# TEST REPORT

**Report Number. :** 14144434-E1V2

| | | |
|---|---|---|
| **Applicant** | : | COGNYTE SOFTWARE LP<br>35 PINELAWN ROAD, SUITE 204<br>MELVILLE, NEW YORK 11747 USA |
| **Model** | : | FALCONET |
| **FCC ID** | : | 2A7A2-FNV1 |
| **EUT Description** | : | PORTABLE MULTI-BTS SDR SYSTEM |
| **Test Standard(s)** | : | FCC CFR 47 PART 22H, 24E, 27C, 90R and 90S |

**Date Of Issue:**
JANUARY 10, 2023

**Prepared by:**
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ACCREDITED
CERT #0751.05

## Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 12/27/2022 | Initial Review | -- |
| V2 | 1/10/2023 | Updated Section 6.2 and 6.4 | Kiya Kedida |

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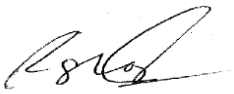
# 1. ATTESTATION OF TEST RESULTS

| | |
|---|---|
| Applicant Name and Address | COGNYTE<br>35 PINELAWN ROAD, SUITE 204<br>MELVILLE, NEW YORK 11747 USA |
| Model | FALCONET |
| FCC ID | 2A7A2-FNV1 |
| EUT Description | PORTABLE MULTI-BTS SDR SYSTEM |
| Serial Number | GI2S BRAIN UNIT(SN:22CU017710265)<br>GI2S CHASSIS(SN:22CU037710556) |
| Date Tested | SEPTEMBER 26, 2022 to NOVEMBER 17, 2022 |
| Applicable Standards | FCC CFR 47 PART 22, 24, 27 and 90S |
| Test Results | COMPLIES |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

| Approved & Released By: | Reviewed By: | Prepared By: |
|---|---|---|
|  |  |  |
| Dan Coronia<br>Operations Leader<br>UL Verification Services Inc. | Kiya Kedida<br>Project Engineer<br>UL Verification Services Inc. | Rolly Alegre<br>Laboratory Engineer<br>UL Verification Services Inc. |

# 2. SUMMARY OF TEST RESULTS

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer."

| Requirement Description | Band | Requirement Clause Number (FCC) | Result* | Remarks |
|---|---|---|---|---|
| RF Conducted Output Power | | 2.1046 | Complies | |
| Equivalent Isotropic Radiated Power | 26 (90S) | 2.1046 , 90.635 (a) | Complies | |
| | 5, 26 | 22.913 (a)(1)(i) | Complies | |
| | 12 | 27.50 (c) (3) | Complies | |
| | 13 | 27.50 (b) (4) | Complies | |
| | 14 | 90.541 (a) | Complies | |
| | 17 | 27.50 (c) (3) | Complies | |
| | 2, 25 | 24.232 (a) (2) | Complies | |
| | 4, 66 | 27.50 (d) (2) | Complies | |
| | 71, n71 | 27.50 (c) (3) | Complies | |

| Requirement Description | Requirement Clause Number (FCC) | Result* | Remarks |
|---|---|---|---|
| Occupied Bandwidth | 2.1049 | Complies | |
| Band Edge and Emission Mask | 2.1051, 22.917 (a), 24.238 (a), 27.53 (h), 27.53 (g), 27.53 (c) (f), 90.543 (e)(f), 90.691 (a) | Complies | |
| Out of Band Emissions | 2.1051, 22.917 (a), 24.238 (a), 27.53 (h), 27.53 (g), 27.53 (c) (f), 90.543 (e)(f), 90.691 (a) | Complies | |
| Frequency Stability | 2.1055, 22.355, 24.235, 27.54, 90.539, 90.213 | Complies | |
| Peak-to-Average Ratio | 22.913 (d), 24.232 (d), 27.50 (d) (5), 27.50 (b) | Complies | |
| Field Strength of Spurious Radiation | 2.1051, 2.1053, 22.917 (a), 24.238 (a), 27.53 (h), 27.53 (g), 27.53 (c) (f), 90.543 (e)(f), 90.691 (a) | Complies | |

# 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with the following:

- ANSI C63.26:2015
- FCC CFR 47 Part 2, Part 22, Part 24, Part 27, Part 90
- FCC KDB 971168 D01 v03r01: Power Meas License Digital Systems
- FCC KDB 971168 D02 v02r01: Misc Rev Approv License Devices
- FCC KDB 412172 D01 v01r01. Determining ERP and EIRP

# 4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, certification #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

| | Address | ISED CABID | ISED Company Number | FCC Registration |
|---|---|---|---|---|
| ☒ | Building 1: 47173 Benicia Street, Fremont, CA 94538, USA | US0104 | 2324A | 208313 |
| ☐ | Building 2: 47266 Benicia Street, Fremont, CA 94538, USA | US0104 | 22541 | 208313 |
| ☒ | Building 4: 47658 Kato Rd, Fremont, CA 94538, USA | US0104 | 2324B | 208313 |

# 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

## 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

## 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

## 5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | $U_{Lab}$ |
|---|---|
| Radio Frequency (Spectrum Analyzer) | 141.16 Hz |
| Occupied Bandwidth | 1.22% |
| Power Spectral Density | 2.47 dB |
| RF Power Measurement Direct Method Using Power Meter | 1.3 dB (PK) / 0.45 dB (AV) |
| Unwanted Emissions, Conducted | 1.94 dB |
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz | 3.78 dB |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz | 3.40 dB |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz | 2.87 dB |
| Worst Case Radiated Disturbance, 30 to 1000 MHz | 6.01 dB |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz | 4.73 dB |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.51 dB |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.29 dB |
| Time Domain Measurements | 3.39% |
| Temperature | 0.57˚C |
| Humidity | 3.39% |
| DC Supply Voltages | 0.57% |

Uncertainty figures are valid to a confidence level of 95%.

## 5.4. SAMPLE CALCULATION

**RADIATED EMISSIONS**

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

**MAINS CONDUCTED EMISSIONS**

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

# 6. EQUIPMENT UNDER TEST

## 6.1. DESCRIPTION OF EUT

The EUT is a base station and support GSM/UMTS/LTE technologies and 5G as well.

## 6.2. MAXIMUM OUTPUT POWER

**EIRP/ERP TEST PROCEDURE**

ANSI C63.26:2015
KDB 971168 D01 Section 5.6

ERP/EIRP = PMeas + GT − LC
where: ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as PMeas, typically dBW or dBm);
PMeas = measured transmitter output power or PSD, in dBm or dBW;
GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);
LC = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

The transmitter has a maximum average conducted and ERP / EIRP output powers as follows:

## GSM MODES

| Part 22 850MHz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | EIRP | | 99% BW (kHz) | Emission Designator |
| | | | | | (dBm) | (W) | | |
| 869.4-893.6 | GPRS | 38.21 | 2.50 | 1640.0 | 40.71 | 11.776 | 247.75 | 248KGXW |
| **Part 24 1900MHz** | | | | | | | | |
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W/MHz) | EIRP | | 99% BW (kHz) | Emission Designator |
| | | | | | (dBm) | (W) | | |
| 1930.4-1989.6 | GPRS | 36.58 | 4.00 | 1640.0 | 40.58 | 11.429 | 248.44 | 248KGXW |

## WCDMA MODE

| Part 22 Band 5 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | EIRP | | 99% BW (kHz) | Emission Designator |
| | | | | | (dBm) | (W) | | |
| 871.4-891.6 | QPSK | 34.20 | 2.50 | 1640.0 | 36.70 | 4.677 | 4174.8 | 4M17F9W |
| **Part 24 Band 2** | | | | | | | | |
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W/MHz) | EIRP | | 99% BW (kHz) | Emission Designator |
| | | | | | (dBm) | (W) | | |
| 1932.4-1987.6 | QPSK | 35.89 | 4.00 | 1640.0 | 39.89 | 9.750 | 4182.6 | 4M18F9W |
| **Part 27 Band 4** | | | | | | | | |
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W/MHz) | EIRP | | 99% BW (kHz) | Emission Designator |
| | | | | | (dBm) | (W) | | |
| 2112.4-2152.6 | QPSK | 38.90 | 3.00 | 1640.0 | 41.90 | 15.488 | 4180.6 | 4M18F9W |

## LTE BAND 2

| Part 24 | |
|---|---|
| EIRP Limit (W/MHz) | 1640.00 |
| Antenna Gain (dBi) | 4.00 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 1932.5 | 1987.5 | 27.40 | 31.40 | 1.380 | 4419.8 | 4M42G7D |

## LTE BAND 4

| Part 27 | |
|---|---|
| EIRP Limit (W/MHz) | 1640.00 |
| Antenna Gain (dBi) | 4.00 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 2112.5 | 2152.5 | 30.17 | 34.17 | 2.612 | 4434.3 | 4M43G7D |

## LTE BAND 5

| Part 22H | |
|---|---|
| ERP Limit (W) | 500.00 |
| Antenna Gain (dBi) | 2.50 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 871.5 | 891.5 | 30.66 | 31.01 | 1.262 | 4436.7 | 4M44G7D |

## LTE BAND 12

| Part 27 | |
|---|---|
| ERP Limit (W/MHz) | 1000.00 |
| Antenna Gain (dBi) | 2.50 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 731.5 | 743.5 | 32.82 | 33.17 | 2.075 | 4481.8 | 4M48G7D |

## LTE BAND 13

| Part 27 | |
|---|---|
| ERP Limit (W/MHz) | 1000.00 |
| Antenna Gain (dBi) | 2.50 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 748.5 | 753.5 | 32.81 | 33.16 | 2.070 | 4435.3 | 4M44G7D |

## LTE BAND 14

| Part 90R | |
|---|---|
| ERP Limit (W/MHz) | 1000.00 |
| Antenna Gain (dBi) | 2.50 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 760.5 | 765.5 | 28.00 | 28.35 | 0.684 | 4465.3 | 4M47G7D |

## LTE BAND 17

| Part 27 | |
|---|---|
| ERP Limit (W/MHz) | 1000.00 |
| Antenna Gain (dBi) | 2.50 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 736.5 | 743.5 | 31.78 | 32.13 | 1.633 | 4426.4 | 4M43G7D |

## LTE BAND 25

| Part 24 | |
|---|---|
| EIRP Limit (W/MHz) | 1640.00 |
| Antenna Gain (dBi) | 4.00 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 1932.5 | 1992.5 | 27.44 | 31.44 | 1.393 | 4472 | 4M47G7D |

## LTE BAND 26

| Part 90S | |
|---|---|
| ERP Limit (W) | 1000.00 |
| Antenna Gain (dBi) | 2.50 |

| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | Conducted Average (W) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
|---|---|---|---|---|---|---|---|---|---|
| 5.0 | QPSK | 861.5 | 866.5 | 27.66 | 0.58 | 28.01 | 0.632 | 4442.6 | 4M44G7D |

**LTE BAND 26**

| Part 22 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ERP Limit (W) | | 500.00 | | | | | | |
| Antenna Gain (dBi) | | 2.50 | | | | | | |
| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0 | QPSK | 871.5 | 891.5 | 32.67 | 33.02 | 2.004 | 4470.9 | 4M47G7D |

**LTE BAND 66**

| Part 27 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| EIRP Limit (W/MHz) | | 1640.00 | | | | | | |
| Antenna Gain (dBi) | | 4.00 | | | | | | |
| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0 | QPSK | 2112.5 | 2197.5 | 24.79 | 28.79 | 0.757 | 4487.1 | 4M49G7D |

**LTE BAND 71**

| Part 27 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ERP Limit (W/MHz) | | 1000.00 | | | | | | |
| Antenna Gain (dBi) | | 3.00 | | | | | | |
| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0 | QPSK | 619.5 | 649.5 | 31.81 | 32.66 | 1.845 | 4468.1 | 4M47G7D |

**5G NR n71**

| Part 27 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ERP Limit (W/MHz) | | 1000.00 | | | | | | |
| Antenna Gain (dBi) | | 3.00 | | | | | | |
| Bandwidth (MHz) | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 20.0 | QPSK | 627.0 | 642.0 | 28.30 | 29.15 | 0.822 | 18838 | 18M8G7D |

## 6.3. SOFTWARE AND FIRMWARE

The EUT software installed during testing was v58.1.116.

The EUT firmware installed during testing was: gsm_7.1.6.4.img,umts_58.1.220916.1.img,lte_fdd_58.1.0.84.img lte_tdd_58.1.0.73.img, nr_58.1.0920.1.img, GUL_v2.17_RevX.exe;, MPAC_BL_v6_42.exe; Matrix_BL_v2_58.exe;, cell_infra_0.6.107.im

## 6.4. MAXIMUM ANTENNA GAIN

The antenna(s) gain, as provided by the manufacturer' are as follows:

| LTE Bands | Frequency Range (MHz) | ANT 1 Antenna Gain (dBi) | ANT 2 Antenna Gain (dBi) | ANT 3 Antenna Gain (dBi) |
|---|---|---|---|---|
| GSM850 | 869 – 894 | 2.5 | - | - |
| GSM1900 | 1930 – 1990 | 4 | - | - |
| UMTS Band 5 | 869 – 894 | 2.5 | - | - |
| UMTS Band 2 | 1930 – 1990 | 4 | - | - |
| UMTS Band 4 | 2110 – 2155 | - | - | 4 |
| LTE Band 2 | 1930 – 1990 | - | 4 | - |
| LTE Band 4 | 2110 – 2155 | - | - | 3 |
| LTE Band 5 | 869 – 894 | 2.5 | - | - |
| LTE Band 12 | 729 – 746 | 2.5 | - | - |
| LTE Band 13 | 746 – 756 | 2.5 | - | - |
| LTE Band 14 | 758 – 768 | 2.5 | - | - |
| LTE Band 17 | 734 – 746 | 2.5 | - | - |
| LTE Band 25 | 1930 – 1995 | - | 4 | - |
| LTE Band 26 (FCC Part 90) | 859 – 869 | 2.5 | - | - |
| LTE Band 26 (FCC Part 22 ) | 869 – 894 | 2.5 | - | - |
| LTE Band 66 | 2110 – 2200 | - | 4 | - |
| LTE Band 71 | 617 – 652 | 3 | - | - |
| 5G NR n71 | 617 – 652 | 3 | - | - |

## 6.5. WORST-CASE CONFIGURATION AND MODE

The EUT supports the following GSM, UMTS, LTE and 5G NR:
GSM850/1900, UMTS Band 2/4/5, LTE Band 2, Band 4, Band 5, Band 12, Band 13, Band 14, Band 17, Band 25, Band 26 PART 90, Band 26 PART 22, Band 66, Band 71, 5G NR n71.

