# TEST REPORT

| | | |
|---|---|---|
| **Eurofins KCTL Co.,Ltd.**<br>65, Sinwon-ro, Yeongtong-gu,<br>Suwon-si, Gyeonggi-do, 16677, Korea<br>TEL: 82-70-5008-1021 FAX: 82-505-299-8311<br>www.kctl.co.kr | Report No.:<br>KR24-SRF0102<br>Page(1) of (68) | eurofins \| KCTL |

**1. Client**

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2024-03-28

**2. Use of Report** : Certification

**3. Name of Product / Model** : Smart Wearable / SM-L705U

**4. Derivative Model** : SM-L705F

**5. Manufacturer / Country of Origin** : Samsung Electronics Co., Ltd. / Vietnam

**6. FCC ID** : A3LSML705

**7. Date of Test** : 2024-04-01 to 2024-05-20

**8. Location of Test** : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

**9. Test method used** : FCC Part 2
FCC Part 90 subpart S
FCC Part 90 subpart R

**10. Test Result** : Refer to the test result in the test report

| | | |
|---|---|---|
| Affirmation | Tested by<br>Name : Kwonse Kim (Signature) | Technical Manager<br>Name : Seungyong Kim (Signature) |

2024-05-22

**Eurofins KCTL Co.,Ltd.**

## REPORT REVISION HISTORY

| Date | Revision | Page No |
|---|---|---|
| 2024-05-22 | Originally issued | - |
| | | |
| | | |
| | | |
| | | |



## General remarks for test reports

**Statement concerning the uncertainty of the measurement systems used for the tests**

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

**Procedure number, issue date and title:**

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

# CONTENTS

# 1. General information

| | | |
|---|---|---|
| Client | : | Samsung Electronics Co., Ltd. |
| Address | : | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea |
| Manufacturer | : | Samsung Electronics Co., Ltd. |
| Address | : | 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea |
| Factory 1 | : | AG TECH CO.,LTD |
| Address 1 | : | Lot G3, Que Vo Industrial Park(Expanded Area), Nam son Ward, Bac Ninh Province, Vietnam |
| Factory 2 | : | ALMUS VINA |
| Address 2 | : | Lot CN07A, Phu Ha Industrial Park, Ha Thach Commune, Phu Tho Town, Phu Tho Province, Vietnam |
| Laboratory | : | Eurofins KCTL Co.,Ltd. |
| Address | : | 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea |
| Accreditations | : | FCC Site Designation No: KR0040, FCC Site Registration No: 687132<br>VCCI Registration No. : R-20080, G-20078, C-20059, T-20056<br>CAB Identifier: KR0040<br>ISED Number: 8035A<br>KOLAS No.: KT231 |

# 2. Device information

| | | | | |
|---|---|---|---|---|
| Equipment under test | : | Smart Wearable | | |
| Model | : | SM-L705U | | |
| Derivative model | : | SM-L705F | | |
| Modulation technique | : | LTE | : | QPSK, 16QAM |
| Power source | : | DC 3.88 V | | |
| Antenna specification | : | PIFA + FPCB Antenna | | |
| Antenna gain | : | LTE B14 | : | -14.1 dBi |
| | | LTE B26 | : | -14.9 dBi |
| Frequency range | : | LTE B14 | : | 790.5 ㎒ ~ 795.5 ㎒ |
| | | LTE B26 | : | 814.7 ㎒ ~ 848.3 ㎒ |
| Bandwidth | : | LTE B14 | : | 5/10 ㎒ |
| | | LTE B26 | : | 1.4/3/5/10/15 ㎒ |
| Software version | : | L705U.001 | | |
| Hardware version | : | REV1.0 | | |
| Test device serial No. | : | Conducted | : | R3AX200WYAD |
| | | Radiated | : | R3AX200WYLH, R3AX200WYCR, R3AX200WYKB, R3AX402DJKP |
| Operation temperature | : | 0 ℃ ~ 35 ℃ | | |

**Note.**

1. The product equality letter includes detailed information about the differences between SM-L705U and SM-L705F model.

## 2.1. Accessory information

| Equipment | Manufacturer | Model | Serial No. | Power source | FCC ID & IC |
|---|---|---|---|---|---|
| Wireless charger | RF TECH | EP-OL300 | - | 5.0 V, 2.0 A | FCC ID : A3LEPOL300<br>IC : 649E-EPOL300 |

## 2.2. Frequency/channel operations

This device contains the following capabilities:
LTE B14/26

**LTE B14**

| Ch. | Frequency (㎒) |
|---|---|
| 23305 | 790.5 |
| 23330 | 793.0 |
| 23355 | 795.5 |

Table 2.2-1. 5M BW

| Ch. | Frequency (㎒) |
|---|---|
| - | - |
| 23330 | 793.0 |
| - | - |

Table 2.2-2. 10M BW

**LTE B26**

| Ch. | Frequency (㎒) |
|---|---|
| 26697 | 814.7 |
| 26740 | 819.0 |
| 26783 | 823.3 |

Table 2.2-3. 1.4M BW

| Ch. | Frequency (㎒) |
|---|---|
| 26705 | 815.5 |
| 26740 | 819.0 |
| 26775 | 822.5 |

Table 2.2-4. 3M BW

| Ch. | Frequency (㎒) |
|---|---|
| 26715 | 816.5 |
| 26740 | 819.0 |
| 26765 | 821.5 |

Table 2.2-5. 5M BW

| Ch. | Frequency (㎒) |
|---|---|
| 26740 | 819.0 |

Table 2.2-6. 10M BW

| Ch. | Frequency (㎒) |
|---|---|
| 26765 | 821.5 |

Table 2.2-7. 15M BW

# 3. Maximum output power

**LTE B14**

| Mode | Tx frequency (㎒) | Emission designator | ERP | |
|---|---|---|---|---|
| | | | Max. power (㏈m) | Max. power (W) |
| LTE B14 | 790.5 ~ 795.5 | 4M56G7D | 14.73 | 0.030 |
| | | 4M55W7D | 13.67 | 0.023 |
| | 793.0 | 8M99G7D | 14.75 | 0.030 |
| | | 9M09W7D | 13.79 | 0.024 |

**LTE B26**

| Mode | Tx frequency (㎒) | Emission designator | Conducted | |
|---|---|---|---|---|
| | | | Max. power (㏈m) | Max. power (W) |
| LTE B26 | 814.7 ~ 823.3 | 1M11G7D | 22.47 | 0.177 |
| | | 1M10W7D | 21.67 | 0.147 |
| | 815.5 ~ 822.5 | 2M71G7D | 22.19 | 0.166 |
| | | 2M72W7D | 21.35 | 0.136 |
| | 816.5 ~ 821.5 | 4M55G7D | 22.19 | 0.166 |
| | | 4M60W7D | 21.21 | 0.132 |
| | 819.0 | 9M04G7D | 22.23 | 0.167 |
| | | 9M04W7D | 21.18 | 0.131 |
| | 821.5 | 13M5G7D | 22.25 | 0.168 |
| | | 13M5W7D | 21.18 | 0.131 |
| Straddle channel | 824.0 | 1M10G7D | 22.39 | 0.173 |
| | | 1M09W7D | 21.23 | 0.133 |
| | | 2M71G7D | 22.15 | 0.164 |
| | | 2M72W7D | 20.96 | 0.125 |
| | | 4M55G7D | 22.09 | 0.162 |
| | | 4M53W7D | 21.13 | 0.130 |
| | | 9M04G7D | 22.31 | 0.170 |
| | | 9M04W7D | 21.24 | 0.133 |
| | | 13M5G7D | 22.30 | 0.170 |
| | | 13M5W7D | 20.88 | 0.122 |

# 4. Summary of tests

| FCC Part section(s) | Parameter | Test Limit | Test Condition | Test results |
|---|---|---|---|---|
| 2.1046<br>90.635 | Conducted Output Power | <100 Watts | Conducted | Pass |
| 2.1049 | Occupied Bandwidth & 26 dB Bandwidth | N/A | | Pass |
| 2.1051<br>90.543(e)<br>90.691(a) | Band Edge Emissions at Antenna Terminal | <65 + 10Log$_{10}$(P) dB between 769-775 MHz and 799-805 MHz,<br><43 + 10Log$_{10}$(P) dB between 775-788 MHz, above 805 MHz and below 758 MHz,<br><50 + 10Log$_{10}$(P) dB at Band Edge and for all out-of-band emissions within 37.5kHz of Block Edge | | Pass |
| | Spurious Emissions at Antenna Terminal | | | Pass |
| - | Peak to Average Power Ratio | <13 dB | | Pass |
| 2.1055<br>90.539(e)<br>90.213 | Frequency stability | <1.25 ppm, <2.5 ppm | | Pass |
| 22.913(a)(5) | Effective Radiated Power | <7 Watts max. ERP | Radiated | Pass |
| 90.542(a)(7) | | <3 Watts max. ERP | | Pass |
| 2.1053<br>90.691(a)<br>90.543(e)(f) | Radiated Spurious Emissions | <43 + 10Log$_{10}$(P) dB,<br><-70dBW/MHz EIRP (Wideband),<br><-80dBW/MHz EIRP (Narrowband)<br>In the 1559 – 1610 MHz band | | Pass |

**Notes:**

1. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.26-2015
   - ANSI/TIA-603-E-2016
   - KDB 971168 D01 v03r01
   - KDB 971168 D02 v02r02

## 4.1. Worst case orientation

1. All modes of operation were investigated and the worst case emissions are reported with the EUT positioning, modulations, RB sizes and offsets, and channel bandwidth configurations in the test data.
2. In the case of radiated spurious emissions, only the worst case bandwidth results were reported.
3. Output power measurements were measured on all of modulation. All tests except output power was performed with below modulation with highest power.
   1) LTE: QPSK, 16QAM
4. However, the PAPR was evaluated for all wave forms and modulations during pre-test, then all bandwidth was performed for the modulations with the highest result.
   1) LTE: QPSK, 16QAM
5. All configurations have been performed (Stand-alone, Stand-alone with TA and Strap).
6. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z and all of the radiated tests have been performed with the accessories as below. It was determined that below orientation was worst case orientation for each band.

| Band | Strap | With charger | Without charger | | |
|---|---|---|---|---|---|
| | | X-axis | X-axis | Y-axis | Z-axis |
| LTE B14 | With strap | O | - | - | - |
| | Without strap | - | - | - | - |
| LTE B26 (Part 90) | With strap | O | - | - | - |
| | Without strap | - | - | - | - |

7. Test Condition
   - The measurement was performed with various configurations then worst results are reported.

1) Radiated measurement

| Test Description | Mode | Condition | | Test Channel |
|---|---|---|---|---|
| Effective Radiated power / Effective Isotropic power | LTE | QPSK, 16QAM | RB Size: 1 | Low, Middle, High |
| Radiated Spurious Emissions | LTE | QPSK | RB Size: 1 | Low, Middle, High |

| Band | Bandwidth (㎒) | RB size | RB offset |
|---|---|---|---|
| LTE B14 | 5, 10 | 1 | Low, Middle, High |
| LTE B26 (Part 90) | 1.4, 3, 5, 10, 15 | | |

2) Conducted measurement

| Test Description | Mode | Condition | | Test Channel |
|---|---|---|---|---|
| OBW & 26 ㏈ BW | LTE | QPSK, 16QAM | RB Size: Full | Low, Middle, High |
| PAPR | LTE | QPSK, 16QAM | RB Size: Full | Middle |
| Band Edge | LTE | QPSK | RB Size: 1, Full | Low, High |
| Spurious Emissions | LTE | QPSK | RB Size: 1 | Low, Middle, High |

| Band | Bandwidth (㎒) | RB size | RB offset |
|---|---|---|---|
| LTE B14 | 5, 10 | 1 | 0, 24, 49 |
| | | Full | 0 |
| LTE B26 (Part 90) | 1.4, 3, 5, 10, 15 | 1 | 0, 5, 14, 24, 49, 74 |
| | | Full | 0 |

## 5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4-2014.

All measurement uncertainty values are shown with a coverage factor of $k$=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the $U_{CISPR}$ measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded uncertainty (±) | |
|---|---|---|
| Conducted RF power | 0.9 dB | |
| Conducted spurious emissions | 1.9 dB | |
| Radiated spurious emissions | Below 1 000 ㎒ | 2.5 dB |
| | 1 000 ㎒ ~ 18 000 ㎒ | 2.5 dB |
| | Above 1 8000 ㎒ | 2.6 dB |

