# FCC Test Report

| | | |
|---|---|---|
| **FCC ID** | : | **UZ7HFDOCK** |
| **Equipment** | : | **EMA DOCK NFC READER BOARD** |
| **Brand Name** | : | **ZEBRA** |
| **Model Name** | : | **HFDOCK** |
| **Applicant/ Manufacturer** | : | **Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742** |
| **Standard** | : | **47 CFR FCC Part 15.225** |

**The product was received on Oct. 31, 2019, and testing was started from Dec. 06, 2019 and completed on Dec. 11, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.**

**The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of United States government.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.**

Approved by: Allen Lin

***SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory***

*No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)*

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# History of this test report

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| FR9O3018AR | 01 | Initial issue of report | Dec. 16, 2019 |
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# Summary of Test Result

| Report Clause | Ref. Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| 1.1.2 | 15.203 | Antenna Requirement | PASS | FCC 15.203 |
| 3.1 | 15.207 | AC Power-line Conducted Emissions | PASS | FCC 15.207 |
| 3.2 | 15.215(c) | Emission Bandwidth | PASS | Fall in band<br>$F_L \geq 13.553$ MHz<br>$F_H \leq 13.567$ MHz |
| 3.3 | 15.225(a)~(d) | Field Strength of Fundamental Emissions and Spectrum Mask | PASS | 124 dBuV/m at 3m |
| 3.4 | 15.225(d) | Transmitter Radiated Unwanted Emissions | PASS | FCC 15.209 |
| 3.5 | 15.225(e) | Frequency Stability | PASS | ± 0.01% (100ppm) |

| **Declaration of Conformity:** |
|---|
| The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. |
| **Comments and explanations:** |
| None |

**Reviewed by: Sam Tsai**

**Report Producer: Kate Lo**

# 1 General Description

## 1.1 Information

### 1.1.1 RF General Information

| RF General Information | | | | |
|---|---|---|---|---|
| **Frequency Range** | **Modulation Mode** | **Ch. Frequency (MHz)** | **Channel Number** | **Field Strength (dBuV/m)** |
| 13.553 – 13.567 MHz | ISO 15693 (ASK) | 13.56 | 1 | 78.37 |
| Note 1: Field strength performed peak level at 3m. | | | | |

### 1.1.2 Antenna Information

| Antenna Category | |
|---|---|
| ☐ | Equipment placed on the market without antennas |
| ☒ | Integral antenna (antenna permanently attached) |
| | ☐ Temporary RF connector provided |
| | ☒ No temporary RF connector provided<br>Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path. |
| ☐ | External antenna (dedicated antennas) |

| Antenna General Information | | |
|---|---|---|
| **No.** | **Ant. Cat.** | **Ant. Type** |
| 1 | Integral | Loop |

### 1.1.3 EUT Information

| Operational Condition | | |
|---|---|---|
| **EUT Power Type** | From DC Power supply | |
| **Type of EUT** | | |
| ☒ | Stand-alone | |
| ☐ | Combined (EUT where the radio part is fully integrated within another device) | |
| | Combined Equipment - Brand Name / Model No.: | |
| ☐ | Plug-in radio (EUT intended for a variety of host systems) | |
| | Host System - Brand Name / Model No.: | |
| ☐ | Other: | |

### 1.1.4 Test Signal Duty Cycle

| Duty Cycle Operation Restriction | | | |
|---|---|---|---|
| The transmitter is used for | | The transmitter is operated | |
| ☒ | Inductive applications | ☒ | Automatically triggered |
| ☐ | Duty cycle fixed mode | ☒ | Duty cycle random mode |
| ☐ | **Duty cycle mode - NFC-A (ISO 14443-3A)** | | |
| Declare transmitter duty cycle / 1 hour = | | 100% | |
| ☐ | **Duty cycle mode - NFC-B (ISO 14443-3B)** | | |
| Declare transmitter duty cycle / 1 hour = | | 100% | |
| ☐ | **Duty cycle mode - NFC-F ( ISO 18092)** | | |
| Declare transmitter duty cycle / 1 hour = | | 100% | |
| ☒ | **Duty cycle mode - NFC-V (ISO 15693)** | | |
| Declare transmitter duty cycle / 1 hour = | | 100% | |

## 1.2 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR FCC Part 15
- ANSI C63.10-2013
- KDB 174176 D01 v01r01

## 1.3 Testing Location Information

| Testing Location | | | |
|---|---|---|---|
| ☒ | HWA YA | ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) | |
| | | TEL : 886-3-327-3456 | FAX : 886-3-327-0973 |
| Test site Designation No. TW1190 with FCC. | | | |

| Test Condition | Test Site No. | Test Engineer | Test Environment | Test Date |
|---|---|---|---|---|
| AC Conduction | CO04-HY | Edward | 20.1~21.3°C / 62%~66% | 11/Dec/2019 |
| RF Conducted | TH06-HY | Raven | 22.5~23.7°C / 58~64% | 06/Dec/2019 |
| Radiated Emission | 03CH03-HY | Justin | 16.2~19.1°C / 53.7~56.8% | 07/Dec/2019 |

## 1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

| Test Items | Uncertainty | Remark |
|---|---|---|
| Conducted Emission (150kHz ~ 30MHz) | 3.54 dB | Confidence levels of 95% |
| Radiated Emission (9kHz ~ 30MHz) | 1.6 dB | Confidence levels of 95% |
| Radiated Emission (30MHz ~ 1,000MHz) | 4.3 dB | Confidence levels of 95% |
| Conducted Emission | 1.3 dB | Confidence levels of 95% |
| Temperature | 0.7 °C | Confidence levels of 95% |
| Humidity | 4 % | Confidence levels of 95% |

# 2 Test Configuration of EUT

## 2.1 Test Condition

| Condition Item | Abbreviation/Remark | Remark |
|---|---|---|
| Frequency Stability | Tnom | 20°C |
| - | Tmin | -20°C |
| - | Tmax | 50°C |
| - | Vnom | 12V |
| - | Vmin | 10.8V |
| - | Vmax | 13.5V |

## 2.2 The Worst Case Modulation Configuration

| Modulation Used for Conformance Testing | |
|---|---|
| **Modulation Mode** | **Field Strength (dBuV/m at 3 m)** |
| NFC | 78.37 |

## 2.3 Test Channel Frequencies Configuration

| Modulation Mode | Test Channel Frequencies (MHz) |
|---|---|
| NFC | 13.56 |

## 2.4 The Worst Case Measurement Configuration

| The Worst Case Mode for Following Conformance Tests | |
|---|---|
| **Tests Item** | AC power-line conducted emissions |
| **Condition** | AC power-line conducted measurement for line and neutral<br>Test Voltage: 120Vac / 60Hz |
| **Operating Mode** | DC Power Supply mode |

| The Worst Case Mode for Following Conformance Tests | |
|---|---|
| **Tests Item** | Emission Bandwidth, Frequency Stability |
| **Test Condition** | Conducted measurement |

| The Worst Case Mode for Following Conformance Tests | | | |
|---|---|---|---|
| **Tests Item** | Field Strength of Fundamental Emissions<br>Spectrum Mask, Transmitter Radiated Unwanted Emissions | | |
| **Test Condition** | Radiated measurement | | |
| **Operating Mode** | DC Power Supply mode | | |
| **Orthogonal Planes of EUT** | **X Plane** | **Y Plane** | **Z Plane** |
| |  |  |  |
| **Worst Planes of EUT** | | V | |

