

# FCC Test Report

|              |                    |
|--------------|--------------------|
| Product Name | NFC Antenna Module |
| Model No.    | MSN09              |
| FCC ID       | 2AAYI-MSN09        |

|           |   |
|-----------|---|
| Applicant | Smart Approach Co.,Ltd.   |
| Address   | Rm. 5, 3F., No.1, Taiyuan 2nd St., Zhubei City,<br>Hsinchu County , Taiwan. |

|                 |                     |
|-----------------|---------------------|
| Date of Receipt | Mar. 02, 2016       |
| Issued Date     | Apr. 11, 2016       |
| Report No.      | 1630080R-RFUSP17V00 |
| Report Version  | V1.0                |



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration of the equipment and evaluated measurement uncertainty herein.

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# Test Report

Issued Date: Apr. 11, 2016

Report No.: 1630080R-RFUSP17V00



|                     |   |
|---------------------|---|
| Product Name        | NFC Antenna Module  |
| Applicant           | Smart Approach Co.,Ltd.   |
| Address             | Rm. 5, 3F., No.1, Taiyuan 2nd St., Zhubei City, Hsinchu County , Taiwan.        |
| Manufacturer        | Smart Approach Co.,Ltd.   |
| Model No.           | MSN09   |
| FCC ID.             | 2AAV1-MSN09   |
| EUT Rated Voltage   | DC 1.8V   |
| EUT Test Voltage    | DC 1.8V   |
| Trade Name          | Smart Approach Co.,Ltd.   |
| Applicable Standard | FCC CFR Title 47 Part 15 Subpart C: 2014<br>ANSI C63.4: 2014, ANSI C63.10: 2013 |
| Test Result         | Complied  |

Documented By :

( Senior Adm. Specialist / Genie Chang )

Tested By

( Assistant Engineer / Nick Chen )

Approved By

( Director / Vincent Lin )

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Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs

## 1. GENERAL INFORMATION

### 1.1. EUT Description

|                 |                         |
|-----------------|-------------------------|
| Product Name    | NFC Antenna Module      |
| Trade Name      | Smart Approach Co.,Ltd. |
| Model No.       | MSN09                   |
| FCC ID          | 2AAYI-MSN09             |
| Frequency Range | 13.56MHz                |
| Modulation      | ASK                     |
| Antenna Type    | Loop Antenna            |

Frequency of Each Channel:

| Channel    | Frequency |
|------------|-----------|
| Channel 1: | 13.56 MHz |

Note:

1. This device is an NFC Antenna Module with a built-in 13.56MHz transceiver.
2. These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.225
3. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case is shown in the report.

|           |                       |
|-----------|-----------------------|
| Test Mode | Mode 1: Transmit mode |
|-----------|-----------------------|

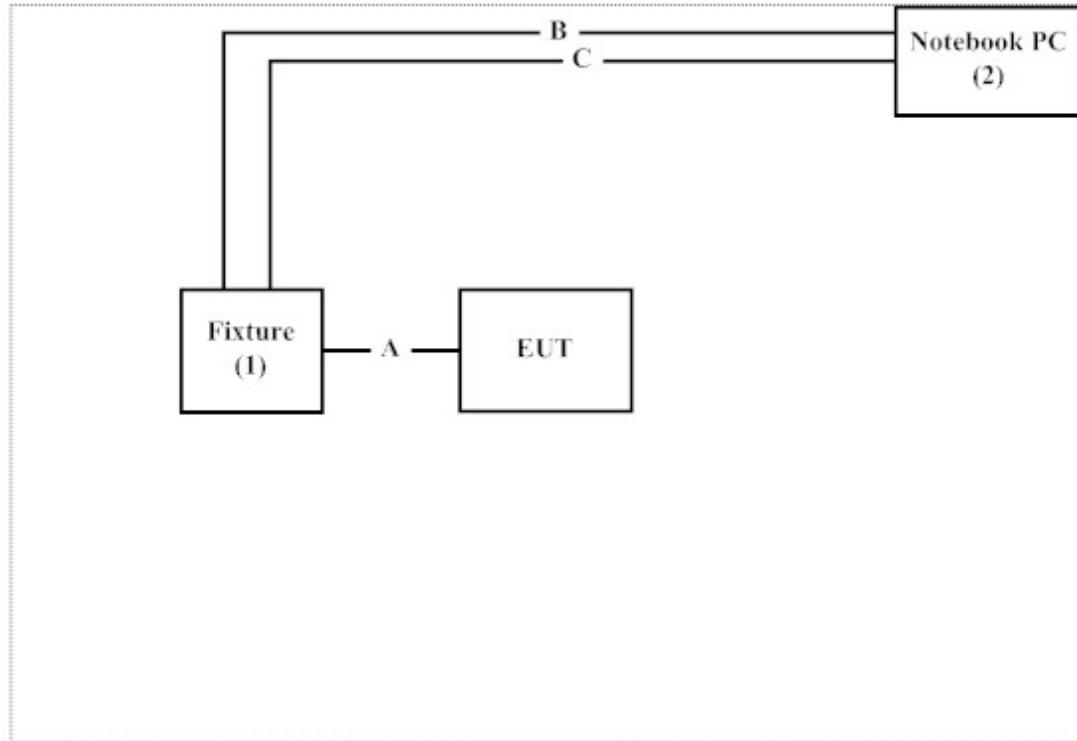
### 1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

