

ISED CABid: ES1909
 Lab. Company Number: 4621A

Test report No:
 77195RRF.001A3

Test Report

USA FCC Part 22

CANADA RSS-132

| | |
|---|--|
| (*) Identification of item tested | Cat1 bis data only module |
| (*) Trademark | u-blox |
| (*) Model and /or type reference | LEXI-R10401D |
| Other identification of the product | FCC ID: XPYUBX23AD01 IC: 8595A-UBX23AD01 |
| (*) Features | LTE Cat1 bis, Wi-fi Scan / Locate HW version: UBX-437C01 SW version: 01.00.A00.03 |
| Applicant | u-blox AG Zürcherstrasse 68, CH-8800 Thalwil, Switzerland |
| Test method requested, standard | USA FCC Part 22 (10-1-23 Edition). CANADA RSS-132 Issue 4, Jan. 2023. ANSI C63.26-2015. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018. |
| Summary | IN COMPLIANCE |
| Approved by (name / position & signature) | José Manuel Gómez Galván EMC Consumer & RF Lab. Manager |
| Date of issue | 2024-06-21 |
| Report template No | FDT08_24 (*) "Data provided by the client" |



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Competences and guarantees

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Uncertainty

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

Data provided by the client

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 LEXI-R10401D is a Cat1 bis data only module for industrial IoT applications.

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 Nº | Description | Model | Serial Nº | Date of reception | Category |
|------------|---------------------------|--------------|-----------|-------------------|--------------------|
| 77195C/015 | Cat1 bis data only module | LEXI-R10401D | - | 23-11-2023 | Element Under Test |
| 77195C/018 | USB Cable | - | - | 23-11-2023 | Auxiliary Element |
| 77195C/025 | USB Cable | - | - | 23-11-2023 | Auxiliary Element |
| 77195C/017 | AC/DC Adaptor | - | - | 23-11-2023 | Auxiliary Element |

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

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

| Control Nº | Description | Model | Serial Nº | Date of reception | Category |
|------------|---------------------------|--------------|-----------|-------------------|--------------------|
| 77195C/008 | Cat1 bis data only module | LEXI-R10401D | - | 23-11-2023 | Element Under Test |
| 77195C/020 | Antenna | - | - | 23-11-2023 | Auxiliary Element |
| 77195C/016 | GPS Antenna | M827B | - | 23-11-2023 | Auxiliary Element |
| 77195C/017 | AC/DC Adaptor | - | - | 23-11-2023 | Auxiliary Element |

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 ⁽³⁾ | |
| | USB | 2 | <input checked="" type="checkbox"/> | <input checked="" 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"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| | <input checked="" type="checkbox"/> | DC: Min: 3.3, Typical: 3.8, Max: 4.5 | | | | |
| Rated Power.....: | - | | | | | |

| | | | |
|--|-------------------------------------|-----------------------------------|---------------------|
| Clock frequencies..... : | 26 MHz | | |
| Other parameters..... : | - | | |
| Software version..... : | 01.00 | | |
| Hardware version..... : | UBX-437C01 | | |
| Dimensions in cm (W x H x D) ... : | 1.6 x 0.2 x 1.6 | | |
| Mounting position..... : | <input 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 checked="" type="checkbox"/> | Other: Industrial modem component | |
| Modules/parts..... : | Module/parts of test item | Type | Manufacturer |
| | - | - | - |
| Accessories (not part of the test item)..... : | Description | Type | Manufacturer |
| | Power supply unit | UUX324-1215 | Unifive |
| | Antenna LTE | GSA.8835 | Taoglass |
| Documents as provided by the applicant..... : | Description | File name | Issue date |
| | - | - | - |

Identification of the client

u-blox AG
 Zürcherstrasse 68, CH-8800 Thalwil, Switzerland

Testing period and place

| | |
|----------------------|--|
| Test Location | DEKRA Testing and Certification S.A.U. |
| Date (start) | 2023-12-01 |
| Date (finish) | 2024-02-21 |
| Date (start) | 2024-06-06 |
| Date (finish) | 2024-06-06 |

*Second period of testing to repeat Vmin extreme conditions.

