

**ELECTROMAGNETIC EMISSIONS  
COMPLIANCE REPORT**

**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

**HVIN:** C302W

**Model Difference:** N/A

**Report Number:** E2/2021/60028

**FCC ID** HFS-C302W

**IC:** 1787B-C302W

**Issue Date:** August 4, 2021

**Date of Test:** June 17, 2021 ~ July 14, 2021

**Date of EUT Received:** June 10, 2021

Approved By

Arno Hsieh

Arno Hsieh

**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 comply with FCC rule part §15.225, ISSED RSS-210.

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

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## Revision History

| Report Number | Revision | Description | Issue Date     | Revised By |
|---------------|----------|-------------|----------------|------------|
| E2/2021/60028 | 00       | Original    | August 4, 2021 | Susan Lin  |
|               |          |             |                |            |
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|               |          |             |                |            |

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## 1 GENERAL INFORMATION

### 1.1 Product Description

|                   |                        |
|-------------------|------------------------|
| Product Name:     | Clover Mini            |
| Brand Name:       | clover                 |
| Model No.:        | C302U                  |
| HVIN:             | C302W                  |
| Model Difference: | N/A                    |
| Hardware Version: | C302W                  |
| Firmware Version: | N/A                    |
| EUT Series No.:   | PJ216092003            |
| Power Supply:     | 12V from AC/DC Adapter |

### 1.2 RF specification

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

**Note:** Antenna information is provided by the applicant.

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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

ANSI C63.10:2013.

### 1.4 Test Facility

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

### 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 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 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. 2-1 Conduction (AC Power Line) & Radiated test set up configuration

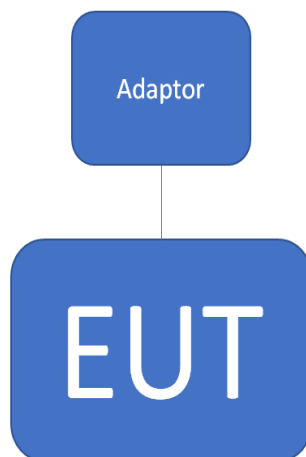


Fig. 2-2 Emission test set up configuration



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 | N/A       | N/A            | N/A        | N/A        | N/A        |
| 2.   | Notebook          | Lenovo    | L420           | S0011721   | N/A        | N/A        |

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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              | 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)            | RSS210 Annex B B.6 (b) | Frequency Stability                           | Compliant |
| §2.1049<br>§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 radiation emission was measured as EUT three orthogonal planes, E1 / E2 / H, are positioned to pre-scan the emission generating the highest one. The worst position is tested and recorded.

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## 5 MEASUREMENT UNCERTAINTY

| Test Items                       | Uncertainty |
|----------------------------------|-------------|
| AC Power Line Conducted Emission | +/- 2.34 dB |
| Frequency Stability              | +/- 1.53 Hz |
| Emission Bandwidth               | +/- 1.53 Hz |
| Temperature                      | +/- 0.4 °C  |
| Humidity                         | +/- 3.5 %   |
| DC / AC Power Source             | +/- 1 %     |

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

### 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<br>MHz                                                                                                                                                              | Limits<br>(dBuV) |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|
|                                                                                                                                                                                     | 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       |
| <b>Note</b><br>1.The lower limit shall apply at the transition frequencies<br>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:

| Radiated Emission Test Site: Conduction A |                                |               |                     |            |            |
|-------------------------------------------|--------------------------------|---------------|---------------------|------------|------------|
| EQUIPMENT TYPE                            | MFR                            | MODEL NUMBER  | SERIAL NUMBER       | LAST CAL.  | CAL DUE.   |
| Test Software                             | audix                          | e3            | Ver. 6.11-20180419c | N.C.R      | N.C.R      |
| LISN                                      | SCHWARZBECK<br>Mess-Elektronik | NSLK8127      | 973                 | 03/25/2021 | 03/24/2022 |
| EMI Test Receiver                         | R&S                            | ESCI          | 101342              | 04/27/2021 | 04/26/2022 |
| Coaxial Cable                             | EC Lab                         | RF-HY-CAB-250 | RF-HY-CAB-250-01    | 03/27/2021 | 03/26/2022 |
| Pulse Limiter                             | EC Lab                         | VTSD 9561F-N  | 485                 | 03/27/2021 | 03/26/2022 |

### 6.3 EUT Setup

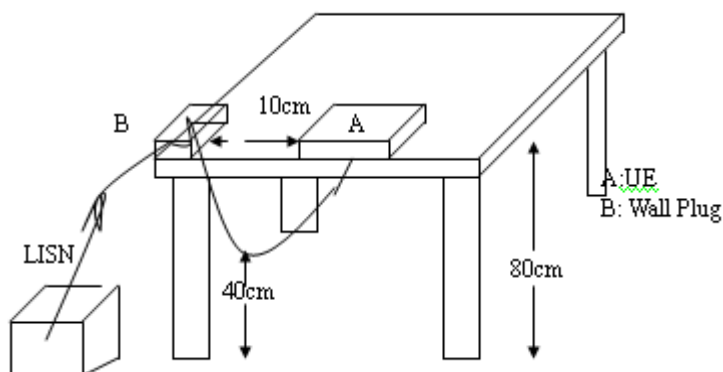
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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



## 6.5 Measurement Procedure

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

## 6.6 Measurement Result

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

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

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## AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number :E2-2021-60028