| Product |             | Manufacturer | Model No.      | Serial No. | Power Cord         |
|---------|-------------|--------------|----------------|------------|--------------------|
| 1       | Fixture     | N/A          | N/A            | N/A        | N/A                |
| 2       | Notebook PC | DELL         | Latitude E5440 | FS9TK32    | Non-Shielded, 0.8m |

| Signal Cable Type |              | Signal cable Description |
|-------------------|--------------|--------------------------|
| A                 | Signal Cable | Non-Shielded, 0.5m       |
| B                 | RS-232 Cable | Shielded, 1.2m           |
| C                 | USB Cable    | Shielded, 1.2m           |

### 1.4. Configuration of tested System



### 1.5. EUT Exercise Software

- (1) Setup the EUT as shown in Section 1.4
- (2) Execute Software "Proxy TAP v1.6.6" on the EUT.
- (3) Start the continuous transmitter.
- (4) Verify that the EUT works properly.

## 1.6. Test Facility

Ambient conditions in the laboratory:

| Items                      | Required (IEC 68-1) | Actual   |
|----------------------------|---------------------|----------|
| Temperature (°C)           | 15-35               | 20-35    |
| Humidity (%RH)             | 25-75               | 50-65    |
| Barometric pressure (mbar) | 860-1060            | 950-1000 |

The related certificate for our laboratories about the test site and management system can be downloaded from QuieTek Corporation's Web Site: <http://www.quietek.com/chinese/about/certificates.aspx?bval=5>

The address and introduction of QuieTek Corporation's laboratories can be founded in our Web site:  
<http://www.quietek.com/>

Site Description: File on  
Federal Communications Commission  
FCC Engineering Laboratory  
7435 Oakland Mills Road  
Columbia, MD 21046  
Registration Number: 92195

Site Name: Quietek Corporation  
Site Address: No.5-22, Ruishukeng,  
Linkou Dist. New Taipei City 24451,  
Taiwan, R.O.C.  
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E-Mail : [service@quietek.com](mailto:service@quietek.com)

FCC Accreditation Number: TW1014

## 2. Conducted Emission

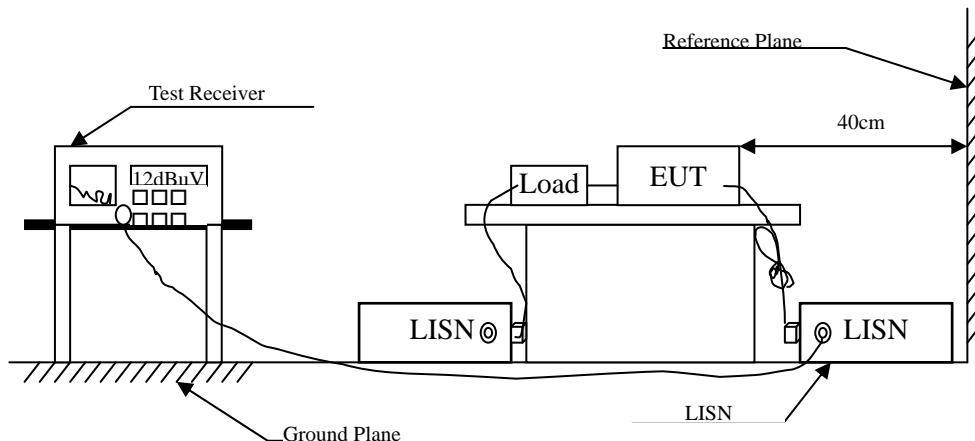
### 2.1. Test Equipment

| Equipment                  | Manufacturer | Model No. / Serial No. | Last Cal.  | Remark      |
|----------------------------|--------------|------------------------|------------|-------------|
| X Test Receiver            | R & S        | ESCS 30 / 825442/018   | Sep., 2015 |             |
| X Artificial Mains Network | R & S        | ENV4200 / 848411/10    | Feb., 2016 | Peripherals |
| X LISN                     | R & S        | ESH3-Z5 / 825562/002   | Feb., 2016 | EUT         |
| DC LISN                    | Schwarzbeck  | 8226 / 176             | Mar, 2016  | EUT         |
| X Pulse Limiter            | R & S        | ESH3-Z2 / 357.8810.52  | Feb., 2016 |             |
| No.1 Shielded Room         |              |                        |            |             |

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

### 2.2. Test Setup



## 2.3. Limits

| FCC Part 15 Subpart C Paragraph 15.207 (dBuV) Limit |                      |                      |
|---|----------------------|----------------------|
| Frequency<br>MHz                                    | Limits               |                      |
|   | QP                   | AV                   |
| 0.15 - 0.50   | 66-56 <sub>(‡)</sub> | 56-46 <sub>(‡)</sub> |
| 0.50-5.0  | 56                   | 46                   |
| 5.0 - 30  | 60                   | 50                   |