## 6. Measurement results explanation example

| Frequency (㎒) | Factor(㏈) | Frequency (㎒) | Factor(㏈) |
|---|---|---|---|
| 30 | 5.82 | 16 000 | 9.29 |
| 50 | 6.09 | 17 000 | 9.50 |
| 100 | 6.15 | 18 000 | 9.55 |
| 200 | 6.09 | 19 000 | 9.31 |
| 300 | 6.28 | 20 000 | 8.51 |
| 400 | 6.51 | 21 000 | 9.00 |
| 500 | 6.57 | 22 000 | 9.52 |
| 600 | 6.62 | 23 000 | 9.53 |
| 700 | 6.67 | 24 000 | 9.95 |
| 800 | 6.70 | 25 000 | 10.82 |
| 900 | 6.74 | 26 000 | 10.60 |
| 1 000 | 6.76 | 26 500 | 10.73 |
| 2 000 | 7.06 | 27 000 | 10.59 |
| 3 000 | 7.25 | 28 000 | 11.48 |
| 4 000 | 7.39 | 29 000 | 10.38 |
| 5 000 | 7.54 | 30 000 | 10.69 |
| 6 000 | 7.94 | 31 000 | 11.57 |
| 7 000 | 8.10 | 32 000 | 11.70 |
| 8 000 | 8.21 | 33 000 | 12.00 |
| 9 000 | 8.26 | 34 000 | 11.88 |
| 10 000 | 7.36 | 35 000 | 11.65 |
| 11 000 | 8.35 | 36 000 | 11.80 |
| 12 000 | 8.40 | 37 000 | 11.51 |
| 13 000 | 8.62 | 38 000 | 10.82 |
| 14 000 | 8.71 | 39 000 | 11.00 |
| 15 000 | 9.02 | 40 000 | 11.30 |

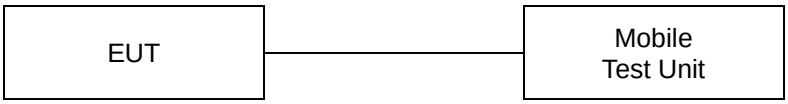
**Note.**

1. Offset(㏈) = RF cable loss(㏈) + Divider (㏈)

# 7. Test results

## 7.1. Conducted output power

**Test setup**




**Limit**

**According to §90.635(b)**

The maximum output power of the transmitter for mobile stations is 100 watts (20 ㏈w).

**Test procedure**

971168 D01 v03r01 – Section 5.2
ANSI C63.26-2015 – Section 5.2.4.2
CFR 47 - Section §2.1046

**Test settings**

When an average power meter is used to perform RF output power measurements, the fundamental condition that measurement be performed only over durations of active transmissions at maximum output power level applies. Thus, an average power meter can always be used to perform the measurement when the EUT can be configured to transmit continuously.

If the EUT cannot be configured to transmit continuously (i.e., burst duty cycle < 98%), then the following options can be implemented to facilitate measurement of the average power with an average power meter:

a) A gated average power meter can be used to perform the measurement if the gating parameters can be adjusted such that the power is measured only during active transmission bursts at maximum output power levels.
b) A conventional average power meter with no signal gating capability can also be used if the measured burst duty cycle is constant (i.e., duty cycle variations are less than or equal to ± 2%) by performing the measurement over the on/off burst cycles and then correcting (increasing) the measured level by a factor equal to [10log (1/duty cycle)]. See 5.2.4.3.4 for guidance with respect to measuring the transmitter duty cycle.

See item r) of 4.1 for more information regarding power meter functional requirements and limitations, and consult the instrumentation-specific application literature for proper set-up and use.

**Notes:**

1. Offset(㏈) = RF cable loss(㏈)

## Test results

| Test Band | Bandwidth (㎒) | Test mode | RB size | RB offset | Maximum Average power (dBm) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Channel | | |
| | | | | | Low | Middle | High |
| LTE B14 | 5 | QPSK | 1 | 0 | 21.94 | 22.07 | 22.08 |
| | | | 1 | 12 | 21.89 | 21.91 | 21.93 |
| | | | 1 | 24 | 21.88 | 21.78 | 21.91 |
| | | | 12 | 0 | 21.40 | 21.43 | 21.46 |
| | | | 12 | 7 | 21.40 | 21.43 | 21.41 |
| | | | 12 | 13 | 21.37 | 21.43 | 21.42 |
| | | | 25 | 0 | 21.43 | 21.42 | 21.43 |
| | | 16QAM | 1 | 0 | 20.68 | 20.86 | 20.87 |
| | | | 1 | 12 | 20.57 | 21.00 | 20.82 |
| | | | 1 | 24 | 20.72 | 20.76 | 20.77 |
| | | | 12 | 0 | 20.28 | 20.27 | 20.34 |
| | | | 12 | 7 | 20.27 | 20.29 | 20.33 |
| | | | 12 | 13 | 20.25 | 20.29 | 20.28 |
| | | | 25 | 0 | 20.28 | 20.29 | 20.36 |
| | 10 | QPSK | 1 | 0 | - | 22.22 | - |
| | | | 1 | 25 | - | 21.98 | - |
| | | | 1 | 49 | - | 21.73 | - |
| | | | 25 | 0 | - | 21.38 | - |
| | | | 25 | 12 | - | 21.34 | - |
| | | | 25 | 25 | - | 21.30 | - |
| | | | 50 | 0 | - | 21.34 | - |
| | | 16QAM | 1 | 0 | - | 21.20 | - |
| | | | 1 | 25 | - | 20.98 | - |
| | | | 1 | 49 | - | 20.96 | - |
| | | | 25 | 0 | - | 20.39 | - |
| | | | 25 | 12 | - | 20.32 | - |
| | | | 25 | 25 | - | 20.29 | - |
| | | | 50 | 0 | - | 20.39 | - |

| Test Band | Bandwidth (㎒) | Test mode | RB size | RB offset | Maximum Average power (㏈m) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Channel | | |
| | | | | | Low | Middle | High |
| LTE B26 | 1.4 | QPSK | 1 | 0 | 21.92 | 21.89 | 22.42 |
| | | | 1 | 3 | 21.90 | 21.97 | 22.18 |
| | | | 1 | 5 | 21.94 | 22.12 | 21.73 |
| | | | 3 | 0 | 22.40 | 21.36 | 21.97 |
| | | | 3 | 1 | 22.41 | 21.56 | 21.53 |
| | | | 3 | 3 | 22.47 | 21.62 | 21.66 |
| | | | 6 | 0 | 21.74 | 21.72 | 21.70 |
| | | 16QAM | 1 | 0 | 21.40 | 21.27 | 21.30 |
| | | | 1 | 3 | 21.06 | 20.34 | 20.50 |
| | | | 1 | 5 | 21.50 | 21.23 | 20.67 |
| | | | 3 | 0 | 21.64 | 20.22 | 20.64 |
| | | | 3 | 1 | 21.67 | 20.50 | 20.73 |
| | | | 3 | 3 | 21.67 | 20.35 | 20.27 |
| | | | 6 | 0 | 20.74 | 20.86 | 20.81 |
| | 3 | QPSK | 1 | 0 | 22.14 | 21.98 | 22.19 |
| | | | 1 | 8 | 21.95 | 21.97 | 22.19 |
| | | | 1 | 14 | 22.08 | 22.03 | 21.72 |
| | | | 8 | 0 | 21.77 | 21.69 | 21.38 |
| | | | 8 | 4 | 21.73 | 21.73 | 21.68 |
| | | | 8 | 7 | 21.72 | 21.28 | 21.49 |
| | | | 15 | 0 | 21.74 | 21.41 | 21.54 |
| | | 16QAM | 1 | 0 | 21.30 | 21.06 | 20.73 |
| | | | 1 | 8 | 21.25 | 20.87 | 20.69 |
| | | | 1 | 14 | 21.35 | 21.04 | 21.17 |
| | | | 8 | 0 | 20.68 | 20.72 | 20.77 |
| | | | 8 | 4 | 20.67 | 20.37 | 20.18 |
| | | | 8 | 7 | 20.66 | 20.18 | 20.45 |
| | | | 15 | 0 | 20.68 | 20.86 | 20.35 |
| | 5 | QPSK | 1 | 0 | 22.19 | 22.04 | 21.88 |
| | | | 1 | 12 | 22.15 | 21.85 | 21.91 |
| | | | 1 | 24 | 22.08 | 21.68 | 21.54 |
| | | | 12 | 0 | 21.77 | 21.67 | 21.85 |
| | | | 12 | 7 | 21.76 | 21.76 | 21.30 |
| | | | 12 | 13 | 21.74 | 21.39 | 21.62 |
| | | | 25 | 0 | 21.78 | 21.41 | 21.45 |
| | | 16QAM | 1 | 0 | 21.00 | 20.89 | 21.21 |
| | | | 1 | 12 | 20.94 | 20.74 | 20.59 |
| | | | 1 | 24 | 20.99 | 21.01 | 21.16 |
| | | | 12 | 0 | 20.70 | 20.74 | 20.86 |
| | | | 12 | 7 | 20.68 | 20.50 | 20.35 |
| | | | 12 | 13 | 20.64 | 20.51 | 20.26 |
| | | | 25 | 0 | 20.70 | 20.43 | 20.72 |

| Test Band | Bandwidth (㎒) | Test mode | RB size | RB offset | Maximum Average power (㏈m) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Channel | | |
| | | | | | Low | Middle | High |
| LTE B26 | 10 | QPSK | 1 | 0 | - | 22.23 | - |
| | | | 1 | 25 | - | 22.06 | - |
| | | | 1 | 49 | - | 22.00 | - |
| | | | 25 | 0 | - | 21.79 | - |
| | | | 25 | 12 | - | 21.74 | - |
| | | | 25 | 25 | - | 21.73 | - |
| | | | 50 | 0 | - | 21.71 | - |
| | | 16QAM | 1 | 0 | - | 21.18 | - |
| | | | 1 | 25 | - | 20.78 | - |
| | | | 1 | 49 | - | 21.15 | - |
| | | | 25 | 0 | - | 20.69 | - |
| | | | 25 | 12 | - | 20.65 | - |
| | | | 25 | 25 | - | 20.60 | - |
| | | | 50 | 0 | - | 20.70 | - |
| | 15 | QPSK | 1 | 0 | - | 22.25 | - |
| | | | 1 | 36 | - | 22.02 | - |
| | | | 1 | 74 | - | 21.93 | - |
| | | | 36 | 0 | - | 21.69 | - |
| | | | 36 | 18 | - | 21.58 | - |
| | | | 36 | 37 | - | 21.53 | - |
| | | | 75 | 0 | - | 21.57 | - |
| | | 16QAM | 1 | 0 | - | 21.18 | - |
| | | | 1 | 36 | - | 20.99 | - |
| | | | 1 | 74 | - | 20.94 | - |
| | | | 36 | 0 | - | 20.72 | - |
| | | | 36 | 18 | - | 20.64 | - |
| | | | 36 | 37 | - | 20.57 | - |
| | | | 75 | 0 | - | 20.71 | - |

