

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

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

OF

**Product Name:** Smart Phone

**FCC ID:** APYHRO00251

**Report No.:** ER/2017/80087

**Issue Date:** Sep. 07, 2017

**FCC Rule Part:** §15.225

**Prepared for:** Sharp Corporation, IoT Communication B.U.  
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**Manufacturer:** Sharp Corporation  
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SGS Taiwan Ltd.  
Electronics & Communication Laboratory

**Prepared by:** No.134, Wu Kung Road, New Taipei Industrial  
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## VERIFICATION OF COMPLIANCE

Sharp Corporation, IoT Communication B.U.

**Applicant:** 2-13-1, Hachihonmatsu-lida, 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

**FCC ID:** APYHRO00251

**File Number:** ER/2017/80087

**Date of test:** Aug. 14, 2017 ~ Sep. 04, 2017

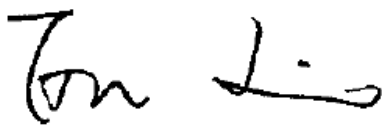
**Date of EUT Received:** Aug. 14, 2017

### 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.

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

**Test By:**

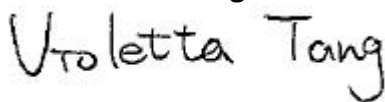


**Date:**

Sep. 07, 2017

*Tin Lin / Engineer*

**Prepared By:**

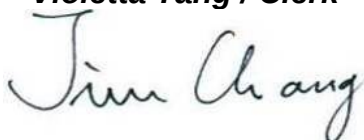


**Date:**

Sep. 07, 2017

*Violetta Tang / Clerk*

**Approved By:**



**Date:**

Sep. 07, 2017

*Jim Chang / Asst. Manager*

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## Revision History

| Report Number | Revision | Description                  | Issue Date    |
|---------------|----------|------------------------------|---------------|
| ER/2017/80087 | Rev.00   | Initial creation of document | Sep. 07, 2017 |
|               |          |                              |               |
|               |          |                              |               |
|               |          |                              |               |

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# 1 GENERAL INFORMATION

## 1.1 Product Description

General:

|                   |                                        |                                                                          |
|-------------------|----------------------------------------|--------------------------------------------------------------------------|
| Product Name:     | Smart Phone                            |                                                                          |
| Hardware Version: | DVT                                    |                                                                          |
| Software Version: | A809G                                  |                                                                          |
| Power Supply:     | 3.85V from Rechargeable Li-ion Battery |                                                                          |
|                   | Battery:                               | Mode No.: UBATIA283AFN2,<br>Supplier: SCUD(FUJIAN) Electronics Co., Ltd. |

NFC:

|                      |                       |
|----------------------|-----------------------|
| Operating Frequency: | 13.56MHz              |
| Transmit Power:      | < 123.90dBuV/m at 3m. |
| Number of Channels:  | 1                     |
| Antenna Type:        | Loop Antenna          |
| Modulation Type:     | ASK                   |

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## 1.2 Test Methodology of Applied Standards

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 F  
New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

(TAF code 0513)

FCC Registration Numbers are: 509634

## 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.

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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

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plan. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. 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 which is 0.8 m above ground plan. 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 hand-held transmitter (EUT) was rotated through one orthogonal axis and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

### 2.4 Measurement Results Explanation Example

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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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 | N/A       | N/A              | N/A        | N/A        | N/A        |
| 2.   | Notebook          | Lenovo    | L430             | P0000081   | 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

#### 4.1 The Worst Test Modes and Channel Details

1. The EUT stay in continuous transmitting 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. Investigation has been done on all the possible configurations for searching the worst case.

| 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 mode) and lie down position (E1, E2 mode) for NFC Transmitter for 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              | +/- 51.33 Hz                |
| 20 dB & 99% OCCUPIED BANDWIDTH   | +/- 51.33 Hz                |
| Temperature                      | +/- 0.65 °C                 |
| Humidity                         | +/- 4.6 %                   |
| DC / AC Power Source             | DC= +/- 0.13%, AC= +/- 0.2% |

Radiated Spurious Emission:

|                                                              |                            |
|--------------------------------------------------------------|----------------------------|
| Measurement uncertainty<br>(Polarization : <b>Vertical</b> ) | 9kHz - 30MHz: +/- 2.87dB   |
|                                                              | 30MHz - 180MHz: +/- 3.37dB |
|                                                              | 180MHz -417MHz: +/- 3.19dB |
|                                                              | 0.417GHz-1GHz: +/- 3.19dB  |

|                                                                |                            |
|----------------------------------------------------------------|----------------------------|
| Measurement uncertainty<br>(Polarization : <b>Horizontal</b> ) | 9kHz - 30MHz: +/- 2.87dB   |
|                                                                | 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 EMISSION TEST

### 6.1 Standard Applicable:

Frequency range within 150kHz 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

- 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         | ESCI7                       | 100760           | 05/11/2017   | 05/10/2018 |
| LISN                         | SCHWARZBECK | NSLK 8127                   | 8127-649         | 05/22/2017   | 05/21/2018 |
| LISN                         | MESS TEC    | FCC-LISN-50/250-<br>25-2-01 | 4034             | 03/19/2017   | 03/18/2018 |
| Coaxial Cables               | N/A         | WK CE Cable                 | N/A              | 11/26/2016   | 11/25/2017 |

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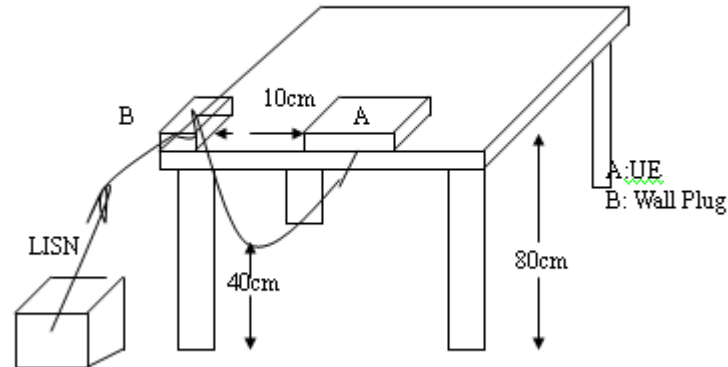
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#### 6.4 Test SET-UP (Block Diagram of Configuration)



#### 6.5 Measurement Procedure:

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

|                 |                |           |      |            |               |
|-----------------|----------------|-----------|------|------------|---------------|
| Operation Mode: | Operation mode |           |      | Test Date: | Aug. 17, 2017 |
| Temperature:    | 20 °C          | Humidity: | 56 % | Test By:   | Tin           |
|                 |                |           |      | Phase:     | L1            |

Site: Conduction Room

Phase: L1

Temperature: 20 °C

Limit: FCC Class B Conduction(QP)