## 2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refers to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were invested over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

## 2.5. Uncertainty

± 2.26 dB

## 2.6. Test Result of Conducted Emission

Product : NFC Antenna Module  
 Test Item : Conducted Emission Test  
 Power Line : Line 1  
 Test Mode : Mode 1: Transmit mode

| Frequency         | Correct Factor | Reading Level | Measurement Level | Margin  | Limit  |
|-------------------|----------------|---------------|-------------------|---------|--------|
| MHz               | dB             | dBuV          | dBuV              | dB      | dBuV   |
| <b>LINE 1</b>     |                |               |                   |         |        |
| <b>Quasi-Peak</b> |                |               |                   |         |        |
| 0.154             | 9.783          | 17.440        | 27.223            | -38.663 | 65.886 |
| 0.267             | 9.780          | 3.750         | 13.530            | -49.127 | 62.657 |
| 0.548             | 9.792          | 13.190        | 22.982            | -33.018 | 56.000 |
| 0.615             | 9.797          | 17.180        | 26.977            | -29.023 | 56.000 |
| 6.716             | 10.041         | 2.250         | 12.291            | -47.709 | 60.000 |
| 14.427            | 10.147         | 17.950        | 28.097            | -31.903 | 60.000 |
| <b>Average</b>    |                |               |                   |         |        |
| 0.154             | 9.783          | 13.000        | 22.783            | -33.103 | 55.886 |
| 0.267             | 9.780          | 0.240         | 10.020            | -42.637 | 52.657 |
| 0.548             | 9.792          | 9.720         | 19.512            | -26.488 | 46.000 |
| 0.615             | 9.797          | 11.580        | 21.377            | -24.623 | 46.000 |
| 6.716             | 10.041         | -1.610        | 8.431             | -41.569 | 50.000 |
| 14.427            | 10.147         | 13.080        | 23.227            | -26.773 | 50.000 |

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. ““ means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : NFC Antenna Module  
 Test Item : Conducted Emission Test  
 Power Line : Line 2  
 Test Mode : Mode 1: Transmit mode

| Frequency         | Correct Factor | Reading Level | Measurement Level | Margin         | Limit         |
|-------------------|----------------|---------------|-------------------|----------------|---------------|
| MHz               | dB             | dBuV          | dBuV              | dB             | dBuV          |
| <b>LINE 2</b>     |                |               |                   |                |               |
| <b>Quasi-Peak</b> |                |               |                   |                |               |
| 0.162             | 9.832          | 15.890        | 25.722            | -39.935        | 65.657        |
| 0.209             | 9.835          | 12.350        | 22.185            | -42.129        | 64.314        |
| <b>0.615</b>      | <b>9.867</b>   | <b>17.220</b> | <b>27.087</b>     | <b>-28.913</b> | <b>56.000</b> |
| 1.107             | 9.905          | 1.120         | 11.025            | -44.975        | 56.000        |
| 4.607             | 10.073         | 1.330         | 11.403            | -44.597        | 56.000        |
| 13.576            | 10.255         | 16.520        | 26.775            | -33.225        | 60.000        |
| <b>Average</b>    |                |               |                   |                |               |
| 0.162             | 9.832          | 1.480         | 11.312            | -44.345        | 55.657        |
| 0.209             | 9.835          | 7.830         | 17.665            | -36.649        | 54.314        |
| <b>0.615</b>      | <b>9.867</b>   | <b>10.640</b> | <b>20.507</b>     | <b>-25.493</b> | <b>46.000</b> |
| 1.107             | 9.905          | -2.180        | 7.725             | -38.275        | 46.000        |
| 4.607             | 10.073         | -1.830        | 8.243             | -37.757        | 46.000        |
| 13.576            | 10.255         | 11.970        | 22.225            | -27.775        | 50.000        |

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. “  “ means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

### 3. Radiated Emission

#### 3.1. Test Equipment

The following test equipments are used during the radiated emission test:

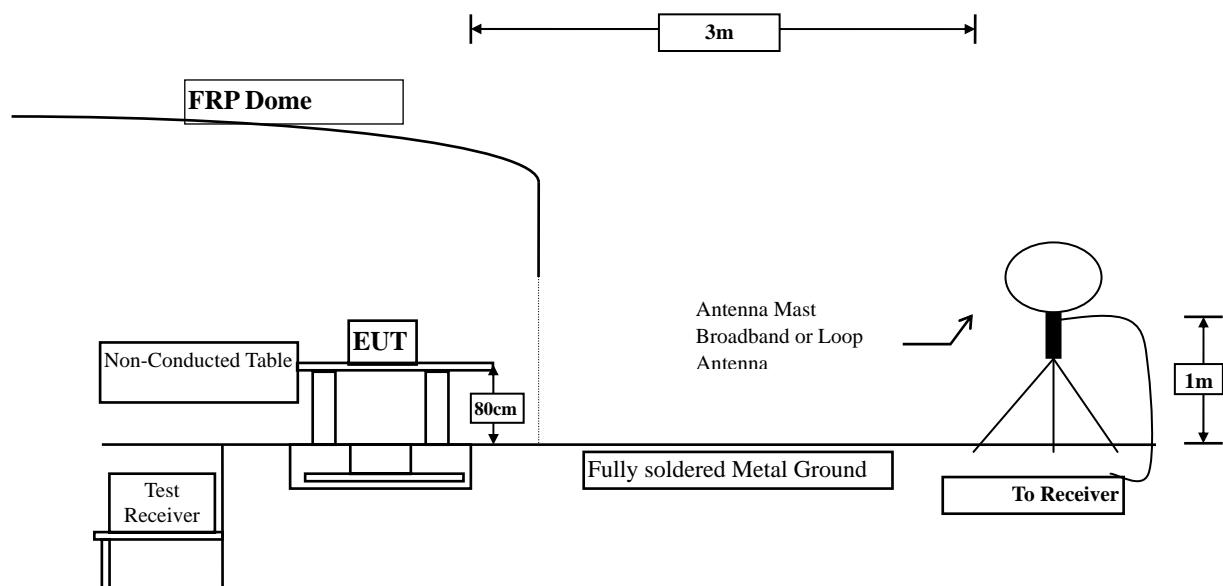
| Test Site                                    | Equipment |                       | Manufacturer    | Model No./Serial No. | Last Cal. |
|--|-----------|-----------------------|-----------------|----------------------|-----------|
| <input checked="" type="checkbox"/> Site # 3 | X         | Magnetic Loop Antenna | Teseq           | HLA6121/ 37133       | Sep, 2015 |
|  | X         | Bilog Antenna         | Schaffner Chase | CBL6112B/ 2707       | Jun, 2015 |
|  | X         | EMI Test Receiver     | R&S             | ESCS 30/838251/ 001  | Jun, 2015 |
|  | X         | Coaxial Cable         | QTK(Arnist)     | RG 214/ LC003-RG     | Jun, 2015 |
|  | X         | Coaxial signal switch | Arnist          | MP59B/ 6200798682    | Jun, 2015 |

| Test Site                                  | Equipment |                   | Manufacturer | Model No./Serial No.        | Last Cal. |
|--|-----------|-------------------|--------------|-----------------------------|-----------|
| <input checked="" type="checkbox"/> CB # 8 | X         | Spectrum Analyzer | R&S          | FSP40/ 100339               | Oct, 2015 |
|  | X         | Horn Antenna      | ETS-Lindgren | 3117/ 35205                 | Mar, 2016 |
|  | X         | Horn Antenna      | Schwarzbeck  | BBHA9170/209                | Jan, 2016 |
|  | X         | Horn Antenna      | TRC          | AH-0801/95051               | Aug, 2016 |
|  | X         | Pre-Amplifier     | EMCI         | EMC012630SE/980210          | Jan, 2016 |
|  | X         | Pre-Amplifier     | MITEQ        | JS41-001040000-58-5P/153945 | Jul, 2015 |
|  | X         | Pre-Amplifier     | NARDA        | DBL-1840N506/013            | Jul, 2015 |

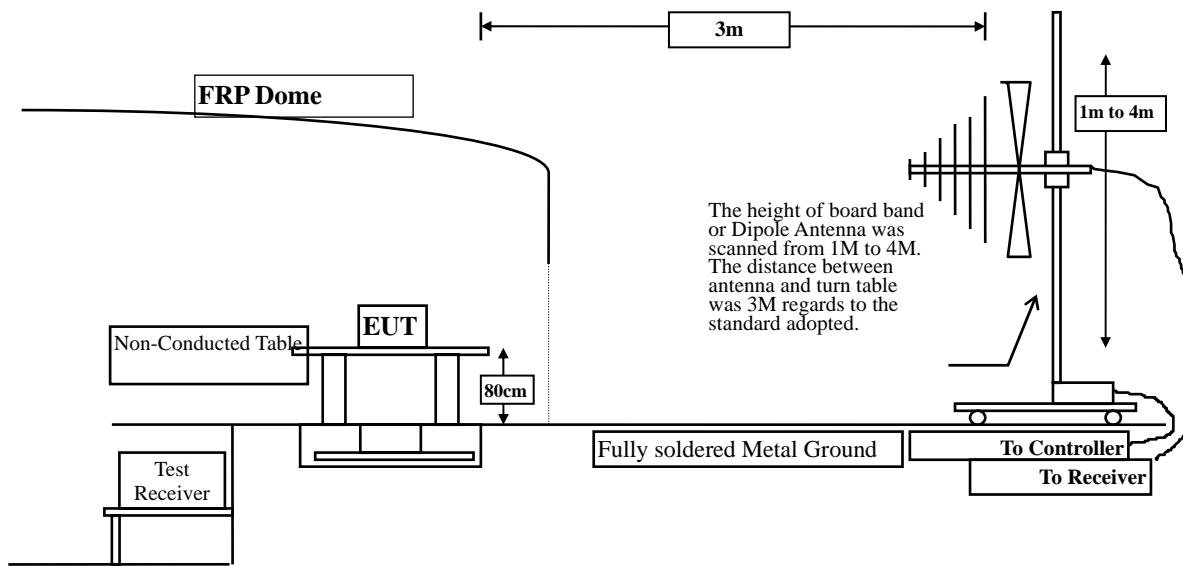
Note: 1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.  
 2. The test instruments marked with “X” are used to measure the final test results.

