

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND ISED RSS-210 REQUIREMENT

OF

Applicant: Quanta Computer Inc.
No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City
33377, Taiwan

Product Name: Clover Mini

Brand Name: clover

Model No.: C302U

Model Difference: N/A

FCC ID HFS-C302U

IC: 1787B-C302U

Report Number: E2/2018/80009

FCC Rule Part Part 15.225

IC Rule: RSS-210 issue 9 Annex B B.6 Nov. 2017

Issue Date: Sep. 10, 2018

Date of Test: Aug. 01, 2018~ Aug. 29, 2018

Date of EUT Received: Aug. 01, 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 of FCC Rules Part 15.225 and ISED RSS-210.

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

Tested By:



Vito Pei / Engineer

Approved By:



Jim Chang / Manager



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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/80009	Rev.00	Initial creation of document	All	Sep. 10, 2018	Stefanie Yu / Clerk

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1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Clover Mini	
Brand Name:	clover	
Model No.:	C302U	
Model Difference:	N/A	
Product SW/HW version:	N/A / 1.0	
Radio SW/HW version:	N/A / N/A	
Test SW Version:	N/A	
RF power setting in TEST SW:	N/A	
Power Supply:	12V from AC/DC Adapter	
	Adapter:	1. Model No.: FSP040-RHBN3, Supplier: FSP 2. Model No.: FSP040-RHBN2, Supplier: FSP

NFC:

Operating Frequency	13.56MHz
Transmit Power	< 123dBuV/m at 3m.
Number of Channels	1
Antenna Type	Loop Antenna
Modulation Type	ASK

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1.2 Test Methodology

FCC Part 15, Subpart C §15.225
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 record 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)
FCC Registration Number and Designation number are: 735305 / TW0002
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.

1.6 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site. There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2 SYSTEM TEST CONFIGURATION

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 which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. the Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8m above ground plane. 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 §15.107. 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. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m above the reference ground plane. 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 transmitter (EUT) was rotated through three orthogonal axes 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.

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2.4 Limitation

(1) Conducted Emission

According to FCC Part 15.207(a) & RSS-Gen section 8.8 Conducted Emission Limits is as following.

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.

(2) Radiated Emission

- a. The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- b. Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- c. Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- d. The field strength of any emissions appearing outside of the 13.110-14.010 MHz shall not exceed the general radiated emission limits in section 15.209 as below.

Frequency (MHz)	Field strength $\mu\text{V}/\text{m}$	Distance (m)	Field strength at 3m $\text{dB}\mu\text{V}/\text{m}$
1.705-30	30	30	69.54
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

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- Remark 1. Emission level in dBuV/m= $20 \log(uV/m)$
 : 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
 3. Distance extrapolation factor = $40 \log(\text{required distance}/\text{test distance})$ (dB);
 4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.
 Ex. $20 \log(30)+40 \log(30/3) = 69.54\text{dBuV/m}$
 5. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205.
 6. The general radiated emission limits in §15.209 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

(3) Frequency Tolerance

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.

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2.5 Configuration of Tested System

Fig. 2-1 Emission test set up configuration

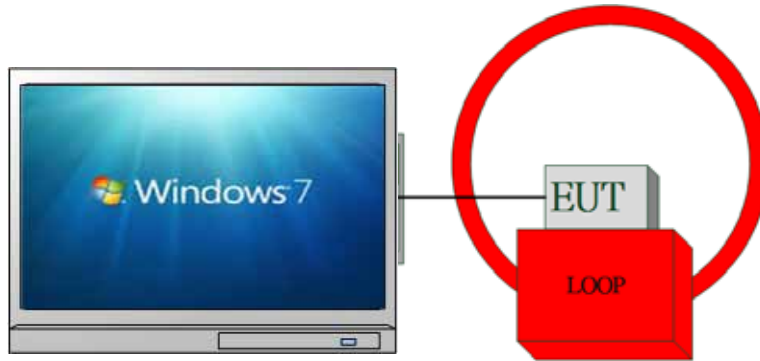


Fig. 2-2 Conduction test set up configuration

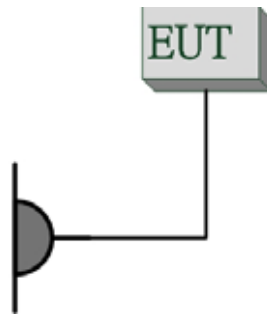


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	NFC Test software	Tera Term	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L420	S0012467	Shielded	Unshielded

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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 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 E1 position was reported.

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Frequency Stability	+/- 123.36 Hz
20 dB OCCUPIED BANDWIDTH	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	9kHz - 30MHz: +/- 2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB

Measurement uncertainty (Polarization : Horizontal)	9kHz - 30MHz: +/- 2.3dB
	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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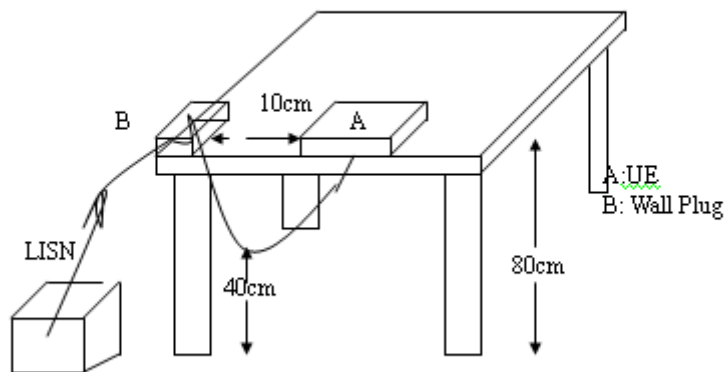
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6 CONDUCTED EMISSIONS TEST

6.1 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. Sweep frequency starting from 150 kHz to 30 MHz for phase L1.
4. Repeating the measurement as lists above for phase neutral.

