

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

**Applicant:** Sharp Corporation, Mobile Communication B.U.  
2-13-1, Hachihonmatsu-lida, Higashi-hiroshima-shi,  
Hiroshima, 739-0192, Japan

**Manufacturer:** Sharp Corporation  
1 Takumi-cho, Sakai-ku, Sakai City, Osaka 590-8522, Japan

**Product Name:** Smart phone

**Report Number:** ER/2019/C0156

**FCC ID** APYHRO00282

**FCC Rule Part** Part 15.225

**Issue Date:** Jan. 30, 2020

**Date of Test:** Dec. 09, 2019 ~ Jan. 10, 2020

**Date of EUT Received:** Dec. 09, 2019

**We hereby certify that:**

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits. The test results of this report relate only to the tested sample identified in this report.

**Approved By:**

*Vito Pei*  
**Vito Pei/ Sr. Engineer**



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## Revision History

| Report Number | Revision | Description | Issue Date    | Remark                   |
|---------------|----------|-------------|---------------|--------------------------|
| ER/2019/C0156 | Rev.00   | Original.   | Jan. 30, 2020 | Revised By:<br>Susan Lin |

**Note:**

Test data is referenced from cross authorization(s)

Conduction measurement results in the original test report ER/2019/C0080 under FCC ID: APYHRO00281 are fully leveraged in this test report.

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# 1 GENERAL INFORMATION

## 1.1 Product Description

|                   |  |
|-------------------|--|
| Product Name:     | Smart phone                            |
| Hardware Version: | DVT                                    |
| Software Version: | N/A                                    |
| Power Supply:     | 3.85V from Rechargeable Li-ion Battery |

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

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## 1.2 Test Methodology

FCC Part 15, Subpart C §15.225  
ANSI C63.10:2013

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

## 1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)  
FCC Designation number: TW0001

## 1.4 Special Accessories

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

## 1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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

Radiated emission below 30MHz is measured in a 9m\*9m\*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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## 2 SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT Exercise

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

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is a placed on 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 according to §15.207. 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.

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## 2.4 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 AC Power Line Conducted Emission

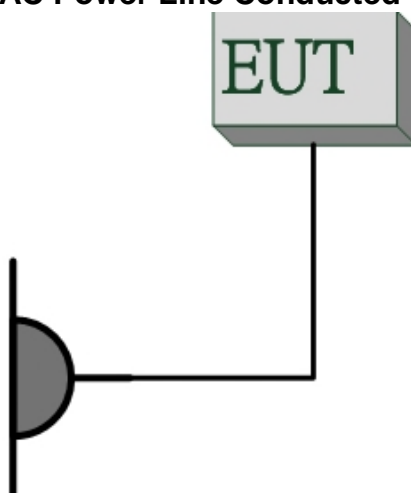


Table 2-1 Equipment Used in Tested System

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

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### 3 SUMMARY OF TEST RESULTS

| FCC Rules              | 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) | 20 dB OCCUPIED BANDWIDTH                      | Compliant |
| §15.203                | Antenna Requirement                           | Compliant |

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## 4 DESCRIPTION OF TEST MODES

### 4.1 The Worst Test Modes and Channel Details

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

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

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

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## 5 MEASUREMENT UNCERTAINTY

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

| Radiated Spurious Emission Measurement Uncertainty |                            |
|--|----------------------------|
| Polarization: Vertical                             | 9kHz~30MHz: +/-2.3dB       |
|  | 30MHz - 180MHz: +/- 3.37dB |
|  | 180MHz -417MHz: +/- 3.19dB |
|  | 0.417GHz-1GHz: +/- 3.19dB  |
|  | 1GHz - 18GHz: +/- 4.04dB   |
|  | 18GHz - 40GHz: +/- 4.04dB  |
| Polarization: Horizontal                           | 9kHz~30MHz: +/-2.3dB       |
|  | 30MHz - 167MHz: +/- 4.22dB |
|  | 167MHz -500MHz: +/- 3.44dB |
|  | 0.5GHz-1GHz: +/- 3.39dB    |
|  | 1GHz - 18GHz: +/- 4.08dB   |
|  | 18GHz - 40GHz: +/- 4.08dB  |

### Note:

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

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## 6 CONDUCTED EMISSIONS TEST

### 6.1 Standard Applicable

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

| Frequency range<br>MHz | Limits<br>dB(μV) |          |
|------------------------|------------------|----------|
|                        | Quasi-peak       | Average  |
| 0.15 to 0.50           | 66 to 56         | 56 to 46 |
| 0.50 to 5              | 56               | 46       |
| 5 to 30                | 60               | 50       |

Note

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

### 6.2 Measurement Equipment Used:

| Conducted Emission Test Site |             |                 |                  |              |            |
|------------------------------|-------------|-----------------|------------------|--------------|------------|
| EQUIPMENT<br>TYPE            | MFR         | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |
| EMI Test Receiver            | R&S         | ESCI 7          | 1166.5950.0<br>7 | 07/04/2019   | 07/03/2020 |
| Coaxial Cables               | N/A         | WK CE Cable     | N/A              | 11/26/2019   | 11/25/2020 |
| LISN                         | SCHWARZBECK | NSLK 8127       | 8127-649         | 04/02/2019   | 04/01/2020 |
| Test Software                | Farad       | EZ-EMC          | Ver.<br>SGS-03A2 | N.C.R        | N.C.R      |

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

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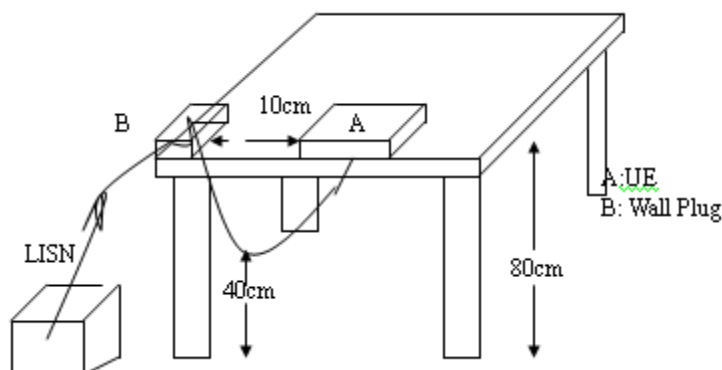
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#### 6.4 Test SET-UP (Block Diagram of Configuration)