#### 3.2. Test Setup

9kHz~30MHz



30MHz~1GHz



### 3.3. Limits

➤ Fundamental electric field strength Limit

| FCC Part 15 Subpart C Paragraph 15.225 Limits |                               |                     |        |                     |
|---|-------------------------------|---------------------|--------|---------------------|
| Fundamental Frequency<br>MHz                  | Field strength of fundamental |                     |        |                     |
|   | uV/m                          | Distance<br>(meter) | dBuV/m | Distance<br>(meter) |
| 13.553 – 13.567                               | 15848                         | 30                  | 124    | 3                   |
| 13.410 – 13.553 and 13.567 – 13.710           | 334                           | 30                  | 90.47  | 3                   |
| 13.110 – 13.410 and 13.710 – 14.010           | 106                           | 30                  | 80.50  | 3                   |
| Outside of the 13.110 – 14.010                | See 15.209 Limits             |                     |        |                     |

Remarks : 1. RF Voltage (dBuV) =  $20 \log \frac{V}{10^{-9}}$

2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
3. The emission limit in this paragraph is based on measurement instrumentation employing an average detector.

➤ Spurious electric field strength Limit

| FCC Part 15 Subpart C Paragraph 15.209 Limits |              |                         |                                 |
|---|--------------|-------------------------|---------------------------------|
| Frequency<br>MHz                              | uV/m         | dBuV/m                  | Measurement distance<br>(meter) |
| 0.009-0.490                                   | 2400/F(kHz)  | See Remark <sup>1</sup> | 300                             |
| 0.490-1.705                                   | 24000/F(kHz) | See Remark <sup>1</sup> | 30                              |
| 1.705-30                                      | 30           | 29.5                    | 30                              |
| 30-88   | 100          | 40                      | 3                               |
| 88-216  | 150          | 43.5                    | 3                               |
| 216-960                                       | 200          | 46                      | 3                               |
| Above 960                                     | 500          | 54                      | 3                               |

Remarks : 1. RF Voltage (dBuV) =  $20 \log \text{RF Voltage (uV)}$

2. In the Above Table, the tighter limit applies at the band edges.
3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

### 3.4. Test Procedure

#### Fundamental electric field strength:

The EUT and its simulators are placed on a turn table which is 1 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum electric field strength.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna which is 1 meter above ground. All X-axis, Y-axis and Z-axis polarization of the antenna are set on measurement.

#### Spurious electric field strength:

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C6310: 2013 on radiated measurement.

On any frequency the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurement are included emission measurement below 1000 MHz, there also is a limit on the radio frequency emissions, as

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measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.

The bandwidth below 30MHz setting on the field strength meter is 9kHz and above 30MHz is 120kHz.

The frequency range from 9kHz to 10th harmonics is checked.

### **3.5. Uncertainty**

± 2.6 dB below 30MHz

± 3.8 dB above 30MHz

### 3.6. Test Result of Radiated Emission

Product : NFC Antenna Module  
 Test Item : Fundamental Radiated Emission  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit mode

| Frequency         | Correct Factor | Reading Level | Measurement Level | Margin  | Limit   |
|-------------------|----------------|---------------|-------------------|---------|---------|
| MHz               | dB             | dBuV          | dBuV/m            | dB      | dBuV/m  |
| <b>X-axis</b>     |                |               |                   |         |         |
| <b>Quasi-Peak</b> |                |               |                   |         |         |
| <b>Horizontal</b> |                |               |                   |         |         |
| 13.560            | 20.410         | 31.530        | 51.940            | -72.060 | 124.000 |
| <b>Vertical</b>   |                |               |                   |         |         |
| 13.560            | 20.410         | 35.670        | 56.080            | -67.920 | 124.000 |
| <b>Y-axis</b>     |                |               |                   |         |         |
| <b>Quasi-Peak</b> |                |               |                   |         |         |
| <b>Horizontal</b> |                |               |                   |         |         |
| 13.560            | 20.410         | 43.480        | 63.890            | -60.110 | 124.000 |
| <b>Vertical</b>   |                |               |                   |         |         |
| 13.560            | 20.410         | 43.050        | 63.460            | -60.540 | 124.000 |
| <b>Z-axis</b>     |                |               |                   |         |         |
| <b>Quasi-Peak</b> |                |               |                   |         |         |
| <b>Horizontal</b> |                |               |                   |         |         |
| 13.560            | 20.410         | 44.300        | 64.710            | -59.290 | 124.000 |
| <b>Vertical</b>   |                |               |                   |         |         |
| 13.560            | 20.410         | 43.340        | 63.750            | -60.250 | 124.000 |

Note:

1. Limit=84dBuV/m + 40\*Log (30(m)/3(m))=124dBuV/m
2. All Readings below 1GHz are Quasi-Peak, above are average value.
3. Measurement Level = Reading Level + Correct Factor.
4. The average measurement was not performed when the peak measured data under the limit of average detection. If the readings given are average, peak measurement should also be supplied.

