

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

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

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

**Product Name:** Smart Phone

**Report Number:** ER/2018/90109

**FCC ID:** APYHRO00263

**FCC Rule Part** Part 15.225

**Issue Date:** Oct. 17, 2018

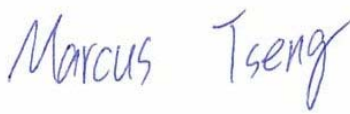
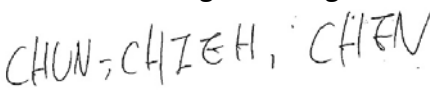
**Date of Test:** Sep. 04, 2018 ~ Oct. 11, 2018

**Date of EUT Received:** Sep. 04, 2018

**We hereby certify that:**

The above equipment was tested by SGS Taiwan Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.225.

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

**Tested By:**  
Marcus Tseng / Sr. Engineer**Approved By:**  
Chun Chieh Chen / Asst. Supervisor

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## Revision History

| Report Number | Revision | Description                  | Effected Page | Issue Date    | Revised By    |
|---------------|----------|------------------------------|---------------|---------------|---------------|
| ER/2018/90109 | Rev.00   | Initial creation of document | All           | Oct. 17, 2018 | Violetta Tang |

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# 1 GENERAL INFORMATION

## 1.1 Product Description

General:

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

NFC:

|                     |                    |
|---------------------|--------------------|
| Operating Frequency | 13.56MHz           |
| Transmit Power      | < 123dBuV/m at 3m. |
| Number of Channels  | 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 Registration Number and Designation number are: 509634 / TW0001

## 1.4 Special Accessories

There is no special accessory used while test was conducted.

## 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.

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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 turn table which is 0.8m 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 §15.107. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table. 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 above the reference ground plane. 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 Limitation

### (1) Conducted Emission

According to section 15.207(a) Conducted Emission Limits is as following.

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

### (2) Radiated Emission

- The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- 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<br>(MHz) | Field strength<br>$\mu\text{V/m}$ | Distance (m) | Field strength at 3m<br>$\text{dB}\mu\text{V/m}$ |
|--------------------|-----------------------------------|--------------|--------------------------------------------------|
| 1.705-30           | 30                                | 30           | 69.54                                            |
| 30-88              | 100                               | 3            | 40                                               |
| 88-216             | 150                               | 3            | 43.5                                             |
| 216-960            | 200                               | 3            | 46                                               |
| Above 960          | 500                               | 3            | 54                                               |

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- Remark 1. Emission level in dBuV/m= $20 \log (\mu\text{V}/\text{m})$   
: 2. Measurement was performed at an antenna to the closed point of EUT distance of     meters.  
3. Distance extrapolation factor =  $40 \log (\text{required distance}/ \text{test distance})$  (dB);  
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.  
Ex. $20 \cdot \log(30)+40 \cdot \log(30/3) = 69.54\text{dBuV}/\text{m}$   
5. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205.  
6. 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.

### (3) Frequency Tolerance

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.

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## 2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 AC Power Line Conducted Emission



Table 2-1 Equipment Used in Tested System

| Item | Equipment         | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|------|-------------------|-----------|----------------|------------|------------|------------|
| 1.   | NFC Test software | Tera Term | N/A            | N/A        | N/A        | N/A        |
| 2.   | Notebook          | Lenovo    | T440P          | P0000564   | Shielded   | Unshielded |

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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 |

### 4 DESCRIPTION OF TEST MODES

The EUT stay in continuous transmitting mode. The frequency 13.56MHz is the default channel to test, where it is the only manipulative channel as this application supports.

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

The data rate as the lowest supported is selected while tests are conducted.

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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 | 9kHz - 30MHz: +/- 2.3dB |
|-------------------------|-------------------------|

|                                                              |                            |
|--------------------------------------------------------------|----------------------------|
| Measurement uncertainty<br>(Polarization : <b>Vertical</b> ) | 30MHz - 180MHz: +/- 3.37dB |
|                                                              | 180MHz -417MHz: +/- 3.19dB |
|                                                              | 0.417GHz-1GHz: +/- 3.19dB  |

|                                                                |                            |
|----------------------------------------------------------------|----------------------------|
| Measurement uncertainty<br>(Polarization : <b>Horizontal</b> ) | 30MHz - 167MHz: +/- 4.22dB |
|                                                                | 167MHz -500MHz: +/- 3.44dB |
|                                                                | 0.5GHz-1GHz: +/- 3.39dB    |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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## 6 CONDUCTED 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(uV) |          |
|------------------------|------------------|----------|
|                        | Quasi-peak       | Average  |
| 0.15 to 0.50           | 66 to 56         | 56 to 46 |
| 0.50 to 5              | 56               | 46       |
| 5 to 30                | 60               | 50       |

Note

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

### 6.2 Measurement Equipment Used:

| EQUIPMENT<br>TYPE | MFR         | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |
|-------------------|-------------|-----------------|------------------|--------------|------------|
| EMI Test Receiver | R&S         | ESCI7           | 100335           | 02/02/2018   | 02/01/2019 |
| LISN              | SCHWARZBECK | NSLK 8127       | 8127-649         | 05/18/2018   | 05/17/2019 |

### 6.3 EUT Setup:

- The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
- The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- The LISN was connected with 120Vac/60Hz power source.

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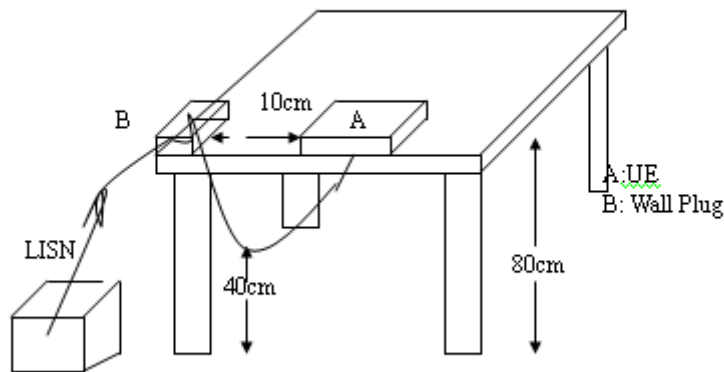
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## 6.4 Test SET-UP (Block Diagram of Configuration)



