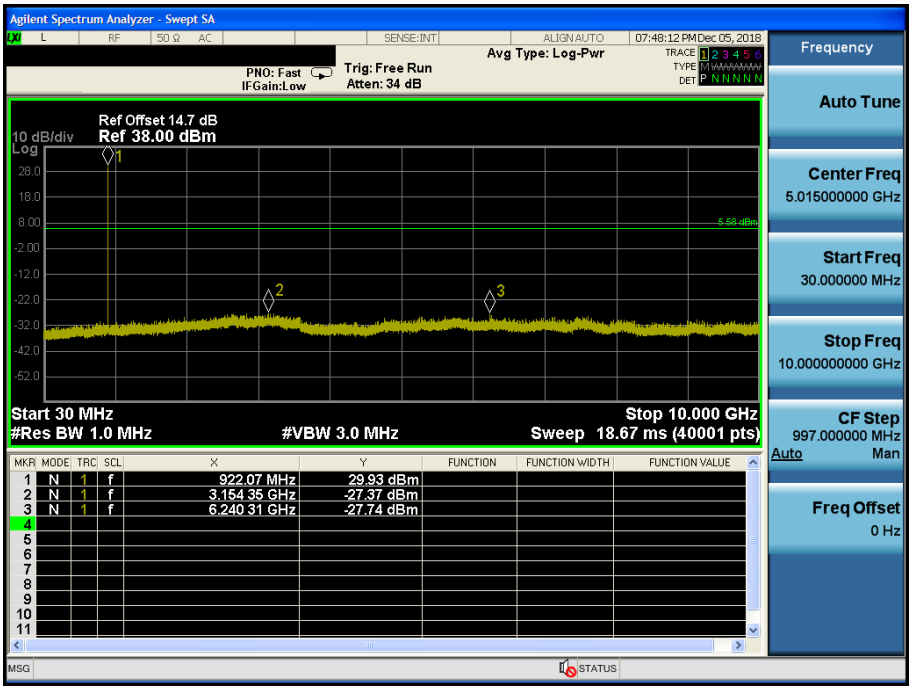


Reference for limit ***Middle Channel***

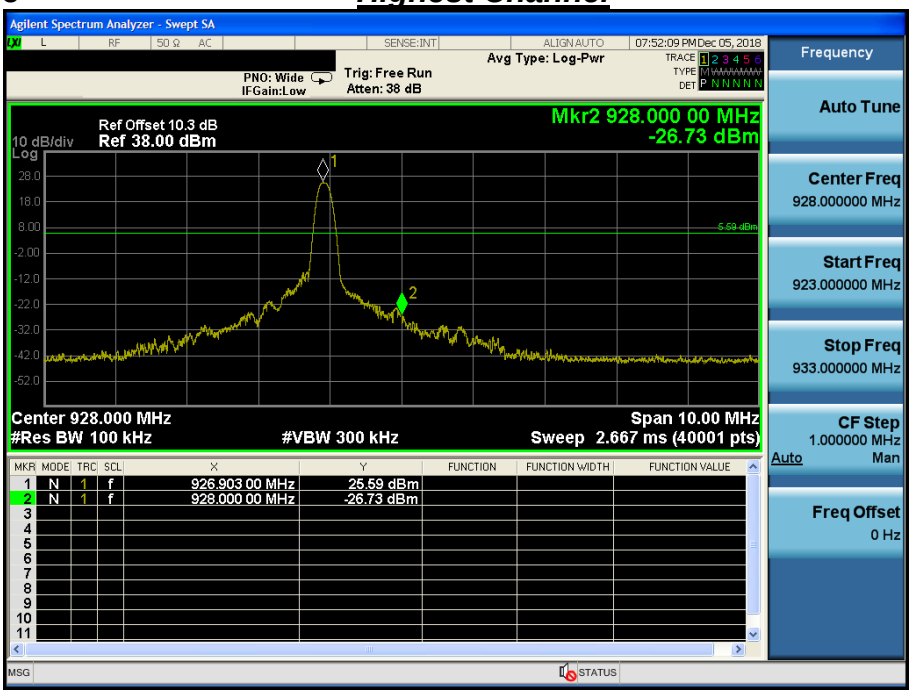