All measurements is tested on QPSK modulation for LTE(5MHz BW only) and 5G NR(20MHz BW only). GPRS slot 1 for GSM, and QPSK modulation for UMTS.

The EUT can only be setup in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation. Radiated spurious emissions were investigated from 30MHz-1GHz, above 1GHz and above 18GHz.

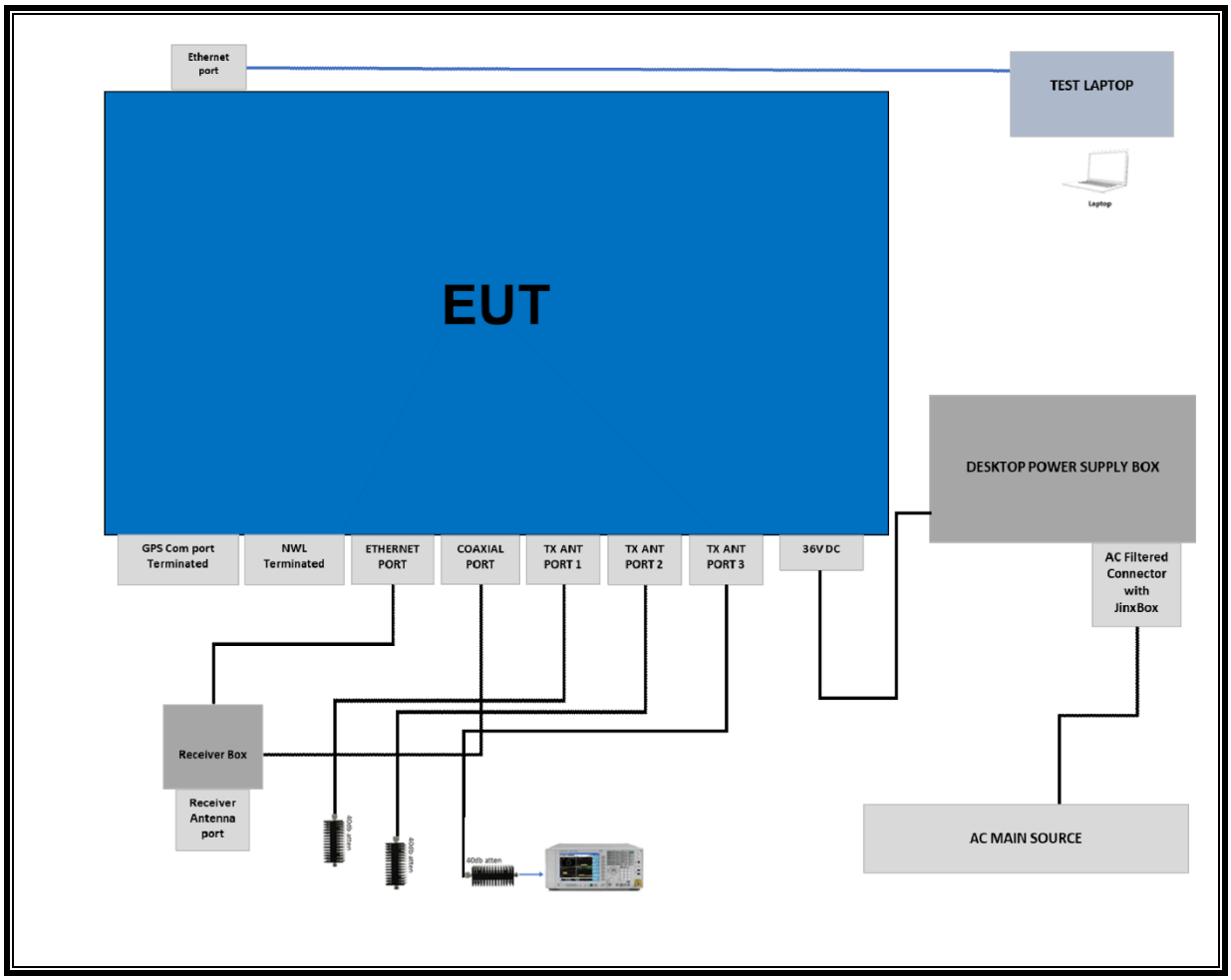
## 6.6. DESCRIPTION OF TEST SETUP

| SUPPORT TEST EQUIPMENT | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Serial Number** | **FCC ID/ DoC** |
| Laptop | Lenovo | ThinkPad T14 Gen 2, Intel Core i7 | PF-385ATZ | N/A |
| AC/DC adapter | Lite-on Technology | ADLX65YLC3D | N/A | N/A |
| AC/DC DPSU (Internal DCDC converter) to EUT | Artesyn | LCM1500U-T-4 | 224A0425C1066 | N/A |
| AC/DC DPSU (S1 designator) to EUT | Souriau | UT0714G1SH | 46-140-0109 | N/A |

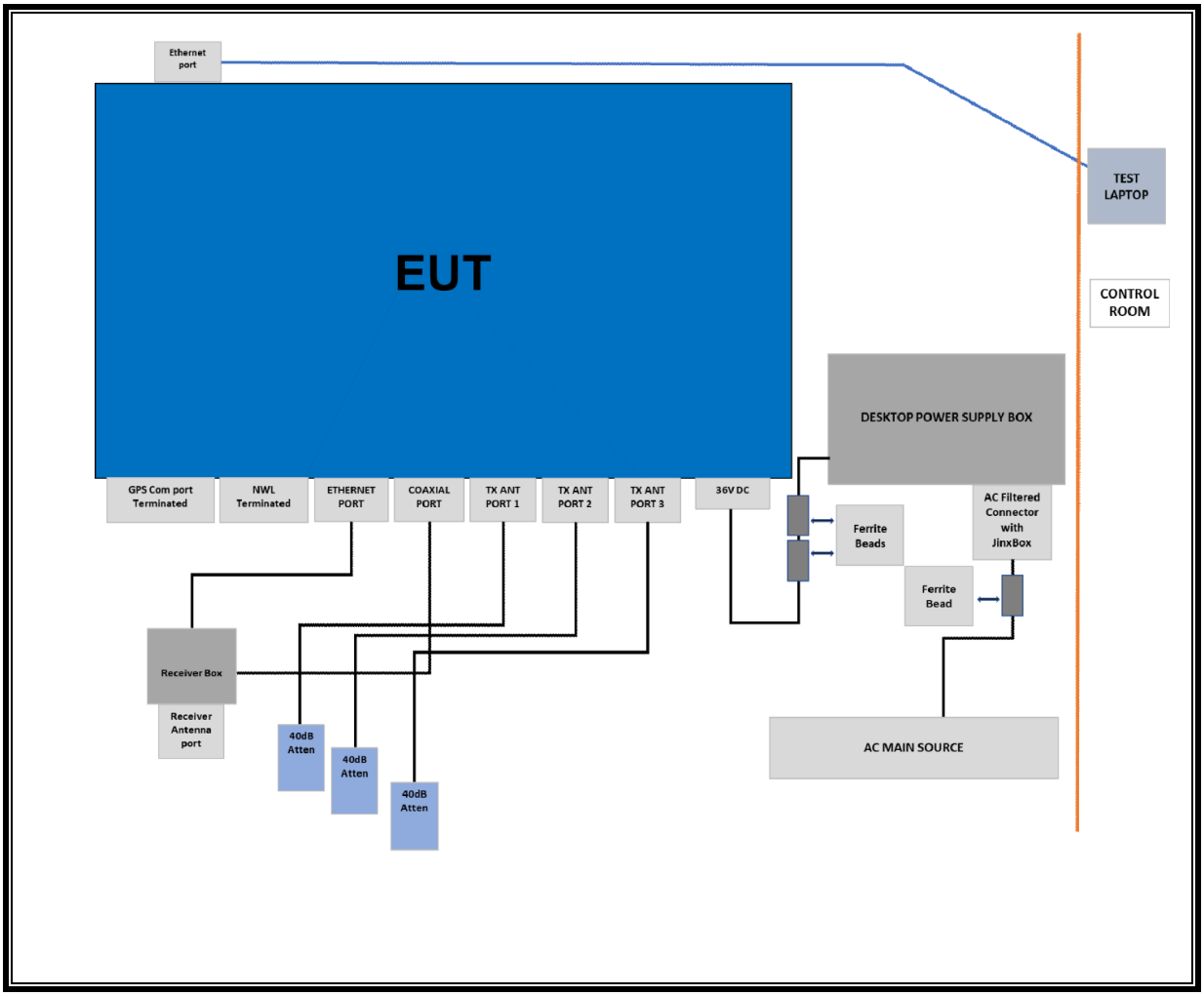
| I/O CABLES (RF CONDUCTED TEST) | | | | | | |
|---|---|---|---|---|---|---|
| **Cable No.** | **Port** | **# of Identical Ports** | **Connector Type** | **Cable Type** | **Cable Length (m)** | **Remarks** |
| 1 | DC DPSU | 1 | TE connectivity and Amphenol | Shielded | 0.5 | N/A |
| 2 | AC DPSU | 1 | AC power cord | Unshielded | 1.5 | N/A |
| 3 | RF In/Out | 1 | 40dB attenuator | N/A | N/A | N/A |
| 4 | RF In/Out | 3 | RF TX cable Q to Ntype female | N/A | 3.0 | N/A |
| 5 | RF In/Out | 1 | RF RX cable Q to Ntype female | N/A | 1.0 | N/A |
| 6 | LAN | 2 | RJ-45 CAT6 | Shielded | 1.0 | N/A |
| 7 | RF In/Out | 1 | SMA cable | Shielded | 0.2 | N/A |

| I/O CABLES (RF RADIATED TEST) | | | | | | |
|---|---|---|---|---|---|---|
| **Cable No.** | **Port** | **# of Identical Ports** | **Connector Type** | **Cable Type** | **Cable Length (m)** | **Remarks** |
| 1 | AC/DPSU | 1 | AC power cord (3-Prong Grounded Male) | Unshielded | 1.5 | To AC Mains |
| 2 | DC/DPSU/36V | 1 | TE connectivity and Amphenol | Shielded | 0.5 | To EUT |
| 3 | RF In/Out | 1 | RF TX cable Q to Ntype female | N/A | 3.0 | To 40dB attenuator |
| 4 | RF In/Out | 2 | RF TX cable Q to Ntype female | N/A | 3.0 | To Terminators |
| 5 | RF In/Out | 1 | RF RX cable Q to Ntype female | N/A | 1.0 | To Receiver Box |
| 6 | LAN | 1 | RJ-45 CAT6 | Shielded | 1.0 | To Receiver Box |
| 7 | RF In/Out | 1 | 40dB attenuator | N/A | N/A | To SMA cable |
| 8 | RF In/Out | 1 | SMA cable | Shielded | 0.2 | To EUT |
| 9 | LAN | 1 | RJ-45 CAT6 | Shielded | 1.0 | From Laptop to EUT |

**CONDUCTED SETUP**



**RADIATED SETUP**



# 7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| TEST EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Asset** | **Cal Due** |
| Antenna, Horn 1-18GHz | ETS Lindgren | 3117 | 80402 | 7/5/2023 |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences | JB1 | 80813 | 6/8/2023 |
| RF Filter Box, 1 to 18GHz | UL FREMONT | SAC-L1 | 197920 | 4/19/2023 |
| Amplifier, 10KHz to 1GHz, 32dB | Sonoma | 310N | 175953 | 2/8/2023 |
| ESW EMI Test Receiver, 2Hz to 44GHz | ROHDE & SCHWARZ | ESW44 | 169927 | 2/16/2023 |
| Power Meter, P-series single channel | Keysight | N1912A | 90630 | 1/24/2023 |
| Power Sensor, P - series, 50MHz to 18GHz, Wideband | Keysight | N1921A | 81319 | 1/24/2023 |
| Spectrum Analyzer, PXA, 3Hz to 50GHz | Keysight | N9030A | 80400 | 2/1/2023 |
| Chamber, Environmental | Thermotron | 29800 | T80 | 11/11/2022 |
| Amplifier 26.5-40GHz +5Vdc, -62dBm P1dB | AMPLICAL | AMP26G40-65 | 172345 | 6/22/2023 |
| Amplifier 18-26.5GHz, +5Vdc, 60dB min | AMPLICAL | AMP18G26.5-60 | 215705 | 2/26/2023 |
| Antenna, Horn 18 to 26.5GHz | ARA | MWH-1826/B | 81138 | 10/13/2022 |
| Antenna, Horn 26.5GHz to 40GHz | ARA | MWH-2640/B | 81104 | 10/14/2022 |
| PSA Spectrum Analyzer | Agilent | E4440A | 80386 | 3/2/2023 |
| **UL AUTOMATION SOFTWARE** | | | | |
| Radiated test software | UL | UL EMC | Ver 9.5 April 30, 2020 | |

# 8. RF OUTPUT POWER VERIFICATION

## 8.1. GSM

**AVERAGE OUTPUT POWER TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

**PEAK OUTPUT POWER TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband peak power sensor. Peak output power was read directly from power meter.

