

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



FCC Applicant: Convadis AG
Stropelstrasse 20, 5417 Untersiggenthal, Switzerland
FCC Manufacturer: Convadis AG
Stropelstrasse 20, 5417 Untersiggenthal, Switzerland
ISED Applicant: Convadis AG
Stropelstrasse 20, 5417 Untersiggenthal, Switzerland
ISED Manufacturer: Convadis AG
Stropelstrasse 20, 5417 Untersiggenthal, Switzerland
Product Name: Access and data acquisition system for Car sharing and fleet management
Brand Name: C-Compact
Model No.: 62
Model Difference: N/A
Report Number: E2/2021/30001
FCC ID: YOB-62
IC: 8602A-62
FCC Rule Part Part 15.225
IC Rule: RSS-210 issue 10 Annex B B.6 Dec. 2019
Issue Date: June 10, 2021
Date of Test: March 10, 2021 - March 30, 2021
Date of EUT Received: March 10, 2021

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab .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.

Approved By: _____



Jay Lin / Asst. Supervisor

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Revision History

Report Number	Revision	Description	Issue Date	Revised By
E2/2021/30001	Rev.00	Original.	June 10, 2021	Elle Chang

Note:

- 1、Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Access and data acquisition system for Car sharing and fleet management
Brand Name:	C-Compact
Model No.:	62
Model Difference:	N/A
Hardware Version:	13
Software Version:	4.62
EUT Series No.:	PJ213024001
Power Supply:	DC 12V

1.2 RF specification

Radio Technology:	NFC
Operating Frequency	13.56MHz
Transmit Power	< 123dBuV/m at 3m.
Number of Channels	1
Antenna Type	1. Loop Antenna (C-Compact) 2. Loop Antenna (C-Intac)
Modulation Type	ASK

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1.3 Test Methodology

FCC Part 15, Subpart C §15.225

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

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

ANSI C63.10:2013.

1.4 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1 SAC 3 Conduction 1 Conducted 1 Conducted 2 Conducted 3 Conducted 4 Conducted 5 Conducted 6	TW0027	TW3702
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction A SAC C SAC D SAC G Conducted A Conducted B Conducted C Conducted D Conducted E Conducted F Conducted G	TW0028	

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

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1.5 Special Accessories

There is no other accessory attached. This is the worst case condition.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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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 a table which is 0.8 m 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. The two LISNs provide 50uH/50 ohm 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 a 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. 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.

2.3.3 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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2.4 Configuration of Tested System

Fig. 2-4-1 Conducted & Emission test set up configuration

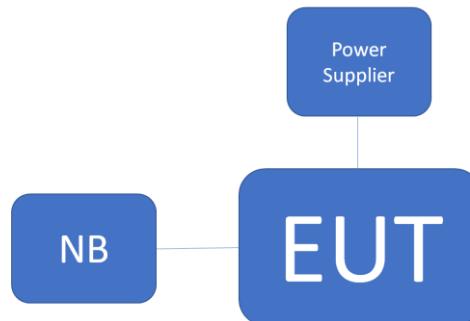


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.
1.	NFC Test Software	N/A	N/A	N/A
2.	DC Power Supply	DHA	DPS-3003	9411005787
3.	Notebook	Lenovo	L440	P0000367

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207	RSS-Gen § 8.8	AC Power Line Conducted Emission	N/A
§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)	RSS210 Annex B B.6 (b)	Frequency Stability	Compliant
§2.1049 §15.215 (c)	RSS-Gen § 6.7	Emission Bandwidth	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Channel Details

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

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

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

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.34 dB
Frequency Stability	+/- 1.54 Hz
99% & 20 dB OCCUPIED BANDWIDTH	+/- 1.54 Hz
Temperature	+/- 0.4 °C
Humidity	+/- 3.5 %
DC / AC Power Source	DC= +/- 1%, AC=+/- 1%

Radiated Spurious Emission Measurement Uncertainty		
Polarization: Vertical	+/- 2.64 dB	9kHz~30MHz: +/- 2.3dB
	+/- 4.93 dB	30MHz - 1000MHz: +/- 3.37dB
	+/- 4.81 dB	1GHz - 18GHz: +/- 4.04dB
	+/- 4.52 dB	18GHz - 40GHz: +/- 4.04dB
Polarization: Horizontal	+/- 2.64 dB	9kHz~30MHz: +/- 2.3dB
	+/- 4.45 dB	30MHz - 1000MHz: +/- 4.22dB
	+/- 4.81 dB	1GHz - 18GHz: +/- 4.08dB
	+/- 4.52 dB	18GHz - 40GHz: +/- 4.08dB

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 CONDUCTED EMISSIONS TEST

6.1 Standard Applicable

According to §15.207 and frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Note

1.The lower limit shall apply at the transition frequencies
2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

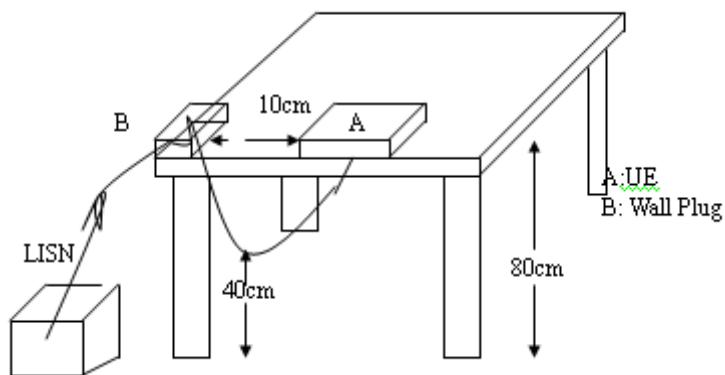
6.2 Measurement Equipment Used:

N/A

6.3 EUT Setup

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

6.4 Test SET-UP (Block Diagram of Configuration)



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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

N/A; Powered from DC 12V.

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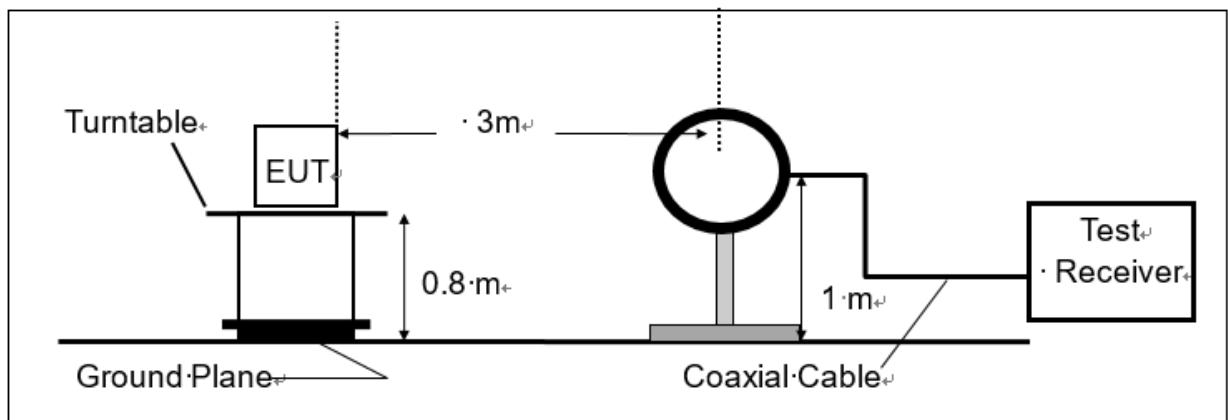
7 RADIATED EMISSION TEST