Test Site :Conduction Room C

Test Mode :NFC

Test Date :2021-06-28

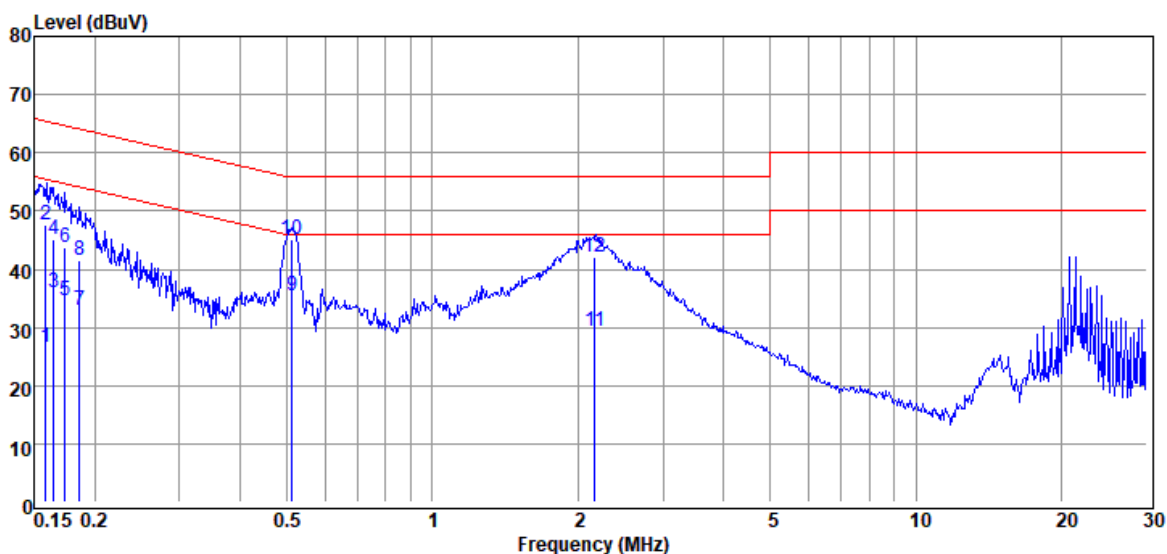
Power :120V/60Hz

Temp./Humi. :25.4/52

Probe :L1

Engineer :Jack Tseng

Note: : Adapter:FSP040-RHBN2



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV | Limit<br>dBuV | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|----------------------|---------------|--------------|
| 0.16         | Average                      | 16.16                             | 10.30        | 26.46                | 55.55         | -29.09       |
| 0.16         | QP                           | 37.23                             | 10.30        | 47.53                | 65.55         | -18.02       |
| 0.17         | Average                      | 25.65                             | 10.22        | 35.87                | 55.21         | -19.34       |
| 0.17         | QP                           | 34.78                             | 10.22        | 45.00                | 65.21         | -20.21       |
| 0.17         | Average                      | 24.36                             | 10.22        | 34.58                | 54.77         | -20.19       |
| 0.17         | QP                           | 33.51                             | 10.22        | 43.73                | 64.77         | -21.04       |
| 0.19         | Average                      | 22.74                             | 10.22        | 32.96                | 54.20         | -21.24       |
| 0.19         | QP                           | 31.28                             | 10.22        | 41.50                | 64.20         | -22.70       |
| 0.51         | Average                      | 25.12                             | 10.31        | 35.43                | 46.00         | -10.57       |
| 0.51         | QP                           | 34.76                             | 10.31        | 45.07                | 56.00         | -10.93       |
| 2.17         | Average                      | 18.24                             | 11.11        | 29.35                | 46.00         | -16.65       |
| 2.17         | QP                           | 30.83                             | 11.11        | 41.94                | 56.00         | -14.06       |

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Report Number :E2-2021-60028

Test Site :Conduction Room C

Test Mode :NFC

Test Date :2021-06-28

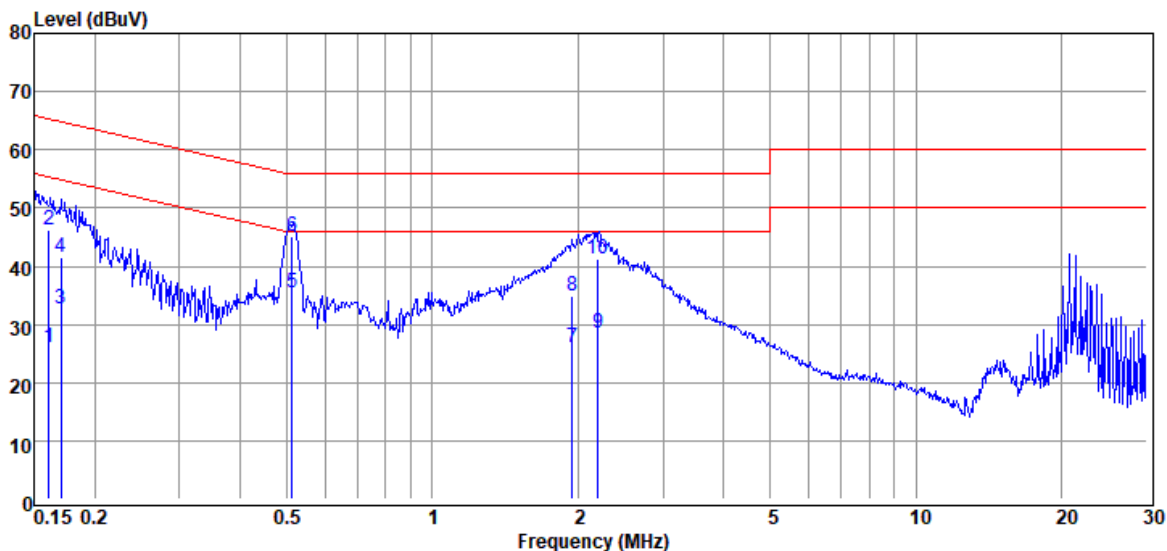
Power :120V/60Hz

Temp./Humi. :25.4/52

Probe :N

Engineer :Jack Tseng

Note: : Adapter:FSP040-RHBN2



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dB $\mu$ V | Factor<br>dB | Actual<br>FS<br>dB $\mu$ V | Limit<br>dB $\mu$ V | Margin<br>dB |
|--------------|------------------------------|-----------------------------------------|--------------|----------------------------|---------------------|--------------|
| 0.16         | Average                      | 15.82                                   | 10.31        | 26.13                      | 55.42               | -29.29       |
| 0.16         | QP                           | 35.96                                   | 10.31        | 46.27                      | 65.42               | -19.15       |
| 0.17         | Average                      | 22.46                                   | 10.21        | 32.67                      | 54.94               | -22.27       |
| 0.17         | QP                           | 31.25                                   | 10.21        | 41.46                      | 64.94               | -23.48       |
| 0.51         | Average                      | 25.06                                   | 10.32        | 35.38                      | 46.00               | -10.62       |
| 0.51         | QP                           | 34.76                                   | 10.32        | 45.08                      | 56.00               | -10.92       |
| 1.95         | Average                      | 15.68                                   | 10.45        | 26.13                      | 46.00               | -19.87       |
| 1.95         | QP                           | 24.51                                   | 10.45        | 34.96                      | 56.00               | -21.04       |
| 2.20         | Average                      | 17.50                                   | 11.12        | 28.62                      | 46.00               | -17.38       |
| 2.20         | QP                           | 30.19                                   | 11.12        | 41.31                      | 56.00               | -14.69       |

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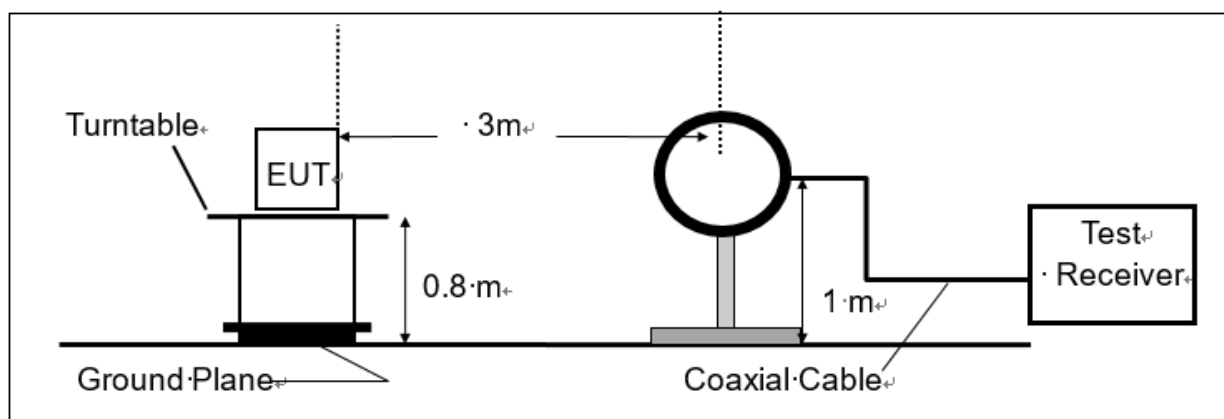
## 7 RADIATED EMISSION TEST