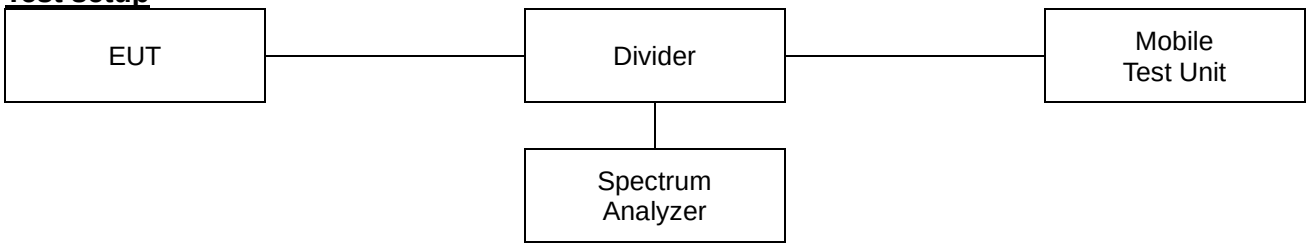
## Straddle channel

| Test Band | Bandwidth (㎒) | Test mode | RB size | RB offset | Maximum Average Power (dBm) |
|---|---|---|---|---|---|
| LTE B26 | 1.4 | QPSK | 1 | 0 | 22.39 |
| | | | 1 | 3 | 22.14 |
| | | | 1 | 5 | 21.84 |
| | | | 3 | 0 | 21.96 |
| | | | 3 | 1 | 21.85 |
| | | | 3 | 3 | 21.36 |
| | | | 6 | 0 | 21.36 |
| | | 16QAM | 1 | 0 | 20.77 |
| | | | 1 | 3 | 20.98 |
| | | | 1 | 5 | 21.23 |
| | | | 3 | 0 | 20.64 |
| | | | 3 | 1 | 20.17 |
| | | | 3 | 3 | 20.66 |
| | | | 6 | 0 | 20.36 |
| | 3 | QPSK | 1 | 0 | 21.98 |
| | | | 1 | 8 | 21.78 |
| | | | 1 | 14 | 22.15 |
| | | | 8 | 0 | 21.57 |
| | | | 8 | 4 | 21.78 |
| | | | 8 | 7 | 21.81 |
| | | | 15 | 0 | 21.54 |
| | | 16QAM | 1 | 0 | 20.96 |
| | | | 1 | 8 | 20.62 |
| | | | 1 | 14 | 20.75 |
| | | | 8 | 0 | 20.31 |
| | | | 8 | 4 | 20.81 |
| | | | 8 | 7 | 20.70 |
| | | | 15 | 0 | 20.68 |
| | 5 | QPSK | 1 | 0 | 22.09 |
| | | | 1 | 12 | 21.63 |
| | | | 1 | 24 | 21.89 |
| | | | 12 | 0 | 21.51 |
| | | | 12 | 7 | 21.84 |
| | | | 12 | 13 | 21.48 |
| | | | 25 | 0 | 21.40 |
| | | 16QAM | 1 | 0 | 21.13 |
| | | | 1 | 12 | 20.78 |
| | | | 1 | 24 | 21.05 |
| | | | 12 | 0 | 20.37 |
| | | | 12 | 7 | 20.17 |
| | | | 12 | 13 | 20.65 |
| | | | 25 | 0 | 20.40 |

| Test Band | Bandwidth (㎒) | Test mode | RB size | RB offset | Maximum Average Power (dBm) |
|---|---|---|---|---|---|
| LTE B26 | 10 | QPSK | 1 | 0 | 22.31 |
| | | | 1 | 25 | 22.12 |
| | | | 1 | 49 | 22.12 |
| | | | 25 | 0 | 21.62 |
| | | | 25 | 12 | 21.80 |
| | | | 25 | 25 | 21.64 |
| | | | 50 | 0 | 21.23 |
| | | 16QAM | 1 | 0 | 20.75 |
| | | | 1 | 25 | 20.61 |
| | | | 1 | 49 | 21.24 |
| | | | 25 | 0 | 20.44 |
| | | | 25 | 12 | 20.45 |
| | | | 25 | 25 | 20.26 |
| | | | 50 | 0 | 20.43 |
| | 15 | QPSK | 1 | 0 | 22.30 |
| | | | 1 | 36 | 21.75 |
| | | | 1 | 74 | 22.10 |
| | | | 36 | 0 | 21.65 |
| | | | 36 | 18 | 21.30 |
| | | | 36 | 37 | 21.78 |
| | | | 75 | 0 | 21.33 |
| | | 16QAM | 1 | 0 | 20.80 |
| | | | 1 | 36 | 20.88 |
| | | | 1 | 74 | 20.65 |
| | | | 36 | 0 | 20.48 |
| | | | 36 | 18 | 20.69 |
| | | | 36 | 37 | 20.17 |
| | | | 75 | 0 | 20.23 |

## 7.2. 99% Occupied Bandwidth & 26 dB Bandwidth

**Test setup**




**Limit**

**According to §2.1049**

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured.

**Test procedure**

971168 D01 v03r01 – Section 4.2 and 4.3
ANSI C63.26-2015 – Section 5.4.3 and 5.4.4

**Test settings**

### ◆ 26dB Bandwidth

c) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.

d) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

e) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.
See guidance provided in 4.2.3.

d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target "−X dB" requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.

e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

f) Determine the reference value by either of the following:
   1) Set the EUT to transmit a modulated signal. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
   2) Set the EUT to transmit an unmodulated carrier. Set the spectrum analyzer marker to the level of the carrier.

g) Determine the "−X dB amplitude" as equal to (Reference Value − X). Alternatively, this calculation can be performed on the spectrum analyzer using the delta-marker measurement function.

h) If the reference value was determined using an unmodulated carrier, turn the EUT modulation on, then either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise the trace from step f) shall be used

for step i).

i) Place two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display such that each marker is at or slightly below the "−X dB amplitude" determined in step f). If a marker is below this "−X dB amplitude" value it should be as close as possible to this value. The OBW is the positive frequency difference between the two markers.

j) The spectral envelope can cross the "−X dB amplitude" at multiple points. The lowest or highest frequency shall be selected as the frequencies that are the farthest away from the center frequency at which the spectral envelope crosses the "−X dB amplitude."

j) The OBW shall be reported by providing plot(s) of the measuring instrument display, to include markers depicting the relevant frequency and amplitude information (e.g., marker table). The frequency and amplitude axis and scale shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

## ◆ 99% Occupied Bandwidth

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

**Notes:**

1. The EUT was setup to maximum output power with all bandwidth and modulation.

## Test results

| Test Band | Bandwidth (㎒) | Channel | Test mode | 26㏈ bandwidth (㎒) | 99 % bandwidth (㎒) |
|---|---|---|---|---|---|
| LTE B14 | 5 | Low | QPSK | 5.48 | 4.56 |
| | | | 16QAM | 5.40 | 4.52 |
| | | Middle | QPSK | 5.42 | 4.55 |
| | | | 16QAM | 5.43 | 4.55 |
| | | High | QPSK | 5.41 | 4.55 |
| | | | 16QAM | 5.40 | 4.53 |
| | 10 | Middle | QPSK | 10.22 | 8.99 |
| | | | 16QAM | 10.37 | 9.09 |

| Test Band | Bandwidth (㎒) | Channel | Test mode | 26㏈ bandwidth (㎒) | 99 % bandwidth (㎒) |
|---|---|---|---|---|---|
| LTE B26 | 1.4 | Low | QPSK | 1.36 | 1.11 |
| | | | 16QAM | 1.37 | 1.10 |
| | | Middle | QPSK | 1.35 | 1.10 |
| | | | 16QAM | 1.34 | 1.10 |
| | | High | QPSK | 1.32 | 1.10 |
| | | | 16QAM | 1.35 | 1.10 |
| | 3 | Low | QPSK | 3.14 | 2.71 |
| | | | 16QAM | 3.13 | 2.72 |
| | | Middle | QPSK | 3.12 | 2.70 |
| | | | 16QAM | 3.13 | 2.71 |
| | | High | QPSK | 3.15 | 2.71 |
| | | | 16QAM | 3.10 | 2.71 |
| | 5 | Low | QPSK | 5.48 | 4.55 |
| | | | 16QAM | 5.33 | 4.60 |
| | | Middle | QPSK | 5.42 | 4.55 |
| | | | 16QAM | 5.42 | 4.56 |
| | | High | QPSK | 5.36 | 4.53 |
| | | | 16QAM | 5.47 | 4.56 |
| | 10 | Middle | QPSK | 10.27 | 9.04 |
| | | | 16QAM | 10.44 | 9.04 |
| | 15 | Middle | QPSK | 15.02 | 13.45 |
| | | | 16QAM | 15.25 | 13.45 |

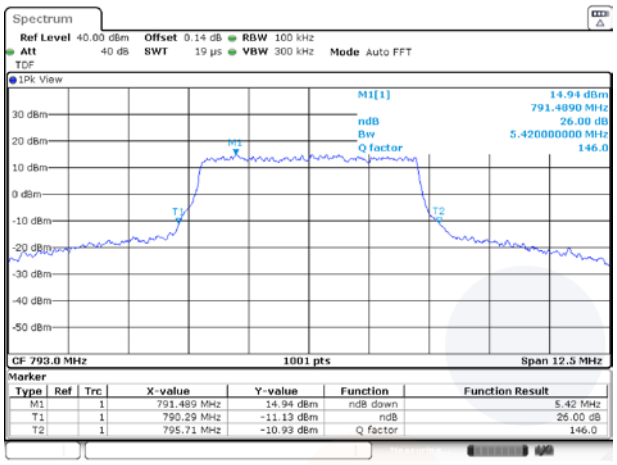
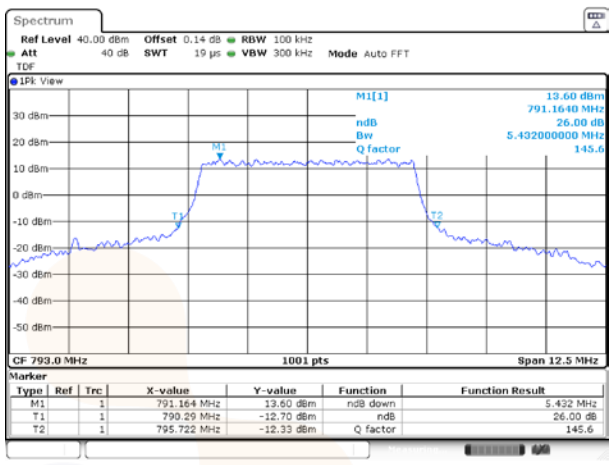
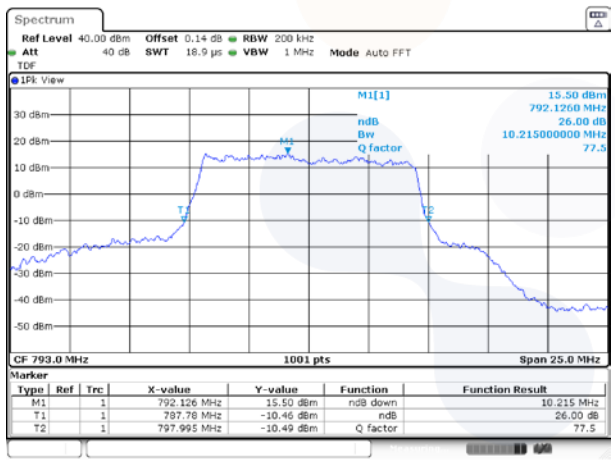
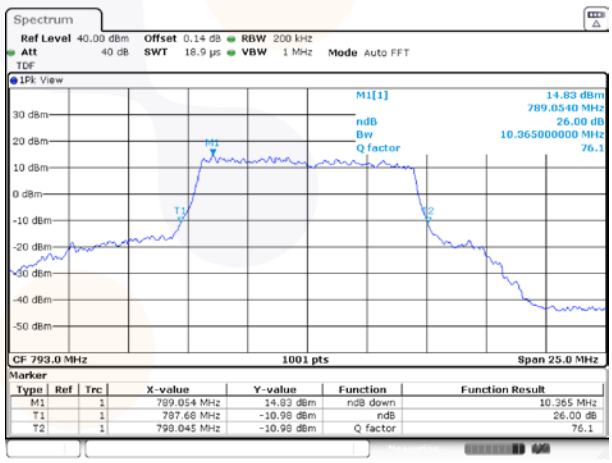
**Straddle channel**

| Test Band | Bandwidth (㎒) | Channel | Test mode | 26㏈ bandwidth (㎒) | 99 % bandwidth (㎒) |
|---|---|---|---|---|---|
| LTE B26 | 1.4 | Middle | QPSK | 1.34 | 1.10 |
| | | | 16QAM | 1.36 | 1.09 |
| | 3 | Middle | QPSK | 3.16 | 2.71 |
| | | | 16QAM | 3.11 | 2.72 |
| | 5 | Middle | QPSK | 5.33 | 4.55 |
| | | | 16QAM | 5.36 | 4.53 |
| | 10 | Middle | QPSK | 10.47 | 9.04 |
| | | | 16QAM | 10.27 | 9.04 |
| | 15 | Middle | QPSK | 15.21 | 13.49 |
| | | | 16QAM | 15.21 | 13.49 |

