

Test Report No:  
75462RRF.004

# Test Report

## USA FCC Part 90

## CANADA RSS-140

|                                           |                                                                                                                                                                            |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (*) Identification of item tested         | LTE Cat-4                                                                                                                                                                  |
| (*) Trademark                             | Sequans Communications                                                                                                                                                     |
| (*) Model and /or type reference          | CA410                                                                                                                                                                      |
| Other identification of the product       | FCC ID: 2AAGMCA410A<br>IC: 12732A-CA410A                                                                                                                                   |
| (*) Features                              | LTE Cat-4<br>HW version: V1<br>SW version: LR4.1.6.0-CBRSA-59334                                                                                                           |
| Applicant                                 | SEQUANS COMMUNICATIONS<br>55 Boulevard Charles de Gaulle, 92700 Colombes,<br>France                                                                                        |
| Test method requested, standard           | USA FCC Part 90 (10-1-21 Edition).<br>CANADA RSS-140 Issue 1, April 2018<br>ANSI C63.26-2015.<br>KDB 971168 D01 Power Meas License Digital Systems<br>v03r01, April. 2018. |
| Summary                                   | IN COMPLIANCE                                                                                                                                                              |
| Approved by (name / position & signature) | José Manuel Gómez Galván<br>EMC Consumer & RF<br>Lab. Manager<br>                     |
| Date of issue                             | 2023-10-17                                                                                                                                                                 |
| Report template No                        | FDT08_24<br>(*) "Data provided by the client"                                                                                                                              |

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digitalmente por  
53680346W JOSE  
MANUEL GOMEZ  
(C:A29507456)  
Fecha: 2023.10.23  
17:43:31 +02'00'

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## Competences and guarantees

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DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación) to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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## General conditions

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1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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## Uncertainty

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Uncertainty (factor  $k=2$ ) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

## Data provided by the client

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The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample model CA410 is ideal for adding LTE connectivity to electronics devices for industrial Internet of Things (IoT), Machine-to-Machine (M2M) and broadband consumer applications. CA410 is compliant with CBRS networks operating on LTE band 48 in USA, with US B8 – known as Anterix band - and with other US MNO bands: bands 2/4/5/12/13/66 as well as Firstnet LTE band 14 and band 26 used in private networks.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

## Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

| Control N°        | Description | Model     | Serial N°      | Date of reception |
|-------------------|-------------|-----------|----------------|-------------------|
| 75462C/ 015<br>*  | LTE Cat-4   | CA410-EVK | FOX-23-26-0660 | 25-07-2023        |
| 76162C/001<br>**  | Testing Box | CA410-EVK | FOX-23-34-0682 | 11-09-2023        |
| 75462C/017        | USB Cable   | -         | -              | 25-07-2023        |
| 75462C/022<br>*** | LTE Cat-4   | CA410-EVK | FOX-23-26-0647 | 20-09-2023        |

Sample S/01 has undergone the following test(s): The conducted tests indicated in Appendix A.

- \* : EUT used in all the conducted tests for the LTE Cat-4 Band 14 but the PAPR test.
- \*\* : EUT used in all the conducted tests for the LTE Cat-4 Band 26 but the Mask EA test.
- \*\*\* : EUT used in the PAPR test for the LTE Cat-4 Band 14 and the Mask EA test for the LTE Cat-4 Band 26.

- Sample S/02 is composed of the following elements:

| Control N° | Description | Model     | Serial N°      | Date of reception |
|------------|-------------|-----------|----------------|-------------------|
| 76162C/001 | Testing Box | CA410-EVK | FOX-23-34-0682 | 11-09-2023        |
| 76162C/002 | Testing Box | CA410-EVK | FOX-23-34-0683 | 11-09-2023        |
| 75462C/003 | Antenna     | -         | -              | -                 |
| 75462C/004 | Antenna     | -         | -              | 25-07-2023        |

Sample S/02 has undergone the following test(s): The radiated tests indicated in Appendix A.

## Test sample description

|                                              |                                         |                              |                                     |                             |                                   |                            |                             |
|----------------------------------------------|-----------------------------------------|------------------------------|-------------------------------------|-----------------------------|-----------------------------------|----------------------------|-----------------------------|
| Ports.....:                                  | Port name and description               | Cable                        |                                     |                             |                                   |                            |                             |
|                                              |                                         | Specified max length [m]     | Attached during test                | Shielded                    | Coupled to patient <sup>(3)</sup> |                            |                             |
|                                              | USB                                     | -                            | <input checked="" type="checkbox"/> | <input type="checkbox"/>    | <input type="checkbox"/>          |                            |                             |
| Supplementary information to the ports.....: | -                                       |                              |                                     |                             |                                   |                            |                             |
| Rated power supply .....                     | Voltage and Frequency                   |                              | Reference poles                     |                             |                                   |                            |                             |
|                                              | <input type="checkbox"/> AC:            |                              | <input type="checkbox"/> L1         | <input type="checkbox"/> L2 | <input type="checkbox"/> L3       | <input type="checkbox"/> N | <input type="checkbox"/> PE |
|                                              | <input checked="" type="checkbox"/> DC: | 3.2V Min, 3.3V Typ, 4.6V Max |                                     |                             |                                   |                            |                             |
| Rated Power.....:                            | -                                       |                              |                                     |                             |                                   |                            |                             |
| Clock frequencies.....:                      | -                                       |                              |                                     |                             |                                   |                            |                             |
| Other parameters .....                       | -                                       |                              |                                     |                             |                                   |                            |                             |
| Software version.....:                       | -                                       |                              |                                     |                             |                                   |                            |                             |

|                                               |                                     |                                |              |
|-----------------------------------------------|-------------------------------------|--------------------------------|--------------|
| Hardware version .....                        | -                                   |                                |              |
| Dimensions in cm (W x H x D) ...              | -                                   |                                |              |
| Mounting position .....                       | <input checked="" type="checkbox"/> | Table top equipment            |              |
|                                               | <input type="checkbox"/>            | Wall/Ceiling mounted equipment |              |
|                                               | <input type="checkbox"/>            | Floor standing equipment       |              |
|                                               | <input type="checkbox"/>            | Hand-held equipment            |              |
|                                               | <input type="checkbox"/>            | Other:                         |              |
| Modules/parts .....                           | Module/parts of test item           | Type                           | Manufacturer |
|                                               | -                                   | -                              | -            |
| Accessories (not part of the test item) ..... | Description                         | Type                           | Manufacturer |
|                                               | USB Cable                           | USB                            | -            |
|                                               | Antenna                             | Antenna                        | -            |
| Documents as provided by the applicant .....  | Description                         | File name                      | Issue date   |
|                                               | -                                   | -                              | -            |

<sup>(3)</sup> Only for Medical Equipment

## Identification of the client

SEQUANS COMMUNICATIONS  
55 Boulevard Charles de Gaulle, 92700, Colombes, France

## Testing period and place

|               |                                        |
|---------------|----------------------------------------|
| Test Location | DEKRA Testing and Certification S.A.U. |
| Date (start)  | 2023-08-02                             |
| Date (finish) | 2023-09-21                             |

## Document history

| Report number | Date       | Description    |
|---------------|------------|----------------|
| 75462RRF.004  | 2023-10-17 | First release. |

## Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

|                   |                              |
|-------------------|------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C |
| Relative humidity | Min. = 20 %<br>Max. = 75 %   |

In the semi-anechoic chamber, the following limits were not exceeded during the test:

|                   |                              |
|-------------------|------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C |
| Relative humidity | Min. = 20 %<br>Max. = 75 %   |

In the chamber for conducted measurements, the following limits were not exceeded during the test:

|                   |                              |
|-------------------|------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C |
| Relative humidity | Min. = 20 %<br>Max. = 75 %   |

## Remarks and comments

The tests have been performed by the technical personnel: Rafael Fernández, Sergio Carrasco, Valentín Andarias, Carmen Vázquez, Irene Bibang, Fernando Chito, Francisco López, Antonio Maireles.

Used instrumentation:

| Control No. | Equipment                                   | Model          | Manufacturer      | Next Calibration |
|-------------|---------------------------------------------|----------------|-------------------|------------------|
| 6794        | Shielded Room                               | S101           | ETS LINDGREN      | N/A              |
| 9229        | Wideband Radio Communication Tester         | CMW500         | ROHDE AND SCHWARZ | 2024-06          |
| 6157        | Signal and Spectrum Analyzer 10 Hz - 40 GHz | FSV40          | ROHDE AND SCHWARZ | 2023-10          |
| 8002        | TEMPERATURE CHAMBER MK56 BINDER             | MK 56          | BINDER            | 2024-04          |
| 6791        | SEMIANECHOIC ABSORBER LINED                 | FACT 3 200 STP | ETS LINDGREN      | N/A              |
| 6792        | SHIELDED ROOM                               | S101           | ETS LINDGREN      | N/A              |
| 6143        | Biconical/Log Antenna 30 MHz - 6 GHz        | 3142E          | ETS LINDGREN      | 2023-10          |
| 4612        | HORN ANTENNA 1-18GHz                        | BBHA 9120 D    | SCHWARZBECK       | 2024-07          |
| 7817        | EMI TEST RECEIVER 2Hz-44GHz                 | ESW44          | ROHDE AND SCHWARZ | 2023-12          |
| 3783        | PRE-AMPLIFIER G>30dB 1GHz-18GHz             | BLMA 0118-3A   | BONN ELEKTRONIK   | 2023-12          |
| 6144        | RF Preamplifier 40 dB, 10 MHz - 6 GHz       | BLNA 0160-01N  | BONN ELEKTRONIK   | 2024-07          |
| 6667        | Wideband Radio Communication Tester         | CMW500         | ROHDE AND SCHWARZ | 2024-06          |
| 7760        | Digital Multimeter                          | 175            | FLUKE             | 2023-11          |
| 7798        | EMC/RF MEASUREMENT SOFTWARE                 | WMS32          | ROHDE AND SCHWARZ | N/A              |
| 4848        | SOFTWARE FOR EMC/RF TESTING                 | EMC32          | ROHDE AND SCHWARZ | N/A              |

## Testing verdicts

|                 |     |
|-----------------|-----|
| Not applicable: | N/A |
| Pass:           | P   |
| Fail:           | F   |
| Not measured:   | N/M |

## Summary

### LTE Cat-4 Band 14.

| FCC PART 90 / RSS-140 PARAGRAPH                                                                                            |         |        |
|----------------------------------------------------------------------------------------------------------------------------|---------|--------|
| Requirement – Test case                                                                                                    | Verdict | Remark |
| FCC 90.542 (a) (7) / RSS-140 Clause 4.3: Transmitter output power: RF output power                                         | P       |        |
| FCC 2.1047 / RSS-140 Clause 4.1: Modulation characteristics                                                                | P       |        |
| FCC 90.213 / RSS-140 Clause 4.2: Frequency stability                                                                       | P       |        |
| FCC 2.1049 / RSS-Gen Clause 6.7: Occupied bandwidth (or 99% emission bandwidth)                                            | P       |        |
| FCC 90.691 / RSS-140 Clause 4.4: Spurious emissions at antenna terminals                                                   | P       |        |
| FCC 90.691 / RSS-140 Clause 4.4: Spurious emissions at antenna terminals (Emission mask requirements for EA-based systems) | P       |        |
| FCC 90.691 / RSS-140 Clause 4.4: Radiated emissions                                                                        | P       |        |
| <u>Supplementary information and remarks:</u><br>None.                                                                     |         |        |

### LTE Cat-4 Band 26.

| FCC PART 90 PARAGRAPH                                                                                 |         |        |
|-------------------------------------------------------------------------------------------------------|---------|--------|
| Requirement – Test case                                                                               | Verdict | Remark |
| FCC 90.635 (b): Transmitter output power: RF output power                                             | P       |        |
| FCC 2.1047: Modulation characteristics                                                                | P       |        |
| FCC 90.213: Frequency stability                                                                       | P       |        |
| FCC 2.1049: Occupied bandwidth (or 99% emission bandwidth)                                            | P       |        |
| FCC 90.691: Spurious emissions at antenna terminals                                                   | P       |        |
| FCC 90.691: Spurious emissions at antenna terminals (Emission mask requirements for EA-based systems) | P       |        |
| FCC 90.691: Radiated emissions                                                                        | P       |        |
| <u>Supplementary information and remarks:</u><br>None.                                                |         |        |

## Appendix A:

Test results for FCC 90 / RSS-140: LTE Cat-4  
Band 14, and for FCC 90: LTE Cat-4 Band 26

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## TEST CONDITIONS

(\*): Declared by the Applicant.

### POWER SUPPLY (\*):

Vnominal: 3.2 Vdc  
Vminimum: 3.3 Vdc  
Vmaximum: 4.6 Vdc

Type of Power Supply: DC External.

### ANTENNA (\*):

| LOW Bands         | GAIN     | ANTENNA TYPE                       |
|-------------------|----------|------------------------------------|
| LTE Cat-4 Band 14 | -1.1 dBi | External (reference 2JW1183-C952B) |
| LTE Cat-4 Band 26 | -1.1 dBi | External (reference 2JW1183-C952B) |

### TEST FREQUENCIES:

LTE Band 14. QPSK and 16QAM:

| Channel (Frequency, MHz) |               |             |
|--------------------------|---------------|-------------|
|                          | BW=5 MHz      | BW=10 MHz   |
| Low                      | 23305 (790.5) | N/A         |
| Middle                   | N/A           | 23330 (793) |
| High                     | 23355 (795.5) | N/A         |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. QPSK and 16QAM:

| Channel (Frequency, MHz) |               |               |               |             |           |
|--------------------------|---------------|---------------|---------------|-------------|-----------|
|                          | BW=1.4 MHz    | BW=3 MHz      | BW=5 MHz      | BW=10 MHz   | BW=15 MHz |
| Low                      | 26697 (814.7) | 26705 (815.5) | 26715 (816.5) | N/A         | N/A       |
| Middle                   | 26740 (819)   | 26740 (819)   | 26740 (819)   | 26740 (819) | N/A       |
| High                     | 26783 (823.3) | 26775 (822.5) | 26765 (821.5) | N/A         | N/A       |

LTE Cat-4 Band 26. Cross-rule Channel (824 MHz). QPSK and 16QAM:

| Channel (Frequency, MHz) |             |             |             |             |
|--------------------------|-------------|-------------|-------------|-------------|
| BW=1.4 MHz               | BW=3 MHz    | BW=5 MHz    | BW=10 MHz   | BW=15 MHz   |
| 26790 (824)              | 26790 (824) | 26790 (824) | 26790 (824) | 26790 (824) |



## RF Output Power

### Limits

#### 1. LTE Cat-4 Band 14:

\* FCC § 90.542 (a) (7):

(a) The following power limits apply to the 763-768 / 793-798 MHz band:

(7) Portable stations (hand-held devices) transmitting in the 763-768 MHz band and the 793-798 MHz band are limited to 3 watts ERP.

\* RSS-140 Clause 4.3: The equivalent radiated power (e.r.p.) for control and mobile equipment shall not exceed 30 W. The e.r.p. for portable equipment including handheld devices shall not exceed 3 W.

Fixed and base station equipment shall comply with the e.r.p. limits in SRSP-540.

In addition, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

#### 2. LTE Cat-4 Band 26:

\* FCC § 90.635 (b): The maximum output power of the transmitter for mobile stations is 100 Watts (20 dBW).

### Method

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

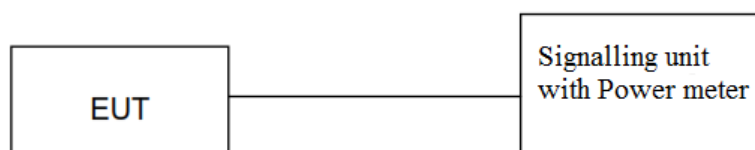
The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

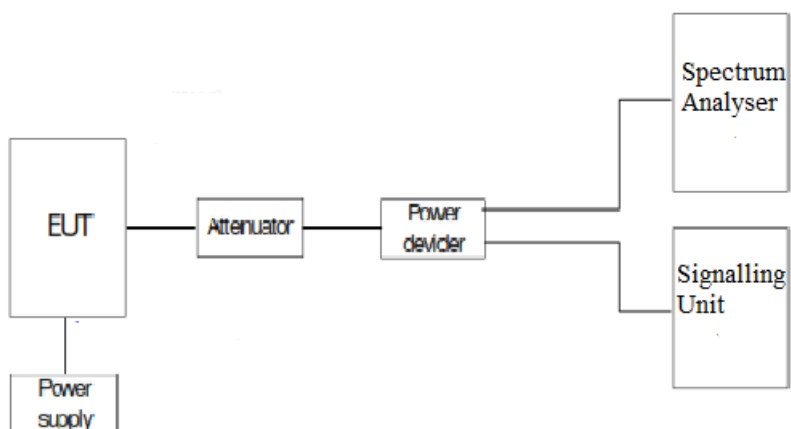
$$\text{E.R.P.} = \text{E.I.R.P.} - 2.15 \text{ dB}$$

### Test Setup

#### 1. CONDUCTED AVERAGE POWER:



## 2. PEAK-TO-AVERAGE POWER RATIO (PAPR):



Results

1. CONDUCTED AVERAGE POWER:

Measurements required on one frequency near top channel and one frequency near bottom channel, according to FCC § 15.31 (m).