Power: AC 120V/60Hz

Humidity: 58 %

Mode: Operation mode

Note:

## Conducted Emission



| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|-----|-----|--------|---------------|----------------|-------------|-------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1   |     | 0.1900 | 48.04         | 0.12           | 48.16       | 64.04 | -15.88 | peak     |         |
| 2   |     | 0.2420 | 42.52         | 0.12           | 42.64       | 62.03 | -19.39 | peak     |         |
| 3   |     | 0.3140 | 40.04         | 0.11           | 40.15       | 59.86 | -19.71 | peak     |         |
| 4   |     | 2.5980 | 39.66         | 0.17           | 39.83       | 56.00 | -16.17 | peak     |         |
| 5 * |     | 4.4700 | 40.97         | 0.26           | 41.23       | 56.00 | -14.77 | peak     |         |
| 6   |     | 5.9820 | 40.42         | 0.32           | 40.74       | 60.00 | -19.26 | peak     |         |

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Site: Conduction Room  
Limit: FCC Class B Conduction(QP)  
Mode: Operation mode  
Note:

Phase: **N**  
Power: AC 120V/60Hz

Temperature: 20 °C  
Humidity: 58 %

### Conducted Emission



| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|-----|-----|--------|---------------|----------------|-------------|-------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1   |     | 0.1900 | 47.86         | 0.07           | 47.93       | 64.04 | -16.11 | peak     |         |
| 2   |     | 0.2420 | 43.07         | 0.07           | 43.14       | 62.03 | -18.89 | peak     |         |
| 3   |     | 0.3260 | 41.19         | 0.08           | 41.27       | 59.55 | -18.28 | peak     |         |
| 4   |     | 2.5980 | 38.10         | 0.14           | 38.24       | 56.00 | -17.76 | peak     |         |
| 5   | *   | 4.3580 | 40.84         | 0.23           | 41.07       | 56.00 | -14.93 | peak     |         |
| 6   |     | 6.1060 | 39.45         | 0.28           | 39.73       | 60.00 | -20.27 | peak     |         |

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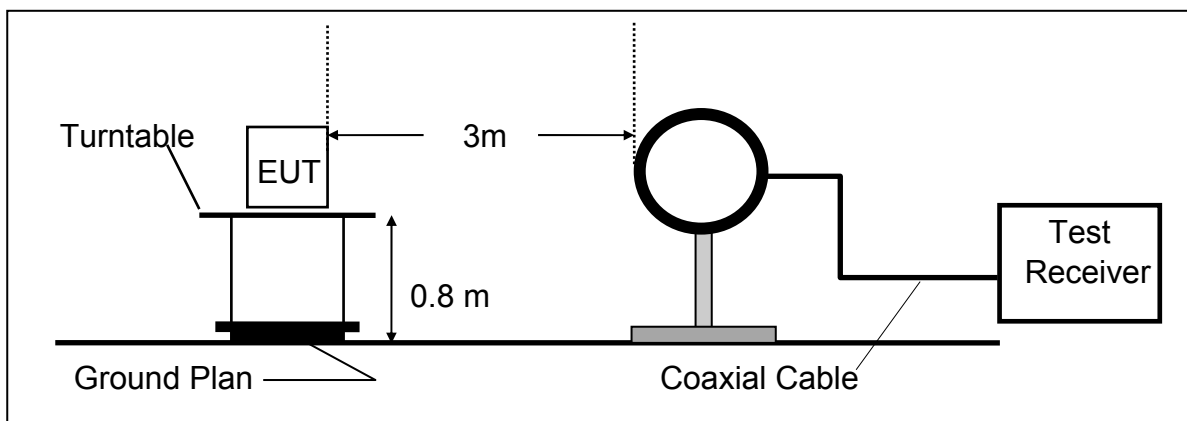
## 7 RADIATED TEST ITEMS

### 7.1 Measurement Procedure

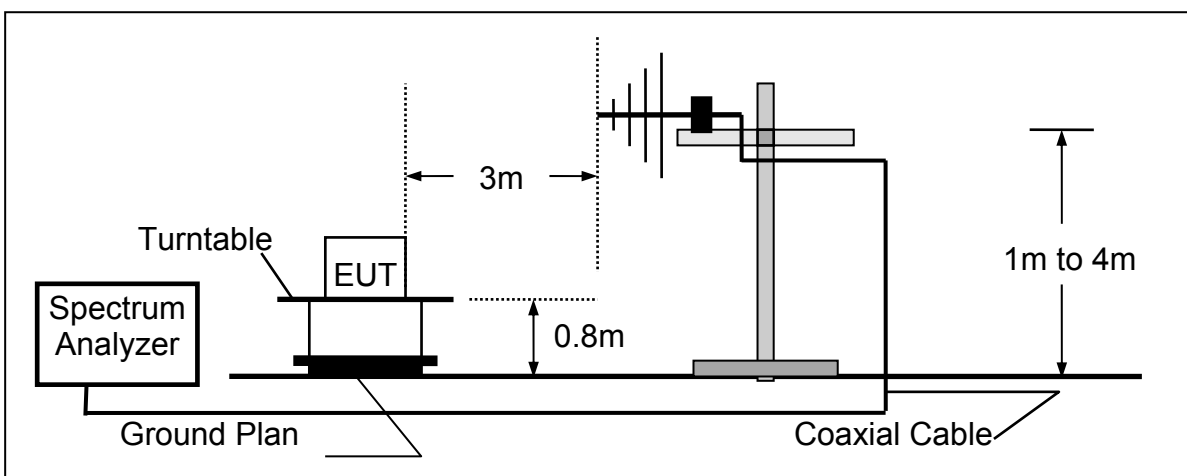
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plan.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out 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

#### (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

| SGS SAC-III       |                       |              |               |                  |                 |
|-------------------|-----------------------|--------------|---------------|------------------|-----------------|
| Name of Equipment | Manufacturer          | Model        | Serial Number | Calibration Date | Calibration Due |
| EMI Test Receiver | R&S                   | ESCI7        | 100760        | 05/11/2017       | 05/10/2018      |
| Spectrum Analyzer | Agilent               | E4446A       | MY51100003    | 04/25/2017       | 04/24/2018      |
| Loop Antenna      | ETS-Lindgren          | 6502         | 148045        | 09/20/2016       | 09/19/2017      |
| Bilog Antenna     | SCHWAZBECK            | VULB9168     | 378           | 12/19/2016       | 12/18/2017      |
| Horn Antenna      | Schwarzbeck           | BBHA9120D    | 1441          | 08/04/2017       | 08/03/2018      |
| Pre-Amplifier     | Agilent               | 8447D        | 2944A07676    | 01/03/2017       | 01/02/2018      |
| Pre-Amplifier     | EMC Instruments Corp. | EMC0126530   | 980038        | 01/03/2017       | 01/02/2018      |
| Turn Table        | HD                    | DT420        | N/A           | N.C.R            | N.C.R           |
| Antenna Tower     | ChamPro               | AM-BS-4500-B | 060776-ABS    | N.C.R            | N.C.R           |
| Controller        | ChamPro               | EM1000       | 60776         | N.C.R            | N.C.R           |
| Low Loss Cable    | Huber Suhner          | 966_RX       | 9             | 01/05/2017       | 01/04/2018      |
| 3m Site NSA       | SGS                   | 966 chamber  | N/A           | 07/01/2017       | 06/30/2018      |
| Low Loss Cable    | Huber Suhner          | 966 TX       | 1             | 01/05/2017       | 01/04/2018      |
| Horn Antenna      | Schwarzbeck           | BBHA9170     | 184           | 12/12/2016       | 12/11/2017      |
| Pre-Amplifier     | EMC Instruments Corp. | EMC184045    | 980135        | 01/05/2017       | 01/04/2018      |