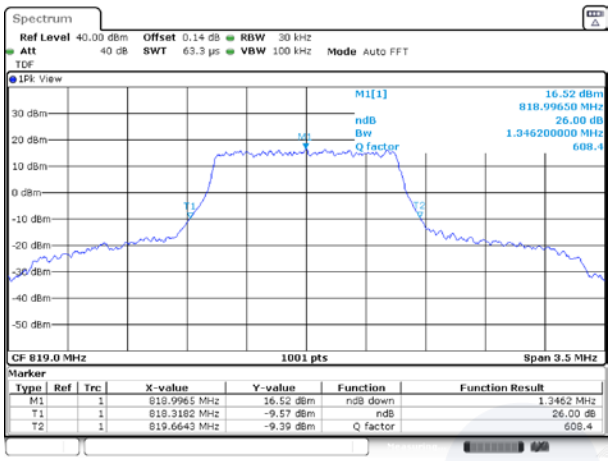
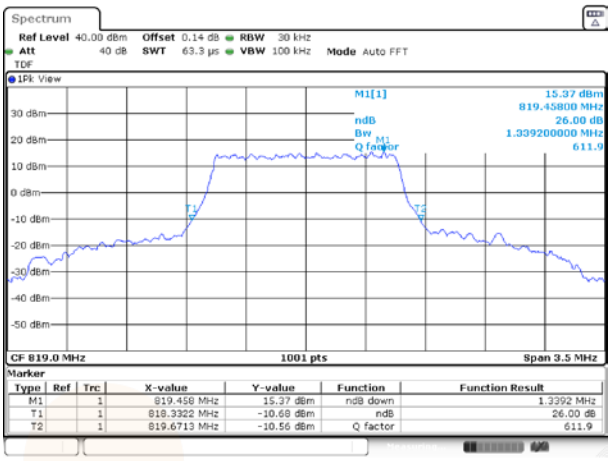
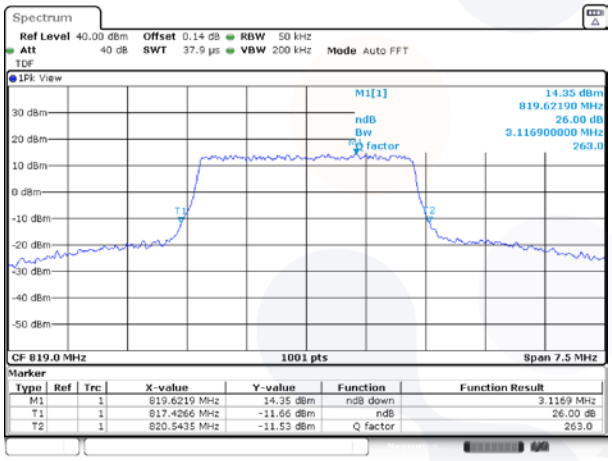
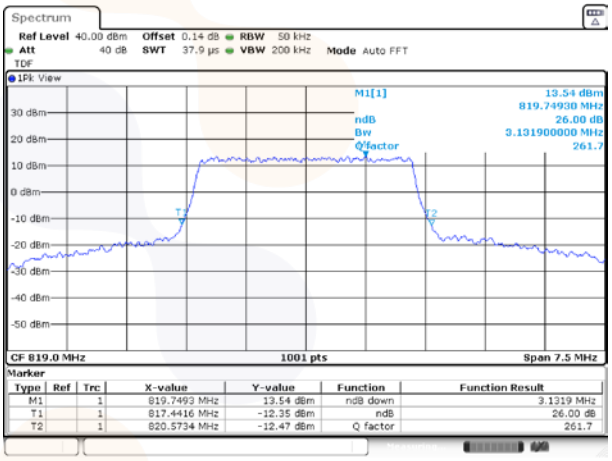
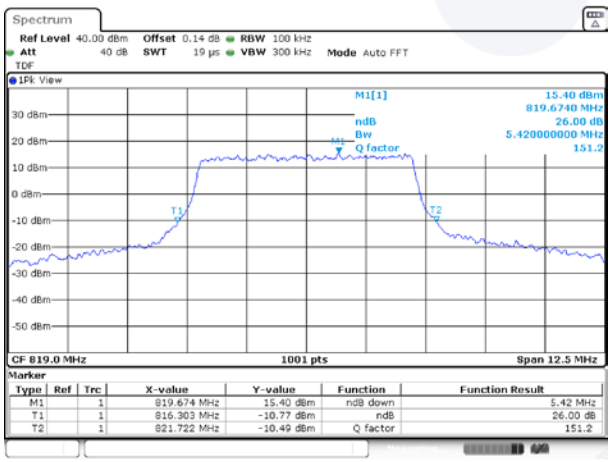
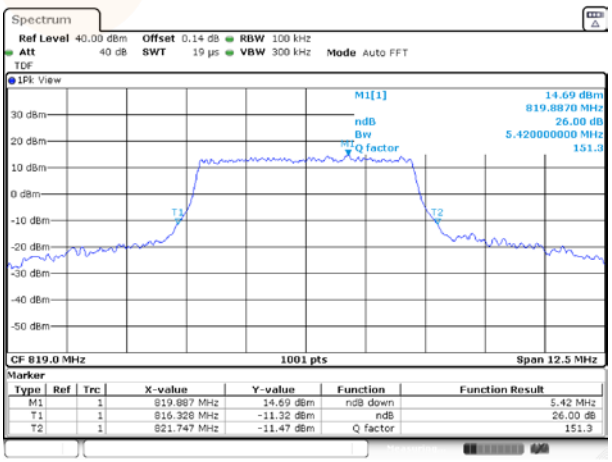
**In order to simplify the report, only Middle channel test plots are attached**

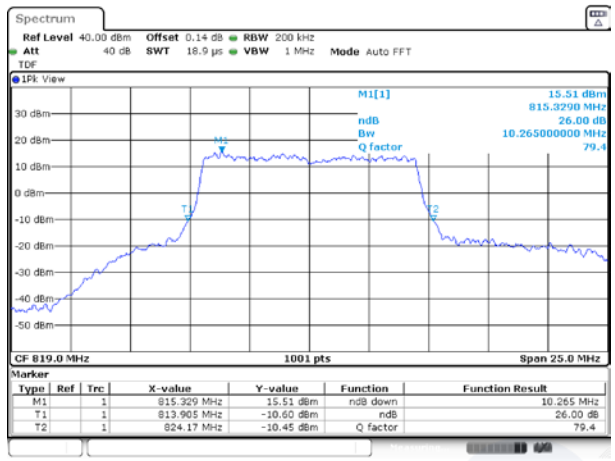
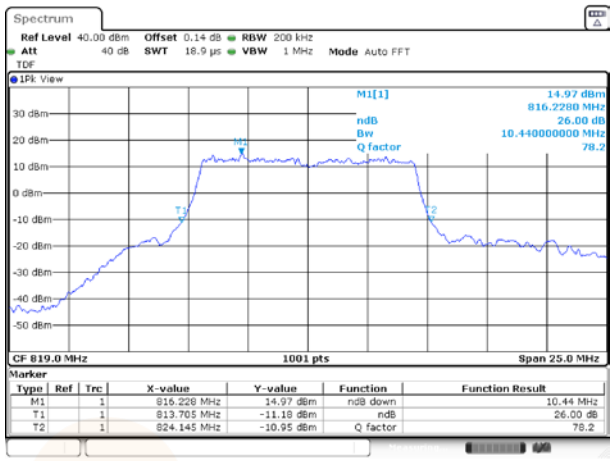
## 26dB Bandwidth

**Test mode: LTE B14**

| 5M BW QPSK Middle channel | 5M BW 16QAM Middle channel |
|---|---|
|  |  |
| **10M BW QPSK Middle channel** | **10M BW 16QAM Middle channel** |
|  |  |

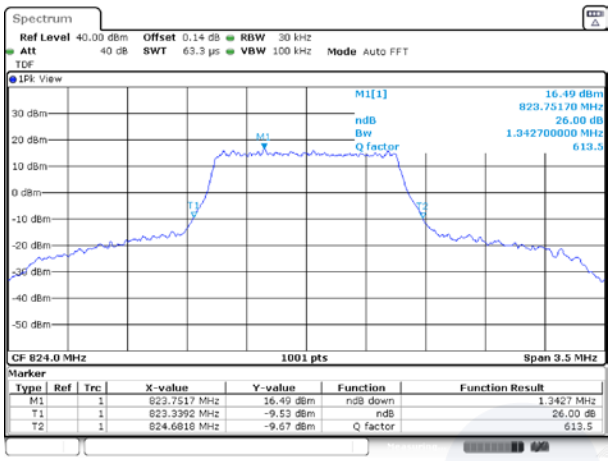
**Test mode: LTE B26**

| 1.4M BW QPSK Middle channel | 1.4M BW 16QAM Middle channel |
|---|---|
|  |  |
| **3M BW QPSK Middle channel** | **3M BW 16QAM Middle channel** |
|  |  |
| **5M BW QPSK Middle channel** | **5M BW 16QAM Middle channel** |
|  |  |

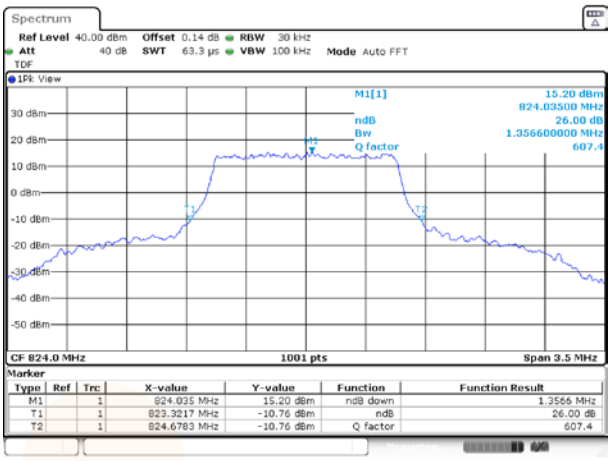
| 10M BW QPSK Middle channel | 10M BW 16QAM Middle channel |
|---|---|
|  |  |
| **15M BW QPSK Middle channel** | **15M BW 16QAM Middle channel** |
|  |  |