6.2 Test SET-UP (Block Diagram of Configuration)



6.3 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	2019/2/13
EMI Test Receiver	R&S	ESCI	101300	2017/11/02	2018/11/1

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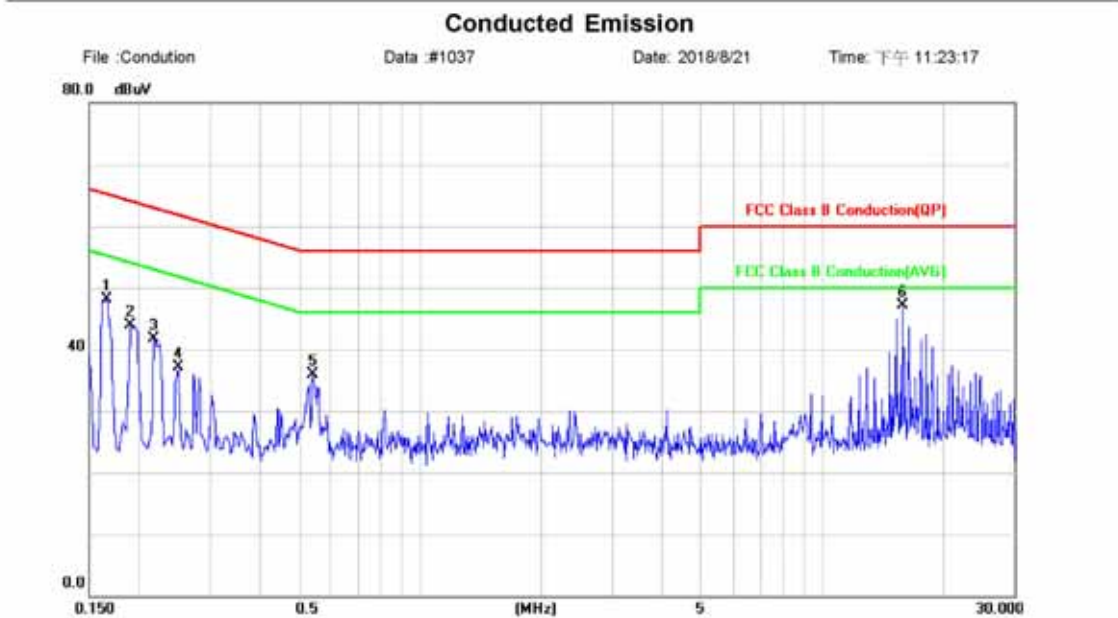
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6.4 Measurement Result:

AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test By:	Jerry
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Site : Conduction Room	Phase: L1	Temperature: 23 °C
Limit: FCC Class B Conduction(QP)	Power: AC 120V/60Hz	Humidity: 69 %
Mode:		
Note:		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1660	28.49	19.68	48.17	65.16	-16.99	peak	
2		0.1900	24.25	19.72	43.97	64.04	-20.07	peak	
3		0.2180	21.86	19.77	41.63	62.89	-21.26	peak	
4		0.2500	17.30	19.82	37.12	61.76	-24.64	peak	
5		0.5420	15.69	20.20	35.89	56.00	-20.11	peak	
6	*	15.8580	27.09	19.99	47.08	60.00	-12.92	peak	

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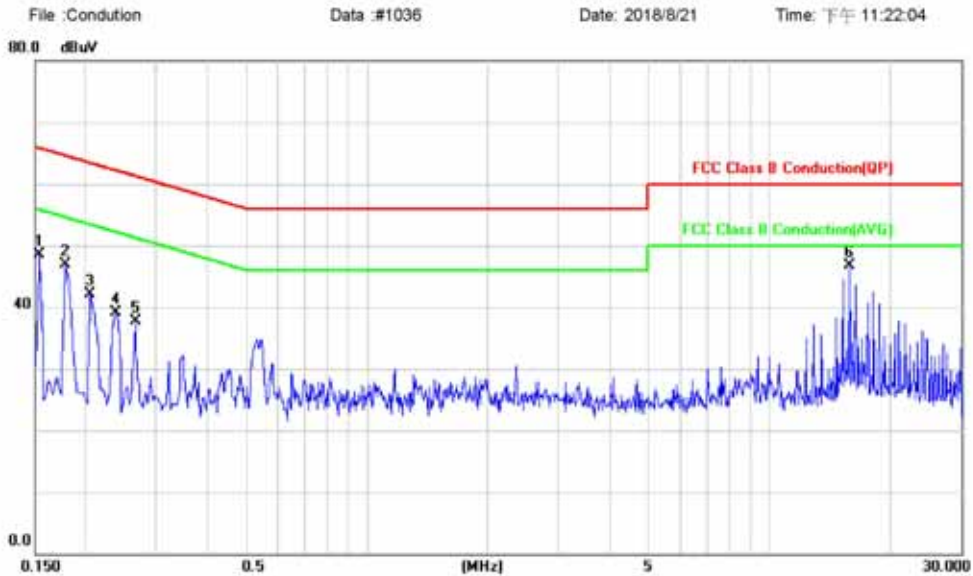
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Site : Conduction Room Phase: **N** Temperature: 23 ℃
 Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 69 %
 Mode:
 Note:

Conducted Emission



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1540	28.93	19.65	48.58	65.78	-17.20	peak	
2		0.1780	27.23	19.69	46.92	64.58	-17.66	peak	
3		0.2060	22.38	19.73	42.11	63.37	-21.26	peak	
4		0.2380	19.23	19.78	39.01	62.17	-23.16	peak	
5		0.2660	17.95	19.83	37.78	61.24	-23.46	peak	
6 *		15.8540	26.77	20.01	46.78	60.00	-13.22	peak	

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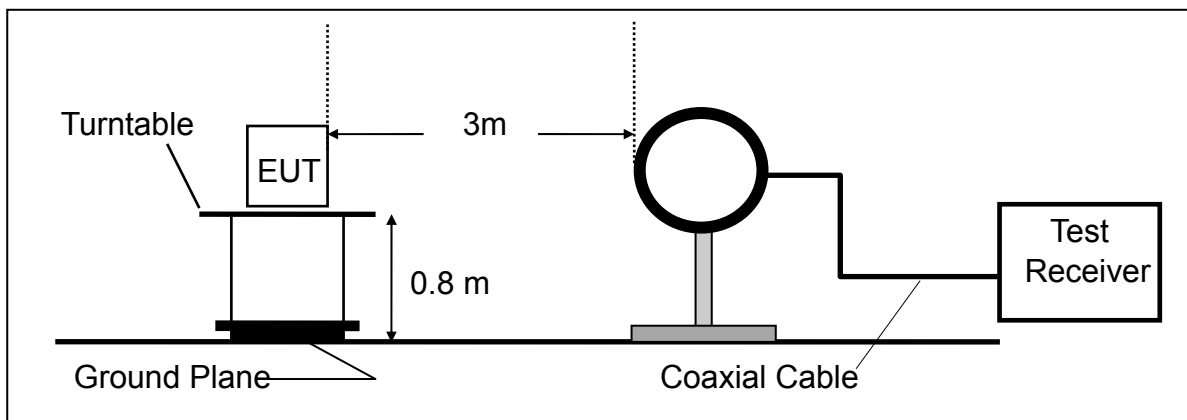
7 RADIATED TEST ITEMS