### 7.1 Measurement Procedure

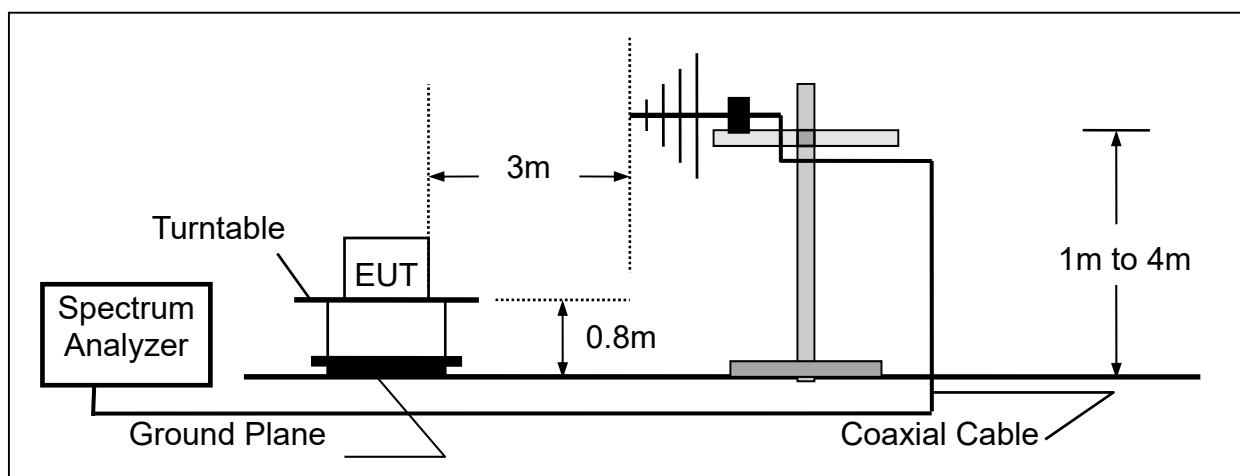
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4.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



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### 7.3 Measurement Equipment Used:

| Radiated Emission Test Site: SAC G |                 |                             |                              |            |            |
|------------------------------------|-----------------|-----------------------------|------------------------------|------------|------------|
| EQUIPMENT TYPE                     | MFR             | MODEL NUMBER                | SERIAL NUMBER                | LAST CAL.  | CAL DUE.   |
| Broadband Antenna                  | SCHWAZBECK      | VULB 9168                   | 1206                         | 02/22/2021 | 02/21/2022 |
| Horn Antenna                       | Schwarzbeck     | DRH18-E                     | 210105A18E                   | 04/09/2021 | 04/08/2022 |
| Horn Antenna                       | Schwarzbeck     | BBHA9170                    | 185                          | 07/30/2020 | 07/29/2021 |
| Loop Antenna                       | ETS.LINDGREN    | 6502                        | 143303                       | 05/07/2021 | 05/06/2022 |
| 3m Site NSA                        | SGS             | 966 chamber G               | N/A                          | 03/30/2021 | 03/29/2022 |
| Spectrum Analyzer                  | KEYSIGHT        | N9010A                      | MY57120290                   | 04/06/2021 | 04/05/2022 |
| Pre-Amplifier                      | EMC Instruments | EMC0011830                  | 980199                       | 11/19/2020 | 11/18/2021 |
| Pre-Amplifier                      | EMC Instruments | EMC330N                     | 980781                       | 03/15/2021 | 03/14/2022 |
| Pre-Amplifier                      | EMC Instruments | EMC118A45SE                 | 980815                       | 03/15/2021 | 03/14/2022 |
| Attenuator                         | Marvelous       | MVE2213-30                  | RF04                         | 11/19/2020 | 11/18/2021 |
| High Pass Filter                   | R&S             | F13 HPF 3GHz                | RF175                        | 11/19/2020 | 11/18/2021 |
| Lowpass Filter                     | Woken           | EWT-56-0019                 | RF173                        | 11/19/2020 | 11/18/2021 |
| High Pass Filter                   | R&S             | HPF7.0                      | RF176                        | 11/19/2020 | 11/18/2021 |
| Notch Filter                       | Woken           | EWT-54-0037                 | RF204                        | 11/19/2020 | 11/18/2021 |
| Coaxial Cable                      | Huber+Suhner    | RG 214/U                    | W21.01                       | 11/19/2020 | 11/18/2021 |
| Coaxial Cable                      | EMC Instruments | EMC104-SM-SM-8000-5000-5000 | 210219、<br>210220、<br>210221 | 03/15/2021 | 03/14/2022 |
| Test Software                      | audix           | e3                          | 20923 sgs<br>Ver.9           | N.C.R      | N.C.R      |

**NOTE:** N.C.R refers to Not Calibrated Required.

### 7.4 Field Strength Calculation

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

$$FS = RA + AF + CL - AG$$

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

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## 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 ( $\mu\text{V/m}$ ) at 30m | Field Strength (dB $\mu\text{V/m}$ ) at 30m | Field Strength (dB $\mu\text{V/m}$ ) 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                                       |

#### Radiated Mask per ISED RSS 210 Annex B B6

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

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

### 30m to 10m

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

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

### 10m to 3m

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

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

#### Note:

1. Distance extrapolation factor =  $40 \log(\text{required distance} / \text{test distance}) \text{ (dB)}$
2. The lower limit shall apply at the transition frequencies.
3. 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(dBμV/m) = Spectrum. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/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.