Conducted Spurious Emissions ***Middle Channel***

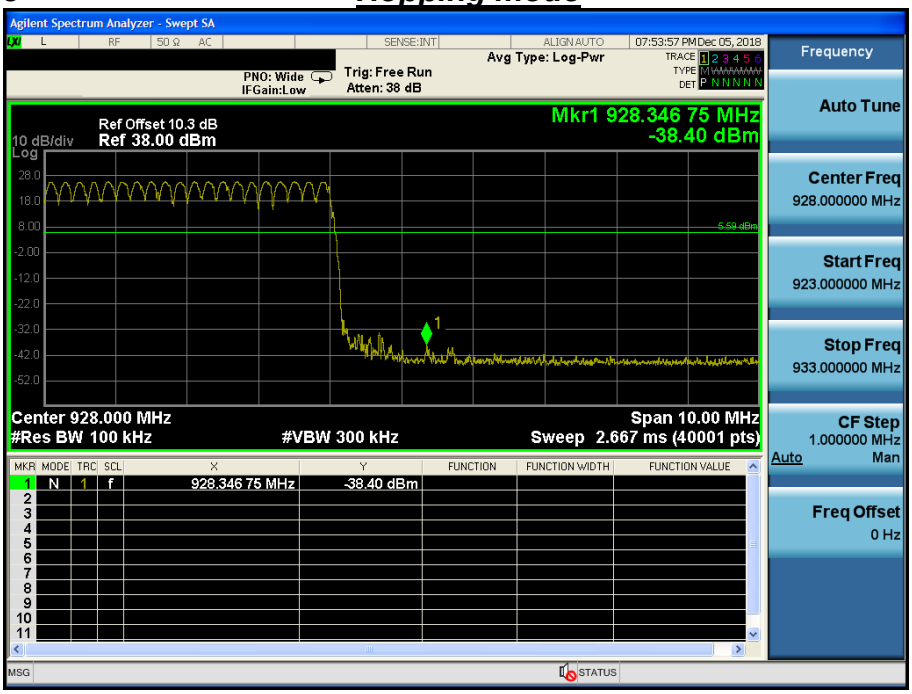




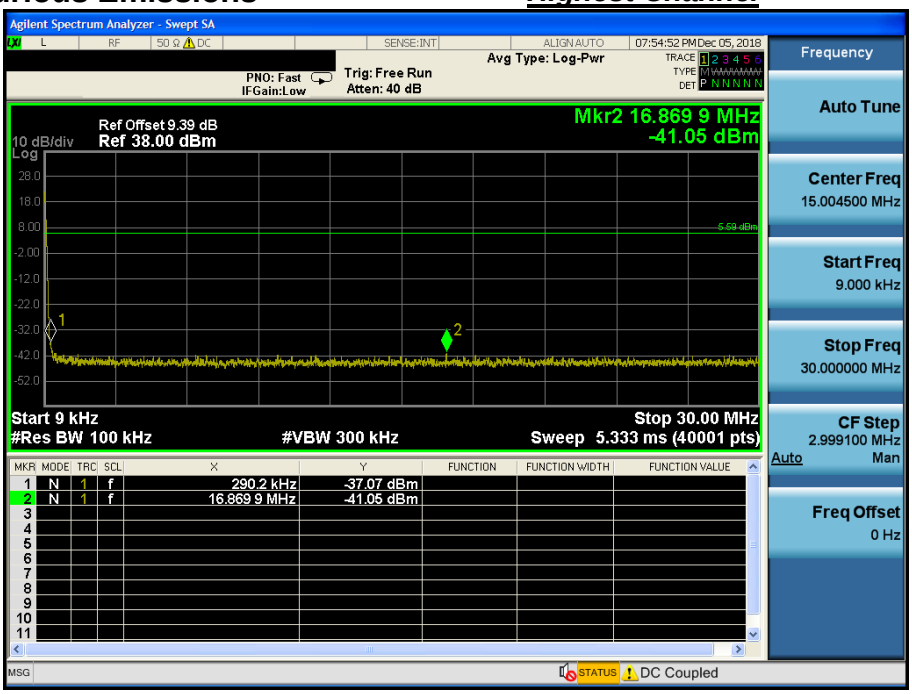
High Band-edge ***Highest Channel***

