

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.: 2022

Model Difference: N/A

FCC ID: C3K2022

IC: 3048A-2022

Report Number: T210908N01

FCC Rule Part: §15.225

IC Rule: RSS-210 issue 10 Annex B B.6 Dec. 2019

Issue Date: Nov. 16, 2021

Date of Test: Sep. 22, 2021 ~ Sep. 24, 2021, Oct. 15, 2021

Date of EUT Received: Sep. 08, 2021

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.

Ted Huang *Oz Ding*

Tested By:

Ted Huang / Engineer Oz Ding / Asst. Engineer

Eric Huang

Approved By:

Eric Huang / Section Manager



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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
T210908N01	Rev.00	Initial creation of document	All	Oct 19, 2021	Gina Lin
T210908N01	Rev.01	See the following note rev.01	Page 19, 21~29, 40	Nov. 12, 2021	Gina Lin
T210908N01	Rev.02	See the following note rev.02	Page 19, 27	Nov. 16, 2021	Gina Lin

Note:

Rev.00 Issue Date: Oct 19, 2021
Original Report

Rev.01 Issue Date: Nov. 12, 2021
Remove the limits of 3m test data.
Revise Measurement Procedure.

Rev.02 Issue Date: Nov. 16, 2021
Revise Measurement Procedure.

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1 GENERAL INFORMATION

1.1 Product Description

General:

Product Name:	Portable Computing Device	
Brand Name:	Microsoft	
Model No.:	2022	
Model Difference:	N/A	
HW Version (Radio)	EV	
SW Version (Radio)	2122-6bb625-c8-00004.33	
NFC Driver Version	12.0.6.0	
Power Supply:	7.66Vdc from Rechargeable Li-polymer Battery or 15Vdc from AC/DC Adapter	
	Battery:	Model No.: DYNU01, Supplier: DYNAPACK
	Adapter:	Model No.: 1735, Supplier: Lite On

Note:

This report is for host FCC ID: C3K2022 which contains the module FCC ID: C3K1956.

This report is for host IC: 3048A-2022 which contains the module IC: 3048A-1956.

NFC:

Operating Frequency:	13.56MHz
Transmit Power:	< 84dBuV/m at 30m.
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

RSS-210 issue 10 Annex B B.6 Dec. 2019

RSS-Gen. issue 5 Amendment 1, Mar. 2019

ANSI C63.10:2013

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

1.3 Test Facility

Compliance Certification Services Inc. Tainan Laboratory

No.8, Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)

OATS: Compliance Certification Services Inc. Tainan Laboratory

No.8, Jiucengling, Xinhua Dist., Tainan City 712, Taiwan (R.O.C.)

FCC Designation Number: TW1109

ISED#: 2324H

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 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 placed on a 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 cables were bundled 30 to 40cm and draped over the back edge of the test table, and through section 2.2 the EUT is being exercised. 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 placed on a turn table which is 0.8 m above ground plane 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 the 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.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 AC Power Line Conducted Emission

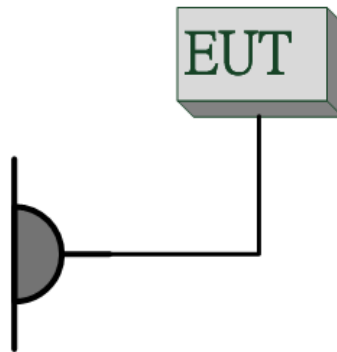


Table 2-1 Equipment Used in Tested System

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

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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-OFF/ON	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	±1.6dB
Frequency Stability	+/- 112 Hz
20 dB & 99% OCCUPIED BANDWIDTH	+/- ± 1.92 Hz
Temperature	+/- 1°C
Humidity	+/- 5 %

Radiated Spurious Emission:

Measurement uncertainty	9kHz - 30MHz: +/- 2.6dB
	30MHz - 200MHz: +/- 3.1dB
	200MHz -1000MHz: +/- 2.7dB

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 room #1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
BNC Coaxial Cable	CCS	BNC50	11	01/21/2021	01/20/2022
EMI Test Receiver	R&S	ESCS 30	100348	02/25/2021	02/24/2022
LISN	FCC	FCC-LISN-50-32-2	08009	06/29/2021	06/28/2022
LISN	SCHWARZBECK	NNLK8130	8130124	01/15/2021	01/14/2022
Pulse Limiter	R&S	ESH3-Z2	100116	01/21/2021	01/20/2022
Software	e3(6.101222)				

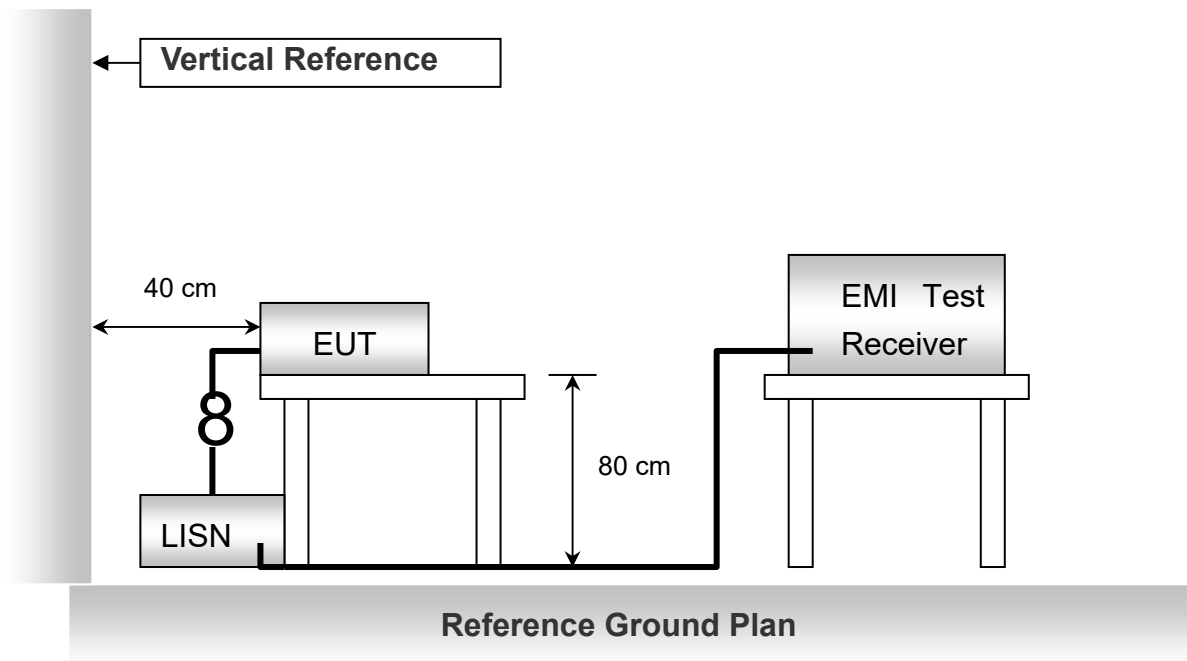
6.3 EUT Setup:

- 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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6.4 Test SET-UP (Block Diagram of Configuration)



For the actual test configuration, please refer to the related item – Photographs of the Test 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

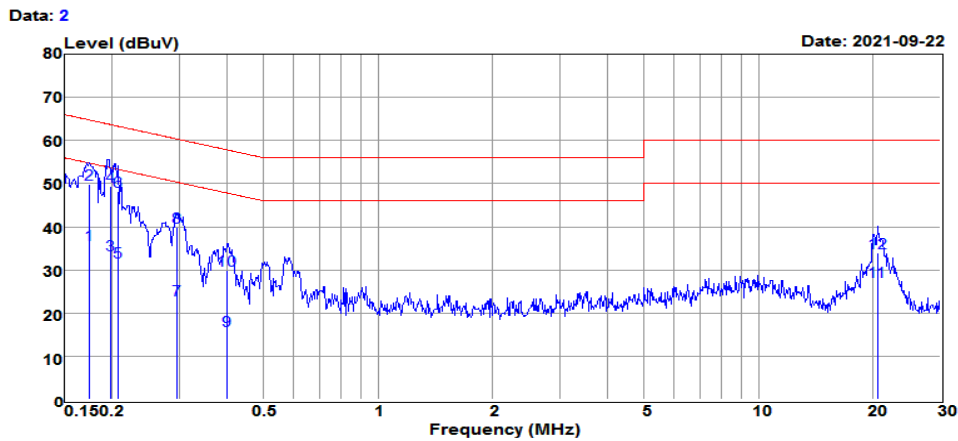
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	NFC mode	Test By:	Oz Ding
-----------------	----------	----------	---------