#### 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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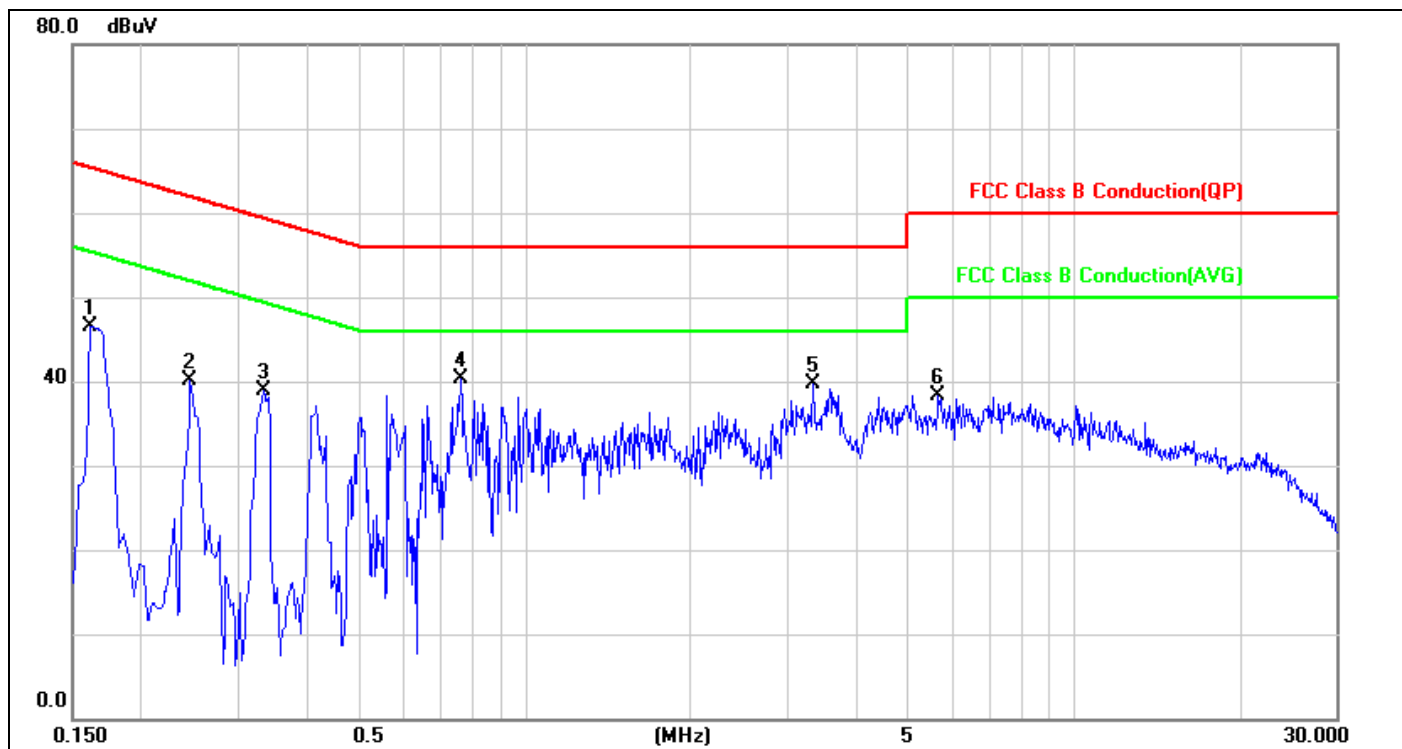
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## AC POWER LINE CONDUCTED EMISSION TEST DATA

Description: Operation  
Line: L1  
Test Voltage: AC 120V/60Hz  
Report: ER-2019-C0080

Date: 2020/01/11  
Temp.(°C)/Hum.(%): 23.6 (°C)/62%  
Test By: Kane



| No. | Mk. | Freq.<br>( MHz ) | Reading<br>( dBuV ) | Factor<br>( dB ) | Measurement<br>( dBuV ) | Limit<br>( dBuV ) | Over<br>( dB ) | Detector | Comment |
|-----|-----|------------------|---------------------|------------------|-------------------------|-------------------|----------------|----------|---------|
| 1   |     | 0.1620           | 46.47               | 0.00             | 46.47                   | 65.36             | -18.89         | peak     |         |
| 2   |     | 0.2460           | 40.13               | 0.01             | 40.14                   | 61.89             | -21.75         | peak     |         |
| 3   |     | 0.3340           | 38.86               | 0.01             | 38.87                   | 59.35             | -20.48         | peak     |         |
| 4   | *   | 0.7660           | 40.22               | 0.02             | 40.24                   | 56.00             | -15.76         | peak     |         |
| 5   |     | 3.3580           | 39.53               | 0.11             | 39.64                   | 56.00             | -16.36         | peak     |         |
| 6   |     | 5.6820           | 38.04               | 0.20             | 38.24                   | 60.00             | -21.76         | peak     |         |

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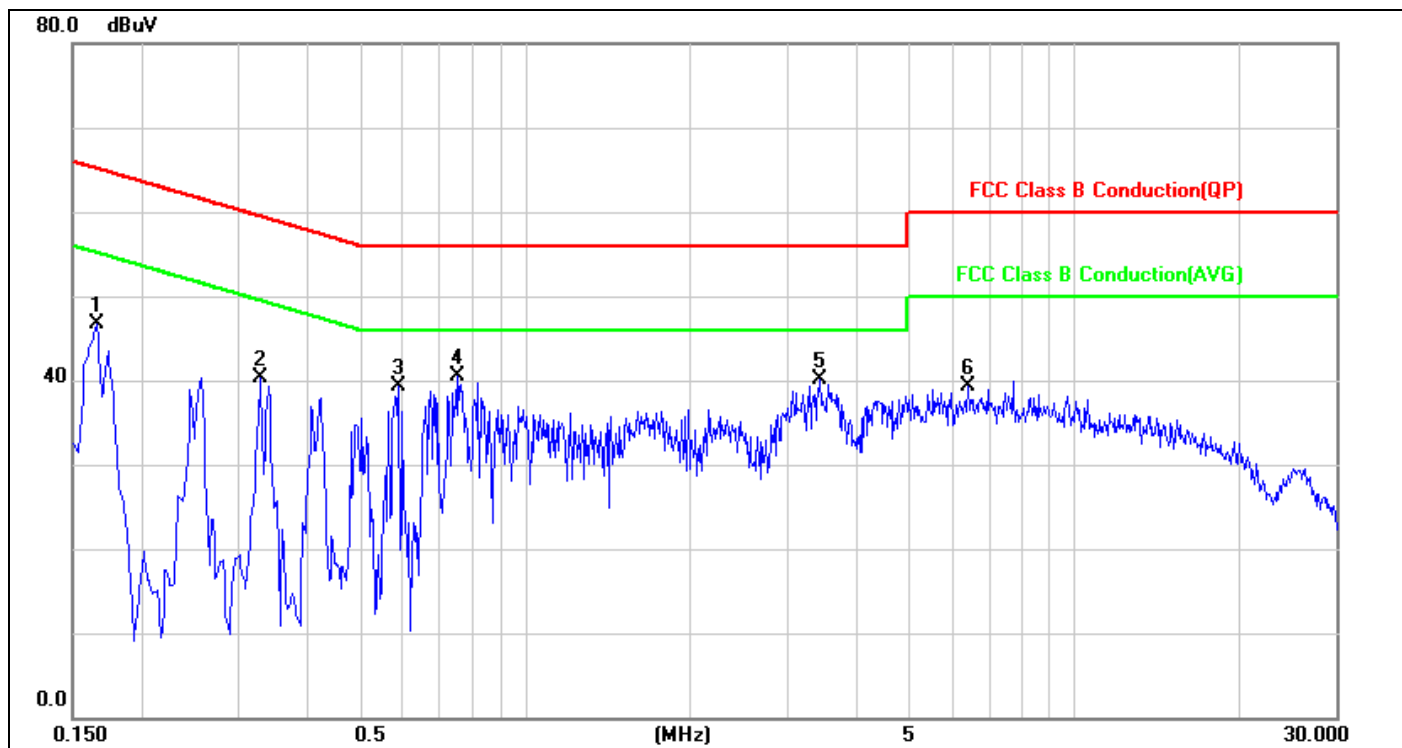
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Description: Operation  
Line: N  
Test Voltage: AC 120V/60Hz  
Report: ER-2019-C0080

Date: 2020/01/11  
Temp.(°C)/Hum.(%): 23.6 (°C)/62%  
Test By: Kane



| No. | Mk. | Freq.<br>( MHz ) | Reading<br>( dBuV ) | Factor<br>( dB ) | Measurement<br>( dBuV ) | Limit<br>( dBuV ) | Over<br>( dB ) | Detector | Comment |
|-----|-----|------------------|---------------------|------------------|-------------------------|-------------------|----------------|----------|---------|
| 1   |     | 0.1660           | 46.61               | 0.03             | 46.64                   | 65.16             | -18.52         | peak     |         |
| 2   |     | 0.3300           | 40.21               | 0.03             | 40.24                   | 59.45             | -19.21         | peak     |         |
| 3   |     | 0.5900           | 39.31               | 0.03             | 39.34                   | 56.00             | -16.66         | peak     |         |
| 4   | *   | 0.7540           | 40.41               | 0.04             | 40.45                   | 56.00             | -15.55         | peak     |         |
| 5   |     | 3.4500           | 39.89               | 0.12             | 40.01                   | 56.00             | -15.99         | peak     |         |
| 6   |     | 6.4020           | 39.05               | 0.22             | 39.27                   | 60.00             | -20.73         | peak     |         |