Document history

| Report number | Date | Description |
|----------------|------------|--|
| 77195RRF.001 | 2024-03-13 | First release. |
| 77195RRF.001A1 | 2024-04-22 | Second release. Antenna gain values corrected and EIRP and ERP values recalculated. This test report replaces and cancel 77195RRF.001 test report. |
| 77195RRF.001A2 | 2024-06-13 | Third release. Extreme conditions testing performed to a different minimum voltage. This test report replaces and cancel 77195RRF.001A1 test report. |
| 77195RRF.001A3 | 2024-06-21 | Fourth release. Tests outside ENAC scope are marked. This test report replaces and cancel 77195RRF.001A2 test report. |

Environmental conditions

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

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

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

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

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

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

Remarks and comments

The tests have been performed by the technical personnel: Rafael Fernández, Carmen Vázquez, Ireneo Bibang, Pablo Redondo, Sergio Carrasco.

Used instrumentation:

| Control No. | Equipment | Next Calibration |
|-------------|--|------------------|
| 08002 | Climatic Chamber BINDER MK 56 | 2025-01 |
| 09555 | Two-channel power supply, 32V, 10/5A, 188W ROHDE AND SCHWARZ HMP2020 | N/A |
| 07794 | Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40 | 2025-04 |
| 09227 | Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500 | 2024-07 |
| 02215 | Power Divider DC-25 GHz PICOSECOND PULSE LABS 5333-104 | 2024-07 |
| 06791 | Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP | N/A |
| 06792 | Shielded Room' ETS LINDGREN S101 | N/A |
| 07760 | Digital Multimeter FLUKE 175 | 2024-11 |
| 04611 | Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D | 2026-01 |
| 06143 | Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E | 2027-01 |
| 03783 | RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A | 2025-02 |
| 06666 | EMI Test Receiver 2 Hz - 44 GHz ROHDE AND SCHWARZ ESW44 | 2024-03 |
| 09229 | Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500 | 2024-06 |
| 07758 | Digital Multimeter FLUKE 175 | 2024-11 |
| 06496 | Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D | 2026-12 |
| 04848 | EMC/RF Testing SW ROHDE AND SCHWARZ EMC32 | N/A |

Testing verdicts

| | |
|-----------------|-----|
| Not Applicable: | N/A |
| Pass: | P |
| Fail: | F |
| Not Measured: | N/M |

Summary

LTE Cat 1bis Band 5:

| FCC PART 22 / RSS-132 PARAGRAPH | | |
|--|---------|--------|
| Requirement – Test case | Verdict | Remark |
| FCC 22.913 / RSS-132 5.4: RF Output Power | P | |
| FCC 2.1047 / RSS-132 5.2: Modulation Characteristics | P | |
| FCC 22.355 / RSS-132 5.3: Frequency Stability | P | |
| FCC 2.1049: Occupied Bandwidth | P | |
| FCC 22.917 / RSS-132 5.5: Spurious Emissions at Antenna Terminals | P | |
| FCC 22.917 / RSS-132 5.5: Spurious Emissions at Antenna Terminals at Block Edges | P | |
| FCC 22.917 / RSS-132 5.5: Radiated Emissions | P | |
| <u>Supplementary information and remarks:</u> | | |
| None. | | |

Appendix A: Test results for FCC 22 / RSS-132

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| Radiated emissions | 42 |

TEST CONDITIONS

(*): Declared by the Applicant.

POWER SUPPLY (*):

Vnominal: 3.8 Vdc
 Vminimum: 3.23 Vdc
 Vmaximum: 4.5 Vdc

Type of Power Supply: DC External (USB).