7.1 Measurement Procedure

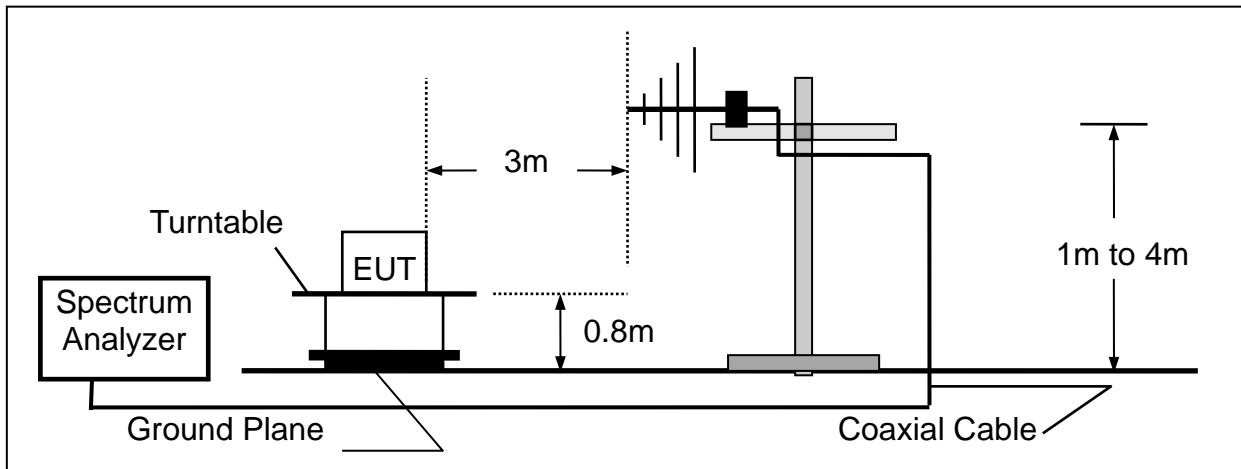
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. 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 form 30MHz to 1000MHz



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7.3 Measurement Equipment Used:

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	TESEQ	CBL 6112D	35240	09/08/2020	09/07/2021
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
EMI Test Receiver	R&S	ESU 40	100363	04/29/2020	04/28/2021
Pre-Amplifier	EMC Instruments	EMC330	980096	11/19/2020	11/18/2021
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/19/2020	11/18/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
Test Software	audix	e3	20923 sgs Ver.9	N.C.R	N.C.R
Notebook	Lenovo	L440	P0000367	N/A	N/A

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 Applicable standard

Rules and specifications	CFR 47 Part 15 section 15.225(a)-(d)		
Frequency of Emission (MHz)	Field Strength (μ V/m) at 30m	Field Strength (dB μ V/m) at 30m	Field Strength (dB μ V/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

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Radiated Mask per ISED 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

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7.5.2 Distance Extrapolation Factor

30m to 3m

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

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

30m to 10m

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

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

10m to 3m

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

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

Note:

1. Emission level in dBuV/m = $20 \log (\mu\text{V}/\text{m})$
2. Distance extrapolation factor = $40 \log (\text{required distance}/ \text{test distance})$ (dB)
3. The lower limit shall apply at the transition frequencies.
4. 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.

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.

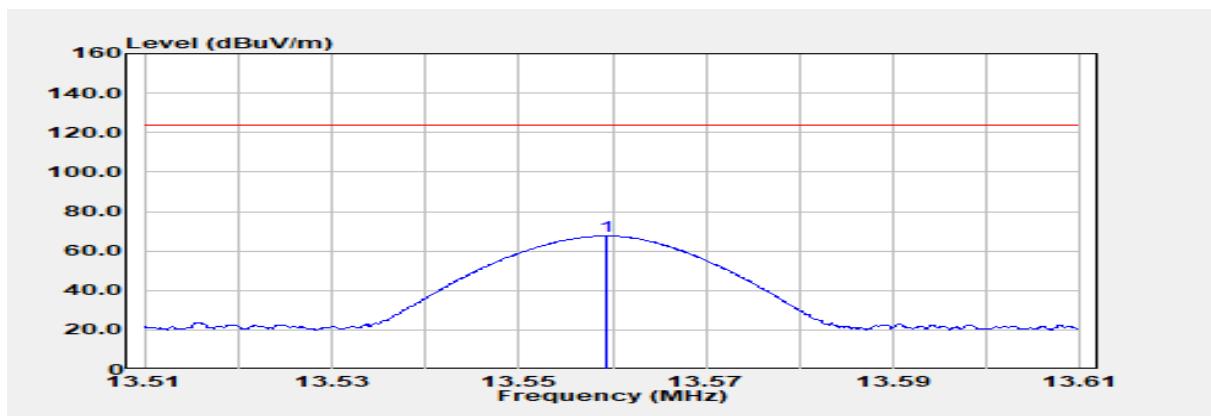
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7.5.3 Field Strength of Fundamental Emission Measurement Result

Loop Antenna (C-Compact):

Report Number	:E2/2021/30001	Test Site	:966 Chamber C
Operation Mode	:NFC	Test Date	:2021-03-18
Test Frequency	:13.56 MHz	Temp./Humi.	:22.2/69
Test Mode	:Main	Antenna Pol.	:Vertical
EUT Pol	:H Plan	Engineer	:Ashton Chiu



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB _u V	Factor dB	Actual FS dB _u V/m	Limit @3m dB _u V/m	Margin dB
13.559	Peak	56.23	11.33	67.56	124.00	-56.44

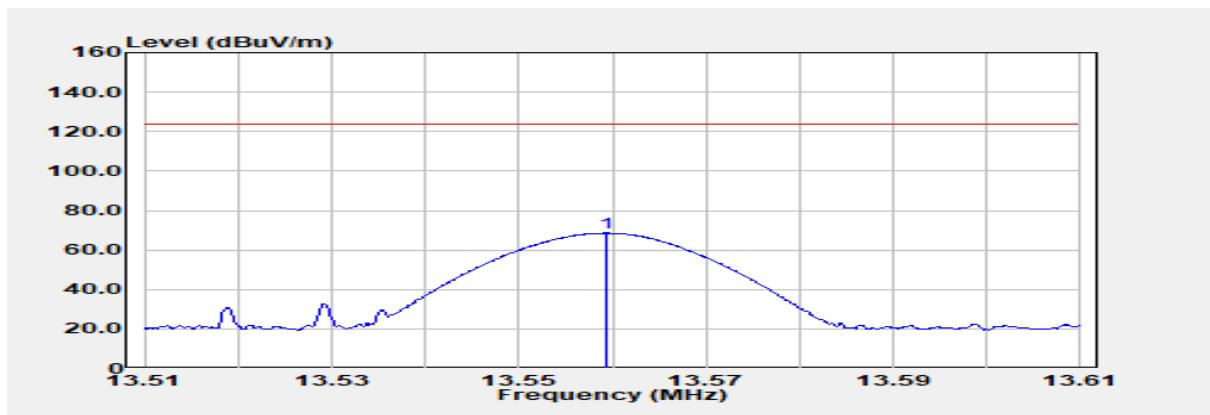
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Main
EUT Pol :H Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.2/69
Antenna Pol. :Horizontal
Engineer :Ashton Chiu