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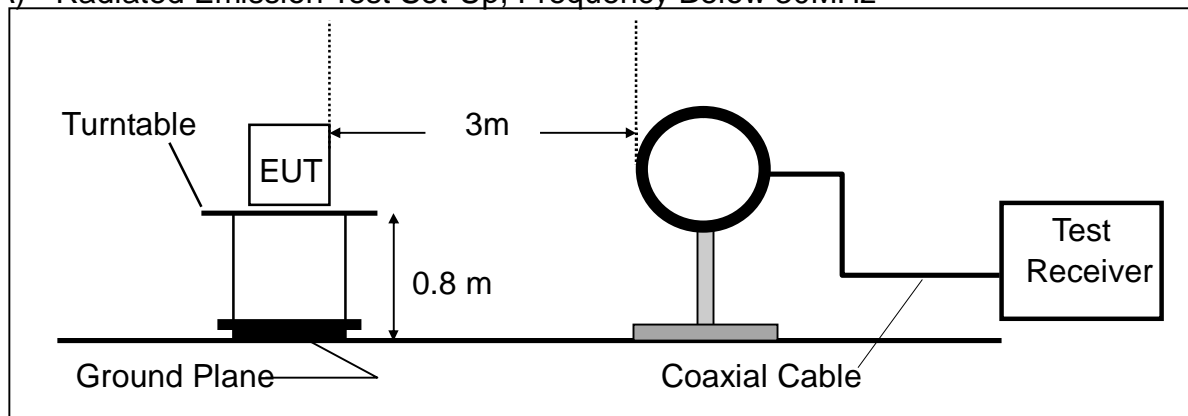
## 7 RADIATED TEST ITEMS

### 7.1 Measurement Procedure

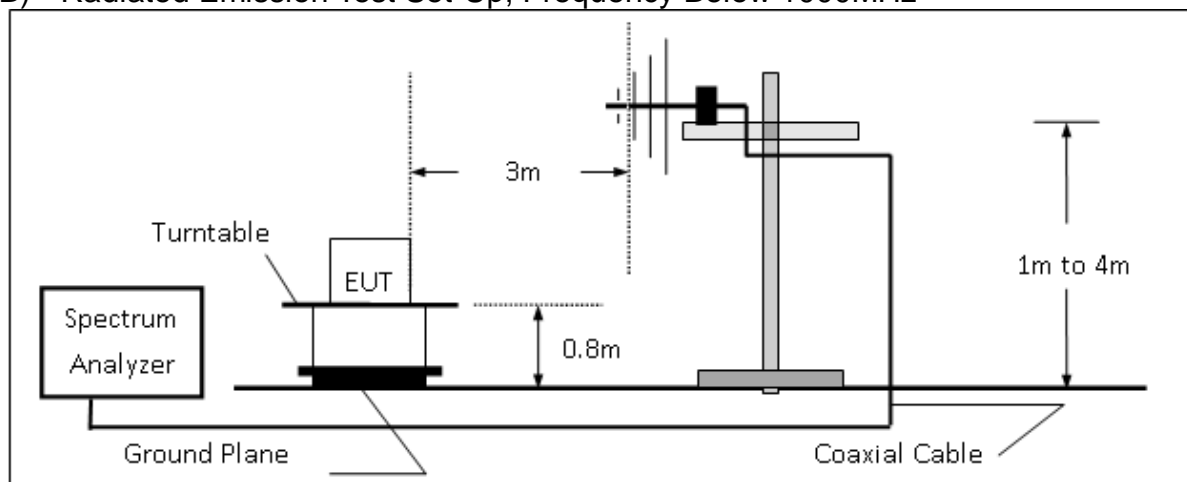
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all default test channel measured were complete.

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

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



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### 7.3 Measurement Equipment Used:

| EQUIPMENT TYPE        | MFR          | MODEL NUMBER       | SERIAL NUMBER    | LAST CAL.  | CAL DUE.   |
|-----------------------|--------------|--------------------|------------------|------------|------------|
| Bi-log Antenna        | TESEO        | CBL 6112D          | 35242 & AT-N0555 | 01/10/2019 | 01/09/2020 |
| Loop Antenna          | ETS.LINDGREN | 6502               | 148045           | 10/15/2019 | 10/14/2020 |
| EMI Test Receiver     | R&S          | ESCI 7             | 1166.5950.07     | 07/04/2019 | 07/03/2020 |
| EXA Spectrum Analyzer | KEYSIGHT     | N9010A             | MY51440113       | 07/15/2019 | 07/14/2020 |
| Pre-Amplifier         | HP           | 8447D              | 2944A09469       | 01/02/2020 | 01/01/2021 |
| Coaxial Cable         | Huber Suhner | succoflex 102      | MY2622/2         | 01/02/2020 | 01/01/2021 |
| Coaxial Cable         | Huber Suhner | succoflex 104A     | 800086/4a        | 01/02/2020 | 01/01/2021 |
| Coaxial Cable         | Huber Suhner | EMC 104-SM-SM-2000 | 160123           | 01/02/2020 | 01/01/2021 |

### 7.4 Field Strength Calculation

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

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

**Where** *FS* = Field Strength

*CL* = Cable Attenuation Factor (Cable Loss)

*RA* = Reading Amplitude

*AG* = Amplifier Gain

*AF* = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts  $20 \cdot \log(\mu V/m)$

Actual FS(dBuV/m) = SPA. Reading level(dBuV) + Factor(dB)

Factor(dB) = Antenna Factor(dBuV/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)

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## 7.5 Field Strength of Fundamental Emission

### 7.5.1 FCC Applicable standard

| Rules and specifications    | CFR 47 Part 15 section 15.225(a)-(d) |                               |                              |
|-----------------------------|--------------------------------------|-------------------------------|------------------------------|
| Frequency of Emission (MHz) | Field Strength (μV/m)at 30m          | Field Strength (dBμV/m)at 30m | Field Strength (dBμV/m)at 3m |
| 1.705~13.110                | 30                                   | 29.5                          | 69.5                         |
| 13.110~13.410               | 106                                  | 40.5                          | 80.5                         |
| 13.410~13.553               | 334                                  | 50.5                          | 90.47                        |
| 13.553~13.567               | 15848                                | 84                            | 124                          |
| 13.567~13.710               | 334                                  | 50.5                          | 90.47                        |
| 13.710~14.010               | 106                                  | 40.5                          | 80.5                         |
| 14.010~30.00                | 30                                   | 29.5                          | 69.5                         |

Field strength of fundamental emissions limit:

The field strength of fundamental emissions shall not exceed 15848 microrvolts/meter at 30 meters. The Limit is converted to 124.00dBuV/m by offsetting the distance extrapolation factor as measurement distance is taken place at 3 meters.

