ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND INDUSTRY CANADA RSS 210 REQUIREMENT

OF

Applicant:	Microsoft Corporation One Microsoft Way, Redmond, WA 98052-6399 USA
Product Name:	Portable Computing Device
Brand Name:	Microsoft
Model No.:	1825
Model Difference:	N/A
FCC ID:	C3K1825
IC:	3048A-1825
Report Number:	E2/2018/70122
FCC Rule Part:	§15.225
IC Rule:	RSS-210 issue 9 Annex B B.6 Nov. 2017
Issue Date:	Sep. 10, 2018
Date of Test:	Jun. 26, 2018 ~ Sep. 10, 2018
Date of EUT Received:	Jun. 26, 2018

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Tested By: _____

Vito Pei / Sr. Engineer

Approved By: _____

Jim Chang / Manager

Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/70122	Rev.00	Initial creation of document	All	Sep. 10, 2018	Violetta Tang

Contents

1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Portable Computing Device	
Brand Name:	Microsoft	
Model No.:	1825	
Model Difference:	N/A	
Product SW/HW version:	Windows 10 Pro / EV2.7	
Radio SW/HW version:	18.33.105.6 / EV2.7	
Test SW Version:	N/A	
Power Supply:	7.66Vdc from Rechargeable Li-ion Battery or 15V from AC/DC Adapter	
	Battery:	Model No.: G16QA043H, Supplier: SMP
	Adapter:	Model No.: 1735, Supplier: LITEON

NFC:

Operating Frequency:	13.56MHz
Transmit Power:	< 123.90dBuV/m at 3m.
Number of Channels:	1
Antenna Type:	Loop Antenna
Modulation Type:	ASK

1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.225

RSS-210 issue 9 Annex B B.6 Nov. 2017

RSS-Gen. issue 5 Apr. 2018

ANSI C63.10:2013

Note: All test items have been performed and recorded as per the above standards.

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)

OATS: SGS Far East Limited Taiwan EMC Laboratory

No.34-2, Dingfu, Linkou Dist., New Taipei City 24442, Taiwan (R.O.C.)

FCC Registration Numbers are: 735305

Canada Registration Number: 4620A-5

1.4 Special Accessories

AC Adapter is used while the test is conducted and there is no other accessory attached. This is the worst case condition.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT is configured to operate in a continuous transmission mode. EUT placement and various angles were checked to find worst mode where the emission characteristics are maximized.

2.2 EUT Exercise

Enable EUT NFC function via Windows and use a tag next to the EUT NFC antenna to manipulate the EUT into continuous transmit mode.

2.3 Test Procedure

2.3.1 Conducted Emissions

EUT is a placed on turn table which is 0.8 m above ground plane. Connected to the public utility (AC) power line, the spacing between EUT is 10cm. Power cable were bundle 30 to 40cm and draped over the back edge of test table, and through section 2.2 the EUT is being exercise. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plan and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m 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.

2.4 Measurement Results Explanation Example

For all conducted test items:

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

2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission

Fig. 2-2 AC Power Line Conducted Emission

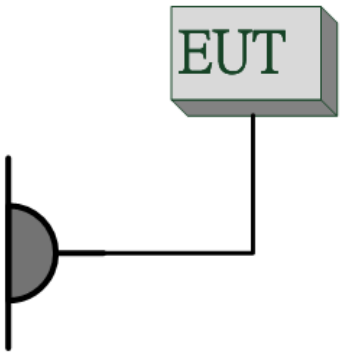


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model / Type No.	Series No.	Data Cable	Power Cord
1.	NFC Test Software	N/A	N/A	N/A	N/A	N/A

3 SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§15.207	RSS-Gen § 8.8	AC Power Line Conducted Emission	Compliant
§15.225 (a)-(d)	RSS210 Annex B B.6	Radiated Emission	Compliant
§15.209	RSS-Gen § 8.9	Radiated Emission Limits, general requirement	Compliant
§15.225 (e)	RSS-Gen § 8.11	Frequency Stability	Compliant
§2.1049 §15.215 (c)	RSS-Gen § 6.7	20 dB & 99% OCCUPIED BANDWIDTH	Compliant
§15.203	RSS-Gen § 6.8	Antenna Requirement	Compliant

4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Channel Details

1. The EUT stay in continuous transmission mode.
2. The frequency 13.56 MHz is the default channel to test, where it is the only manipulative channel as this application supports.
3. Only one configuration is supported/applicable as follows.

RADIATED EMISSION TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
FREQUENCY STABILITY			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK
20dB BANDWIDTH			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
NFC	1	1	ASK

The field strength of spurious radiation emission was measured as EUT stand-up position (H, E1 mode) and lie down position (E2 mode) for NFC Transmitter for channel the worst case H position was reported.

5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Frequency Stability	+/- 51.33 Hz
20 dB & 99% OCCUPIED BANDWIDTH	+/- 51.33 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : **Vertical**)	9kHz - 30MHz: +/- 2.87dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB

Measurement uncertainty (Polarization : **Horizontal**)	9kHz - 30MHz: +/- 2.87dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

6 CONDUCTED EMISSION TEST

6.1 Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

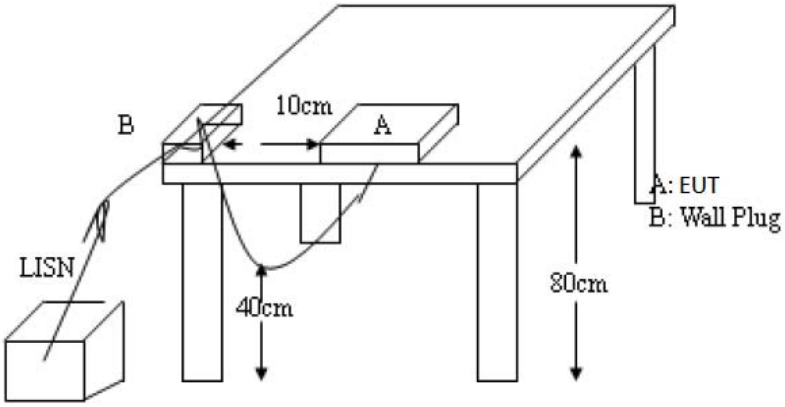
6.2 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
LISN	TESEQ	NNB 51	36076	2018/02/14	2019/02/13
EMI Test Receiver	R&S	ESCI	101300	2017/11/02	2018/11/01
Coaxial Cable	EMC Instruments Corp	EMC5D-BM-BM-3000	1401004	2018/05/25	2019/05/24

6.3 EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.
4. Peak values are being compared against the QP limit.

6.6 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit

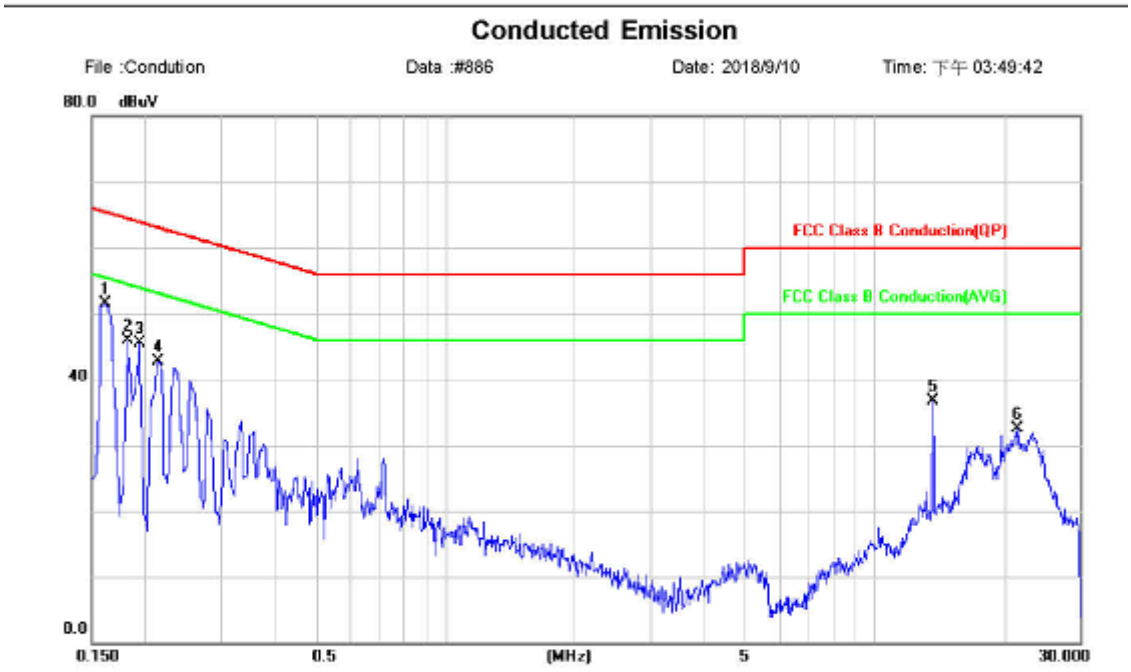
AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test By:	Jerry

Site : Conduction Room
Limit: FCC Class B Conduction(QP)
Mode:
Note:

Phase: L1
Power: AC 120V/60Hz

Temperature: 22 ℃
Humidity: 70 %



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1620	51.41	0.04	51.45	65.36	-13.91	peak	
2		0.1820	45.96	0.03	45.99	64.39	-18.40	peak	
3		0.1940	45.43	0.03	45.46	63.86	-18.40	peak	
4		0.2140	42.65	0.03	42.68	63.05	-20.37	peak	
5		13.6900	36.08	0.60	36.68	60.00	-23.32	peak	
6		21.3780	31.54	0.90	32.44	60.00	-27.56	peak	

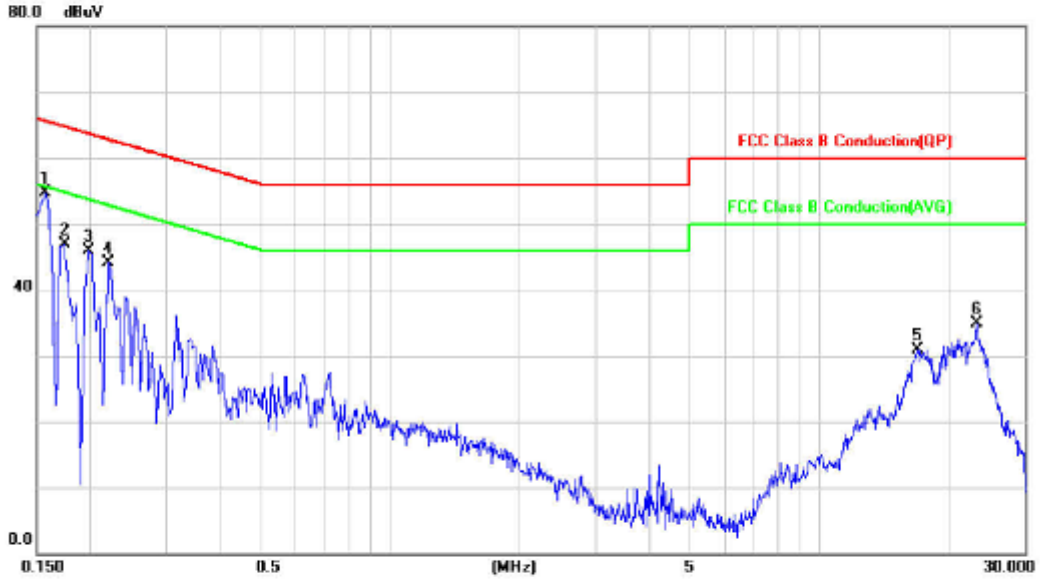
Site : Conduction Room
Limit: FCC Class B Conduction(QP)
Mode:
Note:

Phase: N
Power: AC 120V/60Hz

Temperature: 22 ℃
Humidity: 70 %

Conducted Emission

File :Condution Data :#887 Date: 2018/9/10 Time: 下午 03:51:15



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.1580	54.71	0.04	54.75	65.57	-10.82	peak	
2		0.1740	46.95	0.04	46.99	64.77	-17.78	peak	
3		0.1980	45.83	0.04	45.87	63.69	-17.82	peak	
4		0.2220	43.99	0.05	44.04	62.74	-18.70	peak	
5		16.8460	30.37	0.54	30.91	60.00	-29.09	peak	
6		23.1940	34.20	0.71	34.91	60.00	-25.09	peak	

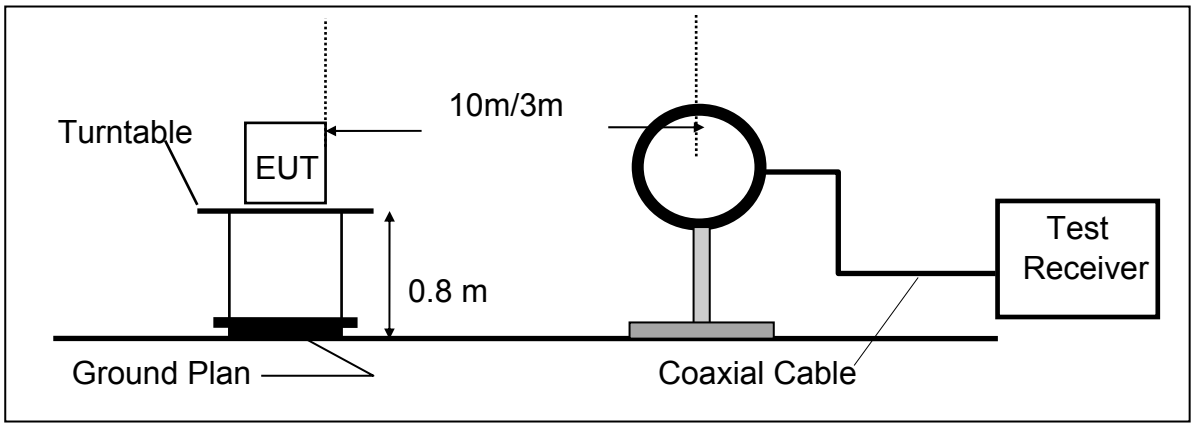
7 RADIATED TEST ITEMS

7.1 Measurement Procedure

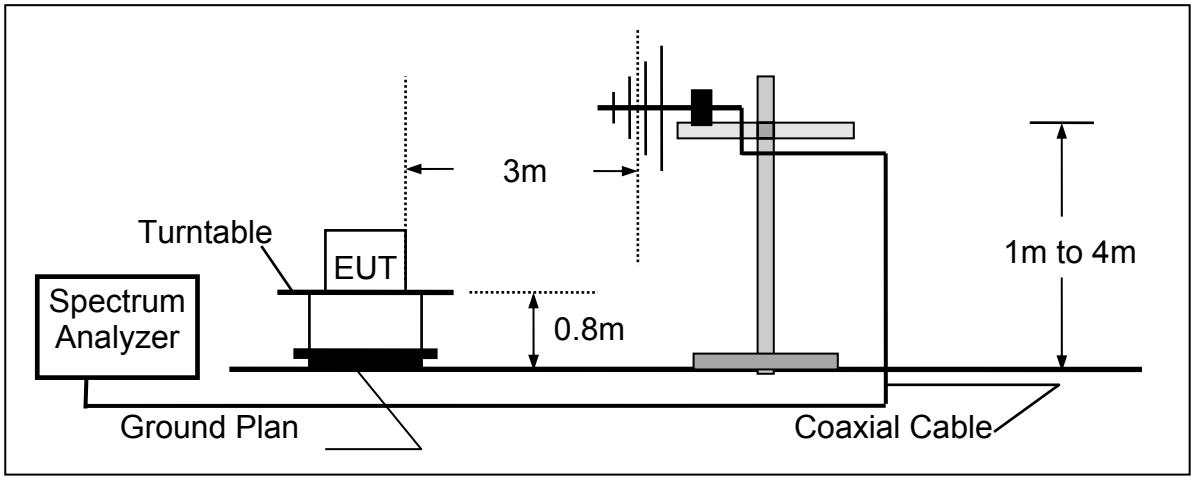
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all default test channel measured were complete.

7.2 Test SET-UP

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



7.3 Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	SCHWAZBECK	VULB 9168	9168-617	2017/10/27	2018/10/26
Loop Antenna	ETS.LINDGREN	6502	148045	2017/09/26	2018/09/25
3m Site NSA	SGS	966 chamber D	N/A	2018/07/06	2019/07/05
EMI Test Receiver	R&S	ESU 40	100363	2018/04/11	2019/04/10
Pre-Amplifier	EMC Instruments	EMC9135	980234	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	2017/12/26	2018/12/25

SGS Open Area Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 3	101342	2018/04/24	2019/04/23
Pre Amplifier	EMC Instruments	EMC330	980122	2018/06/09	2019/06/08
Broadband Antenna	Schaffner	CBL 6112D	23189	2018/05/11	2019/05/10
Coaxial Cable	Huber+Suhner	RG 214	30m	2018/06/22	2019/06/21
Turn Table	Chance Most	N/A	N/A	N.C.R.	N.C.R.
Antenna Tower	Chance Most	N/A	N/A	N.C.R.	N.C.R.
Controller	Chance Most	N/A	N/A	N.C.R.	N.C.R.
Site NSA	SGS	OATS 1	N/A	2018/06/13	2019/06/12
Test S/W	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.
EMI Test Receiver	R&S	ESCI 3	101342	2018/04/24	2019/04/23

Note: N.C.R refers to Not Calibrated Required.

7.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)
Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)
Factor(dB) = Antenna Factor(dB/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

7.5 Field Strength of Fundamental Emissions and Mask Measurement

7.5.1 Standard Applicable

Limit:

Rules and specifiactions	CFR 47 Part 15 section 15.225(a)-(d)		
Frequency of Emission (MHz)	Field Strength (μV/m)at 30m	Field Strength (dBμV/m)at 30m	Field Strength (dBμV/m)at 3m
1.705~13.110	30	29.5	69.5
13.110~13.410	106	40.5	80.5
13.410~13.553	334	50.5	90.47
13.553~13.567	15848	84	124
13.567~13.710	334	50.5	90.47
13.710~14.010	106	40.5	80.5
14.010~30.00	30	29.5	69.5

Field strength of fundamental emissions limit:

The field strength of fundamental emissions shall not exceed 15848 micorvolts/meter at 30 meters. The Limit is converted to 124.00dBuV/m by offsetting the distance extrapolation factor as measurement distance is taken place at 3 meters.

