# RADIO TEST REPORT

Report No.:STS2002173W02

Issued for

Eulum Design LLC

6131B Kellers Church Road, Pipersville, PA 18947, USA

| | |
|---|---|
| **Product Name:** | BLE Module |
| **Brand Name:** | N/A |
| **Model Name:** | RFM-CSB-3 |
| **Series Model:** | N/A |
| **FCC ID:** | 2AJMLEUCSB4 |
| **IC:** | 25884-EUCSB4 |
| **Test Standard:** | FCC Part 15.247 |



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# TEST RESULT CERTIFICATION

| | |
|---|---|
| **Applicant's Name** ..... : | Eulum Design LLC |
| Address ..... : | 6131B Kellers Church Road, Pipersville, PA 18947, USA |
| **Manufacture's Name** ..... : | Eulum Design LLC |
| Address ..... : | 6131B Kellers Church Road, Pipersville, PA 18947, USA |

**Product Description**

| | |
|---|---|
| Product Name ..... : | BLE Module |
| Brand Name ..... : | N/A |
| Model Name ..... : | RFM-CSB-3 |
| Series Model ..... : | N/A |
| **Test Standards** ..... : | FCC Part15.247<br>RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019 |
| Test Procedure ..... : | ANSI C63.10-2013 |

This device described above has been tested by STS, the test results show that the equipment under test (EUT) is in compliance with the FCC/IC requirements. And it is applicable only to the tested sample identified in the report.
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| | |
|---|---|
| **Date of Test** ..... : | |
| Date of receipt of test item ..... : | 24 Feb. 2020 |
| Date (s) of performance of tests ..... : | 24 Feb. 2020 ~ 27 Feb. 2020 |
| Date of Issue ..... : | 27 Feb. 2020 |
| Test Result ..... : | **Pass** |

Testing Engineer : Chris chen
(Chris Chen)

Technical Manager : Sean She
(Sean she)

Authorized Signatory : Vita Li
(Vita Li)

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## Table of Contents

## Revision History

| Rev. | Issue Date | Report NO. | Effect Page | Contents |
|---|---|---|---|---|
| 00 | 27 Feb. 2020 | STS2002173W02 | ALL | Initial Issue |
| | | | | |

# 1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

| FCC Part 15.247,Subpart C<br>RSS-247 Issue 2 | | | |
|---|---|---|---|
| Standard Section | Test Item | Judgment | Remark |
| 15.207<br>RSS-Gen 8.8 | Conducted Emission | PASS | -- |
| 15.247 (a)(2)<br>RSS-Gen 6.7 RSS-247 5.2a) | 6dB&99% Bandwidth | PASS | -- |
| 15.247 (b)(3)<br>RSS-247 5.4 d) | PK Output Power | PASS | -- |
| 15.247 (c)<br>RSS-Gen 8.9 8.10 | Radiated Spurious Emission | PASS | -- |
| 15.247 (d)<br>RSS-247 5.5<br>RSS-Gen 8.9 8.10 | Conducted Spurious & Band Edge Emission | PASS | -- |
| 15.247 (e)<br>RSS-247 5.2 b) | Power Spectral Density | PASS | -- |
| 15.205<br>RSS-Gen 8.9 8.10 | Restricted bands of operation | PASS | -- |
| Part 15.247(d)/part 15.209(a)<br>RSS-247 5.5<br>RSS-Gen 8.9 8.10 | Band Edge Emission | PASS | -- |
| 15.203<br>RSS-Gen 6.8 | Antenna Requirement | PASS | -- |
| RSS-Gen 6.11 8.11 | Frequency Stability | PASS | -- |

NOTE:

(1) 'N/A' denotes test is not applicable in this Test Report.

(2) All tests are according to ANSI C63.10-2013.

## 1.1 TEST FACTORY

SHENZHEN STS TEST SERVICES CO., LTD
Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China
FCC test Firm Registration Number: 625569
IC test Firm Registration Number: 12108A
A2LA Certificate No.: 4338.01

## 1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement **y** ± **U**, where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**, providing a level of confidence of approximately **95** %.

| No. | Item | Uncertainty |
|---|---|---|
| 1 | RF output power, conducted | ±0.68dB |
| 2 | Unwanted Emissions, conducted | ±2.988dB |
| 3 | All emissions, radiated 30-1GHz | ±6.7dB |
| 4 | All emissions, radiated 1G-6GHz | ±5.5dB |
| 5 | All emissions, radiated>6G | ±5.8dB |
| 6 | Conducted Emission (9KHz-150KHz) | ±4.43dB |
| 7 | Conducted Emission (150KHz-30MHz) | ±5dB |

# 2. GENERAL INFORMATION

## 2.1 GENERAL DESCRIPTION OF THE EUT

| | |
|---|---|
| Product Name | BLE Module |
| Trade Name | N/A |
| Model Name | RFM-CSB-3 |
| Series Model | N/A |
| Model Difference | N/A |
| Product Description | The EUT is a BLE Module<br>Operation Frequency: 2402~2480 MHz<br>Modulation Type: GFSK<br>Radio Technology: BLE<br>Bluetooth Version: 4.0<br>Bluetooth Configuration: LE<br>Number Of Channel: 40<br>Antenna Designation: Please refer to the Note 3.<br>Antenna Gain (dBi) 1.3 dBi |
| Channel List | Please refer to the Note 2. |
| Power Rating | Input: DC 3.3V |
| Hardware version number | EU-CBM-3 Rev B |
| Software version number | v26.11 |
| Radio Hardware Version of Test Equipment | MPLY.LR9.W1444,MD.LWTG.MP.V79.P4 |
| Radio Software Version of Test Equipment | SC6531_W13.04.05_Release |
| Test Software | 3.18.19 |
| RF Power Setting TEST Software (power class) | 2.4 GHz:GFSK:-6.5 |
| Connecting I/O Port(s) | Please refer to the Note 1. |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the User Manual.

2.

| Channel List | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 00 | 2402 | 10 | 2422 | 20 | 2442 | 30 | 2462 |
| 01 | 2404 | 11 | 2424 | 21 | 2444 | 31 | 2464 |
| 02 | 2406 | 12 | 2426 | 22 | 2446 | 32 | 2466 |
| 03 | 2408 | 13 | 2428 | 23 | 2448 | 33 | 2468 |
| 04 | 2410 | 14 | 2430 | 24 | 2450 | 34 | 2470 |
| 05 | 2412 | 15 | 2432 | 25 | 2452 | 35 | 2472 |
| 06 | 2414 | 16 | 2434 | 26 | 2454 | 36 | 2474 |
| 07 | 2416 | 17 | 2436 | 27 | 2456 | 37 | 2476 |
| 08 | 2418 | 18 | 2438 | 28 | 2458 | 38 | 2478 |
| 09 | 2420 | 19 | 2440 | 29 | 2460 | 39 | 2480 |

3.

Table for Filed Antenna

| Ant. | Brand | Model Name | Antenna Type | Connector | Gain (dBi) | NOTE |
|---|---|---|---|---|---|---|
| 1 | N/A | RFM-CSB-3 | Ceramic | N/A | 1.3 dBi | BLE ANT |

## 2.2 DESCRIPTION OF THE TEST MODES

For conducted test items and radiated spurious emissions
Each of these EUT operation mode(s) or test configuration mode(s) mentioned below was evaluated respectively.

| Worst Mode | Description | Data/Modulation |
|---|---|---|
| Mode 1 | TX CH00(2402MHz) | 1 Mbps/GFSK |
| Mode 2 | TX CH19(2440MHz) | 1 Mbps/GFSK |
| Mode 3 | TX CH39(2480MHz) | 1 Mbps/GFSK |

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.

(2) We have be tested for all avaiable U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V/60Hz is shown in the report.

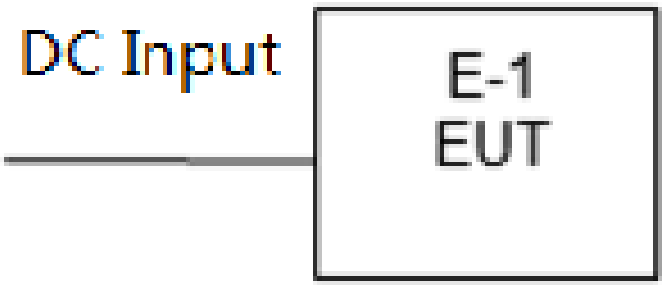
(3) Controlled using a bespoke application on the laptop PC supplied by the customer. The application was used to enable a continuous transmission mode and to select the test channels, data rates and modulation schemes as required.

For AC Conducted Emission

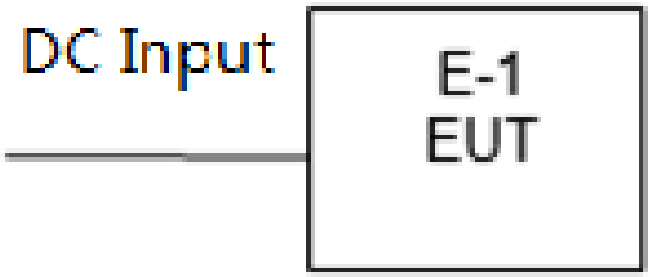
| Test Case | |
|---|---|
| AC Conducted Emission | Mode 4 : Keeping BT TX |

## 2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test




Conducted Emission Test



## 2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

| Item | Equipment | Mfr/Brand | Model/Type No. | Serial No. | Note |
|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | | |
| | | | | | |
| | | | | | |

Support units

| Item | Equipment | Mfr/Brand | Model/Type No. | Serial No. | Note |
|---|---|---|---|---|---|
| N/A | N/A | N/A | N/A | N/A | N/A |
| | | | | | |
| | | | | | |
| | | | | | |

Note:

(1) The support equipment was authorized by Declaration of Confirmation.

(2) For detachable type I/O cable should be specified the length in cm in 『Length』 column.

## 2.5 EQUIPMENTS LIST

Radiation Test equipment

| Kind of Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|
| Test Receiver | R&S | ESCI | 101427 | 2019.07.29 | 2020.07.28 |
| Signal Analyzer | Agilent | N9020A | MY51110105 | 2019.03.02 | 2020.03.01 |
| Active loop Antenna | ZHINAN | ZN30900C | 16035 | 2018.03.11 | 2021.03.10 |
| Bilog Antenna | TESEQ | CBL6111D | 34678 | 2017.11.02 | 2020.11.01 |
| Horn Antenna | SCHWARZBECK | BBHA 9120D(1201) | 9120D-1343 | 2018.10.19 | 2021.10.18 |
| SHF-EHF Horn Antenna (18G-40GHz) | A-INFO | LB-180400-KF | J211020657 | 2018.03.11 | 2021.03.10 |
| Pre-Amplifier(0.1M-3GHz) | EM | EM330 | 060665 | 2019.10.09 | 2020.10.08 |
| Pre-Amplifier (1G-18GHz) | SKET | LNPA-01018G-45 | SK2018080901 | 2019.10.12 | 2020.10.11 |
| Temperature & Humidity | HH660 | Mieo | N/A | 2019.10.12 | 2020.10.11 |
| Turn table | EM | SC100_1 | 60531 | N/A | N/A |
| Antenna mast | EM | SC100 | N/A | N/A | N/A |
| Test SW | FARAD | EZ-EMC(Ver.STSLAB-03A1 RE) | | | |

Conduction Test equipment

| Kind of Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|
| Test Receiver | R&S | ESCI | 101427 | 2019.07.29 | 2020.07.28 |
| LISN | R&S | ENV216 | 101242 | 2019.10.09 | 2020.10.08 |
| LISN | EMCO | 3810/2NM | 23625 | 2019.10.09 | 2020.10.08 |
| Temperature & Humidity | HH660 | Mieo | N/A | 2019.10.12 | 2020.10.11 |
| Test SW | FARAD | EZ-EMC(Ver.STSLAB-03A1 CE) | | | |

RF Connected Test

| Kind of Equipment | Manufacturer | Type No. | Serial No. | Last calibration | Calibrated until |
|---|---|---|---|---|---|
| USB RF power sensor | DARE | RPR3006W | 15I00041SNO03 | 2019.10.09 | 2020.10.08 |
| Signal Analyzer | Agilent | N9020A | MY49100060 | 2019.10.09 | 2020.10.08 |
| Temperature & Humidity | HH660 | Mieo | N/A | 2019.10.12 | 2020.10.11 |
| Test SW | FARAD | LZ-RF /LzRf-3A3 | | | |

# 3. EMC EMISSION TEST

## 3.1 CONDUCTED EMISSION MEASUREMENT

### 3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 207(a)&RSS-Gen Issue 5 limit in the table below has to be followed.

| FREQUENCY (MHz) | Conducted Emission limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 -0.5 | 66 - 56 * | 56 - 46 * |
| 0.50 -5.0 | 56.00 | 46.00 |
| 5.0 -30.0 | 60.00 | 50.00 |

Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

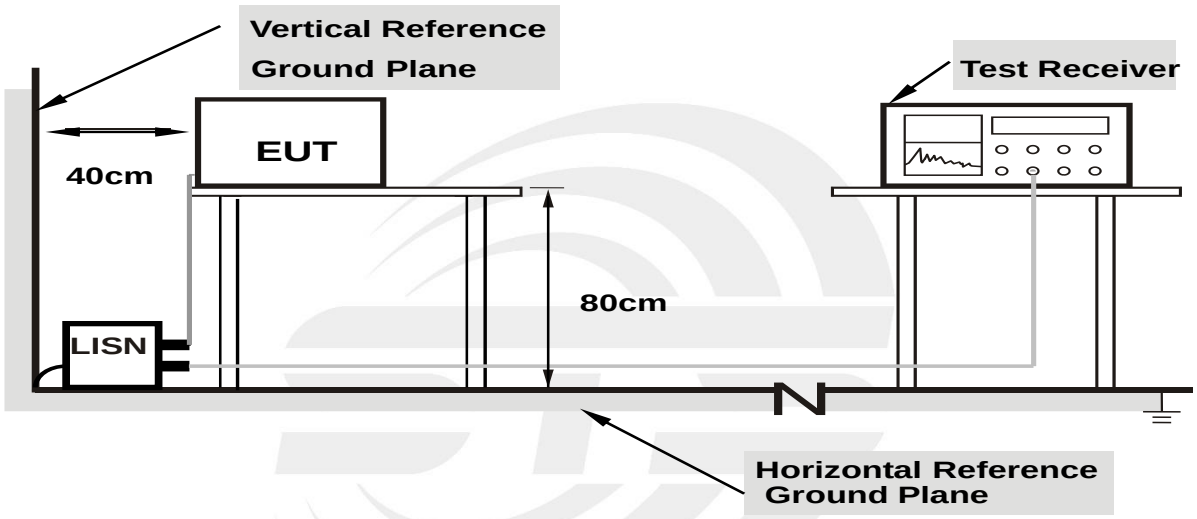
The following table is the setting of the receiver

| Receiver Parameters | Setting |
|---|---|
| Attenuation | 10 dB |
| Start Frequency | 0.15 MHz |
| Stop Frequency | 30 MHz |
| IF Bandwidth | 9 kHz |

3.2 TEST PROCEDURE

a. The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
d. LISN at least 80 cm from nearest part of EUT chassis.
e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

3.3 TEST SETUP




**Note: 1.Support units were connected to second LISN.**
**2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes**

3.4 EUT OPERATING CONDITIONS

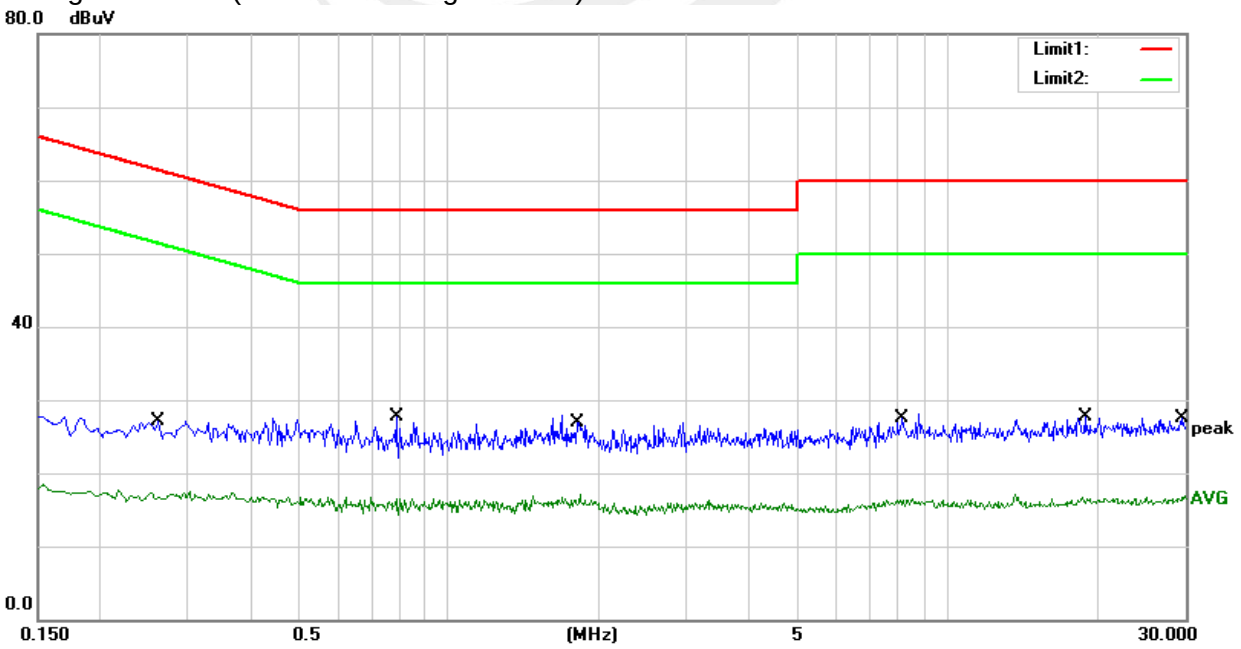
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.5 TEST RESULTS

| Temperature: | 22.9(C) | Relative Humidity: | 47%RH |
|---|---|---|---|
| Test Voltage: | AC 120V/60Hz | Phase: | L |
| Test Mode: | Mode 4 | | |

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB) | (dBuV) | (dBuV) | (dB) | |
| 1 | 0.2620 | 7.13 | 20.06 | 27.19 | 61.37 | -34.18 | QP |
| 2 | 0.2620 | -3.32 | 20.06 | 16.74 | 51.37 | -34.63 | AVG |
| 3 | 0.7860 | 7.90 | 19.83 | 27.73 | 56.00 | -28.27 | QP |
| 4 | 0.7860 | -4.24 | 19.83 | 15.59 | 46.00 | -30.41 | AVG |
| 5 | 1.8140 | 7.22 | 19.78 | 27.00 | 56.00 | -29.00 | QP |
| 6 | 1.8140 | -4.12 | 19.78 | 15.66 | 46.00 | -30.34 | AVG |
| 7 | 8.1300 | 7.56 | 20.01 | 27.57 | 60.00 | -32.43 | QP |
| 8 | 8.1300 | -3.61 | 20.01 | 16.40 | 50.00 | -33.60 | AVG |
| 9 | 18.9100 | 7.33 | 20.41 | 27.74 | 60.00 | -32.26 | QP |
| 10 | 18.9100 | -4.44 | 20.41 | 15.97 | 50.00 | -34.03 | AVG |
| 11 | 29.5820 | 7.13 | 20.28 | 27.41 | 60.00 | -32.59 | QP |
| 12 | 29.5820 | -3.63 | 20.28 | 16.65 | 50.00 | -33.35 | AVG |

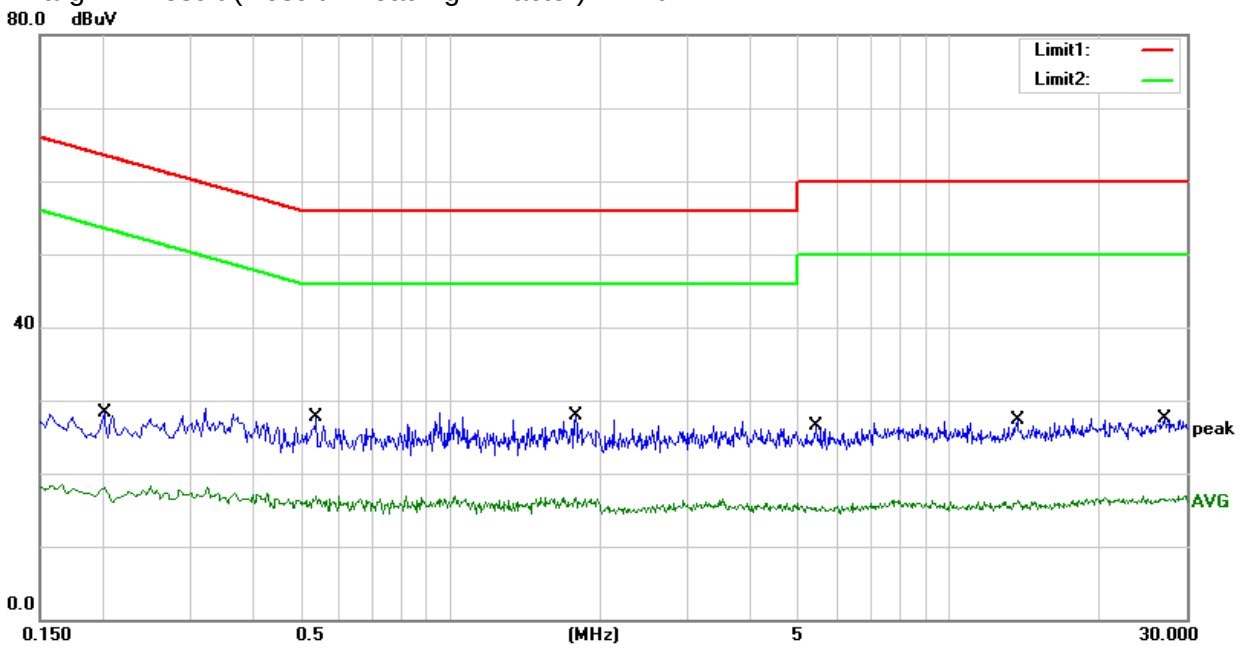
Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.



| | | | |
|---|---|---|---|
| Temperature: | 22.9(C) | Relative Humidity: | 47%RH |
| Test Voltage: | AC 120V/60Hz | Phase: | N |
| Test Mode: | Mode 4 | | |

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB) | (dBuV) | (dBuV) | (dB) | |
| 1 | 0.2020 | 8.35 | 19.88 | 28.23 | 63.53 | -35.30 | QP |
| 2 | 0.2020 | -1.88 | 19.88 | 18.00 | 53.53 | -35.53 | AVG |
| 3 | 0.5380 | 7.65 | 19.96 | 27.61 | 56.00 | -28.39 | QP |
| 4 | 0.5380 | -3.05 | 19.96 | 16.91 | 46.00 | -29.09 | AVG |
| 5 | 1.7820 | 8.06 | 19.85 | 27.91 | 56.00 | -28.09 | QP |
| 6 | 1.7820 | -3.17 | 19.85 | 16.68 | 46.00 | -29.32 | AVG |
| 7 | 5.4220 | 6.63 | 19.91 | 26.54 | 60.00 | -33.46 | QP |
| 8 | 5.4220 | -4.63 | 19.91 | 15.28 | 50.00 | -34.72 | AVG |
| 9 | 13.7060 | 7.29 | 20.04 | 27.33 | 60.00 | -32.67 | QP |
| 10 | 13.7060 | -4.11 | 20.04 | 15.93 | 50.00 | -34.07 | AVG |
| 11 | 27.2060 | 7.04 | 20.39 | 27.43 | 60.00 | -32.57 | QP |
| 12 | 27.2060 | -4.08 | 20.39 | 16.31 | 50.00 | -33.69 | AVG |

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit.



# 4. RADIATED EMISSION MEASUREMENT

## 4.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a), RSS-Gen Issue 5, Amendment 1, March 2019 and RSS-247 Issue 2, February 2017 (5.5) limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

| Frequencies (MHz) | Field Strength (micorvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009~0.490 | 2400/F(KHz) | 300 |
| 0.490~1.705 | 24000/F(KHz) | 30 |
| 1.705~30.0 | 30 | 30 |
| 30~88 | 100 | 3 |
| 88~216 | 150 | 3 |
| 216~960 | 200 | 3 |
| Above 960 | 500 | 3 |

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

| FREQUENCY (MHz) | (dBuV/m) (at 3M) | |
|---|---|---|
| | PEAK | AVERAGE |
| Above 1000 | 74 | 54 |

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m)=20log Emission level (uV/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FCC:

| FREQUENCY (MHz) | FREQUENCY (MHz) | FREQUENCY (MHz) | FREQUENCY (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 | 8.025-8.5 |
| 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 | 13.25-13.4 |
| 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 |
| 13.36-13.41 | | | |

IC:

| FREQUENCY (MHz) | FREQUENCY (MHz) | FREQUENCY (GHz) |
|---|---|---|
| 0.090 - 0.110 | 149.9 - 150.05 | 9.0 - 9.2 |
| 0.495 - 0.505 | 156.52475 - 156.52525 | 9.3 - 9.5 |
| 2.1735 - 2.1905 | 156.7 - 156.9 | 10.6 - 12.7 |
| 3.020 - 3.026 | 162.0125 - 167.17 | 13.25 - 13.4 |
| 4.125 - 4.128 | 167.72 - 173.2 | 14.47 - 14.5 |
| 4.17725 - 4.17775 | 240 – 285 | 15.35 - 16.2 |
| 4.20725 - 4.20775 | 322 - 335.4 | 17.7 - 21.4 |
| 5.677 - 5.683 | 399.9 - 410 | 22.01 - 23.12 |
| 6.215 - 6.218 | 608 - 614 | 23.6 - 24.0 |
| 6.26775 - 6.26825 | 960 - 1427 | 31.2 - 31.8 |
| 6.31175 - 6.31225 | 1435 - 1626.5 | 36.43 - 36.5 |
| 8.291 - 8.294 | 1645.5 - 1646.5 | Above 38.6 |
| 8.362 - 8.366 | 1660 - 1710 | |
| 8.37625 - 8.38675 | 1718.8 - 1722.2 | |
| 8.41425 - 8.41475 | 2200 - 2300 | |
| 12.29 - 12.293 | 2310 - 2390 | |
| 12.51975 - 12.52025 | 2483.5 - 2500 | |
| 12.57675 - 12.57725 | 2655 - 2900 | |
| 13.36 - 13.41 | 3260 – 3267 | |
| 16.42 - 16.423 | 3332 - 3339 | |
| 16.69475 - 16.69525 | 3345.8 - 3358 | |
| 16.80425 - 16.80475 | 3500 - 4400 | |
| 25.5 - 25.67 | 4500 - 5150 | |
| 37.5 - 38.25 | 5350 - 5460 | |
| 73 - 74.6 | 7250 - 7750 | |
| 74.8 - 75.2 | 8025 – 8500 | |
| 108 – 138 | | |

