

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C AND ISED RSS-210 REQUIREMENT

OF

Applicant: Quanta Computer Inc.
No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City
33377, Taiwan

Product Name: Clover Mini

Brand Name: clover

Model No.: C302U

Model Difference: N/A

FCC ID HFS-C302U

IC: 1787B-C302U

Report Number: E2/2018/80009

FCC Rule Part Part 15.225

IC Rule: RSS-210 issue 9 Annex B B.6 Nov. 2017

Issue Date: Sep. 10, 2018

Date of Test: Aug. 01, 2018~ Aug. 29, 2018

Date of EUT Received: Aug. 01, 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 and ISED RSS-210.

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

Tested By:

Vito Pei

Vito Pei / Engineer**Approved By:**

Jim Chang

Jim Chang / Manager

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Revision History

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| E2/2018/80009 | Rev.00 | Initial creation of document | All | Sep. 10, 2018 | Stefanie Yu / Clerk |

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1 GENERAL INFORMATION

1.1 Product Description

General:

| | | |
|------------------------------|------------------------|--|
| Product Name: | Clover Mini | |
| Brand Name: | clover | |
| Model No.: | C302U | |
| Model Difference: | N/A | |
| Product SW/HW version: | N/A / 1.0 | |
| Radio SW/HW version: | N/A / N/A | |
| Test SW Version: | N/A | |
| RF power setting in TEST SW: | N/A | |
| Power Supply: | 12V from AC/DC Adapter | |
| | Adapter: | 1. Model No.: FSP040-RHBN3, Supplier: FSP 2. Model No.: FSP040-RHBN2, Supplier: FSP |

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
 FCC Part 15, Subpart C §15.225
 RSS-210 issue 9 Annex B B.6 Nov. 2017
 RSS-Gen. issue 5 Apr. 2018
 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.2, Keji 1st Rd.,
 Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)
 FCC Registration Number and Designation number are: 735305 / TW0002
 Canada Registration Number: 4620A-5

1.4 Special Accessories

AC Adapter is used while the test is conducted and there is no other accessory attached. This is the worst case condition.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site. There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

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

2.2 EUT Exercise

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

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as 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 a placed on as 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 FCC Part 15.207(a) & RSS-Gen section 8.8 Conducted Emission Limits is as following.

| Frequency range MHz | Limits 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. | | |

(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 (MHz) | Field strength $\mu\text{V/m}$ | Distance (m) | Field strength at 3m $\text{dB}\mu\text{V/m}$ |
|--------------------|-----------------------------------|--------------|--|
| 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= $20 \log (\mu\text{V/m})$
: 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Distance extrapolation factor = $40 \log (\text{required distance/ test distance})$ (dB);
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.
Ex. $20 \log (30)+40 \log (30 / 3)=69.54 \text{ dBuV/m}$
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 Emission test set up configuration

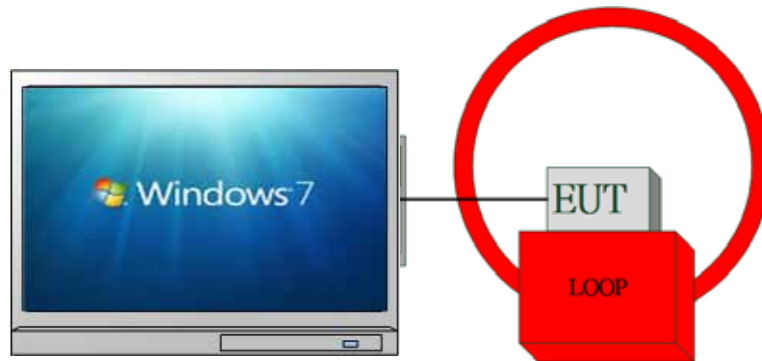


Fig. 2-2 Conduction test set up configuration

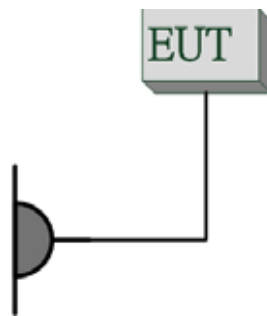


Table 2-1 Equipment Used in Tested System

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|------|-------------------|-----------|----------------|------------|------------|------------|
| 1. | NFC Test software | Tera Term | N/A | N/A | N/A | N/A |
| 2. | Notebook | Lenovo | L420 | S0012467 | Shielded | Unshielded |

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3 SUMMARY OF TEST RESULTS

| FCC Rules | IC Rules | Description Of Test | Result |
|------------------------|--------------------|---|-----------|
| §15.207 | RSS-Gen § 8.8 | AC Power Line Conducted Emission | Compliant |
| §15.225 (a)-(d) | RSS210 Annex B B.6 | Radiated Emission | Compliant |
| §15.209 | RSS-Gen § 8.9 | Radiated Emission Limits, general requirement | Compliant |
| §15.225 (e) | RSS-Gen § 8.11 | Frequency Stability | Compliant |
| §2.1049 §15.215 (c) | RSS-Gen § 6.7 | 20 dB & 99% OCCUPIED BANDWIDTH | Compliant |
| §15.203 | RSS-Gen § 6.8 | Antenna Requirement | Compliant |

4 DESCRIPTION OF TEST MODES

4.1 The Worst Test Modes and Channel Details

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

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

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

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5 MEASUREMENT UNCERTAINTY

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

Radiated Spurious Emission:

| | |
|--|----------------------------|
| Measurement uncertainty (Polarization : Vertical) | 9kHz - 30MHz: +/- 2.3dB |
| | 30MHz - 180MHz: +/- 3.37dB |
| | 180MHz -417MHz: +/- 3.19dB |
| | 0.417GHz-1GHz: +/- 3.19dB |

| | |
|--|----------------------------|
| Measurement uncertainty (Polarization : Horizontal) | 9kHz - 30MHz: +/- 2.3dB |
| | 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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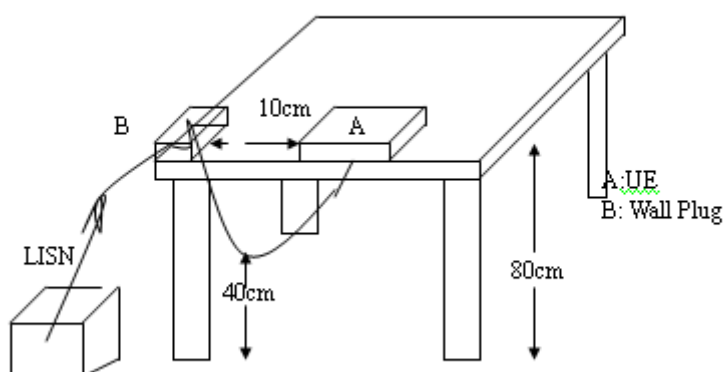
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6 CONDUCTED EMISSIONS TEST

6.1 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Sweep frequency starting from 150 kHz to 30 MHz for phase L1.
4. Repeating the measurement as lists above for phase neutral.

