



CERTIFICATION TEST REPORT

Report Number. : 4789354138-E3V2

Applicant : SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Model : SM-G770U1

FCC ID : A3LSMG770U

EUT Description : GSM/CDMA/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac,
ANT+ and NFC

Test Standard(s) : FCC CFR47 PART 90 SUBPART R

Date Of Issue:

March 09, 2020

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Revision History

| <u>Rev.</u> | <u>Issue Date</u> | <u>Revisions</u> | <u>Revised By</u> |
|-------------|-------------------|-----------------------------------|-------------------|
| V1 | 03/04/20 | Initial issue | Sungeun Lee |
| V2 | 03/09/20 | Updated to address TCB's question | Sungeun Lee |

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: GSM/CDMA/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC

MODEL NUMBER: SM-G770U1

SERIAL NUMBER: R38MC0CECEP, R38MC0CE38V(CONDUCTED);
R38MC0CE7XM, R38MC0CE7RW(RADIATED)

DATE TESTED: FEB 02, 2020 – MAR 04, 2020;

| APPLICABLE STANDARDS | |
|----------------------|--------------|
| STANDARD | TEST RESULTS |
| FCC PART 90R | Pass |

UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. 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 IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:



Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:



Sungeun Lee
Suwon Lab Engineer
UL Korea, Ltd.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with following methods.

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 90.
3. ANSI TIA-603-E, 2016
4. ANSI C63.26, 2015
5. KDB 971168 D01 Power Meas License Digital Systems v03r01

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 218 Maeyeong-ro | |
|-------------------------------------|-----------|
| <input checked="" type="checkbox"/> | Chamber 1 |
| <input checked="" type="checkbox"/> | Chamber 2 |
| <input type="checkbox"/> | Chamber 3 |

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$EIRP = \text{PSA reading with EUT worst orientation (dBm)} + \text{Path loss (dB)} - \text{cable loss (between the SG and substitution antenna)} + \text{Substitution Antenna Factor (dBi)}$

$ERP = \text{PSA reading with EUT worst orientation (dBm)} + \text{Path loss (dB)} - \text{cable loss (between the SG and substitution antenna)}$

(Path loss = Signal generator output – PSA reading with substitution antenna)

4.3. MEASUREMENT UNCERTAINTY

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

| PARAMETER | UNCERTAINTY |
|--|-------------|
| Conducted Disturbance, 0.15 to 30 MHz | 2.35 dB |
| Radiated Disturbance, 30 MHz to 1 GHz | 3.49 dB |
| Radiated Disturbance, 1 GHz to 18 GHz | 5.82 dB |
| Radiated Disturbance, 18 GHz to 40 GHz | 5.49 dB |

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

4.4. DECISION RULE

Decision rule for statement(s) of conformity is based on Procedure 1, Clause 4.4.2 in IEC Guide 115:2007.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a GSM/CDMA/WCDMA/LTE Phone + BT/BLE, DTS/UNII a/b/g/n/ac, ANT+ and NFC. This test report addresses the WWAN operational mode.

5.2. MAXIMUM OUTPUT POWER

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

Note : Conducted output power results were excerpted from RF exposure test report(4789354138-S1 FCC Report SAR).

LTE Band 14

| FCC Part 27 | | | | | | | |
|-------------|-----------------------|-----------------|------------|--------------|---------------|--------------|---------------|
| Band | Frequency Range [MHz] | BandWidth [MHz] | Modulation | Conducted | | Radiated | |
| | | | | Avg [dBm] | Avg [mW] | Avg [dBm] | Avg [mW] |
| Band 14 | 788 ~ 798 | 10 | QPSK | 24.39 | 275.00 | 21.88 | 154.17 |
| | | | 16QAM | 23.35 | 216.38 | 20.73 | 118.30 |
| | | | 64QAM | 22.64 | 183.77 | | |
| | | 5 | QPSK | 24.63 | 290.33 | 21.55 | 142.89 |
| | | | 16QAM | 23.68 | 233.61 | 20.55 | 113.50 |
| | | | 64QAM | 22.44 | 175.46 | | |

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a internal antenna for the [List the bands supported] with a maximum peak gain as follow:

| Frequency (MHz) | Peak Gain (dBi) |
|------------------------------|-----------------|
| LTE Band 14 788 ~ 798 MHz | -4.79 |

5.4. WORST-CASE ORIENTATION

Following modes should be considered as worst-case scenario for all other measurements.

For LTE Band 14, the worst-case scenario for all measurements is based on the average conducted output power measurement investigation results. Output power measurements were measured on QPSK, 16QAM and 64QAM modulations. It was found that QPSK and 16QAM results were worst case. All testing was performed using QPSK and 16QAM modulations to represent the worst case. However, the out of band emissions and spurious radiation were only performed on bandwidth and RB offset(with RB size 1) with the highest power in QPSK.

| Highest power setting for each bands | | | | |
|--------------------------------------|-----------------|-----------------|---------|-----------|
| LTE Band | Frequency (MHz) | Bandwidth (MHz) | RB size | RB offset |
| 14 | 790.5 | 5 | 1 | 24 |
| | 793.0 | | 1 | 24 |
| | 795.5 | | 1 | 24 |

The fundamental and radiated spurious emission were investigated in three orthogonal orientations X, Y and Z, it was determined that below orientation was worst-case orientation for each band.

| Band | ERP/EIRP | | | RSE | | |
|---------|----------|---|---|-----|---|---|
| | X | Y | Z | X | Y | Z |
| LTE B14 | - | - | O | - | - | O |

Note : For ERP/EIRP testing, the EUT didn't attached with travel adapter. But radiated spurious testing, the EUT attached with travel adapter for the worst case condition. The EUT is continuously communicated with the call box during the tests.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

| Support Equipment List | | | | |
|------------------------|--------------|-------------|----------------|--------|
| Description | Manufacturer | Model | Serial Number | FCC ID |
| Charger | SAMSUNG | EP-TA800 | R37MAYF19B7DK3 | N/A |
| Data Cable | SAMSUNG | EP-DA705BBE | N/A | N/A |

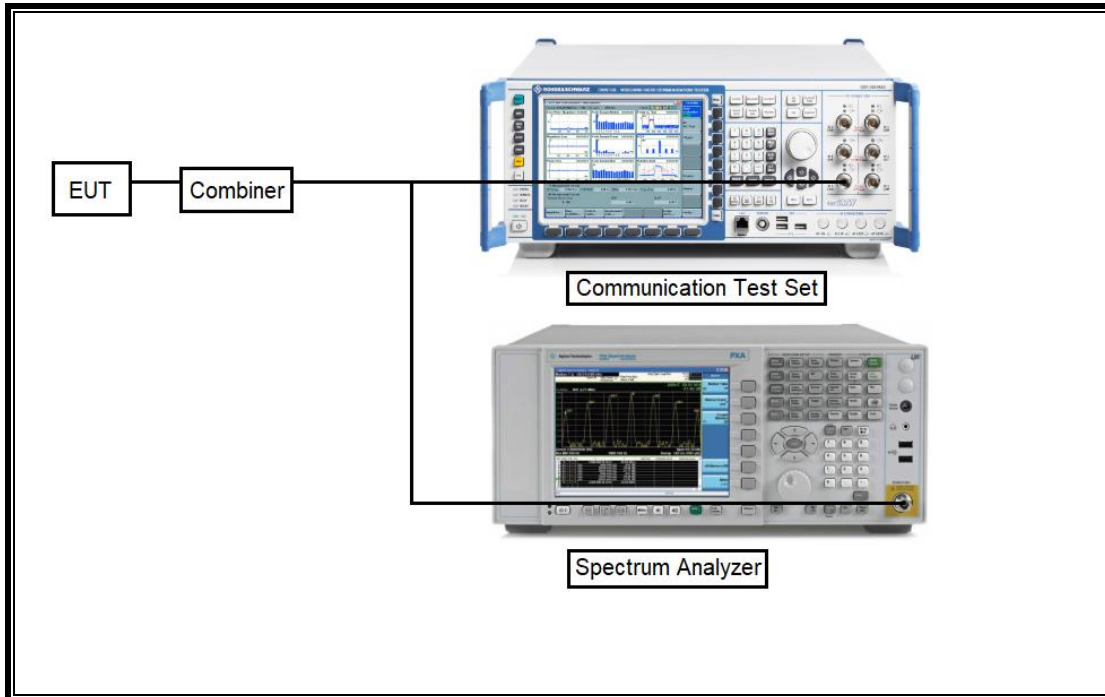
I/O CABLE

| I/O Cable List | | | | | | |
|----------------|----------|----------------------|----------------|------------|------------------|---------|
| Cable No | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | DC Power | 1 | C Type | Shielded | 1.0m | N/A |