## LTE B26 (Straddle channel)

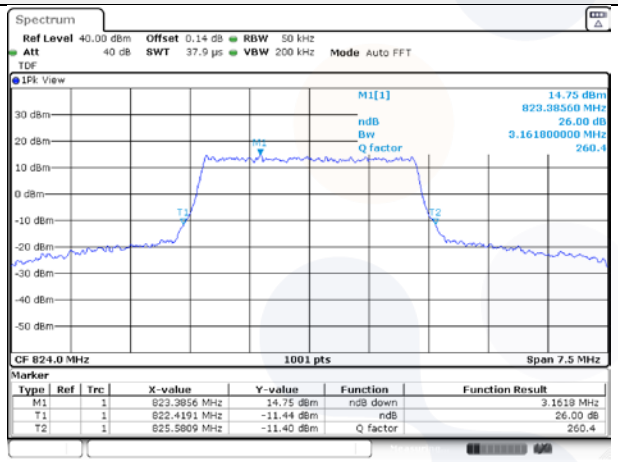
### 1.4M BW QPSK




### 1.4M BW 16QAM

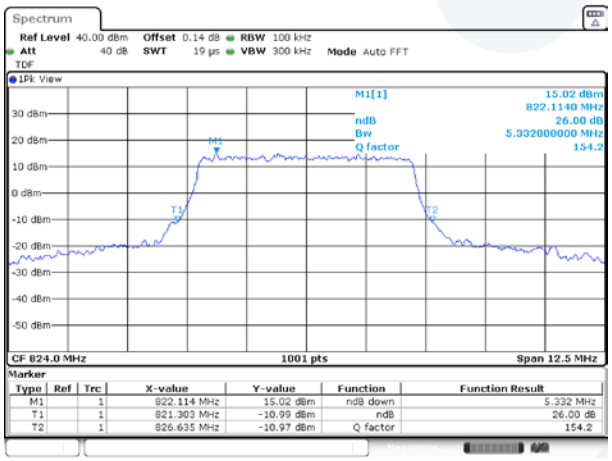



### 3M BW QPSK

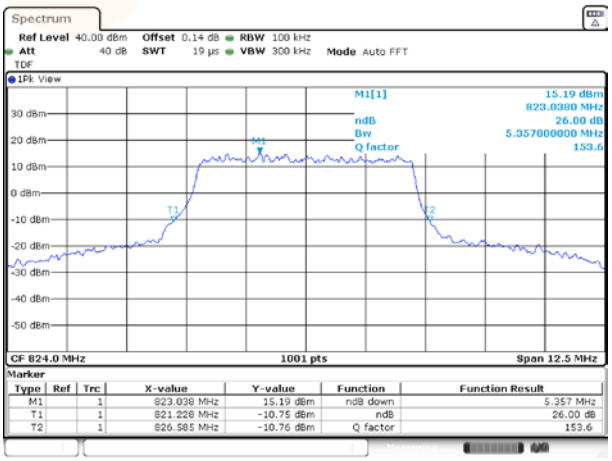


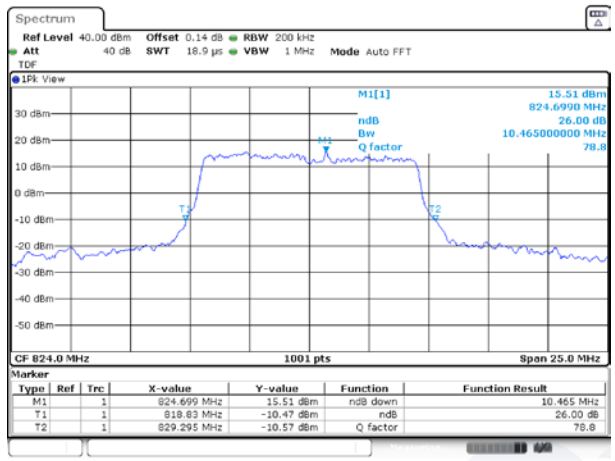
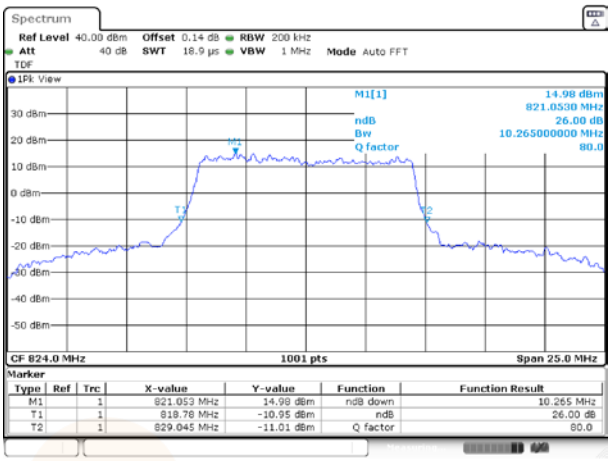
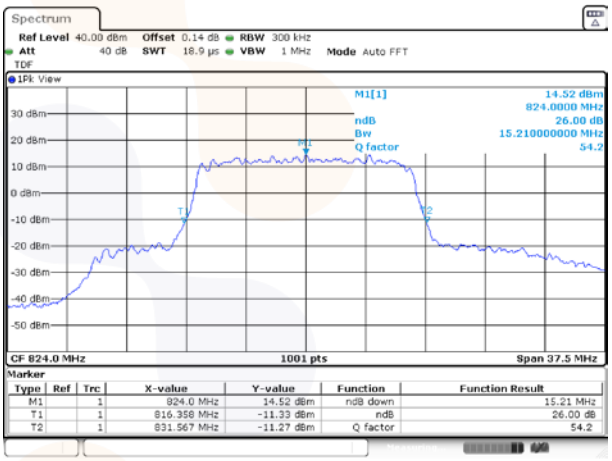

### 3M BW 16QAM


### 5M BW QPSK



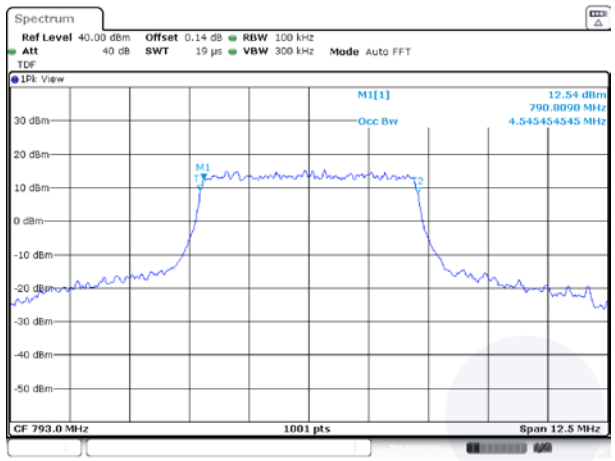
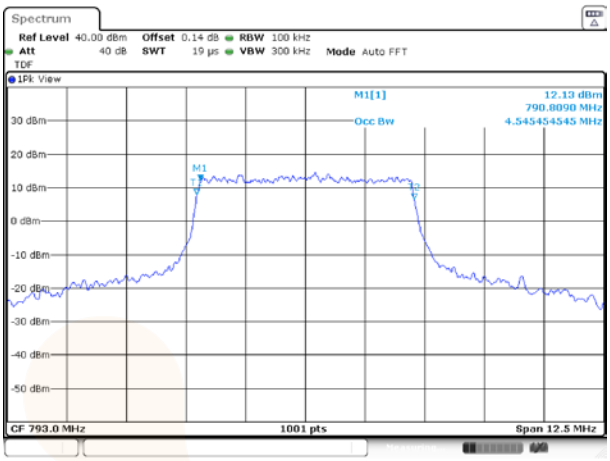
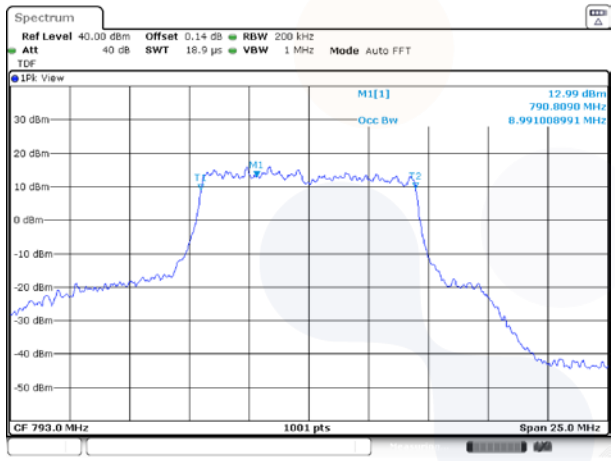
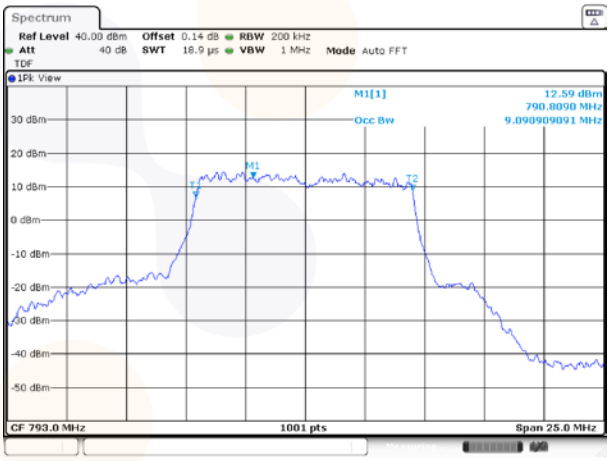

### 5M BW 16QAM



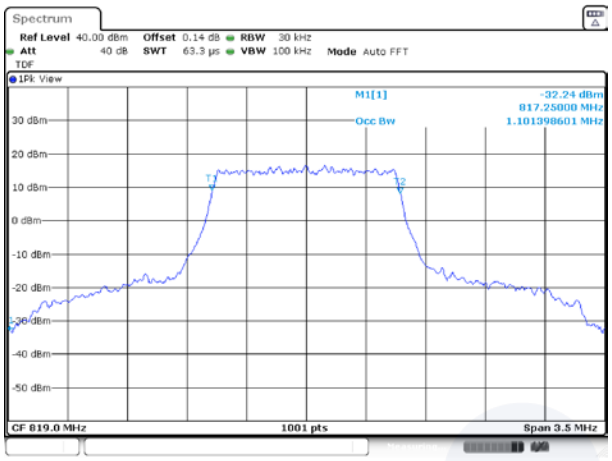
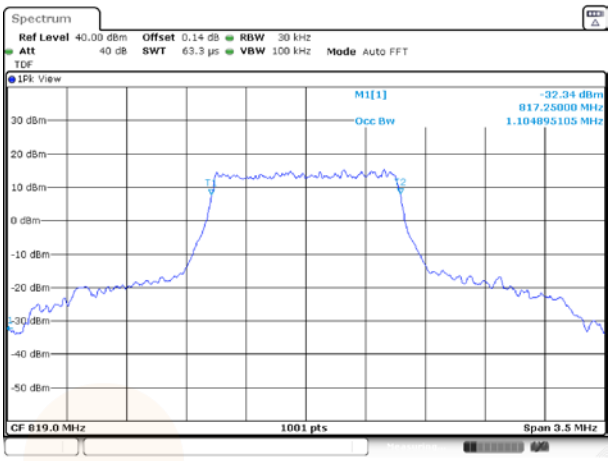
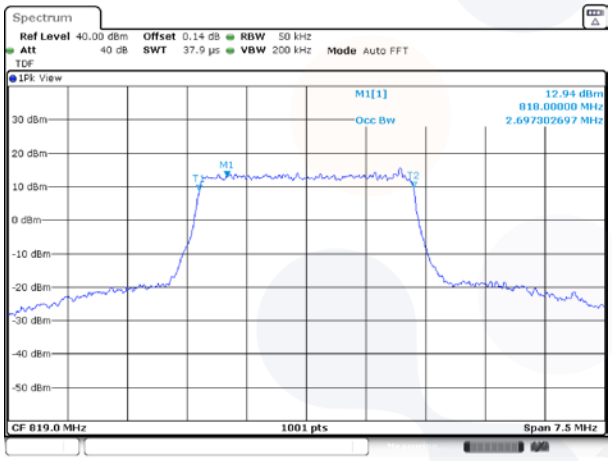
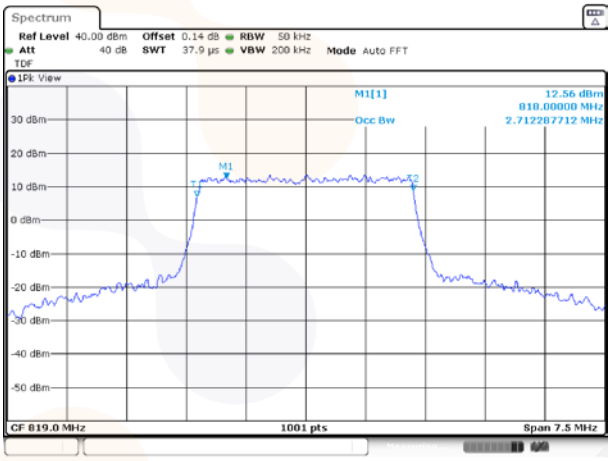
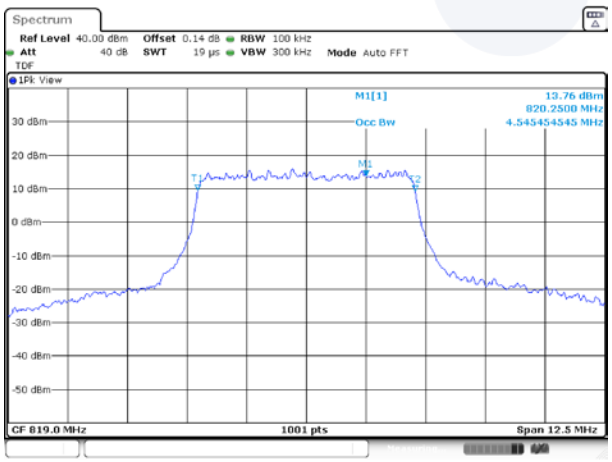
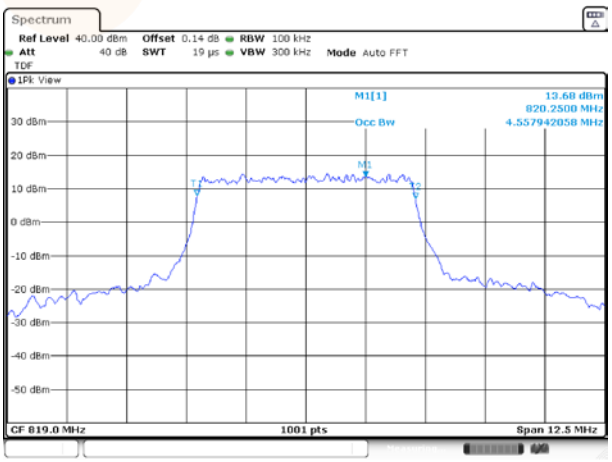
| 10M BW QPSK | 10M BW 16QAM |
|---|---|
|  |  |
| **15M BW QPSK** | **15M BW 16QAM** |
|  |  |