### 8.1.1. GSM 850

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

| Mode | Time Slots | Ch No. | Freq. (MHz) | Conducted Average Power (dBm) |
|---|---|---|---|---|
| | | | | ANT 1 |
| GSM850 | 1 | 129 | 869.4 | **38.21** |
| | | 190 | 881.6 | 37.86 |
| | | 251 | 893.6 | 37.33 |

### 8.1.2. GSM 1900

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

| Mode | Time Slots | Ch No. | Freq. (MHz) | Conducted Average Power (dBm) |
|---|---|---|---|---|
| | | | | ANT 1 |
| GSM1900 | 1 | 512 | 1930.2 | 36.15 |
| | | 661 | 1960 | **36.58** |
| | | 810 | 1989.8 | 35.91 |

## 8.2. UMTS

**QPSK**

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The DUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

| Mode | Subtest | Rel99 |
|---|---|---|
| WCDMA General Settings | Loopback Mode | Test Mode 2 |
| | Rel99 RMC | 12.2kbps RMC |
| | Power Control Algorithm | Algorithm2 |
| | βc/βd | 8/15 |

**HSDPA REL 5**

The following 4 Sub-tests were completed according to Release 5 procedures in table C.10.1.4 of 3GPP TS 34.121-1 A summary of these settings are illustrated below:

**Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ *(SF)* | $\beta_c/\beta_d$ | $\beta_{HS}$ *(Note1, Note 2)* | **CM** (dB) *(Note 3)* | **MPR** (dB) *(Note 3)* |
|---|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 | 0.0 |
| 2 | 12/15 *(Note 4)* | 15/15 *(Note 4)* | 64 | 12/15 *(Note 4)* | 24/15 | 1.0 | 0.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 | 0.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 | 0.5 |

Note 1: $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI}$ = 30/15 with $\beta_{hs}$ = 30/15 * $\beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, $\Delta_{ACK}$ and $\Delta_{NACK}$ = 30/15 with $\beta_{hs}$ = 30/15 * $\beta_c$, and $\Delta_{CQI}$ = 24/15 with $\beta_{hs}$ = 24/15 * $\beta_c$.

Note 3: CM = 1 for $\beta_c/\beta_d$ =12/15, $\beta_{hs}/\beta_c$=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the $\beta_c/\beta_d$ ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c$ = 11/15 and $\beta_d$ = 15/15.

## HSPA REL 6 (HSDPA & HSUPA)

The following 5 Sub-tests were completed according to Release 6 procedures in table C.11.1.3 of 3GPP TS 34.121-1. A summary of these settings are illustrated below:

**Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ (SF) | $\beta_c/\beta_d$ | $\beta_{HS}$ (Note1) | $\beta_{ec}$ | $\beta_{ed}$ (Note 4) (Note 5) | $\beta_{ed}$ (SF) | $\beta_{ed}$ (Codes) | CM (dB) (Note 2) | MPR (dB) (Note 2) (Note 6) | AG Index (Note 5) | E-TFCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11/15 (Note 3) | 15/15 (Note 3) | 64 | 11/15 (Note 3) | 22/15 | 209/225 | 1309/225 | 4 | 1 | 1.0 | 0.0 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 94/75 | 4 | 1 | 3.0 | 2.0 | 12 | 67 |
| 3 | 15/15 | 9/15 | 64 | 15/9 | 30/15 | 30/15 | $\beta_{ed}1$: 47/15<br>$\beta_{ed}2$: 47/15 | 4<br>4 | 2 | 2.0 | 1.0 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 2/15 | 56/75 | 4 | 1 | 3.0 | 2.0 | 17 | 71 |
| 5 | 15/15 | 0 | - | - | 5/15 | 5/15 | 47/15 | 4 | 1 | 1.0 | 0.0 | 12 | 67 |

Note 1: For sub-test 1 to 4, $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI}$ = 30/15 with $\beta_{hs}$ = 30/15 * $\beta_c$. For sub-test 5, $\Delta_{ACK}$, $\Delta_{NACK}$ and $\Delta_{CQI}$ = 5/15 with $\beta_{hs}$ = 5/15 * $\beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d$ =12/15, $\beta_{hs}/\beta_c$=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the $\beta_c/\beta_d$ ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c$ = 10/15 and $\beta_d$ = 15/15.

Note 4: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 5: $\beta_{ed}$ can not be set directly; it is set by Absolute Grant Value.

Note 6: For subtests 2, 3 and 4, UE may perform E-DPDCH power scaling at max power which could results in slightly smaller MPR values.

## DUAL CARRIER HSDPA (DC-HSDPA (REL 8, CAT 24)

The following 4 Sub-tests for DC-HSDPA were completed according to Release 8 procedures in table C08.1.12 of 3GPP TS 34.121-1. A summary of subtest settings are illustrated below:

**Table C.8.1.12: Fixed Reference Channel H-Set 12**

| Parameter | Unit | Value |
|---|---|---|
| Nominal Avg. Inf. Bit Rate | kbps | 60 |
| Inter-TTI Distance | TTI's | 1 |
| Number of HARQ Processes | Processes | 6 |
| Information Bit Payload ( $N_{INF}$ ) | Bits | 120 |
| Number Code Blocks | Blocks | 1 |
| Binary Channel Bits Per TTI | Bits | 960 |
| Total Available SML's in UE | SML's | 19200 |
| Number of SML's per HARQ Proc. | SML's | 3200 |
| Coding Rate | | 0.15 |
| Number of Physical Channel Codes | Codes | 1 |
| Modulation | | QPSK |

Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.

Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.

**AVERAGE OUTPUT POWER TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

**PEAK OUTPUT POWER TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband peak power sensor. Peak output power was read directly from power meter.

### 8.2.1. UMTS B5

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

| Band | | UL Ch No. | Freq. (MHz) | MPR (dB) | Conducted Average |
|---|---|---|---|---|---|
| UMTS B5 | QPSK | 4357 | 871.4 | N/A | 33.88 |
| | | 4408 | 881.6 | N/A | 34.12 |
| | | 4458 | 891.6 | N/A | **34.20** |

### 8.2.2. UMTS B4

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

| Band | | UL Ch No. | Freq. (MHz) | MPR (dB) | Conducted Average |
|---|---|---|---|---|---|
| UMTS B4 | QPSK | 10562 | 2112.4 | N/A | **38.90** |
| | | 10663 | 2132.6 | N/A | 38.50 |
| | | 10763 | 2152.6 | N/A | 38.60 |

### 8.2.3. UMTS B2

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

| Band | | UL Ch No. | Freq. (MHz) | MPR (dB) | Conducted Average |
|---|---|---|---|---|---|
| UMTS B2 | QPSK | 9662 | 1932.4 | N/A | 35.50 |
| | | 9800 | 1960.0 | N/A | **35.89** |
| | | 9938 | 1987.6 | N/A | 35.80 |

## 8.3. LTE CONDUCTED OUTPUT POWER MEASUREMENT PROCEDURE

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS 38.521-1 specification.

The allowed MPR for SRS, PUCCH formats 0, 1, 3 and 4, and PRACH shall be as specified for QPSK modulated DFTs-OFDM of equivalent RB allocation. The allowed MPR for PUCCH format 2 shall be as specified for QPSK modulated CP-OFDM of equivalent RB allocation.

**Table 6.2.2.3-1: Maximum power reduction (MPR) for power class 3**

<table>
<tr><th colspan="2" rowspan="2">Modulation</th><th colspan="3">MPR (dB)</th></tr>
<tr><th>Edge RB allocations</th><th>Outer RB allocations</th><th>Inner RB allocations</th></tr>
<tr><td rowspan="6">DFT-s-OFDM</td><td>Pi/2 BPSK</td><td>≤ 3.5[1]</td><td>≤ 1.2[1]</td><td>≤ 0.2[1]</td></tr>
<tr><td>Pi/2 BPSK w Pi/2 BPSK DMRS</td><td colspan="2">≤ 0.5[2]</td><td>0[2]</td></tr>
<tr><td>Pi/2 BPSK w Pi/2 BPSK DMRS</td><td>≤ 0.5[2]</td><td colspan="2">0[2]</td></tr>
<tr><td>QPSK</td><td colspan="2">≤ 1</td><td>0</td></tr>
<tr><td>16 QAM</td><td colspan="2">≤ 2</td><td>≤ 1</td></tr>
<tr><td>64 QAM</td><td colspan="3">≤ 2.5</td></tr>
<tr><td>256 QAM</td><td colspan="3">≤ 4.5</td></tr>
<tr><td rowspan="4">CP-OFDM</td><td>QPSK</td><td colspan="2">≤ 3</td><td>≤ 1.5</td></tr>
<tr><td>16 QAM</td><td colspan="2">≤ 3</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td colspan="3">≤ 3.5</td></tr>
<tr><td>256 QAM</td><td colspan="3">≤ 6.5</td></tr>
<tr><td colspan="5">NOTE 1: Applicable for UE operating in TDD mode with Pi/2 BPSK modulation and UE indicates support for UE capability powerBoosting-pi2BPSK and if the IE powerBoostPi2BPSK is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0dB MPR is 26dBm.<br>NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 with Pi/2 BPSK modulation and if the IE powerBoostPi2BPSK is set to 0 and if more than 40% of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79.</td></tr>
</table>

**Table 6.2.2.3-2: Maximum power reduction (MPR) for power class 2**

| Modulation | | MPR (dB) | | |
|---|---|---|---|---|
| | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.5 | ≤ 0.5 | 0 |
| | QPSK | ≤ 3.5 | ≤ 1 | 0 |
| | 16 QAM | ≤ 3.5 | ≤ 2 | ≤ 1 |
| | 64 QAM | ≤ 3.5 | ≤ 2.5 | |
| | 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3.5 | ≤ 3 | ≤ 1.5 |
| | 16 QAM | ≤ 3.5 | ≤ 3 | ≤ 2 |
| | 64 QAM | ≤ 3.5 | | |
| | 256 QAM | ≤ 6.5 | | |

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS 36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS_01".

**Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)**

| Network Signalling value | Requirements (subclause) | E-UTRA Band | Channel bandwidth (MHz) | Resources Blocks ($N_{RB}$) | A-MPR (dB) |
|---|---|---|---|---|---|
| NS_01 | 6.6.2.1.1 | Table 5.5-1 | 1.4, 3, 5, 10, 15, 20 | Table 5.6-1 | N/A |
| NS_03 | 6.6.2.2.1 | 2, 4,10, 23, 25, 35, 36, 66, 70 | 3 | >5 | ≤ 1 |
| | | | 5 | >6 | ≤ 1 |
| | | | 10 | >6 | ≤ 1 |
| | | | 15 | >8 | ≤ 1 |
| | | | 20 | >10 | ≤ 1 |
| NS_04 | 6.6.2.2.2, 6.6.3.3.19 | 41 | 5, 10, 15, 20 | Table 6.2.4-4, Table 6.2.4-4a | |

The allowed A-MPR values specified below in Table 6.2.3.3.1-1 of 3GPP TS 38.521-1 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS_01".

**Table 6.2.3.3.1-1: Additional maximum power reduction (A-MPR)**

| Network signalling label | Requirements (subclause) | NR Band | Channel bandwidth (MHz) | Resources blocks ($N_{RB}$) | A-MPR (dB) |
|---|---|---|---|---|---|
| NS_01 | | Table 5.2-1 | 5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 90, 100 | Table 5.3.2-1 | N/A |
| NS_03 | 6.5.2.3.3.3 | n2, n25, n66, n70, n86 | | | Clause 6.2.3.3.7 |
| NS_03U | 6.5.2.3.3.3, 6.5.2.4.2.3 | n2, n25, n66, n86 | | | Clause 6.2.3.3.7 |
| NS_04 | 6.5.2.3.3.2, 6.5.3.3.3.1 | n41 | 10, 15, 20, 40, 50, 60, 80, 90, 100 | | Clause 6.2.3.3.2 |

**AVERAGE OUTPUT POWER TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

**PEAK OUTPUT POWER TEST PROCEDURE**

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband peak power sensor. Peak output power was read directly from power meter.

**RESULTS**

## 8.3.1. LTE BAND 2

| Test Engineer ID: | 39005 | Test Date: | 10/28/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 2 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 625 | 900 | 1175 |
| | | | | 1932.5 | 1960.0 | 1987.5 |
| 5.0 | QPSK | 25 | 0 | 27.3 | **27.4** | 27.2 |

## 8.3.2. LTE BAND 4

| Test Engineer ID: | 39005 | Test Date: | 10/28/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 4 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 1975 | 2175 | 2375 |
| | | | | 2112.5 | 2132.5 | 2152.5 |
| 5.0 | QPSK | 25 | 0 | **30.2** | 30.1 | 30.0 |

## 8.3.3. LTE BAND 5

| Test Engineer ID: | 39005 | Test Date: | 10/28/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 5 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 2425 | 2525 | 2625 |
| | | | | 871.5 | 881.5 | 891.5 |
| 5.0 | QPSK | 25 | 0 | **30.7** | 30.7 | 30.5 |

## 8.3.4. LTE BAND 12

| Test Engineer ID: | 39005 | Test Date: | 10/28/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 12 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 5035 | 5095 | 5155 |
| | | | | 731.5 | 737.5 | 743.5 |
| 5.0 | QPSK | 25 | 0 | 32.7 | **32.8** | 32.6 |

### 8.3.5. LTE BAND 13

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 13 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 5205 | 5230 | 5255 |
| | | | | 748.5 | 751.0 | 753.5 |
| 5.0 | QPSK | 25 | 0 | **32.8** | 32.7 | 32.6 |

### 8.3.6. LTE BAND 14

| Test Engineer ID: | 39005 | Test Date: | 10/27/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 14 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 5305 | 5330 | 5355 |
| | | | | 760.5 | 763.0 | 765.5 |
| 5.0 | QPSK | 25 | 0 | 27.9 | **28.0** | 27.9 |

### 8.3.7. LTE BAND 17

| Test Engineer ID: | 39005 | Test Date: | 10/27/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 14 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 5755 | 5790 | 5825 |
| | | | | 736.5 | 740.0 | 743.5 |
| 5.0 | QPSK | 25 | 0 | 31.6 | 31.7 | **31.8** |

