

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.: 1824

Model Difference: N/A

FCC ID: C3K1824

IC: 3048A-1824

Report Number: E2/2018/10174

FCC Rule Part: §15.225

IC Rule: RSS-210 issue 9 Aug. 2016

Issue Date: Jun. 08, 2018

Date of Test: Jan. 17, 2018 ~ Jun. 08, 2018

Date of EUT Received: Jan. 17, 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 / Asst. Manager



Testing Laboratory
0513

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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/10174	Rev.00	Initial creation of document	All	Jun. 08, 2018	Tiffany Kao

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1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Portable Computing Device	
Brand Name:	Microsoft	
Model No.:	1824	
Model Difference:	N/A	
Product SW/HW version:	Windows 10 Pro / EV1824	
Radio SW/HW version:	12.0.0.461 / V3.2	
Test SW Version:	N/A	
RF power setting in TEST SW:	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

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.225

IC RSS 210 issue 9 Aug. 2016 Annex B

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.

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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 tag close to EUT NFC Antenna, in order to manipulate the EUT into continued exercised and transmit operation in normal 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. 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. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through one orthogonal axe and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 AC Power Line Conducted Emission

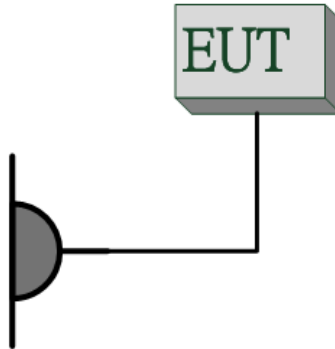


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model / Type No.	Series No.	Data Cable	Power Cord
1.	---					

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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 transmitting 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. Investigation has been done on all the possible configurations for searching the worst case.

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.

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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.

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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

- The lower limit shall apply at the transition frequencies
- 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.
EMI Test Receiver	R&S	ESCI 7	100950	12/24/2017	12/23/2018
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	08/30/2016	08/29/2017
LISN	Schwarzbeck	NSLK 8127	8127-648	06/13/2017	06/12/2018
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.

6.3 EUT Setup:

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

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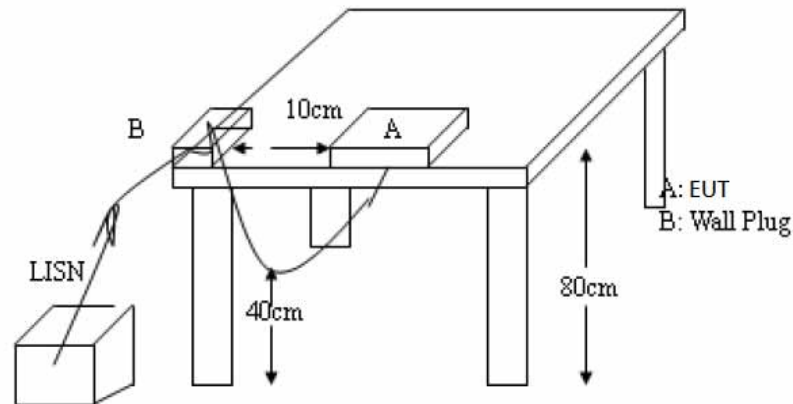
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6.4 Test SET-UP (Block Diagram of Configuration)



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.

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

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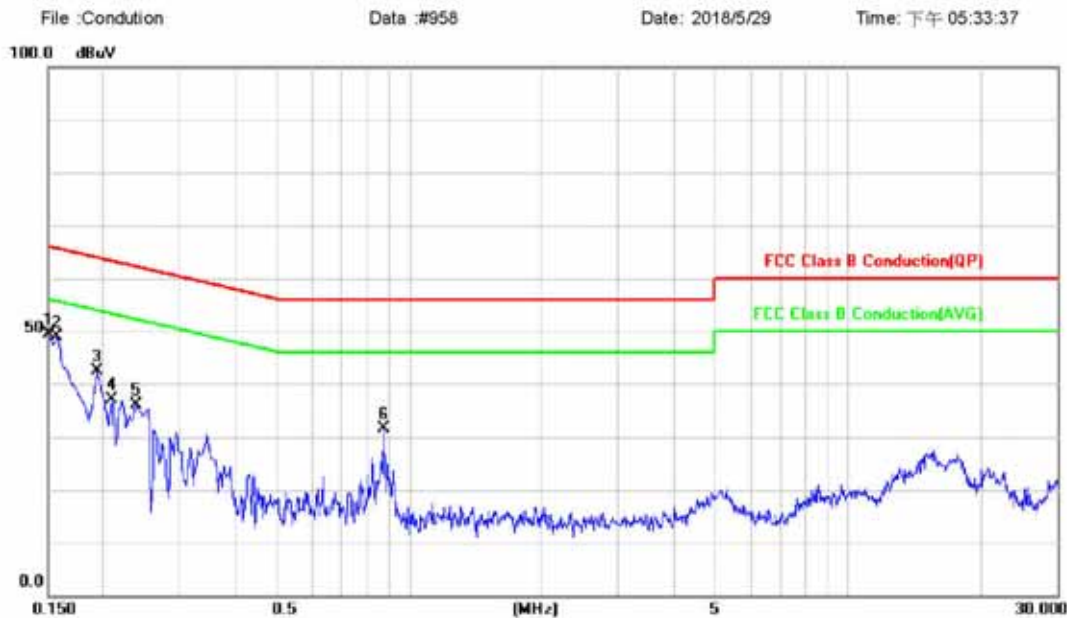
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test By:	Jerry
-----------------	----------------	----------	-------

Site : Conduction Room	Phase: L1	Temperature: 25 ℃
Limit: FCC Class B Conduction(QP)	Power: AC 120V/60Hz	Humidity: 85 %
Mode:		
Note:		

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1500	39.68	9.70	49.38	66.00	-16.62	peak	
2		0.1580	39.16	9.70	48.86	65.57	-16.71	peak	
3		0.1940	32.60	9.70	42.30	63.86	-21.56	peak	
4		0.2100	27.37	9.72	37.09	63.21	-26.12	peak	
5		0.2380	26.36	9.79	36.15	62.17	-26.02	peak	
6		0.8740	21.66	9.96	31.62	56.00	-24.38	peak	

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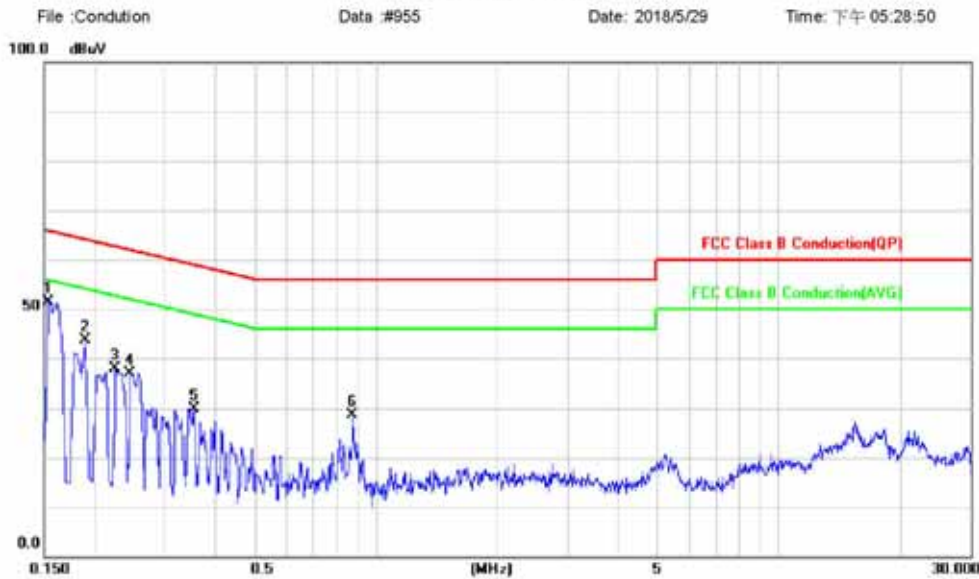
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Site : Conduction Room Phase: **N** Temperature: 25 °C
 Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 85 %
 Mode:
 Note:

Conducted Emission



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Comment
		MHz	dBuV	dB	dBuV	dBuV	dB		
1	*	0.1548	41.69	9.70	51.39	65.74	-14.35	peak	
2		0.1900	33.98	9.70	43.68	64.04	-20.36	peak	
3		0.2260	28.14	9.76	37.90	62.60	-24.70	peak	
4		0.2460	27.14	9.81	36.95	61.89	-24.94	peak	
5		0.3540	19.92	10.08	30.00	58.87	-28.87	peak	
6		0.8780	18.79	9.96	28.75	56.00	-27.25	peak	