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

#### 30m to 3m

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

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

#### 30m to 10m

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

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

#### 10m to 3m

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

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

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**Note:**

1. Emission level in dBuV/m=20 log ( $\mu$ V/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance below 30MHz at 10m and 3m and above 30MHz at 3m, where extrapolation factor is offset to convert the limit of the measurement.
5. KDB 414788 D01 OATS and 3m semi-anechoic chamber Justification:  
Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. OATS and 3m SAC chamber testing had been performed and 3m SAC measured test result is the worst case test result.
6. Emission level in dBuV/m=20 log ( $\mu$ V/m)
7. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
8. The lower limit shall apply at the transition frequencies.
9. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

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

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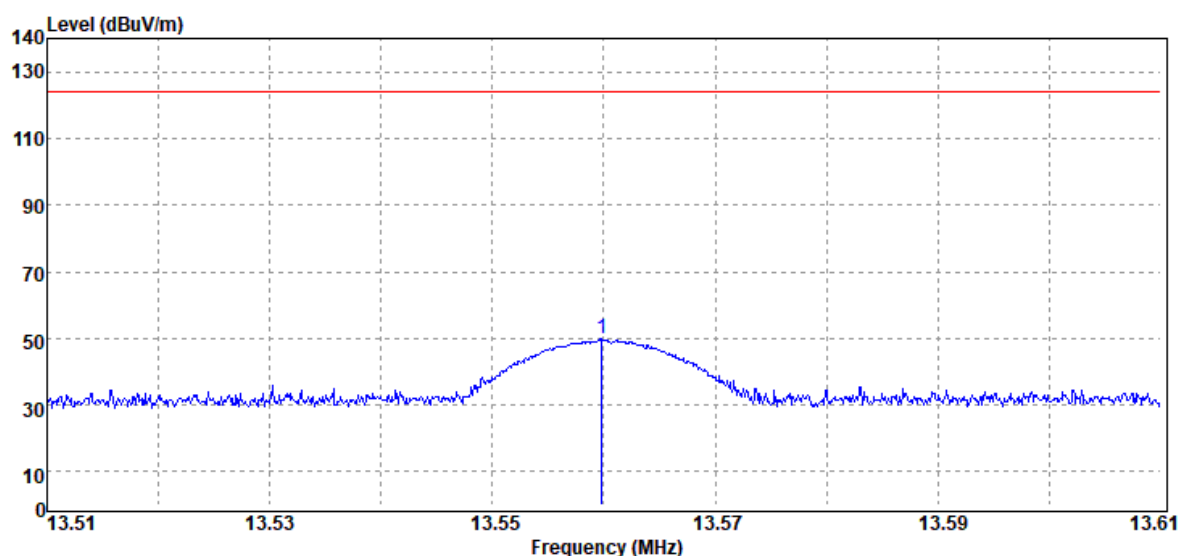
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## 7.6 Field Strength of Fundamental Emission Measurement Result

|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/C0156 | Test Date    | :2020-01-09 |
| Operation Mode | :NFC           | Temp./Humi.  | :22.2/55    |
| Test Channel   | :13.56 MHz     | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Main          | Engineer     | :Thomas     |
| EUT Pol        | :H Plane       |              |             |



| 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 |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 13.56        | Peak                         | 38.44                                   | 11.26        | 49.70                        | 124.00                       | -74.30       |

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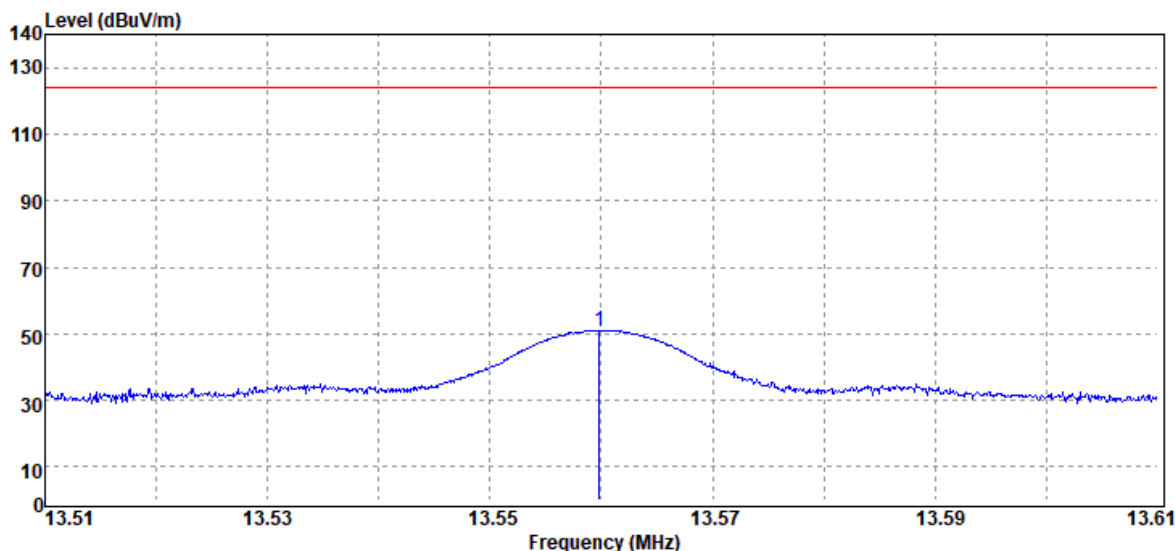
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Report Number :ER/2019/C0156  
Operation Mode :NFC  
Test Channel :13.56 MHz  
Test Mode :Main  
EUT Pol :H Plane

Test Date :2020-01-09  
Temp./Humi. :22.2/55  
Antenna Pol. :HORIZONTAL  
Engineer :Thomas



| Freq. | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|-------|----------|---------------|--------|--------|--------|--------|
| MHz   | Mode     | Reading Level |        | FS     | @3m    |        |
|       | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 13.56 | Peak     | 39.73         | 11.26  | 50.99  | 124.00 | -73.01 |

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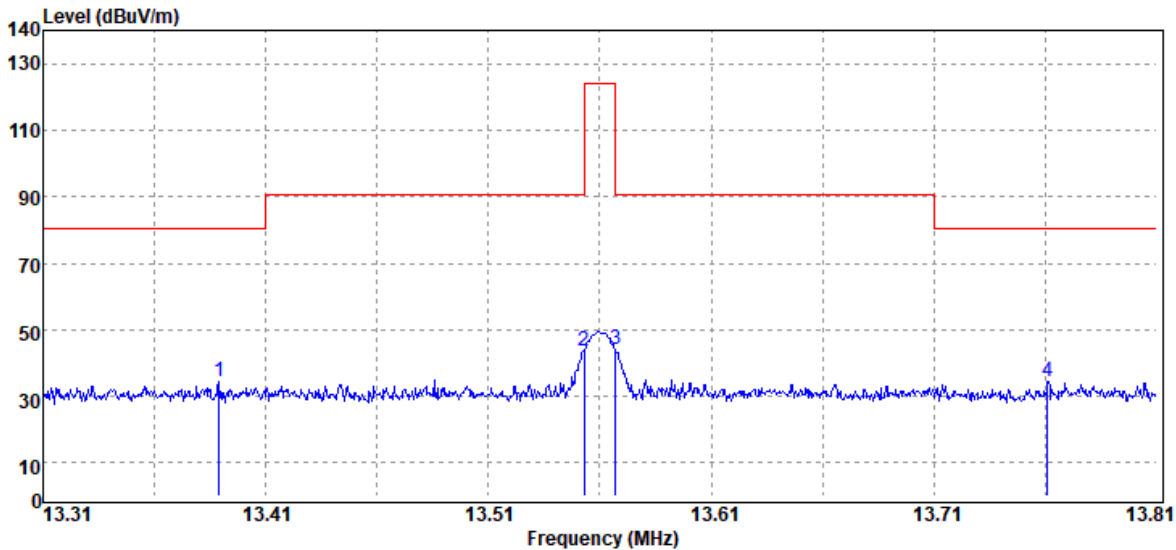
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Report Number :ER/2019/C0156  
 Operation Mode :NFC  
 Test Channel :13.56 MHz  
 Test Mode :Mask  
 EUT Pol :H Plane

Test Date :2020-01-09  
 Temp./Humi. :22.2/55  
 Antenna Pol. :VERTICAL  
 Engineer :Thomas



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.39        | Peak                         | 23.20                             | 11.27        | 34.47                  | 80.54                  | -46.07       |
| 13.55        | Peak                         | 32.28                             | 11.26        | 43.54                  | 90.47                  | -46.93       |
| 13.57        | Peak                         | 32.75                             | 11.26        | 44.01                  | 90.47                  | -46.46       |
| 13.76        | Peak                         | 23.34                             | 11.25        | 34.59                  | 80.50                  | -45.91       |