## 6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plan.
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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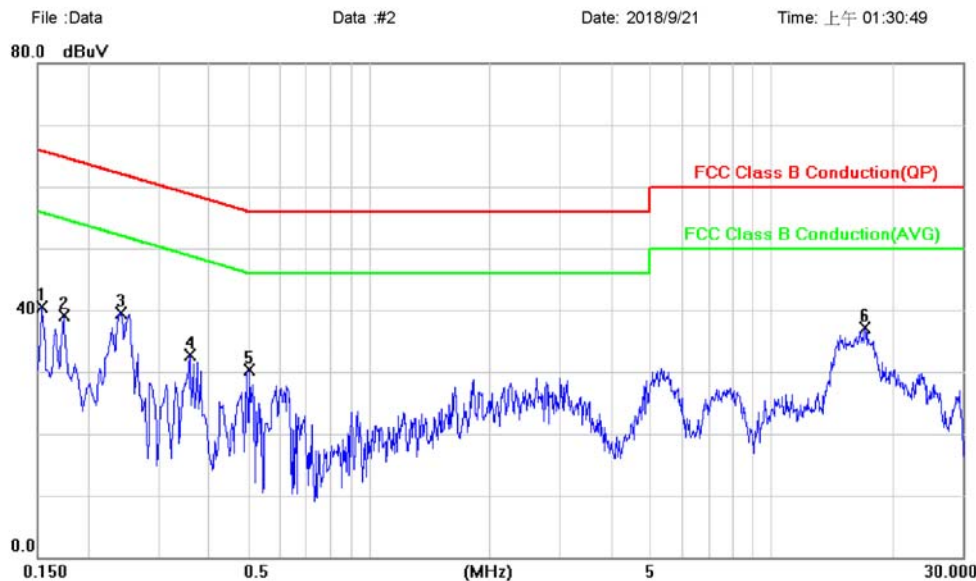
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## AC POWER LINE CONDUCTED EMISSION TEST DATA

Site: Conduction Room Phase: **L1** Temperature: 25 °C  
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 85 %  
Mode: Operation  
Note:

### Conducted Emission



| No. | Mk. | Freq.   | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|-----|-----|---------|---------------|----------------|-------------|-------|--------|----------|---------|
|     |     | MHz     | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1   |     | 0.1540  | 40.41         | 0.04           | 40.45       | 65.78 | -25.33 | peak     |         |
| 2   |     | 0.1740  | 39.09         | 0.04           | 39.13       | 64.77 | -25.64 | peak     |         |
| 3   | *   | 0.2420  | 39.53         | 0.04           | 39.57       | 62.03 | -22.46 | peak     |         |
| 4   |     | 0.3580  | 32.71         | 0.04           | 32.75       | 58.77 | -26.02 | peak     |         |
| 5   |     | 0.5060  | 30.23         | 0.04           | 30.27       | 56.00 | -25.73 | peak     |         |
| 6   |     | 17.1940 | 36.70         | 0.39           | 37.09       | 60.00 | -22.91 | peak     |         |

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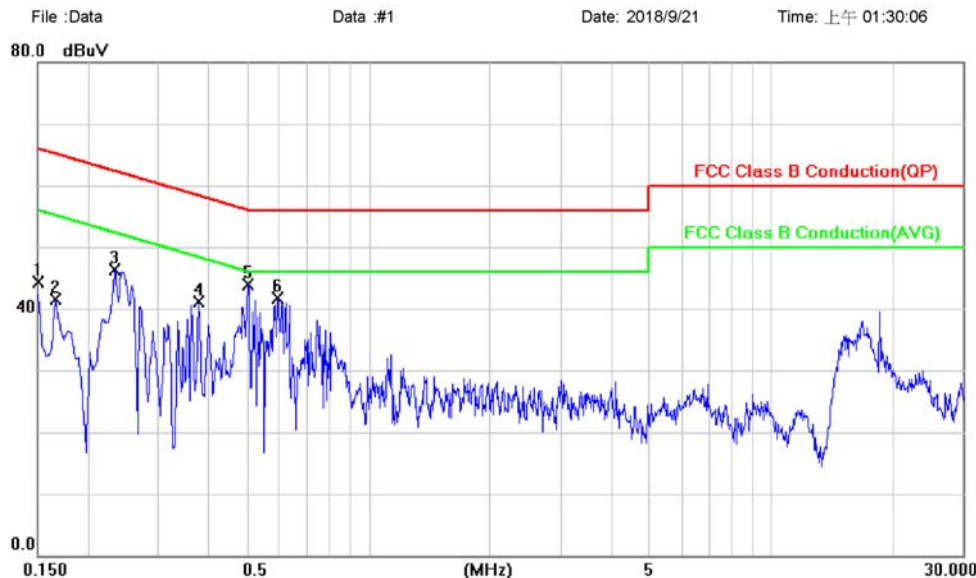
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|                                   |                     |                    |
|-----------------------------------|---------------------|--------------------|
| Site: Conduction Room             | Phase: <b>N</b>     | Temperature: 25 °C |
| Limit: FCC Class B Conduction(QP) | Power: AC 120V/60Hz | Humidity: 85 %     |
| Mode: Operation                   |                     |                    |
| Note:                             |                     |                    |

### Conducted Emission



| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|-----|-----|--------|---------------|----------------|-------------|-------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1   |     | 0.1500 | 44.36         | 0.04           | 44.40       | 66.00 | -21.60 | peak     |         |
| 2   |     | 0.1660 | 41.48         | 0.04           | 41.52       | 65.16 | -23.64 | peak     |         |
| 3   |     | 0.2340 | 46.29         | 0.04           | 46.33       | 62.31 | -15.98 | peak     |         |
| 4   |     | 0.3780 | 40.97         | 0.04           | 41.01       | 58.32 | -17.31 | peak     |         |
| 5 * |     | 0.5020 | 43.96         | 0.04           | 44.00       | 56.00 | -12.00 | peak     |         |
| 6   |     | 0.5940 | 41.66         | 0.04           | 41.70       | 56.00 | -14.30 | peak     |         |

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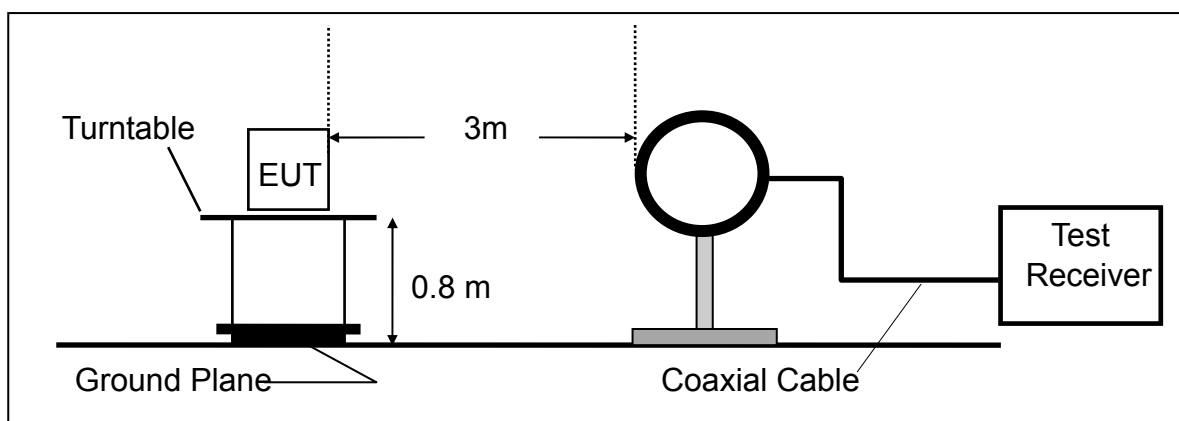
## 7 RADIATED EMISSION TEST