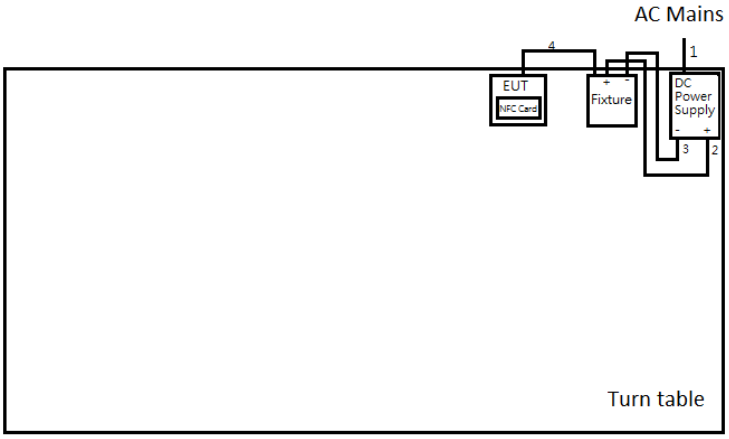
## 2.5 Support Equipment

| Support Equipment - RF Conducted | | | |
|---|---|---|---|
| **No.** | **Equipment** | **Brand Name** | **Model Name** |
| 1 | DC Power Source | GW | APS-9102 |
| 2 | EMA DOCKING STATION CONTROLLER BOARD | HannStar | K MV-4 E89382 94V-0 |
| 3 | EMA_DM_NFC_READER_CABLE | ZEBRA | 1414-0CTY000 |

| Support Equipment - AC Conduction and Radiated | | | |
|---|---|---|---|
| **No.** | **Equipment** | **Brand Name** | **Model Name** |
| 1 | DC power supply | GW | GPS-3030DD |
| 2 | EMA DOCKING STATION CONTROLLER BOARD | HannStar | K MV-4 E89382 94V-0 |
| 3 | EMA_DM_NFC_READER_CABLE | ZEBRA | 1414-0CTY000 |

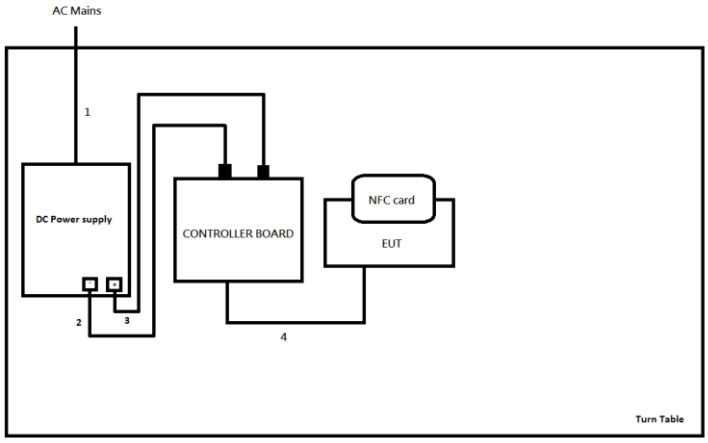
## 2.6 Test Setup Diagram

**Test Setup Diagram – AC Line Conducted Emission Test**




| Item | Connection | Shielded | Length(m) | Remark |
|---|---|---|---|---|
| 1 | AC Power Cable | No | 1.8 | - |
| 2 | DC Power Cable | No | 1.0 | - |
| 3 | DC Power Cable | No | 1. | - |
| 4 | EMA_DM_NFC_READER_CABLE | No | 0.3 | - |

**Test Setup Diagram - Radiated Test**




| Item | Connection | Shielded | Length(m) | Remark |
|---|---|---|---|---|
| 1 | AC power cable | No | 1.8 | - |
| 2 | DC power cable | No | 1 | - |
| 3 | DC power cable | No | 1 | - |
| 4 | EMA_DM_NFC_READER_CABLE | No | 0.3 | - |

# 3 Transmitter Test Result

## 3.1 AC Power-line Conducted Emissions

### 3.1.1 AC Power-line Conducted Emissions Limit

| AC Power-line Conducted Emissions Limit | | |
|---|---|---|
| **Frequency Emission (MHz)** | **Quasi-Peak** | **Average** |
| 0.15-0.5 | 66 - 56 * | 56 - 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |
| Note 1: * Decreases with the logarithm of the frequency. | | |

### 3.1.2 Measuring Instruments

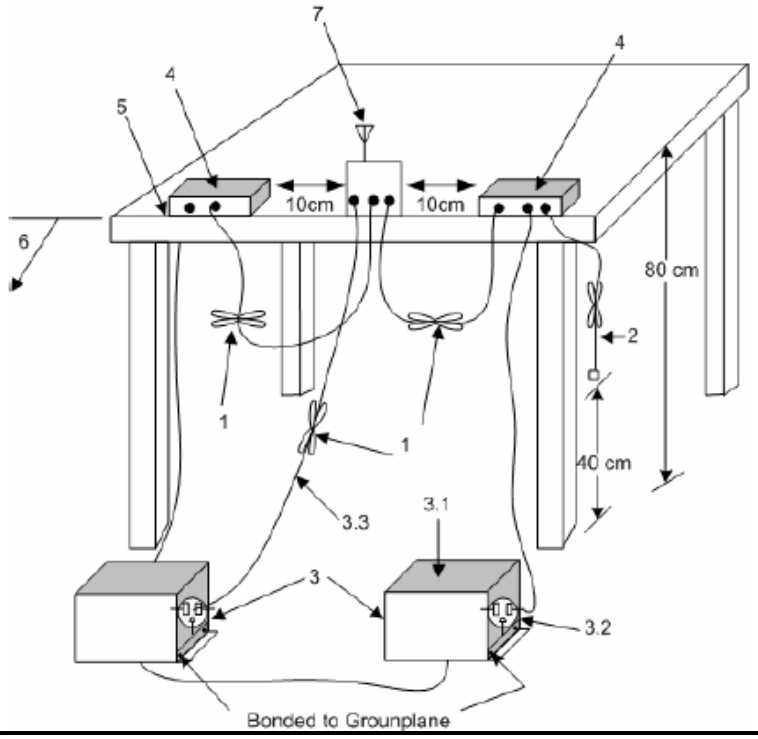
Refer a test equipment and calibration data table in this test report.

### 3.1.3 Test Procedures

| Test Method | |
|---|---|
| ☒ | Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions. |
| ☒ | If AC conducted emissions fall in operating band, then following below test method confirm final result. |
| ☐ | Accept measurements done with a suitable dummy load replacing the antenna under the following conditions:<br>(1) Perform the AC line conducted tests with the antenna connected to determine compliance with FCC 15.207 limits outside the transmitter's fundamental emission band;<br>(2) Retest with a dummy load to determine compliance with FCC 15.207 limits within the transmitter's fundamental emission band. |
| ☒ | For a device with a permanent antenna operating at or below 30 MHz, accept measurements done with a suitable dummy load, in lieu of the permanent antenna under the following conditions:<br>(1) Perform the AC line conducted tests with the permanent antenna to determine compliance with the FCC 15.207 limits outside the transmitter's fundamental emission band;<br>(2) Retest with a dummy load in lieu of the permanent antenna to determine compliance with the FCC 15.207 limits within the transmitter's fundamental emission band. |

