# FCC TEST REPORT

| | |
|---|---|
| **Product Name:** | Handheld Smart Terminal |
| **Trade Mark:** | or RHINO |
| **Model No.:** | T5se |
| **Add. Model No.:** | N/A |
| **Report Number:** | 220412017RFM-2 |
| **Test Standards:** | FCC 47 CFR Part 90 Subpart R |
| **FCC ID:** | 2AUOUT5SE |
| **Test Result:** | PASS |
| **Date of Issue:** | August 8, 2022 |

Prepared for:

**Rhino Mobility LLC**
**8 The Green, Suite A, Dover, Delaware,19901, USA**

Prepared by:

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**
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| | | | |
|---|---|---|---|
| Prepared by: | Kieron Luo<br>Project Engineer | Reviewed by: | Henry Lu<br>Team Leader |
| Approved by: | Kevin Liang<br>Assistant Manager | Date: | August 8, 2022 |

## Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | August 8, 2022 | Original |

# CONTENTS

# 1. GENERAL INFORMATION

## 1.1 CLIENT INFORMATION

| | |
|---|---|
| **Applicant:** | Rhino Mobility LLC |
| **Address of Applicant:** | 8 The Green, Suite A, Dover, Delaware,19901, USA |
| **Manufacturer:** | Rhino Mobility LLC |
| **Address of Manufacturer:** | 8 The Green, Suite A, Dover, Delaware,19901, USA |

## 1.2 EUT INFORMATION

### 1.2.1 General Description of EUT

| | | | |
|---|---|---|---|
| **Product Name:** | Handheld Smart Terminal | | |
| **Model No.:** | T5se | | |
| **Add. Model No.:** | N/A | | |
| **Trade Mark:** |  or RHINO | | |
| **DUT Stage:** | Identical Prototype | | |
| **EUT Supports Function:** (Provided by the customer) | UTRA Bands: | Band II/ Band IV/ Band V | |
| | E-UTRA Bands: | FDD Band 2/ Band 4/ Band 5/ Band 7/ Band 12/ Band 13/ Band 14/ Band 17/ Band 25/ Band 26/ Band 30/ Band 66/ Band 71 | |
| | | TDD Band 41 | |
| | 2.4 GHz ISM Band: | IEEE 802.11b/g/n | |
| | | Bluetooth V4.2 | |
| | 5 GHz U-NII Bands: | 5 150 MHz to 5 250 MHz | IEEE 802.11a/n/ac |
| | | 5 250 MHz to 5 350 MHz | IEEE 802.11a/n/ac |
| | | 5 725 MHz to 5 850 MHz | IEEE 802.11a/n/ac |
| | RNSS Bands: | 1559 MHz to 1610 MHz | GPS/ Galileo/ GLONASS |
| | NFC: | 13.553 MHz to 13.567 MHz | |
| **Software Version:** | T5se(001)_20220624 (Provided by the customer) | | |
| **Hardware Version:** | AL_Z06_MB_V12 (Provided by the customer) | | |
| **Sample Received Date:** | April 13, 2022 | | |
| **Sample Tested Date:** | April 15, 2022 to June 27, 2022 | | |
| Note: The T5se have two LCD modules from different vendors. This report has evaluated and pre-testing of two batches of LCD modules, with only the worst data recorded in the report. | | | |
| **Remark:** The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description. | | | |

### 1.2.2 Description of Accessories

| Adapter | |
|---|---|
| **Model No.:** | XY-PP018U1 |
| **Input:** | 100-240 V~50/60 Hz 0.5A |
| **Output:** | 3.6-6.0 V ⎓ 3.0A, 6.0-9.0 V ⎓ 2.0A, 9.0-12.0 V ⎓ 1.5A |
| **AC Cable:** | N/A |
| **DC Cable:** | N/A |

| Internal Battery | |
|---|---|
| **Model No.:** | BPT5se |
| **Battery Type:** | Lithium-ion Rechargeable Battery |
| **Rated Voltage:** | 3.85 Vdc |
| **Limited Charge Voltage:** | 4.4 Vdc |
| **Rated Capacity:** | 3000 mAh |

| External Battery Pack | |
|---|---|
| **Model No.:** | T5SE-EBAT-3K-BLK |
| **Battery Type:** | Lithium-ion Rechargeable Battery |
| **Rated Voltage:** | 3.85 Vdc |
| **Limited Charge Voltage:** | 4.4 Vdc |
| **Rated Capacity:** | 3030 mAh |

| Cable | |
|---|---|
| **Description:** | USB Type-C Plug Cable |
| **Cable Type:** | Shielded without ferrite |
| **Length:** | 1 Meter |

## 1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

| | | | |
|---|---|---|---|
| **Support Networks:** | LTE | | |
| **Type of Modulation:** | LTE Band 14: | | QPSK, 16QAM, 64QAM |
| **Frequency Range:** | LTE Band 14 (Channel Bandwidth: 5 MHz): | | 790.5-795.5 MHz |
| | LTE Band 14 (Channel Bandwidth: 10 MHz): | | 793 MHz |
| **Max RF Output Power:** | LTE Band 14 (Channel Bandwidth: 5 MHz): | | 24.15 dBm |
| | LTE Band 14 (Channel Bandwidth: 10 MHz): | | 24.36 dBm |
| **Type of Emission:** | LTE Band 14 QPSK | Channel Bandwidth: 5 MHz | 4M55G7D |
| | | Channel Bandwidth: 10 MHz | 9M02G7D |
| | LTE Band 14 16QAM | Channel Bandwidth: 5 MHz | 4M54W7D |
| | | Channel Bandwidth: 10 MHz | 9M00W7D |
| | LTE Band 14 64QAM | Channel Bandwidth: 5 MHz | 4M54W7D |
| | | Channel Bandwidth: 10 MHz | 8M99W7D |
| **IEMI:** | Radiated: 354657110011383 | | |
| | Conducted: 354657110011581, 354657110011771 | | |
| **Antenna Type:** (Provided by the customer) | LDS Antenna | | |
| **Antenna Gain:** (Provided by the customer) | -0.69 dBi | | |
| **Normal Test Voltage:** | 3.85 Vdc | | |
| **Extreme Test Voltage:** | 3.4 to 4.4Vdc | | |
| **Extreme Test Temperature:** | -30 °C to +50 °C | | |

## 1.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

| Description | Manufacturer | Model No. | Serial Number | Supplied by |
|---|---|---|---|---|
| -- | -- | -- | -- | -- |

2) Support Cable

| Cable No. | Description | Connector | Length | Supplied by |
|---|---|---|---|---|
| 1 | Antenna Cable | SMA | 0.3 Meter | UnionTrust |

## 1.5 TEST LOCATION

**Shenzhen UnionTrust Quality and Technology Co., Ltd.**

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China, China 518109
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

## 1.6 TEST FACILITY

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

**CNAS-Lab Code: L9069**
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

**A2LA-Lab Certificate No.: 4312.01**
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**ISED Wireless Device Testing Laboratories**
CAB identifier: CN0032

**FCC Accredited Lab.**
Designation Number: CN1194
Test Firm Registration Number: 259480

## 1.7 DEVIATION FROM STANDARDS

None.

## 1.8 ABNORMALITIES FROM STANDARD CONDITIONS

None.

## 1.9 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

## 1.10 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| No. | Item | Measurement Uncertainty |
|---|---|---|
| 1 | Conducted Output Power | ±0.7 dB |
| 2 | 99%&26dB Bandwidth | ±1.86 % |
| 3 | Emission Mask | ±2.7 dBm |
| 4 | Spurious emissions at antenna terminals | ±2.7 dBm |
| 5 | Field strength of spurious radiation | 30 MHz-1 GHz: ±4.9 dB<br>1 GHz-18 GHz: ±4.8 dB<br>18 GHz-40 GHz: ±5.1 dB |
| 6 | Frequency stability | ±6.5 x $10^{-8}$ |
| 7 | Humidity | ±3.9 % |
| 8 | Temperature | ±0.62 ℃ |
| 9 | DC Voltages | ±0.68 % |

## 2. TEST SUMMARY

| FCC 47 CFR Part 90 Subpart R Test Cases | | | |
|---|---|---|---|
| **Test Item** | **Test Requirement** | **Test Method** | **Result** |
| **Effective Radiated Power (ERP)** | FCC 47 CFR Part 2.1046 & FCC 47 CFR Part 90.542(a)(7) | KDB 412172 D01 | PASS |
| **Conducted Output Power** | FCC 47 CFR Part 2.1046 | ANSI C63.26-2015, Clause 5.2 | PASS |
| **99%&26dB Bandwidth** | FCC 47 CFR Part 2.1049 | ANSI C63.26-2015, Clause 5.4 | PASS |
| **Emission Mask** | FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543 | ANSI C63.26-2015, Clause 5.7 | PASS |
| **Spurious emissions at antenna terminals** | FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543 | ANSI C63.26-2015, Clause 5.7 | PASS |
| **Field strength of spurious radiation** | FCC 47 CFR Part 2.1053 & FCC 47 CFR Part 90.543 | ANSI C63.26-2015, Clause 5.5 | PASS |
| **Frequency stability** | FCC 47 CFR Part 2.1055 & FCC 47 CFR Part 90.539 | ANSI C63.26-2015, Clause 5.6 | PASS |
| **Peak-to-average power ratio (PAPR)** | N/A | ANSI C63.26-2015, Clause 5.2.3.4 | PASS |
| **Disclaimer and Explanations:** The declared of product specification and data (e.g. antenna gain, RF specification, etc) for EUT presented in the report are provided by the customer, and the customer takes all the responsibilities for the accuracy of product specification. | | | |

# 3. EQUIPMENT LIST

| Radiated Emission Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date** | **Cal. Due date** |
| ☒ | 3M Chamber & Accessory Equipment | ETS-LINDGREN | 3M | Euroshiedpn-CT001270-1317 | 22-Jan-2021 | 21-Jan-2024 |
| ☒ | Receiver | R&S | ESIB26 | 100114 | 5-Nov-2021 | 4-Nov-2022 |
| ☐ | EXA Spectrum Analyzer | KEYSIGHT | N9010A | MY51440197 | 15-Apr-2022 | 14-Apr-2023 |
| ☐ | Loop Antenna | ETS-LINDGREN | 6502 | 00202525 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | Broadband Antenna | ETS-LINDGREN | 3142E | 00201566 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103001 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | Preamplifier | HP | 8447F | 2805A02960 | 5-Nov-2021 | 4-Nov-2022 |
| ☐ | Broadband Antenna (Pre-amplifier) | ETS-LINDGREN | 3142E-PA | 00201891 | 30-Apr-2021 | 29-Apr-2023 |
| ☐ | 6dB Attenuator | Talent | RA6A5-N-18 | 18103002 | 5-Nov-2021 | 4-Nov-2022 |
| ☐ | Horn Antenna | ETS-LINDGREN | 3117 | 00164202 | 11-Nov-2021 | 10-Nov-2023 |
| ☒ | Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3117-PA | 00201874 | 17-Apr-2022 | 16-Apr-2024 |
| ☒ | Pre-amplifier | ETS-LINDGREN | 00118385 | 00201874 | 6-Nov-2021 | 5-Nov-2022 |
| ☐ | Horn Antenna | ETS-LINDGREN | 3116C | 00200180 | 17-Apr-2022 | 16-Apr-2024 |
| ☒ | Horn Antenna (Pre-amplifier) | ETS-LINDGREN | 3116C-PA | 00202652 | 14-Nov-2020 | 13-Nov-2022 |
| ☒ | Pre-amplifier | ETS-LINDGREN | 00118384 | 00202652 | 17-Nov-2020 | 16-Nov-2022 |
| ☒ | Multi device Controller | ETS-LINDGREN | 7006-001 | 00160105 | N/A | N/A |
| ☒ | Test Software | Audix | e3 | Software Version: 9.160323 | | |

| RF Conducted Test Equipment List | | | | | | |
|---|---|---|---|---|---|---|
| **Used** | **Equipment** | **Manufacturer** | **Model No.** | **Serial Number** | **Cal. date** | **Cal. Due date** |
| ☐ | EXA Spectrum Analyzer | KEYSIGHT | N9010A | MY51440197 | 15-Apr-2022 | 14-Apr-2023 |
| ☒ | EXA Spectrum Analyzer | KEYSIGHT | N9020A | MY51286807 | 5-Nov-2021 | 4-Nov-2022 |
| ☐ | Spectrum analyzer | R&S | FSV40-N | 101653 | 15-Apr-2022 | 14-Apr-2023 |
| ☒ | DC Source | KIKUSUI | PWR400L | LK003024 | 20-Aug-2021 | 19-Aug-2022 |
| ☐ | Temp & Humidity chamber | Espec | GL(U)04KA(W) | 16921H201P3 | 20-Aug-2021 | 19-Aug-2022 |
| ☒ | Temp & Humidity chamber | Votisch | VT4002 | 58566133290020 | 15-Apr-2022 | 14-Apr-2023 |
| ☐ | Wideband Radio Communication Tester | R&S | CMW500 | 119583 | 15-Apr-2022 | 14-Apr-2023 |
| ☒ | Wideband Radio Communication Tester | R&S | CMW500 | 120932 | 15-Apr-2022 | 14-Apr-2023 |

