

# TEST REPORT

Report No: KST-FCR-160004(1)

|                      |                                       |  |
|----------------------|---------------------------------------|--|
| <b>Applicant</b>     | Name                                  | CHANG SHIN INFOTEL CO.,LTD   |
|                      | Address                               | 3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil, seo-gu, Deajeon, South Korea |
| <b>Manufacturer</b>  | Name                                  | CHANG SHIN INFOTEL CO.,LTD   |
|                      | Address                               | 3F, Yonhap News Bldg, 64, Deadeok-Daero, 168beon-gil, seo-gu, Deajeon, South Korea |
| <b>Equipment</b>     | Name                                  | Access Controlled Security System with zigbee & RFID                               |
|                      | Model No                              | SG-2000  |
|                      | Brand                                 | huinu  |
|                      | FCC ID                                | 2ABZV-SG-2000  |
| <b>Test Standard</b> | FCC CFR 47, Part 15. Subpart C-15.225 |  |
| <b>Test Date(s)</b>  | 2016. 03. 28 - 2016. 03. 29           |  |
| <b>Issue Date</b>    | 2016. 03. 31                          |  |
| <b>Test Result</b>   | Compliance                            |  |
| <b>Note</b>          | -                                     |  |

## Supplementary Information

The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in ANSI C 63.10-2013.

We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by Mi-Young, Lee

Approved by Gyeong-Hyeon, Park

Signature



Signature



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## 1. GENERAL INFORMATION

### 1.1 Test Facility

#### Test laboratory and address

KOSTEC Co., Ltd.

128(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

#### Registration information

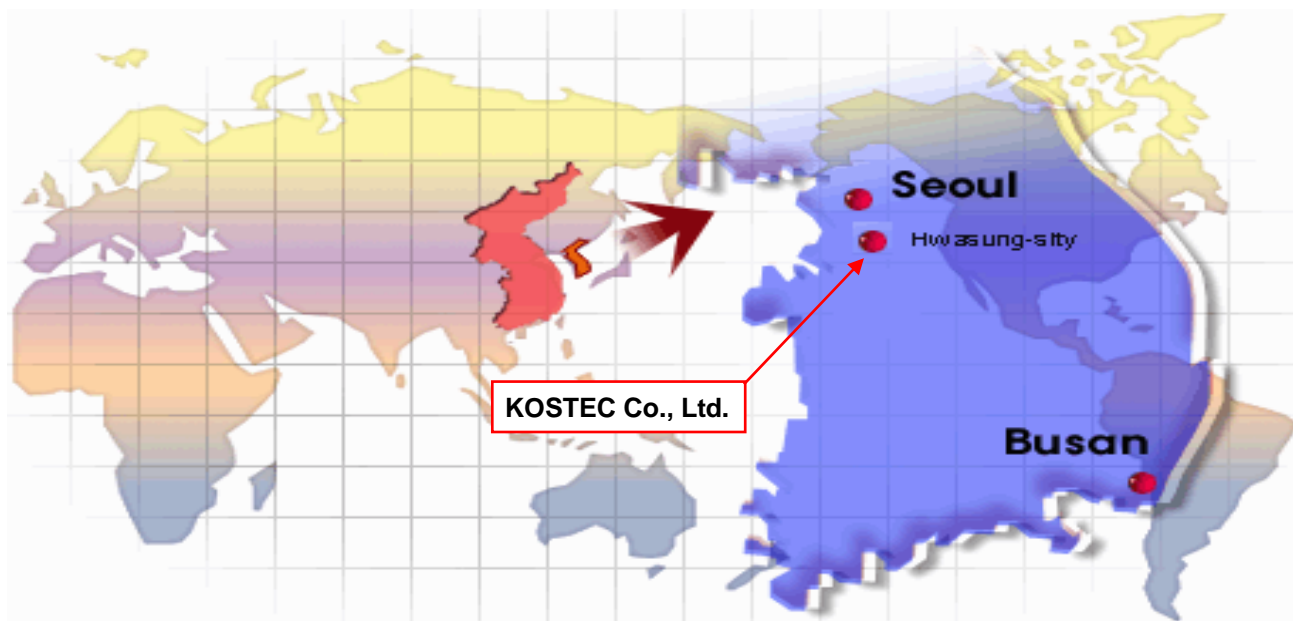
KOLAS No. : 232

FCC Designation No. : KR0041

FCC Registration No. : 525762

IC Registration Site No. : 8305A

### 1.2 Location



## Revision History of test report

| Rev. | Revisions               | Effect page | Reviewed           | Date       |
|------|-------------------------|-------------|--------------------|------------|
| -    | Initial issue           | All         | Gyeong-Hyeon, Park | 2016.03.31 |
| 1    | Add Procedure Reference | 11          | Gyeong-Hyeon, Park | 2016.04.22 |

## 2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

|                       |   |
|-----------------------|---|
| Equipment Name        | Access Controlled Security System with zigbee&RFID  |
| Model No              | SG-2000   |
| Usage                 | Access Controlled Security System with zigbee&RFID  |
| Serial Number         | Proto type  |
| Modulation type       | ASK   |
| Oscillation Type      | X-tal   |
| Maximum output power  | 12.22 dB $\mu$ V/m @ 30 meter   |
| Operated Frequency    | 13.56 MHz   |
| Channel Number        | 1   |
| Operation temperature | -20 °C - + 50 °C  |
| Power Source          | AC/DC Adaptor, output: DC 12 V<br>PoE, DC 48 V  |
| Antenna Description   | Internal PCB antenna  |
| Remark                | <p>1. The device was operating at its maximum output power for all measurements.</p> <p>2. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case (X) is shown in the report.</p> <p>3. The above DUT's information was declared by manufacturer. Please refer to the specifications or user manual for more detailed description.</p> |
| FCC ID                | 2ABZV-SG-2000   |

### 3. SYSTEM CONFIGURATION FOR TEST

#### 3.1 Characteristics of equipment

This equipment is a wireless authentication key that you wirelessly communicate with each other in 2.4GHz zigbee. It is used as a key of access control systems as the product which satisfies users' convenience and security. As it doesn't require users' authentication behaviors like RF-ID or finer scan

#### 3.2 Used peripherals list

| Description | Model No.    | Serial No. | Manufacture | Remark       |
|-------------|--------------|------------|-------------|--------------|
| Notebook    | BCM-1063     | 2Z7S1Z1    | Dell Inc    |              |
| Adapter     | DA65NM111-00 | None       | Dell Inc    | For notebook |

#### 3.3 Product Modification

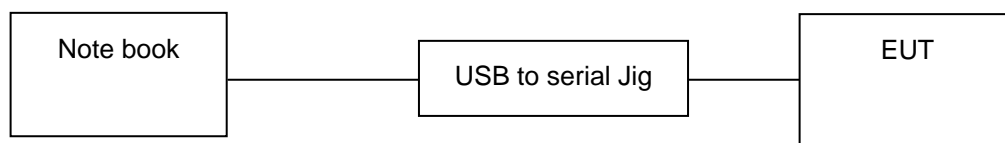
N/A

#### 3.4 Operating Mode

Constantly transmitting with a modulated carrier at maximum power.

#### 3.5 Test Setup of EUT

The measurements were taken in continuous transmit mode using the test mode which controlled by Tera Term. The test command and the test Jig and cables were provided by the applicant.