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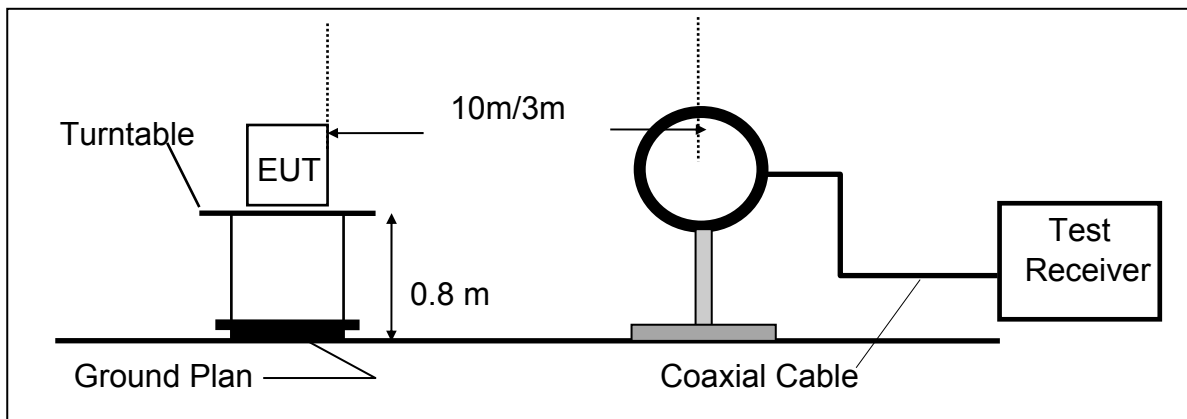
7 RADIATED TEST ITEMS

7.1 Measurement Procedure

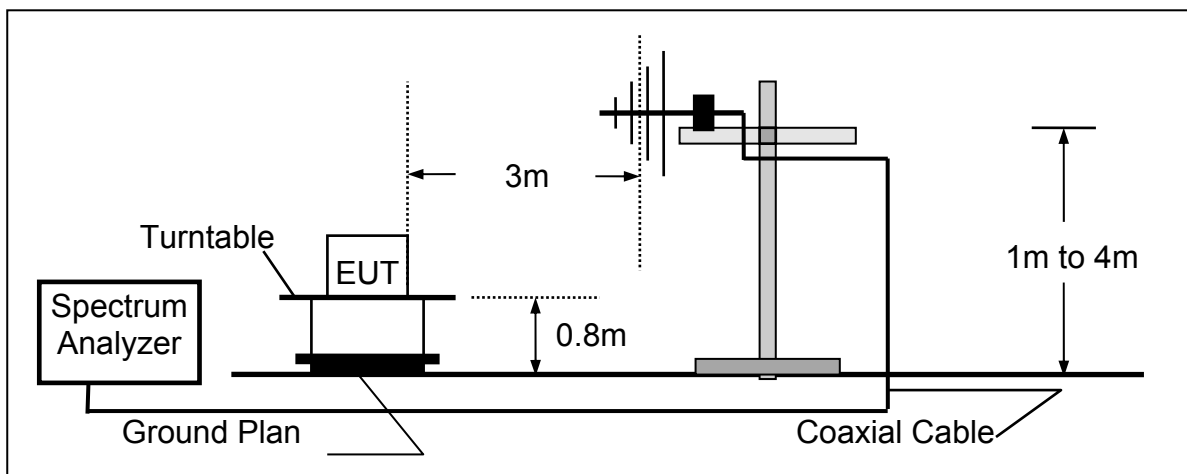
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out 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



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7.3 Measurement Equipment Used

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESU 40	100363	04/11/2018	04/10/2019
Loop Antenna	ETS-Lindgren	6502	00143303	12/04/2017	12/03/2018
Broadband Antenna	TESEQ	CBL 6112D	35240	11/03/2017	11/02/2018
Pre Amplifier	EMC Instruments	EMC330	980096	12/24/2017	12/23/2018
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/24/2017	12/23/2018
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/24/2017	12/23/2018
Site NSA	SGS	966 Chamber C	SAC-C	03/02/2018	03/01/2019
Site VSWR	SGS	966 Chamber C	SAC-C	03/02/2018	03/01/2019
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2017	05/03/2018
Controller	MF	MF-7802	N/A	N.C.R.	N.C.R.
Antenna Master	MF	N/A	N/A	N.C.R.	N.C.R.
Turn Table	MF	N/A	N/A	N.C.R.	N.C.R.
Test Software	World-Pallas	Dr. E	V 3.0 Lite	N.C.R.	N.C.R.

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2018	05/03/2019

Note: The measurement was taken place with the long duration of the time, and additional equipment list as shown above indicate those equipment of which has been subject to undertake the calibration in intermediate period of time of the measurement.

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Open Area Test Site

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

SGS Open Area Test Site No.1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI 3	101342	12/21/2017	12/20/2018
Pre Amplifier	EMC Instruments	EMC330	980122	06/09/2017	06/08/2018
Broadband Antenna	TESEQ	CBL 6112D	23189	05/23/2017	05/22/2018
Loop Antenna	ETS-Lindgren	6502	00143303	12/04/2017	12/03/2018
Coaxial Cable	Huber+Suhner	RG 214	30m	06/22/2017	06/21/2018
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	06/13/2017	06/12/2018
Test S/W	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.

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 $20 \cdot \log(\mu\text{V}/\text{m})$

Actual FS(dB μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note :

“F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

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7.5 Field Strength of Fundamental Emissions and Mask Measurement

7.5.1 Standard Applicable

Limit:

Rules and specifications	CFR 47 Part 15 section 15.225(a)-(d)		
	Frequency of Emission (MHz)	Field Strength ($\mu\text{V/m}$) at 30m	Field Strength ($\text{dB}\mu\text{V/m}$) at 30m
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 microrvolts/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 = $40 \cdot \log(30/3) = 40 \text{ dB}$

Limit is re-adjusted in terms of limit taken in 3m = $20 \cdot \log(15848 \text{ uV/m}) + 40 = 124.00\text{dBuV/m}$

30m to 10m

Distance extrapolation = $40 \cdot \log(30/10) = 19.08 \text{ dB}$

Limit is re-adjusted in terms of limit taken in 3m = $20 \cdot \log(15848 \text{ uV/m}) + 19.08 = 103.08\text{dBuV/m}$

10m to 3m

Distance extrapolation = $40 \cdot \log(10/3) = 20.92 \text{ dB}$

Limit is re-adjusted in terms of limit taken in 3m = $20 \cdot \log(15848 \text{ uV/m}) + 20.92 = 104.92\text{dBuV/m}$

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1. Emission level in dBuV/m=20 log (μ V/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 (μ V/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.

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Radiated Mask for RSS 210 Annex B B6

- (a) 15.848 millivolts/m (84 dB μ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB μ V/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB μ V/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 = $40 \cdot \log(30/3) = 40$ dB

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

- a) $20 \cdot \log(15848\text{uV/m}) + 40\text{dB} = 124.00\text{dBuV/m}$
- b) $20 \cdot \log(334\text{uV/m}) + 40\text{dB} = 90.47\text{dBuV/m}$
- c) $20 \cdot \log(106\text{uV/m}) + 40\text{dB} = 80.50\text{dBuV/m}$

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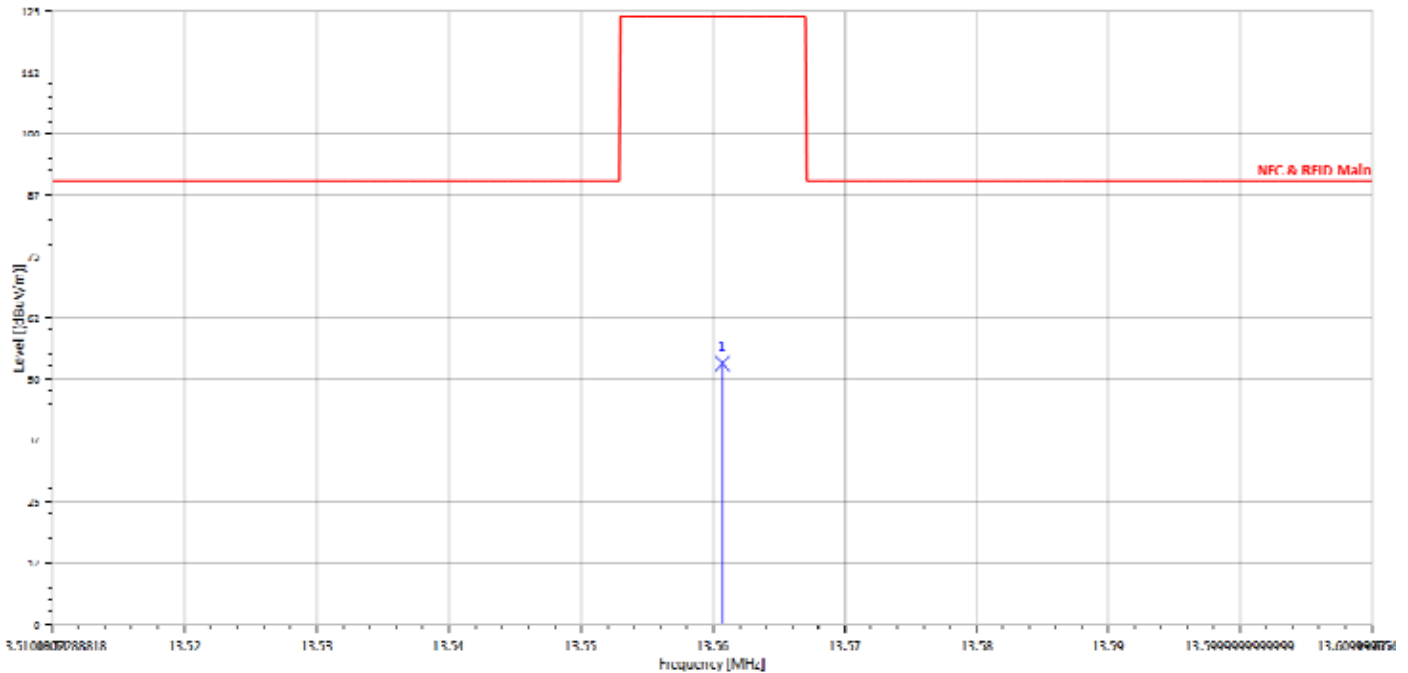
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7.5.2 Field Strength of Fundamental Emission Measurement Result 3m Chamber