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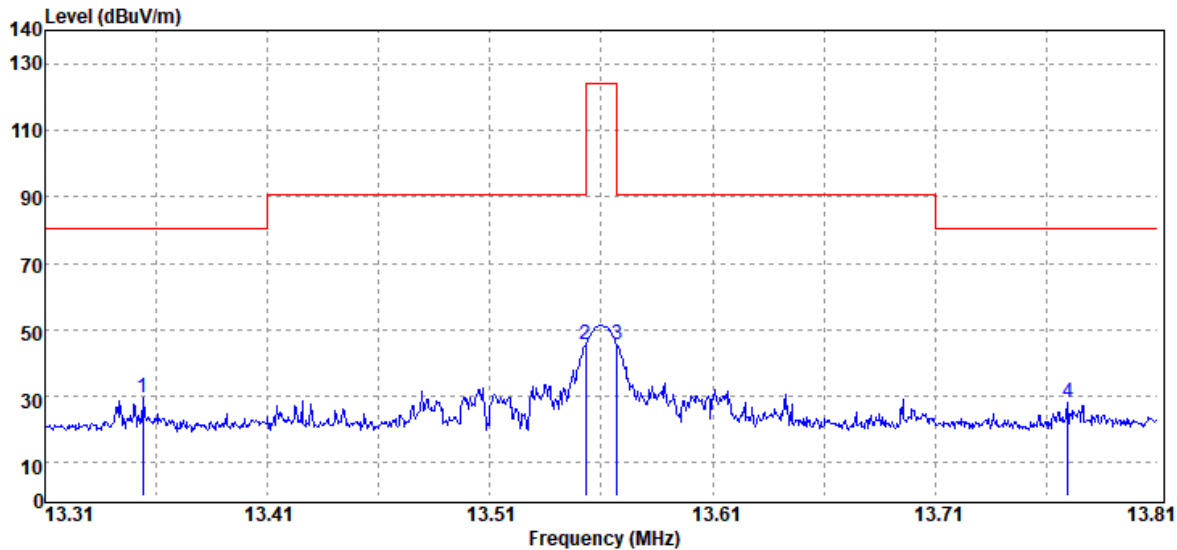
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Report Number :ER/2019/C0156  
Operation Mode :NFC  
Test Channel :13.56 MHz  
Test Mode :Mask  
EUT Pol :H Plane

Test Date :2020-01-09  
Temp./Humi. :22.2/55  
Antenna Pol. :HORIZONTAL  
Engineer :Thomas


| Freq. | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|-------|----------|---------------|--------|--------|--------|--------|
| MHz   | Mode     | Reading Level |        | FS     | @3m    |        |
|       | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 13.35 | Peak     | 18.22         | 11.28  | 29.50  | 80.54  | -51.04 |
| 13.55 | Peak     | 34.36         | 11.26  | 45.62  | 90.47  | -44.85 |
| 13.57 | Peak     | 34.45         | 11.26  | 45.71  | 90.47  | -44.76 |
| 13.77 | Peak     | 16.95         | 11.25  | 28.20  | 80.50  | -52.30 |

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## 7.7 Radiated Emission Measurement

### 7.7.1 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 (μV/m)
2. Distance extrapolation factor = 40 log (required distance/ test distance) (dB)
3. 20\*log(30uV/m) + 40dB = 69.54 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.

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## 7.7.2 Radiated Emission Measurement Result

Report Number :ER/2019/C0156

Test Date :2020-01-09

Operation Mode :NFC

Temp./Humi. :22.2/55

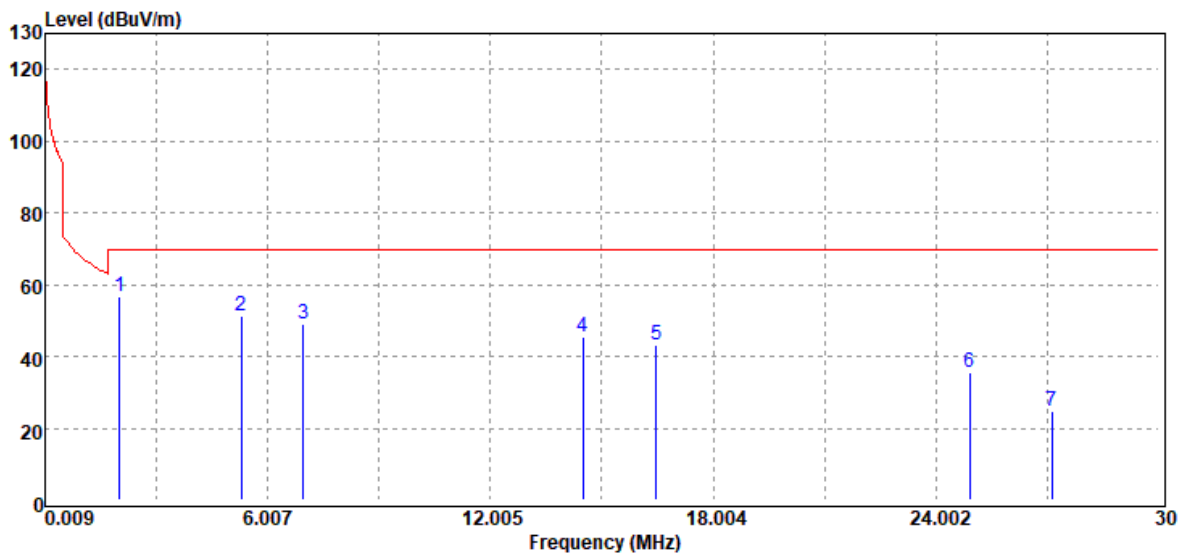
Test Channel :13.56 MHz

Antenna Pol. :VERTICAL

Test Mode :TX

Engineer :Thomas

EUT Pol :H Plane



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2.02         | Peak                         | 45.90                             | 10.84        | 56.74                  | 69.54                  | -12.80       |
| 5.29         | Peak                         | 40.20                             | 11.16        | 51.36                  | 69.54                  | -18.18       |
| 6.97         | Peak                         | 37.63                             | 11.33        | 48.96                  | 69.54                  | -20.58       |
| 14.50        | Peak                         | 34.41                             | 11.19        | 45.60                  | 69.54                  | -23.94       |
| 16.47        | Peak                         | 32.33                             | 11.06        | 43.39                  | 69.54                  | -26.15       |
| 24.90        | Peak                         | 25.86                             | 9.72         | 35.58                  | 69.54                  | -33.96       |
| 27.12        | Peak                         | 15.31                             | 9.27         | 24.58                  | 69.54                  | -44.96       |

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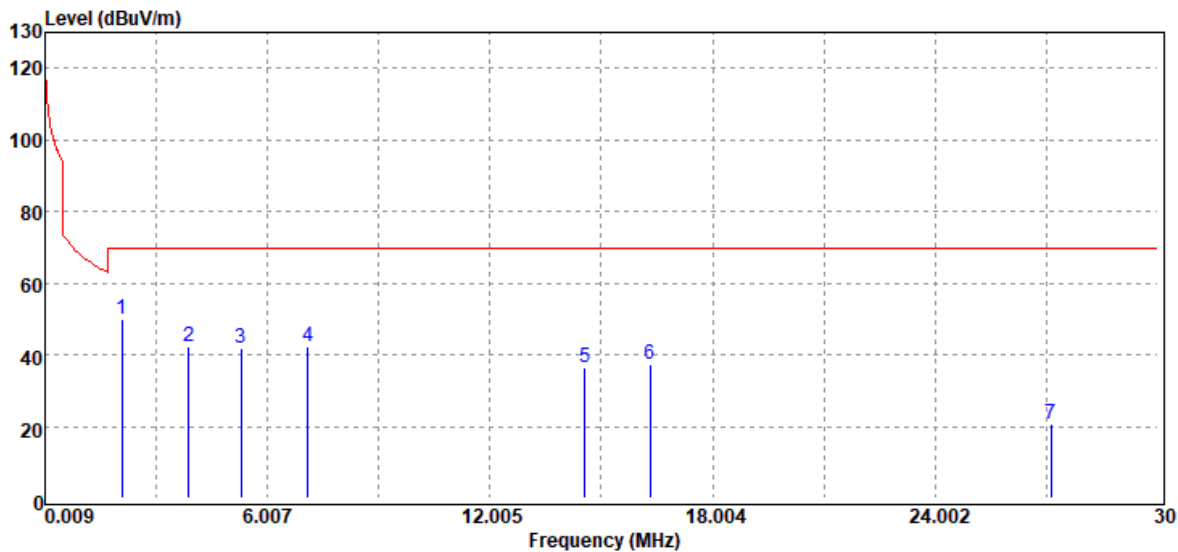
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Report Number :ER/2019/C0156  
Operation Mode :NFC  
Test Channel :13.56 MHz  
Test Mode :TX  
EUT Pol :H Plane