For Radiated Emission

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Detector | Peak/QP/AV |
| Start Frequency | 9 KHz/150KHz(Peak/QP/AV) |
| Stop Frequency | 150KHz/30MHz(Peak/QP/AV) |
| RB / VB (emission in restricted band) | 200Hz (From 9kHz to 0.15MHz)/<br>9KHz (From 0.15MHz to 30MHz);<br>200Hz (From 9kHz to 0.15MHz)/<br>9KHz (From 0.15MHz to 30MHz) |

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Detector | Peak/QP |
| Start Frequency | 30 MHz(Peak/QP) |
| Stop Frequency | 1000 MHz (Peak/QP) |
| RB / VB (emission in restricted band) | 120 KHz / 300 KHz |

| Spectrum Parameter | Setting |
|---|---|
| Attenuation | Auto |
| Detector | Peak/AV |
| Start Frequency | 1000 MHz(Peak/AV) |
| Stop Frequency | 10th carrier hamonic(Peak/AV) |
| RB / VB (emission in restricted band) | 1 MHz / 3 MHz(Peak)<br>1 MHz/1/T MHz(AVG) |

For Restricted band

| Spectrum Parameter | Setting |
|---|---|
| Detector | Peak/AV |
| Start/Stop Frequency | Lower Band Edge: 2310 to 2410 MHz<br>Upper Band Edge: 2470 to 2570 MHz |
| RB / VB | 1 MHz / 3 MHz(Peak)<br>1 MHz/1/T MHz(AVG) |

| Receiver Parameter | Setting |
|---|---|
| Start ~ Stop Frequency | 9kHz~90kHz / RB 200Hz for PK & AV |
| Start ~ Stop Frequency | 90kHz~110kHz / RB 200Hz for QP |
| Start ~ Stop Frequency | 110kHz~490kHz / RB 200Hz for PK & AV |
| Start ~ Stop Frequency | 490kHz~30MHz / RB 9kHz for QP |
| Start ~ Stop Frequency | 30MHz~1000MHz / RB 120kHz for QP |

4.2 TEST PROCEDURE

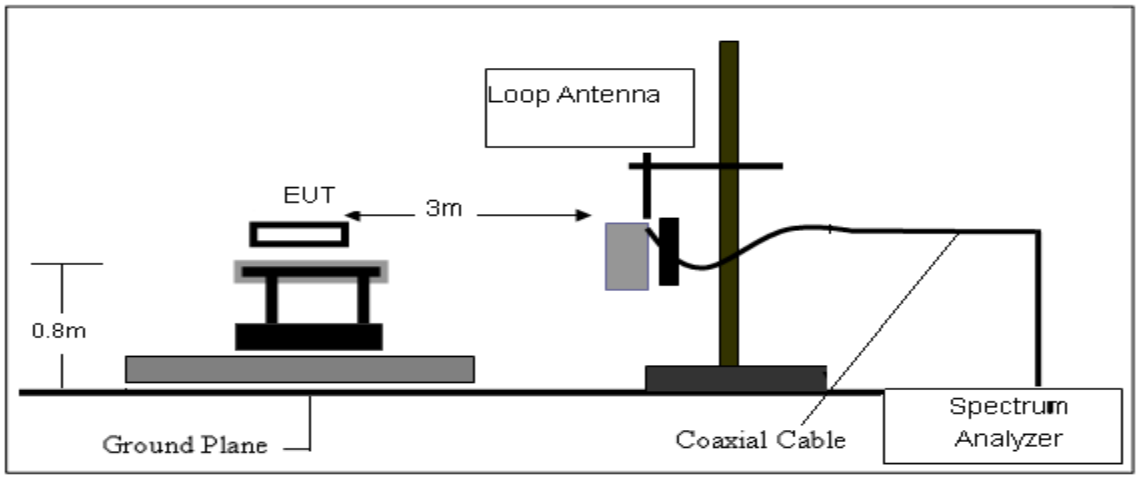
a. The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
b. The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The height of the equipment shall be 0.8 m(above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarizations of the antenna are set to make the measurement.
d. The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
e. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.
f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

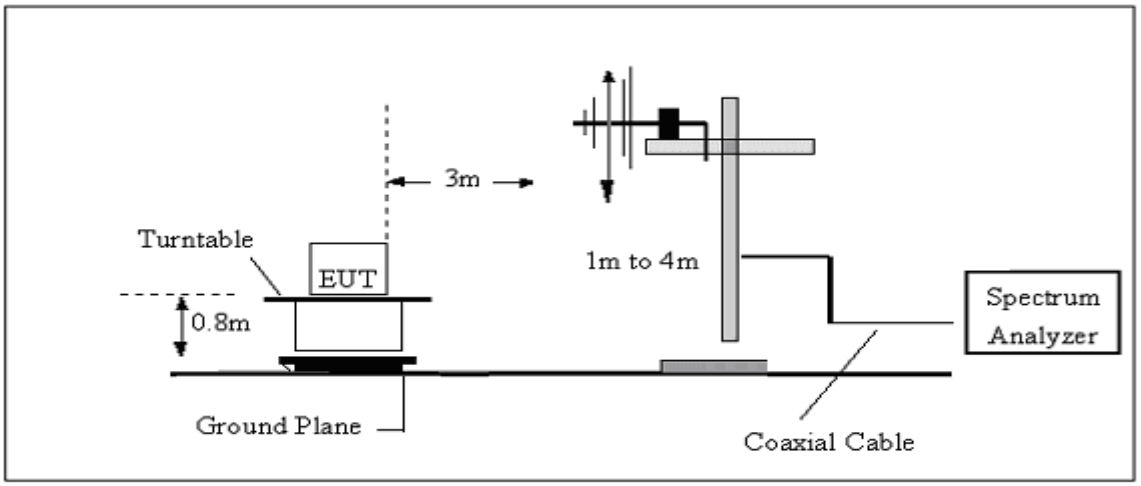
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

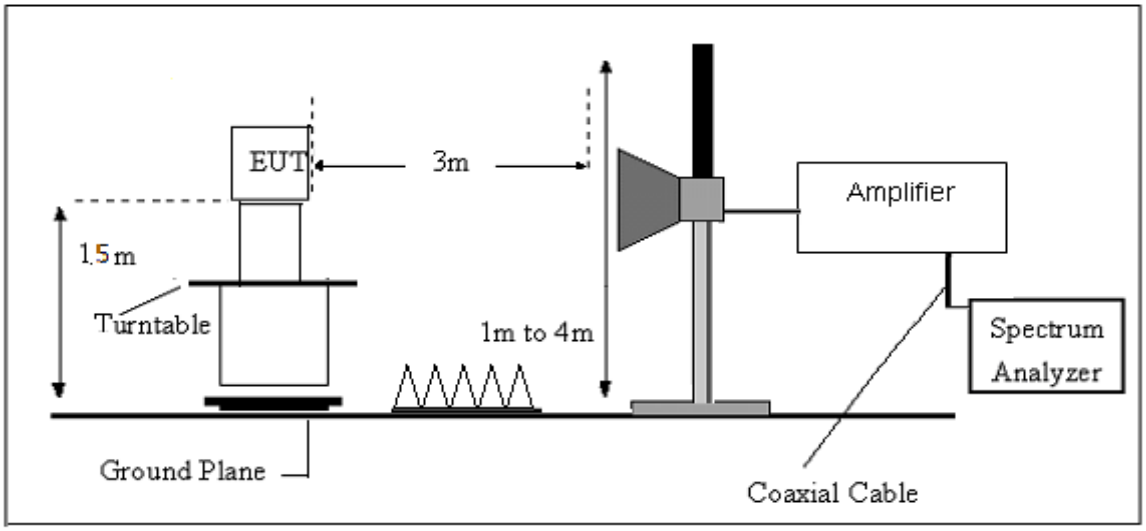
(A) Radiated Emission Test-Up Frequency Below 30MHz




(B) Radiated Emission Test-Up Frequency 30MHz~1GHz




(C) Radiated Emission Test-Up Frequency Above 1GHz




4.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

4.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

| Frequency | FS | RA | AF | CL | AG | Factor |
|---|---|---|---|---|---|---|
| (MHz) | (dBμV/m) | (dBμV/m) | (dB) | (dB) | (dB) | (dB) |
| 300 | 40 | 58.1 | 12.2 | 1.6 | 31.9 | -18.1 |

Factor=AF+CL-AG

4.6 TEST RESULTS

(Between 9KHz – 30 MHz)

| | | | |
|---|---|---|---|
| Temperature: | 23.8(C) | Relative Humidtity: | 66%RH |
| Test Voltage: | DC 3.3V | Polarization: | -- |
| Test Mode: | TX Mode | | |

| Freq. | Reading | Limit | Margin | State |
|---|---|---|---|---|
| (MHz) | (dBuV/m) | (dBuV/m) | (dB) | P/F |
| -- | -- | -- | -- | PASS |
| -- | -- | -- | -- | PASS |

Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =40 log (specific distance/test distance)(dB);

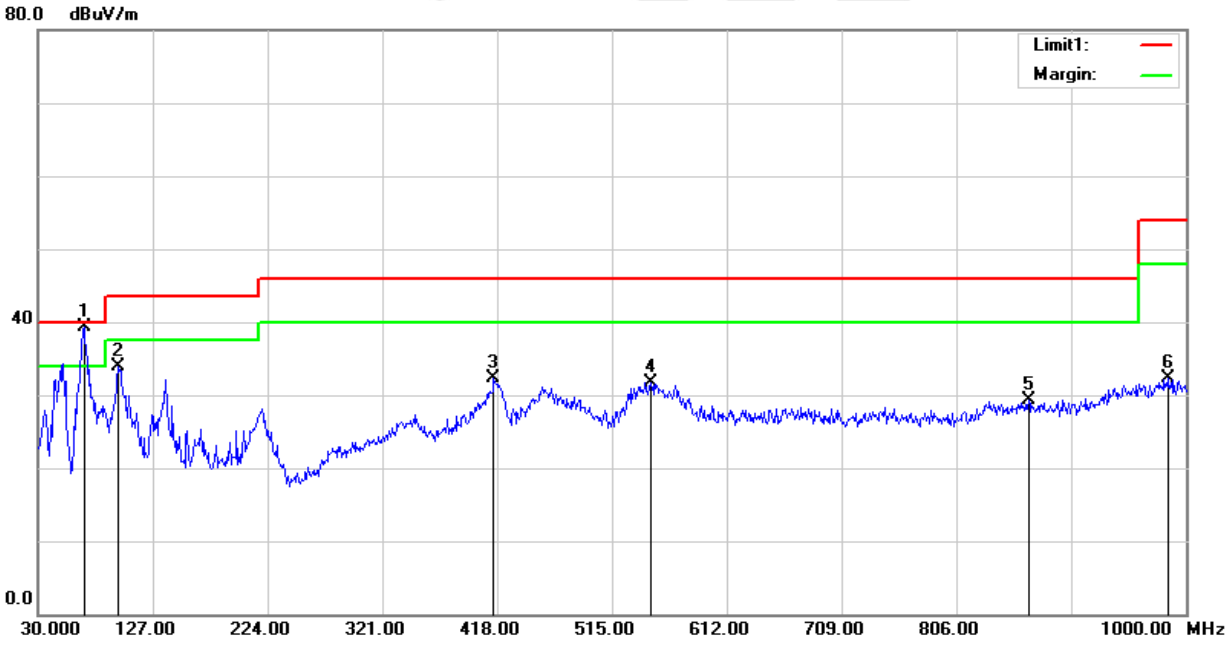
Limit line = specific limits(dBuv) + distance extrapolation factor.