### 8.3.8. LTE BAND 25

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 25 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 8065 | 8365 | 8665 |
| | | | | 1932.5 | 1962.5 | 1992.5 |
| 5.0 | QPSK | 25 | 0 | 27.1 | **27.4** | 27.4 |

## 8.3.9. LTE BAND 26 (FCC Part 90S)

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 26 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 8715 | 8740 | 8765 |
| | | | | 861.5 | 864.0 | 866.5 |
| 5.0 | QPSK | 25 | 0 | 27.4 | 27.5 | **27.7** |

## 8.3.10. LTE BAND 26 (FCC Part 22)

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 26 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 8815 | 8915 | 9015 |
| | | | | 871.5 | 881.5 | 891.5 |
| 5.0 | QPSK | 25 | 0 | 32.4 | **32.7** | 32.6 |

## 8.3.11. LTE BAND 66

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 66 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 66461 | 66886 | 67111 |
| | | | | 2112.5 | 2155.0 | 2177.5 |
| 5.0 | QPSK | 25 | 0 | 24.1 | 24.2 | **24.8** |

## 8.3.12. LTE BAND 71

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR LTE BAND 71 (5.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 68611 | 68761 | 68911 |
| | | | | 619.5 | 634.5 | 649.5 |
| 5.0 | QPSK | 25 | 0 | 31.6 | 31.7 | **31.8** |

### 8.3.13. 5G NR n71

| Test Engineer ID: | 39005 | Test Date: | 11/17/2022 |
|---|---|---|---|

**OUTPUT POWER FOR 5G NR n71 (20.0 MHz)**

| Bandwidth (MHz) | Modulation | RB Allocation | RB Offset | Power | | |
|---|---|---|---|---|---|---|
| | | | | Conducted Average (dBm) | | |
| | | | | 68693 | 68753 | 68824 |
| | | | | 627.7 | 633.7 | 640.8 |
| 20.0 | QPSK | 100 | 0 | 27.9 | **28.3** | 28.1 |

# 9. CONDUCTED TEST RESULTS

## 9.1. OCCUPIED BANDWIDTH

**RULE PART(S)**

FCC: §2.1049

**LIMITS**

For reporting purposes only.

**TEST PROCEDURE**

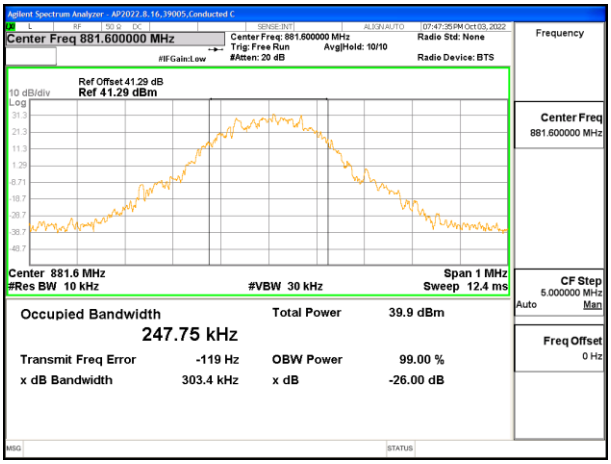
The transmitter output was connected to a calibrated coaxial cable and coupler, the other end of which was connected to a spectrum analyzer. The occupied bandwidth was measured with the spectrum analyzer at the middle channel in each band. The 99% and -26dB bandwidths was also measured and recorded.

**RESULTS**

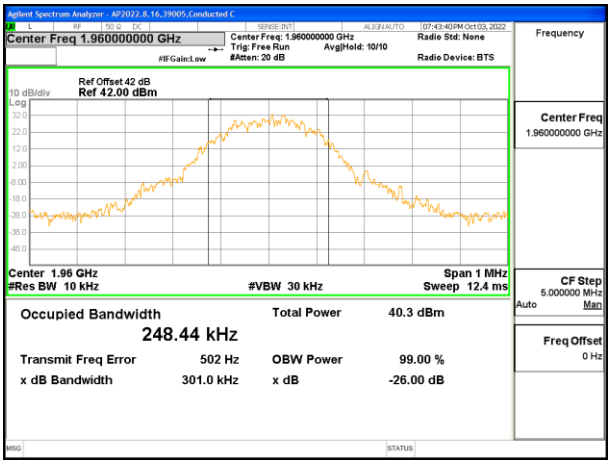
There is no limit required and power is the same for low, middle and high channel; therefore, only middle channel was tested.

| Band | Modulation | Channel | f(MHz) | 99% BW (kHz) | -26dB BW (kHz) |
|---|---|---|---|---|---|
| GSM850 | GPRS | 190 | 881.6 | 247.75 | 303.4 |
| GSM1900 | GPRS | 661 | 1960 | 248.44 | 301.0 |
| **Band** | **Modulation** | **Channel** | **f(MHz)** | **99% BW (MHz)** | **-26dB BW (MHz)** |
| UMTS BAND 5 | QPSK | 4408 | 881.6 | 4.1748 | 4.584 |
| UMTS BAND 2 | QPSK | 9800 | 1960 | 4.1826 | 4.595 |
| UMTS BAND 4 | QPSK | 1638 | 2132.6 | 4.1806 | 4.593 |

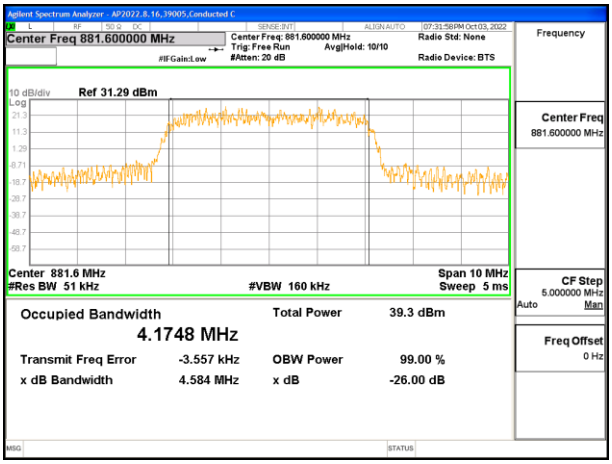
| Band | Mode | f(MHz) | 99% BW (MHz) | -26dB BW (MHz) |
|---|---|---|---|---|
| LTE BAND 2 | 5MHz, QPSK | 1960 | 4.4198 | 4.790 |
| LTE BAND 4 | | 2132.5 | 4.4343 | 4.742 |
| LTE BAND 5 | | 881.5 | 4.4367 | 4.677 |
| LTE BAND 12 | | 737.5 | 4.4818 | 4.738 |
| LTE BAND 13 | | 751 | 4.4353 | 4.732 |
| LTE BAND 14 | | 763 | 4.4653 | 4.807 |
| LTE BAND 17 | | 740 | 4.4264 | 4.675 |
| LTE BAND 25 | | 1962.5 | 4.4720 | 4.780 |
| LTE BAND 26 (FCC Part 90S) | | 864 | 4.4426 | 4.673 |
| LTE BAND 26 (FCC Part 22) | | 881.5 | 4.4709 | 4.687 |
| LTE BAND 66 | | 2155 | 4.4871 | 4.722 |
| LTE BAND 71 | | 634.5 | 4.4681 | 4.656 |
| 5G NR n71 | 20MHz, QPSK | 633.7 | 18.838 | 19.63 |