30m to 3m

Distance extrapolation = 40 *log (30/3) = 40 dB
Limit is re-adjusted in terms of limit taken in 3m = 20 *log (15848 uV/m) + 40 = 124.00dBuV/m

30m to 10m

Distance extrapolation = 40 *log (30/10) = 19.08 dB
Limit is re-adjusted in terms of limit taken in 3m = 20 *log (15848 uV/m) + 19.08 = 103.08dBuV/m

10m to 3m

Distance extrapolation = 40 *log (10/3) = 20.92 dB
Limit is re-adjusted in terms of limit taken in 3m = 20 *log (15848 uV/m) + 20.92 = 104.92dBuV/m

1. Emission level in dBuV/m=20 log (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance below 30MHz at 10m and 3m and above 30MHz at 3m, where extrapolation factor is offset to convert the limit of the measurement.
5. KDB 414788 D01 OATS and 3m semi-anechoic chamber Justification:
   Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OATS and 3m SAC chamber testing had been performed and 3m SAC measured test result is the worst case test result.
6. Emission level in dBuV/m=20 log (μV/m)
7. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
8. The lower limit shall apply at the transition frequencies.
9. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

Radiated Mask for RSS 210 Annex B B6

(a) 15.848 millivolts/m (84 dBμV/m) at 30 m, within the band 13.553-13.567 MHz.
(b) 334 microvolts/m (50.5 dBμV/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
(c) 106 microvolts/m (40.5 dBμV/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.
(d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

Distance extrapolation = 40 *log (30/3) = 40 dB

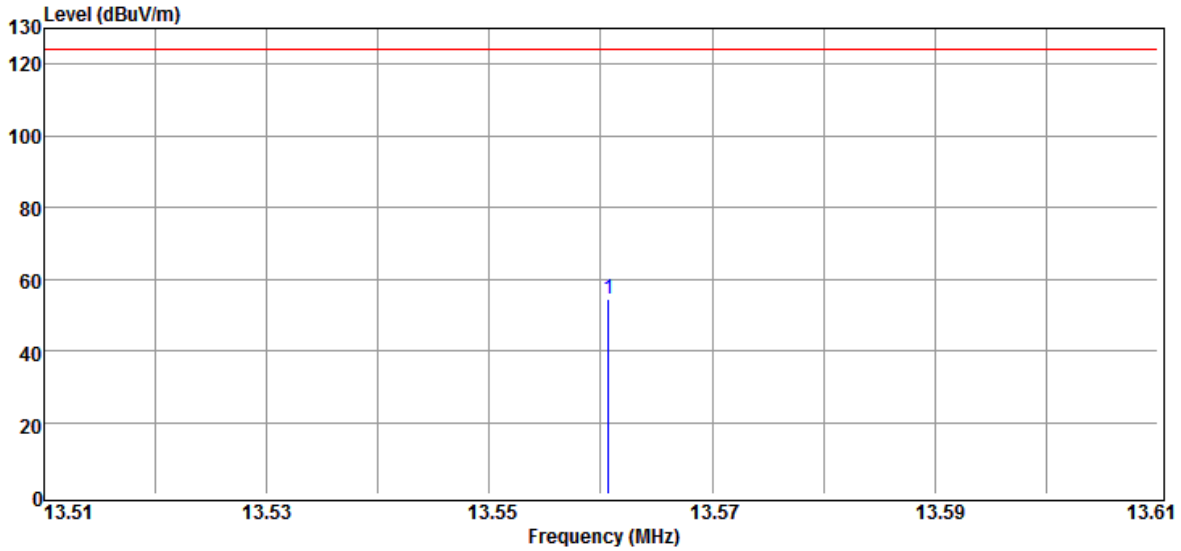
Limit is re-adjusted in terms of limit taken in 3m for the following frequency segment of the interest:

a) 20 *log (15848uV/m) + 40dB = 124.00dBuV/m
b) 20 *log(334uV/m) + 40dB = 90.47dBuV/m
c) 20*log(106uV/m) + 40dB = 80.50dBuV/m

7.5.2 Field Strength of Fundamental Emission Measurement Result

3m Chamber

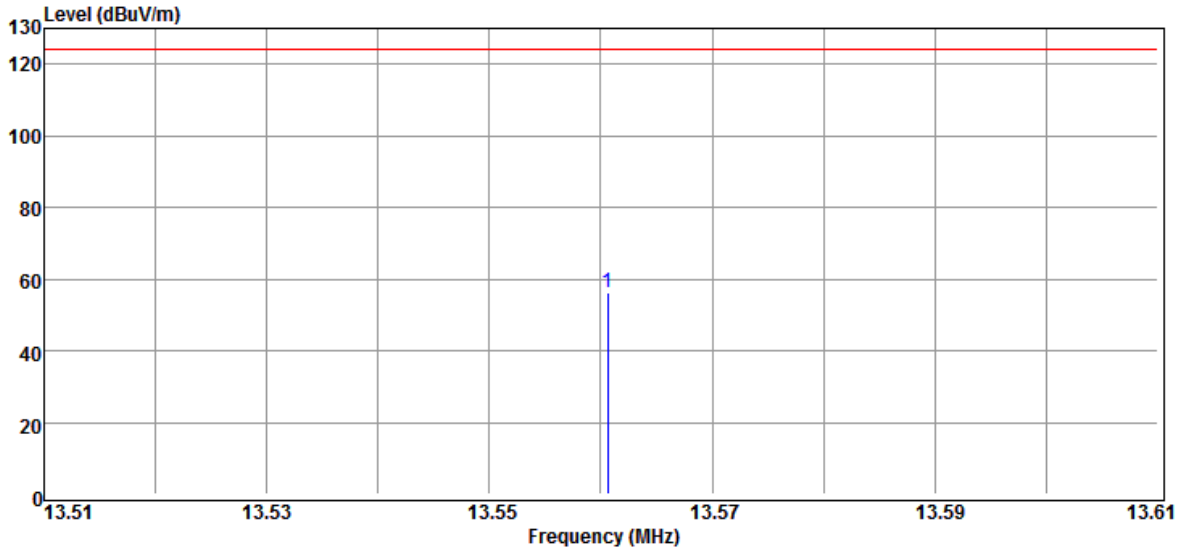
Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Main CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
13.56	Peak	42.82	11.56	54.38	124.00	-69.62

Transfer the test data from the testing distance at 3M to 30M: **14.38 dBuV/m**

Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Main CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry

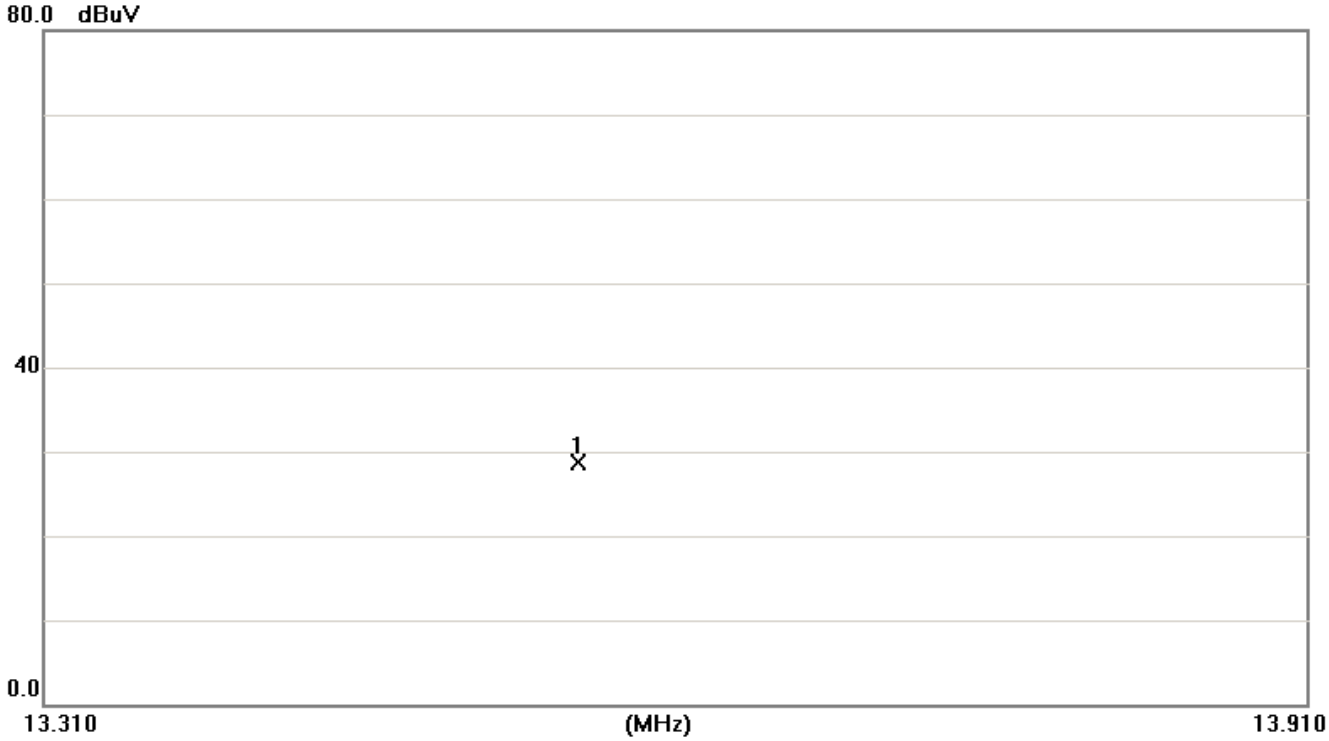


Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
13.56	Peak	44.53	11.56	56.09	124.00	-67.91