LTE Cat-4 Band 14:

Worst case of RF Power is BW=5 MHz, Low Channel, QPSK, RB Size=1, RB Offset=24.

| BANDWIDTH<br>(MHz) | CHANNEL       | FREQUENCY<br>(MHz) | MODULATION | RB<br>SIZE | RB<br>OFFSET | AVERAGE<br>POWER<br>(dBm) |
|--------------------|---------------|--------------------|------------|------------|--------------|---------------------------|
| 5                  | Low<br>23305  | 790.5              | QPSK       | 1          | 0            | 23.8                      |
|                    |               |                    |            | 1          | 12           | 23.84                     |
|                    |               |                    |            | 1          | 24           | 23.9                      |
|                    |               |                    |            | 12         | 0            | 22.72                     |
|                    |               |                    |            | 12         | 6            | 22.65                     |
|                    |               |                    |            | 12         | 11           | 22.43                     |
|                    |               |                    |            | 25         | 0            | 22.67                     |
|                    |               |                    | 16-QAM     | 1          | 0            | 22.95                     |
|                    |               |                    |            | 1          | 12           | 22.87                     |
|                    |               |                    |            | 1          | 24           | 22.93                     |
|                    |               |                    |            | 12         | 0            | 21.71                     |
|                    |               |                    |            | 12         | 6            | 21.68                     |
|                    |               |                    |            | 12         | 11           | 21.53                     |
|                    |               |                    |            | 25         | 0            | 21.72                     |
|                    | High<br>23355 | 795.5              | QPSK       | 1          | 0            | 23.82                     |
|                    |               |                    |            | 1          | 12           | 23.02                     |
|                    |               |                    |            | 1          | 24           | 22.74                     |
|                    |               |                    |            | 12         | 0            | 22.64                     |
|                    |               |                    |            | 12         | 6            | 22.21                     |
|                    |               |                    |            | 12         | 11           | 21.93                     |
|                    |               |                    |            | 25         | 0            | 22.25                     |
|                    |               |                    | 16-QAM     | 1          | 0            | 22.89                     |
|                    |               |                    |            | 1          | 12           | 22.13                     |
|                    |               |                    |            | 1          | 24           | 21.81                     |
|                    |               |                    |            | 12         | 0            | 21.68                     |
|                    |               |                    |            | 12         | 6            | 21.27                     |
|                    |               |                    |            | 12         | 11           | 20.99                     |
|                    |               |                    |            | 25         | 0            | 21.33                     |

BW=5 MHz. QPSK:

| MAX<br>POWER | QPSK<br>COND.<br>POWER<br>AVG (dBm) | ANTENNA<br>GAIN (dBi) | RAD.<br>POWER<br>AVG<br>ERP(dBm) |
|--------------|-------------------------------------|-----------------------|----------------------------------|
| LOW          | 23.9                                | -1.1                  | 20.65                            |
| HIGH         | 23.82                               | -1.1                  | 20.57                            |
| MAX:         | 23.9                                | -1.1                  | 20.65                            |

BW=5 MHz. 16QAM:

| MAX<br>POWER | 16QAM<br>COND.<br>POWER<br>AVG (dBm) | ANTENNA<br>GAIN (dBi) | RAD.<br>POWER<br>AVG<br>ERP(dBm) |
|--------------|--------------------------------------|-----------------------|----------------------------------|
| LOW          | 22.95                                | -1.1                  | 19.7                             |
| HIGH         | 22.89                                | -1.1                  | 19.64                            |
| MAX:         | 22.95                                | -1.1                  | 19.7                             |

LTE Cat-4 Band 26. Sub-band 814-824 MHz:

Worst case of RF Power is BW=5 MHz, Low Channel, 16QAM, RB Size=1, RB Offset=24.

| BANDWIDTH<br>(MHz) | CHANNEL       | FREQUENCY<br>(MHz) | MODULATION | RB<br>SIZE | RB<br>OFFSET | AVERAGE<br>POWER<br>(dBm) |
|--------------------|---------------|--------------------|------------|------------|--------------|---------------------------|
| 5                  | Low<br>26715  | 816.5              | QPSK       | 1          | 0            | 22.73                     |
|                    |               |                    |            | 1          | 12           | 22.57                     |
|                    |               |                    |            | 1          | 24           | 22.9                      |
|                    |               |                    |            | 12         | 0            | 21.57                     |
|                    |               |                    |            | 12         | 6            | 21.49                     |
|                    |               |                    |            | 12         | 11           | 21.52                     |
|                    |               |                    |            | 25         | 0            | 21.62                     |
|                    |               |                    | 16-QAM     | 1          | 0            | 21.79                     |
|                    |               |                    |            | 1          | 12           | 21.53                     |
|                    |               |                    |            | 1          | 24           | 21.93                     |
|                    |               |                    |            | 12         | 0            | 20.56                     |
|                    |               |                    |            | 12         | 6            | 20.6                      |
|                    |               |                    |            | 12         | 11           | 20.64                     |
|                    |               |                    |            | 25         | 0            | 20.65                     |
|                    | High<br>26765 | 821.5              | QPSK       | 1          | 0            | 22.85                     |
|                    |               |                    |            | 1          | 12           | 22.61                     |
|                    |               |                    |            | 1          | 24           | 22.72                     |
|                    |               |                    |            | 12         | 0            | 21.73                     |
|                    |               |                    |            | 12         | 6            | 21.58                     |
|                    |               |                    |            | 12         | 11           | 21.8                      |
|                    |               |                    |            | 25         | 0            | 21.6                      |
|                    |               |                    | 16-QAM     | 1          | 0            | 22.09                     |
|                    |               |                    |            | 1          | 12           | 21.86                     |
|                    |               |                    |            | 1          | 24           | 21.77                     |
|                    |               |                    |            | 12         | 0            | 20.8                      |
|                    |               |                    |            | 12         | 6            | 20.62                     |
|                    |               |                    |            | 12         | 11           | 20.81                     |
|                    |               |                    |            | 25         | 0            | 20.61                     |

BW=5 MHz. QPSK:

| MAX<br>POWER | QPSK<br>COND.<br>POWER<br>AVG (dBm) | ANTENNA<br>GAIN (dBi) | RAD.<br>POWER<br>AVG<br>ERP(dBm) |
|--------------|-------------------------------------|-----------------------|----------------------------------|
| LOW          | 22.9                                | -1.1                  | 19.65                            |
| HIGH         | 22.85                               | -1.1                  | 19.6                             |
| MAX:         | 22.9                                |                       | 19.65                            |

BW=5 MHz. 16QAM:

| MAX<br>POWER | QPSK<br>COND.<br>POWER<br>AVG (dBm) | ANTENNA<br>GAIN (dBi) | RAD.<br>POWER<br>AVG<br>ERP(dBm) |
|--------------|-------------------------------------|-----------------------|----------------------------------|
| LOW          | 21.93                               | -1.1                  | 18.68                            |
| HIGH         | 22.09                               | -1.1                  | 18.84                            |
| MAX:         | 22.09                               |                       | 18.84                            |

LTE Cat-4 Band 26. Cross-rule Channel 824 MHz:

Worst case of RF Power is BW=15 MHz, Middle Channel, QPSK, RB Size=1, RB Offset=37.

| BANDWIDTH<br>(MHz) | CHANNEL         | FREQUENCY<br>(MHz) | MODULATION | RB<br>SIZE | RB<br>OFFSET | AVERAGE<br>POWER<br>(dBm) |
|--------------------|-----------------|--------------------|------------|------------|--------------|---------------------------|
| 15                 | Single<br>26790 | 824                | QPSK       | 1          | 0            | 22.68                     |
|                    |                 |                    |            | 1          | 37           | 22.88                     |
|                    |                 |                    |            | 1          | 74           | 22.63                     |
|                    |                 |                    |            | 36         | 0            | 21.5                      |
|                    |                 |                    |            | 36         | 18           | 21.64                     |
|                    |                 |                    |            | 36         | 37           | 21.45                     |
|                    |                 |                    |            | 75         | 0            | 21.39                     |
|                    |                 |                    | 16-QAM     | 1          | 0            | 21.95                     |
|                    |                 |                    |            | 1          | 37           | 22.22                     |
|                    |                 |                    |            | 1          | 74           | 22                        |
|                    |                 |                    |            | 36         | 0            | 20.52                     |
|                    |                 |                    |            | 36         | 18           | 20.73                     |
|                    |                 |                    |            | 36         | 37           | 20.44                     |
|                    |                 |                    |            | 75         | 0            | 20.46                     |

BW=10 MHz. QPSK:

| MAX<br>POWER | QPSK<br>COND.<br>POWER<br>AVG (dBm) | ANTENNA<br>GAIN (dBi) | RAD.<br>POWER<br>AVG<br>ERP(dBm) |
|--------------|-------------------------------------|-----------------------|----------------------------------|
| SINGLE       | 22.88                               | -1.1                  | 19.63                            |
| MAX:         | 22.88                               |                       | 19.63                            |

BW=10 MHz. 16QAM:

| MAX<br>POWER | 16QAM<br>COND.<br>POWER<br>AVG (dBm) | ANTENNA<br>GAIN (dBi) | RAD.<br>POWER<br>AVG<br>ERP(dBm) |
|--------------|--------------------------------------|-----------------------|----------------------------------|
| SINGLE       | 22.22                                | -1.1                  | 18.97                            |
| MAX:         | 22.22                                |                       | 18.97                            |

Measurement uncertainty (dB) <±1.11

**Verdict**

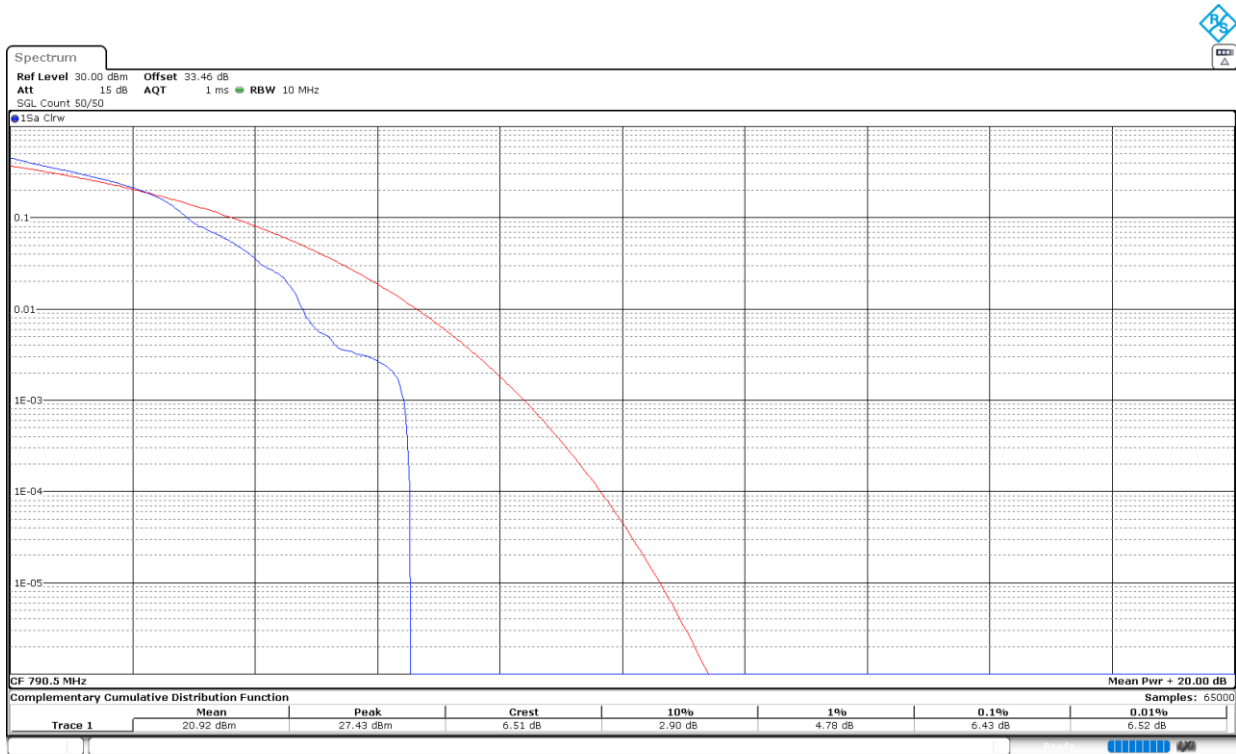
Pass

2. PEAK-TO-AVERAGE POWER RATIO (PAPR):

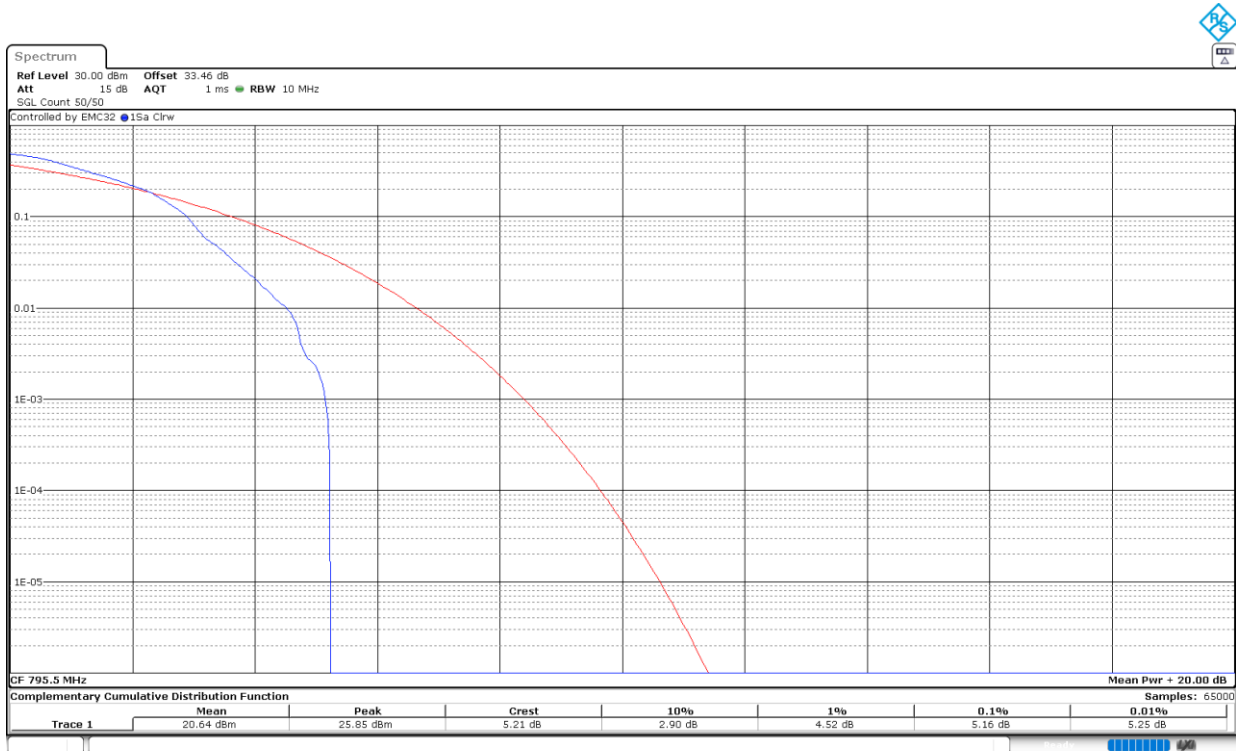
LTE Cat-4 Band 14:

Preliminary measurements determined the worst case of PAPR is BW=5 MHz, Low Channel, 16QAM, RB Size=1, RB Offset=0.

Low Channel:



High Channel:



|           |      |      |
|-----------|------|------|
| 16QAM     | Low  | High |
| PAPR (dB) | 6.43 | 5.16 |

Measurement uncertainty (dB) <±1.11

**Verdict**

Pass

## Frequency Stability

### Limits

#### 1. LTE Cat-4 Band 14:

\* FCC § 2.1055:

- (a) The frequency stability shall be measured with variation of ambient temperature as follows:
  - (1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- (b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.
- (c) The frequency stability shall be measured with variation of primary supply voltage as follows:
  - (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
  - (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
  - (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

\* RSS-140 Clause 4.2:

The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested at the temperature and supply voltage variations specified in RSS-Gen.

#### 2. LTE Cat-4 Band 26:

\* FCC § 2.1055:

- (a) The frequency stability shall be measured with variation of ambient temperature as follows:
  - (1) From -30° to +50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- (b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.
- (c) The frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
- (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
- (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

\* FCC § 90.213:

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

| MINIMUM FREQUENCY STABILITY<br>[Parts per million (ppm)] |                           |                              |
|----------------------------------------------------------|---------------------------|------------------------------|
| Frequency range (MHz)                                    | Mobile stations           |                              |
|                                                          | Over 2 watts output power | 2 watts or less output power |
| 809-824                                                  | 2.5                       | 2.5                          |

(b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

### Method

The frequency tolerance measurements over temperature variations were made over the temperature range of -30°C to +50°C. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10°C steps from -30°C up to +50°C.

The supply voltage was varied between 85% and 115% of nominal voltage.

The EUT was set in "Radio Resource Control (RRC) mode" in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.

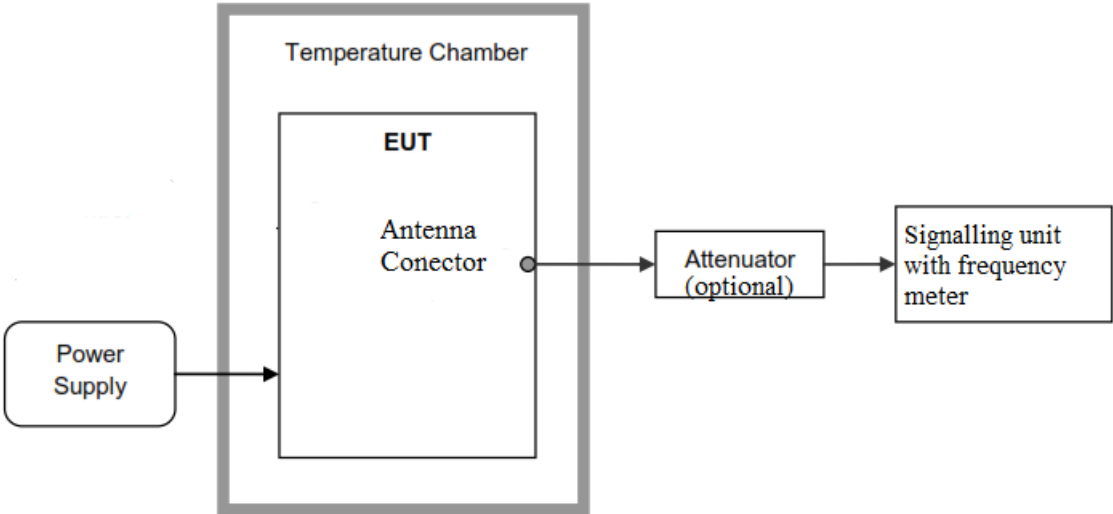
The worst case LTE mode for conducted power was used for the test.

In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the Low and High channel of operation are identified as fL and fH respectively. The worst case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

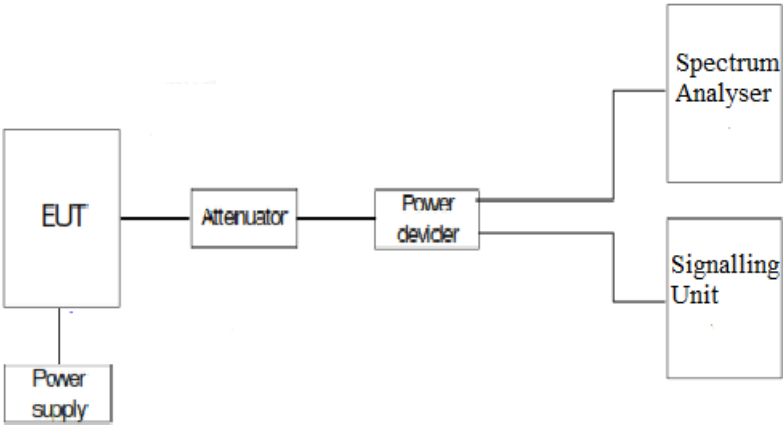
The reference point measurements were made at the RF output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

Test Setup

1. Frequency Tolerance:



2. Reference Frequency Points fL and fH:



## Results

### LTE Cat-4 Band 14:

The worst case modulation in terms of Frequency Stability is BW=10 MHz, QPSK, RB Size=1, RB Offset=0.