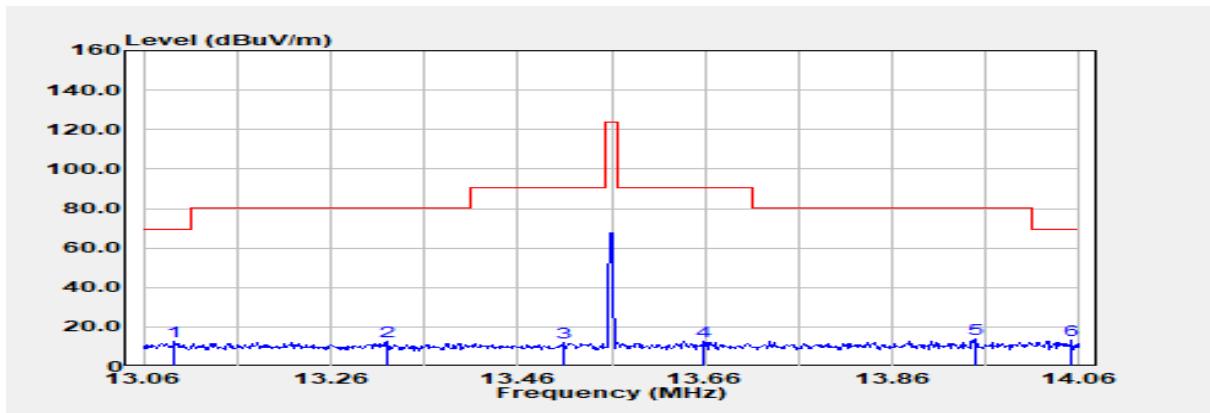
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
13.559	Peak	57.20	11.33	68.53	124.00	-55.47

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Report Number :E2/2021/30001 Test Site :966 Chamber C
Operation Mode :NFC Test Date :2021-03-18
Test Frequency :13.56 MHz Temp./Humi. :22.2/69
Test Mode :Mask Antenna Pol. :Vertical
EUT Pol :H Plan Engineer :Ashton Chiu



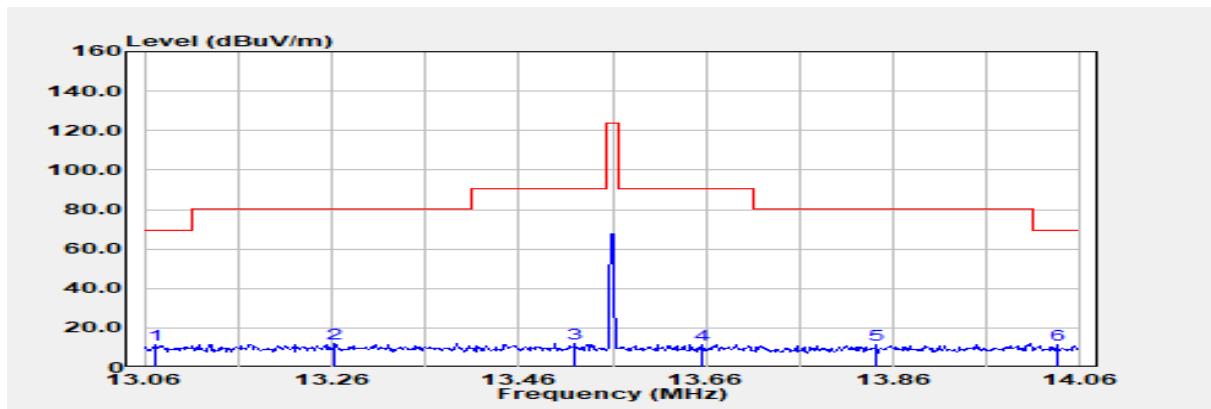
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
13.094	Peak	1.27	11.36	12.64	69.54	-56.90
13.321	Peak	1.49	11.35	12.84	80.50	-67.66
13.509	Peak	0.47	11.33	11.80	90.47	-78.67
13.659	Peak	1.20	11.32	12.52	90.47	-77.95
13.949	Peak	2.78	11.30	14.09	80.50	-66.41
14.052	Peak	2.08	11.29	13.37	69.54	-56.17

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Report Number :E2/2021/30001 Test Site :966 Chamber C
Operation Mode :NFC Test Date :2021-03-18
Test Frequency :13.56 MHz Temp./Humi. :22.2/69
Test Mode :Mask Antenna Pol. :Horizontal
EUT Pol :H Plan Engineer :Ashton Chiu



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
13.071	Peak	-0.11	11.36	11.25	69.54	-58.29
13.264	Peak	0.55	11.35	11.90	80.50	-68.60
13.520	Peak	0.86	11.33	12.19	90.47	-78.28
13.655	Peak	0.10	11.32	11.42	90.47	-79.05
13.842	Peak	0.31	11.31	11.61	80.50	-68.89
14.034	Peak	0.14	11.30	11.44	69.54	-58.10

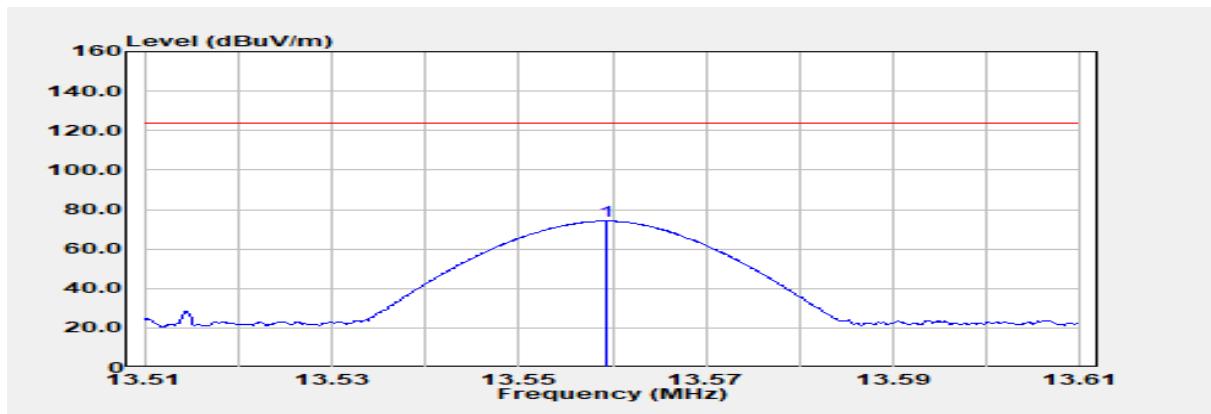
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Loop Antenna (C-Intac):

Report Number	:E2/2021/30001	Test Site	:966 Chamber C
Operation Mode	:NFCp	Test Date	:2021-03-18
Test Frequency	:13.56 MHz	Temp./Humi.	:22.5/66
Test Mode	:Main	Antenna Pol.	:Vertical
EUT Pol	:E1 Plan	Engineer	:Ashton Chiu



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
13.559	Peak	62.75	11.33	74.08	124.00	-49.92