### 3.7 Used Test Equipment List

| No. | Instrument                          | Model            | S/N          | Manufacturer               | Due to cal date | Cal interval | used                                |
|-----|-------------------------------------|------------------|--------------|----------------------------|-----------------|--------------|-------------------------------------|
| 1   | T & H Chamber                       | EY-101           | 90E14260     | TABAI ESPEC                | 2016.09.17      | 1 year       | <input checked="" type="checkbox"/> |
| 2   | T & H Chamber                       | SH-641           | 92006831     | ESPEC CORP                 | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 3   | Constant switch Tester              | DS-COT           | None         | Dong sung Ele.             | N/A             | N/A          | <input type="checkbox"/>            |
| 4   | Vibration Tester                    | 70UA             | L90016       | IDEX Co.,Ltd               | N/A             | N/A          | <input type="checkbox"/>            |
| 5   | Vibration Meter                     | VM-6360          | N225098      | LANDTEK                    | 2016.04.07      | 1 year       | <input type="checkbox"/>            |
| 6   | Falling Tester                      | SWD-8000         | None         | Sinwoo                     | N/A             | N/A          | <input type="checkbox"/>            |
| 7   | Spectrum Analyzer                   | 8563E            | 3846A10662   | Agilent Technology         | 2017.02.02      | 1 year       | <input type="checkbox"/>            |
| 8   | Spectrum Analyzer                   | 8593E            | 3710A02859   | Agilent Technology         | 2017.02.02      | 1 year       | <input type="checkbox"/>            |
| 9   | Spectrum Analyzer                   | FSV30            | 20-353063    | Rohde & Schwarz            | 2017.02.02      | 1 year       | <input checked="" type="checkbox"/> |
| 10  | EMI Test Receiver                   | ESCI7            | 100823       | Rohde & Schwarz            | 2017.02.02      | 1 year       | <input checked="" type="checkbox"/> |
| 11  | EMI Test Receiver                   | ESI              | 837514/004   | Rohde & Schwarz            | 2016.10.08      | 1 year       | <input type="checkbox"/>            |
| 12  | Vector Signal Analyzer              | 89441A           | 3416A02620   | Agilent Technology         | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 13  | Network Analyzer                    | 8753ES           | US39172348   | AGILENT                    | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 14  | EPM Series Power meter              | E4418B           | GB39512547   | Agilent Technology         | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 15  | RF Power Sensor                     | E9300A           | MY41496631   | Agilent Technology         | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 16  | Microwave Frequency Counter         | 5352B            | 2908A00480   | Agilent Technology         | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 17  | Modulation Analyzer                 | 8901A            | 3538A07071   | Agilent Technology         | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 18  | Audio Analyzer                      | 8903B            | 3514A16919   | Agilent Technology         | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 19  | Audio Telephone Analyzer            | DD-5601CID       | 520010281    | CREDIX                     | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 20  | Digital storage Oscilloscope        | TDS3052          | B015962      | Tektronix                  | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 21  | ESG-D Series Signal Generator       | E4436B           | US39260458   | Agilent Technology         | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 22  | ESG Vector Signal Generator         | E4438C           | MY42083133   | Agilent Technology         | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 23  | Vector Signal Generator             | SMBV100A         | 257557       | Rohde & Schwarz            | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 24  | Tracking Source                     | 85645A           | 070521-A1    | Agilent Technology         | 2017.02.02      | 1 year       | <input type="checkbox"/>            |
| 25  | SLIDAC                              | None             | 0207-4       | Myoung sung Ele.           | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 26  | DC Power supply                     | DRP-5030         | 9028029      | Digital Electronic Co.,Ltd | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 27  | DC Power supply                     | 6038A            | 3440A12674   | Agilent Technology         | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 28  | DC Power supply                     | E3610A           | KR24104505   | Agilent Technology         | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 29  | DC Power supply                     | UP-3005T         | 68           | Unicon Co.,Ltd             | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 30  | DC Power Supply                     | SM 3004-D        | 114701000117 | DELTAELEKTRONIKA           | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 31  | Dummy Load                          | 8173             | 3780         | Bird Electronic Co., Corp  | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 32  | Attenuator                          | 50FH-030-500     | 140410 9433  | JEW Industries Inc.        | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 33  | Attenuator                          | 765-20           | 9703         | Narda                      | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 34  | Attenuator                          | 8498A            | 3318A09485   | HP                         | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 35  | Step Attenuator                     | 8494B            | 3308A32809   | HP                         | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 36  | Step Attenuator                     | 8495D            | 3308A01464   | HP                         | 2017.02.02      | 1 year       | <input checked="" type="checkbox"/> |
| 37  | Power divider                       | 11636B           | 51212        | HP                         | 2017.02.02      | 1 year       | <input type="checkbox"/>            |
| 38  | 3Way Power divider                  | KPDSU3W          | 00070365     | KMW                        | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 39  | 4Way Power divider                  | 70052651         | 173834       | KRYTAR                     | 2017.02.02      | 1 year       | <input type="checkbox"/>            |
| 40  | Band rejection filter               | WTR-BRF2442-84NN | 09020001     | WAVE TECH Co.,LTD          | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 41  | White noise audio filter            | ST31EQ           | 101902       | SoundTech                  | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 42  | Dual directional coupler            | 778D             | 17693        | HEWLETT PACKARD            | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 43  | Dual directional coupler            | 772D             | 2839A00924   | HEWLETT PACKARD            | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 44  | Band rejection filter               | 3TNF-0006        | 26           | DOVER Tech                 | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 45  | Band rejection filter               | 3TNF-0008        | 317          | DOVER Tech                 | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 46  | Band rejection filter               | 3TNF-0007        | 311          | DOVER Tech                 | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 47  | Highpass Filter                     | WHJS1100-10EF    | 1            | WAINWRIGHT                 | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 48  | Highpass Filter                     | WHJS3000-10EF    | 1            | WAINWRIGHT                 | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 49  | Radio Communication Alalyzer        | MT8815A          | 6200429622   | ANRITSU                    | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 50  | CDMA Mobile Station Test Set        | E8285A           | US40081298   | AGILENT                    | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 51  | WideBand Radio Communication Tester | CMW500           | 102276       | Rohde & Schwarz            | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 52  | Radio Communication Tester          | CMU 200          | 112026       | Rohde & Schwarz            | 2017.02.03      | 1 year       | <input type="checkbox"/>            |