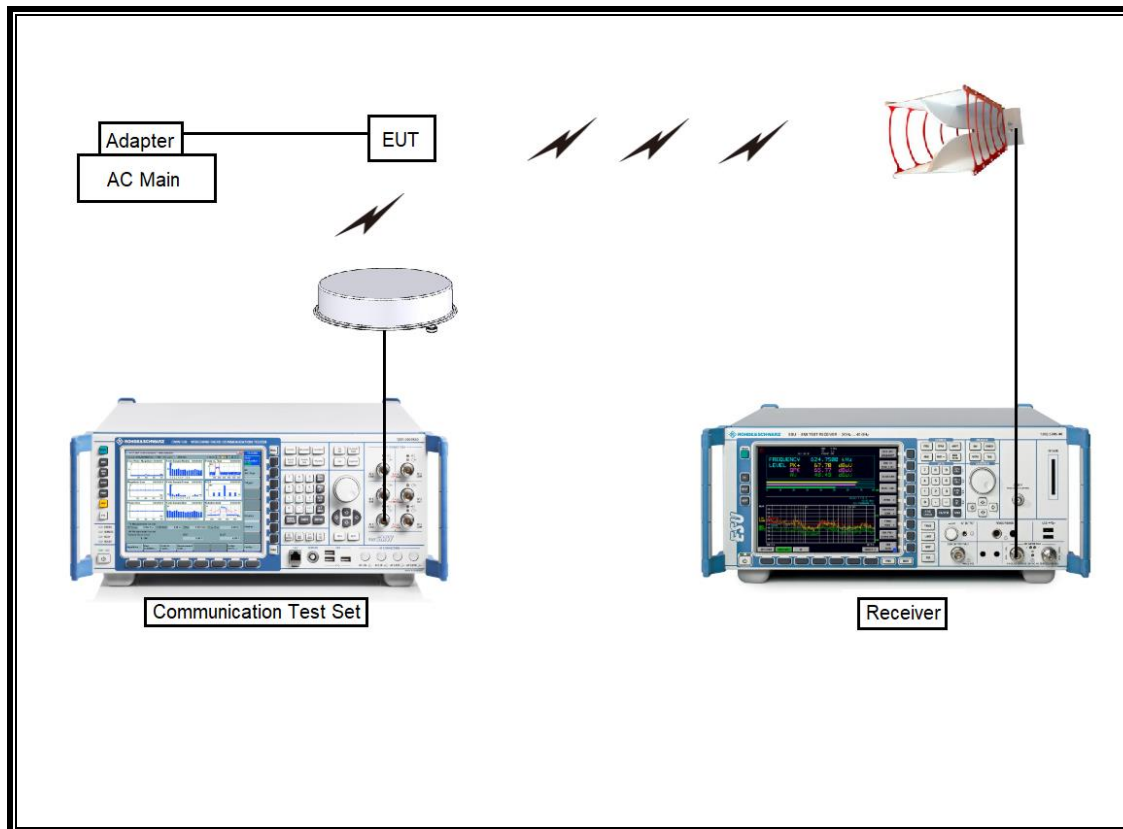
TEST SETUP

The EUT is continuously communicated with the call box during the tests.

SETUP DIAGRAM FOR TESTS (CONDUCTED TEST SETUP)



SETUP DIAGRAM FOR TESTS (RADIATED TEST SETUP)



6. 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 | S/N | Cal Due |
| Antenna, Tuned Dipole 400~1000 MHz | ETS | 3121D DB4 | 00164753 | 01-30-21 |
| Antenna, Horn, 40 GHz | ETS | 3116C | 00166155 | 08-13-20 |
| Preamplifier | ETS | 3116C-PA | 00168841 | 08-08-20 |
| Antenna, Horn, 40 GHz | ETS | 3116C | 00168645 | 10-02-21 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK | VULB9163 | 750 | 08-04-20 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK | VULB9163 | 845 | 08-04-20 |
| Antenna, Bilog, 30MHz-1GHz | SCHWARZBECK | VULB9163 | 749 | 08-04-20 |
| Antenna, Horn, 18 GHz | ETS | 3115 | 00167211 | 08-04-20 |
| Antenna, Horn, 18 GHz | ETS | 3115 | 00161451 | 08-04-20 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00168724 | 08-04-20 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00205959 | 08-04-20 |
| Antenna, Horn, 18 GHz | ETS | 3117 | 00168717 | 08-04-20 |
| Combiner | WEINSCHTEL | 1575 | 2150 | 08-08-20 |
| Communications Test Set | R&S | CMW500 | 115331 | 08-05-20 |
| DC Power Supply | Agilent / HP | E3640A | MY54226395 | 08-06-20 |
| Preamplifier, 1000 MHz | Sonoma | 310N | 341282 | 08-05-20 |
| Preamplifier, 1000 MHz | Sonoma | 310N | 370599 | 08-05-20 |
| Preamplifier, 1000 MHz | Sonoma | 310N | 351741 | 08-05-20 |
| Preamplifier, 18 GHz | Miteq | AFS42-00101800-25-S-42 | 1876511 | 08-06-20 |
| Preamplifier, 18 GHz | Miteq | AFS42-00101800-25-S-42 | 2029169 | 08-06-20 |
| Preamplifier, 18 GHz | Miteq | AFS42-00101800-25-S-42 | 1896138 | 08-06-20 |
| Spectrum Analyzer, 44 GHz | Agilent / HP | N9030A | MY54490312 | 08-06-20 |
| EMI Test Receive, 40 GHz | R&S | ESU40 | 100439 | 08-06-20 |
| EMI Test Receive, 40 GHz | R&S | ESU40 | 100457 | 08-06-20 |
| Directional Antenna | Cobham | FPA3-0.8-6.0R/1329 | 80108-0004 | N/A |
| High Pass Filter 1.2GHz | Micro-Tronics | HPM50108-02 | G005 | 08-05-20 |
| High Pass Filter 1.2GHz | Micro-Tronics | HPM50108-02 | G006 | 08-05-20 |
| High Pass Filter 2.8GHz | Micro-Tronics | HPM50111-02 | 010 | 08-05-20 |
| High Pass Filter 2.8GHz | Micro-Tronics | HPM50111-02 | 011 | 08-05-20 |
| High Pass Filter 4GHz | Micro-Tronics | HPM50118-02 | G001 | 08-05-20 |
| High Pass Filter 4GHz | Micro-Tronics | HPM50118-02 | G002 | 08-05-20 |
| Attenuator | PASTERNAK | PE7087-10 | A009 | 08-08-20 |
| Attenuator | PASTERNAK | PE7087-10 | A001 | 08-08-20 |
| Attenuator | PASTERNAK | PE7087-10 | A008 | 08-08-20 |
| Attenuator | PASTERNAK | PE7087-10 | 2 | 08-08-20 |
| Attenuator | PASTERNAK | PE7395-10 | A011 | 08-08-20 |
| Antenna, Loop, 9kHz-30MHz | R&S | HFH2-Z2 | 100418 | 10-02-21 |
| Temperature Chamber | ESPEC | SH-642 | 93001109 | 08-05-20 |
| UL Software | | | | |
| Description | Manufacturer | Model | Version | |
| Antenna port test software | UL | CLT | Ver 2.5 | |