### 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(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

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

#### Note :

“F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

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## 7.5 Field Strength of Fundamental Emissions and Mask Measurement

### 7.5.1 Standard Applicable

Limit:

| 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                             | 123.9                         |
| 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 micorvolts/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.

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

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

1. Emission level in dBuV/m =  $20 \log (\mu\text{V/m})$
2. Distance extrapolation factor =  $40 \log (\text{required distance/ test distance})$  (dB)
3. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

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**Radiated Mask for RSS 210 Annex B B6**

- (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.
- (d) RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

Distance extrapolation =  $40 \cdot \log(30/3) = 40$  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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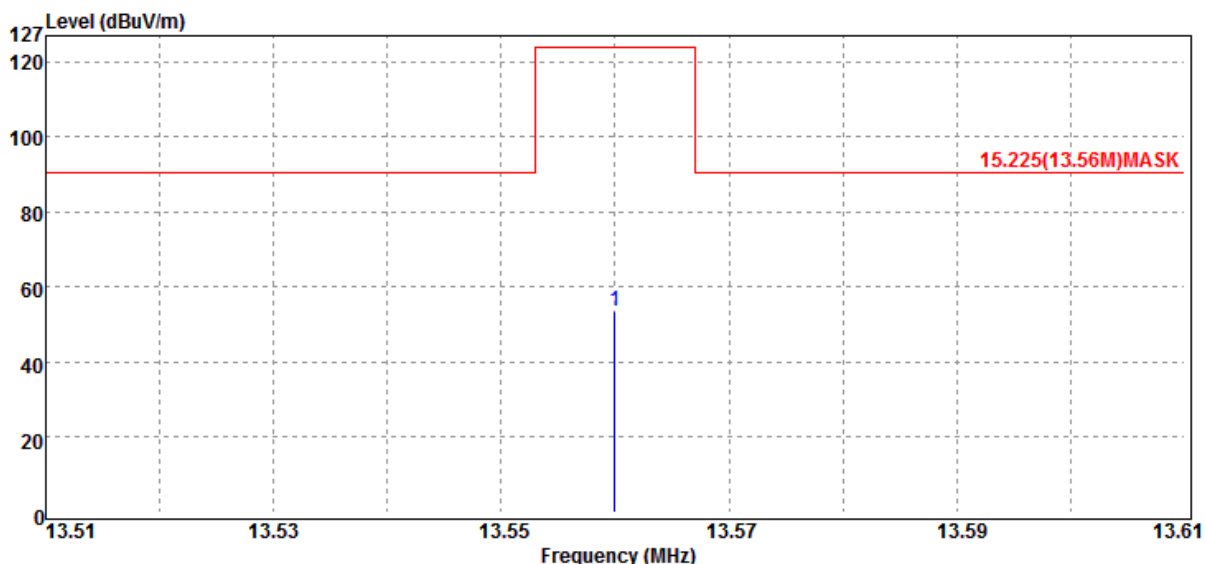
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## 7.5.2 Field Strength of Fundamental Emission Measurement Result

|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :NFC       | Test Date                | :2017-08-16       |
| 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. | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Safe   |
|-------|---------|----------|---------------|--------|--------|--------|--------|
| MHz   | F/H/E/S | Mode     | Reading Level |        | FS     | @3m    | Margin |
| MHz   | F/H/E/S | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 13.56 | F       | Peak     | 42.01         | 11.43  | 53.44  | 123.90 | -70.46 |

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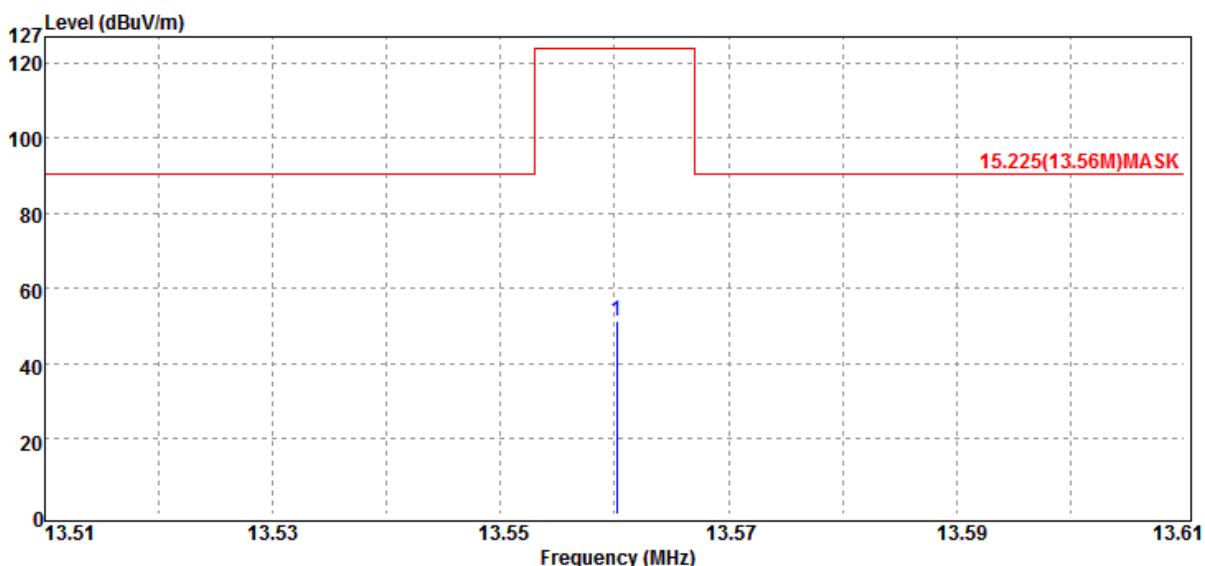
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|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :NFC       | Test Date                | :2017-08-16       |
| Fundamental Frequency | :13.56 MHz | Temp./Humi.              | :21 deg_C / 62 RH |
| Operation Mode        | :MAIN      | Engineer                 | :Tin              |
| EUT Pol.              | :H Plane   | Measurement Antenna Pol. | :HORIZONTAL       |



| Freq. | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Safe   |
|-------|---------|----------|---------------|--------|--------|--------|--------|
| MHz   | F/H/E/S | Mode     | Reading Level |        | FS     | @3m    | Margin |
| MHz   | F/H/E/S | PK/QP/AV | dBuV          | dB     | dBuV/m | dBuV/m | dB     |
| 13.56 | F       | Peak     | 40.18         | 11.43  | 51.61  | 123.90 | -72.29 |

