# FCC Test Report
# (Part 24)

| | |
|---|---|
| **Report No.:** | RF181221C07D |
| **FCC ID:** | VBNAHFB-01 |
| **Test Model:** | AHFB |
| **Received Date:** | Oct. 15, 2019 |
| **Test Date:** | Apr. 16 ~ Apr. 23, 2020 |
| **Issued Date:** | Jun. 08, 2020 |
| **Applicant:** | Nokia Solutions and Networks |
| **Address:** | 3201 Olympus Blvd, Dallas, Texas 75019 |
| **Issued By:** | Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch<br>Lin Kou Laboratories |
| **Lab Address:** | No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan |
| **Test Location:** | No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan |
| **FCC Registration / Designation Number:** | 788550 / TW0003 |

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The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies

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**Release Control Record**

| Issue No. | Description | Date Issued |
|---|---|---|
| RF181221C07D | Original release | Jun. 08, 2020 |

## 1 Certificate of Conformity

| | |
|---|---|
| **Product:** | AirScale Base Station RRH 1.9GHz |
| **Brand:** | Nokia |
| **Test Model:** | AHFB |
| **Sample Status:** | Mass product |
| **Applicant:** | Nokia Solutions and Networks |
| **Test Date:** | Apr. 16 ~ Apr. 23, 2020 |
| **Standards:** | FCC Part 24, Subpart E |

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

**Prepared by :** Pettie Chen , **Date:** Jun. 08, 2020

Pettie Chen / Senior Specialist

**Approved by :** Bruce Chen , **Date:** Jun. 08, 2020

Bruce Chen / Senior Project Engineer

## 2 Summary of Test Results

| Applied Standard: FCC Part 24 & Part 2 | | | |
|---|---|---|---|
| FCC Clause | Test Item | Result | Remarks |
| 2.1046<br>24.232 | Effective radiated power | Pass | Meet the requirement of limit. |
| 2.1046<br>24.232(d) | Peak To Average Ratio | Pass | Meet the requirement of limit. |
| 2.1047 | Modulation Characteristics | Pass | Meet the requirement |
| 2.1055<br>24.235 | Frequency Stability | Pass | Meet the requirement of limit. |
| 2.1049<br>24.238(b) | Occupied Bandwidth | Pass | Meet the requirement of limit. |
| 24.238(b) | Band Edge Measurements | Pass | Meet the requirement of limit. |
| 2.1051<br>24.238 | Conducted Spurious Emissions | Pass | Meet the requirement of limit. |
| 2.1053<br>24.238 | Radiated Spurious Emissions | Pass | Meet the requirement of limit.<br>Minimum passing margin is -10.6dB at 58.13MHz. |

Note:
Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

| Measurement | Frequency | Expanded Uncertainty (k=2) (±) |
|---|---|---|
| Radiated Emissions up to 1 GHz | 9kHz ~ 30MHz | 3.04 dB |
| | 30MHz ~ 200MHz | 3.59 dB |
| | 200MHz ~1000MHz | 3.60 dB |
| Radiated Emissions above 1 GHz | 1GHz ~ 18GHz | 2.29 dB |
| | 18GHz ~ 40GHz | 2.29 dB |

## 2.2 Test Site and Instruments

| Description & Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Due |
|---|---|---|---|---|
| Test Receiver KEYSIGHT | N9038A | MY55420137 | Apr. 15, 2019 | Apr. 14, 2020 |
| | | | Apr. 16, 2020 | Apr. 15, 2021 |
| Spectrum Analyzer ROHDE & SCHWARZ | FSP40 | 100269 | Jun. 04, 2019 | Jun. 03, 2020 |
| BILOG Antenna SCHWARZBECK | VULB9168 | 9168-160 | Nov. 21, 2018 | Nov. 20, 2019 |
| | | | Nov. 07, 2019 | Nov. 06, 2020 |
| HORN Antenna SCHWARZBECK | BBHA 9120 D | 9120D-1169 | Nov. 25, 2018 | Nov. 24, 2019 |
| | | | Nov. 24, 2019 | Nov. 23, 2020 |
| HORN Antenna SCHWARZBECK | BBHA 9170 | BBHA9170241 | Nov. 25, 2018 | Nov. 24, 2019 |
| | | | Nov. 24, 2019 | Nov. 23, 2020 |
| Loop Antenna TESEQ | HLA 6121 | 45745 | Jul. 01, 2019 | Jun. 30, 2020 |
| Preamplifier Agilent (Below 1GHz) | 8447D | 2944A10638 | Jul. 11, 2019 | Jul. 10, 2020 |
| Preamplifier Agilent (Above 1GHz) | 8449B | 3008A02367 | Feb. 19, 2019 | Feb. 18, 2020 |
| | | | Feb. 18, 2020 | Feb. 17, 2021 |
| RF signal cable HUBER+SUHNER&EMCI | SUCOFLEX 104 & EMC104-SM-SM8000 | CABLE-CH9-02 (248780+171006) | Jan. 19, 2019 | Jan. 18, 2020 |
| | | | Jan. 18, 2020 | Jan. 17, 2021 |
| RF signal cable HUBER+SUHNER | SUCOFLEX 104 | CABLE-CH9-(250795/4) | Jul. 11, 2019 | Jul. 10, 2020 |
| RF signal cable Woken | 8D-FB | Cable-CH9-01 | Jul. 30, 2019 | Jul. 29, 2020 |
| Software BV ADT | ADT_Radiated_ V7.6.15.9.5 | NA | NA | NA |
| Antenna Tower EMCO | 2070/2080 | 512.835.4684 | NA | NA |
| Turn Table EMCO | 2087-2.03 | NA | NA | NA |
| Antenna Tower &Turn BV ADT | AT100 | AT93021705 | NA | NA |
| Turn Table BV ADT | TT100 | TT93021705 | NA | NA |
| Turn Table Controller BV ADT | SC100 | SC93021705 | NA | NA |
| Boresight Antenna Fixture | FBA-01 | FBA-SIP01 | NA | NA |
| WIT Standard Temperature And Humidity Chamber | TH-4S-C | W981030 | Jun. 03, 2019 | Jun. 02, 2020 |
| JFW 20dB attenuation | 50HF-020-SMA | NA | NA | NA |

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 9.

# 3 General Information

## 3.1 General Description of EUT

| | | | | | |
|---|---|---|---|---|---|
| Product | AirScale Base Station RRH 1.9GHz | | | | |
| Brand | Nokia | | | | |
| Test Model | AHFB | | | | |
| Sample Status | Mass product | | | | |
| Power Supply Rating | DC: -40.5V to -57VDC<br>AC: 100-240VAC | | | | |
| Modulation Type | QPSK, 16QAM, 64QAM, 256QAM | | | | |
| Operating Frequency | **Multi Carrier** | | | | |
| | LTE Band 25<br>(Channel Bandwidth: 65MHz) | 1962.5MHz | | | |
| | | QPSK | 16QAM | 64QAM | 256QAM |
| Max. EIRP Power | **Multi Carrier** | | | | |
| | LTE Band 25<br>(Channel Bandwidth: 65MHz) | 363078.055mW<br>(55.60dBm) | 359749.335mW<br>(55.56dBm) | 349945.167mW<br>(55.44dBm) | 349140.315mW<br>(55.43dBm) |
| Emission Designator | **Multi Carrier** | | | | |
| | LTE Band 25<br>(Channel Bandwidth: 65MHz) | 63M4G7D | 63M4D7W | 63M4D7W | 63M4D7W |
| Antenna Type | Direction Panel antenna with 12.5dBi gain | | | | |
| Antenna Connector | Nex10 | | | | |
| S/N | 474036A.102 | | | | |
| HW Version | A102 | | | | |
| SW Version | 5G19B | | | | |
| Accessory Device | Refer to Note as below | | | | |
| Cable Supplied | NA | | | | |