7. SUMMARY TABLE

| FCC Part Section | Test Description | Test Limit | Test Condition | Test Result |
|------------------|---|---------------|----------------|-------------|
| 2.1049 | Occupied Band width (99%) | N/A | Conducted | Pass |
| 90.691 | Band Edge / Conducted Spurious Emission | -13dBm | | Pass |
| 90.543(e) | | -35 dBm | | Pass |
| 90.691 | Emission mask | Section 9.2.2 | | Pass |
| 2.1046 | Conducted output power | N/A | | Pass |
| 90.213 | Frequency Stability | 2.5PPM | | Pass |
| 90.635(b) | Effective Radiated Power | 50 dBm | Radiated | Pass |
| 90.691 | Radiated Spurious Emission | -13dBm | | Pass |

8. PEAK TO AVERAGE RATIO

Test Procedure

Per KDB 971168 D01 Power Meas License Digital Systems v03r01;

The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The PAR were measured on the Spectrum Analyzer.

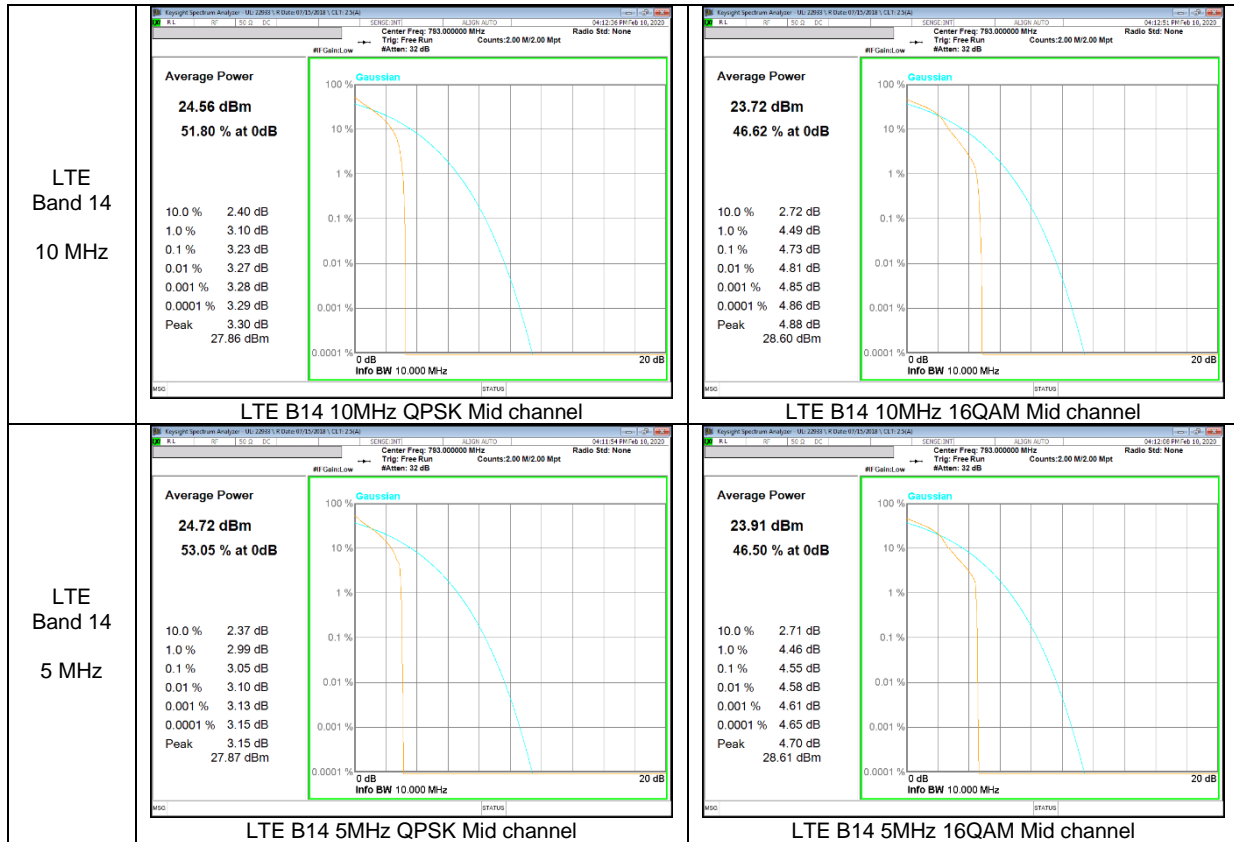
Test Spec

In addition, when the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13 dB.

RESULTS

8.1. CONDUCTED PEAK TO AVERAGE RESULT

LTE Band 14



9. LIMITS AND CONDUCTED 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 low, middle and high channel in each band. The -26dB bandwidth was also measured and recorded.

(KDB 971168 D01 Power Meas License Digital Systems v03r01)

RESULTS

See the following pages.

9.1.1. OCCUPIED BANDWIDTH RESULTS

LTE Band 14

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------|--|--------------------|-------------|----------|-------------------|--|--|---------------------|------------|-----------|----------------|-----------|------|--|--|-----------|---|--------------------|-------------|----------|-------------------|--|--|---------------------|-------------|-----------|----------------|-----------|------|--|--|-----------|
| <p>Band 14 10MHz</p> |  <p>Center Freq 793.000000 MHz #Res BW 150 kHz #VBW 470 kHz Span 15 MHz Sweep 1.333 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>32.0 dBm</td> </tr> <tr> <td>8.9529 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-6.112 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>9.807 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> <p>10MHz QPSK Mid channel</p> | Occupied Bandwidth | Total Power | 32.0 dBm | 8.9529 MHz | | | Transmit Freq Error | -6.112 kHz | OBW Power | x dB Bandwidth | 9.807 MHz | x dB | | | -26.00 dB |  <p>Center Freq 793.000000 MHz #Res BW 150 kHz #VBW 470 kHz Span 15 MHz Sweep 1.333 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>31.0 dBm</td> </tr> <tr> <td>8.9542 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-12.419 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>9.691 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> <p>10MHz 16QAM Mid channel</p> | Occupied Bandwidth | Total Power | 31.0 dBm | 8.9542 MHz | | | Transmit Freq Error | -12.419 kHz | OBW Power | x dB Bandwidth | 9.691 MHz | x dB | | | -26.00 dB |
| Occupied Bandwidth | Total Power | 32.0 dBm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8.9529 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | -6.112 kHz | OBW Power | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 9.807 MHz | x dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Occupied Bandwidth | Total Power | 31.0 dBm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8.9542 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | -12.419 kHz | OBW Power | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 9.691 MHz | x dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Band 14 5MHz</p> |  <p>Center Freq 793.000000 MHz #Res BW 75 kHz #VBW 220 kHz Span 7.5 MHz Sweep 4 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>31.9 dBm</td> </tr> <tr> <td>4.4876 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>1.559 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>4.931 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> <p>5MHz QPSK Mid channel</p> | Occupied Bandwidth | Total Power | 31.9 dBm | 4.4876 MHz | | | Transmit Freq Error | 1.559 kHz | OBW Power | x dB Bandwidth | 4.931 MHz | x dB | | | -26.00 dB |  <p>Center Freq 793.000000 MHz #Res BW 75 kHz #VBW 220 kHz Span 7.5 MHz Sweep 4 ms</p> <table border="1"> <tr> <td>Occupied Bandwidth</td> <td>Total Power</td> <td>30.6 dBm</td> </tr> <tr> <td>4.4838 MHz</td> <td></td> <td></td> </tr> <tr> <td>Transmit Freq Error</td> <td>-1.103 kHz</td> <td>OBW Power</td> </tr> <tr> <td>x dB Bandwidth</td> <td>4.919 MHz</td> <td>x dB</td> </tr> <tr> <td></td> <td></td> <td>-26.00 dB</td> </tr> </table> <p>5MHz 16QAM Mid channel</p> | Occupied Bandwidth | Total Power | 30.6 dBm | 4.4838 MHz | | | Transmit Freq Error | -1.103 kHz | OBW Power | x dB Bandwidth | 4.919 MHz | x dB | | | -26.00 dB |
| Occupied Bandwidth | Total Power | 31.9 dBm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.4876 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | 1.559 kHz | OBW Power | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 4.931 MHz | x dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Occupied Bandwidth | Total Power | 30.6 dBm | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.4838 MHz | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Transmit Freq Error | -1.103 kHz | OBW Power | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| x dB Bandwidth | 4.919 MHz | x dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | -26.00 dB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

