# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

| | |
|---|---|
| **Applicant:** | Quanta Computer Inc.<br>No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City 33377, Taiwan |
| **Manufacturer:** | Quanta Computer Inc.<br>No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City 33377, Taiwan |
| **Product Name:** | Clover Companion |
| **Brand Name:** | Clover |
| **Model No.:** | C800 |
| **Report Number:** | TERF2404000850E2 |
| **FCC ID** | HFS-C800 |
| **Date of EUT Received:** | Mar. 29, 2024 |
| **Date of Test:** | Apr. 01, 2024～May 02, 2024 |
| **Issue Date:** | May 06, 2024 |

***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.

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

# Revision History

| Report Number | Revision | Description | Issue Date | Revised By | Remark |
|---|---|---|---|---|---|
| TERF2404000850E2 | 00 | Original | Apr. 26, 2024 | Yami Kuo | |
| TERF2404000850E2 | 01 | Revised chapter 7 | May 06, 2024 | Yami Kuo | * |
| | | | | | |
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**Note:**

1、 The remark "*" indicates modification of the report upon requests from certification body.

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# 1 GENERAL INFORMATION

## 1.1 Product Description

| | |
|---|---|
| Product Name: | Clover Companion |
| Brand Name: | Clover |
| Model No.: | C800 |
| Hardware Version: | N/A |
| Firmware Version: | N/A |
| EUT Series No.: | C080UG40940094 |
| Power Supply: | 12Vdc |
| Test Software (Name/Version) | adb.exe |

## 1.2 RF specification

| | |
|---|---|
| Radio Technology: | NFC |
| Operating Frequency | 13.56MHz |
| Transmit Power | 36.23 dBuV/m at 30m; 76.23 dBuV/m at 3m. |
| Number of Channels | 1 |
| Modulation Type | ASK |
| Antenna Type | Loop |

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

## 1.3 Test Methodology

FCC Part 15, Subpart C §15.225

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 | TW0027 | TW3702 |
| | | SAC 2 | | |
| | | 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 C | TW0028 | |
| | | SAC C | | |
| | | SAC D | | |
| | | SAC G | | |
| | | Conducted A | | |
| | | Conducted B | | |
| | | Conducted C | | |
| | | Conducted D | | |
| | | Conducted E | | |
| | | Conducted F | | |
| | | Conducted G | | |

**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.

## 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.

# 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

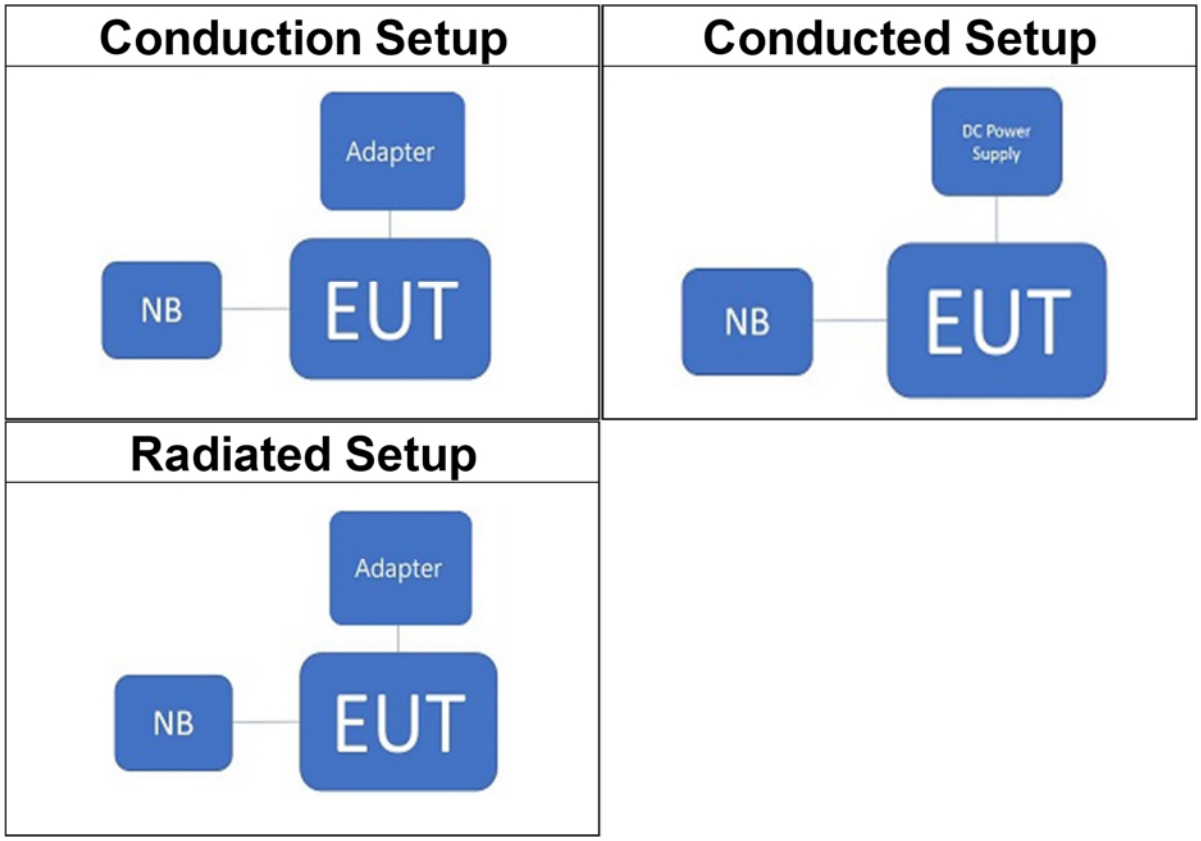
### 2.3.1 Conducted Emissions

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.

## 2.4 Test Configuration




## 2.5 Control Unit(s)

| AC Power-Line Conducted Emission Test Site: Conduction C | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Adapter | clover | S024CEU1200200 | N/A | N/A | N/A |
| Notebook | Lenovo | L480 | P0002332 | N/A | N/A |
| Conducted Emission Test Site: Conducted C | | | | | |
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Adapter | clover | S024CEU1200200 | N/A | N/A | N/A |
| Notebook | Lenovo | T14 | P0003332 | N/A | N/A |
| Radiated Emission Test Site: SAC G | | | | | |
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Adapter | clover | S024CEU1200200 | N/A | N/A | N/A |
| Notebook | Lenovo | L480 | P0002332 | N/A | N/A |

# 3 SUMMARY OF TEST RESULTS

| FCC Rules | Description Of Test | Result |
|---|---|---|
| §15.207 | AC Power Line Conducted Emission | Compliant |
| §15.225 (a)-(d) | Radiated Emission | Compliant |
| §15.209 | Radiated Emission Limits, general requirement | Compliant |
| §15.225 (e) | Frequency Stability | Compliant |
| §2.1049<br>§15.215 (c) | Emission Bandwidth | Compliant |
| §15.203 | Antenna Requirement | Compliant |
| §15.205 | Restricted Bands | Compliant |

# 4 DESCRIPTION OF TEST MODES

## 4.1 The Worst Test Modes and Channel Details

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

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

The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

## 5 MEASUREMENT UNCERTAINTY

| Test Items | Uncertainty | | |
|---|---|---|---|
| AC Power Line Conducted Emission | +/- | 1.54 | dB |
| Frequency Stability | +/- | 1.48 | Hz |
| Emission Bandwidth | +/- | 1.38 | Hz |
| Temperature | +/- | 0.6 | °C |
| Humidity | +/- | 3 | % |
| DC / AC Power Source | +/- | 1 | % |

| Radiated Spurious Emission Measurement Uncertainty | | | | |
|---|---|---|---|---|
| **Polarization: Vertical** | **+/-** | **1.89** | **dB** | 9kHz~30MHz |
| | **+/-** | **4.15** | **dB** | 30MHz - 1000MHz |
| | **+/-** | **3.43** | **dB** | 1GHz - 18GHz |
| | **+/-** | **3.86** | **dB** | 18GHz - 40GHz |
| **Polarization: Horizontal** | **+/-** | **1.89** | **dB** | 9kHz~30MHz |
| | **+/-** | **4.02** | **dB** | 30MHz - 1000MHz |
| | **+/-** | **3.43** | **dB** | 1GHz - 18GHz |
| | **+/-** | **3.86** | **dB** | 18GHz - 40GHz |
| **Radiated Spurious Emission** | **+/-** | **2** | **dB** | 33GHz-50GHz |
| | **+/-** | **1.59** | **dB** | 50GHz-60GHz |
| | **+/-** | **1.7** | **dB** | 60GHz-90GHz |
| | **+/-** | **1.64** | **dB** | 90GHz-140GHz |
| | **+/-** | **3.83** | **dB** | 140GHz-220GHz |