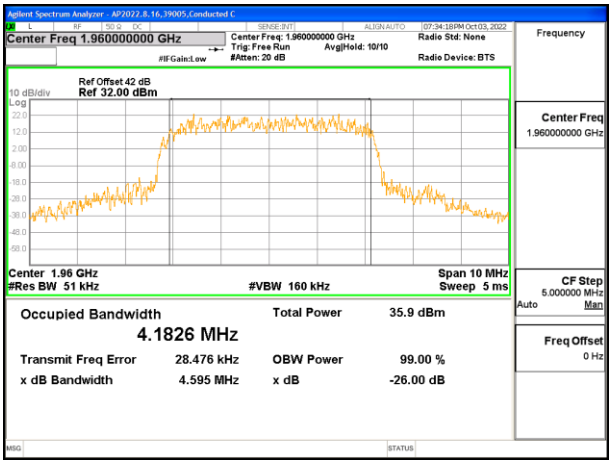

GSM 850 GPRS Middle Channel



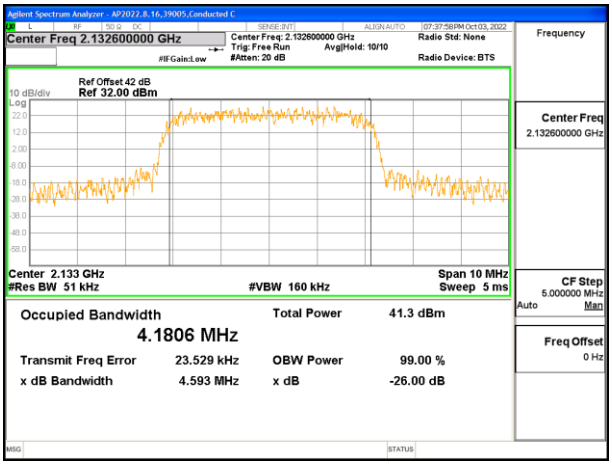

GSM 1900 GPRS Middle Channel



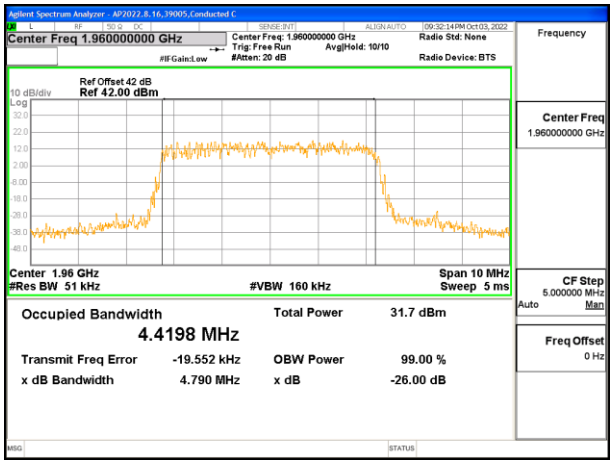

UMTS Band 5 QPSK Middle Channel



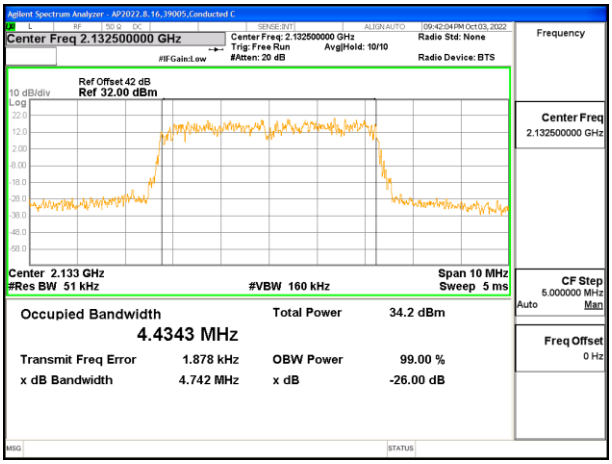

UMTS Band 2 QPSK Middle Channel



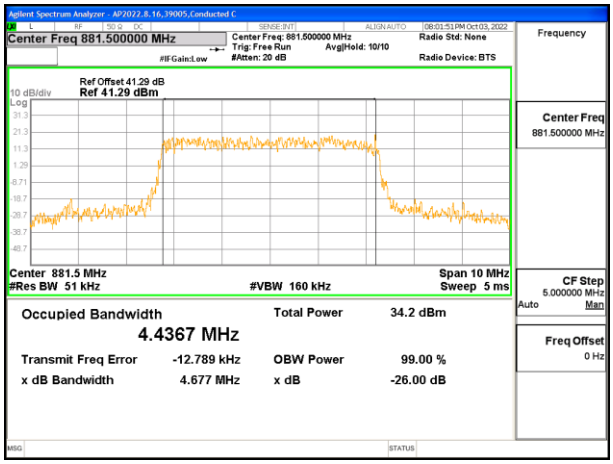

UMTS Band 4 QPSK Middle Channel



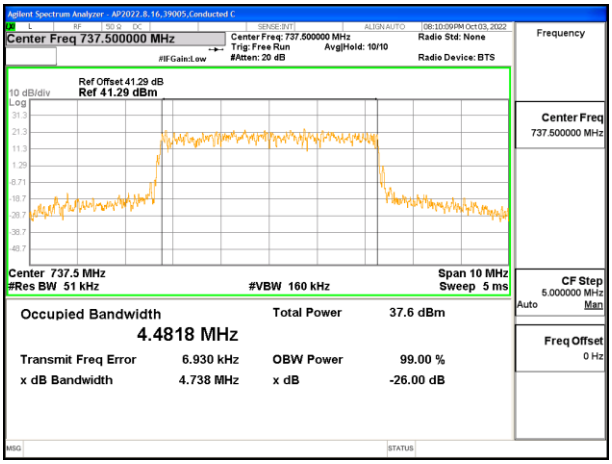

LTE B2 5MHz QPSK Middle Channel



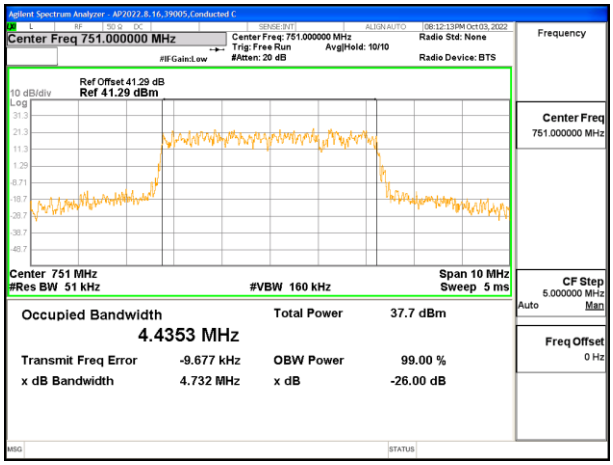

LTE B4 5MHz QPSK Middle Channel



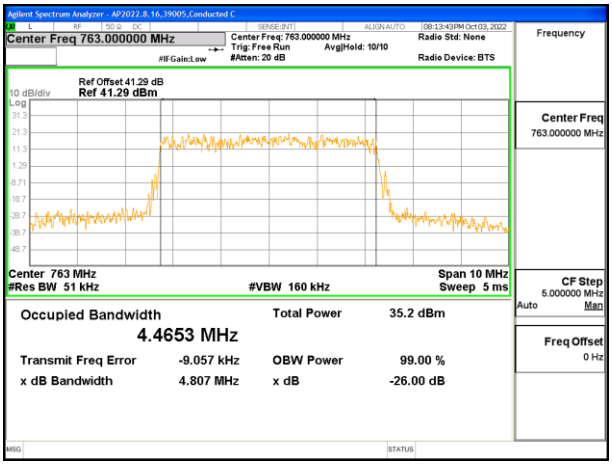

LTE B5 5MHz QPSK Middle Channel



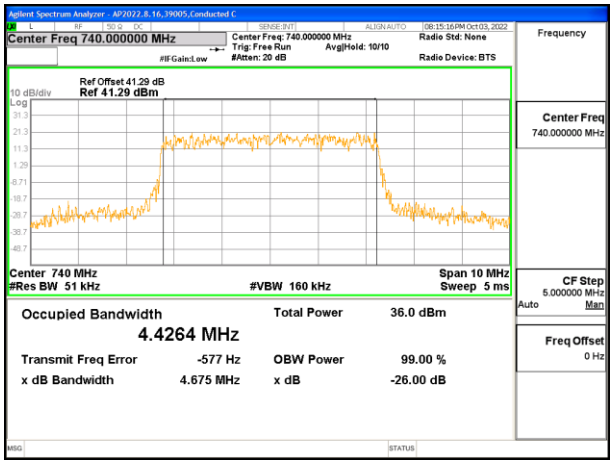

LTE B12 5MHz QPSK Middle Channel



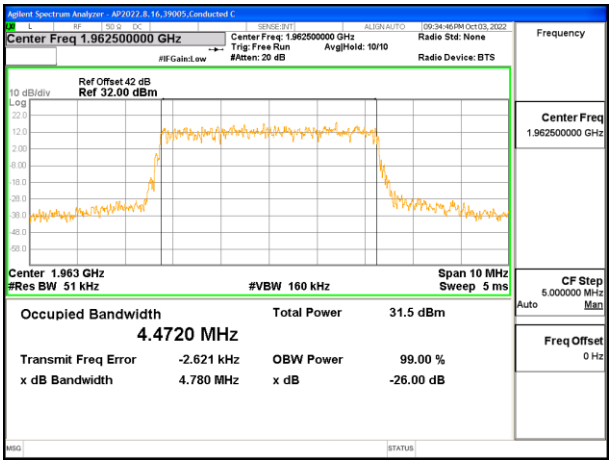

LTE B13 5MHz QPSK Middle Channel



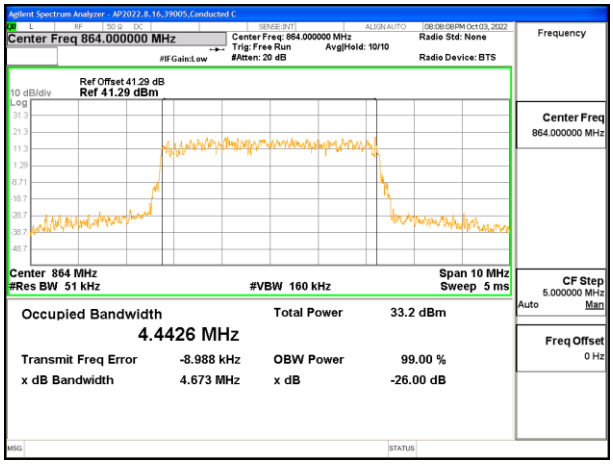

LTE B14 5MHz QPSK Middle Channel



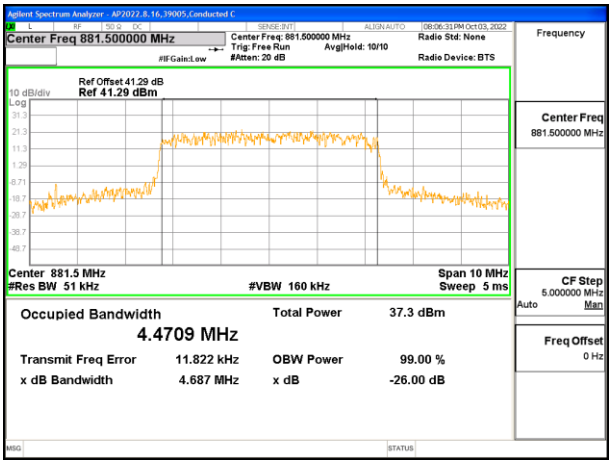

LTE B17 5MHz QPSK Middle Channel



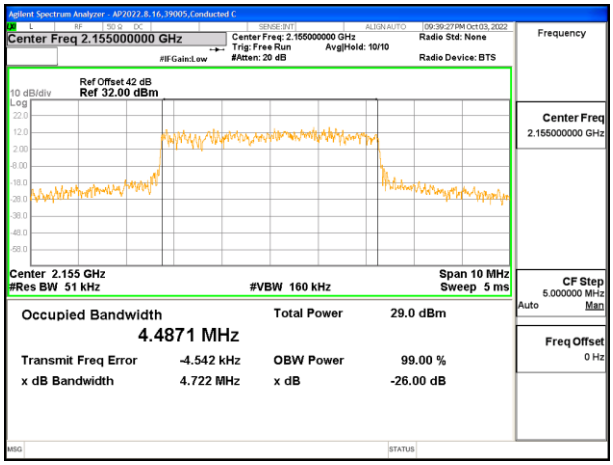

LTE B25 5MHz QPSK Middle Channel



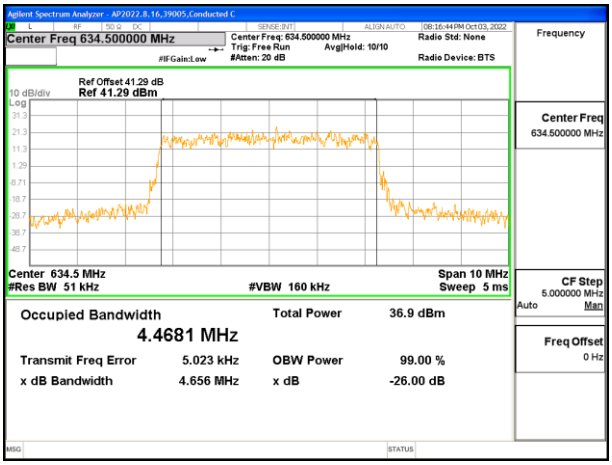

LTE B26 5MHz QPSK Middle Channel (FCC Part 90S)



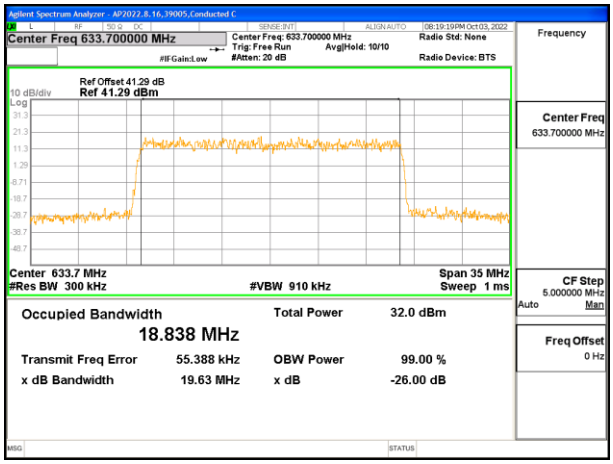

LTE B26 5MHz QPSK Middle Channel (FCC Part 22)




LTE B66 5MHz QPSK Middle Channel




LTE B71 5MHz QPSK Middle Channel




5G NR n71 QPSK Middle Channel

## 9.2. BAND EDGE/EMISSION MASK AND ADJACENT CHANNEL POWER

For Spectrum Emission Mask plots, the Keysight PXA N9030A is configured to sweep with a moving integration window, the width of which can be adjusted to different sizes across the sweep. The window width is configured to be greater than or equal to the required reference bandwidth. The center frequencies of the integration window for the different integration windows was set such that the upper and lower edges of the windows are aligned with the transition points in the reference bandwidths. This is achieved by setting the start / stop frequencies of the window with an offset equal to the reference bandwidth / 2 from the transition point.

**RULE PART(S)**

FCC: 22.917 (a), 24.238 (a), 27.53 (h), 27.53 (g), 27.53 (c) (f), 90.543 (e)(f), 90.691 (a)

**TEST PROCEDURE**

The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

For each band edge measurement:

1. Set the spectrum analyzer span to include the block edge frequency.
2. Set a marker to point the corresponding band edge frequency in each test case.
3. Set display line at -13, -20, -25, -40, -42, -45, and -46dBm
4. Set resolution bandwidth to at least 1% of emission bandwidth.

**TEST PROCEDURE (FCC LTE BAND 14)**

(b)ACP measurement procedure. The following are the procedures for making the transmitter ACP measurements. For all measurements modulate the transmitter as it would be modulated in normal operating conditions. For time division multiple access (TDMA) systems, the measurements are to be made under TDMA operation only during time slots when the transmitter is active. All measurements are made at the transmitter's output port. If a transmitter has an integral antenna, a suitable power coupling device shall be used to couple the RF signal to the measurement instrument. The coupling device shall substantially maintain the proper transmitter load impedance. The ACP measurements may be made with a spectrum analyzer capable of making direct ACP measurements. “Measurement bandwidth”, as used for non-swept measurements, implies an instrument that measures the power in many narrow bandwidths equal to the nominal resolution bandwidth and integrates these powers to determine the total power in the specified measurement bandwidth.

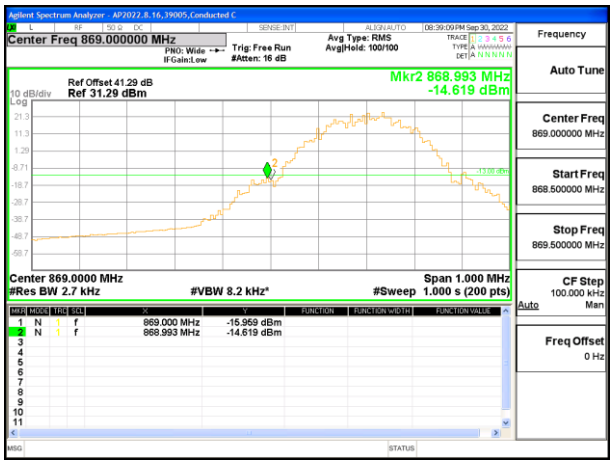
(1)Setting reference level. Set transmitter to maximum output power. Using a spectrum analyzer capable of ACP measurements, set the measurement bandwidth to the channel size. For example, for a 6.25 kHz transmitter set the measurement bandwidth to 6.25 kHz. Set the frequency offset of the measurement bandwidth to zero and adjust the center frequency of the instrument to the assigned center frequency to measure the average power level of the transmitter. Record this power level in dBm as the “reference power level.”

(2)Non-swept power measurement. Using a spectrum analyzer capable of ACP measurements, set the measurement bandwidth and frequency offset from the assigned center frequency as shown in the tables in §90.543 (a) above. Any value of resolution bandwidth may be used as long as it does not exceed 2 percent of the specified measurement bandwidth. Measure the power level in dBm. These measurements should be made at maximum power. Calculate ACP by subtracting the reference power level measured in (b)(1) from the measurements made in this step. The absolute value of the calculated ACP must be greater than or equal to the absolute value of the ACP given in the table for each condition above.

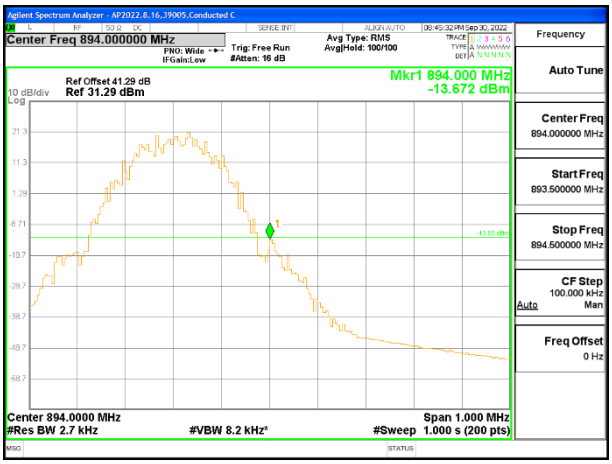
(3)Swept power measurement. Set a spectrum analyzer to 30 kHz resolution bandwidth, 1 MHz video bandwidth and average, sample, or RMS detection. Set the reference level of the spectrum analyzer to the RMS value of the transmitter power. Sweep above and below the carrier frequency to the limits defined in the tables. Calculate ACP by subtracting the reference power level measured in (b)(1) from the measurements made in this step. The absolute value of the calculated ACP must be greater than or equal to the absolute value of the ACP given in the table for each condition above.