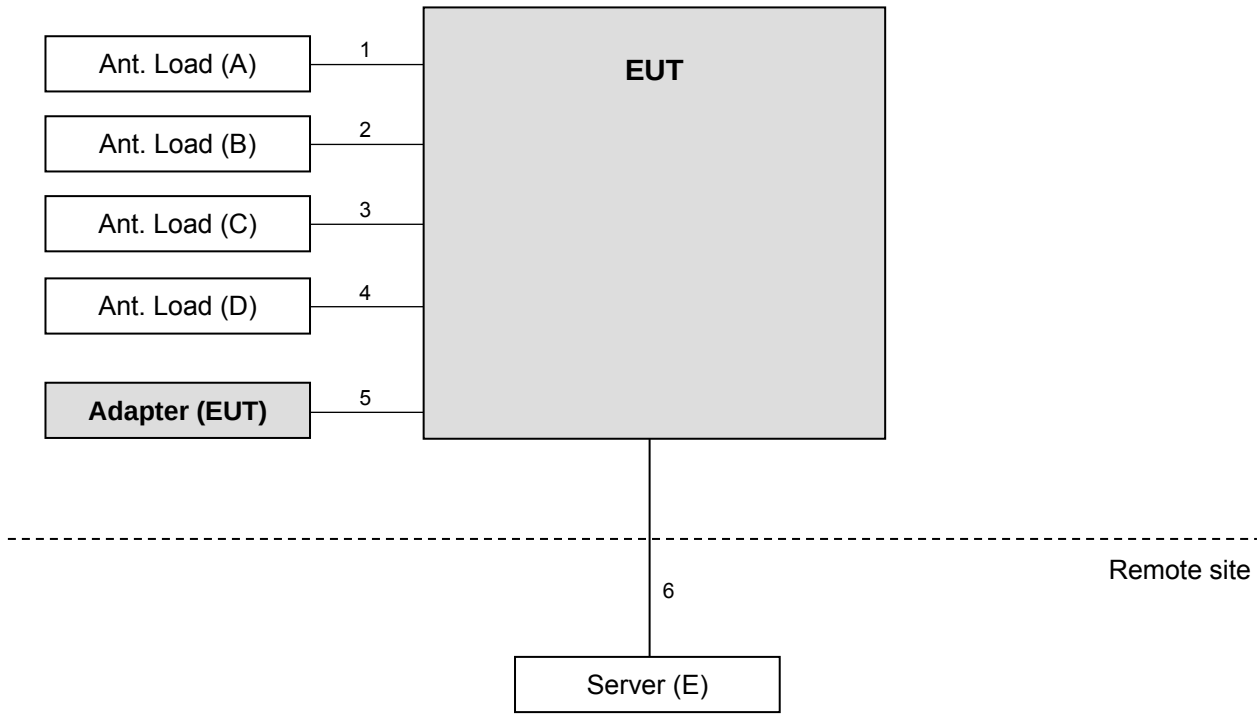
Note:

1. This report is prepared for FCC class II permissive change. This report is issued as a supplementary report of BV CPS report no.: RF181221C07C. Difference compared with the original report is adding LTE Multiple carrier (up to 65MHz). Therefore, the EUT was re-tested and presented in the test report.
2. The EUT contains following accessory devices.

| AC PSU (Optional) | |
|---|---|
| Brand | Nokia |
| Model | APAB |
| Sales Item | 474130A.102 |
| S/N | U7174800066 |
| Remark | SUPLET/S818A16 |
| Input Power | 100-240Vac, 50-60Hz, 3A MAX |
| Output Power | -54Vdc, 3A MAX |

3. This device operate with Multiple Antennas Using Multiple-input, Multiple-output (MIMO) Technology for uncorrelated Transmission.
4. A representative Nokia antenna, AAFA 12.5dBi antenna, is referred to comply with the EIRP limits.

## 3.2 Configuration of System under Test




### 3.2.1 Description of 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.

| ID | Product | Brand | Model No. | Serial No. | FCC ID | Remarks |
|---|---|---|---|---|---|---|
| A. | Ant. Load | NA | NA | NA | NA | Provided by manufacturer |
| B. | Ant. Load | NA | NA | NA | NA | Provided by manufacturer |
| C. | Ant. Load | NA | NA | NA | NA | Provided by manufacturer |
| D. | Ant. Load | NA | NA | NA | NA | Provided by manufacturer |
| E. | Server | Nokia | ASIK | EA193380917 | NA | Provided by manufacturer |

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item E acted as a communication partner to transfer data.

| ID | Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks |
|---|---|---|---|---|---|---|
| 1. | Ant. Cable | 1 | 0.3 | Y | 0 | - |
| 2. | Ant. Cable | 1 | 0.3 | Y | 0 | - |
| 3. | Ant. Cable | 1 | 0.3 | Y | 0 | - |
| 4. | Ant. Cable | 1 | 0.3 | Y | 0 | - |
| 5. | DC Cable | 1 | 0.55 | N | 0 | Provided by manufacturer |
| 6. | Fiber Cable | 1 | 2 | N | 0 | - |

### 3.3 Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case was found when positioned on X-plane. Following channel(s) was (were) selected for the final test as listed below:

LTE Band 25

**Multi Carrier:**

| Test Condition |
|---|
| LTE Band 25 QPSK (LTE(20M)+LTE(20M)+LTE(20M)+LTE(5M)) |

| EUT Configure Mode | Test item | Available channel | Tested Channel | | Channel Bandwidth | Modulation | Mode |
|---|---|---|---|---|---|---|---|
| - | EIRP | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK / 16QAM / 64QAM / 256QAM | Full RB |
| - | Frequency Stability | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK | Full RB |
| - | Occupied Bandwidth | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK / 16QAM / 64QAM / 256QAM | Full RB |
| - | Band Edge | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK | Full RB |
| - | Peak to Average Ratio | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK / 16QAM / 64QAM / 256QAM | Full RB |
| - | Conducted Emission | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK | Full RB |
| - | Radiated Emission Below 1GHz | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK | Full RB |
| - | Radiated Emission Above 1GHz | 8140 to 8665 | 8365 (1962.5MHz) | CH 8140 (1940.0MHz)+ CH 8340 (1960.0MHz)+ CH 8540 (1980.0MHz)+ CH 8665 (1992.5MHz) | 65MHz | QPSK | Full RB |

Test Condition:

| Test Item | Environmental Conditions | Input Power (system) | Tested By |
|---|---|---|---|
| EIRP | 24deg. C, 64%RH | 120Vac, 60Hz | James Yang |
| Modulation Characteristics | 24deg. C, 64%RH | 120Vac, 60Hz | James Yang |
| Frequency Stability | 24deg. C, 64%RH | -48Vdc | James Yang |
| Occupied Bandwidth | 24deg. C, 64%RH | 120Vac, 60Hz | James Yang |
| Band Edge | 24deg. C, 64%RH | 120Vac, 60Hz | James Yang |
| Peak To Average Ratio | 24deg. C, 64%RH | 120Vac, 60Hz | James Yang |
| Conducted Emission | 24deg. C, 64%RH | 120Vac, 60Hz | James Yang |
| Radiated Emission | 24deg. C, 68%RH | 120Vac, 60Hz | Greg Lin |

### 3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

### 3.5 General Description of Applied Standards and References

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards and References:

**Test Standard:**

**FCC 47 CFR Part 2**
**FCC 47 CFR Part 24**
**ANSI/TIA/EIA-603-E 2016**
**ANSI 63.26-2015**

All test items have been performed and recorded as per the above standards.

**References Test Guidance:**

**KDB 971168 D01 Power Meas License Digital Systems v03r01**

All test items have been performed as a reference to the above KDB test guidance.

# 4 Test Types and Results

## 4.1 Output Power Measurement

### 4.1.1 Limits of Output Power Measurement

Para. No. 24.232(a)(2) Base stations with an emission bandwidth greater than 1 MHz are limited to 1640 watts/MHz equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters

### 4.1.2 Test Procedures

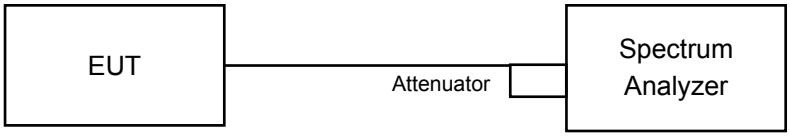
**Conducted Power Measurement:**

The EUT was set up for the maximum power link data modulation and link up with spectrum. Set the EUT to transmit under low, middle and high channel and record the power level.

EIRP=Conducted power+antenna gain

### 4.1.3 Test Setup

**Conducted Power Measurement:**




For the actual test configuration, please refer to the attached file (Test Setup Photo).

### 4.1.4 Test Results

**LTE Band 25**
**Multi Carrier:**
**Conducted Output Power (dBm)**
**1TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0 | 36.95 | 36.94 | 36.81 | 37.04 |
| | 1 | **37.35** | 36.85 | 36.91 | 36.74 |
| | 2 | 37.03 | 37.09 | **37.21** | 36.75 |
| | 3 | 36.98 | **37.28** | 36.73 | **37.10** |

**2TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0+1 | **40.16** | 39.91 | 39.87 | 39.90 |
| | 2+3 | 40.02 | **40.20** | **39.99** | **39.94** |

**3TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0+1+2 | **41.88** | **41.73** | **41.75** | **41.62** |

**4TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0+1+2+3 | **43.10** | **43.06** | **42.94** | **42.93** |

*All available TX Chain combination as below:

**2TX:**

1. Chain 0+ Chain 1
2. Chain 0+ Chain 2
3. Chain 0+ Chain 3
4. Chain 1+ Chain 2
5. Chain 1+ Chain 3
6. Chain 2+ Chain 3

The worst combination is Chain 0+Chain 1 & Chain 2+Chain 3, therefore they were chosen for the final test.