***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.

# 6 MEASUREMENT EQUIPMENT USED

## 6.1 Emission from AC power line

| AC Power-Line Conducted Emission Test Site: Conduction C | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| LISN | SCHWARZBECK Mess-Elektronik | NSLK8127 | 974 | 06/19/2023 | 06/18/2024 |
| EMI Test Receiver | R&S | ESCI | 101342 | 04/29/2024 | 04/28/2025 |
| Coaxial Cable | EC Lab | RF-HY-CAB-250 | RF-HY-CAB-250-01 | 03/27/2024 | 03/26/2025 |
| Pulse Limiter | EC Lab | VTSD 9561F-N | 485 | 03/27/2024 | 03/26/2025 |
| Test Software | audix | e3 | E3 20923 SGS Ver.9 ( C ) | N.C.R | N.C.R |

## 6.2 Conducted Measurement

| Conducted Emission Test Site: Conducted C | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| H-Loop Near Field Antenna | LANGER EMV-Technik | LF-R 400 | 02-1597 | N.C.R | N.C.R |
| Spectrum Analyzer | KEYSIGHT | N9010B | MY59071573 | 05/23/2023 | 05/22/2024 |
| Temperature Chamber | TERCHY | MHK-120LK | 1020582 | 06/17/2023 | 06/16/2024 |
| DC Power Supply | HOLA | DP-3003 | D7070035 | 06/12/2023 | 06/11/2024 |

## 6.3 Radiated Measurement

| Radiated Emission Test Site: SAC G | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Broadband Antenna | SCHWARZBECK | VULB 9168 | 1208 | 07/21/2023 | 07/20/2024 |
| Loop Antenna | ETS.LINDGREN | 6502 | 143303 | 05/23/2023 | 05/22/2024 |
| 3m Site NSA | SGS | 966 chamber G | N/A | 03/30/2024 | 03/29/2025 |
| Spectrum Analyzer | KEYSIGHT | N9010A | MY51440113 | 07/17/2023 | 07/16/2024 |
| Test Software | audix | e3 | E3 20923 SGS Ver.9 ( C ) | N.C.R | N.C.R |
| Pre-Amplifier | EMC Instruments | EMC330N | 980781 | 03/15/2024 | 03/14/2025 |
| Coaxial Cable | EMC Instruments | EMCCFD400-NM-NM-8000-5000-2000 | 210216、210217、210218 | 03/15/2024 | 03/14/2025 |

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

# 7 CONDUCTED EMISSIONS TEST

## 7.1 Standard Applicable

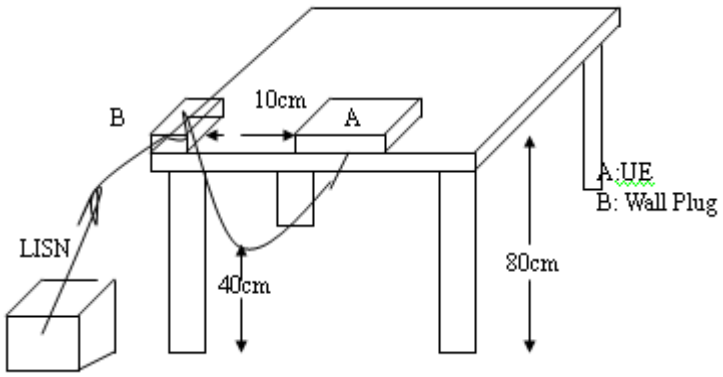
Frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

| Frequency range MHz | Limits (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 |
| Note<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. | | |

## 7.2 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.

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




## 7.4 Measurement Procedure

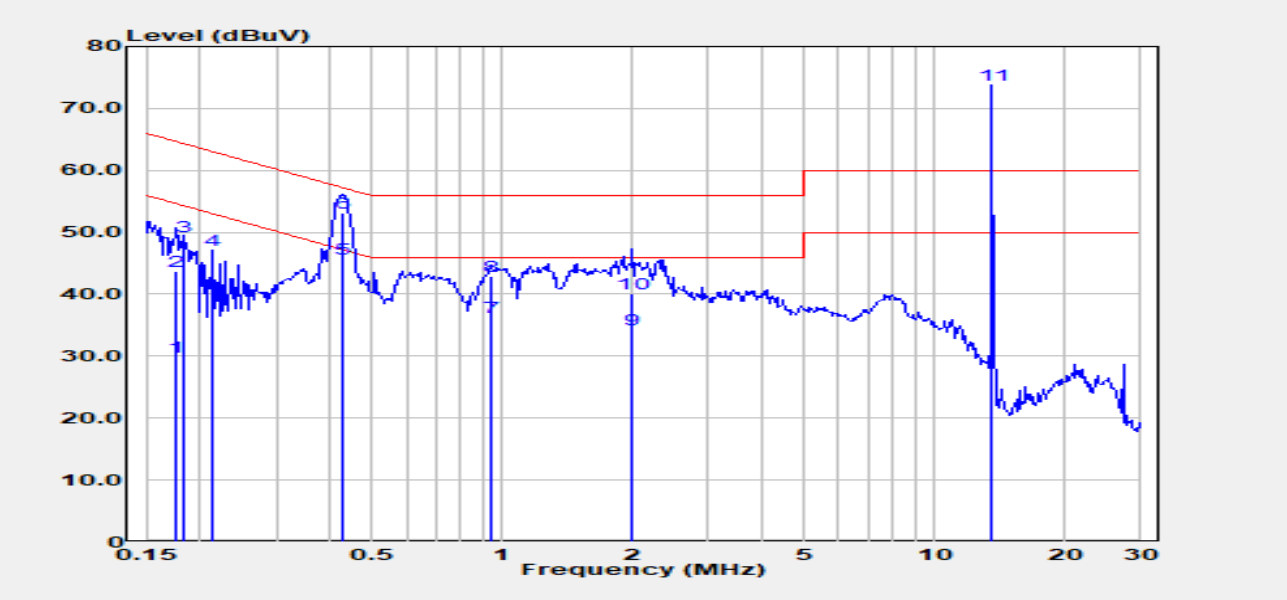
1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## 7.5 Measurement Result

Note: Refer to next page for measurement data and plots.
Note2: The * reveals the worst-case results that closest to the limit.

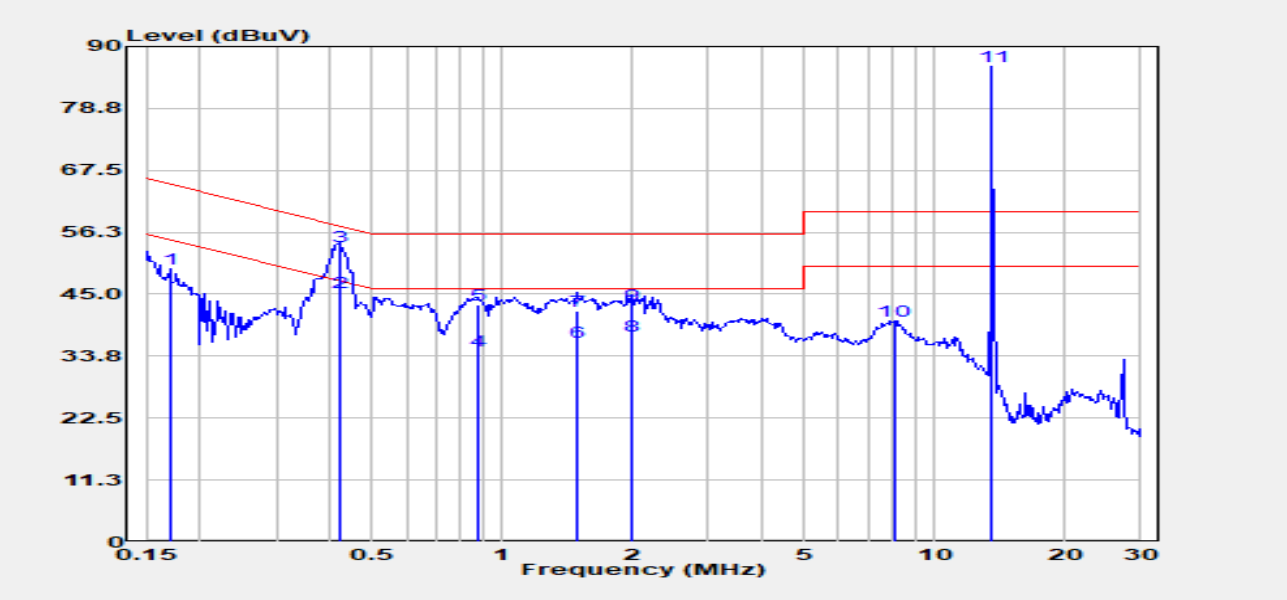
# AC POWER LINE CONDUCTED EMISSION TEST DATA