**RESULTS**

## 9.2.1. GSM 850



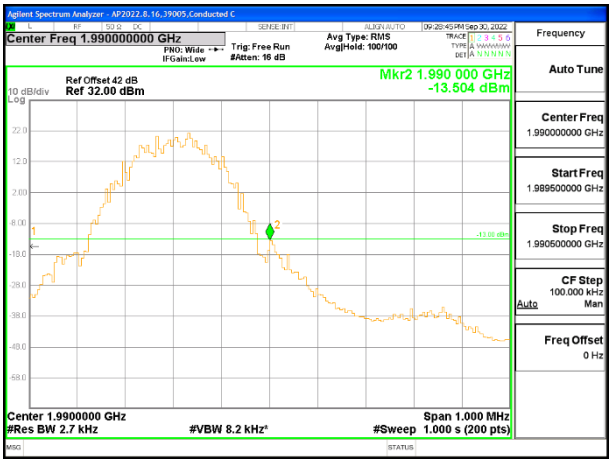

GSM 850 GPRS Low Channel




GSM 850 GPRS High Channel

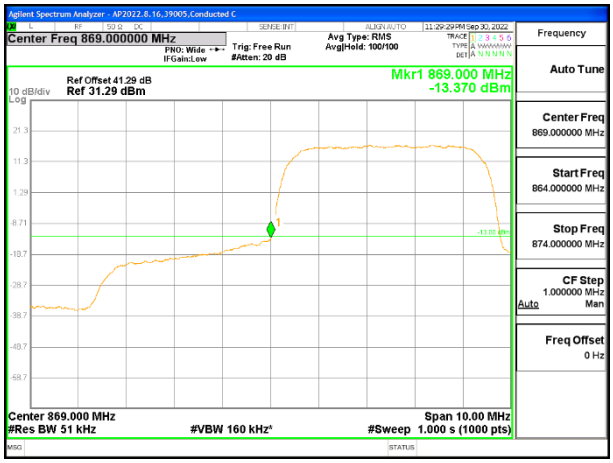
## 9.2.2. GSM 1900


GSM 1900 GPRS Low Channel

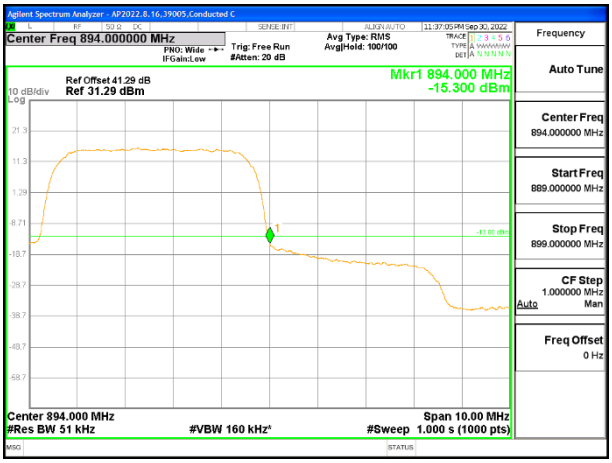



GSM 1900 GPRS High Channel

## 9.2.3. UMTS BAND 5

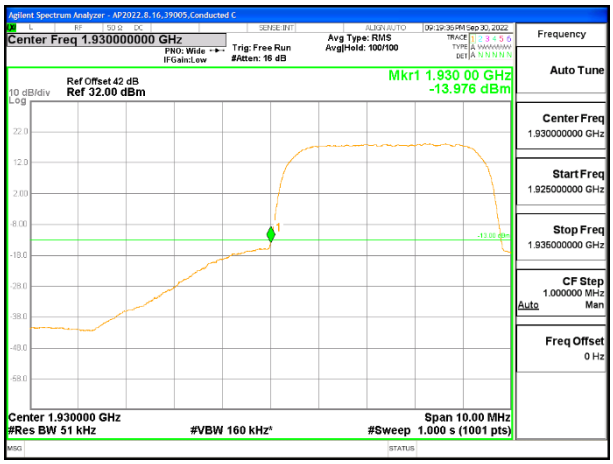


UMTS Band 5 QPSK Low Channel

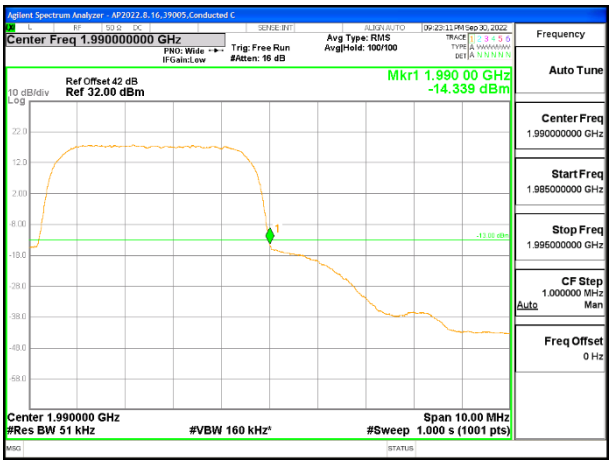


UMTS Band 5 QPSK High Channel

## 9.2.4. UMTS BAND 2

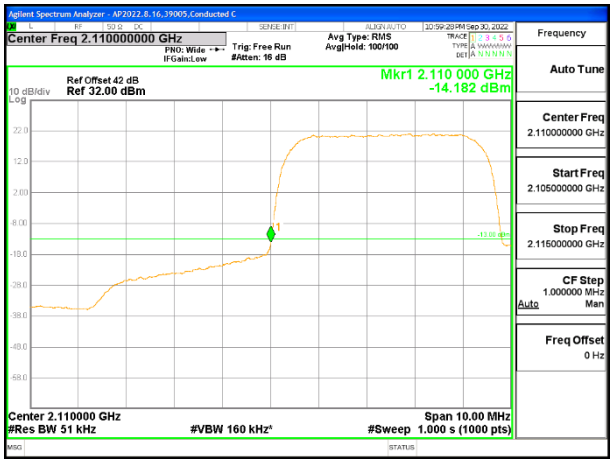


UMTS Band 2 QPSK Low Channel

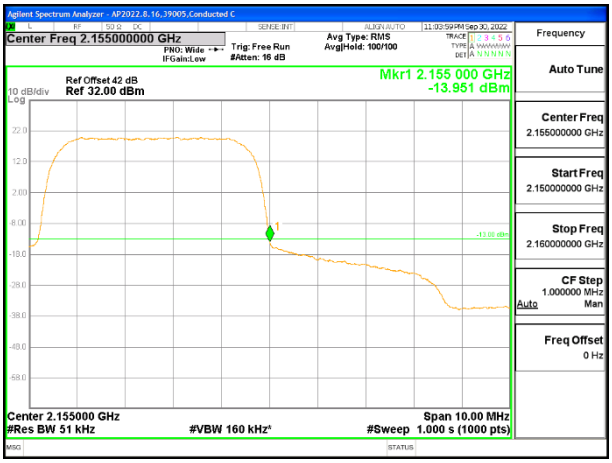


UMTS Band 2 QPSK High Channel

## 9.2.5. UMTS BAND 4




UMTS Band 4 QPSK Low Channel



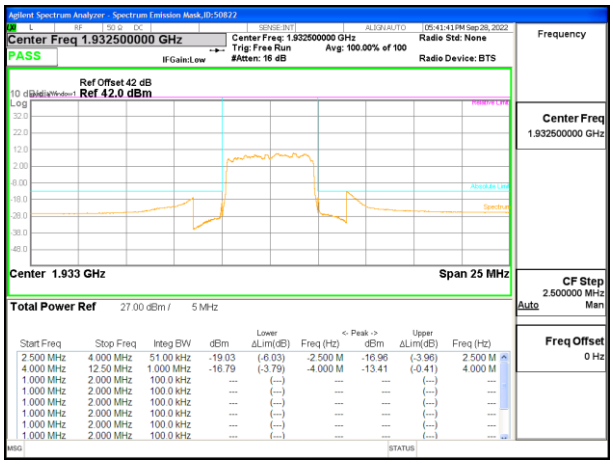

UMTS Band 4 QPSK High Channel

## 9.2.6. LTE BAND 2 EMISSION MASK

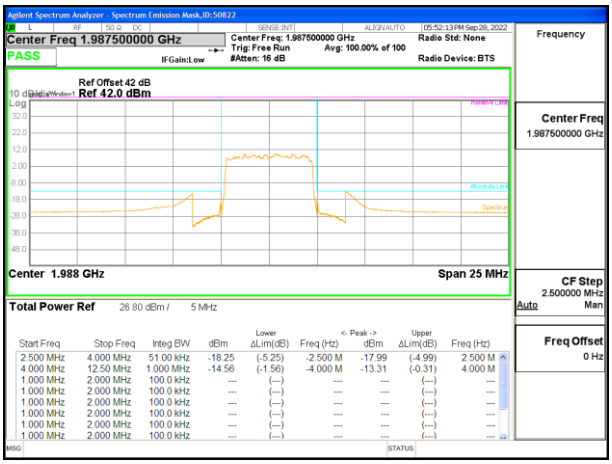
### LIMITS

FCC: §24.238 (a)
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.

### LTE BAND 2 BANDEDGE




LTE B2 5MHz QPSK Low Channel




LTE B2 5MHz QPSK High Channel

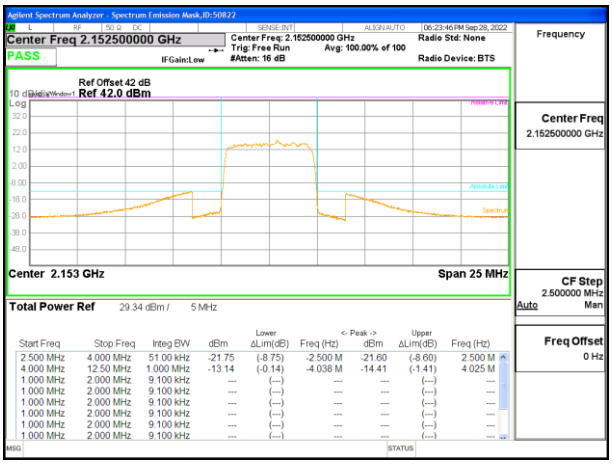
## 9.2.7. LTE BAND 4 EMISSION MASK

### LIMITS

FCC: §27.53(h)
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.

### LTE BAND 4 BANDEGE


LTE B4 5MHz QPSK Low Channel




LTE B4 5MHz QPSK High Channel

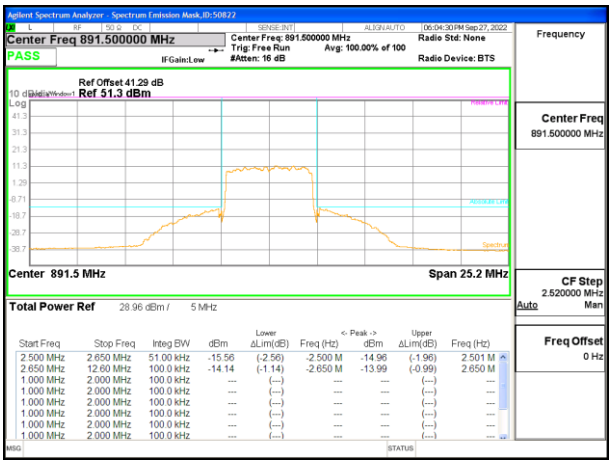
## 9.2.8. LTE BAND 5 EMISSION MASK

### LIMITS

FCC: §22.917 (a)
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.

### LTE BAND 5 EMISSION MASK


LTE B5 5MHz QPSK Low Channel



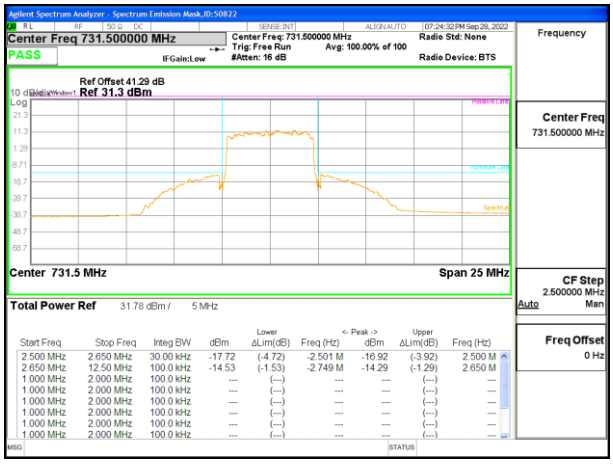

LTE B5 5MHz QPSK High Channel

## 9.2.9. LTE BAND 12 EMISSION MASK

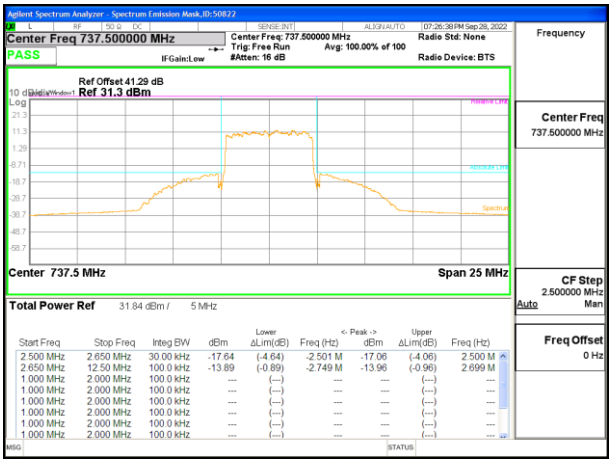
### LIMITS

FCC: §27.53
(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

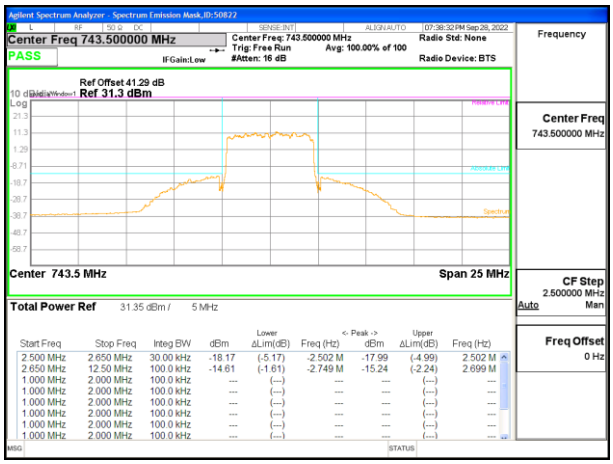
### LTE BAND 12 EMISSION MASK




LTE B12 5MHz QPSK Low Channel




LTE B12 5MHz QPSK Middle Channel




LTE B12 5MHz QPSK High Channel

## 9.2.10. LTE BAND 13 EMISSION MASK

**LIMITS**

FCC: §27.53
(c )For operations in the 746-758 MHz band and the 776-788 MHz band, 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:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