ANTENNA (*):

| MIDDLE BAND | GAIN | ANTENNA TYPE |
|---------------------|----------|---|
| LTE Cat 1bis Band 5 | 2.59 dBi | External (Taoglass GSA_8835 (standard reference antenna provided with EVK)) |

TEST FREQUENCIES:

LTE Cat 1bis Band 5. QPSK and 16QAM:

| | Channel (Frequency MHz) | | | |
|--------|-------------------------|----------------|----------------|----------------|
| | BW=1.4 MHz | BW=3 MHz | BW=5 MHz | BW=10 MHz |
| Low | 20407 (824.70) | 20415 (825.50) | 20425 (826.50) | 20450 (829.00) |
| Middle | 20525 (836.50) | 20525 (836.50) | 20525 (836.50) | 20525 (836.50) |
| High | 20643 (848.30) | 20635 (847.50) | 20625 (846.50) | 20600 (844.00) |

RF Output Power

Limits

* FCC § 22.913:

Licensees in the Cellular Radiotelephone Service are subject to the effective radiated power (ERP) limits and other requirements in this Section. See also § 22.169.

(a) Maximum ERP. The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(5) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts (38.45 dBm E.R.P.).

* FCC § 2.1046. Measurements required: RF power output.

* RSS-132, 5.4:

The transmitter output power shall be measured in terms of average power. The equivalent radiated power (e.r.p.) shall not exceed 7 watts for mobile equipment and 3 watts for portable equipment.

The effective isotropic radiated power (e.i.r.p.) shall not exceed the limits specified in SRSP-503 for base station equipment.

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

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 peak-to-average power ratio (PAPR) is measured using an attenuator, power splitter and spectrum analyser with a Complementary Cumulative Distribution Function implemented.

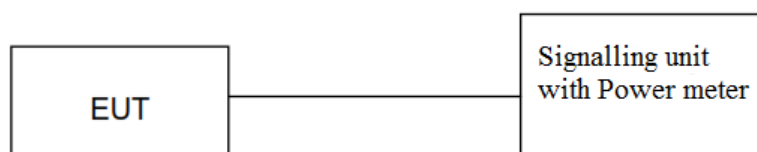
The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

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:

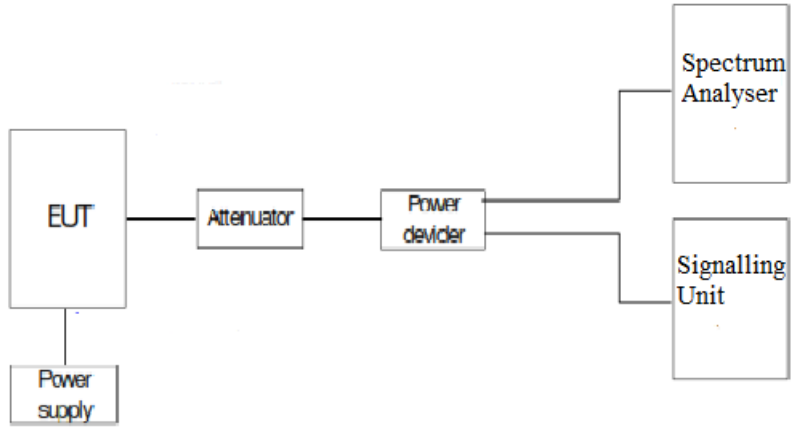
$$E.R.P. = E.I.R.P. - 2.15 \text{ dB}$$

Test Setup

1. CONDUCTED AVERAGE POWER:



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



Results

1. CONDUCTED AVERAGE POWER:

LTE Cat 1bis Band 5:

Preliminary measurements determined the worst case of RF Power is BW=10 MHz, High Channel, QPSK, RB Size=1, RB Offset=24.