### 7.1 Measurement Procedure

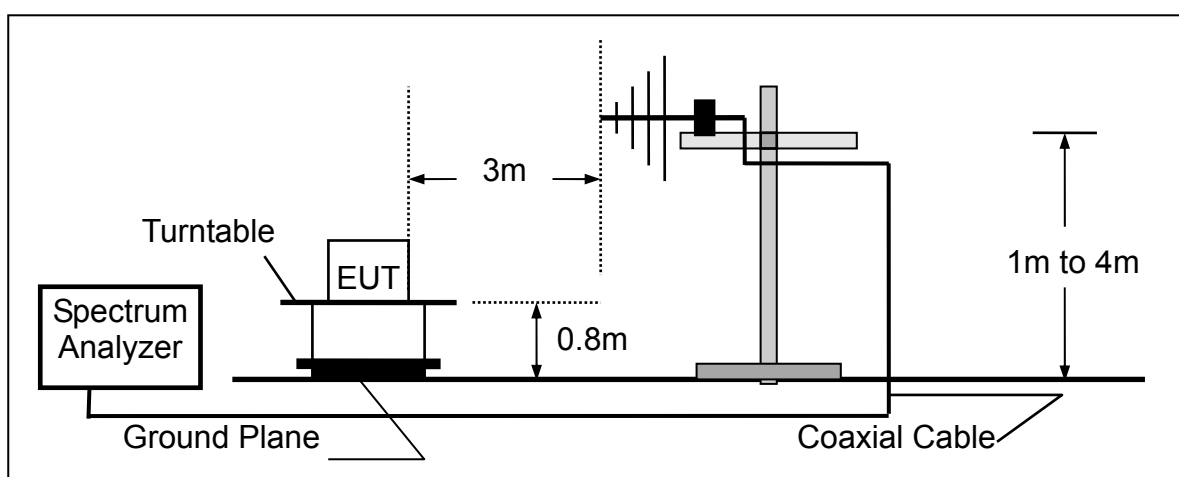
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

### 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        | SCHWAZBECK      | VULB9168     | 378           | 12/29/2017 | 12/28/2018 |
| Horn Antenna          | Schwarzbeck     | BBHA9120D    | 1441          | 08/16/2018 | 08/15/2019 |
| Horn Antenna          | Schwarzbeck     | BBHA9170     | 184           | 12/12/2017 | 12/11/2018 |
| Loop Antenna          | ETS.LINDGREN    | 6502         | 148045        | 09/26/2017 | 09/25/2018 |
| 3m Site NSA           | SGS             | 966 chamber  | N/A           | 01/02/2018 | 01/01/2019 |
| Spectrum Analyzer     | Agilent         | E4446A       | MY51100003    | 05/15/2018 | 05/14/2019 |
| EMI Test Receiver     | R&S             | ESCI7        | 100335        | 02/02/2018 | 02/01/2019 |
| Pre-Amplifier         | HP              | 8449B        | 3008A00578    | 01/02/2018 | 01/01/2019 |
| Pre-Amplifier         | HP              | 8447D        | 2944A07676    | 01/02/2018 | 01/01/2019 |
| Pre-Amplifier         | EMC Instruments | EMC184045B   | 980135        | 10/27/2017 | 10/26/2018 |
| Attenuator            | Mini-Circuit    | BW-S10W2+    | 2             | 01/02/2018 | 01/01/2019 |
| 2GHz High Pass Filter | Micro-Tronics   | HPM50110     | 36            | 01/02/2018 | 01/01/2019 |
| Filter 5150-5350 MHz  | Micro-Tronics   | BRM50703     | 1             | 01/02/2018 | 01/01/2019 |
| Low Loss Cable        | Huber Suhner    | 966_RX       | 9             | 01/02/2018 | 01/01/2019 |

### 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 Limit

Field strength of fundamental emissions limit:

The field strength of fundamental emissions shall not exceed 15848 micorvolts/meter at 30 meters. The Limit is converted to 123.90dBuV/m by offsetting the distance extrapolation factor as measurement distance is taken place at 3 meters.

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

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

Note:

$$\text{Actual FS(dB}\mu\text{V/m)} = \text{Spectrum. Reading level(dB}\mu\text{V)} + \text{Factor(dB)}$$

$$\text{Factor(dB)} = \text{Antenna Factor(dB}\mu\text{V/m)} + \text{Cable Loss(dB)} - \text{Pre\_Amplifier Gain(dB)}$$

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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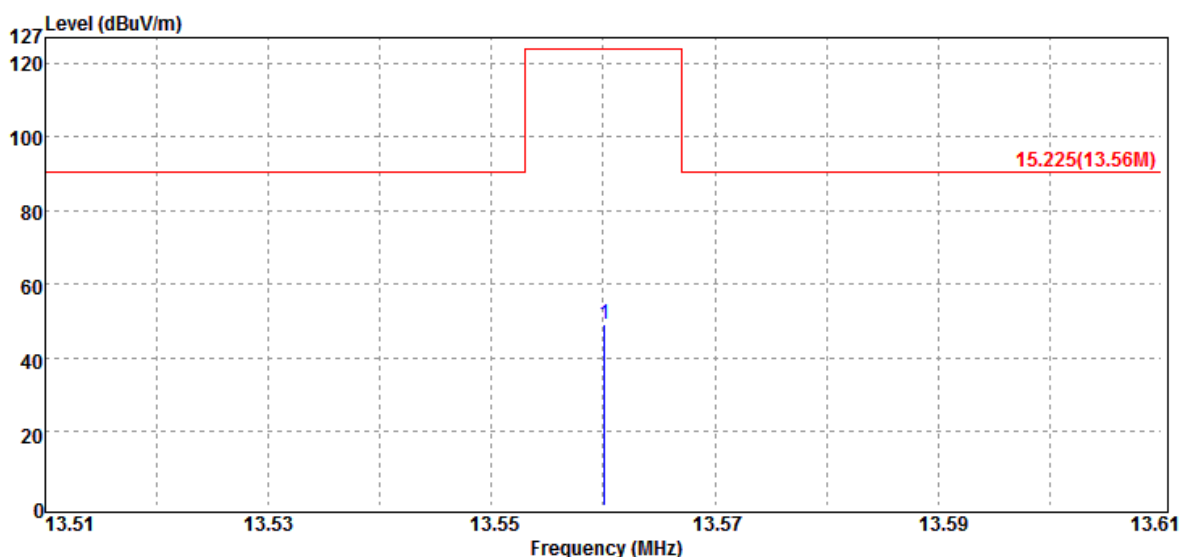
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## 7.5.2 Field Strength of Fundamental Emission Measurement Result

|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :NFC       | Test Date                | :2018-09-14       |
| Fundamental Frequency | :13.56 MHz | Temp./Humi.              | :21 deg_C / 62 RH |
| Operation Mode        | :MAIN      | Engineer                 | :Tin              |
| EUT Pol.              | :H Plane   | Measurement Antenna Pol. | :VERTICAL         |



| Freq. | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|-------|----------|---------------|--------|--------|--------|--------|
| MHz   | Mode     | Reading Level |        | FS     | @3m    |        |
|       | PK/QP/AV | dBuV          | dB     | dBuV/m | dBuV/m | dB     |
| 13.56 | Peak     | 37.77         | 11.52  | 49.29  | 123.90 | -74.61 |