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :Conduction C |
| Test Mode | :NFC | Test Date | :2024-05-02 |
| Power | :120V/60Hz | Temp./Humi. | :24.3℃/52% |
| Probe | :L1 | Engineer | :Temo Chen |
| Note | :NFC ON | | |



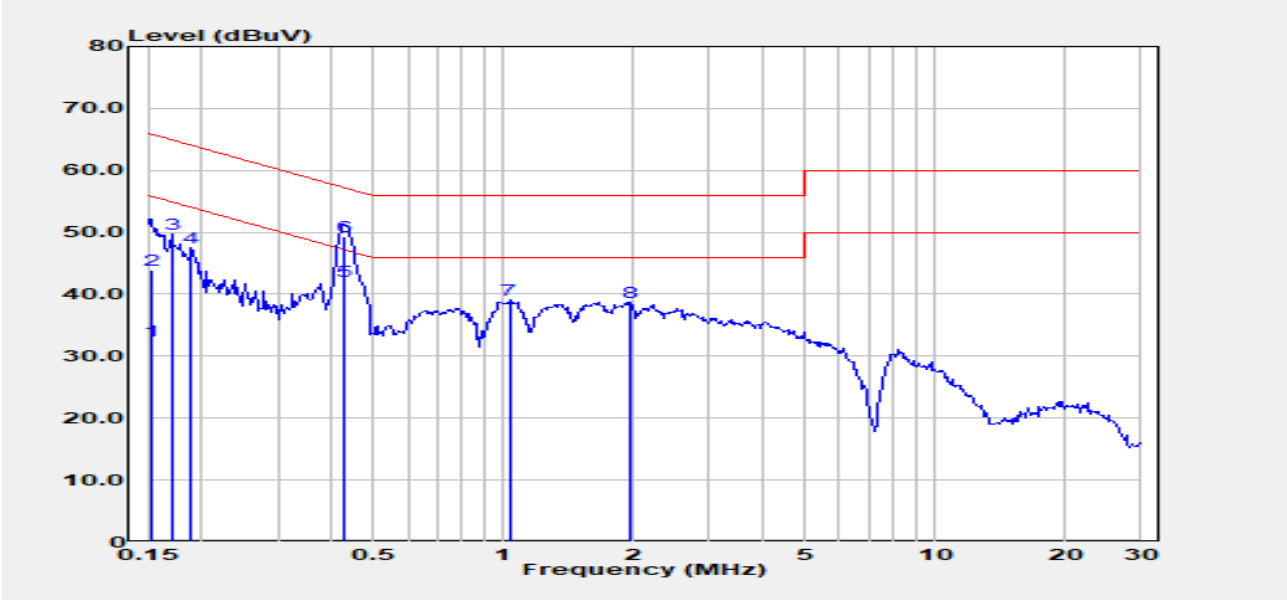

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV | dBμV | dB |
| 0.176 | Average | 19.30 | 10.65 | 29.95 | 54.66 | -24.71 |
| 0.176 | QP | 33.10 | 10.65 | 43.75 | 64.66 | -20.91 |
| 0.184 | Peak | 38.75 | 10.65 | 49.40 | 64.31 | -14.90 |
| 0.214 | Peak | 36.43 | 10.65 | 47.08 | 63.04 | -15.96 |
| 0.426 | Average | 35.10 | 10.62 | 45.72 | 47.33 | -1.61 |
| 0.426 | QP | 42.60 | 10.62 | 53.22 | 57.33 | -4.11 |
| 0.939 | Average | 25.60 | 10.68 | 36.28 | 46.00 | -9.72 |
| 0.939 | QP | 32.30 | 10.68 | 42.98 | 56.00 | -13.02 |
| 1.999 | Average | 23.60 | 10.77 | 34.37 | 46.00 | -11.63 |
| 1.999 | QP | 29.40 | 10.77 | 40.17 | 56.00 | -15.83 |
| 13.560 | Peak | - | - | - | - | - |

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :Conduction C |
| Test Mode | :NFC | Test Date | :2024-05-02 |
| Power | :120V/60Hz | Temp./Humi. | :24.3℃/52% |
| Probe | :N | Engineer | :Temo Chen |
| Note | :NFC ON | | |




| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBµV | dB | dBµV | dBµV | dB |
| 0.170 | Peak | 38.90 | 10.66 | 49.55 | 64.94 | -15.39 |
| 0.419 | Average | 34.80 | 10.61 | 45.41 | 47.47 | -2.06 |
| 0.419 | QP | 43.00 | 10.61 | 53.61 | 57.47 | -3.86 |
| 0.877 | Average | 24.10 | 10.66 | 34.76 | 46.00 | -11.24 |
| 0.877 | QP | 32.40 | 10.66 | 43.06 | 56.00 | -12.94 |
| 1.485 | Average | 25.60 | 10.72 | 36.32 | 46.00 | -9.68 |
| 1.485 | QP | 31.20 | 10.72 | 41.92 | 56.00 | -14.08 |
| 1.999 | Average | 26.60 | 10.75 | 37.35 | 46.00 | -8.65 |
| 1.999 | QP | 32.40 | 10.75 | 43.15 | 56.00 | -12.85 |
| 8.045 | Peak | 29.22 | 10.95 | 40.16 | 60.00 | -19.84 |
| 13.620 | Peak | - | - | - | - | - |

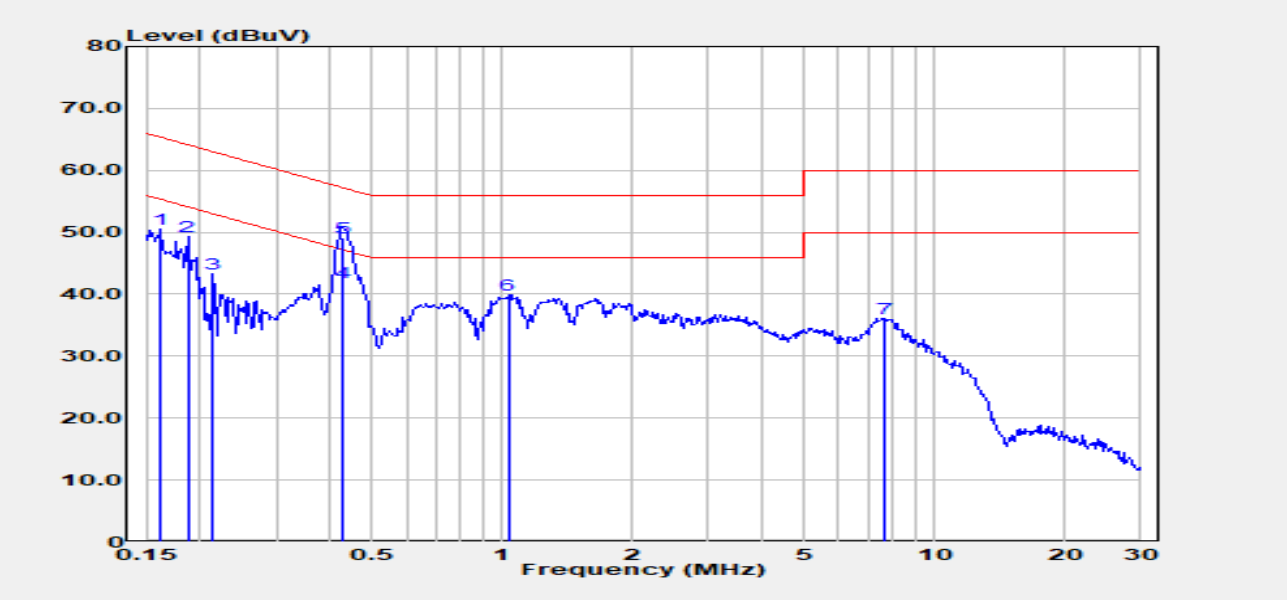
| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :Conduction C |
| Test Mode | :NFC | Test Date | :2024-05-02 |
| Power | :120V/60Hz | Temp./Humi. | :24.3℃/52% |
| Probe | :L1 | Engineer | :Temo Chen |
| Note | :Standby mode* | | |




| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBµV | dB | dBµV | dBµV | dB |
| 0.153 | Average | 21.80 | 10.65 | 32.45 | 55.86 | -23.41 |
| 0.153 | QP | 33.30 | 10.65 | 43.95 | 65.86 | -21.91 |
| 0.170 | Peak | 39.02 | 10.65 | 49.67 | 64.94 | -15.27 |
| 0.189 | Peak | 36.90 | 10.65 | 47.55 | 64.10 | -16.55 |
| 0.426 | Average | 31.40 | 10.62 | 42.02 | 47.33 | -5.31 |
| 0.426 | QP | 38.70 | 10.62 | 49.32 | 57.33 | -8.01 |
| 1.031 | Peak | 28.39 | 10.69 | 39.08 | 56.00 | -16.92 |
| 1.965 | Peak | 28.02 | 10.77 | 38.78 | 56.00 | -17.22 |