Transfer the test data from the testing distance at 3M to 30M: **16.09 dBuV/m**

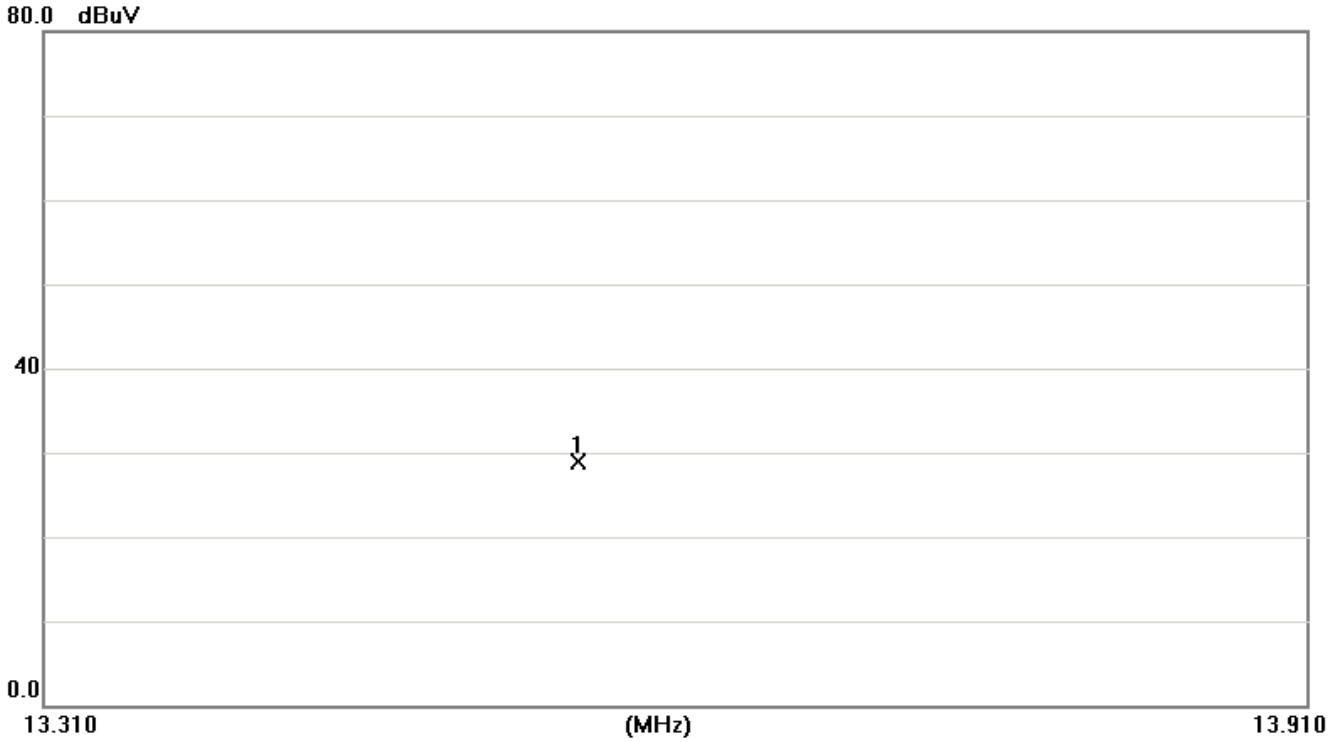
OATS:

Operation Mode :	NFC	Test Date :	2018/08/14
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	33deg_C/75RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol. :	Horizontal



No.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector
	(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)	
1	13.5600	15.93	12.79	28.72	103.08	-74.36	peak

Operation Mode :	NFC	Test Date :	2018/08/14
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	33deg_C/75RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	HORIZONTAL

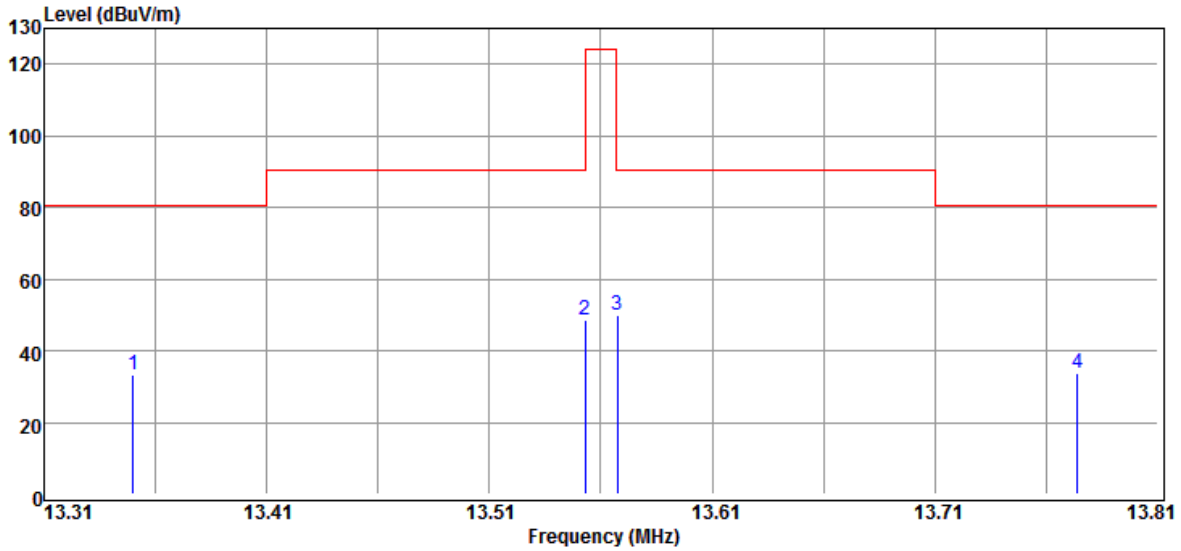


No.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector
	(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)	
1	13.5600	16.17	12.79	29.96	103.08	-73.12	peak

7.5.3 Mask Measurement Result

3m Chamber:

Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Mask CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
13.35	Peak	21.60	11.58	33.18	80.54	-47.36
13.55	Peak	36.86	11.56	48.42	90.47	-42.05
13.57	Peak	38.47	11.56	50.03	90.47	-40.44
13.77	Peak	22.01	11.55	33.56	80.50	-46.94

Transfer the test data from the testing distance at 3M to 30M:

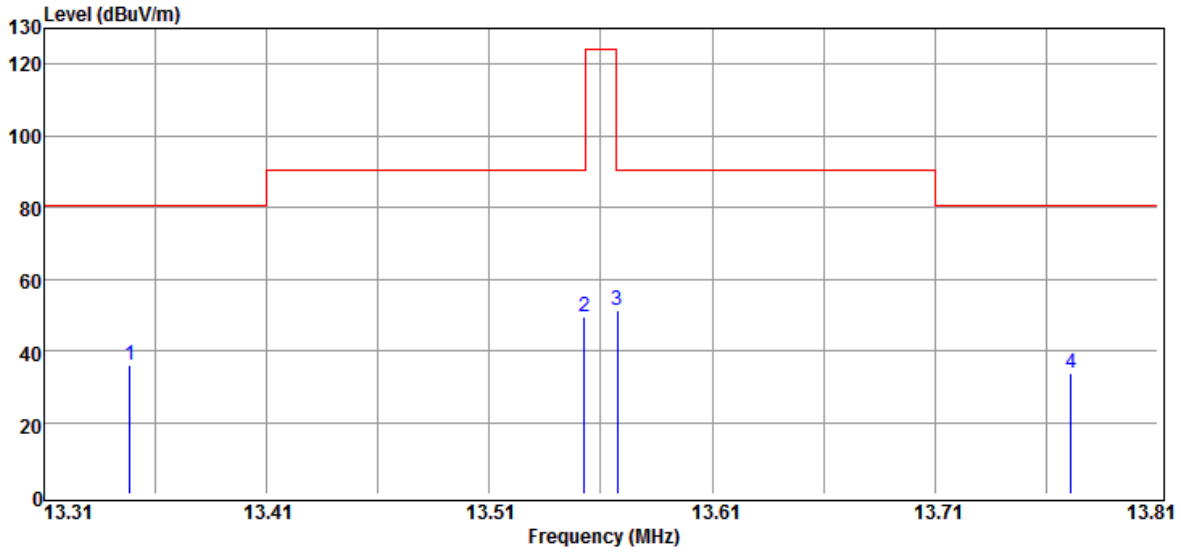
33.18-40= -6.82 dBuV/m

48.42-40= 8.42 dBuV/m

50.03-40= 10.03 dBuV/m

33.56-40= -6.44 dBuV/m

Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Mask CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
13.35	Peak	24.21	11.58	35.79	80.54	-44.75
13.55	Peak	38.00	11.56	49.56	90.47	-40.91
13.57	Peak	39.58	11.56	51.14	90.47	-39.33
13.77	Peak	22.01	11.55	33.56	80.50	-46.94