# 4. TEST CONFIGURATION

## 4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

| Test Environment | Selected Values During Tests | | |
|---|---|---|---|
| Test Condition | Ambient | | |
| | Temperature (°C) | Voltage (V) | Relative Humidity (%) |
| TN/VN | +15 to +35 | 3.85 | 20 to 75 |
| TL/VL | -30 | 3.4 | 20 to 75 |
| TH/VL | +50 | 3.4 | 20 to 75 |
| TL/VH | -30 | 4.4 | 20 to 75 |
| TH/VH | +50 | 4.4 | 20 to 75 |

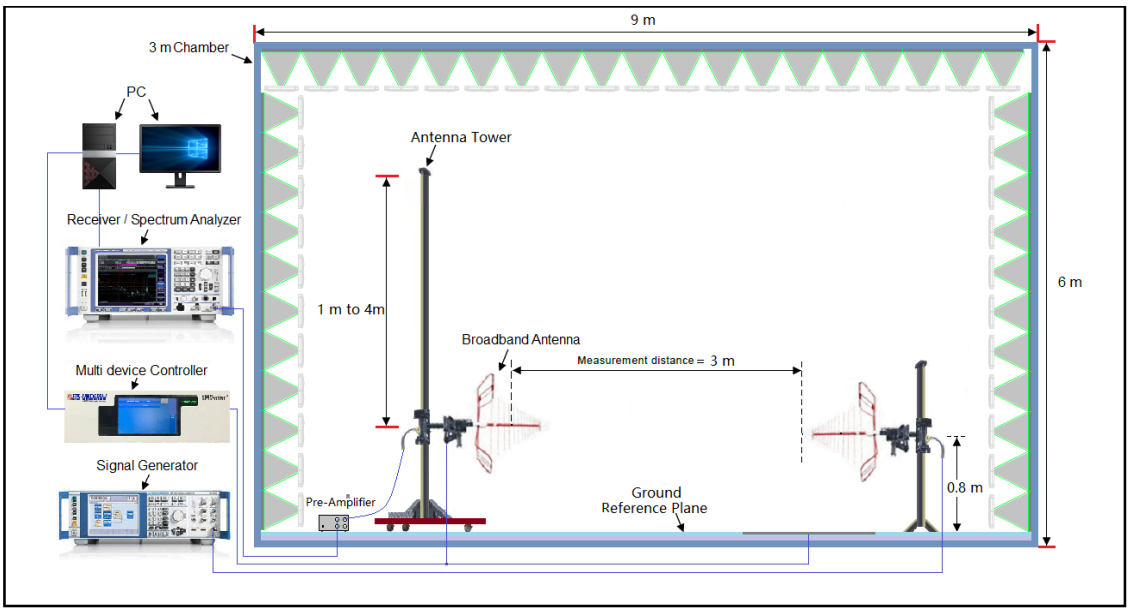
**Remark:**

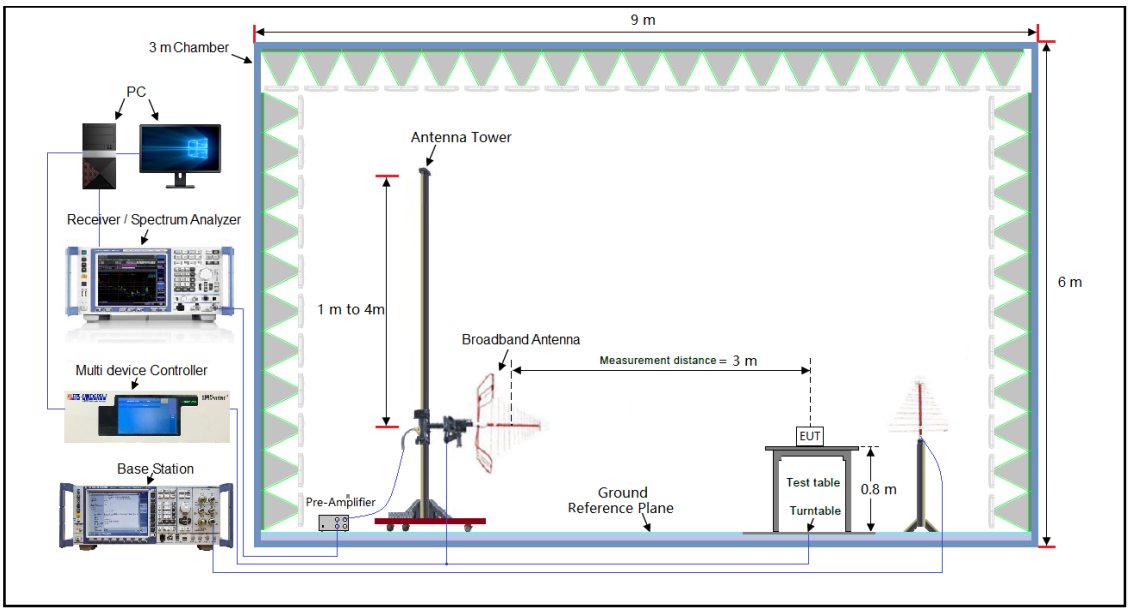
1) The EUT just work in such extreme temperature of -30 °C to +50 °C and the extreme voltage of 3.4 V to 4.4 V, so here the EUT is tested in the temperature of -30 °C to +50 °C and the voltage of 3.4 V to 4.4 V.
2) VN: Normal Voltage; TN: Normal Temperature;
TL: Low Extreme Test Temperature; TH: High Extreme Test Temperature;
VL: Low Extreme Test Voltage; VH: High Extreme Test Voltage.

## 4.2 TEST SETUP

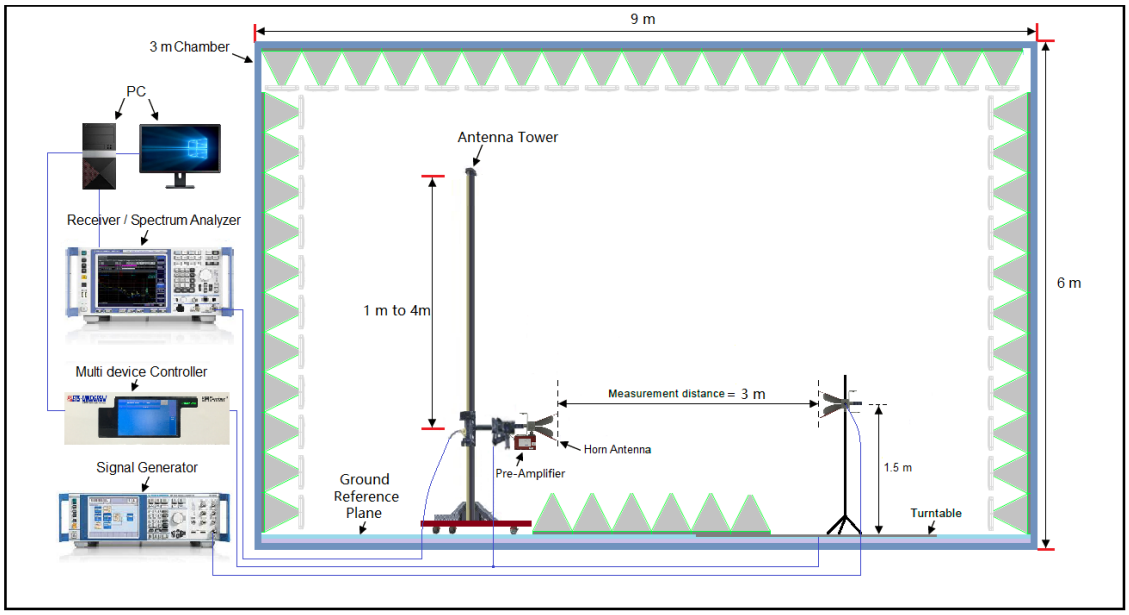
### 4.2.1 For Radiated Emissions test setup