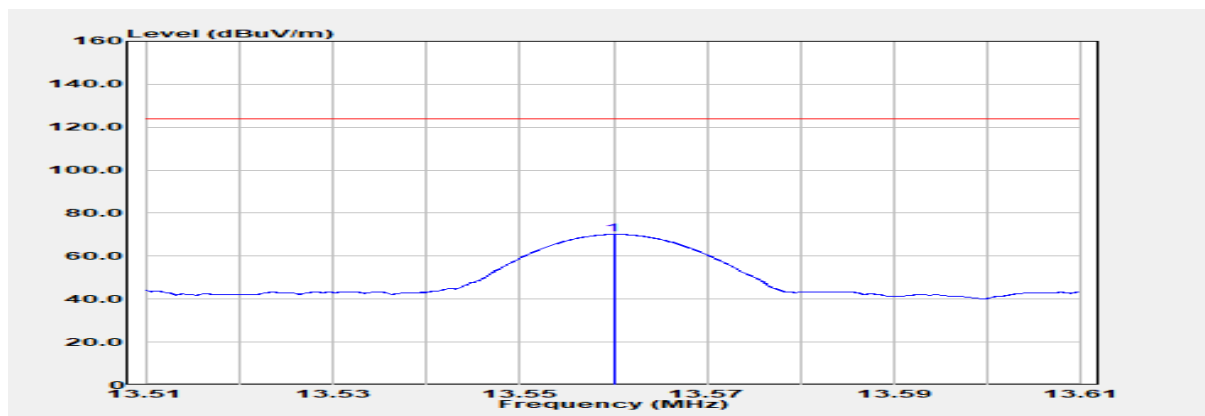
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### 7.5.3 Field Strength of Fundamental Emission Measurement Result

|                |                |              |                |
|----------------|----------------|--------------|----------------|
| Report Number  | :E2/2021/60028 | Test Site    | :966 Chamber G |
| Operation Mode | :NFC           | Test Date    | :2021-06-25    |
| Test Frequency | :13.56 MHz     | Temp./Humi.  | :23.3/58       |
| Test Mode      | :Main          | Antenna Pol. | :Vertical      |
| EUT Pol        | :H Plane       | Engineer     | :Jack Tseng    |



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dB $\mu$ V | Factor<br>dB | Actual<br>FS<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------------|--------------|------------------------------|------------------------------|--------------|
| 13.560       | Peak                         | 59.22                                   | 10.89        | 70.11                        | 124.00                       | -53.89       |

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Report Number :E2/2021/60028

Test Site :966 Chamber G

Operation Mode :NFC

Test Date :2021-06-25

Test Frequency :13.56 MHz

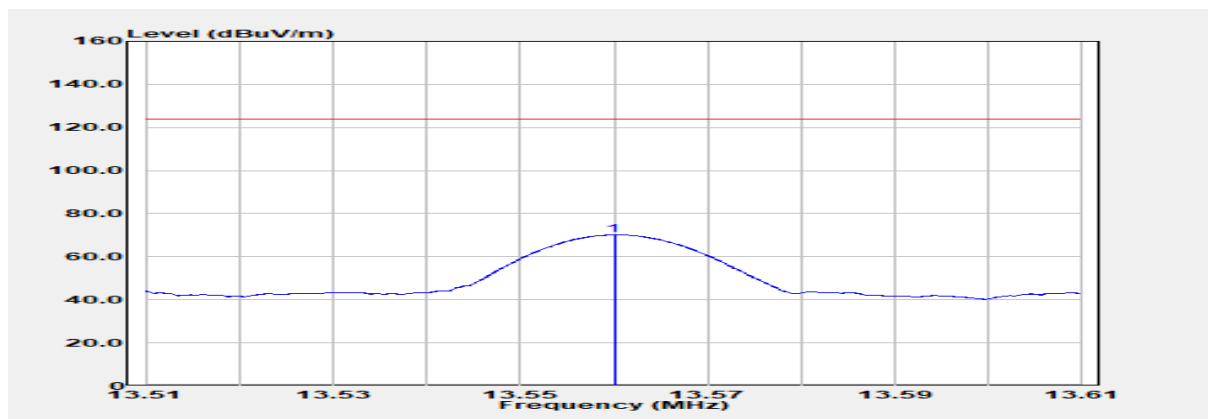
Temp./Humi. :23.3/58

Test Mode :Main

Antenna Pol. :Horizontal

EUT Pol :H Plane

Engineer :Jack Tseng



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dB $\mu$ V | Factor<br>dB | Actual<br>FS<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------------|--------------|------------------------------|------------------------------|--------------|
| 13.560       | Peak                         | 59.24                                   | 10.89        | 70.14                        | 124.00                       | -53.86       |

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Report Number :E2/2021/60028

Test Site :966 Chamber G

Operation Mode :NFC

Test Date :2021-06-25

Test Frequency :13.56 MHz

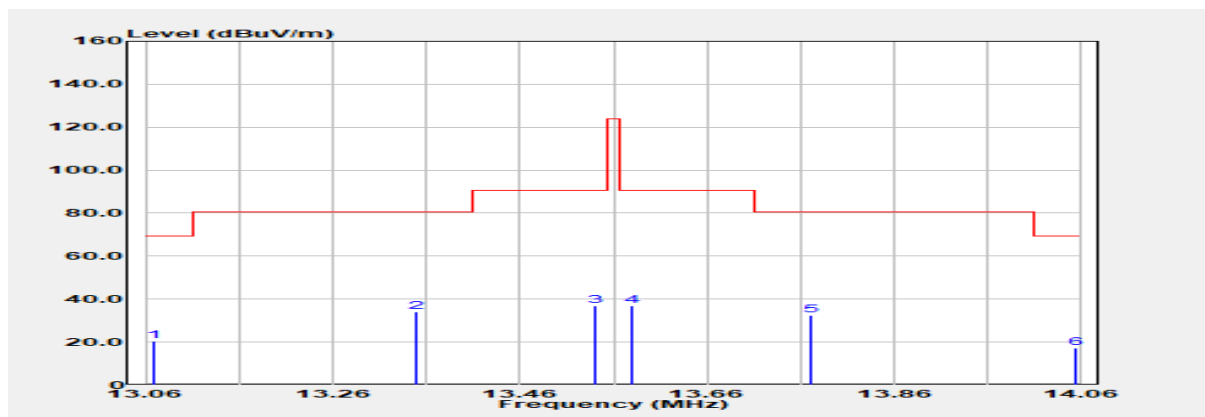
Temp./Humi. :23.3/58

Test Mode :Mask

Antenna Pol. :Vertical

EUT Pol :H Plane

Engineer :Jack Tseng



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.070       | Peak                         | 9.62                              | 10.93        | 20.55                  | 69.54                  | -48.99       |
| 13.348       | Peak                         | 23.21                             | 10.91        | 34.11                  | 80.50                  | -46.39       |
| 13.540       | Peak                         | 26.08                             | 10.89        | 36.98                  | 90.47                  | -53.49       |
| 13.580       | Peak                         | 25.89                             | 10.89        | 36.78                  | 90.47                  | -53.69       |
| 13.772       | Peak                         | 21.53                             | 10.88        | 32.41                  | 80.50                  | -48.09       |
| 14.053       | Peak                         | 6.52                              | 10.86        | 17.38                  | 69.54                  | -52.16       |

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Report Number :E2/2021/60028