7.1 Measurement Procedure

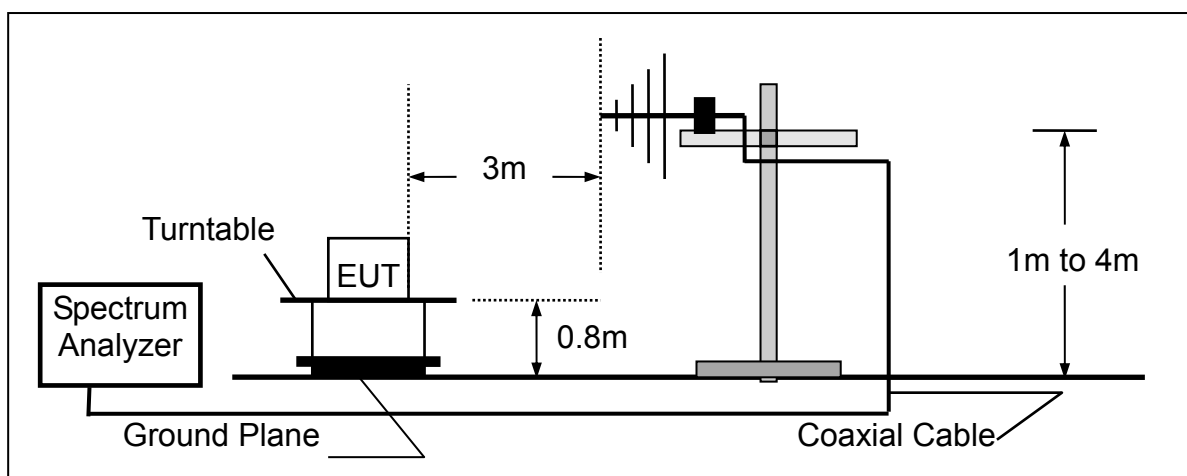
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. 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 (Block Diagram of Configuration)

(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:

SGS 966 Chamber No.C

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Broadband Antenna	SCHWAZBEC K	VULB 9168	9168-617	2017/10/27	2018/10/26
Loop Antenna	ETS.LINDGR EN	6502	148045	2017/09/26	2018/9/25
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	2019/4/10
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

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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	

7.5 Field Strength of Fundamental Emission

7.5.1 FCC Applicable standard

Rules and specifications	CFR 47 Part 15 section 15.225(a)-(d)		
	Field Strength ($\mu\text{V}/\text{m}$) at 30m	Field Strength ($\text{dB}\mu\text{V}/\text{m}$) at 30m	Field Strength ($\text{dB}\mu\text{V}/\text{m}$) 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 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.

$$\text{Distance extrapolation} = 40 * \log (30/3) = 40 \text{ dB}$$

30m to 3m

$$\text{Distance extrapolation} = 40 * \log (30/3) = 40 \text{ dB}$$

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

30m to 10m

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

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

10m to 3m

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

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

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7.5.2 ISED Applicable standard

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) $20 \cdot \log(106\text{uV/m}) + 40\text{dB} = 80.50\text{dBuV/m}$

Note:

1. Emission level in dBuV/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 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 = $20 \log(\mu\text{V/m})$
7. Distance extrapolation factor = $40 \log(\text{required distance}/\text{test distance})$ (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.

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

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

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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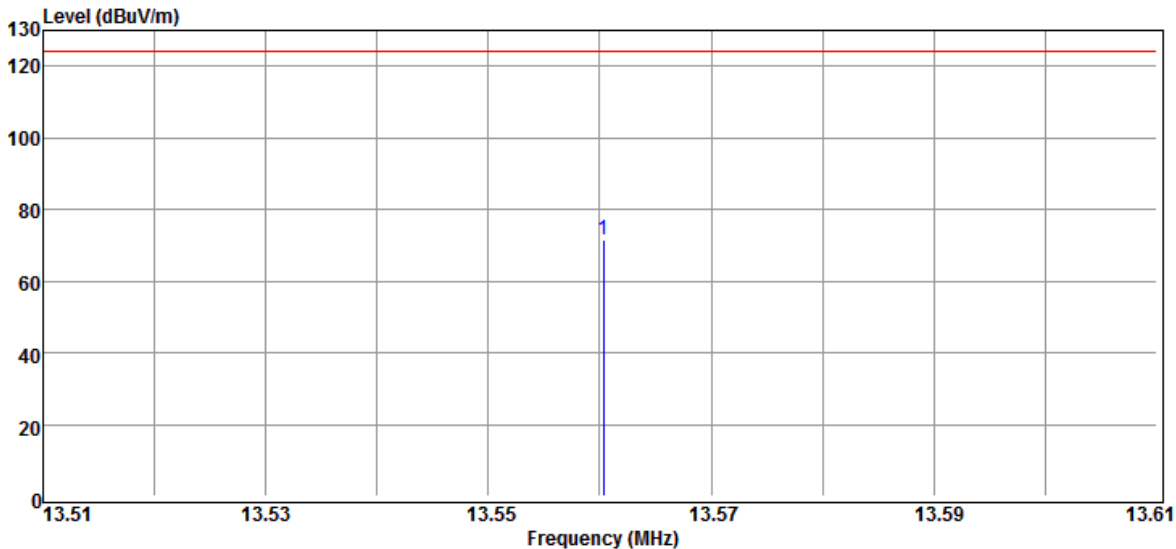
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7.6 Field Strength of Fundamental Emission Measurement Result

Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Main CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
13.56	Peak	60.01	11.56	71.57	124.00	-52.43