6.2 Test SET-UP (Block Diagram of Configuration)



6.3 Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|------------------------------|-------|--------------|---------------|------------|-----------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| LISN | TESEQ | NNB 51 | 36076 | 2018/02/14 | 2019/2/13 |
| EMI Test Receiver | R&S | ESCI | 101300 | 2017/11/02 | 2018/11/1 |

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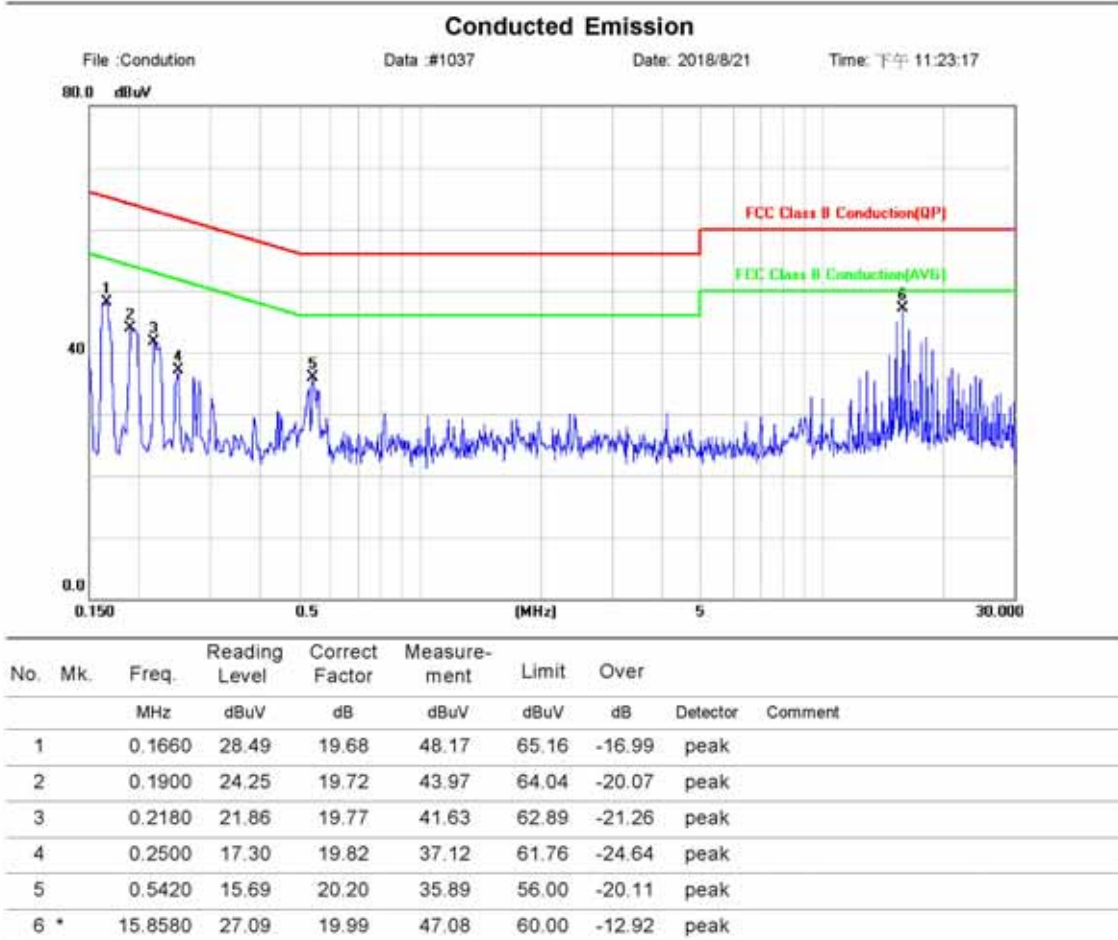
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6.4 Measurement Result:

AC POWER LINE CONDUCTED EMISSION TEST DATA

| | | | |
|-----------------|----------------|----------|-------|
| Operation Mode: | Operation mode | Test By: | Jerry |
|-----------------|----------------|----------|-------|

| | | |
|-----------------------------------|---------------------|--------------------|
| Site : Conduction Room | Phase: L1 | Temperature: 23 °C |
| Limit: FCC Class B Conduction(QP) | Power: AC 120V/60Hz | Humidity: 69 % |
| Mode: | | |
| Note: | | |



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Site : Conduction Room Phase: **N** Temperature: 23 °C
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 69 %
Mode:
Note:

Conducted Emission



| No. | Mk. | Freq. MHz | Reading Level dBuV | Correct Factor dB | Measure- ment dBuV | Limit dBuV | Over dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1 | | 0.1540 | 28.93 | 19.65 | 48.58 | 65.78 | -17.20 | peak | |
| 2 | | 0.1780 | 27.23 | 19.69 | 46.92 | 64.58 | -17.66 | peak | |
| 3 | | 0.2060 | 22.38 | 19.73 | 42.11 | 63.37 | -21.26 | peak | |
| 4 | | 0.2380 | 19.23 | 19.78 | 39.01 | 62.17 | -23.16 | peak | |
| 5 | | 0.2660 | 17.95 | 19.83 | 37.78 | 61.24 | -23.46 | peak | |
| 6 * | | 15.8540 | 26.77 | 20.01 | 46.78 | 60.00 | -13.22 | peak | |

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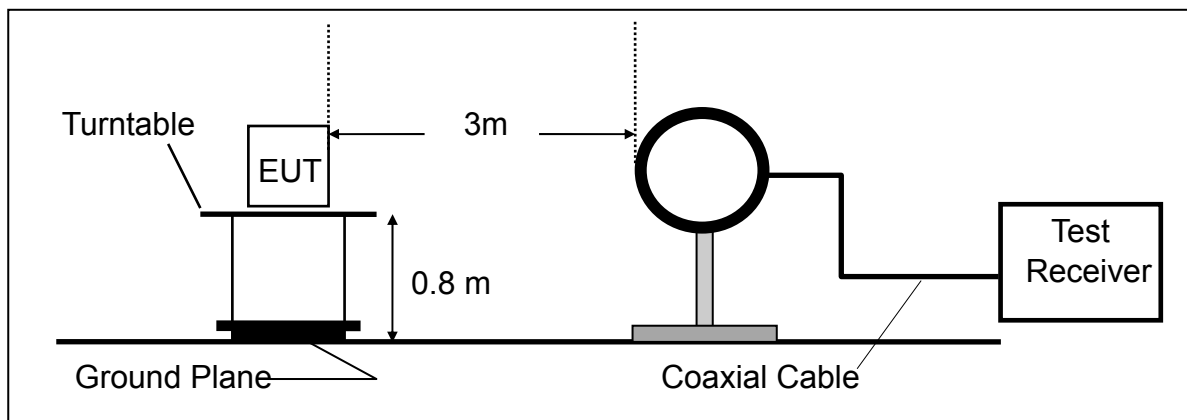
7 RADIATED TEST ITEMS