#### 1. Frequency Tolerance:

- Frequency Stability over Temperature Variations:

| Temperature (°C) | Frequency Error (Hz) | Frequency Error (ppm) |
|------------------|----------------------|-----------------------|
| +65              | -5,47                | -0,006897856          |
| +60              | 7,3                  | 0,009205549           |
| +50              | 0.69                 | 0.000870113           |
| +40              | -0.44                | -0.000554855          |
| +30              | -0.64                | -0.000807062          |
| +20              | -0.93                | -0.001172762          |
| +10              | 0.31                 | 0.000390921           |
| 0                | 1.16                 | 0.001462799           |
| -10              | 1.79                 | 0.002257251           |
| -20              | 2.06                 | 0.00259773            |
| -30              | 4.03                 | 0.005081967           |
| -40              | -2,1                 | -0,002648172          |

- Frequency Stability over Voltage Variations.

| Battery Supply voltage | Voltage (V) | Frequency Error (Hz) | Frequency Error (ppm) |
|------------------------|-------------|----------------------|-----------------------|
| Vmax                   | 4.6         | 2,17                 | 0,002736444           |
| Vmin                   | 3.2         | 5,06                 | 0,006380832           |

#### 2. Reference Frequency Points f<sub>L</sub> and f<sub>H</sub>:

The worst case frequency offsets added or subtracted per band and bandwidth:

|                      |          |
|----------------------|----------|
| f <sub>L</sub> (MHz) | 788.0591 |
| f <sub>H</sub> (MHz) | 797.9115 |

The reference frequency points f<sub>L</sub> and f<sub>H</sub> stay within the authorized blocks for all the band above.

Measurement uncertainty (Hz) <± 249.55

## Results

PASS

## **LTE Cat-4 Band 26. Sub-band 814-824 MHz:**

The worst case modulation in terms of Frequency Stability is BW=10 MHz, QPSK.

### **1. Frequency Tolerance:**

- Frequency Stability over Temperature Variations:**

| Temperature (°C) | Frequency Error (Hz) | Frequency Error (ppm) |
|------------------|----------------------|-----------------------|
| 65               | -6,84                | -0,008351648          |
| 60               | 2,35                 | 0,002869353           |
| +50              | -2.43                | -0.002967033          |
| +40              | -2.97                | -0.003626374          |
| +30              | -6.85                | -0.008363858          |
| +20              | 0.59                 | 0.000720391           |
| +10              | -2.41                | -0.002942613          |
| 0                | -1.18                | -0.001440781          |
| -10              | 1.62                 | 0.001978022           |
| -20              | 1.02                 | 0.001245421           |
| -30              | 1.09                 | 0.001330891           |
| -40              | -2,56                | -0,003125763          |

- Frequency Stability over Voltage Variations.**

| Battery Supply voltage | Voltage (V) | Frequency Error (Hz) | Frequency Error (ppm) |
|------------------------|-------------|----------------------|-----------------------|
| Vmax                   | 4,6         | 0,39                 | 0,00047619            |
| Vmin                   | 3,2         | -3,45                | -0,004212454          |

Measurement uncertainty (Hz)  $\leq \pm 249.55$

## **Results**

PASS

## Modulation Characteristics

### Limits

#### 1. LTE Cat-4 Band 14:

- \* FCC § 2.1047: Measurements required: Modulation characteristics.
- \* RSS-140 Clause 4.1: Equipment shall employ digital modulation techniques.

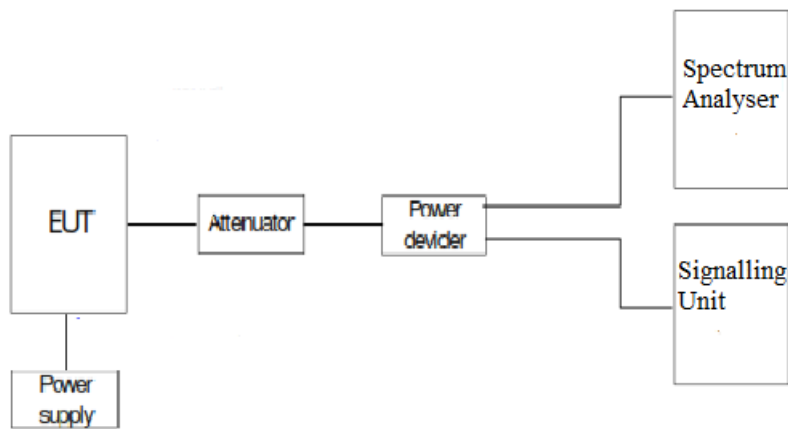
#### 2. LTE Cat-4 Band 26:

- \* FCC § 2.1047: Measurements required: Modulation characteristics.

### Method

For LTE the EUT operates with QPSK and 16QAM modes in which the information is digitised and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

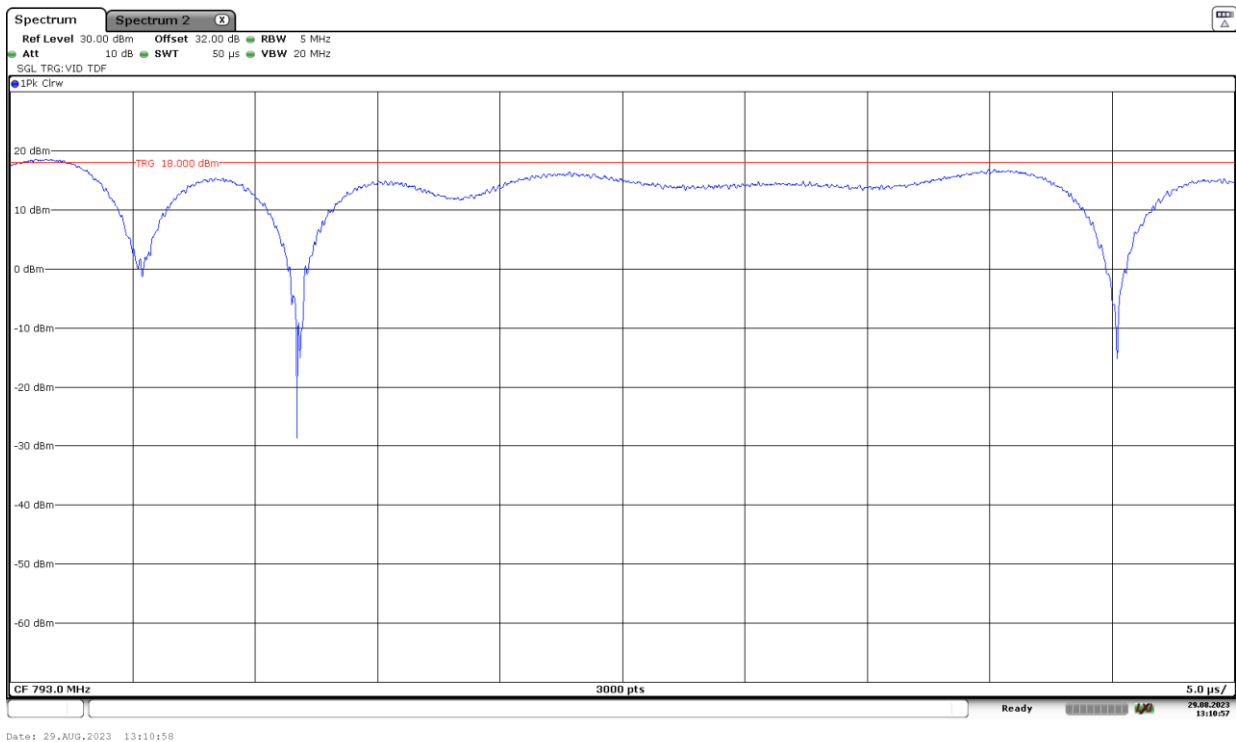
### Test Setup



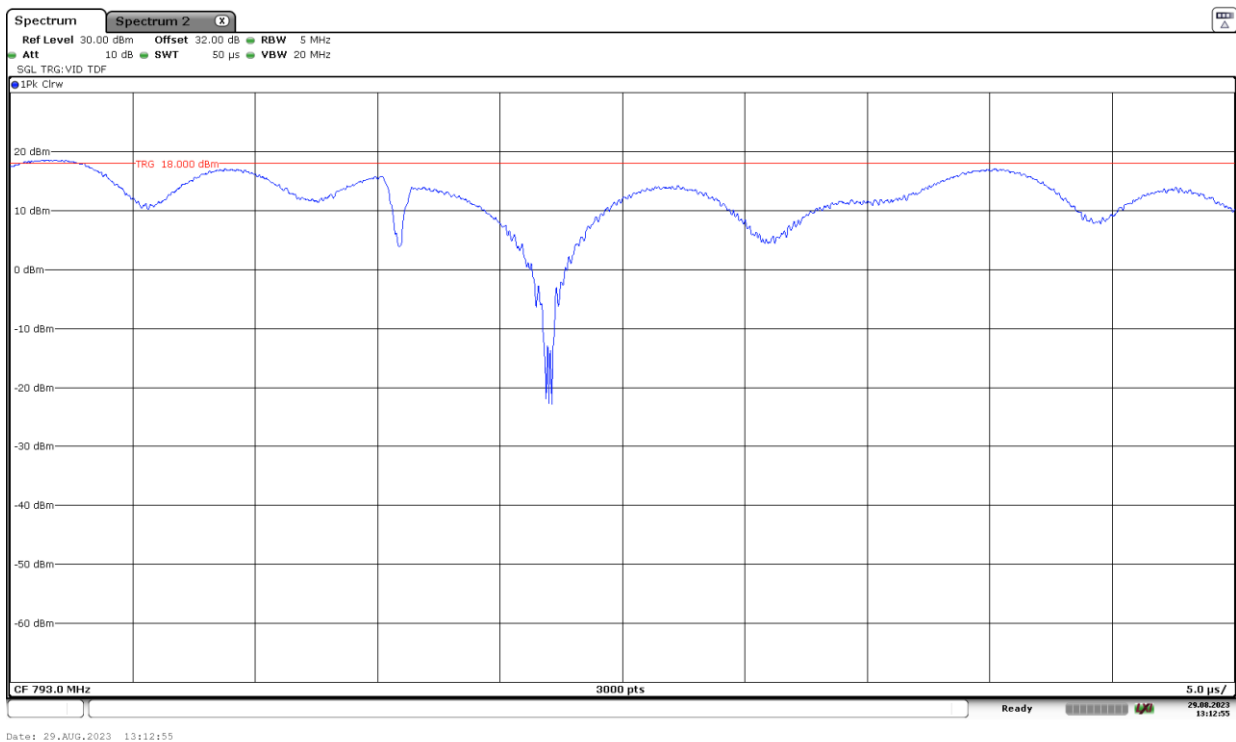
Results

The following plots show the modulation schemes in the EUT.

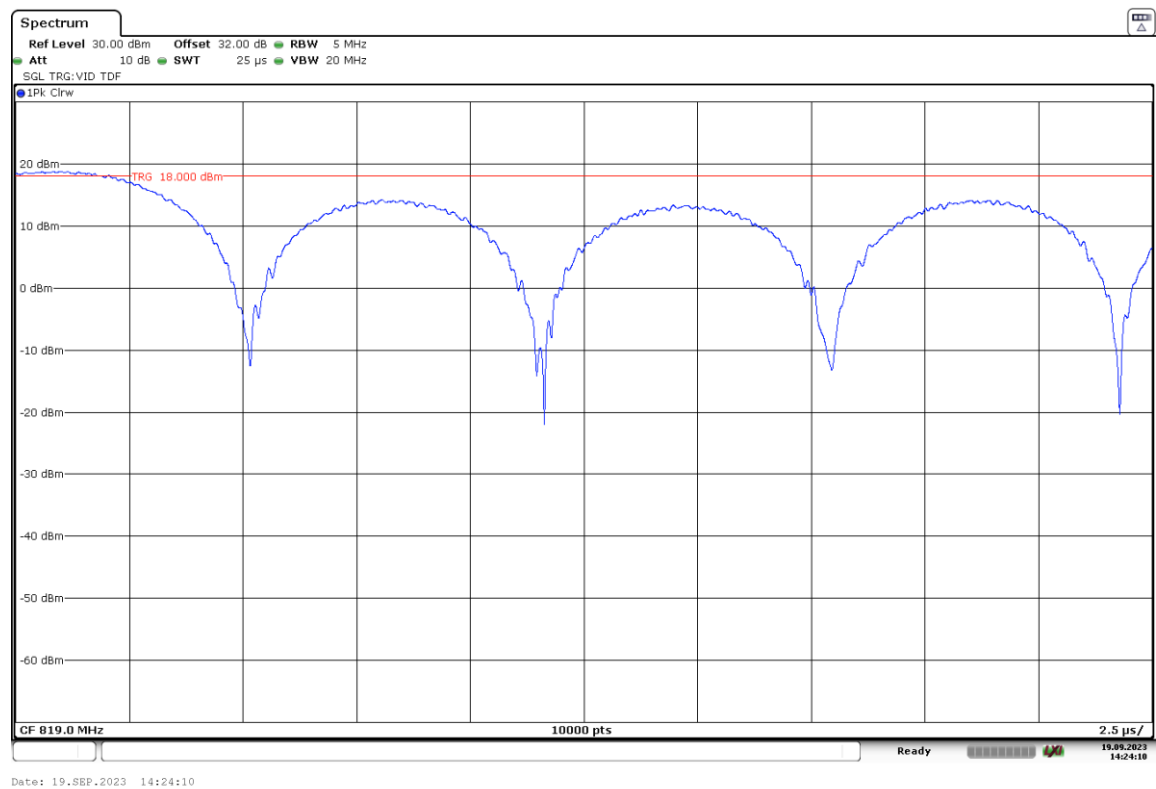
**LTE Cat-4 Band 14:** BW = 10 MHz. QPSK.



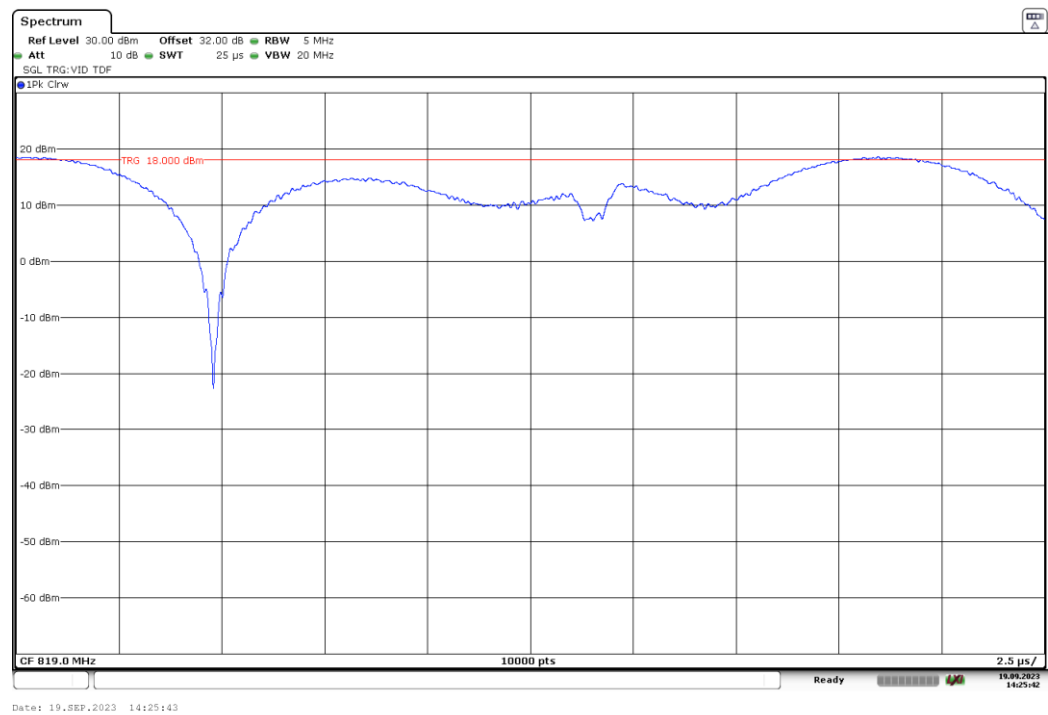
**LTE Cat-4 Band 14:** BW = 10 MHz. 16QAM.



**LTE Cat-4 Band 26. Sub-band 814-824 MHz:** BW = 10 MHz. QPSK.



**LTE Cat-4 Band 26. Sub-band 814-824 MHz:** BW = 10 MHz. 16QAM.



## Occupied Bandwidth

### Limits

#### 1. LTE Cat-4 Band 14:

\* FCC § 2.1049. Measurements required: Occupied bandwidth.

\* RSS-Gen Clause 6.7: The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

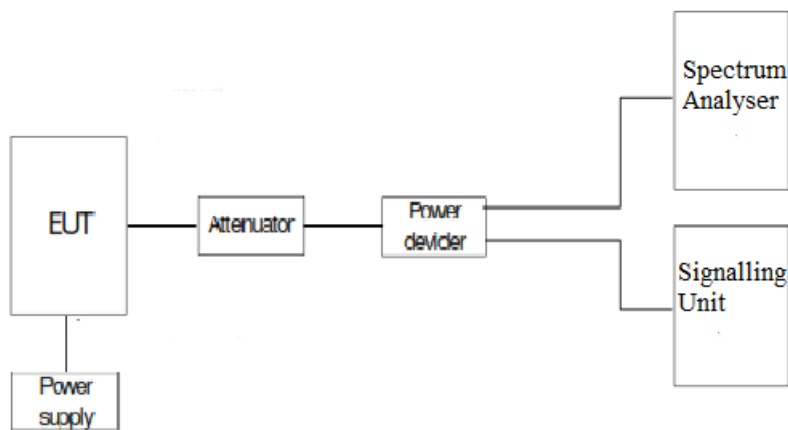
#### 2. LTE Cat-4 Band 26:

\* FCC § 2.1049. Measurements required: Occupied bandwidth.

### Method

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator, power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

### Test Setup



## Results

**LTE Bands:** The worst case of Occupied Bandwidth corresponds to Resource Blocks (RB) Max., regardless the nominal bandwidth selected.

### LTE Cat-4 Band 14:

LTE Cat-4 Band 14. BW = 5 MHz. QPSK. RB Size=Max.