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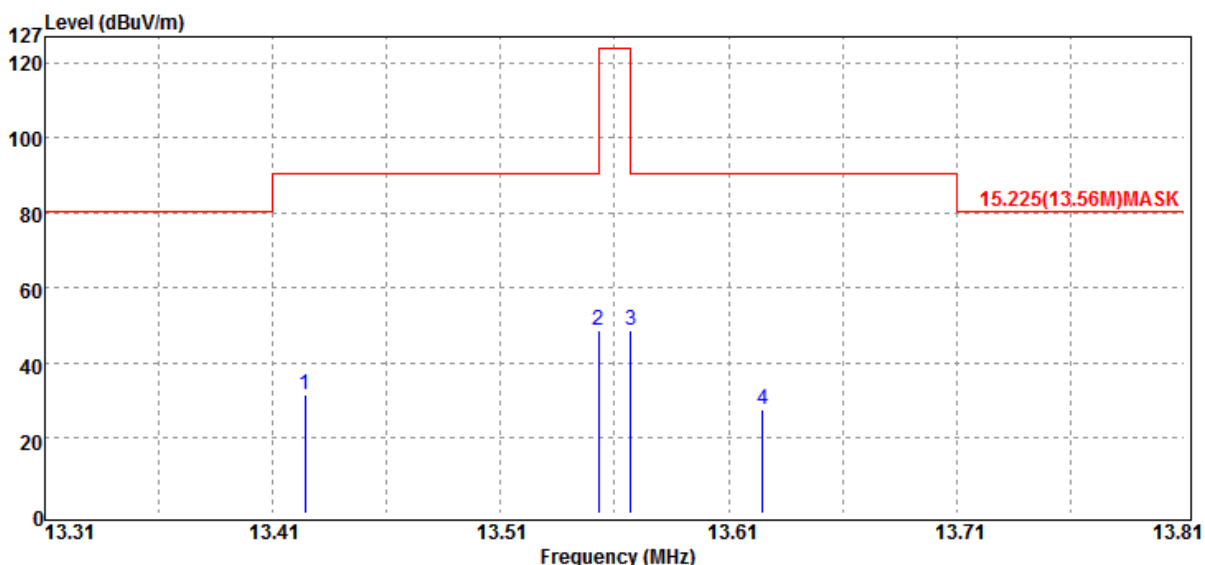
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### 7.5.3 Mask Measurement Result

|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :NFC       | Test Date                | :2017-08-16       |
| Fundamental Frequency | :13.56 MHz | Temp./Humi.              | :21 deg_C / 62 RH |
| Operation Mode        | :MASK      | Engineer                 | :Tin              |
| EUT Pol.              | :H Plane   | Measurement Antenna Pol. | :VERTICAL         |



| Freq. | Note    | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|-------|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz   | F/H/E/S | Mode     | Reading Level | dB     | FS           | @3m          | dB     |
| MHz   | F/H/E/S | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 13.42 | S       | Peak     | 20.13         | 11.43  | 31.56        | 90.47        | -58.91 |
| 13.55 | S       | Peak     | 37.43         | 11.43  | 48.86        | 90.47        | -41.61 |
| 13.57 | S       | Peak     | 37.42         | 11.43  | 48.85        | 90.47        | -41.62 |
| 13.63 | S       | Peak     | 16.20         | 11.43  | 27.63        | 90.47        | -62.84 |

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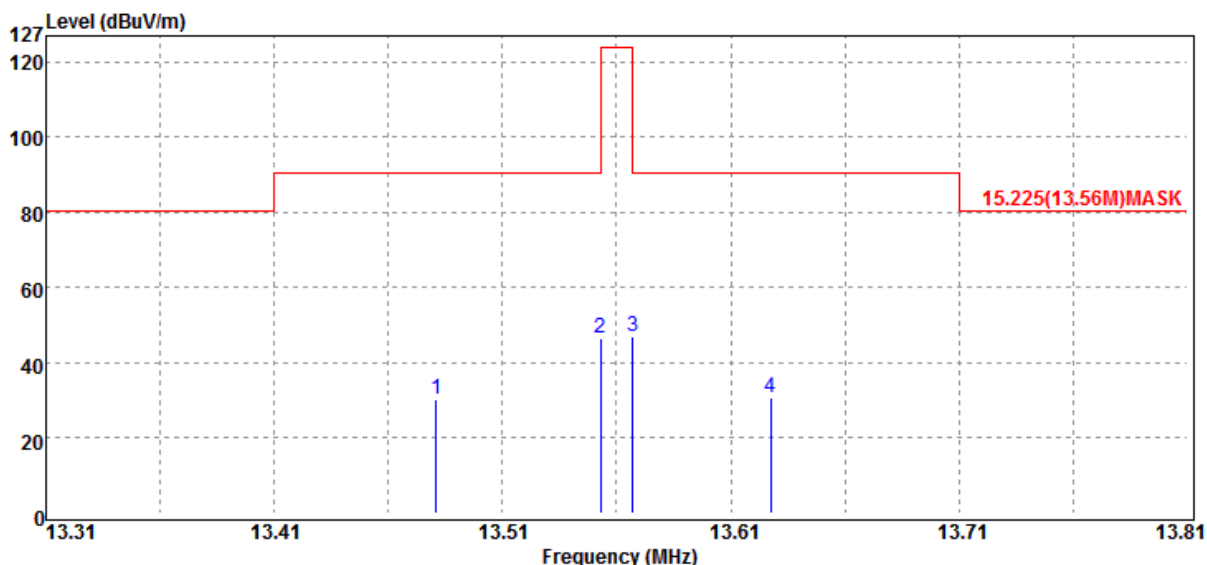
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :MASK  
EUT Pol. :H Plane

Test Date :2017-08-16  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| Freq. | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|-------|---------|----------|---------------|--------|--------|--------|--------|
| MHz   | F/H/E/S | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz   | F/H/E/S | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 13.48 | S       | Peak     | 18.84         | 11.43  | 30.27  | 90.47  | -60.20 |
| 13.55 | S       | Peak     | 35.11         | 11.43  | 46.54  | 90.47  | -43.93 |
| 13.57 | S       | Peak     | 35.43         | 11.43  | 46.86  | 90.47  | -43.61 |
| 13.63 | S       | Peak     | 19.20         | 11.43  | 30.63  | 90.47  | -59.84 |