Site: CON 1 Test Voltage: 120Vac/60Hz
 M/N: 2022 Mode: NFC ON
 POL: LINE Engineer: Oz.Ding Temp: 27.4 Humidity: 62%
 REMARK:



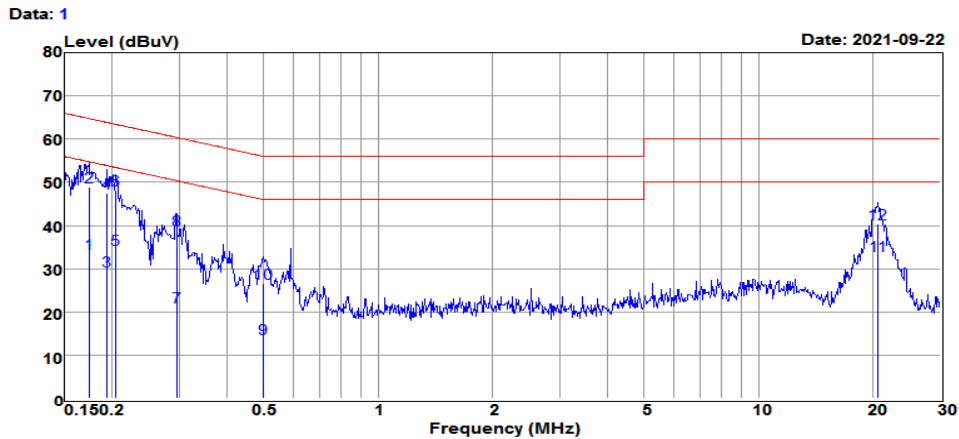
Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dB	Detector
0.175	25.90	9.92	35.82	54.72	-18.90	Average
0.175	40.01	9.92	49.93	64.72	-14.79	QP
0.198	23.51	9.92	33.43	53.68	-20.25	Average
0.198	39.54	9.92	49.46	63.68	-14.22	QP
0.207	21.90	9.92	31.82	53.32	-21.50	Average
0.207	38.29	9.92	48.21	63.32	-15.11	QP
0.296	13.10	9.89	22.99	50.37	-27.38	Average
0.296	30.00	9.89	39.89	60.37	-20.48	QP
0.402	6.14	9.89	16.03	47.81	-31.78	Average
0.402	19.93	9.89	29.82	57.81	-27.99	QP
20.486	16.86	10.52	27.38	50.00	-22.62	Average
20.486	23.48	10.52	34.00	60.00	-26.00	QP

CON

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Site: CON 1 Test Voltage: 120Vac/60Hz
 M/N: 2022 Mode: NFC ON
 POL: NEUTRAL Engineer: Oz.Ding Temp: 27.4 Humidity: 62%
 REMARK:



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dB	Detector
0.174	23.52	9.92	33.44	54.77	-21.33	Average
0.174	38.90	9.92	48.82	64.77	-15.95	QP
0.193	19.50	9.92	29.42	53.89	-24.47	Average
0.193	37.51	9.92	47.43	63.89	-16.46	QP
0.204	24.48	9.92	34.40	53.45	-19.05	Average
0.204	38.27	9.92	48.19	63.45	-15.26	QP
0.297	11.17	9.89	21.06	50.34	-29.28	Average
0.297	29.03	9.89	38.92	60.34	-21.42	QP
0.499	4.01	9.88	13.89	46.01	-32.12	Average
0.499	16.68	9.88	26.56	56.01	-29.45	QP
20.594	22.52	10.51	33.03	50.00	-16.97	Average
20.594	29.77	10.51	40.28	60.00	-19.72	QP

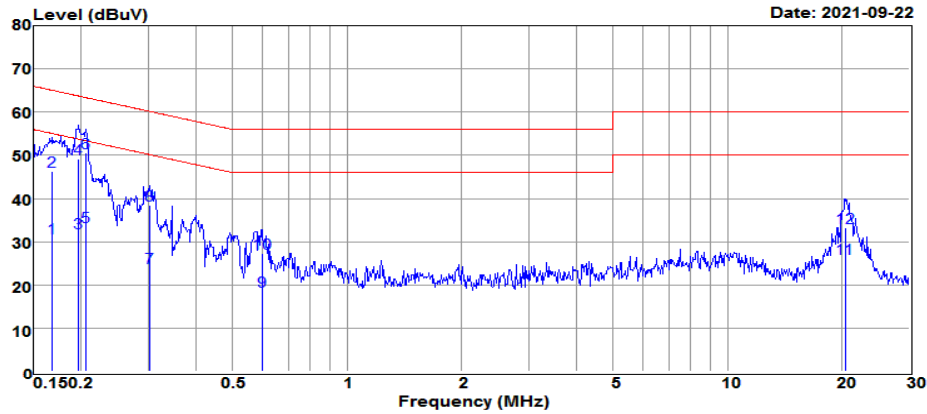
CON

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Site: CON 1 Test Voltage: 120Vac/60Hz
 M/N: 2022 Mode: NFC OFF
 POL: LINE Engineer: Oz.Ding Temp: 27.4 Humidity: 62%
 REMARK: NFC OFF

Data: 3



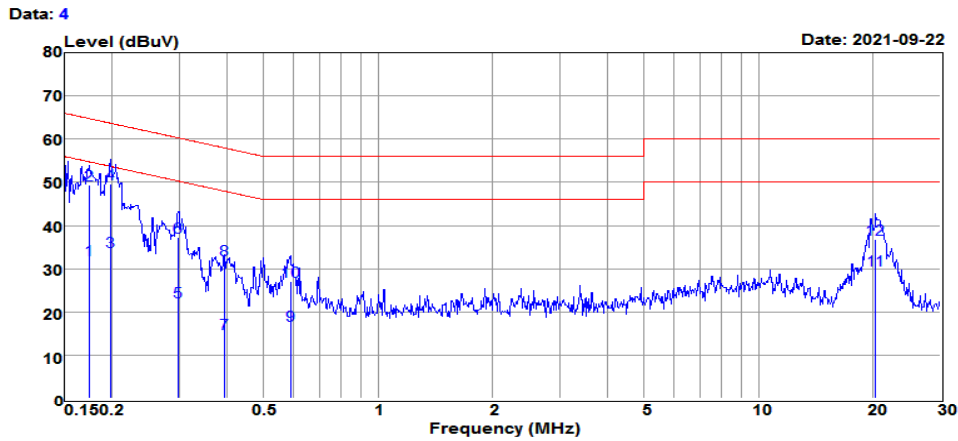
Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dB	Detector
0.169	20.87	9.92	30.79	55.03	-24.24	Average
0.169	36.38	9.92	46.30	65.03	-18.73	QP
0.198	22.09	9.92	32.01	53.71	-21.70	Average
0.198	39.30	9.92	49.22	63.71	-14.49	QP
0.206	23.67	9.92	33.59	53.36	-19.77	Average
0.206	40.71	9.92	50.63	63.36	-12.73	QP
0.303	14.01	9.89	23.90	50.15	-26.25	Average
0.303	28.65	9.89	38.54	60.15	-21.61	QP
0.598	8.62	9.90	18.52	46.00	-27.48	Average
0.598	17.34	9.90	27.24	56.00	-28.76	QP
20.377	15.54	10.52	26.06	50.00	-23.94	Average
20.377	22.74	10.52	33.26	60.00	-26.74	QP