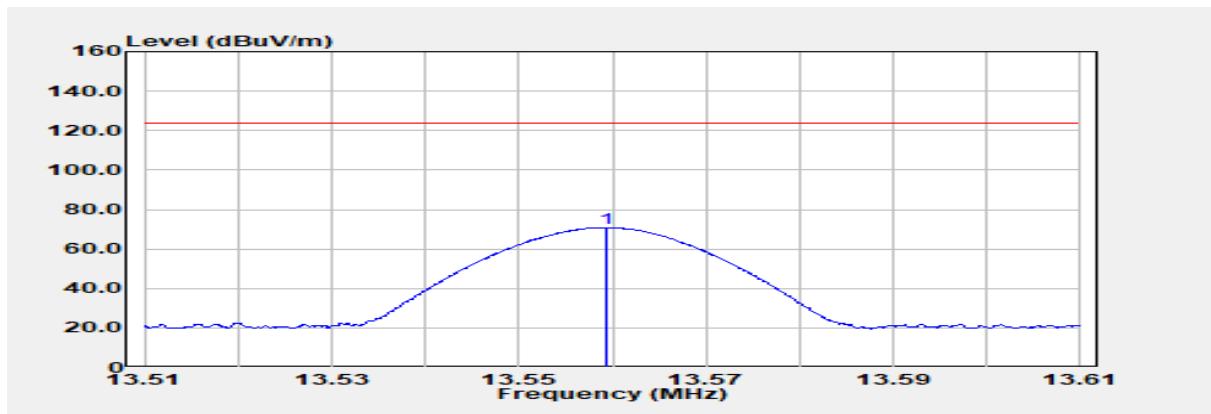
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Main
EUT Pol :E1 Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.5/66
Antenna Pol. :Horizontal
Engineer :Ashton Chiu



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
13.559	Peak	59.47	11.33	70.80	124.00	-53.20

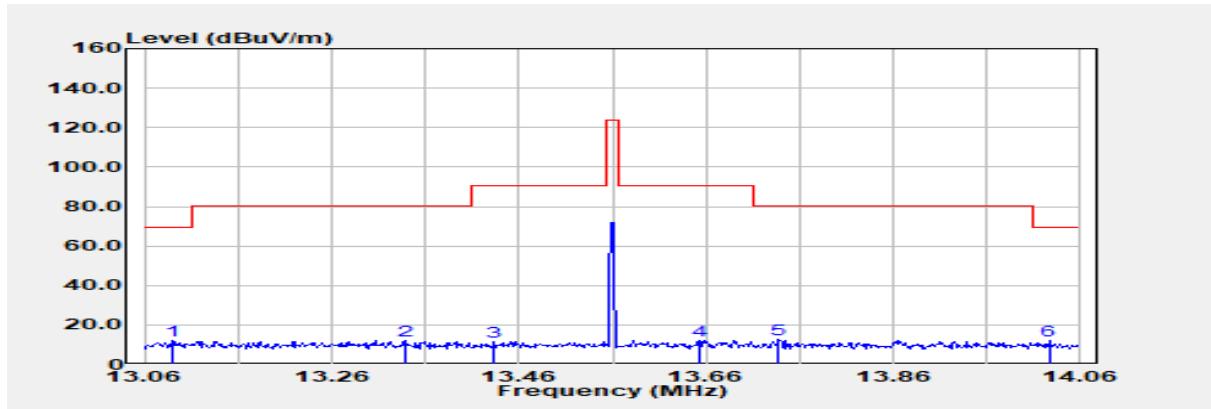
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Mask
EUT Pol :E1 Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.5/66
Antenna Pol. :Vertical
Engineer :Ashton Chiu



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
13.089	Peak	0.47	11.36	11.83	69.54	-57.71
13.339	Peak	0.63	11.34	11.97	80.50	-68.53
13.433	Peak	0.01	11.34	11.35	90.47	-79.12
13.653	Peak	0.82	11.32	12.15	90.47	-78.32
13.738	Peak	1.42	11.32	12.74	80.50	-67.76
14.026	Peak	0.59	11.30	11.88	69.54	-57.66

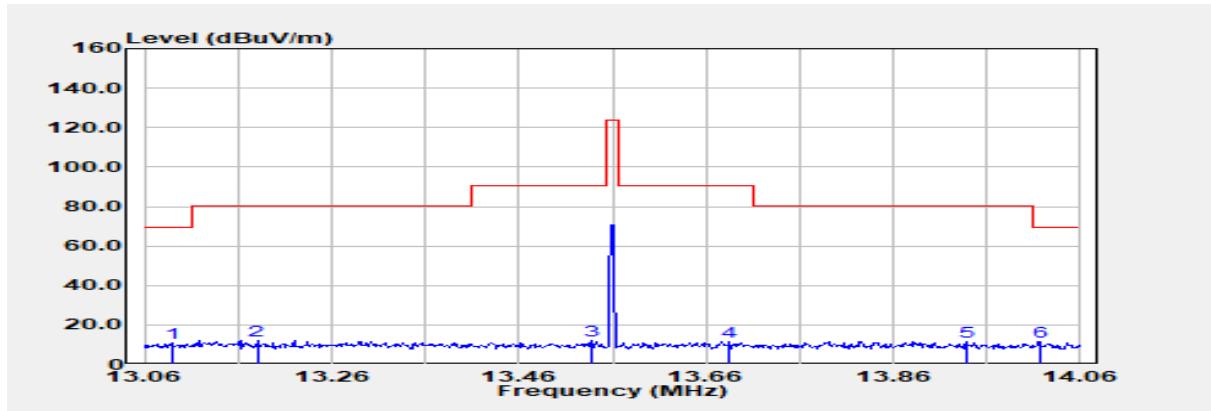
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Mask
EUT Pol :E1 Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.5/66
Antenna Pol. :Horizontal
Engineer :Ashton Chiu



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
13.089	Peak	-0.20	11.36	11.16	69.54	-58.38
13.180	Peak	0.67	11.36	12.02	80.50	-68.48
13.538	Peak	0.98	11.33	12.31	90.47	-78.16
13.685	Peak	0.26	11.32	11.58	90.47	-78.89
13.938	Peak	0.31	11.30	11.61	80.50	-68.89
14.017	Peak	0.35	11.30	11.64	69.54	-57.90

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7.6 Radiated Spurious Emission Measurement

7.6.1 Standard Applicable

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 (μ 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 $\text{dB}\mu\text{V}/\text{m} = 20 \log (\mu\text{V}/\text{m})$
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.
6. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205 and RSS-Gen §8.10.
7. The general radiated emission limits in §15.209 and RSS-Gen §8.9 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

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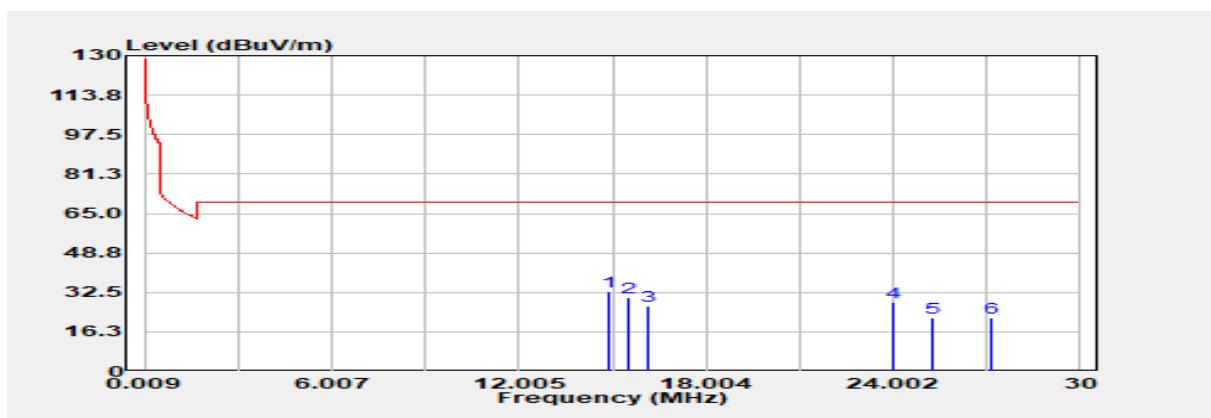
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7.6.2 Radiated Spurious Emission Measurement Result