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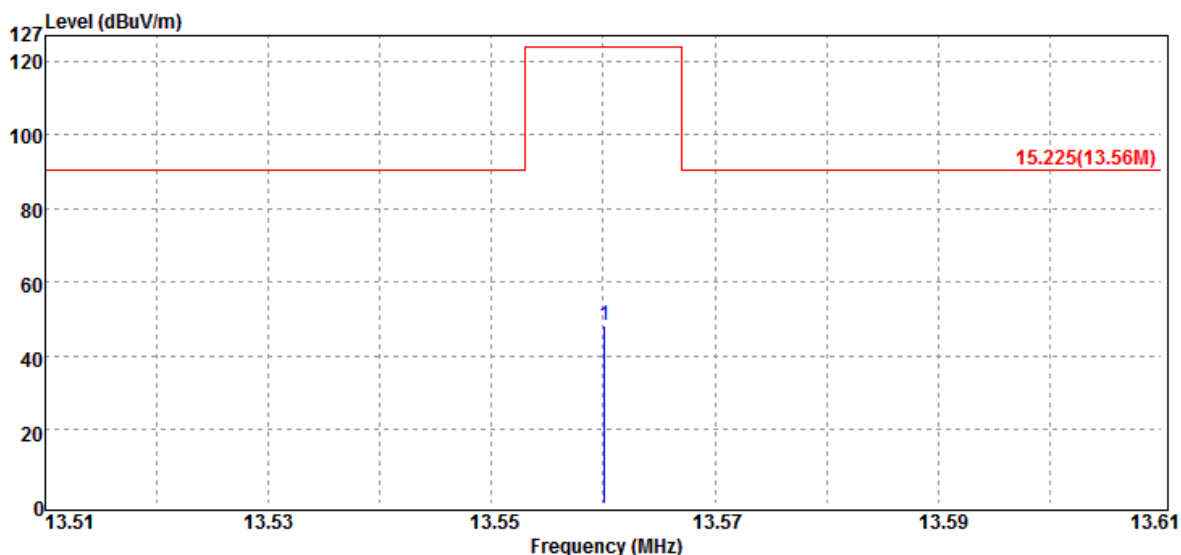
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :MAIN  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.56        | Peak                         | 36.83                             | 11.52        | 48.35                  | 123.90                 | -75.55       |

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### 7.5.3 Radiated Mask

- (a) 15.848 millivolts/m (84 dB $\mu$ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB $\mu$ 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 $\mu$ V/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.

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

Limit is re-adjusted in terms of limit taken in 3m for the following frequency segment of the interest:

- a)  $20 \cdot \log(15848 \mu\text{V/m}) + 40 \text{ dB} = 124.00 \text{ dB}\mu\text{V/m}$
- b)  $20 \cdot \log(334 \mu\text{V/m}) + 40 \text{ dB} = 90.47 \text{ dB}\mu\text{V/m}$
- c)  $20 \cdot \log(106 \mu\text{V/m}) + 40 \text{ dB} = 80.50 \text{ dB}\mu\text{V/m}$

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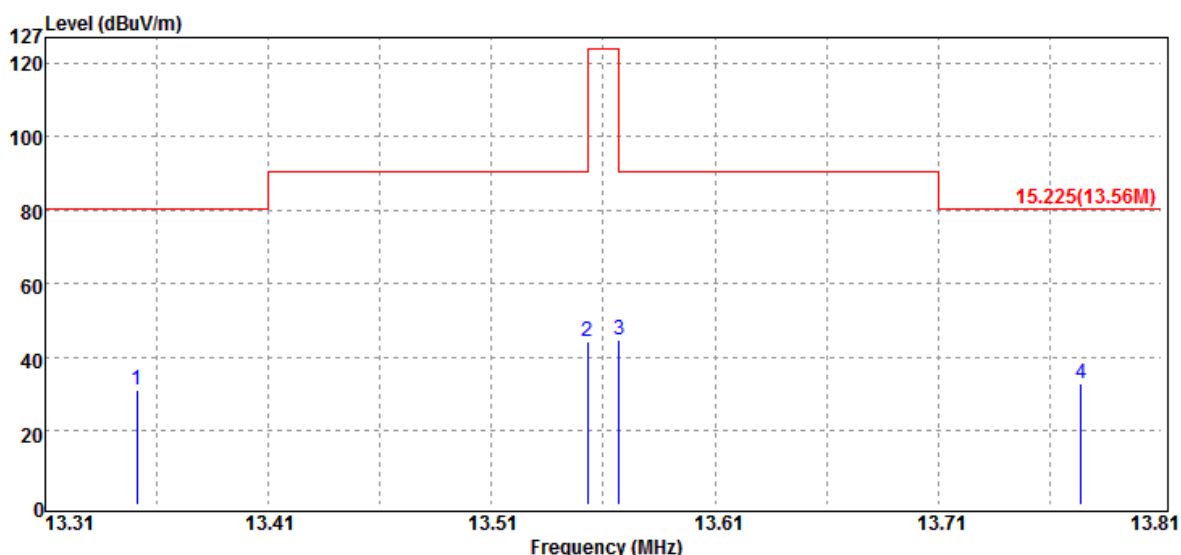
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :MASK  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :VERTICAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.35        | Peak                         | 19.54                             | 11.52        | 31.06                  | 80.50                  | -49.44       |
| 13.55        | Peak                         | 32.73                             | 11.52        | 44.25                  | 90.47                  | -46.22       |
| 13.57        | Peak                         | 33.30                             | 11.52        | 44.82                  | 90.47                  | -45.65       |
| 13.77        | Peak                         | 21.47                             | 11.53        | 33.00                  | 80.50                  | -47.50       |

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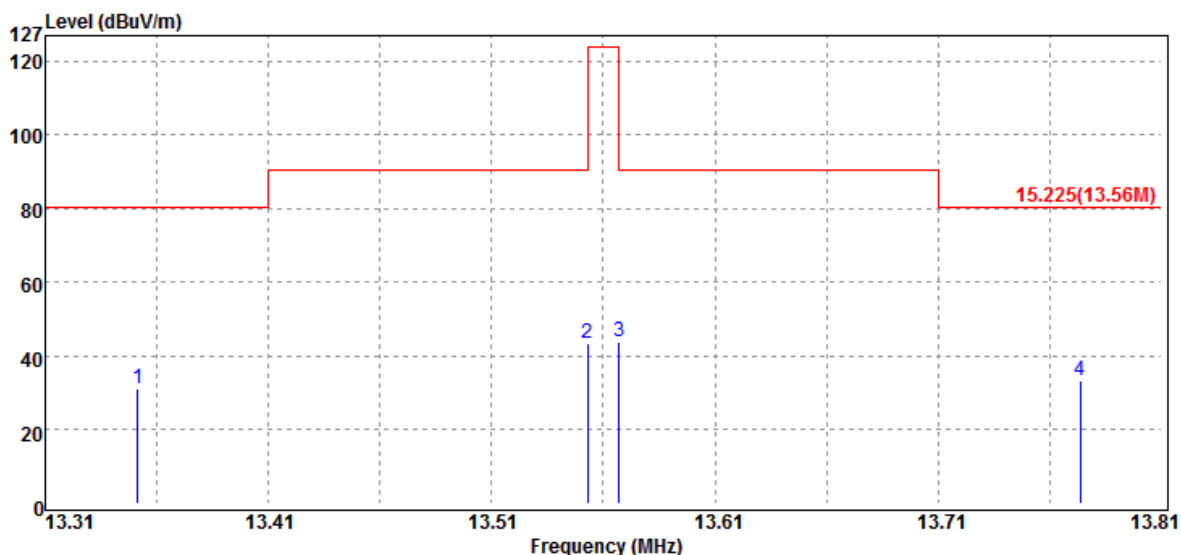
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :MASK  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.35        | Peak                         | 19.73                             | 11.52        | 31.25                  | 80.50                  | -49.25       |
| 13.55        | Peak                         | 31.91                             | 11.52        | 43.43                  | 90.47                  | -47.04       |
| 13.57        | Peak                         | 32.58                             | 11.52        | 44.10                  | 90.47                  | -46.37       |
| 13.77        | Peak                         | 21.91                             | 11.53        | 33.44                  | 80.50                  | -47.06       |