Product : NFC Antenna Module  
 Test Item : General Radiated Emission Data (below 30MHz)  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit mode

| Frequency         | Correct Factor | Reading Level | Measurement Level | Margin  | Limit  |
|-------------------|----------------|---------------|-------------------|---------|--------|
| MHz               | dB             | dBuV          | dBuV/m            | dB      | dBuV/m |
| <b>Horizontal</b> |                |               |                   |         |        |
| 27.120            | 19.950         | 3.700         | 23.650            | -45.890 | 69.540 |
| <b>Vertical</b>   |                |               |                   |         |        |
| 27.120            | 19.950         | 6.400         | 26.350            | -43.190 | 69.540 |

Note:

1. Limit=29.54dBuV/m + 40\*Log (30(m)/3(m))=69.54dBuV/m
2. All Readings below 1GHz are Quasi-Peak, above are average value.
3. “” means the worst emission level.
4. Measurement Level = Reading Level + Correct Factor.

Product : NFC Antenna Module  
 Test Item : General Radiated Emission Data (above 30MHz)  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit mode

| Frequency | Correct Factor | Reading Level | Measurement Level | Margin | Limit  |
|-----------|----------------|---------------|-------------------|--------|--------|
| MHz       | dB             | dBuV          | dBuV/m            | dB     | dBuV/m |

### Horizontal

#### QP Detector

|         |        |        |        |         |        |
|---------|--------|--------|--------|---------|--------|
| 230.529 | 13.203 | 16.672 | 29.875 | -16.125 | 46.000 |
| 350.224 | 18.225 | 17.177 | 35.401 | -10.599 | 46.000 |
| 491.683 | 21.860 | 21.939 | 43.799 | -2.201  | 46.000 |
| 633.141 | 26.149 | 11.693 | 37.842 | -8.158  | 46.000 |
| 844.551 | 26.323 | 7.739  | 34.062 | -11.938 | 46.000 |
| 984.455 | 26.832 | 1.631  | 28.462 | -25.538 | 54.000 |

### Vertical

#### QP Detector

|         |        |        |        |         |        |
|---------|--------|--------|--------|---------|--------|
| 39.327  | 14.963 | 21.798 | 36.762 | -3.238  | 40.000 |
| 221.202 | 20.178 | 11.357 | 31.535 | -14.465 | 46.000 |
| 491.683 | 20.650 | 19.573 | 40.223 | -5.777  | 46.000 |
| 633.141 | 23.345 | 10.007 | 33.352 | -12.648 | 46.000 |
| 796.362 | 24.601 | 14.913 | 39.514 | -6.486  | 46.000 |
| 940.929 | 27.384 | 3.930  | 31.314 | -14.686 | 46.000 |

#### Note:

1. All Readings below 1GHz are Quasi-Peak, above are average value.
2. “” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