Loop Antenna (C-Compact):

Report Number	:E2/2021/30001	Test Site	:966 Chamber C
Operation Mode	:NFC	Test Date	:2021-03-18
Test Frequency	:13.56 MHz	Temp./Humi.	:22.3/64
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:H Plan	Engineer	:Ashton Chiu



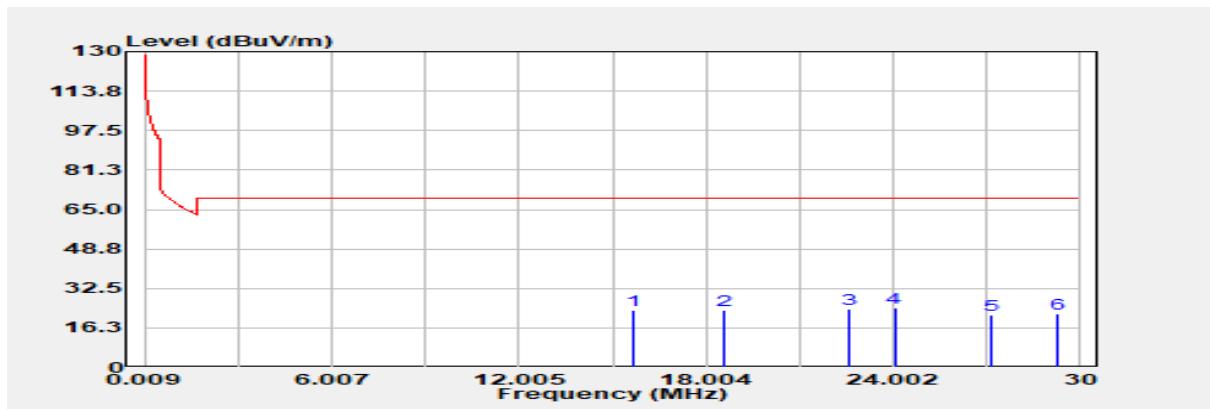
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
14.908	Peak	21.51	11.24	32.75	69.54	-36.79
15.485	Peak	19.32	11.20	30.52	69.54	-39.02
16.158	Peak	15.86	11.16	27.02	69.54	-42.52
23.992	Peak	18.18	10.07	28.25	69.54	-41.29
25.290	Peak	12.50	9.82	22.32	69.54	-47.22
27.120	Peak	12.40	9.49	21.89	69.54	-47.65

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Report Number :E2/2021/30001 Test Site :966 Chamber C
Operation Mode :NFC Test Date :2021-03-18
Test Frequency :13.56 MHz Temp./Humi. :22.3/64
Test Mode :Tx Antenna Pol. :Horizontal
EUT Pol :H Plan Engineer :Ashton Chiu



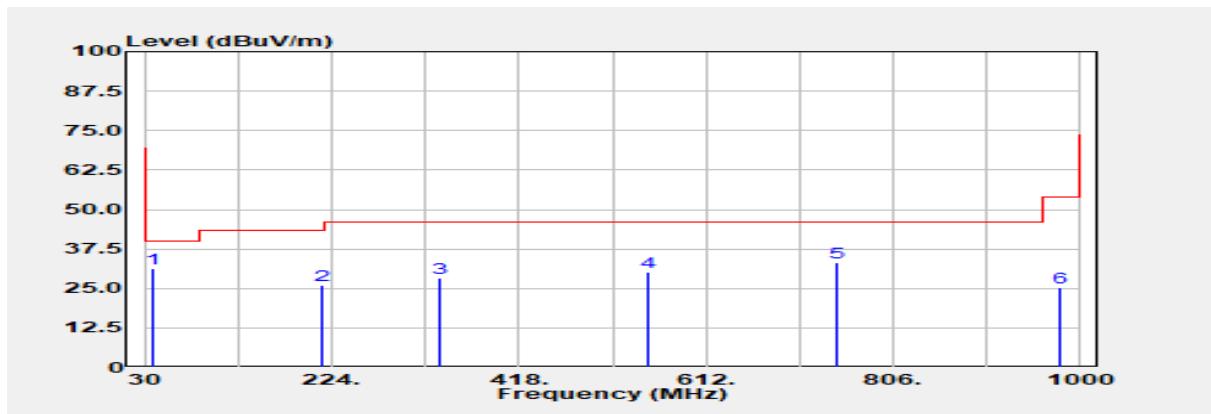
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
15.677	Peak	12.27	11.19	23.46	69.54	-46.08
18.561	Peak	12.31	11.03	23.34	69.54	-46.20
22.550	Peak	13.44	10.37	23.82	69.54	-45.72
24.040	Peak	14.52	10.06	24.58	69.54	-44.96
27.120	Peak	12.06	9.49	21.55	69.54	-47.99
29.231	Peak	13.11	9.14	22.26	69.54	-47.28

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Report Number :E2/2021/30001 Test Site :966 Chamber C
Operation Mode :NFC Test Date :2021-03-18
Test Frequency :13.56 MHz Temp./Humi. :22.3/64
Test Mode :Tx Antenna Pol. :Vertical
EUT Pol :H Plan Engineer :Ashton Chiu



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
39.327	Peak	42.82	-11.58	31.25	40.00	-8.75
214.984	Peak	45.78	-19.74	26.05	43.50	-17.45
336.234	Peak	42.84	-14.54	28.30	46.00	-17.70
552.308	Peak	39.26	-8.97	30.29	46.00	-15.71
748.173	Peak	40.74	-7.54	33.20	46.00	-12.80
979.792	Peak	30.13	-4.79	25.34	54.00	-28.66

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Report Number :E2/2021/30001

Test Site :966 Chamber C

Operation Mode :NFC

Test Date :2021-03-18

Test Frequency :13.56 MHz

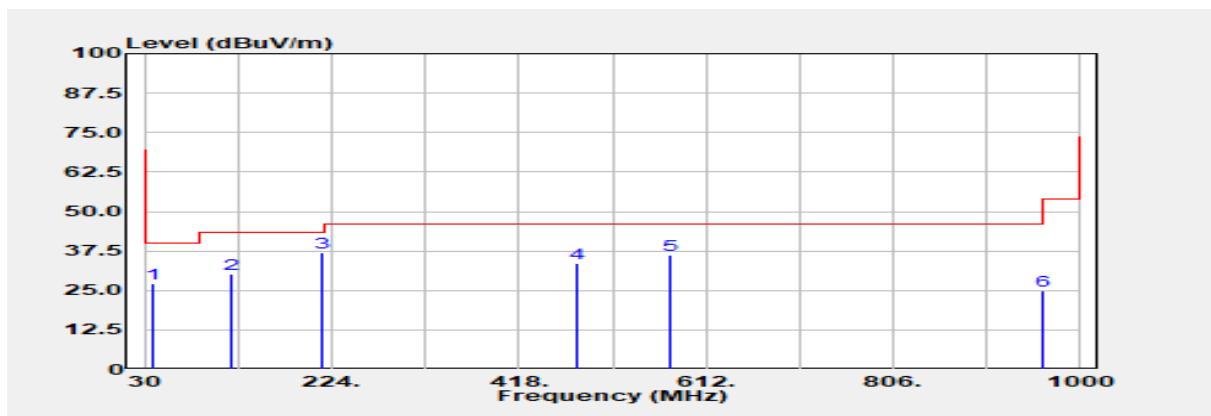
Temp./Humi. :22.3/64

Test Mode :Tx

Antenna Pol. :Horizontal

EUT Pol :H Plan

Engineer :Ashton Chiu



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
39.327	Peak	38.61	-11.58	27.04	40.00	-12.96
120.160	Peak	47.37	-17.01	30.36	43.50	-13.14
214.984	Peak	56.86	-19.74	37.12	43.50	-6.38
479.247	Peak	43.94	-10.48	33.46	46.00	-12.54
575.625	Peak	45.23	-8.85	36.39	46.00	-9.61
961.138	Peak	30.82	-5.96	24.86	54.00	-29.14