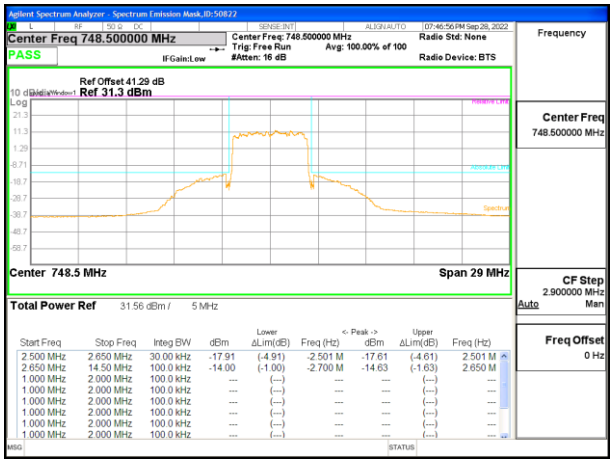
(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(5) Compliance with the provisions of paragraphs (c)(2) 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 at least 30 kHz may be employed;

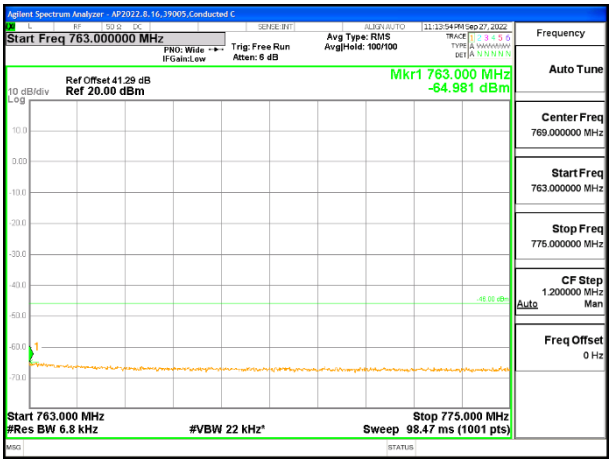
(6) Compliance with the provisions of paragraphs (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

(f) or operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals. (-70 dBW/MHz = -40dBm/MHz).

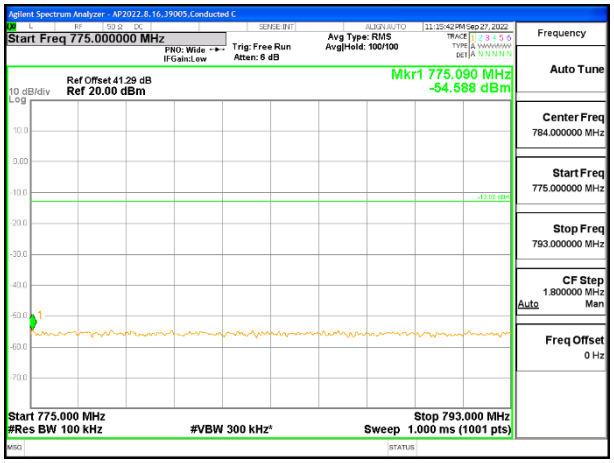
## LTE BAND 13 EMISSION MASK



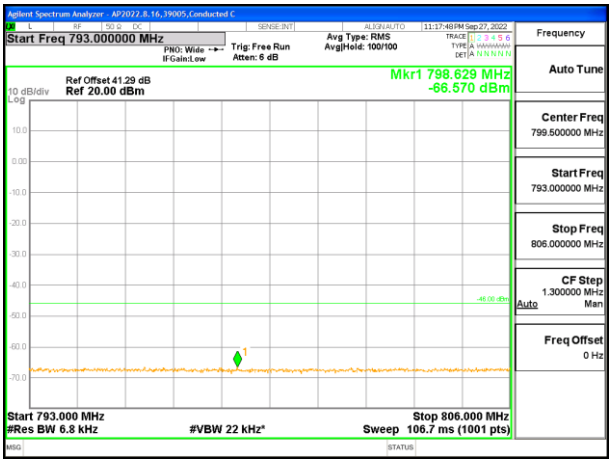

LTE B13 5MHz QPSK Low Channel



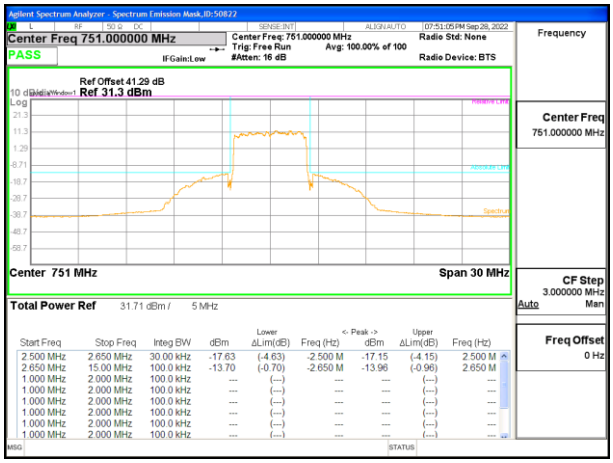

Second segment 763MHz-775MHz



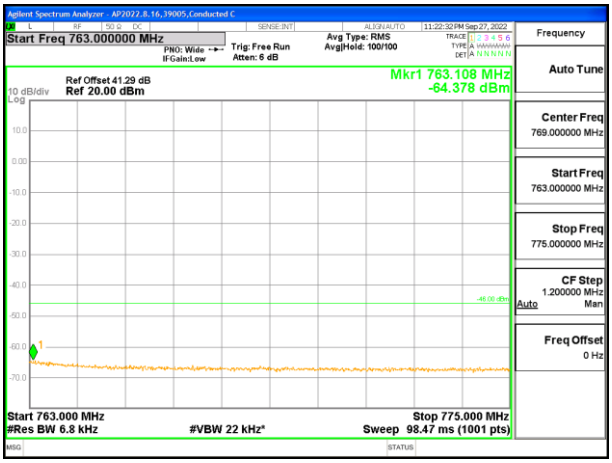

Third segment 775MHz-793MHz



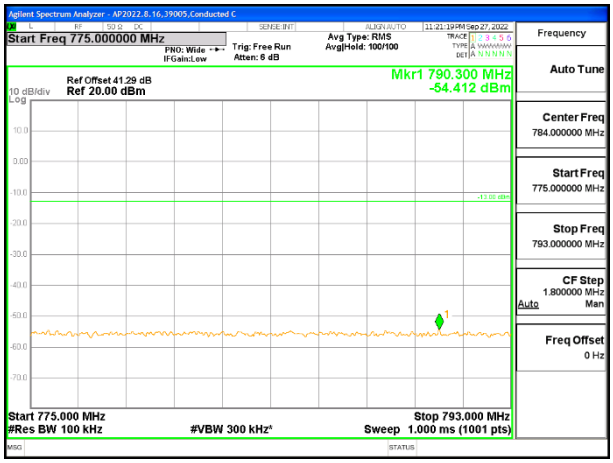

Fourth segment 793MHz-806MHz



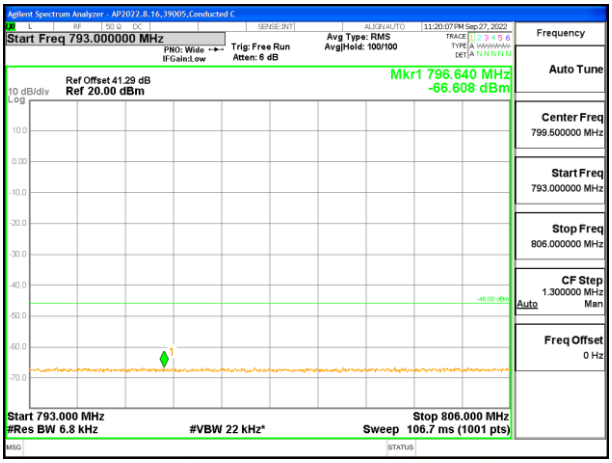

LTE B13 5MHz QPSK Middle Channel



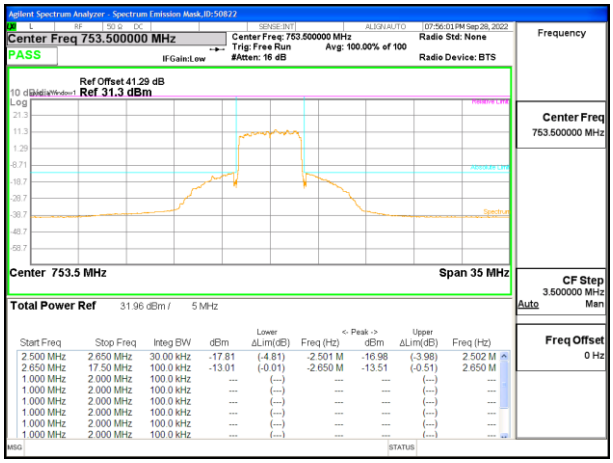

Second segment 763MHz-775MHz



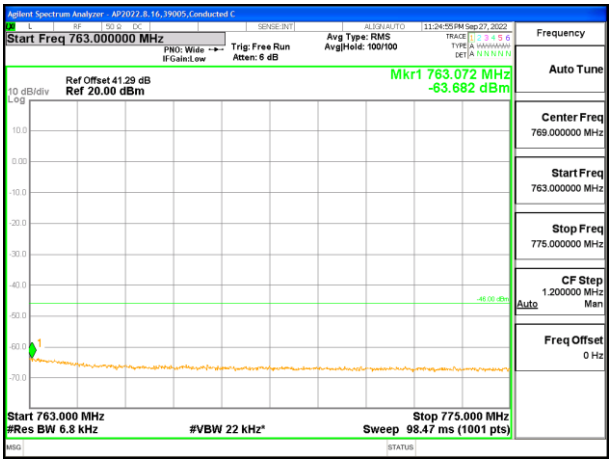

Third segment 775MHz-793MHz



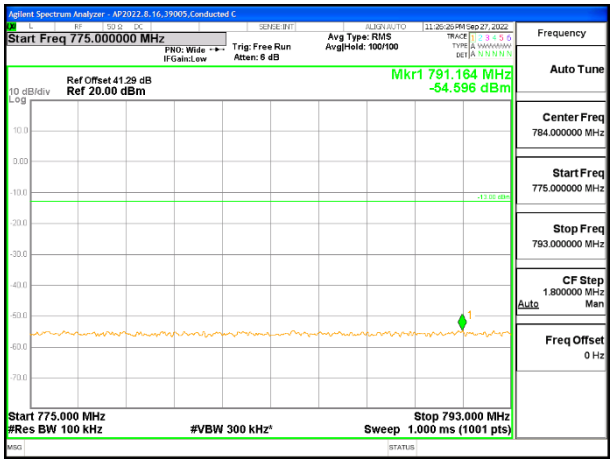

Fourth segment 793MHz-806MHz



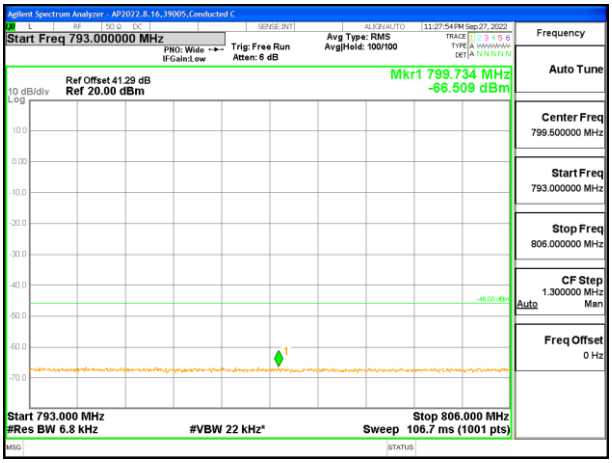

LTE B13 5MHz QPSK High Channel




Second segment 763MHz-775MHz




Third segment 775MHz-793MHz




Fourth segment 793MHz-806MHz

## 9.2.11. LTE BAND 14 EMISSION MASK

**LIMITS**

FCC: §90.543 Emission Limitations.
(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:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.

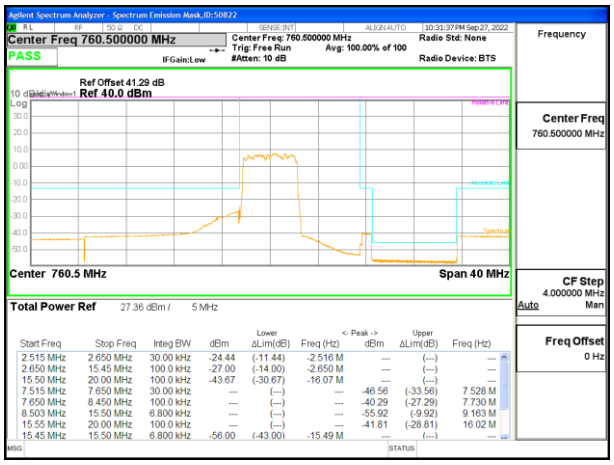
(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(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.