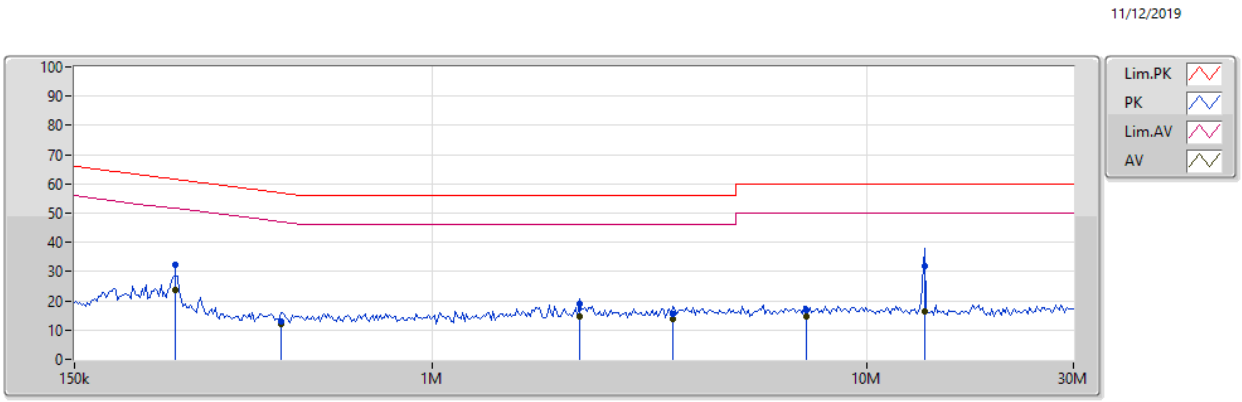
### 3.1.4 Test Setup

**AC Power-line Conducted Emissions**



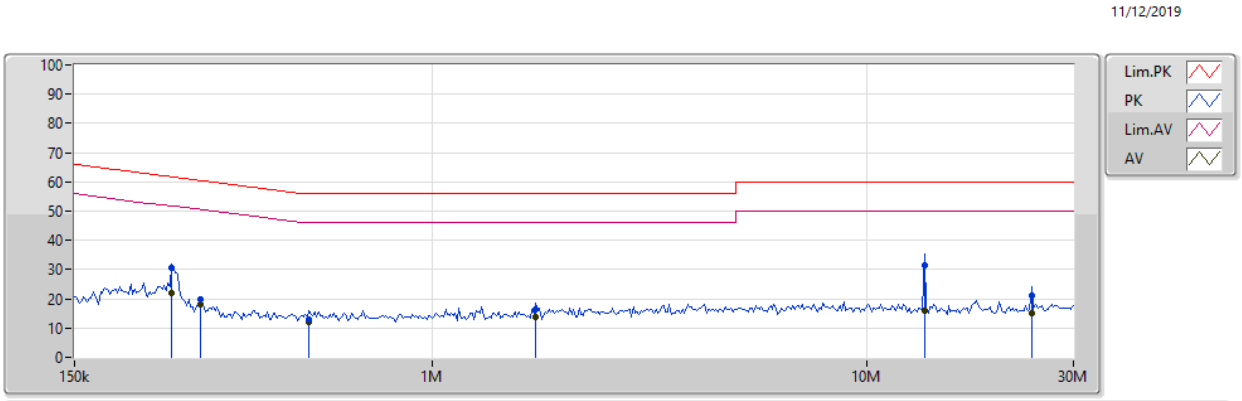
### 3.1.5 Test Result of AC Power-line Conducted Emissions

| AC Power-line Conducted Emissions Result | | | |
|---|---|---|---|
| **Operating Mode** | 1 | **Power Phase** | Neutral |
| **Operating Function** | DC Power Supply mode | | |




| Type | Freq | Level | Limit | Margin | Factor | Condition | Comment | Raw | LISN | CL | AT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV) | (dBuV) | (dB) | (dB) | | | (dBuV) | (dB) | (dB) | (dB) |
| QP | 256.712k | 32.39 | 61.54 | -29.15 | 19.63 | Neutral | - | 12.76 | 9.64 | 0.12 | 9.87 |
| AV | 256.712k | 23.77 | 51.54 | -27.77 | 19.63 | Neutral | "Worst" | 4.14 | 9.64 | 0.12 | 9.87 |
| QP | 448.17k | 12.87 | 56.92 | -44.05 | 19.63 | Neutral | - | -6.76 | 9.63 | 0.13 | 9.87 |
| AV | 448.17k | 12.14 | 46.92 | -34.78 | 19.63 | Neutral | - | -7.49 | 9.63 | 0.13 | 9.87 |
| QP | 2.18M | 19.16 | 56.00 | -36.84 | 19.67 | Neutral | - | -0.51 | 9.65 | 0.15 | 9.87 |
| AV | 2.18M | 14.85 | 46.00 | -31.15 | 19.67 | Neutral | - | -4.82 | 9.65 | 0.15 | 9.87 |
| QP | 3.586M | 15.57 | 56.00 | -40.43 | 19.72 | Neutral | - | -4.15 | 9.66 | 0.18 | 9.88 |
| AV | 3.586M | 13.76 | 46.00 | -32.24 | 19.72 | Neutral | - | -5.96 | 9.66 | 0.18 | 9.88 |
| QP | 7.268M | 16.61 | 60.00 | -43.39 | 19.81 | Neutral | - | -3.20 | 9.69 | 0.24 | 9.88 |
| AV | 7.268M | 14.59 | 50.00 | -35.41 | 19.81 | Neutral | - | -5.22 | 9.69 | 0.24 | 9.88 |
| QP | 13.604M | 31.91 | 60.00 | -28.09 | 19.89 | Neutral | - | 12.02 | 9.71 | 0.30 | 9.88 |
| AV | 13.604M | 16.34 | 50.00 | -33.66 | 19.89 | Neutral | - | -3.55 | 9.71 | 0.30 | 9.88 |

| AC Power-line Conducted Emissions Result | | | |
|---|---|---|---|
| **Operating Mode** | 1 | **Power Phase** | Line |
| **Operating Function** | DC Power Supply mode | | |




| Type | Freq | Level | Limit | Margin | Factor | Condition | Comment | Raw | LISN | CL | AT |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV) | (dBuV) | (dB) | (dB) | | | (dBuV) | (dB) | (dB) | (dB) |
| QP | 251.653k | 30.42 | 61.70 | -31.28 | 19.64 | Line | - | 10.78 | 9.65 | 0.12 | 9.87 |
| AV | 251.653k | 22.11 | 51.70 | -29.59 | 19.64 | Line | - | 2.47 | 9.65 | 0.12 | 9.87 |
| QP | 292.162k | 19.67 | 60.46 | -40.79 | 19.63 | Line | - | 0.04 | 9.64 | 0.12 | 9.87 |
| AV | 292.162k | 17.90 | 50.46 | -32.56 | 19.63 | Line | - | -1.73 | 9.64 | 0.12 | 9.87 |
| QP | 520.311k | 13.06 | 56.00 | -42.94 | 19.64 | Line | - | -6.58 | 9.64 | 0.13 | 9.87 |
| AV | 520.311k | 12.11 | 46.00 | -33.89 | 19.64 | Line | - | -7.53 | 9.64 | 0.13 | 9.87 |
| QP | 1.734M | 16.55 | 56.00 | -39.45 | 19.66 | Line | - | -3.11 | 9.65 | 0.14 | 9.87 |
| AV | 1.734M | 13.76 | 46.00 | -32.24 | 19.66 | Line | - | -5.90 | 9.65 | 0.14 | 9.87 |
| QP | 13.604M | 31.67 | 60.00 | -28.33 | 19.85 | Line | "Worst" | 11.82 | 9.67 | 0.30 | 9.88 |
| AV | 13.604M | 15.86 | 50.00 | -34.14 | 19.85 | Line | - | -3.99 | 9.67 | 0.30 | 9.88 |
| QP | 23.988M | 21.30 | 60.00 | -38.70 | 19.86 | Line | - | 1.44 | 9.58 | 0.40 | 9.88 |
| AV | 23.988M | 15.20 | 50.00 | -34.80 | 19.86 | Line | - | -4.66 | 9.58 | 0.40 | 9.88 |