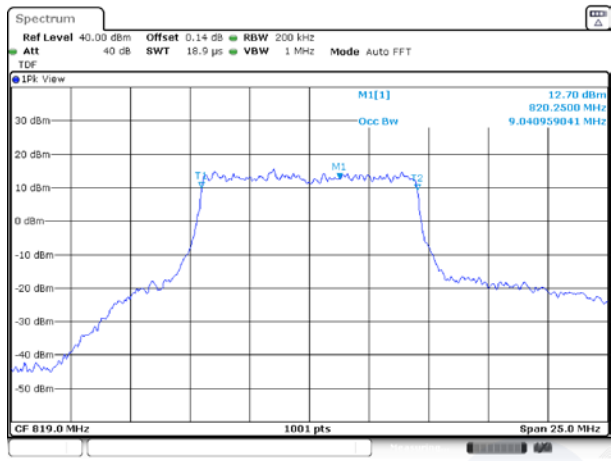
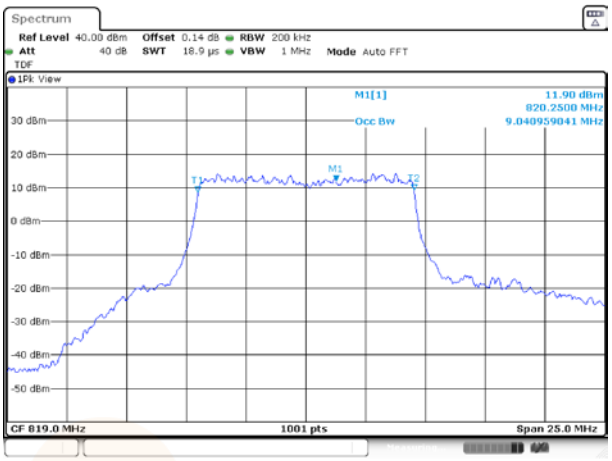
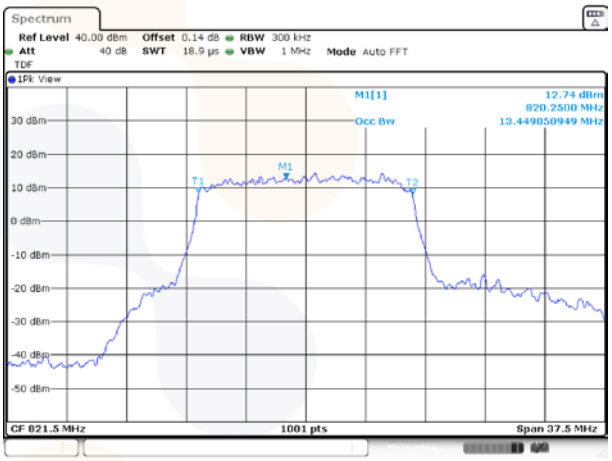
## 99% Occupied Bandwidth

### Test mode: LTE B14

| 5M BW QPSK Middle channel | 5M BW 16QAM Middle channel |
|---|---|
|  |  |
| **10M BW QPSK Middle channel** | **10M BW 16QAM Middle channel** |
|  |  |

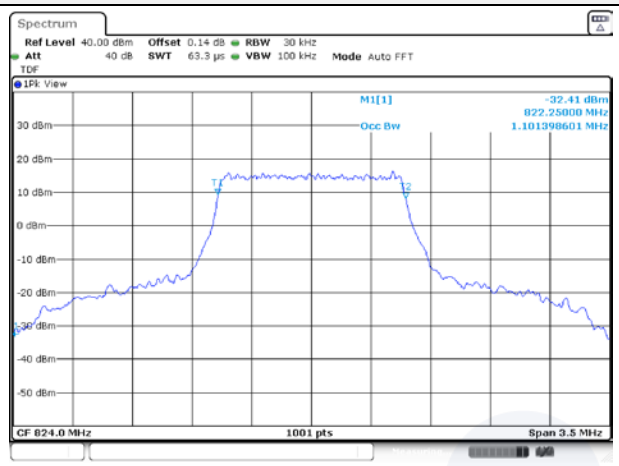
**Test mode: LTE B26**

| 1.4M BW QPSK Middle channel | 1.4M BW 16QAM Middle channel |
|---|---|
|  |  |
| **3M BW QPSK Middle channel** | **3M BW 16QAM Middle channel** |
|  |  |
| **5M BW QPSK Middle channel** | **5M BW 16QAM Middle channel** |
|  |  |

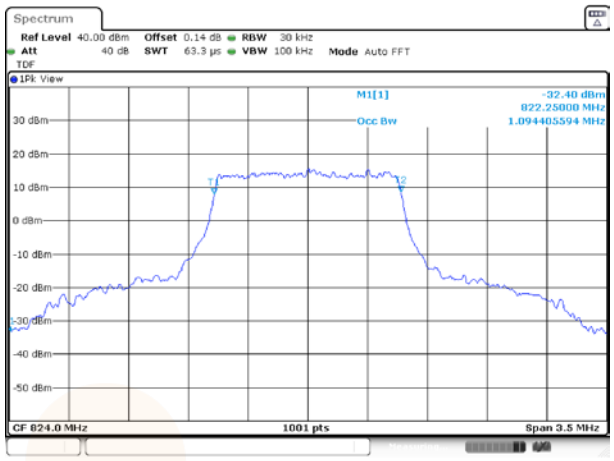
| 10M BW QPSK Middle channel | 10M BW 16QAM Middle channel |
|---|---|
|  |  |
| **15M BW QPSK Middle channel** | **15M BW 16QAM Middle channel** |
|  |  |

## LTE B26 (Straddle channel)

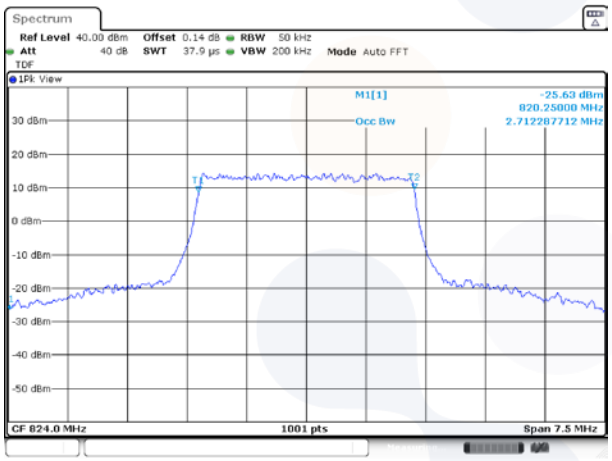
### 1.4M BW QPSK



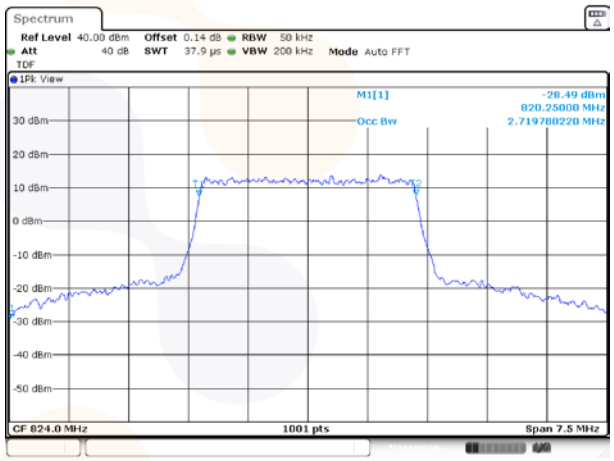

### 1.4M BW 16QAM



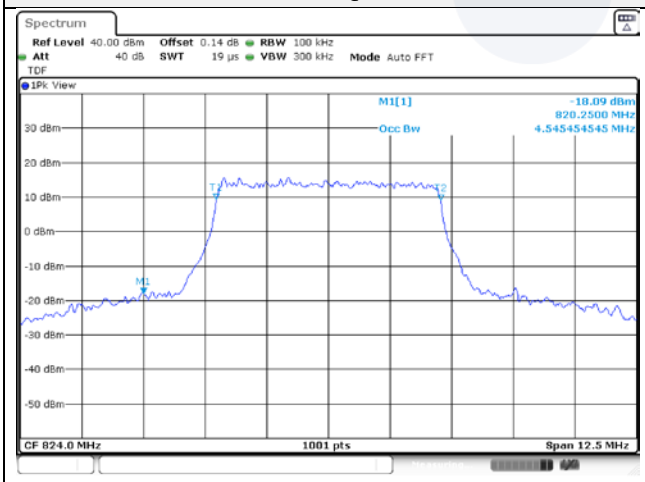

### 3M BW QPSK



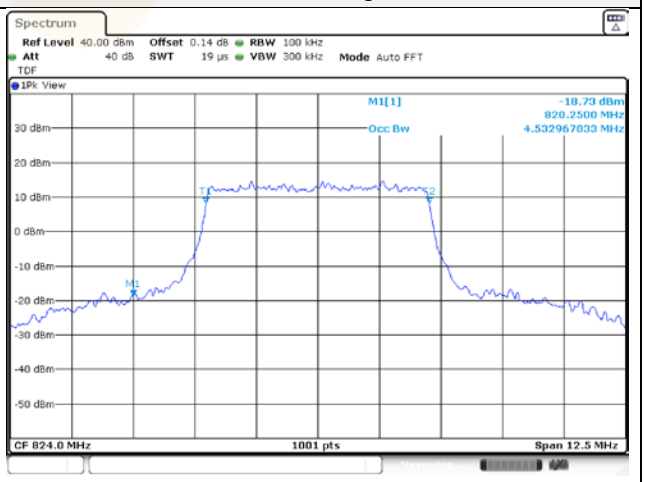

### 3M BW 16QAM

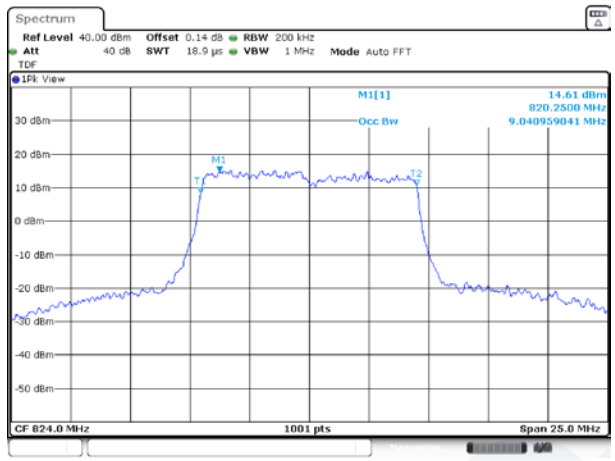
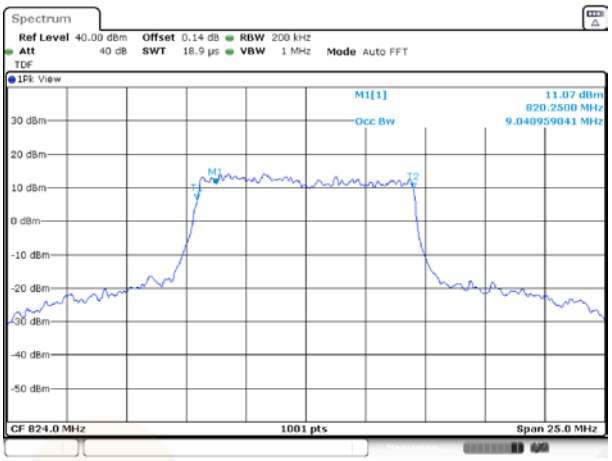
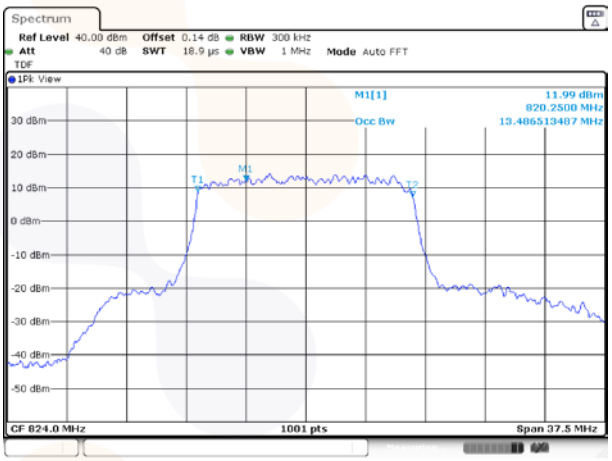



### 5M BW QPSK



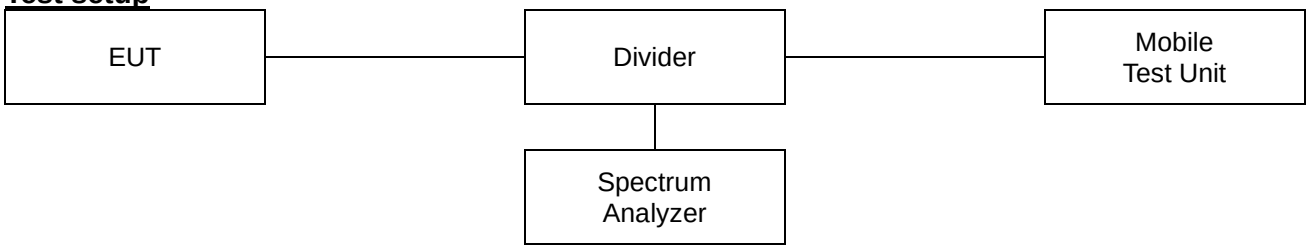

### 5M BW 16QAM



| 10M BW QPSK | 10M BW 16QAM |
|---|---|
|  |  |
| **15M BW QPSK** | **15M BW 16QAM** |
|  |  |

## 7.3. Band Edge Emissions at Antenna Terminal

**Test setup**




**Limit**

**According to §90.543(e),**

For operations in the 758-768 ㎒ and the 788-798 ㎒ 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 ㎒ and 799-805 ㎒, by a factor not less than 76+10log(P) ㏈ in a 6.25 ㎑ band segment, for base and fixed stations.