| BANDWIDTH (MHz) | CHANNEL | FREQUENCY (MHz) | MODULATION | RB SIZE | RB OFFSET | AVERAGE POWER (dBm) |
|-----------------|-----------------|-----------------|------------|---------|-----------|---------------------|
| 10 | Low 20450 | 829 MHz | QPSK | 1 | 0 | 23.01 |
| | | | | 1 | 24 | 23.17 |
| | | | | 1 | 49 | 23.42 |
| | | | | 25 | 0 | 22.38 |
| | | | | 25 | 12 | 22.42 |
| | | | | 25 | 24 | 22.47 |
| | | | 16-QAM | 50 | 0 | 22.04 |
| | | | | 1 | 0 | 21.92 |
| | | | | 1 | 24 | 22.11 |
| | | | | 1 | 49 | 22.34 |
| | | | | 25 | 0 | 21.47 |
| | | | | 25 | 12 | 21.51 |
| | | | | 25 | 24 | 21.57 |
| | | | | 50 | 0 | * |
| | Middle 20525 | 836.5 MHz | QPSK | 1 | 0 | 23.12 |
| | | | | 1 | 24 | 23.32 |
| | | | | 1 | 49 | 23.21 |
| | | | | 25 | 0 | 22.25 |
| | | | | 25 | 12 | 22.34 |
| | | | | 25 | 24 | 22.34 |
| | | | 16-QAM | 50 | 0 | 21.91 |
| | | | | 1 | 0 | 22.17 |
| | | | | 1 | 24 | 22.39 |
| | | | | 1 | 49 | 22.32 |
| | | | | 25 | 0 | 21.44 |
| | | | | 25 | 12 | 21.51 |
| | | | | 25 | 24 | 21.54 |
| 50 | | | | 0 | * | |
| High 20600 | 844 MHz | QPSK | 1 | 0 | 23.17 | |
| | | | 1 | 24 | 23.48 | |
| | | | 1 | 49 | 21.78 | |
| | | | 25 | 0 | 22.52 | |
| | | | 25 | 12 | 22.51 | |
| | | | 25 | 24 | 22.02 | |
| | | 16-QAM | 50 | 0 | 22.04 | |
| | | | 1 | 0 | 22.26 | |

| | | | | | | |
|--|--|--|--|----|----|-------|
| | | | | 1 | 24 | 22.51 |
| | | | | 1 | 49 | 20.87 |
| | | | | 25 | 0 | 21.74 |
| | | | | 25 | 12 | 21.63 |
| | | | | 25 | 24 | 21.18 |
| | | | | 50 | 0 | * |

* Not supported

BW=10 MHz. QPSK:

| MAX POWER | QPSK COND. POWER AVG (dBm) | ANTENNA GAIN (dBi) | RAD. POWER AVG EIRP (dBm) | RAD. POWER AVG ERP (dBm) |
|-----------|----------------------------|--------------------|---------------------------|--------------------------|
| LOW | 23.42 | 2.59 | 26.01 | 23.86 |
| MIDDLE | 23.32 | 2.59 | 25.91 | 23.76 |
| HIGH | 23.48 | 2.59 | 26.07 | 23.92 |
| MAX: | 23.48 | | 26.07 | 23.92 |

BW=10 MHz. 16QAM:

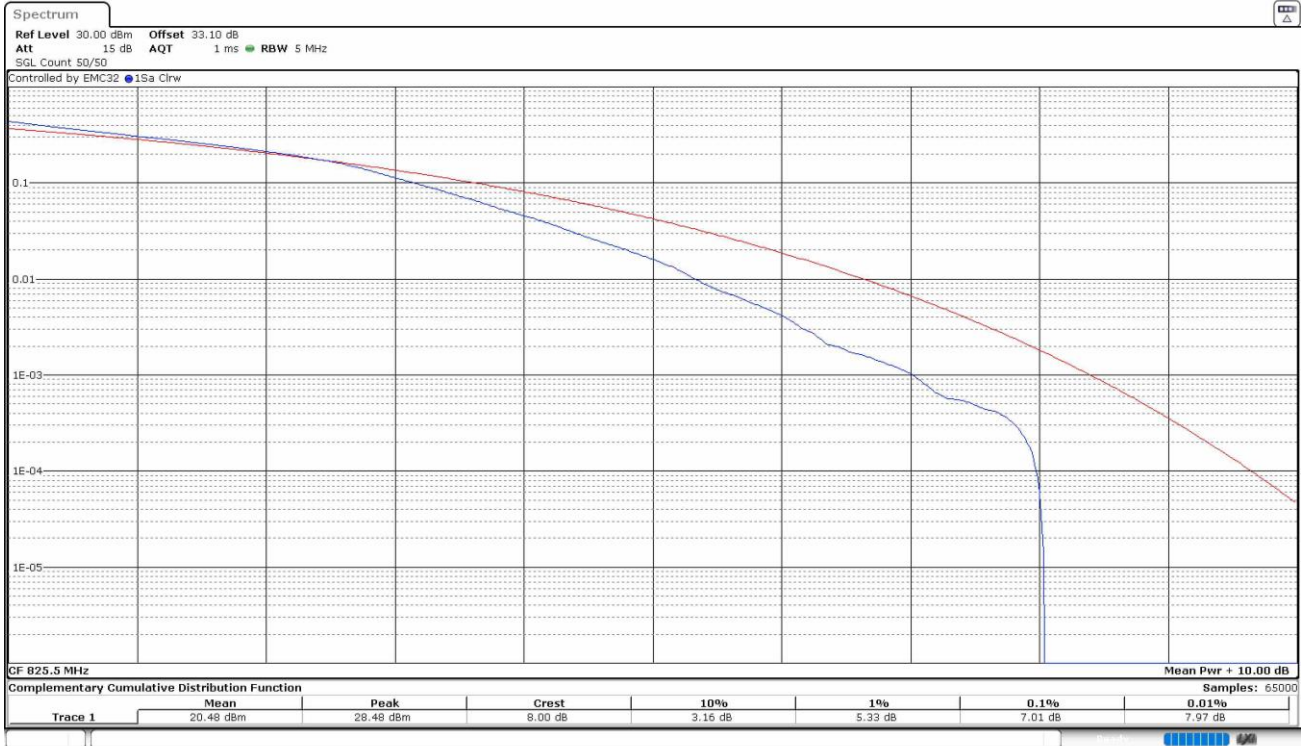
| MAX POWER | 16QAM COND. POWER AVG (dBm) | ANTENNA GAIN (dBi) | RAD. POWER AVG EIRP (dBm) | RAD. POWER AVG ERP (dBm) |
|-----------|-----------------------------|--------------------|---------------------------|--------------------------|
| LOW | 22.34 | 2.59 | 24.93 | 22.78 |
| MIDDLE | 22.39 | 2.59 | 24.98 | 22.83 |
| HIGH | 22.51 | 2.59 | 25.1 | 22.95 |
| MAX: | 22.51 | | 25.1 | 22.95 |

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

LTE Cat 1bis Band 5:

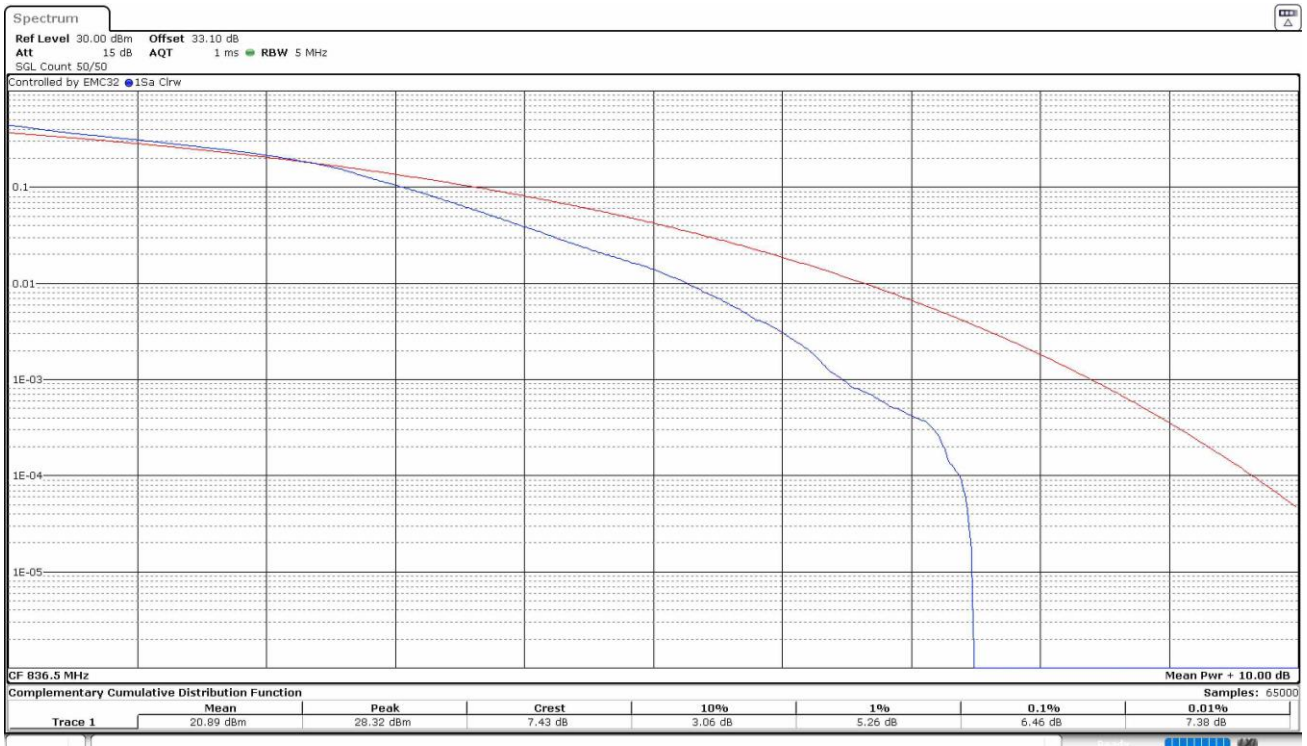
Preliminary measurements determined the worst-case of PAPR is BW=3 MHz, Low Channel, 16QAM, RB Size=8, RB Offset=4.

Low Channel:



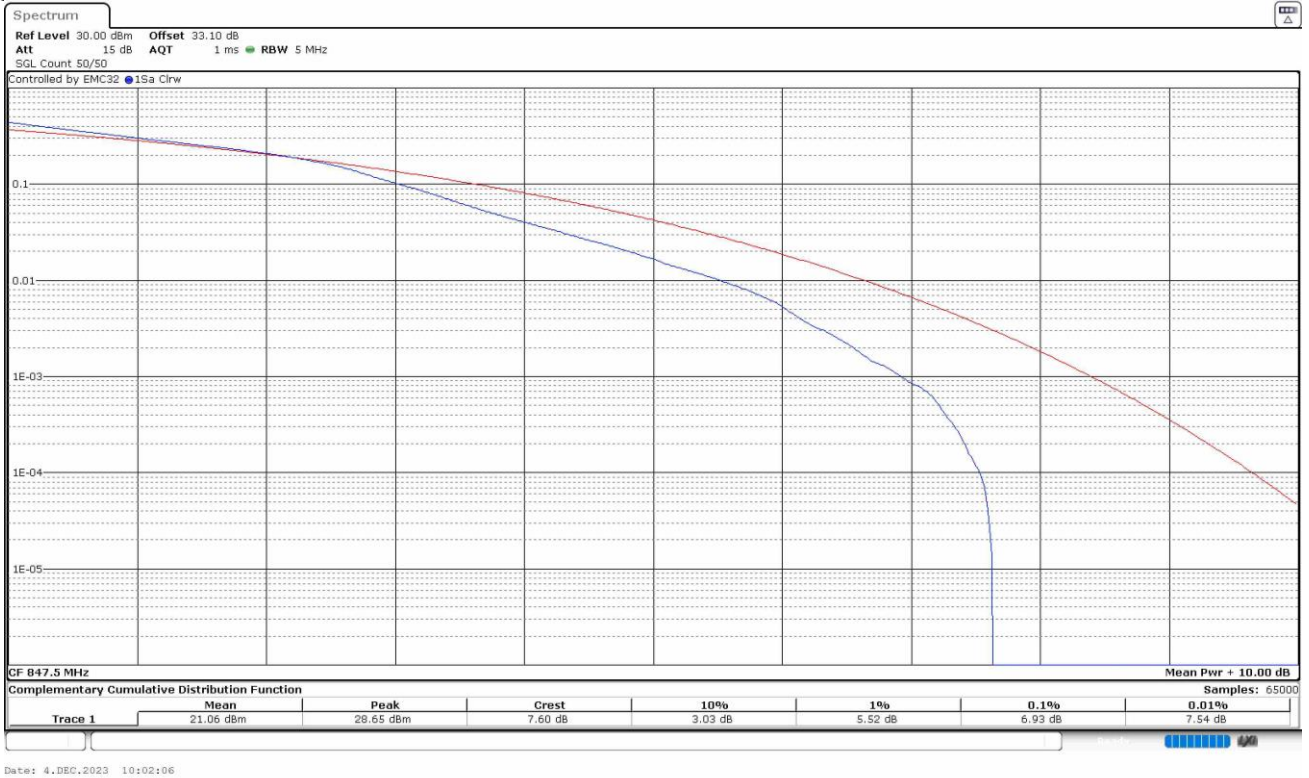
Date: 4. DEC. 2023 09:57:35

Middle Channel:



Date: 4. DEC. 2023 09:59:50

High Channel:



| 16QAM | Low | Middle | High |
|-----------|------|--------|------|
| PAPR (dB) | 7.01 | 6.62 | 6.93 |

Measurement uncertainty (dB) $<\pm 1.11$

Verdict

Pass

Frequency Stability

Limits

* FCC § 22.355:

Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table C–1 of this section.

Table C–1—Frequency Tolerance for Transmitters in the Public Mobile Services

| Frequency range (MHz) | Base, fixed (ppm) | Mobile >3 watts (ppm) | Mobile ≤3 watts (ppm) |
|-----------------------|-------------------|-----------------------|-----------------------|
| 821 to 896 | 1.5 | 2.5 | 2.5 |

* FCC § 2.1055: Measurements required: Frequency stability.

* RSS-132, 5.3. The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within each of the sub-bands when tested at the temperature and supply voltage variations specified in RSS-Gen.

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.

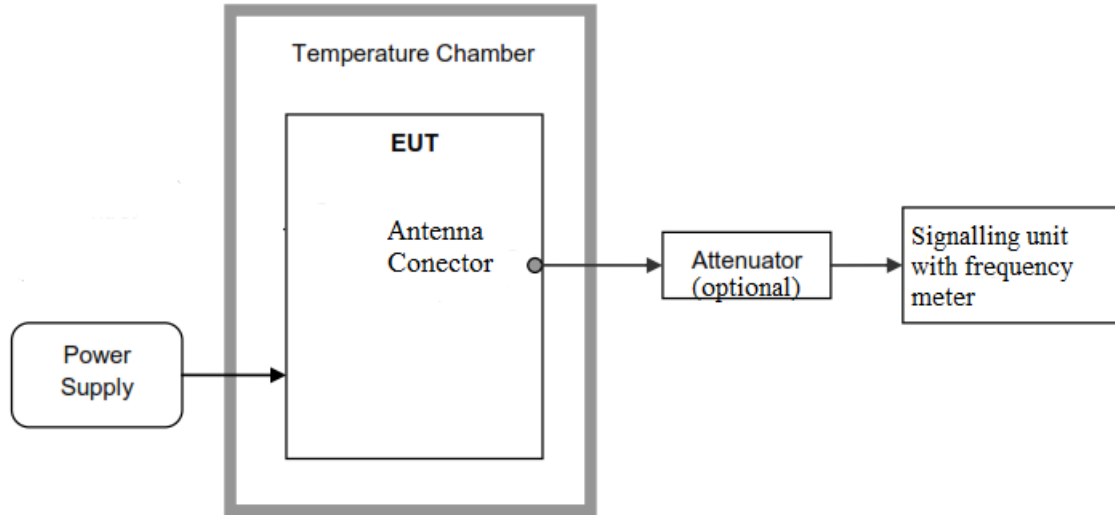
Temperature and voltage range of testing has been extended to the maximum and minimum values declared by customer.