# 3.2 Emission Bandwidth

## 3.2.1 Emission Bandwidth Limit

| 20dB Bandwidth Limit |
|---|
| ☒ Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (13.553 – 13.567 MHz). |

## 3.2.2 Measuring Instruments

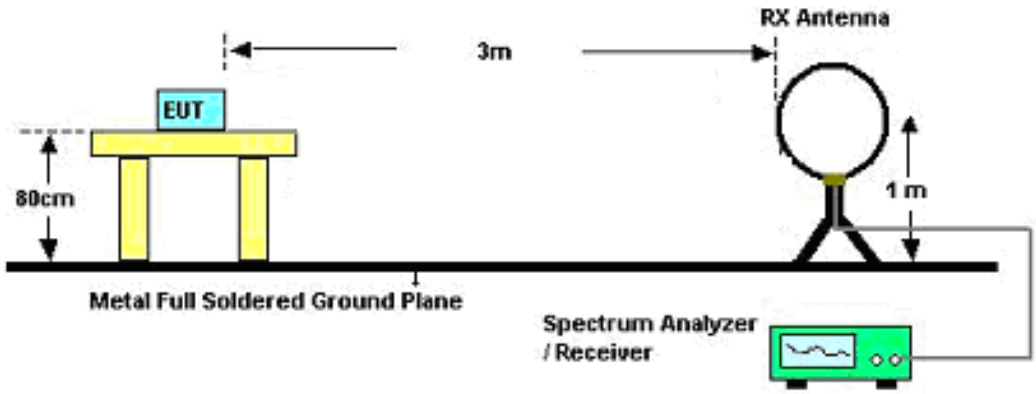
Refer a test equipment and calibration data table in this test report.

## 3.2.3 Test Procedures

| Test Method |
|---|
| ☒ For the emission bandwidth refer ANSI C63.10, clause 6.9.1 for occupied bandwidth testing. |
| ☒ For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level. |

## 3.2.4 Test Setup

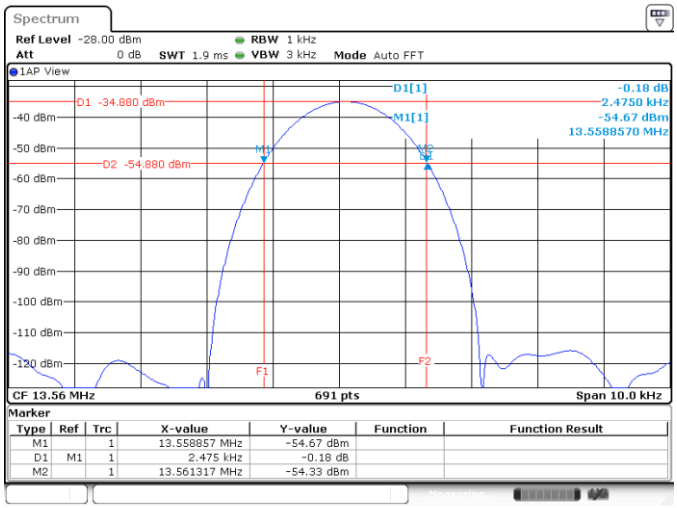
**Emission Bandwidth**



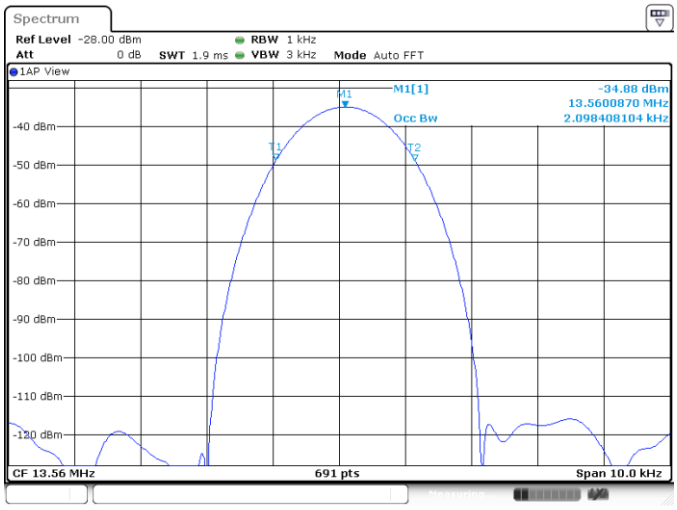
### 3.2.5 Test Result of Emission Bandwidth

| Occupied Channel Bandwidth Result | | | | | |
|---|---|---|---|---|---|
| Modulation Mode | Frequency (MHz) | 20dB Bandwidth (kHz) | 99% Bandwidth (kHz) | $F_L$ at 20dB BW (MHz) | $F_H$ at 20dB BW (MHz) |
| NFC | 13.56 | 2.475 | 2.098 | 13.559 | 13.561 |
| **Limit** | | **N/A** | **N/A** | **13.553** | **13.567** |
| **Result** | | **Complied** | | | |

**Emission Bandwidth Plot - 20dB Bandwidth**




**Emission Bandwidth Plot - 99% Bandwidth**



# 3.3 Field Strength of Fundamental Emissions and Spectrum Mask

## 3.3.1 Field Strength of Fundamental Emissions and Spectrum Mask Limit

| Field Strength of Fundamental Emissions For FCC | | | | | |
|---|---|---|---|---|---|
| **Emissions** | **(uV/m)@30m** | **(dBuV/m)@30m** | **(dBuV/m)@10m** | **(dBuV/m)@3m** | **(dBuV/m)@1m** |
| fundamental | 15848 | 84.0 | 103.1 | 124.0 | 143.1 |
| Quasi peak measurement of the fundamental. | | | | | |

| Spectrum Mask For FCC | | | | | |
|---|---|---|---|---|---|
| **Freq. of Emission (MHz)** | **(uV/m)@30m** | **(dBuV/m)@30m** | **(dBuV/m)@10m** | **(dBuV/m)@3m** | **(dBuV/m)@1m** |
| 1.705~13.110 | 30 | 29.5 | 48.6 | 69.5 | 88.6 |
| 13.110~13.410 | 106 | 40.5 | 59.6 | 80.5 | 99.6 |
| 13.410~13.553 | 334 | 50.5 | 69.6 | 90.5 | 109.6 |
| 13.553~13.567 | 15848 | 84.0 | 103.1 | 124.0 | 143.1 |
| 13.567~13.710 | 334 | 50.5 | 69.6 | 90.5 | 109.6 |
| 13.710~14.010 | 106 | 40.5 | 59.6 | 80.5 | 99.6 |
| 14.010~30.000 | 30 | 29.5 | 48.6 | 69.5 | 88.6 |

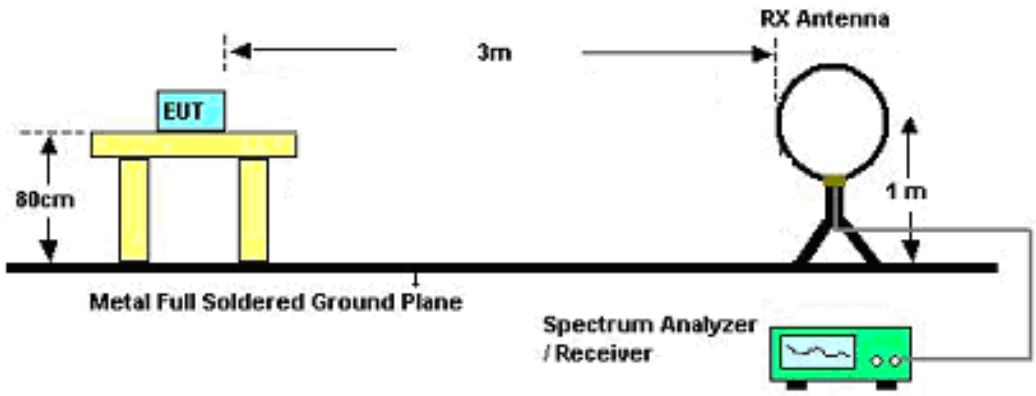
## 3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