**3TX:**

1. Chain 0+ Chain 1+ Chain 2
2. Chain 0+ Chain 1+ Chain 3
3. Chain 1+ Chain 2+ Chain 3

The worst combination is Chain 0+Chain 1+Chain 2, therefore it was chosen for the final test.

**EIRP Power (dBm)**

**1TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0 | 49.45 | 49.44 | 49.31 | 49.54 |
| | 1 | **49.85** | 49.35 | 49.41 | 49.24 |
| | 2 | 49.53 | 49.59 | **49.71** | 49.25 |
| | 3 | 49.48 | **49.78** | 49.23 | **49.60** |

**2TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0+1 | **52.66** | 52.41 | 52.37 | 52.40 |
| | 2+3 | 52.52 | **52.70** | **52.49** | **52.44** |

**3TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0+1+2 | **54.38** | **54.23** | **54.25** | **54.12** |

**4TX**

| Band / BW | Chain | QPSK | 16QAM | 64QAM | 256QAM |
|---|---|---|---|---|---|
| | | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 | Mid CH 8365 |
| | | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz | 1962.5 MHz |
| LTE Band 25 / 65M | 0+1+2+3 | **55.60** | **55.56** | **55.44** | **55.43** |

Note: EIRP(dBm) = Conducted Output Power (dBm) + antenna gain (dBi)
*All available TX Chain combination as below:

**2TX:**

1. Chain 0+Chain 1
2. Chain 0+Chain 2
3. Chain 0+Chain 3
4. Chain 1+Chain 2
5. Chain 1+Chain 3
6. Chain 2+Chain 3

The worst combination is Chain 0+Chain 1 & Chain 2+Chain 3, therefore they were chosen for the final test.

**3TX:**

1. Chain 0+Chain 1+Chain 2
2. Chain 0+Chain 1+Chain 3
3. Chain 1+Chain 2+Chain 3

The worst combination is Chain 0+Chain 1+Chain 2, therefore it was chosen for the final test.

## 4.2 Modulation Characteristics Measurement

### 4.2.1 Limits of Modulation Characteristics

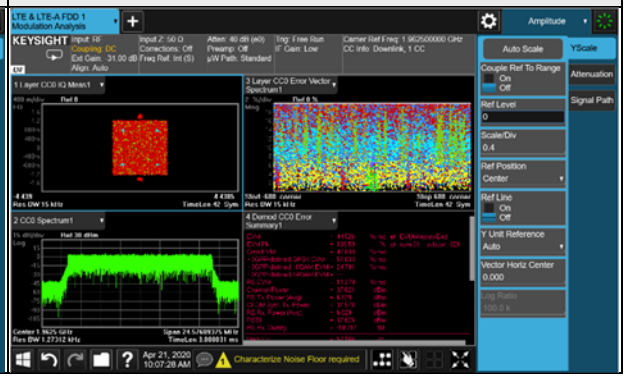
N/A

### 4.2.2 Test Procedure

Connect the EUT to Communication Simulator via the antenna connector, the frequency band is set as EUT supported Modulation and Channels, the EUT output is matched with 50 ohm load, the waveform quality and constellation of the EUT was tested.

### 4.2.3 Test Setup


### 4.2.4 Test Results

| LTE Band 25 | |
|---|---|
| Spectrum Plot of Measurement Value | |
| Channel: 8365 / Frequency (MHz): 1962.5MHz | |
| QPSK | 16QAM |
|  |  |
| 64QAM | 256QAM |
|  |  |

## 4.3 Frequency Stability Measurement

### 4.3.1 Limits of Frequency Stabiliity Measurement

1.5 ppm is for base and fixed station.

### 4.3.2 Test Instruments

| Description & Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Due |
|---|---|---|---|---|
| Spectrum Analyzer ROHDE & SCHWARZ | FSP40 | 100040 | Sep. 23, 2019 | Sep. 22, 2020 |
| WIT Standard Temperature And Humidity Chamber | TH-4S-C | W981030 | Jun. 03, 2019 | Jun. 02, 2020 |
| Digital Multimeter Fluke | 87-III | 70360742 | Jun. 27, 2019 | Jun. 26, 2020 |
| DC Power Supply Topward | 6306A | 727263 | NA | NA |
| True RMS Clamp Meter / Fluke | 325 | 31130711WS | May 21, 2019 | May 20, 2020 |

### 4.3.3 Test Procedure

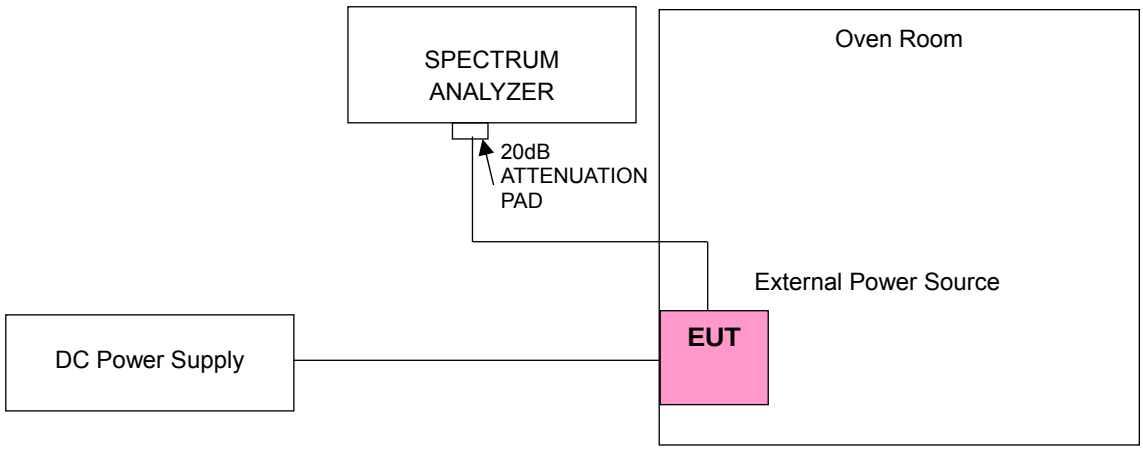
a. Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.

b. EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.

c. The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ±0.5 ℃ during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

Note: The frequency error was recorded frequency error from the communication simulator.

### 4.3.4 Conducted Setup



### 4.3.5 Test Results

**Multi Carrier:**

Frequency Error vs. Voltage

| Voltage (Volts) | LTE Band 25 | |
|---|---|---|
| | Channel Bandwidth: 65 MHz | |
| | Frequency (MHz) | Frequency Error (ppm) |
| -40.5 | 1962.500003 | 0.001 |
| -48 | 1962.500003 | 0.001 |
| -57.0 | 1962.500003 | 0.002 |

Note: The applicant defined the normal working voltage is from -40.5Vdc to -57.0Vdc.

Frequency Error vs. Temperature

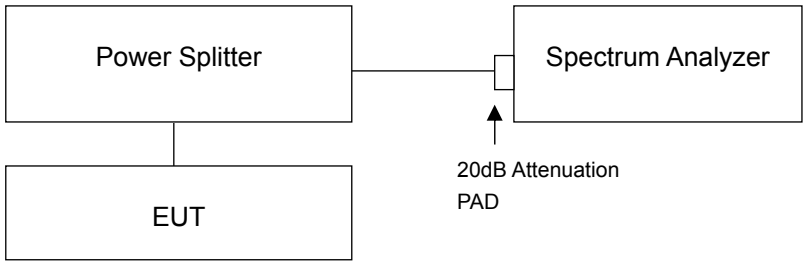
| Temp. (℃) | LTE Band 25 | |
|---|---|---|
| | Channel Bandwidth: 65 MHz | |
| | Low Channel | |
| | Frequency (MHz) | Frequency Error (ppm) |
| -30 | 1962.500004 | 0.002 |
| -20 | 1962.500002 | 0.001 |
| -10 | 1962.500002 | 0.001 |
| 0 | 1962.500003 | 0.001 |
| 10 | 1962.500003 | 0.002 |
| 20 | 1962.499997 | -0.002 |
| 30 | 1962.499997 | -0.001 |
| 40 | 1962.499996 | -0.002 |
| 50 | 1962.499997 | -0.001 |

## 4.4 Occupied Bandwidth Measurement

### 4.4.1 Test Procedure

The EUT makes a call to the communication simulator. All measurements were done at low, middle and high operational frequency range. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