| No. | Instrument           | Model     | S/N         | Manufacturer      | Due to cal date | Cal interval | used                                |
|-----|----------------------|-----------|-------------|-------------------|-----------------|--------------|-------------------------------------|
| 53  | Bluetooth Tester     | TC-3000B  | 3000B6A0166 | TESCOM CO., LTD.  | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 54  | RF Up/Down Converter | DCP-1780  | 980901003   | CREDIX            | 2017.02.03      | 1 year       | <input type="checkbox"/>            |
| 55  | DECT Test set        | 8923B     | 3829U00364  | HP                | 2017.02.04      | 1 year       | <input type="checkbox"/>            |
| 56  | DECT Test set        | CMD60     | 840677/005  | Rohde & Schwarz   | 2016.09.16      | 1 year       | <input type="checkbox"/>            |
| 57  | Loop Antenna         | 6502      | 9203-0493   | EMCO              | 2017.06.04      | 2 year       | <input checked="" type="checkbox"/> |
| 58  | Dipole Antenna       | HZ-12     | 100005      | Rohde & Schwarz   | 2016.07.01      | 2 year       | <input type="checkbox"/>            |
| 59  | Dipole Antenna       | HZ-13     | 100007      | Rohde & Schwarz   | 2016.07.01      | 2 year       | <input type="checkbox"/>            |
| 60  | BiconiLog Antenna    | 3142B     | 1745        | EMCO              | 2016.06.16      | 2 year       | <input checked="" type="checkbox"/> |
| 61  | Horn Antenna         | 3115      | 9605-4834   | EMCO              | 2016.06.16      | 2 year       | <input type="checkbox"/>            |
| 62  | Horn Antenna         | 3115      | 2996        | EMCO              | 2018.02.12      | 2 year       | <input type="checkbox"/>            |
| 63  | Horn Antenna         | BBHA9170  | BBHA9170152 | SCHWARZBECK       | 2017.04.30      | 2 year       | <input type="checkbox"/>            |
| 64  | Antenna Mast(OSA)    | AT14      | None        | Daeil EMC         | N/A             | N/A          | <input type="checkbox"/>            |
| 65  | Turn table(OSA)      | None      | None        | Daeil EMC         | N/A             | N/A          | <input type="checkbox"/>            |
| 66  | RF Amplifier(OSA)    | 8447D     | 2944A07881  | AGILENT           | 2017.02.01      | 1 year       | <input type="checkbox"/>            |
| 67  | Antenna Master(3)    | AT13      | None        | AUDIX             | N/A             | N/A          | <input type="checkbox"/>            |
| 68  | Turn Table(3)        | None      | None        | AUDIX             | N/A             | N/A          | <input type="checkbox"/>            |
| 69  | PREAMPLIFIER(3)      | 8449B     | 3008A02577  | Agilent           | 2016.02.05      | 1 year       | <input type="checkbox"/>            |
| 70  | Antenna Master(10)   | MA4000-EP | None        | inno systems GmbH | N/A             | N/A          | <input checked="" type="checkbox"/> |
| 71  | Turn Table(10)       | None      | None        | inno systems GmbH | N/A             | N/A          | <input checked="" type="checkbox"/> |
| 72  | AMPLIFIER(10)        | TK-PA6S   | 120009      | TESTEK            | 2017.02.02      | 1 year       | <input checked="" type="checkbox"/> |
| 73  | Vernier Calipers     | None      | 8280373     | Mitutoyo          | 2016.09.17      | 1 year       | <input type="checkbox"/>            |



## 4. SUMMARY TEST RESULTS

| Description of Test   | FCC Rule        | Reference Clause | Used                                | Test Result |
|---|-----------------|------------------|-------------------------------------|-------------|
| Carrier frequency tolerance   | 15.225(e)       | Clause 5.1       | <input checked="" type="checkbox"/> | Compliance  |
| Field strength of radiated emission   | 15.225(a) ~ (d) | Clause 5.2       | <input checked="" type="checkbox"/> | Compliance  |
| AC Conducted emission   | 15.207          | Clause 5.3       | <input checked="" type="checkbox"/> | Compliance  |
| Antenna requirement   | 15.203, 15.247  | Clause 5.4       | <input checked="" type="checkbox"/> | Compliance  |
| 20 dB bandwidth measurement   | 2.1049          | Clause 5.5       | <input checked="" type="checkbox"/> | Compliance  |
| <p>Compliance/pass : The EUT complies with the essential requirements in the standard.</p> <p>Not Compliance : The EUT does not comply with the essential requirements in the standard.</p> <p>N/A : The test was not applicable in the standard.</p> |                 |                  |                                     |             |

### Procedure Reference

FCC CFR 47, Part 15. Subpart C-15.225

ANSI C 63.10-2013

## 5. MEASUREMENT RESULTS

### 5.1 Carrier Frequency tolerance

#### 5.1.1 Standard Applicable [FCC §15.225(e)]

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency Over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation In the primary supply 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.

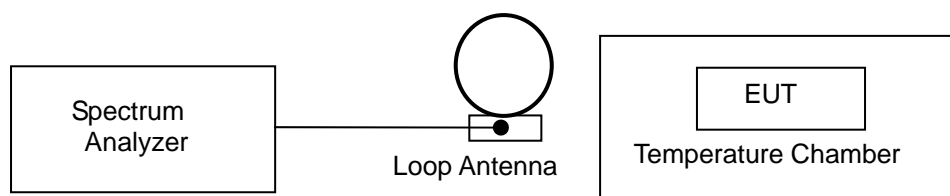
#### 5.1.2 Test Environment conditions

- Ambient temperature : (22 - 23) °C
- Relative Humidity : (50 - 52) % R.H.

#### 5.1.3 Measurement Procedure

Before measurements are made the equipment shall have reached thermal balance in the Test chamber period. and then it is normal operating for about 15 minutes after thermal balance has been reached. For tests at the extreme temperature, the equipment shall be left in the test chamber until thermal balance is attained, then the standby or receive condition for a period of a few minute after which the equipment shall meet the specified requirements. The test data sheet recorded measured value by frequency counter.

#### 5.1.4 Test setup



#### 5.1.5 Measurement Result

##### ■ Adapter

| Frequency (13.56 MHz)    |                           |                                      | Measured frequency<br>[Hz] | Frequency Tolerance |    |
|--------------------------|---------------------------|--------------------------------------|----------------------------|---------------------|----|
|                          |                           |                                      |                            | %                   | Hz |
| T <sub>NOM</sub> + 22 °C | V <sub>NOM</sub> 12.0 Vdc | 13 560 128                           | 0.0009                     | 128                 |    |
|                          | V <sub>MIN</sub> 10.2 Vdc | 13 560 127                           | 0.0009                     | 127                 |    |
|                          | V <sub>MAX</sub> 13.8 Vdc | 13 560 128                           | 0.0009                     | 128                 |    |
| T <sub>MIN</sub> - 20 °C | V <sub>NOM</sub> 12.0 Vdc | 13 560 129                           | 0.0010                     | 129                 |    |
| T <sub>MAX</sub> +55 °C  | V <sub>NOM</sub> 12.0 Vdc | 13 560 129                           | 0.0010                     | 129                 |    |
| Limit                    |                           | Within in (±) 0.01 % or (±) 1 356 Hz |                            |                     |    |
| Max. Tolerance           |                           | 0.0010 %, (±)129 Hz                  |                            |                     |    |
| Result                   |                           | Compliance                           |                            |                     |    |

■ PoE

| Frequency (13.56 MHz)    |                  |          | Measured frequency<br>[Hz]           | Frequency Tolerance |     |
|--------------------------|------------------|----------|--------------------------------------|---------------------|-----|
|                          |                  |          |                                      | %                   | Hz  |
| T <sub>NOM</sub> + 22 °C | V <sub>NOM</sub> | 48.0 Vdc | 13 560 136                           | 0.0010              | 136 |
|                          | V <sub>MIN</sub> | 40.8 Vdc | 13 560 135                           | 0.0010              | 135 |
|                          | V <sub>MAX</sub> | 55.2 Vdc | 13 560 138                           | 0.0010              | 138 |
| T <sub>MIN</sub> - 20 °C | V <sub>NOM</sub> | 48.0 Vdc | 13 560 122                           | 0.0009              | 122 |
| T <sub>MAX</sub> + 55 °C | V <sub>NOM</sub> | 48.0 Vdc | 13 560 141                           | 0.0010              | 141 |
| Limit                    |                  |          | Within in (±) 0.01 % or (±) 1 356 Hz |                     |     |
| Max. Tolerance           |                  |          | 0.0010 %, 141 Hz                     |                     |     |
| Result                   |                  |          | Compliance                           |                     |     |

## 5.2 Field strength of radiated emissions

### 5.2.1 Standard Applicable [FCC §15.225 (a) ~ (d)]

(a) The Field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848  $\mu\text{V}/\text{m}$  at 30 meter

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 micro volts/meter at 30 meter

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 micro volts/meter at 30 meter