9.2. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §90.691

LIMITS

Part 90.691:

(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 $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ 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 $43 + 10 \log_{10}(P)$ 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.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

LTE

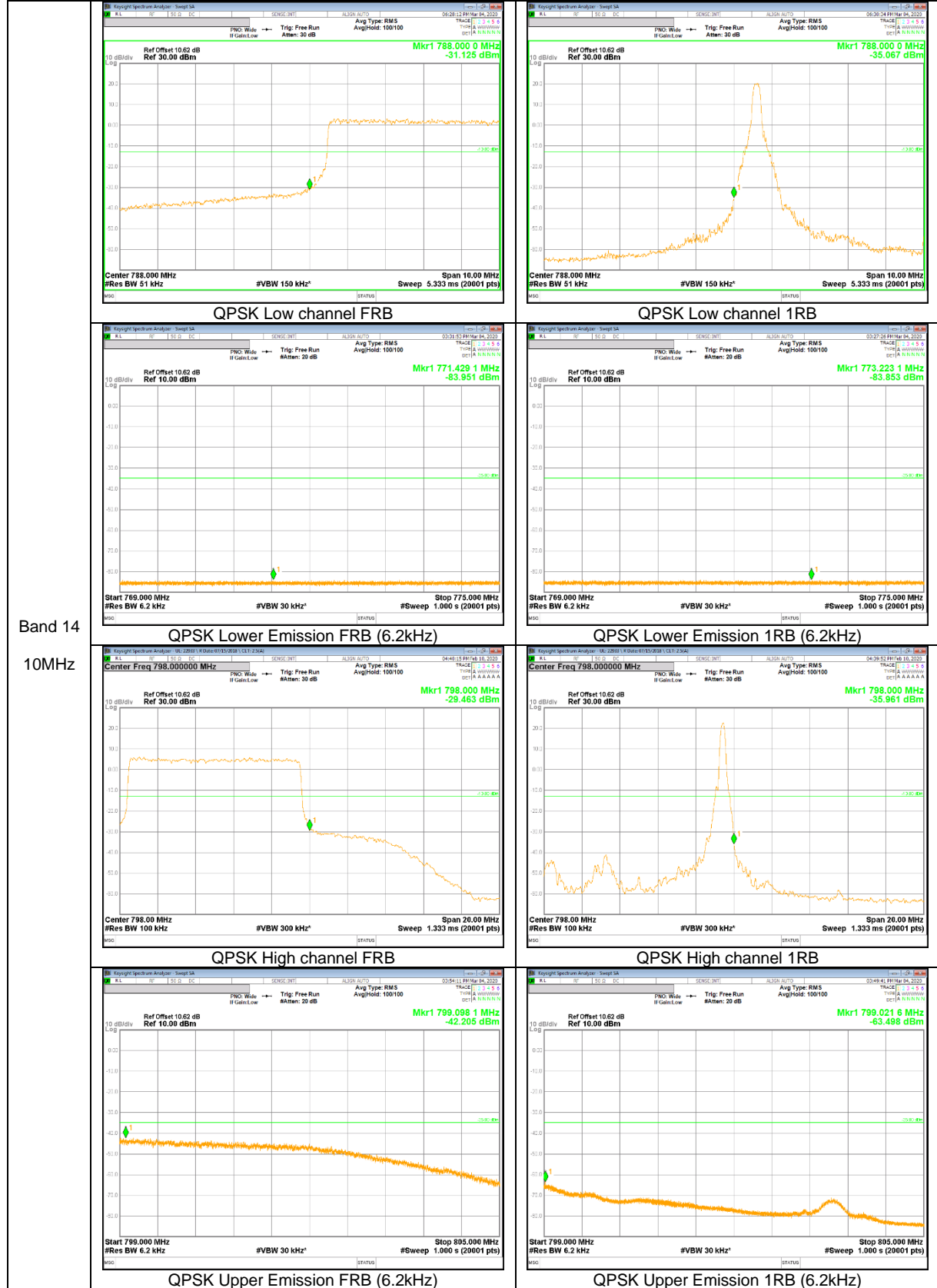
- a) Set the RBW = 1 ~ 1.5 % of OBW(Typically limited to a minimum RBW of 1% of the OBW)
- b) Set VBW $\geq 3 \times$ RBW;
- c) Set span ≥ 1.5 times the OBW;
- d) Sweep time = Auto;
- e) Detector = RMS;
- f) Ensure that the number of measurement points $\geq 2 \times$ Span/RBW;
- g) Trace mode = Average (100);

RESULTS

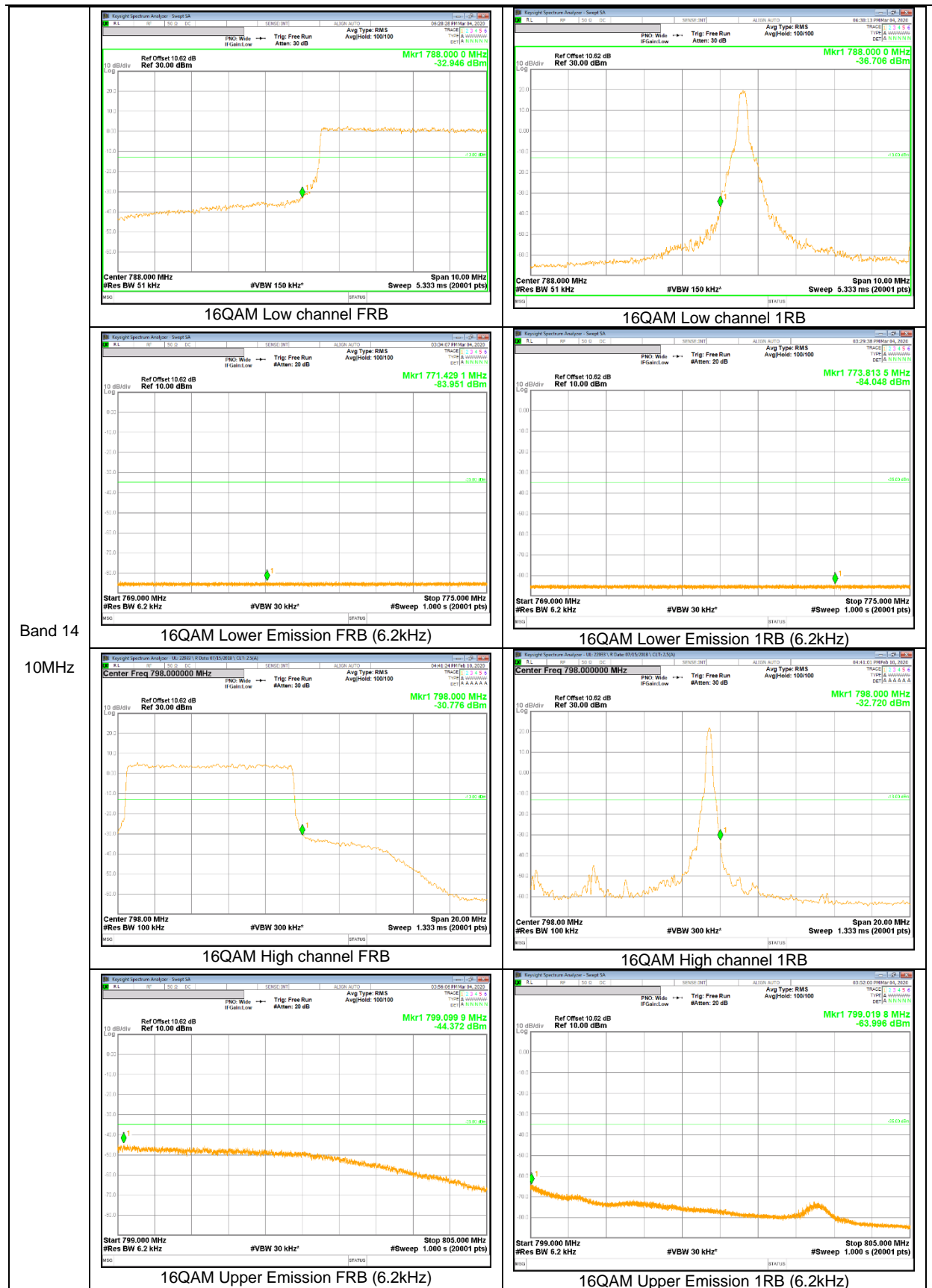
See the following pages.