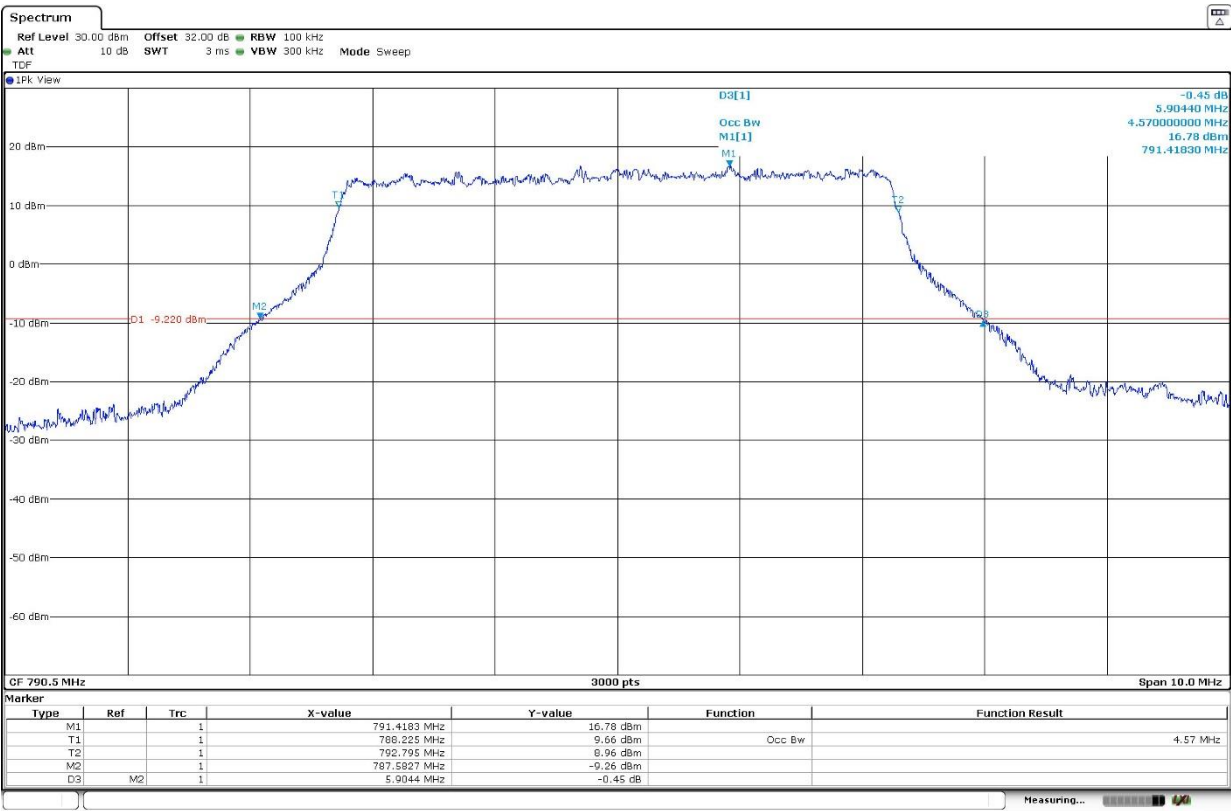
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 4.570       | 4.603        |
| -26 dBc Bandwidth (MHz)       | 5.904       | 5.960        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 14. BW = 5 MHz. 16QAM. RB Size = Max.

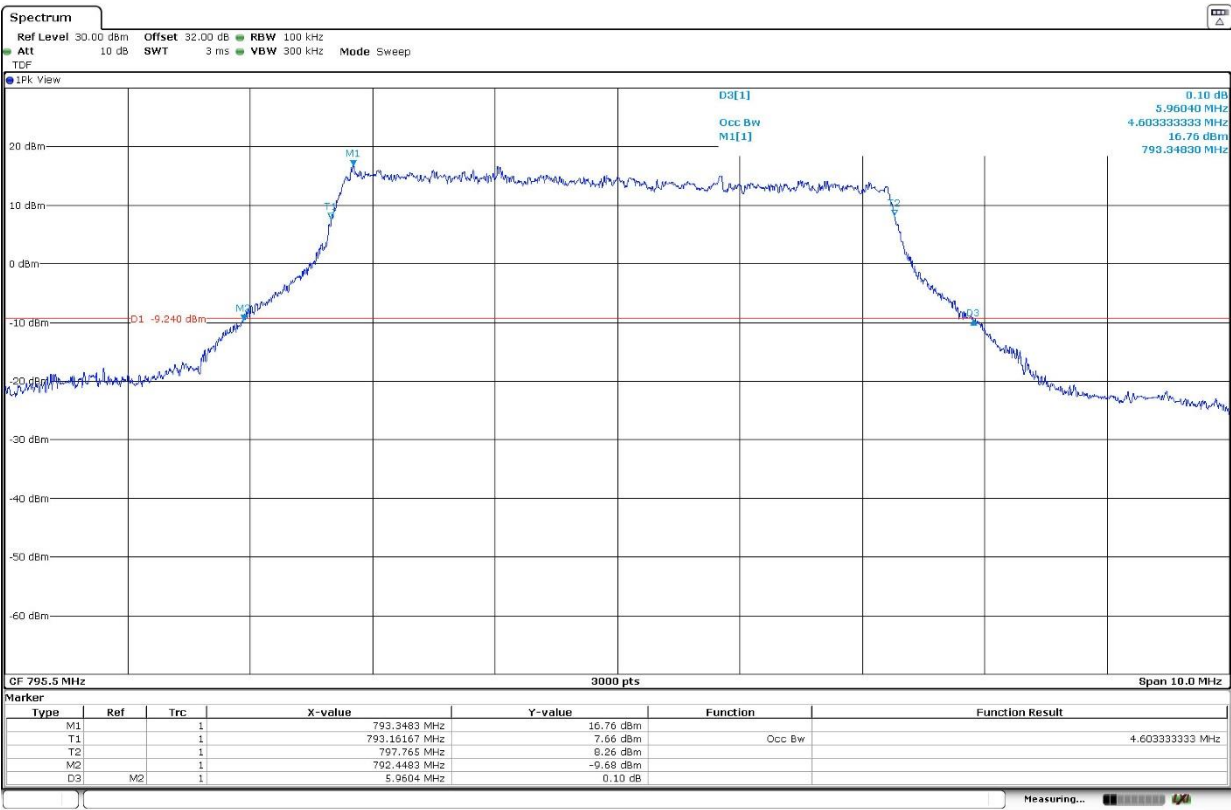
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 4.577       | 4.623        |
| -26 dBc Bandwidth (MHz)       | 5.971       | 6.070        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 14.      BW = 5 MHz. QPSK.

Low Channel:

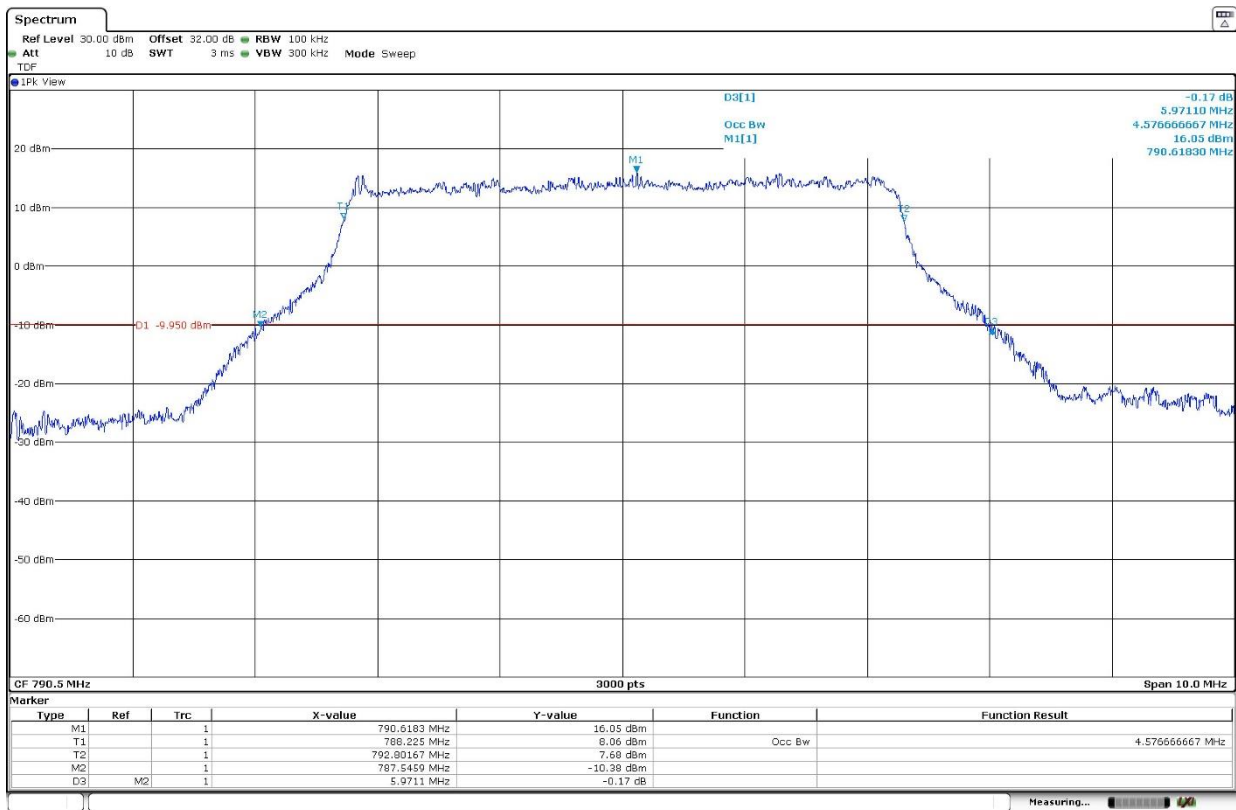


High Channel:

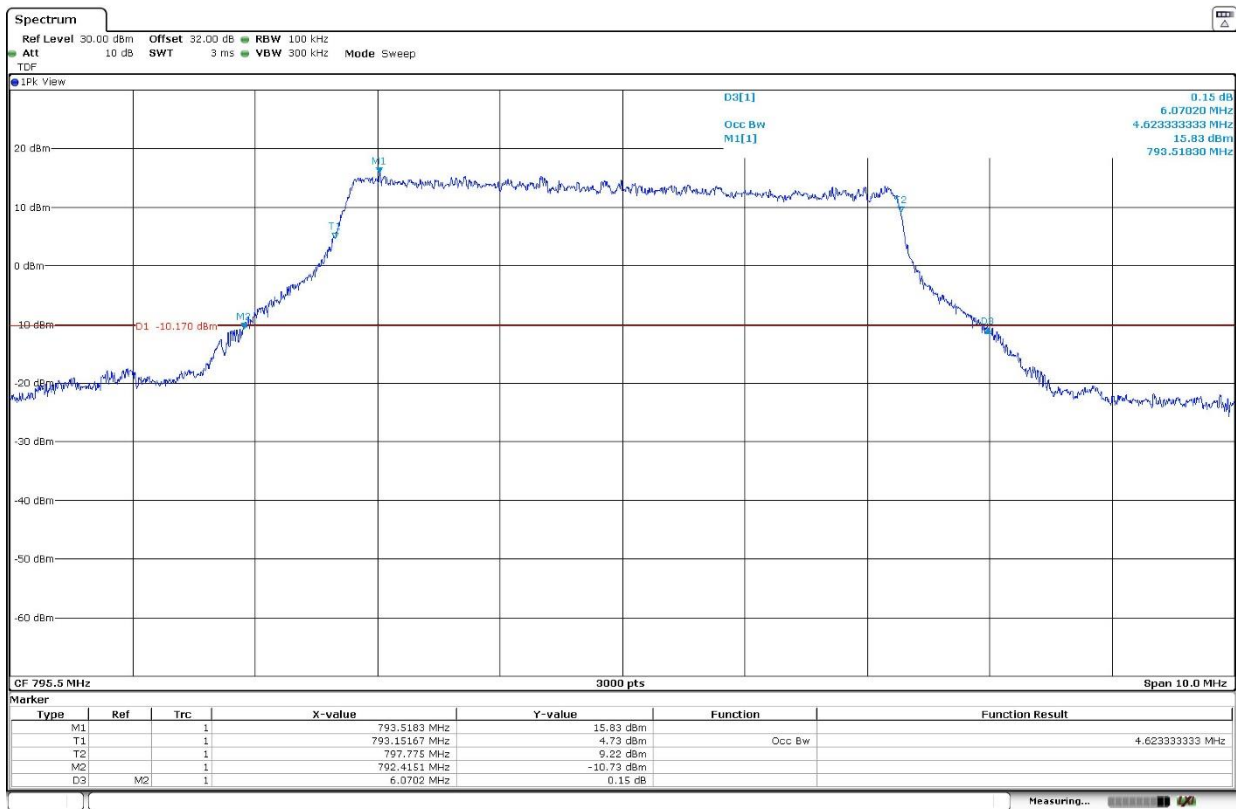


LTE Cat-4 Band 14. BW = 5 MHz. 16QAM.

Low Channel:



High Channel:



LTE Cat-4 Band 14. BW = 10 MHz. QPSK. RB Size=Max.

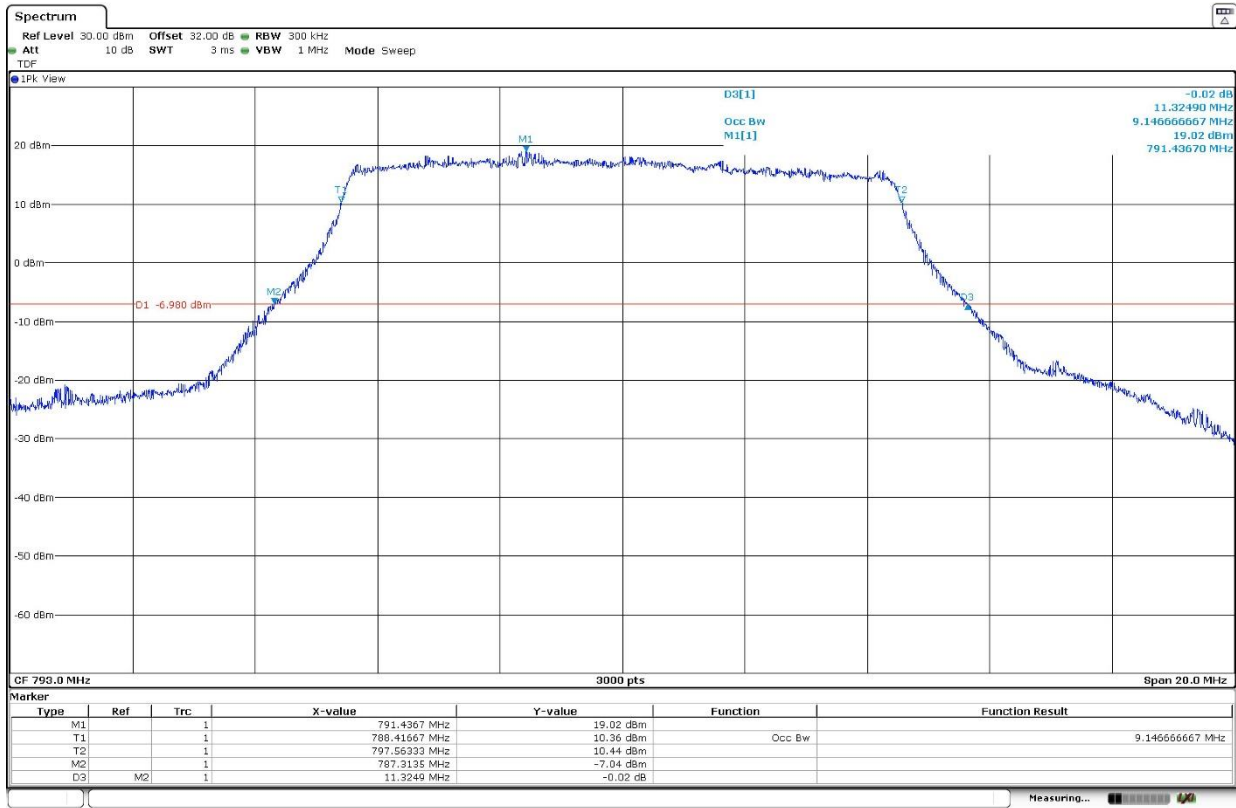
|                               | Middle Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 9.147          |
| -26 dBc Bandwidth (MHz)       | 11.325         |
| Measurement uncertainty (kHz) | <±4.67         |

LTE Cat-4 Band 14. BW = 10 MHz. 16QAM. RB Size = Max.

|                               | Middle Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 9.120          |
| -26 dBc Bandwidth (MHz)       | 11.439         |
| Measurement uncertainty (kHz) | <±4.67         |

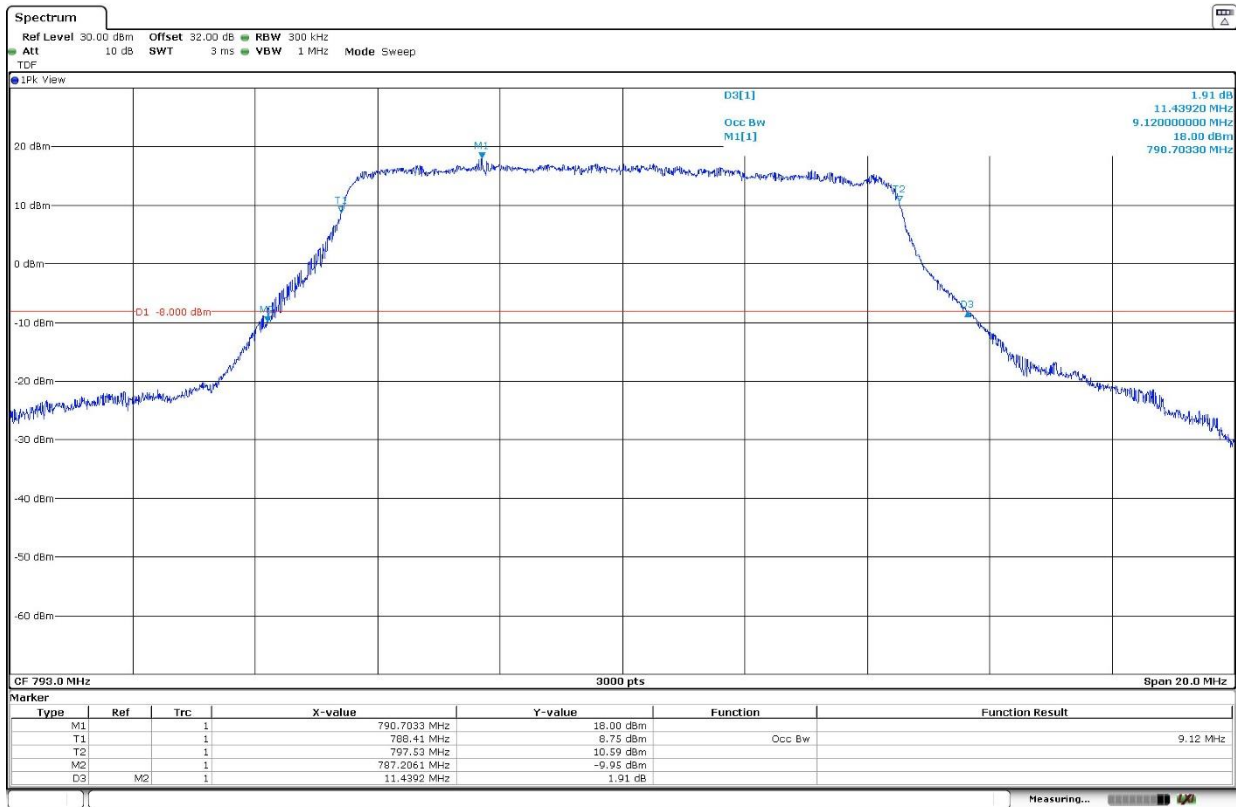
LTE Cat-4 Band 14. BW = 10 MHz. QPSK.

Middle Channel:



LTE Cat-4 Band 14. BW = 10 MHz. 16QAM.

Middle Channel:



### **LTE Cat-4 Band 26. Sub-band 814-824 MHz:**

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 1.4 MHz. QPSK. RB Size = All.