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## 7.6 Radiated Emission Measurement

### 7.6.1 Standard Applicable

The field strength of any emission which appear outside of 13.553~13.567MHz Band shall not exceed the general radiated emissions limits.

| 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. The lower limit shall apply at the transition frequencies.
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

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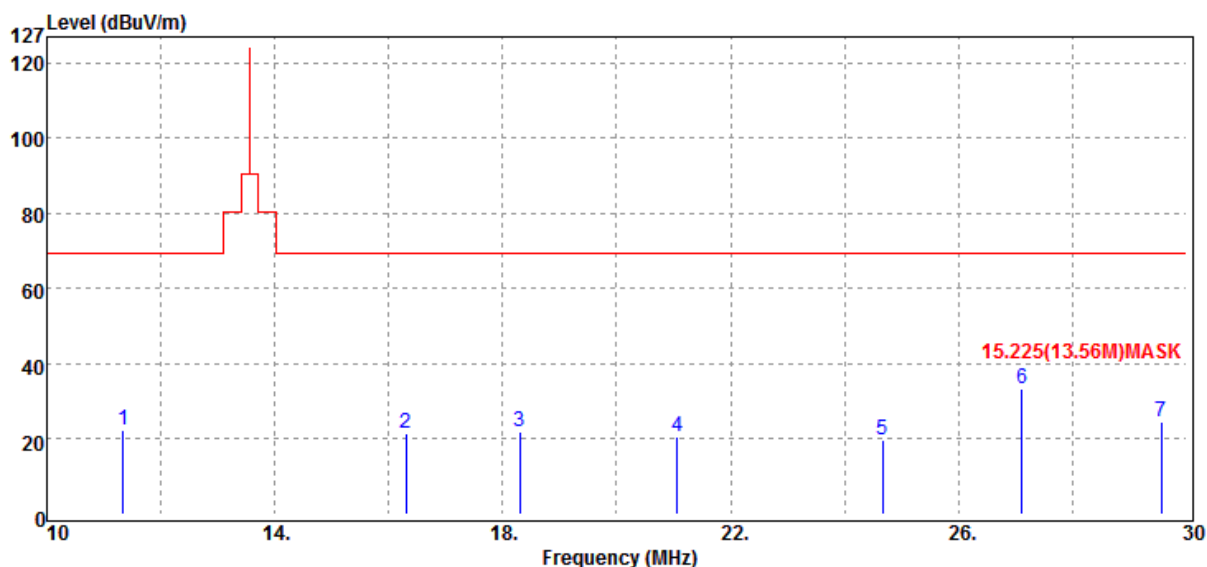
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## Radiated Emission Measurement Result

|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :NFC       | Test Date                | :2017-08-16       |
| Fundamental Frequency | :13.56 MHz | Temp./Humi.              | :21 deg_C / 62 RH |
| Operation Mode        | :Tx CH MID | Engineer                 | :Tin              |
| EUT Pol.              | :H Plane   | Measurement Antenna Pol. | :VERTICAL         |



| Freq. | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|-------|---------|----------|---------------|--------|--------|--------|--------|
| MHz   | F/H/E/S | Mode     | Reading Level | dB     | FS     | @3m    | dB     |
| MHz   | F/H/E/S | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 11.34 | S       | Peak     | 10.96         | 11.38  | 22.34  | 69.54  | -47.20 |
| 16.30 | S       | Peak     | 10.13         | 11.50  | 21.63  | 69.54  | -47.91 |
| 18.30 | S       | Peak     | 10.44         | 11.55  | 21.99  | 69.54  | -47.55 |
| 21.06 | S       | Peak     | 9.37          | 11.26  | 20.63  | 69.54  | -48.91 |
| 24.66 | S       | Peak     | 9.45          | 10.28  | 19.73  | 69.54  | -49.81 |
| 27.12 | H       | Peak     | 23.91         | 9.70   | 33.61  | 69.54  | -35.93 |
| 29.56 | S       | Peak     | 15.62         | 9.16   | 24.78  | 69.54  | -44.76 |

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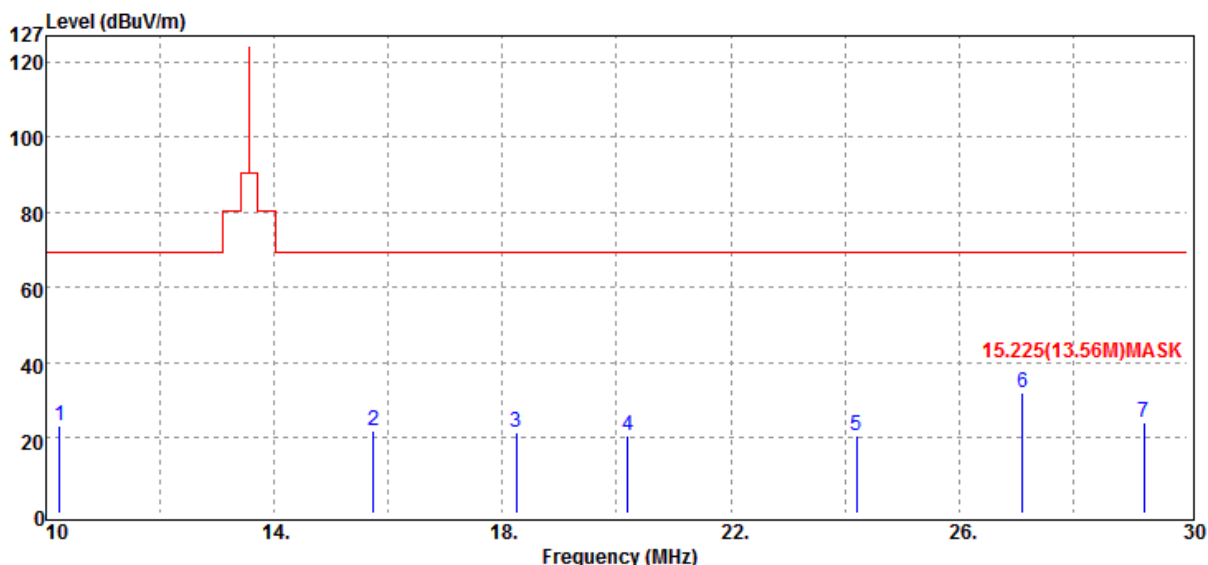
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :Tx CH MID  
EUT Pol. :H Plane