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#### 7.5.4 Radiated Emission –

Limit:

§15.225

(d) 30 microvolts/m (29.4 dBμV/m) at 30 m, outside the band 13.110-14.010 MHz.

Limit is converted by adding the distance extrapolation factor as the measurement distance was taken place at 3m.

§RSS-210 A2.6

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

$$a) 20 \cdot \log(30 \mu\text{V/m}) + 40\text{dB} = 69.54 \text{ dB}\mu\text{V/m}$$

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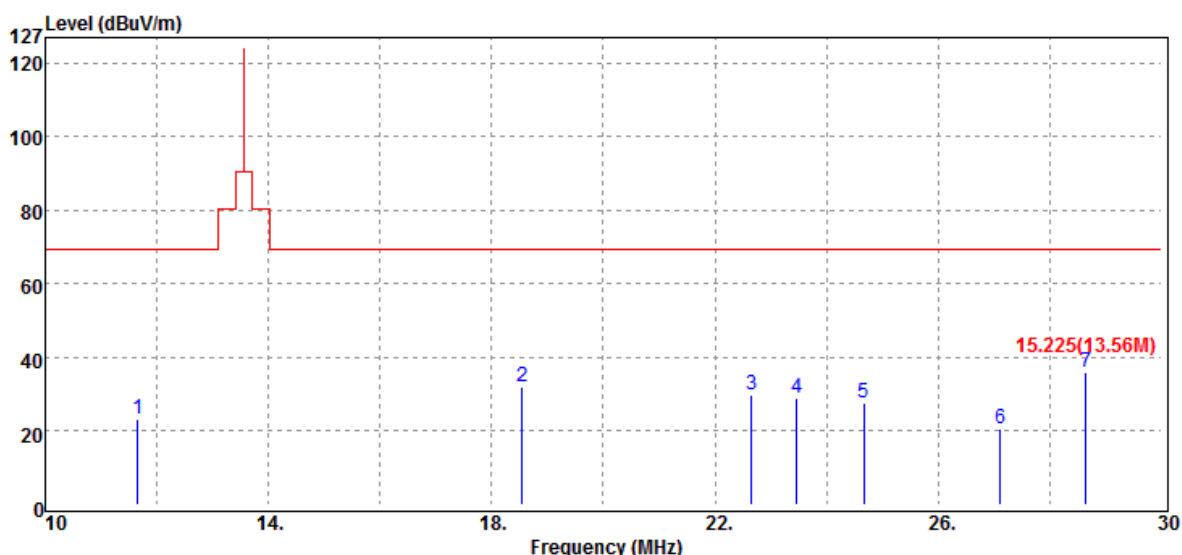
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :Tx  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :VERTICAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 11.66        | Peak                         | 11.95                             | 11.47        | 23.42                  | 69.54                  | -46.12       |
| 18.54        | Peak                         | 20.33                             | 11.64        | 31.97                  | 69.54                  | -37.57       |
| 22.66        | Peak                         | 18.91                             | 10.95        | 29.86                  | 69.54                  | -39.68       |
| 23.46        | Peak                         | 18.33                             | 10.75        | 29.08                  | 69.54                  | -40.46       |
| 24.66        | Peak                         | 17.13                             | 10.47        | 27.60                  | 69.54                  | -41.94       |
| 27.12        | Peak                         | 10.93                             | 9.94         | 20.87                  | 69.54                  | -48.67       |
| 28.64        | Peak                         | 26.41                             | 9.62         | 36.03                  | 69.54                  | -33.51       |

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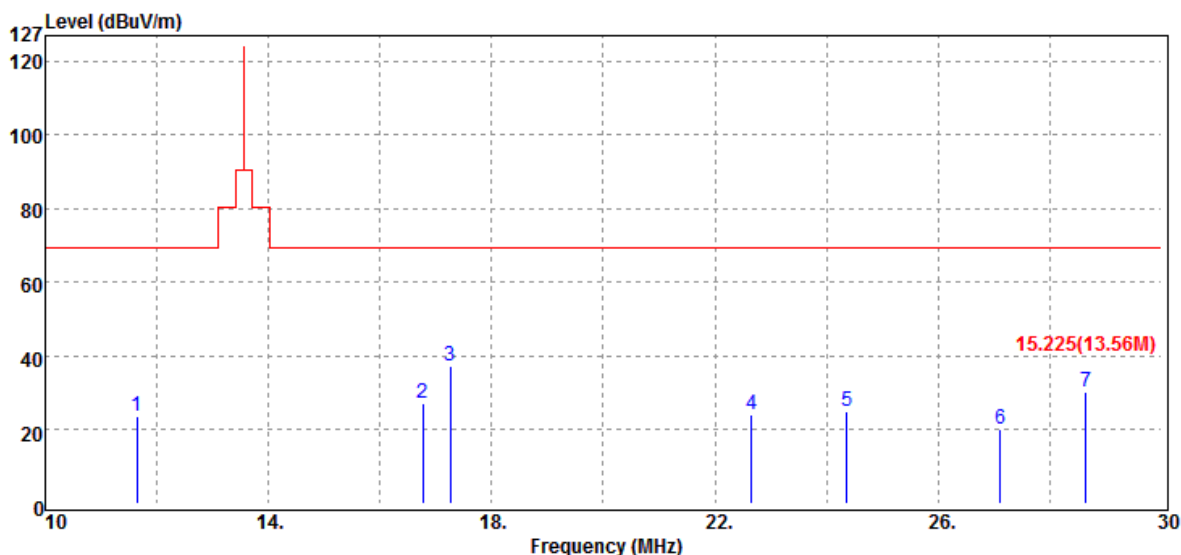
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :Tx  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 11.64        | Peak                         | 12.44                             | 11.47        | 23.91                  | 69.54                  | -45.63       |
| 16.76        | Peak                         | 15.55                             | 11.59        | 27.14                  | 69.54                  | -42.40       |
| 17.26        | Peak                         | 25.81                             | 11.61        | 37.42                  | 69.54                  | -32.12       |
| 22.66        | Peak                         | 13.16                             | 10.95        | 24.11                  | 69.54                  | -45.43       |
| 24.36        | Peak                         | 14.63                             | 10.54        | 25.17                  | 69.54                  | -44.37       |
| 27.12        | Peak                         | 10.42                             | 9.94         | 20.36                  | 69.54                  | -49.18       |
| 28.64        | Peak                         | 20.79                             | 9.62         | 30.41                  | 69.54                  | -39.13       |