### 4.4.2 Test Setup



### 4.4.3 Test Result

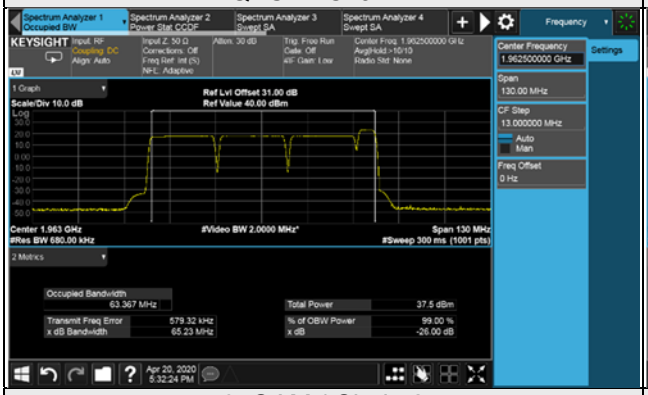
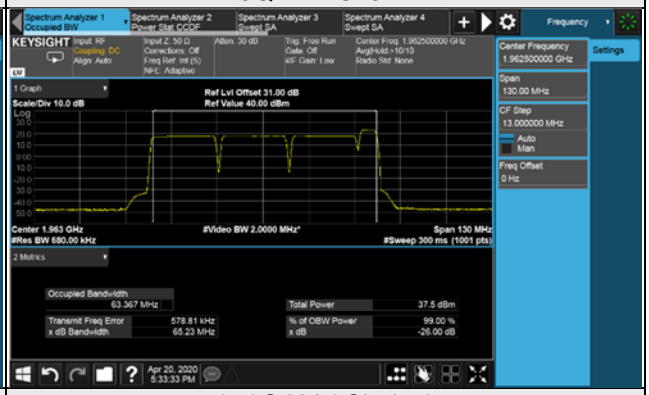
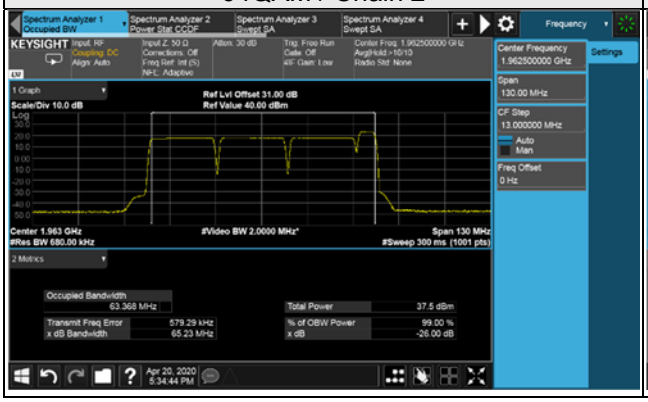
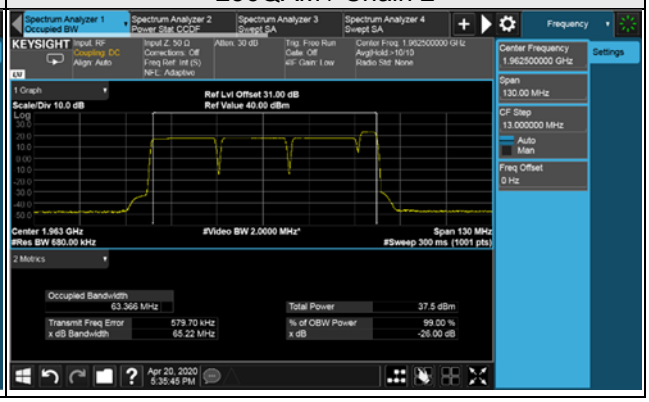
**Multi Carrier:**

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | | | |
| | | QPSK | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 63.35 | 63.37 | 63.37 | 63.36 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | | | |
| | | 16QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 63.35 | 63.37 | 63.37 | 63.36 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | | | |
| | | 64QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 63.35 | 63.36 | 63.37 | 63.36 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | | | |
| | | 256QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 63.35 | 63.37 | 63.37 | 63.35 |

| Spectrum Plot of Worst Value | |
|---|---|
| QPSK / Chain 2 | 16QAM / Chain 2 |
|  |  |
| 64QAM / Chain 2 | 256QAM / Chain 2 |
|  |  |

26dB Bandwidth

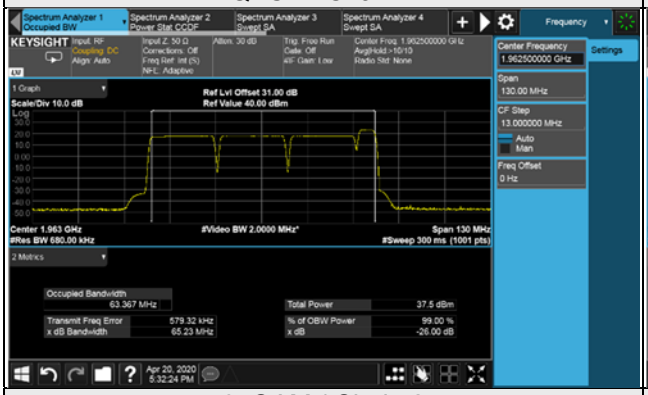
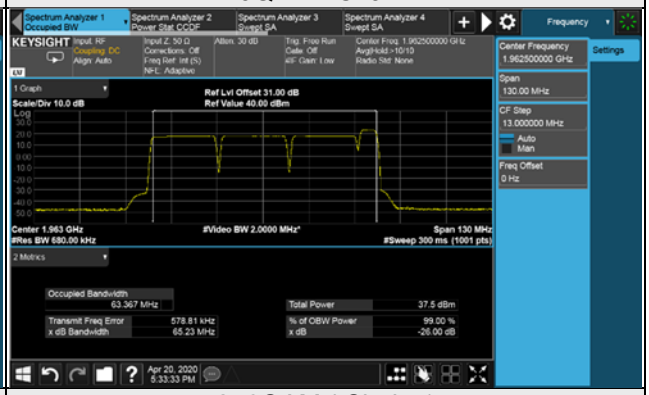
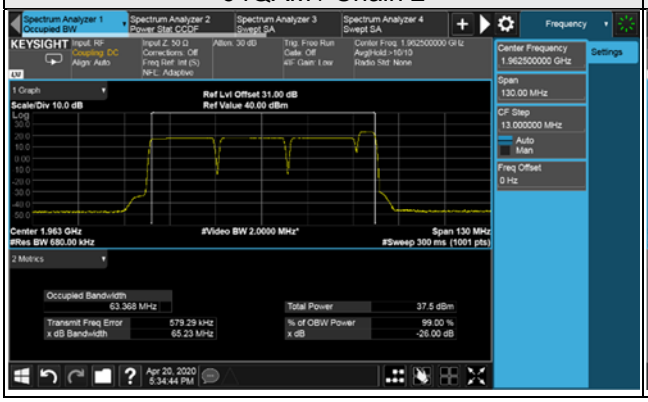
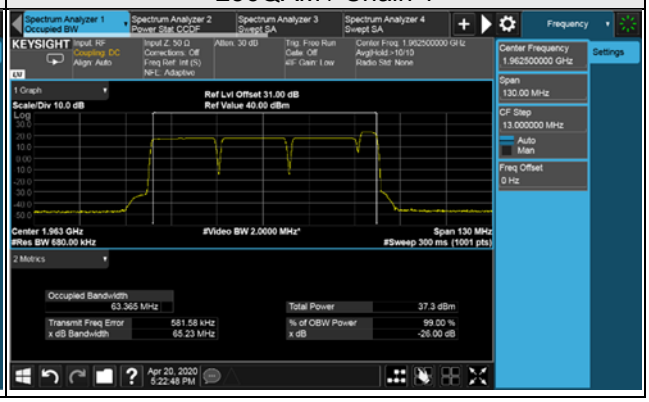
**Multi Carrier:**

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 26dBc Bandwidth (MHz) | | | |
| | | QPSK | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 65.21 | 65.22 | 65.23 | 65.22 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 26dBc Bandwidth (MHz) | | | |
| | | 16QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 65.22 | 65.22 | 65.23 | 65.22 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 26dBc Bandwidth (MHz) | | | |
| | | 64QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 65.22 | 65.22 | 65.23 | 65.22 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | 26dBc Bandwidth (MHz) | | | |
| | | 256QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 65.22 | 65.23 | 65.22 | 65.22 |

| Spectrum Plot of Worst Value | |
|---|---|
| QPSK / Chain 2 | 16QAM / Chain 2 |
|  |  |
| 64QAM / Chain 2 | 256QAM / Chain 1 |
|  |  |

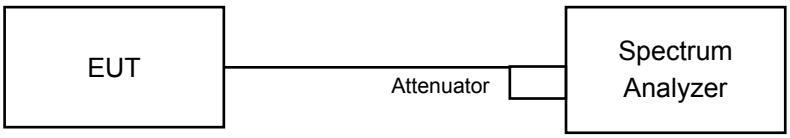
## 4.5 Band Edge Measurement

### 4.5.1 Limits of Band Edge Measurement

Power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

Note:
This device can be impelement MIMO function, so the limit of spurious emissions needs to be reduced by 10log($Numbers_{Ant}$) according to FCC KDB 662911 D01 guidance.