Test Date :2017-08-16  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| Freq. | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|-------|---------|----------|---------------|--------|--------|--------|--------|
| MHz   | F/H/E/S | Mode     | Reading Level |        | FS     | @3m    |        |
|       |         | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 10.24 | S       | Peak     | 11.99         | 11.34  | 23.33  | 69.54  | -46.21 |
| 15.74 | S       | Peak     | 10.55         | 11.49  | 22.04  | 69.54  | -47.50 |
| 18.24 | S       | Peak     | 10.14         | 11.55  | 21.69  | 69.54  | -47.85 |
| 20.20 | S       | Peak     | 9.19          | 11.52  | 20.71  | 69.54  | -48.83 |
| 24.20 | S       | Peak     | 10.06         | 10.39  | 20.45  | 69.54  | -49.09 |
| 27.12 | H       | Peak     | 22.55         | 9.70   | 32.25  | 69.54  | -37.29 |
| 29.24 | S       | Peak     | 14.80         | 9.23   | 24.03  | 69.54  | -45.51 |

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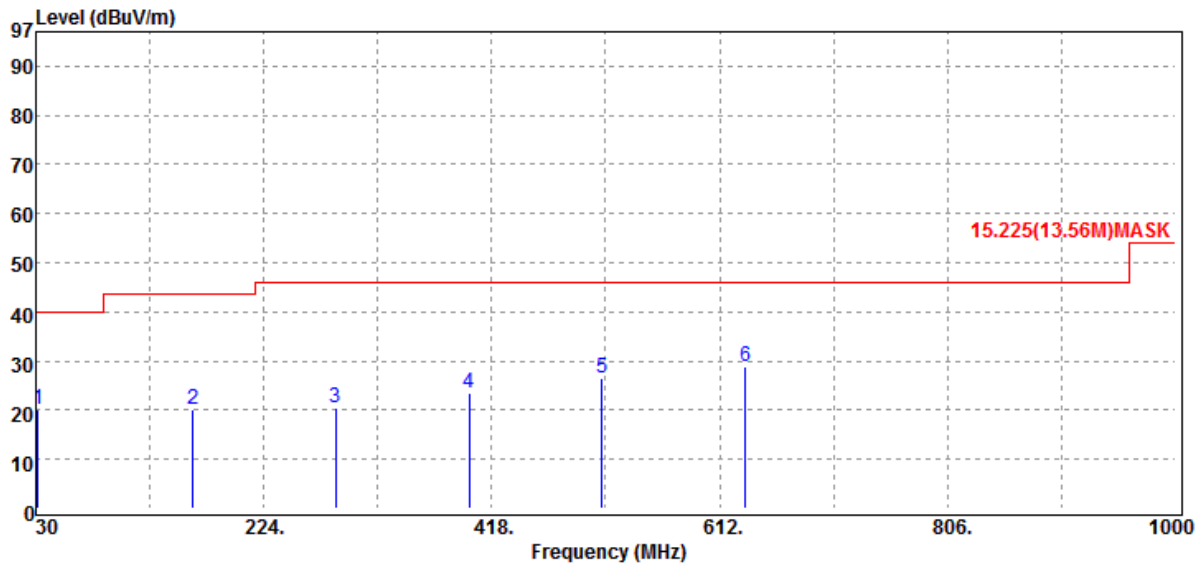
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|                       |            |                          |                   |
|-----------------------|------------|--------------------------|-------------------|
| Operation Band        | :NFC       | Test Date                | :2017-08-16       |
| Fundamental Frequency | :13.56 MHz | Temp./Humi.              | :21 deg_C / 62 RH |
| Operation Mode        | :Tx CH MID | Engineer                 | :Tin              |
| EUT Pol.              | :H Plane   | Measurement Antenna Pol. | :VERTICAL         |



| Freq.  | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|--------|---------|----------|---------------|--------|--------|--------|--------|
| MHz    | F/H/E/S | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz    | F/H/E/S | PK/QP/AV | dBuV          | dB     | dBuV/m | dBuV/m | dB     |
| 31.94  | S       | Peak     | 29.41         | -9.11  | 20.30  | 40.00  | -19.70 |
| 163.86 | S       | Peak     | 27.63         | -7.45  | 20.18  | 43.50  | -23.32 |
| 285.11 | S       | Peak     | 26.64         | -6.24  | 20.40  | 46.00  | -25.60 |
| 398.60 | S       | Peak     | 27.43         | -3.97  | 23.46  | 46.00  | -22.54 |
| 512.09 | S       | Peak     | 28.41         | -1.98  | 26.43  | 46.00  | -19.57 |
| 634.31 | S       | Peak     | 28.28         | 0.51   | 28.79  | 46.00  | -17.21 |

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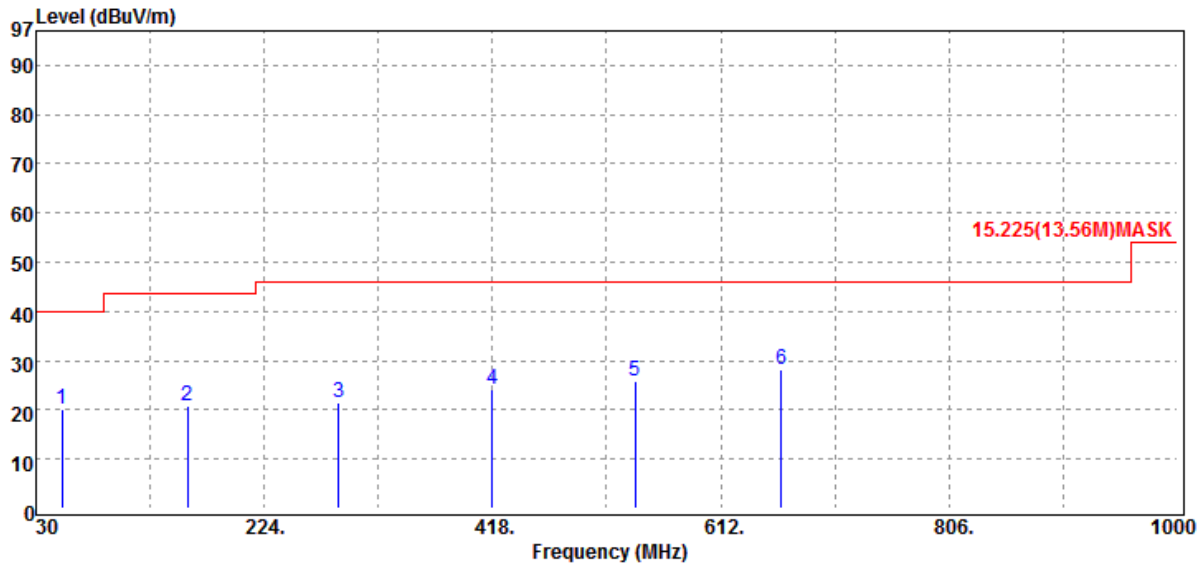
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Operation Band :NFC  
Fundamental Frequency :13.56 MHz  
Operation Mode :Tx CH MID  
EUT Pol. :H Plane