## 3.3.3 Test Procedures

| Test Method | |
|---|---|
| ☒ | Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz and test distance is 3m. |
| ☒ | At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be following below methods. |
| ☐ | The results shall be extrapolated to the specified distance by making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor. |
| ☒ | The results shall be by using the square of an inverse linear distance extrapolation factor (40 dB/decade). |
| ☒ | For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level. |

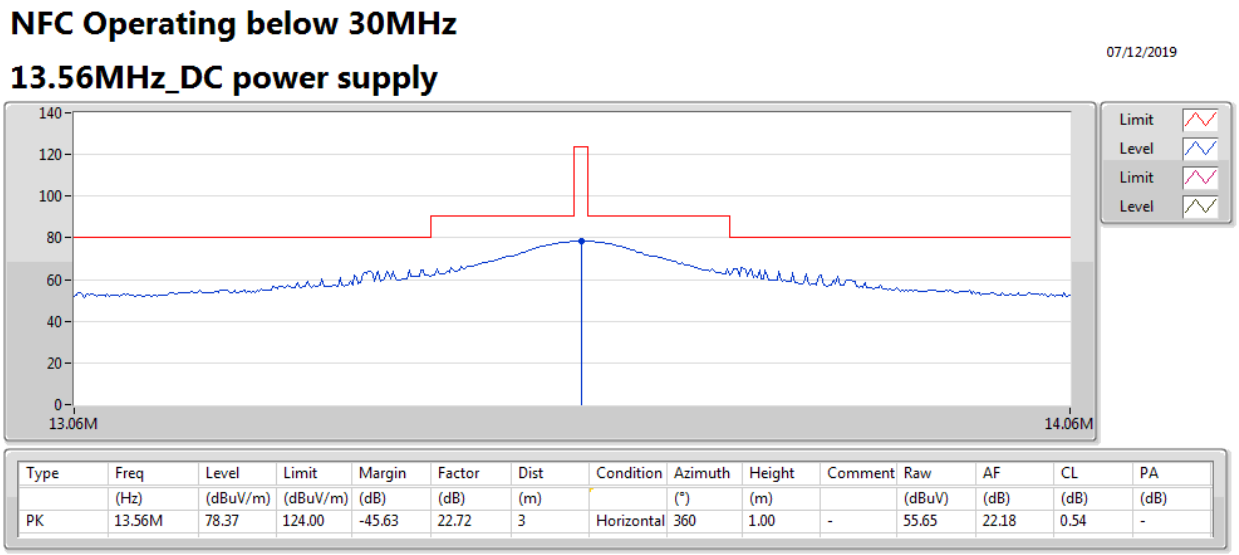
### 3.3.4 Test Setup

| Field Strength of Fundamental Emissions and Spectrum Mask |
|---|
|  |



### 3.3.5 Test Result of Field Strength of Fundamental Emissions and Spectrum Mask

| Field Strength of Fundamental Emissions Result | | | | | |
|---|---|---|---|---|---|
| **Modulation Mode** | **Frequency (MHz)** | **Fundamental (dBuV/m)@3m** | **Polarization** | **Margin (dB)** | **Limit (dBuV/m)@3m** |
| NFC | 13.56 | 78.37 | H | -45.63 | 124.00 |
| **Result** | | **Complied** | | | |
| Note 1: Measurement worst emissions of receive antenna polarization: H(Horizontal). | | | | | |

| Spectrum Mask Plot |
|---|
|  |



| Type | Freq | Level | Limit | Margin | Factor | Dist | Condition | Azimuth | Height | Comment | Raw | AF | CL | PA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV/m) | (dBuV/m) | (dB) | (dB) | (m) | | (°) | (m) | | (dBuV) | (dB) | (dB) | (dB) |
| PK | 13.56M | 78.37 | 124.00 | -45.63 | 22.72 | 3 | Horizontal | 360 | 1.00 | - | 55.65 | 22.18 | 0.54 | - |

# 3.4 Transmitter Radiated Unwanted Emissions

## 3.4.1 Transmitter Radiated Unwanted Emissions Limit

| Transmitter Radiated Unwanted Emissions Limit | | | |
|---|---|---|---|
| **Frequency Range (MHz)** | **Field Strength (uV/m)** | **Field Strength (dBuV/m)** | **Measure Distance (m)** |
| 0.009~0.490 | 2400/F(kHz) | 48.5 - 13.8 | 300 |
| 0.490~1.705 | 24000/F(kHz) | 33.8 - 23 | 30 |
| 1.705~30.0 | 30 | 29 | 30 |
| 30~88 | 100 | 40 | 3 |
| 88~216 | 150 | 43.5 | 3 |
| 216~960 | 200 | 46 | 3 |
| Above 960 | 500 | 54 | 3 |

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

## 3.4.2 Measuring Instruments

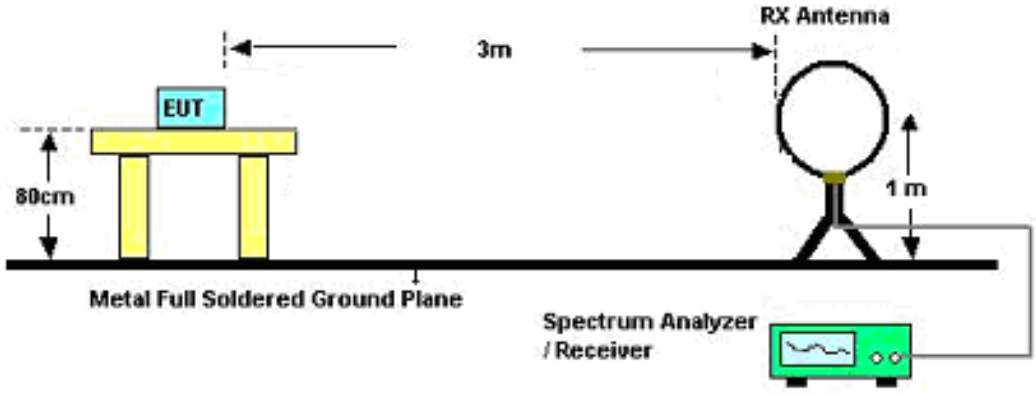
Refer a test equipment and calibration data table in this test report.

