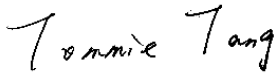
# TEST REPORT

| | |
|---|---|
| **Application No.:** | KSCR2404000691AT |
| **FCC ID:** | 2AVK2AT60MF1T1RP32A |
| **Applicant:** | Airtouch (Shanghai) Intelligent Technology Co., Ltd |
| **Address of Applicant:** | 11th Floor, Building 4, Lane 388, Shengrong Road, Pudong New Area, Shanghai, China |
| **Manufacturer:** | Airtouch (Shanghai) Intelligent Technology Co., Ltd |
| **Address of Manufacturer:** | 11th Floor, Building 4, Lane 388, Shengrong Road, Pudong New Area, Shanghai, China |
| **Factory:** | Airtouch (Shanghai) Intelligent Technology Co., Ltd |
| **Address of Factory:** | 11th Floor, Building 4, Lane 388, Shengrong Road, Pudong New Area, Shanghai, China |
| **Equipment Under Test (EUT):** | |
| **EUT Name:** | 60Ghz millimeter wave radar sensor |
| **Model No.:** | AT60MF1T1RP32A, AT60MF1T2RS32A, AT60MF1T2RP32A ♣ |
| ♣ | Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical. |
| **Trade Mark:** | Airtouch |
| **Standard(s) :** | 47 CFR Part 15, Subpart C 15.255 |
| **Date of Receipt:** | 2024-04-23 |
| **Date of Test:** | 2024-04-24 to 2024-12-10 |
| **Date of Issue:** | 2024-12-10 |
| **Test Result:** | **Pass*** |

* In the configuration tested, the EUT complied with the standards specified above.

| Revision Record | | | |
|---|---|---|---|
| ***Version*** | **Description** | ***Date*** | ***Remark*** |
| 00 | Original | 2024-12-10 | / |
| | | | |
| | | | |

| | | | | |
|---|---|---|---|---|
| **Authorized for issue by:** | | | | |
| **Tested By** | |  | | |
| | | **Tommie_Tang/Project Engineer** | | |
| **Approved By** | |  | | |
| | | **Terry Hou /Reviewer** | | |

# 2 Test Summary

| Radio Spectrum Technical Requirement | | | | |
|---|---|---|---|---|
| **Item** | **Standard** | **Method** | **Requirement** | **Result** |
| Antenna Requirement | 47 CFR Part 15, Subpart C 15.255 | N/A | 47 CFR Part 15, Subpart C 15.203 | Pass |

N/A: Not applicable

| Radio Spectrum Matter Part | | | | |
|---|---|---|---|---|
| **Item** | **Standard** | **Method** | **Requirement** | **Result** |
| Transmitter power and Transmitter off-times | 47 CFR Part 15, Subpart C 15.255 | ANSI C63.10, Sections 9.4, 9.5 | 47 CFR Part 15, Subpart C 15.255(c)(2)(iii)(A) | PASS |
| Occupied bandwidth | 47 CFR Part 15, Subpart C 15.255 | ANSI C63.10 (2013) Section 9.3 | 47 CFR Part 15, Subpart C 15.215(c),15.255(c2) | PASS |
| Radiated spurious emissions below 40 GHz | 47 CFR Part 15, Subpart C 15.255 | ANSI C63.10 (2013) Section 9.13 | 47 CFR Part 15, Subpart C 15.255(d)(2) | PASS |
| Radiated emissions outside assigned band and above 40 GHz up to 200 GHz | 47 CFR Part 15, Subpart C 15.255 | ANSI C63.10 (2013) Section 9.9, 9.12 | 47 CFR Part 15, Subpart C 15. 255(d)(3) | PASS |
| Frequency stability | 47 CFR Part 15, Subpart C 15.255 | ANSI C63.10 (2013) Section 9.4 | 47 CFR Part 15, Subpart C 15. 255(f) | PASS |

**Declaration of EUT Family Grouping:**

Note: There are series models mentioned in this report, and they are identical in electrical and electronic characters. Only the model AT60MF1T1RP32A was tested since their differences were the model number and software which adapts to different application scenarios without affecting RF parameters.

# 3 Contents

# 4 General Information

## 4.1 Details of E.U.T.

Power supply: DC 3.3V
Frequency: 59-64GHz
Modulation Type: FMCW
Antenna Type: Integrated Patch Antenna
Antenna Gain: 5dBi (Provided by the manufacturer)

## 4.2 Description of Support Units

| Description | Manufacturer | Model No. | Serial No. |
|---|---|---|---|
| DC Power Supply | Agilent | E3632A | / |

## 4.3 Measurement Uncertainty

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Radio Frequency | $8.4 \times 10^{-8}$ |
| 2 | Timeout | 2s |
| 3 | Duty Cycle | 0.37% |
| 4 | Occupied Bandwidth | 3% |
| 5 | RF Radiated Power | 5.2dB (Below 1GHz) |
| | | 5.9dB (Above 1GHz) |
| 6 | Radiated Spurious Emission Test | 4.2dB (Below 30MHz) |
| | | 4.5dB (30MHz-1GHz) |
| | | 5.1dB (1GHz-18GHz) |
| | | 5.4dB (Above 18GHz) |
| 7 | Temperature Test | 1°C |
| 8 | Humidity Test | 3% |
| 9 | Supply Voltages | 1.5% |
| 10 | Time | 3% |
| Note: The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2. | | |

## 4.4 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1.SGS is not responsible for wrong test results due to incorrect information (e.g., max. internal working frequency, antenna gain, cable loss, etc) is provided by the applicant. (If applicable).

2.SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (If applicable).

## 4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

**• A2LA**

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

**• FCC**

Compliance Certification Services Inc. has been recognized as an accredited testing laboratory.

Designation Number: CN1172.

**• ISED**

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

**• VCCI**

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

## 4.6 Deviation from Standards

None

## 4.7 Abnormalities from Standard Conditions

None

# 5 Equipment List

| Item | Equipment | Manufacturer | Model | Inventory No | Cal Date | Cal. Due Date |
|---|---|---|---|---|---|---|
| 1 | Spectrum Analyzer | R&S | FSV40 | KUS1806E003 | 08/24/2023 | 08/23/2024 |
| | Spectrum Analyzer | R&S | FSV40 | KUS1806E003 | 08/06/2024 | 08/05/2025 |
| 2 | PXA Spectrum Analyzer | KEYSIGHT | N9030B | KSEM021-1 | 01/15/2024 | 01/14/2025 |
| 3 | Signal Generator | Agilent | E8257C | KS301066 | 08/24/2023 | 08/23/2024 |
| | Signal Generator | Agilent | E8257C | KS301066 | 08/06/2024 | 08/05/2025 |
| 4 | Loop Antenna | COM-POWER | AL-130R | KUS1806E001 | 03/18/2023 | 03/17/2025 |
| 5 | Bilog Antenna | TESEQ | CBL 6112D | KUS1806E005 | 06/29/2023 | 06/28/2025 |
| 6 | Amplifier(30MHz~18GHz) | PANSHAN TECHNOLOGY | LNA:1~18G | KSEM010-1 | 01/15/2024 | 01/14/2025 |
| 7 | Horn-antenna(1-18GHz) | ETS-LINDGREN | 3117 | KS301186 | 04/07/2023 | 04/06/2025 |
| 8 | Amplifier(18~40GHz) | PANSHAN TECHNOLOGY | LNA180400G40 | KSEM038 | 08/24/2023 | 08/23/2024 |
| | Amplifier(18~40GHz) | PANSHAN TECHNOLOGY | LNA180400G40 | KSEM038 | 08/12/2024 | 08/11/2025 |
| 9 | Horn Antenna(18-40GHz) | Schwarzbeck | BBHA9170 | CZ301058 | 01/07/2024 | 01/06/2026 |
| 10 | Horn-antenna(40-60GHz) | ERAVANT | SAZ-2410-19-S1 | KSEM003-1 | 02/02/2021* | 02/01/2031** |
| 11 | Horn-antenna(50-75GHz) | ERAVANT | SAZ-2410-15-S1 | KSEM003-2 | 02/02/2021* | 02/01/2031** |
| 12 | Horn-antenna(50-75GHz) | ERAVANT | SAZ-2410-15-S1 | KSEM003-7 | 12/14/2022* | 12/13/2032** |
| 13 | Horn-antenna(60-90GHz) | ERAVANT | SAZ-2410-12-S1 | KSEM003-8 | 12/14/2022* | 12/13/2032** |
| 14 | Horn-antenna(75-110GHz) | ERAVANT | SAZ-2410-10-S1 | KSEM003-3 | 02/02/2021* | 02/01/2031** |
| 15 | Horn-antenna(90-140GHz) | ERAVANT | SAZ-2410-08-S1 | KSEM003-9 | 12/14/2022* | 12/13/2032** |
| 16 | Horn-antenna(110-170GHz) | ERAVANT | SAZ-2410-06-S1 | KSEM003-4 | 02/02/2021* | 02/01/2031** |
| 17 | Horn-antenna(140-220GHz) | ERAVANT | SAZ-2410-05-S1 | KSEM003-5 | 02/02/2021* | 02/01/2031** |
| 18 | Horn-antenna(140-220GHz) | ERAVANT | SAZ-2410-05-S1 | KSEM003-10 | 12/14/2022* | 12/13/2032** |
| 19 | Horn-antenna(220-325GHz) | ERAVANT | SAR-2309-03-S2 | KSEM003-6 | 02/02/2021* | 02/01/2031** |
| 20 | Extended waveguide(40-60GHz) | ERAVANT | SWG-19025-FB | KSEM004-1 | 02/02/2021* | 02/01/2031** |
| 21 | Extended waveguide(50-75GHz) | ERAVANT | SWG-15025-FB | KSEM004-2 | 02/02/2021* | 02/01/2031** |
| 22 | Extended waveguide(50-75GHz) | ERAVANT | SWG-15025-FB | KSEM004-7 | 12/14/2022* | 12/13/2032** |
| 23 | Extended waveguide(60-90GHz) | ERAVANT | SWG-12025-FB | KSEM004-8 | 12/14/2022* | 12/13/2032** |
| 24 | Extended waveguide(75-110GHz) | ERAVANT | SWG-10025-FB | KSEM004-3 | 02/02/2021* | 02/01/2031** |
| 25 | Extended waveguide(90-140GHz) | ERAVANT | SWG-08025-FB | KSEM004-9 | 12/14/2022* | 12/13/2032** |
| 26 | Extended waveguide(110-170GHz) | ERAVANT | SWG-06025-FB | KSEM004-4 | 02/02/2021* | 02/01/2031** |
| 27 | Extended waveguide(140-220GHz) | ERAVANT | SWG-05025-FB | KSEM004-5 | 02/02/2021* | 02/01/2031** |
| 28 | Extended waveguide(140-220GHz) | ERAVANT | SWG-05025-FB | KSEM004-10 | 12/14/2022* | 12/13/2032** |
| 29 | Extended waveguide(220-325GHz) | ERAVANT | SWG-03025-FB | KSEM004-6 | 02/02/2021* | 02/01/2031** |

| | | | | | | |
|---|---|---|---|---|---|---|
| 30 | Harmonic mixer(40-60GHz) | ERAVANT | STH-19SF-S1 | KSEM005-2 | 10/01/2020* | 09/30/2030** |
| 31 | Harmonic Mixer(50-75GHz) | VDI | SAX WR15 | KSEM007-1 | 08/23/2023* | 08/23/2033** |
| 32 | Harmonic Mixer(60-90GHz) | VDI | SAX WR12 | KSEM007-2 | 08/23/2023* | 08/23/2033** |
| 33 | Harmonic mixer(90-140GHz) | VDI | SAX WR8.0 | KSEM007-3 | 08/23/2023* | 08/23/2033** |
| 34 | Harmonic mixer(140-220GHz) | VDI | SAX WR5.1 | KSEM007-4 | 08/23/2023* | 08/23/2033** |
| 35 | Harmonic mixer(220-325GHz) | ERAVANT | HM 220-325 | KSEM005-4 | 04/20/2021* | 04/19/2031** |
| 36 | Upconverter | Talent | TMAM-060090-0612-12-AC | KSEM043 | 01/18/2022* | 01/17/2032** |
| 37 | Temperature & Humidity Recorder | Renke Control | RS-WS-N01-6J | KSEM024-4 | 03/19/2024 | 03/18/2025 |
| 38 | Software | Faratronic | EZ_EMC-v 3A1 | / | NCR | NCR |
| 39 | Software | ESE | E3_V 6.111221a | / | NCR | NCR |

*Calibration date provided by the equipment manufacturer.

**Calibration every ten years. During this period, there will be daily check files for the equipment and the requirements for operators will be clearly defined through SOP.

# 6 Radio Spectrum Technical Requirement

## 6.1 Antenna Requirement

### 6.1.1 Test Requirement:

FCC 47 CFR Part 15C Section 15.203

### 6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of an so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is Integrated Patch Antenna and no consideration of replacement.

Antenna location: Refer to EUT Photos.

# 7 Radio Spectrum Matter Test Results

## 7.1 Occupied bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.215(c),15.255(c2)

Test Method: ANSI C63.10, Section 9.3

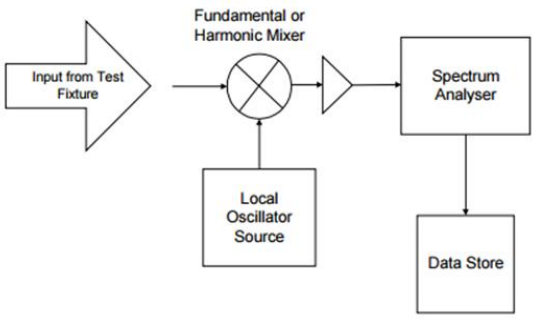
### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 24.5 °C Humidity: 50.1 % RH Atmospheric Pressure: 1010 mbar

Test Mode: a: TX mode _ Keep the EUT in continuously transmitting mode.

### 7.1.2 Test Setup Diagram




### 7.1.3 Measurement Procedure and Data

1) Place the EUT on the table and set it in the transmitting mode
2) SA set RBW=1%~5% OBW, VBW=3*RBW and Detector=Peak, or a minimum of 1 MHz if this is not possible due to a large OBW.
3) Measure and record the result of 20dB and 99% bandwidth

Please Refer to Appendix for Details

## 7.2 Transmitter power and Transmitter off-times

| | |
|---|---|
| Test Requirement | 47 CFR Part 15, Subpart C 15.255(c)(2)(iii)(A) |
| Test Method: | ANSI C63.10, Sections 9.4, 9.5 |
| Limit: | The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds. |

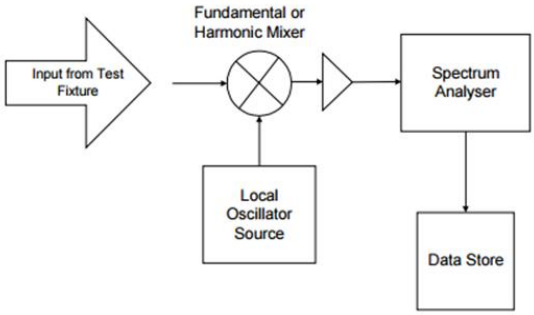
### 7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 24.5 °C Humidity: 50.1 % RH Atmospheric Pressure: 1010 mbar

Test Mode: a: TX mode _ Keep the EUT in continuously transmitting mode.

### 7.2.2 Test Setup Diagram




### 7.2.3 Measurement Procedure and Data

1) Place the EUT on the table and set it in the transmitting mode
2) SA set RBW=1MHz , VBW=3*RBW , Detector=Peak/Average, Trace: Mask Hold, Peak Search
3) The EUT was turned from 0 degrees to 360 degrees to find the maximum reading.

Please Refer to Appendix for Details

## 7.3 Out of band radiated emissions below 40 GHz

Test Requirement 47 CFR Part 15, Subpart C 15.255(d)(2)

Test Method: ANSI C63.10, Section 9.13

Limit:

**Below 30MHz**

| Frequency | Field Strength (μV/m) | Measurement Distance (metres) |
|---|---|---|
| 9 - 490 kHz | 2,400/F (kHz) | 300 |
| 490 - 1,705 kHz | 24,000/F (kHz) | 30 |
| 1.705-30 MHz | 30 | 30 |
| Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. | | |

**Above 30MHz**

| Frequency (MHz) | Field Strength (μV/m) | Measurement Distance (metres) |
|---|---|---|
| 30-88 | 100** | 3 |
| 88-216 | 150** | 3 |
| 216-960 | 200** | 3 |
| Above 960 | 500 | 3 |

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating 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, e.g., §§ 15.231 and 15.241.

| Frequency (MHz) | Field strength at 3 m, dB(uV/m)* Within restricted bands | | |
|---|---|---|---|
| | Peak | Quasi Peak | Average |
| 0.009 - 0.090 | 148.5 - 128.5 | NA | 128.5 - 108.5** |
| 0.090 - 0.110 | NA | 108.5 - 106.8** | NA |
| 0.110 - 0.490 | 126.8 - 113.8 | NA | 106.8 - 93.8** |
| 0.490 - 1.705 | NA | 73.8 - 63.0** | NA |
| 1.705 - 30.0* | | 69.5 | |
| 30 - 88 | | 40.0 | |
| 88 - 216 | | 43.5 | |
| 216 - 960 | | 46.0 | |
| 960-40000 | | 54.0 | |

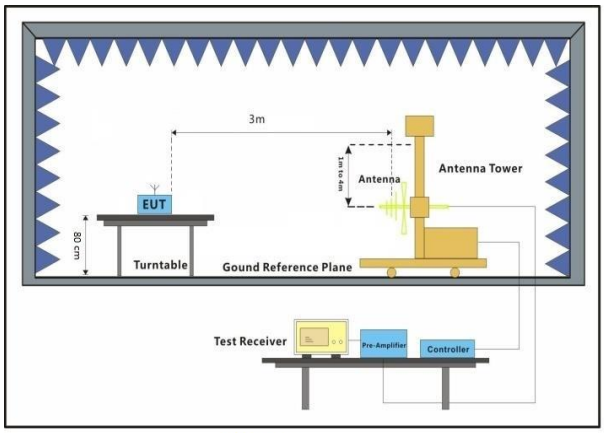
### 7.3.1 E.U.T. Operation

Operating Environment:

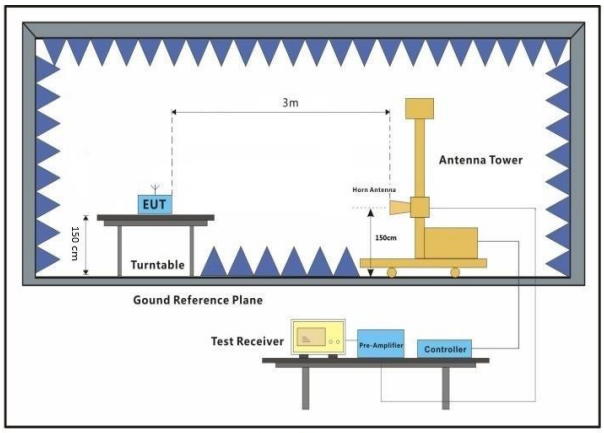
Temperature: 24.5 °C Humidity: 50.1 % RH Atmospheric Pressure: 1010 mbar

Test Mode: a: TX mode _ Keep the EUT in continuously transmitting mode.

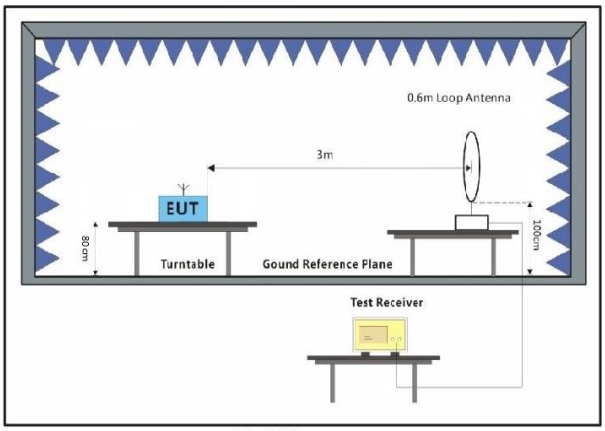
### 7.3.2 Test Setup Diagram




30MHz-1GHz




1GHz-40GHz




Below 30MHz

### 7.3.3 Measurement Procedure and Data

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For 1-40GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was t tuned to the same hight (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

h. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Remark 3: Scan from 9kHz to 30MHz, the disturbance was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

Please Refer to Appendix for Details

## 7.4 Out of band radiated emissions above 40 GHz

Test Requirement 47 CFR Part 15, Subpart C 15.255(d)(3)
Test Method: ANSI C63.10, Section 9.9, 9.12
Limit:

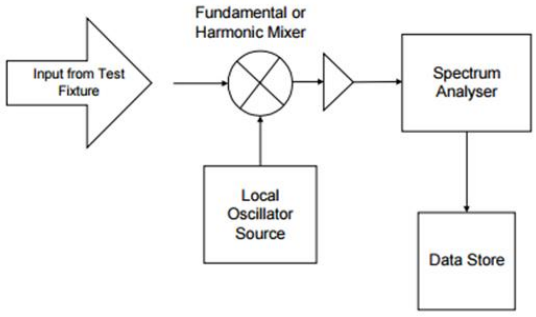
**Above 40GHz**

| Frequency (GHz) | Power density at 3 m distance ($pW/cm^2$) | Distance (m) | Field strength (dBuV/m)*, peak | Field strength (dBuV/m)*, average |
|---|---|---|---|---|
| 40 - 200 | 90 | 3.0 | 105.31 | 85.31 |
| * - Field strength was calculated per equation (26) of ANSI C63.10-2013 section 9 as follows: E=sqrt(PD×377), where PD is the power density at the distance specified by the limit in $W/m^2$, E- field strength in V/m. | | | | |

### 7.4.1 E.U.T. Operation

Operating Environment:
Temperature: 24.5 °C Humidity: 50.1% RH Atmospheric Pressure: 1010 mbar
Test mode: a: TX mode _ Keep the EUT in continuously transmitting mode.

### 7.4.2 Test Setup Diagram




Above 40GHz

### 7.4.3 Measurement Procedure and Data

a. For above 40GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation

b. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

c. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to the same hight (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

d. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

e. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

f. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.

g. Repeat above procedures until all frequencies measured was complete.

Remark 1: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

Please Refer to Appendix for Details

## 7.5 Frequency stability

Test Requirement 47 CFR Part 15, Subpart C 15. 255(f)

Test Method: ANSI C63.10, Section 9.14

Limit:

| Frequency (GHz) | Limit |
|---|---|
| 57 - 64 | The signal must be contained within assigned frequency band |

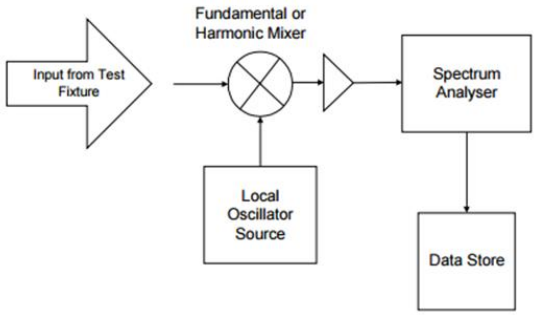
### 7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 24.5 °C Humidity: 50.1% RH Atmospheric Pressure: 1010 mbar

Test mode: a: TX mode _ Keep the EUT in continuously transmitting mode.

### 7.5.2 Test Setup Diagram



### 7.5.3 Measurement Procedure and Data

1. Temperature conditions:
   a) The RF output port of the EUT was connected to Frequency Meter;
   b) Set the working Frequency in the middle channel;
   c) record the 20°C and norminal voltage frequency value as reference point;
   d) vary the temperature from -20°C to 50°C with step 10°C
   e) when reach a temperature point, keep the temperature banlance at least 1 hour to make the product working in this status;
   f) read the frequency at the relative temperature.
2. Voltage conditions:
   a) record the 20°C and norminal voltage frequency value as reference point;
   b) vary the voltage from -15% norminal voltage to +15% voltage;
   read the frequency at the relative voltage.

Please Refer to Appendix for Details

# 8 Test Setup Photo

Refer to Appendix - Test Setup Photo for KSCR2404000691AT

# 9 EUT Constructional Details (EUT Photos)

Refer to Appendix - Photographs of EUT Constructional Details for KSCR2404000691AT

# 10 Appendix

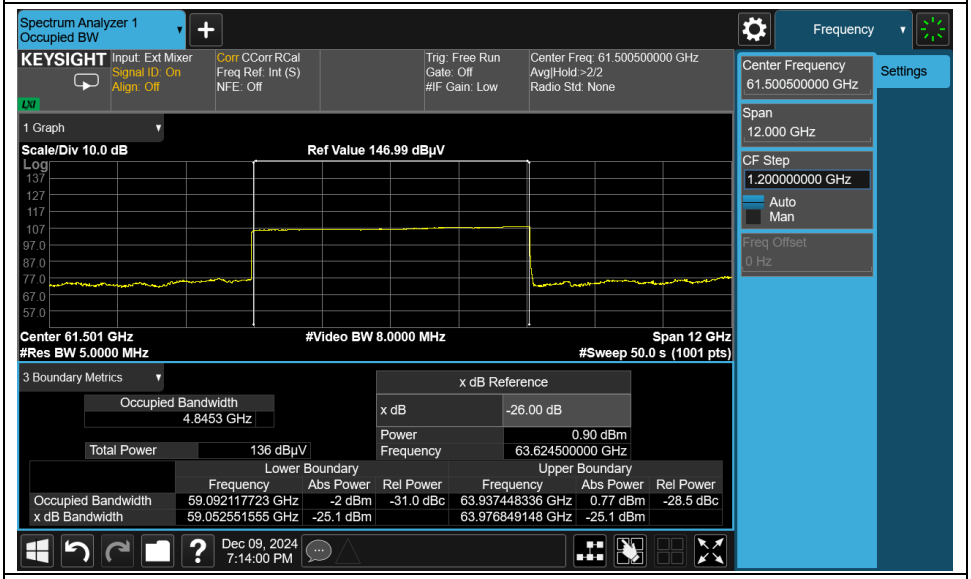
## 10.1 Occupied bandwidth

| Centre Frequency (GHz) | 99% OCW (MHz) | -20dB OCW (MHz) | $F_L$ (GHz) | $F_H$ (GHz) | Limit (GHz) | Result |
|---|---|---|---|---|---|---|
| 61.501 | 48453 | 48465 | 59.092 | 63.937 | 57-64 | Pass |

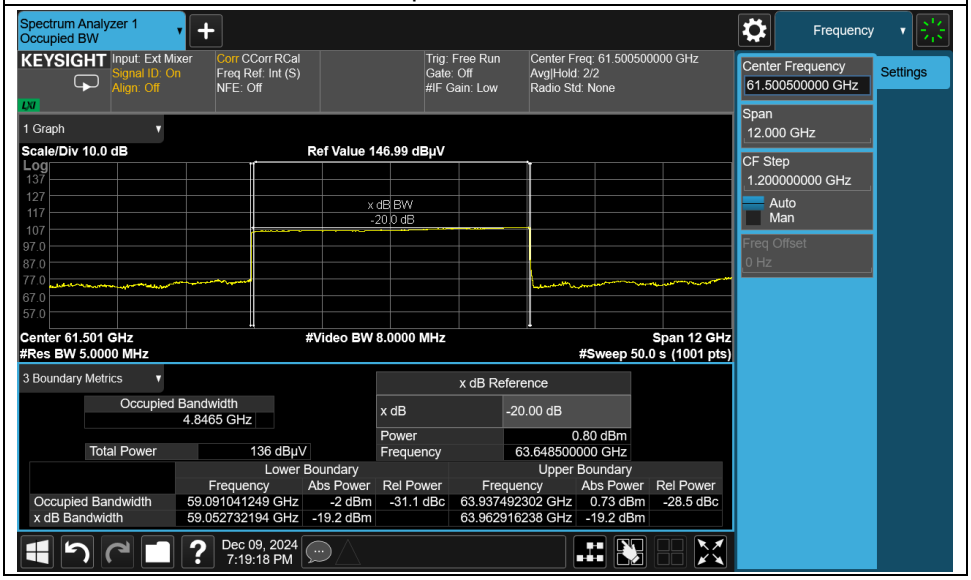
Remark:

$F_L$: Frequency Low Band Edge, $F_H$: Frequency High Band Edge

99% Occupied Channel Bandwidth




-20dB Occupied Channel Bandwidth



## 10.2 Transmitter power and Transmitter off-times

| Frequency (GHz) | Distance (m) | Polarity | dBuV/m @ 3m | Desensitization factor (dB) | E.I.R.P. Power (dBm) | E.I.R.P Limit (dBm) | Remark | Result |
|---|---|---|---|---|---|---|---|---|
| 61.501 | 3 | Horizontal | 106.81 | 0.46 | 12.04 | 14 | peak | Pass |
| | | Vertical | 99.21 | 0.46 | 4.44 | 14 | peak | Pass |

Remark 1: EIRP[dBm] = E[dBμV/m] + 20 log(d[meters]) - 104.77, where E = field strength and d = distance at which field strength limit is specified in the rules

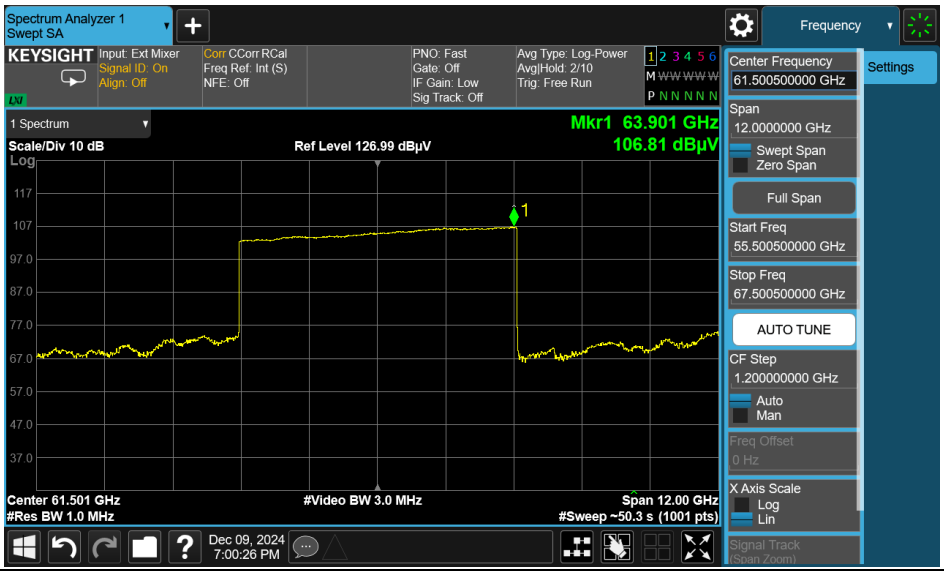
Remark 2: The FMCW modulation desensitization correct factor 0.46 was calculated with equation below, where the $BW_{Chirp}$=5000MHz, $T_{chirp}$=4.52mS, B=1MHz.

$$\alpha = \frac{1}{\sqrt{1+\left(\frac{2\ln(2)}{\pi}\right)^2\left(\frac{BW_{Chirp}}{T_{Chirp}B^2}\right)^2}}$$

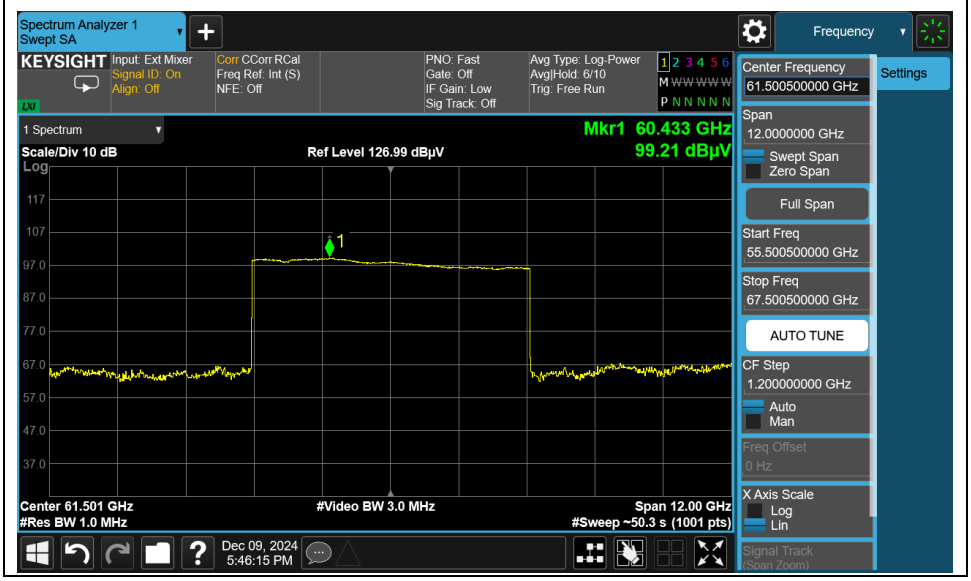
where

| | |
|---|---|
| $\alpha$ | is the reduction in amplitude |
| $BW_{Chirp}$ | is the FMCW Chirp Bandwidth |
| $T_{Chirp}$ | is the FMCW Chirp Time |
| $B$ | is the 3 dB IF Bandwidth = RBW |

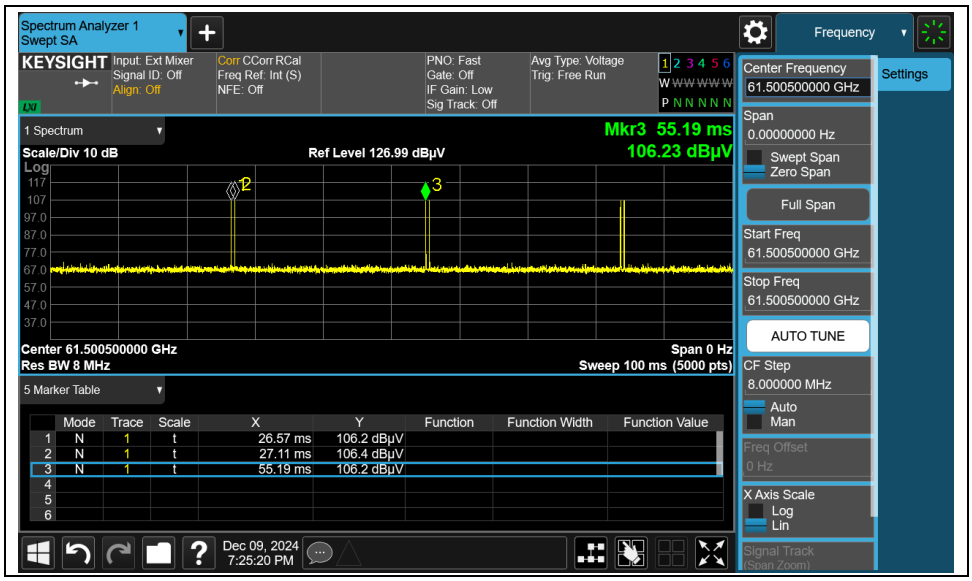
Peak E.I.R.P. Horizontal



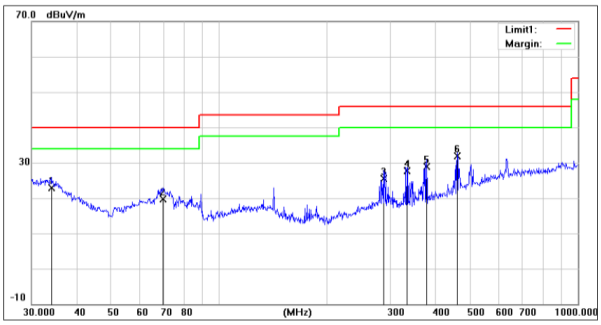
Peak E.I.R.P. Vertical




| Frequency (GHz) | Transmitter On-times (ms) | Transmitter Off-times (ms) | Interval Period (mS) | Limit (ms) | Result |
|---|---|---|---|---|---|
| 61.501 | 1.08 | 31.92 | 33 | ⩾25.5 | Pass |

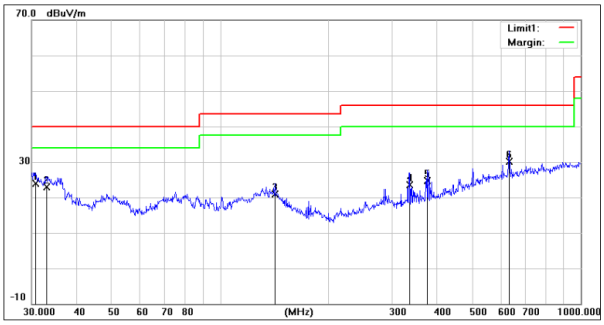


## 10.3 Out of band radiated emissions below 40 GHz



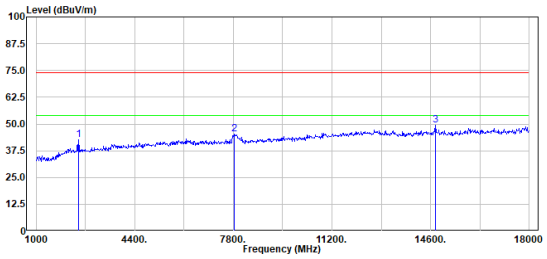

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 34.0365 | 6.18 | 16.72 | 22.90 | 40.00 | -17.10 | 100 | 118 | QP |
| 2 | 69.6005 | 11.91 | 7.74 | 19.65 | 40.00 | -20.35 | 100 | 226 | QP |
| 3 | 286.9823 | 9.96 | 15.64 | 25.60 | 46.00 | -20.40 | 100 | 302 | QP |
| 4 | 333.6867 | 11.31 | 16.42 | 27.73 | 46.00 | -18.27 | 100 | 281 | QP |
| 5 | 378.5843 | 11.81 | 17.04 | 28.85 | 46.00 | -17.15 | 100 | 357 | QP |
| 6 | 460.7271 | 12.19 | 19.74 | 31.93 | 46.00 | -14.07 | 100 | 7 | QP |

30MHz-1GHz-Horizontal




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 30.7455 | 5.16 | 18.83 | 23.99 | 40.00 | -16.01 | 100 | 180 | QP |
| 2 | 32.9791 | 5.41 | 17.44 | 22.85 | 40.00 | -17.15 | 100 | 74 | QP |
| 3 | 141.8262 | 7.08 | 13.87 | 20.95 | 43.50 | -22.55 | 200 | 48 | QP |
| 4 | 336.0352 | 7.26 | 16.22 | 23.48 | 46.00 | -22.52 | 300 | 113 | QP |
| 5 | 375.9385 | 7.76 | 16.99 | 24.75 | 46.00 | -21.25 | 200 | 197 | QP |
| 6 | 633.9073 | 6.76 | 23.35 | 30.11 | 46.00 | -15.89 | 100 | 358 | QP |

30MHz-1GHz-Vertical

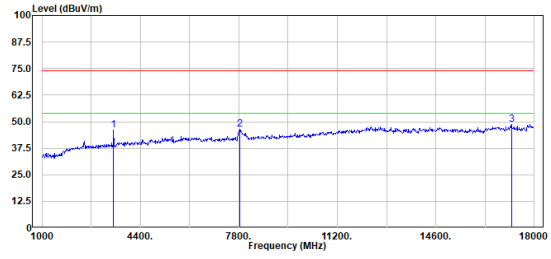



Antenna Polarity :Horizontal

| No. | Freq | Read level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuv | dB/m | dB | dB | dBuv/m | dBuv/m | dB | |
| | 2462.00 | 59.84 | 32.16 | 3.79 | 53.10 | 42.69 | 74.00 | -31.31 | Peak |
| | 7834.00 | 52.43 | 35.48 | 10.68 | 53.24 | 45.35 | 74.00 | -28.65 | Peak |
| | 14770.00 | 53.41 | 39.81 | 9.73 | 53.50 | 49.45 | 74.00 | -24.55 | Peak |

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

1GHz-18GHz-Horizontal

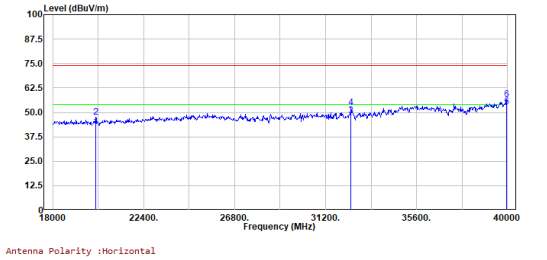



Antenna Polarity :Vertical

| No. | Freq | Read level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuv | dB/m | dB | dB | dBuv/m | dBuv/m | dB | |
| | 3465.00 | 62.23 | 32.59 | 4.59 | 53.21 | 46.20 | 74.00 | -27.80 | Peak |
| | 7834.00 | 53.50 | 35.48 | 10.68 | 53.24 | 46.42 | 74.00 | -27.58 | Peak |
| | 17218.00 | 50.91 | 40.82 | 10.46 | 53.49 | 48.70 | 74.00 | -25.30 | Peak |

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

1GHz-18GHz-Vertical

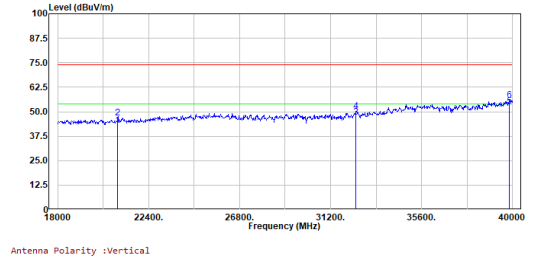



Antenna Polarity :Horizontal

| No. | Freq | Read level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuv | dB/m | dB | dB | dBuv/m | dBuv/m | dB | |
| | 20090.00 | 56.98 | 37.90 | 4.45 | 56.65 | 42.68 | 54.00 | -11.32 | Average |
| | 20090.00 | 61.68 | 37.90 | 4.45 | 56.65 | 47.38 | 74.00 | -26.62 | Peak |
| | 32432.00 | 54.85 | 40.65 | 7.29 | 54.63 | 48.16 | 54.00 | -5.84 | Average |
| | 32432.00 | 59.12 | 40.65 | 7.29 | 54.63 | 52.43 | 74.00 | -21.57 | Peak |
| | 39956.00 | 50.66 | 43.80 | 10.71 | 52.19 | 52.98 | 54.00 | -1.02 | Average |
| | 39956.00 | 54.30 | 43.80 | 10.71 | 52.19 | 56.62 | 74.00 | -17.38 | Peak |

Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

18GHz-40GHz-Horizontal



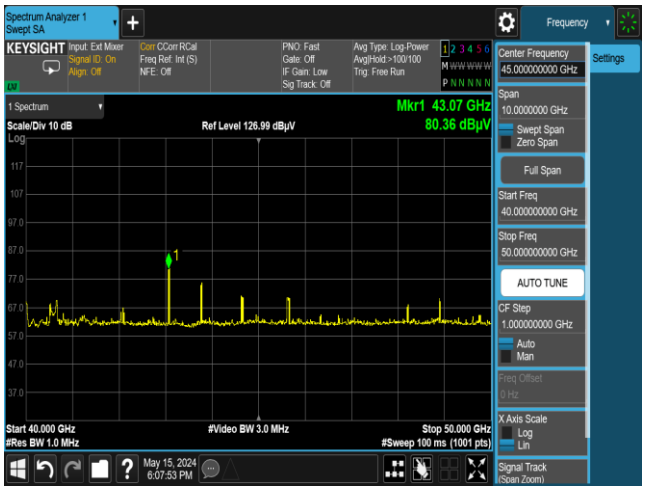
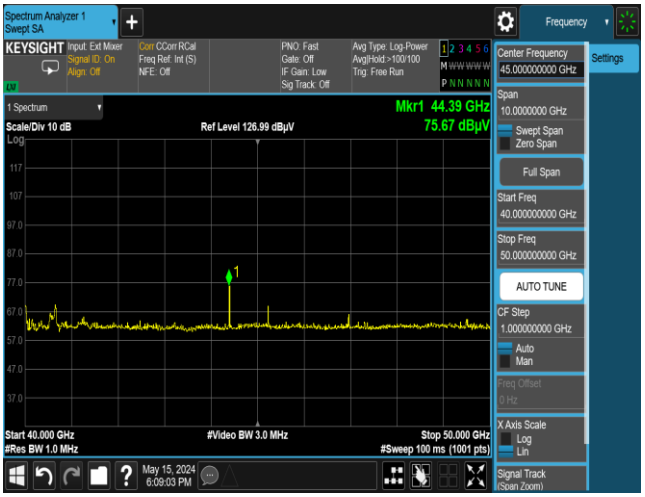

Antenna Polarity :Vertical

| No. | Freq | Read level | Antenna Factor | Cable Loss | Preamp Factor | Emission Level | Limit Line | Over Limit | Remark |
|---|---|---|---|---|---|---|---|---|---|
| | MHz | dBuv | dB/m | dB | dB | dBuv/m | dBuv/m | dB | |
| | 20904.00 | 56.77 | 38.07 | 4.69 | 56.56 | 42.97 | 54.00 | -11.03 | Average |
| | 20904.00 | 60.55 | 38.07 | 4.69 | 56.56 | 46.75 | 74.00 | -27.25 | Peak |
| | 32432.00 | 53.87 | 40.65 | 7.29 | 54.63 | 47.18 | 54.00 | -6.82 | Average |
| | 32432.00 | 57.04 | 40.65 | 7.29 | 54.63 | 50.35 | 74.00 | -23.65 | Peak |
| | 39846.00 | 50.52 | 43.76 | 10.89 | 52.51 | 52.66 | 54.00 | -1.34 | Average |
| | 39846.00 | 53.85 | 43.76 | 10.89 | 52.51 | 55.99 | 74.00 | -18.01 | Peak |

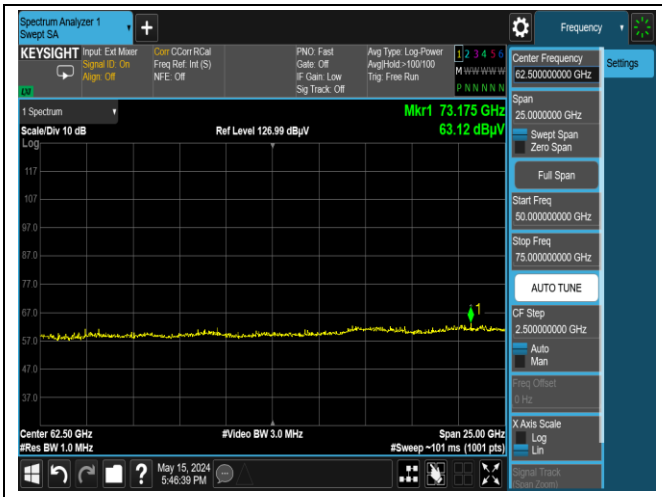
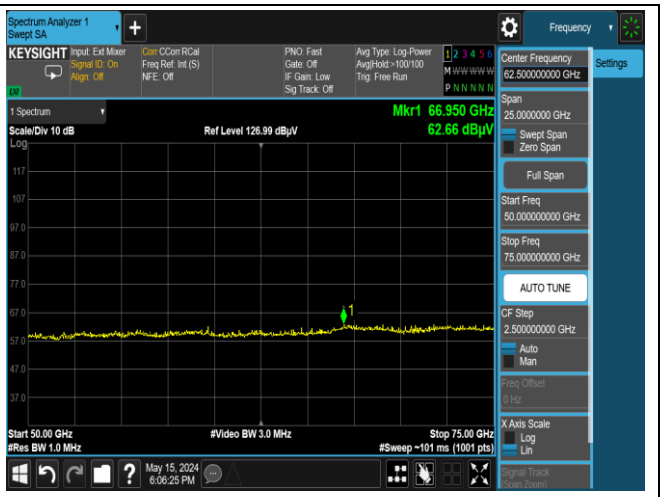
Notes: Emission Level=Read Level+Antenna Factor+Cable loss-Preamp Factor

18GHz-40GHz-Vertical

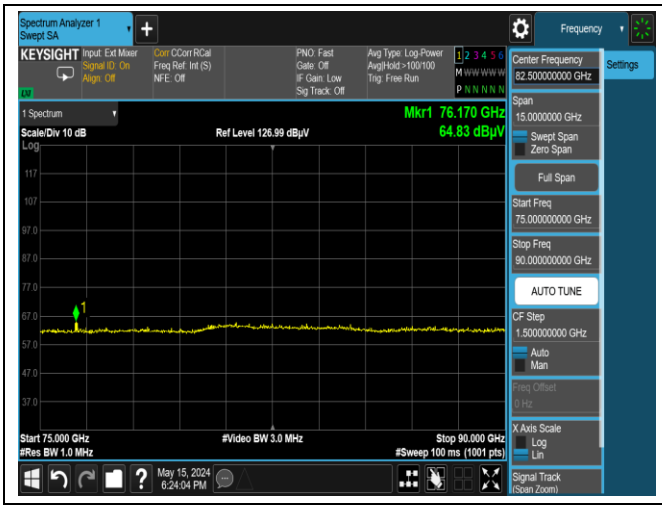
## 10.4 Out of band radiated emissions above 40 GHz

| | |
|---|---|
|  |  |
| 40GHz-50GHz-Horizontal | 40GHz-50GHz-Vertical |

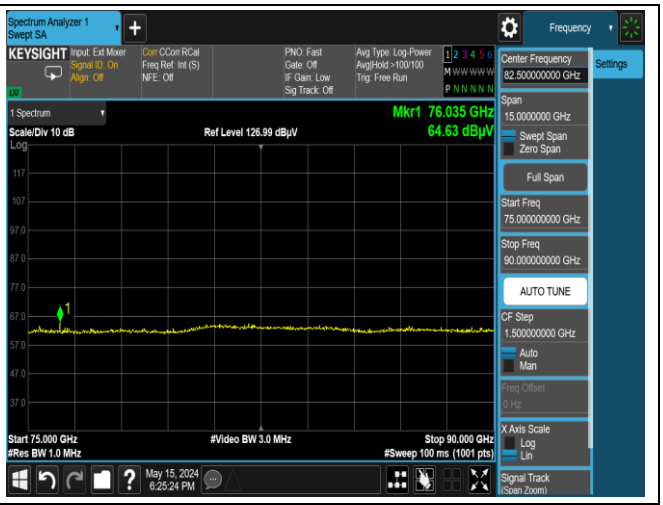
| Frequency (GHz) | Distance (M) | PK Value (dBuV/m) | PK Limit (dBuV/m) | AV Limit (dBuV/m) | Polarization | Result |
|---|---|---|---|---|---|---|
| 44.08 | 3 | 69.97 | 105.31 | 85.31 | Horizontal | PASS |
| 43.96 | 3 | 69.64 | 105.31 | 85.31 | Vertical | PASS |

| | |
|---|---|
|  |  |
| 50GHz-75GHz-Horizontal | 50GHz-75GHz-Vertical |

| Frequency (GHz) | Distance (M) | PK Value (dBuV/m) | PK Limit (dBuV/m) | AV Limit (dBuV/m) | Polarization | Result |
|---|---|---|---|---|---|---|
| 73.175 | 3 | 63.12 | 105.31 | 85.31 | Horizontal | PASS |
| 66.950 | 3 | 62.66 | 105.31 | 85.31 | Vertical | PASS |

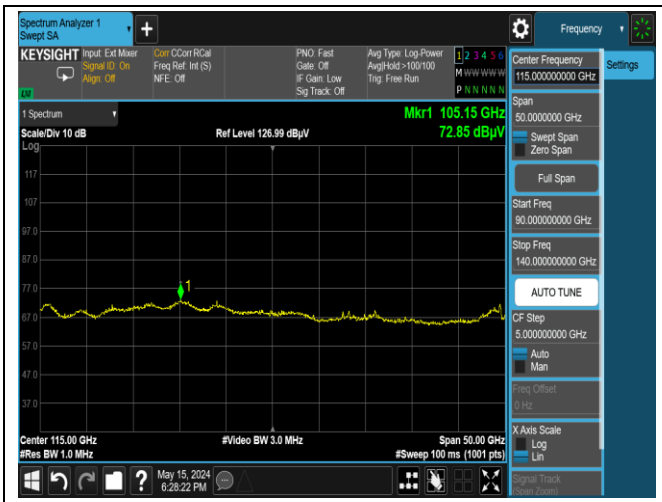



75GHz-90GHz-Horizontal

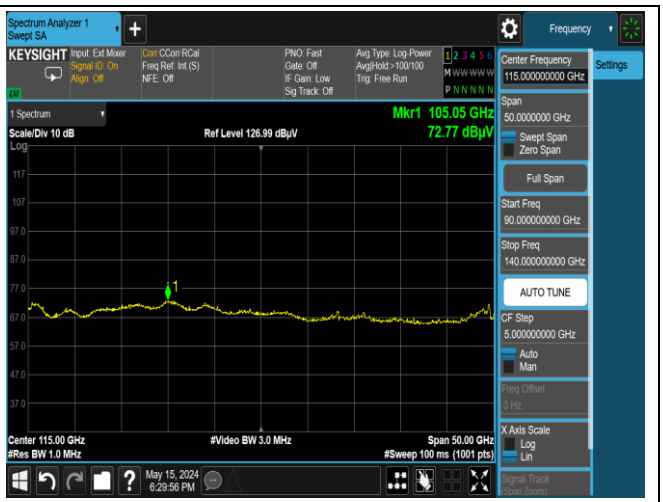



75GHz-90GHz-Vertical

| Frequency (GHz) | Distance (M) | PK Value (dBuV/m) | PK Limit (dBuV/m) | AV Limit (dBuV/m) | Polarization | Result |
|---|---|---|---|---|---|---|
| 76.170 | 3 | 64.83 | 105.31 | 85.31 | Horizontal | PASS |
| 76.035 | 3 | 64.63 | 105.31 | 85.31 | Vertical | PASS |

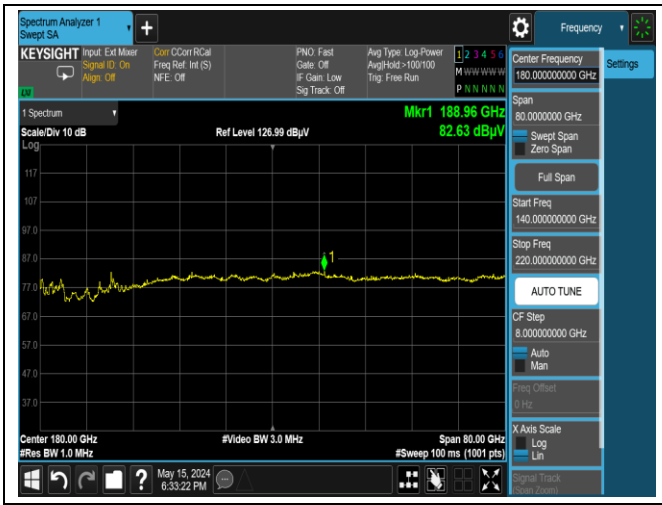
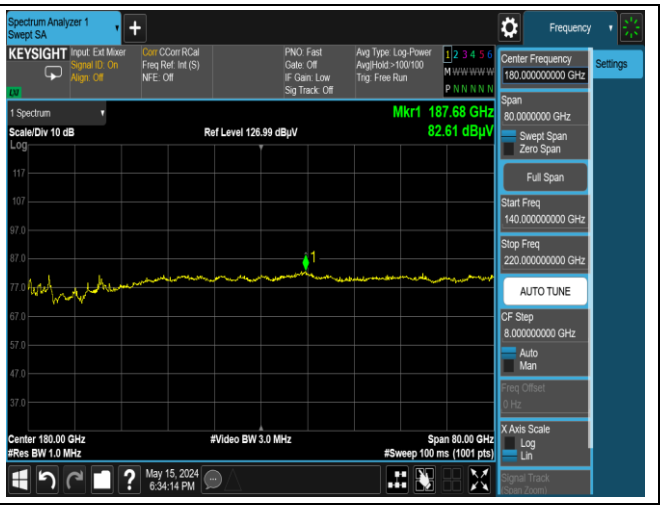



90GHz-140GHz-Horizontal




90GHz-140GHz-Vertical

| Frequency (GHz) | Distance (M) | PK Value (dBuV/m) | PK Limit (dBuV/m) | AV Limit (dBuV/m) | Polarization | Result |
|---|---|---|---|---|---|---|
| 105.15 | 3 | 72.85 | 105.31 | 85.31 | Horizontal | Pass |
| 105.05 | 3 | 72.77 | 105.31 | 85.31 | Vertical | Pass |

| | |
|---|---|
|  |  |
| 140GHz-220GHz-Horizontal | 140GHz-220GHz-Vertical |

| Frequency (GHz) | Distance (M) | PK Value (dBuV/m) | PK Limit (dBuV/m) | AV Limit (dBuV/m) | Polarization | Result |
|---|---|---|---|---|---|---|
| 188.96 | 3 | 82.63 | 105.31 | 85.31 | Horizontal | Pass |
| 187.68 | 3 | 82.61 | 105.31 | 85.31 | Vertical | Pass |

## 10.5 Frequency stability

Frequency Stability vs temperature:

Test for 57GHz to 64GHz (Channel=61.501GHz)

| Frequency (GHz) | Temperature (°C) | Voltage (V DC) | $F_L$ (GHz) | Limit (GHz) | $F_H$ (GHz) | Limit (GHz) | Result |
|---|---|---|---|---|---|---|---|
| 57-64 | 50 | 3.300 | 59.0918 | 57 | 63.9371 | 64 | Pass |
| | 40 | 3.300 | 59.0916 | 57 | 63.9370 | 64 | Pass |
| | 30 | 3.300 | 59.0920 | 57 | 63.9369 | 64 | Pass |
| | 20 | 3.300 | 59.0921 | 57 | 63.9374 | 64 | Pass |
| | 10 | 3.300 | 59.0920 | 57 | 63.9368 | 64 | Pass |
| | 0 | 3.300 | 59.0917 | 57 | 63.9372 | 64 | Pass |
| | -10 | 3.300 | 59.0921 | 57 | 63.9370 | 64 | Pass |
| | -20 | 3.300 | 59.0920 | 57 | 63.9372 | 64 | Pass |
| | 20 | 3.795 | 59.0918 | 57 | 63.9371 | 64 | Pass |
| | 20 | 3.000 | 59.0918 | 57 | 63.9375 | 64 | Pass |

Remark 1: $F_L$: Frequency Low Band Edge, $F_H$: Frequency High Band Edge

Remark 2: We use DC 3.0V as lowest voltage in extreme environment test since the absolute working voltage of EUT is DC 3.0V~5.5V.