7.1 Measurement Procedure

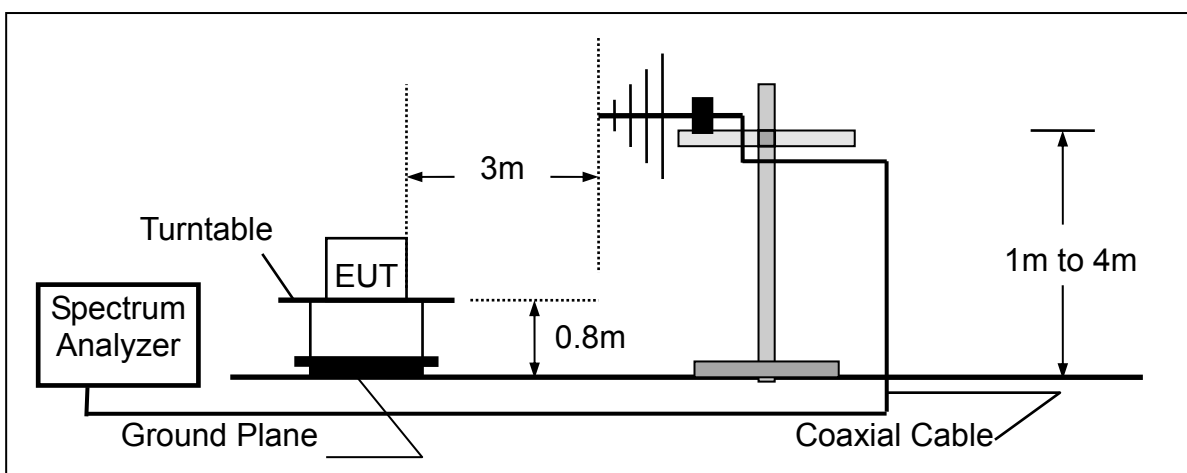
1. Configure the EUT according to ANSI C63.10.
2. The EUT was placed on a turn table which is 0.8m above ground plane and been measured in the frequency range between 0.009MHz to 30MHz and 30MHz to 1GHz.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4.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

7.2 Test SET-UP (Block Diagram of Configuration)

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



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



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7.3 Measurement Equipment Used:

| SGS 966 Chamber No.C | | | | | |
|----------------------|-----------------|---------------|---------------|------------------|-----------------|
| Name of Equipment | Manufacturer | Model | Serial Number | Calibration Date | Calibration Due |
| Broadband Antenna | SCHWAZBEC K | VULB 9168 | 9168-617 | 2017/10/27 | 2018/10/26 |
| Loop Antenna | ETS.LINDGR EN | 6502 | 148045 | 2017/09/26 | 2018/9/25 |
| 3m Site NSA | SGS | 966 chamber D | N/A | 2018/07/06 | 2019/07/05 |
| EMI Test Receiver | R&S | ESU 40 | 100363 | 2018/04/11 | 2019/4/10 |
| Pre-Amplifier | EMC Instruments | EMC9135 | 980234 | 2017/12/26 | 2018/12/25 |
| Coaxial Cable | Huber Suhner | RG 214/U | W22.03 | 2017/12/26 | 2018/12/25 |

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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 | |

7.5 Field Strength of Fundamental Emission

7.5.1 FCC Applicable standard

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

Field strength of fundamental emissions limit:

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

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

30m to 3m

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

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

30m to 10m

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

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

10m to 3m

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

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

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7.5.2 ISED Applicable standard

Radiated Mask for RSS 210 Annex B B6

- (a) 15.848 millivolts/m (84 dB μ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB μ 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 μ 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) $20 \cdot \log(106 \mu\text{V/m}) + 40\text{dB} = 80.50\text{dB}\mu\text{V/m}$

Note:

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

Actual FS(dB μ V/m) = Spectrum. Reading level(dB μ V) + Factor(dB)Factor(dB) = Antenna Factor(dB μ V/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

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

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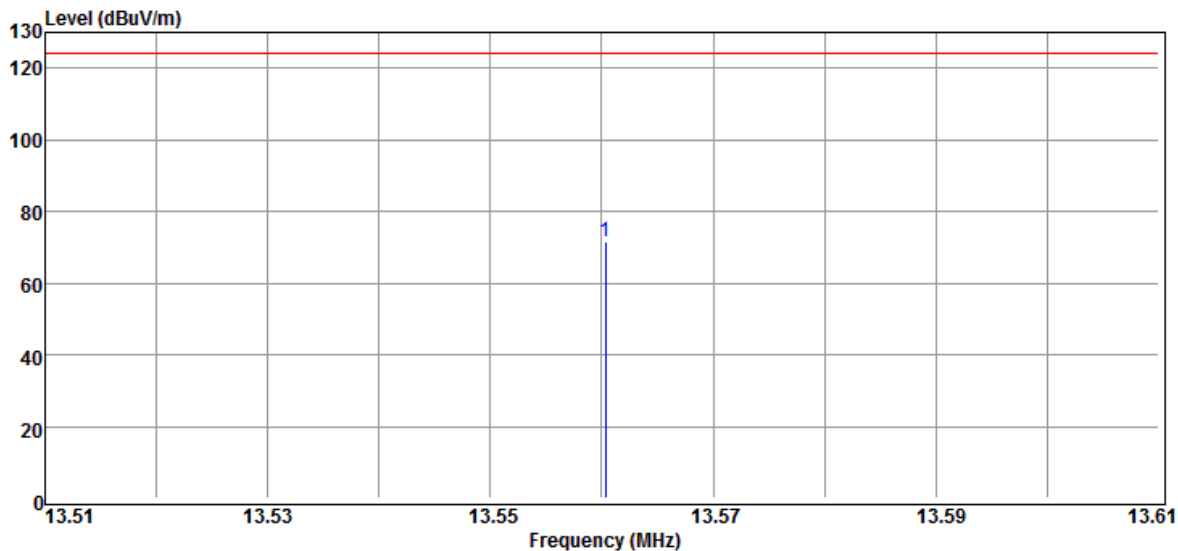
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7.6 Field Strength of Fundamental Emission Measurement Result

| | | | |
|----------------|--------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Main CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :VERTICAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.56 | Peak | 60.01 | 11.56 | 71.57 | 124.00 | -52.43 |