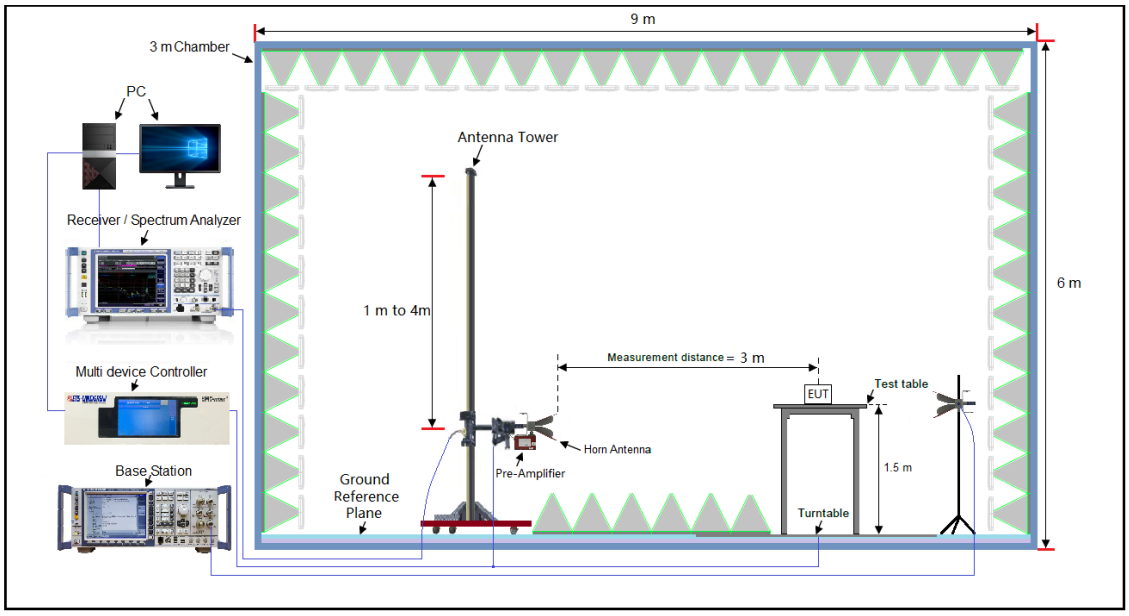
**Setup - 1_ERP Test setup**



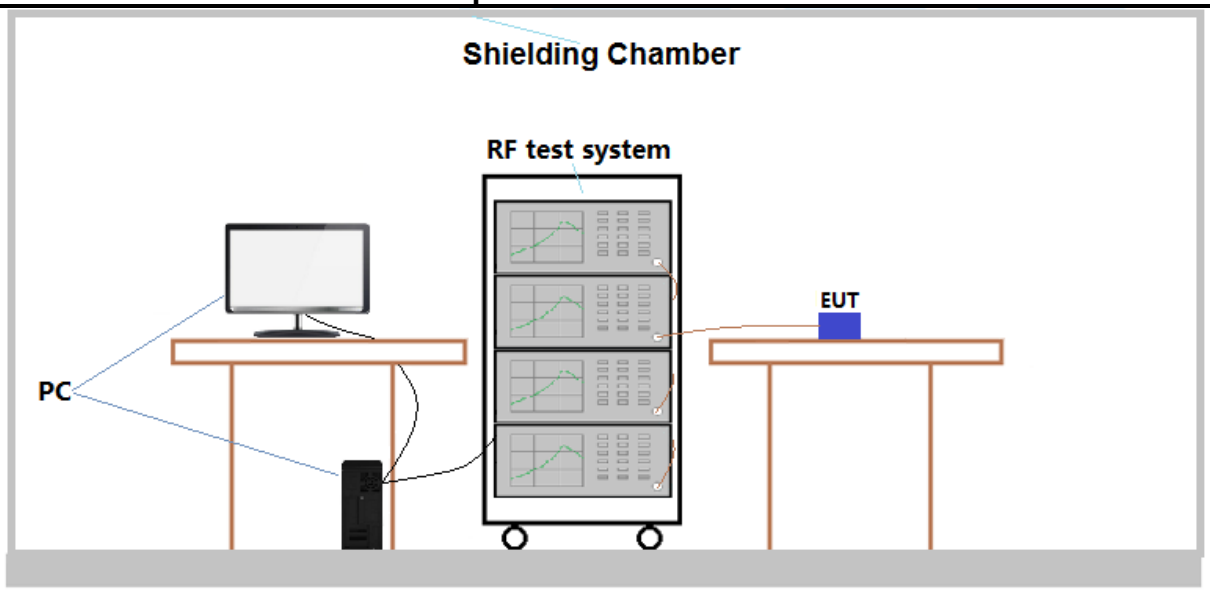



**Setup - 2_EIRP Test setup**

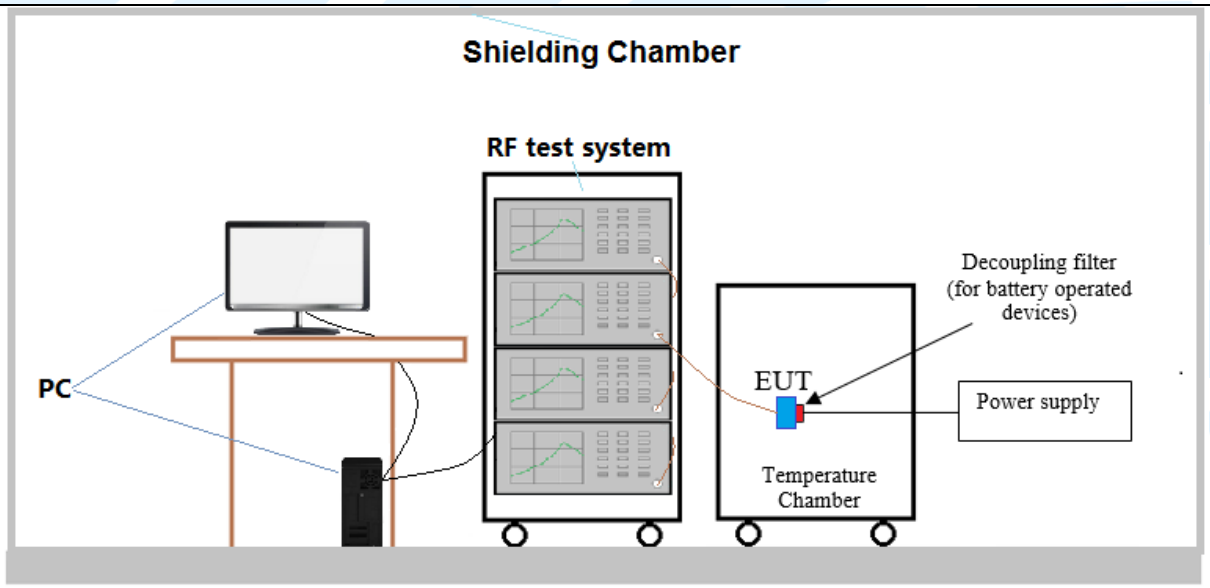


### 4.2.2 For Conducted RF test setup




Normal Environment




Extreme Environment

## 4.3 TEST CHANNELS

| Band | Test Frequency ID | Bandwidth (MHz) | Number [UL] | Frequency of Uplink (MHz) |
|---|---|---|---|---|
| TX: 788 MHz to 798 MHz | Low Range | 5 | 23305 | 790.5 |
| | | 10 | 23330 | 793 |
| | Middle Range | 5/10 | 23330 | 793 |
| | High Range | 5 | 23355 | 795.5 |
| | | 10 | 23330 | 793 |

## 4.4 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.85V battery. Only the worst-case data were recorded in this test report.

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, X/Y/Z axis, and antenna ports.

All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000MHz. The resolution is 1 MHz or greater for frequencies above 1000MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

## 4.5 PRE-SCAN

During all testing, EUT is in link mode with base station emulator at maximum power level. LTE worse case mode applicability and tested channel detail as below:

| Item | Channel Bandwidth (MHz) | | | | | | Modulation | | | RB # | | | Test Channel | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1.4 | 3 | 5 | 10 | 15 | 20 | QPSK | 16QAM | 64QAM | 1 | Half | Full | L | M | H |
| **LTE Band 14** | | | | | | | | | | | | | | | |
| **Conducted output power** | ☐ | ☐ | ☒ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ | ☒ | ☒ | ☒ | ☒ | ☒ | ☒ |
| **Peak-to-average ratio** | ☐ | ☐ | ☐ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ | ☐ | ☐ | ☒ | ☐ | ☒ | ☐ |
| **99%&26dB Bandwidth** | ☐ | ☐ | ☒ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ | ☒ |
| **Band Edge at antenna terminals** | ☐ | ☐ | ☒ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ | ☒ | ☐ | ☒ | ☒ | ☐ | ☒ |
| **Spurious emissions at antenna terminals** | ☐ | ☐ | ☒ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ |
| **Field strength of spurious radiation** | ☐ | ☐ | ☒ | ☒ | ☐ | ☐ | ☒ | ☐ | ☐ | ☒ | ☐ | ☐ | ☒ | ☒ | ☒ |
| **Frequency stability** | ☐ | ☐ | ☐ | ☒ | ☐ | ☐ | ☒ | ☐ | ☐ | ☐ | ☐ | ☒ | ☐ | ☒ | ☐ |

Remark:
The mark "☒" means is chosen for testing;
The mark "☐" means is not chosen for testing;
The mark "--" means is not supported bandwidth.

# 5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

## 5.1 REFERENCE DOCUMENTS FOR TESTING

| No. | Identity | Document Title |
|---|---|---|
| 1 | FCC 47 CFR Part 2 | Frequency allocations and radio treaty matters; general rules and regulations |
| 2 | FCC 47 CFR Part 90 | Private Land Mobile Radio Services |
| 3 | ANSI C63.26-2015 | American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services |
| 4 | KDB 412172 D01 Determining ERP and EIRP v01r01 | Guidelines for determining the effective radiated power (ERP) and isotropically radiated power (EIRP) of an RF transmitting system |

## 5.2 CONDUCTED OUTPUT POWER AND ERP

**Test Requirement:** FCC 47 CFR Part 2.1046

**Test Method:** ANSI C63.26-2015, Clause 5.2

**Limit:**

- **Conducted Output Power:** No Limit
- **Effective Radiated Power (ERP):** Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

**Test Procedure:**

- **Conducted Output Power:** The EUT was set up for the maximum power with CMW500, and LTE link data modulation and link up with simulator. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

  Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

- **Effective Radiated Power (ERP)**
  According to KDB 412172 D01 Power Approach,
  - **ERP or EIRP = $P_T + G_T - L_C$**
  - **ERP = EIRP -2.15**

  where
  - **$P_T$** = transmitter output power, expressed in dBW, dBm, or PSD;
  - **$G_T$** = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
  - **$L_C$** = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

**Test Setup:** Refer to section 4.2.2 for details.

**Instruments Used:** Refer to section 3 for details

**Test Mode:** Link mode

**Test Results:** Pass

**Conducted Output Power:**

| Conducted Power (dBm) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Modulation | | | QPSK | | | 16QAM | | | 64QAM | | |
| Band | Bandwidth (MHz) | RB | 5305 | 5330 | 5355 | 5305 | 5330 | 5355 | 5305 | 5330 | 5355 |
| | | | 790.5 | 793 | 795.5 | 790.5 | 793 | 795.5 | 790.5 | 793 | 795.5 |
| 14 | 5 | 1@0 | 24.15 | 24.06 | 24.05 | 23.14 | 23.20 | 22.92 | 22.20 | 22.32 | 22.10 |
| | | 1@12 | 24.14 | 24.10 | 24.08 | 23.12 | 23.06 | 22.95 | 22.19 | 22.16 | 22.02 |
| | | 1@24 | 24.06 | 24.04 | 24.10 | 22.98 | 23.05 | 22.98 | 22.02 | 22.12 | 21.99 |
| | | 12@0 | 23.14 | 23.20 | 23.20 | 22.11 | 22.23 | 22.17 | 21.26 | 21.30 | 21.31 |
| | | 12@7 | 23.18 | 23.22 | 23.20 | 22.16 | 22.16 | 22.11 | 21.24 | 21.18 | 21.19 |
| | | 12@13 | 23.21 | 23.22 | 23.22 | 22.16 | 22.17 | 22.07 | 21.20 | 21.19 | 21.22 |
| | | 25@0 | 23.24 | 23.16 | 23.19 | 22.32 | 22.20 | 22.23 | 21.38 | 21.34 | 21.30 |
| Band | Bandwidth (MHz) | RB | -- | 5330 | -- | -- | 5330 | -- | -- | 5330 | -- |
| | | | -- | 793 | -- | -- | 793 | -- | -- | 793 | -- |
| 14 | 10 | 1@0 | -- | 24.29 | -- | -- | 23.31 | -- | -- | 22.33 | -- |
| | | 1@25 | | 24.36 | | | 23.34 | | | 22.43 | |
| | | 1@49 | | 24.25 | | | 23.25 | | | 22.42 | |
| | | 25@0 | | 23.45 | | | 22.33 | | | 21.35 | |
| | | 25@12 | | 23.24 | | | 22.19 | | | 21.29 | |
| | | 25@25 | | 23.28 | | | 22.19 | | | 21.21 | |
| | | 50@0 | | 23.27 | | | 22.20 | | | 21.33 | |

**ERP, ($G_T$ - $L_C$) = -0.69 dB**

| Channel | LTE Band 14 Maximum ERP (dBm) | | | | LTE Band 14 Maximum ERP (W) | | | | Result |
|---|---|---|---|---|---|---|---|---|---|
| | QPSK | 16QAM | 64QAM | Limit (dBm) | QPSK | 16QAM | 64QAM | Limit (W) | |
| **Channel Bandwidth: 5MHz** | | | | | | | | | |
| Lowest | 21.31 | 20.30 | 19.36 | 34.77 | 0.1352 | 0.1072 | 0.0863 | 3 | Pass |
| Middle | 21.26 | 20.36 | 19.48 | 34.77 | 0.1337 | 0.1086 | 0.0887 | 3 | Pass |
| Highest | 21.26 | 20.14 | 19.26 | 34.77 | 0.1337 | 0.1033 | 0.0843 | 3 | Pass |
| **Channel Bandwidth: 10MHz** | | | | | | | | | |
| Middle | 21.52 | 20.50 | 19.59 | 34.77 | 0.1419 | 0.1122 | 0.0910 | 3 | Pass |

Note: The maximum ERP/EIRP is calculated from max output power and antenna gain, the antenna gain provided by the customer, and the customer takes all the responsibilities for the accuracy of antenna gain.