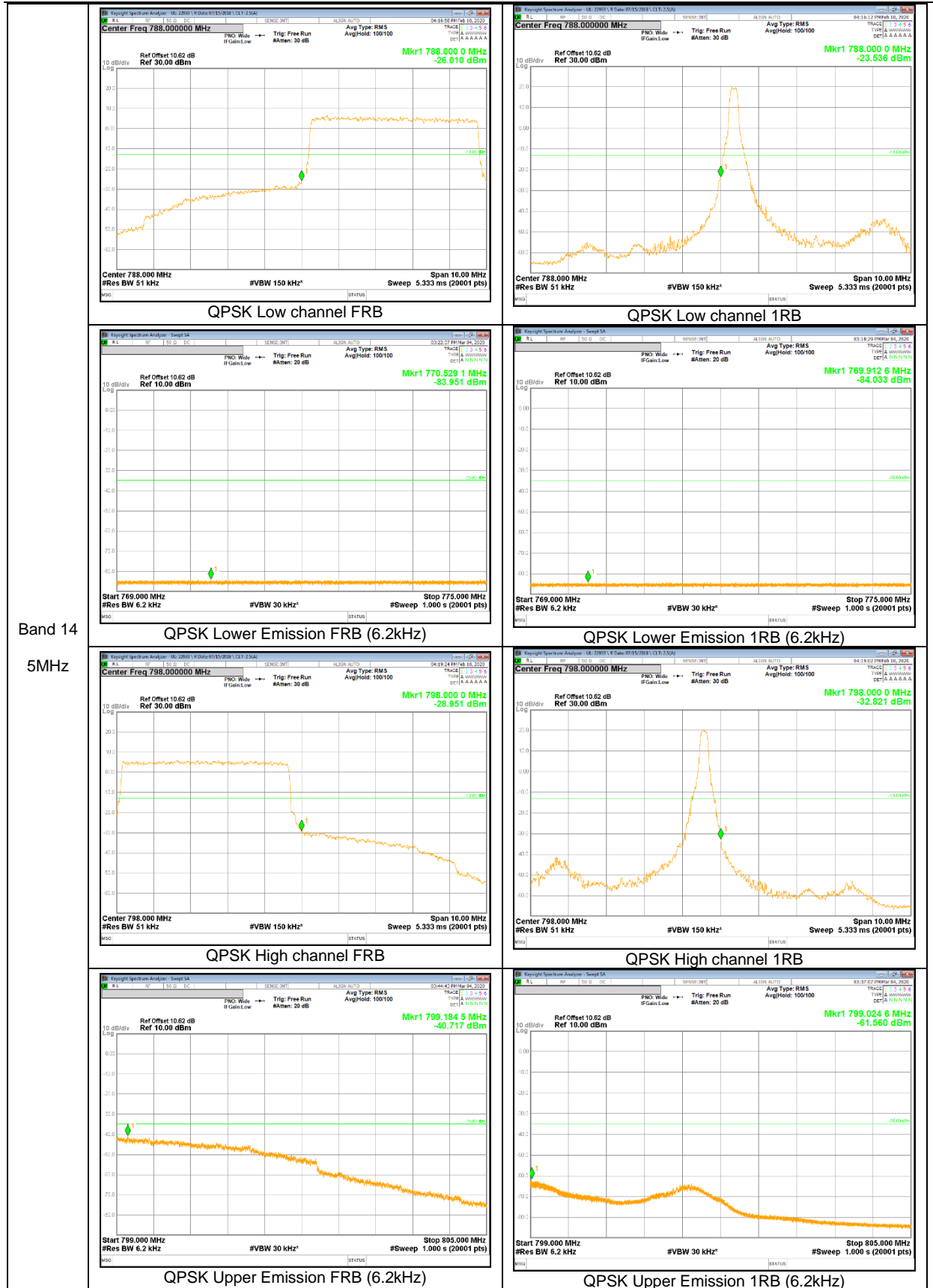
9.2.1. BAND EDGE RESULT

LTE Band 14

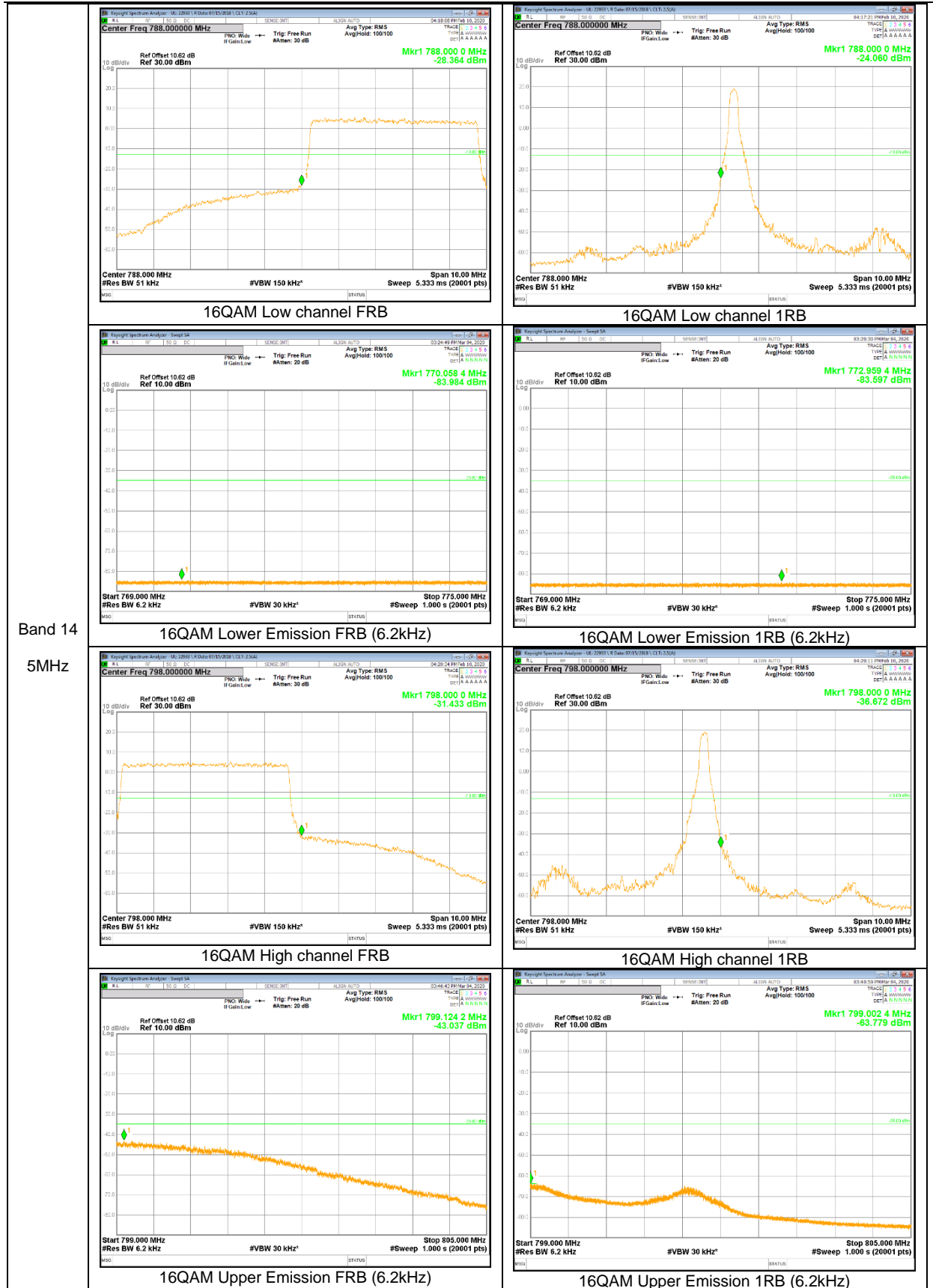


Band 14
10MHz





Band 14
 5MHz



Band 14
 5MHz

9.3. OUT OF BAND EMISSIONS

RULE PART(S)

FCC: §2.1051 and 90.691

LIMITS

Part 90.691(a):

(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 $116 \text{ Log}_{10}(f/6.1)$ decibels or $50 + 10 \text{ Log}_{10}(P)$ 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 $43 + 10 \text{ Log}_{10}(P)$ 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. (NOTE : Use 100kHz reference bandwidth)

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band Emissions, if any, up to 10th harmonic. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