### 4.5.2 Test Setup




### 4.5.3 Test Procedures

a. All measurements were done at low and high operational frequency range.

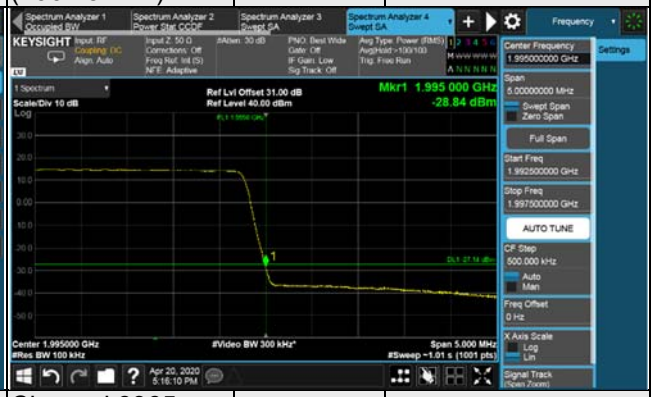
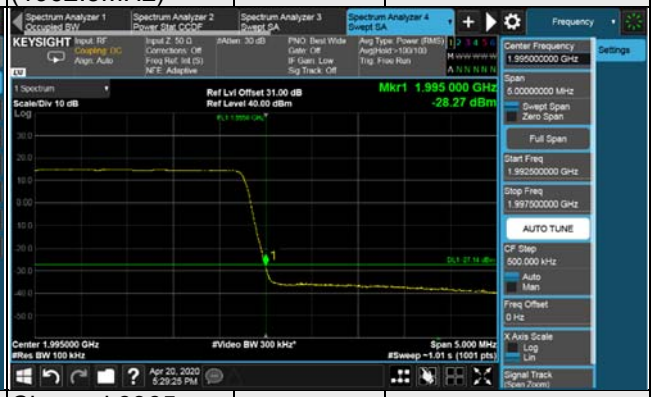
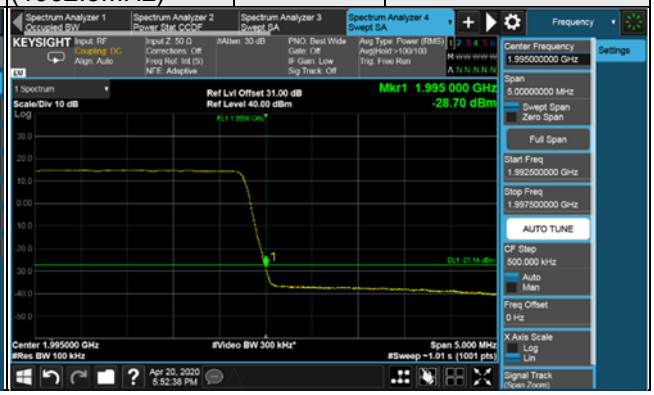
b. For Multi Carrier:

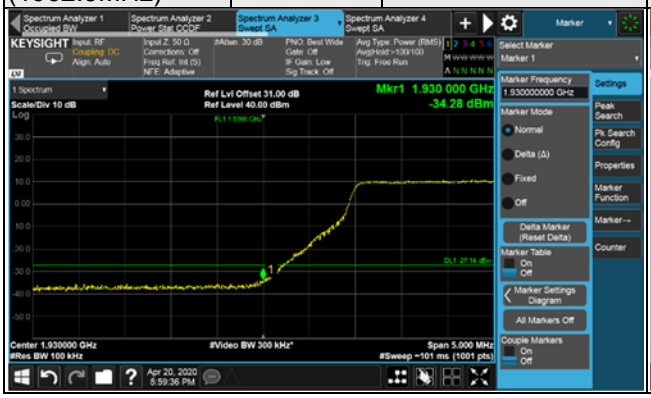
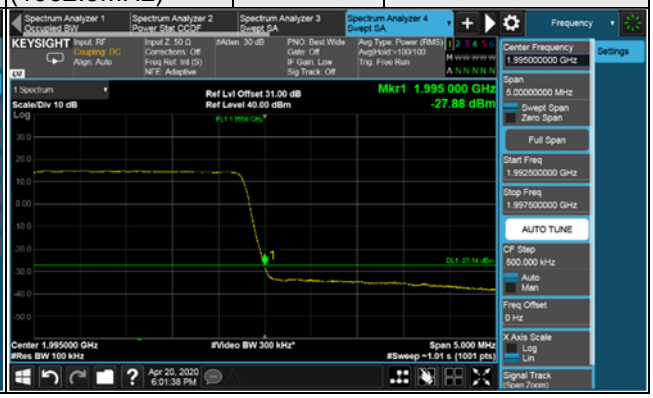
   Multi-Carrier BW, extend the 1% range from 650kHz above and below the channel edge and then reduce the limit further by 10 log (100/650)=-8.12dB (i.e. total -19.02+(-8.12)=-27.14dBm) to compensate for the integration from 100kHz.

c. Record the max trace plot into the test report.

### 4.5.4 Test Results

**Multi Carrier:**

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel 8365 (1962.5MHz) | QPSK | Chain 0 | Channel 8365 (1962.5MHz) | QPSK | Chain 0 |
|  | | |  | | |
| Channel 8365 (1962.5MHz) | QPSK | Chain 1 | Channel 8365 (1962.5MHz) | QPSK | Chain 1 |
|  | | |  | | |
| Channel 8365 (1962.5MHz) | QPSK | Chain 2 | Channel 8365 (1962.5MHz) | QPSK | Chain 2 |
|  | | |  | | |

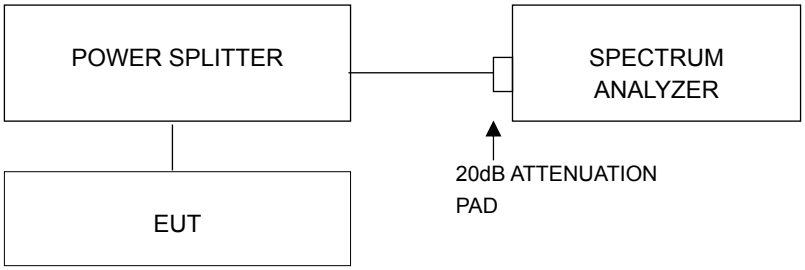
| | | | | | |
|---|---|---|---|---|---|
| Channel 8365 (1962.5MHz) | QPSK | Chain 3 | Channel 8365 (1962.5MHz) | QPSK | Chain 3 |
|  | | |  | | |

## 4.6 Peak to Average Ratio

### 4.6.1 Limits of Peak to Average Ratio Measurement

In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB

### 4.6.2 Test Setup




### 4.6.3 Test Procedures

a. Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;
b. Set the number of counts to a value that stabilizes the measured CCDF curve;
c. Record the maximum PAPR level associated with a probability of 0.1%.

### 4.6.4 Test Results

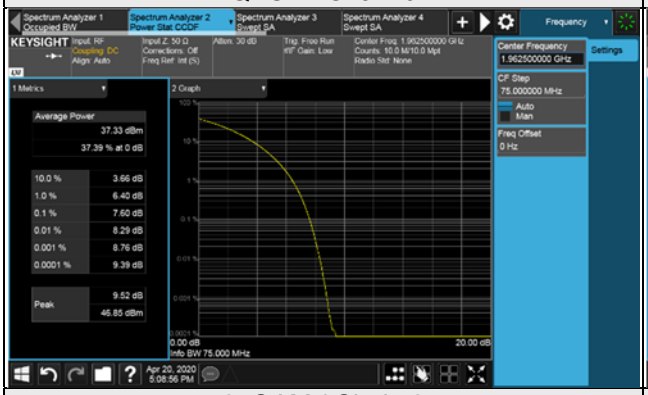
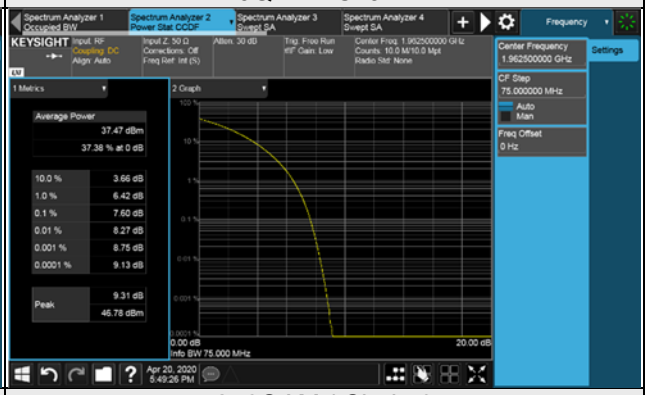
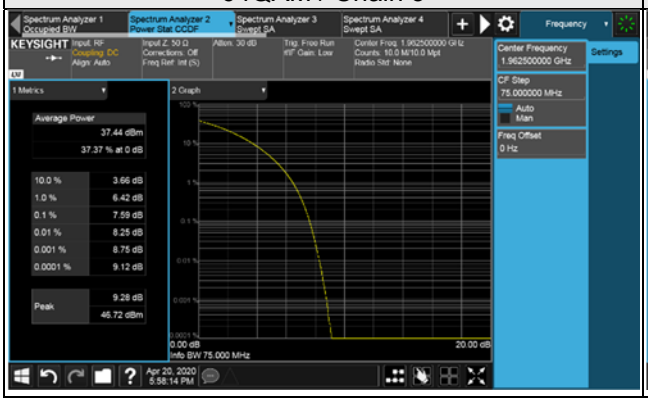
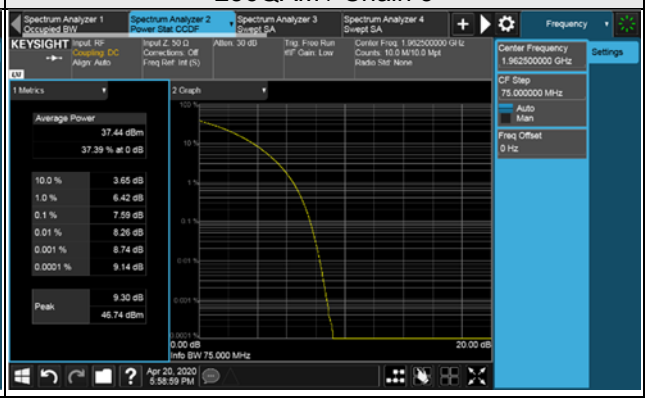
**Multi Carrier:**