### 3.4.3 Test Procedures

| Test Method | |
|---|---|
| ☒ | Refer as ANSI C63.10, clause 6.5 for radiated emissions from 30 MHz to 1 GHz and test distance is 3m. |
| ☒ | Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz and test distance is 3m. |
| ☒ | At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be following below methods. |
| ☐ | The results shall be extrapolated to the specified distance by making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor. |
| ☒ | The results shall be by using the square of an inverse linear distance extrapolation factor (40 dB/decade). |
| ☒ | For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level. |
| ☒ | The any unwanted emissions level shall not exceed the fundamental emission level. |
| ☒ | All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported. |

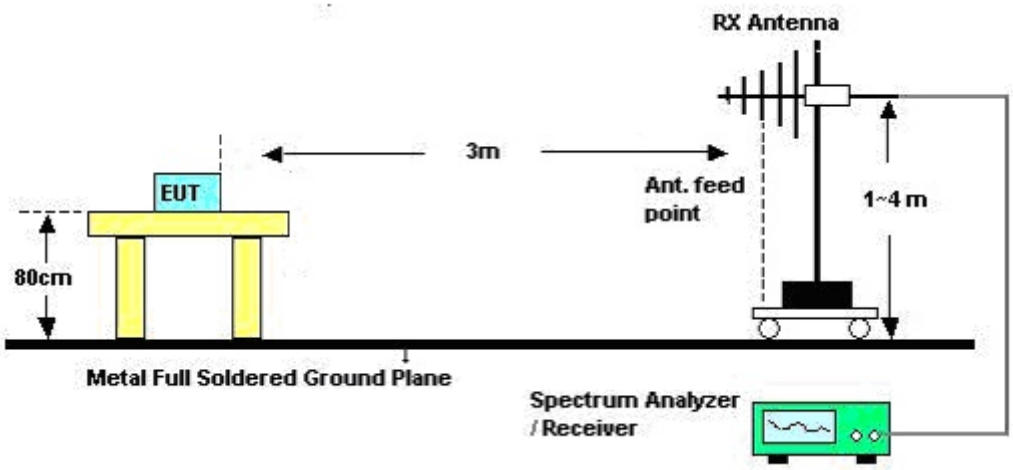
### 3.4.4 Test Setup

**Transmitter Radiated Unwanted Emissions**




Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna. The center of the loop shall be 1 m above the ground.

**Transmitter Radiated Bandedge Emissions**




Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna. the antenna height shall be varied from 1 m to 4 m.

### 3.4.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

**Summary**

| Mode | Result | Type | Freq (Hz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Factor (dB) | Dist (m) | Azimuth (°) | Height (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13.553-13.567MHz | - | - | - | - | - | - | - | - | - | - | - |
| NFC | Pass | PK | 3.493M | 35.95 | 69.50 | -33.55 | 20.40 | 3 | 0 | 1.00 | - |

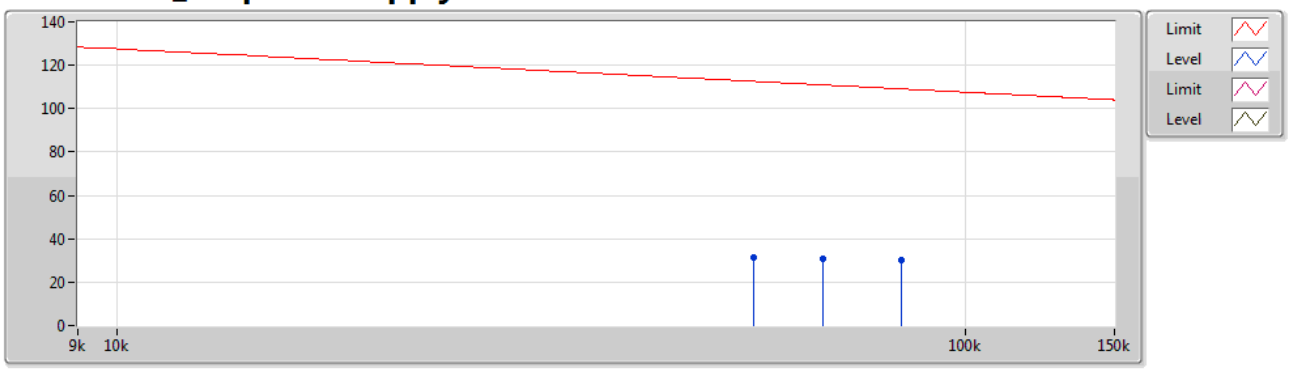
**Result**

| Mode | Result | Type | Freq (Hz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Factor (dB) | Dist (m) | Azimuth (°) | Height (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NFC | - | - | - | - | - | - | - | - | - | - | - |
| 13.56MHz_DC power supply | Pass | PK | 56.376k | 31.18 | 112.57 | -81.39 | 20.47 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 67.938k | 30.87 | 110.95 | -80.08 | 20.29 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 84.012k | 30.31 | 109.11 | -78.80 | 20.04 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 3.016M | 34.45 | 69.50 | -35.05 | 20.31 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 3.493M | 35.95 | 69.50 | -33.55 | 20.40 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 5.702M | 34.44 | 69.50 | -35.06 | 20.92 | 3 | 0 | 1.00 | - |

## NFC Operating below 30MHz

07/12/2019

## 13.56MHz_DC power supply

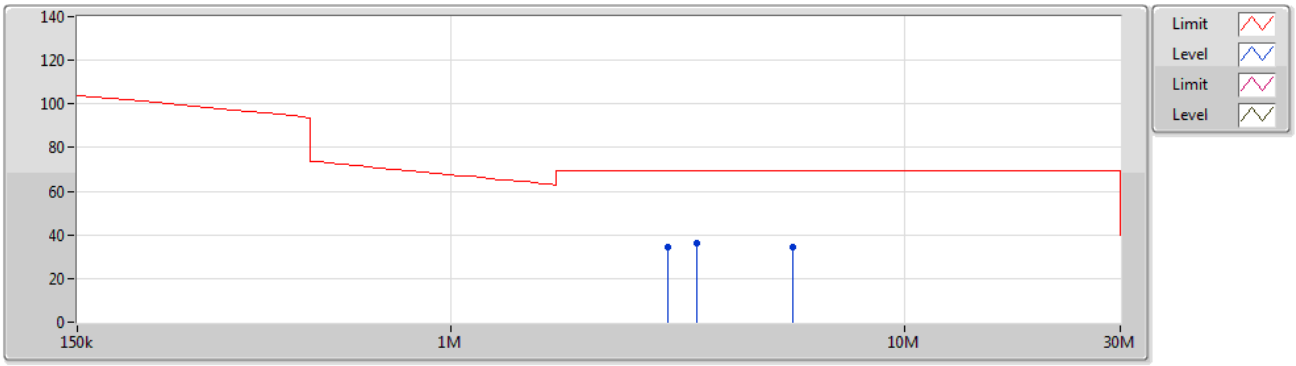



| Type | Freq | Level | Limit | Margin | Factor | Dist | Condition | Azimuth | Height | Comment | Raw | AF | CL | PA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV/m) | (dBuV/m) | (dB) | (dB) | (m) | | (°) | (m) | | (dBuV) | (dB) | (dB) | (dB) |
| PK | 56.376k | 31.18 | 112.57 | -81.39 | 20.47 | 3 | Horizontal | 360 | 1.00 | - | 10.71 | 20.39 | 0.08 | - |
| PK | 67.938k | 30.87 | 110.95 | -80.08 | 20.29 | 3 | Horizontal | 360 | 1.00 | - | 10.58 | 20.21 | 0.08 | - |
| PK | 84.012k | 30.31 | 109.11 | -78.80 | 20.04 | 3 | Horizontal | 360 | 1.00 | - | 10.27 | 19.95 | 0.09 | - |

## NFC Operating below 30MHz

07/12/2019

## 13.56MHz_DC power supply




| Type | Freq | Level | Limit | Margin | Factor | Dist | Condition | Azimuth | Height | Comment | Raw | AF | CL | PA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV/m) | (dBuV/m) | (dB) | (dB) | (m) | | (°) | (m) | | (dBuV) | (dB) | (dB) | (dB) |
| PK | 3.016M | 34.45 | 69.50 | -35.05 | 20.31 | 3 | Horizontal | 0 | 1.00 | - | 14.14 | 20.10 | 0.21 | - |
| PK | 3.493M | 35.95 | 69.50 | -33.55 | 20.40 | 3 | Horizontal | 0 | 1.00 | - | 15.55 | 20.18 | 0.22 | - |
| PK | 5.702M | 34.44 | 69.50 | -35.06 | 20.92 | 3 | Horizontal | 0 | 1.00 | - | 13.52 | 20.62 | 0.30 | - |