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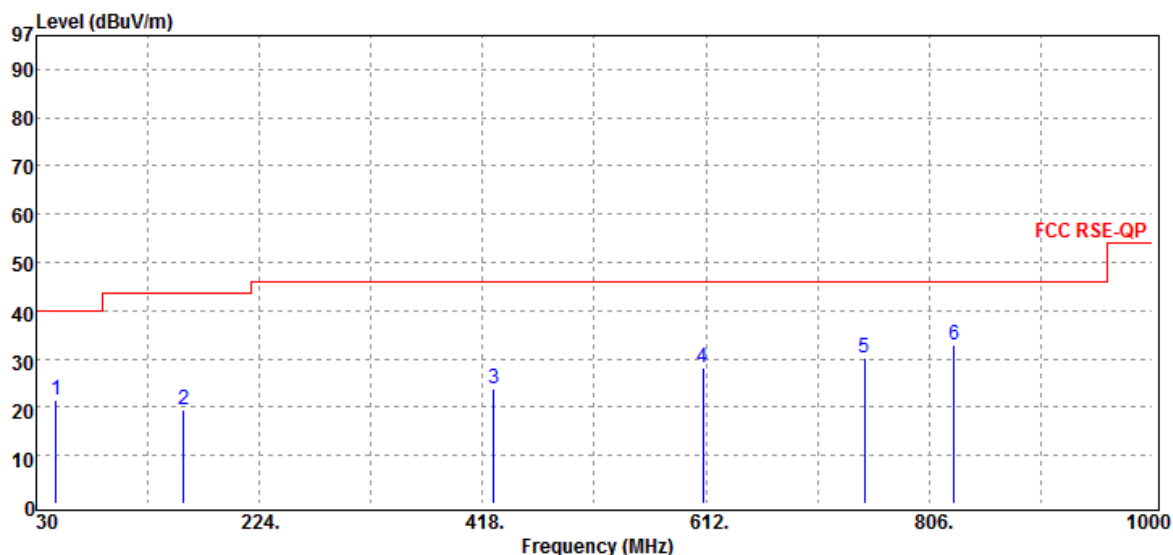
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :Tx  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :VERTICAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 47.46        | Peak                         | 29.10                             | -7.64        | 21.46                  | 40.00                  | -18.54       |
| 158.04       | Peak                         | 26.58                             | -7.17        | 19.41                  | 43.50                  | -24.09       |
| 427.70       | Peak                         | 26.67                             | -2.88        | 23.79                  | 46.00                  | -22.21       |
| 609.09       | Peak                         | 28.43                             | -0.11        | 28.32                  | 46.00                  | -17.68       |
| 749.74       | Peak                         | 27.02                             | 3.29         | 30.31                  | 46.00                  | -15.69       |
| 827.34       | Peak                         | 28.57                             | 4.17         | 32.74                  | 46.00                  | -13.26       |

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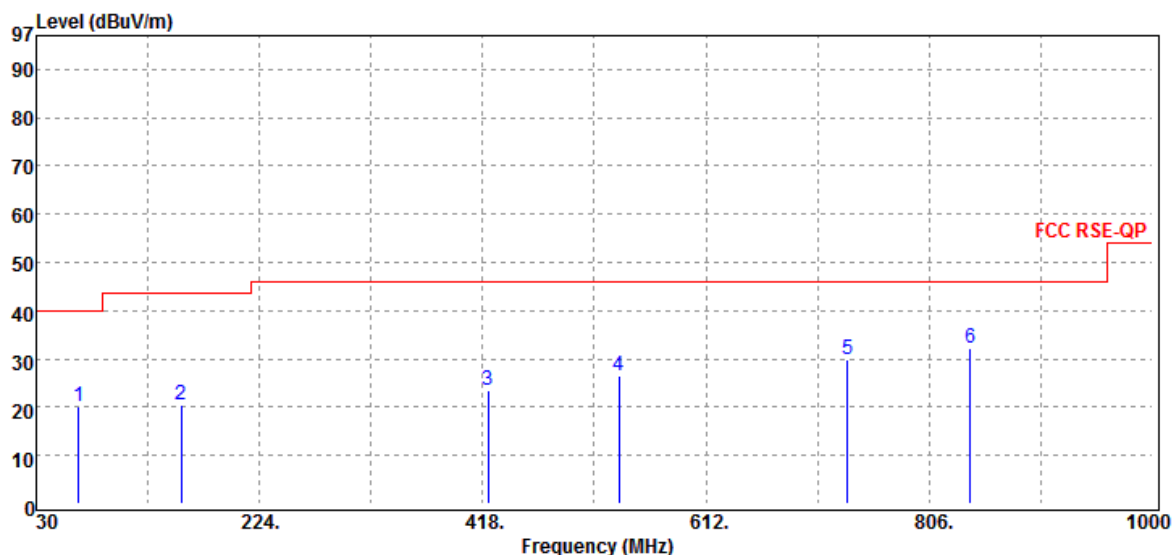
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :Tx  
EUT Pol. :H Plane

Test Date :2018-09-14  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| 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 |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 66.86        | Peak                         | 29.43                             | -9.42        | 20.01                  | 40.00                  | -19.99       |
| 156.10       | Peak                         | 27.64                             | -7.24        | 20.40                  | 43.50                  | -23.10       |
| 422.85       | Peak                         | 26.43                             | -2.99        | 23.44                  | 46.00                  | -22.56       |
| 536.34       | Peak                         | 28.45                             | -1.83        | 26.62                  | 46.00                  | -19.38       |
| 735.19       | Peak                         | 26.66                             | 3.19         | 29.85                  | 46.00                  | -16.15       |
| 841.89       | Peak                         | 27.05                             | 5.16         | 32.21                  | 46.00                  | -13.79       |