Transfer the test data from the testing distance at 3M to 30M:

35.79-40= -4.21 dBuV/m

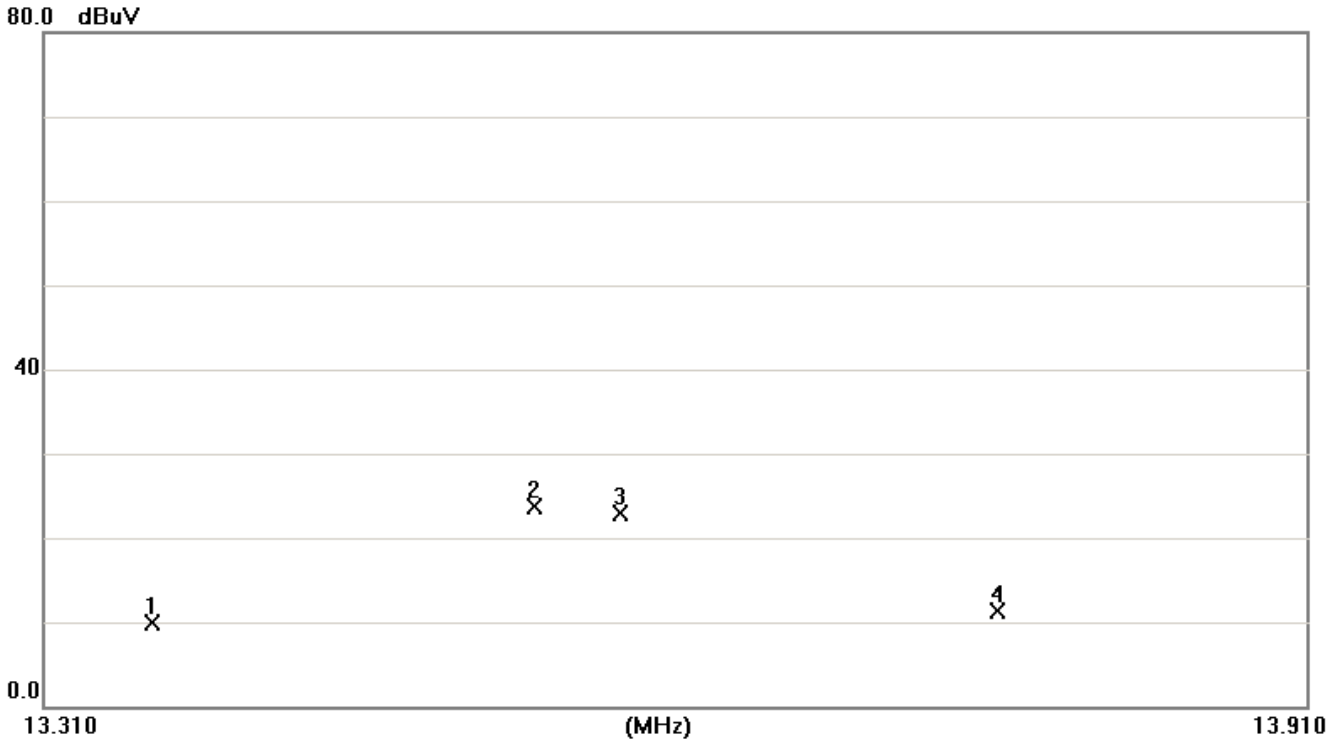
49.56-40= 9.56 dBuV/m

51.14-40= 11.14 dBuV/m

33.56-40= -6.44 dBuV/m

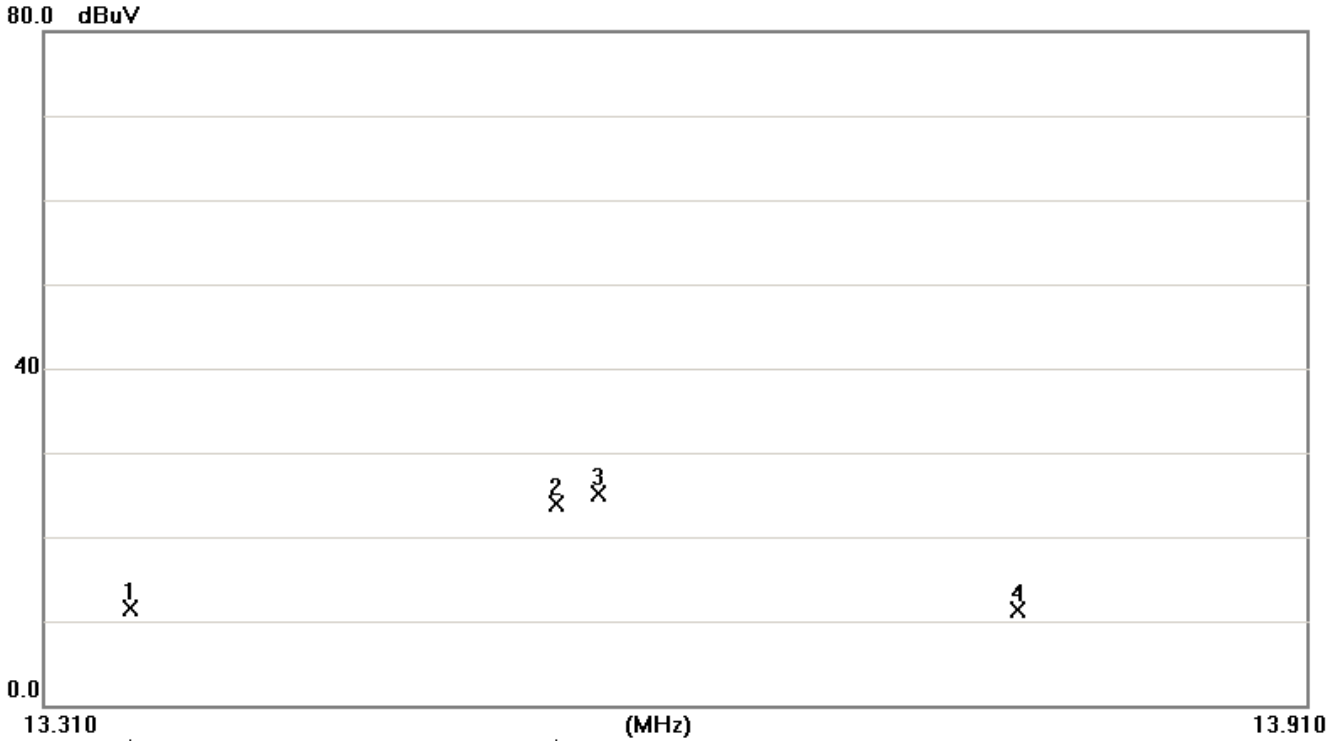
OATS:

Operation Mode :	NFC	Test Date :	2018/08/14
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	33deg_C/75RH
Operation Band :	Mask CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	VERTICAL



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.3600	-2.90	12.79	9.89	59.58	-49.69	peak
2	13.5400	11.00	12.79	23.79	69.58	-45.79	peak
3	13.5800	10.15	12.79	22.94	69.58	-46.64	peak
4	13.7600	-1.50	12.79	11.29	59.58	-48.29	peak

Operation Mode :	NFC	Test Date :	2018/08/14
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	33deg_C/75RH
Operation Band :	Mask CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	HORIZONTAL



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	13.3400	-1.10	12.80	11.70	59.58	-47.88	peak
2	13.5300	10.17	12.79	22.96	69.58	-46.62	peak
3	13.5800	11.10	12.79	23.89	69.58	-45.69	peak
4	13.7700	-1.66	12.79	11.13	59.58	-48.45	peak

7.6 Radiated Emission Measurement

7.6.1 Standard Applicable

The field strength of any emission which appear outside of 13.553~13.567MHz Band shall not exceed the general radiated emissions limits.

Frequency (MHz)	Field strength (μV/m)	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	3
88-216	150	3
216-960	200	3
Above 960	500	3

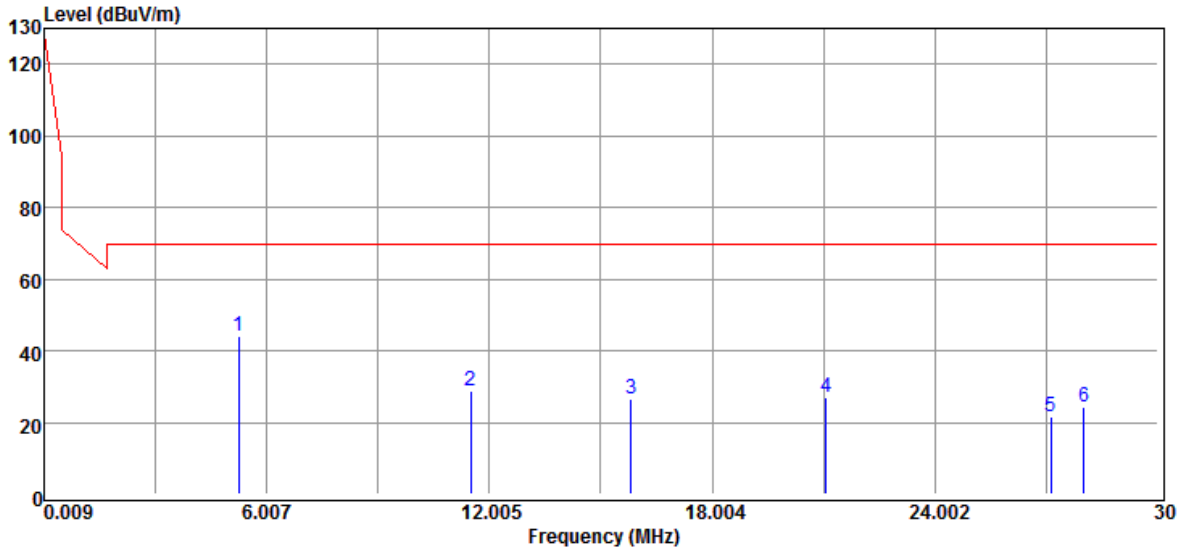
Note:

1. Emission level in dBμV/m=20 log (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

Radiated Emission Measurement Result

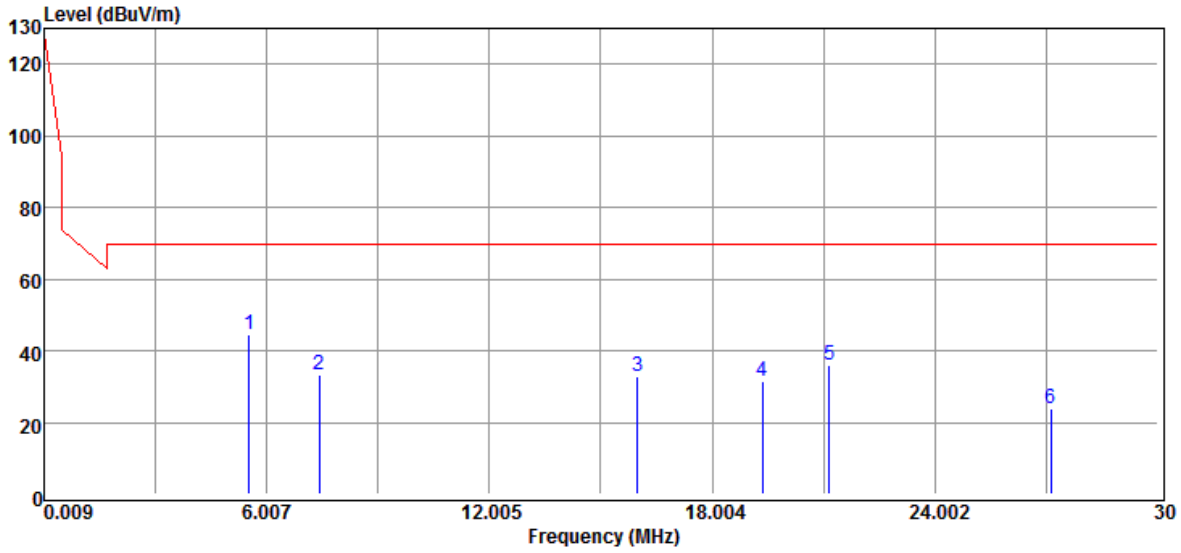
3m Chamber:

Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
5.26	Peak	32.93	11.19	44.12	69.54	-25.42
11.50	Peak	17.16	11.69	28.85	69.54	-40.69
15.81	Peak	15.05	11.45	26.50	69.54	-43.04
21.06	Peak	16.04	11.00	27.04	69.54	-42.50
27.12	Peak	11.97	9.67	21.64	69.54	-47.90
28.02	Peak	14.69	9.50	24.19	69.54	-45.35

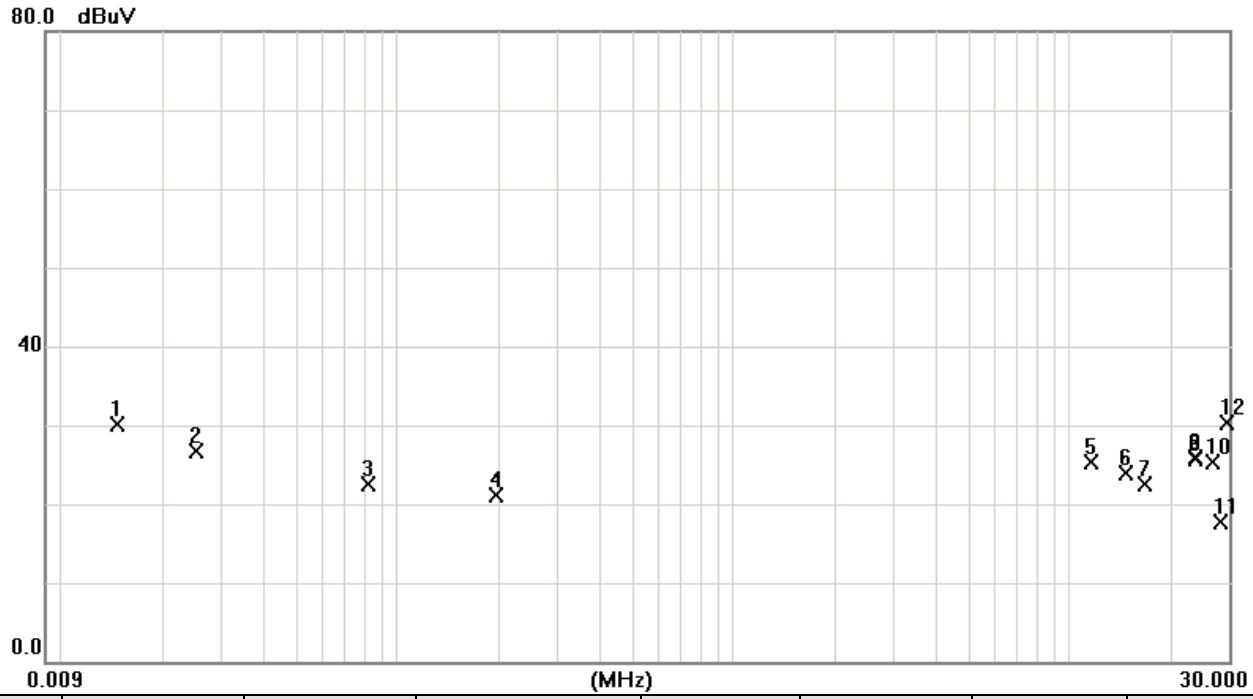
Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
5.53	Peak	33.45	11.24	44.69	69.54	-24.85
7.42	Peak	21.94	11.51	33.45	69.54	-36.09
15.99	Peak	21.30	11.44	32.74	69.54	-36.80
19.35	Peak	20.09	11.29	31.38	69.54	-38.16
21.15	Peak	24.86	10.98	35.84	69.54	-33.70
27.12	Peak	14.00	9.67	23.67	69.54	-45.87

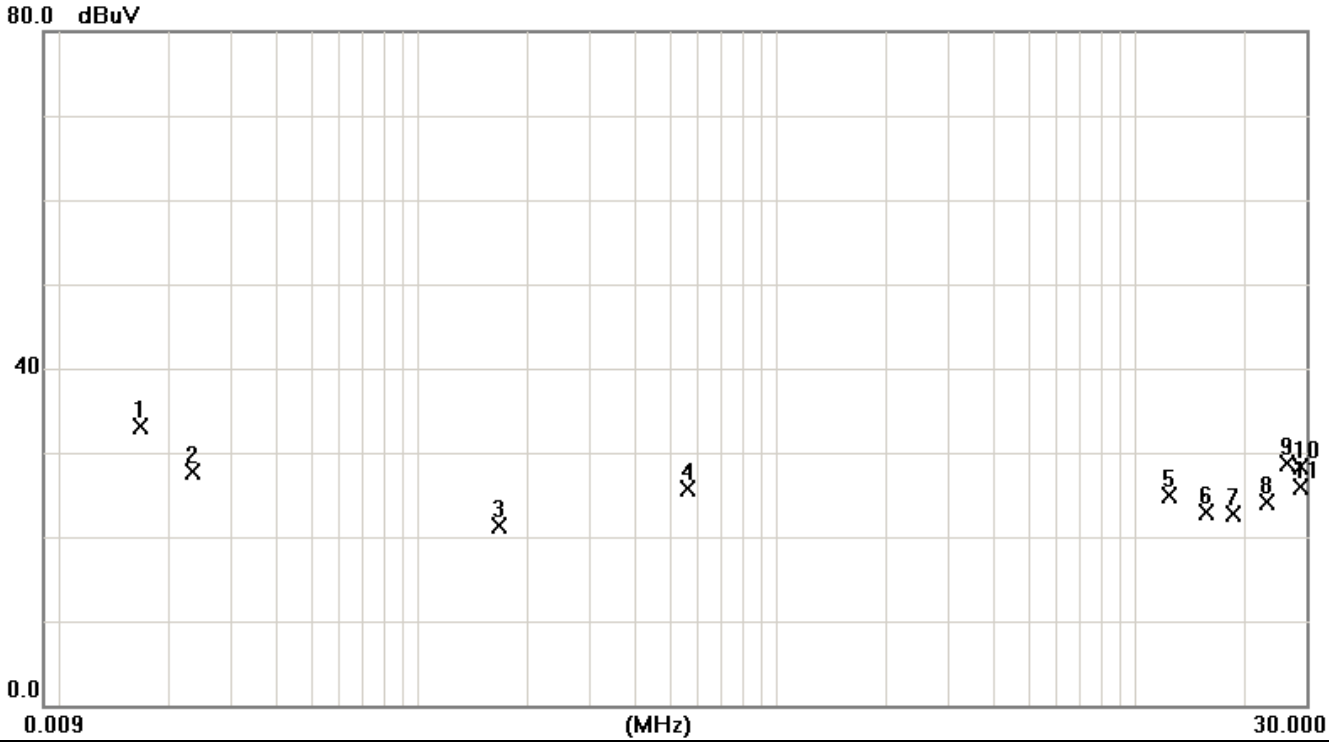
OATS:

Operation Mode :	NFC	Test Date :	2018/08/14
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	33deg_C/75RH
Operation Band :	Tx CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	VERTICAL



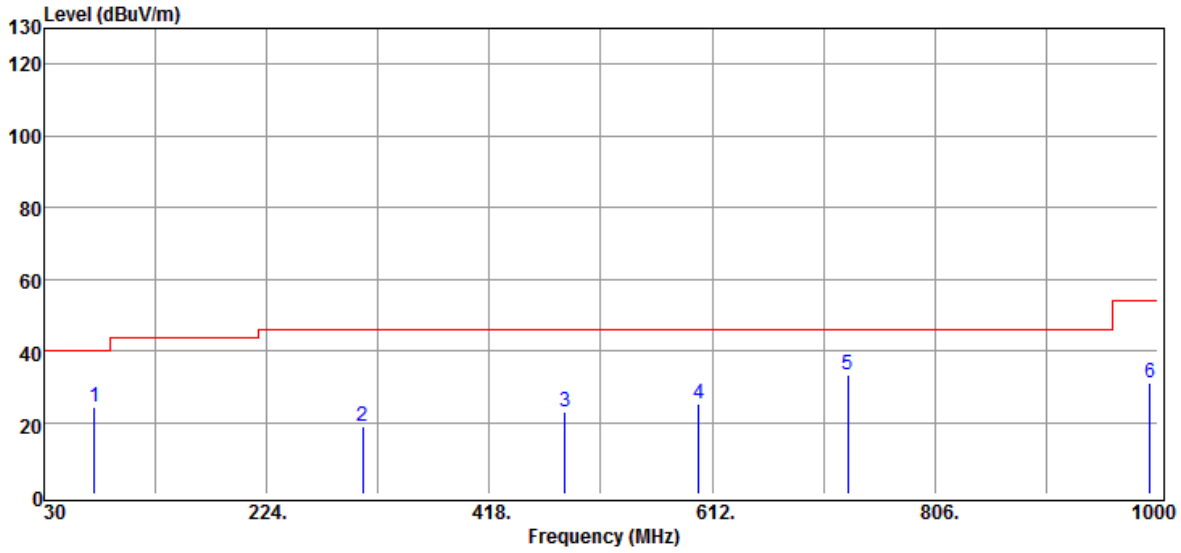
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	0.0146	12.87	17.33	30.20	103.46	-73.26	peak
2	0.0251	11.63	15.13	26.76	98.29	-71.53	peak
3	0.0815	10.10	12.34	22.44	88.51	-66.07	peak
4	0.1952	9.02	12.09	21.11	80.83	-59.72	peak
5	11.5700	12.53	12.85	25.38	48.62	-23.24	peak
6	14.6700	11.15	12.76	23.91	48.62	-24.71	peak
7	16.6500	9.83	12.70	22.53	48.62	-26.09	peak
8	23.5600	14.02	11.89	25.91	48.62	-22.71	peak
9	23.6500	13.75	11.87	25.62	48.62	-23.00	peak
10	26.7700	13.98	11.25	25.23	48.62	-23.39	peak
11	28.1000	6.66	10.98	17.64	48.62	-30.98	peak
12	29.3100	19.50	10.74	30.24	48.62	-18.38	peak

Operation Mode :	NFC	Test Date :	2018/08/14
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	33deg_C/75RH
Operation Band :	Tx CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	Horizontal



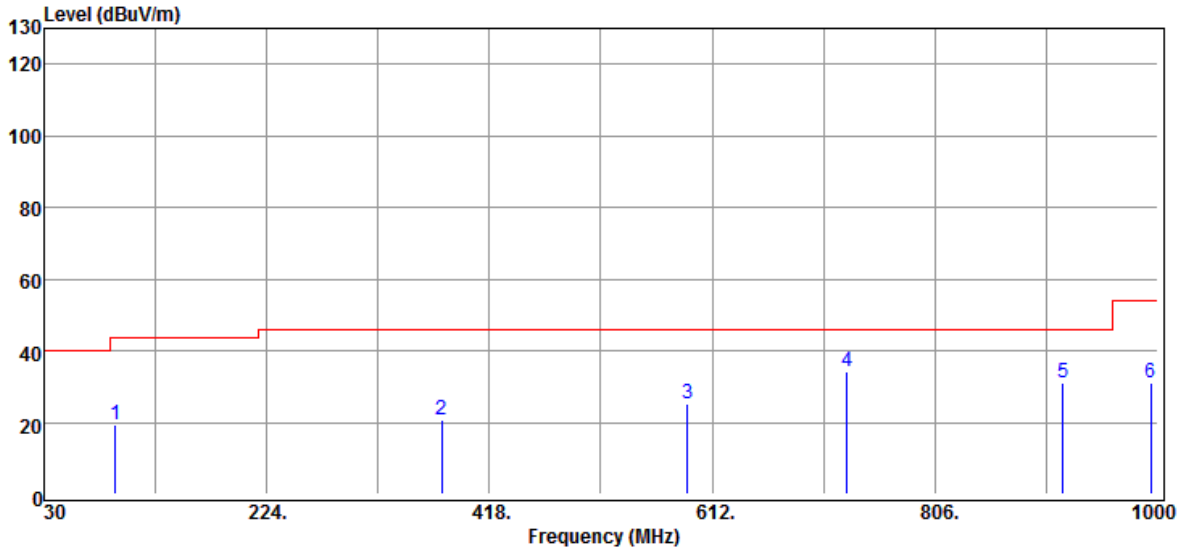
No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0168	16.21	16.87	33.08	102.33	-69.25	peak
2	0.0234	12.18	15.49	27.67	99.19	-71.52	peak
3	0.1667	9.31	12.03	21.34	82.33	-60.99	peak
4	0.5618	13.48	12.29	25.77	51.69	-25.92	peak
5	12.3400	12.01	12.83	24.84	48.62	-23.78	peak
6	15.7800	10.26	12.73	22.99	48.62	-25.63	peak
7	18.6600	10.15	12.64	22.79	48.62	-25.83	peak
8	23.1700	12.18	11.96	24.14	48.62	-24.48	peak
9	26.1800	17.36	11.36	28.72	48.62	-19.9	peak
10	28.6500	17.41	10.87	28.28	48.62	-20.34	peak
11	28.7500	15.10	10.86	25.96	48.62	-22.66	peak

Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
73.65	Peak	44.32	-20.23	24.09	40.00	-15.91
307.42	Peak	34.09	-15.05	19.04	46.00	-26.96
483.96	Peak	33.81	-11.05	22.76	46.00	-23.24
600.36	Peak	34.46	-9.14	25.32	46.00	-20.68
730.34	Peak	40.62	-7.26	33.36	46.00	-12.64
993.21	Peak	34.69	-3.84	30.85	54.00	-23.15

Operation Mode	:NFC	Test Date	:2018-08-02
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
92.08	Peak	42.04	-22.63	19.41	43.50	-24.09
376.29	Peak	34.06	-13.31	20.75	46.00	-25.25
590.66	Peak	34.10	-8.75	25.35	46.00	-20.65
729.37	Peak	41.29	-7.30	33.99	46.00	-12.01
917.55	Peak	35.37	-4.47	30.90	46.00	-15.10
994.18	Peak	34.94	-3.83	31.11	54.00	-22.89

8 FREQUENCY STABILITY

8.1 Standard Applicable

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

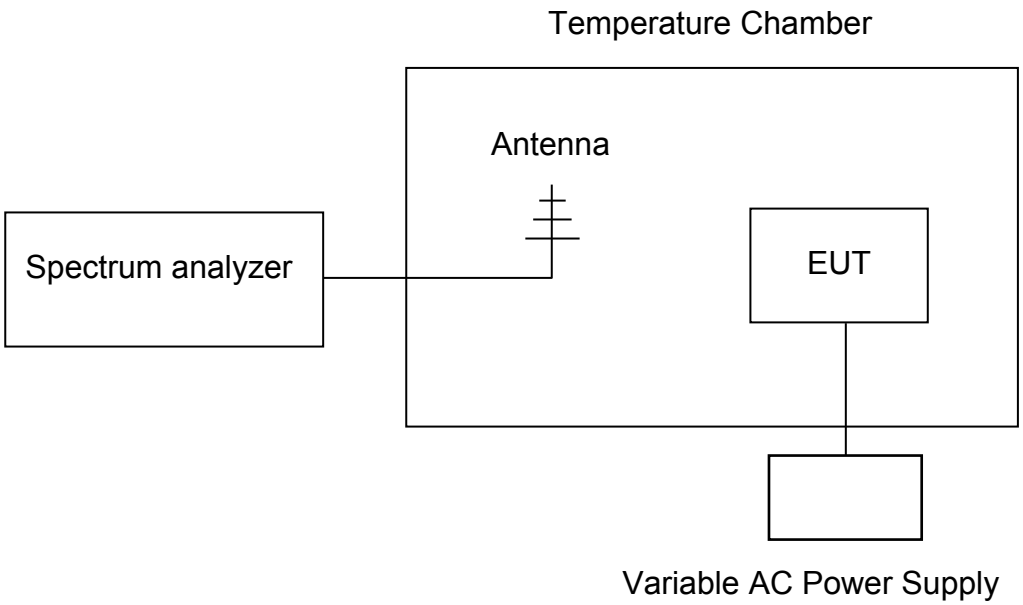
Carrier frequency stability shall be maintained to ±0.01% (±100 ppm).

For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F).

8.2 Measurement Procedure

1. The EUT was placed inside temperature chamber and powered by nominal DC voltage.
2. Set EUT as normal operation.
3. Turn the EUT on and couple its output to spectrum.
4. Turn the EUT off and set the chamber to the highest temperature specified.
5. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT and measure the operating frequency.
6. Repeat step with the temperature chamber set to the lowest temperature.
7. Set spectrum Center Frequency = fundamental frequency, RBW, VBW= 10 kHz, Span =100 kHz, Detector =Max hold, Mark peak.

8.3 Test SET-UP



8.4 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	N9010A	MY53400256	2017/10/25	2018/10/24
Temperature Chamber	TERCHY	MHK-120LK	1020582	2018/07/10	2019/07/09
DC Power Supply	Agilent	E3640A	MY53140006	2018/04/29	2019/04/28
Loop Antenna	ETS-Lindgren	6502	00143303	2018/04/19	2019/04/18

8.5 Measurement Results:

Startup:

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
7.66	-20	13.5597	0.40000	+/- 1.356
7.66	-10	13.5597	0.40000	+/- 1.356
7.66	0	13.5598	0.30000	+/- 1.356
7.66	10	13.56	0.10000	+/- 1.356
7.66	20	13.5601	0.00000	+/- 1.356
7.66	30	13.5601	0.00000	+/- 1.356
7.66	40	13.5604	-0.30000	+/- 1.356
7.66	50	13.5605	-0.40000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (KHz)	Limit (KHz)
8.8	20	13.5604	-0.30000	+/- 1.356
7.66	20	13.5601	0.00000	+/- 1.356
6	20	13.5596	0.50000	+/- 1.356

2 minutes:

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (Hz)	Limit (KHz)
7.66	-20	13.5606	200.00000	+/- 1.356
7.66	-10	13.5607	100.00000	+/- 1.356
7.66	0	13.5605	300.00000	+/- 1.356
7.66	10	13.5607	100.00000	+/- 1.356
7.66	20	13.5608	0.00000	+/- 1.356
7.66	30	13.5608	0.00000	+/- 1.356
7.66	40	13.5606	200.00000	+/- 1.356
7.66	50	13.5607	100.00000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (Hz)	Limit (KHz)
8.8	20	13.5608	-100.00000	+/- 1.356
7.66	20	13.5607	0.00000	+/- 1.356
6.51	20	13.5609	-200.00000	+/- 1.356

5 minutes:

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (Hz)	Limit (KHz)
7.66	-20	13.5605	200.00000	+/- 1.356
7.66	-10	13.5606	100.00000	+/- 1.356
7.66	0	13.5605	200.00000	+/- 1.356
7.66	10	13.5606	100.00000	+/- 1.356
7.66	20	13.5607	0.00000	+/- 1.356
7.66	30	13.5608	-100.00000	+/- 1.356
7.66	40	13.5607	0.00000	+/- 1.356
7.66	50	13.5606	100.00000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (Hz)	Limit (KHz)
8.8	20	13.5607	0.00000	+/- 1.356
7.66	20	13.5607	0.00000	+/- 1.356
6.51	20	13.5606	100.00000	+/- 1.356

10 minutes:

A. Temperature Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (Hz)	Limit (KHz)
7.66	-20	13.5604	200.00000	+/- 1.356
7.66	-10	13.5605	100.00000	+/- 1.356
7.66	0	13.5605	100.00000	+/- 1.356
7.66	10	13.5605	100.00000	+/- 1.356
7.66	20	13.5606	0.00000	+/- 1.356
7.66	30	13.5606	0.00000	+/- 1.356
7.66	40	13.5605	100.00000	+/- 1.356
7.66	50	13.5606	0.00000	+/- 1.356

B. Supply Voltage Variation

Power Supply Vdc	Environment Temperature (℃)	Frequency (MHz)	Delta (Hz)	Limit (KHz)
8.8	20	13.5605	200.00000	+/- 1.356
7.66	20	13.5607	0.00000	+/- 1.356
6.51	20	13.5607	0.00000	+/- 1.356

9 20 dB & 99% OCCUPIED BANDWIDTH MEASUREMENT

9.1 Standard Applicable:

The 20 dB bandwidth shall be specified in operating frequency band.

9.2 Limit:

None

9.3 Test Set-up

Refer to section 7.2 in this report

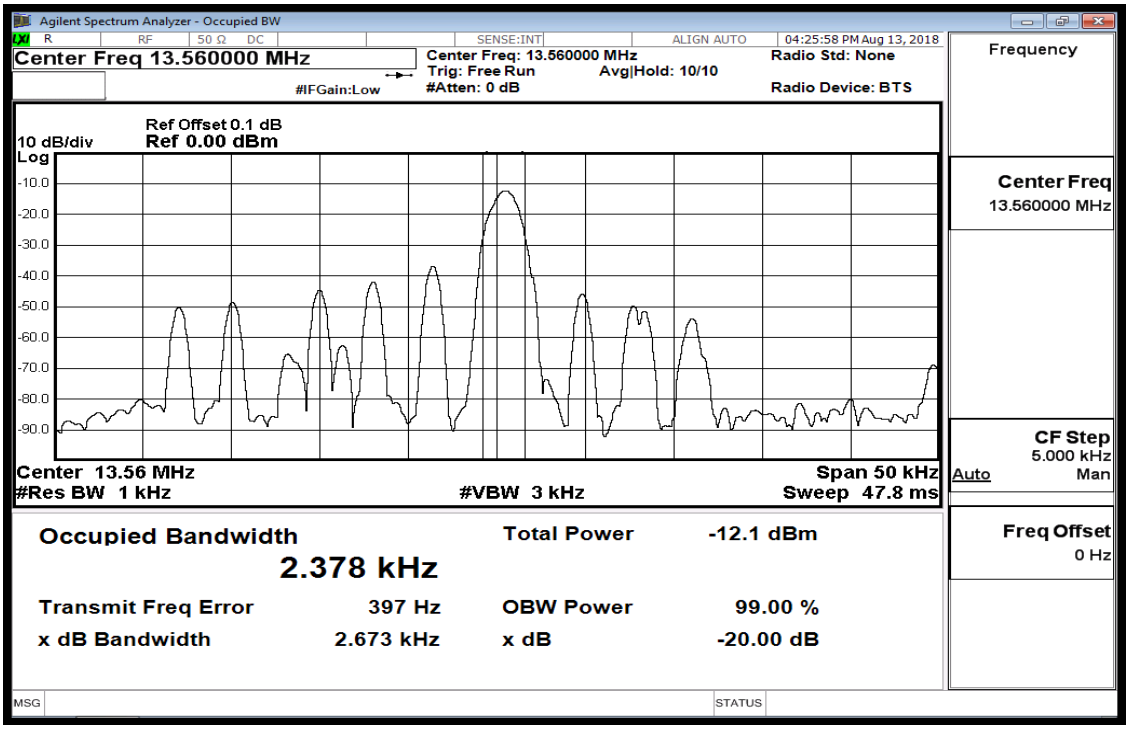
9.4 Measurement Procedure

1. Placed the EUT on the testing table.
2. Set the EUT under transmission condition continuously at specific channel frequency.
3. 20dB Bandwidth the resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
4. Measured the spectrum width with power higher than 20dB below carrier.

9.5 Measurement Equipment Used

Refer to section 7.3 in this report

9.6 Measurement Result:



10 ANTENNA REQUIREMENT

10.1. Standard Applicable

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 of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer.
For transmitters of RF output power of 10 milliwatts or less, only the portion of the antenna gain that is in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power to demonstrate compliance with the radiated power limits specified in the applicable standard. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power limits.

According to RSS-GEN 8.3
The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.
Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.9 When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

10.2. Antenna Connected Construction

The antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

~ End of Report ~