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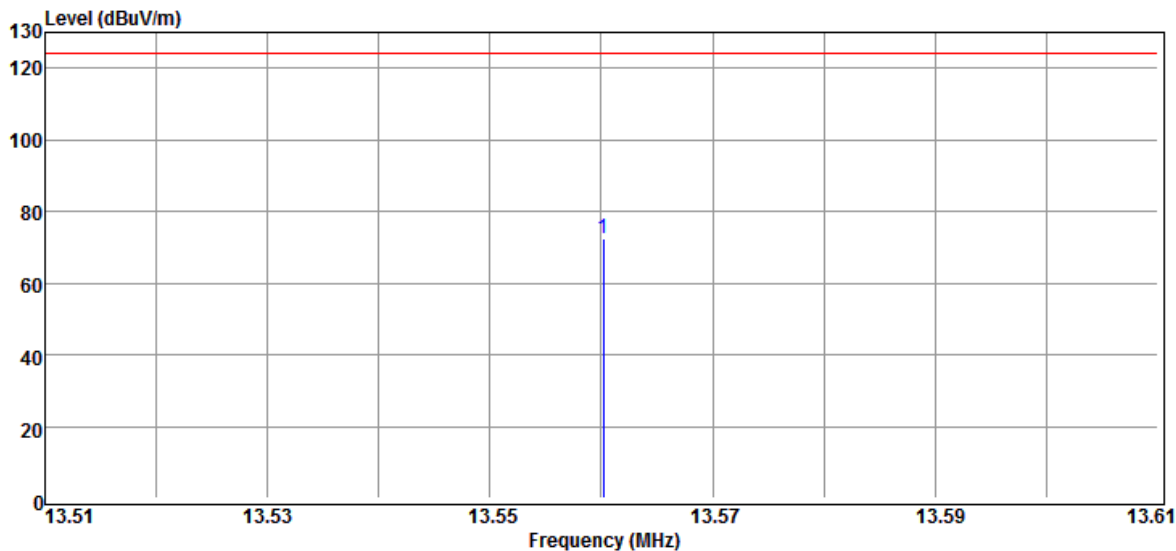
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| | | | |
|----------------|--------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Main CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :HORIZONTAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.56 | Peak | 60.66 | 11.56 | 72.22 | 124.00 | -51.78 |

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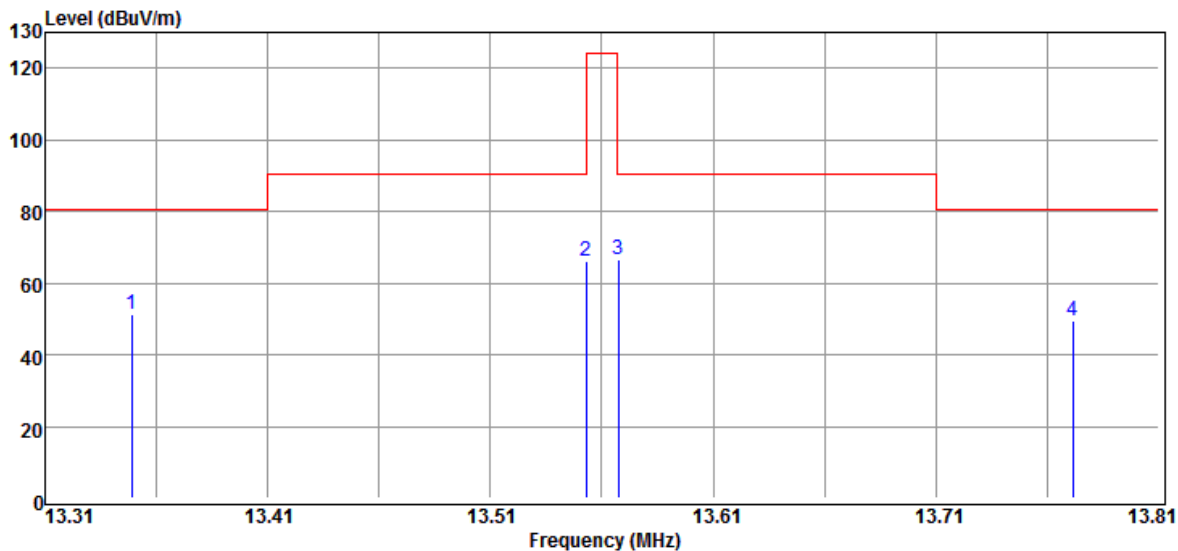
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7.6.1 Radiated Mask

| | | | |
|----------------|--------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Mask CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :VERTICAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.35 | Peak | 39.76 | 11.58 | 51.34 | 80.54 | -29.20 |
| 13.55 | Peak | 54.72 | 11.56 | 66.28 | 90.47 | -24.19 |
| 13.57 | Peak | 55.05 | 11.56 | 66.61 | 90.47 | -23.86 |
| 13.77 | Peak | 38.09 | 11.55 | 49.64 | 80.50 | -30.86 |

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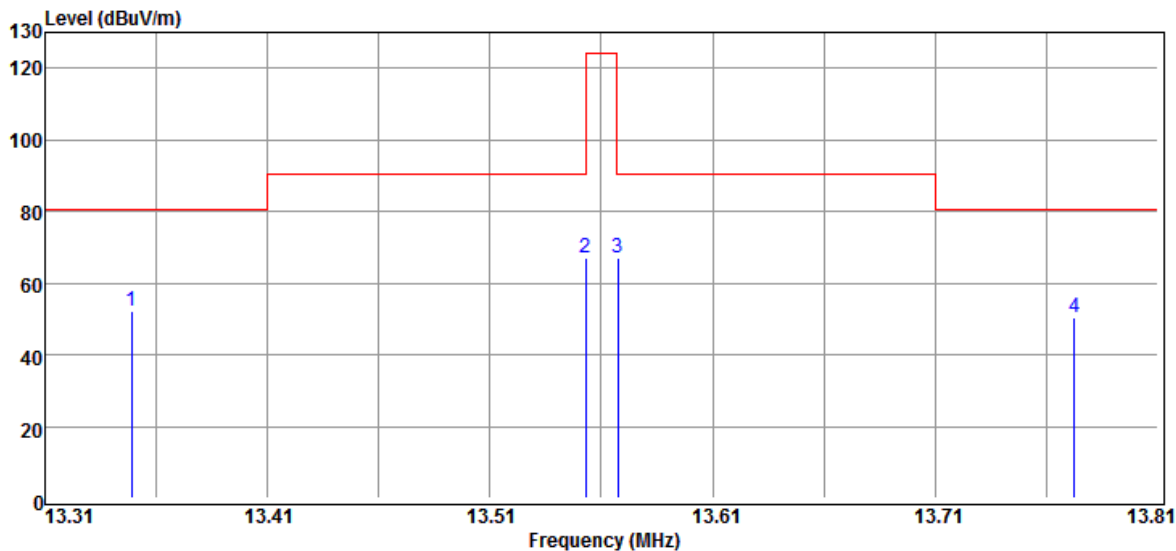
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| | | | |
|----------------|--------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Mask CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :HORIZONTAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 13.35 | Peak | 40.48 | 11.58 | 52.06 | 80.54 | -28.48 |
| 13.55 | Peak | 55.24 | 11.56 | 66.80 | 90.47 | -23.67 |
| 13.57 | Peak | 55.60 | 11.56 | 67.16 | 90.47 | -23.31 |
| 13.77 | Peak | 38.89 | 11.55 | 50.44 | 80.50 | -30.06 |

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7.7 Radiated Emission Measurement

7.7.1 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. $20 \cdot \log(30 \mu\text{V/m}) + 40\text{dB} = 69.54 \text{ dBuV/m}$
4. The lower limit shall apply at the transition frequencies.
5. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.