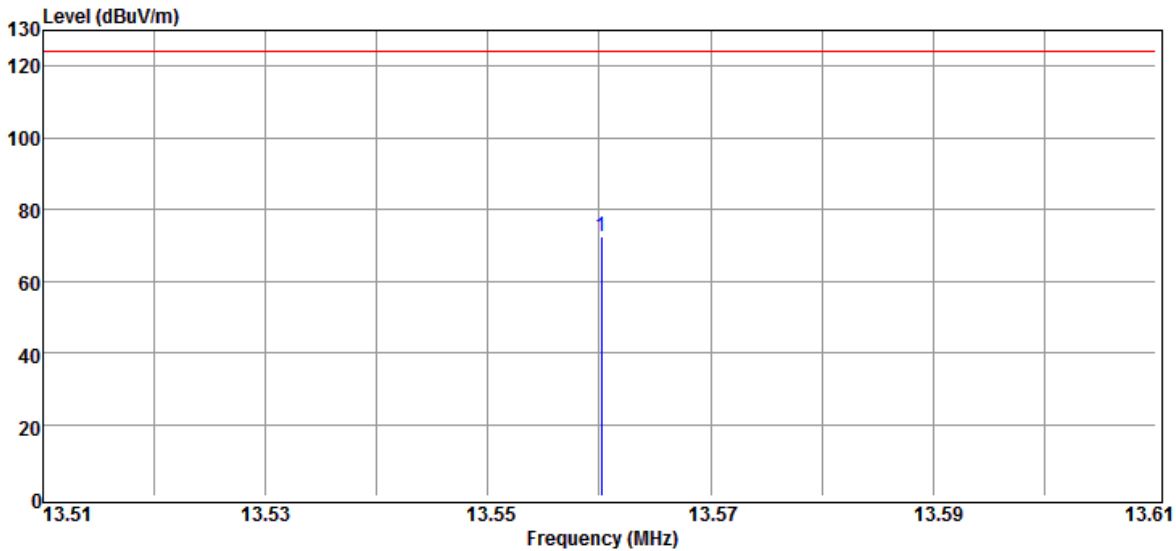
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Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Main CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
13.56	Peak	60.66	11.56	72.22	124.00	-51.78

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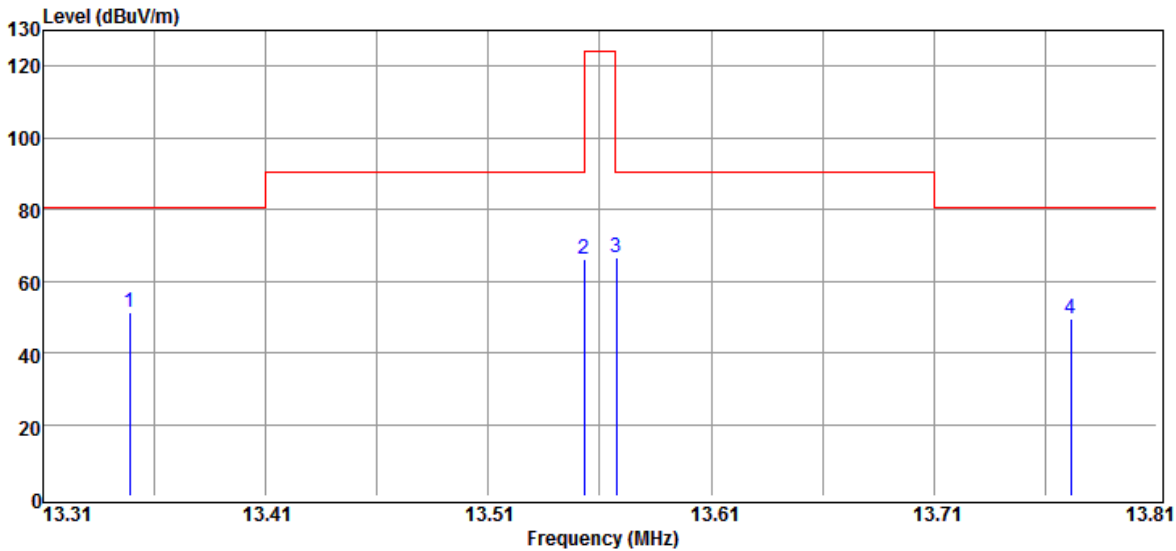
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7.6.1 Radiated Mask

Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Mask CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
13.35	Peak	39.76	11.58	51.34	80.54	-29.20
13.55	Peak	54.72	11.56	66.28	90.47	-24.19
13.57	Peak	55.05	11.56	66.61	90.47	-23.86
13.77	Peak	38.09	11.55	49.64	80.50	-30.86

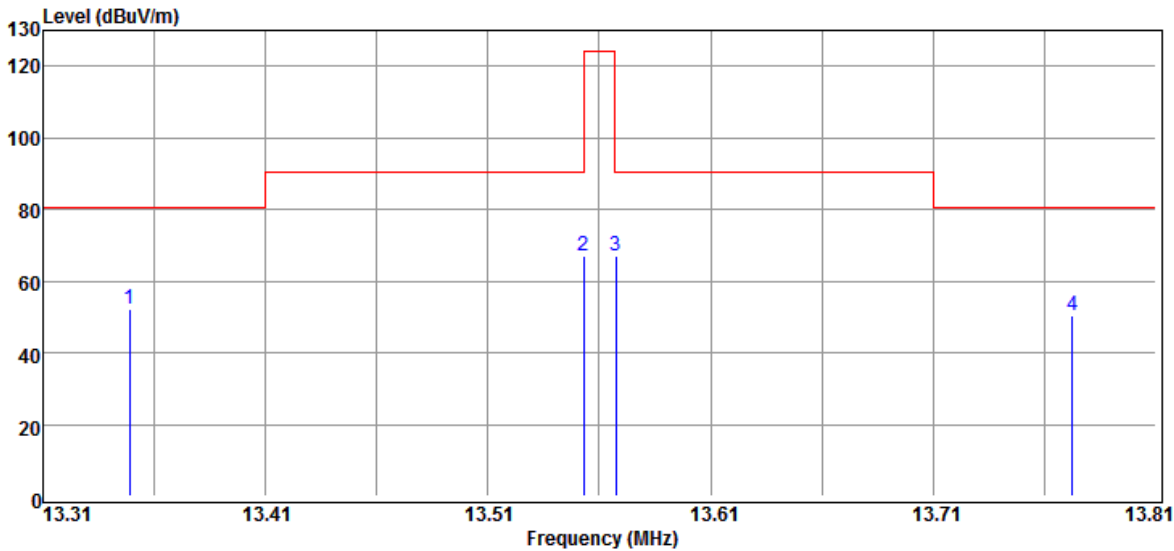
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Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Mask CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
13.35	Peak	40.48	11.58	52.06	80.54	-28.48
13.55	Peak	55.24	11.56	66.80	90.47	-23.67
13.57	Peak	55.60	11.56	67.16	90.47	-23.31
13.77	Peak	38.89	11.55	50.44	80.50	-30.06