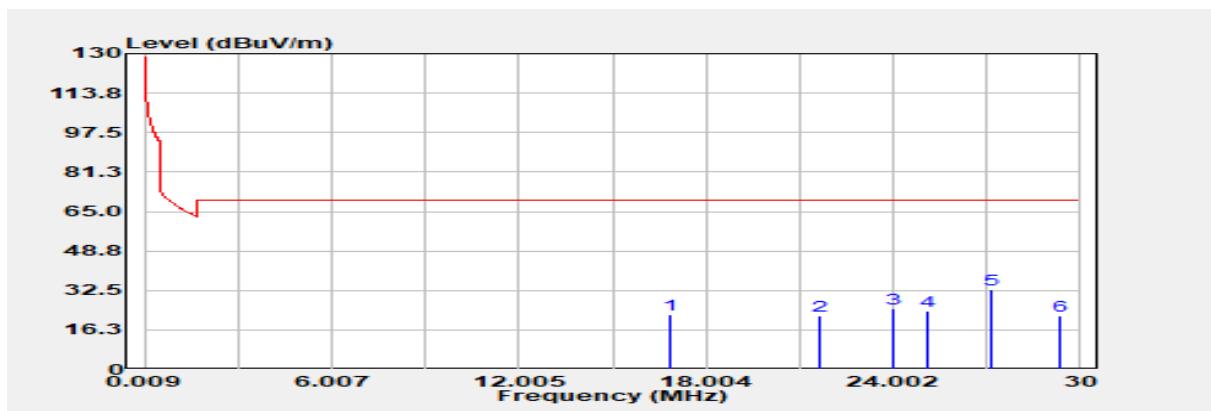
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Loop Antenna (C-Intac):

Report Number :E2/2021/30001 Test Site :966 Chamber C
Operation Mode :NFC Test Date :2021-03-18
Test Frequency :13.56 MHz Temp./Humi. :22.8/63
Test Mode :Tx Antenna Pol. :Vertical
EUT Pol :E1 Plan Engineer :Ashton Chiu



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
16.819	Peak	11.33	11.12	22.45	69.54	-47.09
21.660	Peak	11.70	10.57	22.27	69.54	-47.27
24.008	Peak	14.84	10.07	24.90	69.54	-44.64
25.111	Peak	14.07	9.85	23.92	69.54	-45.62
27.120	Peak	23.46	9.49	32.95	69.54	-36.59
29.377	Peak	12.83	9.12	21.95	69.54	-47.59

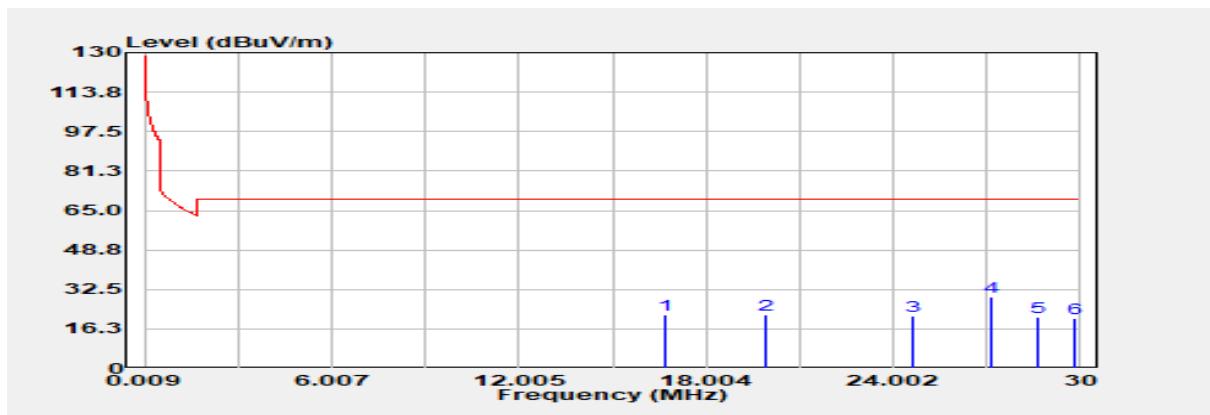
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Tx
EUT Pol :E1 Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.8/63
Antenna Pol. :Horizontal
Engineer :Ashton Chiu



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
16.723	Peak	11.19	11.13	22.32	69.54	-47.22
19.934	Peak	11.07	10.96	22.03	69.54	-47.51
24.632	Peak	11.81	9.94	21.75	69.54	-47.79
27.120	Peak	19.91	9.49	29.41	69.54	-40.13
28.658	Peak	11.81	9.24	21.05	69.54	-48.49
29.808	Peak	11.72	9.05	20.78	69.54	-48.76

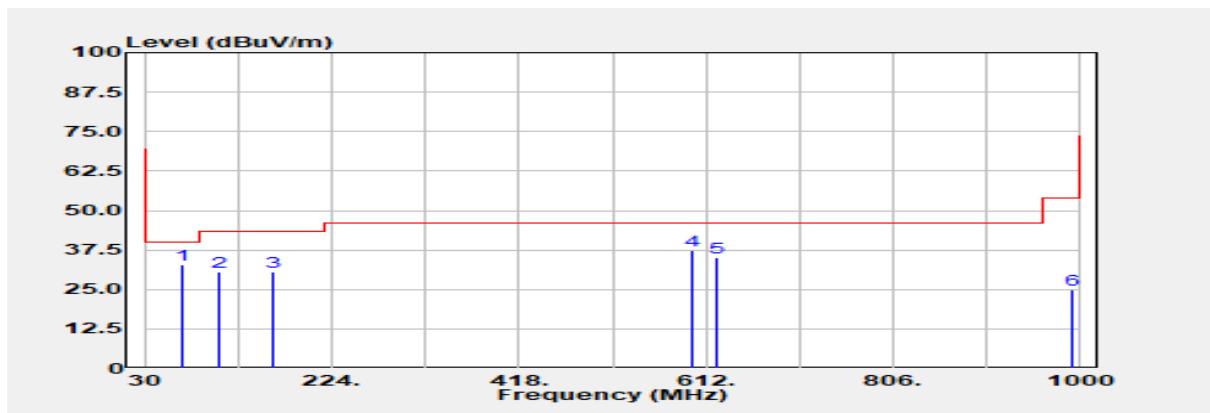
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Tx
EUT Pol :E1 Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.8/63
Antenna Pol. :Vertical
Engineer :Ashton Chiu



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
68.862	Peak	55.45	-22.61	32.84	40.00	-7.16
107.724	Peak	49.02	-18.50	30.52	43.50	-12.98
162.131	Peak	49.88	-19.42	30.46	43.50	-13.04
597.388	Peak	46.62	-9.15	37.47	46.00	-8.53
623.814	Peak	43.68	-8.41	35.27	46.00	-10.73
990.673	Peak	29.80	-4.79	25.02	54.00	-28.98