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

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

(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 ㎑ 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 ㎑ or greater. However, in the 100 ㎑ bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 ㎑ may be employed.

**According to §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 ㎑, 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 where f is greater than 12.5 ㎑.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 ㎑, 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 ㎑.

**Test procedure**

971168 D01 v03r01 - Section 6
971168 D02 v02r02 – Section VIII
ANSI C63.26-2015 – Section 5.7

**Test settings**

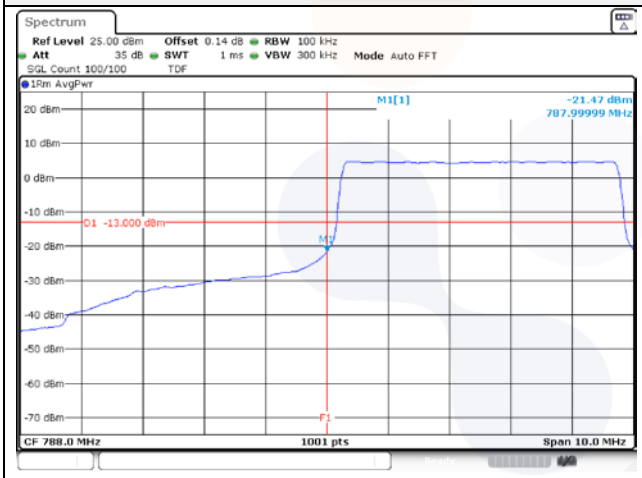
1) Start and stop frequency were set such that the band edge would be placed in the center of the plot
2) Span was set large enough so as to capture all out of band emissions near the band edge.
3) Set the RBW > 1% of the emission bandwidth.
4) Set the VBW ≥ 3 x RBW.
5) Set the number of sweep points ≥ 2 x Span/RBW
6) Detector = RMS
7) Trace mode = trace average
8) Sweep time should be auto for peak detection. For RMS detection the sweep time should be set as follows:
   - If the device can be configured to transmit continuously (duty cycle ≥ 98%), set the (sweep time) > (number of points in sweep) x (symbol period) (e.g., by a factor of 10 x symbol period x number of points) Increasing the sweep time (i.e., slowing the sweep speed) will allow for averaging over multiple symbols.
   - If the device cannot transmit continuously (duty cycle < 98%), a gated sweep shall be used when possible (i.e., gate triggered such that the analyzer only sweeps when the device is transmitting at full power), set the sweep time > (number of points in sweep) x (symbol period) but the sweep time shall always be maintained at a value that is less than or equal to the minimum transmission time
   - If the device cannot be configured to transmit continuously (duty cycle > 98%), and a free-running sweep must be used, set the sweep time so that the averaging is performed over multiple on/off cycles by setting the sweep time > (number of points in sweep) × (transmitter period) (i.e., the transmit on-time + the off-time). The spectrum analyzer readings shall subsequently be corrected by [10 log (1/duty cycle)]. This assumes that the transmission period and duty cycle is relatively constant (duty cycle variation ≤ ±2%).
   - If the device cannot be configured to transmit continuously and a free-running sweep must be used, and if the transmissions exhibit a non-constant duty cycle (duty cycle variations > ±2%), set the sweep time so that the averaging is performed over the on-period by setting the sweep time > (symbol period) × (number of points), while also maintaining the sweep time < (transmitter on-time). The trace mode shall be set to max hold, since not every display point will be averaged only over just the on-time. Thus, multiple sweeps (e.g., 100) in maximum hold art necessary to ensure that the maximum power is measured.
9) Allow trace to fully stabilize.

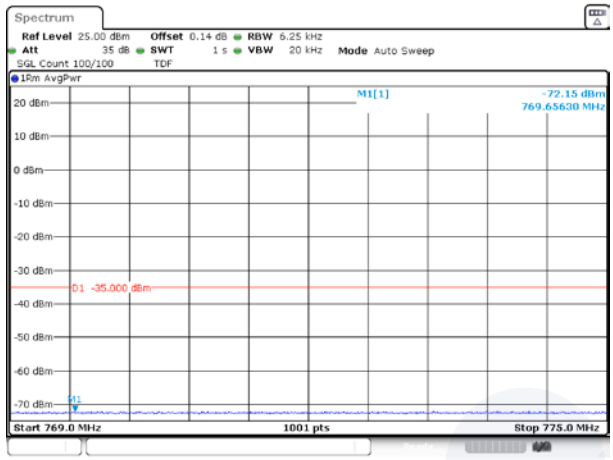
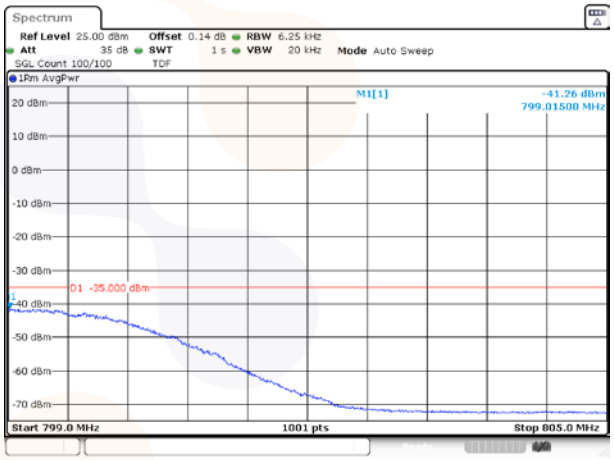
**Notes:**

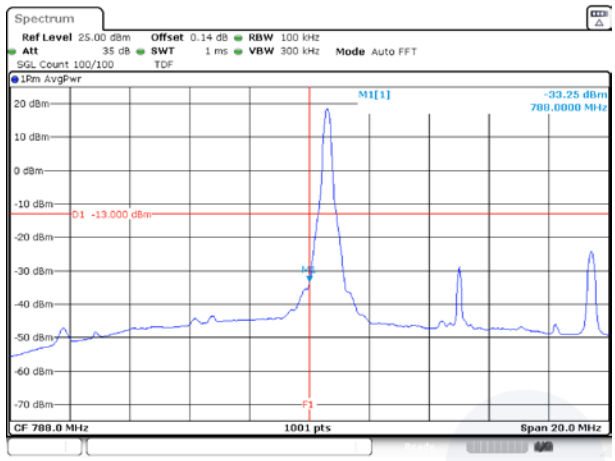
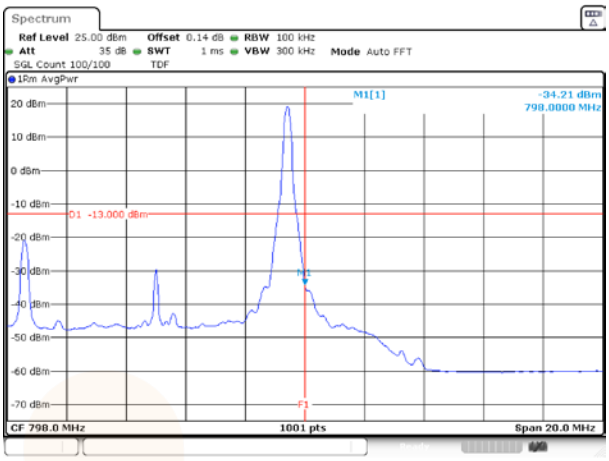
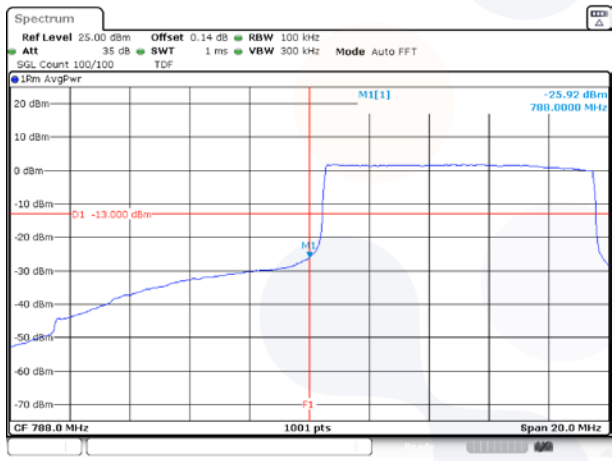
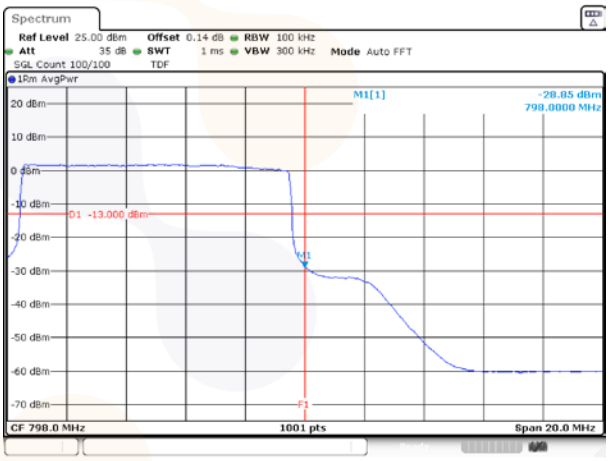
1. For Section 90.691(a) compliance testing, use RBW = 300 ㎐ for offsets less than 37.5 ㎑ from a channel edge; RBW = 100 ㎑ for offsets greater than 37.5 ㎑ is allowed.
2. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 ㎒ or greater. however in the 1 ㎒ bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 ㏈ below the transmitter power.
3. The EUT was setup to maximum output power as its lowest and highest channel with all bandwidth, modulation and RB configurations.

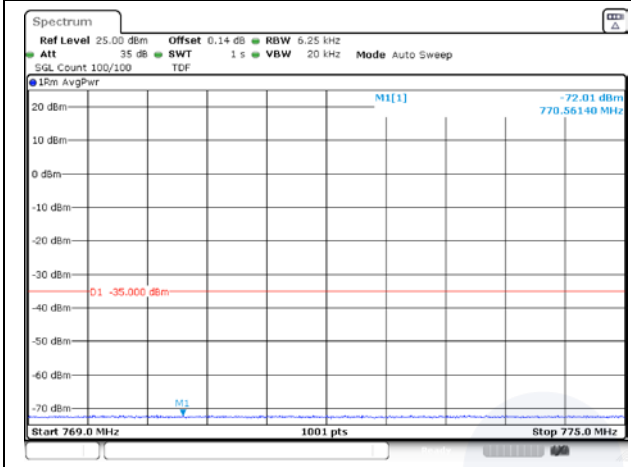
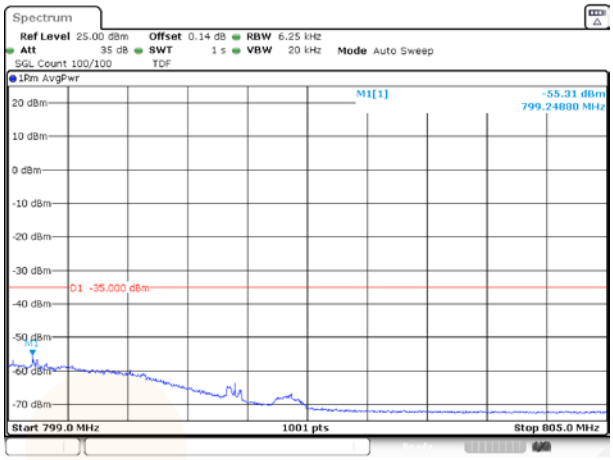
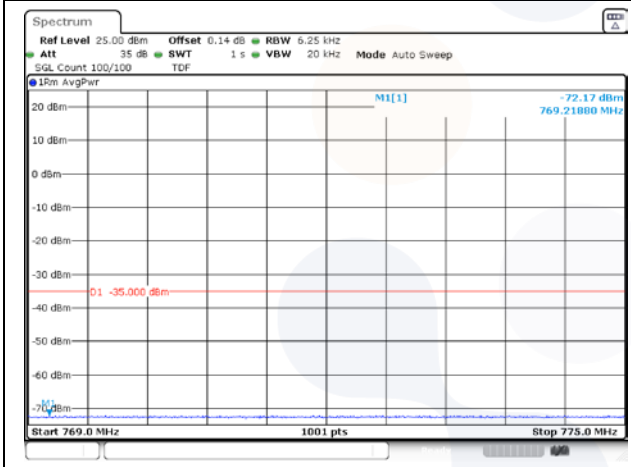
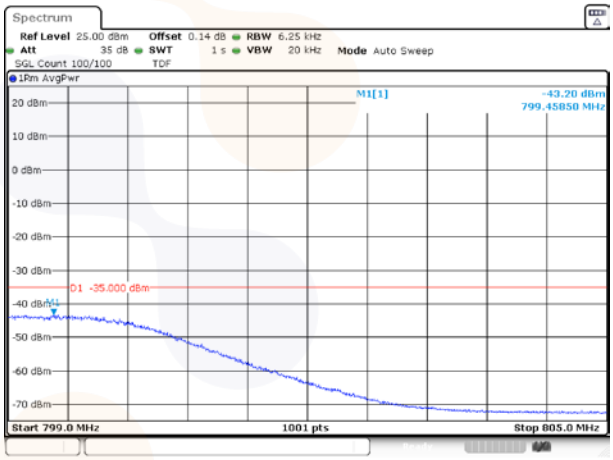
## Test results