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

Above required standard (a ~ c) and (d) is brief describe table as follows

#### § 15.225 [(a) ~ (c)] : Limit for in-band field strength

| Frequency Band (MHz)               | Limit                      |                              | Measurement distance (meter) |
|------------------------------------|----------------------------|------------------------------|------------------------------|
|                                    | ( $\mu\text{V}/\text{m}$ ) | (dB $\mu\text{V}/\text{m}$ ) |                              |
| 13.553 – 13.567                    | 15,848                     | 84.00                        | 30                           |
| 13.410 – 13.553<br>13.567 – 13.710 | 334                        | 50.47                        | 30                           |
| 13.110 – 13.410<br>13.710 – 14.010 | 106                        | 40.50                        | 30                           |

#### §15.209. limits for radiated emissions measurements

| Frequency Band | Limit [ $\mu\text{V}/\text{m}$ ] | Limit [dB $\mu\text{V}/\text{m}$ ] | Measurement distance (meter) | Detector       |
|----------------|----------------------------------|------------------------------------|------------------------------|----------------|
| 0.009 – 0.490  | 2 400/F (kHz)                    | -                                  | 300                          |                |
| 0.490 – 1.705  | 2 4000/F (kHz)                   | -                                  | 30                           |                |
| 1.705 – 30.0   | 30                               | 29.54                              | 30                           | Quasi peak     |
| 30 - 88        | 100 **                           | 40.0                               | 3                            | Quasi peak     |
| 88 - 216       | 150 **                           | 43.5                               | 3                            | Quasi peak     |
| 216 - 960      | 200 **                           | 46.0                               | 3                            | Quasi peak     |
| Above 960      | 500                              | 54.0                               | 3                            | Peak & Average |

\*\* fundamental emissions from intentional radiators operation under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz, or 470-806 MHz. However, operation within these Frequency bands is permitted under other sections of this Part Section 15.231 and 15.241

### §15.205. Restrict Band of Operation

Only spurious emissions are permitted in any of the frequency bands listed below ;

| [MHz]               | [MHz]                 | [MHz]           | [GHz]         |
|---------------------|-----------------------|-----------------|---------------|
| 0.090 - 0.110       | 16.42 - 16.423        | 399.9 - 410     | 4.5 - 5.15    |
| 0.495 - 0.505**     | 16.69475 - 16.69525   | 608 - 614       | 5.35 - 5.46   |
| 2.1735 - 2.1905     | 16.80425 - 16.80475   | 960 - 1240      | 7.25 - 7.75   |
| 4.125 - 4.128       | 25.5 - 25.67          | 1300 - 1427     | 8.025 - 8.    |
| 4.17725 - 4.17775   | 37.5 - 38.25          | 1435 - 1626.5   | 9.0 - 9.2     |
| 4.20725 - 4.20775   | 73 - 74.6             | 1645.5 - 1646.5 | 9.3 - 9.5     |
| 6.215 - 6.218       | 74.8 - 75.2           | 1660 - 1710     | 10.6 - 12.7   |
| 6.26775 - 6.26825   | 108 - 121.94          | 1718.8 - 1722.2 | 13.25 - 13.   |
| 6.31175 - 6.31225   | 123 - 138             | 2200 - 2300     | 14.47 - 14.5  |
| 8.291 - 8.294       | 149.9 - 150.05        | 2310 - 2390     | 15.35 - 16.2  |
| 8.362 - 8.366       | 156.52475 - 156.52525 | 2483.5 - 2500   | 17.7 - 21.4   |
| 8.37625 - 8.38675   | 156.7 - 156.9         | 2690 - 2900     | 22.01 - 23.12 |
| 8.41425 - 8.41475   | 162.0125 - 167.17     | 3260 - 3267     | 23.6 - 24.0   |
| 12.29 - 12.293      | 167.72 - 173.2        | 3332 - 3339     | 31.2 - 31.8   |
| 12.51975 - 12.52025 | 240 - 285             | 3345.8 - 3358   | 36.43 - 36.5  |
| 12.57675 - 12.57725 | 322 - 335.4           | 3600 - 4400     | Above 38.6    |

\*\* Until February 1, 1999, this restricted band shall be 0.490-0.510

### 5.2.2 Test Environment conditions

- Ambient temperature : (19 - 21) °C
- Relative Humidity : (36 - 37) % R.H.

### 5.2.3 Measurement Procedure

The measurements procedure of the transmitter radiated E-field is as following describe method.

The test is performed in a Shield chamber to determine the accurate frequencies, after maximum emissions level will be checked on a test chamber and measuring distance is 3 m from EUT to test antenna.

(The chamber is ensured that comply with at least 6 dB above the ambient noise level)

- ① The EUT was powered ON with continuously operating mode and placed on a 0.8 meter high non-conductive table on the reference ground plane.
- ② The test antenna was used on Horn antenna for above 1 GHz, and if the below 1 GHz, broad-band antenna and Loop antenna were used for below 30 MHz and it's antenna positioned in both the horizontal and vertical plane was location at EUT during the test for maximized the emission measurement.
- ③ The output of the test antenna will be connected to a measuring receiver, and it is set to tuned over the frequency range according to required standard
- ④ The measuring detector type of the measurement receiver is based on average value of measurement instrumentation employing a CISPR Quasi Peak detector according to required standard and for above 1 GHz, set the spectrum analyzer on a average and peak detector for the provisions in §15.35 and investigated frequency range is set the spectrum analyzer according to §15.33.
- ⑤ The fundamental frequency at which a relevant radiated signal component is detected, the test antenna will be raised and lowered through the specified range of heights in horizontal and vertical polarized orientation, until an maximum signal level is detected on the measuring receiver.
- ⑥ The transmitter is position x,y,z axis on rotating through 360 degrees, until the maximum signal level is detected by the measuring receiver.

⑦ The receiver is scanned from requested measuring frequency band and then the maximum meter reading is recorded. The radiated emissions were measured with required standard.

- The measurement results are obtained as described below:

$$\text{Result(dB } \mu\text{V/m)} = \text{Reading(dB } \mu\text{V)} + \text{Antenna factor(dB/m)} + \text{CL(dB)} + \text{other applicable factor (dB)}$$

- According to §15.33 (a)(1), Frequency range of radiated measurement is performed the tenth harmonic.

※ if necessary, additionally receiver is adopted high-pass filter and preamp because lower radiated signal

※ The transmitter radiated spectrum was investigated from 9 kHz to 1 GHz

## 5.2.4 Measurement Uncertainty

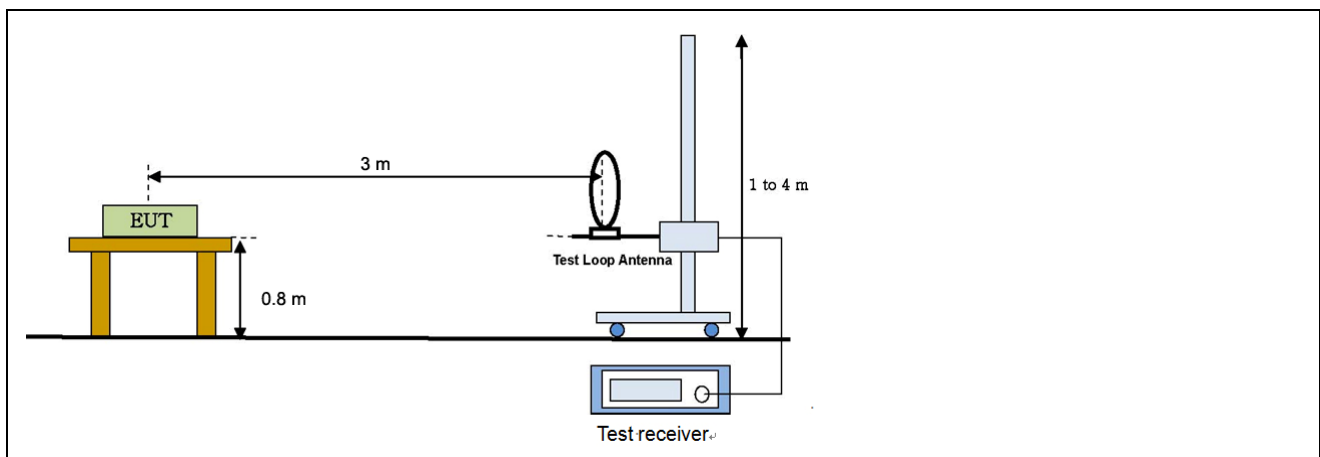
All measurements involve certain levels of uncertainties. The factors contributing to uncertainties are test receiver, Cable loss, Antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, Antenna frequency interpolation, measurement distance variation, Site imperfection, mismatch, and system repeatability based on NIS 80,81.

Radiated Emission measurement: 30 - 1000 MHz: 4.4 dB (CL: Approx 95 %,  $k=2$ )

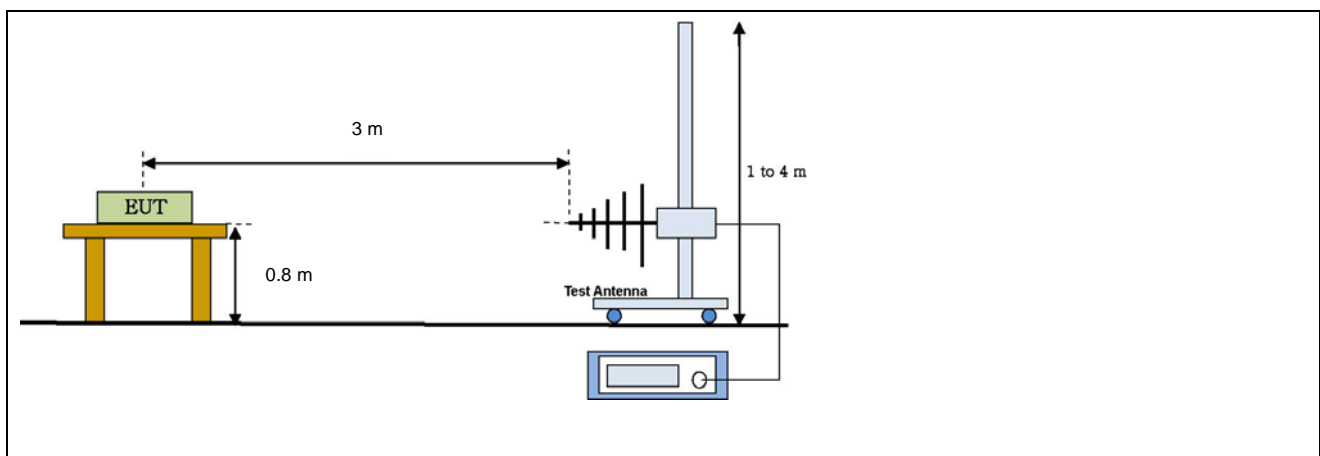
Above 1 GHz: 4.88 dB (CL: Approx 95 %,  $k=2$ )

## 5.2.5 Test Configuration

Radiated emission setup, Below 30 MHz



Radiated emission setup, Below 1 000 MHz



## 5.2.6 Measurement Result

### ■ IN-BAND

#### ■ Adapter

| Freq.<br>(MHz) | Reading<br>(dB $\mu$ V/m) | Table<br>(Deg) | Pstn<br>(axis) | Antenna       |               |                 | CL<br>(dB) | Pre<br>AMP<br>(dB) | Distn<br>factor<br>(dB) | Meas<br>Result<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Mgn<br>(dB) | Result     |
|----------------|---------------------------|----------------|----------------|---------------|---------------|-----------------|------------|--------------------|-------------------------|----------------------------------|-------------------------|-------------|------------|
|                |                           |                |                | Height<br>(m) | Pol.<br>(H/V) | Fctr.<br>(dB/m) |            |                    |                         |                                  |                         |             |            |
| 13.560*        | 51.99                     | 170            | X              | 1.0           | -             | 9.95            | 0.60       | -                  | -40                     | 11.99                            | 84.00                   | 72.01       | Compliance |
| 13.428         | 31.84                     | 170            | X              | 1.0           | -             | 9.95            | 0.60       | -                  | -40                     | -8.16                            | 50.47                   | 58.63       | Compliance |
| 13.480         | 31.59                     | 170            | X              | 1.0           | -             | 9.95            | 0.60       | -                  | -40                     | -8.41                            | 50.47                   | 58.88       | Compliance |
| 13.692         | 32.25                     | 170            | X              | 1.0           | -             | 9.95            | 0.60       | -                  | -40                     | -7.75                            | 50.47                   | 58.22       | Compliance |
| 13.770         | 31.52                     | 170            | X              | 1.0           | -             | 9.95            | 0.60       | -                  | -40                     | -8.48                            | 40.50                   | 48.98       | Compliance |

#### ■ PoE

| Freq.<br>(MHz) | Reading<br>(dB $\mu$ V/m) | Table<br>(Deg) | Pstn<br>(axis) | Antenna       |               |                 | CL<br>(dB) | Pre<br>AMP<br>(dB) | Distn<br>factor<br>(dB) | Meas<br>Result<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Mgn<br>(dB) | Result     |
|----------------|---------------------------|----------------|----------------|---------------|---------------|-----------------|------------|--------------------|-------------------------|----------------------------------|-------------------------|-------------|------------|
|                |                           |                |                | Height<br>(m) | Pol.<br>(H/V) | Fctr.<br>(dB/m) |            |                    |                         |                                  |                         |             |            |
| 13.560*        | 52.22                     | 180            | X              | 1             | -             | 9.95            | 0.6        | -                  | -40                     | 12.22                            | 84.00                   | 71.78       | Compliance |
| 43.427         | 31.50                     | 180            | X              | 1             | -             | 9.95            | 0.6        | -                  | -40                     | -8.50                            | 50.47                   | 58.97       | Compliance |
| 13.481         | 32.00                     | 170            | X              | 1             | -             | 9.95            | 0.6        | -                  | -40                     | -8.00                            | 50.47                   | 58.47       | Compliance |
| 13.691         | 31.86                     | 170            | X              | 1             | -             | 9.95            | 0.6        | -                  | -40                     | -8.14                            | 50.47                   | 58.61       | Compliance |
| 13.771         | 32.10                     | 170            | X              | 1             | -             | 9.95            | 0.6        | -                  | -40                     | -7.90                            | 40.50                   | 48.40       | Compliance |

\*It is fundamental frequency

Note1. above measured frequency have been done at 3 m distance and corrected according to required FCC 15.209. e)  
 $\therefore$  Extrapolation distance factor :  $40\log(3/30) = -40$  dB If Measurement distance is 3 m and Mandatory requirement distance is 30 m at 30 MHz or less, extrapolation distance factor(dB) is 40 / decade =  $40 \log_{10}^{(MRD/MD)}$   
 MRD is Mandatory requirement distance and MD is Measured distance

Note2. above measured frequencies is apply required standard FCC Part 15.225

Note3. All measurements were performed using a loop antenna. The antenna was positioned in three orthogonal positions (X front, Y side, Z top) and the position with the highest emission level was recorded.

Note4. All measurements were recorded using a quasi-peak detector.

Freq.(MHz) : Measurement frequency, Reading(dB $\mu$ V/m) : Indicated value for test receiver,  
 Table (Deg) : Directional degree of Turn table, Pstn(axis) : Location axis of EUT  
 Antenna (Height, Pol, Fctr) : Antenna Height, Polarization and Factor  
 Cbl(dB) : Cable loss, Distn factor(dB) : distance correction factor [40 dB/decade as per § 15.31f (2)]  
 Meas Result (dB $\mu$ V/m) : Reading(dB $\mu$ V/m)+ Antenna factor.(dB/m) + CL(dB) + Distn factor(dB)  
 Limit(dB $\mu$ V/m): Limit value specified with FCC Rule, Mgn(dB) : FCC Limit (dB $\mu$ V/m) – Meas Result(dB $\mu$ V/m)

■ OUT- BAND

■ Adapter

| Freq.<br>(MHz) | Reading<br>(dB $\mu$ V/m) | Table<br>(Deg) | Antenna       |               |                 | CL<br>(dB) | Pre<br>AMP<br>(dB) | Meas<br>Result<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Mgn<br>(dB) | Result     |
|----------------|---------------------------|----------------|---------------|---------------|-----------------|------------|--------------------|----------------------------------|-------------------------|-------------|------------|
|                |                           |                | Height<br>(m) | Pol.<br>(H/V) | Fctr.<br>(dB/m) |            |                    |                                  |                         |             |            |
| 40.56          | 57.32                     | 160            | 1.3           | V             | 10.68           | 1.01       | -40.51             | 28.50                            | 40.00                   | 11.50       | Compliance |
| 299.25         | 50.80                     | 160            | 1.3           | V             | 14.23           | 2.36       | -41.27             | 26.12                            | 46.00                   | 19.88       | Compliance |
| 354.15         | 51.31                     | 170            | 1.3           | V             | 16.08           | 2.52       | -41.08             | 28.83                            | 46.00                   | 17.17       | Compliance |
| 404.65         | 52.53                     | 160            | 1.3           | V             | 17.52           | 2.68       | -40.93             | 31.80                            | 46.00                   | 14.20       | Compliance |
| 462.35         | 56.32                     | 160            | 1.3           | V             | 18.53           | 2.86       | -40.66             | 37.05                            | 46.00                   | 8.95        | Compliance |

■ PoE

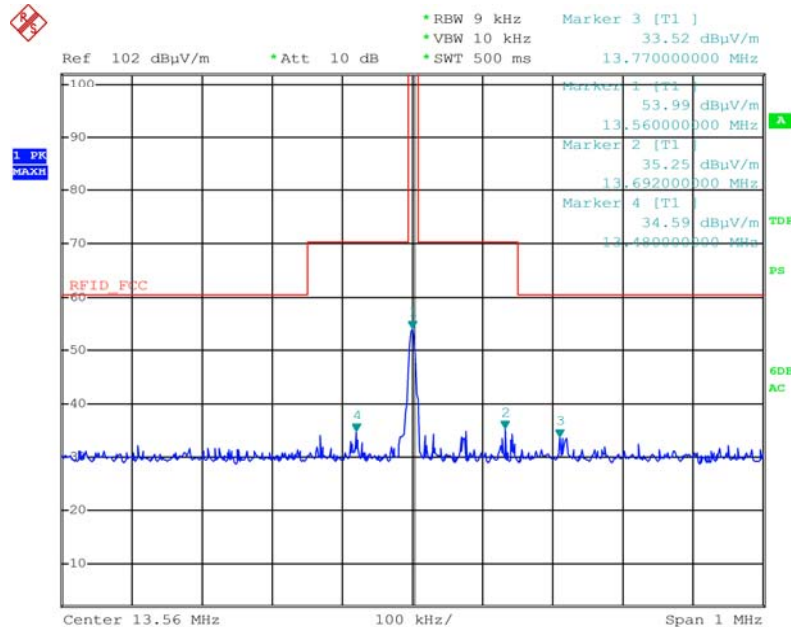
| Freq.<br>(MHz) | Reading<br>(dB $\mu$ V/m) | Table<br>(Deg) | Antenna       |               |                 | CL<br>(dB) | Pre<br>AMP<br>(dB) | Meas<br>Result<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Mgn<br>(dB) | Result     |
|----------------|---------------------------|----------------|---------------|---------------|-----------------|------------|--------------------|----------------------------------|-------------------------|-------------|------------|
|                |                           |                | Height<br>(m) | Pol.<br>(H/V) | Fctr.<br>(dB/m) |            |                    |                                  |                         |             |            |
| 40.55          | 58.52                     | 170            | 1.5           | V             | 10.68           | 1.01       | -40.51             | 29.70                            | 40.00                   | 10.30       | Compliance |
| 283.21         | 50.91                     | 160            | 1.5           | V             | 13.88           | 2.32       | -41.31             | 25.80                            | 46.00                   | 20.20       | Compliance |
| 352.22         | 52.09                     | 170            | 1.5           | V             | 16.03           | 2.52       | -41.09             | 29.54                            | 46.00                   | 16.46       | Compliance |
| 404.50         | 53.25                     | 160            | 1.5           | V             | 17.52           | 2.68       | -40.93             | 32.52                            | 46.00                   | 13.48       | Compliance |
| 460.37         | 57.36                     | 160            | 1.5           | V             | 18.50           | 2.86       | -40.67             | 38.05                            | 46.00                   | 7.95        | Compliance |

Freq.(MHz) : Measurement frequency, Reading(dB $\mu$ V/m) : Indicated value for test receiver,  
Table (Deg) : Directional degree of Turn table,  
Antenna (Height, Pol, Fctr) : Antenna Height, Polarization and Factor  
Cbl(dB) : Cable loss, Pre AMP(dB) : Preamplifier gain(dB)  
Meas Result (dB $\mu$ V/m) : Reading(dB $\mu$ V/m)+ Antenna factor.(dB/m)+ CL(dB) - Pre AMP(dB)  
Limit(dB $\mu$ V/m): Limit value specified with FCC Rule, Mgn(dB) : FCC Limit (dB $\mu$ V/m) – Meas Result(dB $\mu$ V/m)

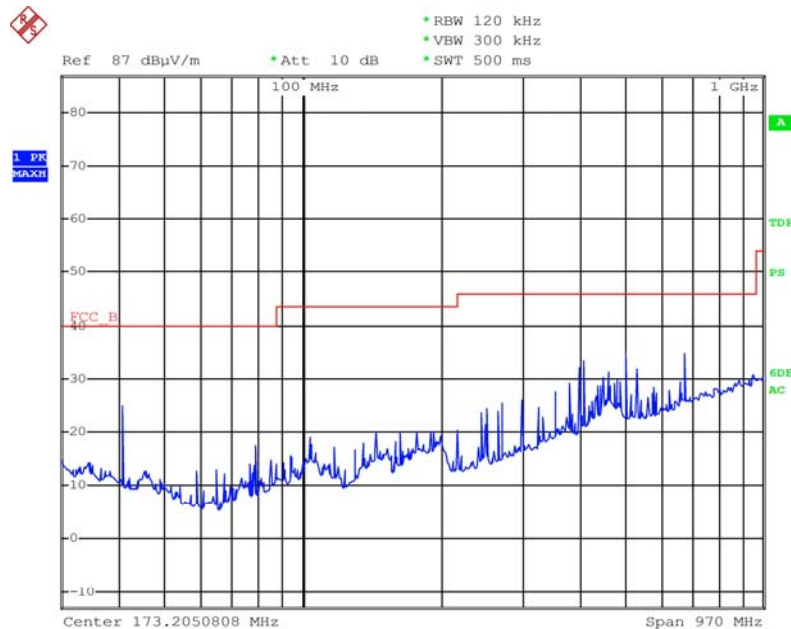


## 5.2.7 Test plot

### ■ Fundamental frequency level & $\leq 30$ MHz spectrum mask



### ■ OUT- BAND Spurious



\* Worst case only

## 5.3 AC Power Conducted emissions

### 5.3.1 Standard Applicable [FCC §15.207(a)]

For intentional radiator that is designed to be connected to the public utility(AC)power line, the radio frequency. Voltage that is conducted back onto the AC power line on any frequencies hopping mode within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 uH/50 ohms line Impedance stabilization network(LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

§15.207 limits for AC line conducted emissions;

| Frequency of Emission(MHz) | Conducted Limit (dB $\mu$ V) |            |
|----------------------------|------------------------------|------------|
|                            | Quasi-peak                   | Average    |
| 0.15 ~ 0.5                 | 66 to 56 *                   | 56 to 46 * |
| 0.5 ~ 5                    | 56                           | 46         |
| 5 ~ 30                     | 60                           | 50         |

\* Decreases with the logarithm of the frequency

### 5.3.2 Test Environment conditions

- Ambient temperature : (19 - 21) °C
- Relative Humidity : (36 - 37) % R.H.

### 5.3.3 Measurement Procedure

EUT was placed on a non- metallic table height of 0.8 m above the reference ground plane. Cables connected to EUT were fixed to cause maximum emission. Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the Maximum signal strength.

### 5.3.4 Used equipment

| Equipment     | Model No. | Serial No. | Manufacturer    | Next cal date | Cal interval | Used |
|---------------|-----------|------------|-----------------|---------------|--------------|------|
| Test receiver | ESCS30    | 100111     | Rohde & Schwarz | 2017. 02. 02  | 1 year       | ●    |
| LISN          | ESH2-Z5   | 100044     | R&S             | 2017. 02. 02  | 1 year       | ●    |
|               | ESH3-Z5   | 100147     | R&S             | 2017. 02. 02  | 1 year       | ●    |

\*Test Program: " ESXS-K1 V2.2"

Measurement uncertainty

Conducted Emission measurement: 3.5 dB (CL: Approx 95%,  $k=2$ )

### 5.3.5 Measurement Result

Line. Live

Kostec Co., Ltd.

29 Mar 2016 10:04

#### Conducted Emission

EUT: SG-2000  
 Manuf: CHANG SHIN INFOTEL CO.,LTD  
 Op Cond: AC 120V 60HZ  
 Operator: LEE  
 Test Spec: FCC Part 15  
 Comment: L

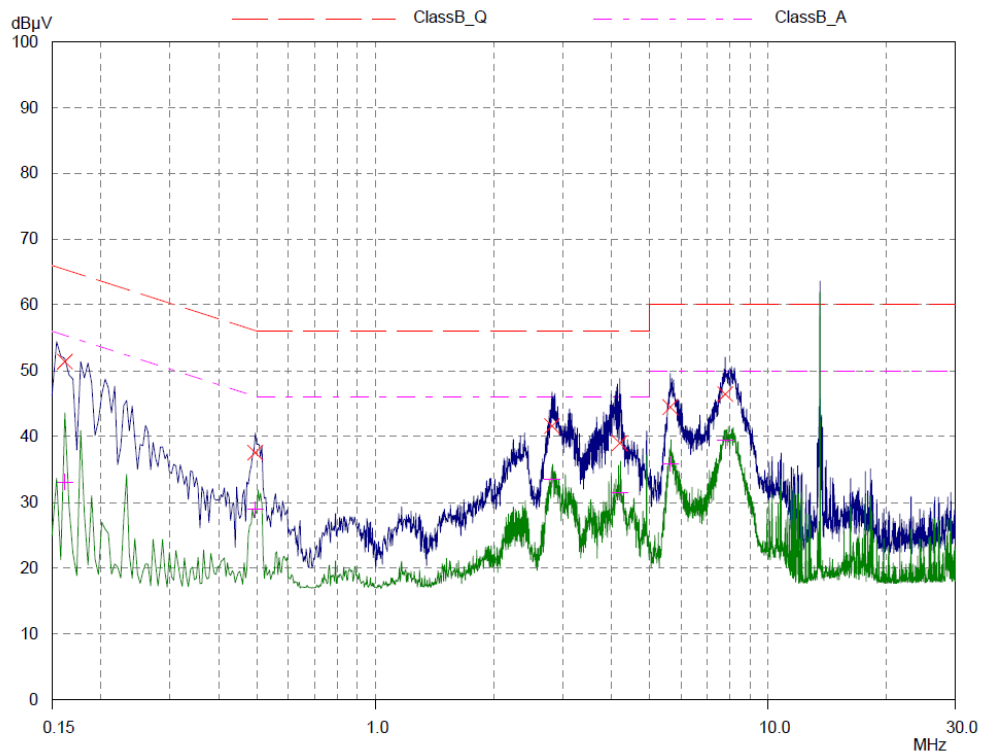
Result File: 0052\_1.dat : New Measurement

#### Scan Settings (1 Range)

| Frequencies |       |           | Receiver Settings |          |        |       |              |       |
|-------------|-------|-----------|-------------------|----------|--------|-------|--------------|-------|
| Start       | Stop  | Step      | IF BW             | Detector | M-Time | Atten | Preamplifier | OpRge |
| 150kHz      | 30MHz | 3.9063kHz | 9kHz              | PK+AV    | 10msec | 15 dB | OFF          | 60dB  |

| Transducer | No. | Start | Stop  | Name      |
|------------|-----|-------|-------|-----------|
|            | 12  | 9kHz  | 30MHz | CNEFactor |

Final Measurement: Detectors: X QP / + AV  
 Meas Time: 1sec  
 Subranges: 25  
 Acc Margin: 50 dB



PAGE 1

## Line. Live

Kostec Co., Ltd.

29 Mar 2016 10:04

### Conducted Emission

EUT: SG-2000  
Manuf: CHANG SHIN INFOTEL CO.,LTD  
Op Cond: AC 120V 60HZ  
Operator: LEE  
Test Spec: FCC Part 15  
Comment: L

Result File: 0052\_I.dat : New Measurement

#### Scan Settings (1 Range)

| Frequencies |       | Receiver Settings |       |
|-------------|-------|-------------------|-------|
| Start       | Stop  | Step              | IF BW |
| 150kHz      | 30MHz | 3.9063kHz         | 9kHz  |

| Transducer | No. | Start | Stop  | Name      |
|------------|-----|-------|-------|-----------|
|            | 12  | 9kHz  | 30MHz | CNEFactor |

Final Measurement: Detectors: X QP / + AV  
Meas Time: 1sec  
Subranges: 25  
Acc Margin: 50 dB

#### Final Measurement Results

| Frequency<br>MHz | QP Level<br>dBμV | QP Limit<br>dBμV | QP Delta<br>dB |
|------------------|------------------|------------------|----------------|
| 0.16171          | 51.38            | 65.38            | 14.00          |
| 0.49375          | 37.55            | 56.10            | 18.55          |
| 2.81406          | 41.61            | 56.00            | 14.39          |
| 4.18905          | 39.01            | 56.00            | 16.99          |
| 5.63437          | 44.46            | 60.00            | 15.54          |
| 7.77109          | 46.43            | 60.00            | 13.57          |

| Frequency<br>MHz | AV Level<br>dBμV | AV Limit<br>dBμV | AV Delta<br>dB |
|------------------|------------------|------------------|----------------|
| 0.16171          | 33.09            | 55.38            | 22.29          |
| 0.49375          | 28.94            | 46.10            | 17.16          |
| 2.81406          | 33.55            | 46.00            | 12.45          |
| 4.18905          | 31.49            | 46.00            | 14.51          |
| 5.63437          | 35.85            | 50.00            | 14.15          |
| 7.77109          | 39.40            | 50.00            | 10.60          |

\* limit exceeded

PAGE 2



## Line. Neutral

Kostec Co., Ltd.