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Peak To Average Ratio (dB) | | | |
| | | QPSK | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 7.60 | 7.58 | 7.59 | 7.58 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Peak To Average Ratio (dB) | | | |
| | | 16QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 7.59 | 7.56 | 7.60 | 7.59 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Peak To Average Ratio (dB) | | | |
| | | 64QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 7.59 | 7.58 | 7.58 | 7.59 |

| LTE Band 25, Channel Bandwidth 65MHz | | | | | |
|---|---|---|---|---|---|
| Channel | Frequency (MHz) | Peak To Average Ratio (dB) | | | |
| | | 256QAM | | | |
| | | Chain 0 | Chain 1 | Chain 2 | Chain 3 |
| 8365 | 1962.5 | 7.59 | 7.57 | 7.59 | 7.59 |

| Spectrum Plot of Worst Value | |
|---|---|
| QPSK / Chain 0 | 16QAM / Chain 2 |
|  |  |
| 64QAM / Chain 3 | 256QAM / Chain 3 |
|  |  |

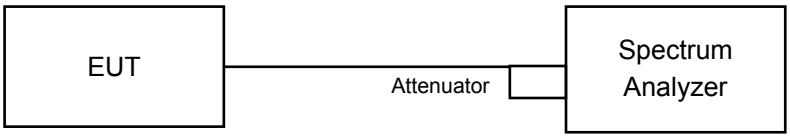
## 4.7 Conducted Spurious Emissions

### 4.7.1 Limits of Conducted Spurious Emissions Measurement

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit equal to –13dBm.

Note:
This device can be impelement MIMO function, so the limit of spurious emissions needs to be reduced by $10\log(Numbers_{Ant})$ according to FCC KDB 662911 D01 guidance.

### 4.7.2 Test Setup



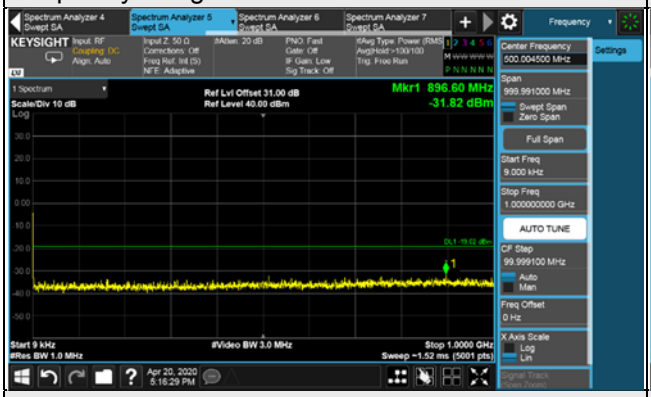
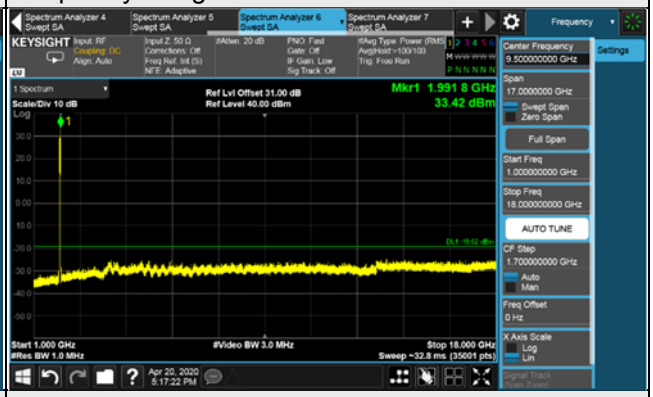
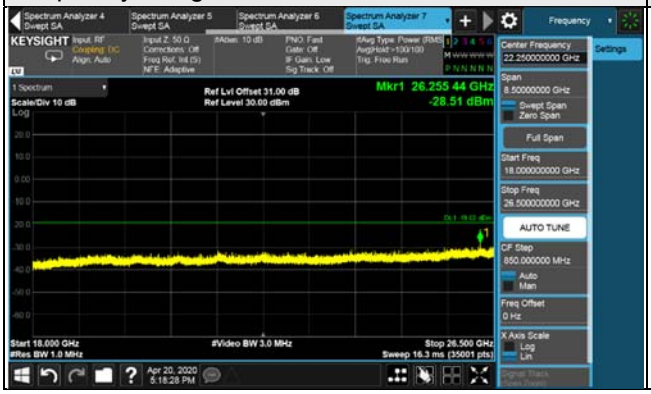

### 4.7.3 Test Procedure

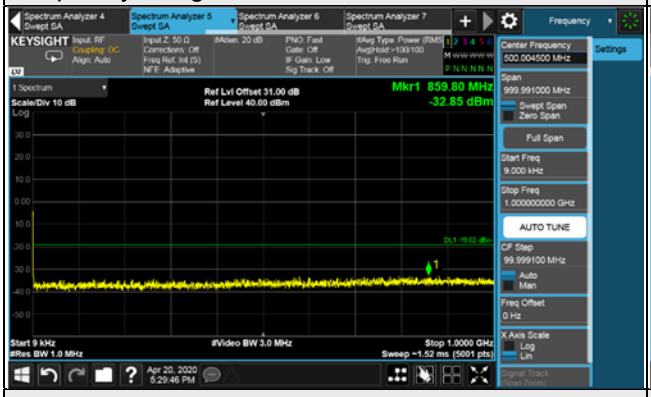
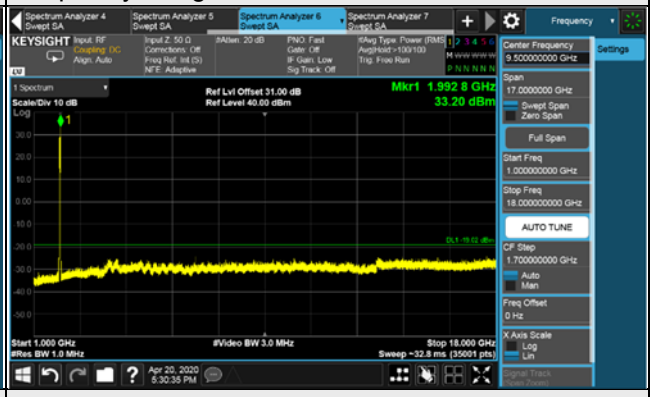
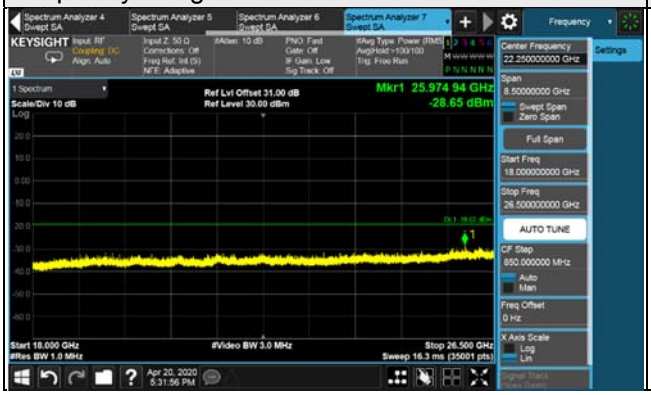
a. All measurements were done at low, middle and high operational frequency range.