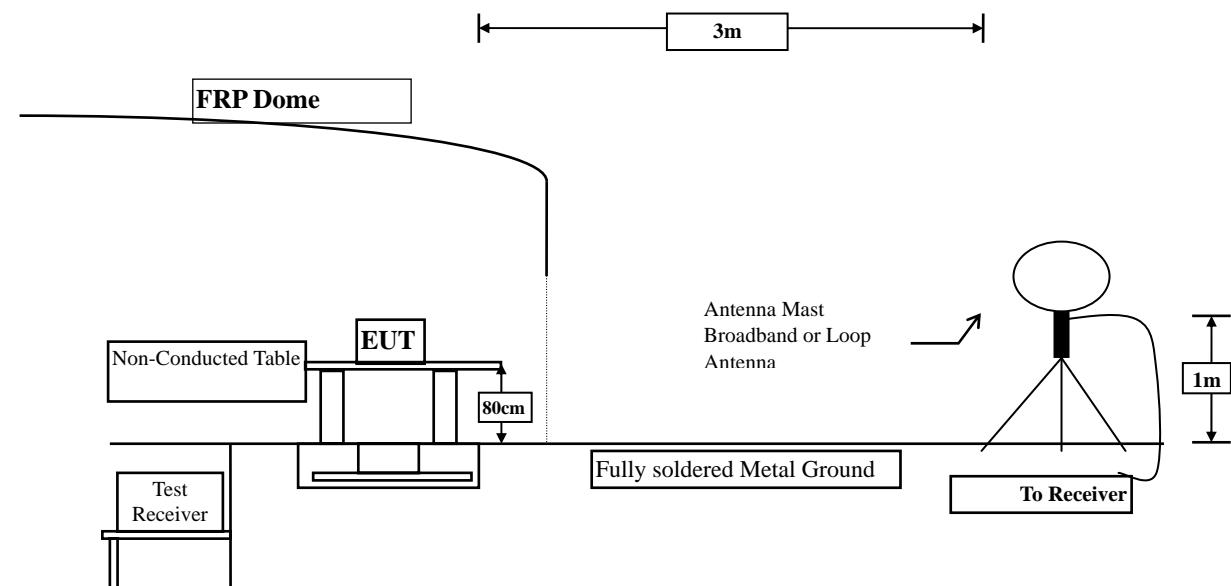
## 4. Band Edge

### 4.1. Test Equipment

| Test Site  | Equipment |                       | Manufacturer    | Model No./Serial No. | Last Cal. |
|------------|-----------|-----------------------|-----------------|----------------------|-----------|
| ☒ Site # 3 | X         | Magnetic Loop Antenna | Teseq           | HLA6121/ 37133       | Sep, 2015 |
|            | X         | Bilog Antenna         | Schaffner Chase | CBL6112B/ 2707       | Jun, 2015 |
|            | X         | EMI Test Receiver     | R&S             | ESCS 30/838251/ 001  | Jun, 2015 |
|            | X         | Coaxial Cable         | QTK(Arnist)     | RG 214/ LC003-RG     | Jun, 2015 |
|            | X         | Coaxial signal switch | Arnist          | MP59B/ 6200798682    | Jun, 2015 |

Note: 1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.  
 2. The test instruments marked with "X" are used to measure the final test results.

### 4.2. Test Setup



#### **4.3. Limits**

In any 9 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 50 dB below that in the 9 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

#### **4.4. Test Procedure**

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

The bandwidth below 30MHz setting on the field strength meter is 9kHz and above 30MHz is 120kHz.

#### **4.5. Uncertainty**

Radiated is  $\pm$  2.6 dB

#### 4.6. Test Result of Band Edge

Product : NFC Antenna Module  
 Test Item : Band Edge Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit mode

#### RF Radiated Measurement

##### (Horizontal)

| Frequency (MHz) | Correct Factor (dB) | Reading Level (dBuV) | Emission Level (dBuV/m) | QP Limit (dBuV/m) | Result |
|-----------------|---------------------|----------------------|-------------------------|-------------------|--------|
| 13.110          | 20.430              | 7.900                | 28.330                  | 69.540            | Pass   |
| 13.360          | 20.420              | 19.300               | 39.720                  | 69.540            | Pass   |
| 13.410          | 20.420              | 14.900               | 35.320                  | 69.540            | Pass   |
| 14.010          | 20.400              | 8.800                | 29.200                  | 69.540            | Pass   |

Note:

1. All Readings below 1GHz are Quasi-Peak, above are average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

##### (Vertical)

| Frequency (MHz) | Correct Factor (dB) | Reading Level (dBuV) | Emission Level (dBuV/m) | QP Limit (dBuV/m) | Result |
|-----------------|---------------------|----------------------|-------------------------|-------------------|--------|
| 13.110          | 20.430              | 7.200                | 27.630                  | 69.540            | Pass   |
| 13.360          | 20.420              | 18.300               | 38.720                  | 69.540            | Pass   |
| 13.410          | 20.420              | 13.900               | 34.320                  | 69.540            | Pass   |
| 14.010          | 20.400              | 7.800                | 28.200                  | 69.540            | Pass   |

Note:

1. All Readings below 1GHz are Quasi-Peak, above are average value.
2. “ ” means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

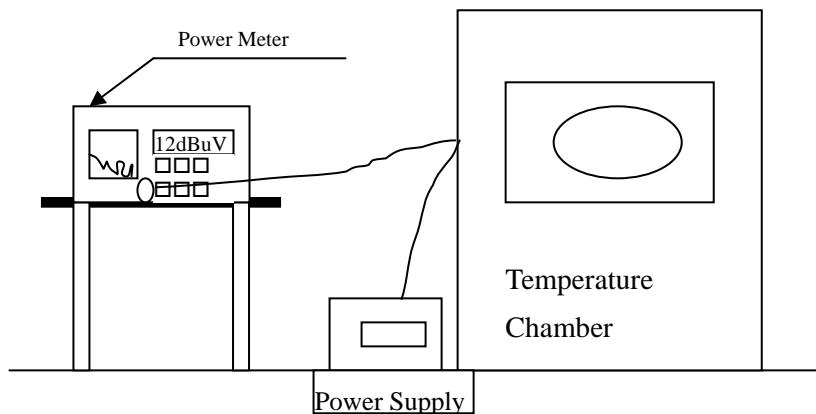
## 5. Frequency Tolerance

### 5.1. Test Equipment

| Equipment             | Manufacturer | Model No./Serial No. | Last Cal.   |
|-----------------------|--------------|----------------------|-------------|
| Spectrum Analyzer     | R&S          | FSP40 / 100170       | Jun, 2016   |
| Spectrum Analyzer     | Agilent      | E4407B / US39440758  | Jun, 2016   |
| X Spectrum Analyzer   | Agilent      | N9010A / MY48030495  | Apr., 2016  |
| X Temperature Chamber | TDE          | CHM 150CT            | March, 2016 |

Note: All equipments are calibrated every one year.