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7.7 Radiated Emission Measurement

7.7.1 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 ($\mu\text{V}/\text{m}$)	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 $\text{dB}\mu\text{V}/\text{m} = 20 \log (\mu\text{V}/\text{m})$
2. Distance extrapolation factor = $40 \log (\text{required distance}/ \text{test distance})$ (dB)
3. $20 * \log(30\mu\text{V}/\text{m}) + 40\text{dB} = 69.54 \text{ dB}\mu\text{V}/\text{m}$
4. The lower limit shall apply at the transition frequencies.
5. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

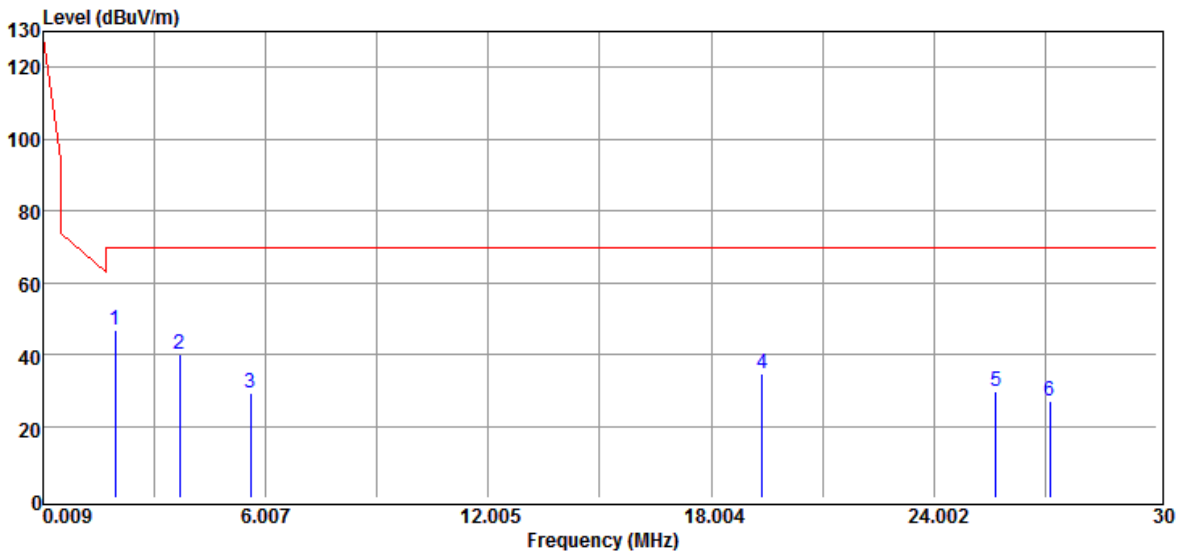
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Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1.96	Peak	35.24	11.64	46.88	69.54	-22.66
3.70	Peak	29.10	11.10	40.20	69.54	-29.34
5.59	Peak	18.11	11.24	29.35	69.54	-40.19
19.38	Peak	23.42	11.29	34.71	69.54	-34.83
25.68	Peak	19.69	9.95	29.64	69.54	-39.90
27.12	Peak	17.34	9.67	27.01	69.54	-42.53

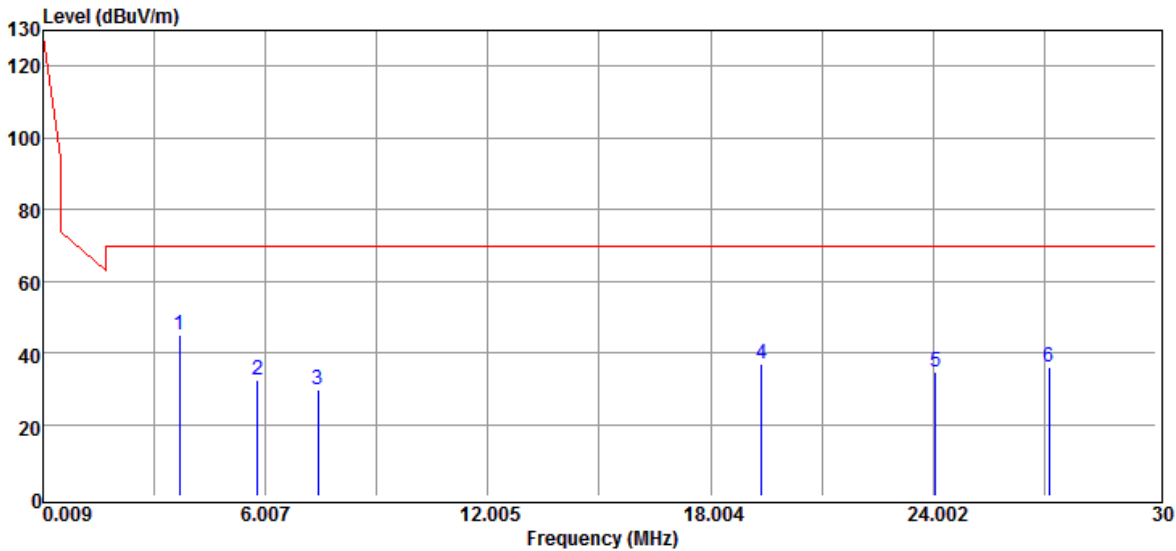
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Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
3.70	Peak	33.91	11.10	45.01	69.54	-24.53
5.80	Peak	20.92	11.28	32.20	69.54	-37.34
7.42	Peak	18.27	11.51	29.78	69.54	-39.76
19.38	Peak	25.70	11.29	36.99	69.54	-32.55
24.06	Peak	24.34	10.30	34.64	69.54	-34.90
27.12	Peak	26.36	9.67	36.03	69.54	-33.51