CON

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Site: CON 1 Test Voltage: 120Vac/60Hz
 M/N: 2022 Mode: NFC OFF
 POL: NEUTRAL Engineer: Oz.Ding Temp: 27.4 Humidity: 62%
 REMARK:



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dB	Detector
0.174	22.23	9.92	32.15	54.77	-22.62	Average
0.174	39.35	9.92	49.27	64.77	-15.50	QP
0.199	24.04	9.92	33.96	53.67	-19.71	Average
0.199	39.64	9.92	49.56	63.67	-14.11	QP
0.299	12.36	9.89	22.25	50.28	-28.03	Average
0.299	27.48	9.89	37.37	60.28	-22.91	QP
0.396	5.02	9.89	14.91	47.95	-33.04	Average
0.396	22.25	9.89	32.14	57.95	-25.81	QP
0.589	6.89	9.89	16.78	46.00	-29.22	Average
0.589	17.23	9.89	27.12	56.00	-28.88	QP
20.270	19.24	10.50	29.74	50.00	-20.26	Average
20.270	26.39	10.50	36.89	60.00	-23.11	QP

CON

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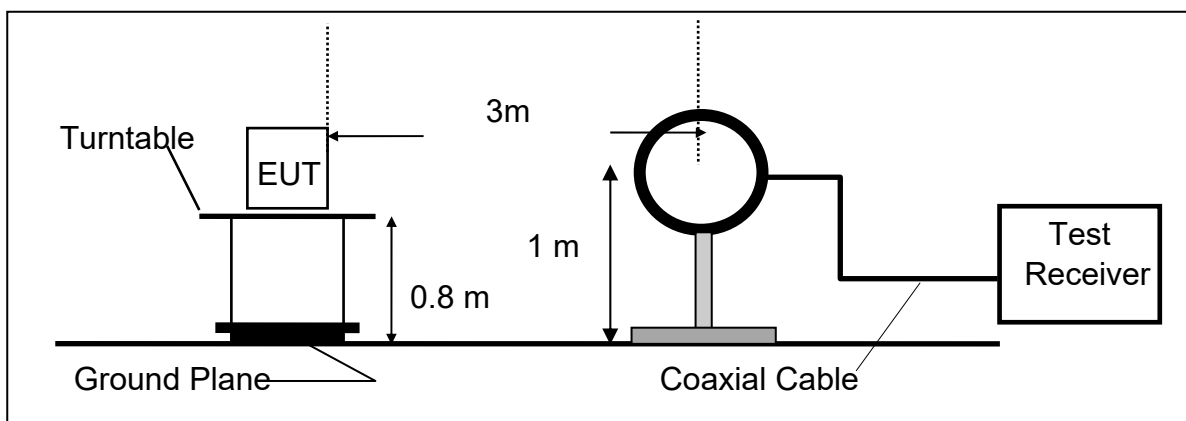
7 RADIATED TEST ITEMS

7.1 Measurement Procedure

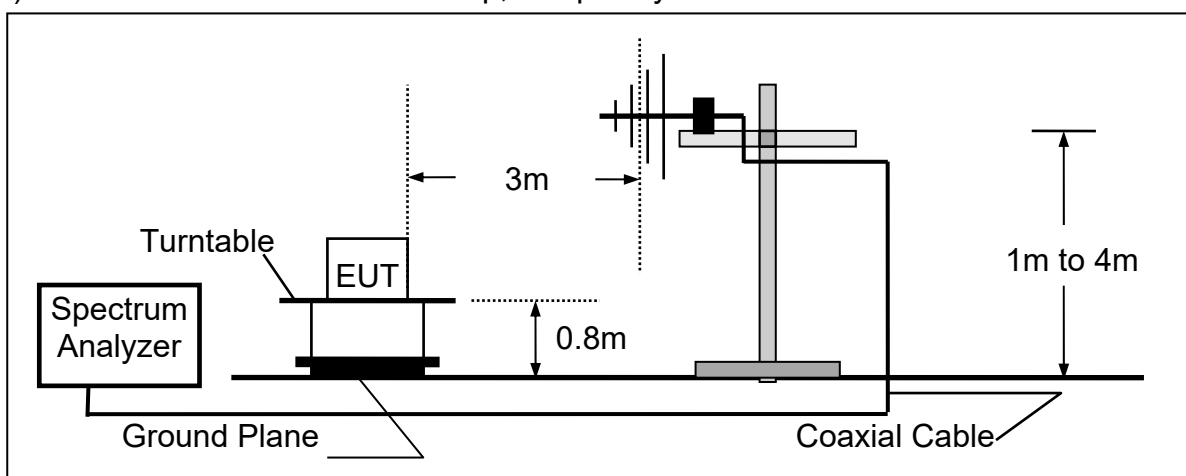
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which 9k-30MHz constant 1m height , 30M-1GHz 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.
Active Loop Antenna	ETS-LINDREN	6502	8905-2356	09/06/2021	09/05/2023
Bilog Antenna with 5dB Attenuator	TESEQ & EMCI	CBL 6112D & N-6-05	35378 & AT-N0564	09/15/2021	09/14/2022
Cable	CCS	CCS	CB966B-2	05/24/2021	05/23/2022
EMI Test Receiver	R&S	ESCI 7	100856	07/01/2021	06/30/2022
Horn Antenna	Com-Power	AH-118	071032	05/04/2021	05/03/2022
MXA Signal Analyzer	KEYSIGHT	N9020A	MY56060171	08/23/2021	08/22/2022
Pre-Amplifier	EMCI	EMC330N	980691	08/09/2021	08/08/2022
Software	e3(v6.101222)				

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

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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	

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)

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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
13.110~13.410	106	40.5
13.410~13.553	334	50.5
13.553~13.567	15848	84
13.567~13.710	334	50.5
13.710~14.010	106	40.5
14.010~30.00	30	29.5

Field strength of fundamental emissions limit:

The field strength of fundamental emissions shall not exceed 15848 microrvolts/meter at 30 meters.

1. Emission level in $\text{dB}\mu\text{V/m}=20 \log (\mu\text{V/m})$
2. Distance extrapolation factor = $40 \log (\text{required distance/ test distance})$ (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance below 30MHz at 3m and above 30MHz at 3m to extrapolate the 30m data.
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 $\text{dB}\mu\text{V/m}=20 \log (\mu\text{V/m})$
7. Distance extrapolation factor = $40 \log (\text{required distance/ test distance})$ (dB)
8. The lower limit shall apply at the transition frequencies.

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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

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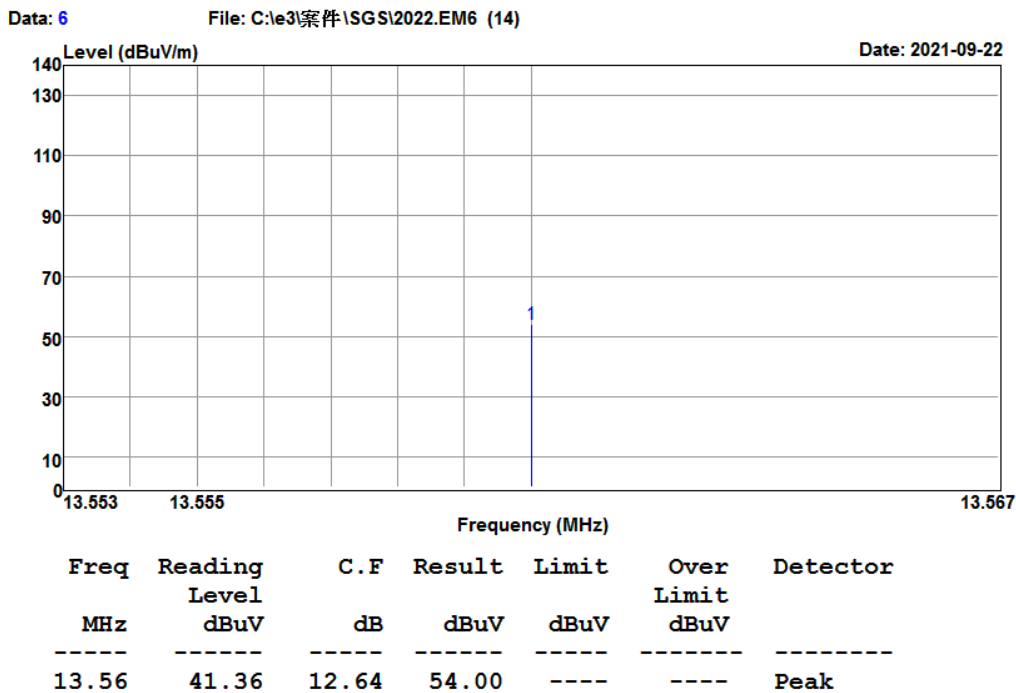
7.5.2 Field Strength of Fundamental Emission Measurement Result 3m Chamber

EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X



Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
Y: Y axis, orientation of antenna is perpendicular.