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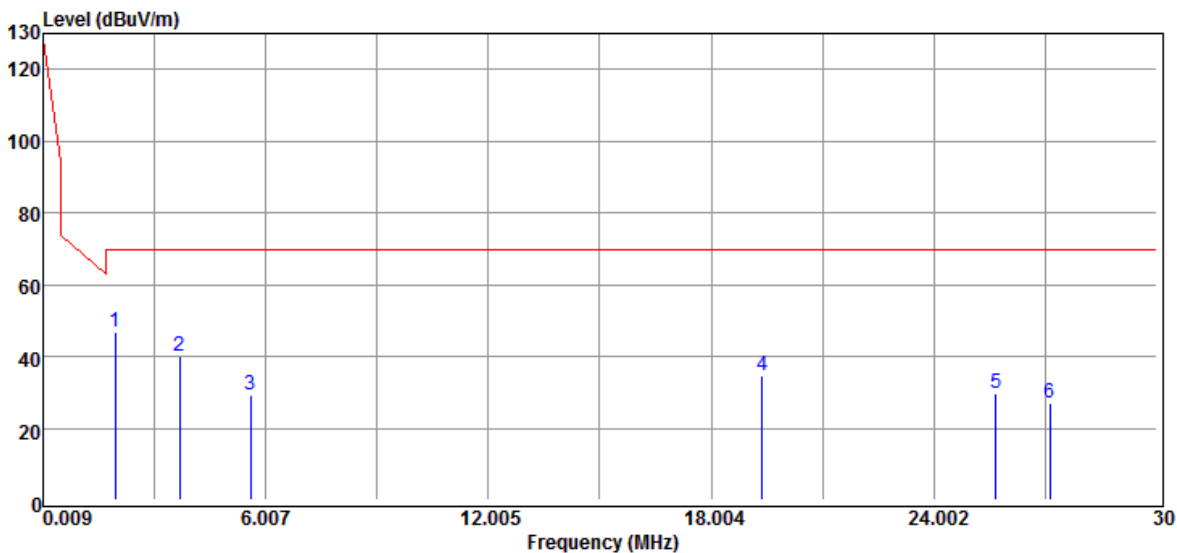
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| | | | |
|----------------|------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Tx CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :VERTICAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 1.96 | Peak | 35.24 | 11.64 | 46.88 | 69.54 | -22.66 |
| 3.70 | Peak | 29.10 | 11.10 | 40.20 | 69.54 | -29.34 |
| 5.59 | Peak | 18.11 | 11.24 | 29.35 | 69.54 | -40.19 |
| 19.38 | Peak | 23.42 | 11.29 | 34.71 | 69.54 | -34.83 |
| 25.68 | Peak | 19.69 | 9.95 | 29.64 | 69.54 | -39.90 |
| 27.12 | Peak | 17.34 | 9.67 | 27.01 | 69.54 | -42.53 |

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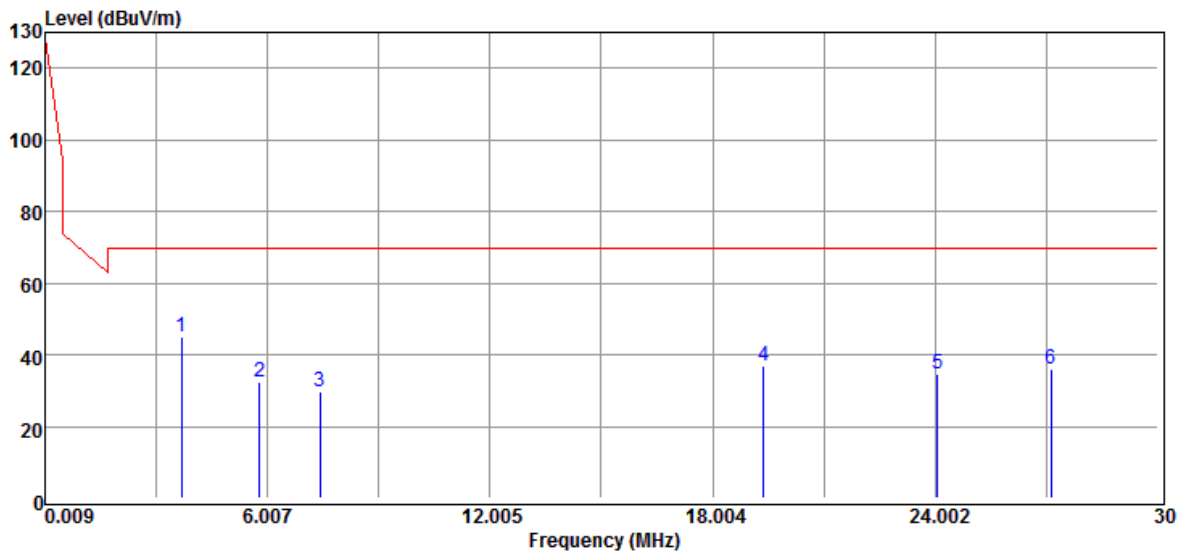
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| | | | |
|----------------|------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Tx CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :HORIZONTAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 3.70 | Peak | 33.91 | 11.10 | 45.01 | 69.54 | -24.53 |
| 5.80 | Peak | 20.92 | 11.28 | 32.20 | 69.54 | -37.34 |
| 7.42 | Peak | 18.27 | 11.51 | 29.78 | 69.54 | -39.76 |
| 19.38 | Peak | 25.70 | 11.29 | 36.99 | 69.54 | -32.55 |
| 24.06 | Peak | 24.34 | 10.30 | 34.64 | 69.54 | -34.90 |
| 27.12 | Peak | 26.36 | 9.67 | 36.03 | 69.54 | -33.51 |