### Test mode: LTE B14

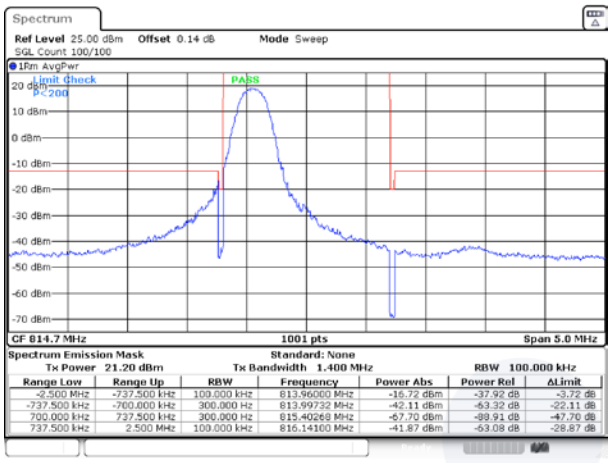
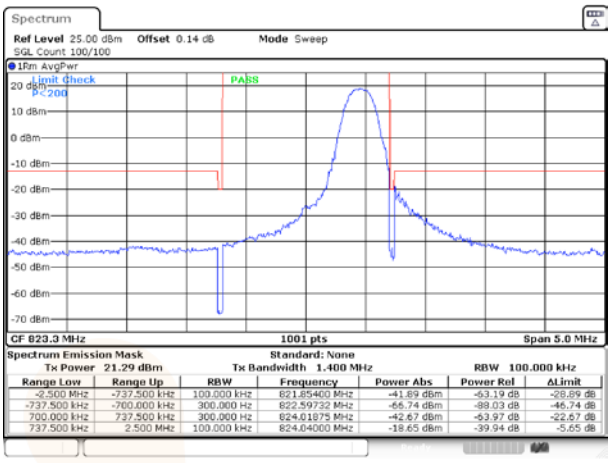
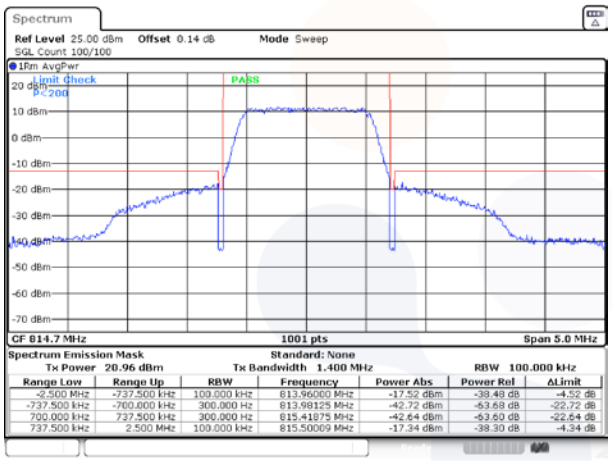
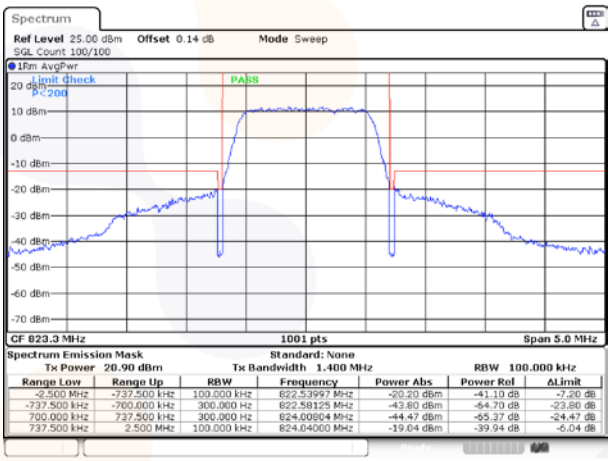
| 5M BW QPSK | |
|---|---|
| **Low channel 1RB** | **High channel 1RB** |
|  |  |
| **Low channel FRB** | **High channel FRB** |
|  |  |

| 5M BW QPSK | |
|---|---|
| **Lower extended 1RB** | **Upper extended 1RB** |
|  |  |
| **Lower extended FRB** | **Upper extended FRB** |
|  |  |

| 10M BW QPSK | |
|---|---|
| **Middle channel Lower 1RB** | **Middle channel Upper 1RB** |
|  |  |
| **Middle channel Lower FRB** | **Middle channel Upper FRB** |
|  |  |

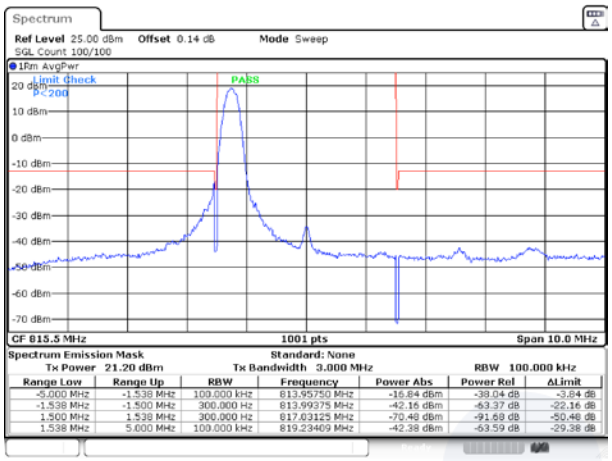
| 10M BW QPSK | |
|---|---|
| **Lower extended 1RB** | **Upper extended 1RB** |
|  |  |
| **Lower extended FRB** | **Upper extended FRB** |
|  |  |

**Test mode: LTE B26**

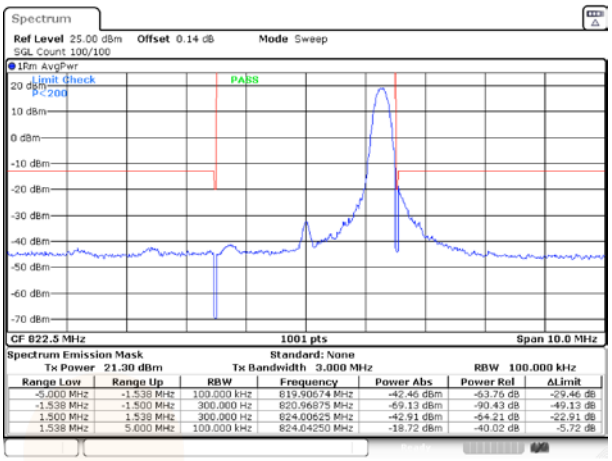
| 1.4M BW QPSK | |
|---|---|
| **Low channel 1RB** | **High channel 1RB** |
|  |  |
| **Low channel FRB** | **High channel FRB** |
|  |  |

## 3M BW QPSK

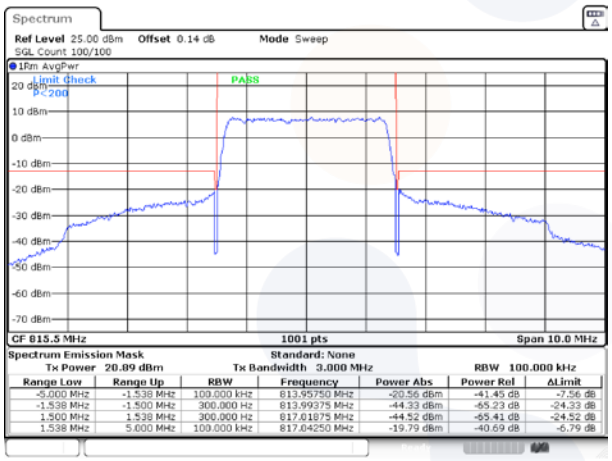
### Low channel 1RB



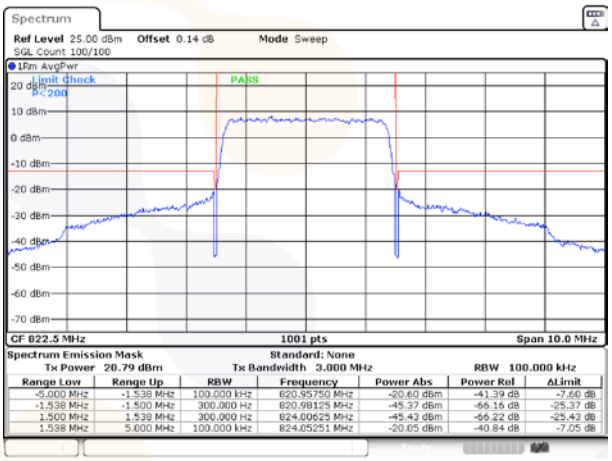

### High channel 1RB




### Low channel FRB

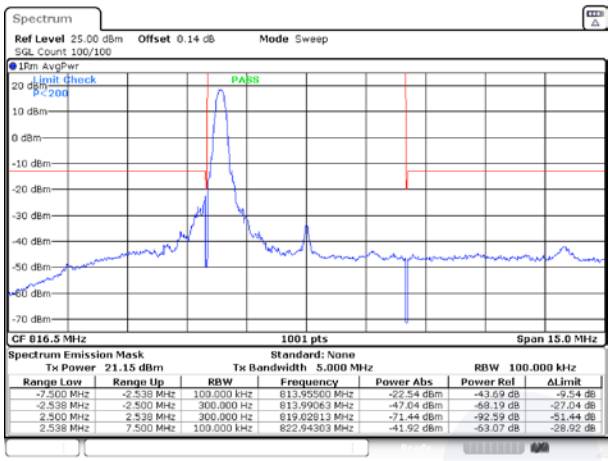



### High channel FRB

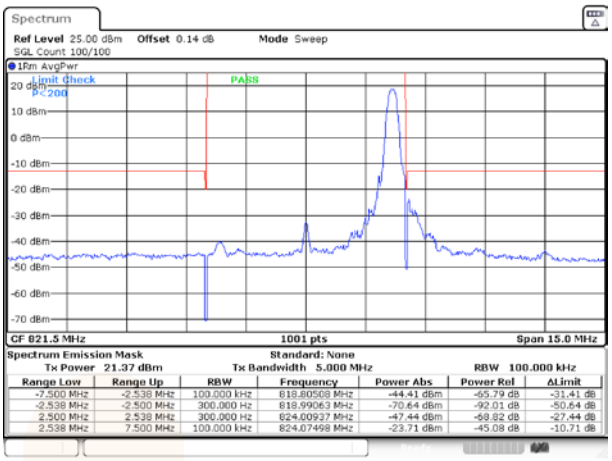


## 5M BW QPSK

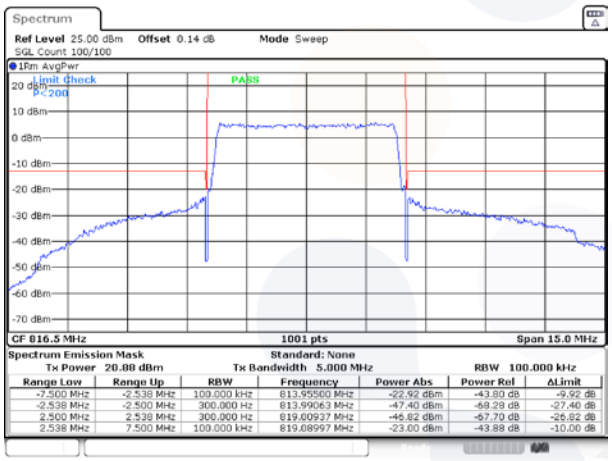
### Low channel 1RB




### High channel 1RB




### Low channel FRB




### High channel FRB