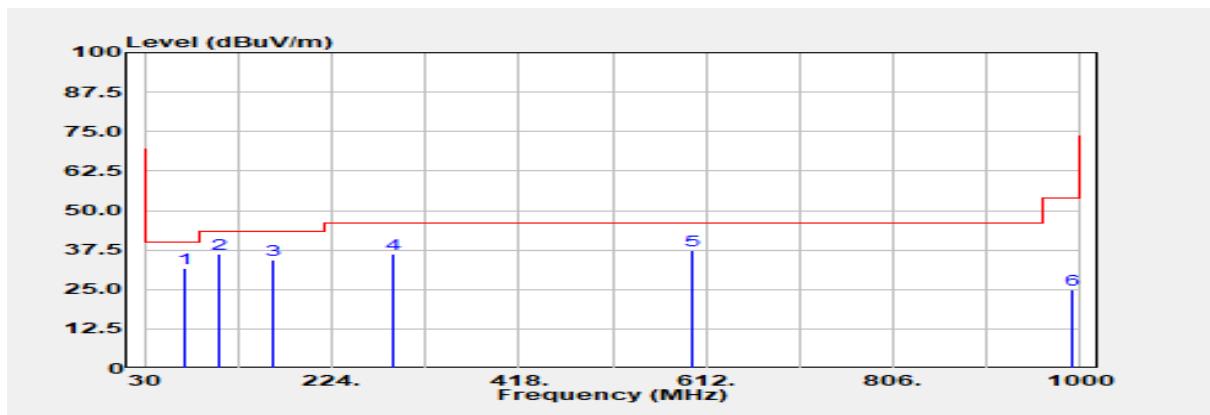
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Report Number :E2/2021/30001
Operation Mode :NFC
Test Frequency :13.56 MHz
Test Mode :Tx
EUT Pol :E1 Plan

Test Site :966 Chamber C
Test Date :2021-03-18
Temp./Humi. :22.8/63
Antenna Pol. :Horizontal
Engineer :Ashton Chiu



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
71.971	Peak	53.64	-22.03	31.61	40.00	-8.39
107.724	Peak	54.68	-18.50	36.18	43.50	-7.32
162.131	Peak	53.66	-19.42	34.24	43.50	-9.26
288.045	Peak	51.65	-15.54	36.12	46.00	-9.88
597.388	Peak	46.65	-9.15	37.50	46.00	-8.50
992.228	Peak	29.89	-4.82	25.07	54.00	-28.93

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8 FREQUENCY STABILITY

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.

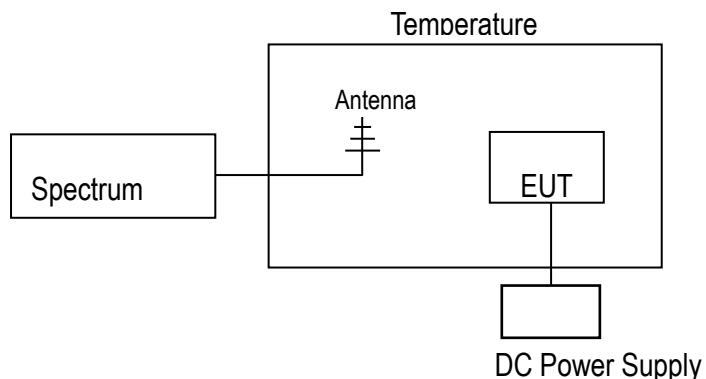
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

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: Conducted B					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/23/2020	07/22/2021
Temperature Chamber	TERCHY	MHK-120LK	1020582	07/08/2020	07/07/2021
DC Block	PASTERNACK	PE8210	RF156	11/19/2020	11/18/2021
Coaxial Cables	Woken	00100A1F1A185C	RF71	11/19/2020	11/18/2021
DC Power Supply	DHA	DPS-3003	9411005787	08/19/2020	08/18/2021
Attenuator	Marvelous	MVE2213-10	RF05	11/19/2020	11/18/2021

8.5 Measurement Results

Startup

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
12	-20	13.5606	0.00000	+/- 1.356
12	-10	13.5605	0.10000	+/- 1.356
12	0	13.5605	0.10000	+/- 1.356
12	10	13.5606	0.00000	+/- 1.356
12	20	13.5606	0.00000	+/- 1.356
12	30	13.5609	-0.30000	+/- 1.356
12	40	13.5609	-0.30000	+/- 1.356
12	50	13.5605	0.10000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
13.8	20	13.5605	0.10000	+/- 1.356
12	20	13.5606	0.00000	+/- 1.356
10.2	20	13.5608	-0.20000	+/- 1.356

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2 minutes**A. Temperature Variation**

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
12	-20	13.5605	0.40000	+/- 1.356
12	-10	13.5608	0.10000	+/- 1.356
12	0	13.5608	0.10000	+/- 1.356
12	10	13.5608	0.10000	+/- 1.356
12	20	13.5609	0.00000	+/- 1.356
12	30	13.5605	0.40000	+/- 1.356
12	40	13.5606	0.30000	+/- 1.356
12	50	13.5605	0.40000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
13.8	20	13.5608	0.10000	+/- 1.356
12	20	13.5609	0.00000	+/- 1.356
10.2	20	13.5608	0.10000	+/- 1.356

5 minutes**A. Temperature Variation**

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
12	-20	13.5609	-0.40000	+/- 1.356
12	-10	13.5606	-0.10000	+/- 1.356
12	0	13.5607	-0.20000	+/- 1.356
12	10	13.5607	-0.20000	+/- 1.356
12	20	13.5605	0.00000	+/- 1.356
12	30	13.5606	-0.10000	+/- 1.356
12	40	13.5605	0.00000	+/- 1.356
12	50	13.5608	-0.30000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
13.8	20	13.5606	-0.10000	+/- 1.356
12	20	13.5605	0.00000	+/- 1.356
10.2	20	13.5607	-0.20000	+/- 1.356

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10 minutes

A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
12	-20	13.5605	0.30000	+/- 1.356
12	-10	13.5609	-0.10000	+/- 1.356
12	0	13.5607	0.10000	+/- 1.356
12	10	13.5607	0.10000	+/- 1.356
12	20	13.5608	0.00000	+/- 1.356
12	30	13.5606	0.20000	+/- 1.356
12	40	13.5609	-0.10000	+/- 1.356
12	50	13.5605	0.30000	+/- 1.356

B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
13.8	20	13.5605	0.30000	+/- 1.356
12	20	13.5608	0.00000	+/- 1.356
10.2	20	13.5605	0.30000	+/- 1.356

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9 EMISSION BANDWIDTH MEASUREMENT

9.1 Applicable Standard:

The 20 dB and 99% 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 Equipment Used:

Refer to section 8.4 in this report

9.5 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.