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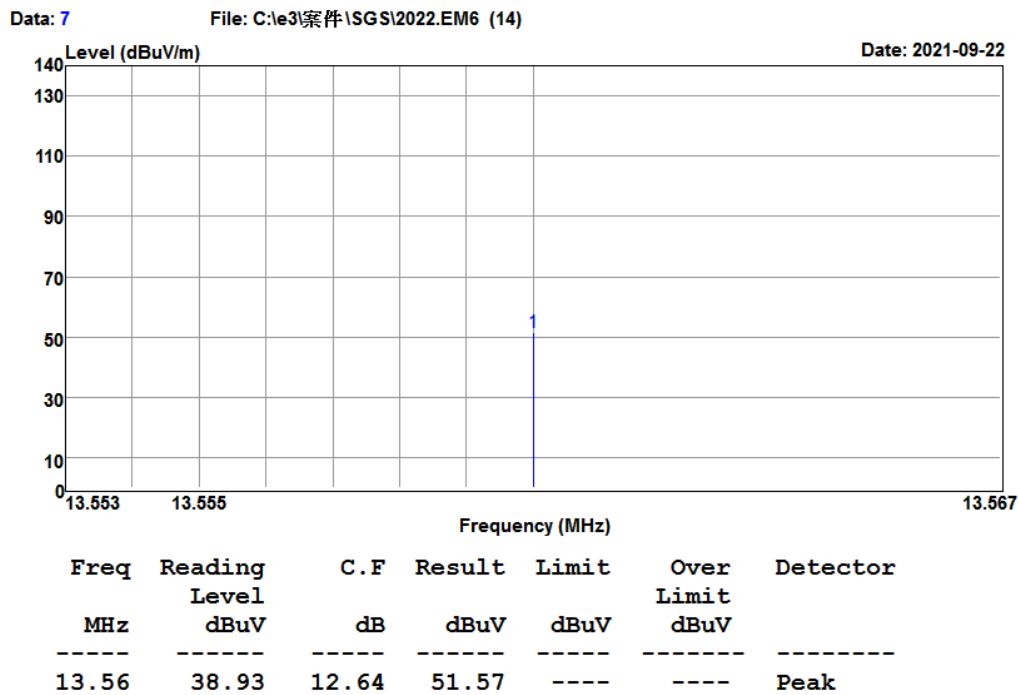
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EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : Engineer :Ted.Huang Temp/Humi:24/44%

REMARK: Y



Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
Y: Y axis, orientation of antenna is perpendicular.

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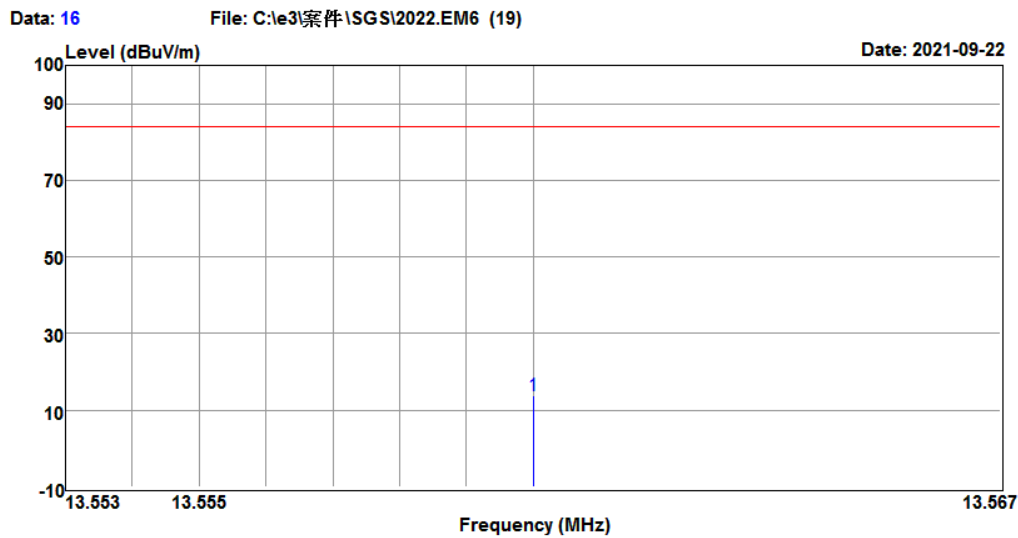
Standard distance

EUT : Portable Computing Deviceage :120Vac/60Hz

 M/N : 2022 Test Mode :NFC ON

 POL : Engineer :Ted.Huang Temp/Humi :24/44%

 REMARK: X



Freq	Reading	C.F	Result	Limit	Over	Detector
MHz	dBuV	dB	dBuV	dBuV	Limit	
-----	-----	-----	-----	-----	-----	-----
13.56	1.36	12.64	14.00	84.00	-70.00	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
 X: X axis, orientation of antenna is parallel.
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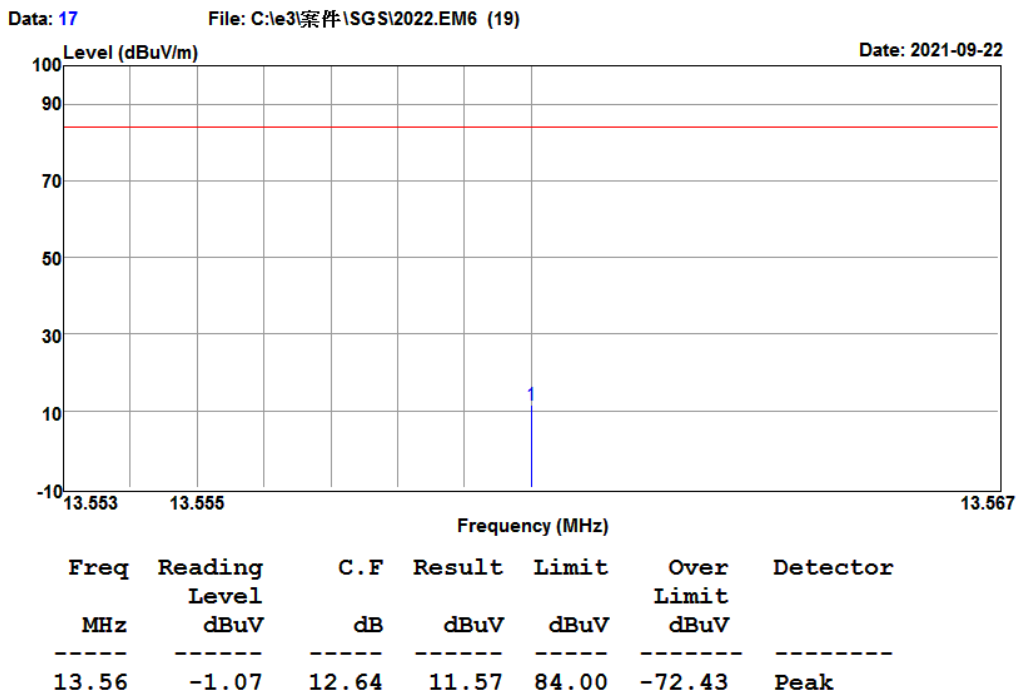
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EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : Engineer :Ted.Huang Temp/Humi:24/44%

REMARK: Y



Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
Y: Y axis, orientation of antenna is perpendicular.