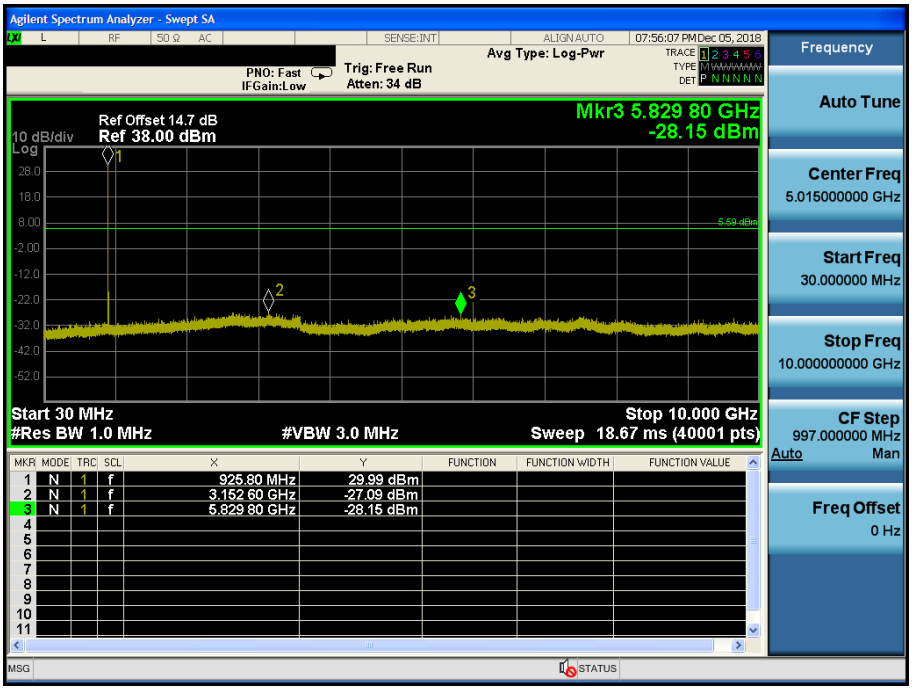


High Band-edge ***Hopping mode***



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)