Test Date :2017-08-16  
Temp./Humi. :21 deg\_C / 62 RH  
Engineer :Tin  
Measurement Antenna Pol. :HORIZONTAL



| Freq.  | Note    | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|--------|---------|----------|---------------|--------|--------|--------|--------|
| MHz    | F/H/E/S | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz    | F/H/E/S | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 52.31  | S       | Peak     | 27.74         | -7.76  | 19.98  | 40.00  | -20.02 |
| 159.01 | S       | Peak     | 28.07         | -7.38  | 20.69  | 43.50  | -22.81 |
| 287.05 | S       | Peak     | 27.53         | -6.19  | 21.34  | 46.00  | -24.66 |
| 418.00 | S       | Peak     | 27.66         | -3.37  | 24.29  | 46.00  | -21.71 |
| 539.25 | S       | Peak     | 27.39         | -1.58  | 25.81  | 46.00  | -20.19 |
| 663.41 | S       | Peak     | 28.00         | 0.25   | 28.25  | 46.00  | -17.75 |

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## 8 FREQUENCY STABILITY

### 8.1 Standard Applicable

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.

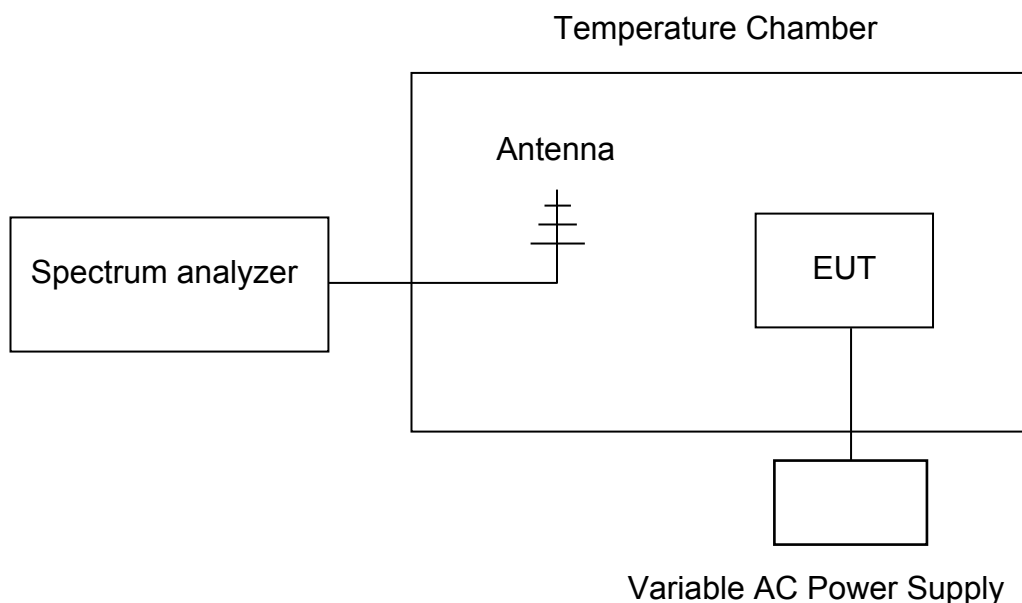
Carrier frequency stability shall be maintained to  $\pm 0.01\%$  ( $\pm 100$  ppm).

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 inside temperature chamber and powered and powered by nominal DC voltage.
2. Set EUT as normal operation.
3. Turn the EUT on and couple its output to spectrum.
4. Turn the EUT off and set the chamber to the highest temperature specified.
5. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT and measure the operating frequency.
6. Repeat step with the temperature chamber set to the lowest temperature.
7. Set spectrum Center Frequency = fundamental frequency, RBW, VBW= 10 kHz, Span =100 kHz, Detector =Max hold, Mark peak.

### 8.3 Test SET-UP



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## 8.4 Measurement Equipment Used

| SGS Conducted Room    |               |           |               |                  |                 |
|-----------------------|---------------|-----------|---------------|------------------|-----------------|
| Name of Equipment     | Manufacturer  | Model     | Serial Number | Calibration Date | Calibration Due |
| Power Meter           | Anritsu       | ML2495A   | 1005007       | 12/15/2016       | 12/14/2017      |
| Power Sensor          | Anritsu       | MA2411B   | 917032        | 12/15/2016       | 12/14/2017      |
| EXA Spectrum Analyzer | Agilent       | N9030A    | MY53120760    | 03/21/2017       | 03/20/2018      |
| DC Block              | Mini-Circuits | BLK-18-S+ | 1             | 01/05/2017       | 01/04/2018      |

## 8.5 Measurement Results:

### Startup:

#### A. Temperature Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 3.85         | -20              | 13.55942458 | 575.41600  | +/- 1.356   |
| 3.85         | -10              | 13.55962475 | 375.25000  | +/- 1.356   |
| 3.85         | 0                | 13.56027468 | -274.68000 | +/- 1.356   |
| 3.85         | 10               | 13.56013572 | -135.72000 | +/- 1.356   |
| 3.85         | 20               | 13.56       | 0.00000    | +/- 1.356   |
| 3.85         | 30               | 13.56015435 | -154.35000 | +/- 1.356   |
| 3.85         | 40               | 13.56027635 | -276.35000 | +/- 1.356   |
| 3.85         | 50               | 13.56022784 | -227.84000 | +/- 1.356   |

#### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 4.42         | 20               | 13.5601499  | -149.89930 | +/- 1.356   |
| 3.85         | 20               | 13.56       | 0.00000    | +/- 1.356   |
| 3.27         | 20               | 13.56017346 | -173.45830 | +/- 1.356   |

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## 2 minutes:

### A. Temperature Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 3.85         | -20              | 13.55995564 | 168.37800  | +/- 1.356   |
| 3.85         | -10              | 13.55974632 | 377.70200  | +/- 1.356   |
| 3.85         | 0                | 13.56012958 | -5.55730   | +/- 1.356   |
| 3.85         | 10               | 13.56022133 | -97.31200  | +/- 1.356   |
| 3.85         | 20               | 13.56012402 | 0.00000    | +/- 1.356   |
| 3.85         | 30               | 13.56012422 | -0.19900   | +/- 1.356   |
| 3.85         | 40               | 13.56032322 | -199.19900 | +/- 1.356   |
| 3.85         | 50               | 13.56015342 | -29.39800  | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 4.42         | 20               | 13.56016112 | -33.90000  | +/- 1.356   |
| 3.85         | 20               | 13.56012722 | 0.00000    | +/- 1.356   |
| 3.27         | 20               | 13.56016635 | -39.12420  | +/- 1.356   |