## 5.3 99%&26DB BANDWIDTH

**Test Requirement:** FCC 47 CFR Part 2.1049

**Test Method:** ANSI C63.26-2015, Clause 5.4

**Limit:** No Limit

**Test Procedure:**

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the low, middle and high channel in each band. The 99% and -26dB bandwidths was also measured and recorded.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

**Test Setup:** Refer to section 4.2.2 for details.

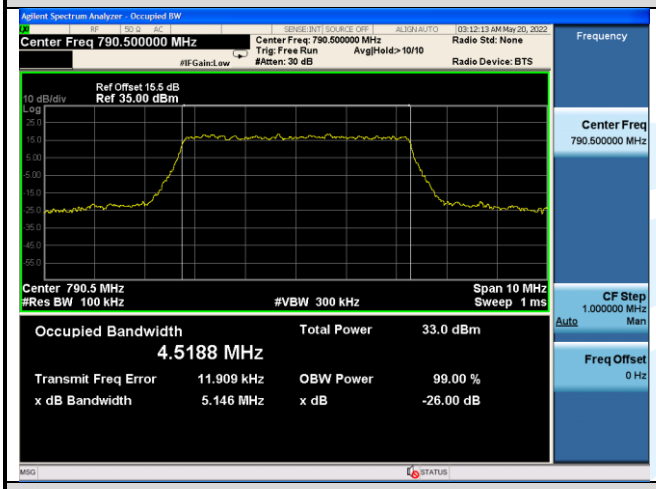
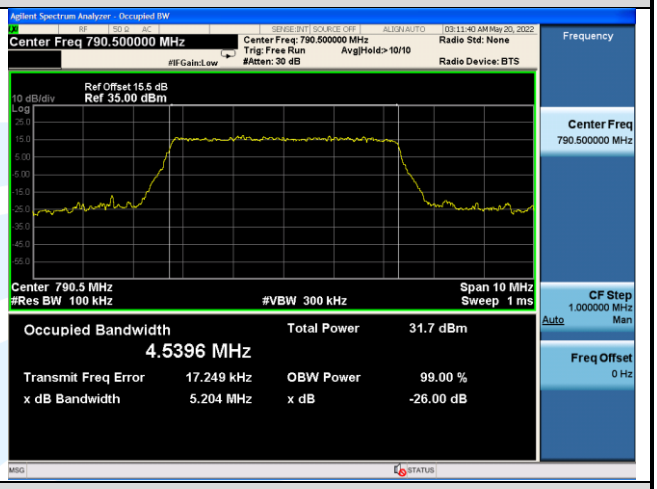
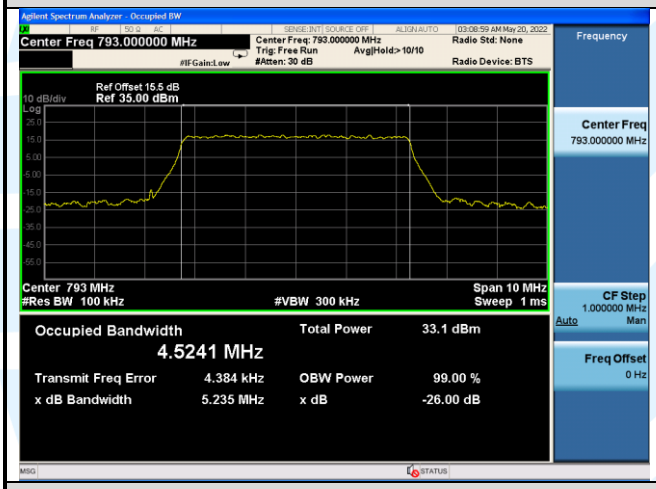
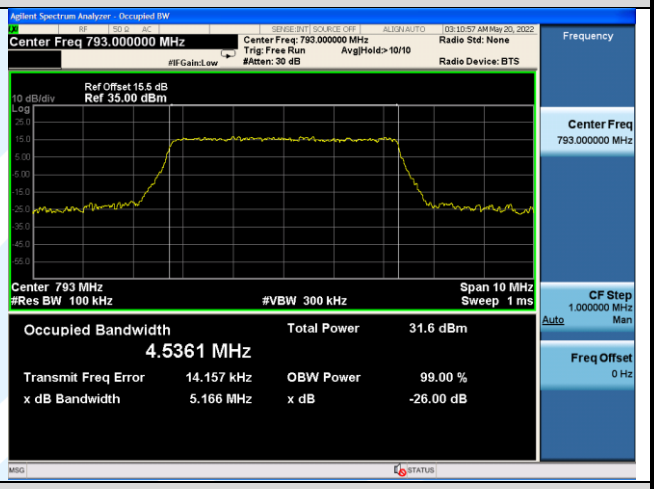
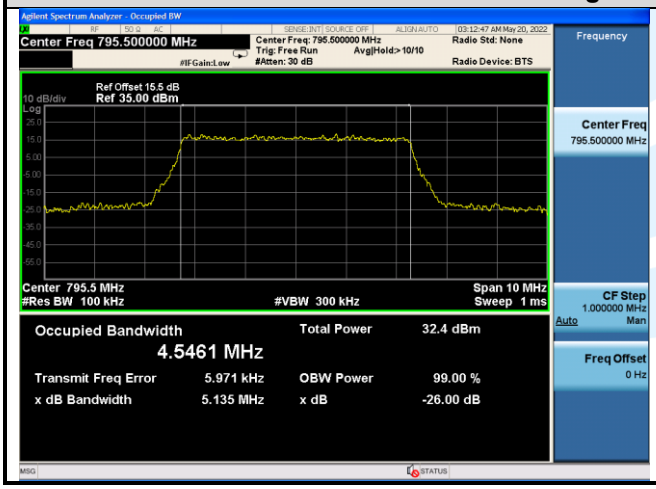
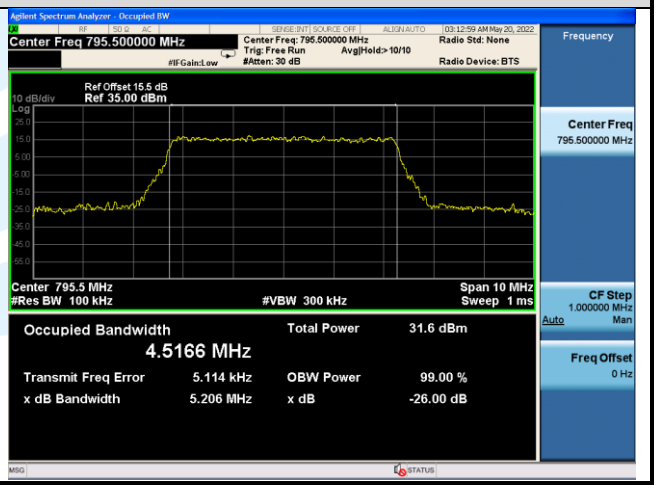
**Instruments Used:** Refer to section 3 for details

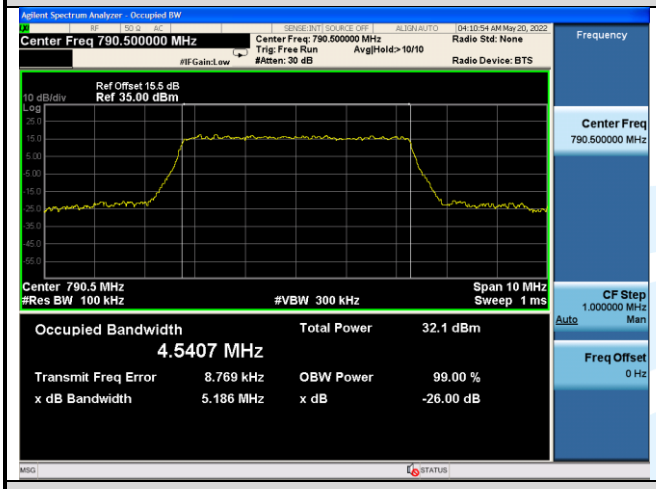
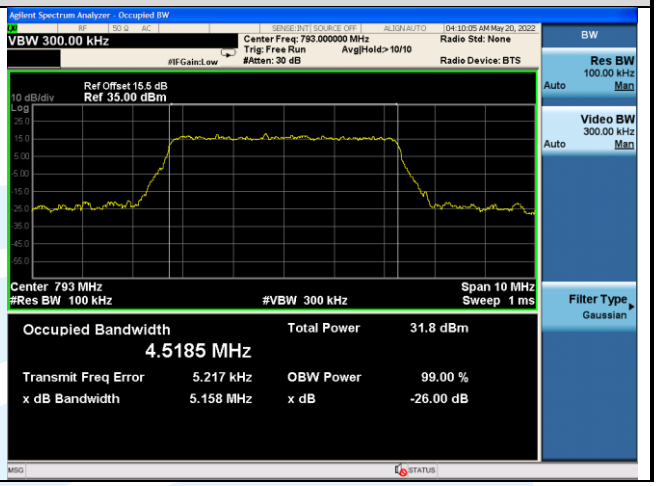
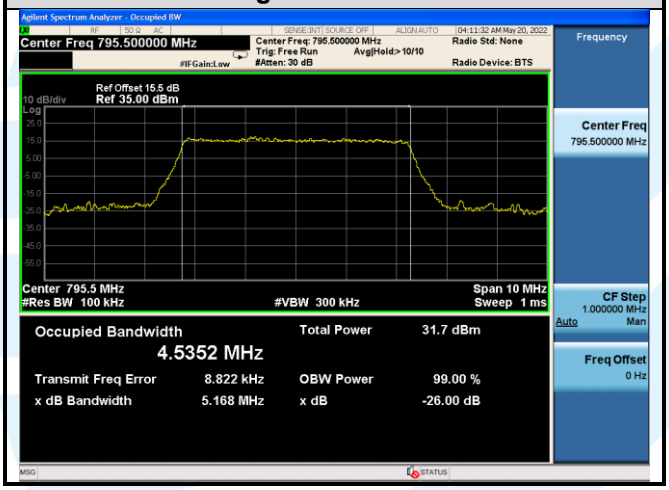
**Test Mode:** Link mode

**Test Results:** Pass

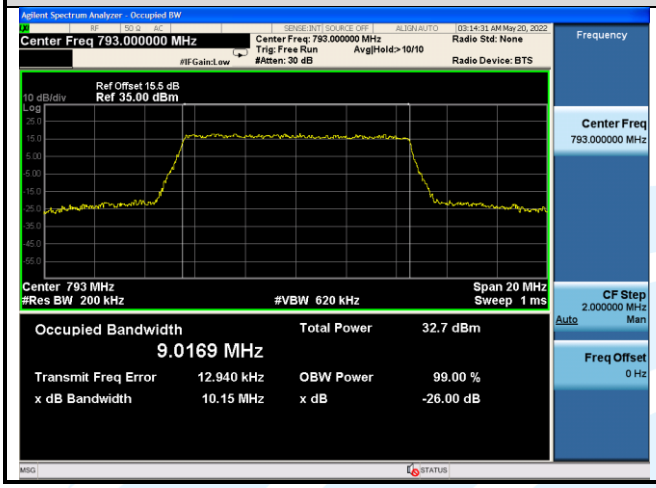
| LTE Band 14 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel | RB Configuration | | 26 dB BW (MHz) | | | 99% BW (MHz) | | |
| | Size | Offset | QPSK | 16QAM | 64QAM | QPSK | 16QAM | 64QAM |
| Channel Bandwidth: 5 MHz | | | | | | | | |
| Lowest | 25 | 0 | 5.146 | 5.204 | 5.186 | 4.5188 | 4.5396 | 4.5407 |
| Middle | 25 | 0 | 5.235 | 5.166 | 5.158 | 4.5241 | 4.5361 | 4.5185 |
| Highest | 25 | 0 | 5.135 | 5.206 | 5.168 | 4.5461 | 4.5166 | 4.5352 |
| Channel Bandwidth: 10 MHz | | | | | | | | |
| Middle | 50 | 0 | 10.15 | 10.04 | 10.11 | 9.0169 | 9.0020 | 8.9936 |