Operation Mode :	NFC	Test Date :	2018/4/18
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol. :	Vertical



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
13.56	F	Peak	41.42	11.67	53.08	124	-70.92

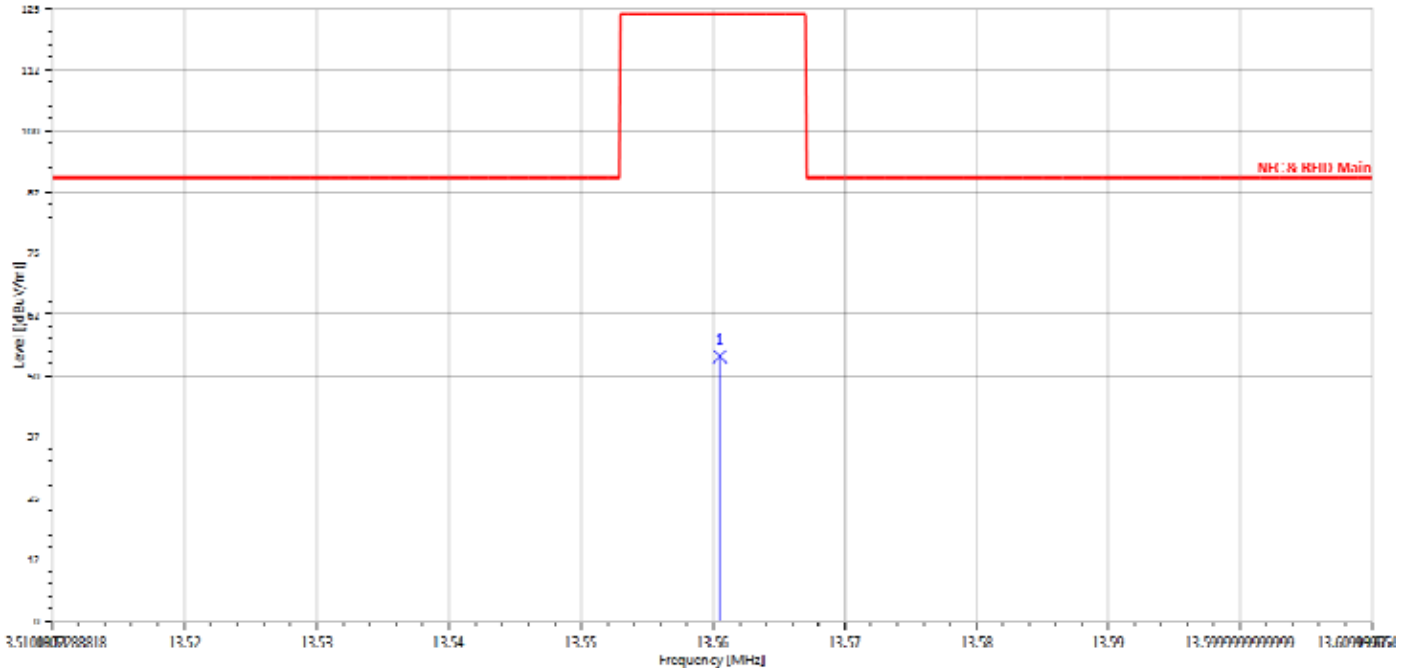
Transfer the test data from the testing distance at 3M to 30M: **13.08 dBuV/m**

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Operation Mode : NFC Test Date : 2018/4/18
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Main CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.56	F	Peak	42.25	11.67	53.92	123.9	-69.98

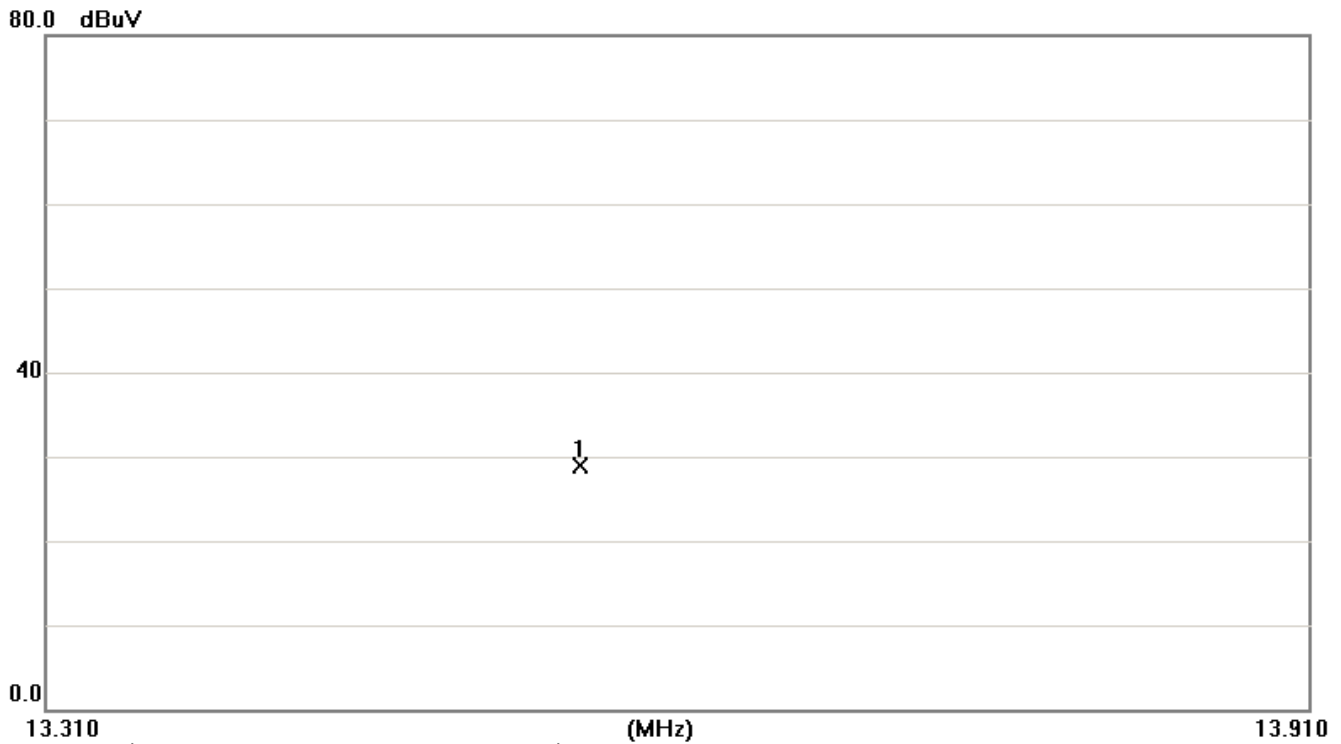
Transfer the test data from the testing distance at 3M to 30M: **13.92 dBuV/m**

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OATS:

Operation Mode :	NFC	Test Date :	2018/05/23
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol. :	Horizontal



No.	Freq. (MHz)	Reading dBuV	Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector
1	13.5600	16.10	12.79	28.89	103.08	-74.19	peak