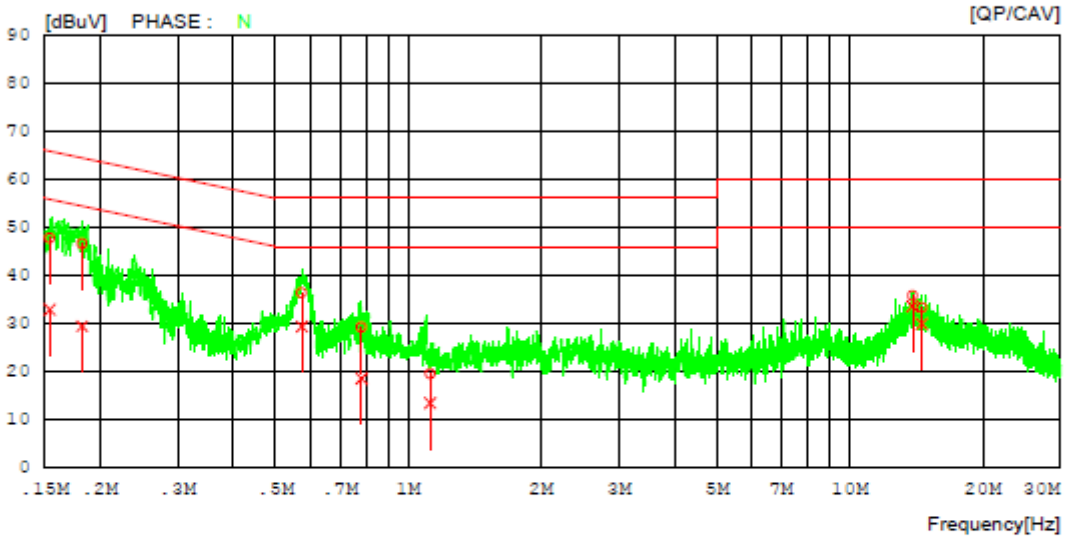
Results of Conducted Emission

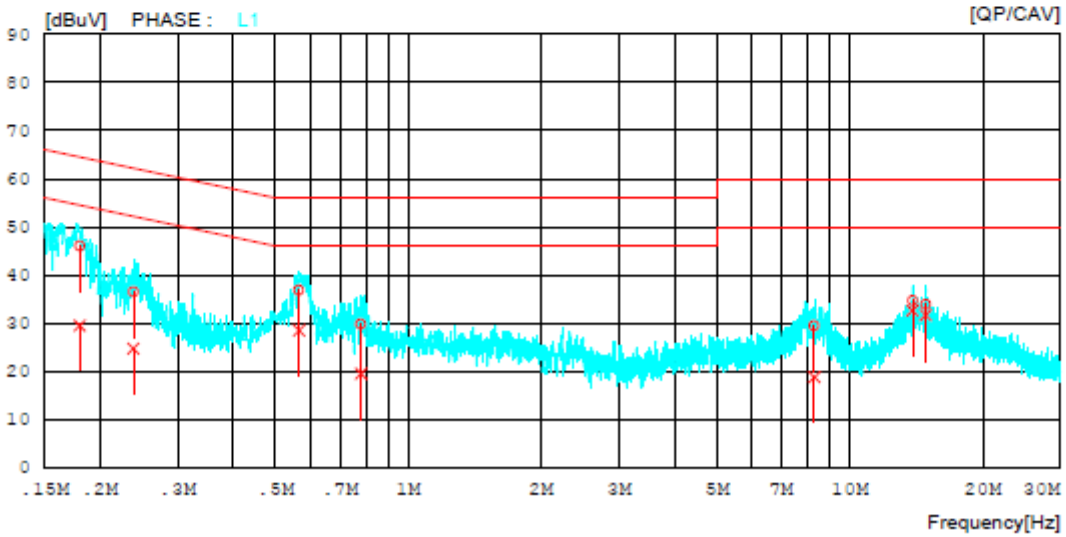
DTNC Date 2018-12-21

Order No.		Referrence No.	
Model No.	RED4S	Power Supply	
Serial No.		Temp/Humi.	22 'C / 38 %
Test Condition	900 MHz	Operator	M.H.LEE

Memo

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





AC Line Conducted Emissions (List)

Results of Conducted Emission

DTNC Date 2018-12-21

Order No.		Referrence No.	
Model No.	RED4S	Power Supply	
Serial No.		Temp/Humi.	22 ℃ / 38 %
Test Condition	900 MHz	Operator	M.H.LEE