## 3.4.6 Transmitter Radiated Unwanted Emissions (Above 30MHz)

**Summary**

| Mode | Result | Type | Freq (Hz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Factor (dB) | Dist (m) | Azimuth (°) | Height (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13.553-13.567MHz | - | - | - | - | - | - | - | - | - | - | - |
| NFC | Pass | PK | 406.36M | 42.25 | 46.00 | -3.75 | -2.85 | 3 | 360 | 1.00 | - |

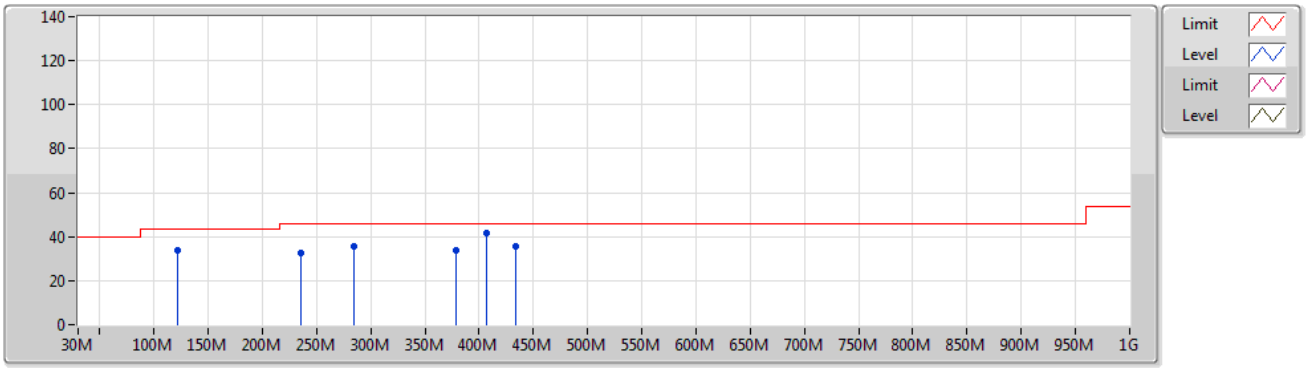
**Result**

| Mode | Result | Type | Freq (Hz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Factor (dB) | Dist (m) | Azimuth (°) | Height (m) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| NFC | - | - | - | - | - | - | - | - | - | - | - |
| 13.56MHz_DC power supply | Pass | PK | 121.18M | 33.93 | 43.50 | -9.57 | -8.37 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 235.64M | 32.36 | 46.00 | -13.64 | -8.47 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 284.14M | 35.73 | 46.00 | -10.27 | -6.04 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 379.2M | 34.04 | 46.00 | -11.96 | -4.07 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 406.36M | 41.89 | 46.00 | -4.11 | -2.85 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 433.52M | 35.53 | 46.00 | -10.47 | -2.60 | 3 | 0 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 121.18M | 35.29 | 43.50 | -8.21 | -8.37 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 233.7M | 40.24 | 46.00 | -5.76 | -8.73 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 284.14M | 39.95 | 46.00 | -6.05 | -6.04 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 379.2M | 41.40 | 46.00 | -4.60 | -4.07 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 406.36M | 42.25 | 46.00 | -3.75 | -2.85 | 3 | 360 | 1.00 | - |
| 13.56MHz_DC power supply | Pass | PK | 433.52M | 40.16 | 46.00 | -5.84 | -2.60 | 3 | 360 | 1.00 | - |

## NFC Operating above 30MHz

07/12/2019

## 13.56MHz_DC power supply

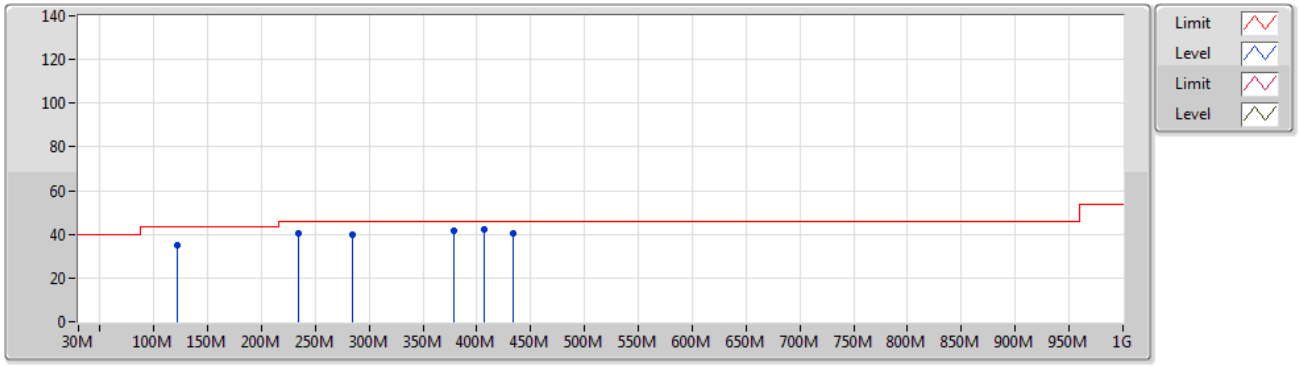



| Type | Freq | Level | Limit | Margin | Factor | Dist | Condition | Azimuth | Height | Comment | Raw | AF | CL | PA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV/m) | (dBuV/m) | (dB) | (dB) | (m) | | (°) | (m) | | (dBuV) | (dB) | (dB) | (dB) |
| PK | 121.18M | 33.93 | 43.50 | -9.57 | -8.37 | 3 | Vertical | 0 | 1.00 | - | 42.30 | 17.25 | 1.69 | 27.31 |
| PK | 235.64M | 32.36 | 46.00 | -13.64 | -8.47 | 3 | Vertical | 0 | 1.00 | - | 40.83 | 15.93 | 2.40 | 26.80 |
| PK | 284.14M | 35.73 | 46.00 | -10.27 | -6.04 | 3 | Vertical | 0 | 1.00 | - | 41.77 | 18.02 | 2.66 | 26.72 |
| PK | 379.2M | 34.04 | 46.00 | -11.96 | -4.07 | 3 | Vertical | 0 | 1.00 | - | 38.11 | 19.99 | 3.10 | 27.16 |
| PK | 406.36M | 41.89 | 46.00 | -4.11 | -2.85 | 3 | Vertical | 0 | 1.00 | - | 44.74 | 21.28 | 3.21 | 27.34 |
| PK | 433.52M | 35.53 | 46.00 | -10.47 | -2.60 | 3 | Vertical | 0 | 1.00 | - | 38.13 | 21.65 | 3.32 | 27.57 |