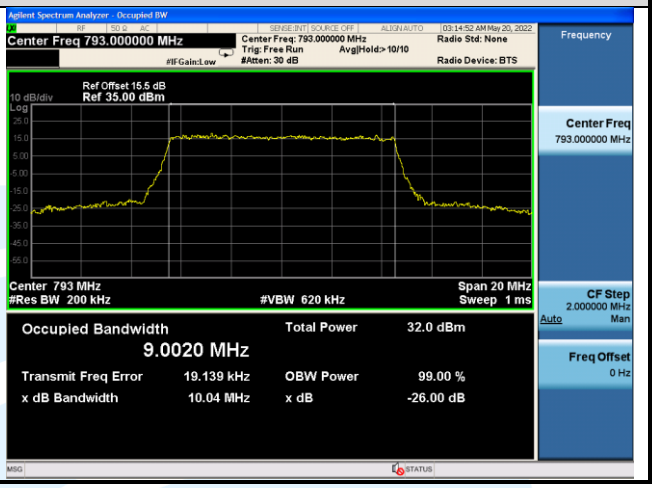
**The test plot as follows:**

| LTE Band 14_ Channel Bandwidth: 5 MHz | |
|---|---|
| QPSK | 16QAM |
| **Lowest Channel** | |
|  |  |
| **Middle Channel** | |
|  |  |
| **Highest Channel** | |
|  |  |

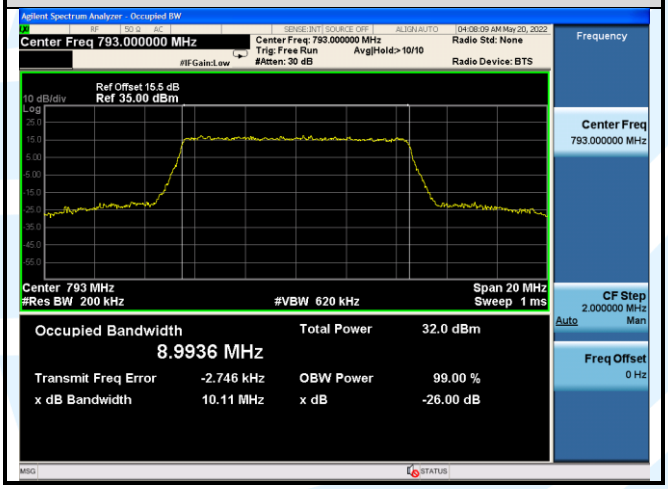
| LTE Band 14_ Channel Bandwidth: 5 MHz | |
|---|---|
| 64QAM | 64QAM |
| Lowest Channel | Middle Channel |
|  |  |
| 64QAM | |
| Highest Channel | |
|  | |

| LTE Band 14_ Channel Bandwidth: 10 MHz | |
|---|---|
| QPSK | 16QAM |
| Middle Channel | |




| LTE Band 14 / 10MHz / 64QAM |
|---|
| Lowest Channel |



## 5.4 EMISSION MASK

**Test Requirement:** FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.691

**Test Method:** ANSI C63.26-2015, Clause 5.7

**Limit:**

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

**Test Procedure:**

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer.

For each band edge measurement:

1) Set the spectrum analyzer span to include the low or high channels.
2) Set the emissions mask of low or high channels.
3) Set resolution bandwidth to at least 1% of emission bandwidth and the VBW set 3 times of RBW.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

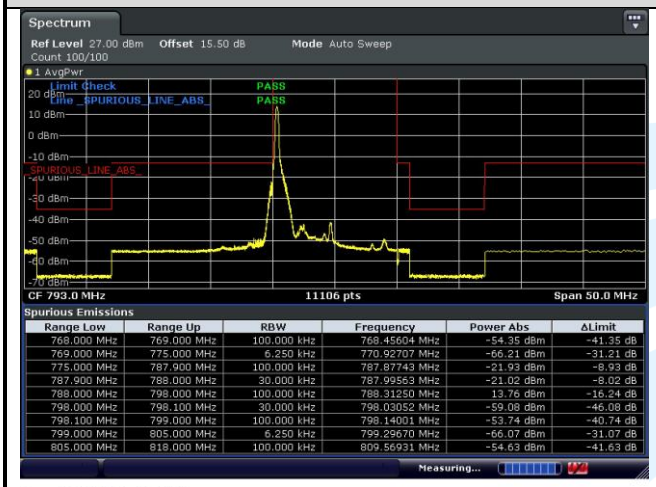
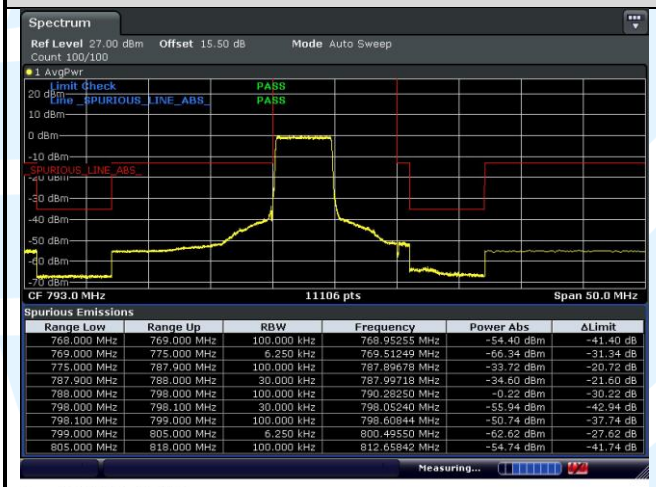
**Test Setup:** Refer to section 4.2.2 for details.

**Instruments Used:** Refer to section 3 for details

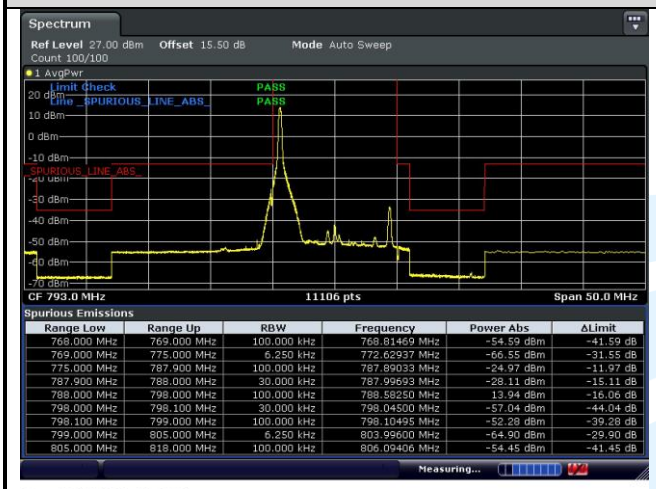
**Test Mode:** Link mode

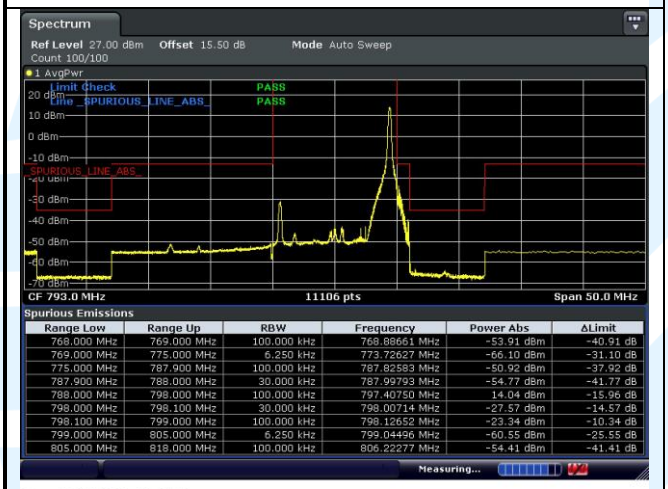
**Test Results:** Pass

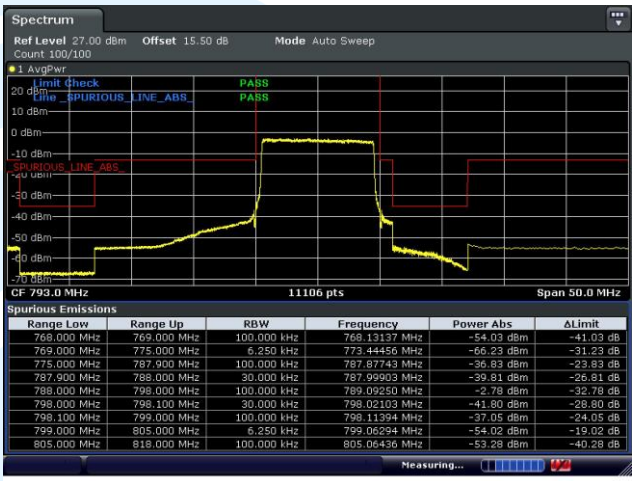
**The test plot as follows:**

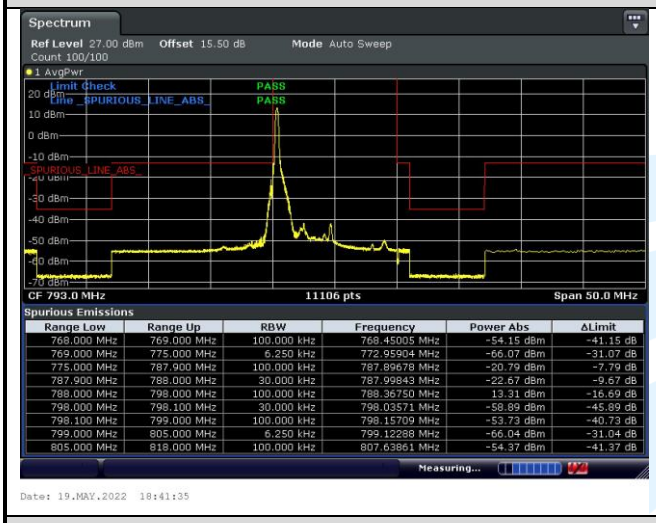
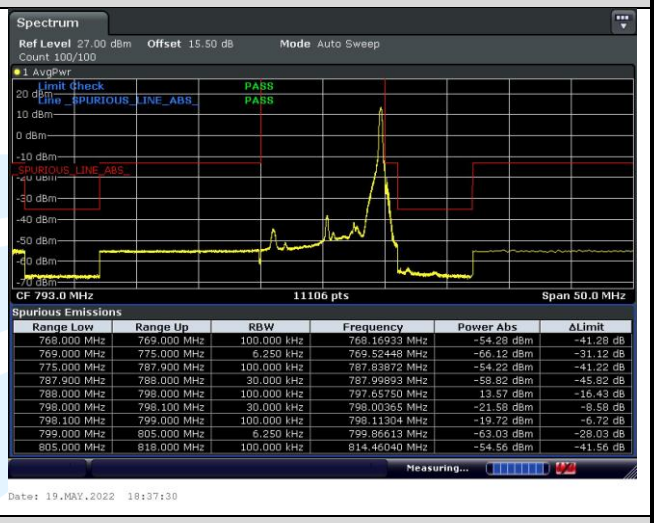
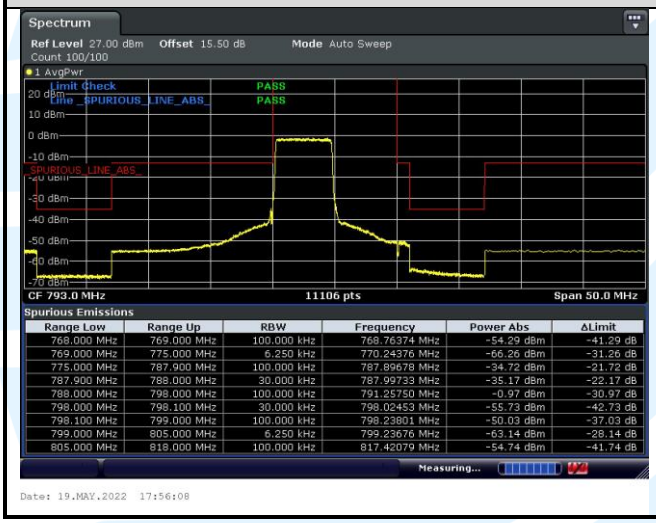
| LTE Band 14 / 5 MHz / QPSK | |
|---|---|
| **Lowest Channel** | **Highest Channel** |
| **1 RB** | |
|  |  |
| **Full RB** | |
|  |  |