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	0.15385	37.52	22.67	10.27	47.79	32.94	65.79	55.79	18.00	22.85	N
2	0.18212	36.54	19.33	10.11	46.65	29.44	64.39	54.39	17.74	24.95	N
3	0.57285	26.29	19.33	10.03	36.32	29.36	56.00	46.00	19.68	16.64	N
4	0.78264	19.16	8.54	10.04	29.20	18.58	56.00	46.00	26.80	27.42	N
5	1.11940	9.47	3.37	10.05	19.52	13.42	56.00	46.00	36.48	32.58	N
6	13.85500	25.30	23.13	10.47	35.77	33.60	60.00	50.00	24.23	16.40	N
7	14.55840	22.86	19.48	10.50	33.36	29.98	60.00	50.00	26.64	20.02	N
8	0.17980	35.93	19.40	10.09	46.02	29.49	64.49	54.49	18.47	25.00	L1
9	0.23820	26.46	14.65	9.97	36.43	24.62	62.16	52.16	25.73	27.54	L1
10	0.56524	26.79	18.46	10.01	36.80	28.47	56.00	46.00	19.20	17.53	L1
11	0.77954	19.77	9.39	10.00	29.77	19.39	56.00	46.00	26.23	26.61	L1
12	8.30440	19.06	8.44	10.27	29.33	18.71	60.00	50.00	30.67	31.29	L1
13	13.85420	24.15	22.13	10.43	34.58	32.56	60.00	50.00	25.42	17.44	L1
14	14.83600	23.37	21.09	10.48	33.85	31.57	60.00	50.00	26.15	18.43	L1

10. Antenna Requirement

10.1 Procedure

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.

10.2 Conclusion

: **Comply**

The antenna employs a unique antenna connector.

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.

11. Occupied Bandwidth (99 %)

11.1 Test Setup

Refer to the APPENDIX I.

11.2 Limit

Limit : Not Applicable

11.3 Test Procedure

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.

The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 × RBW.

Spectrum analyzer plots are included on the following pages.

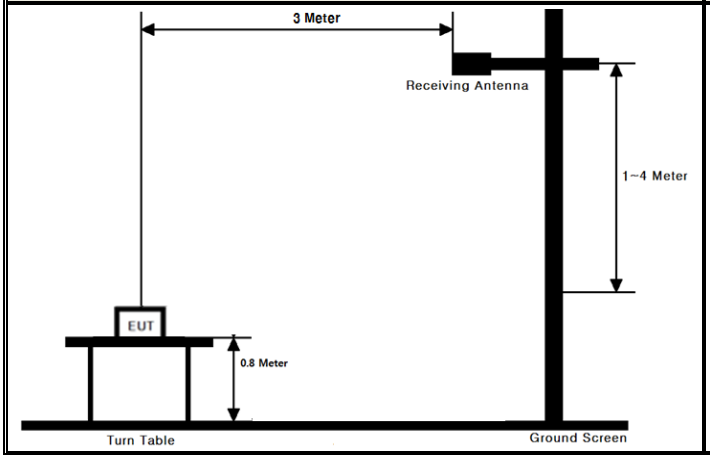
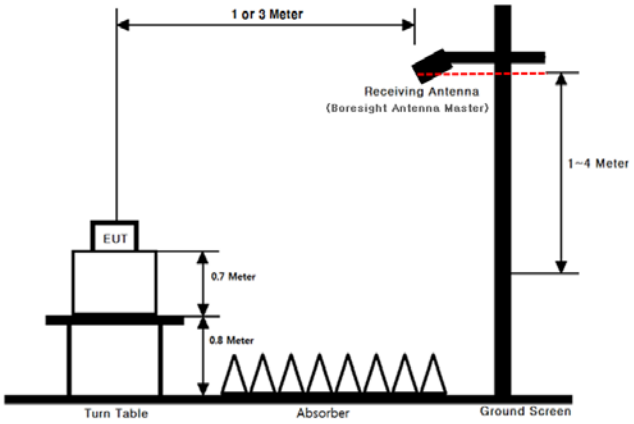
10.4 Test Results

Not Applicable

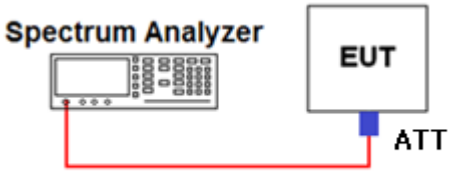
APPENDIX I

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	9.39	1000	10.38
500	9.96	5000	12.23
917.1 & 921.9 & 926.9	10.30	10000	14.70
-	-	-	-

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

Lowest & X & Hor **Detector Mode : AV**