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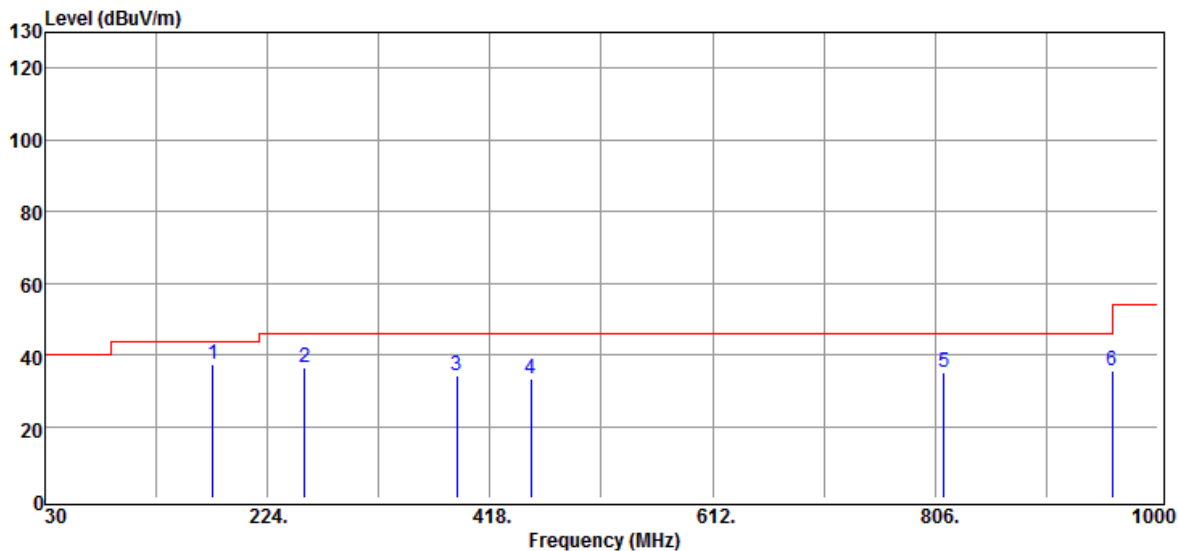
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| | | | |
|----------------|------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Tx CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :VERTICAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 176.47 | Peak | 54.29 | -17.06 | 37.23 | 43.50 | -6.27 |
| 256.01 | Peak | 53.32 | -16.74 | 36.58 | 46.00 | -9.42 |
| 388.90 | Peak | 47.24 | -13.07 | 34.17 | 46.00 | -11.83 |
| 453.89 | Peak | 44.86 | -11.74 | 33.12 | 46.00 | -12.88 |
| 813.76 | Peak | 41.13 | -5.99 | 35.14 | 46.00 | -10.86 |
| 960.23 | Peak | 39.52 | -4.07 | 35.45 | 54.00 | -18.55 |

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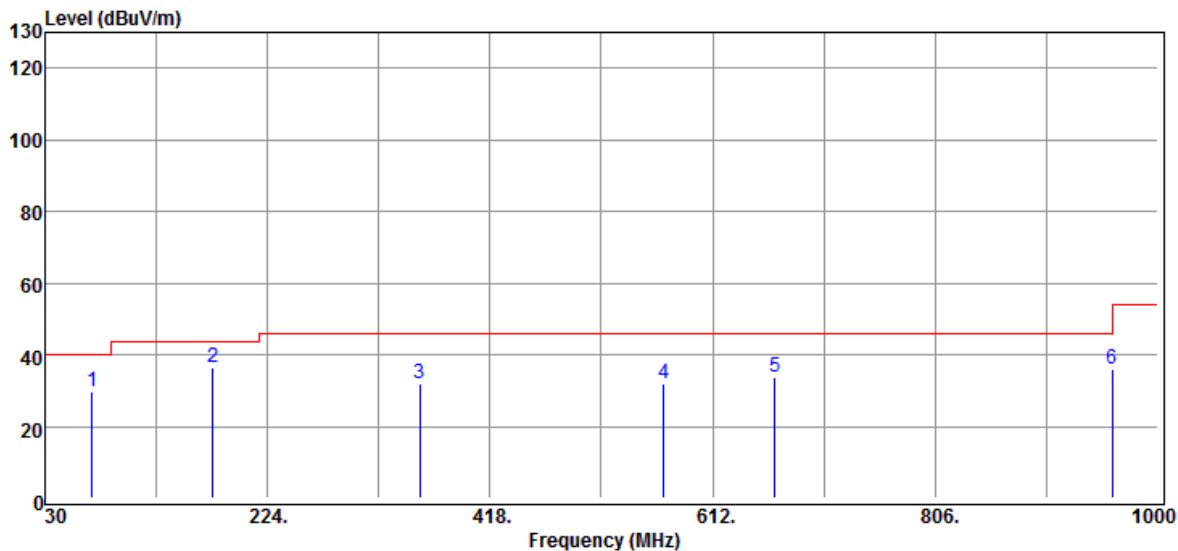
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| | | | |
|----------------|------------|--------------|-------------|
| Operation Mode | :NFC | Test Date | :2018-08-21 |
| Test Mode | :Tx CH Mid | Temp./Humi. | :25/60 |
| EUT Pol | :E1 Plan | Antenna Pol. | :HORIZONTAL |
| Test Channel | :13.56 MHz | Engineer | :Jerry |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 70.74 | Peak | 50.02 | -20.13 | 29.89 | 40.00 | -10.11 |
| 176.47 | Peak | 58.28 | -21.97 | 36.31 | 43.50 | -7.19 |
| 356.89 | Peak | 45.71 | -13.81 | 31.90 | 46.00 | -14.10 |
| 569.32 | Peak | 41.72 | -9.65 | 32.07 | 46.00 | -13.93 |
| 666.32 | Peak | 42.27 | -8.72 | 33.55 | 46.00 | -12.45 |
| 960.23 | Peak | 40.07 | -4.07 | 36.00 | 54.00 | -18.00 |

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8 FREQUENCY TOLERANCE

8.1 Applicable Standard

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

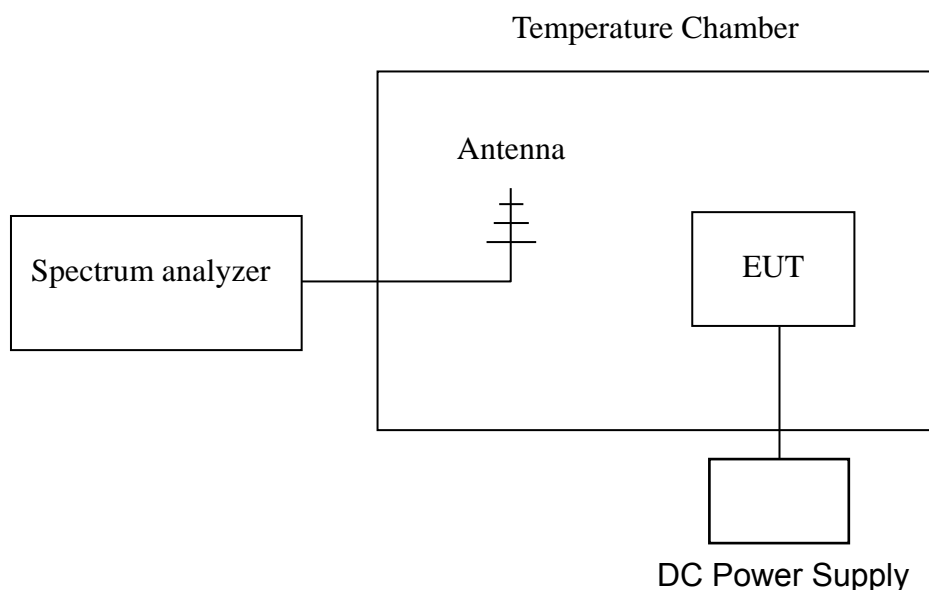
Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

For licence-exempt radio apparatus, the frequency stability shall be measured at temperatures of -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F).