Test Site :966 Chamber G

Operation Mode :NFC

Test Date :2021-06-25

Test Frequency :13.56 MHz

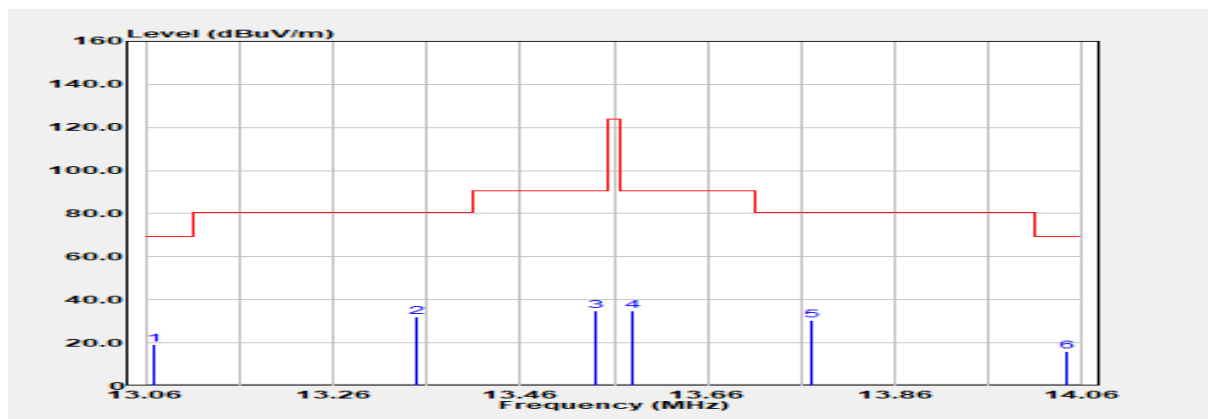
Temp./Humi. :23.3/58

Test Mode :Mask

Antenna Pol. :Horizontal

EUT Pol :H Plane

Engineer :Jack Tseng



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.070       | Peak                         | 8.36                              | 10.93        | 19.29                  | 69.54                  | -50.25       |
| 13.349       | Peak                         | 21.35                             | 10.91        | 32.26                  | 80.50                  | -48.24       |
| 13.540       | Peak                         | 23.96                             | 10.89        | 34.85                  | 90.47                  | -55.62       |
| 13.580       | Peak                         | 24.15                             | 10.89        | 35.04                  | 90.47                  | -55.43       |
| 13.772       | Peak                         | 19.58                             | 10.88        | 30.46                  | 80.50                  | -50.04       |
| 14.043       | Peak                         | 5.23                              | 10.86        | 16.08                  | 69.54                  | -53.46       |

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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 (μV/m) | Distance (meters) |
|-----------------|-----------------------|-------------------|
| 0.009~0.490     | 2400/F(kHz)           | 300               |
| 0.490~1.705     | 24000/F(kHz)          | 30                |
| 1.705-30        | 30                    | 30                |
| 30-88           | 100                   | 3                 |
| 88-216          | 150                   | 3                 |
| 216-960         | 200                   | 3                 |
| Above 960       | 500                   | 3                 |

**Note:**

1. Emission level in dBμV/m =  $20 \log (\mu\text{V/m})$
2. Distance extrapolation factor =  $40 \log (\text{required distance} / \text{test distance})$  (dB)
3.  $20 * \log(30 \mu\text{V/m}) + 40 \text{dB} = 69.54 \text{ dBuV/m}$
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.

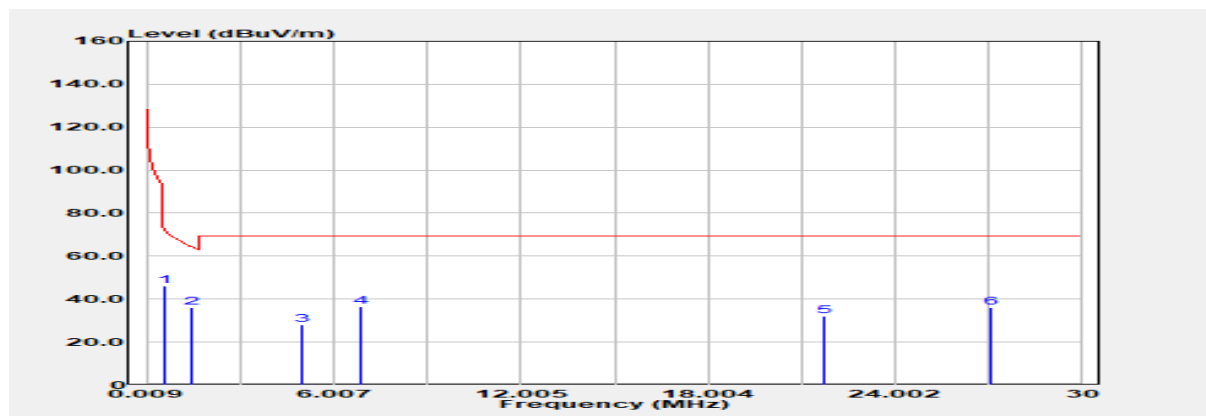
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## 7.6.2 Radiated Spurious Emission Measurement Result

|                |                |              |                |
|----------------|----------------|--------------|----------------|
| Report Number  | :E2/2021/60028 | Test Site    | :966 Chamber G |
| Operation Mode | :NFC           | Test Date    | :2021-06-25    |
| Test Frequency | :13.56 MHz     | Temp./Humi.  | :23.3/58       |
| Test Mode      | :TX CH MID     | Antenna Pol. | :Vertical      |
| EUT Pol        | :H Plane       | Engineer     | :Jack Tseng    |



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dB $\mu$ V | Factor<br>dB | Actual<br>FS<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------------|--------------|------------------------------|------------------------------|--------------|
| 0.579        | Peak                         | 34.97                                   | 10.98        | 45.95                        | 72.36                        | -26.41       |
| 1.419        | Peak                         | 25.22                                   | 10.71        | 35.93                        | 64.57                        | -28.64       |
| 5.017        | Peak                         | 17.42                                   | 10.80        | 28.22                        | 69.54                        | -41.32       |
| 6.877        | Peak                         | 25.44                                   | 10.98        | 36.42                        | 69.54                        | -33.12       |
| 21.752       | Peak                         | 21.91                                   | 10.09        | 32.00                        | 69.54                        | -37.54       |
| 27.031       | Peak                         | 27.26                                   | 9.01         | 36.27                        | 69.54                        | -33.27       |