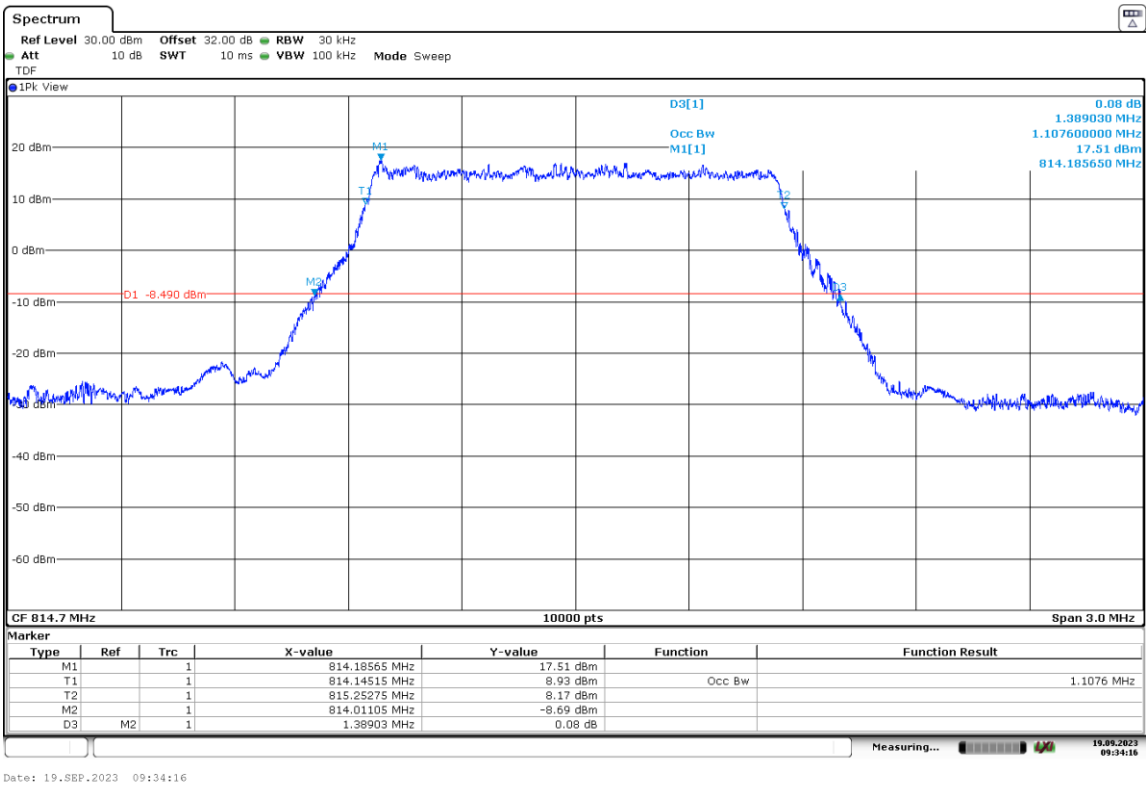
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 1.108       | 1.104        |
| -26 dBc Bandwidth (MHz)       | 1.389       | 1.377        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 1.4 MHz. 16QAM. RB Size = All.

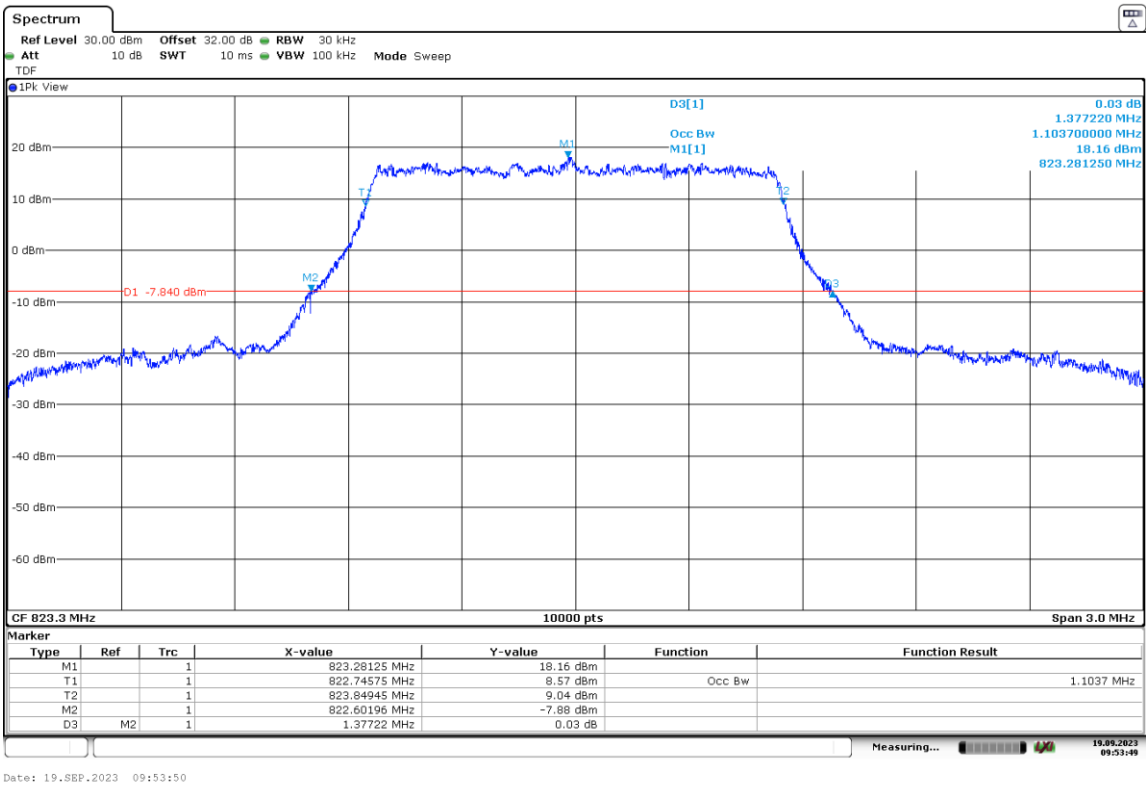
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 1.106       | 1.115        |
| -26 dBc Bandwidth (MHz)       | 1.379       | 1.385        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 1.4 MHz. QPSK.

Low Channel:

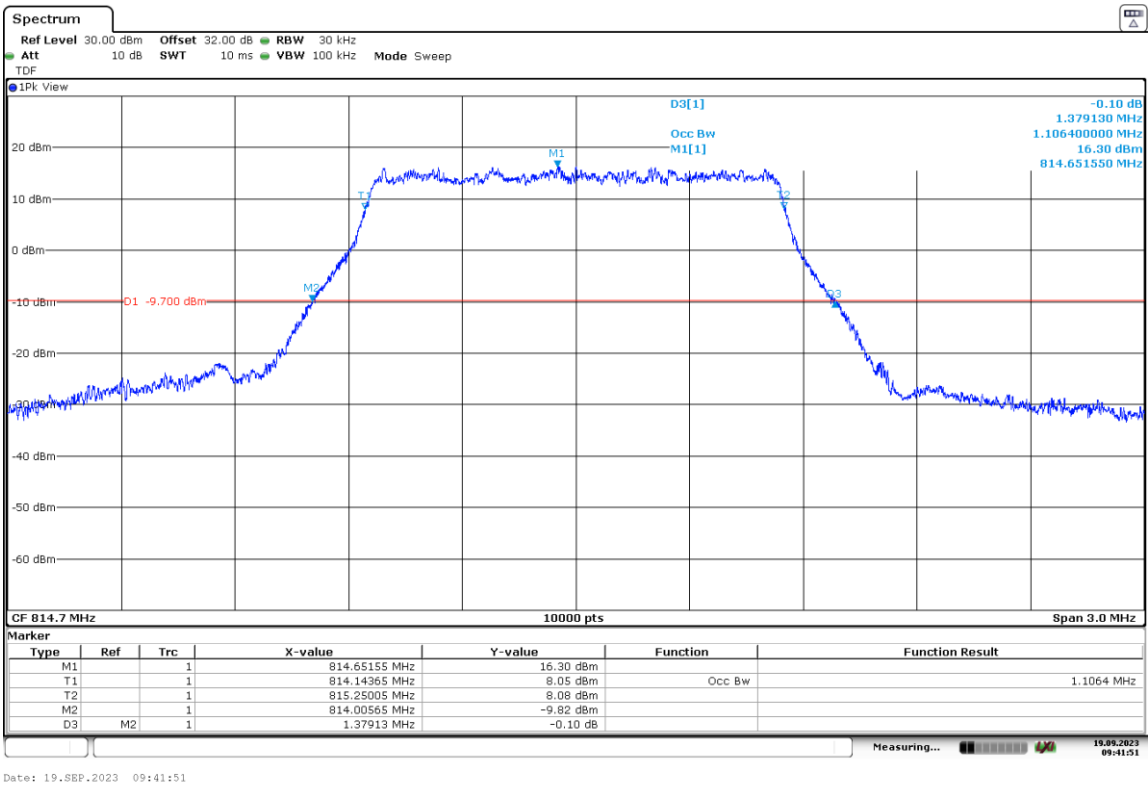


High Channel:

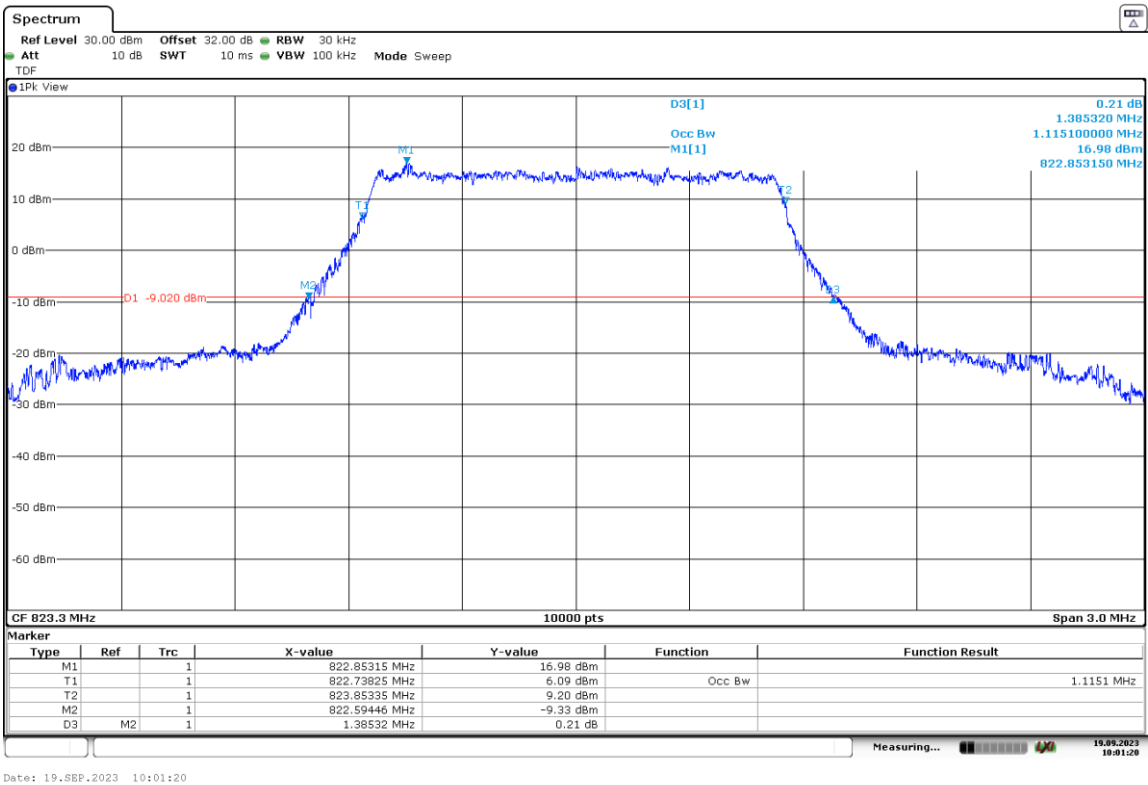


LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 1.4 MHz. 16QAM.

Low Channel:



High Channel:



LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 3 MHz. QPSK. RB Size = All.

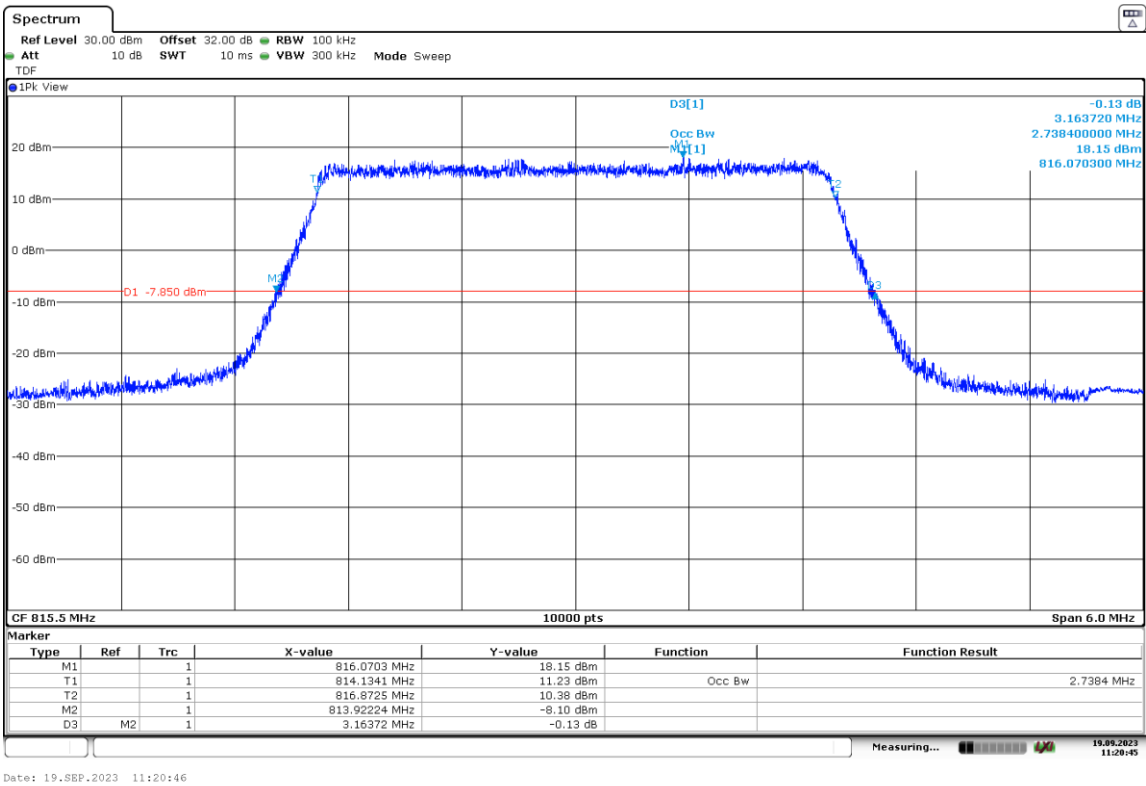
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 2.738       | 2.735        |
| -26 dBc Bandwidth (MHz)       | 3.164       | 3.174        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 3 MHz. 16QAM. RB Size = All.

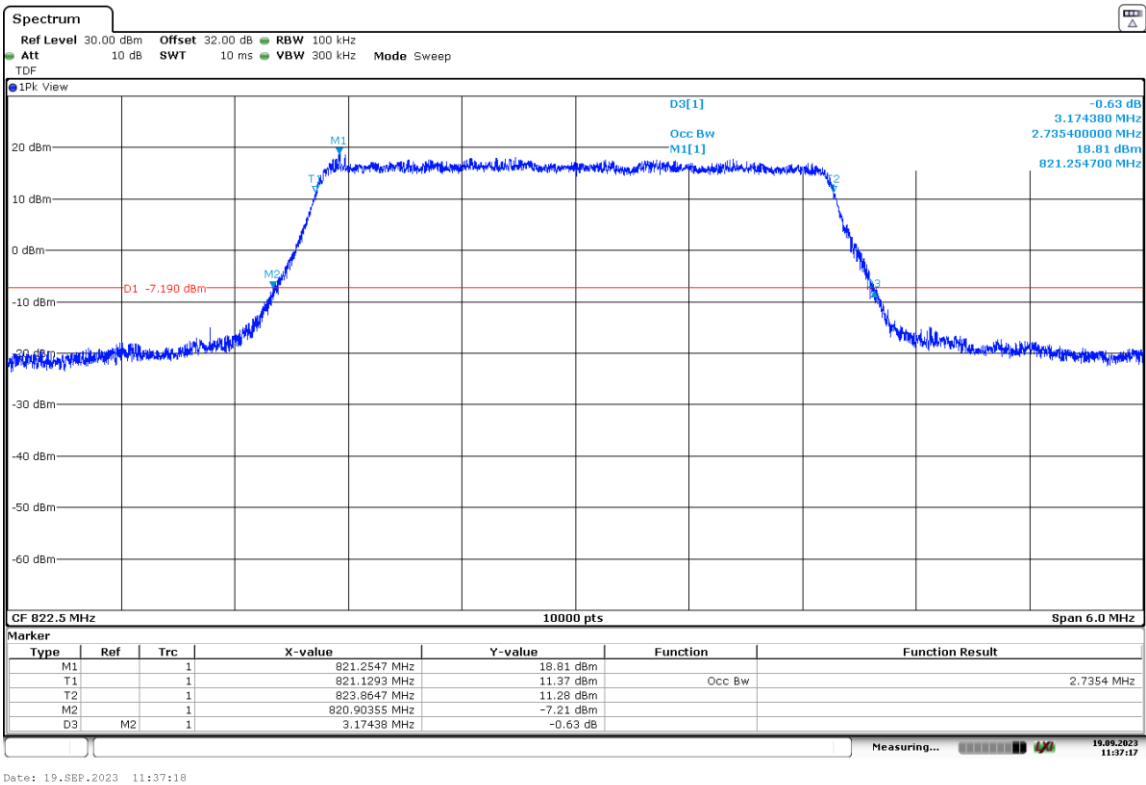
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 2.740       | 2.749        |
| -26 dBc Bandwidth (MHz)       | 3.160       | 3.238        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 3 MHz. QPSK.