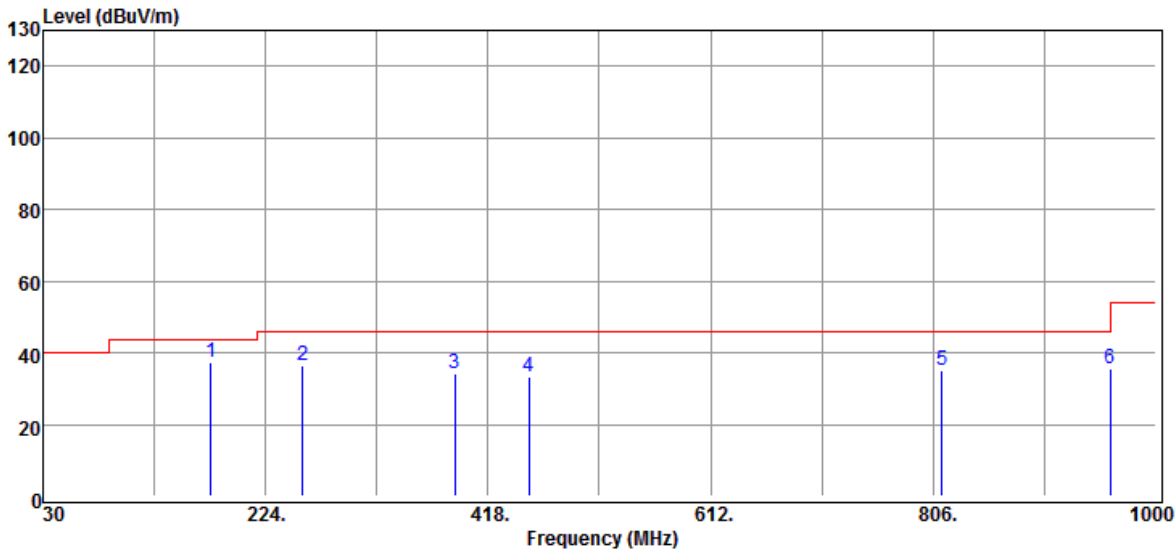
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EUT Pol	:E1 Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
176.47	Peak	54.29	-17.06	37.23	43.50	-6.27
256.01	Peak	53.32	-16.74	36.58	46.00	-9.42
388.90	Peak	47.24	-13.07	34.17	46.00	-11.83
453.89	Peak	44.86	-11.74	33.12	46.00	-12.88
813.76	Peak	41.13	-5.99	35.14	46.00	-10.86
960.23	Peak	39.52	-4.07	35.45	54.00	-18.55

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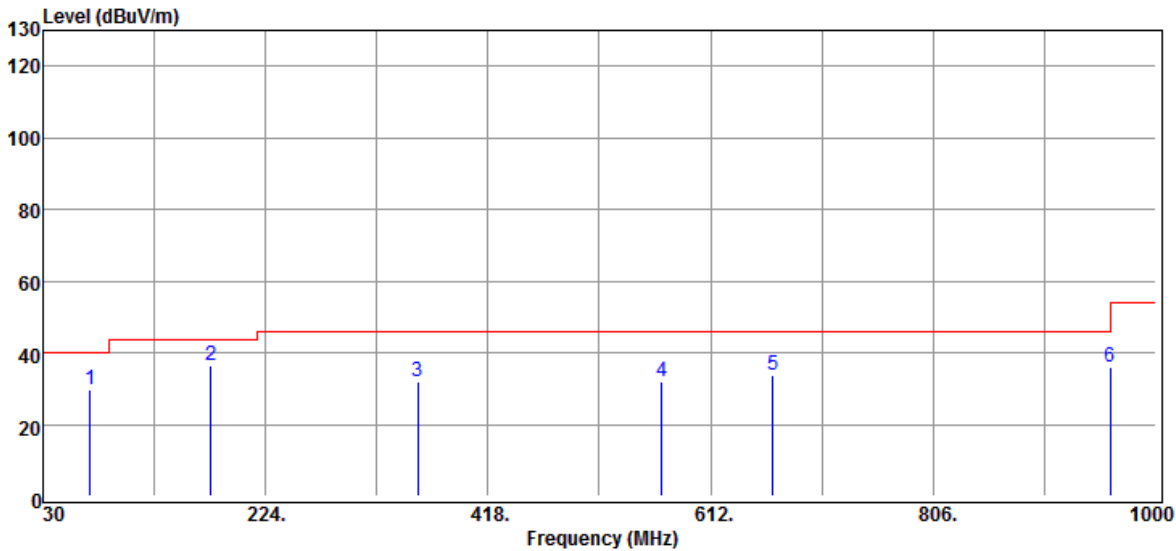
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Operation Mode	:NFC	Test Date	:2018-08-21
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:E1 Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
70.74	Peak	50.02	-20.13	29.89	40.00	-10.11
176.47	Peak	58.28	-21.97	36.31	43.50	-7.19
356.89	Peak	45.71	-13.81	31.90	46.00	-14.10
569.32	Peak	41.72	-9.65	32.07	46.00	-13.93
666.32	Peak	42.27	-8.72	33.55	46.00	-12.45
960.23	Peak	40.07	-4.07	36.00	54.00	-18.00

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8 FREQUENCY TOLERANCE

8.1 Applicable Standard

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.