| LTE Band 14 / 10 MHz / QPSK_ Middle Channel | |
|---|---|
| 1 RB | Full RB |

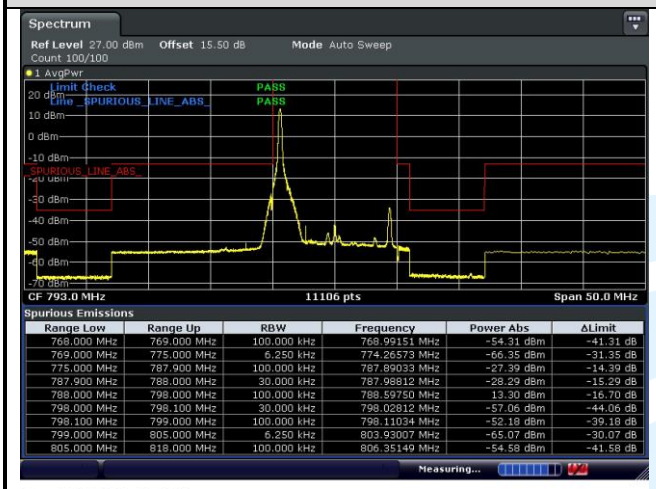


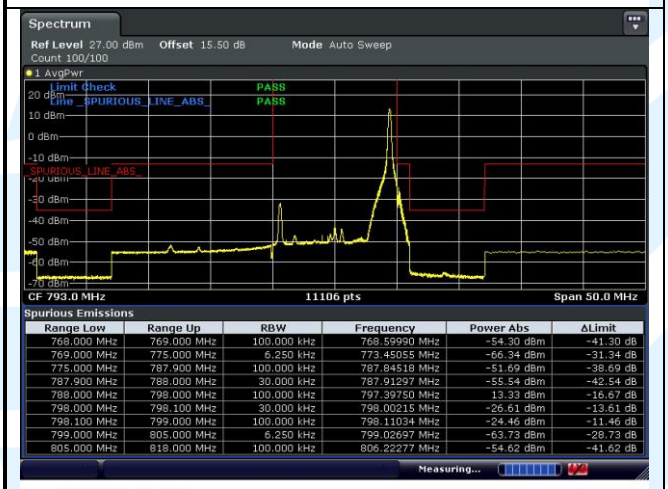



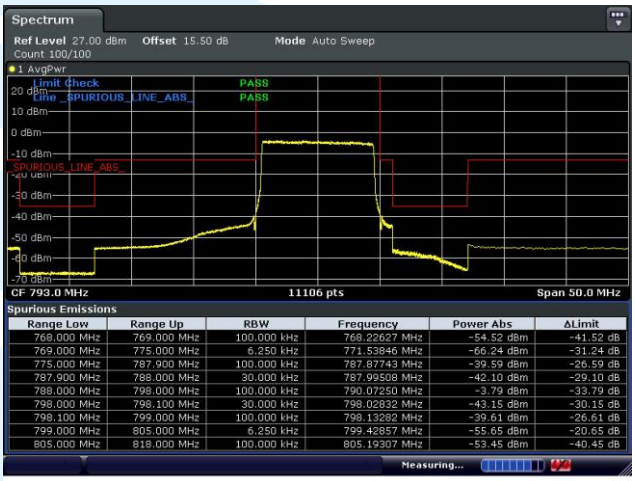



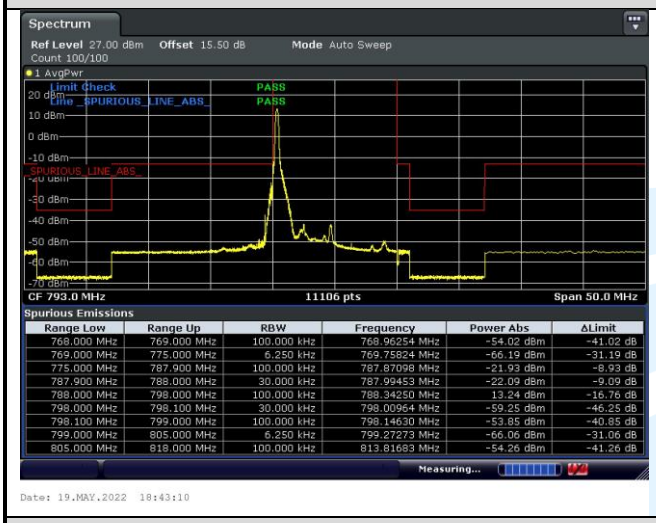
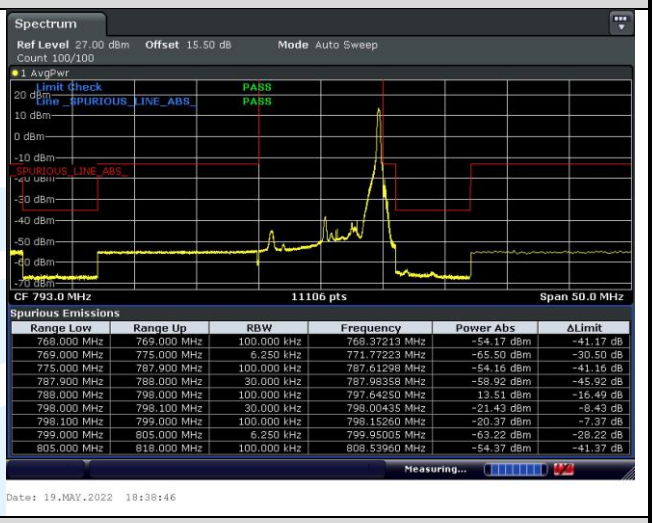
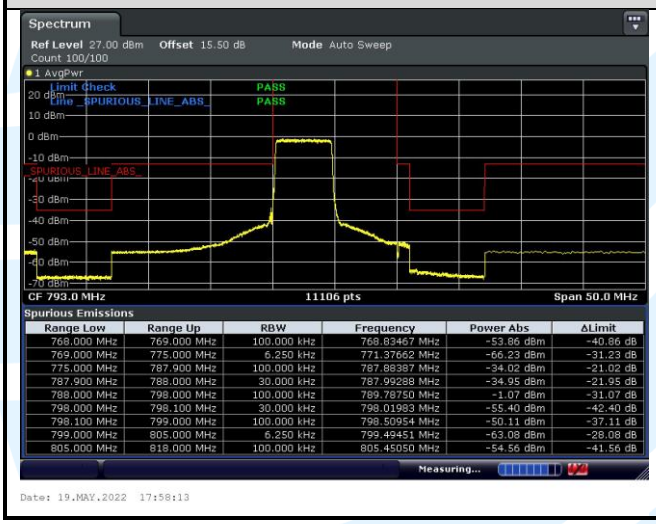
| LTE Band 14 / 5 MHz / 16QAM | |
|---|---|
| **Lowest Channel** | **Highest Channel** |
| **1 RB** | |
|  |  |
| **Full RB** | |
|  |  |

| LTE Band 14 / 10 MHz / 16QAM_ Middle Channel | |
|---|---|
| 1 RB | Full RB |

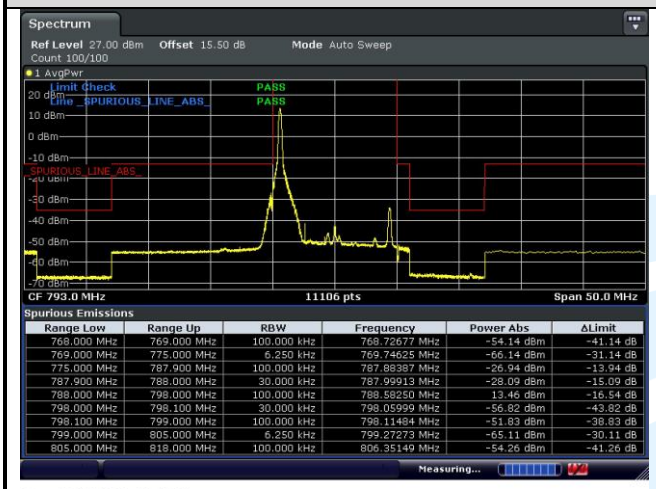


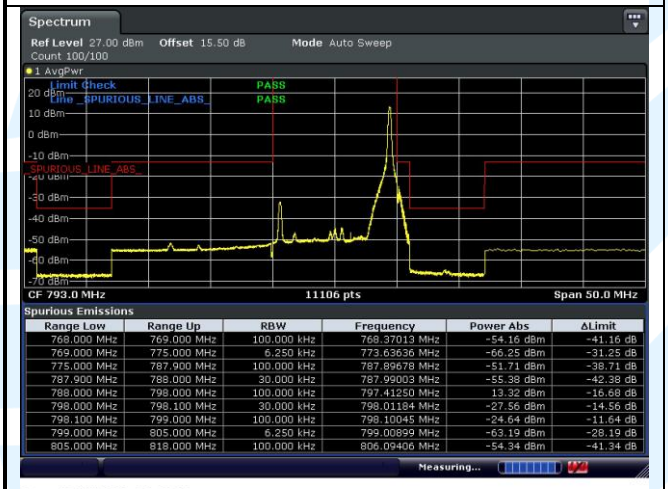



| LTE Band 14 / 5 MHz / 64QAM | |
|---|---|
| **Lowest Channel** | **Highest Channel** |
| **1 RB** | |
|  |  |
| **Full RB** | |
|  |  |

| LTE Band 14 / 10 MHz / 64QAM_ Middle Channel | |
|---|---|
| 1 RB | Full RB |




## 5.5 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

**Test Requirement:** FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543

**Test Method:** ANSI C63.26-2015, Clause 5.7

**Limit:**

The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.

**Test Procedure:**

The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range. b. Measuring frequency range is from 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