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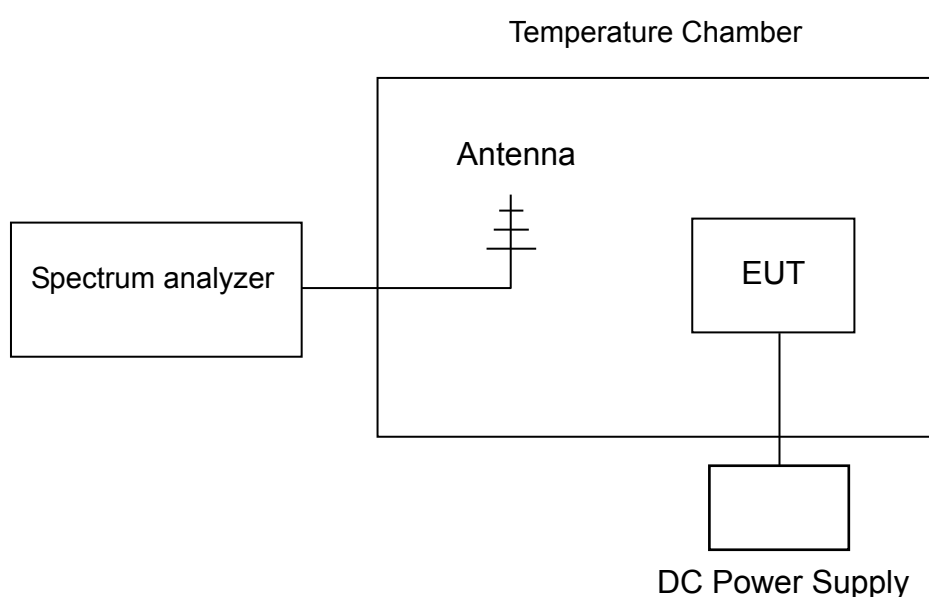
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## 8 FREQUENCY TOLERANCE

### 8.1 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.

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



### 8.3 Measurement Equipment Used:

| EQUIPMENT TYPE        | MFR          | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------|--------------|--------------|---------------|------------|------------|
| Loop Antenna          | ETS.LINDGREN | 6502         | 148045        | 09/26/2017 | 09/25/2018 |
| EXA Spectrum Analyzer | Agilent      | N9010A       | MY57120290    | 02/14/2018 | 02/13/2019 |
| Coaxial Cables        | N/A          | WK CE Cable  | N/A           | 01/02/2018 | 01/01/2019 |

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## 8.4 Measurement Results

### Startup:

#### A. Temperature Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 3.85         | -20              | 13.560007 | -0.00510    | +/- 1.356   |
| 3.85         | -10              | 13.560007 | -0.00430    | +/- 1.356   |
| 3.85         | 0                | 13.559997 | 0.00510     | +/- 1.356   |
| 3.85         | 10               | 13.559999 | 0.00330     | +/- 1.356   |
| 3.85         | 20               | 13.560002 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.559998 | 0.00400     | +/- 1.356   |
| 3.85         | 40               | 13.560004 | -0.00140    | +/- 1.356   |
| 3.85         | 50               | 13.559993 | 0.00950     | +/- 1.356   |

#### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 4.43         | 20               | 13.560006 | -0.00350    | +/- 1.356   |
| 3.85         | 20               | 13.560002 | 0.00000     | +/- 1.356   |
| 3.27         | 20               | 13.560007 | -0.00450    | +/- 1.356   |

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## 2 Minutes:

### A. Temperature Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 3.85         | -20              | 13.559995 | 0.00440     | +/- 1.356   |
| 3.85         | -10              | 13.559994 | 0.00540     | +/- 1.356   |
| 3.85         | 0                | 13.56     | 0.00010     | +/- 1.356   |
| 3.85         | 10               | 13.560006 | -0.00620    | +/- 1.356   |
| 3.85         | 20               | 13.56     | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.559995 | 0.00520     | +/- 1.356   |
| 3.85         | 40               | 13.559998 | 0.00150     | +/- 1.356   |
| 3.85         | 50               | 13.559992 | 0.00810     | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 4.43         | 20               | 13.56001  | -0.01010    | +/- 1.356   |
| 3.85         | 20               | 13.56     | 0.00000     | +/- 1.356   |
| 3.27         | 20               | 13.559994 | 0.00630     | +/- 1.356   |

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## 5 Minutes:

### A. Temperature Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 3.85         | -20              | 13.559991 | 0.00250     | +/- 1.356   |
| 3.85         | -10              | 13.56     | -0.00630    | +/- 1.356   |
| 3.85         | 0                | 13.560006 | -0.01230    | +/- 1.356   |
| 3.85         | 10               | 13.559992 | 0.00190     | +/- 1.356   |
| 3.85         | 20               | 13.559994 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.559995 | -0.00140    | +/- 1.356   |
| 3.85         | 40               | 13.559991 | 0.00300     | +/- 1.356   |
| 3.85         | 50               | 13.559999 | -0.00510    | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 4.43         | 20               | 13.560009 | -0.01590    | +/- 1.356   |
| 3.85         | 20               | 13.559994 | 0.00000     | +/- 1.356   |
| 3.27         | 20               | 13.559992 | 0.00170     | +/- 1.356   |

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## 10 Minutes:

### A. Temperature Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 3.85         | -20              | 13.559997 | -0.00590    | +/- 1.356   |
| 3.85         | -10              | 13.559992 | -0.00130    | +/- 1.356   |
| 3.85         | 0                | 13.560003 | -0.01220    | +/- 1.356   |
| 3.85         | 10               | 13.560004 | -0.01300    | +/- 1.356   |
| 3.85         | 20               | 13.559991 | 0.00000     | +/- 1.356   |
| 3.85         | 30               | 13.559992 | -0.00050    | +/- 1.356   |
| 3.85         | 40               | 13.560004 | -0.01250    | +/- 1.356   |
| 3.85         | 50               | 13.559999 | -0.00810    | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|------------------|-----------|-------------|-------------|
| Vdc          | Temperature (°C) | (MHz)     |             |             |
| 4.43         | 20               | 13.559991 | 0.00030     | +/- 1.356   |
| 3.85         | 20               | 13.559991 | 0.00000     | +/- 1.356   |
| 3.27         | 20               | 13.560001 | -0.01020    | +/- 1.356   |

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## 9 20 dB OCCUPIED BANDWIDTH MEASUREMENT

### 9.1 Standard Applicable:

§2.1049 & §15.215 (c)

### 9.2 Limit:

None

### 9.3 Test Set-up

Refer to section 6.2 in this report

### 9.4 Measurement Procedure

20dB bandwidth

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak mode.
2. 20dB Bandwidth the resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.