(30MHz -1000MHz)

| Temperature: | 23.8(C) | Relative Humidity: | 66%RH |
|---|---|---|---|
| Test Voltage: | DC 3.3V | Phase: | Horizontal |
| Test Mode: | Mode 1/2/3 (Mode 1 worst mode) | | |

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 68.8000 | 64.35 | -25.09 | 39.26 | 40.00 | -0.74 | QP |
| 2 | 97.9000 | 54.45 | -20.46 | 33.99 | 43.50 | -9.51 | QP |
| 3 | 415.0900 | 42.61 | -10.33 | 32.28 | 46.00 | -13.72 | QP |
| 4 | 547.9800 | 37.77 | -5.99 | 31.78 | 46.00 | -14.22 | QP |
| 5 | 867.1100 | 29.89 | -0.50 | 29.39 | 46.00 | -16.61 | QP |
| 6 | 984.4800 | 29.82 | 2.40 | 32.22 | 54.00 | -21.78 | QP |

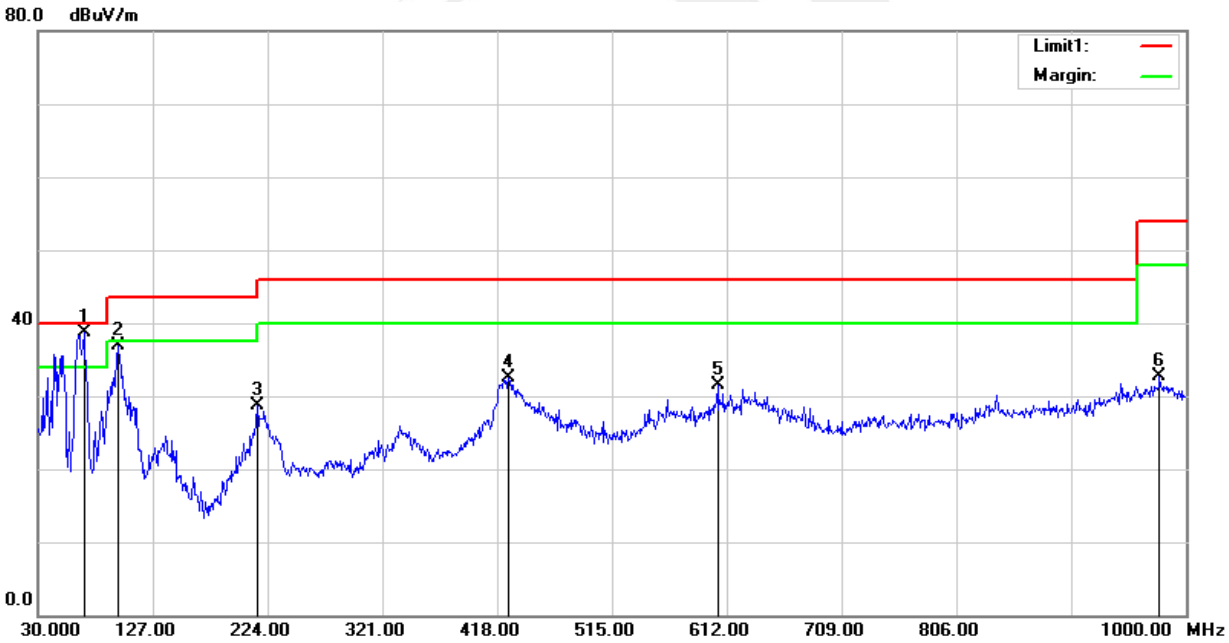
Remark:
1. Margin = Result (Result =Reading + Factor )–Limit



| Temperature: | 23.8(C) | Relative Humidity: | 66%RH |
|---|---|---|---|
| Test Voltage: | DC 3.3V | Phase: | Vertical |
| Test Mode: | Mode 1/2/3 (Mode 1 worst mode) | | |

| No. | Frequency | Reading | Correct | Result | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | Factor(dB/m) | (dBuV/m) | (dBuV/m) | (dB) | |
| 1 | 68.8000 | 63.85 | -25.09 | 38.76 | 40.00 | -1.24 | QP |
| 2 | 97.9000 | 57.31 | -20.46 | 36.85 | 43.50 | -6.65 | QP |
| 3 | 215.2700 | 48.94 | -20.17 | 28.77 | 43.50 | -14.73 | QP |
| 4 | 427.7000 | 42.66 | -10.13 | 32.53 | 46.00 | -13.47 | QP |
| 5 | 604.2400 | 37.13 | -5.70 | 31.43 | 46.00 | -14.57 | QP |
| 6 | 977.6900 | 30.22 | 2.52 | 32.74 | 54.00 | -21.26 | QP |

Remark:
1. Margin = Result (Result =Reading + Factor )–Limit



(1GHz-25GHz) Spurious emission Requirements

## GFSK

| Frequency | Meter Reading | Amplifier | Loss | Antenna Factor | Orrected Factor | Emission Level | Limits | Margin | Detector | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBμV) | （dB） | （dB） | （dB/m） | （dB） | (dBμV/m) | (dBμV/m) | (dB) | Type | |
| Low Channel (2402 MHz) | | | | | | | | | | |
| 3264.72 | 61.08 | 44.70 | 6.70 | 28.20 | -9.80 | 51.28 | 74.00 | -22.72 | PK | Vertical |
| 3264.72 | 50.25 | 44.70 | 6.70 | 28.20 | -9.80 | 40.45 | 54.00 | -13.55 | AV | Vertical |
| 3264.86 | 61.15 | 44.70 | 6.70 | 28.20 | -9.80 | 51.35 | 74.00 | -22.65 | PK | Horizontal |
| 3264.86 | 50.77 | 44.70 | 6.70 | 28.20 | -9.80 | 40.97 | 54.00 | -13.03 | AV | Horizontal |
| 4804.35 | 58.39 | 44.20 | 9.04 | 31.60 | -3.56 | 54.83 | 74.00 | -19.17 | PK | Vertical |
| 4804.35 | 50.50 | 44.20 | 9.04 | 31.60 | -3.56 | 46.94 | 54.00 | -7.06 | AV | Vertical |
| 4804.40 | 59.14 | 44.20 | 9.04 | 31.60 | -3.56 | 55.58 | 74.00 | -18.42 | PK | Horizontal |
| 4804.40 | 49.40 | 44.20 | 9.04 | 31.60 | -3.56 | 45.84 | 54.00 | -8.16 | AV | Horizontal |
| 5359.81 | 48.89 | 44.20 | 9.86 | 32.00 | -2.34 | 46.55 | 74.00 | -27.45 | PK | Vertical |
| 5359.81 | 39.32 | 44.20 | 9.86 | 32.00 | -2.34 | 36.98 | 54.00 | -17.02 | AV | Vertical |
| 5359.82 | 47.14 | 44.20 | 9.86 | 32.00 | -2.34 | 44.80 | 74.00 | -29.20 | PK | Horizontal |
| 5359.82 | 39.52 | 44.20 | 9.86 | 32.00 | -2.34 | 37.18 | 54.00 | -16.82 | AV | Horizontal |
| 7205.84 | 54.52 | 43.50 | 11.40 | 35.50 | 3.40 | 57.92 | 74.00 | -16.08 | PK | Vertical |
| 7205.84 | 43.92 | 43.50 | 11.40 | 35.50 | 3.40 | 47.32 | 54.00 | -6.68 | AV | Vertical |
| 7205.84 | 53.76 | 43.50 | 11.40 | 35.50 | 3.40 | 57.16 | 74.00 | -16.84 | PK | Horizontal |
| 7205.84 | 44.70 | 43.50 | 11.40 | 35.50 | 3.40 | 48.10 | 54.00 | -5.90 | AV | Horizontal |
| Middle Channel (2440 MHz) | | | | | | | | | | |
| 3264.63 | 61.32 | 44.70 | 6.70 | 28.20 | -9.80 | 51.52 | 74.00 | -22.48 | PK | Vertical |
| 3264.63 | 51.48 | 44.70 | 6.70 | 28.20 | -9.80 | 41.68 | 54.00 | -12.32 | AV | Vertical |
| 3264.63 | 61.86 | 44.70 | 6.70 | 28.20 | -9.80 | 52.06 | 74.00 | -21.94 | PK | Horizontal |
| 3264.63 | 50.93 | 44.70 | 6.70 | 28.20 | -9.80 | 41.13 | 54.00 | -12.87 | AV | Horizontal |
| 4880.56 | 58.99 | 44.20 | 9.04 | 31.60 | -3.56 | 55.43 | 74.00 | -18.57 | PK | Vertical |
| 4880.56 | 50.25 | 44.20 | 9.04 | 31.60 | -3.56 | 46.69 | 54.00 | -7.31 | AV | Vertical |
| 4880.34 | 58.37 | 44.20 | 9.04 | 31.60 | -3.56 | 54.81 | 74.00 | -19.19 | PK | Horizontal |
| 4880.34 | 50.30 | 44.20 | 9.04 | 31.60 | -3.56 | 46.74 | 54.00 | -7.26 | AV | Horizontal |
| 5359.71 | 48.56 | 44.20 | 9.86 | 32.00 | -2.34 | 46.22 | 74.00 | -27.78 | PK | Vertical |
| 5359.71 | 39.41 | 44.20 | 9.86 | 32.00 | -2.34 | 37.07 | 54.00 | -16.93 | AV | Vertical |
| 5359.68 | 47.46 | 44.20 | 9.86 | 32.00 | -2.34 | 45.12 | 74.00 | -28.88 | PK | Horizontal |
| 5359.68 | 39.43 | 44.20 | 9.86 | 32.00 | -2.34 | 37.09 | 54.00 | -16.91 | AV | Horizontal |
| 7320.88 | 54.44 | 43.50 | 11.40 | 35.50 | 3.40 | 57.84 | 74.00 | -16.16 | PK | Vertical |
| 7320.88 | 44.71 | 43.50 | 11.40 | 35.50 | 3.40 | 48.11 | 54.00 | -5.89 | AV | Vertical |
| 7320.79 | 53.54 | 43.50 | 11.40 | 35.50 | 3.40 | 56.94 | 74.00 | -17.06 | PK | Horizontal |
| 7320.79 | 43.96 | 43.50 | 11.40 | 35.50 | 3.40 | 47.36 | 54.00 | -6.64 | AV | Horizontal |

| High Channel (2480 MHz) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3264.79 | 61.08 | 44.70 | 6.70 | 28.20 | -9.80 | 51.28 | 74.00 | -22.72 | PK | Vertical |
| 3264.79 | 51.48 | 44.70 | 6.70 | 28.20 | -9.80 | 41.68 | 54.00 | -12.32 | AV | Vertical |
| 3264.79 | 61.61 | 44.70 | 6.70 | 28.20 | -9.80 | 51.81 | 74.00 | -22.19 | PK | Horizontal |
| 3264.79 | 50.40 | 44.70 | 6.70 | 28.20 | -9.80 | 40.60 | 54.00 | -13.40 | AV | Horizontal |
| 4960.51 | 58.60 | 44.20 | 9.04 | 31.60 | -3.56 | 55.04 | 74.00 | -18.96 | PK | Vertical |
| 4960.51 | 50.60 | 44.20 | 9.04 | 31.60 | -3.56 | 47.04 | 54.00 | -6.96 | AV | Vertical |
| 4960.35 | 58.23 | 44.20 | 9.04 | 31.60 | -3.56 | 54.67 | 74.00 | -19.33 | PK | Horizontal |
| 4960.35 | 50.18 | 44.20 | 9.04 | 31.60 | -3.56 | 46.62 | 54.00 | -7.38 | AV | Horizontal |
| 5359.81 | 48.58 | 44.20 | 9.86 | 32.00 | -2.34 | 46.24 | 74.00 | -27.76 | PK | Vertical |
| 5359.81 | 38.93 | 44.20 | 9.86 | 32.00 | -2.34 | 36.59 | 54.00 | -17.41 | AV | Vertical |
| 5359.73 | 47.33 | 44.20 | 9.86 | 32.00 | -2.34 | 44.99 | 74.00 | -29.01 | PK | Horizontal |
| 5359.73 | 38.99 | 44.20 | 9.86 | 32.00 | -2.34 | 36.65 | 54.00 | -17.35 | AV | Horizontal |
| 7439.86 | 54.51 | 43.50 | 11.40 | 35.50 | 3.40 | 57.91 | 74.00 | -16.09 | PK | Vertical |
| 7439.86 | 43.62 | 43.50 | 11.40 | 35.50 | 3.40 | 47.02 | 54.00 | -6.98 | AV | Vertical |
| 7439.81 | 53.87 | 43.50 | 11.40 | 35.50 | 3.40 | 57.27 | 74.00 | -16.73 | PK | Horizontal |
| 7439.81 | 44.96 | 43.50 | 11.40 | 35.50 | 3.40 | 48.36 | 54.00 | -5.64 | AV | Horizontal |

Note:

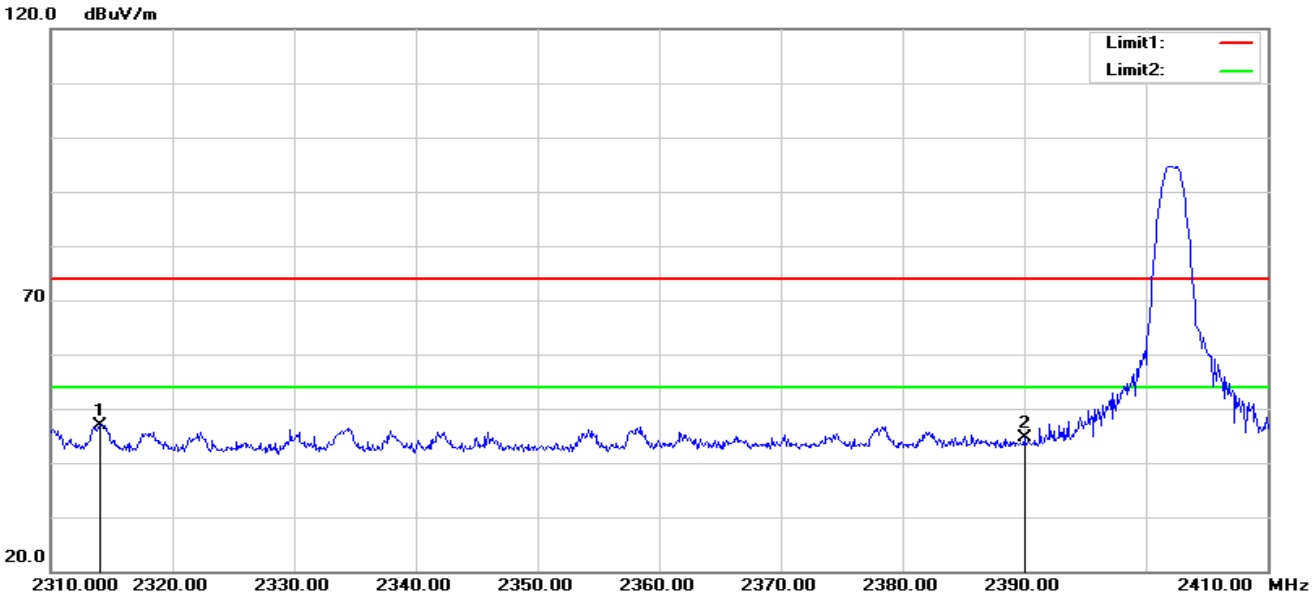
1) Factor = Antenna Factor + Cable Loss – Pre-amplifier.
   Emission Level = Reading + Factor

2) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.

4.6 TEST RESULTS (Restricted Bands Requirements)

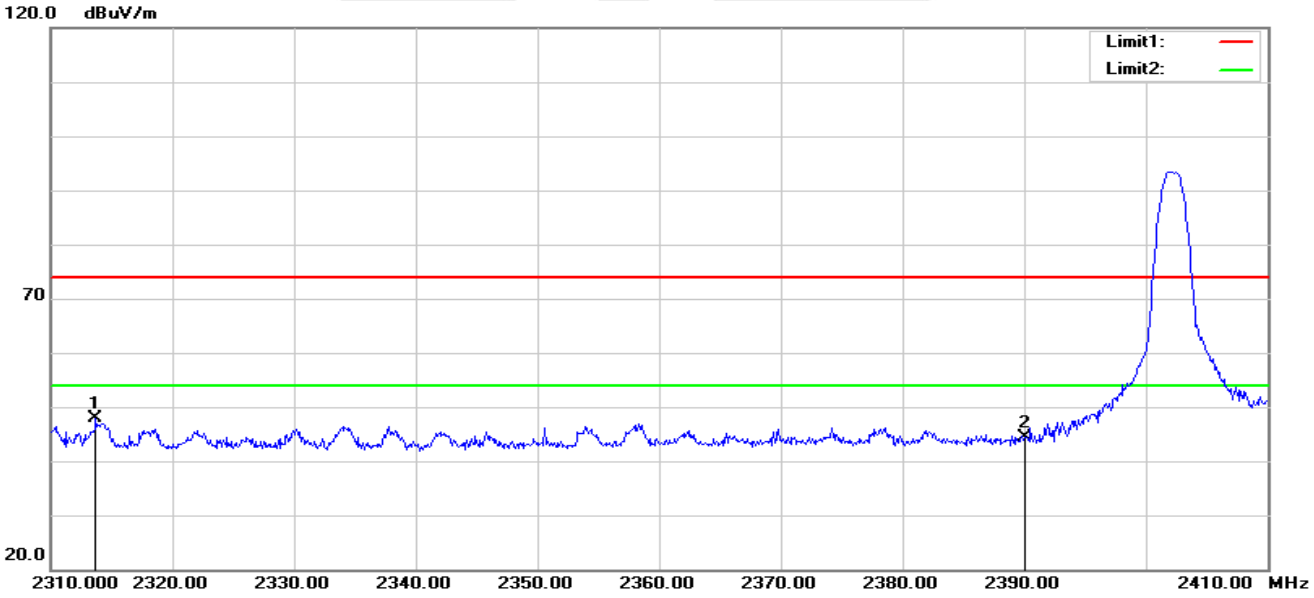
**GFSK-Low**

Horizontal




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 2314.100 | 43.28 | 3.55 | 46.83 | 74.00 | -27.17 | peak |
| 2 | 2390.000 | 40.39 | 4.34 | 44.73 | 74.00 | -29.27 | peak |

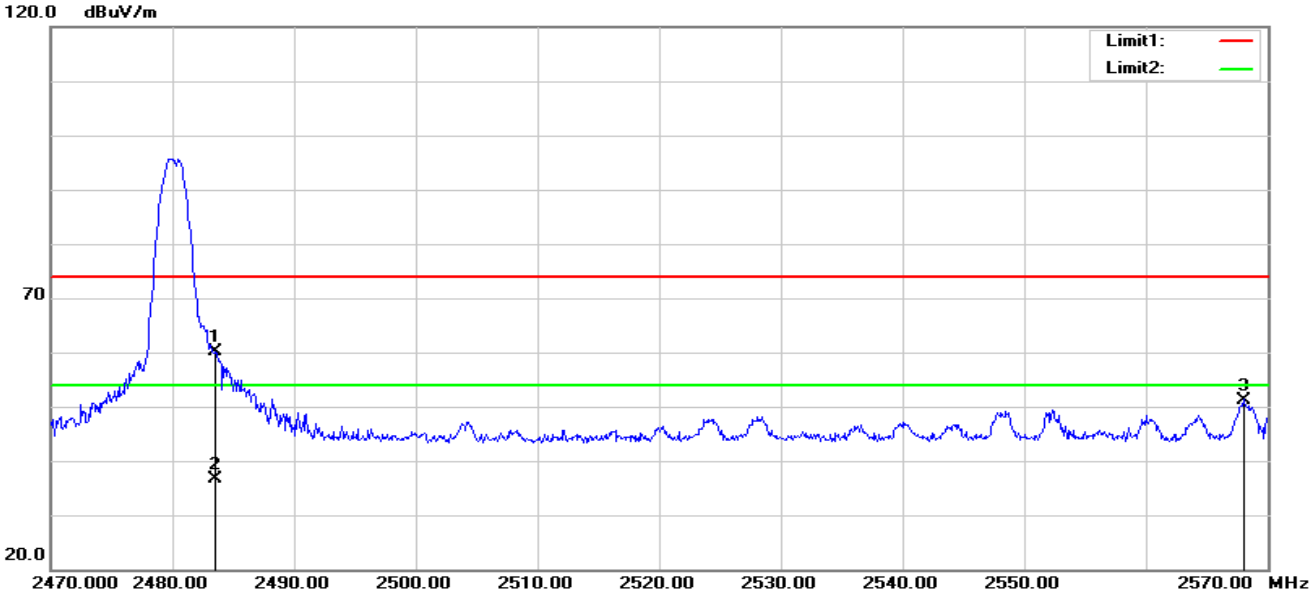
Vertical




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 2313.700 | 44.24 | 3.55 | 47.79 | 74.00 | -26.21 | peak |
| 2 | 2390.000 | 40.06 | 4.34 | 44.40 | 74.00 | -29.60 | peak |

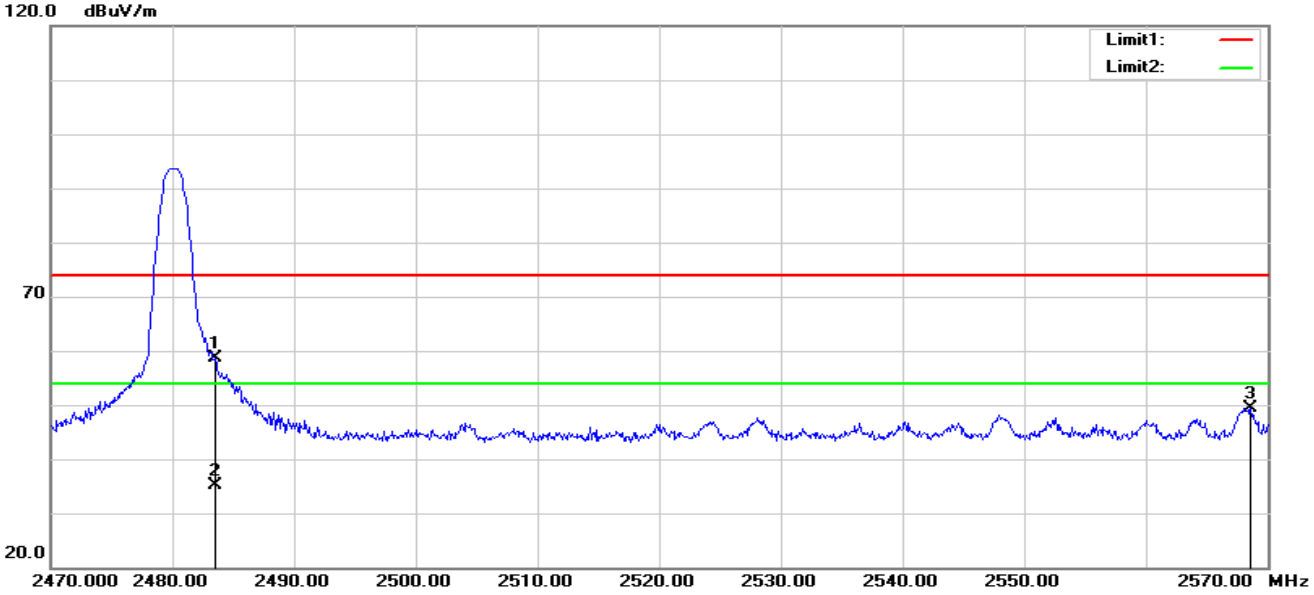
**GFSK-High**

Horizontal




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 55.60 | 4.60 | 60.20 | 74.00 | -13.80 | peak |
| 2 | 2483.500 | 31.97 | 4.60 | 36.57 | 54.00 | -17.43 | AVG |

Vertical




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 2483.500 | 53.95 | 4.60 | 58.55 | 74.00 | -15.45 | peak |
| 2 | 2483.500 | 30.52 | 4.60 | 35.12 | 54.00 | -18.88 | AVG |

# 5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

## 5.1 LIMIT

According to FCC section 15.247(d) & RSS-247 Issue 2, in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

## 5.2 TEST PROCEDURE

| Spectrum Parameter | Setting |
|---|---|
| Detector | Peak |
| Start/Stop Frequency | 30 MHz to 10th carrier harmonic |
| RB / VB (emission in restricted band) | 100 KHz/300 KHz |
| Trace-Mode: | Max hold |

.

For Band edge

| Spectrum Parameter | Setting |
|---|---|
| Detector | Peak |
| Start/Stop Frequency | Lower Band Edge: 2300 – 2403 MHz<br>Upper Band Edge: 2479 – 2500 MHz |
| RB / VB (emission in restricted band) | 100 KHz/300 KHz |
| Trace-Mode: | Max hold |

## 5.3 TEST SETUP


The EUT which is powered by the DC Power, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50 Ohm; the path loss as the factor is calibrated to correct the reading. Make the measurement with the spectrum analyzer's resolution bandwidth(RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

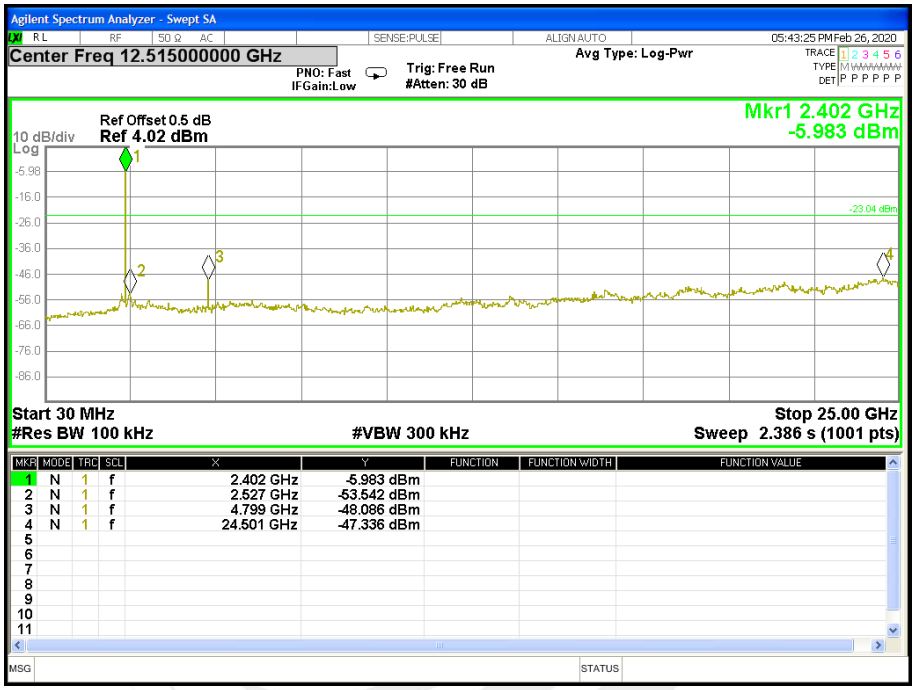
## 5.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

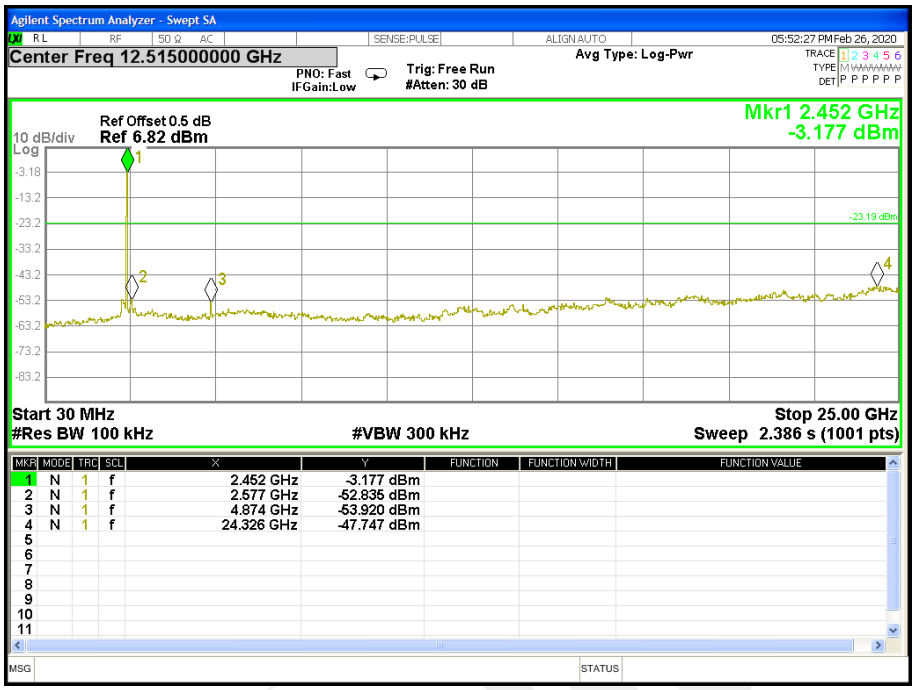
## 5.5 TEST RESULTS

| Temperature: | 25 ℃ | Relative Humidity: | 50% |
|---|---|---|---|
| Test Voltage: | DC 3.3V | Test Mode: | TX Mode /CH00, CH19, CH39 |

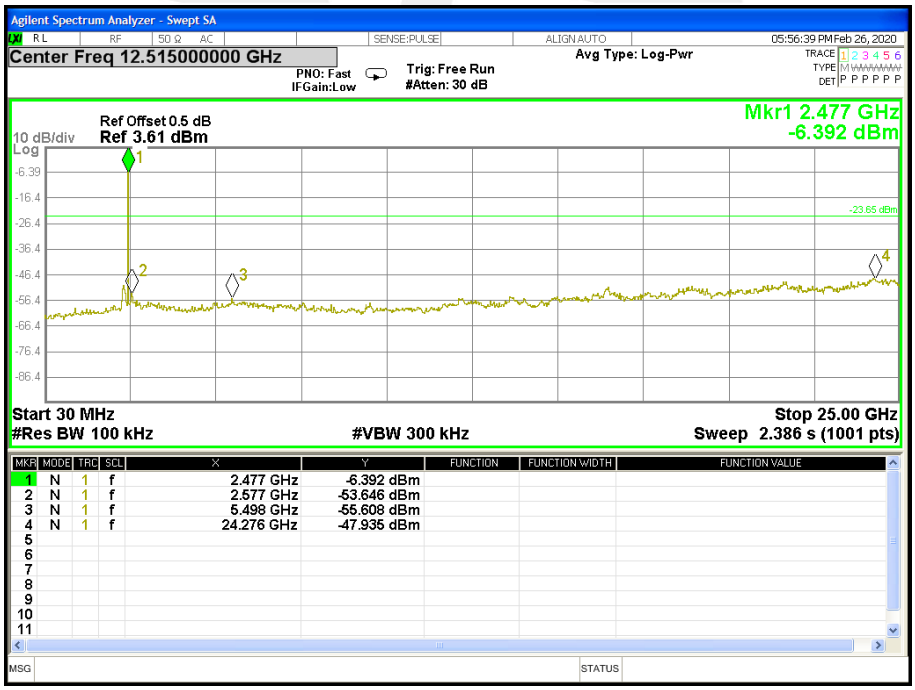
00 CH



19 CH

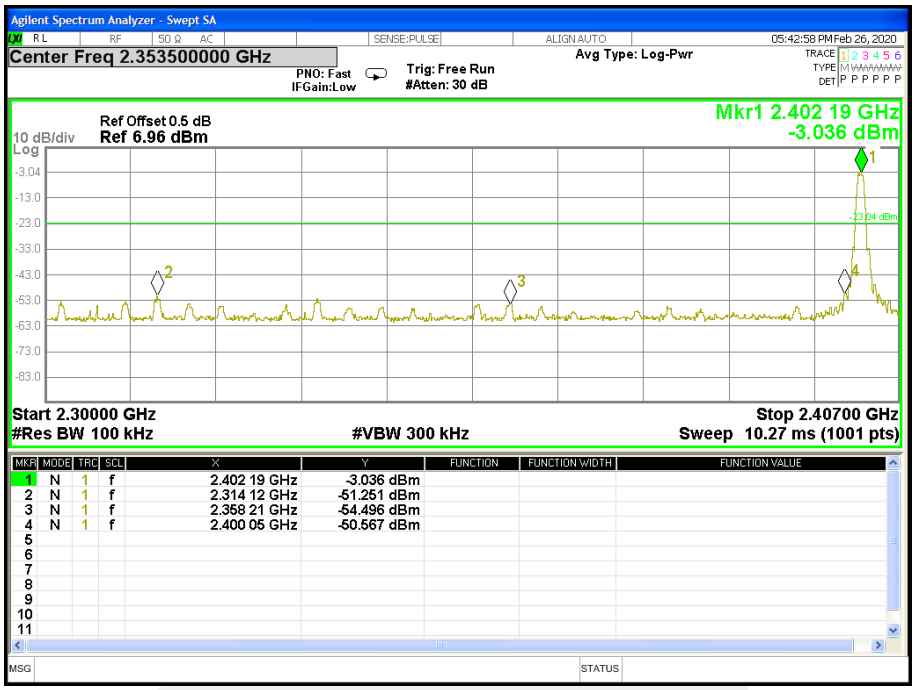

Agilent Spectrum Analyzer - Swept SA
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
05:52:27 PM Feb 26, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 6.82 dBm
Mkr1 2.452 GHz
-3.177 dBm
-23.19 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
1 N 1 f 2.452 GHz -3.177 dBm
2 N 1 f 2.577 GHz -52.835 dBm
3 N 1 f 4.874 GHz -53.920 dBm
4 N 1 f 24.326 GHz -47.747 dBm

39 CH

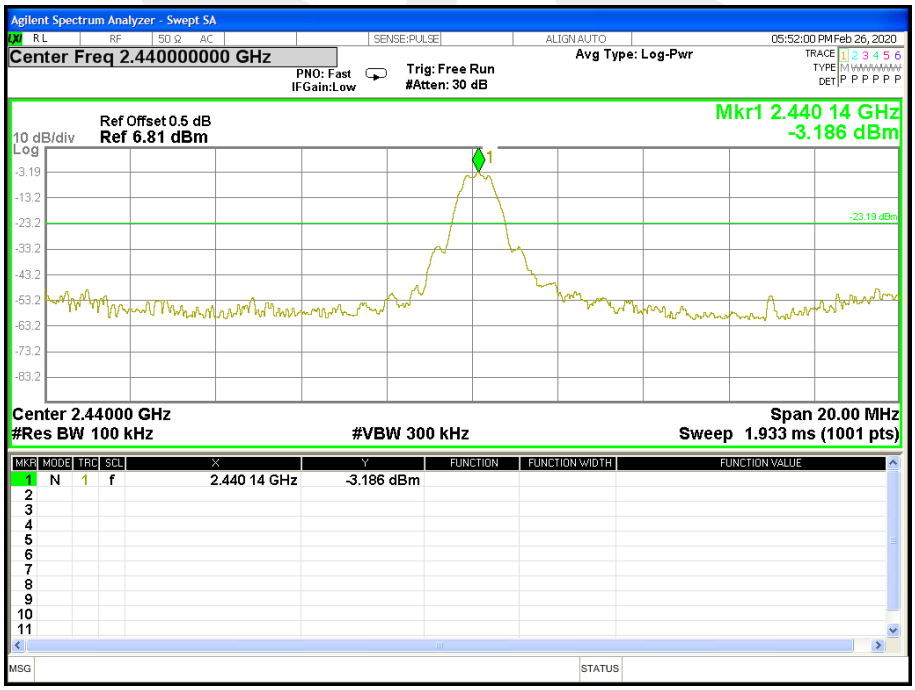

Agilent Spectrum Analyzer - Swept SA
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
05:56:39 PM Feb 26, 2020
Ref Offset 0.5 dB
10 dB/div
Ref 3.61 dBm
Mkr1 2.477 GHz
-6.392 dBm
-23.65 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
1 N 1 f 2.477 GHz -6.392 dBm
2 N 1 f 2.577 GHz -53.646 dBm
3 N 1 f 5.498 GHz -55.608 dBm
4 N 1 f 24.276 GHz -47.935 dBm

For Band edge(it's also the reference level for conducted spurious emission)

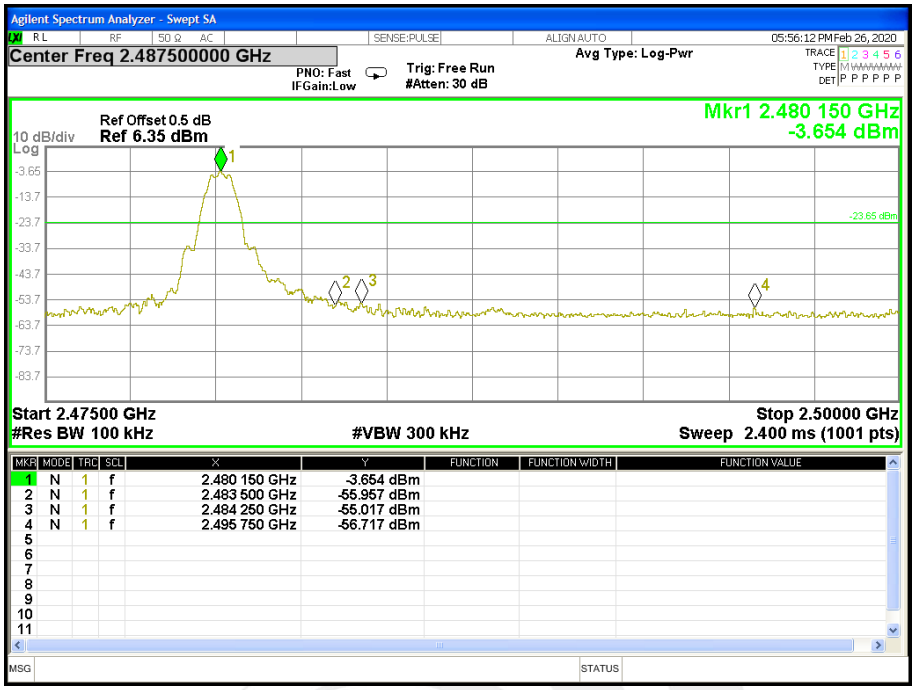
**00 CH**




**19 CH**



## 39 CH


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:PULSE
ALIGN AUTO
05:56:12 PM Feb 26, 2020
Center Freq 2.487500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 0.5 dB
10 dB/div
Ref 6.35 dBm
Log
Mkr1 2.480 150 GHz
-3.654 dBm
-3.65
-13.7
-23.7
-33.7
-43.7
-53.7
-63.7
-73.7
-83.7
-23.65 dBm
Start 2.47500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.400 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.480 150 GHz -3.654 dBm
2 N 1 f 2.483 500 GHz -55.957 dBm
3 N 1 f 2.484 250 GHz -55.017 dBm
4 N 1 f 2.495 750 GHz -56.717 dBm
MSG
STATUS

# 6. POWER SPECTRAL DENSITY TEST

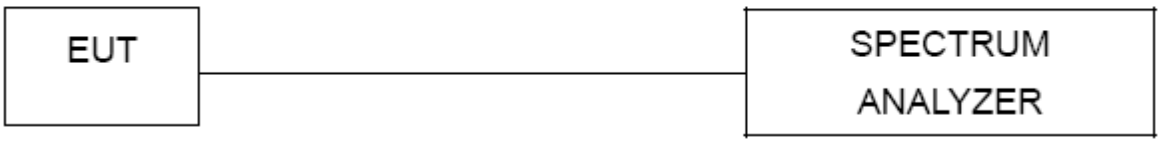
## 6.1 LIMIT

| FCC Part 15.247,Subpart C<br>RSS-247 Issue 2 | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247(e)<br>RSS-247<br>Issue 2 | Power Spectral Density | ≤8 dBm<br>(RBW≥3KHz) | 2400-2483.5 | PASS |

## 6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW to: 100 kHz ≥ RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

## 6.3 TEST SETUP




## 6.4 EUT OPERATION CONDITIONS

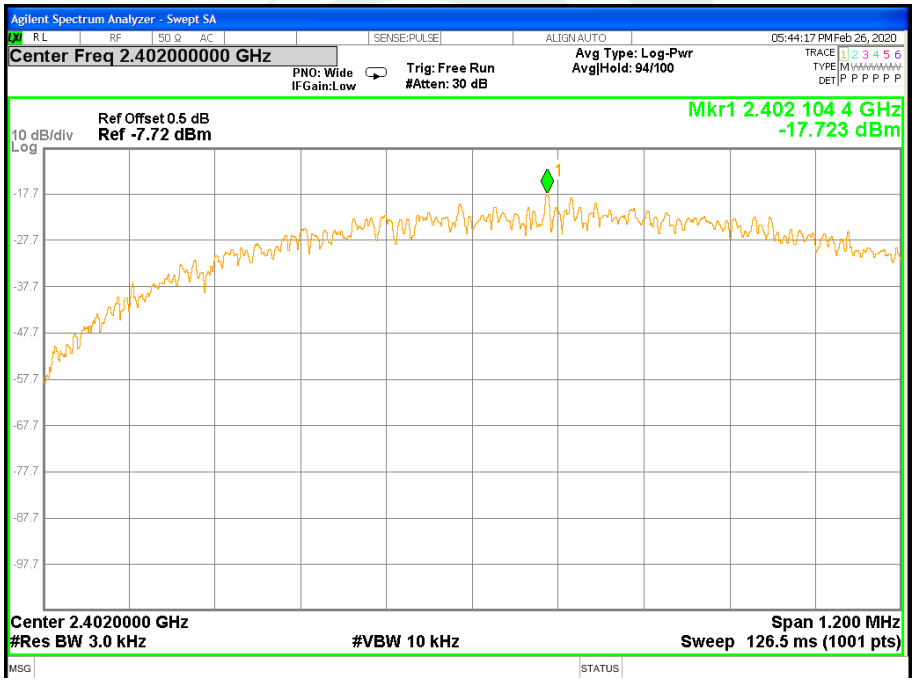
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

## 6.5 TEST RESULTS

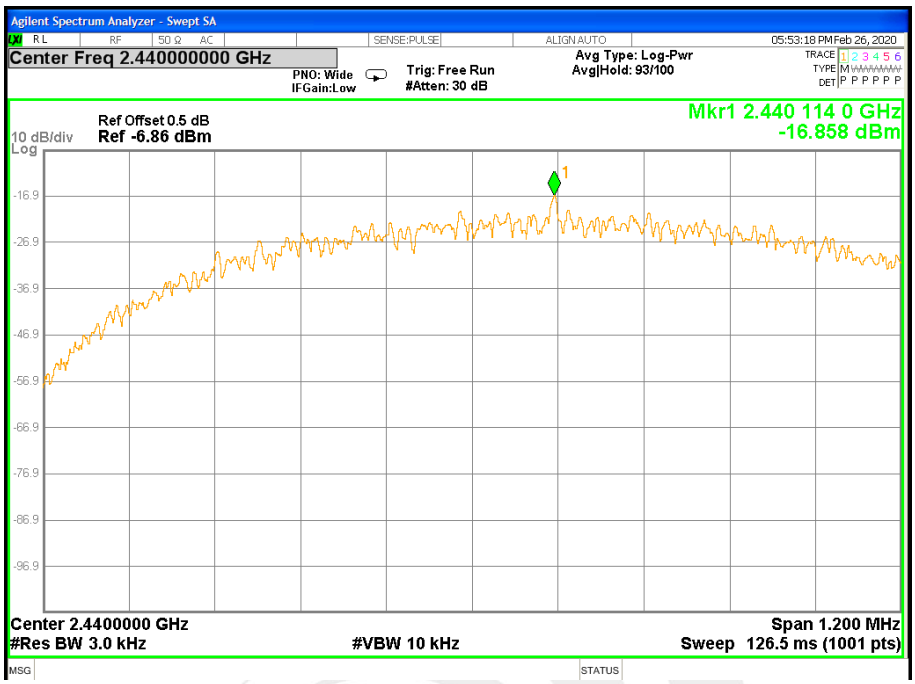
| Temperature: | 25 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Voltage: | DC 3.3V | Test Mode: | TX Mode /CH00, CH19, CH39 |

| Frequency | Power Density (dBm/3kHz) | Limit (dBm/3KHz) | Result |
|---|---|---|---|
| 2402 MHz | -17.723 | ≤8 | PASS |
| 2440 MHz | -16.858 | ≤8 | PASS |
| 2480 MHz | -18.995 | ≤8 | PASS |

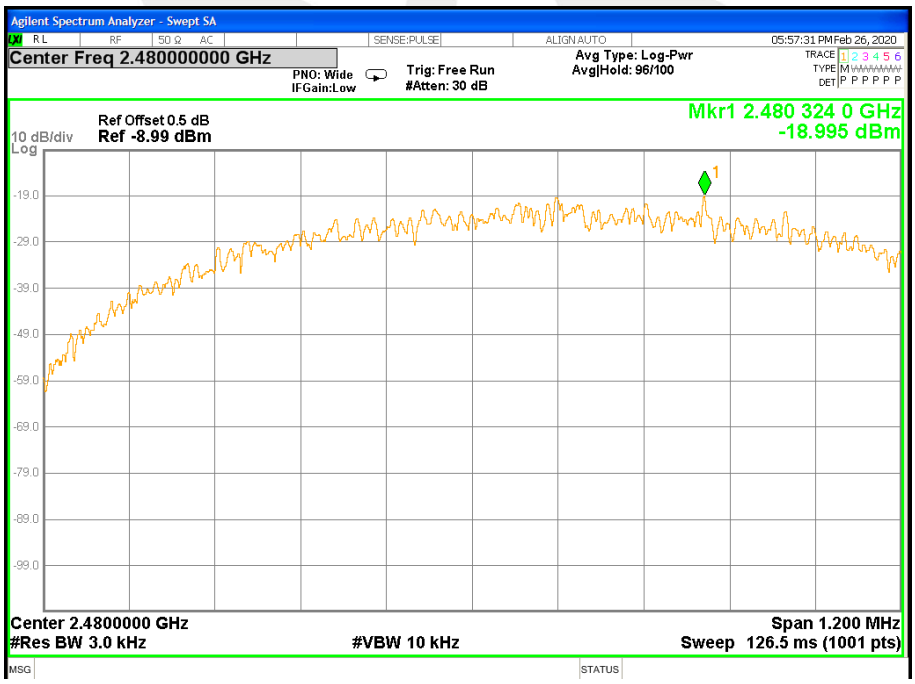
**TX CH00**



## TX CH19




## TX CH39



# 7. BANDWIDTH TEST

## 7.1 LIMIT

| FCC Part 15.247,Subpart C<br>RSS-Gen Clause 6.7 | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247(a)(2)<br>RSS-Gen<br>Clause 6.7 | Bandwidth | >= 500KHz<br>(6dB bandwidth) | 2400-2483.5 | PASS |
| RSS-Gen<br>Clause 6.7 | 99%<br>Bandwidth | For reporting<br>purposes only. | 2400-2483.5 | PASS |

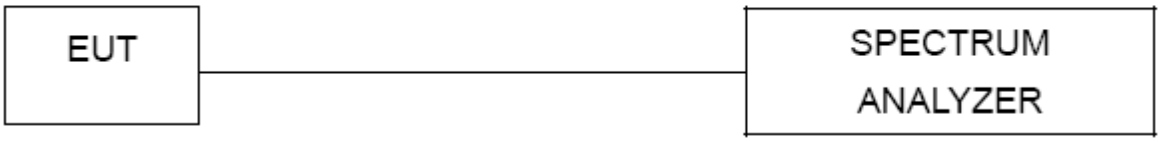
## 7.2 TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

| | |
|---|---|
| Center Frequency | The centre frequency of the channel under test |
| Detector | Peak |
| RBW | For 6 dB Bandwidth :100KHz<br>For 99% Bandwidth :1% to 5% of the occupied bandwidth |
| VBW | For 6dB Bandwidth : ≥3 × RBW<br>For 99% Bandwidth : approximately 3×RBW |
| Trace | Max hold |
| Sweep | Auto |

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

## 7.3 TEST SETUP




## 7.4 EUT OPERATION CONDITIONS

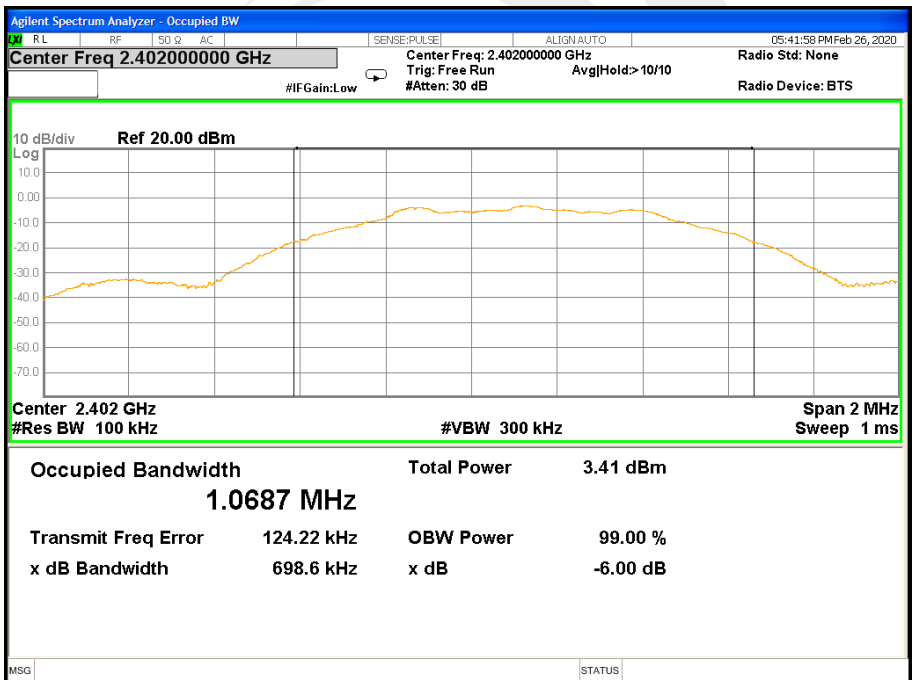
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

7.5 TEST RESULTS

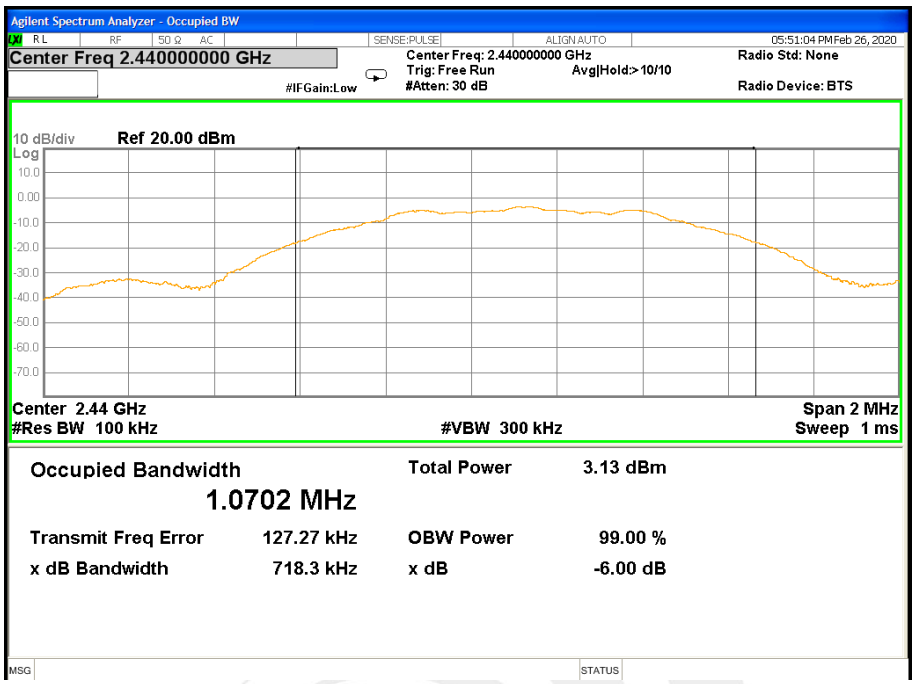
| Temperature: | 25 ℃ | Relative Humidity: | 60% |
|---|---|---|---|
| Test Voltage: | DC 3.3V | Test Mode: | TX Mode /CH00, CH19, CH39 |

| Frequency | 6dB Bandwidth (KHz) | 99% Bandwidth (KHz) | Channel Separation (KHz) | Result |
|---|---|---|---|---|
| 2402 MHz | 698.600 | 10598.000 | ≥500KHz | PASS |
| 2440 MHz | 718.300 | 10601.000 | ≥500KHz | PASS |
| 2480 MHz | 702.800 | 10566.000 | ≥500KHz | PASS |

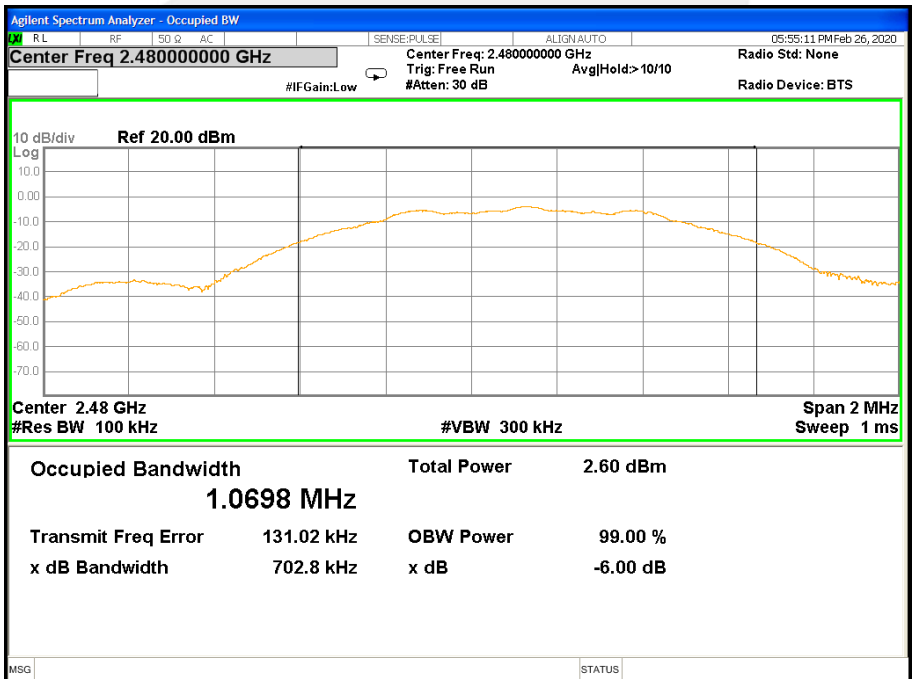
**6dB Bandwidth TX CH 00**



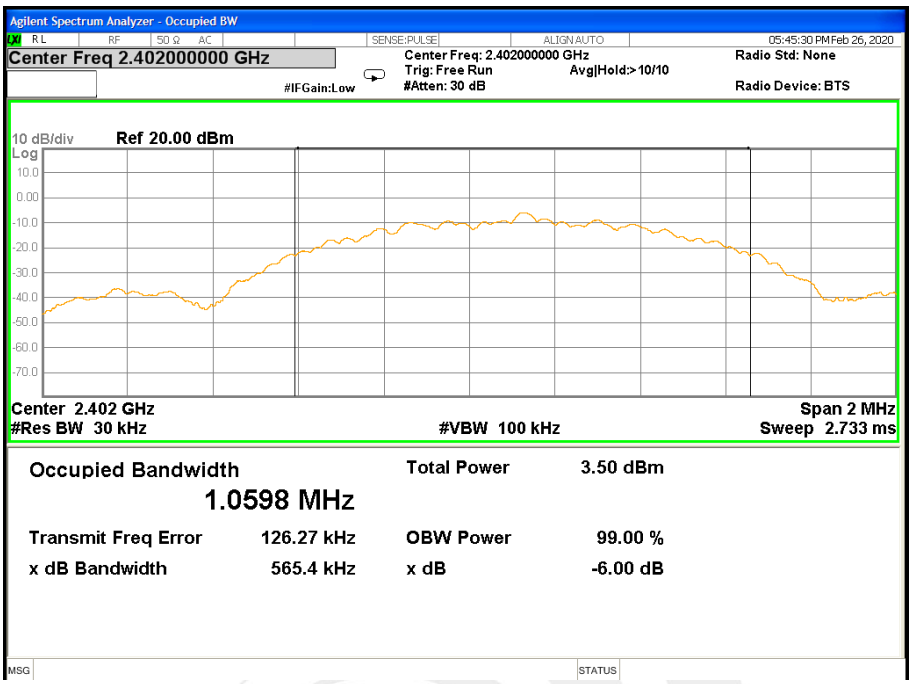
## 6dB Bandwidth TX CH 19



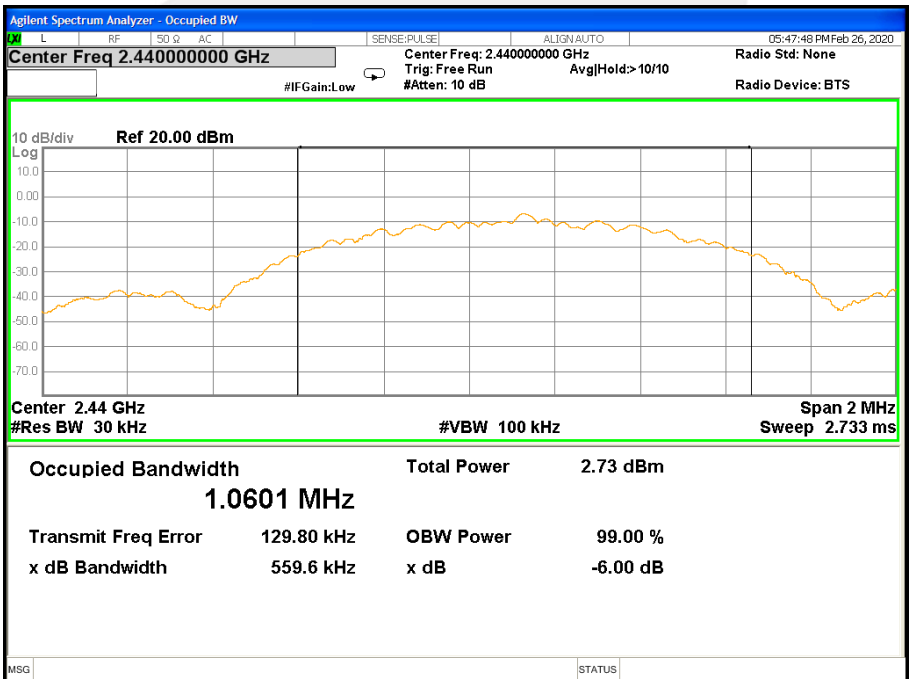

## 6dB Bandwidth TX CH 39



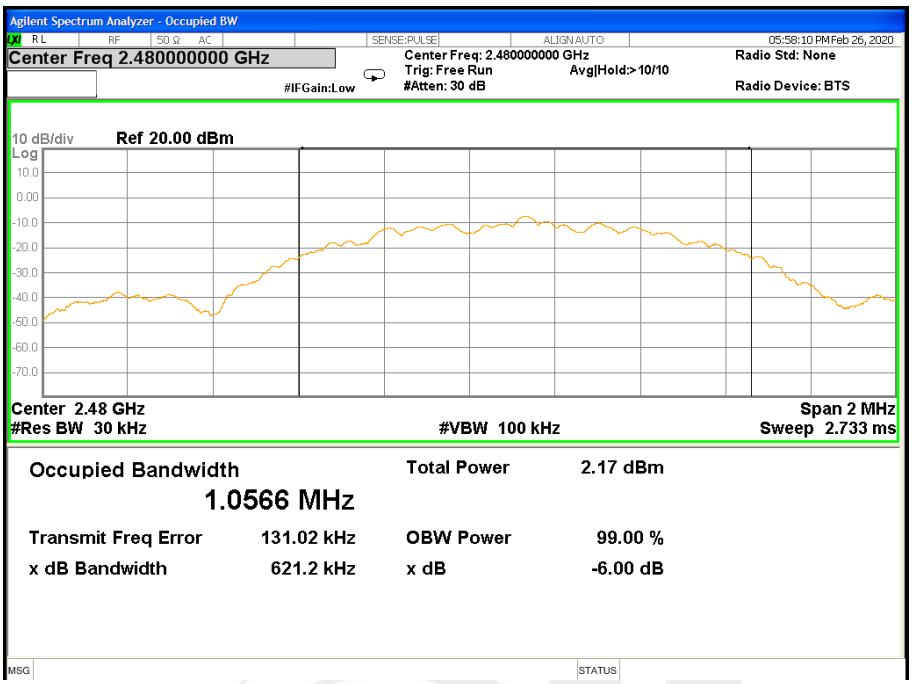
## 99% Bandwidth TX CH 00




## 99% Bandwidth TX CH 19



## 99% Bandwidth TX CH 39



# 8. PEAK OUTPUT POWER TEST

## 8.1 LIMIT

| FCC Part 15.247,Subpart C<br>RSS-247 Issue 2 | | | | |
|---|---|---|---|---|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247(b)(3)<br>RSS 247 Issue 2 | Output Power | 1 watt or 30dBm | 2400-2483.5 | PASS |
| RSS-247 | EIRP | 4W | 2400-2483.5 | PASS |

## 8.2 TEST PROCEDURE

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

Integrated band power method:

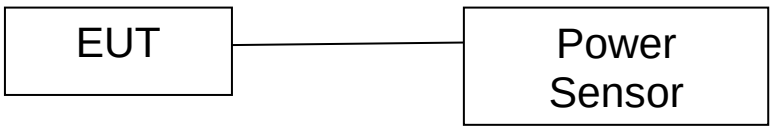
The following procedure can be used when the maximum available RBW of the instrument is less than the
DTS bandwidth:

a) Set the RBW = 1 MHz.
b) Set the VBW ≥ [3 × RBW].
c) Set the span ≥ [1.5 × DTS bandwidth].
d) Detector = peak.
e) Sweep time = auto couple.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use the instrument's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some instruments, this may require a manual override to select the peak detector). If the instrument does not have a band power function, then sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth.

PKPM1 Peak power meter method:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

## 8.3 TEST SETUP




## 8.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

8.5 TEST RESULTS

| | | | |
|---|---|---|---|
| Temperature: | 25 ℃ | Relative Humidity: | 60% |
| Test Voltage: | DC 3.3V | Test Mode: | TX Mode /CH00, CH19, CH39 |

| Test Channe | Frequency | Peak Conducted Output Power | Average Conducted Output Power |
|---|---|---|---|
| | (MHz) | (dBm) | (dBm) |
| CH0 | 2402 | -2.42 | -6.74 |
| CH19 | 2440 | -2.99 | -7.38 |
| CH39 | 2480 | -3.02 | -8.02 |

EIRP Power

| Test Channe | Frequency | Peak Conducted Output Power | Antenna Gain | EIRP Power | LIMIT |
|---|---|---|---|---|---|
| | (MHz) | (dBm) | (dBi) | (dBm) | dBm |
| CH0 | 2402 | -2.42 | 1.30 | -1.12 | 36.00 |
| CH19 | 2440 | -2.99 | 1.30 | -1.69 | 36.00 |
| CH39 | 2480 | -3.02 | 1.30 | -1.72 | 36.00 |

# 9. ANTENNA REQUIREMENT

## 9.1 STANDARD REQUIREMENT

RSS GEN&15.203 requirement: For intentional device, according to RSS GEN&15.203: 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.

## 9.2 EUT ANTENNA

The EUT antenna is Ceramic Antenna. It comply with the standard requirement.

# 10. FREQUENCY STABILITY

## 10.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

The frequency tolerance of the carrier signal shall be maintained within +/-0.02% of the operating frequency over a temperature variation of -30 degrees to 50 degrees C at normal supply voltage,and for a variation in primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees.

## 10.2 TEST PROCEDURE

1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize,turn the EUT on and measure the operating frequency after 2,5,and 10 minutes.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes.The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

## 10.3 TEST RESULT

Channel 19 (2440MHz)

Voltage vs. Frequency Stability

| Voltage(V) | Measurement Frequency(MHz) |
|---|---|
| 3.795 | 2440.0023 |
| 3.3 | 2440.0018 |
| 2.805 | 2440.0019 |
| Max.Deviation(MHz) | 0.0023 |
| Max.Deviation(ppm) | 0.94 |

Rated working voltage: DC 3.3V

Temperature vs. Frequency Stability

| Temperature(℃) | Measurement Frequency(MHz) |
|---|---|
| -30 | 2440.0021 |
| -20 | 2440.0019 |
| -10 | 2440.0016 |
| 0 | 2440.0016 |
| 10 | 2440.0016 |
| 20 | 2440.0013 |
| 30 | 2440.0014 |
| 40 | 2440.0018 |
| 50 | 2440.0019 |
| Max.Deviation(MHz) | 0.0021 |
| Max.Deviation(ppm) | 0.86 |

## 11. EUT TEST PHOTO

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※