**Test Setup:** Refer to section 4.2.2 for details.

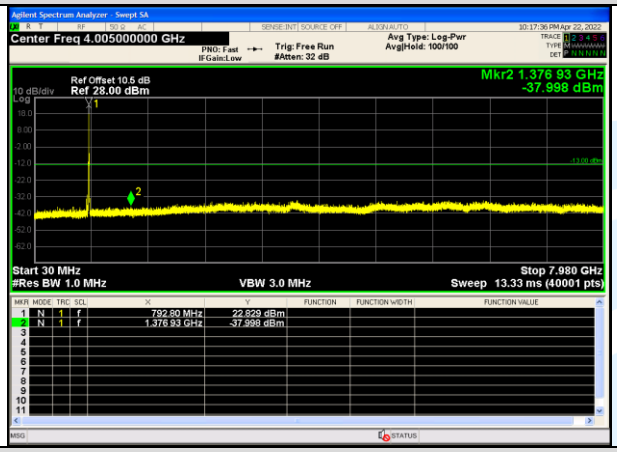
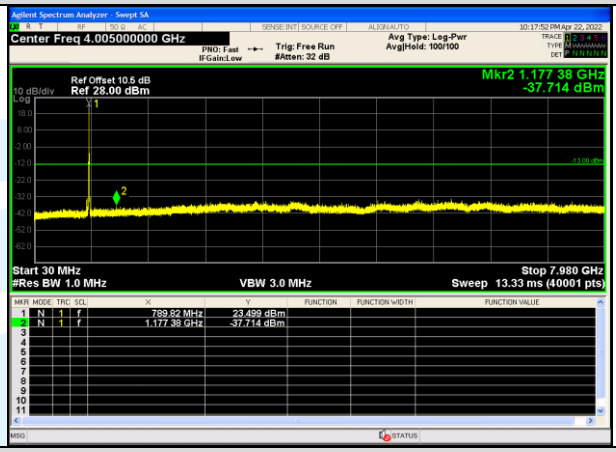
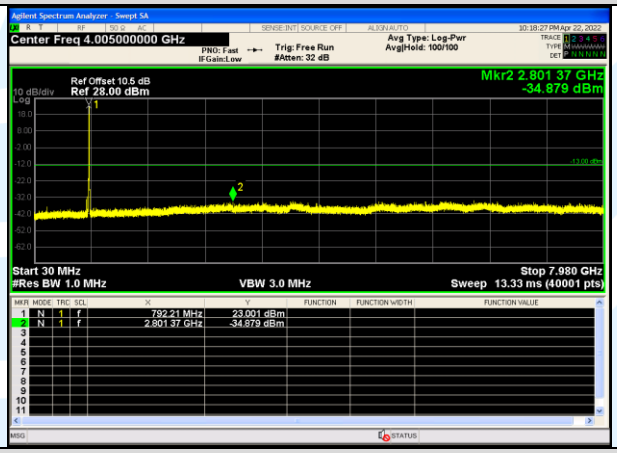
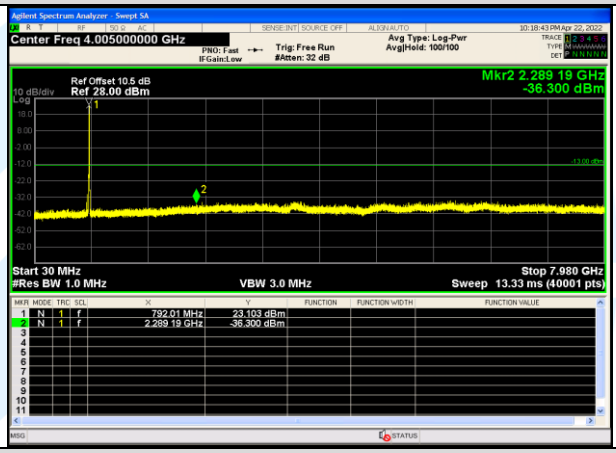
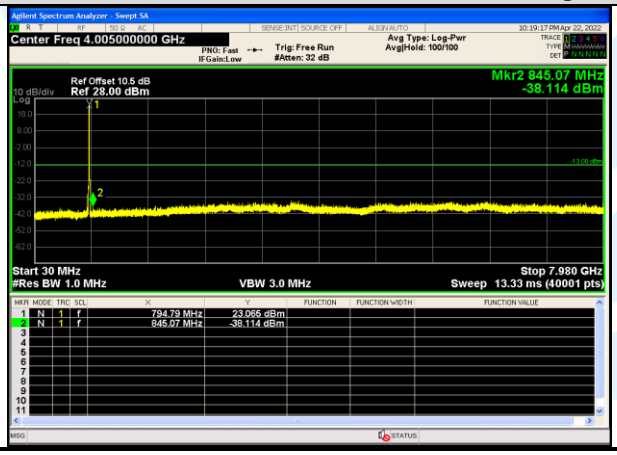
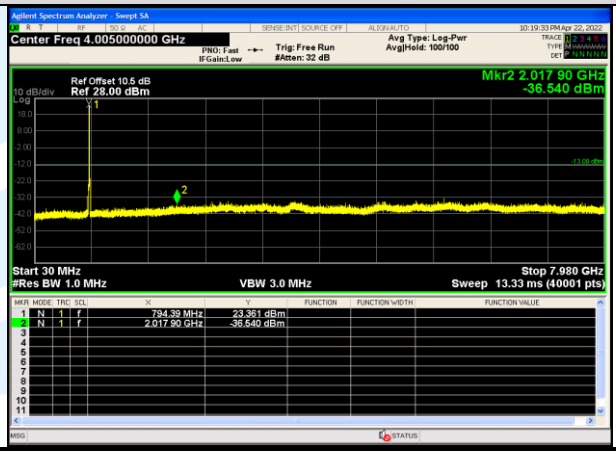
**Instruments Used:** Refer to section 3 for details

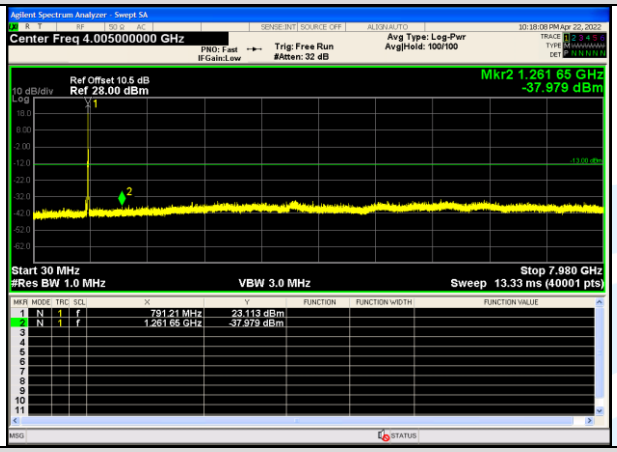
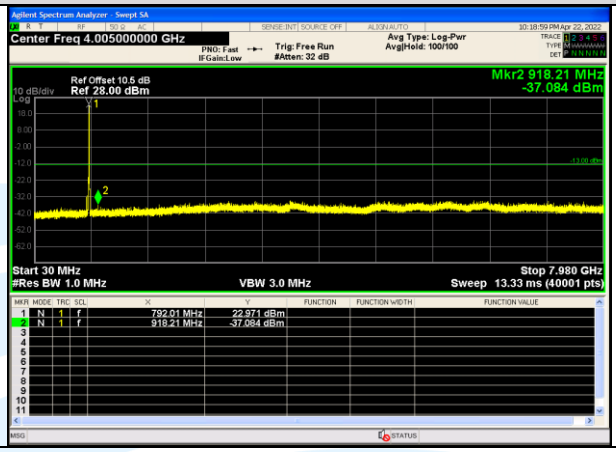
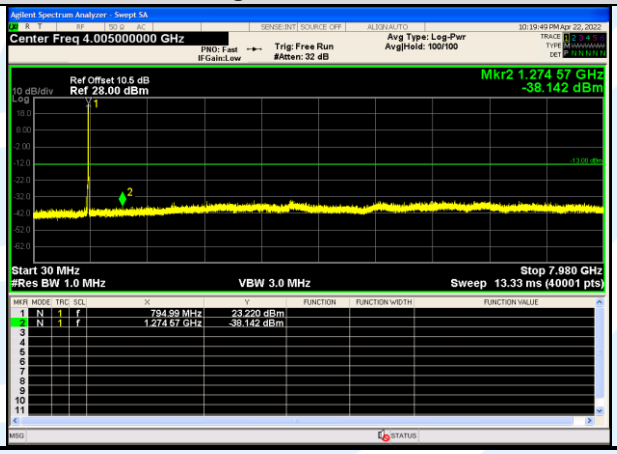
**Test Mode:** Link mode

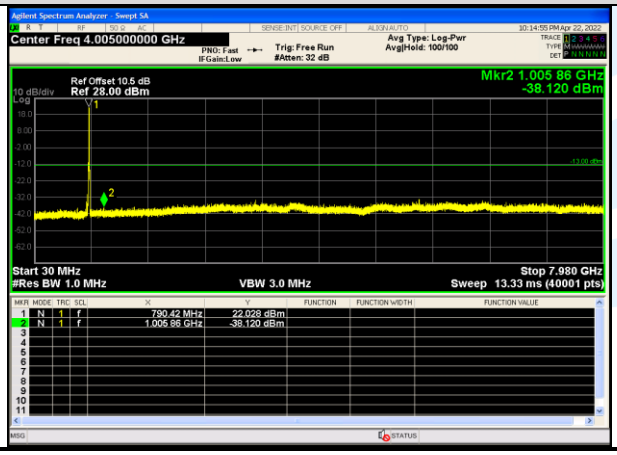
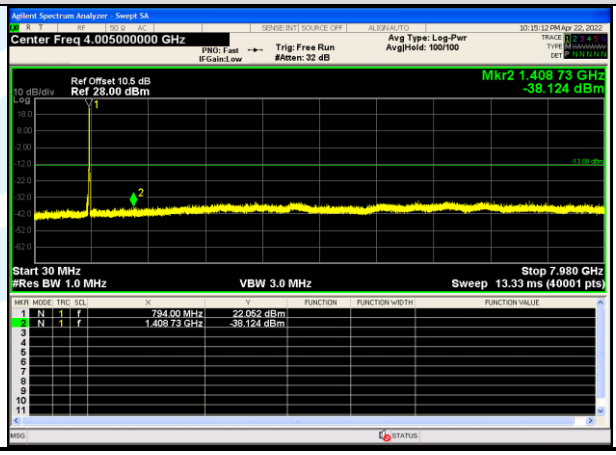
**Test Results:** Pass

**Test Data:** **Please refer to Appendix A**

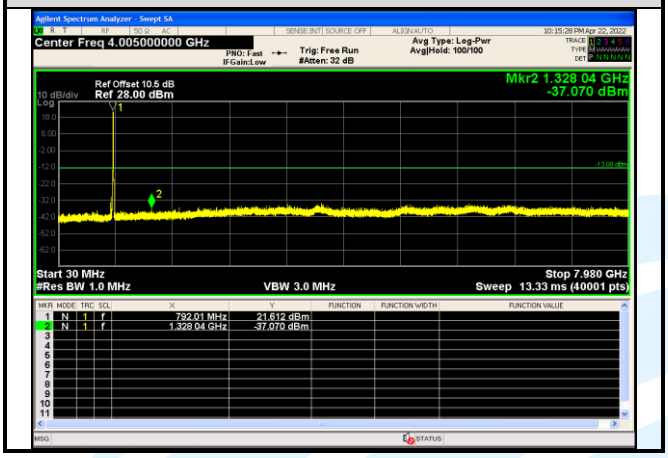
**The test plot as follows:**

| LTE Band 14_ Channel Bandwidth: 5 MHz | |
|---|---|
| QPSK | 16QAM |
| **Lowest Channel** | |
|  |  |
| **Middle Channel** | |
|  |  |
| **Highest Channel** | |
|  |  |

| LTE Band 14_ Channel Bandwidth: 5 MHz | |
|---|---|
| 64QAM | 64QAM |
| Lowest Channel | Middle Channel |
|  |  |
| 64QAM | |
| Highest Channel | |
|  | |

| LTE Band 14_ Channel Bandwidth: 10 MHz | |
|---|---|
| QPSK | 16QAM |
| Middle Channel | |
|  |  |

| LTE Band 14 / 10MHz / 64QAM |
| --- |
| Lowest Channel |




Note: Radiated data in section 5.6 compliance with narrowband limits for GPS 1559-1610MHz band.

## 5.6 FIELD STRENGTH OF SPURIOUS RADIATION

**Test Requirement:** FCC 47 CFR Part 2.1051 & FCC 47 CFR Part 90.543

**Test Method:** ANSI C63.26-2015, Clause 5.5

**Limits:**

(e) (3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

**Test Setup:** Refer to section 4.2.1 for details.

**Test Procedures:**

1. Scan up to 10th harmonic, find the maximum radiation frequency to measure.
2. The technique used to find the Spurious Emissions of the transmitter was the antenna substitution method. Substitution method was performed to determine the actual ERP/EIRP emission levels of the EUT.

Test procedure as below:

1) The EUT was powered ON and placed on a 0.8/1.5m high table at a 3 meter semi/fully Anechoic Chamber. The antenna of the transmitter was extended to its maximum length. Modulation mode and the measuring receiver shall be tuned to the frequency of the transmitter under test.
2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3) The disturbance of the transmitter was maximized on the test receiver display by raising and lowering from 1m to 4m the receive antenna and by rotating through 360° the turntable. After the fundamental emission was maximized, a field strength measurement was made.
4) Steps 1) to 3) were performed with the EUT and the receive antenna in both vertical and horizontal polarization.
5) The transmitter was then removed and replaced with another antenna. The center of the antenna was approximately at the same location as the center of the transmitter.
6) A signal at the disturbance was fed to the substitution antenna by means of a non-radiating cable. With both the substitution and the receive antennas horizontally polarized, the receive antenna was raised and lowered to obtain a maximum reading at the test receiver. The level of the signal generator was adjusted until the measured field strength level in step 3) is obtained for this set of conditions.
7) The output power into the substitution antenna was then measured.
8) Steps 6) and 7) were repeated with both antennas polarized.
9) Calculate power in dBm by the following formula:

ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd)
EIRP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBi)
EIRP=ERP+2.15dB

where:
Pg is the generator output power into the substitution antenna.