9.6 Measurement Result

FCC			
20dB BW (kHz)	Operation range	Frequency (MHz)	Limit (MHz)
2.7	Low	13.55805	>13.11
	High	13.56040	<14.01

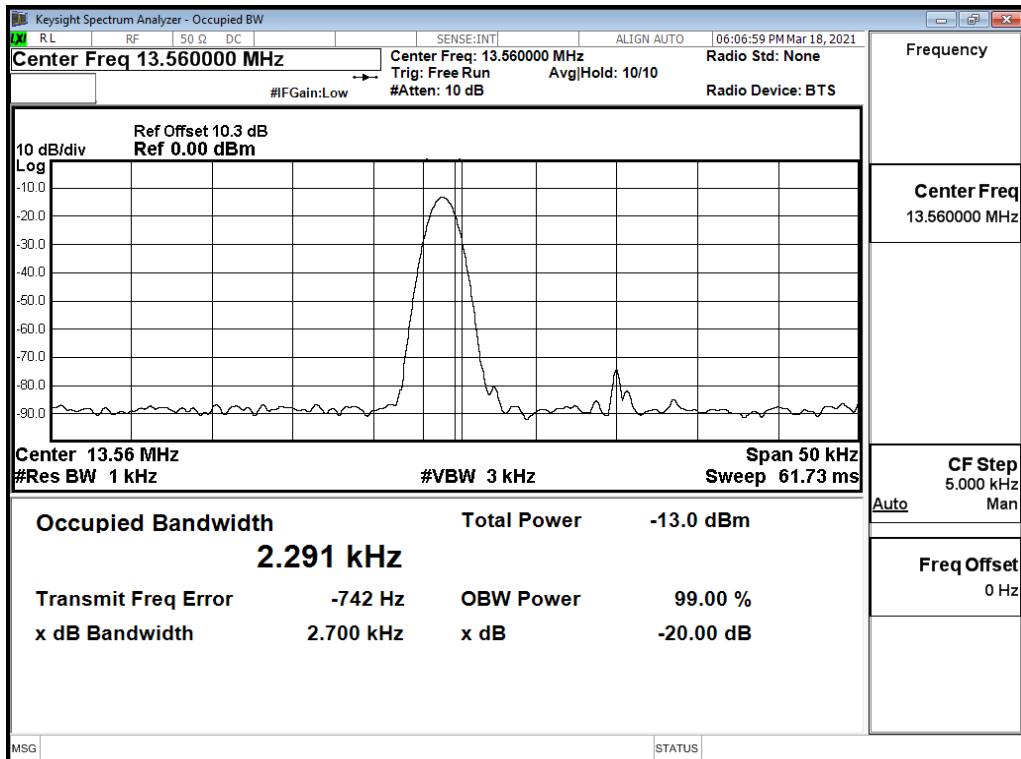
IC	
99% BW (kHz)	2.291

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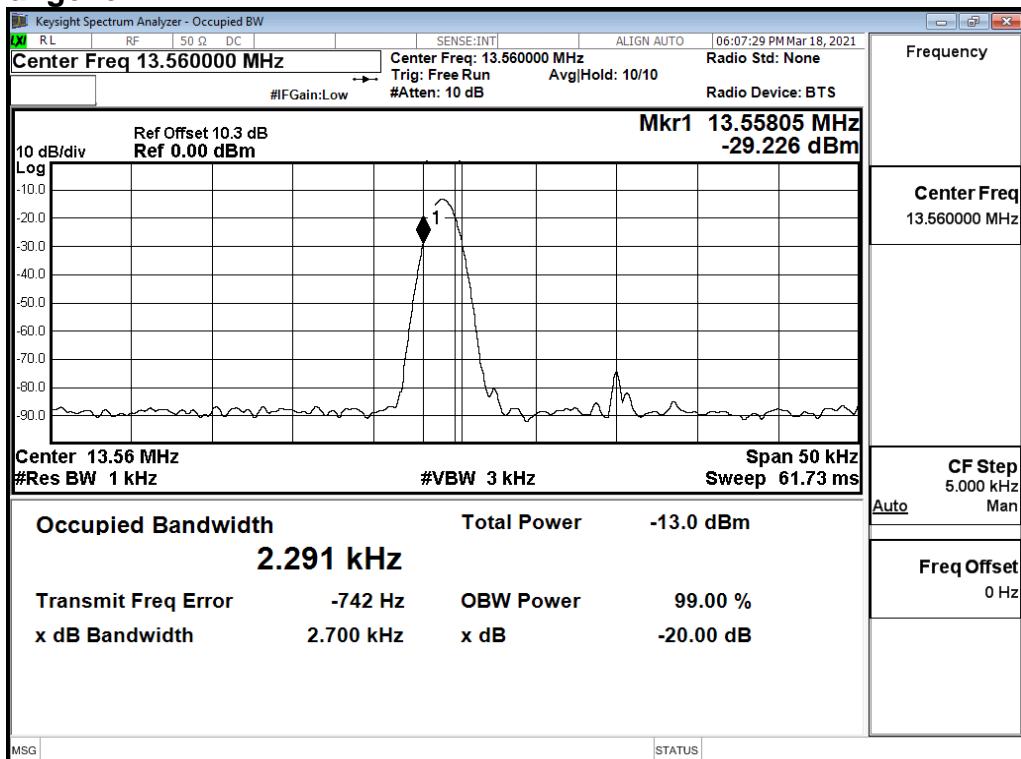
Bandwidth



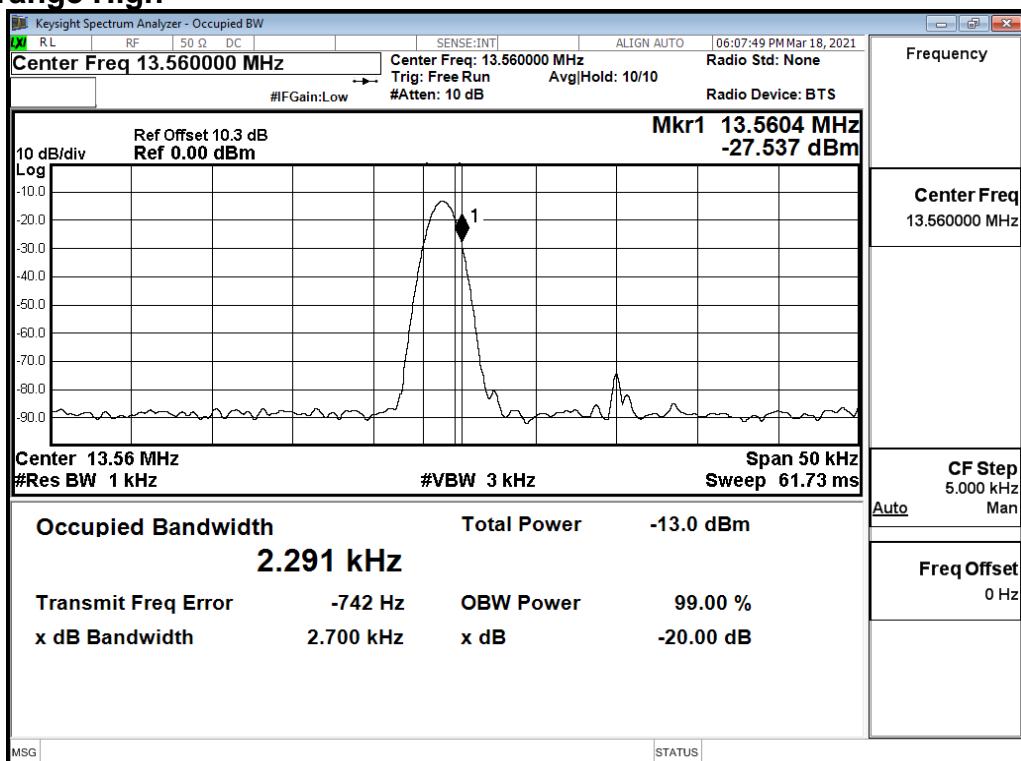
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Operation range low



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.

~ End of Report ~

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