### 5.2. Test Setup



### 5.3. Limits

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency.

### 5.4. Test Procedure

The over 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.

### 5.5. Uncertainty

$\pm 150$  Hz

## 5.6. Test Result of Frequency Stability

Product : NFC Antenna Module  
 Test Item : Frequency Tolerance  
 Test Site : Temperature Chamber  
 Test Mode : Mode 1: Transmit mode

| Temperature<br>(°C) | Voltage<br>(V) | Observe<br>Time | Declared<br>Frequency<br>(MHz) | Read<br>Frequency<br>(MHz) | Tolerance<br>(%) | Limit<br>(%) |
|---------------------|----------------|-----------------|--------------------------------|----------------------------|------------------|--------------|
| 20                  | 120            | start           | 13.56                          | 13.56032                   | 0.002360         | ± 0.01 %     |
|                     |                | 2mins           | 13.56                          | 13.56032                   | 0.002360         |              |
|                     |                | 5mins           | 13.56                          | 13.56032                   | 0.002360         |              |
|                     |                | 10mins          | 13.56                          | 13.56032                   | 0.002360         |              |
| 20                  | 138            | start           | 13.56                          | 13.56032                   | 0.002360         | ± 0.01 %     |
|                     |                | 2mins           | 13.56                          | 13.56032                   | 0.002360         |              |
|                     |                | 5mins           | 13.56                          | 13.56032                   | 0.002360         |              |
|                     |                | 10mins          | 13.56                          | 13.56032                   | 0.002360         |              |
| 20                  | 102            | start           | 13.56                          | 13.56032                   | 0.002360         | ± 0.01 %     |
|                     |                | 2mins           | 13.56                          | 13.56032                   | 0.002360         |              |
|                     |                | 5mins           | 13.56                          | 13.56032                   | 0.002360         |              |
|                     |                | 10mins          | 13.56                          | 13.56032                   | 0.002360         |              |
| 50                  | 120            | start           | 13.56                          | 13.56012                   | 0.000885         | ± 0.01 %     |
|                     |                | 2mins           | 13.56                          | 13.56012                   | 0.000885         |              |
|                     |                | 5mins           | 13.56                          | 13.56012                   | 0.000885         |              |
|                     |                | 10mins          | 13.56                          | 13.56012                   | 0.000885         |              |
| 40                  | 120            | start           | 13.56                          | 13.56018                   | 0.001327         | ± 0.01 %     |
|                     |                | 2mins           | 13.56                          | 13.56018                   | 0.001327         |              |
|                     |                | 5mins           | 13.56                          | 13.56018                   | 0.001327         |              |
|                     |                | 10mins          | 13.56                          | 13.56018                   | 0.001327         |              |
| 30                  | 120            | start           | 13.56                          | 13.56017                   | 0.001254         | ± 0.01 %     |
|                     |                | 2mins           | 13.56                          | 13.56017                   | 0.001254         |              |
|                     |                | 5mins           | 13.56                          | 13.56017                   | 0.001254         |              |
|                     |                | 10mins          | 13.56                          | 13.56017                   | 0.001254         |              |

|     |     |        |       |          |           |          |
|-----|-----|--------|-------|----------|-----------|----------|
| 10  | 120 | start  | 13.56 | 13.55998 | -0.000147 | ± 0.01 % |
|     |     | 2mins  | 13.56 | 13.55998 | -0.000147 |          |
|     |     | 5mins  | 13.56 | 13.55998 | -0.000147 |          |
|     |     | 10mins | 13.56 | 13.55998 | -0.000147 |          |
| 0   | 120 | start  | 13.56 | 13.55997 | -0.000221 | ± 0.01 % |
|     |     | 2mins  | 13.56 | 13.55997 | -0.000221 |          |
|     |     | 5mins  | 13.56 | 13.55997 | -0.000221 |          |
|     |     | 10mins | 13.56 | 13.55997 | -0.000221 |          |
| -10 | 120 | start  | 13.56 | 13.55989 | -0.000811 | ± 0.01 % |
|     |     | 2mins  | 13.56 | 13.55989 | -0.000811 |          |
|     |     | 5mins  | 13.56 | 13.55989 | -0.000811 |          |
|     |     | 10mins | 13.56 | 13.55989 | -0.000811 |          |
| -20 | 120 | start  | 13.56 | 13.55986 | -0.001032 | ± 0.01 % |
|     |     | 2mins  | 13.56 | 13.55986 | -0.001032 |          |
|     |     | 5mins  | 13.56 | 13.55986 | -0.001032 |          |
|     |     | 10mins | 13.56 | 13.55986 | -0.001032 |          |

## **6. EMI Reduction Method During Compliance Testing**

No modification was made during testing.

Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs