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Report Template Version: V04
Report Template Revision Date: 2018-07-06

# TEST REPORT

| | |
|---|---|
| **Report No.:** | CQASZ20200800871E-01 |
| **Applicant:** | IoTree Limited |
| **Address of Applicant:** | Room B2, 4/F, Wah Shing Industrial Building, 18 Cheung Shun Street, Cheung Sha Wan, Hong Kong |
| **Equipment Under Test (EUT):** | |
| **EUT Name:** | IoT Gateway |
| **Model No.:** | ICT-GW001 |
| **Brand Name:** | IoTree |
| **FCC ID:** | 2AW9Y-GW001 |
| **Standards:** | 47 CFR Part 15, Subpart C |
| **Date of Receipt:** | 2020-08-18 |
| **Date of Test:** | 2018-08-18 to 2020-09-01 |
| **Date of Issue:** | 2020-09-01 |
| **Test Result:** | **PASS*** |

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

***Tested By:*** Martin Lee

***( Martin Lee )***

***Reviewed By:*** Sheek. Luo

***( Sheek Luo )***

***Approved By:***

***( Jack Ai )***

The test report is effective only with both signature and specialized stamp, The result(s) shown in this report refer only to the sample(s) tested. Without written approval of CQA, this report can't be reproduced except in full.

# 1 Version

**Revision History Of Report**

| Report No. | Version | Description | Issue Date |
|---|---|---|---|
| CQASZ20200800871E-01 | Rev.01 | Initial report | 2020-09-01 |

# 2 Test Summary

| Test Item | Test Requirement | Test method | Result |
|---|---|---|---|
| Antenna Requirement | 47 CFR Part 15, Subpart C Section 15.203/15.247 (c) | ANSI C63.10 2013 | PASS |
| AC Power Line Conducted Emission | 47 CFR Part 15, Subpart C Section 15.207 | ANSI C63.10 2013 | PASS |
| Conducted Peak Output Power | 47 CFR Part 15, Subpart C Section 15.247 (b)(3) | ANSI C63.10 2013 | PASS |
| 6dB Occupied Bandwidth | 47 CFR Part 15, Subpart C Section 15.247 (a)(2) | ANSI C63.10 2013 | PASS |
| Power Spectral Density | 47 CFR Part 15, Subpart C Section 15.247 (e) | ANSI C63.10 2013 | PASS |
| Band-edge for RF Conducted Emissions | 47 CFR Part 15, Subpart C Section 15.247(d) | ANSI C63.10 2013 | PASS |
| RF Conducted Spurious Emissions | 47 CFR Part 15, Subpart C Section 15.247(d) | ANSI C63.10 2013 | PASS |
| Radiated Spurious Emissions | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 2013 | PASS |
| Restricted bands around fundamental frequency (Radiated Emission) | 47 CFR Part 15, Subpart C Section 15.205/15.209 | ANSI C63.10 2013 | PASS |

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# 4 General Information

## 4.1 Client Information

| | |
|---|---|
| Applicant: | IoTree Limited |
| Address of Applicant: | Room B2, 4/F, Wah Shing Industrial Building, 18 Cheung Shun Street, Cheung Sha Wan, Hong Kong |
| Manufacturer: | Icreatec Limited |
| Address of Manufacturer: | Room 13, 25/F, ONE Midtown, 11 Hoi Shing Road, Tsuen Wan, N.T. Hong Kong |
| Factory: | Icreatec Limited |
| Address of Factory: | Room 13, 25/F, ONE Midtown, 11 Hoi Shing Road, Tsuen Wan, N.T. Hong Kong |

## 4.2 General Description of EUT

| | |
|---|---|
| Product Name: | IoT Gateway |
| Model No.: | ICT-GW001 |
| Trade Mark: | IoTree |
| Hardware Version: | ICT-GW-S-V1.0 |
| Software Version: | ICT-GW-H-V1.0 |
| Operation Frequency: | 2430MHz~2475MHz |
| Channel Numbers: | 10 |
| Channel Separation: | 5MHz |
| Type of Modulation: | O-QPSK |
| Product Type: | ☐ Mobile ☐ Portable ☒ Fix Location |
| Test Software of EUT: | RF Test (manufacturer declare) |
| Antenna Type: | PCB antenna |
| Antenna Gain: | 2.0dBi |
| EUT Power Supply: | DC 5V |

| Operation Frequency each of channel | | | | | | | |
|---|---|---|---|---|---|---|---|
| Channel | Frequency | Channel | Frequency | Channel | Frequency | Channel | Frequency |
| 1 | 2430MHz | 4 | 2445MHz | 7 | 2460MHz | 10 | 2475MHz |
| 2 | 2435MHz | 5 | 2450MHz | 8 | 2465MHz | / | / |
| 3 | 2440MHz | 6 | 2455MHz | 9 | 2470MHz | / | / |

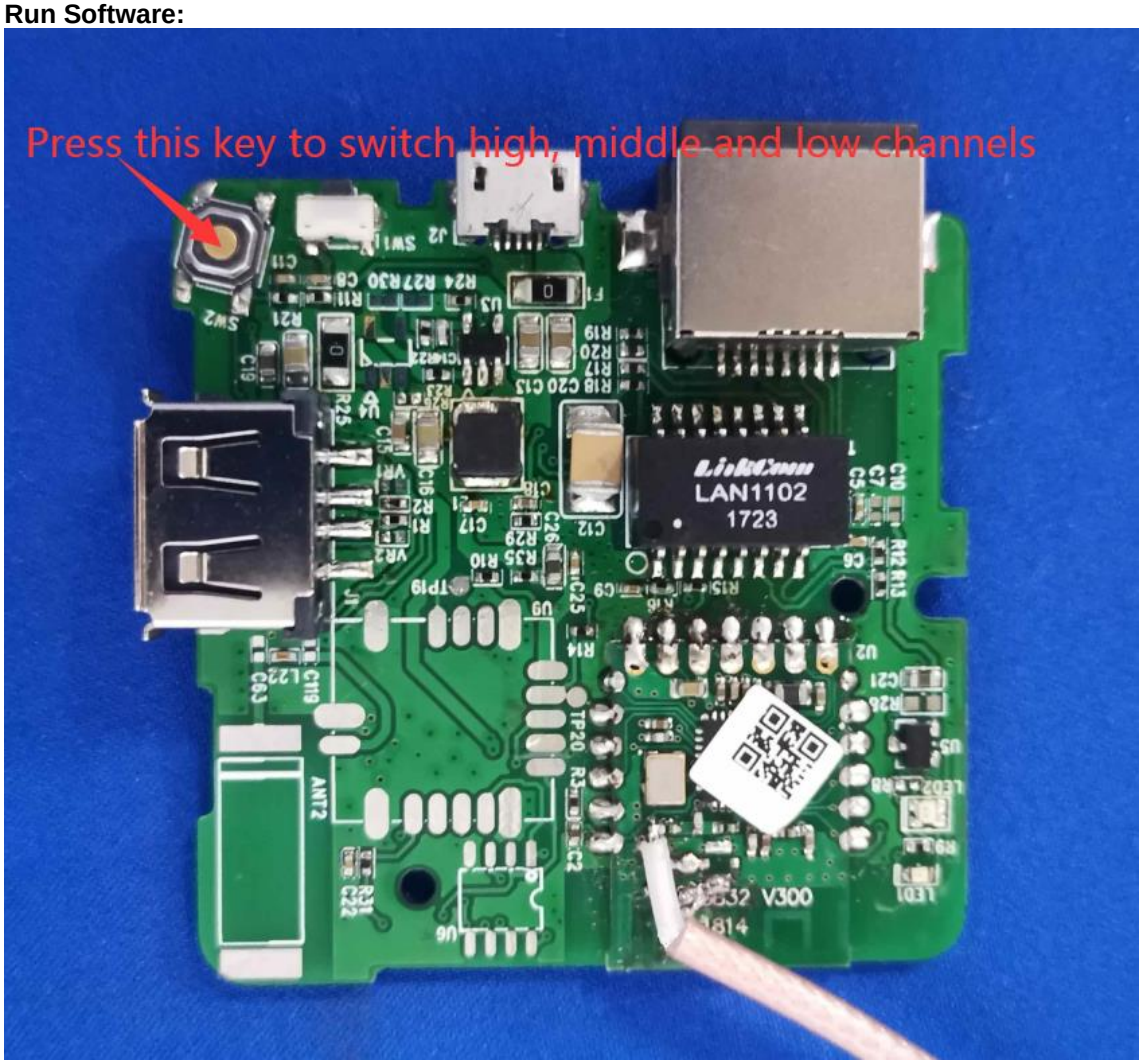
Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

| Channel | Frequency |
|---|---|
| The lowest channel | 2430MHz |
| The middle channel | 2450MHz |
| The highest channel | 2475MHz |

## 4.3 Additional Instructions

| EUT Test Software Settings: | |
|---|---|
| Mode: | ☒Special software is used.<br>☐Through engineering command into the engineering mode.<br>engineering command: *#*#3646633#*#* |
| Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT. | |

**Run Software:**



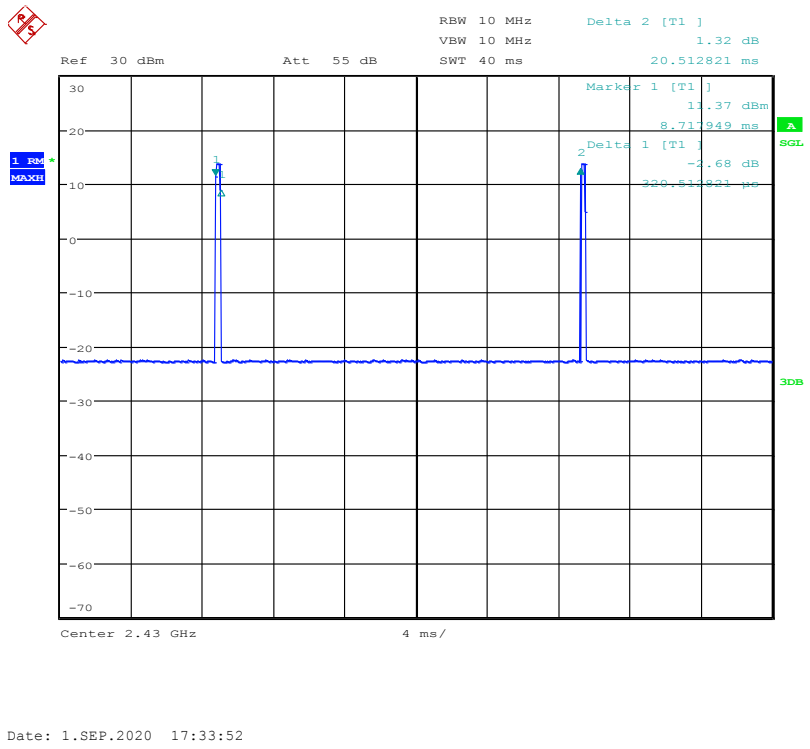
| Operated Mode for Worst Duty Cycle: | | |
|---|---|---|
| Test Mode | Duty Cycle(x) | Average correction factor(dB) |
| O-QPSK | 1.56% | 18.07 |
| **Power Level:** | | |
| The lowest channel | 17 dBm | |
| The middle channel | 16 dBm | |
| The highest channel | 17 dBm | |

**Remark:**

1) Duty cycle= On Time/ Period;

2) Duty Cycle factor = 10 * log(1/ Duty cycle);

Test Graph_Duty Cycle:



## 4.4 Test Environment

| | |
|---|---|
| **Operating Environment:** | |
| **Radiated Emissions:** | |
| Temperature: | 25.6 °C |
| Humidity: | 56 % RH |
| Atmospheric Pressure: | 1009 mbar |
| **Conducted Emissions:** | |
| Temperature: | 25.6 °C |
| Humidity: | 56 % RH |
| Atmospheric Pressure: | 1009 mbar |
| **Radio conducted item test (RF Conducted test room):** | |
| Temperature: | 25.4 °C |
| Humidity: | 70 % RH |
| Atmospheric Pressure: | 1009 mbar |
| **Test mode:** | |
| Transmitting mode: | Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT. |

## 4.5 Description of Support Units

The EUT has been tested with associated equipment below.

1）Support equipment

| Description | Manufacturer | Model No. | Certification | Supplied by |
|---|---|---|---|---|
| Adapter | HUAWEI | LPL-C010050200Z | DOC | CQA |

2) Cable

| Cable No. | Description | Manufacturer | Cable Type/Length | Supplied by |
|---|---|---|---|---|
| / | / | / | / | / |

## 4.6 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the **Shenzhen Huaxia Testing Technology Co., Ltd.** quality system acc. to DIN EN ISO/IEC 17025.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQA laboratory is reported:

| No. | Item | Uncertainty | Notes |
|---|---|---|---|
| 1 | Radiated Emission (Below 1GHz) | 5.12dB | (1) |
| 2 | Radiated Emission (Above 1GHz) | 4.60dB | (1) |
| 3 | Conducted Disturbance (0.15~30MHz) | 3.34dB | (1) |
| 4 | Radio Frequency | $3\times10^{-8}$ | (1) |
| 5 | Duty cycle | 0.6 %. | (1) |
| 6 | Occupied Bandwidth | 1.1% | (1) |
| 7 | RF conducted power | 0.86dB | (1) |
| 8 | RF power density | 0.74 | (1) |
| 9 | Conducted Spurious emissions | 0.86dB | (1) |
| 10 | Temperature test | 0.8℃ | (1) |
| 11 | Humidity test | 2.0% | (1) |
| 12 | Supply voltages | 0.5 %. | (1) |
| 13 | Frequency Error | 5.5 Hz | (1) |

(1)This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

## 4.7 Test Location

**Shenzhen Huaxia Testing Technology Co., Ltd,**

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua District, Shenzhen, China

## 4.8 Test Facility

- **A2LA (Certificate No. 4742.01)**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

- **FCC Registration No.: 522263**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.:522263

## 4.9 Deviation from Standards

None.

## 4.10 Other Information Requested by the Customer

None.

## 4.11Equipment List

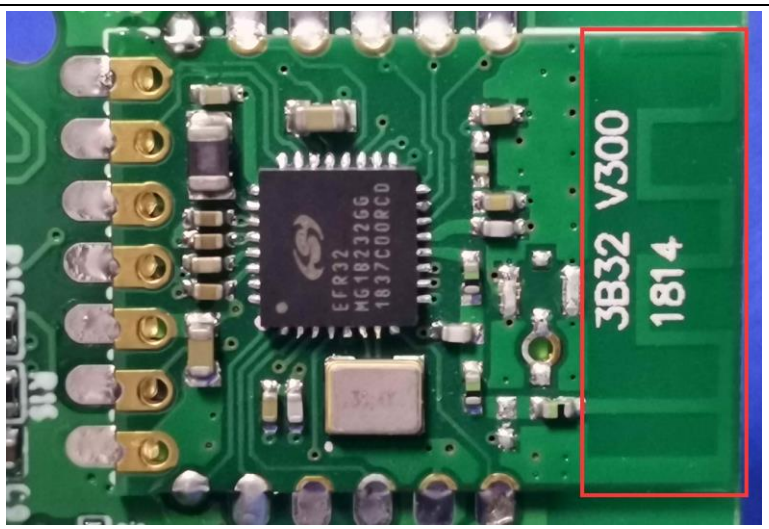
| Test Equipment | Manufacturer | Model No. | Instrument No. | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| EMI Test Receiver | R&S | ESR7 | CQA-005 | 2019/10/25 | 2020/10/24 |
| Spectrum analyzer | R&S | FSU26 | CQA-038 | 2019/10/25 | 2020/10/24 |
| Preamplifier | MITEQ | AMF-6D-02001800-29-20P | CQA-036 | 2019/10/25 | 2020/10/24 |
| Loop antenna | Schwarzbeck | FMZB1516 | CQA-060 | 2019/10/21 | 2020/10/20 |
| Bilog Antenna | R&S | HL562 | CQA-011 | 2019/9/26 | 2020/9/25 |
| Horn Antenna | R&S | HF906 | CQA-012 | 2019/9/26 | 2020/9/25 |
| Horn Antenna | Schwarzbeck | BBHA 9170 | CQA-088 | 2019/9/25 | 2020/9/24 |
| Coaxial Cable (Above 1GHz) | CQA | N/A | C007 | 2019/9/26 | 2020/9/25 |
| Coaxial Cable (Below 1GHz) | CQA | N/A | C013 | 2019/9/26 | 2020/9/25 |
| Antenna Connector | CQA | RFC-01 | CQA-080 | 2019/9/26 | 2020/9/25 |
| RF cable(9KHz~40GHz) | CQA | RF-01 | CQA-079 | 2019/9/26 | 2020/9/25 |
| Power divider | MIDWEST | PWD-2533-02-SMA-79 | CQA-067 | 2019/9/26 | 2020/9/25 |
| EMI Test Receiver | R&S | ESR7 | CQA-005 | 2019/10/25 | 2020/10/24 |
| LISN | R&S | ENV216 | CQA-003 | 2019/10/23 | 2020/10/22 |
| Coaxial cable | CQA | N/A | CQA-C009 | 2019/9/26 | 2020/9/25 |
| DC power | KEYSIGHT | E3631A | CQA-028 | 2019/9/26 | 2020/9/25 |

Note:

The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

# 5 Test results and Measurement Data

## 5.1 Antenna Requirement

| **Standard requirement:** | 47 CFR Part 15C Section 15.203 /247(c) |
|---|---|
| 15.203 requirement:<br>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 a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.<br>15.247(b) (4) requirement:<br>The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi. | |
| **EUT Antenna:** |  |
| The antenna is PCB antenna. The best case gain of the antenna is 2.0dBi. | |

## 5.2 Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.207 |
| Test Method: | ANSI C63.10: 2013 |
| Test Frequency Range: | 150kHz to 30MHz |
| Limit: | |

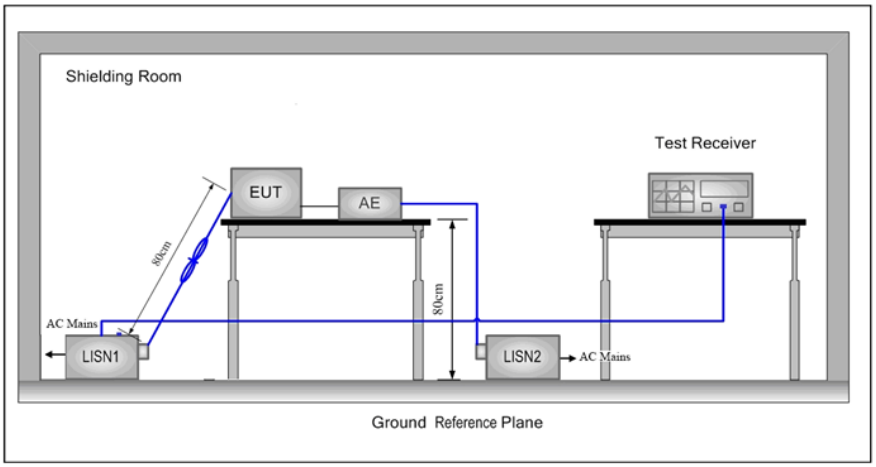
| Frequency range (MHz) | Limit (dBuV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency.

**Test Procedure:**

1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane.
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

**Test Setup:**

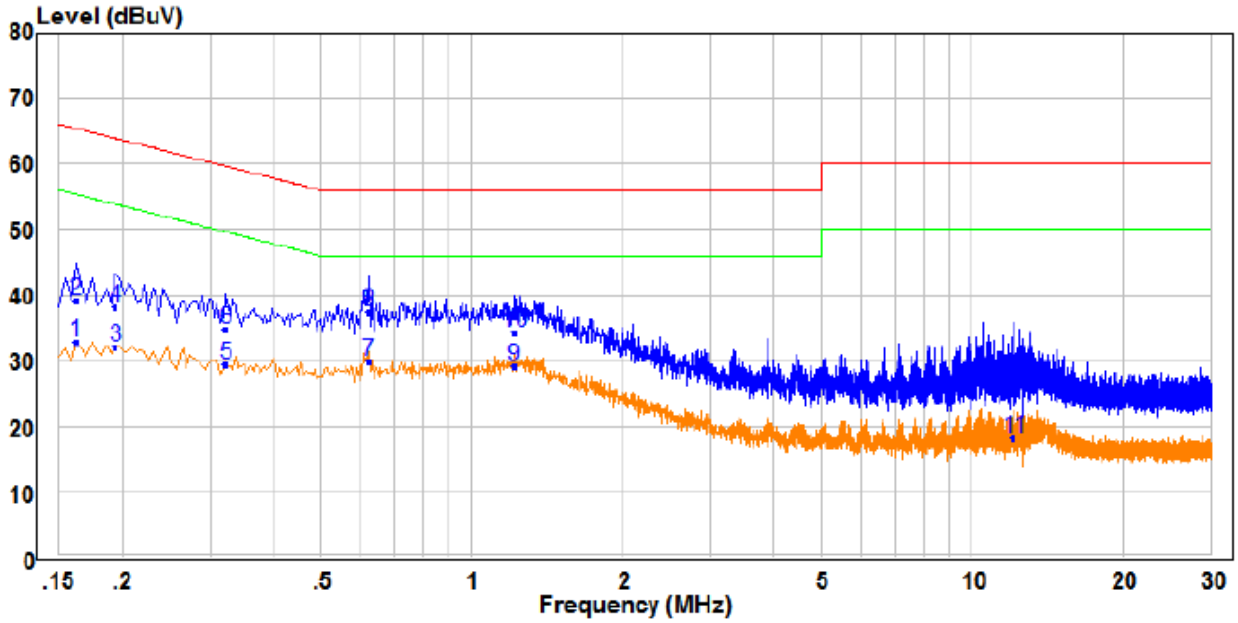



| | |
|---|---|
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Final Test Mode: | Through Pre-scan, find at lowest channel is the worst case. |

| | |
|---|---|
| | Only the worst case is recorded in the report. |
| Test voltage: | 120V60Hz |
| Test Results: | Pass |

**Measurement Data**

Live line:




| | | Freq | Read Level | Factor | Level | Limit Line | Over Limit | Remark | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | | |
| 1 | | 0.162 | 23.24 | 9.49 | 32.73 | 55.36 | -22.63 | Average | Line |
| 2 | | 0.162 | 29.75 | 9.49 | 39.24 | 65.36 | -26.12 | QP | Line |
| 3 | | 0.194 | 22.71 | 9.49 | 32.20 | 53.86 | -21.66 | Average | Line |
| 4 | | 0.194 | 28.82 | 9.49 | 38.31 | 63.86 | -25.55 | QP | Line |
| 5 | | 0.322 | 19.92 | 9.49 | 29.41 | 49.66 | -20.25 | Average | Line |
| 6 | | 0.322 | 25.31 | 9.49 | 34.80 | 59.66 | -24.86 | QP | Line |
| 7 | PP | 0.622 | 20.22 | 9.74 | 29.96 | 46.00 | -16.04 | Average | Line |
| 8 | QP | 0.622 | 27.81 | 9.74 | 37.55 | 56.00 | -18.45 | QP | Line |
| 9 | | 1.214 | 19.75 | 9.53 | 29.28 | 46.00 | -16.72 | Average | Line |
| 10 | | 1.214 | 24.77 | 9.53 | 34.30 | 56.00 | -21.70 | QP | Line |
| 11 | | 12.097 | 8.49 | 9.85 | 18.34 | 50.00 | -31.66 | Average | Line |
| 12 | | 12.097 | 16.39 | 9.85 | 26.24 | 60.00 | -33.76 | QP | Line |

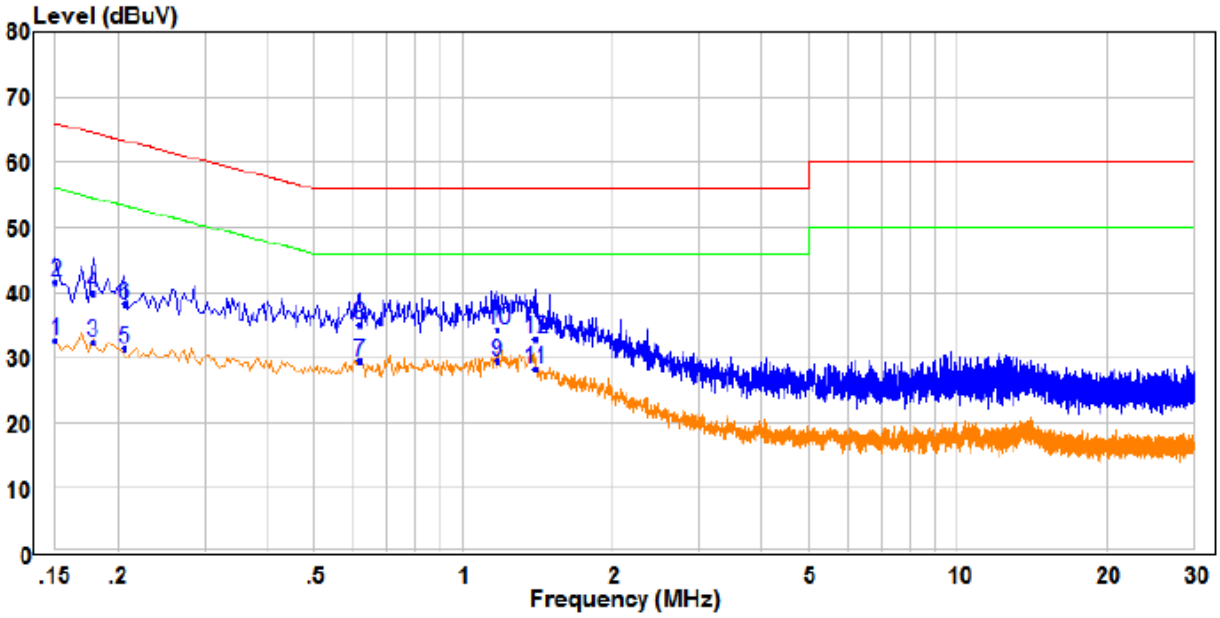
Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:

2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:

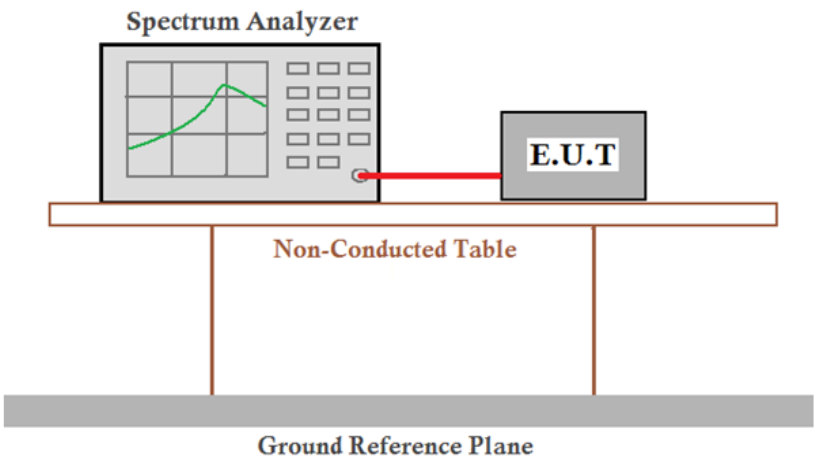



| | | Freq | Read Level | Factor | Level | Limit Line | Over Limit | Remark | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | | |
| 1 | | 0.150 | 23.23 | 9.48 | 32.71 | 56.00 | -23.29 | Average | Neutral |
| 2 | | 0.150 | 32.03 | 9.48 | 41.51 | 66.00 | -24.49 | QP | Neutral |
| 3 | | 0.178 | 22.96 | 9.48 | 32.44 | 54.58 | -22.14 | Average | Neutral |
| 4 | | 0.178 | 30.47 | 9.48 | 39.95 | 64.58 | -24.63 | QP | Neutral |
| 5 | | 0.206 | 21.86 | 9.48 | 31.34 | 53.37 | -22.03 | Average | Neutral |
| 6 | | 0.206 | 28.71 | 9.48 | 38.19 | 63.37 | -25.18 | QP | Neutral |
| 7 | PP | 0.618 | 19.75 | 9.74 | 29.49 | 46.00 | -16.51 | Average | Neutral |
| 8 | QP | 0.618 | 25.17 | 9.74 | 34.91 | 56.00 | -21.09 | QP | Neutral |
| 9 | | 1.170 | 19.72 | 9.72 | 29.44 | 46.00 | -16.56 | Average | Neutral |
| 10 | | 1.170 | 24.69 | 9.72 | 34.41 | 56.00 | -21.59 | QP | Neutral |
| 11 | | 1.398 | 18.58 | 9.72 | 28.30 | 46.00 | -17.70 | Average | Neutral |
| 12 | | 1.398 | 23.17 | 9.72 | 32.89 | 56.00 | -23.11 | QP | Neutral |

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

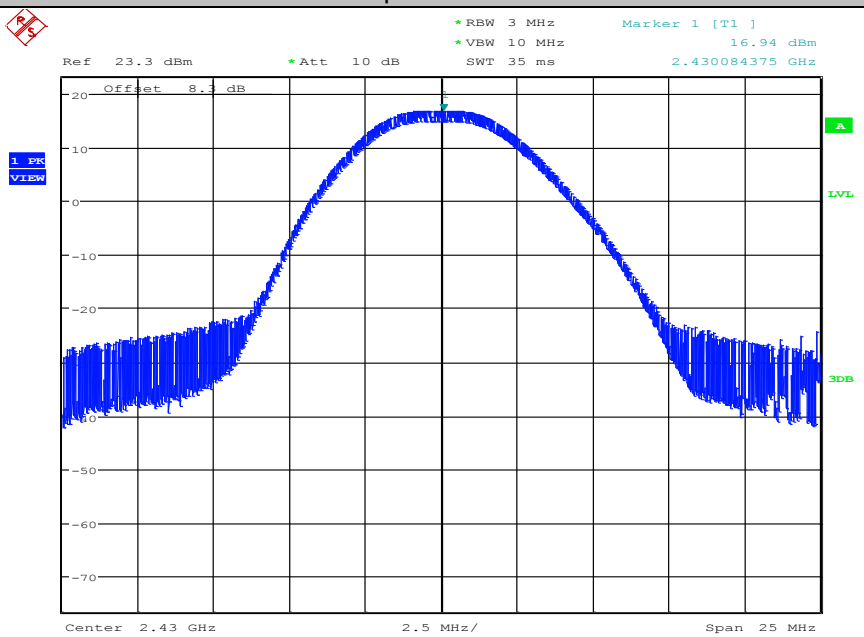
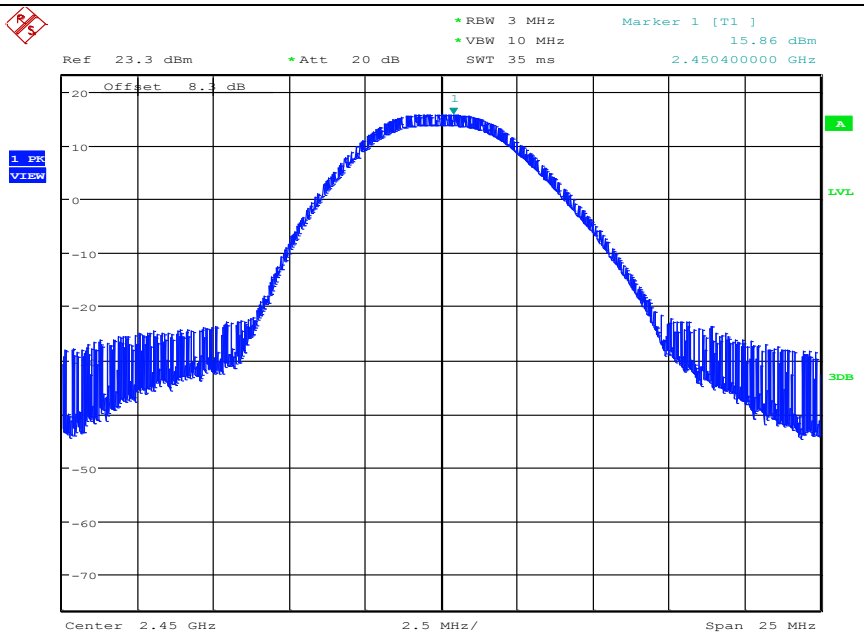
## 5.3 Conducted Peak Output Power

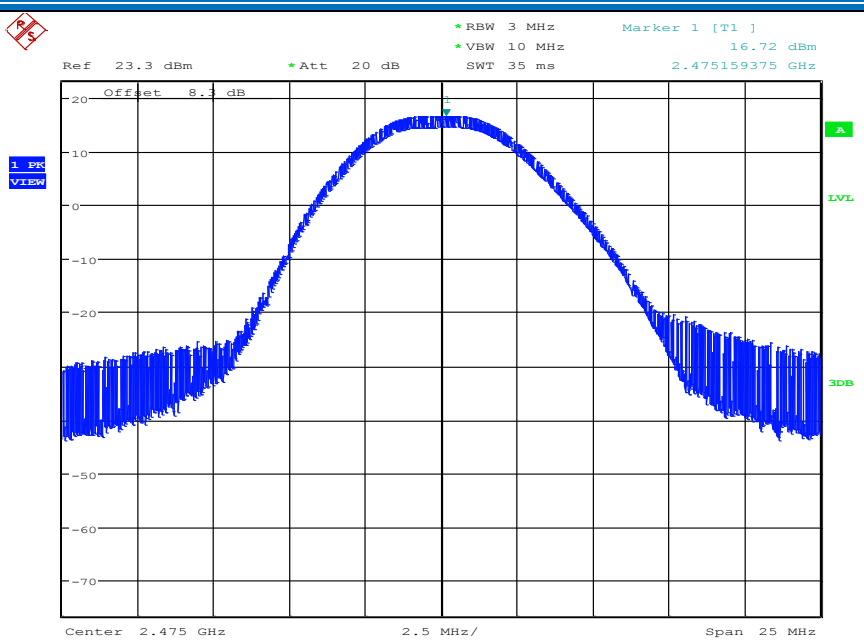
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (b)(1) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>*Remark: Offset=Cable loss+ attenuation factor.* |
| Limit: | 30dBm |
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Test Results: | Pass |

**Measurement Data**

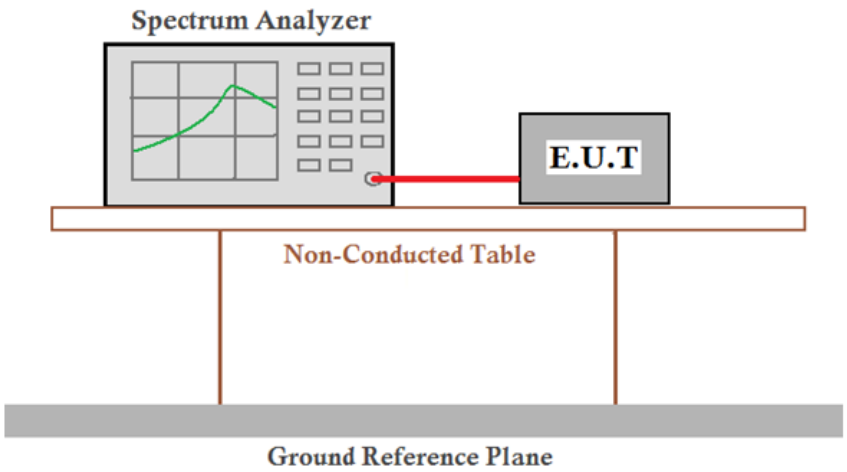
| O-QPSK mode | | | |
|---|---|---|---|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 16.94 | 30.00 | Pass |
| Middle | 15.86 | 30.00 | Pass |
| Highest | 16.72 | 30.00 | Pass |

**Test plot as follows:**

| Graphs | |
|---|---|
| LCH |  <br>Date: 31.AUG.2020 14:18:15 |
| MCH |  <br>Date: 31.AUG.2020 14:49:46 |

| | |
|---|---|
| HCH |  RBW 3 MHz<br>VBW 10 MHz<br>SWT 35 ms<br>Marker 1 [T1 ]<br>16.72 dBm<br>2.475159375 GHz<br>Ref 23.3 dBm<br>Att 20 dB<br>Offset 8.3 dB<br>1 PK VIEW<br>A<br>LVL<br>3DB<br>20<br>10<br>0<br>-10<br>-20<br>-50<br>-60<br>-70<br>Center 2.475 GHz<br>2.5 MHz/<br>Span 25 MHz<br>Date: 31.AUG.2020 15:07:28 |

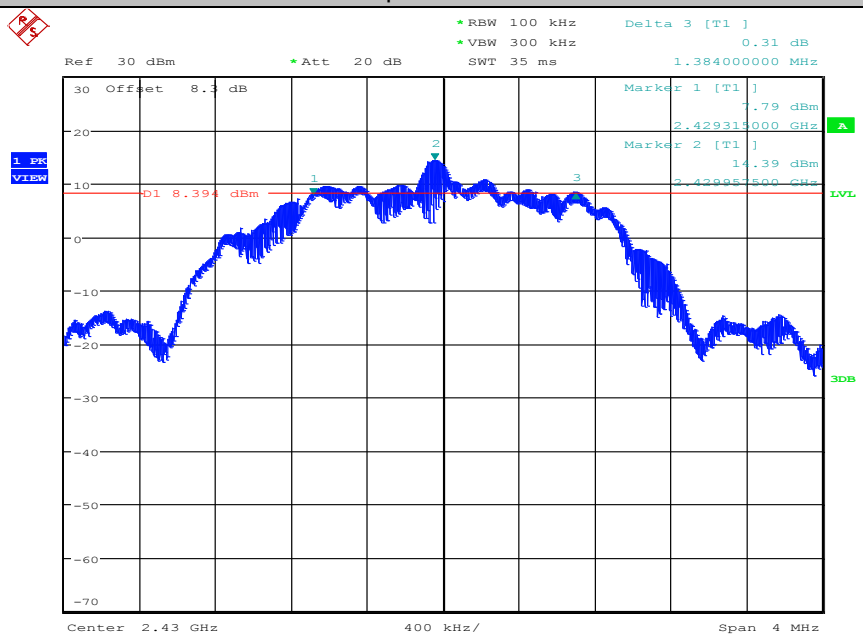
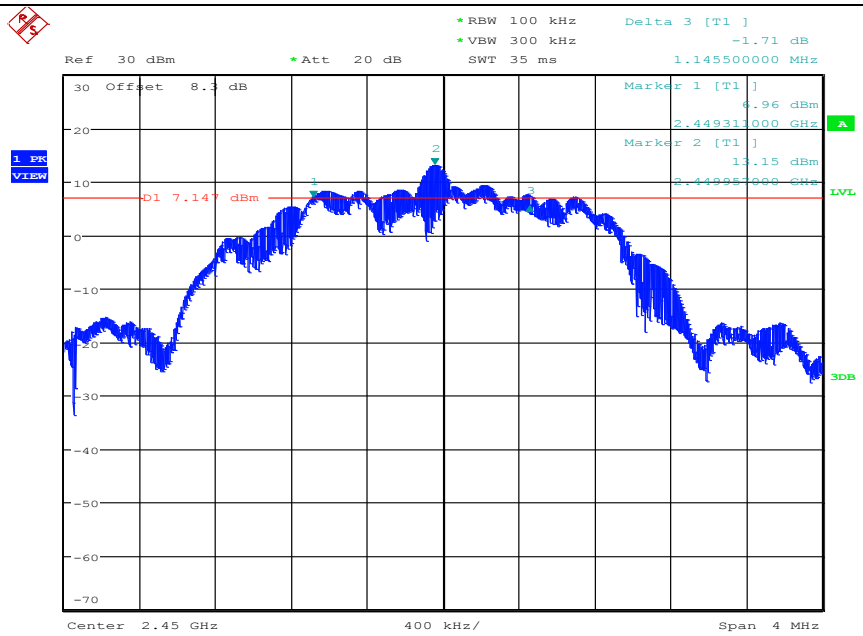
## 5.4 6dB Occupy Bandwidth

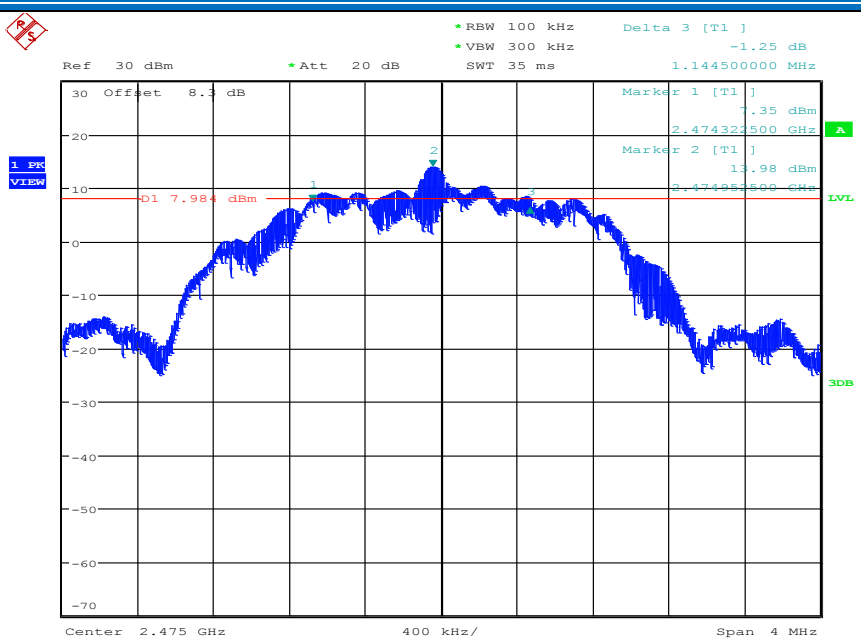
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (a)(2) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>*Remark: Offset=Cable loss+ attenuation factor.* |
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Limit: | ≥ 500 kHz |
| Test Results: | Pass |

**Measurement Data**

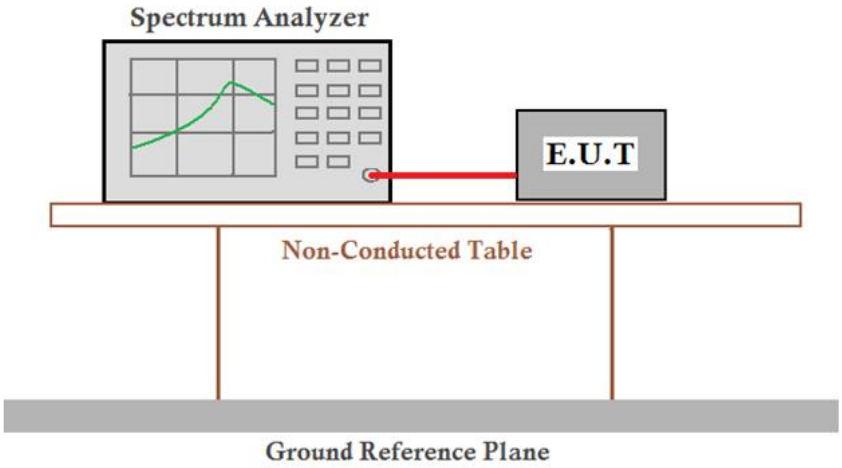
| O-QPSK mode | | | |
|---|---|---|---|
| Test channel | 6dB Occupy Bandwidth (MHz) | Limit (MHz) | Result |
| Lowest | 1.384 | ≥0.5 | Pass |
| Middle | 1.145 | ≥0.5 | Pass |
| Highest | 1.144 | ≥0.5 | Pass |

**Test plot as follows:**

| Graphs | |
|---|---|
| LCH |  <br>Date: 31.AUG.2020 14:11:05 |
| MCH |  <br>Date: 31.AUG.2020 14:43:15 |

| | |
|---|---|
| HCH |  <br>Date: 31.AUG.2020 15:01:14 |

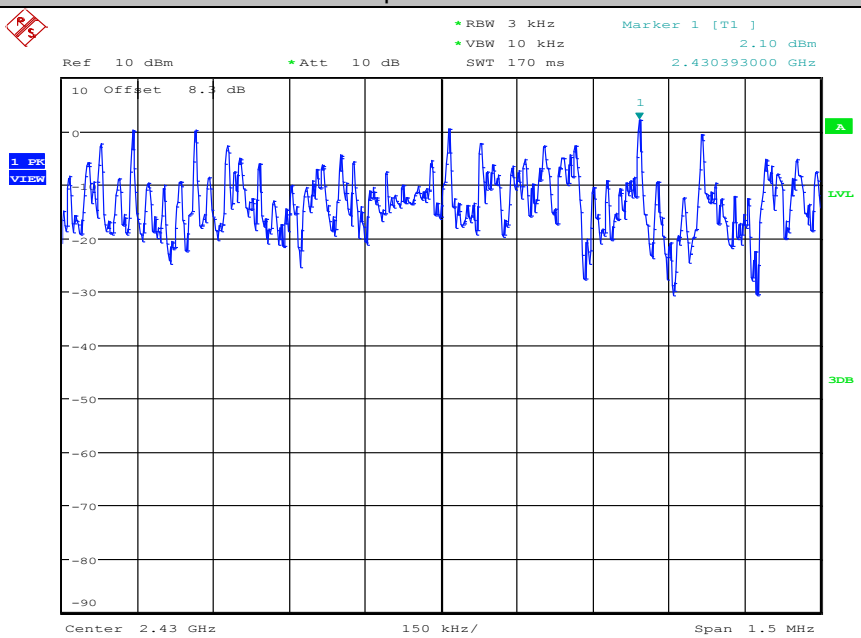
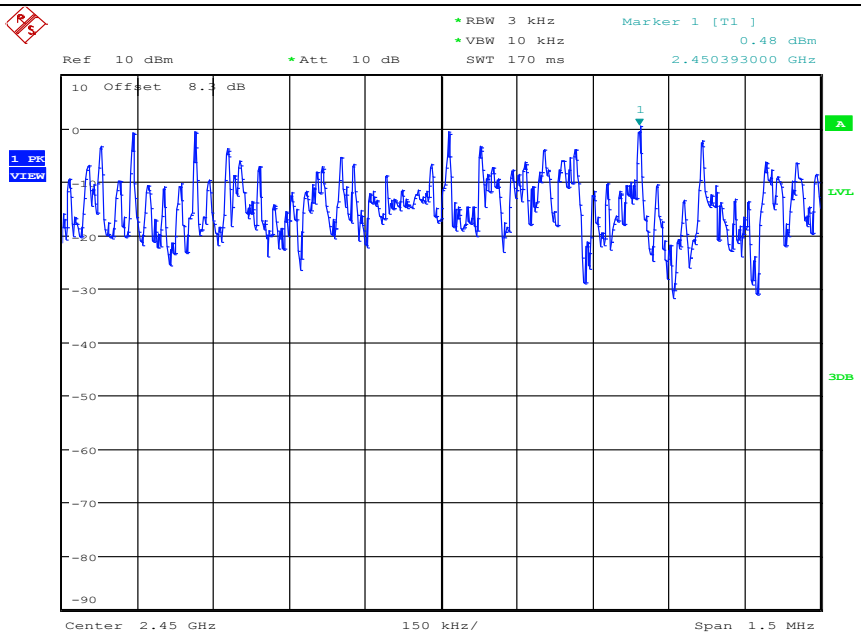
## 5.5 Power Spectral Density

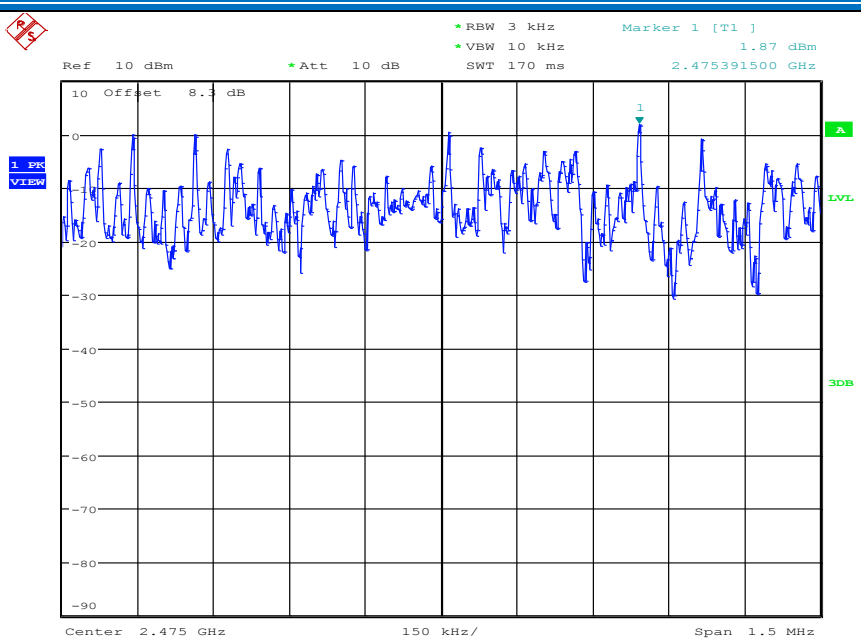
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (e) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>*Remark: Offset=Cable loss+ attenuation factor.* |
| Limit: | ≤8.00dBm/3kHz |
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Test Results: | Pass |

**Measurement Data**

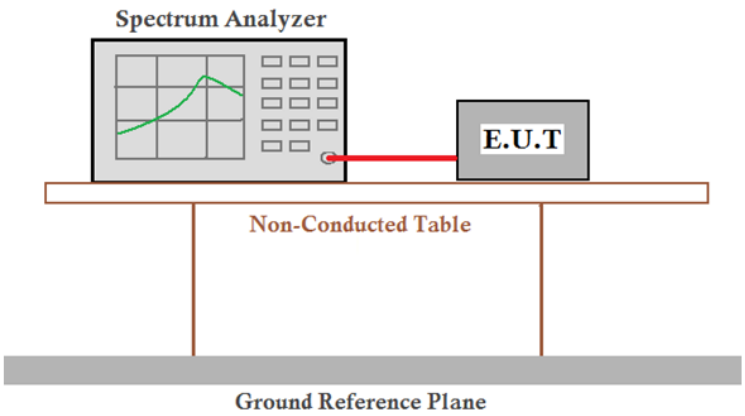
| O-QPSK mode | | | |
|---|---|---|---|
| Test channel | Power Spectral Density (dBm/3kHz) | Limit (dBm/3kHz) | Result |
| Lowest | 2.100 | ≤8.00 | Pass |
| Middle | 0.480 | ≤8.00 | Pass |
| Highest | 1.870 | ≤8.00 | Pass |

**Test plot as follows:**

| Graphs | |
|---|---|
| LCH |  <br>Date: 31.AUG.2020 14:23:12 |
| MCH |  <br>Date: 31.AUG.2020 14:51:03 |

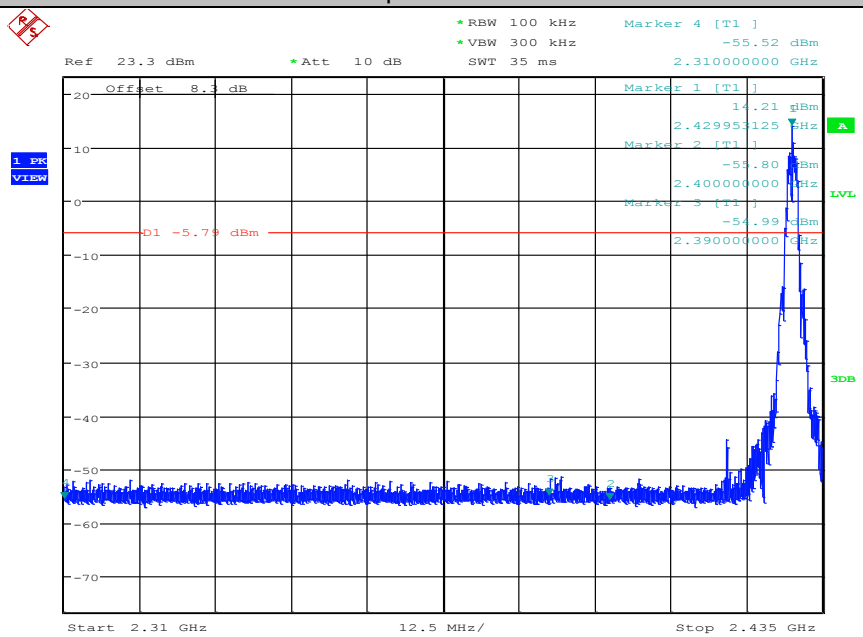
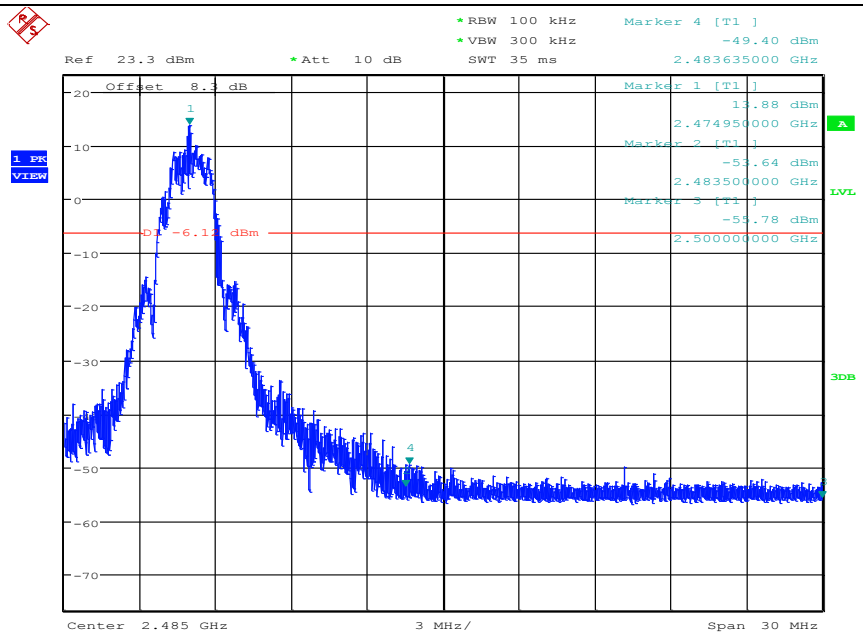
| | |
|---|---|
| HCH |  <br>Date: 31.AUG.2020 15:10:29 |

## 5.6 Band-edge for RF Conducted Emissions

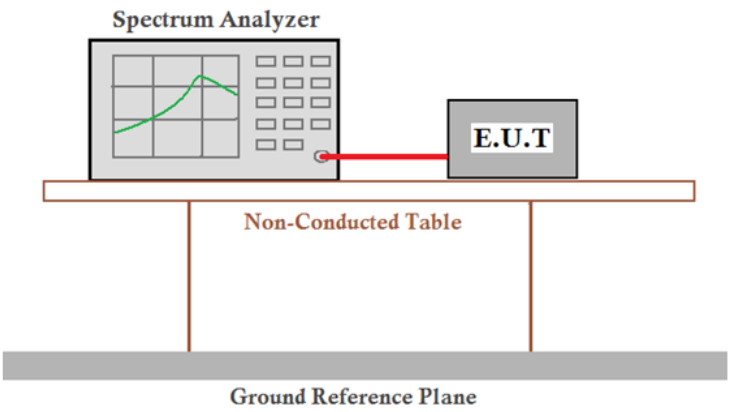
| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>*Remark: Offset=Cable loss+ attenuation factor.* |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. |
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Test Results: | Pass |

| O-QPSK mode | | | | |
|---|---|---|---|---|
| Test channel | Frequency(MHz) | Emission Level(dBm) | Limit(dBm) | Result |
| Lowest | 2400 | -55.800 | -5.79 | Pass |
| Highest | 2483.5 | -53.640 | -6.12 | Pass |

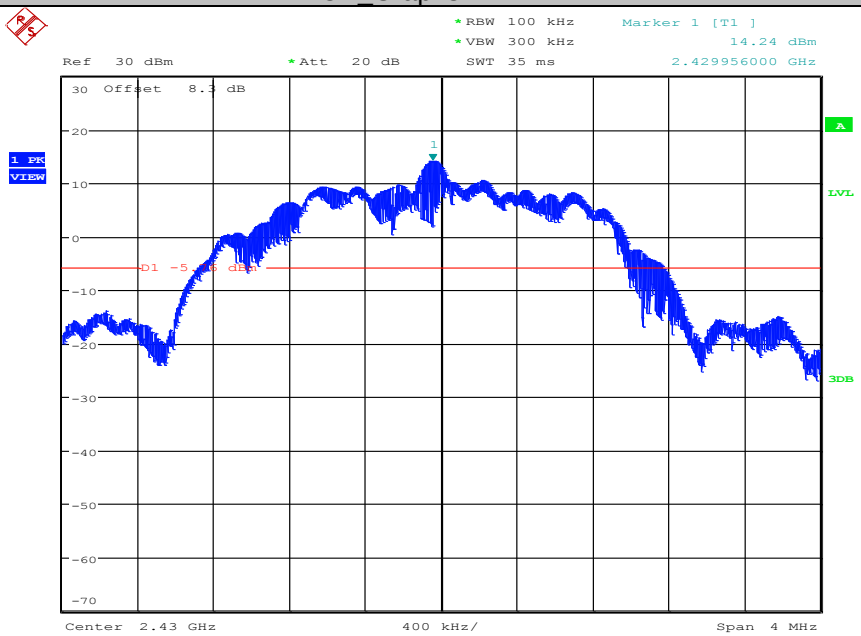
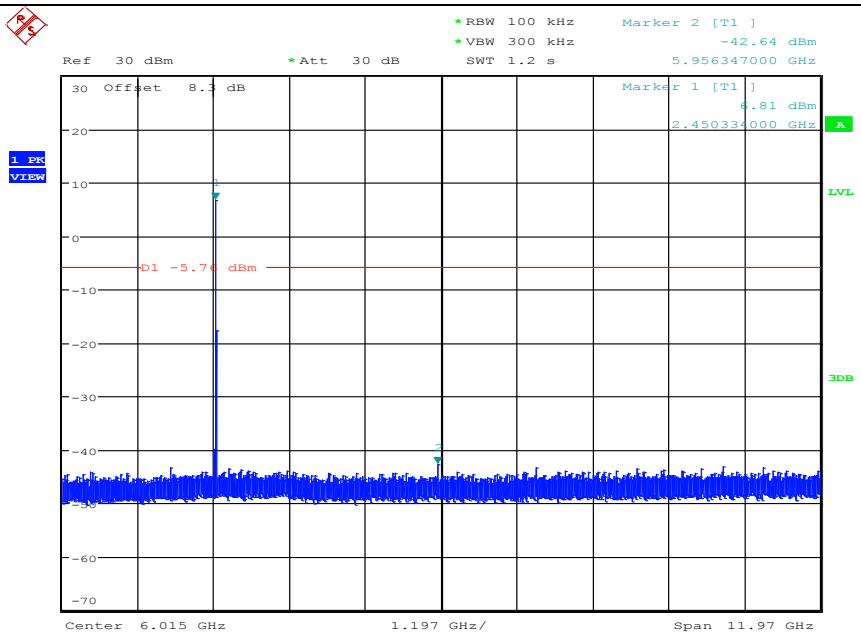
**Test plot as follows:**

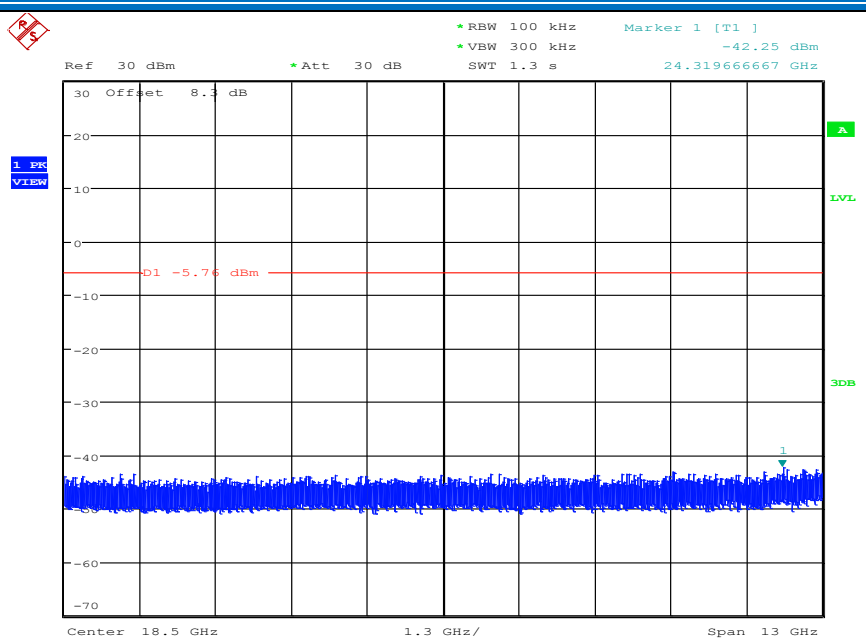
| Graphs | |
|---|---|
| LCH |  <br>Date: 31.AUG.2020 14:32:09 |
| HCH |  <br>Date: 31.AUG.2020 15:13:03 |

## 5.7 Spurious RF Conducted Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.247 (d) |
| Test Method: | ANSI C63.10 2013 |
| Test Setup: |  <br>*Remark: Offset=Cable loss+ attenuation factor.* |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. |
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Test Results: | Pass |

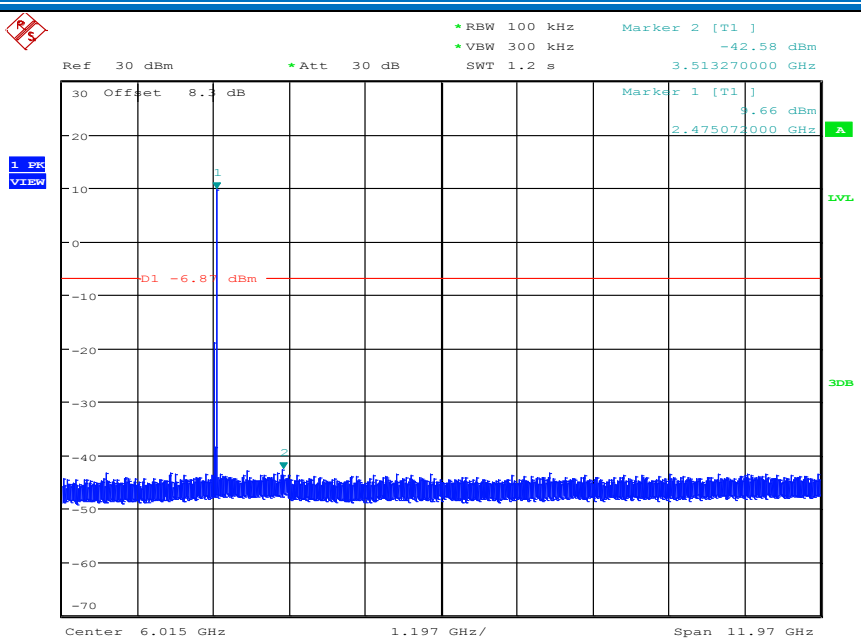
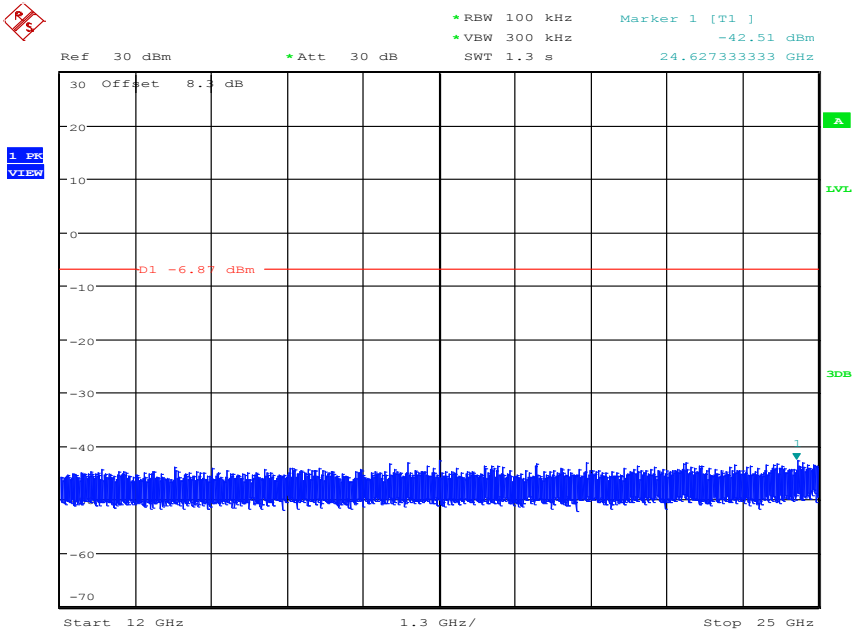
**Test plot as follows:**

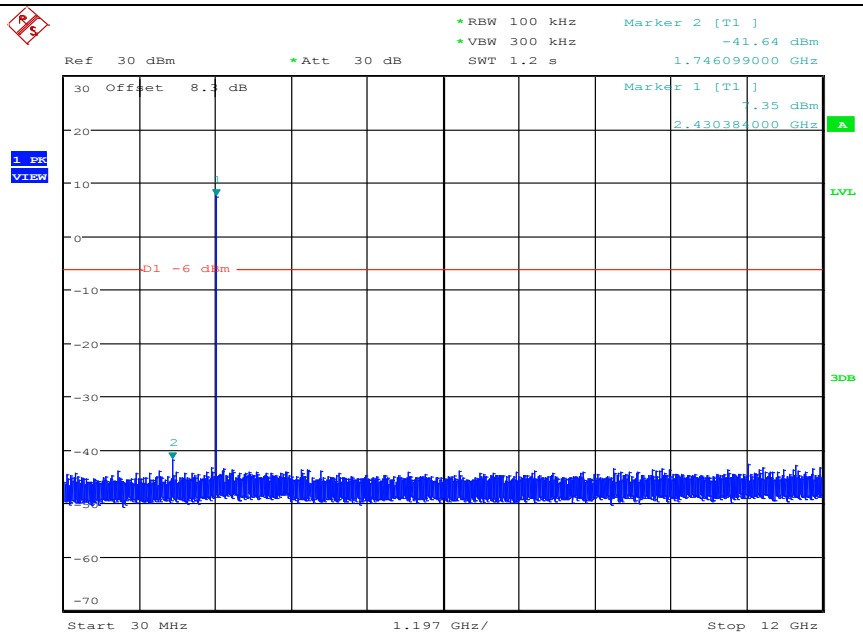
| LCH_Graphs | |
|---|---|
| LCH |  |
| LCH |  |

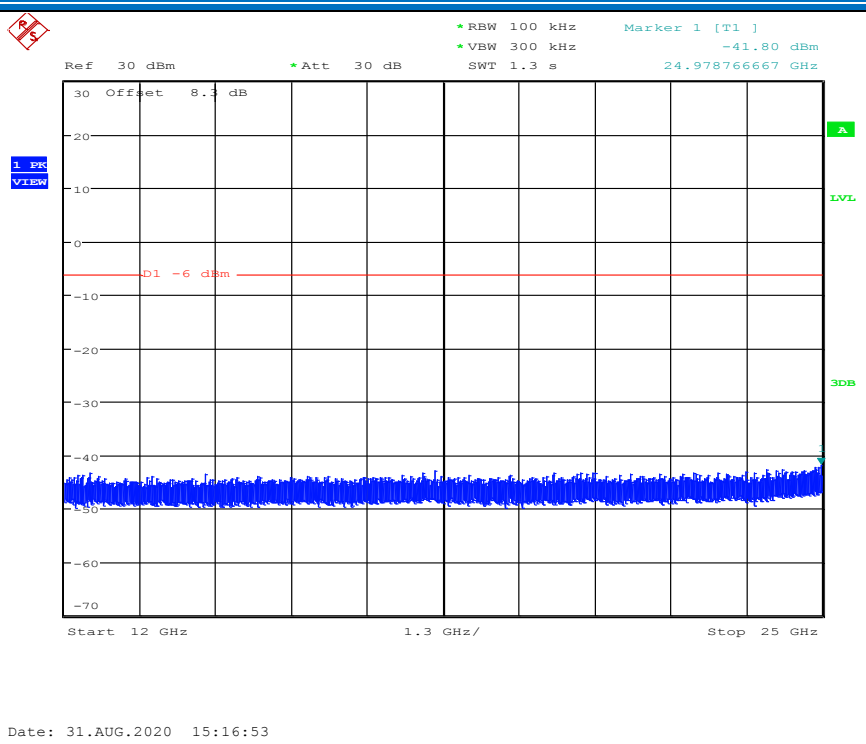



## MCH_Graphs

MCH

| | |
|---|---|
| MCH |  RBW 100 kHz<br>VBW 300 kHz<br>SWT 1.2 s<br>Marker 2 [T1 ]<br>-42.58 dBm<br>3.513270000 GHz<br>Ref 30 dBm<br>Att 30 dB<br>30 Offset 8.3 dB<br>Marker 1 [T1 ]<br>9.66 dBm<br>2.475072000 GHz<br>D1 -6.87 dBm<br>Center 6.015 GHz<br>1.197 GHz/<br>Span 11.97 GHz<br>Date: 31.AUG.2020 14:57:16<br>  RBW 100 kHz<br>VBW 300 kHz<br>SWT 1.3 s<br>Marker 1 [T1 ]<br>-42.51 dBm<br>24.627333333 GHz<br>Ref 30 dBm<br>Att 30 dB<br>30 Offset 8.3 dB<br>D1 -6.87 dBm<br>Start 12 GHz<br>1.3 GHz/<br>Stop 25 GHz<br>Date: 31.AUG.2020 14:57:37 |

| HCH_Graphs | |
|---|---|
| HCH | <br>Date: 31.AUG.2020 15:15:12 |
| HCH |  <br>Date: 31.AUG.2020 15:16:04 |




Remark:

Pretest 9kHz to 25GHz, find the highest point when testing, so only the worst data were shown in the test report. Per FCC Part 15.33 (a) and 15.31 (o) ,The amplitude of spurious emissions from intentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

## 5.8 Radiated Spurious Emission & Restricted bands

### 5.8.1 Spurious Emissions

| | |
|---|---|
| Test Requirement: | 47 CFR Part 15C Section 15.209 and 15.205 |
| Test Method: | ANSI C63.10 2013 |
| Test Site: | Measurement Distance: 3m (Semi-Anechoic Chamber) |

Receiver Setup:

| Frequency | Detector | RBW | VBW | Remark |
|---|---|---|---|---|
| 0.009MHz-0.090MHz | Peak | 10kHz | 30kHz | Peak |
| 0.009MHz-0.090MHz | Average | 10kHz | 30kHz | Average |
| 0.090MHz-0.110MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 0.110MHz-0.490MHz | Peak | 10kHz | 30kHz | Peak |
| 0.110MHz-0.490MHz | Average | 10kHz | 30kHz | Average |
| 0.490MHz -30MHz | Quasi-peak | 10kHz | 30kHz | Quasi-peak |
| 30MHz-1GHz | Quasi-peak | 100 kHz | 300kHz | Quasi-peak |
| Above 1GHz | Peak | 1MHz | 3MHz | Peak |
| | Peak | 1MHz | 10Hz[1)] | Average |

1): VBW = 10 Hz or 1/T for average levels,

| Mode | On Time (msec) | 1/ T Minimum VBW (kHz) |
|---|---|---|
| O-QPSK | 0.321 | 3.12 |

Limit:

| Frequency | Field strength (microvolt/meter) | Limit (dBuV/m) | Remark | Measurement distance (m) |
|---|---|---|---|---|
| 0.009MHz-0.490MHz | 2400/F(kHz) | - | - | 300 |
| 0.490MHz-1.705MHz | 24000/F(kHz) | - | - | 30 |
| 1.705MHz-30MHz | 30 | - | - | 30 |
| 30MHz-88MHz | 100 | 40.0 | Quasi-peak | 3 |
| 88MHz-216MHz | 150 | 43.5 | Quasi-peak | 3 |
| 216MHz-960MHz | 200 | 46.0 | Quasi-peak | 3 |
| 960MHz-1GHz | 500 | 54.0 | Quasi-peak | 3 |
| Above 1GHz | 500 | 54.0 | Average | 3 |

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

| Test Setup: | |
|---|---|

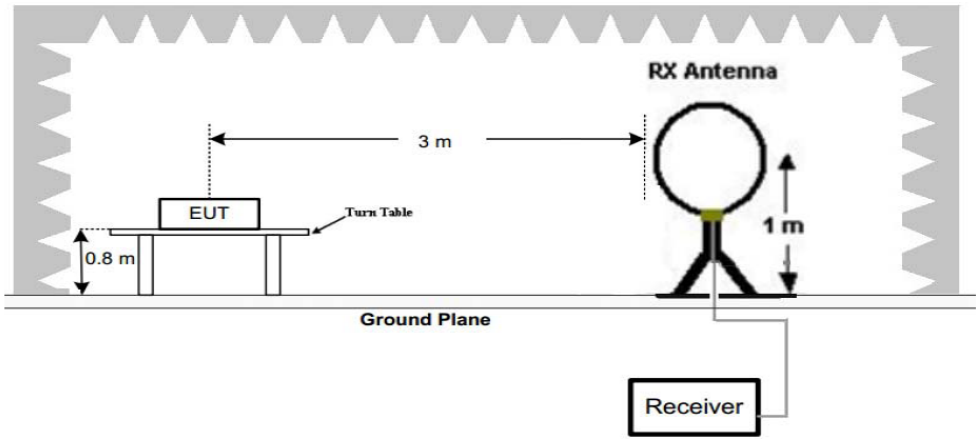



Figure 1. Below 30MHz

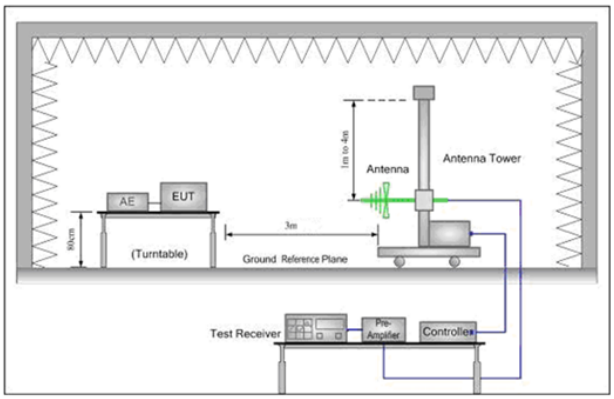



Figure 2. 30MHz to 1GHz

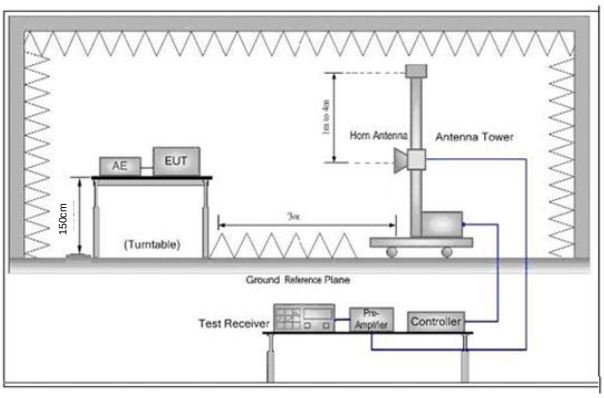
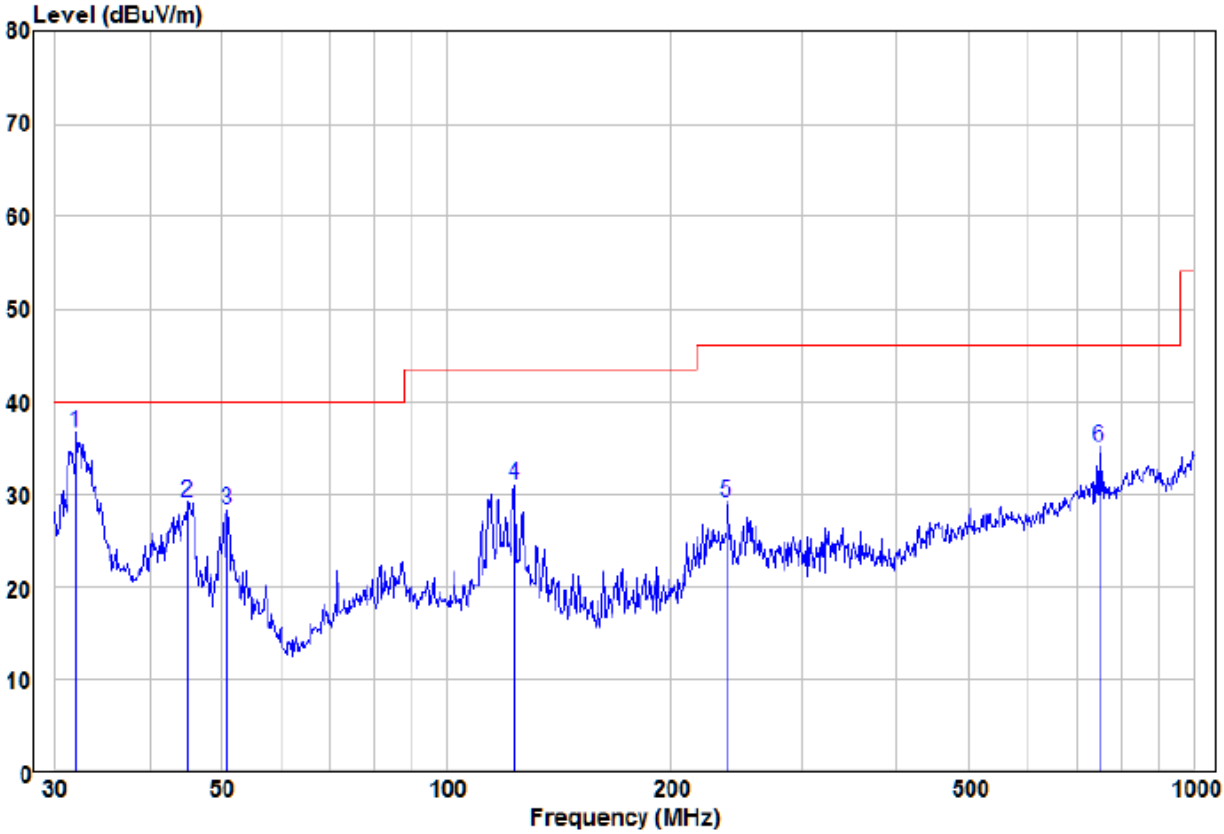



Figure 3. Above 1 GHz

| Test Procedure: | a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.<br>Note: For the radiated emission test above 1GHz:<br>Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.<br>b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.<br>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 |
|---|---|

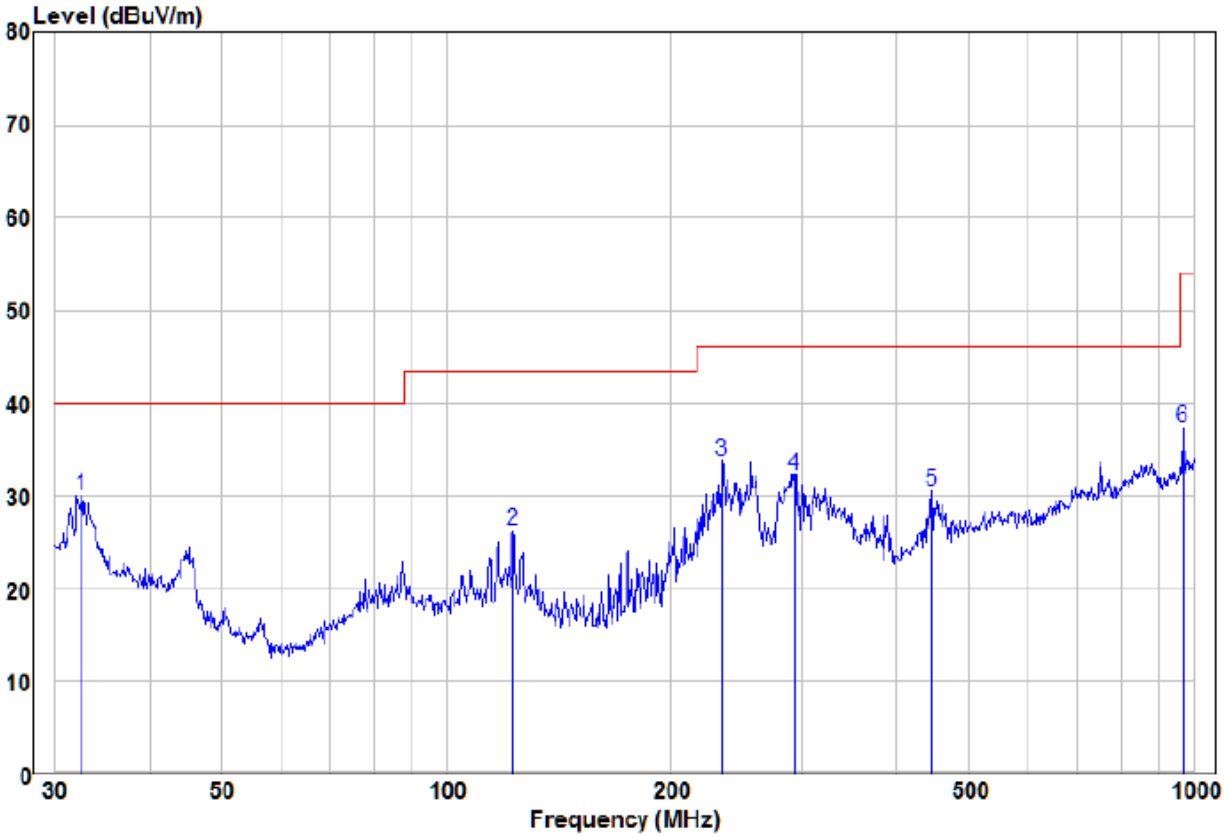
| | |
|---|---|
| | measurement.<br>d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.<br>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.<br>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.<br>g. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz)<br>h. 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.<br>i. Repeat above procedures until all frequencies measured was complete. |
| Test Mode: | Transmitting with O-QPSK at lowest, middle and highest channel. |
| Final Test Mode: | For below 1GHz, through Pre-scan, find at middle channel is the worst case.<br>Only the worst case is recorded in the report. |
| Test Results: | Pass |

| Radiated Emission below 1GHz | | |
|---|---|---|
| 30MHz~1GHz, the worst case | | |
| Test mode: | Transmitting mode | Vertical |




| | Freq | Read Level | Factor | Level | Limit Line | Over Limit | Remark | Pol/Phase |
|---|---|---|---|---|---|---|---|---|
| | MHz | dBuV | dB/m | dBuV/m | dBuV/m | dB | | |
| 1 pp | 31.95 | 21.20 | 15.41 | 36.61 | 40.00 | -3.39 | QP | VERTICAL |
| 2 | 45.06 | 18.72 | 10.42 | 29.14 | 40.00 | -10.86 | QP | VERTICAL |
| 3 | 50.94 | 20.44 | 7.89 | 28.33 | 40.00 | -11.67 | QP | VERTICAL |
| 4 | 123.70 | 20.49 | 10.56 | 31.05 | 43.50 | -12.45 | QP | VERTICAL |
| 5 | 237.48 | 17.87 | 11.28 | 29.15 | 46.00 | -16.85 | QP | VERTICAL |
| 6 | 747.48 | 13.22 | 21.90 | 35.12 | 46.00 | -10.88 | QP | VERTICAL |

| 30MHz~1GHz, the worst case | | |
|---|---|---|
| Test mode: | Transmitting mode | Horizontal |




| | | Freq | Read Level | Factor | Level | Limit Line | Over Limit | Remark | Pol/Phase |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB/m | dBuV/m | dBuV/m | dB | | |
| 1 | pp | 32.52 | 14.82 | 15.25 | 30.07 | 40.00 | -9.93 | QP | HORIZONTAL |
| 2 | | 122.83 | 15.70 | 10.59 | 26.29 | 43.50 | -17.21 | QP | HORIZONTAL |
| 3 | | 234.17 | 22.95 | 10.91 | 33.86 | 46.00 | -12.14 | QP | HORIZONTAL |
| 4 | | 292.06 | 18.84 | 13.46 | 32.30 | 46.00 | -13.70 | QP | HORIZONTAL |
| 5 | | 446.41 | 13.98 | 16.62 | 30.60 | 46.00 | -15.40 | QP | HORIZONTAL |
| 6 | | 968.93 | 13.05 | 24.27 | 37.32 | 54.00 | -16.68 | QP | HORIZONTAL |

Transmitter Emission above 1GHz

| Test mode: | | O-QPSK | | Test channel: | | Lowest | |
|---|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Over | Detector Type | Ant. Pol. |
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | | H/V |
| **2390** | **53.95** | **-9.2** | **44.75** | **74** | **-29.25** | **Peak** | **H** |
| 2400 | 54.92 | -9.39 | 45.53 | 74 | -28.47 | Peak | H |
| 4860 | 51.72 | -4.17 | 47.55 | 74 | -26.45 | Peak | H |
| 7290 | 50.96 | 0.63 | 51.59 | 74 | -22.41 | Peak | H |
| **2390** | **55.02** | **-9.2** | **45.82** | **74** | **-28.18** | **Peak** | **V** |
| 2400 | 52.03 | -9.39 | 42.64 | 74 | -31.36 | Peak | V |
| 4860 | 54.67 | -4.17 | 50.5 | 74 | -23.5 | Peak | V |
| 7290 | 49.54 | 0.63 | 50.17 | 74 | -23.83 | Peak | V |

| Test mode: | | O-QPSK | | Test channel: | | Middle | |
|---|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Over | Detector Type | Ant. Pol. |
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | | H/V |
| 4900 | 53.16 | -4.12 | 49.04 | 74 | -24.96 | peak | H |
| 7350 | 49.31 | 1.46 | 50.77 | 74 | -23.23 | peak | H |
| 4900 | 52.26 | -4.12 | 48.14 | 74 | -25.86 | peak | V |
| 7350 | 48.83 | 1.46 | 50.29 | 74 | -23.71 | peak | V |

| Test mode: | | O-QPSK | | Test channel: | | Highest | |
|---|---|---|---|---|---|---|---|
| Frequency | Meter Reading | Factor | Emission Level | Limits | Over | Detector Type | Ant. Pol. |
| (MHz) | (dBμV) | (dB) | (dBμV/m) | (dBμV/m) | (dB) | | H/V |
| **2483.5** | **56.24** | **-9.29** | **46.95** | **74** | **-27.05** | **Peak** | **H** |
| 4950 | 52.85 | -4.04 | 48.81 | 74 | -25.19 | Peak | H |
| 7425 | 49.30 | 1.65 | 50.95 | 74 | -23.05 | Peak | H |
| **2483.5** | **55.41** | **-9.29** | **46.12** | **74** | **-27.88** | **Peak** | **V** |
| 4950 | 50.47 | -4.04 | 46.43 | 74 | -27.57 | Peak | V |
| 7425 | 49.16 | 1.65 | 50.81 | 74 | -23.19 | Peak | V |

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

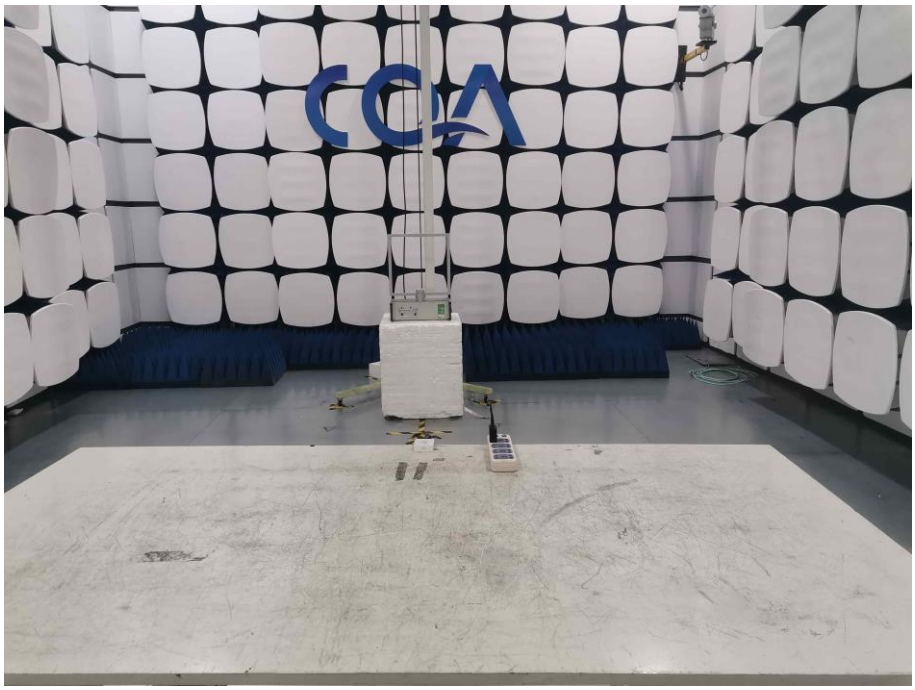
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, 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. So, only the peak measurements were shown in the report.

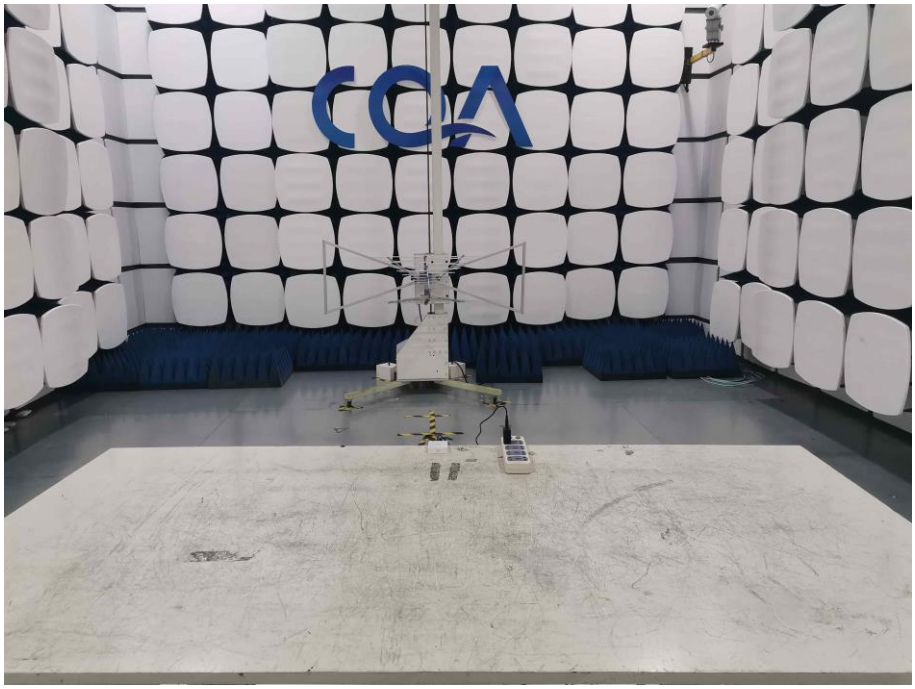
# 6 Photographs - EUT Test Setup

## 6.1 Radiated Spurious Emission

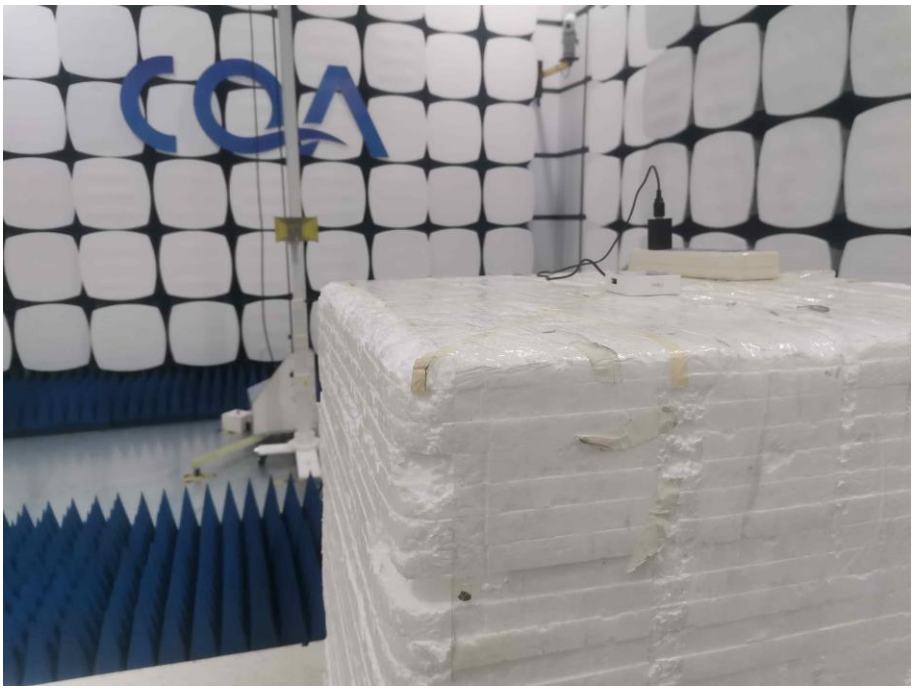
9kHz~30MHz:



30MHz~1GHz:



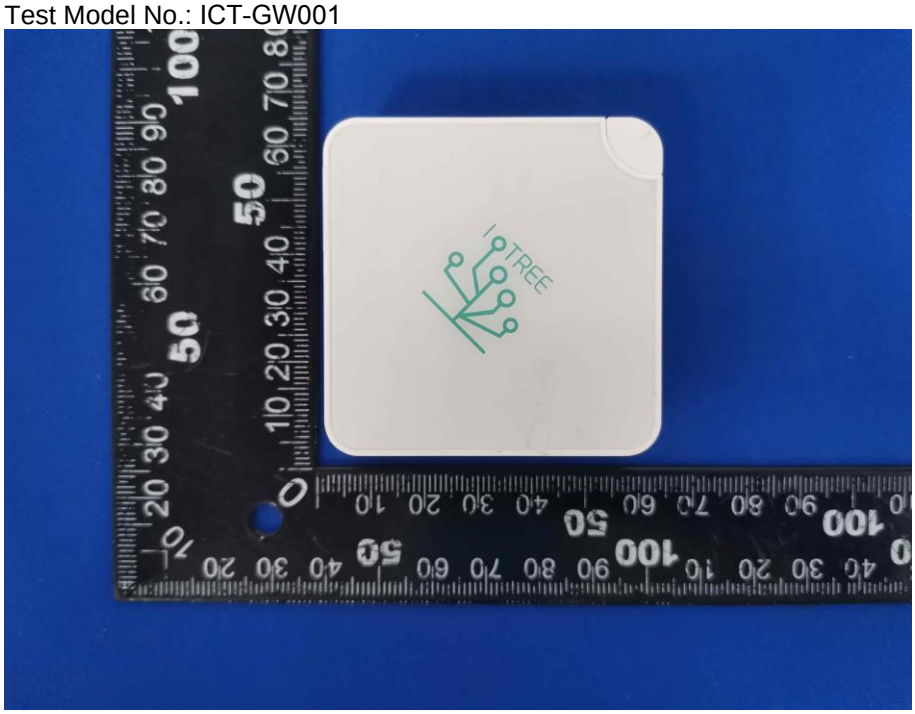
Above 1GHz:

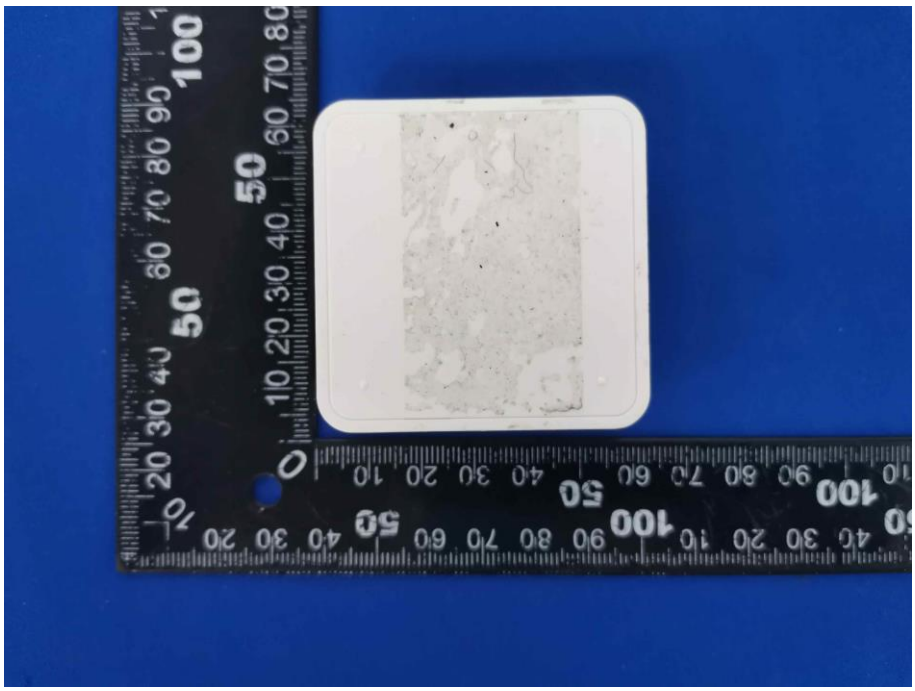


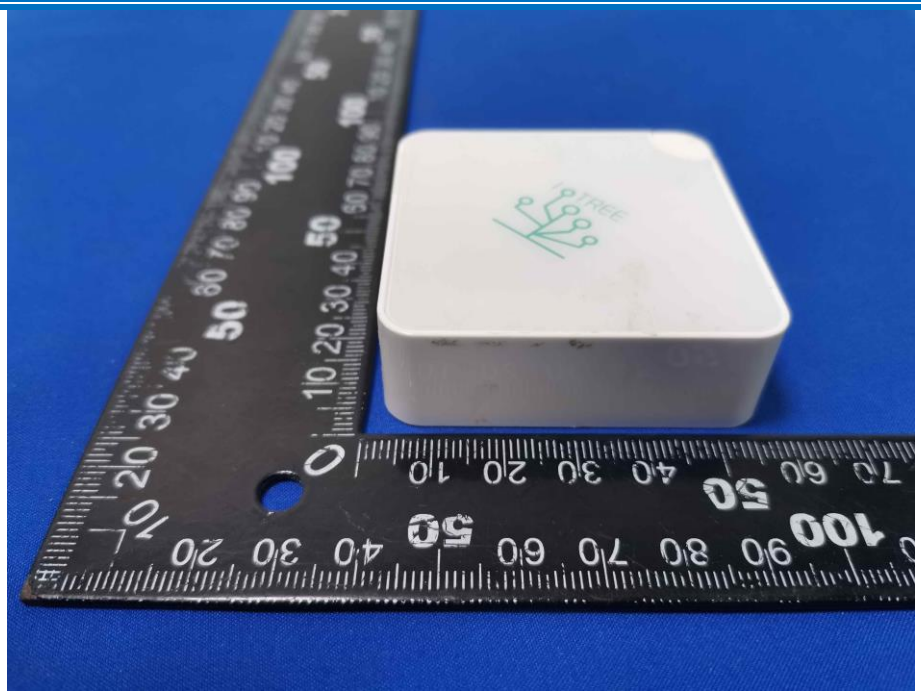
## 6.2 Conducted Emission

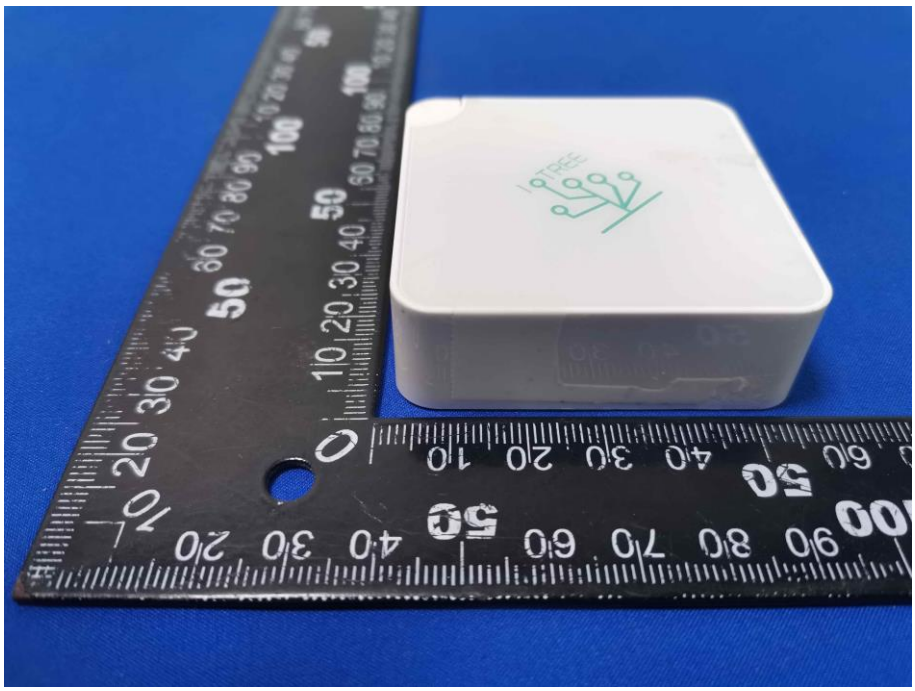
# 7 Photographs - EUT Constructional Details

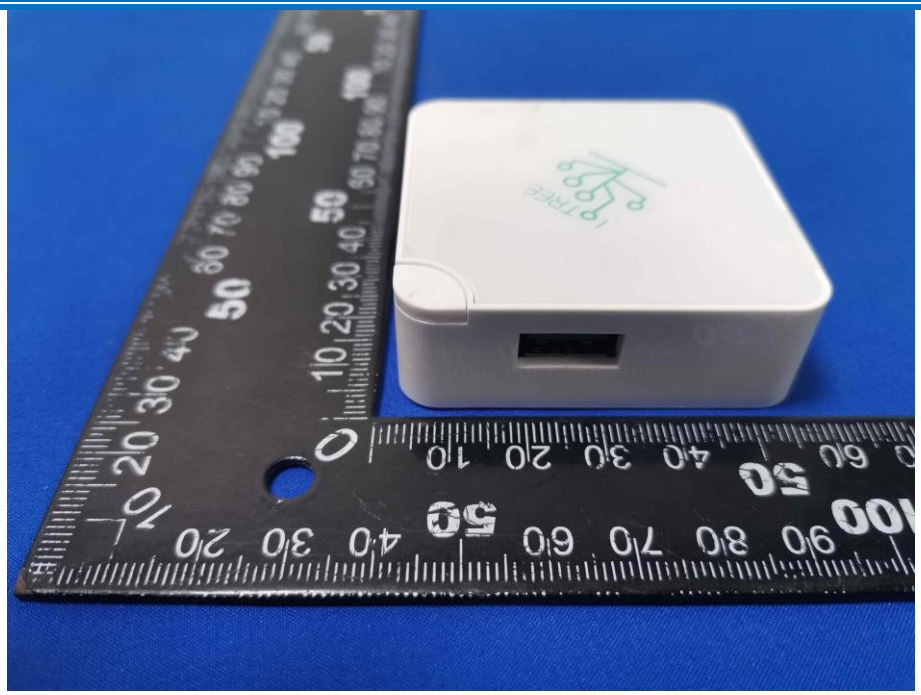
Test Model No.: ICT-GW001









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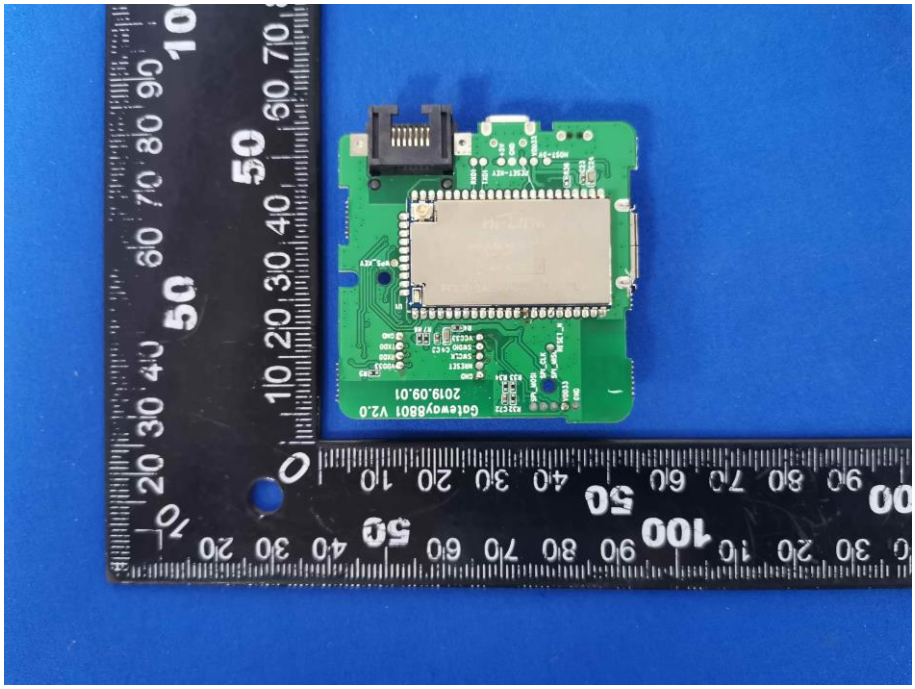
2019.09.01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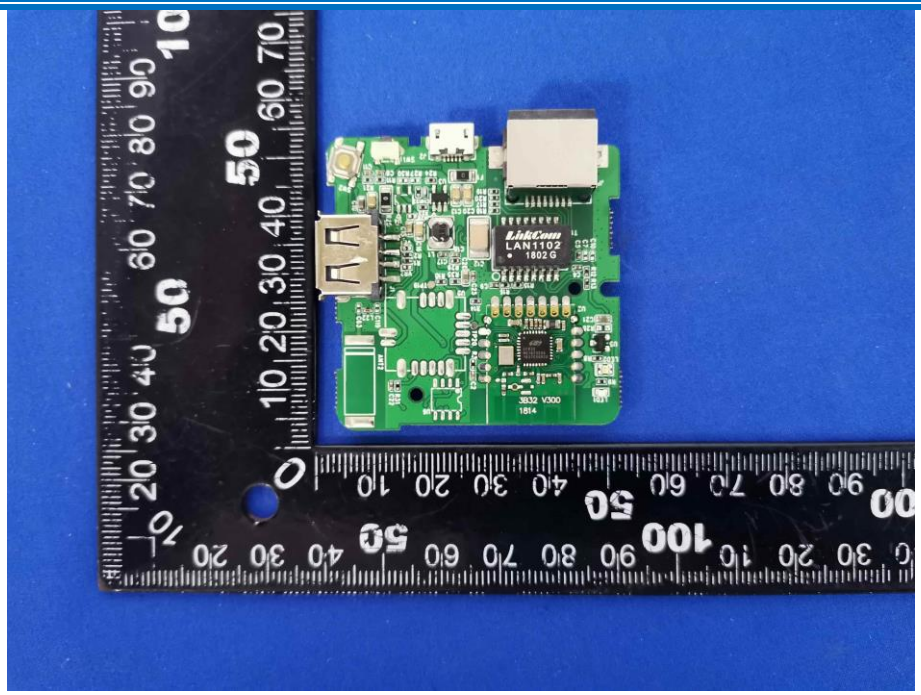
LinkCom
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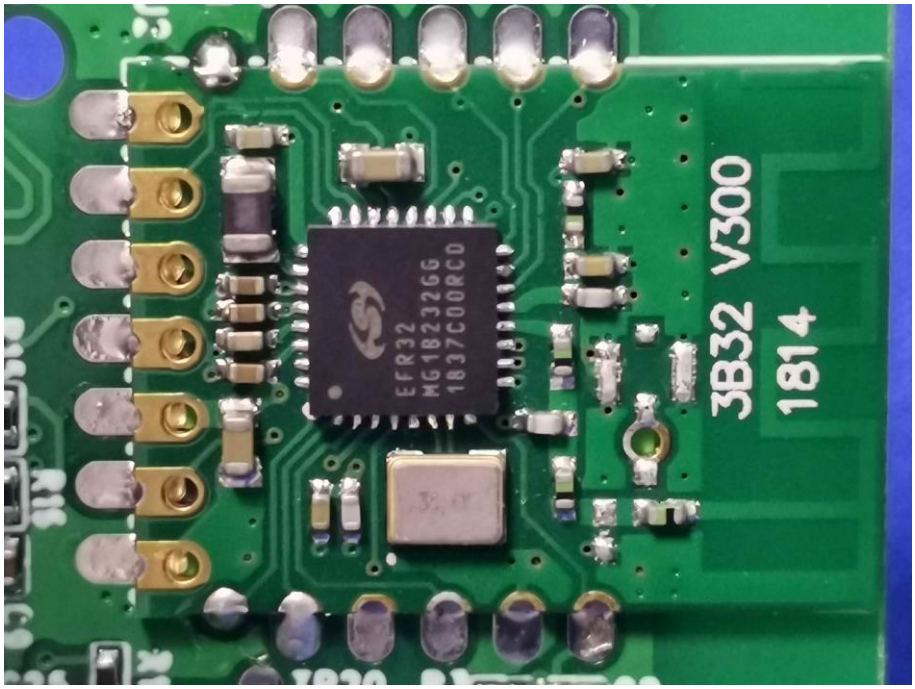
3B32 V300
1814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The End