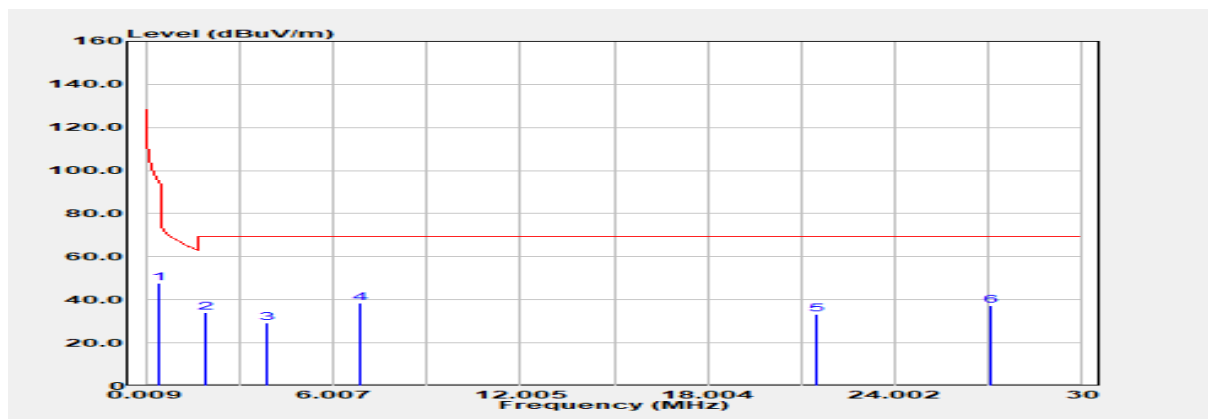
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Report Number :E2/2021/60028  
 Operation Mode :NFC  
 Test Frequency :13.56 MHz  
 Test Mode :TX CH MID  
 EUT Pol :H Plane

Test Site :966 Chamber G  
 Test Date :2021-06-25  
 Temp./Humi. :23.3/58  
 Antenna Pol. :Horizontal  
 Engineer :Jack Tseng



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 0.459        | Peak                         | 36.59                             | 11.00        | 47.59                  | 94.37                  | -46.78       |
| 1.958        | Peak                         | 23.56                             | 10.53        | 34.09                  | 69.54                  | -35.45       |
| 3.908        | Peak                         | 18.77                             | 10.56        | 29.33                  | 69.54                  | -40.21       |
| 6.847        | Peak                         | 27.36                             | 10.98        | 38.34                  | 69.54                  | -31.20       |
| 21.483       | Peak                         | 23.05                             | 10.15        | 33.20                  | 69.54                  | -36.34       |
| 27.031       | Peak                         | 28.12                             | 9.01         | 37.14                  | 69.54                  | -32.40       |

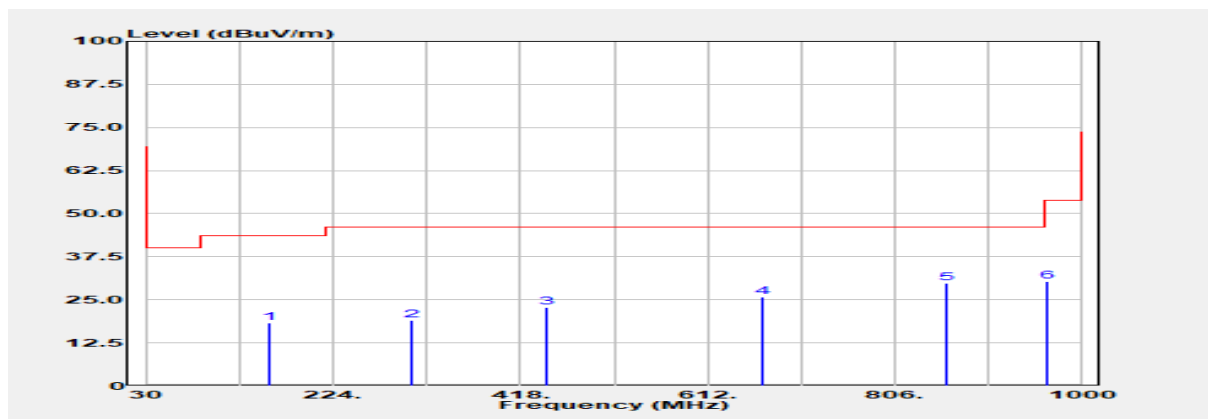
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 Operation Mode :NFC  
 Test Frequency :13.56 MHz  
 Test Mode :TX CH MID  
 EUT Pol :H Plane

Test Site :966 Chamber G  
 Test Date :2021-06-25  
 Temp./Humi. :23.3/58  
 Antenna Pol. :Vertical  
 Engineer :Jack Tseng



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 158.040      | Peak                         | 31.39                             | -13.08       | 18.31                  | 43.50                  | -25.19       |
| 306.450      | Peak                         | 31.27                             | -12.24       | 19.03                  | 46.00                  | -26.97       |
| 445.160      | Peak                         | 31.40                             | -8.47        | 22.93                  | 46.00                  | -23.07       |
| 669.230      | Peak                         | 30.05                             | -4.33        | 25.72                  | 46.00                  | -20.28       |
| 859.350      | Peak                         | 30.96                             | -1.04        | 29.91                  | 46.00                  | -16.09       |
| 963.140      | Peak                         | 29.82                             | 0.50         | 30.32                  | 54.00                  | -23.68       |

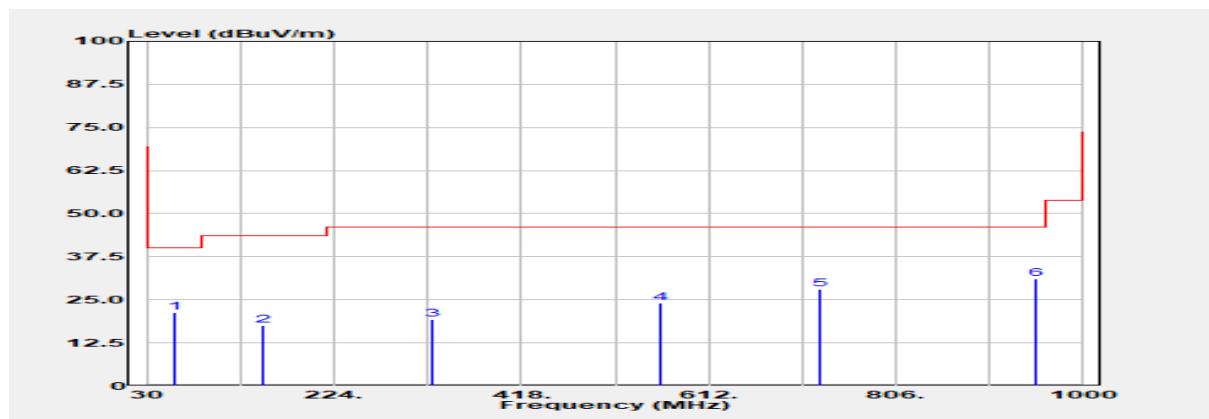
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Report Number :E2/2021/60028  
 Operation Mode :NFC  
 Test Frequency :13.56 MHz  
 Test Mode :TX CH MID  
 EUT Pol :H Plane

Test Site :966 Chamber G  
 Test Date :2021-06-25  
 Temp./Humi. :23.3/58  
 Antenna Pol. :Horizontal  
 Engineer :Jack Tseng