Test Date :2020-01-09  
Temp./Humi. :22.2/55  
Antenna Pol. :HORIZONTAL  
Engineer :Thomas



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2.08         | Peak                         | 39.05                             | 10.84        | 49.89                  | 69.54                  | -19.65       |
| 3.88         | Peak                         | 31.47                             | 10.91        | 42.38                  | 69.54                  | -27.16       |
| 5.29         | Peak                         | 30.76                             | 11.16        | 41.92                  | 69.54                  | -27.62       |
| 7.09         | Peak                         | 30.72                             | 11.34        | 42.06                  | 69.54                  | -27.48       |
| 14.56        | Peak                         | 25.40                             | 11.20        | 36.60                  | 69.54                  | -32.94       |
| 16.32        | Peak                         | 26.33                             | 11.07        | 37.40                  | 69.54                  | -32.14       |
| 27.12        | Peak                         | 11.54                             | 9.27         | 20.81                  | 69.54                  | -48.73       |

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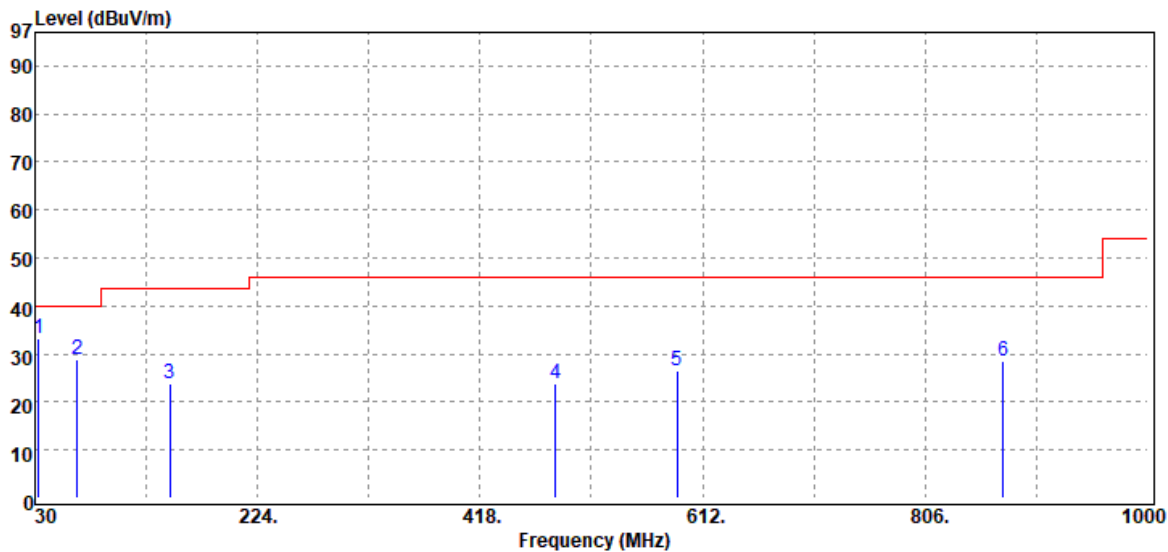
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Report Number :ER/2019/C0156  
Operation Mode :NFC  
Test Channel :13.56 MHz  
Test Mode :TX  
EUT Pol :H Plane

Test Date :2020-01-09  
Temp./Humi. :22.2/55  
Antenna Pol. :VERTICAL  
Engineer :Thomas



| 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 |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 32.91        | QP                           | 39.02                                   | -5.85        | 33.17                        | 40.00                        | -6.83        |
| 66.86        | Peak                         | 46.20                                   | -17.39       | 28.81                        | 40.00                        | -11.19       |
| 147.37       | Peak                         | 35.89                                   | -12.03       | 23.86                        | 43.50                        | -19.64       |
| 483.96       | Peak                         | 29.21                                   | -5.36        | 23.85                        | 46.00                        | -22.15       |
| 589.69       | Peak                         | 30.09                                   | -3.70        | 26.39                        | 46.00                        | -19.61       |
| 873.90       | Peak                         | 27.87                                   | 0.52         | 28.39                        | 46.00                        | -17.61       |

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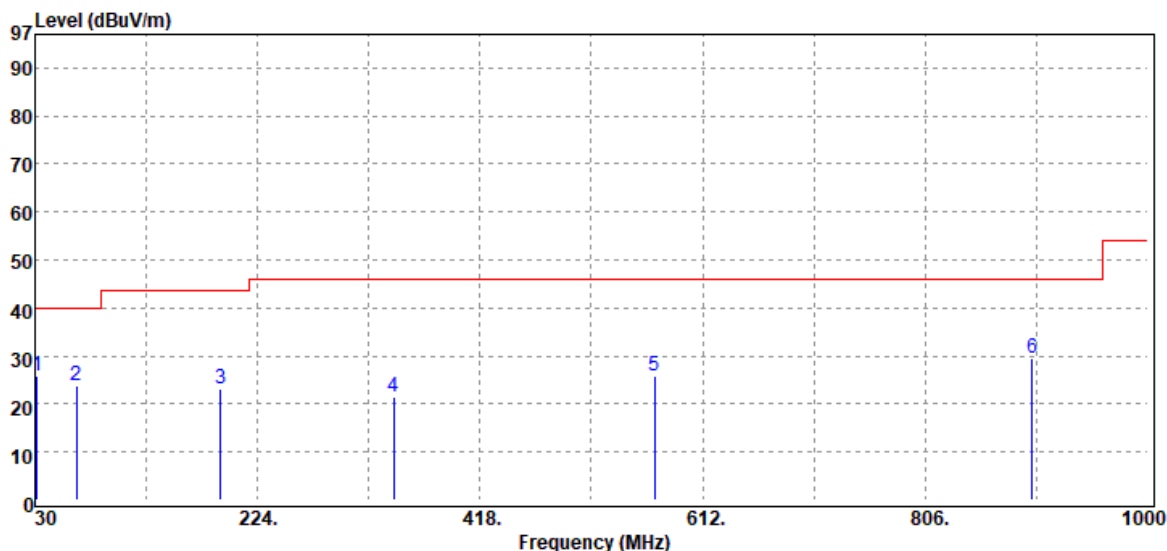
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Report Number :ER/2019/C0156  
Operation Mode :NFC  
Test Channel :13.56 MHz  
Test Mode :TX  
EUT Pol :H Plane

Test Date :2020-01-09  
Temp./Humi. :22.2/55  
Antenna Pol. :HORIZONTAL  
Engineer :Thomas



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 31.94        | Peak                         | 31.00                             | -5.09        | 25.91                  | 40.00                  | -14.09       |
| 65.89        | Peak                         | 41.10                             | -17.42       | 23.68                  | 40.00                  | -16.32       |
| 191.99       | Peak                         | 36.29                             | -13.10       | 23.19                  | 43.50                  | -20.31       |
| 342.34       | Peak                         | 28.79                             | -7.34        | 21.45                  | 46.00                  | -24.55       |
| 570.29       | Peak                         | 29.84                             | -3.93        | 25.91                  | 46.00                  | -20.09       |
| 899.12       | Peak                         | 28.49                             | 1.18         | 29.67                  | 46.00                  | -16.33       |