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7.5.3 Mask Measurement Result 3m Chamber

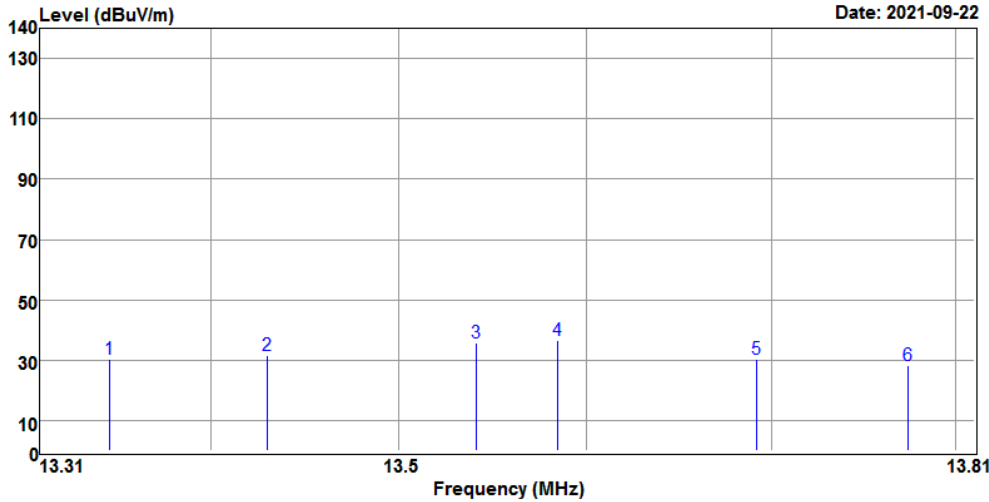
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 8 File: C:\e3\案件\SGS\2022.EM6 (15) Date: 2021-09-22



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
13.35	17.71	12.64	30.35	----	----	Peak
13.43	18.84	12.64	31.48	----	----	Peak
13.54	23.21	12.64	35.85	----	----	Peak
13.59	24.11	12.64	36.75	----	----	Peak
13.69	17.61	12.63	30.24	----	----	Peak
13.77	15.71	12.63	28.34	----	----	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
Y: Y axis, orientation of antenna is perpendicular.

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Standard distance

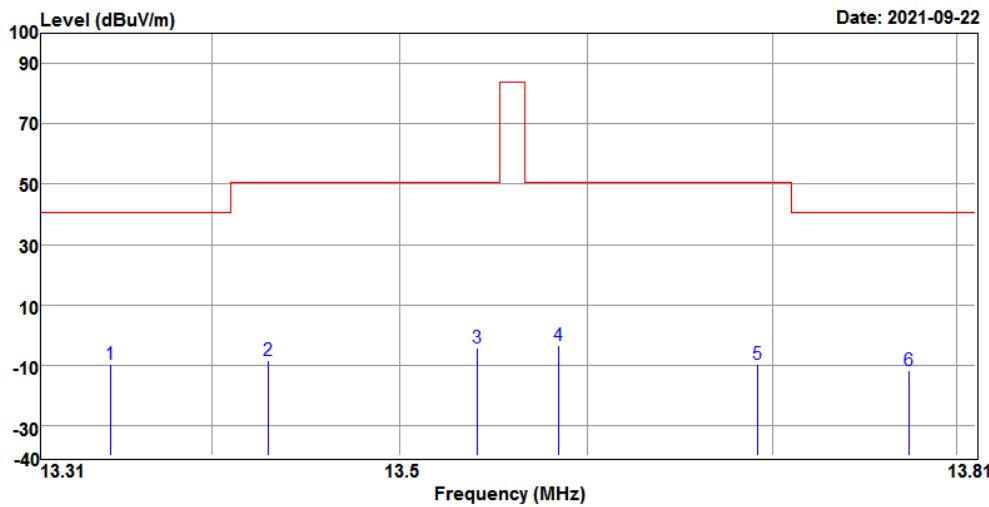
EUT : Portable Computing Deviceage :120Vac/60Hz

 M/N : 2022 Test Mode :NFC ON

 POL : Engineer :Ted.Huang Temp/Humi :24/44%

 REMARK: X

Data: 15 File: C:\e3\案件\SGS\2022.EM6 (15) Date: 2021-09-22



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
13.35	-22.29	12.64	-9.65	40.50	-50.15	Peak
13.43	-21.16	12.64	-8.52	50.50	-59.02	Peak
13.54	-16.79	12.64	-4.15	50.50	-54.65	Peak
13.59	-15.89	12.64	-3.25	50.50	-53.75	Peak
13.69	-22.39	12.63	-9.76	50.50	-60.26	Peak
13.77	-24.29	12.63	-11.66	40.50	-52.16	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
 X: X axis, orientation of antenna is parallel.
 Y: Y axis, orientation of antenna is perpendicular.

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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 = $40 \log (\text{required distance/ test distance})$ (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance at 3m to extrapolate the 30m data.

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Radiated Emission Measurement 3m Chamber

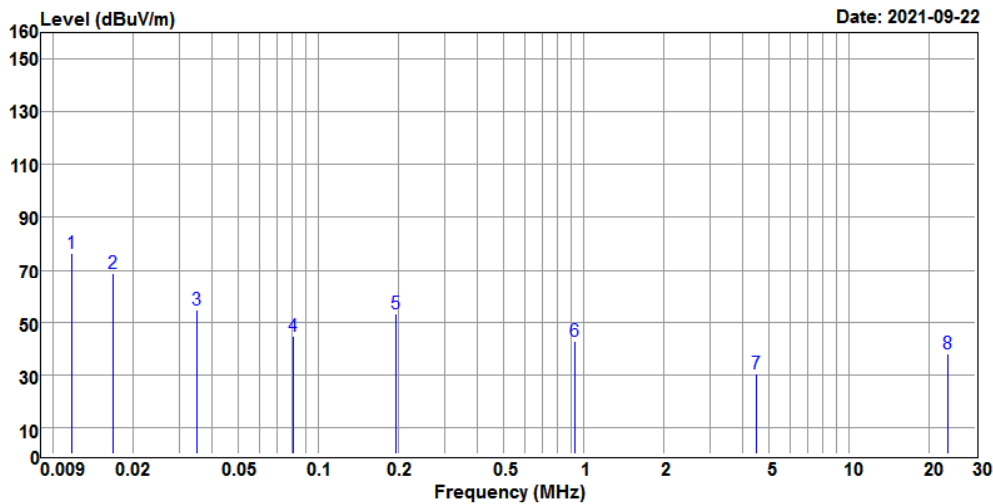
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 9 File: C:\e3\案件\SGS\2022\EM6 (14) Date: 2021-09-22



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
0.01	58.17	18.22	76.39	----	----	Average
0.02	51.85	16.95	68.80	----	----	Average
0.04	40.48	14.17	54.65	----	----	Average
0.08	33.62	11.17	44.79	----	----	Average
0.20	42.14	10.98	53.12	----	----	Average
0.93	31.49	11.19	42.68	----	----	Peak
4.50	19.31	11.12	30.43	----	----	Peak
23.51	26.73	11.34	38.07	----	----	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
Y: Y axis, orientation of antenna is perpendicular.