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dB $\mu$ V | Factor<br>dB | Actual<br>FS<br>dB $\mu$ V/m | Limit<br>@3m<br>dB $\mu$ V/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------------|--------------|------------------------------|------------------------------|--------------|
| 58.130       | Peak                         | 34.77                                   | -13.44       | 21.33                        | 40.00                        | -18.67       |
| 151.250      | Peak                         | 30.57                                   | -13.05       | 17.52                        | 43.50                        | -25.98       |
| 324.880      | Peak                         | 31.02                                   | -11.75       | 19.27                        | 46.00                        | -26.73       |
| 562.530      | Peak                         | 30.59                                   | -6.43        | 24.17                        | 46.00                        | -21.83       |
| 726.460      | Peak                         | 30.61                                   | -2.59        | 28.03                        | 46.00                        | -17.97       |
| 951.500      | Peak                         | 30.81                                   | 0.37         | 31.19                        | 46.00                        | -14.81       |

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## 8 FREQUENCY STABILITY

### 8.1 Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  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.

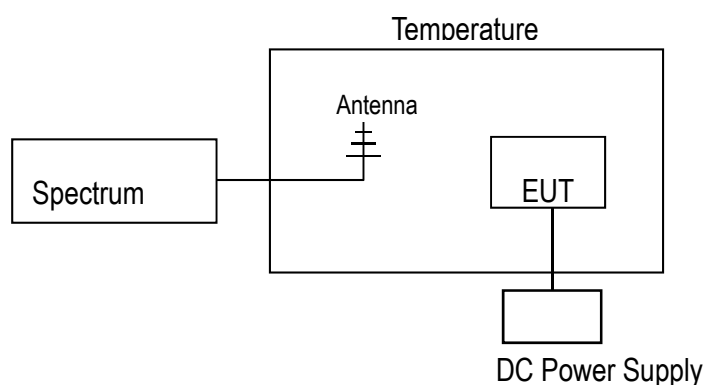
Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  ppm).

For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ),  $+20^{\circ}\text{C}$  ( $+68^{\circ}\text{F}$ ) and  $+50^{\circ}\text{C}$  ( $+122^{\circ}\text{F}$ ).

### 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 G |              |                |               |            |            |
|-------------------------------------------|--------------|----------------|---------------|------------|------------|
| EQUIPMENT TYPE                            | MFR          | MODEL NUMBER   | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
| Loop Antenna                              | ETS.LINDGREN | 6502           | 143303        | 05/07/2021 | 05/06/2022 |
| Spectrum Analyzer                         | KEYSIGHT     | N9010B         | MY59071574    | 06/24/2020 | 06/23/2021 |
| Temperature Chamber                       | TERCHY       | MHK-120LK      | 1020582       | 07/08/2020 | 07/07/2021 |
| Attenuator                                | Marvelous    | MVE2213-10     | RF06          | 11/19/2020 | 11/18/2021 |
| DC Block                                  | PASTERNAK    | PE8210         | RF154         | 11/19/2020 | 11/18/2021 |
| Coaxial Cables                            | Woken        | 00100A1F2A196C | RF60          | 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              | 13.5600038 | 0.14620     | +/- 1.356   |
| 12           | -10              | 13.5599981 | 0.15190     | +/- 1.356   |
| 12           | 0                | 13.5599971 | 0.15290     | +/- 1.356   |
| 12           | 10               | 13.5600021 | 0.14790     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 12           | 30               | 13.5600018 | 0.14820     | +/- 1.356   |
| 12           | 40               | 13.5599983 | 0.15170     | +/- 1.356   |
| 12           | 50               | 13.5600016 | 0.14840     | +/- 1.356   |

#### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 13.8         | 20               | 13.5599952 | 0.15480     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 10.2         | 20               | 13.5600021 | 0.14790     | +/- 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              | 13.5600003 | 0.14970     | +/- 1.356   |
| 12           | -10              | 13.5600019 | 0.14810     | +/- 1.356   |
| 12           | 0                | 13.5599997 | 0.15030     | +/- 1.356   |
| 12           | 10               | 13.5600013 | 0.14870     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 12           | 30               | 13.5600035 | 0.14650     | +/- 1.356   |
| 12           | 40               | 13.5599959 | 0.15410     | +/- 1.356   |
| 12           | 50               | 13.5600004 | 0.14960     | +/- 1.356   |

## B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 13.8         | 20               | 13.5600001 | 0.14990     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 10.2         | 20               | 13.5599958 | 0.15420     | +/- 1.356   |

## 5 minutes

## A. Temperature Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 12           | -20              | 13.5600019 | 0.14810     | +/- 1.356   |
| 12           | -10              | 13.5599983 | 0.15170     | +/- 1.356   |
| 12           | 0                | 13.5600036 | 0.14640     | +/- 1.356   |
| 12           | 10               | 13.5600038 | 0.14620     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 12           | 30               | 13.5599968 | 0.15320     | +/- 1.356   |
| 12           | 40               | 13.5600004 | 0.14960     | +/- 1.356   |
| 12           | 50               | 13.5600003 | 0.14970     | +/- 1.356   |

## B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 13.8         | 20               | 13.5599964 | 0.15360     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 10.2         | 20               | 13.5599997 | 0.15030     | +/- 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              | 13.5600016 | 0.14840     | +/- 1.356   |
| 12           | -10              | 13.5600014 | 0.14860     | +/- 1.356   |
| 12           | 0                | 13.5600028 | 0.14720     | +/- 1.356   |
| 12           | 10               | 13.559995  | 0.15500     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 12           | 30               | 13.5599982 | 0.15180     | +/- 1.356   |
| 12           | 40               | 13.5600005 | 0.14950     | +/- 1.356   |
| 12           | 50               | 13.5600014 | 0.14860     | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 13.8         | 20               | 13.5599955 | 0.15450     | +/- 1.356   |
| 12           | 20               | 13.56015   | 0.00000     | +/- 1.356   |
| 10.2         | 20               | 13.5600002 | 0.14980     | +/- 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

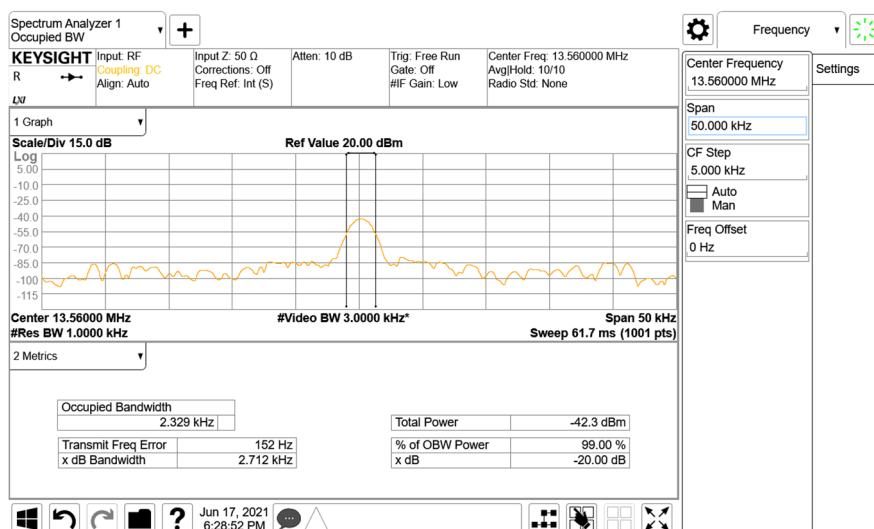
## 9.5 Measurement Procedure

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) |  | Opration range | Frequency (MHz) | Limit (MHz) |
| 2.712         |  | Low            | 13.55895        | >13.11      |
|               |  | High           | 13.56145        | <14.01      |
| IC            |  |                |                 |             |
| 99% BW (kHz)  |  |                |                 |             |
| 2.329         |  |                |                 |             |