*Terminate the RF output and retest with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :Conduction C |
| Test Mode | :NFC | Test Date | :2024-05-02 |
| Power | :120V/60Hz | Temp./Humi. | :24.3℃/52% |
| Probe | :N | Engineer | :Temo Chen |
| Note | :Standby mode* | | |



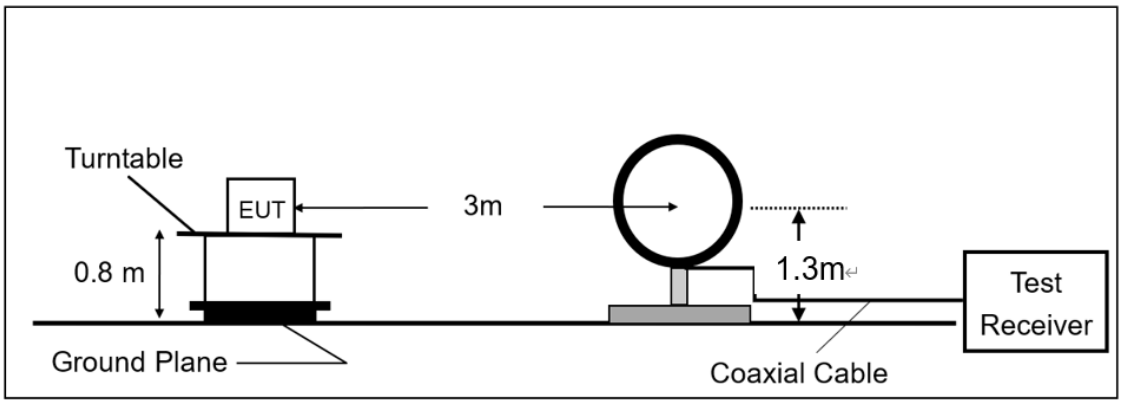

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBµV | dB | dBµV | dBµV | dB |
| 0.162 | Peak | 39.78 | 10.66 | 50.43 | 65.37 | -14.93 |
| 0.187 | Peak | 38.71 | 10.65 | 49.36 | 64.17 | -14.80 |
| 0.214 | Peak | 32.62 | 10.65 | 43.27 | 63.04 | -19.77 |
| 0.426 | Average | 31.20 | 10.61 | 41.81 | 47.33 | -5.52 |
| 0.426 | QP | 38.60 | 10.61 | 49.21 | 57.33 | -8.12 |
| 1.031 | Peak | 29.24 | 10.67 | 39.92 | 56.00 | -16.08 |
| 7.646 | Peak | 25.13 | 10.94 | 36.07 | 60.00 | -23.93 |

*Terminate the RF output and retest with a dummy load in lieu of the antenna to determine compliance with Section 15.207 limits within the transmitter's fundamental emission band.

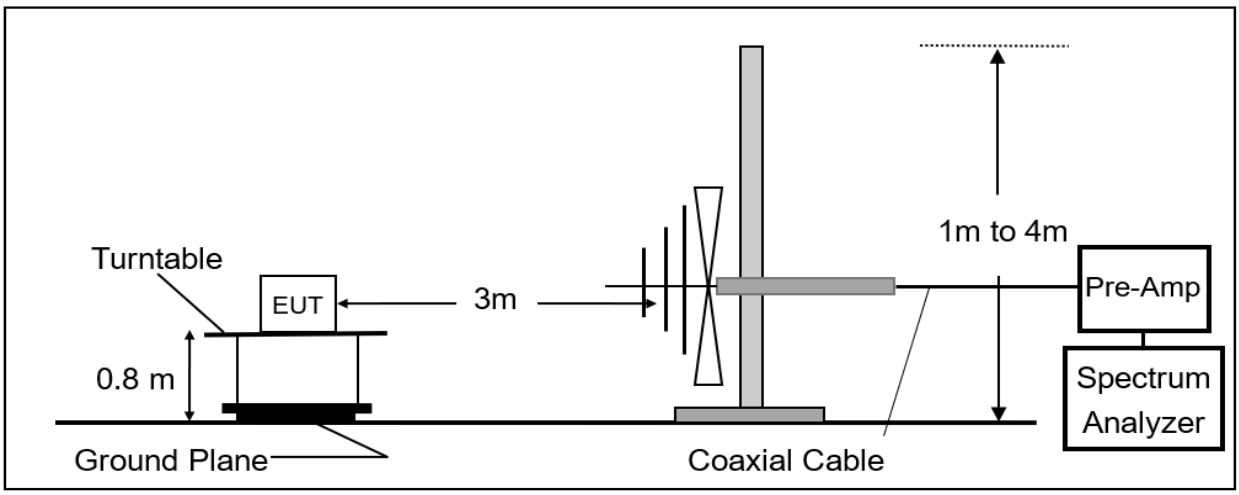
# 8 RADIATED EMISSION TEST

## 8.1 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.




## 8.2 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.

## 8.3 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 | |

## 8.4 Field Strength of Fundamental Emission

### 8.4.1 Applicable standard

| Rules and specifications | CFR 47 Part 15 section 15.225(a)-(d) | |
|---|---|---|
| **Frequency of Emission (MHz)** | **Field Strength (μV/m)at 30m** | **Field Strength (dBμV/m)at 30m** |
| 1.705~13.110 | 30 | 29.5 |
| 13.110~13.410 | 106 | 40.5 |
| 13.410~13.553 | 334 | 50.5 |
| 13.553~13.567 | 15848 | 84 |
| 13.567~13.710 | 334 | 50.5 |
| 13.710~14.010 | 106 | 40.5 |
| 14.010~30.00 | 30 | 29.5 |

### 8.4.2 Distance Extrapolation Factor

**30m to 3m**

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

**30m to 10m**

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

**10m to 3m**

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

***Note:***

1. Distance extrapolation factor = 40 log (required distance/ test distance) (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)

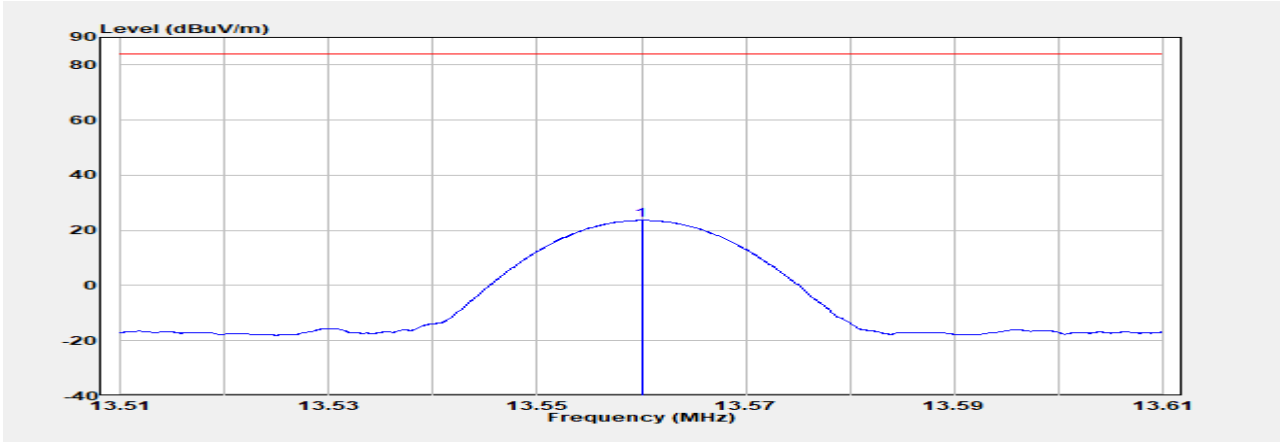
Below 30 MHz of Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Distance Factor (dB)