- a) Set the RBW = 100KHz for emission below 1GHz and 1MHz for emissions above 1GHz (Tests were performed 1MHz [Worst case], to sweep 1 time for all frequency range)
- b) Set VBW $\geq 3 \times$ RBW;
- c) Set span ≥ 1.5 times the OBW;
- d) Sweep time = auto couple;
- e) Detector = rms;
- f) Ensure that the number of measurement points = Max (40001);
- g) Trace mode = average(LTE);

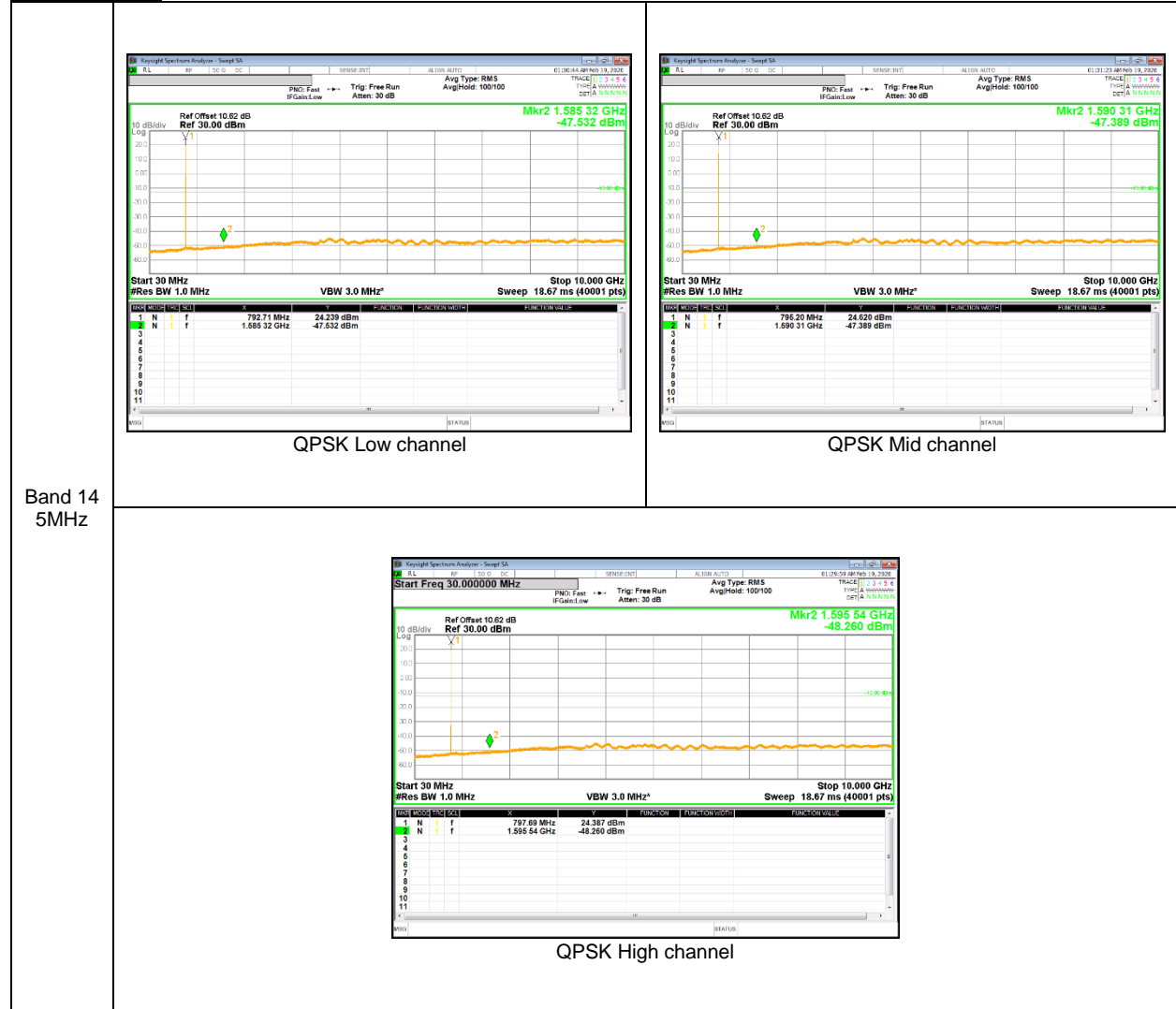
RESULTS

See the following pages.

NOTE : Please refer to section 5.4 for bandwidth and RB setting about LTE bands.

9.3.1. OUT OF BAND EMISSIONS RESULT

LTE Band 14



9.4. FREQUENCY STABILITY

RULE PART(S)

FCC: §2.1055 and §90.213

LIMITS

§90.213 - The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

RESULTS

See the following pages.