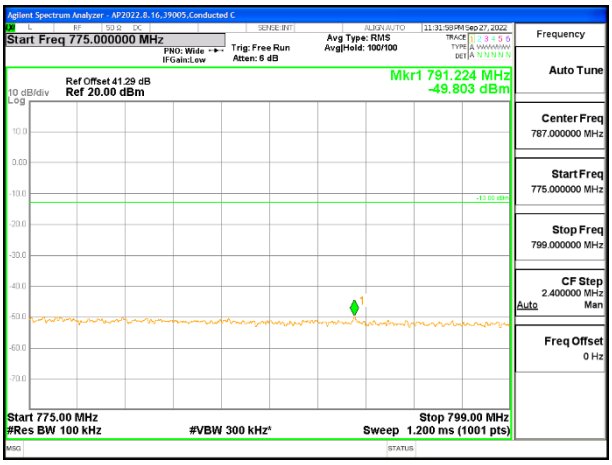
(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may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

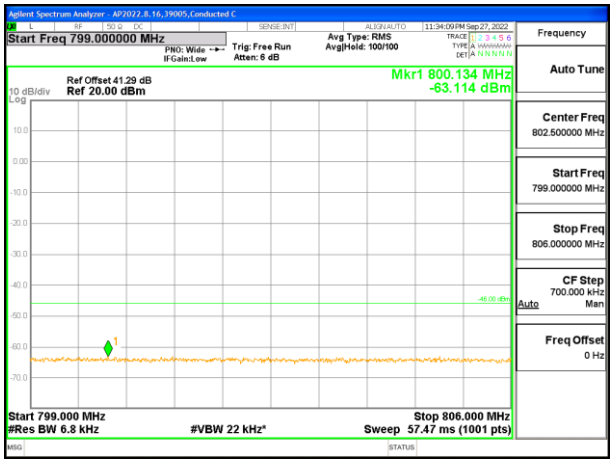
## LTE BAND 14 EMISSION MASK



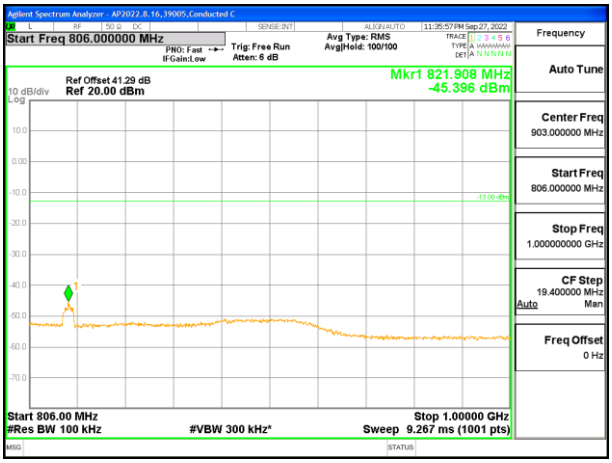

LTE B14 5MHz QPS Low Channel



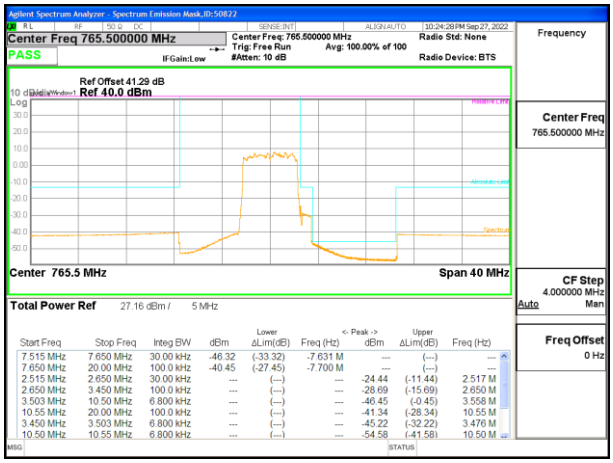

Second segment 775MHz-799MHz



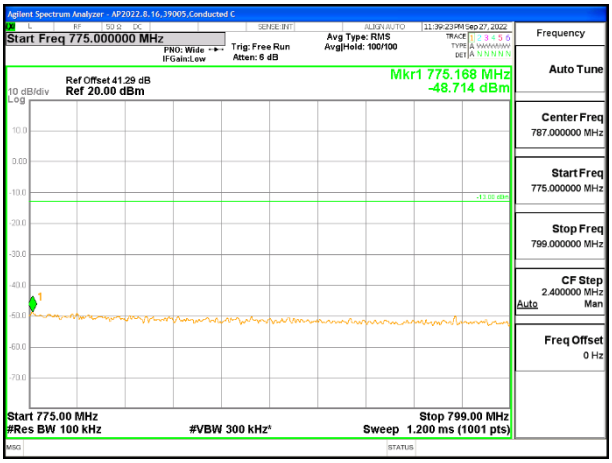

Third segment 799MHz-806MHz



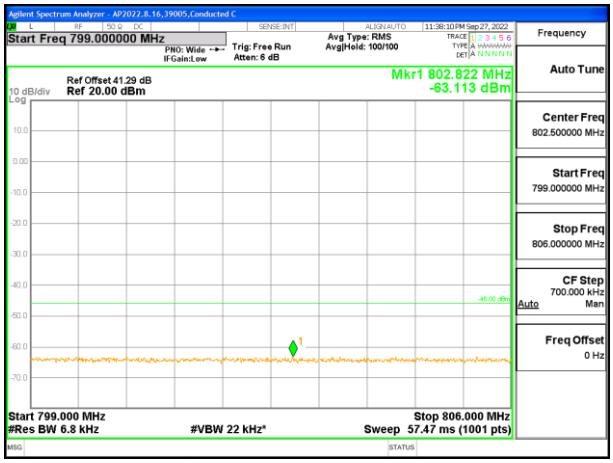

Fourth segment 806MHz-1GHz



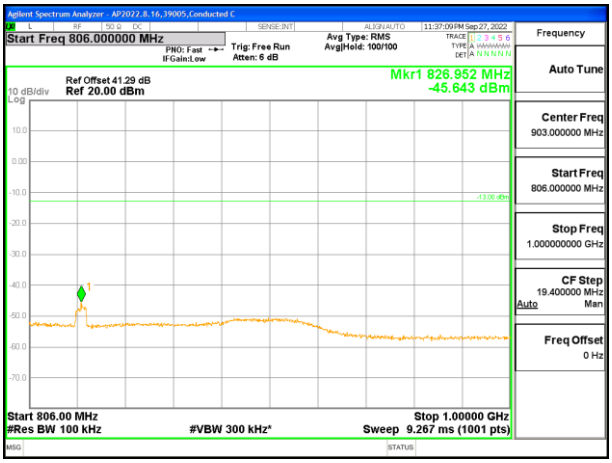

LTE B14 5MHz QPSK High Channel




Second segment 775MHz-799MHz




Third segment 799MHz-806MHz



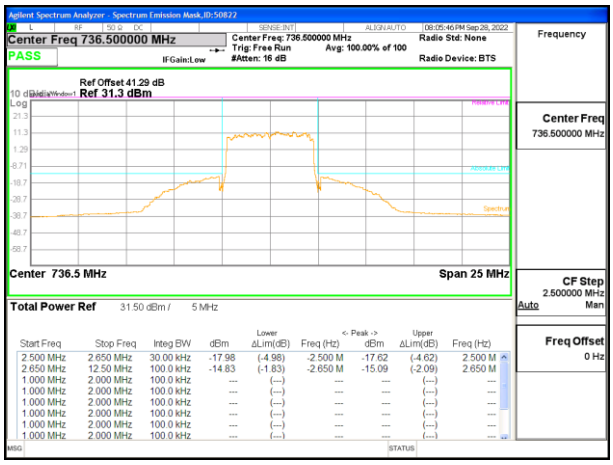

Fourth segment 806MHz-1GHz

## 9.2.12. LTE BAND 17 EMISSION MASK

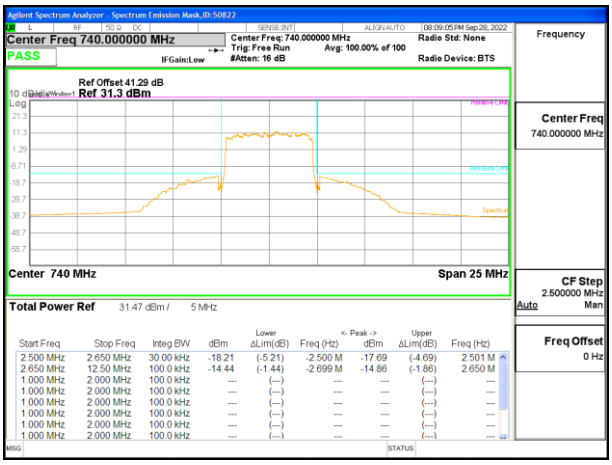
### LIMITS

FCC: §27.53
(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a 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, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

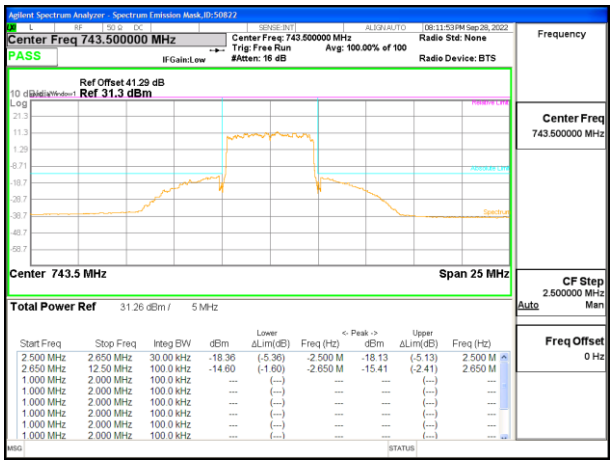
### LTE BAND 17 EMISSION MASK




LTE B17 5MHz QPSK Low Channel




LTE B17 5MHz QPSK Middle Channel



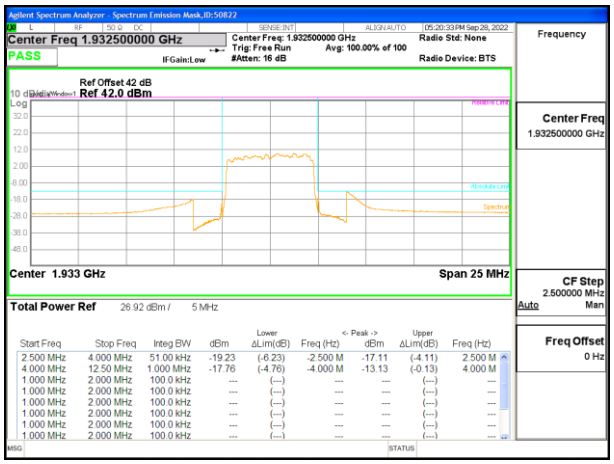

LTE B17 5MHz QPSK High Channel

## 9.2.13. LTE BAND 25 EMISSION MASK

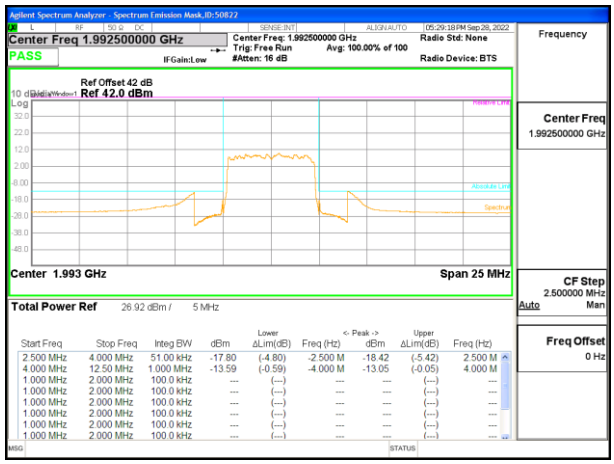
### LIMITS

FCC: §24.238 (a)
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.

### LTE BAND 25 BANDEDGE




LTE B25 5MHz QPSK Low Channel




LTE B25 5MHz QPSK High Channel

## 9.2.14. LTE BAND 26 EMISSION MASK (FCC PART 90S)

**LIMITS**

FCC: §90.691 Emission mask requirements for EA-based systems.
(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

**LTE BAND 26 EMISSION MASK**


LTE B26 5MHz QPSK Low Channel

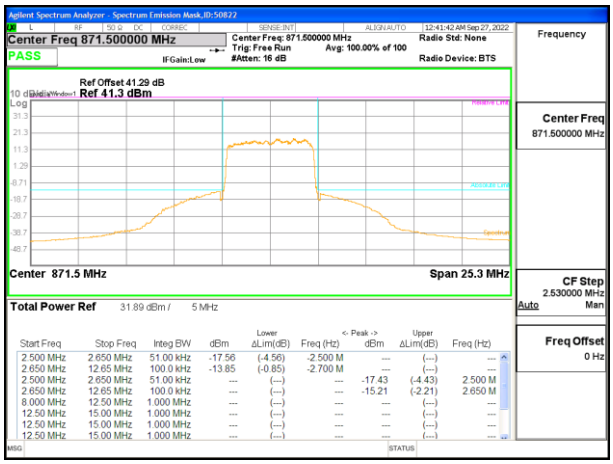

LTE B26 5MHz QPSK High Channel

## 9.2.15. LTE BAND 26 EMISSION MASK (FCC PART 22)

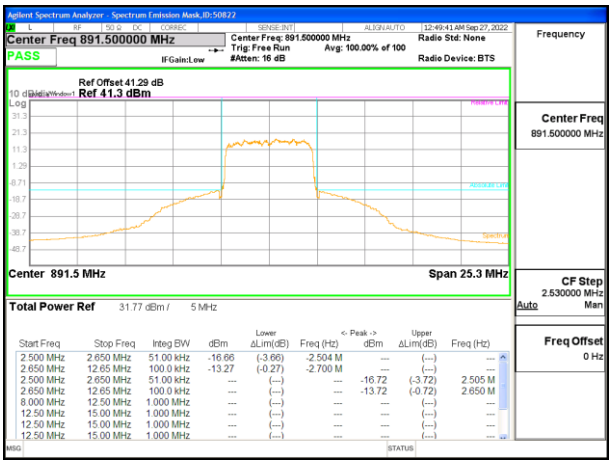
### LIMITS

FCC: §22.917 (a)
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.

### LTE BAND 26 EMISSION MASK




LTE B26 5MHz QPSK Low Channel




LTE B26 5MHz QPSK High Channel