Above 30 MHz of Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amp Gain (dB)

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

### 8.4.3 Field Strength of Fundamental Emission Measurement Result

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Main | Antenna Pol. | :Vertical |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |



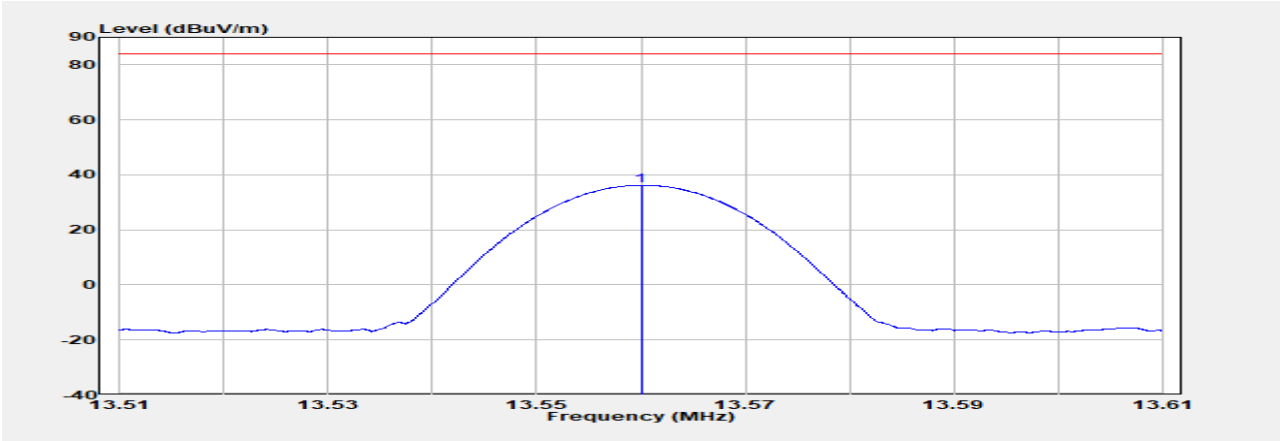

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 13.560 | Peak | 51.87 | -28.25 | 23.62 | 84.00 | -60.38 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Main | Antenna Pol. | :Horizontal |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |



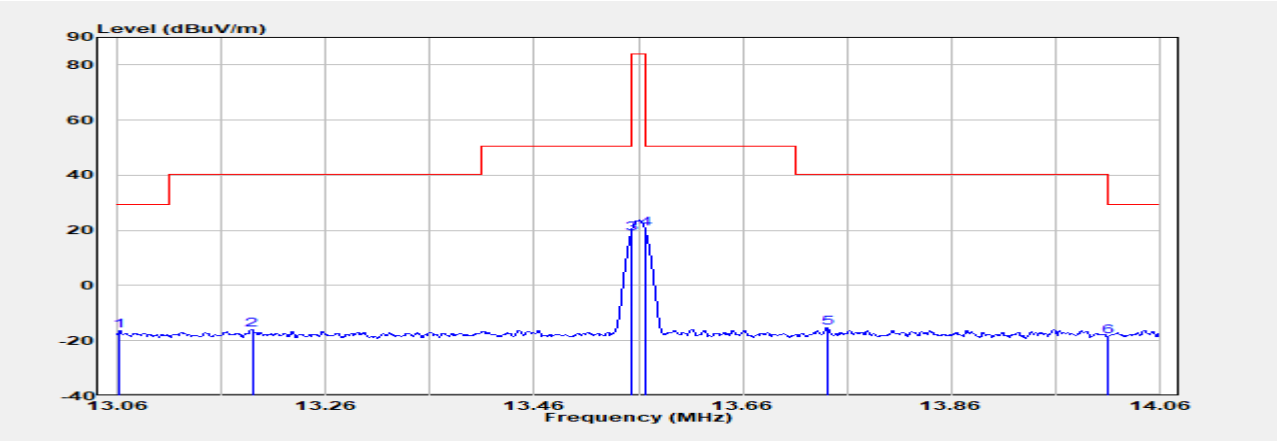

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 13.560 | Peak | 64.47 | -28.25 | 36.23 | 84.00 | -47.77 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Mask | Antenna Pol. | :Vertical |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |



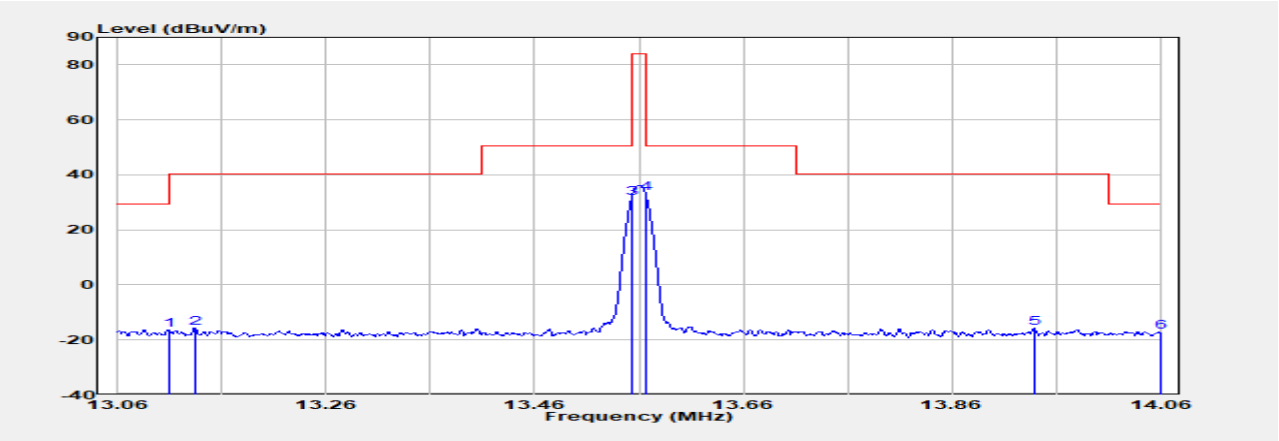

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 13.062 | Peak | 11.69 | -28.21 | -16.52 | 29.54 | -46.06 |
| 13.189 | Peak | 12.07 | -28.22 | -16.15 | 40.50 | -56.65 |
| 13.553 | Peak | 47.00 | -28.25 | 18.75 | 50.47 | -31.72 |
| 13.566 | Peak | 48.78 | -28.25 | 20.53 | 84.00 | -63.47 |
| 13.741 | Peak | 12.96 | -28.26 | -15.30 | 40.50 | -55.80 |
| 14.010 | Peak | 9.70 | -28.28 | -18.58 | 29.54 | -48.12 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Mask | Antenna Pol. | :Horizontal |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |




| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 13.109 | Peak | 11.78 | -28.21 | -16.43 | 29.54 | -45.97 |
| 13.134 | Peak | 12.63 | -28.21 | -15.58 | 40.50 | -56.08 |
| 13.553 | Peak | 59.64 | -28.25 | 31.39 | 50.47 | -19.08 |
| 13.566 | Peak | 61.40 | -28.25 | 33.15 | 84.00 | -50.85 |
| 13.939 | Peak | 12.47 | -28.27 | -15.81 | 40.50 | -56.31 |
| 14.060 | Peak | 11.34 | -28.28 | -16.95 | 29.54 | -46.49 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