10) Test the EUT in the lowest channel, the middle channel the Highest channel
11) The radiation measurements are performed in X, Y, Z axis positioning for EUT operation mode, and found the Y axis positioning which it is worse case.

1) Repeat above procedures until all frequencies measured was complete.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

**The measurement data as follows:**

| No. | Frequency (MHz) | Reading (dBm) | Correction factor (dB/m) | Result (dBm) | Limit (dBm) | Margin (dB) | Ant. Pol. |
|---|---|---|---|---|---|---|---|
| LTE Band 14 / 5 MHz / QPSK_ Lowest Channel | | | | | | | |
| 1 | 488.326 | -88.1 | 35.7 | -52.5 | -13.0 | -39.5 | Horizontal |
| 2 | 765.648 | -88.4 | 41.0 | -47.4 | -13.0 | -34.4 | Horizontal |
| 3 | 919.132 | -87.9 | 42.9 | -45.0 | -13.0 | -32.0 | Horizontal |
| 4 | 1581 | -66.2 | -0.2 | -66.4 | -40.0 | -26.4 | Horizontal |
| 5 | 2371.5 | -66.2 | 3.2 | -63.0 | -13.0 | -50.0 | Horizontal |
| 6 | 590.351 | -89.1 | 38.0 | -51.2 | -13.0 | -38.2 | Vertical |
| 7 | 744.427 | -87.9 | 40.8 | -47.1 | -13.0 | -34.1 | Vertical |
| 8 | 958.714 | -87.7 | 43.0 | -44.6 | -13.0 | -31.6 | Vertical |
| 9 | 1581 | -65.4 | -0.2 | -65.6 | -40.0 | -25.6 | Vertical |
| 10 | 2371.5 | -66.0 | 3.2 | -62.8 | -13.0 | -49.8 | Vertical |
| LTE Band 14 / 5 MHz / QPSK_ Middle Channel | | | | | | | |
| 1 | 582.112 | -89.7 | 37.5 | -52.2 | -13.0 | -39.2 | Horizontal |
| 2 | 679.435 | -89.4 | 39.8 | -49.5 | -13.0 | -36.5 | Horizontal |
| 3 | 945.334 | -87.7 | 43.0 | -44.7 | -13.0 | -31.7 | Horizontal |
| 4 | 1586 | -67.5 | -0.2 | -67.6 | -40.0 | -27.6 | Horizontal |
| 5 | 2379 | -66.7 | 3.3 | -63.4 | -13.0 | -50.4 | Horizontal |
| 6 | 573.988 | -89.4 | 37.5 | -51.9 | -13.0 | -38.9 | Vertical |
| 7 | 693.91 | -88.6 | 40.3 | -48.3 | -13.0 | -35.3 | Vertical |
| 8 | 906.304 | -87.8 | 42.8 | -45.0 | -13.0 | -32.0 | Vertical |
| 9 | 1586 | -65.7 | -0.2 | -65.9 | -40.0 | -25.9 | Vertical |
| 10 | 2379 | -65.6 | 3.3 | -62.3 | -13.0 | -49.3 | Vertical |
| LTE Band 14 / 5 MHz / QPSK_ HIghest Channel | | | | | | | |
| 1 | 665.261 | -88.8 | 39.8 | -49.0 | -13.0 | -36.0 | Horizontal |
| 2 | 723.793 | -88.7 | 40.7 | -48.0 | -13.0 | -35.0 | Horizontal |
| 3 | 986.044 | -87.5 | 43.3 | -44.2 | -13.0 | -31.2 | Horizontal |
| 4 | 1591 | -64.3 | -0.2 | -64.4 | -40.0 | -24.4 | Horizontal |
| 5 | 2386.5 | -65.8 | 3.3 | -62.5 | -13.0 | -49.5 | Horizontal |
| 6 | 458.399 | -90.3 | 34.9 | -55.4 | -13.0 | -42.4 | Vertical |
| 7 | 655.977 | -88.5 | 39.5 | -49.0 | -13.0 | -36.0 | Vertical |
| 8 | 932.141 | -87.5 | 42.9 | -44.6 | -13.0 | -31.6 | Vertical |
| 9 | 1591 | -64.8 | -0.2 | -64.9 | -40.0 | -24.9 | Vertical |
| 10 | 2386.5 | -65.8 | 3.3 | -62.6 | -13.0 | -49.6 | Vertical |

| No. | Frequency (MHz) | Reading (dBm) | Correction factor (dB/m) | Result (dBm) | Limit (dBm) | Margin (dB) | Ant. Pol. |
|---|---|---|---|---|---|---|---|
| LTE Band 14 / 10 MHz / QPSK_ Middle Channel | | | | | | | |
| 1 | 346.074 | -89.1 | 32.6 | -56.5 | -13.0 | -43.5 | Horizontal |
| 2 | 651.383 | -88.3 | 39.4 | -48.9 | -13.0 | -35.9 | Horizontal |
| 3 | 932.141 | -86.5 | 42.9 | -43.6 | -13.0 | -30.6 | Horizontal |
| 4 | 1586 | -64.7 | -0.2 | -64.9 | -40.0 | -24.9 | Horizontal |
| 5 | 2379 | -66.2 | 3.3 | -62.9 | -13.0 | -49.9 | Horizontal |
| 6 | 542.61 | -89.2 | 37.1 | -52.1 | -13.0 | -39.1 | Vertical |
| 7 | 660.602 | -88.8 | 39.6 | -49.3 | -13.0 | -36.3 | Vertical |
| 8 | 919.132 | -87.3 | 42.9 | -44.5 | -13.0 | -31.5 | Vertical |
| 9 | 1586 | -64.7 | -0.2 | -64.9 | -40.0 | -24.9 | Vertical |
| 10 | 2379 | -65.7 | 3.3 | -62.4 | -13.0 | -49.4 | Vertical |

Note: Emissions in the GPS band were wideband emissions therefore the -40 dBm/MHz limit was used.

## 5.7 FREQUENCY STABILITY

**Test Requirement:** FCC 47 CFR Part 2.1055, FCC 47 CFR Part 90.539

**Test Method:** ANSI C63.26-2015, Clause 5.6

**Limits:**

The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

**Test Setup:** Refer to section 4.2.2 for details.

**Test Procedures:**

1) Use CMW 500 with Frequency Error measurement capability.
   a) Temp. =−30° to +50°C
   b) Voltage =low voltage, 3.4 Vdc, Normal, 3.85 Vdc and High voltage, 4.4 Vdc.
2) Frequency Stability vs Temperature:

The EUT is place inside a temperature chamber. The temperature is set to 20ºC and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until +50ºC is reached.

3) Frequency Stability vs Voltage:

The peak frequency error is recorded (worst-case).

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

| Modulation | Channel/ Frequency (MHz) | Voltage (Vdc) | Temperature (℃) | Deviation (Hz) | Deviation (ppm) | Limit (ppm) | Pass/ Fail |
|---|---|---|---|---|---|---|---|
| LTE Band 14 / 10MHz / Full RB | | | | | | | |
| QPSK | 23330 / 793 | VL | TN | -5 | -0.0063 | ± 1.25 | Pass |
| | | VN | | -6 | -0.0076 | | Pass |
| | | VH | | -7 | -0.0088 | | Pass |
| | | VN | 50 | -4 | -0.0050 | | Pass |
| | | | 40 | -7 | -0.0088 | | Pass |
| | | | 30 | -6 | -0.0076 | | Pass |
| | | | 20 | -2 | -0.0025 | | Pass |
| | | | 10 | -6 | -0.0076 | | Pass |
| | | | 0 | -4 | -0.0050 | | Pass |
| | | | -10 | -6 | -0.0076 | | Pass |
| | | | -20 | -6 | -0.0076 | | Pass |
| | | | -30 | -7 | -0.0088 | | Pass |

## 5.8 PEAK-TO-AVERAGE RATIO

**Test Method:** ANSI C63.26-2015, Clause 5.2.3.4

**Limit:** 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

**Test Procedure:**

The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer.

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 %

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

**Test Setup:** Refer to section 4.2.2 for details.

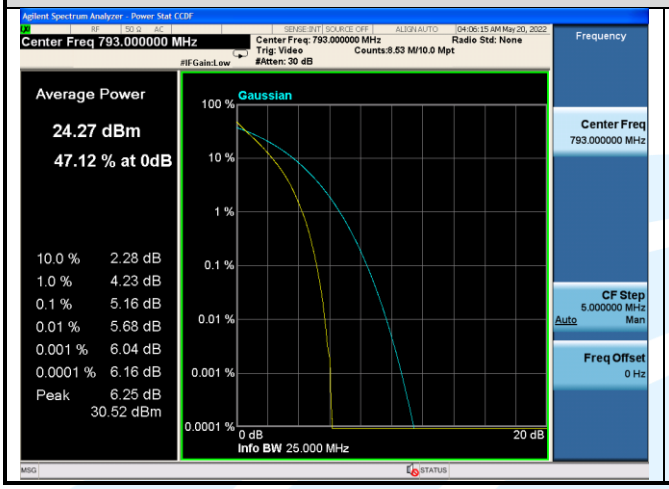
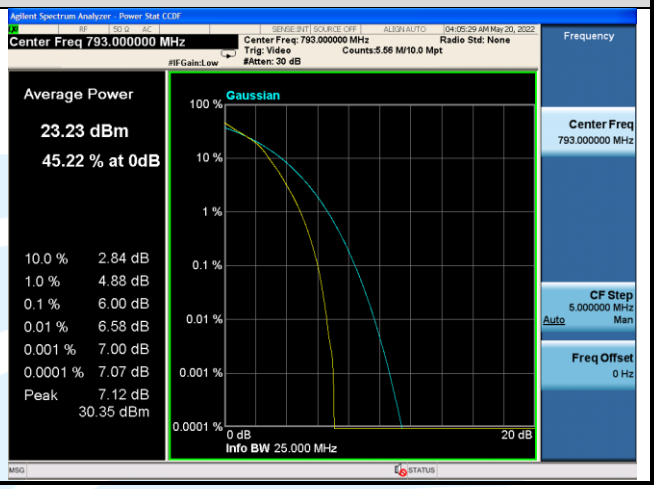
**Instruments Used:** Refer to section 3 for details

**Test Mode:** Link mode

**Test Results:** Pass

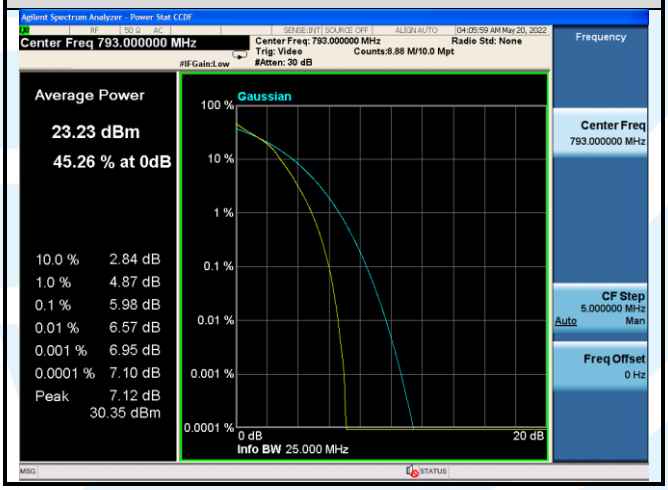
| LTE Band 14 Peak-to-average ratio (dB) | | | | | | |
|---|---|---|---|---|---|---|
| Channel | RB Configuration | Channel Bandwidth: 10 MHz | | | Limit (dB) | Result |
| | | QPSK | 16QAM | 64QAM | | |
| Middle | Full RB | 5.16 | 4.88 | 5.98 | 13 | Pass |

**The test plot as follows:**

| LTE Band 14 / 10 MHz | |
|---|---|
| QPSK | 16QAM |
| Middle Channel | |
|  |  |





| LTE Band 14 / 10MHz / 64QAM |
|---|
| Lowest Channel |
|  |

## APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

## APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***