8.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10kHz, Span =100kHz.
4. Set SPA Max hold. Mark peak.

8.3 Test SET-UP (Block Diagram of Configuration)



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8.4 Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|------------------------------|--------------|--------------|---------------|--------------|--------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Spectrum Analyzer | Agilent | N9010A | MY53400256 | Oct.30, 2017 | Oct.29, 2018 |
| Temperature Chamber | TERCHY | MHK-120LK | 1020582 | Jul.10, 2018 | Jul.09, 2019 |
| DC Power Supply | Agilent | E3640A | MY53140006 | Apr.29, 2018 | Apr.28, 2019 |
| Loop Antenna | ETS-Lindgren | 6502 | 00143303 | Apr.19, 2018 | Apr.18, 2019 |

8.5 Measurement Results

Startup:

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12 | -20 | 13.5598 | 0.40000 | +/- 1.356 |
| 12 | -10 | 13.5598 | 0.40000 | +/- 1.356 |
| 12 | 0 | 13.5599 | 0.30000 | +/- 1.356 |
| 12 | 10 | 13.561 | -0.80000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 12 | 30 | 13.5602 | 0.00000 | +/- 1.356 |
| 12 | 40 | 13.5603 | -0.10000 | +/- 1.356 |
| 12 | 50 | 13.5604 | -0.20000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12.6 | 20 | 13.5606 | -0.40000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 11.4 | 20 | 13.5598 | 0.40000 | +/- 1.356 |

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2 minutes:

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12 | -20 | 13.5597 | 0.50000 | +/- 1.356 |
| 12 | -10 | 13.5598 | 0.40000 | +/- 1.356 |
| 12 | 0 | 13.5597 | 0.50000 | +/- 1.356 |
| 12 | 10 | 13.5598 | 0.40000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 12 | 30 | 13.5603 | -0.10000 | +/- 1.356 |
| 12 | 40 | 13.5605 | -0.30000 | +/- 1.356 |
| 12 | 50 | 13.5607 | -0.50000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12.6 | 20 | 13.5603 | -0.10000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 11.4 | 20 | 13.5596 | 0.60000 | +/- 1.356 |

5 minutes:

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12 | -20 | 13.5596 | 0.50000 | +/- 1.356 |
| 12 | -10 | 13.5597 | 0.40000 | +/- 1.356 |
| 12 | 0 | 13.5597 | 0.40000 | +/- 1.356 |
| 12 | 10 | 13.5597 | 0.40000 | +/- 1.356 |
| 12 | 20 | 13.5601 | 0.00000 | +/- 1.356 |
| 12 | 30 | 13.5602 | -0.10000 | +/- 1.356 |
| 12 | 40 | 13.5606 | -0.50000 | +/- 1.356 |
| 12 | 50 | 13.5607 | -0.60000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12.6 | 20 | 13.5609 | -0.70000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 11.4 | 20 | 13.5596 | 0.60000 | +/- 1.356 |

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10 minutes:

A. Temperature Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12 | -20 | 13.5595 | 0.70000 | +/- 1.356 |
| 12 | -10 | 13.5596 | 0.60000 | +/- 1.356 |
| 12 | 0 | 13.5595 | 0.70000 | +/- 1.356 |
| 12 | 10 | 13.5599 | 0.30000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 12 | 30 | 13.5604 | -0.20000 | +/- 1.356 |
| 12 | 40 | 13.5606 | -0.40000 | +/- 1.356 |
| 12 | 50 | 13.5607 | -0.50000 | +/- 1.356 |

B. Supply Voltage Variation

| Power Supply | Environment | Frequency | Delta (KHz) | Limit (KHz) |
|--------------|-----------------|-----------|-------------|-------------|
| Vdc | Temperature () | (MHz) | | |
| 12.6 | 20 | 13.5609 | -0.70000 | +/- 1.356 |
| 12 | 20 | 13.5602 | 0.00000 | +/- 1.356 |
| 11.4 | 20 | 13.5596 | 0.60000 | +/- 1.356 |

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9 20 dB & 99% OCCUPIED BANDWIDTH MEASUREMENT

9.1 Applicable Standard:

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

9.2 Limit:

None

9.3 Test Set-up

Refer to section 8.3 in this report

9.4 Measurement Procedure

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

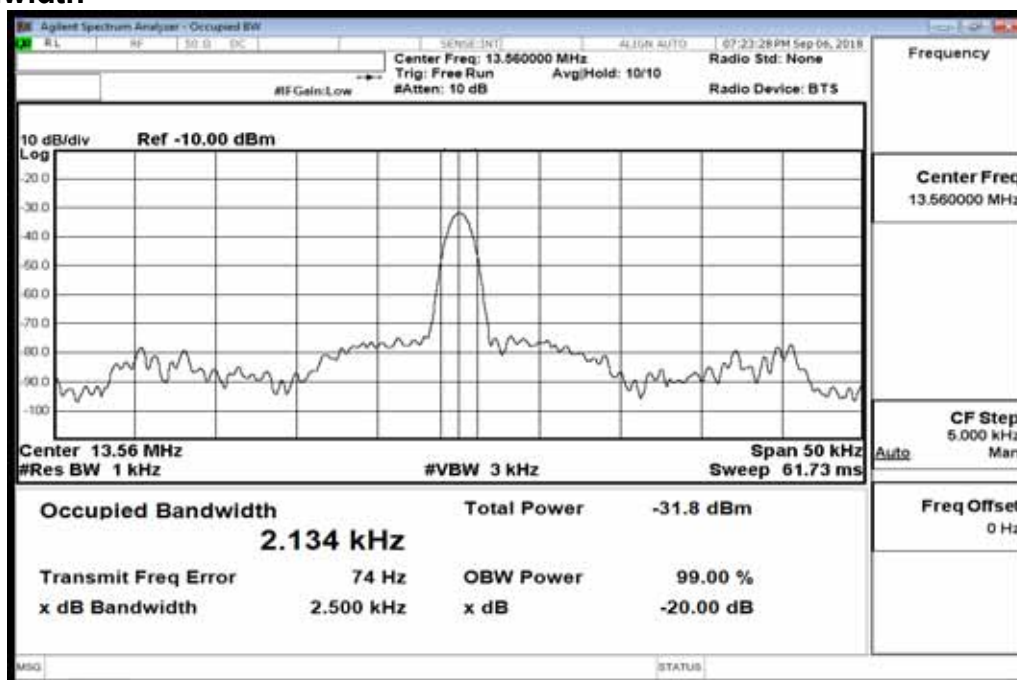
9.5 Measurement Equipment Used:

Refer to section 8.4 in this report

9.6 Measurement Result

| | Operation range | Frequency (MHz) | Limit (MHz) |
|---------------|-----------------|-----------------|-------------|
| 20dB BW (kHz) | Low | 13.55885 | >13.11 |
| 2.5 | High | 13.56115 | <14.01 |

-20dB Bandwidth



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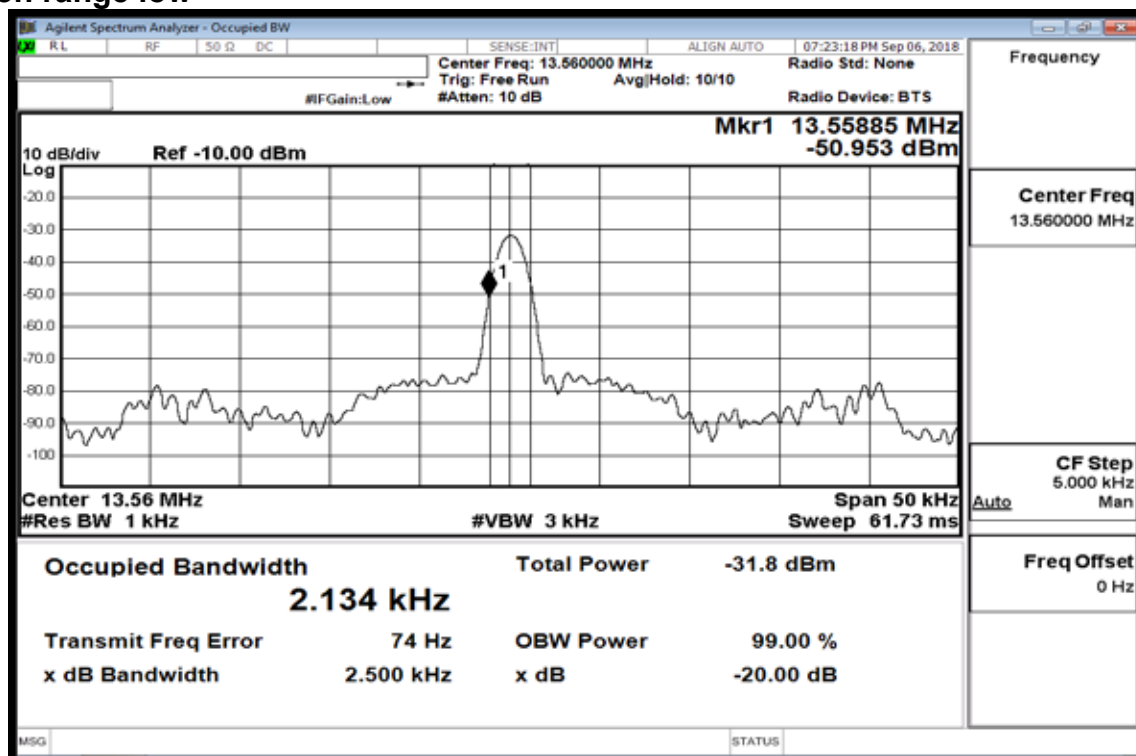
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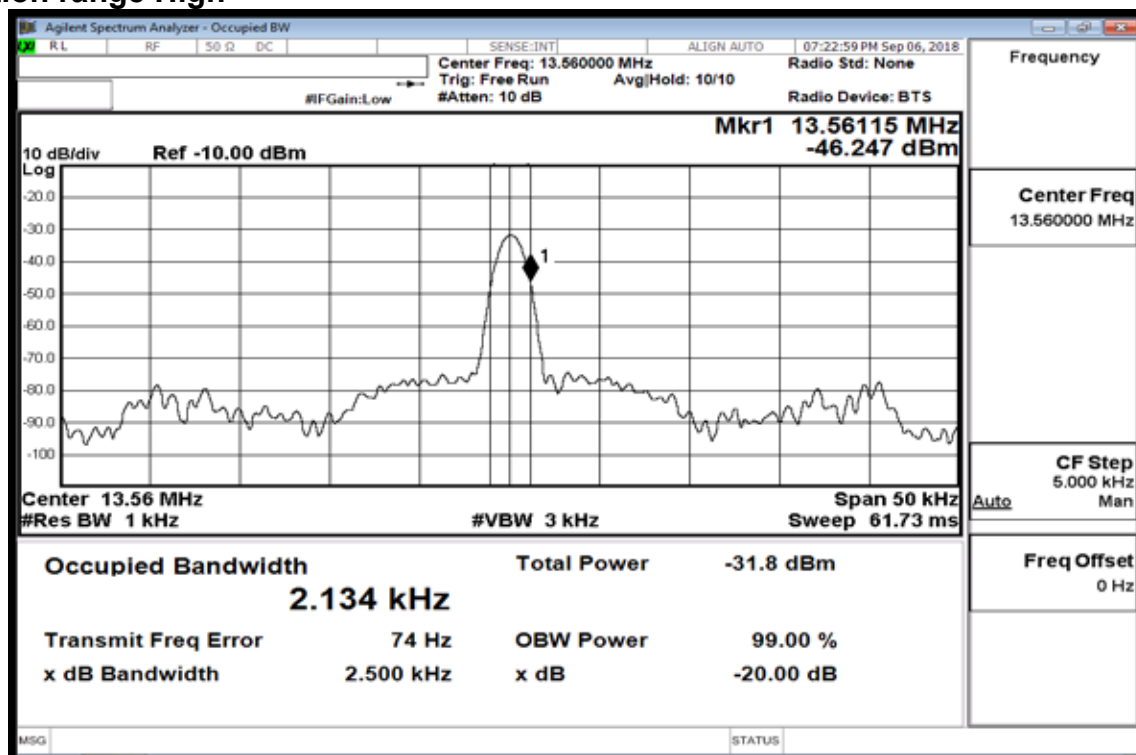
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Operation range low



Operation range High



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10 ANTENNA REQUIREMENT

10.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

10.2 Antenna Connected Construction:

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

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