Low Channel:

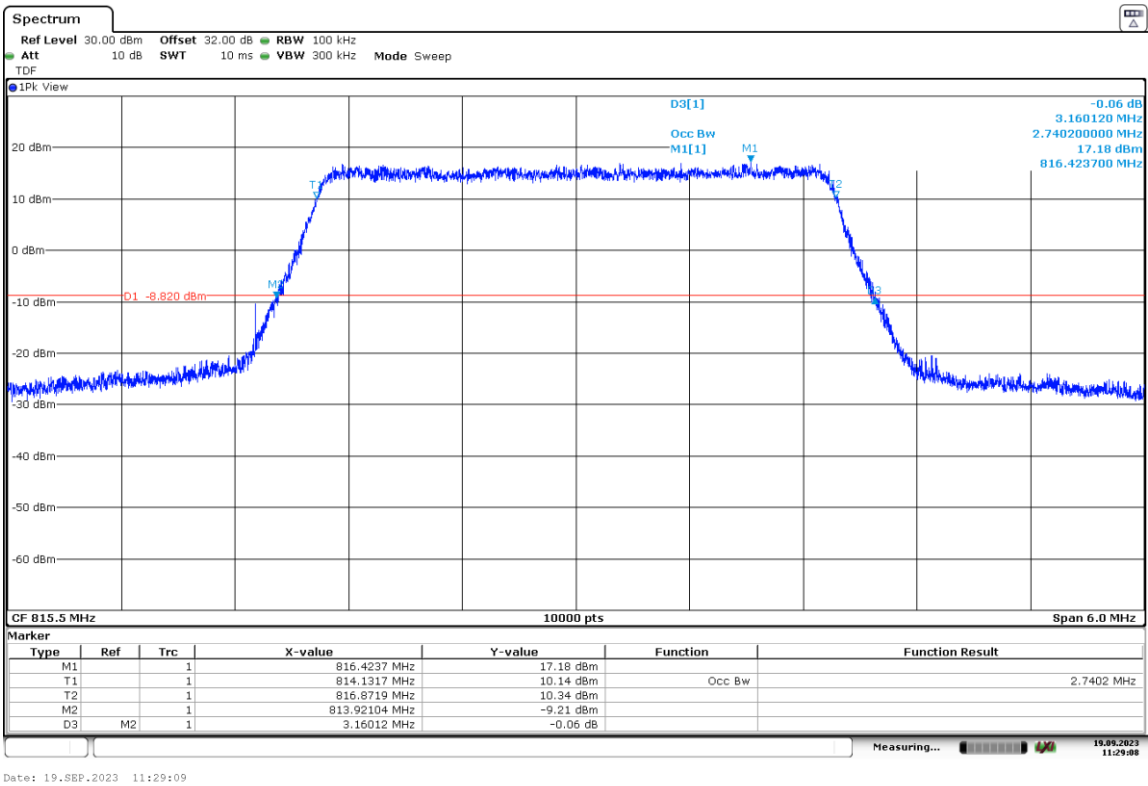


High Channel:

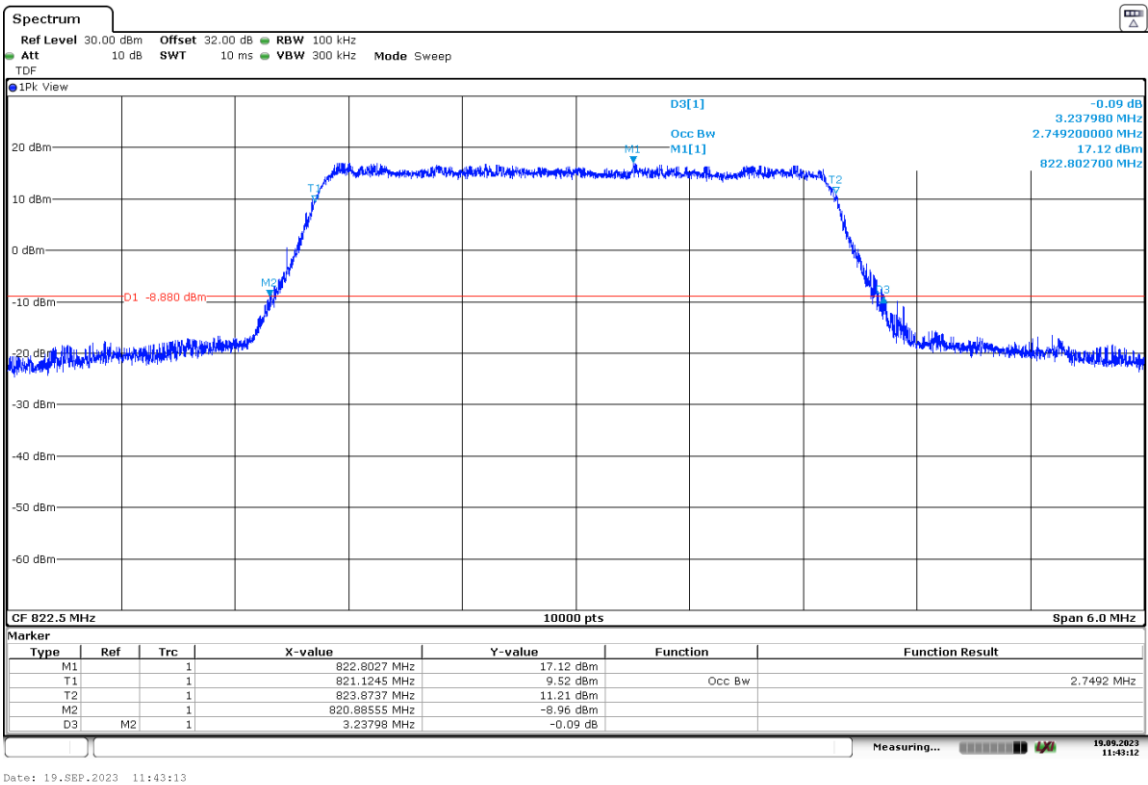


LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 3 MHz. 16QAM.

Low Channel:



High Channel:



LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 5 MHz. QPSK. RB Size = All.

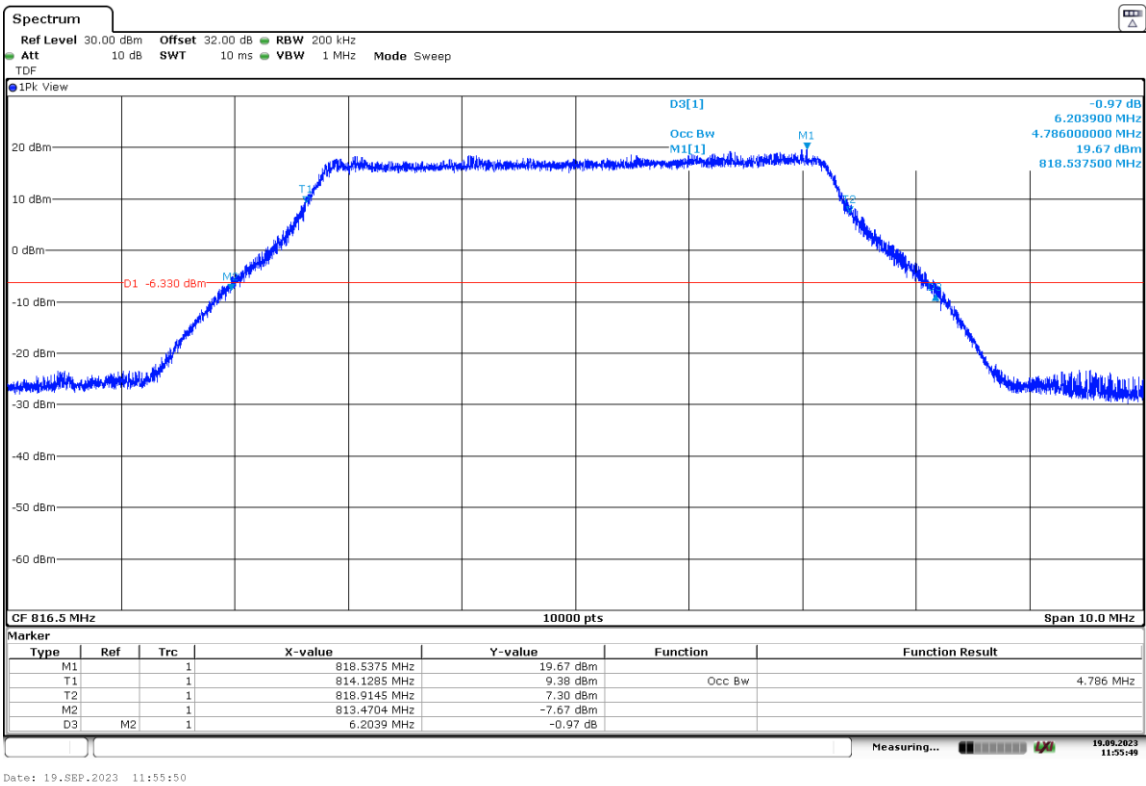
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 4.786       | 4.742        |
| -26 dBc Bandwidth (MHz)       | 6.204       | 6.317        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 5 MHz. 16QAM. RB Size = All.

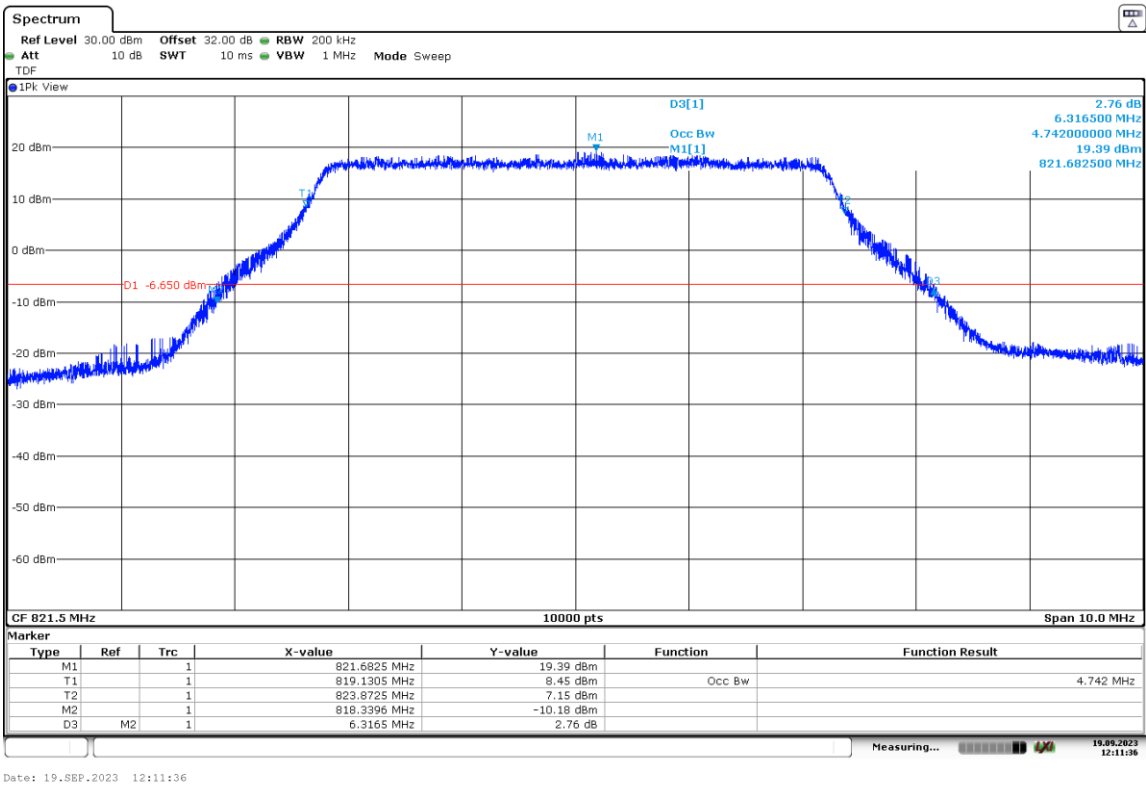
|                               | Low Channel | High Channel |
|-------------------------------|-------------|--------------|
| 99% Occupied Bandwidth (MHz)  | 4.826       | 4.726        |
| -26 dBc Bandwidth (MHz)       | 6.326       | 6.168        |
| Measurement uncertainty (kHz) | <±4.67      |              |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 5 MHz. QPSK.

Low Channel:

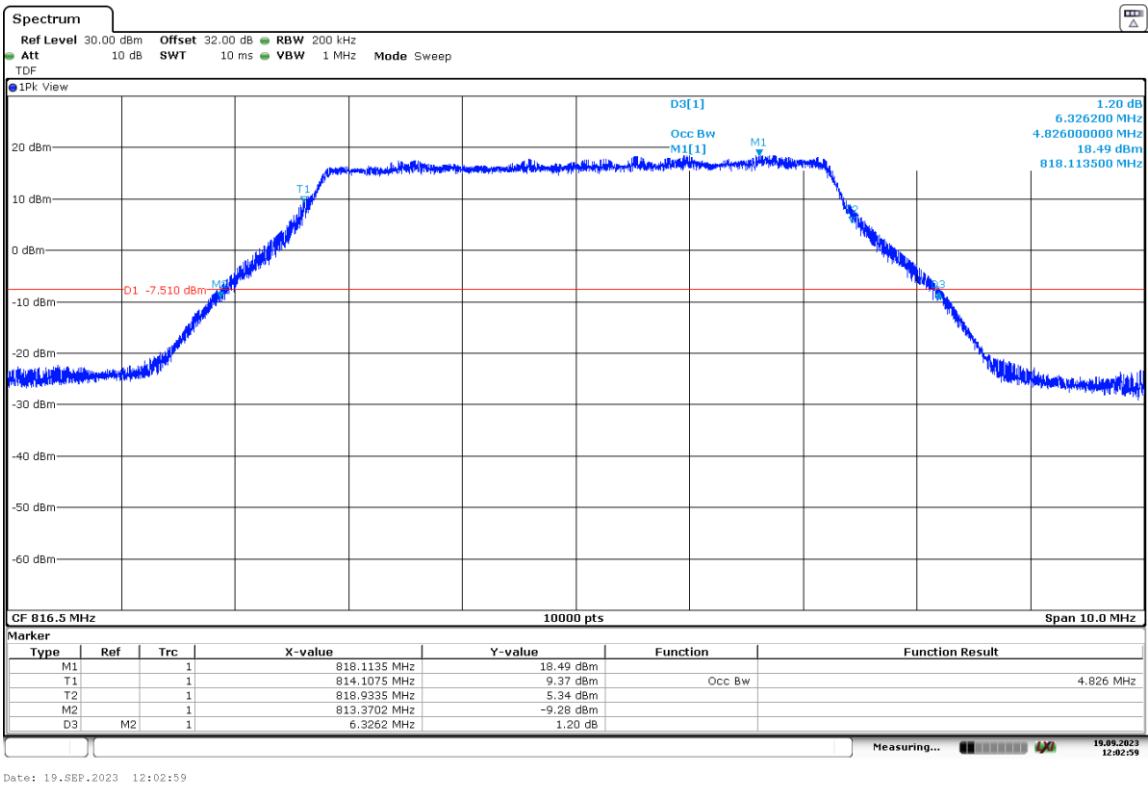


High Channel:

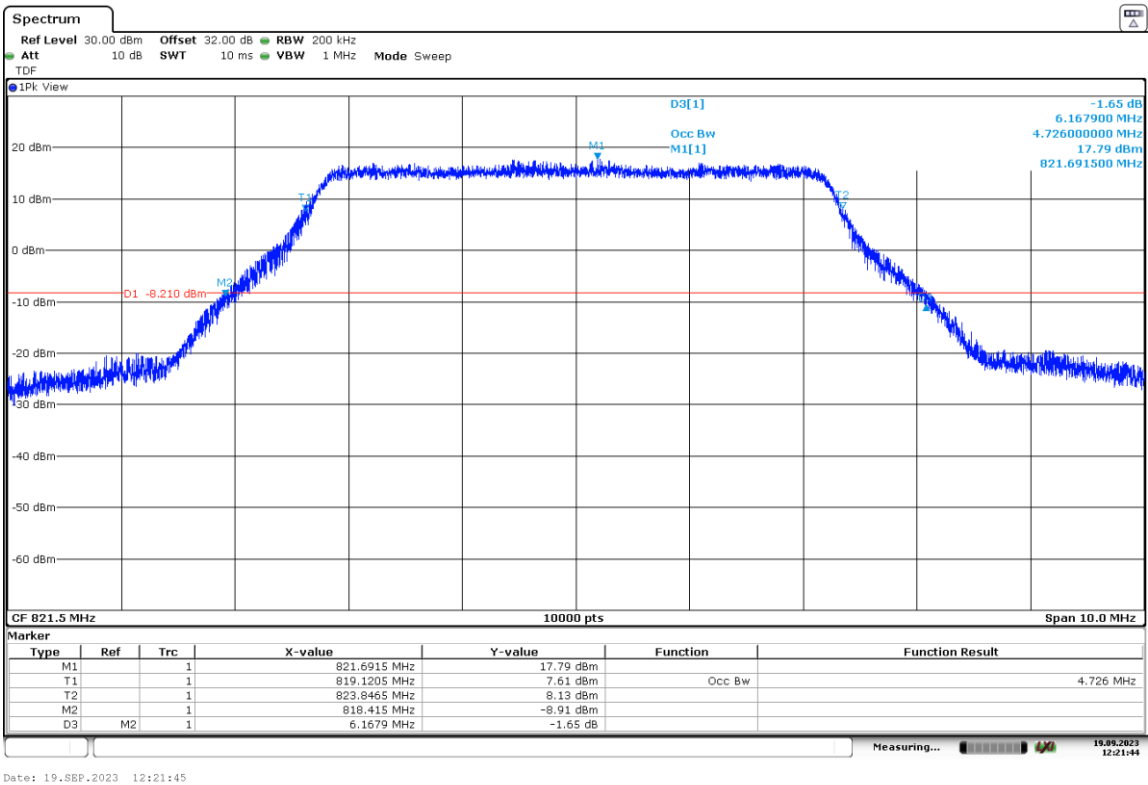


LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 5 MHz. 16QAM.

Low Channel:



High Channel:



LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 10 MHz. QPSK. RB Size = All.