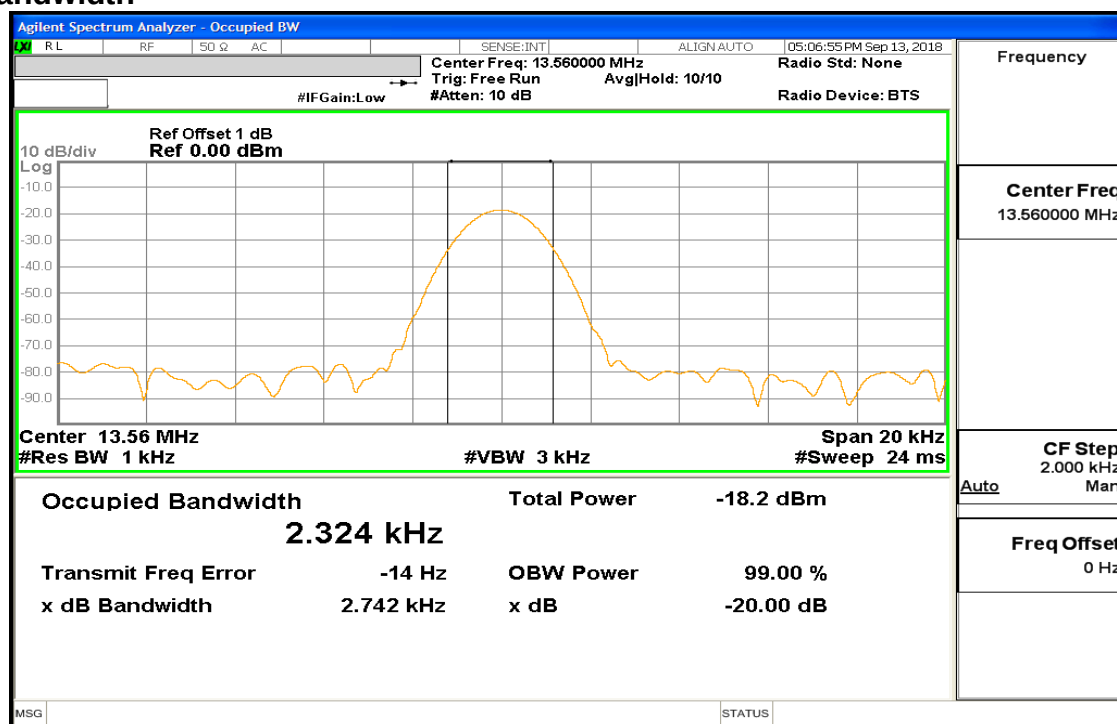
### 9.5 Measurement Equipment Used:

Refer to section 8.3 in this report

### 9.6 Measurement Result

| 20dB BW (kHz) | Operation range | Frequency (MHz) | Limit (MHz) |
|---------------|-----------------|-----------------|-------------|
| 2.742         | Low             | 13.55878        | >13.11      |
|               | High            | 13.56114        | <14.01      |

### -20dB Bandwidth



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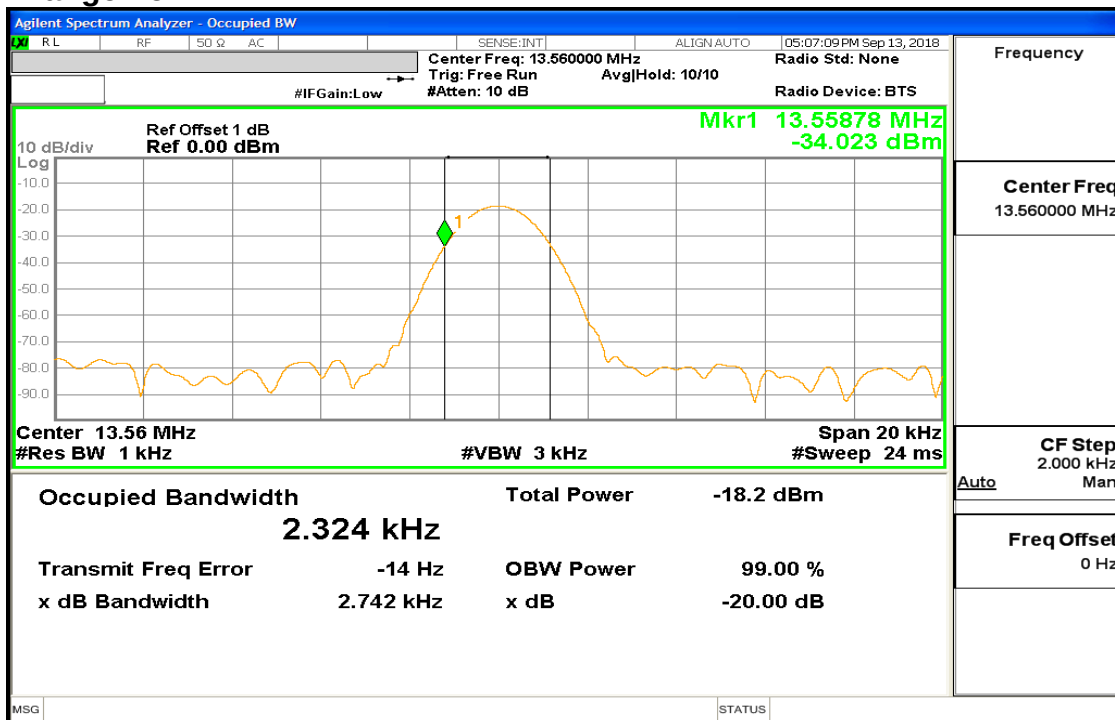
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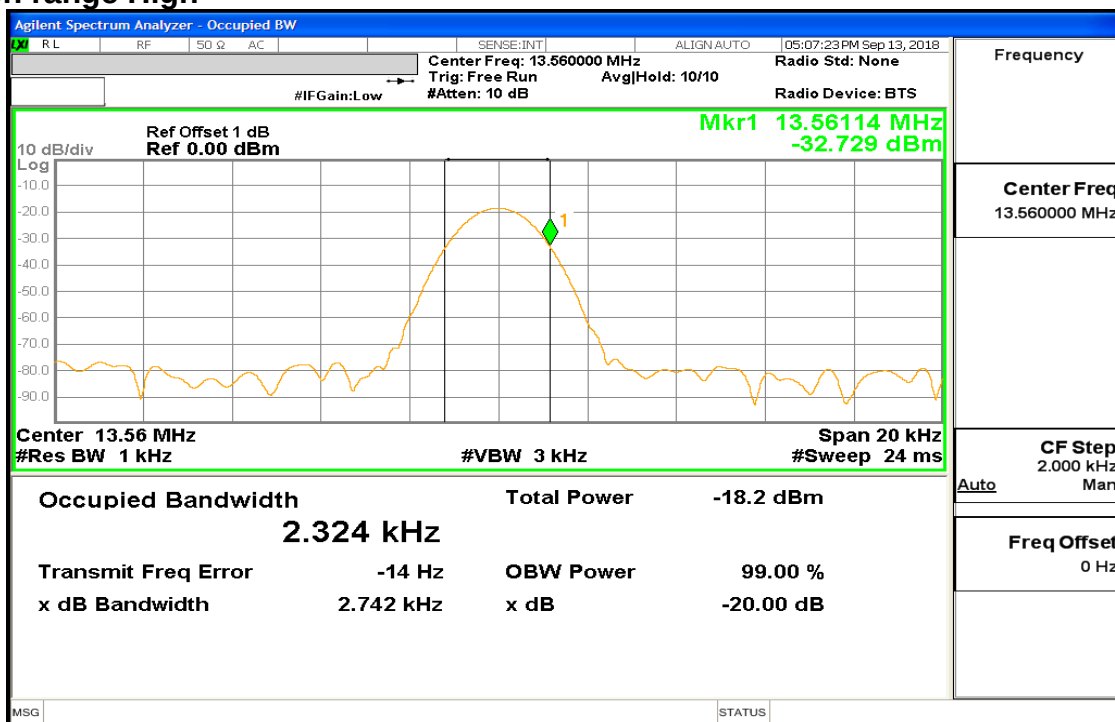
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## Operation range Low



## Operation range High



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## 10 ANTENNA REQUIREMENT

### 10.1 Standard Applicable:

According to §15.203, Antenna requirement.

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

### 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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