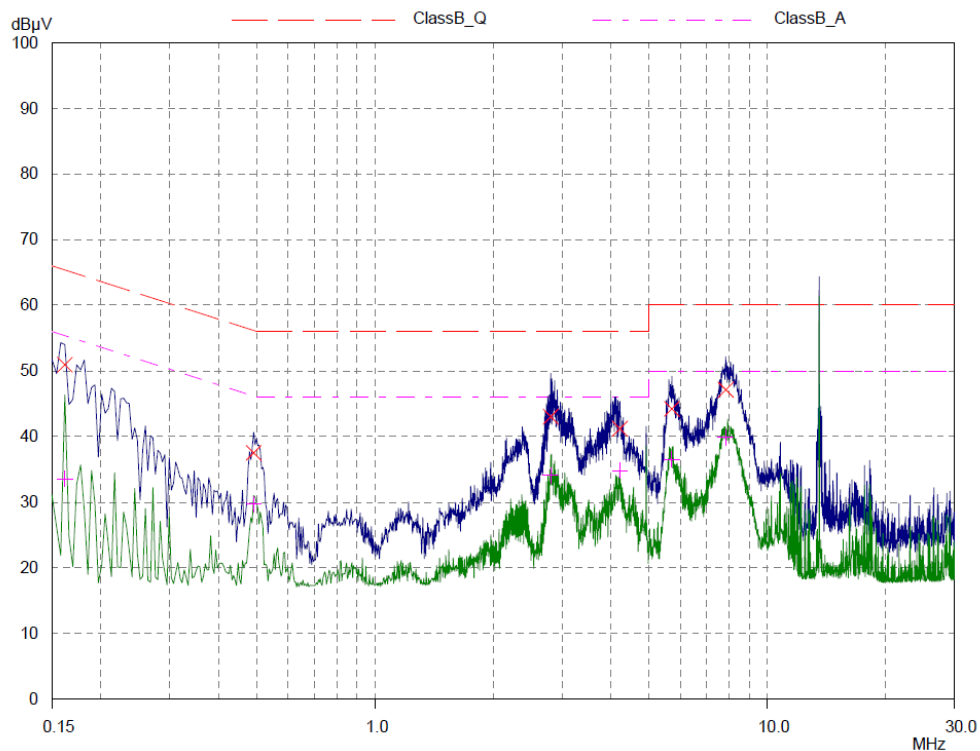
29 Mar 2016 10:10

### Conducted Emission

EUT: SG-2000  
Manuf: CHANG SHIN INFOTEL CO.,LTD  
Op Cond: AC 120V 60HZ  
Operator: LEE  
Test Spec: FCC Part 15  
Comment: N

Result File: 0052\_n.dat : New Measurement

| Scan Settings      |       | (1 Range)   |             |           | Receiver Settings |       |        |       |  |
|--------------------|-------|-------------|-------------|-----------|-------------------|-------|--------|-------|--|
| Frequencies        |       | Step        | IF BW       | Detector  | M-Time            | Atten | Preamp | OpRge |  |
| Start              | Stop  |             |             |           |                   |       |        |       |  |
| 150kHz             | 30MHz | 3.9063kHz   | 9kHz        | PK+AV     | 10msec            | 15 dB | OFF    | 60dB  |  |
| Transducer         | No.   | Start       | Stop        | Name      |                   |       |        |       |  |
|                    | 12    | 9kHz        | 30MHz       | CNEFactor |                   |       |        |       |  |
| Final Measurement: |       | Detectors:  | X QP / + AV |           |                   |       |        |       |  |
|                    |       | Meas Time:  | 1sec        |           |                   |       |        |       |  |
|                    |       | Subranges:  | 25          |           |                   |       |        |       |  |
|                    |       | Acc Margin: | 50 dB       |           |                   |       |        |       |  |



PAGE 1

## Line. Neutral

Kostec Co., Ltd.

29 Mar 2016 10:10

### Conducted Emission

EUT: SG-2000  
Manuf: CHANG SHIN INFOTEL CO.,LTD  
Op Cond: AC 120V 60HZ  
Operator: LEE  
Test Spec: FCC Part 15  
Comment: N

Result File: 0052\_n.dat : New Measurement

#### Scan Settings (1 Range)

| Frequencies |       |           |       | Receiver Settings |        |       |        |       |
|-------------|-------|-----------|-------|-------------------|--------|-------|--------|-------|
| Start       | Stop  | Step      | IF BW | Detector          | M-Time | Atten | Preamp | OpRge |
| 150kHz      | 30MHz | 3.9063kHz | 9kHz  | PK+AV             | 10msec | 15 dB | OFF    | 60dB  |

|            |     |       |       |           |
|------------|-----|-------|-------|-----------|
| Transducer | No. | Start | Stop  | Name      |
|            | 12  | 9kHz  | 30MHz | CNEFactor |

Final Measurement: Detectors: X QP / + AV  
Meas Time: 1sec  
Subranges: 25  
Acc Margin: 50 dB

#### Final Measurement Results

| Frequency<br>MHz | QP Level<br>dBμV | QP Limit<br>dBμV | QP Delta<br>dB |
|------------------|------------------|------------------|----------------|
| 0.16171          | 50.94            | 65.38            | 14.44          |
| 0.48984          | 37.51            | 56.17            | 18.66          |
| 2.80234          | 43.03            | 56.00            | 12.97          |
| 4.20468          | 41.21            | 56.00            | 14.79          |
| 5.70468          | 44.24            | 60.00            | 15.76          |
| 7.82968          | 47.13            | 60.00            | 12.87          |

| Frequency<br>MHz | AV Level<br>dBμV | AV Limit<br>dBμV | AV Delta<br>dB |
|------------------|------------------|------------------|----------------|
| 0.16171          | 33.55            | 55.38            | 21.83          |
| 0.48984          | 29.68            | 46.17            | 16.49          |
| 2.80234          | 34.07            | 46.00            | 11.93          |
| 4.20468          | 34.80            | 46.00            | 11.20          |
| 5.70468          | 36.53            | 50.00            | 13.47          |
| 7.82968          | 39.86            | 50.00            | 10.14          |

\* limit exceeded

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## 5.4 Antenna requirement

### 5.4.1 Standard applicable [FCC §15.203, §15.247(4)(1)]

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

The use of a permanently attached antenna or of an antenna that user a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The manufacturer may design the unit So that broken antenna can be replaced by the user, but the Use of a standard antenna jack or electrical connector is prohibited.

The NFC antenna is built-in PCB of EUT So this product is complies with the requirement of §15.203.

## 5.5 20 dB bandwidth measurement

### 5.5.1 Standard applicable [FCC §2.1049]

The 20 dB bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

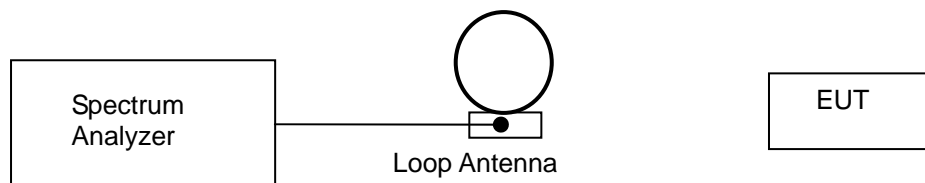
### 5.5.2 Test Environment conditions

- Ambient temperature : (22 - 23) °C
- Relative Humidity : (50 - 52) % R.H.

### 5.5.3 Measurement Procedure

Please refer 5.5.1

### 5.5.4 Test setup



### 5.5.5 Measurement Result

| Frequency | 20 dB bandwidth |
|-----------|-----------------|
| 13.56 MHz | 6.19 kHz        |

### 5.5.6 Test plot