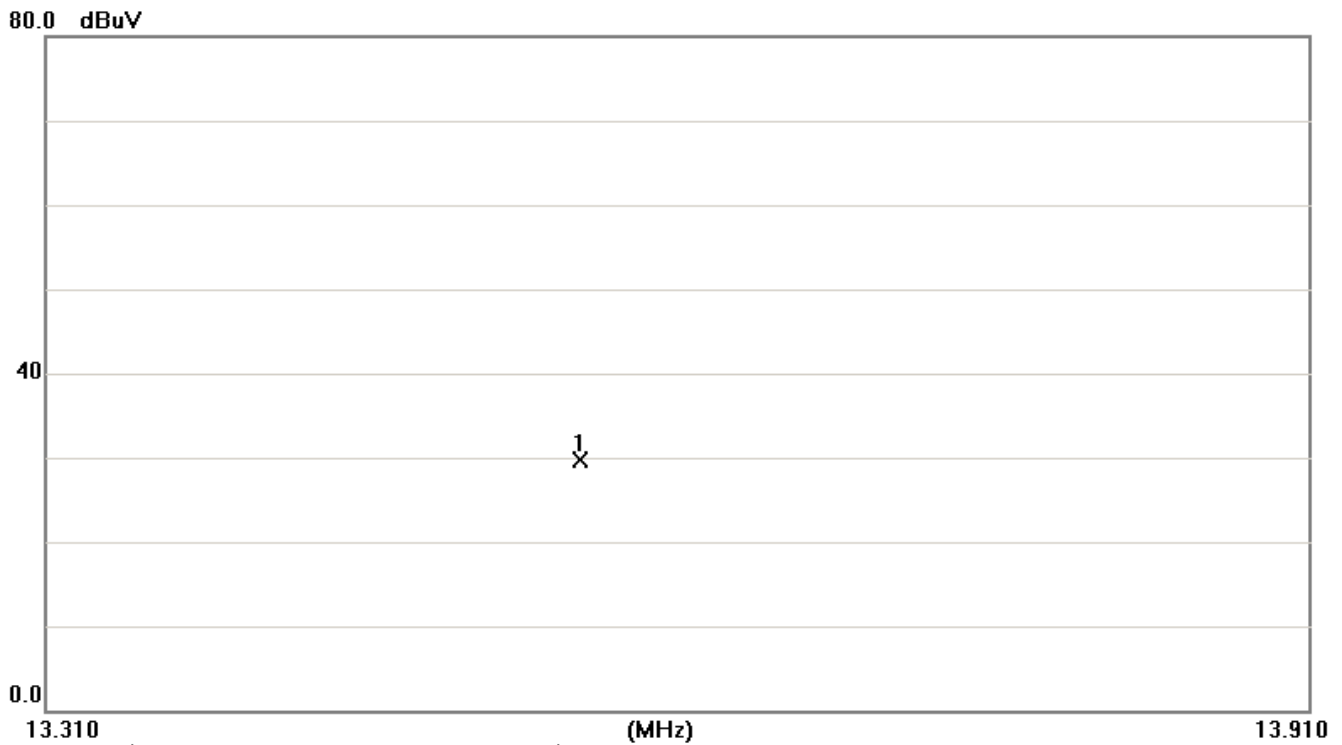
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Operation Mode :	NFC	Test Date :	2018/05/23
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	HORIZONTAL



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	13.5600	16.90	12.79	29.69	103.08	-73.39	peak

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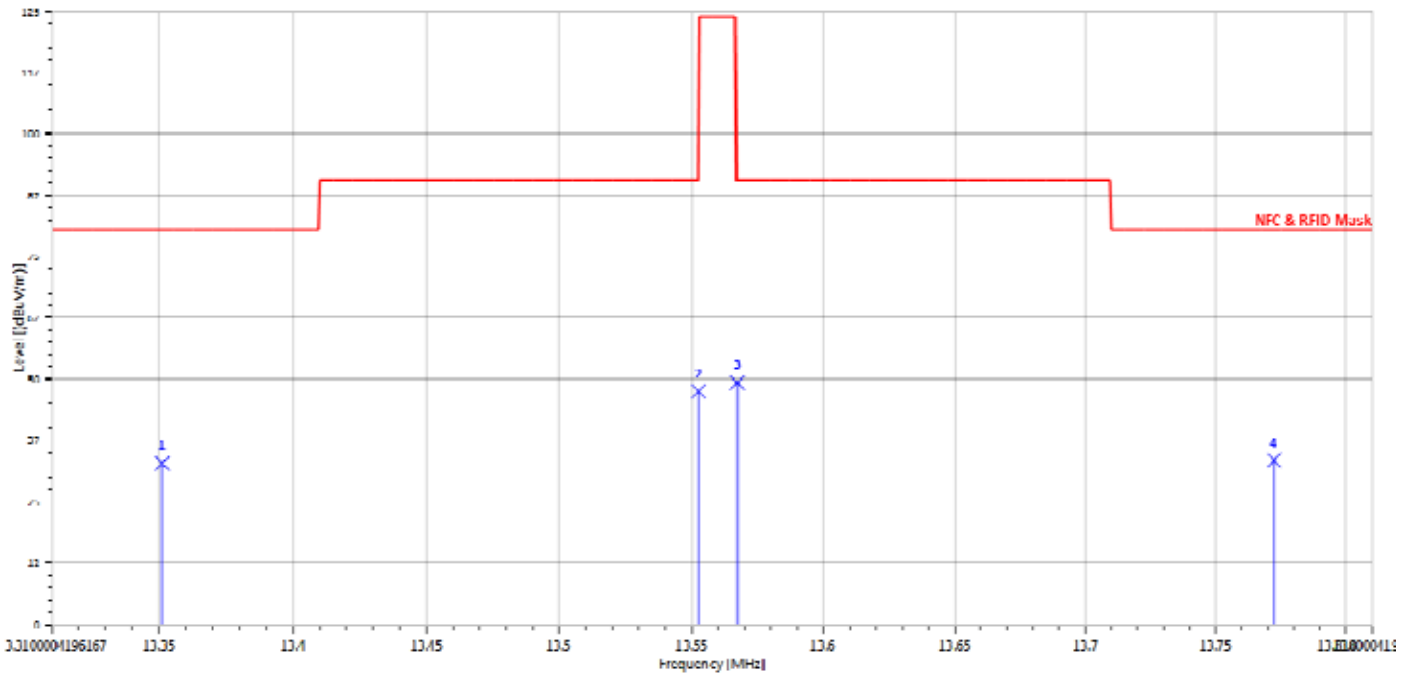
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7.5.3 Mask Measurement Result

3m Chamber:

Operation Mode :	NFC	Test Date :	2018/4/18
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Mask CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
13.35	S	Peak	21.15	11.67	32.82	80.5	-47.68
13.55	S	Peak	35.84	11.67	47.50	90.47	-42.97
13.57	S	Peak	37.60	11.67	49.26	90.47	-41.21
13.77	S	Peak	21.78	11.66	33.44	80.5	-47.06

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

$$32.82-40= -7.18 \text{ dBuV/m}$$

$$47.50-40= 7.50 \text{ dBuV/m}$$

$$49.26-40= 9.26 \text{ dBuV/m}$$

$$33.44-40= -6.56 \text{ dBuV/m}$$

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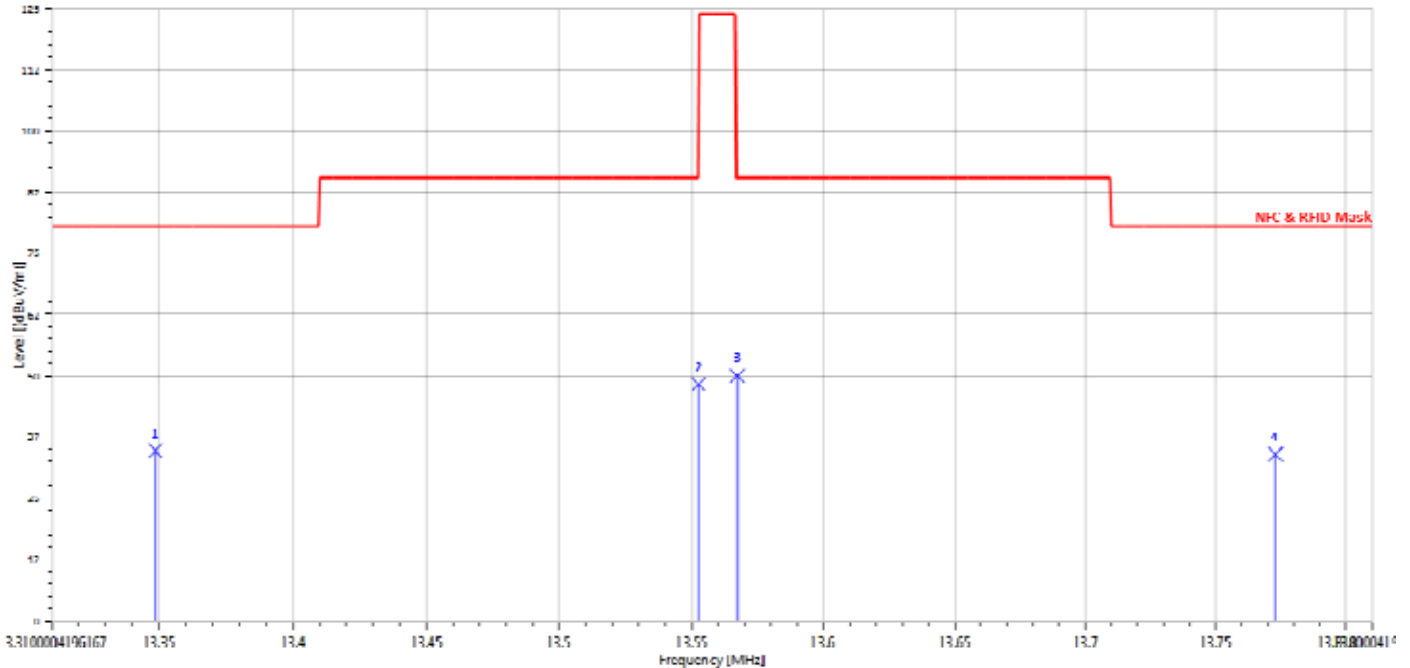
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Operation Mode : NFC Test Date : 2018/4/18
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Mask CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol. : Horizontal



Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
13.35	S	Peak	23.02	11.67	34.69	80.5	-45.81
13.55	S	Peak	36.57	11.67	48.24	90.47	-42.23
13.57	S	Peak	38.31	11.67	49.98	90.47	-40.49
13.77	S	Peak	22.29	11.66	33.95	80.5	-46.55

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

- 34.69-40= -5.31 dBuV/m
- 48.24-40= 8.24 dBuV/m
- 49.98-40= 9.98 dBuV/m
- 33.95-40= -6.05 dBuV/m

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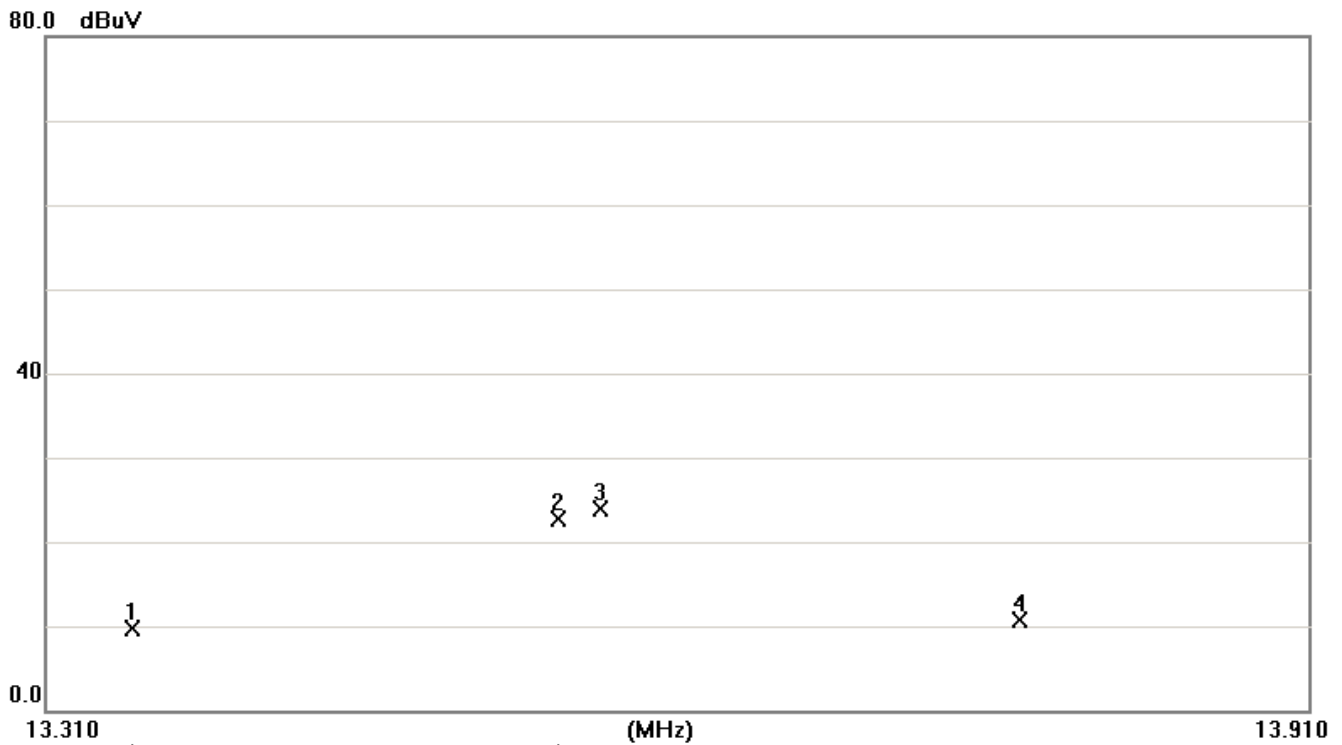
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OATS:

Operation Mode :	NFC	Test Date :	2018/05/23
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	VERTICAL



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	13.3500	-3.00	12.80	9.80	59.58	-49.78	peak
2	13.5500	10.00	12.79	22.79	69.58	-46.79	peak
3	13.5700	11.20	12.79	23.99	69.58	-45.59	peak
4	13.7700	-2.00	12.79	10.79	59.58	-48.79	peak

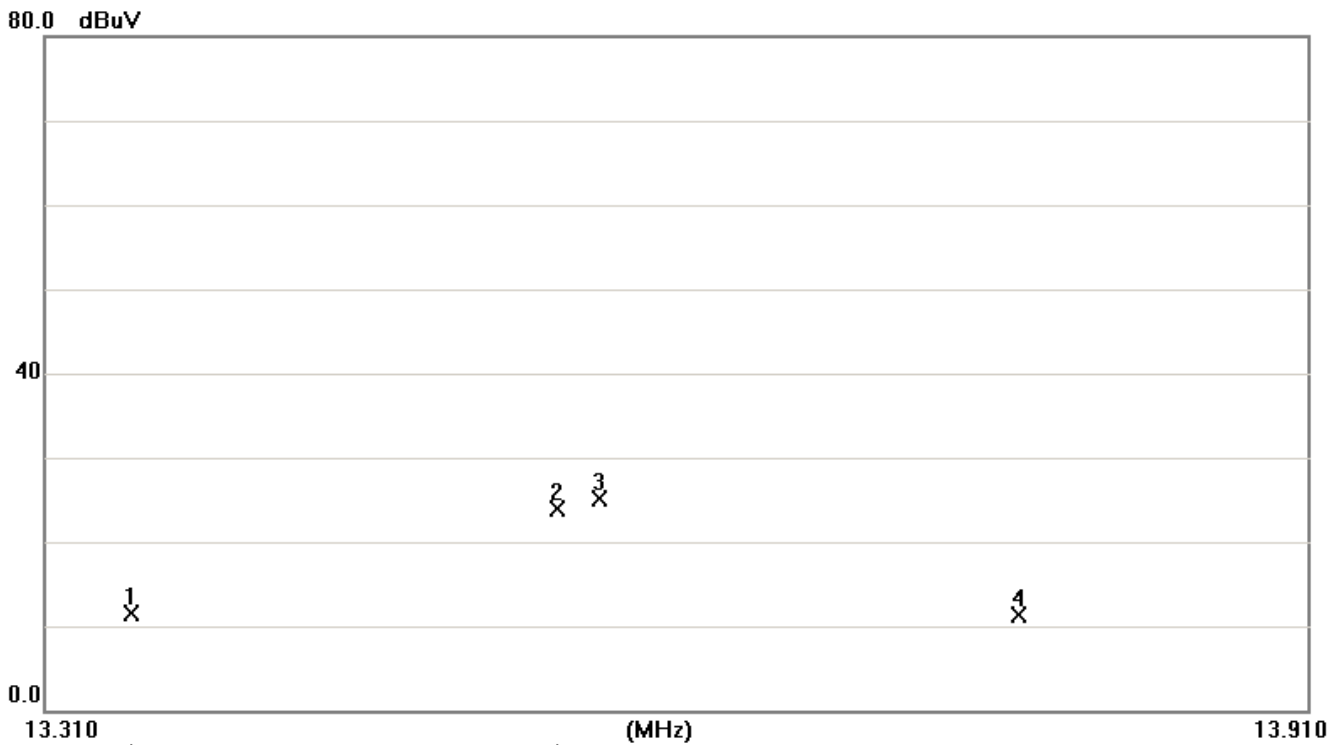
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Operation Mode : NFC Test Date : 2018/05/23
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Main CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol.: HORIZONTAL



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	13.3500	-1.30	12.80	11.50	59.58	-48.08	peak
2	13.5500	11.20	12.79	23.99	69.58	-45.59	peak
3	13.5700	12.30	12.79	25.09	69.58	-44.49	peak
4	13.7700	-1.40	12.79	11.39	59.58	-48.19	peak

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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 ($\mu\text{V/m}$)	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 $\text{dB}\mu\text{V/m} = 20 \log (\mu\text{V/m})$
2. Distance extrapolation factor = $40 \log (\text{required distance}/ \text{test distance})$ (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.

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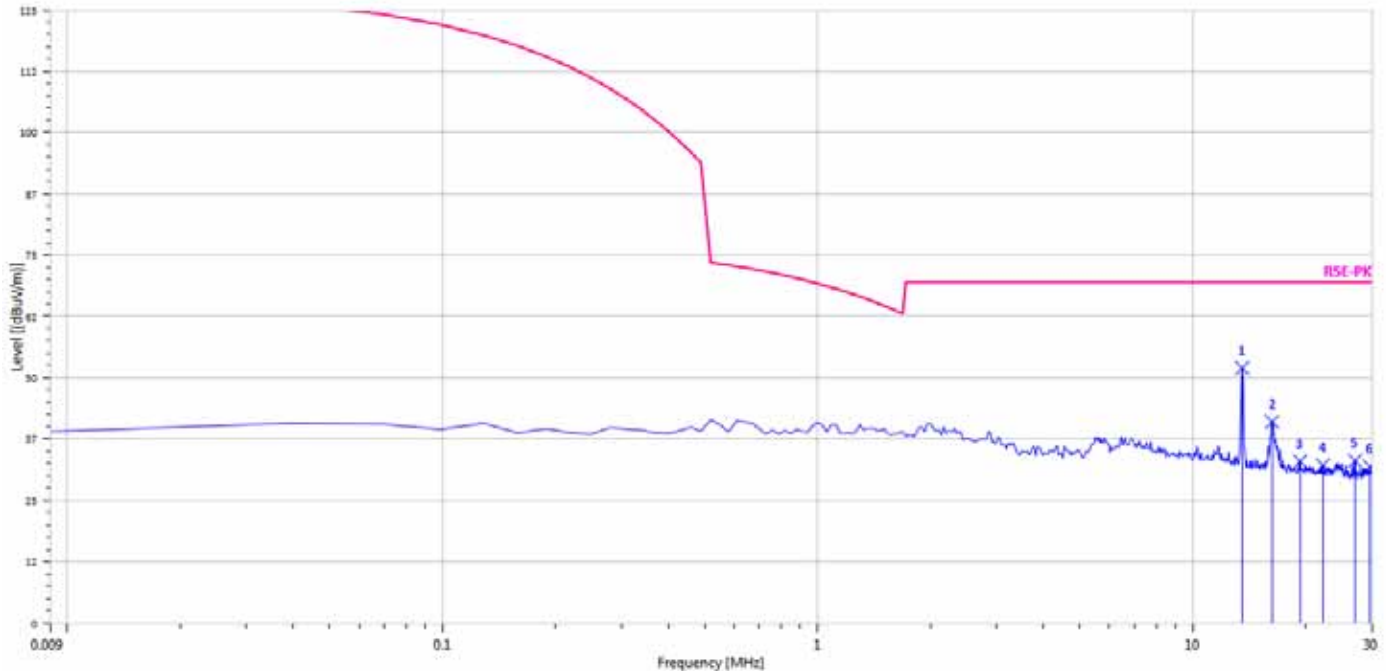
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Radiated Emission Measurement Result

3m Chamber:

Operation Mode :	NFC	Test Date :	2018/6/7
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Tx CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol. :	Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.56	F	Peak	40.32	11.67	51.98	69.54	-17.56
16.29	S	Peak	29.40	11.61	41.01	69.54	-28.53
19.35	S	Peak	21.41	11.54	32.95	69.54	-36.59
22.26	S	Peak	21.12	10.99	32.11	69.54	-37.43
27.12	H	Peak	23.23	9.82	33.05	69.54	-36.49
29.67	S	Peak	22.69	9.21	31.90	69.54	-37.64

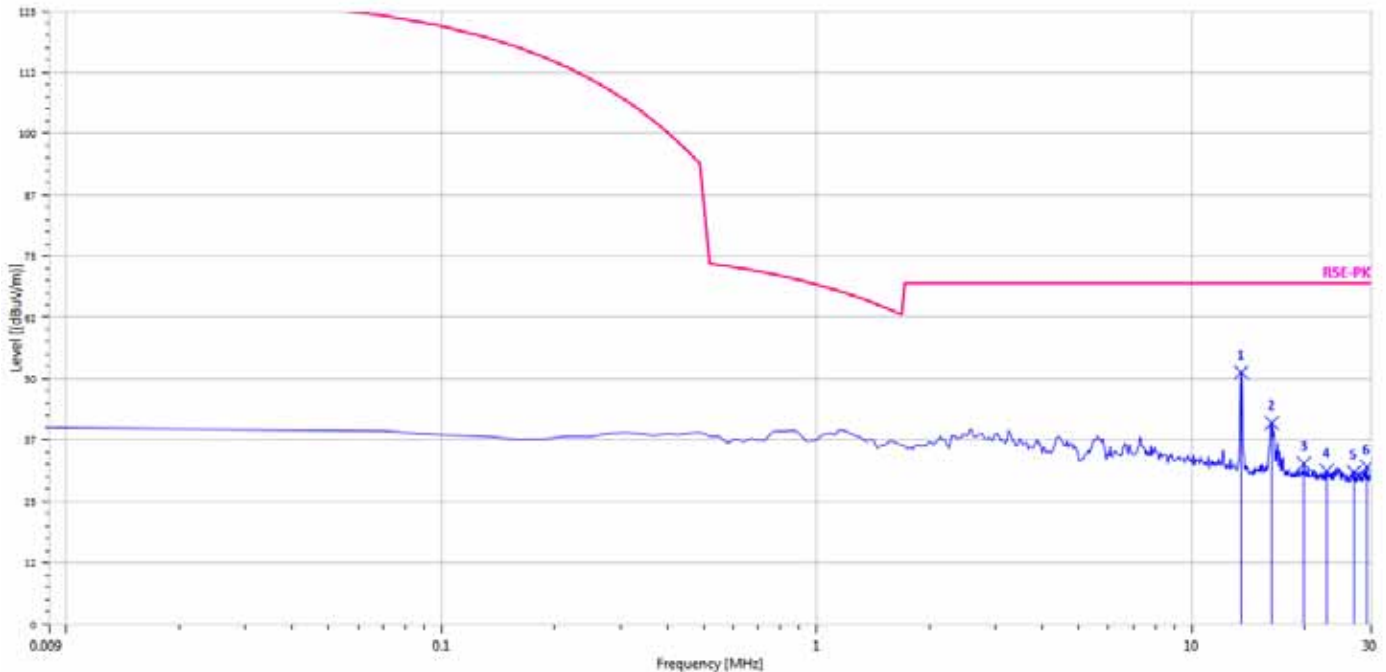
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Operation Mode : NFC Test Date : 2018/6/7
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
13.56	F	Peak	39.64	11.67	51.30	69.54	-18.24
16.35	S	Peak	29.36	11.61	40.97	69.54	-28.57
19.92	S	Peak	21.15	11.53	32.68	69.54	-36.86
22.92	S	Peak	20.42	10.83	31.25	69.54	-38.29
27.12	H	Peak	21.13	9.82	30.95	69.54	-38.59
29.34	S	Peak	22.76	9.29	32.04	69.54	-37.50

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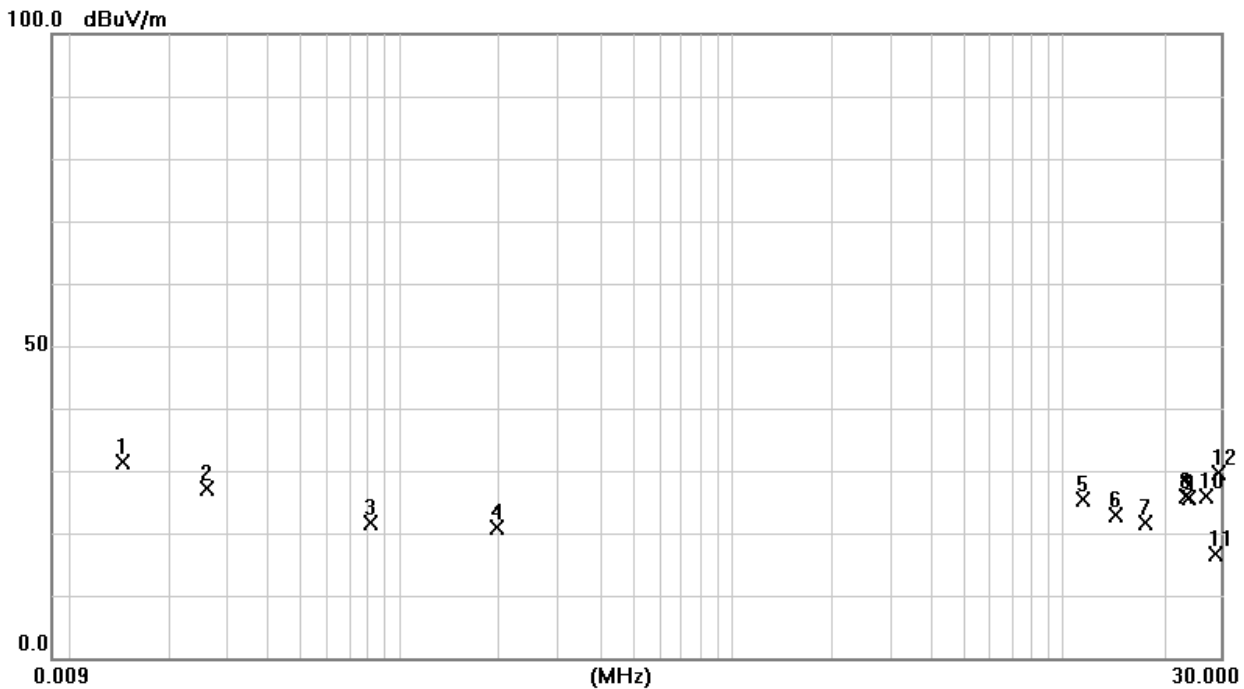
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OATS:

Operation Mode :	NFC	Test Date :	2018/05/25
Fundamental Frequency :	13.56 MHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Jerry
EUT Pol. :	H	Measurement Antenna Pol.:	VERTICAL



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0145	13.99	17.35	31.34	103.46	-72.12	peak
2	0.0263	12.13	14.88	27.01	98.29	-71.28	peak
3	0.0810	9.36	12.36	21.72	88.51	-66.79	peak
4	0.1960	8.77	12.09	20.86	80.83	-59.97	peak
5	11.4600	12.50	12.86	25.36	48.62	-23.26	peak
6	14.1700	10.05	12.78	22.83	48.62	-25.79	peak
7	17.4500	8.98	12.68	21.66	48.62	-26.96	peak
8	23.4800	13.91	11.90	25.81	48.62	-22.81	peak
9	23.6700	13.88	11.86	25.74	48.62	-22.88	peak
10	26.7800	14.75	11.25	26.00	48.62	-22.62	peak
11	28.3600	5.78	10.93	16.71	48.62	-31.91	peak
12	29.2400	18.83	10.75	29.58	48.62	-19.04	peak

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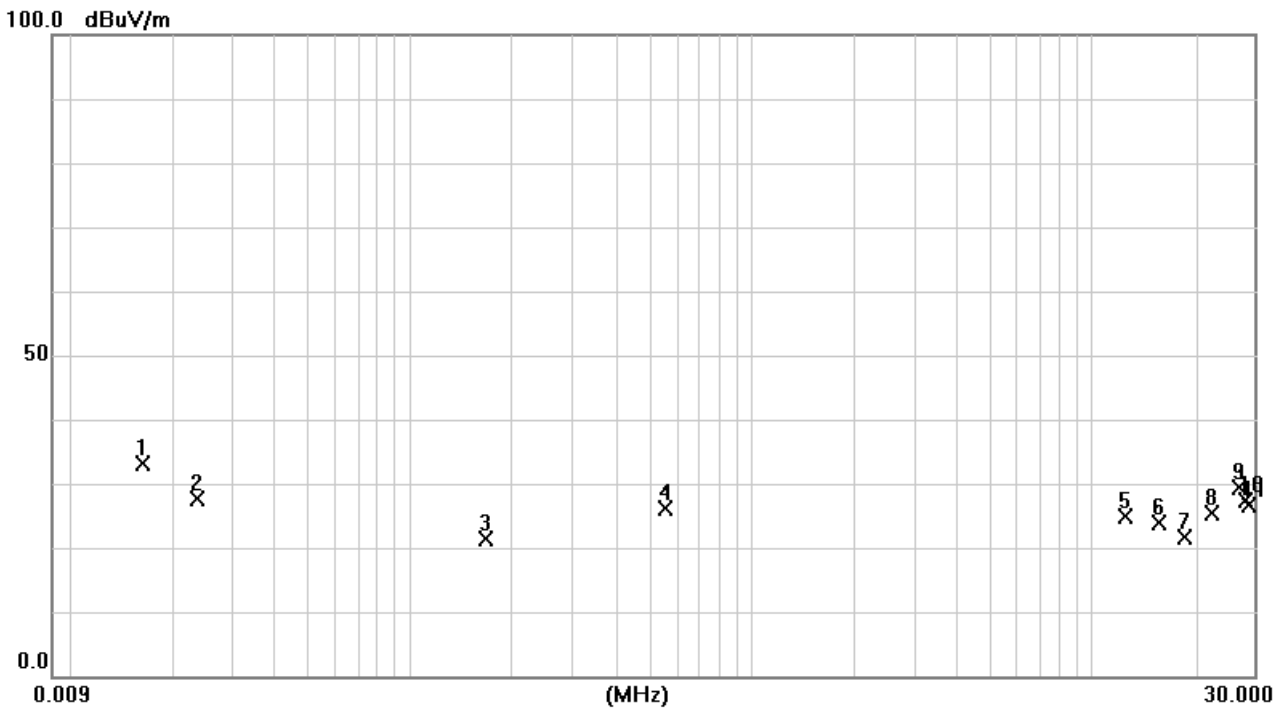
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Operation Mode : NFC Test Date : 2018/05/25
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Main CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol.: Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0165	16.14	16.93	33.07	102.33	-69.26	peak
2	0.0237	12.12	15.42	27.54	99.19	-71.65	peak
3	0.1650	9.25	12.03	21.28	82.33	-61.05	peak
4	0.5615	13.76	12.29	26.05	51.69	-25.64	peak
5	12.3700	12.08	12.82	24.90	48.62	-23.72	peak
6	15.5000	11.13	12.74	23.87	48.62	-24.75	peak
7	18.6400	9.05	12.65	21.70	48.62	-26.92	peak
8	22.4700	13.31	12.11	25.42	48.62	-23.2	peak
9	26.5700	18.03	11.28	29.31	48.62	-19.31	peak
10	28.1500	16.46	10.97	27.43	48.62	-21.19	peak
11	28.3600	15.64	10.93	26.57	48.62	-22.05	peak

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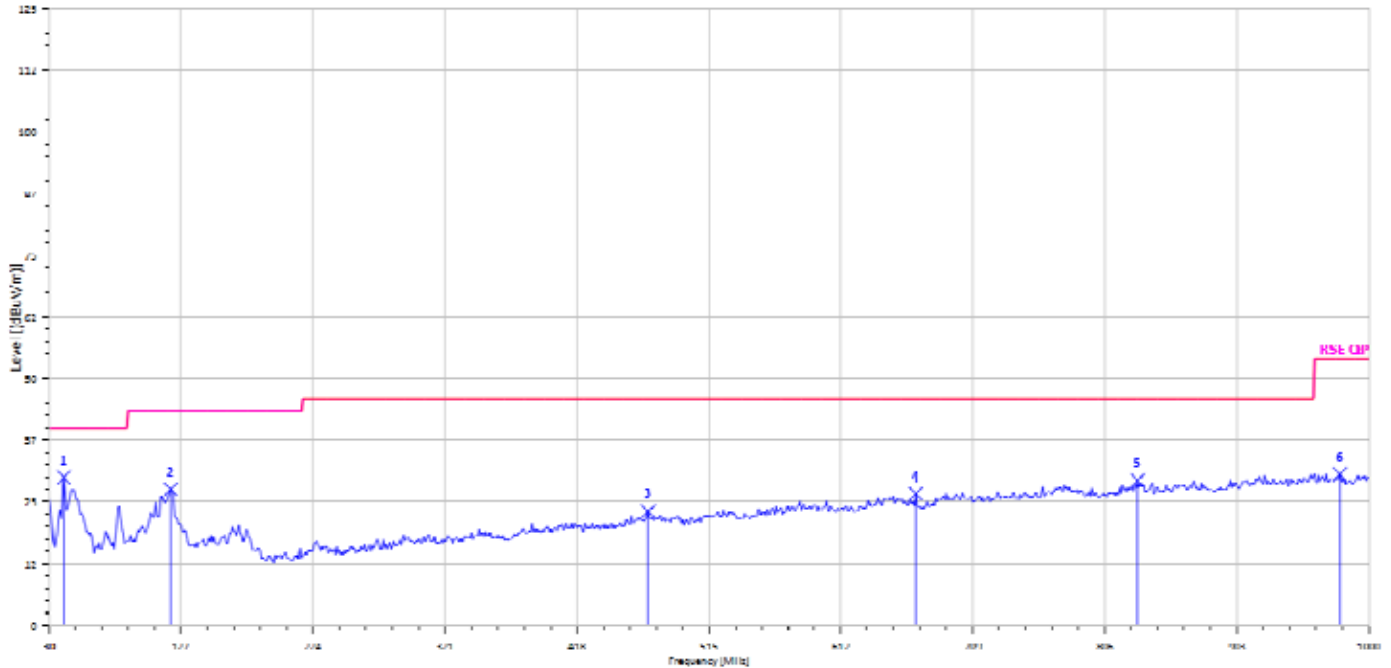
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Operation Mode : NFC Test Date : 2018/5/23
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol. : Vertical



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
40.68	H	Peak	47.17	-17.25	29.92	40	-10.08
119.24	S	Peak	46.29	-18.77	27.52	43.5	-15.98
470.38	S	Peak	34.19	-11.10	23.10	46	-22.90
667.29	S	Peak	35.14	-8.53	26.61	46	-19.39
830.25	S	Peak	35.23	-5.88	29.35	46	-16.65
978.66	S	Peak	34.63	-4.06	30.57	54	-23.43

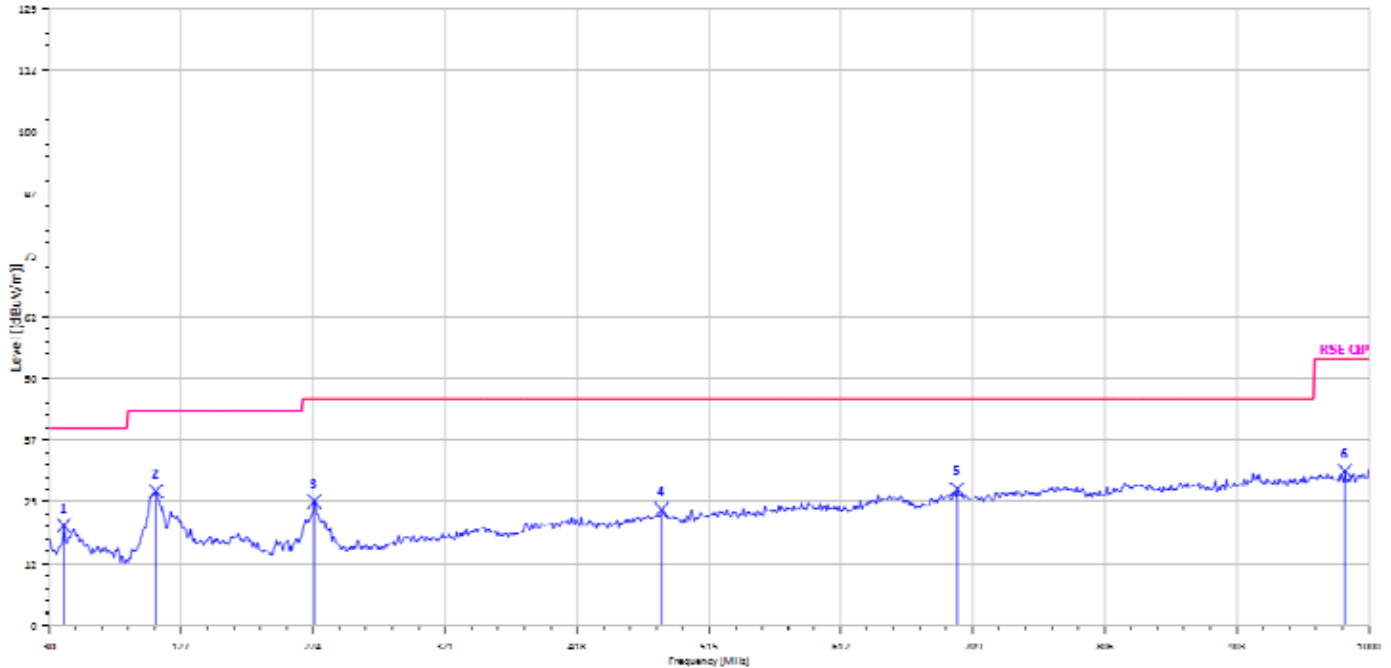
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Operation Mode : NFC Test Date : 2018/5/23
 Fundamental Frequency : 13.56 MHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH Mid Test Engineer : Jerry
 EUT Pol. : H Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
40.68	H	Peak	37.44	-17.25	20.20	40	-19.80
108.57	S	Peak	46.88	-19.69	27.18	43.5	-16.32
224.97	S	Peak	43.28	-18.19	25.09	46	-20.91
480.08	S	Peak	34.58	-11.10	23.49	46	-22.51
697.36	S	Peak	35.16	-7.55	27.61	46	-18.39
982.54	S	Peak	35.26	-4.06	31.20	54	-22.80

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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.

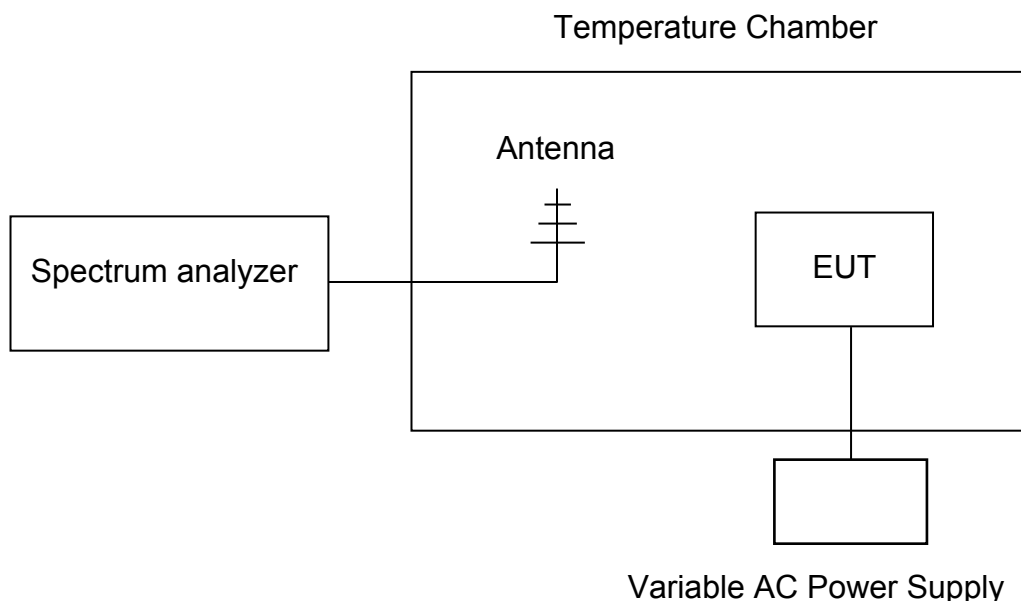
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

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 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



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8.4 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1326001	06/23/2017	06/22/2018
Power Sensor	Anritsu	MA2411B	1315048	06/23/2017	06/22/2018
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	10/30/2017	10/29/2018
DC Block	PASTERNAK	PE8210	RF29	12/24/2017	12/23/2018

8.5 Measurement Results:

Startup:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
7.66	-20	13.5607	0.00000	+/- 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	13.5607	0.00000	+/- 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	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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

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2 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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

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5 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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

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10 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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	Environment	Frequency	Delta (Hz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
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

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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

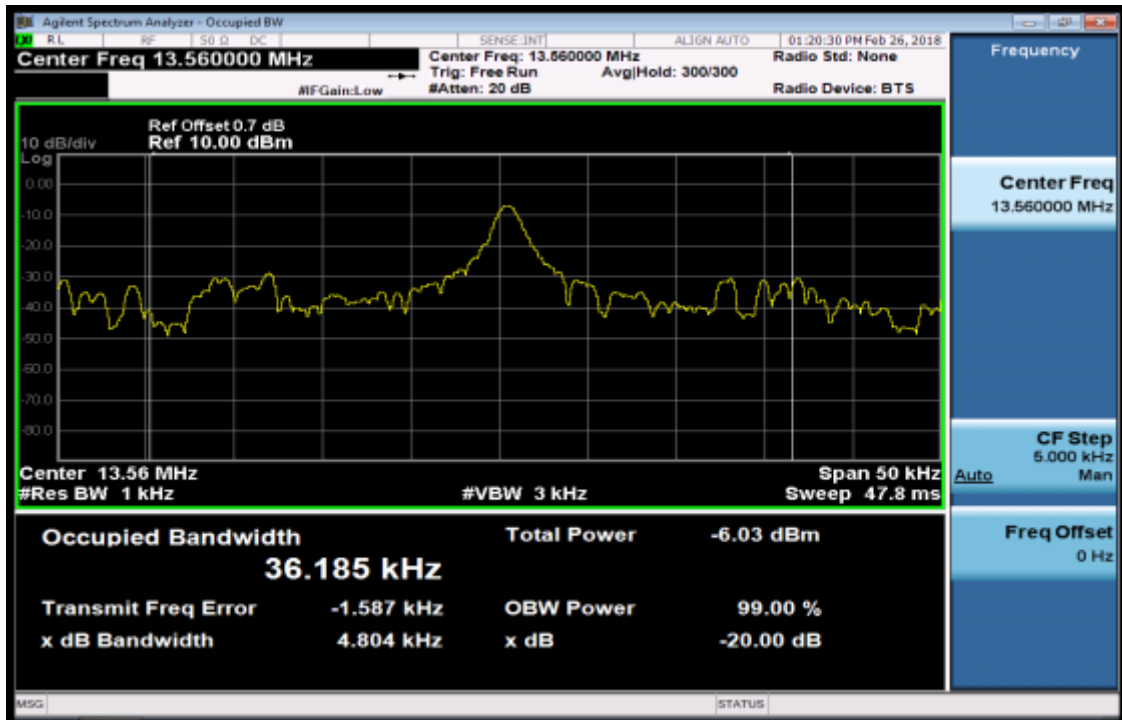
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9.6 Measurement Result:



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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.

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