NOTE : Test were performed each lowest or highest frequency on the modulation condition of more wide bandwidth.(Please refer to section 9.1.1 OBW results)

9.4.1. FREQUENCY STABILITY RESULTS

LTE Band 14

| Reference Frequency : LTE Band 14 Low Channel 790.5 MHz / High Channel 795.5 MHz @ 20°C | | | | | | | |
|---|------------------------------|---|--------------|---------------------|--------------|-------------|----|
| Limit: +/- 2.5 ppm = | | Low Channel | 988.125 | Hz | High Channel | 994.375 | Hz |
| Power Supply [Vdc] | Environment Temperature [°C] | Frequency Deviation Measured with Time Elapse | | | | Limit [ppm] | |
| | | Low Channel | | High Channel | | | |
| | | [MHz] | Delta [ppm] | [MHz] | Delta [ppm] | | |
| 3.85 | 50 | 790.49998236 | 0.012 | 795.49998471 | 0.003 | 1.25 | |
| 3.85 | 40 | 790.49998170 | 0.014 | 795.49998223 | 0.010 | 1.25 | |
| 3.85 | 30 | 790.49998860 | -0.004 | 795.49998740 | -0.003 | 1.25 | |
| 3.85 | 20 | 790.49998715 | 0.000 | 795.49998607 | 0.000 | 1.25 | |
| 3.85 | 10 | 790.49998631 | 0.002 | 795.49998519 | 0.002 | 1.25 | |
| 3.85 | 0 | 790.49998989 | -0.007 | 795.49999365 | -0.019 | 1.25 | |
| 3.85 | -10 | 790.49999039 | -0.008 | 795.49999101 | -0.012 | 1.25 | |
| 3.85 | -20 | 790.49999157 | -0.011 | 795.49999248 | -0.016 | 1.25 | |
| 3.85 | -30 | 790.49999542 | -0.021 | 795.49999328 | -0.018 | 1.25 | |

| Reference Frequency : LTE Band 14 Low Channel 790.5 MHz / High Channel 795.5 MHz @ 20°C | | | | | | | |
|---|------------------------------|---|-------------|---------------------|--------------|-------------|----|
| Limit: +/- 2.5 ppm = | | Low Channel | 988.125 | Hz | High Channel | 994.375 | Hz |
| Power Supply [Vdc] | Environment Temperature [°C] | Frequency Deviation Measured with Time Elapse | | | | Limit [ppm] | |
| | | Low Channel | | High Channel | | | |
| | | [MHz] | Delta [ppm] | [MHz] | Delta [ppm] | | |
| 3.85 | 20 | 790.49998715 | 0 | 795.49998607 | 0 | 1.25 | |
| 4.35 | 20 | 790.49998687 | 0.001 | 795.49998846 | -0.006 | 1.25 | |
| 3.75 | 20 | 790.49999137 | -0.011 | 795.49999040 | -0.011 | 1.25 | |

10. RADIATED TEST RESULTS

10.1. RADIATED POWER (ERP & EIRP)

RULE PART(S)

FCC: §2.1046 and §90.635

LIMITS

Part 90.542(a)(7) Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

In addition, when the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13dB.

TEST PROCEDURE

ANSI / TIA / EIA 603 E Clause 2.2.17; ESU40 setting reference to 971168 D01 v03r01

For radiated output power measurement with a ESU40:

a) Set the RBW \geq OBW; b) Set VBW \geq 3 \times RBW; c) Set span \geq 2 \times RBW; d) Sweep time = auto couple; e) Detector = rms; f) Ensure that the number of measurement points \geq span/RBW; g) Trace mode = max hold(GSM, WCDMA), average(LTE);

TEST RESULTS

10.1.1. ERP/EIRP Results

LTE Band 14

| Band | BW [MHz] | Mode | RB Size/ RB Offset | f [MHz] | ERP / EIRP | |
|---------|----------|-------|-----------------------|---------|--------------|---------------|
| | | | | | [dBm] | [mW] |
| Band 14 | 10 | QPSK | 1 / 0 | 793.0 | 21.88 | 154.17 |
| | | 16QAM | 1 / 0 | 793.0 | 20.73 | 118.30 |
| | 5 | QPSK | 1 / 24 | 790.5 | 21.45 | 139.64 |
| | | | 1 / 24 | 793.0 | 21.32 | 135.52 |
| | | | 1 / 24 | 795.5 | 21.55 | 142.89 |
| | | 16QAM | 1 / 24 | 790.5 | 20.43 | 110.41 |
| | | | 1 / 24 | 793.0 | 20.55 | 113.50 |
| | | | 1 / 24 | 795.5 | 20.43 | 110.41 |

10.1.2. ERP/EIRP DATA

LTE Band 14

| LTE Band 14 10MHz QPSK | UL Verification Services, Inc. High Frequency Substitution Measurement | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|---|-----------------|------------------|--------------------|-----------------|--------------------|------------|-------------|------------|-------|--------|--|--|--|--|--|--|--|--|--------|-------|---|-----|------|-------|------|-------|--|--------|-------|---|-----|------|-------|------|-------|--|
| | Company: Samsung Project #: 4789354138 Date: 2020-02-10 Test Engineer: 20896 Configuration: EUT, Z-Position Location: Chamber 2 Mode: LTE_QPSK Band 14 Fundamentals, 10MHz Bandwidth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Test Equipment: Receiving: VULB9163-749, and Chamber 2 SMA Cables Substitution: Dipole 3121_DB4, 8.5m SMA-type Cable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>f MHz</th> <th>SG reading (dBm)</th> <th>Ant. Pol. (H/V)</th> <th>Cable Loss (dB)</th> <th>Antenna Gain (dBd)</th> <th>ERP (dBm)</th> <th>Limit (dBm)</th> <th>Delta (dB)</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>Mid Ch</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>793.00</td> <td>25.89</td> <td>V</td> <td>3.0</td> <td>-1.1</td> <td>21.88</td> <td>34.8</td> <td>-12.9</td> <td></td> </tr> <tr> <td>793.00</td> <td>14.23</td> <td>H</td> <td>3.0</td> <td>-1.1</td> <td>10.23</td> <td>34.8</td> <td>-24.5</td> <td></td> </tr> </tbody> </table> | f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Antenna Gain (dBd) | ERP (dBm) | Limit (dBm) | Delta (dB) | Notes | Mid Ch | | | | | | | | | 793.00 | 25.89 | V | 3.0 | -1.1 | 21.88 | 34.8 | -12.9 | | 793.00 | 14.23 | H | 3.0 | -1.1 | 10.23 | 34.8 | -24.5 | |
| f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Antenna Gain (dBd) | ERP (dBm) | Limit (dBm) | Delta (dB) | Notes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mid Ch | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 793.00 | 25.89 | V | 3.0 | -1.1 | 21.88 | 34.8 | -12.9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 793.00 | 14.23 | H | 3.0 | -1.1 | 10.23 | 34.8 | -24.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LTE Band 14 10MHz 16QAM | UL Verification Services, Inc. High Frequency Substitution Measurement | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Company: Samsung Project #: 4789354138 Date: 2020-02-10 Test Engineer: 20896 Configuration: EUT, Z-Position Location: Chamber 2 Mode: LTE_16QAM Band 14 Fundamentals, 10MHz Bandwidth | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Test Equipment: Receiving: VULB9163-749, and Chamber 2 SMA Cables Substitution: Dipole 3121_DB4, 8.5m SMA-type Cable | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>f MHz</th> <th>SG reading (dBm)</th> <th>Ant. Pol. (H/V)</th> <th>Cable Loss (dB)</th> <th>Antenna Gain (dBd)</th> <th>ERP (dBm)</th> <th>Limit (dBm)</th> <th>Delta (dB)</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>Mid Ch</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>793.00</td> <td>24.74</td> <td>V</td> <td>3.0</td> <td>-1.1</td> <td>20.73</td> <td>34.8</td> <td>-14.0</td> <td></td> </tr> <tr> <td>793.00</td> <td>13.32</td> <td>H</td> <td>3.0</td> <td>-1.1</td> <td>9.32</td> <td>34.8</td> <td>-25.5</td> <td></td> </tr> </tbody> </table> | f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Antenna Gain (dBd) | ERP (dBm) | Limit (dBm) | Delta (dB) | Notes | Mid Ch | | | | | | | | | 793.00 | 24.74 | V | 3.0 | -1.1 | 20.73 | 34.8 | -14.0 | | 793.00 | 13.32 | H | 3.0 | -1.1 | 9.32 | 34.8 | -25.5 | |
| f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Antenna Gain (dBd) | ERP (dBm) | Limit (dBm) | Delta (dB) | Notes | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mid Ch | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 793.00 | 24.74 | V | 3.0 | -1.1 | 20.73 | 34.8 | -14.0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 793.00 | 13.32 | H | 3.0 | -1.1 | 9.32 | 34.8 | -25.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| LTE Band 14 5MHz QPSK | UL Verification Services, Inc. High Frequency Substitution Measurement | | | | | | | | |
|---------------------------------|---|------------------|-----------------|-----------------|--------------------|-----------|-------------|------------|-------|
| | Company: Samsung Project #: 4789354138 Date: 2020-02-10 Test Engineer: 20896 Configuration: EUT, Z-Position Location: Chamber 2 Mode: LTE_QPSK Band 14 Fundamentals, 5MHz Bandwidth | | | | | | | | |
| | Test Equipment: Receiving: VULB9163-749, and Chamber 2 SMA Cables Substitution: Dipole 3121_DB4, 8.5m SMA-type Cable | | | | | | | | |
| | f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Antenna Gain (dBd) | ERP (dBm) | Limit (dBm) | Delta (dB) | Notes |
| | Low Ch | | | | | | | | |
| | 790.50 | 25.45 | V | 3.0 | -1.1 | 21.45 | 34.8 | -13.3 | |
| | 790.50 | 13.92 | H | 3.0 | -1.1 | 9.92 | 34.8 | -24.9 | |
| | Mid Ch | | | | | | | | |
| | 793.00 | 25.33 | V | 3.0 | -1.1 | 21.32 | 34.8 | -13.4 | |
| | 793.00 | 14.08 | H | 3.0 | -1.1 | 10.08 | 34.8 | -24.7 | |
| High Ch | | | | | | | | | |
| 795.50 | 25.56 | V | 3.0 | -1.1 | 21.55 | 34.8 | -13.2 | | |
| 795.50 | 14.19 | H | 3.0 | -1.1 | 10.18 | 34.8 | -24.6 | | |
| LTE Band 14 5MHz 16QAM | UL Verification Services, Inc. High Frequency Substitution Measurement | | | | | | | | |
| | Company: Samsung Project #: 4789354138 Date: 2020-02-10 Test Engineer: 20896 Configuration: EUT, Z-Position Location: Chamber 2 Mode: LTE_16QAM Band 14 Fundamentals, 5MHz Bandwidth | | | | | | | | |
| | Test Equipment: Receiving: VULB9163-749, and Chamber 2 SMA Cables Substitution: Dipole 3121_DB4, 8.5m SMA-type Cable | | | | | | | | |
| | f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Antenna Gain (dBd) | ERP (dBm) | Limit (dBm) | Delta (dB) | Notes |
| | Low Ch | | | | | | | | |
| | 790.50 | 24.43 | V | 3.0 | -1.1 | 20.43 | 34.8 | -14.3 | |
| | 790.50 | 12.81 | H | 3.0 | -1.1 | 8.81 | 34.8 | -26.0 | |
| | Mid Ch | | | | | | | | |
| | 793.00 | 24.56 | V | 3.0 | -1.1 | 20.55 | 34.8 | -14.2 | |
| | 793.00 | 12.82 | H | 3.0 | -1.1 | 8.82 | 34.8 | -26.0 | |
| High Ch | | | | | | | | | |
| 795.50 | 24.44 | V | 3.0 | -1.1 | 20.43 | 34.8 | -14.3 | | |
| 795.50 | 13.18 | H | 3.0 | -1.1 | 9.17 | 34.8 | -25.6 | | |