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## 5 minutes:

### A. Temperature Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 3.85         | -20              | 13.55986133 | 138.66670  | +/- 1.356   |
| 3.85         | -10              | 13.55978738 | 212.61800  | +/- 1.356   |
| 3.85         | 0                | 13.56002254 | -22.53500  | +/- 1.356   |
| 3.85         | 10               | 13.56010236 | -102.36100 | +/- 1.356   |
| 3.85         | 20               | 13.56       | 0.00000    | +/- 1.356   |
| 3.85         | 30               | 13.56005335 | -53.35400  | +/- 1.356   |
| 3.85         | 40               | 13.56011344 | -113.43500 | +/- 1.356   |
| 3.85         | 50               | 13.56012146 | -121.45700 | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 4.42         | 20               | 13.56005334 | -53.34400  | +/- 1.356   |
| 3.85         | 20               | 13.56       | 0.00000    | +/- 1.356   |
| 3.27         | 20               | 13.56006234 | -62.34245  | +/- 1.356   |

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## 10 minutes:

### A. Temperature Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 3.85         | -20              | 13.55962355 | 407.92200  | +/- 1.356   |
| 3.85         | -10              | 13.55995233 | 79.14100   | +/- 1.356   |
| 3.85         | 0                | 13.56016243 | -130.96200 | +/- 1.356   |
| 3.85         | 10               | 13.56012318 | -91.71200  | +/- 1.356   |
| 3.85         | 20               | 13.56003147 | 0.00000    | +/- 1.356   |
| 3.85         | 30               | 13.56014357 | -112.10000 | +/- 1.356   |
| 3.85         | 40               | 13.56018429 | -152.82010 | +/- 1.356   |
| 3.85         | 50               | 13.56016394 | -132.46900 | +/- 1.356   |

### B. Supply Voltage Variation

| Power Supply | Environment      | Frequency   | Delta (Hz) | Limit (KHz) |
|--------------|------------------|-------------|------------|-------------|
| Vdc          | Temperature (°C) | (MHz)       |            |             |
| 4.42         | 20               | 13.56013562 | -104.15030 | +/- 1.356   |
| 3.85         | 20               | 13.56003147 | 0.00000    | +/- 1.356   |
| 3.27         | 20               | 13.56006765 | -36.17420  | +/- 1.356   |

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## 9 20 dB OCCUPIED BANDWIDTH MEASUREMENT

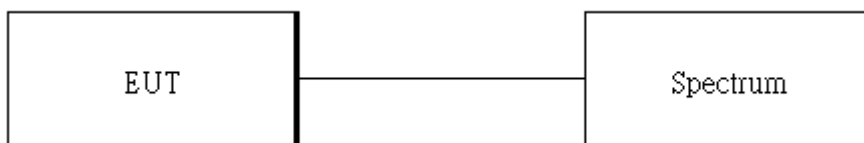
### 9.1 Standard Applicable:

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

### 9.2 Limit:

None

### 9.3 Test Set-up



### 9.4 Measurement Procedure

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

| SGS Conducted Room    |               |           |               |                  |                 |
|-----------------------|---------------|-----------|---------------|------------------|-----------------|
| Name of Equipment     | Manufacturer  | Model     | Serial Number | Calibration Date | Calibration Due |
| EXA Spectrum Analyzer | Agilent       | N9030A    | MY53120760    | 03/21/2017       | 03/20/2018      |
| DC Block              | Mini-Circuits | BLK-18-S+ | 1             | 01/05/2017       | 01/04/2018      |
| Attenuator            | Mini-Circuit  | BW-S10W2+ | 2             | 01/05/2017       | 01/04/2018      |

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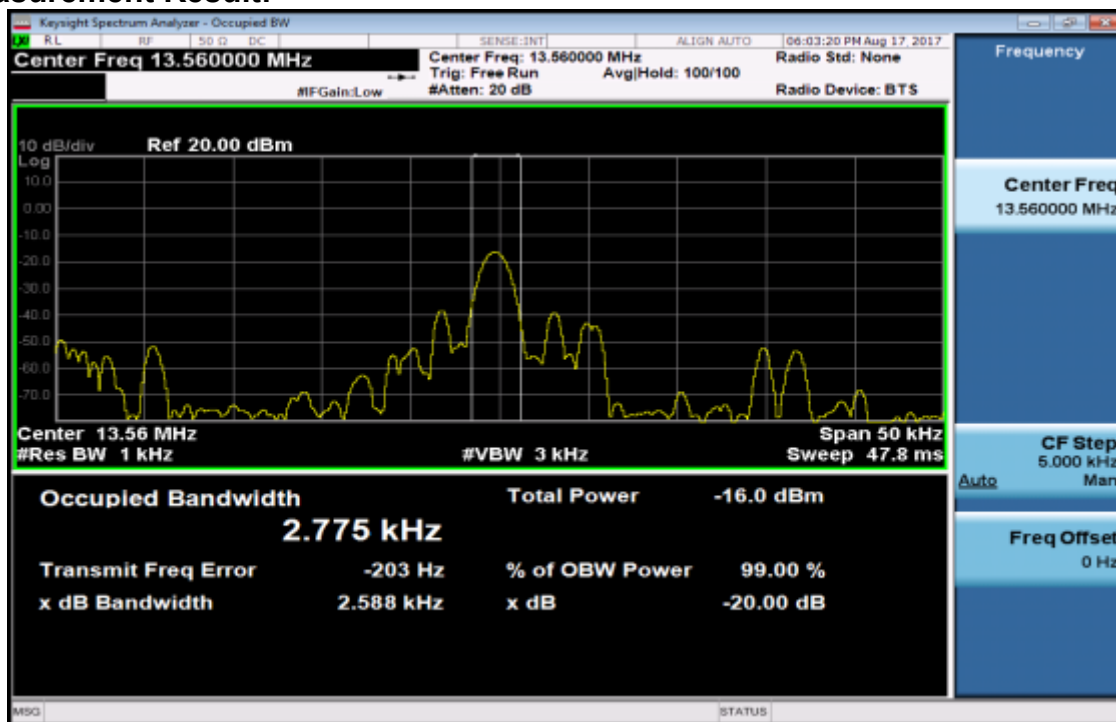
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## 9.6 Measurement Result:



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## 10 ANTENNA REQUIREMENT

### 10.1. Standard Applicable

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of 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.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer.

For transmitters of RF output power of 10 milliwatts or less, only the portion of the antenna gain that is in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power to demonstrate compliance with the radiated power limits specified in the applicable standard. For transmitters of output power greater than 10 milliwatts, the total antenna gain shall be added to the measured RF output power to demonstrate compliance to the specified radiated power limits.

### 10.2. Antenna Connected Construction

An embedded-in antenna design is used.

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo and antenna spec. for details.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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