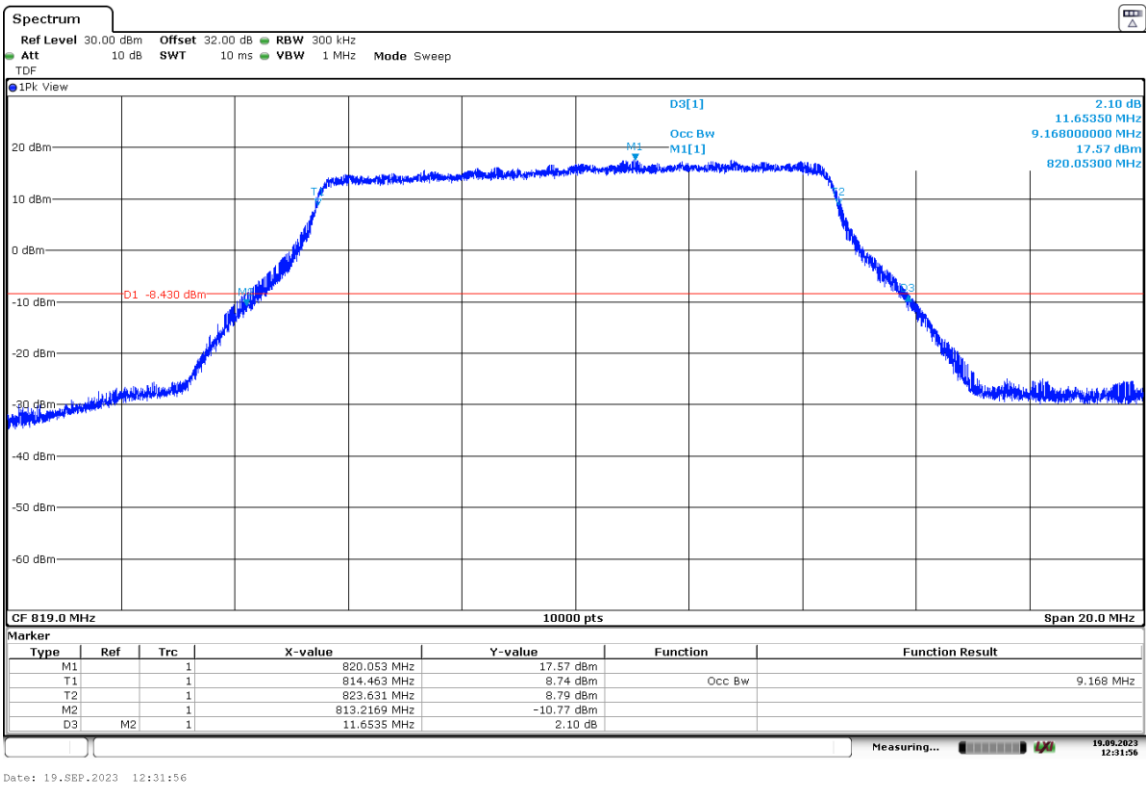
|                               | Middle Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 9.168          |
| -26 dBc Bandwidth (MHz)       | 11.654         |
| Measurement uncertainty (kHz) | <±4.67         |

LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 10 MHz. 16QAM. RB Size = All.

|                               | Middle Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 9.108          |
| -26 dBc Bandwidth (MHz)       | 11.480         |
| Measurement uncertainty (kHz) | <±4.67         |

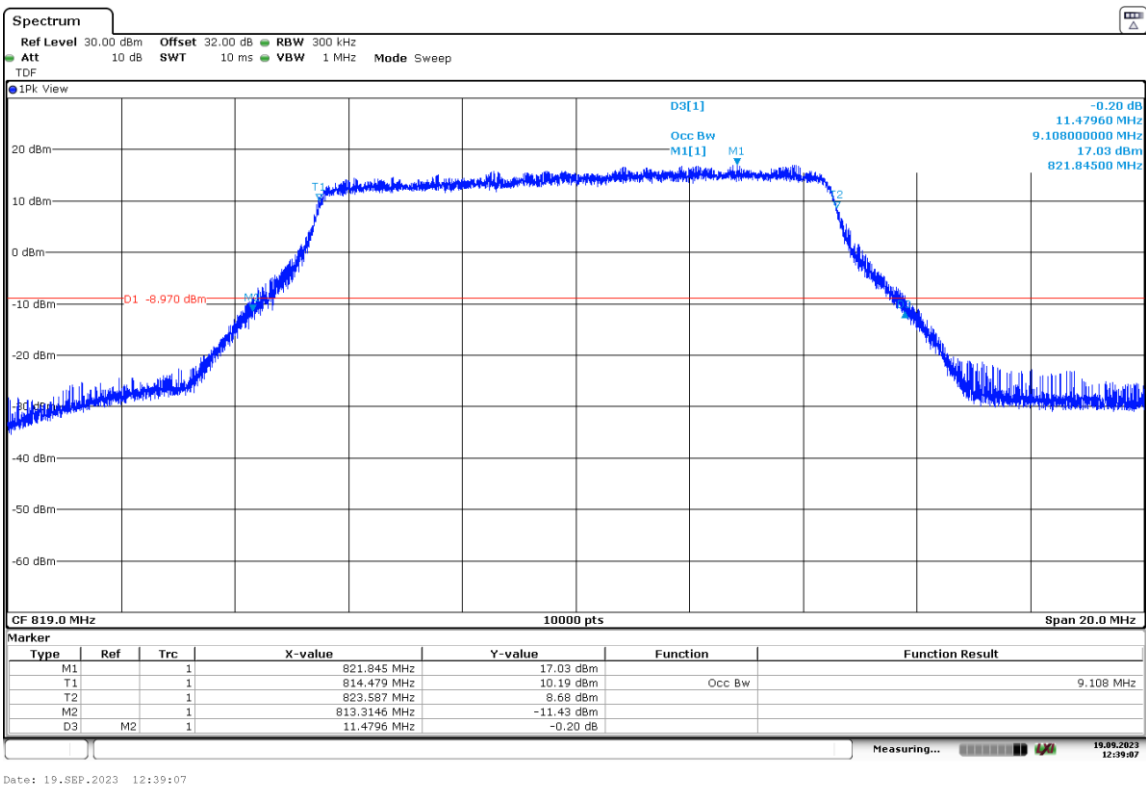
LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 10 MHz. QPSK.

Middle Channel:



LTE Cat-4 Band 26. Sub-band 814-824 MHz. BW = 10 MHz. 16QAM.

Middle Channel:



#### **LTE Cat-4 Band 26. Cross-rule Channel 824 MHz:**

LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 1.4 MHz. QPSK. RB Size = All.

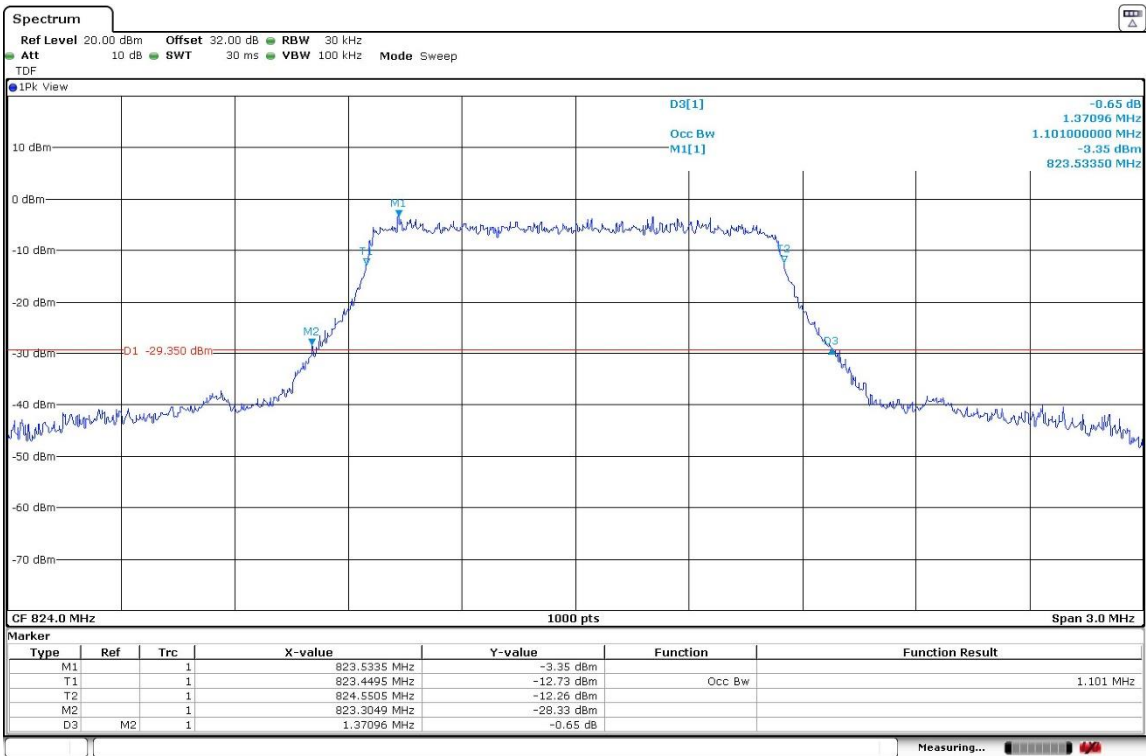
|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 1.101000       |
| -26 dBc Bandwidth (MHz)       | 1.370960       |
| Measurement uncertainty (kHz) | <±4.67         |

LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 1.4 MHz. 16QAM. RB Size = All.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 1.110000       |
| -26 dBc Bandwidth (MHz)       | 1.400960       |
| Measurement uncertainty (kHz) | <±4.67         |

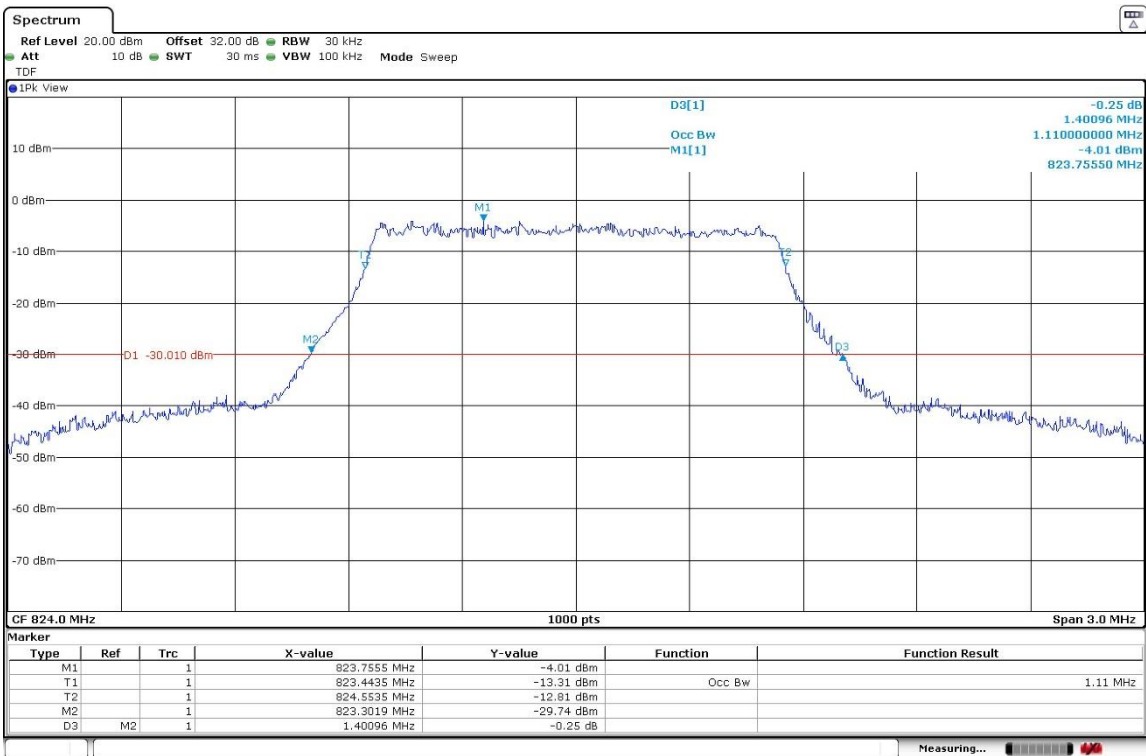
LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 1.4 MHz. QPSK.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 1.4 MHz. 16QAM.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz.      BW = 3 MHz. QPSK. RB Size = All.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 2.742000       |
| -26 dBc Bandwidth (MHz)       | 3.172470       |
| Measurement uncertainty (kHz) | <±4.67         |

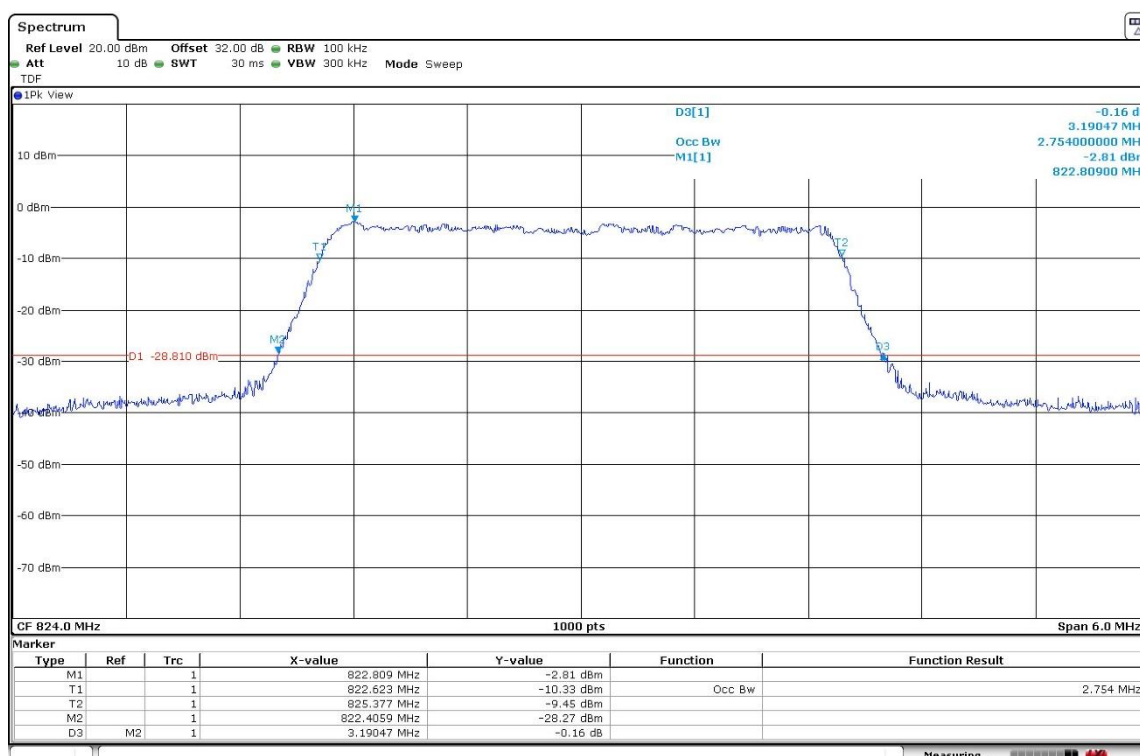
LTE Cat-4 Band 26. Cross-rule Channel 824 MHz.      BW = 3 MHz. 16QAM. RB Size = All.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 2.754000       |
| -26 dBc Bandwidth (MHz)       | 3.190470       |
| Measurement uncertainty (kHz) | <±4.67         |

Cross-rule Channel 824 MHz:



Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 5 MHz. QPSK. RB Size = All.

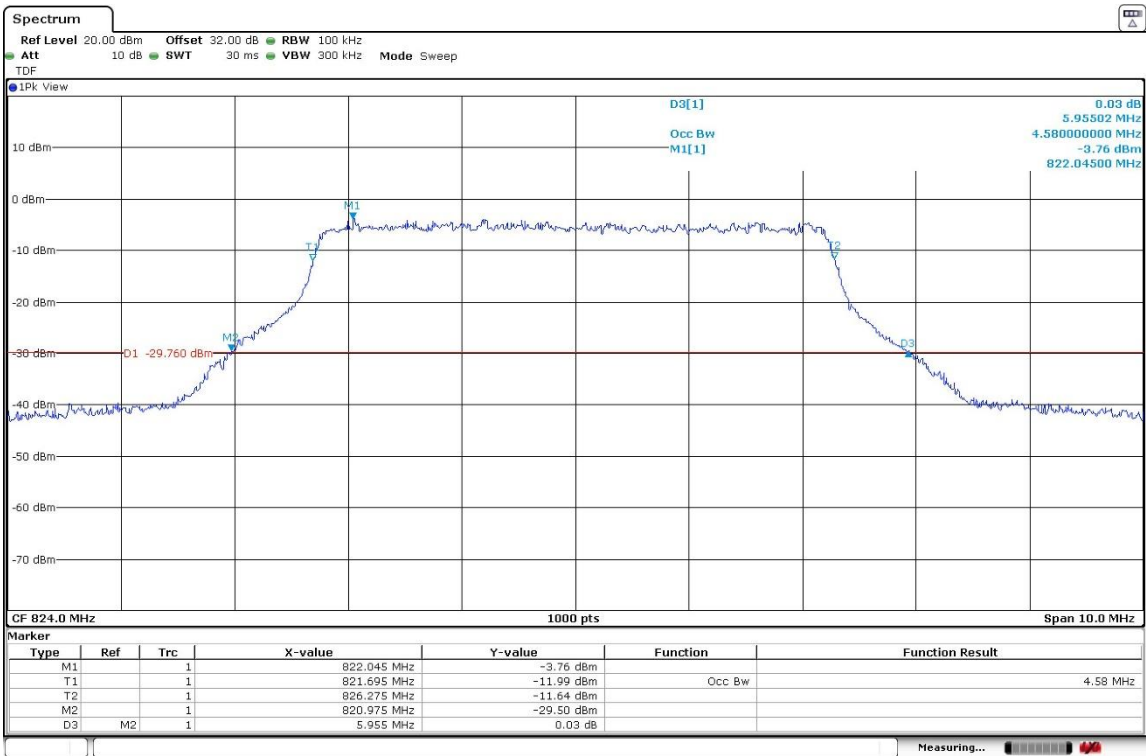
|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 4.580000       |
| -26 dBc Bandwidth (MHz)       | 5.955020       |
| Measurement uncertainty (kHz) | <±4.67         |

LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 5 MHz. 16QAM. RB Size = All.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 4.590000       |
| -26 dBc Bandwidth (MHz)       | 5.855020       |
| Measurement uncertainty (kHz) | <±4.67         |

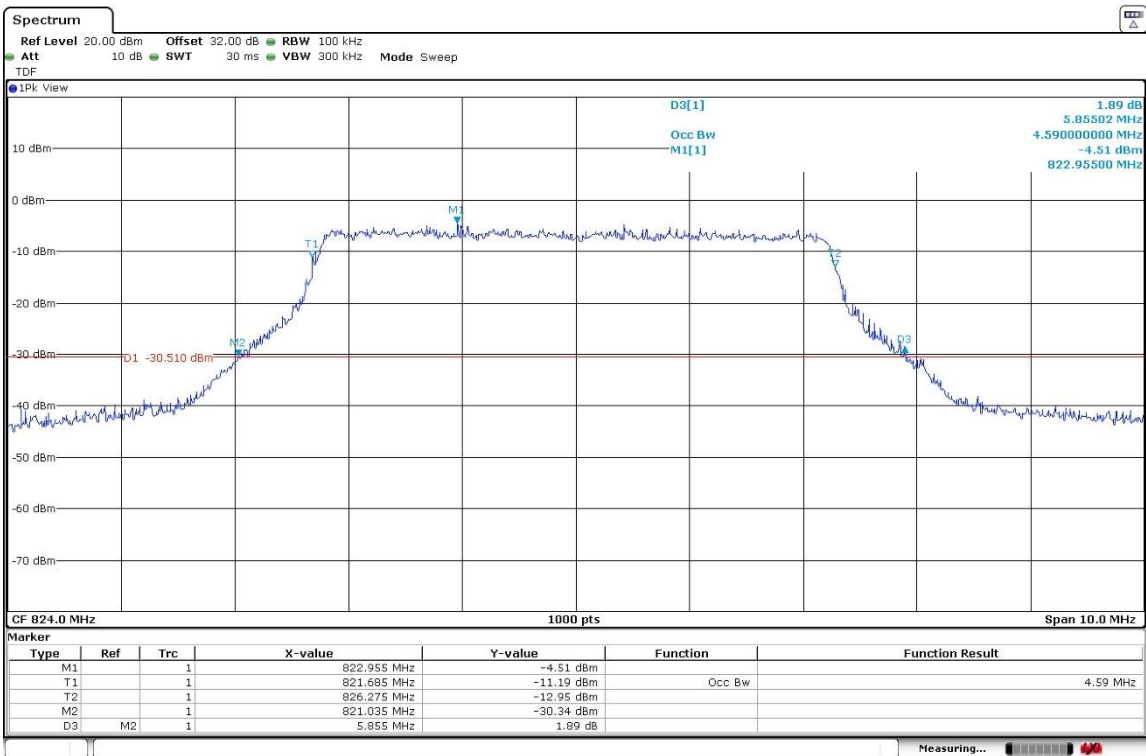
LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 5 MHz. QPSK.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 5 MHz. 16QAM.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 10 MHz. QPSK. RB Size = All.