## Bandwidth

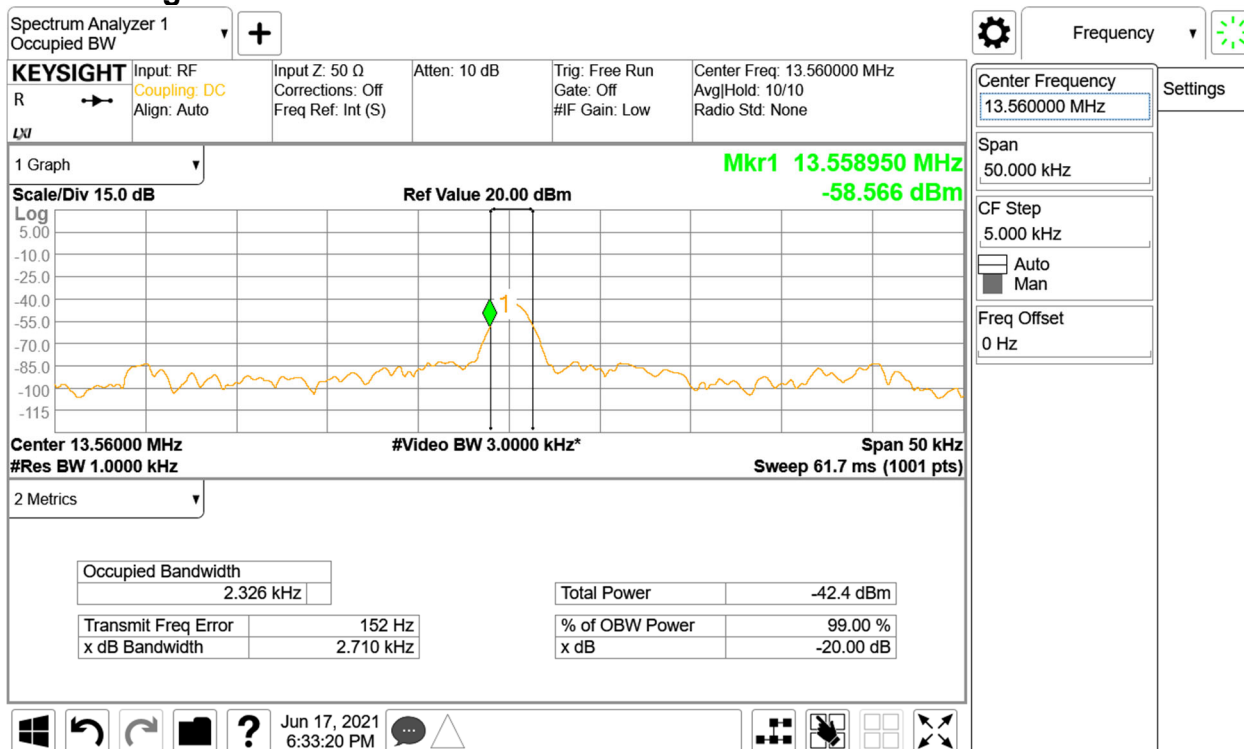


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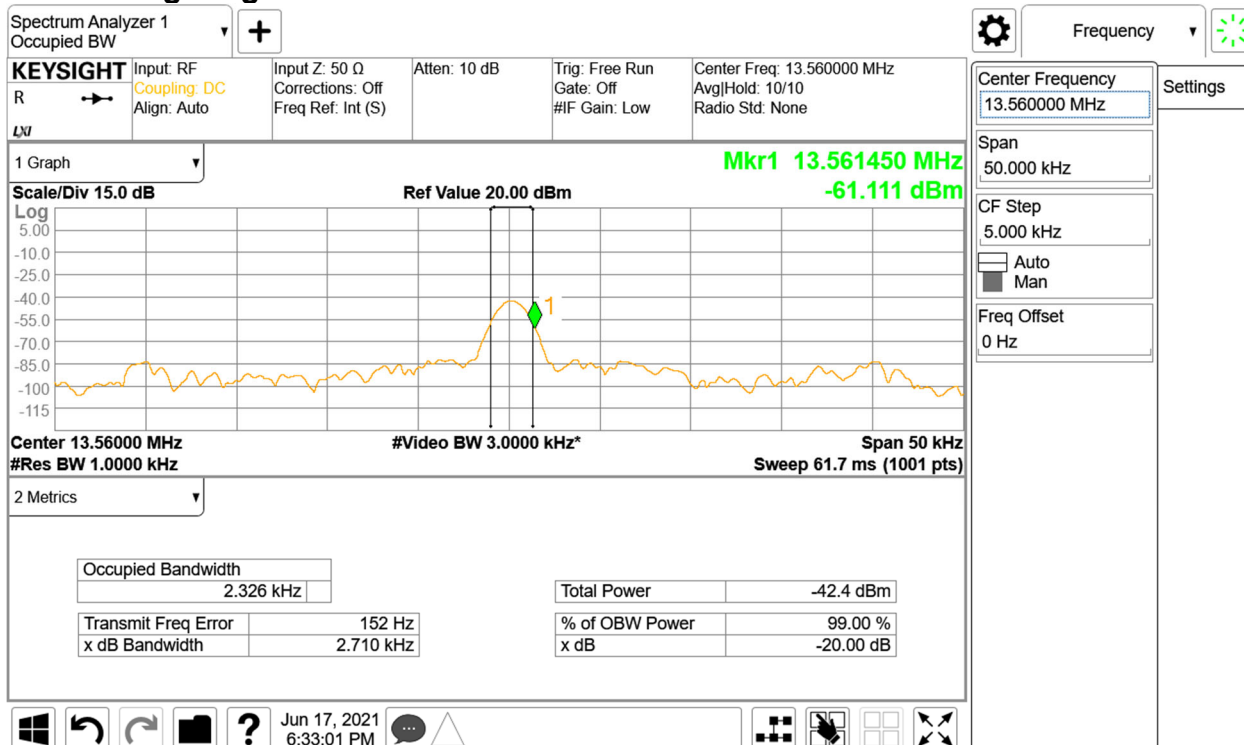
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## Operation range Low



## 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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