## 8.5 Radiated Spurious Emission Measurement

### 8.5.1 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 as below.

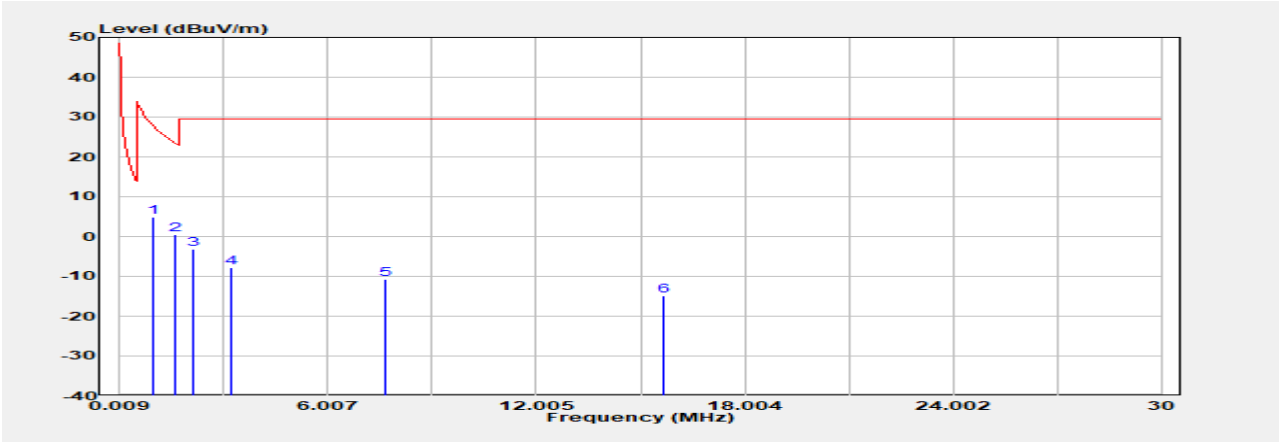
| Frequency (MHz) | Field strength (μV/m) | Distance (meters) |
|---|---|---|
| 0.009~0.490 | 2400/F(kHz) | 300 |
| 0.490~1.705 | 24000/F(kHz) | 30 |
| 1.705-30 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

**Note:**

1. Emission level in dBμV/m=20 log (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. 20*log(30uV/m) = 29.54 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.
7. The general radiated emission limits in §15.209 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

## 8.5.2 Radiated Spurious Emission Measurement Result

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Tx | Antenna Pol. | :Vertical |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |



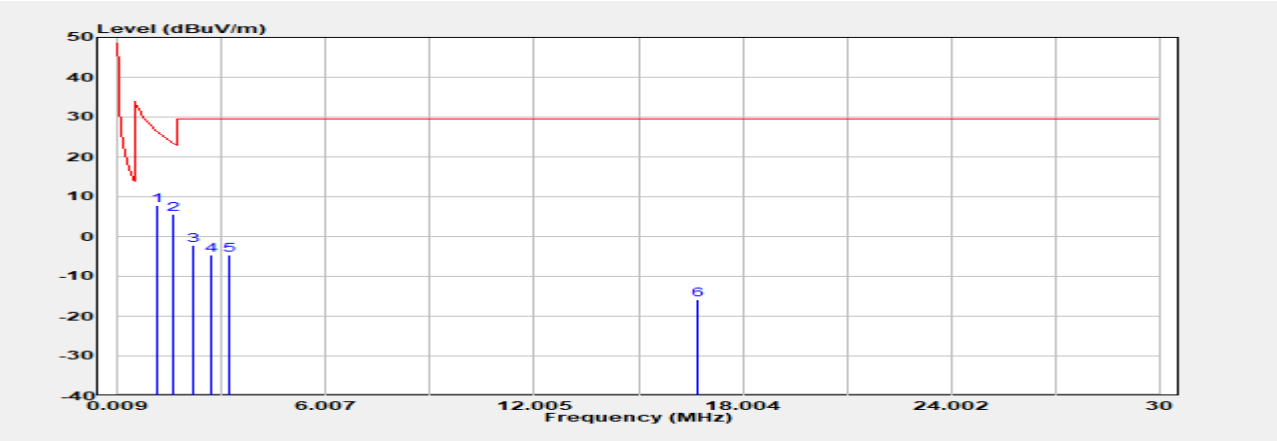

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 0.969 | Peak | 33.60 | -28.79 | 4.81 | 27.88 | -23.07 |
| 1.629 | Peak | 29.32 | -28.89 | 0.42 | 23.37 | -22.94 |
| 2.138 | Peak | 25.82 | -28.95 | -3.13 | 29.54 | -32.67 |
| 3.188 | Peak | 21.30 | -29.04 | -7.74 | 29.54 | -37.28 |
| 7.657 | Peak | 17.64 | -28.34 | -10.70 | 29.54 | -40.24 |
| 15.664 | Peak | 13.62 | -28.40 | -14.78 | 29.54 | -44.32 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Tx | Antenna Pol. | :Horizontal |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |



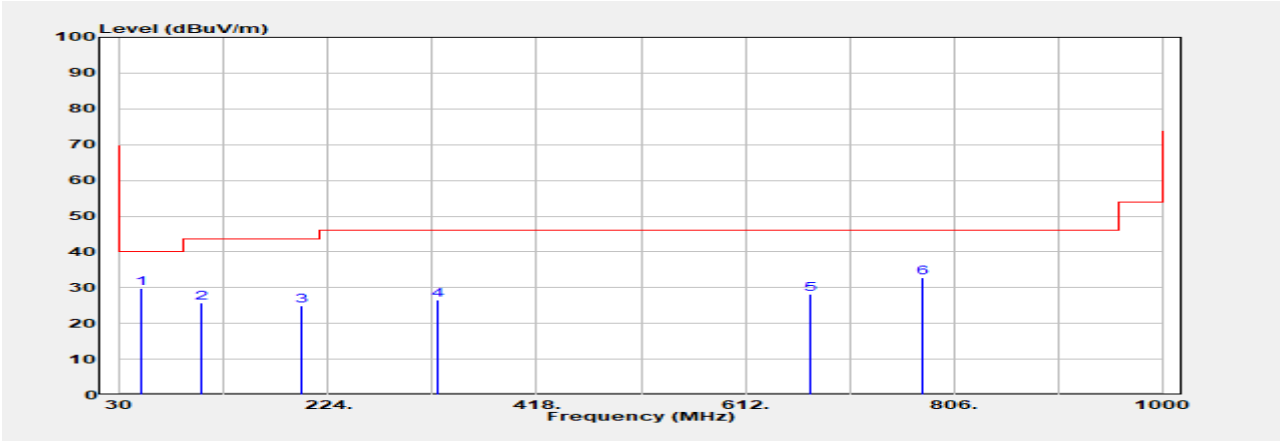

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 1.119 | Peak | 36.55 | -28.81 | 7.74 | 26.63 | -18.89 |
| 1.629 | Peak | 34.52 | -28.89 | 5.63 | 23.37 | -17.74 |
| 2.168 | Peak | 26.68 | -28.95 | -2.27 | 29.54 | -31.81 |
| 2.708 | Peak | 24.44 | -29.02 | -4.58 | 29.54 | -34.12 |
| 3.218 | Peak | 24.45 | -29.04 | -4.58 | 29.54 | -34.12 |
| 16.684 | Peak | 12.50 | -28.46 | -15.96 | 29.54 | -45.50 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Tx | Antenna Pol. | :Vertical |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |



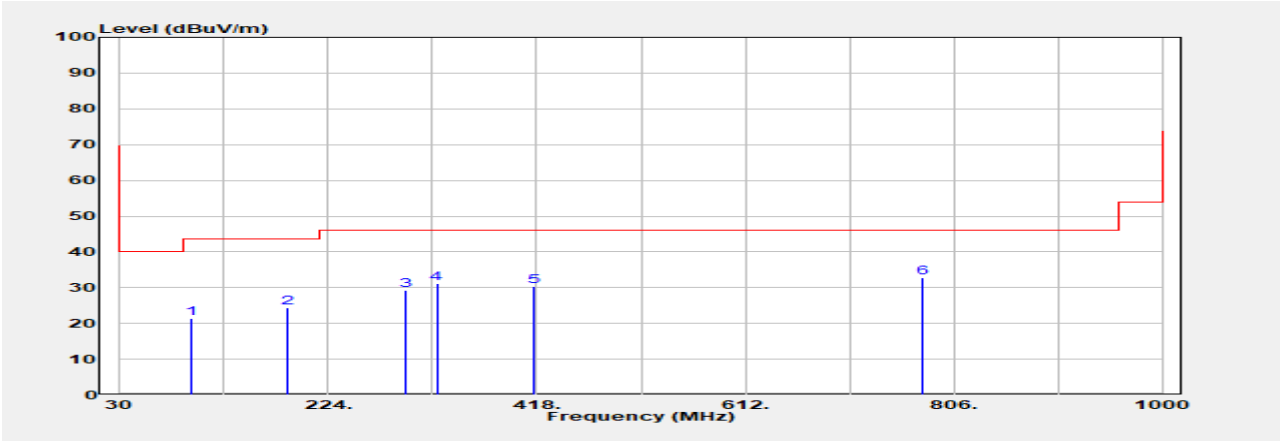

| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 49.400 | Peak | 42.53 | -12.68 | 29.85 | 40.00 | -10.15 |
| 105.660 | Peak | 42.53 | -16.73 | 25.80 | 43.50 | -17.70 |
| 199.750 | Peak | 40.77 | -15.78 | 24.99 | 43.50 | -18.51 |
| 325.850 | Peak | 37.76 | -11.18 | 26.59 | 46.00 | -19.41 |
| 672.140 | Peak | 31.52 | -3.37 | 28.15 | 46.00 | -17.85 |
| 776.900 | Peak | 34.17 | -1.51 | 32.66 | 46.00 | -13.34 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