10.2. FIELD STRENGTH OF SPURIOUS RADIATION

RULE PART(S)

FCC: §2.1053 and §90.691

LIMIT

Part 90.691(a):

(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 $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ 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 $43 + 10 \log_{10}(P)$ 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. (NOTE : Use 100kHz reference bandwidth)

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

TEST PROCEDURE

ANSI / TIA / EIA 603 E Clause 2.2.12; ESU40 setting reference to 971168 D01 v03r01

For peak power measurement with a ESU40:

- a) Set the RBW = 100 KHz for emission below 1GHz and 1MHz for emissions above 1GHz
- b) Set VBW $\geq 3 \times$ RBW;
- c) Set span ≥ 1.5 times the OBW;
- d) Sweep time = auto couple;
- e) Detector = rms;
- f) Ensure that the number of measurement points \geq span/RBW;
- g) Trace mode = average(LTE);

RESULTS

See the following pages.

NOTE : Please refer to section 5.4 for bandwidth and RB setting about LTE bands.

10.2.1. SPURIOUS RADIATION PLOTS

LTE Band 14

| | | UL Verification Services, Inc. Above 1GHz High Frequency Substitution Measurement | | | | | | | | |
|-------------------|---------------------|---|-----------------|----------------|----------------|---------------|----------------|---------------|-------|--|
| | | Company: Samsung Project #: 4789354138 Date: 2020-02-10 Test Engineer: 20896 Configuration: EUT / AC Adapter, Z-Position Location: Chamber 2 Mode: LTE_QPSK Band 14 Harmonics, 5MHz Bandwidth | | | | | | | | |
| f MHz | SG reading (dBm) | Ant. Pol. (H/V) | Distance (m) | Preamp (dB) | Filter (dB) | EIRP (dBm) | Limit (dBm) | Delta (dB) | Notes | |
| LTE | | | | | | | | | | |
| Band 13 | | | | | | | | | | |
| 5MHz | | | | | | | | | | |
| QPSK | | | | | | | | | | |
| Low Ch, 790.5MHz | | | | | | | | | | |
| 1581.00 | -29.9 | V | 3.0 | 40.7 | 1.0 | -69.6 | -40.0 | -29.6 | | |
| 2371.50 | -11.4 | V | 3.0 | 41.1 | 1.0 | -51.6 | -13.0 | -38.6 | | |
| 3162.00 | -9.3 | V | 3.0 | 42.0 | 1.0 | -50.3 | -13.0 | -37.3 | | |
| 1581.00 | -30.8 | H | 3.0 | 40.7 | 1.0 | -70.5 | -40.0 | -30.5 | | |
| 2371.50 | -10.7 | H | 3.0 | 41.1 | 1.0 | -50.8 | -13.0 | -37.8 | | |
| 3162.00 | -8.8 | H | 3.0 | 42.0 | 1.0 | -49.9 | -13.0 | -36.9 | | |
| Mid Ch, 793MHz | | | | | | | | | | |
| 1586.00 | -28.8 | V | 3.0 | 40.7 | 1.0 | -68.5 | -40.0 | -28.5 | | |
| 2379.00 | -12.3 | V | 3.0 | 41.1 | 1.0 | -52.4 | -13.0 | -39.4 | | |
| 3172.00 | -9.1 | V | 3.0 | 42.0 | 1.0 | -50.1 | -13.0 | -37.1 | | |
| 1586.00 | -29.9 | H | 3.0 | 40.7 | 1.0 | -69.5 | -40.0 | -29.5 | | |
| 2379.00 | -11.8 | H | 3.0 | 41.1 | 1.0 | -52.0 | -13.0 | -39.0 | | |
| 3172.00 | -7.6 | H | 3.0 | 42.0 | 1.0 | -48.6 | -13.0 | -35.6 | | |
| High Ch, 795.5MHz | | | | | | | | | | |
| 1591.00 | -29.9 | V | 3.0 | 40.7 | 1.0 | -69.6 | -40.0 | -29.6 | | |
| 2386.50 | -12.3 | V | 3.0 | 41.1 | 1.0 | -52.4 | -13.0 | -39.4 | | |
| 3182.00 | -9.2 | V | 3.0 | 42.0 | 1.0 | -50.2 | -13.0 | -37.2 | | |
| 1591.00 | -30.9 | H | 3.0 | 40.7 | 1.0 | -70.6 | -40.0 | -30.6 | | |
| 2386.50 | -11.7 | H | 3.0 | 41.1 | 1.0 | -51.9 | -13.0 | -38.9 | | |
| 3182.00 | -9.1 | H | 3.0 | 42.0 | 1.0 | -50.1 | -13.0 | -37.1 | | |

END OF REPORT