## NFC Operating above 30MHz

07/12/2019

## 13.56MHz_DC power supply




| Type | Freq | Level | Limit | Margin | Factor | Dist | Condition | Azimuth | Height | Comment | Raw | AF | CL | PA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Hz) | (dBuV/m) | (dBuV/m) | (dB) | (dB) | (m) | | (°) | (m) | | (dBuV) | (dB) | (dB) | (dB) |
| PK | 121.18M | 35.29 | 43.50 | -8.21 | -8.37 | 3 | Horizontal | 360 | 1.00 | - | 43.66 | 17.25 | 1.69 | 27.31 |
| PK | 233.7M | 40.24 | 46.00 | -5.76 | -8.73 | 3 | Horizontal | 360 | 1.00 | - | 48.97 | 15.69 | 2.39 | 26.81 |
| PK | 284.14M | 39.95 | 46.00 | -6.05 | -6.04 | 3 | Horizontal | 360 | 1.00 | - | 45.99 | 18.02 | 2.66 | 26.72 |
| PK | 379.2M | 41.40 | 46.00 | -4.60 | -4.07 | 3 | Horizontal | 360 | 1.00 | - | 45.47 | 19.99 | 3.10 | 27.16 |
| PK | 406.36M | 42.25 | 46.00 | -3.75 | -2.85 | 3 | Horizontal | 360 | 1.00 | - | 45.10 | 21.28 | 3.21 | 27.34 |
| PK | 433.52M | 40.16 | 46.00 | -5.84 | -2.60 | 3 | Horizontal | 360 | 1.00 | - | 42.76 | 21.65 | 3.32 | 27.57 |

# 3.5 Frequency Stability

## 3.5.1 Frequency Stability Limit

| Frequency Stability Limit |
|---|
| ☒ Carrier frequency stability shall be maintained to ±0.01% (±100 ppm). |

## 3.5.2 Measuring Instruments

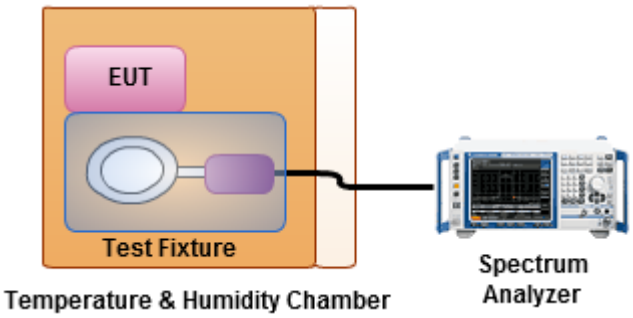
Refer a test equipment and calibration data table in this test report.

## 3.5.3 Test Procedures

| Test Method | |
|---|---|
| ☒ | Refer as ANSI C63.10, clause 6.8 for frequency stability tests |
| | ☒ Frequency stability with respect to ambient temperature |
| | ☒ Frequency stability when varying supply voltage |
| ☐ | For conducted measurement. |
| ☒ | For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level. |

## 3.5.4 Test Setup

**Frequency Stability**



### 3.5.5 Test Result of Frequency Stability

| Frequency Stability Result | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Condition | Ch. Freq. (MHz) | Frequency Stability (ppm) | | | | | | | |
| | | Test Frequency (MHz) | | | | Frequency Stability (ppm) | | | |
| | | 0 min | 2 min | 5 min | 10 min | 0 min | 2 min | 5 min | 10 min |
| $T_{20°C}$Vmax | 13.56 | 13.56004 | 13.56055 | 13.55948 | 13.56016 | 2.73 | 40.34 | -38.13 | 11.80 |
| $T_{20°C}$Vmin | 13.56 | 13.55978 | 13.56007 | 13.56001 | 13.56016 | -16.22 | 5.31 | 0.37 | 11.43 |
| $T_{50°C}$Vnom | 13.56 | 13.56038 | 13.56000 | 13.56044 | 13.56004 | 28.10 | 0.07 | 32.45 | 2.73 |
| $T_{40°C}$Vnom | 13.56 | 13.56004 | 13.56012 | 13.56024 | 13.56004 | 2.73 | 9.14 | 17.40 | 2.95 |
| $T_{30°C}$Vnom | 13.56 | 13.56029 | 13.56005 | 13.56054 | 13.55970 | 21.53 | 3.32 | 39.97 | -22.27 |
| $T_{20°C}$Vnom | 13.56 | 13.56009 | 13.56021 | 13.55968 | 13.56002 | 6.71 | 15.12 | -23.45 | 1.77 |
| $T_{10°C}$Vnom | 13.56 | 13.55996 | 13.56003 | 13.56016 | 13.56036 | -3.24 | 2.29 | 11.58 | 26.62 |
| $T_{0°C}$Vnom | 13.56 | 13.56004 | 13.55945 | 13.56001 | 13.55981 | 3.02 | -40.63 | 1.03 | -14.16 |
| $T_{-10°C}$Vnom | 13.56 | 13.55965 | 13.56030 | 13.56051 | 13.56080 | -25.88 | 22.05 | 37.76 | 59.07 |
| $T_{-20°C}$Vnom | 13.56 | 13.55998 | 13.56004 | 13.56042 | 13.56004 | -1.77 | 2.65 | 31.19 | 2.88 |
| Limit (ppm) | | - | | | | 100 | | | |
| Result | | Complied | | | | | | | |

Note 1: Measure at 85 % [Vmin] and 115 % [Vmax] of the nominal voltage [Vnom]. The nominal voltage refer test report clause 2.1 for EUT operational condition.
Note 2: Measure maximum deviation frequency at operating frequency at startup and two, five, and ten min.

# 4 Test Equipment and Calibration Data

**Instrument for AC Conduction**

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| EMC Receiver | R&S | ESR3 | 102052 | 9kHz~3.6GHz | 09/Apr/2019 | 08/Apr/2020 |
| LISN | R&S | ENV216 | 101295 | 9kHz~30MHz | 04/Nov/2019 | 05/Nov/2020 |
| RF Cable-CON | MTJ | RG142 | CB002-CO | 9kHz~200MHz | 12/Sep/2019 | 11/Sep/2020 |
| AC POWER | APC | AFC-11005G | F310050055 | 47Hz~63Hz 5~300V | NCR | NCR |
| Impuls Begrenzer Pulse Limiter | SCHWARZBECK | VTSD 9561-F | 9561-F041 | 9kHz~30MHz | 24/Sep/2019 | 23/Sep/2020 |

**Instrument for Conducted Test**

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| Spectrum Analyzer | R&S | FSV 40 | 101013 | 10Hz~40GHz | 13/Mar/2019 | 12/Mar/2020 |
| Loop Antenna | TESEQ | HLA 6120 | 31244 | 9kHz~30MHz | 15/Mar/2019 | 14/Mar/2020 |
| Temp. and Humidity Chamber | Giant Force | GTH-225-20-SP-SD | MAA1112-007 | -20~100℃ | 21/May/2019 | 20/May/2020 |

**Instrument for Radiated Test**

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| 3m Semi Anechoic Chamber | SIDT FRANKONIA | SAC-3M | 03CH03-HY | 30MHz~1GHz 3m | 30/ Aug/2019 | 29/ Aug/2020 |
| 3m Semi Anechoic Chamber | SIDT FRANKONIA | SAC-3M | 03CH03-HY | 1GHz~18GHz 3m | 30/ Aug/2019 | 29/ Aug/2020 |
| Amplifier | HP | 8447D | 2944A08033 | 10kHz~1.3GHz | 22/Apr/2019 | 21/Apr/2020 |
| EMI Test Receiver | R&S | ESR3 | 102052 | 9kHz~3.6GHz | 09/Apr/2019 | 08/Apr/2020 |
| Bilog Antenna & 5dB Attenuator | SCHAFFNER / MTJ | CBL 6112B / MTJ6102-05 | 2723 / 2 | 30MHz~2GHz | 11/Oct/2019 | 10/Oct//2020 |
| Signal Analyzer | R&S | FSP40 | 100305 | 9kHz~40GHz; -140-+30dBm | 10/Jun/2019 | 09/Jun/2020 |
| RF Cable-R03m | Jye Bao | RG142 | CB021 | 9kHz~1GHz | 22/Mar/2019 | 21/Mar/2020 |
| Loop Antenna | TESEQ | HLA 6120 | 31244 | 9k~30MHz | 15/Mar/2019 | 14/Mar/2020 |