| | | | |
|---|---|---|---|
| Report Number | :TERF2404000850E2 | Test Site | :SAC G Chamber |
| Operation Mode | :NFC | Test Date | :2024-04-11 |
| Test Frequency | :13.56 MHz | Temp./Humi. | :23.0℃/50% |
| Test Mode | :Tx | Antenna Pol. | :Horizontal |
| EUT Pol | :E2 Plane | Engineer | :Temo Chen |




| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 95.960 | Peak | 39.45 | -17.96 | 21.50 | 43.50 | -22.00 |
| 186.170 | Peak | 39.24 | -14.97 | 24.26 | 43.50 | -19.24 |
| 296.750 | Peak | 41.36 | -12.06 | 29.30 | 46.00 | -16.70 |
| 324.880 | Peak | 42.32 | -11.18 | 31.14 | 46.00 | -14.86 |
| 415.090 | Peak | 39.90 | -9.41 | 30.49 | 46.00 | -15.51 |
| 776.900 | Peak | 34.36 | -1.51 | 32.85 | 46.00 | -13.15 |

Actual level = Reading level + Factor
Factor = Antenna factor + cable loss – Pre_Amplifier Gain — distance factor

Test distance= 3m

For Actual level and limit:
Field strength (dBuV/m) at 300m, within the band 9 kHz - 490 kHz.
Field strength (dBuV/m) at 30m, within the band 490 kHz - 30 MHz.

# 9 FREQUENCY STABILITY

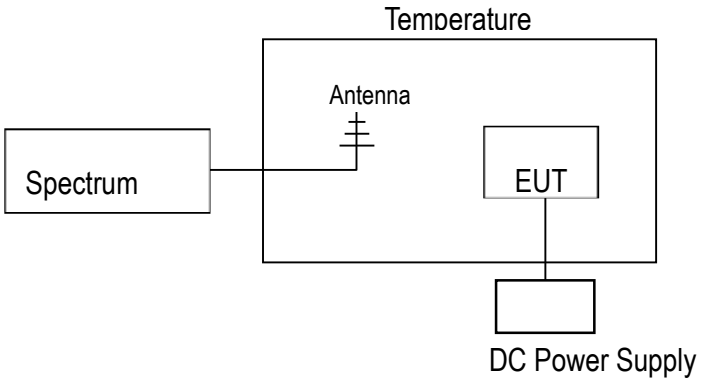
## 9.1 Applicable Standard

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.

## 9.2 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.

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



## 9.4 Measurement Results

**Startup**

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 12 | -20 | 13.5594 | -0.60000 | +/- 1.356 |
| 12 | -10 | 13.55935 | -0.65000 | +/- 1.356 |
| 12 | 0 | 13.55948 | -0.52000 | +/- 1.356 |
| 12 | 10 | 13.55999 | -0.01000 | +/- 1.356 |
| 12 | 20 | 13.55912 | -0.88000 | +/- 1.356 |
| 12 | 30 | 13.55933 | -0.67000 | +/- 1.356 |
| 12 | 40 | 13.55936 | -0.64000 | +/- 1.356 |
| 12 | 50 | 13.55981 | -0.19000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 13.8 | 20 | 13.55969 | -0.31000 | +/- 1.356 |
| 12 | 20 | 13.55912 | -0.88000 | +/- 1.356 |
| 10.2 | 20 | 13.55942 | -0.58000 | +/- 1.356 |

**2 minutes**

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 12 | -20 | 13.55957 | -0.43000 | +/- 1.356 |
| 12 | -10 | 13.55982 | -0.18000 | +/- 1.356 |
| 12 | 0 | 13.55973 | -0.27000 | +/- 1.356 |
| 12 | 10 | 13.55971 | -0.29000 | +/- 1.356 |
| 12 | 20 | 13.55914 | -0.86000 | +/- 1.356 |
| 12 | 30 | 13.55921 | -0.79000 | +/- 1.356 |
| 12 | 40 | 13.55985 | -0.15000 | +/- 1.356 |
| 12 | 50 | 13.55912 | -0.88000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 13.8 | 20 | 13.55939 | -0.61000 | +/- 1.356 |
| 12 | 20 | 13.55914 | -0.86000 | +/- 1.356 |
| 10.2 | 20 | 13.55907 | -0.93000 | +/- 1.356 |

**5 minutes**

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 12 | -20 | 13.55971 | -0.29000 | +/- 1.356 |
| 12 | -10 | 13.55918 | -0.82000 | +/- 1.356 |
| 12 | 0 | 13.55961 | -0.39000 | +/- 1.356 |
| 12 | 10 | 13.55979 | -0.21000 | +/- 1.356 |
| 12 | 20 | 13.56002 | 0.02000 | +/- 1.356 |
| 12 | 30 | 13.55908 | -0.92000 | +/- 1.356 |
| 12 | 40 | 13.55948 | -0.52000 | +/- 1.356 |
| 12 | 50 | 13.55932 | -0.68000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 13.8 | 20 | 13.55994 | -0.06000 | +/- 1.356 |
| 12 | 20 | 13.56002 | 0.02000 | +/- 1.356 |
| 10.2 | 20 | 13.55959 | -0.41000 | +/- 1.356 |

**10 minutes**

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 12 | -20 | 13.55941 | -0.59000 | +/- 1.356 |
| 12 | -10 | 13.55937 | -0.63000 | +/- 1.356 |
| 12 | 0 | 13.55946 | -0.54000 | +/- 1.356 |
| 12 | 10 | 13.55918 | -0.82000 | +/- 1.356 |
| 12 | 20 | 13.55928 | -0.72000 | +/- 1.356 |
| 12 | 30 | 13.55908 | -0.92000 | +/- 1.356 |
| 12 | 40 | 13.55935 | -0.65000 | +/- 1.356 |
| 12 | 50 | 13.55908 | -0.92000 | +/- 1.356 |

B. Supply Voltage Variation

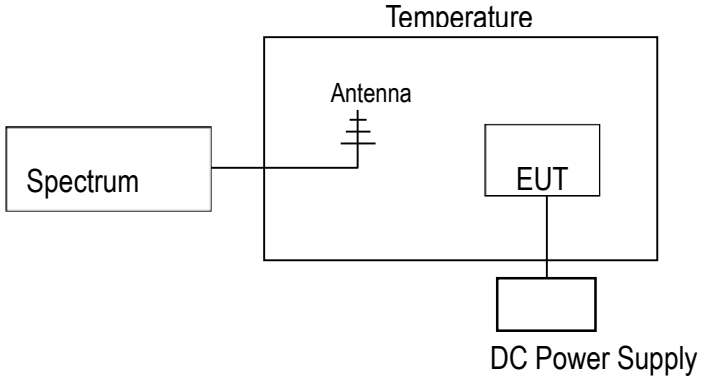
| Power Supply | Environment | Frequency | Delta (kHz) | Limit (kHz) |
|---|---|---|---|---|
| Vdc | Temperature (℃) | (MHz) | | |
| 13.8 | 20 | 13.55984 | -0.16000 | +/- 1.356 |
| 12 | 20 | 13.55928 | -0.72000 | +/- 1.356 |
| 10.2 | 20 | 13.55973 | -0.27000 | +/- 1.356 |

# 10 EMISSION BANDWIDTH MEASUREMENT

## 10.1 Applicable Standard:

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

## 10.2 Test Set-up




## 10.3 Measurement Procedure

1. Placed the EUT on the testing table.
2. Set the EUT under transmission condition continuously at specific channel frequency.
3. Set SPA Center Frequency = fundamental frequency, RBW=1% to 5% OBW, VBW=3 x RBW, Span = large enough to capture all products of the modulation process.
4. Measured the spectrum width with power higher than 20dB below carrier.