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## 8 FREQUENCY TOLERANCE

### 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.

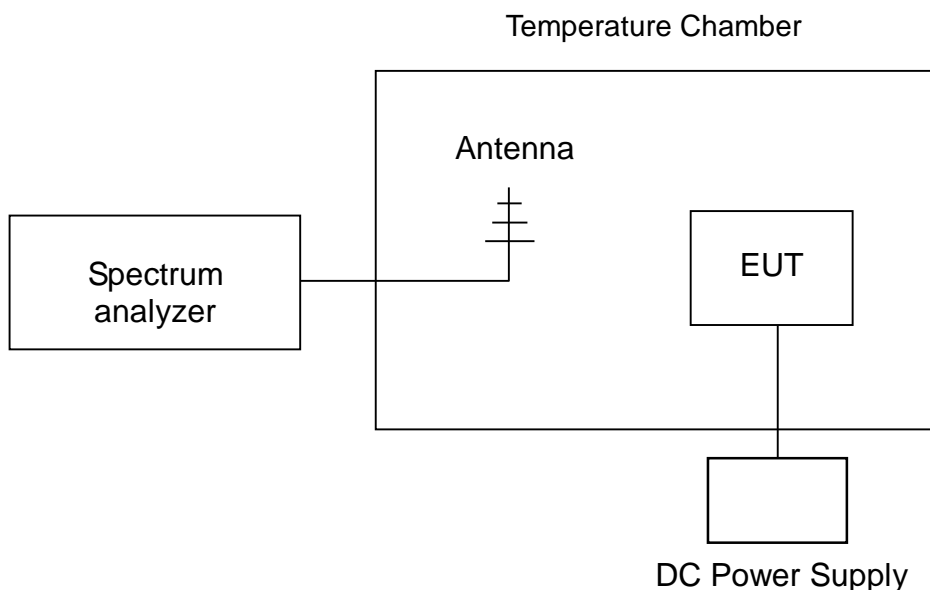
Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  ppm).

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:

| EQUIPMENT TYPE        | MFR          | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------|--------------|--------------|---------------|------------|------------|
| Loop Antenna          | ETS.LINDGREN | 6502         | 148045        | 10/15/2019 | 10/14/2020 |
| EXA Spectrum Analyzer | Agilent      | N9010A       | MY50420195    | 05/02/2019 | 05/01/2020 |
| Temperature Chamber   | TERCHY       | MHG-120LF    | 911009        | 05/17/2019 | 05/16/2020 |

#### 8.5 Measurement Results

##### Startup:

##### Startup

##### A. Temperature Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 3.85         | -20              | 13.5600029 | -0.00780    | +/- 1.356   |
| 3.85         | -10              | 13.5599938 | 0.00130     | +/- 1.356   |
| 3.85         | 0                | 13.5599903 | 0.00480     | +/- 1.356   |
| 3.85         | 10               | 13.5599978 | -0.00270    | +/- 1.356   |
| 3.85         | 20               | 13.5599951 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.5600092 | -0.01410    | +/- 1.356   |
| 3.85         | 40               | 13.5600029 | -0.00780    | +/- 1.356   |
| 3.85         | 50               | 13.5600052 | -0.01010    | +/- 1.356   |

##### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 4            | 20               | 13.5600027 | -0.00760    | +/- 1.356   |
| 3.85         | 20               | 13.5599951 | 0.00000     | +/- 1.356   |
| 3.7          | 20               | 13.5600033 | -0.00820    | +/- 1.356   |

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2 minutes:

### 2 minutes

#### A. Temperature Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 3.85         | -20              | 13.5600023 | -0.00910    | +/- 1.356   |
| 3.85         | -10              | 13.5599983 | -0.00510    | +/- 1.356   |
| 3.85         | 0                | 13.5600031 | -0.00990    | +/- 1.356   |
| 3.85         | 10               | 13.5600086 | -0.01540    | +/- 1.356   |
| 3.85         | 20               | 13.5599932 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.5600037 | -0.01050    | +/- 1.356   |
| 3.85         | 40               | 13.5600044 | -0.01120    | +/- 1.356   |
| 3.85         | 50               | 13.5600085 | -0.01530    | +/- 1.356   |

#### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 4            | 20               | 13.5600056 | -0.01240    | +/- 1.356   |
| 3.85         | 20               | 13.5599932 | 0.00000     | +/- 1.356   |
| 3.7          | 20               | 13.5600083 | -0.01510    | +/- 1.356   |

5 minutes:

### 5 minutes

#### A. Temperature Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 3.85         | -20              | 13.5600035 | -0.00330    | +/- 1.356   |
| 3.85         | -10              | 13.5599931 | 0.00710     | +/- 1.356   |
| 3.85         | 0                | 13.5599996 | 0.00420     | +/- 1.356   |
| 3.85         | 10               | 13.5600004 | -0.00020    | +/- 1.356   |
| 3.85         | 20               | 13.5600002 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.5600091 | -0.00890    | +/- 1.356   |
| 3.85         | 40               | 13.5599928 | 0.00740     | +/- 1.356   |
| 3.85         | 50               | 13.560008  | -0.00780    | +/- 1.356   |

#### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 4            | 20               | 13.5599994 | 0.00080     | +/- 1.356   |
| 3.85         | 20               | 13.5600002 | 0.00000     | +/- 1.356   |
| 3.7          | 20               | 13.5599951 | 0.00510     | +/- 1.356   |

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10 minutes:

### 10 minutes

#### A. Temperature Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 3.85         | -20              | 13.5599933 | -0.00180    | +/- 1.356   |
| 3.85         | -10              | 13.5599979 | -0.00640    | +/- 1.356   |
| 3.85         | 0                | 13.5599991 | -0.00760    | +/- 1.356   |
| 3.85         | 10               | 13.5599912 | 0.00030     | +/- 1.356   |
| 3.85         | 20               | 13.5599915 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.5599904 | 0.00110     | +/- 1.356   |
| 3.85         | 40               | 13.5599987 | -0.00720    | +/- 1.356   |
| 3.85         | 50               | 13.5599972 | -0.00570    | +/- 1.356   |

#### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency  | Delta (KHz) | Limit (KHz) |
|--------------|------------------|------------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)      |             |             |
| 4            | 20               | 13.5599994 | -0.00250    | +/- 1.356   |
| 3.85         | 20               | 13.5599915 | 0.00000     | +/- 1.356   |
| 3.7          | 20               | 13.5599981 | -0.00660    | +/- 1.356   |

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## 9 20 dB OCCUPIED BANDWIDTH MEASUREMENT

### 9.1 Applicable Standard:

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

### 9.2 Limit:

None

### 9.3 Test Set-up

Refer to section 8.3 in this report.

### 9.4 Measurement Procedure

1. Placed the EUT on the testing table.
2. Set the EUT under transmission condition continuously at specific channel frequency.
3. The resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
4. Measured the spectrum width with power higher than 20dB below carrier.

### 9.5 Measurement Equipment Used:

Refer to section 8.4 in this report.