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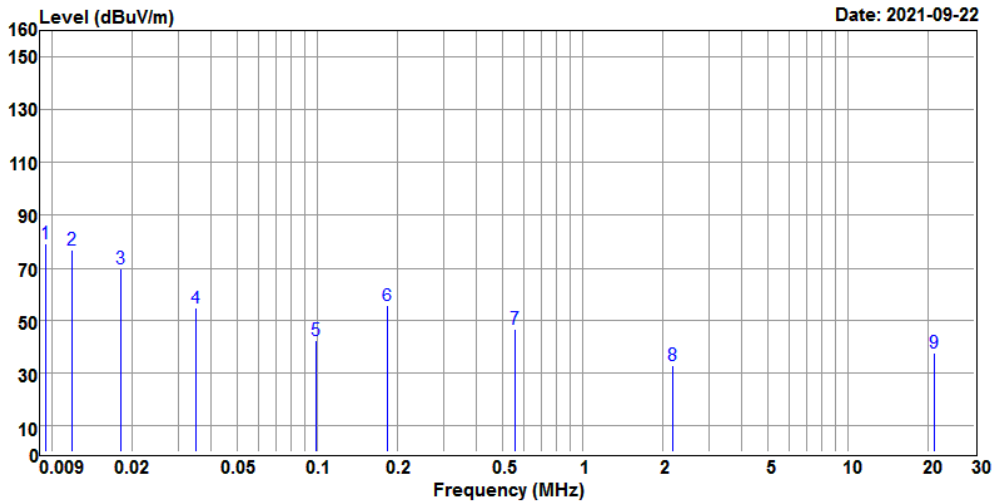
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC OFF

POL : Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 10 File: C:\e3\案件\SGS\2022\EM6 (14) Date: 2021-09-22



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
0.01	60.11	19.20	79.31	----	----	Average
0.01	58.73	18.22	76.95	----	----	Average
0.02	53.18	16.72	69.90	----	----	Average
0.04	40.68	14.17	54.85	----	----	Average
0.10	31.57	10.57	42.14	----	----	Peak
0.18	44.51	10.94	55.45	----	----	Average
0.56	35.26	11.11	46.37	----	----	Peak
2.20	21.93	10.90	32.83	----	----	Peak
21.26	25.48	12.00	37.48	----	----	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
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Standard distance

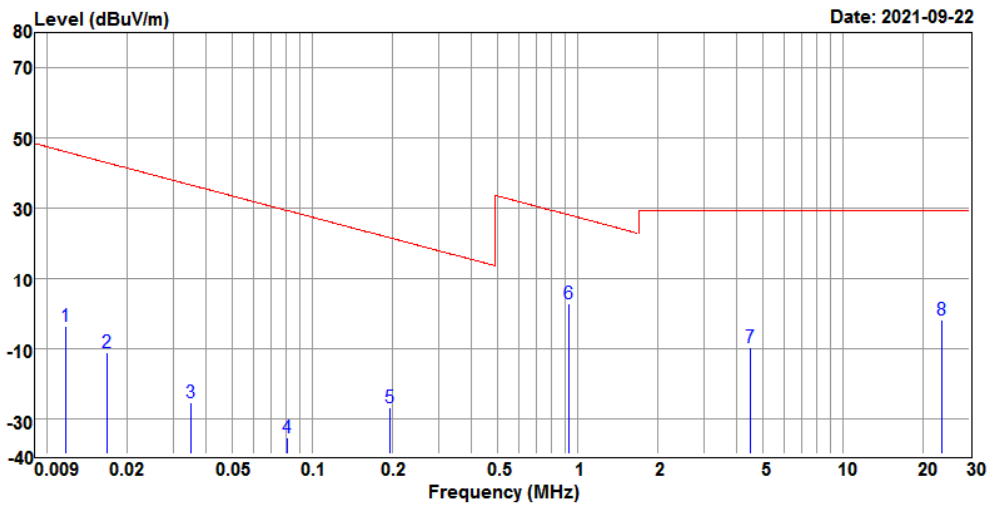
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : Engineer :Ted.Huang Temp/Humi:24/44%

REMARK: X

Data: 18 File: C:\e3\案件\SGS\2022.EM6 (19) Date: 2021-09-22



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
0.01	-21.83	18.22	-3.61	46.13	-49.74	Average
0.02	-28.15	16.95	-11.20	43.00	-54.20	Average
0.04	-39.52	14.17	-25.35	36.70	-62.05	Average
0.08	-46.38	11.17	-35.21	29.47	-64.68	Average
0.20	-37.86	10.98	-26.88	21.78	-48.66	Average
0.93	-8.51	11.19	2.68	28.25	-25.57	Peak
4.50	-20.69	11.12	-9.57	29.54	-39.11	Peak
23.51	-13.27	11.34	-1.93	29.54	-31.47	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
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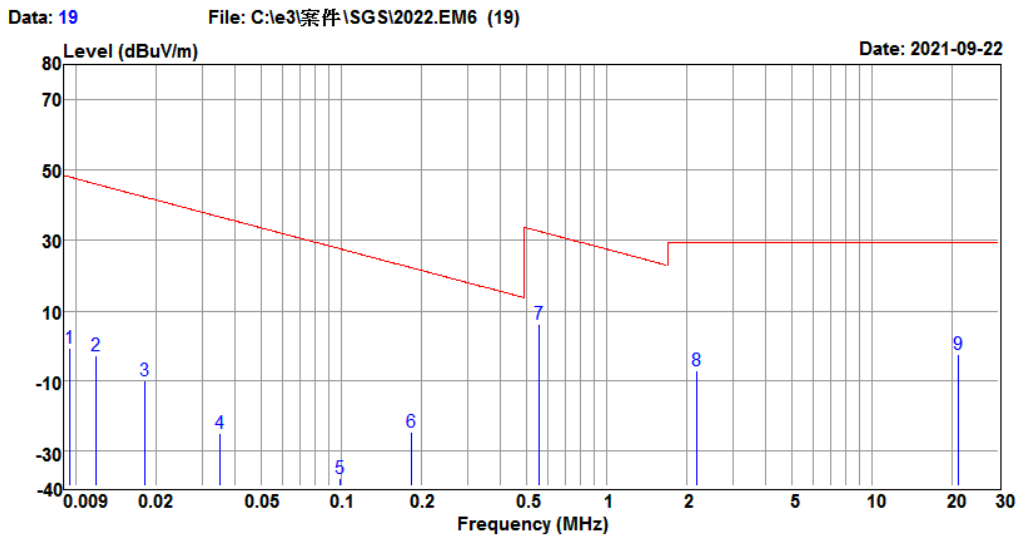
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EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC OFF

POL : Engineer :Ted.Huang Temp/Humi:24/44%

REMARK: X



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
0.01	-19.89	19.20	-0.69	47.99	-48.68	Average
0.01	-21.27	18.22	-3.05	46.08	-49.13	Average
0.02	-26.82	16.72	-10.10	42.42	-52.52	Average
0.04	-39.32	14.17	-25.15	36.70	-61.85	Average
0.10	-48.43	10.57	-37.86	27.67	-65.53	Peak
0.18	-35.49	10.94	-24.55	22.28	-46.83	Average
0.56	-4.74	11.11	6.37	32.71	-26.34	Peak
2.20	-18.07	10.90	-7.17	29.54	-36.71	Peak
21.26	-14.42	12.00	-2.42	29.54	-31.96	Peak

Note: LEVEL unite: dBuV/m = dBuA/m+51.5dB
X: X axis, orientation of antenna is parallel.
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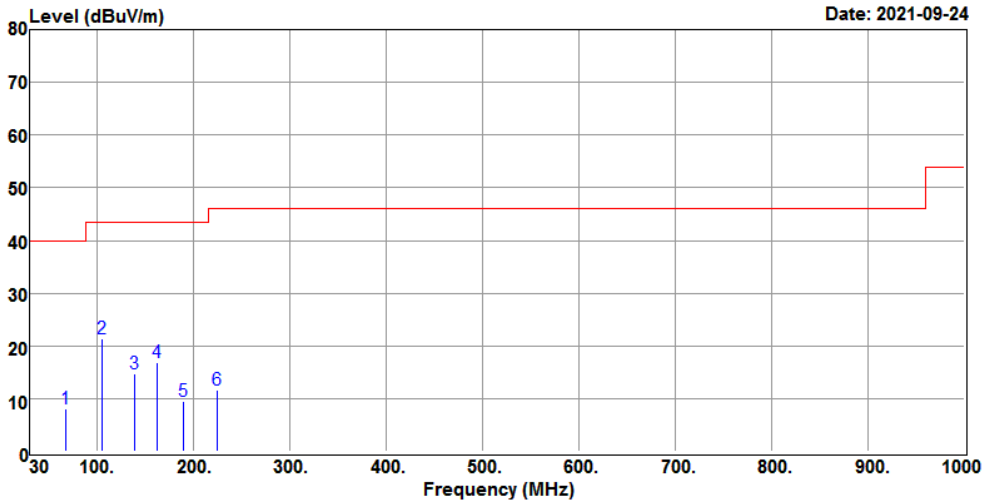
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : HORIZONTAL Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 12 File: C:\e3\案件\SGS\2022\EM6 (14) Date: 2021-09-24