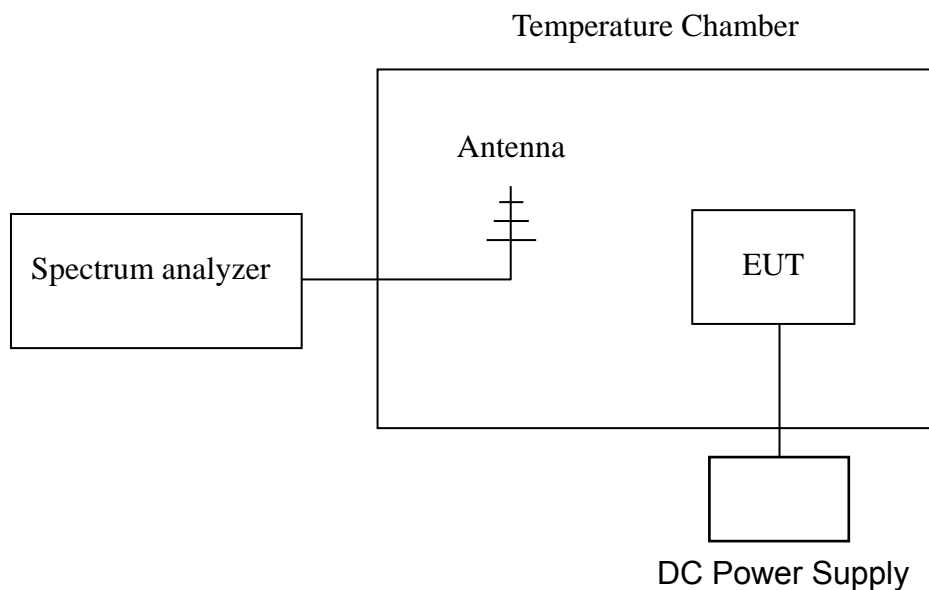
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

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 on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10kHz, Span =100kHz.
4. Set SPA Max hold. Mark peak.

8.3 Test SET-UP (Block Diagram of Configuration)



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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	Oct.30, 2017	Oct.29, 2018
Temperature Chamber	TERCHY	MHK-120LK	1020582	Jul.10, 2018	Jul.09, 2019
DC Power Supply	Agilent	E3640A	MY53140006	Apr.29, 2018	Apr.28, 2019
Loop Antenna	ETS-Lindgren	6502	00143303	Apr.19, 2018	Apr.18, 2019

8.5 Measurement Results

Startup:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12	-20	13.5598	0.40000	+/- 1.356
12	-10	13.5598	0.40000	+/- 1.356
12	0	13.5599	0.30000	+/- 1.356
12	10	13.561	-0.80000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
12	30	13.5602	0.00000	+/- 1.356
12	40	13.5603	-0.10000	+/- 1.356
12	50	13.5604	-0.20000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12.6	20	13.5606	-0.40000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
11.4	20	13.5598	0.40000	+/- 1.356

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2 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12	-20	13.5597	0.50000	+/- 1.356
12	-10	13.5598	0.40000	+/- 1.356
12	0	13.5597	0.50000	+/- 1.356
12	10	13.5598	0.40000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
12	30	13.5603	-0.10000	+/- 1.356
12	40	13.5605	-0.30000	+/- 1.356
12	50	13.5607	-0.50000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12.6	20	13.5603	-0.10000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
11.4	20	13.5596	0.60000	+/- 1.356

5 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12	-20	13.5596	0.50000	+/- 1.356
12	-10	13.5597	0.40000	+/- 1.356
12	0	13.5597	0.40000	+/- 1.356
12	10	13.5597	0.40000	+/- 1.356
12	20	13.5601	0.00000	+/- 1.356
12	30	13.5602	-0.10000	+/- 1.356
12	40	13.5606	-0.50000	+/- 1.356
12	50	13.5607	-0.60000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12.6	20	13.5609	-0.70000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
11.4	20	13.5596	0.60000	+/- 1.356

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10 minutes:

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12	-20	13.5595	0.70000	+/- 1.356
12	-10	13.5596	0.60000	+/- 1.356
12	0	13.5595	0.70000	+/- 1.356
12	10	13.5599	0.30000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
12	30	13.5604	-0.20000	+/- 1.356
12	40	13.5606	-0.40000	+/- 1.356
12	50	13.5607	-0.50000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature ()	(MHz)		
12.6	20	13.5609	-0.70000	+/- 1.356
12	20	13.5602	0.00000	+/- 1.356
11.4	20	13.5596	0.60000	+/- 1.356

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9 20 dB & 99% OCCUPIED BANDWIDTH MEASUREMENT

9.1 Applicable Standard:

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

9.2 Limit:

None

9.3 Test Set-up

Refer to section 8.3 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. 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.

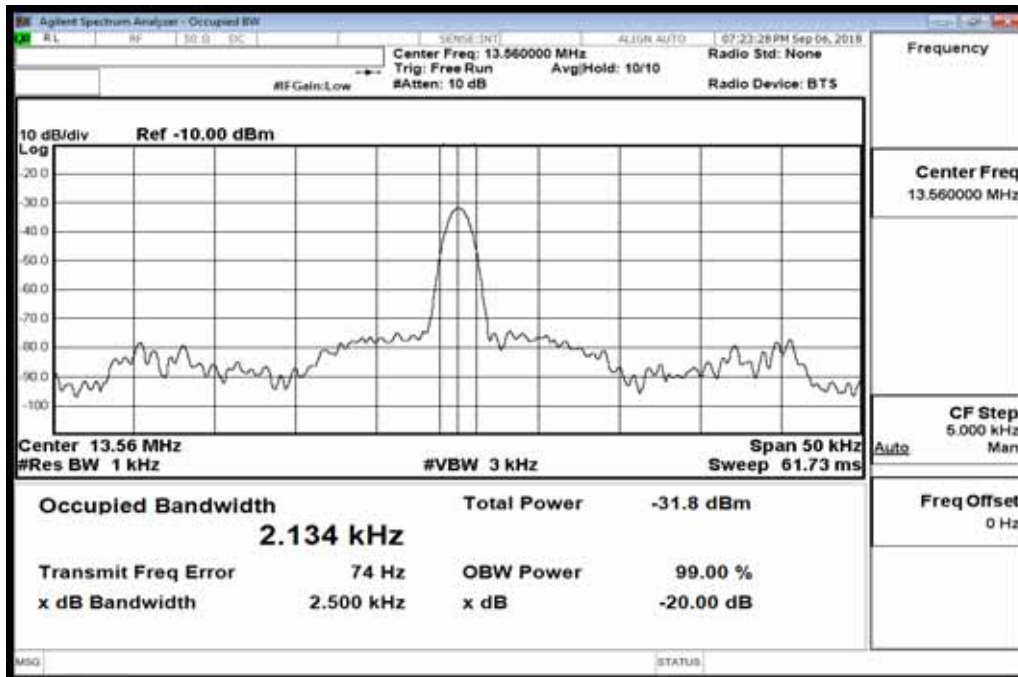
9.5 Measurement Equipment Used:

Refer to section 8.4 in this report

9.6 Measurement Result

	Operation range	Frequency (MHz)	Limit (MHz)
20dB BW (kHz)	Low	13.55885	>13.11
2.5	High	13.56115	<14.01

-20dB Bandwidth



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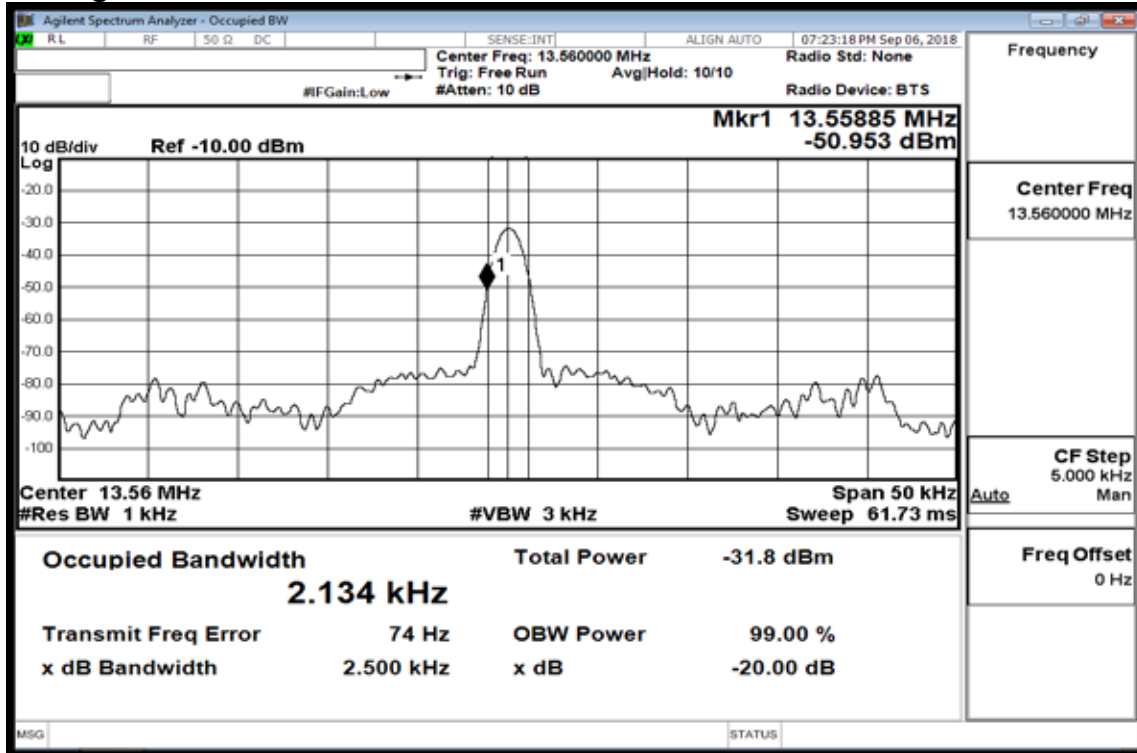
t (886-2) 2299-3279

f (886-2) 2298-0488

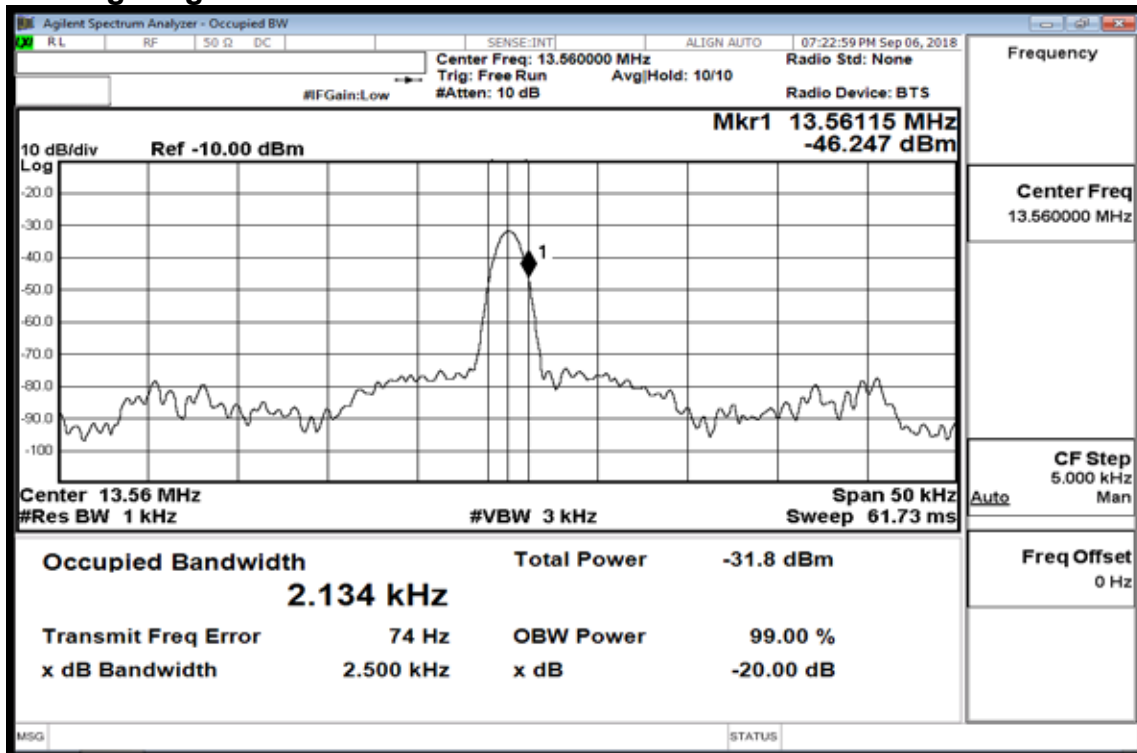
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Operation range low



Operation range High



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10 ANTENNA REQUIREMENT

10.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

10.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

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