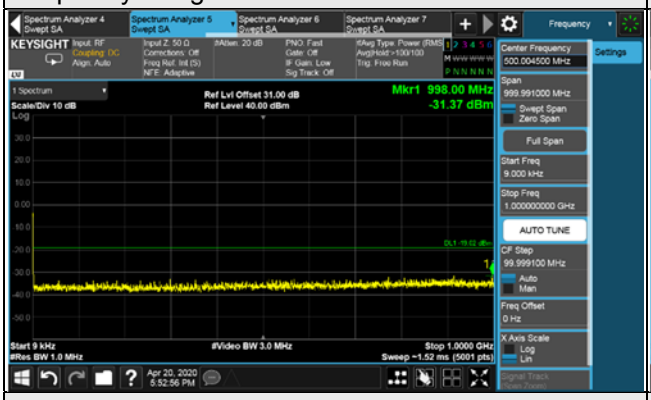
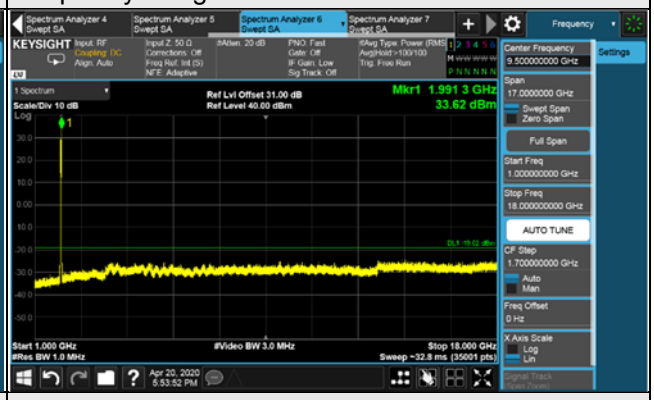
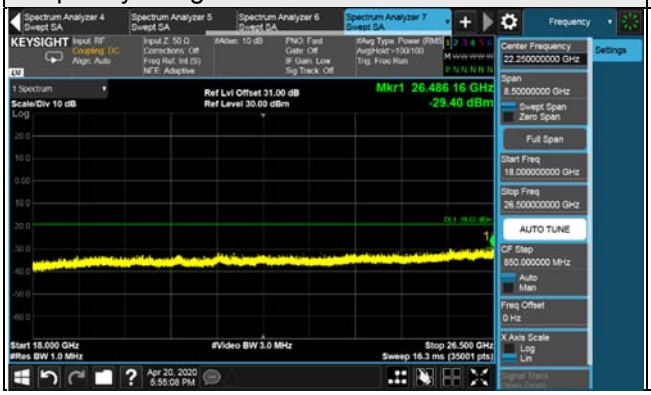
b. Measuring frequency range is from 9 kHz to 26.5GHz. 20dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz is used for conducted emission measurement.

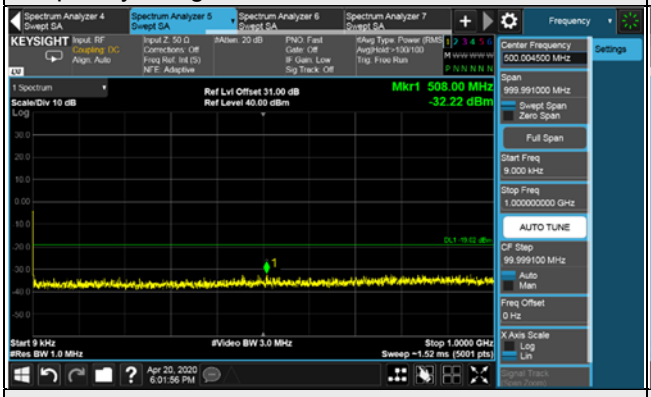
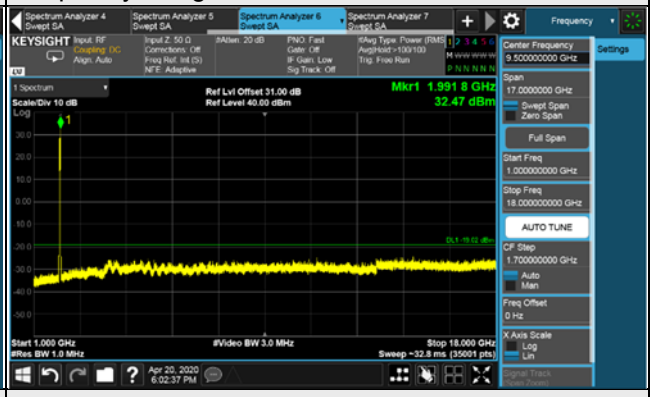
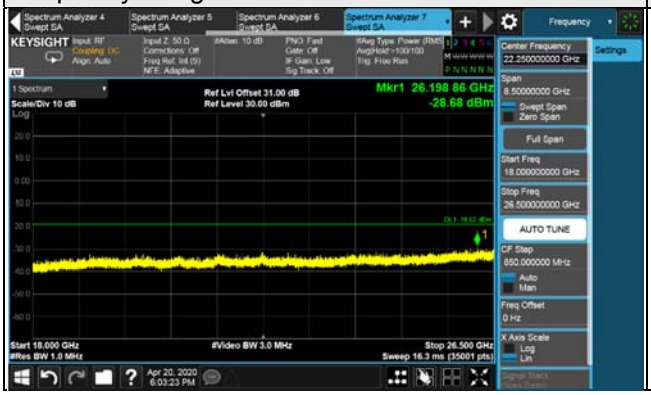
### 4.7.4 Test Results

**Multi Carrier:**

| LTE Band 25, Channel Bandwidth 65MHz, Chain 0 | |
|---|---|
| Channel 8365 (1962.5MHz) | |
| Frequency Range : 9kHz~1GHz | Frequency Range : 1GHz~18GHz |
|  |  |
| Frequency Range : 18GHz~26.5GHz | |
|  | |

| LTE Band 25, Channel Bandwidth 65MHz, Chain 1 | |
|---|---|
| Channel 8365 (1962.5MHz) | |
| Frequency Range : 9kHz~1GHz | Frequency Range : 1GHz~18GHz |
|  |  |
| Frequency Range : 18GHz~26.5GHz | |
|  | |

| LTE Band 25, Channel Bandwidth 65MHz, Chain 2 | |
|---|---|
| Channel 8365 (1962.5MHz) | |
| Frequency Range : 9kHz~1GHz | Frequency Range : 1GHz~18GHz |
|  |  |
| Frequency Range : 18GHz~26.5GHz | |
|  | |

| LTE Band 25, Channel Bandwidth 65MHz, Chain 3 | |
|---|---|
| Channel 8365 (1962.5MHz) | |
| Frequency Range : 9kHz~1GHz | Frequency Range : 1GHz~18GHz |
|  |  |
| Frequency Range : 18GHz~26.5GHz | |
|  | |

## 4.8 Radiated Emission Measurement

### 4.8.1 Limits of Radiated Emission Measurement

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB. The emission limit equal to –13dBm.

### 4.8.2 Test Procedure

a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
b. The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value” of step a. Record the power level of S.G
c. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.
d. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.R.P power - 2.15dBi.

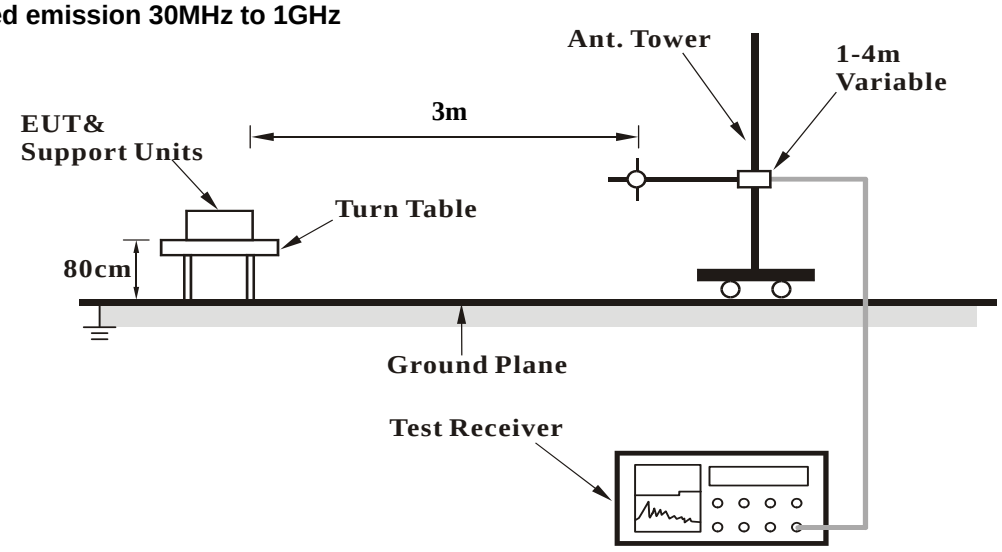
NOTE: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