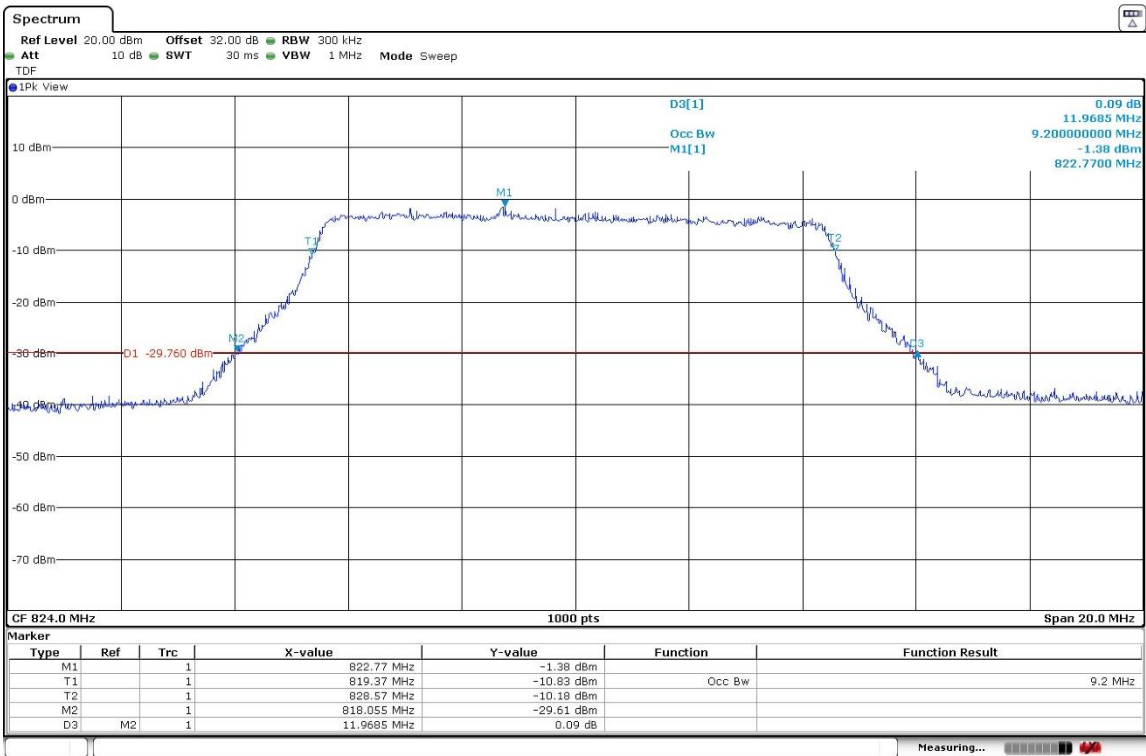
|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 9.200000       |
| -26 dBc Bandwidth (MHz)       | 11.968500      |
| Measurement uncertainty (kHz) | <±4.67         |

LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 10 MHz. 16QAM. RB Size = All.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 9.240000       |
| -26 dBc Bandwidth (MHz)       | 11.649000      |
| Measurement uncertainty (kHz) | <±4.67         |

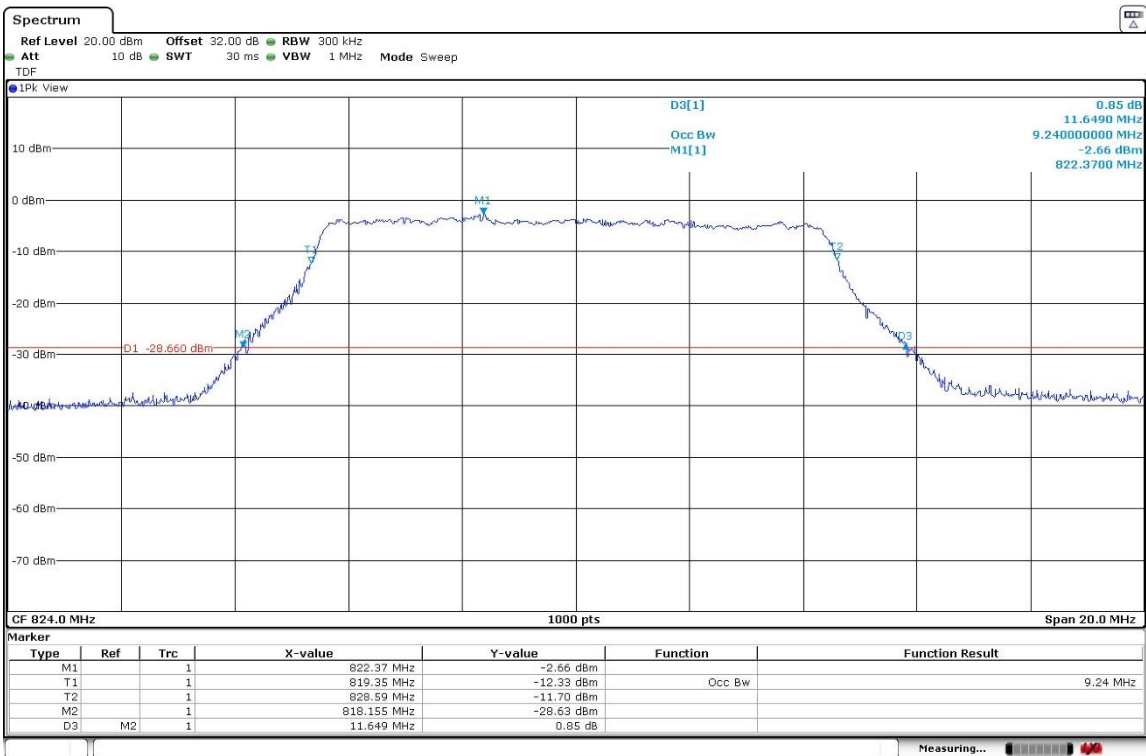
LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 10 MHz. QPSK.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 10 MHz. 16QAM.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 15 MHz. QPSK. RB Size = All.

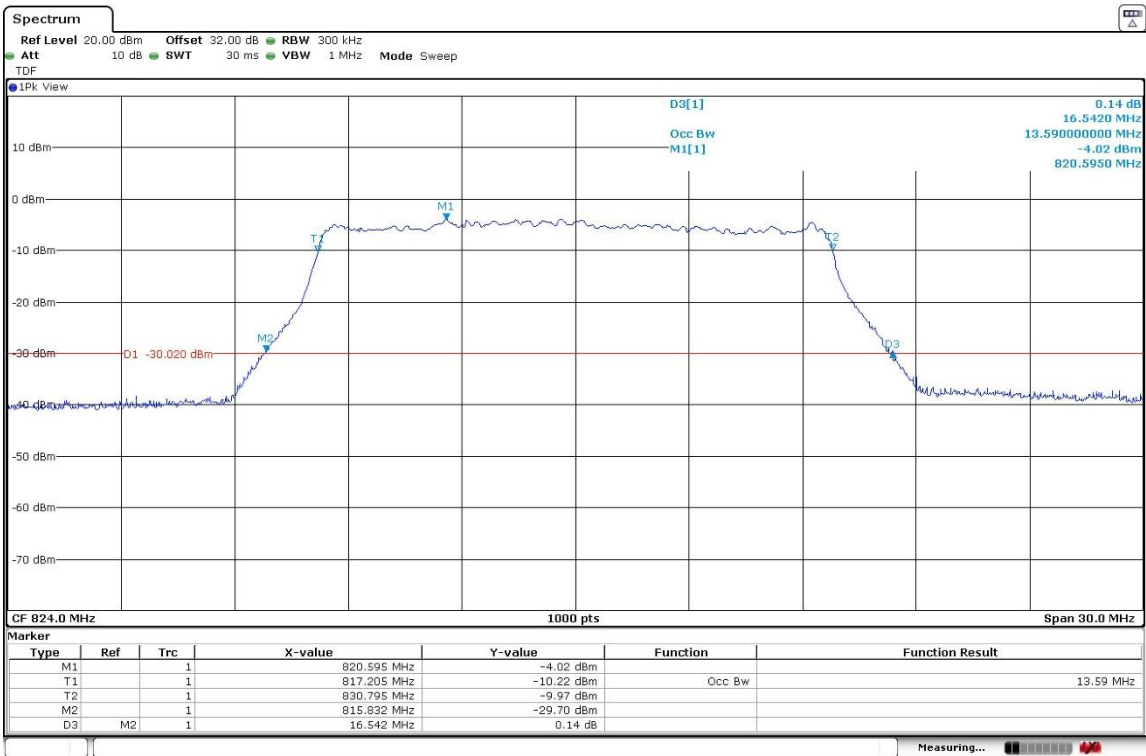
|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 13.590000      |
| -26 dBc Bandwidth (MHz)       | 16.542000      |
| Measurement uncertainty (kHz) | <±4.67         |

LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 15 MHz. 16QAM. RB Size = All.

|                               | Single Channel |
|-------------------------------|----------------|
| 99% Occupied Bandwidth (MHz)  | 16.422200      |
| -26 dBc Bandwidth (MHz)       | 13.620000      |
| Measurement uncertainty (kHz) | <±4.67         |

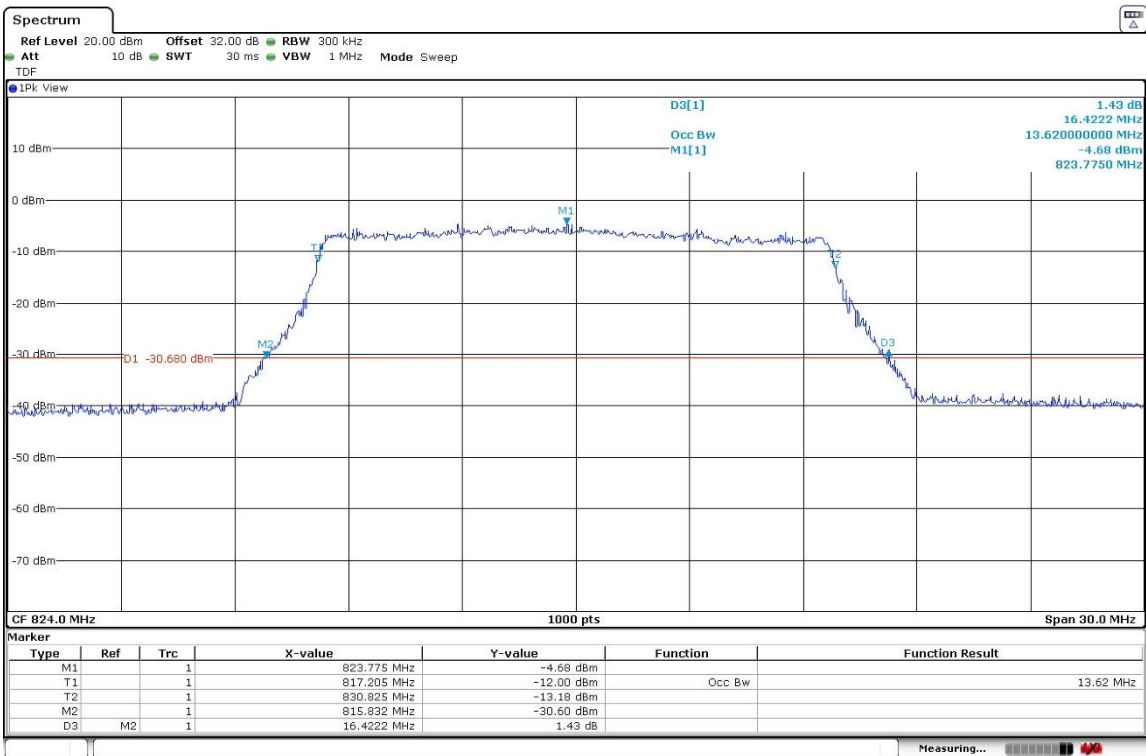
LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 15 MHz. QPSK.

Cross-rule Channel 824 MHz:



LTE Cat-4 Band 26. Cross-rule Channel 824 MHz. BW = 15 MHz. 16QAM.

Cross-rule Channel 824 MHz:



## Spurious emissions at antenna terminals

### Limits

#### 1. LTE Cat-4 Band 14:

\* FCC § 90.543 (e) (2) (3) & (5):

Transmitters operating in 758-768 MHz and 788-798 MHz bands must meet the emission limitations in (e) of this section.

(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.

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

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

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

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

\* RSS-140 Clause 4.4:

The power of any unwanted emission outside the band 788-798 MHz shall be attenuated below the Transmitter output power P in dBW as follows, where p is the transmitter output power in watts:

- a. For any frequency between 769-775 MHz and 799-806 MHz:
  - i.  $76 + 10 \log (p)$ , dB in a 6.25 kHz band for fixed and base station equipment
  - ii.  $65 + 10 \log (p)$ , dB in a 6.25 kHz band for mobile and portable/hand-held equipment
- b. For any frequency between 775-788 MHz, above 806 MHz, and below 758 MHz:  $43 + 10 \log (p)$ , dB in a bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency bands 758-768 MHz and 788-798 MHz, a resolution bandwidth of 30 kHz may be employed.

#### 2. LTE Cat-4 Band 26:

\* FCC § 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.

(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.

### Method

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 Ohm attenuator and a power divider.

The spectrum was investigated from 9 kHz to 8 GHz for LTE Cat-4 Band 14; from 9 kHz to 10 GHz for LTE Cat-4 Band 26.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of Resource Blocks and modulation which is the worst case for conducted power was used.

### Measurement Limit:

According to specification, the power of emissions shall be attenuated below the transmitter power ( $P$ ) by a factor not less  $65 + 10 \log(P)$  dB in a 6.25 kHz band segment.  $P$  in watts.

At  $P_o$  transmitting power, the specified minimum attenuation becomes  $65 + 10 \log(P_o)$ , and the level in dBm relative  $P_o$  becomes:

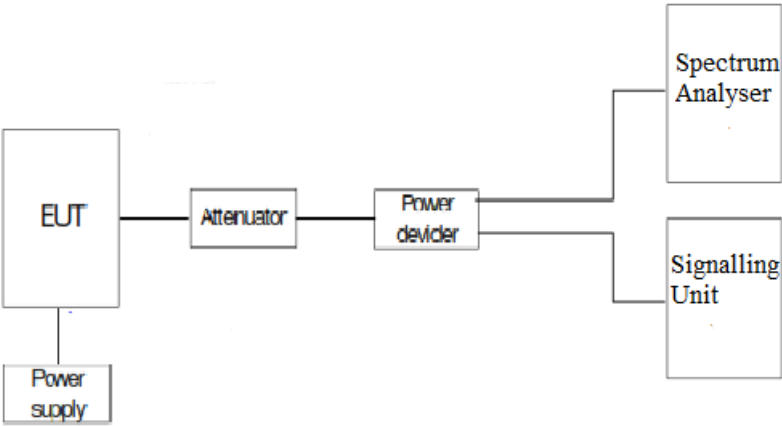
$$P_o \text{ (dBm)} - [65 + 10 \log(P_o \text{ in mwatts}) - 30] = -35 \text{ dBm}$$

According to specification, the power of emissions shall be attenuated below the transmitter power ( $P$ ) by a factor of at least  $43 + 10 \log(P)$  dB.  $P$  in watts.

At  $P_o$  transmitting power, the specified minimum attenuation becomes  $43 + 10 \log(P_o)$ , and the level in dBm relative  $P_o$  becomes:

$$P_o \text{ (dBm)} - [43 + 10 \log(P_o \text{ in mwatts}) - 30] = -13 \text{ dBm}$$

### Test Setup



## Results

The next results are for the test performed on the worst case Bandwidth, Modulation, RB Size and RB Offset for each LTE band.

**LTE Cat-4 Band 14:** BW = 5 MHz. QPSK. RB Size=1. RB Offset=24.

### Frequency range 9 KHz - 8 GHz:

- Low Channel: No spurious frequencies detected at less than 20 dB below the limit.
- High Channel: Spurious frequencies detected at less than 20 dB below the limit:

| Frequency (MHz) | Emission limitations conducted (dBm) |
|-----------------|--------------------------------------|
| 802.1047        | -43.53                               |

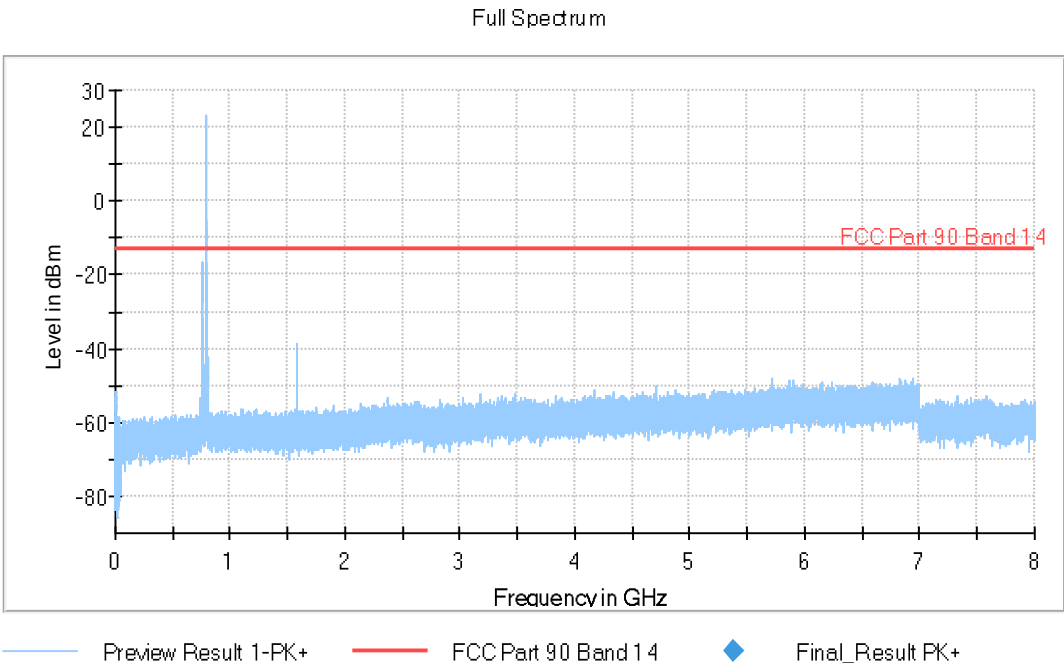
## Verdict

PASS

| Subrange           | Step Size  | Detectors | Bandwidth | Sweep Time | Preamp |
|--------------------|------------|-----------|-----------|------------|--------|
| Receiver: [FSV 40] |            |           |           |            |        |
| 9 kHz - 150 kHz    | 14.1 Hz    | PK+       | 300 Hz    | Coupled    | 0 dB   |
| 150 kHz - 30 MHz   | 932.812 Hz | PK+       | 10 kHz    | Coupled    | 0 dB   |
| 30 MHz - 1 GHz     | 30.312 kHz | PK+       | 100 kHz   | Coupled    | 0 dB   |
| 1 GHz - 10 GHz     | 281.25 kHz | PK+       | 1 MHz     | Coupled    | 0 dB   |

**LTE Cat-4 Band 14:** BW = 5 MHz. QPSK. RB Size=1. RB Offset=24.

Low Channel:



The peak above the limit is the carrier frequency.