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
67.23	26.78	-18.79	7.99	40.00	-32.01	QP
105.50	34.59	-13.24	21.35	43.50	-22.15	QP
138.40	27.80	-13.18	14.62	43.50	-28.88	QP
162.00	31.35	-14.43	16.92	43.50	-26.58	QP
190.30	24.67	-15.24	9.43	43.50	-34.07	QP
224.30	25.98	-14.31	11.67	46.00	-34.33	QP

Note: X: X axis, orientation of antenna is parallel.
Y: Y axis, orientation of antenna is perpendicular.

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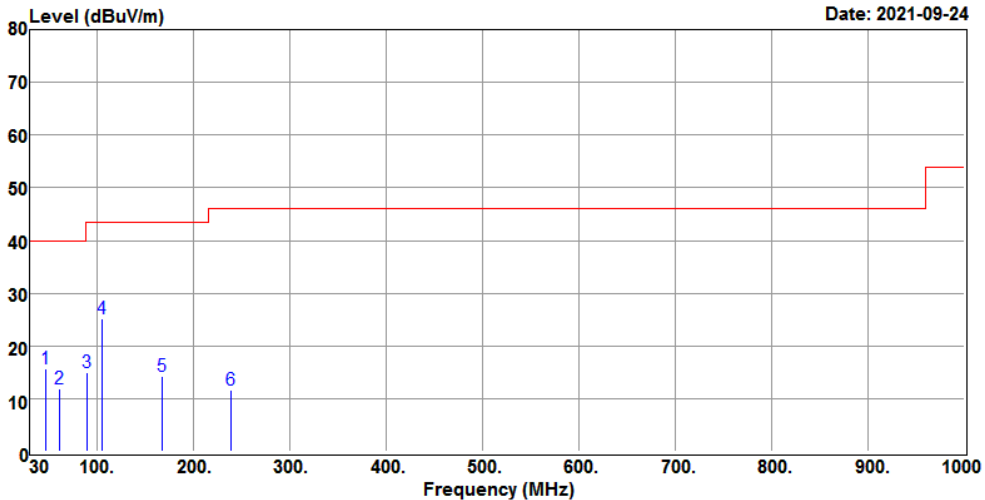
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC ON

POL : VERTICAL Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 11 File: C:\e3\案件\SGS\2022\EM6 (14) Date: 2021-09-24



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
47.13	31.66	-15.95	15.71	40.00	-24.29	QP
60.87	30.89	-18.90	11.99	40.00	-28.01	QP
90.27	30.84	-15.81	15.03	43.50	-28.47	QP
105.90	38.50	-13.28	25.22	43.50	-18.28	QP
168.20	28.83	-14.68	14.15	43.50	-29.35	QP
239.60	24.22	-12.51	11.71	46.00	-34.29	QP

Note: X: X axis, orientation of antenna is parallel.
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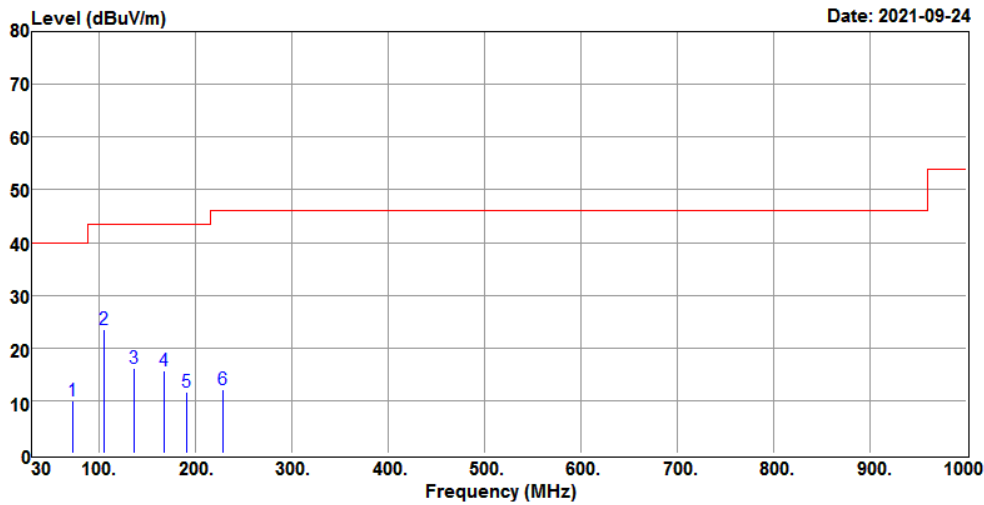
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC OFF

POL : HORIZONTAL Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 13 File: C:\e3\案件\SGS\2022\EM6 (14)



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
72.56	28.49	-18.55	9.94	40.00	-30.06	QP
105.46	36.64	-13.24	23.40	43.50	-20.10	QP
136.96	29.30	-13.18	16.12	43.50	-27.38	QP
167.83	30.37	-14.67	15.70	43.50	-27.80	QP
191.30	26.80	-15.21	11.59	43.50	-31.91	QP
229.10	25.85	-13.80	12.05	46.00	-33.95	QP

Note: X: X axis, orientation of antenna is parallel.
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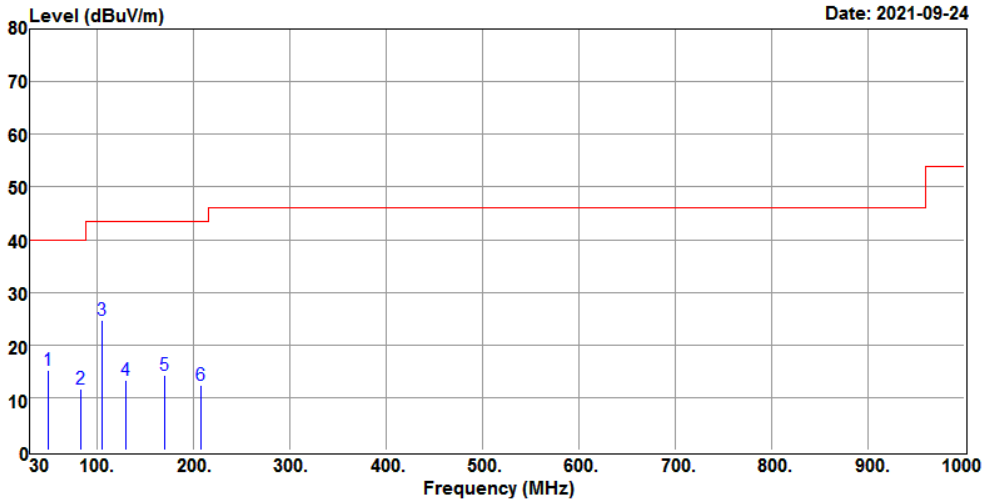
EUT : Portable Computing Deviceage :120Vac/60Hz

M/N : 2022 Test Mode :NFC OFF

POL : VERTICAL Engineer :Ted.Huang Temp/Humi :24/44%

REMARK: X

Data: 14 File: C:\e3\案件\SGS\2022\EM6 (14) Date: 2021-09-24



Freq MHz	Reading Level dBuV	C.F dB	Result dBuV	Limit dBuV	Over Limit dBuV	Detector
49.39	32.01	-16.89	15.12	40.00	-24.88	QP
82.57	28.99	-17.44	11.55	40.00	-28.45	QP
104.97	37.94	-13.20	24.74	43.50	-18.76	QP
129.75	25.92	-12.61	13.31	43.50	-30.19	QP
169.70	29.07	-14.74	14.33	43.50	-29.17	QP
208.00	27.12	-14.66	12.46	43.50	-31.04	QP

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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.