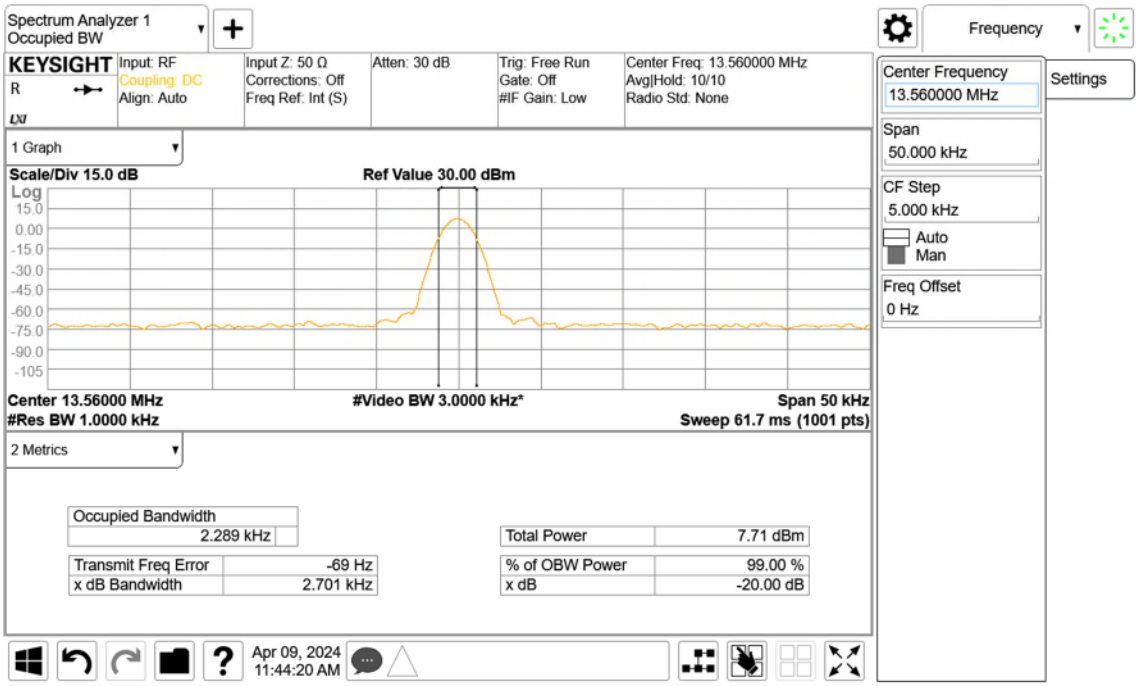
## 10.4 Measurement Result

FCC

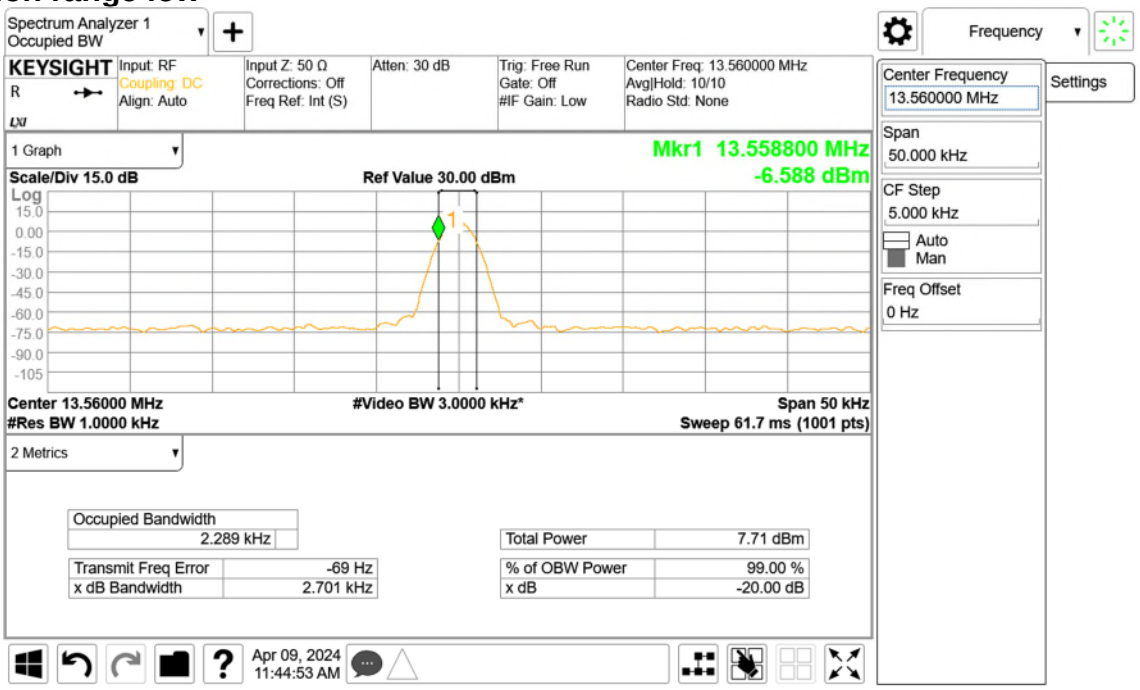
| 20dB BW (kHz) |
|---|
| 2.701 |

| Opration range | Frequency (MHz) | Limit (MHz) |
|---|---|---|
| Low | 13.55880 | >13.11 |
| High | 13.56110 | <14.01 |

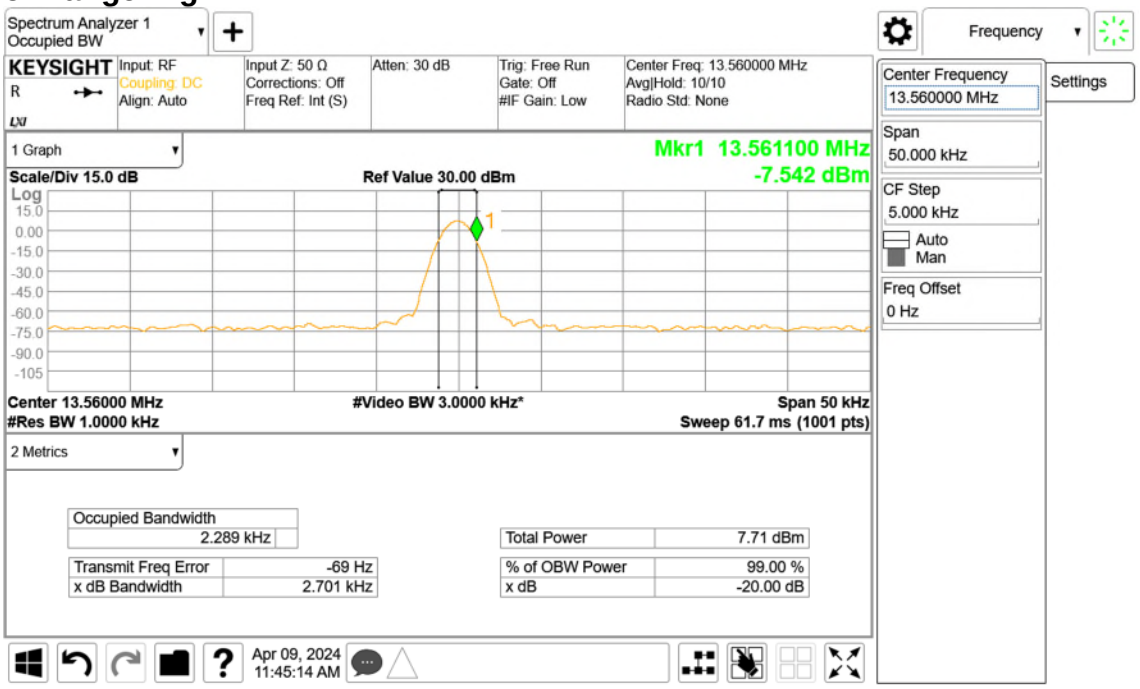
## Bandwidth



## Operation range low




## Operation range High



# 11 ANTENNA REQUIREMENT

## 11.1 Standard Applicable:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

## 11.2 Antenna Connected Construction:

The antenna complies with this requirement and no consideration of replacement. Please see EUT photo for details.

***~ End of Report ~***