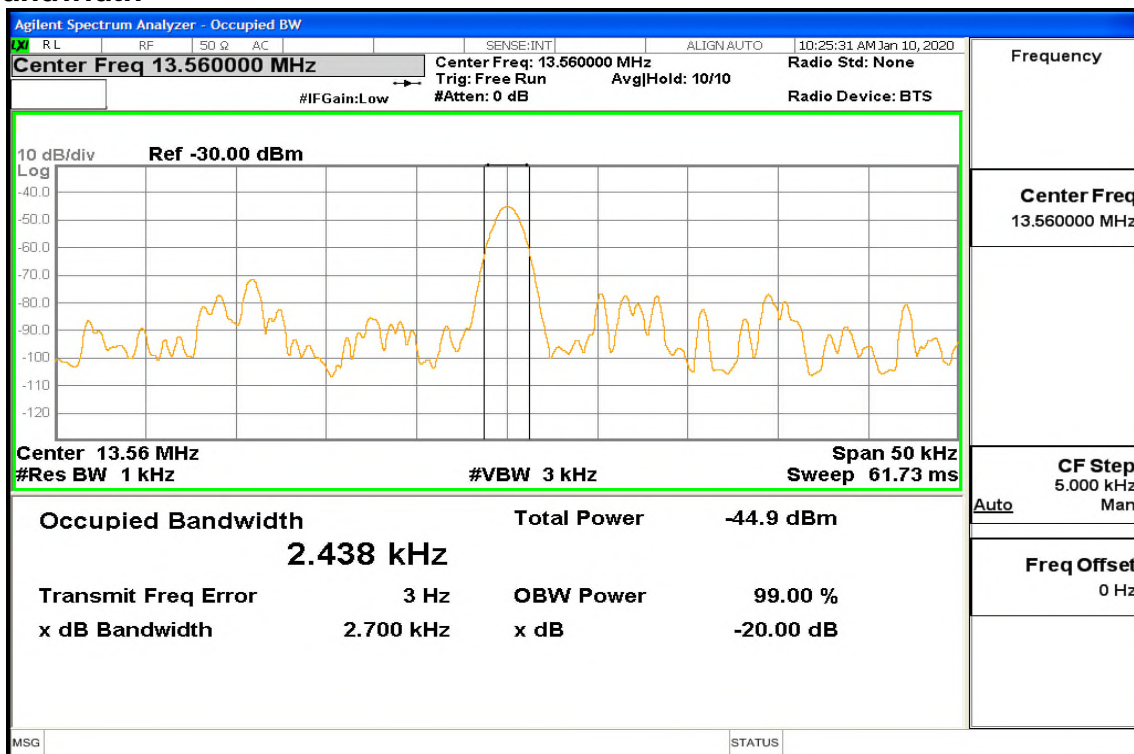
### 9.6 Measurement Result

FCC

| 20dB BW (kHz) |
|---------------|
| 2.7           |

| Operation range | Frequency (MHz) | Limit (MHz) |
|-----------------|-----------------|-------------|
| Low             | 13.55870        | >13.11      |
| High            | 13.56120        | <14.01      |

### -20dB Bandwidth



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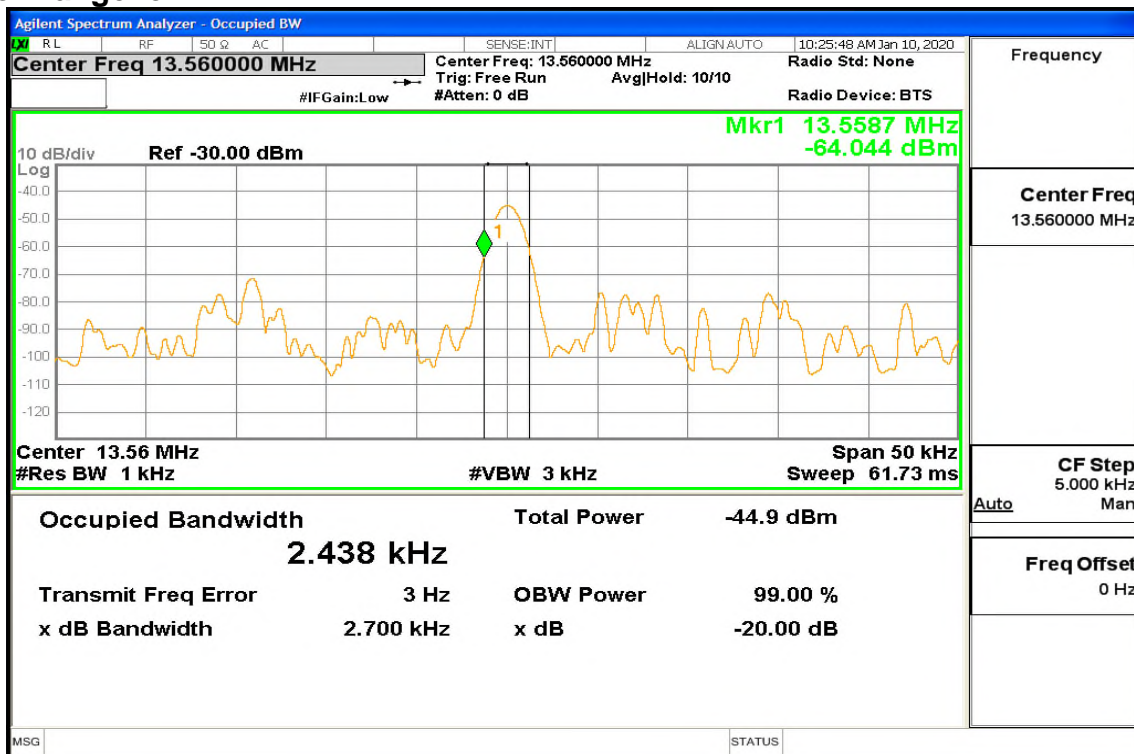
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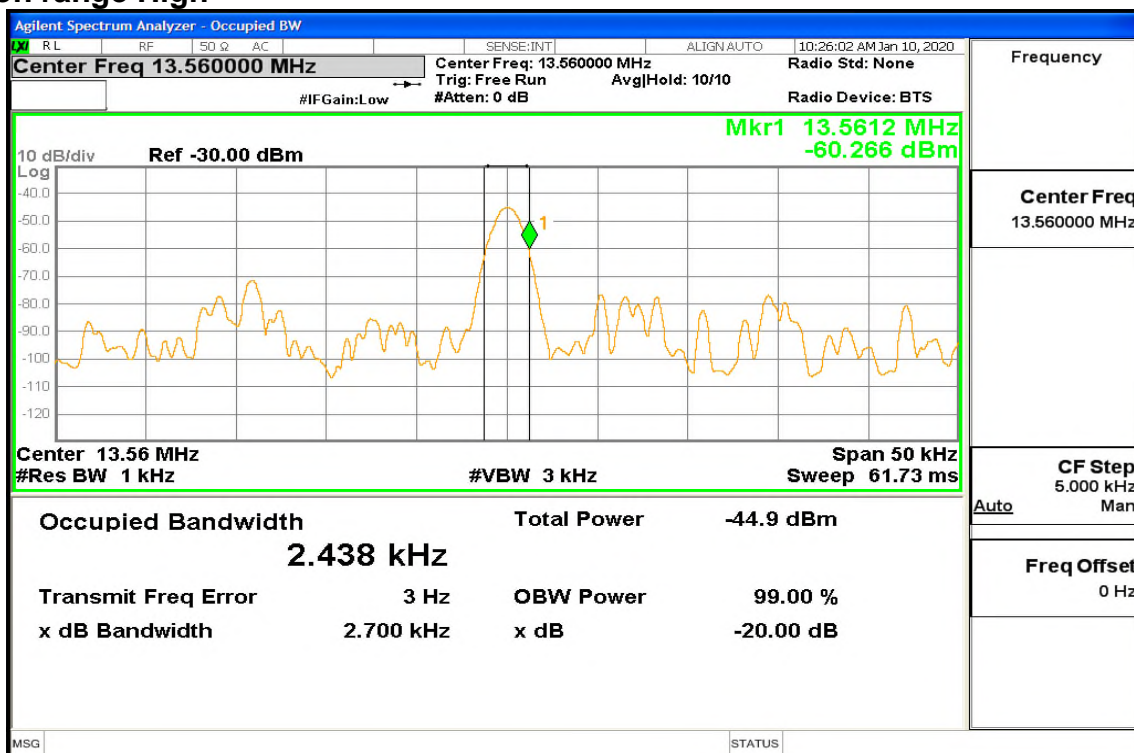
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## Operation range low



## 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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