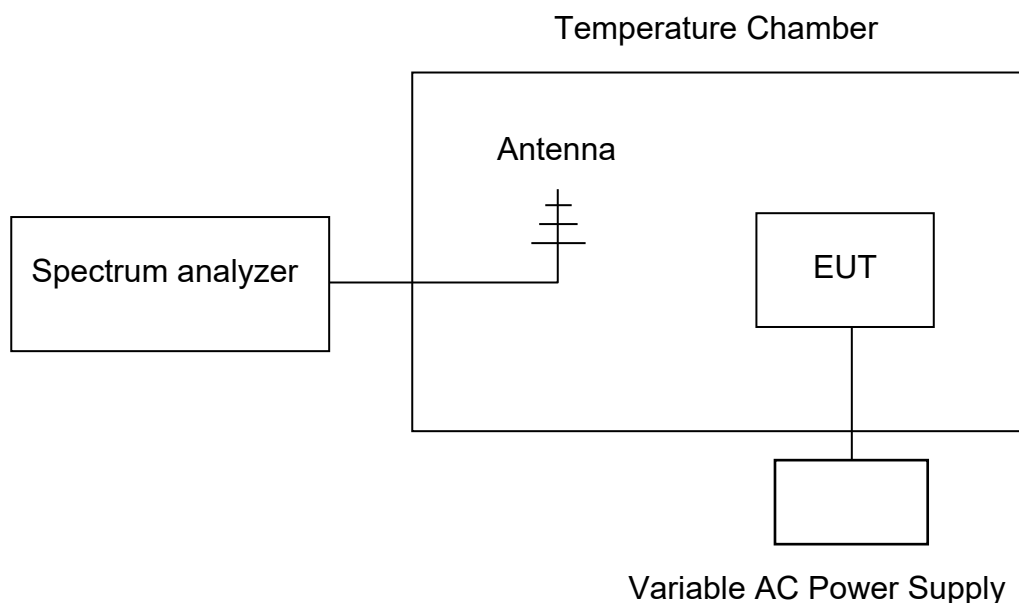
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

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 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

Chamber 9*6*6					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Active Loop Antenna	ETS-LINDREN	6502	8905-2356	09/06/2021	09/05/2023
MXA Signal Analyzer	KEYSIGHT	N9020A	MY56060171	08/23/2021	08/22/2022
SMA Cable + 10dB Attenuator	CCS	SMA+10dB ATT	SMA/10dB	01/29/2021	01/28/2022
Tem/Hum Chamber	K.SON	THS-M1	242	09/28/2020	09/27/2021
Near Field Probe	EMCO	TS-7405	7405-903	N.C.R	N.C.R
Software	Excel(ccs-o6-2020 v1.1)				

8.5 Measurement Results:

Startup:

Test Temp.	Test Voltage	Frequency	Delta	Limit
	(Vdc)	(MHz)	(kHz)	(kHz)
50°C	6.77	13.559952	-0.048	±1.356
40°C	6.77	13.559950	-0.05	
30°C	6.77	13.559954	-0.046	
20°C	8.8	13.559952	-0.048	
	6.51	13.559950	-0.05	
10°C	6.77	13.559986	-0.014	
0°C	6.77	13.560008	0.008	

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2 minutes:

Test Temp.	Test Voltage	Frequency	Delta	Limit
	(Vdc)	(MHz)	(kHz)	(kHz)
50°C	6.77	13.559944	-0.056	±1.356
40°C	6.77	13.559948	-0.052	
30°C	6.77	13.559958	-0.042	
20°C	8.8	13.559960	-0.04	
	6.51	13.559958	-0.042	
10°C	6.77	13.560010	0.01	
0°C	6.77	13.560028	0.028	

5 minutes:

Test Temp.	Test Voltage	Frequency	Delta	Limit
	(Vdc)	(MHz)	(kHz)	(kHz)
50°C	6.77	13.559940	-0.06	±1.356
40°C	6.77	13.559460	-0.54	
30°C	6.77	13.559956	-0.044	
20°C	8.8	13.559968	-0.032	
	6.51	13.559972	-0.028	
10°C	6.77	13.560016	0.016	
0°C	6.77	13.560040	0.04	

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10 minutes:

Test Temp.	Test Voltage	Frequency	Delta	Limit
	(Vdc)	(MHz)	(kHz)	(kHz)
50°C	6.77	13.559932	-0.068	±1.356
40°C	6.77	13.559940	-0.06	
30°C	6.77	13.559958	-0.042	
20°C	8.8	13.559972	-0.028	
	6.51	13.559972	-0.028	
10°C	6.77	13.560032	0.032	
0°C	6.77	13.560048	0.048	

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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. 99% Occupied Bandwidth the resolution bandwidth of 10 kHz and the video bandwidth of 30 kHz were used.
4. 20dB Bandwidth the resolution bandwidth of 10 kHz and the video bandwidth of 30 kHz were used.
5. Measured the spectrum width with power higher than 20dB below carrier.

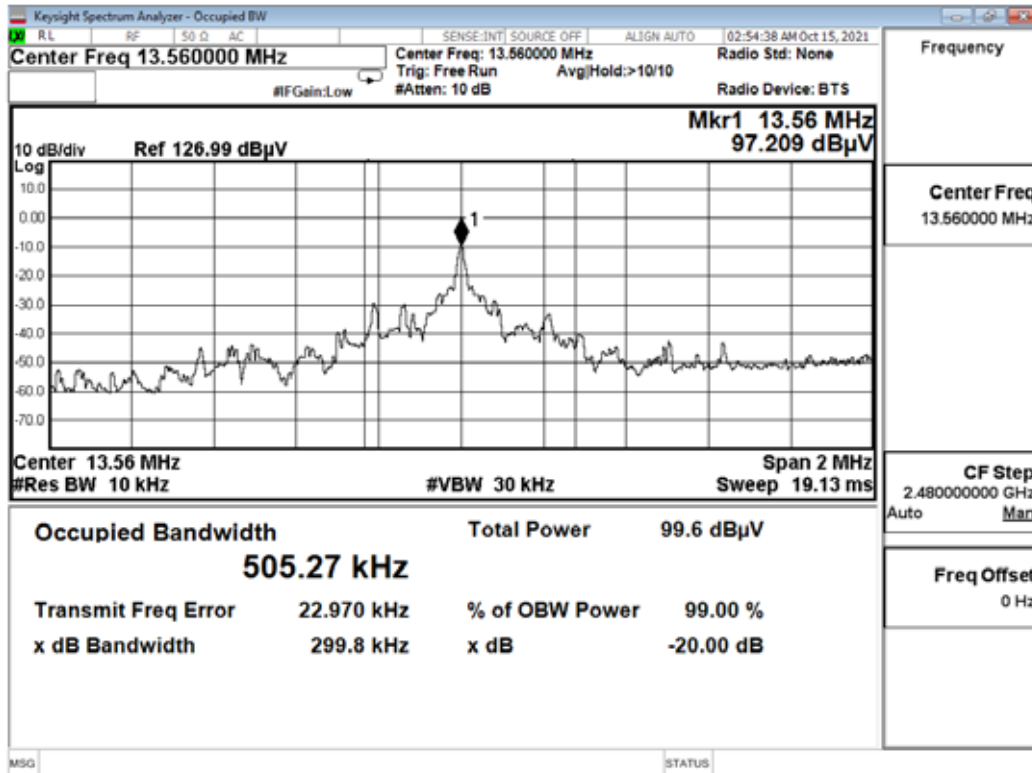
9.5 Measurement Equipment Used

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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