### 4.8.3 Deviation from Test Standard

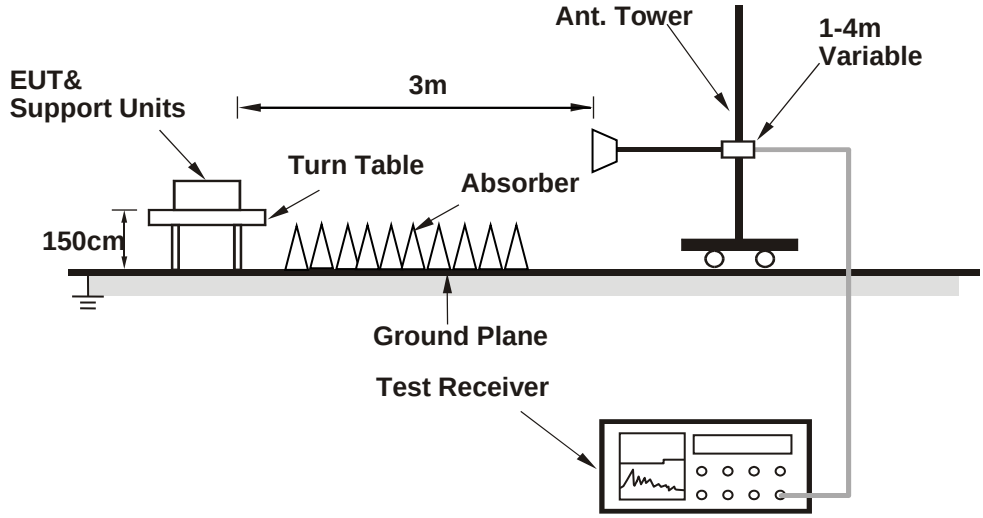
No deviation.

### 4.8.4 Test Setup

**For radiated emission 30MHz to 1GHz**




**For radiated emission above 1GHz**




For the actual test configuration, please refer to the attached file (Test Setup Photo).

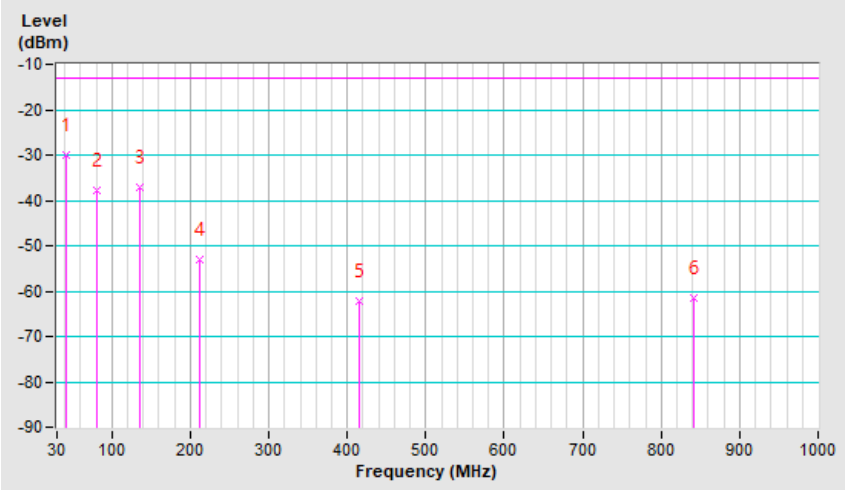
### 4.8.5 Test Results

Below 1GHz
LTE Band 25
**Multi Carrier:**
Channel Bandwidth: 65MHz

| | | | |
|---|---|---|---|
| Mode | TX channel 8365 (1962.5MHz) | Frequency Range | Below 1000 MHz |
| Environmental Conditions | 24deg. C, 68%RH | Input Power | 120Vac, 60Hz |
| Tested By | Greg Lin | | |

| Antenna Polarity & Test Distance: Horizontal at 3 M | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Freq. (MHz) | Reading (dBm) | S.G Power Value (dBm) | Correction Factor (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| 1 | 41.64 | -32.0 | -17.6 | -12.3 | -29.9 | -13.0 | -16.9 |
| 2 | 80.44 | -33.0 | -38.4 | 0.5 | -37.9 | -13.0 | -24.9 |
| 3 | 134.76 | -31.1 | -33.9 | -3.2 | -37.1 | -13.0 | -24.1 |
| 4 | 212.36 | -44.6 | -51.0 | -2.1 | -53.1 | -13.0 | -40.1 |
| 5 | 416.06 | -62.2 | -65.6 | 3.4 | -62.2 | -13.0 | -49.2 |
| 6 | 840.92 | -68.1 | -65.1 | 3.7 | -61.4 | -13.0 | -48.4 |

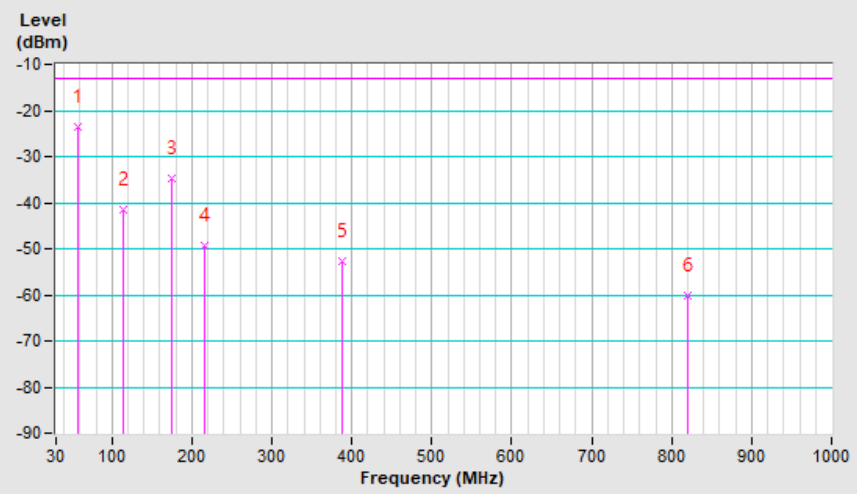
Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



| Mode | TX channel 8365 (1962.5MHz) | Frequency Range | Below 1000 MHz |
|---|---|---|---|
| Environmental Conditions | 24deg. C, 68%RH | Input Power | 120Vac, 60Hz |
| Tested By | Greg Lin | | |

| Antenna Polarity & Test Distance: Vertical at 3 M | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Freq. (MHz) | Reading (dBm) | S.G Power Value (dBm) | Correction Factor (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| **1** | **58.13** | **-16.7** | **-19.4** | **-4.2** | **-23.6** | **-13.0** | **-10.6** |
| 2 | 114.39 | -34.2 | -38.7 | -2.8 | -41.5 | -13.0 | -28.5 |
| 3 | 175.50 | -31.1 | -32.0 | -2.8 | -34.8 | -13.0 | -21.8 |
| 4 | 215.27 | -45.6 | -47.3 | -2.0 | -49.3 | -13.0 | -36.3 |
| 5 | 386.96 | -52.0 | -56.1 | 3.5 | -52.6 | -13.0 | -39.6 |
| 6 | 820.55 | -67.4 | -64.0 | 3.9 | -60.1 | -13.0 | -47.1 |

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).



Above 1GHz
LTE Band 25
**Multi Carrier:**

| | | | |
|---|---|---|---|
| Mode | TX channel 8365 (1962.5MHz) | Frequency Range | 1GHz ~ 20GHz |
| Environmental Conditions | 24deg. C, 68%RH | Input Power | 120Vac, 60Hz |
| Tested By | Greg Lin | | |

| Antenna Polarity & Test Distance: Horizontal at 3 M | | | | | | | |
|---|---|---|---|---|---|---|---|
| No. | Freq. (MHz) | Reading (dBm) | S.G Power Value (dBm) | Correction Factor (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| 1 | 3925.00 | -62.2 | -53.7 | 1.3 | -52.4 | -13.0 | -39.4 |
| Antenna Polarity & Test Distance: Vertical at 3 M | | | | | | | |
| No. | Freq. (MHz) | Reading (dBm) | S.G Power Value (dBm) | Correction Factor (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| 1 | 3925.00 | -60.4 | -51.7 | 1.3 | -50.4 | -13.0 | -37.4 |

Remarks:
1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) + Cable Loss (dB).

## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

**Appendix – Information of the Testing Laboratories**

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following: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The address and road map of all our labs can be found in our web site also.

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