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 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:



Results

LTE Cat 1bis Band 5:

The worst case modulation in terms of Frequency Stability is BW=1.4 MHz, QPSK, RB Size=1, RB Offset=0.

1. Frequency Tolerance:

- **Frequency Stability over Temperature Variations:**

| Temperature (°C) | Frequency Error (Hz) | Frequency Error (ppm) |
|------------------|----------------------|-----------------------|
| +85 [#] | 3.7 | 0.004423192 |
| +80 [#] | 2.54 | 0.003036461 |
| +70 [#] | 2.79 | 0.003335326 |
| +60 [#] | 1.7 | 0.002032277 |
| +50 | 3.23 | 0.003861327 |
| +40 | 2.12 | 0.002534369 |
| +30 | 2.78 | 0.003323371 |
| +20 | -1.01 | -0.001207412 |
| +10 | -0.34 | -0.000406455 |
| 0 | -1.56 | -0.001864913 |
| -10 | -2.51 | -0.003000598 |
| -20 | -1.91 | -0.002283323 |
| -30 | -2.41 | -0.002881052 |
| -40 [#] | -3.35 | -0.004004782 |

Tests conditions marked with “#” are out of the scope of ENAC accreditation.

- **Frequency Stability over Voltage Variations:**

| Supply voltage | Voltage (V) | Frequency Error (Hz) | Frequency Error (ppm) |
|----------------|-------------|----------------------|-----------------------|
| Vmax | 4.5 | -1.74 | -0.002080096 |
| Vmin | 3.23 | 1.04 | 0.001243276 |

2. Reference Frequency Points fL and fH:

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

| | |
|----------|----------|
| fL (MHz) | 824.0040 |
| fH (MHz) | 848.9920 |

The reference frequency points fL and fH stay within the authorized blocks for the band above.

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

Verdict

Pass

Modulation Characteristics

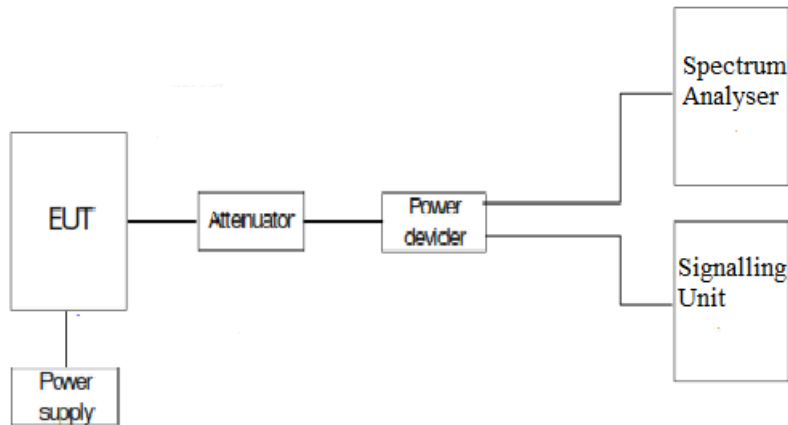
Limits

- * FCC § 2.1047: Measurements required: Modulation characteristics.
- * RSS-132, 5.2: Digital modulation shall be used.

Method

For LTE the EUT operates with QPSK and 16QAM modes in which the information is digitized 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).

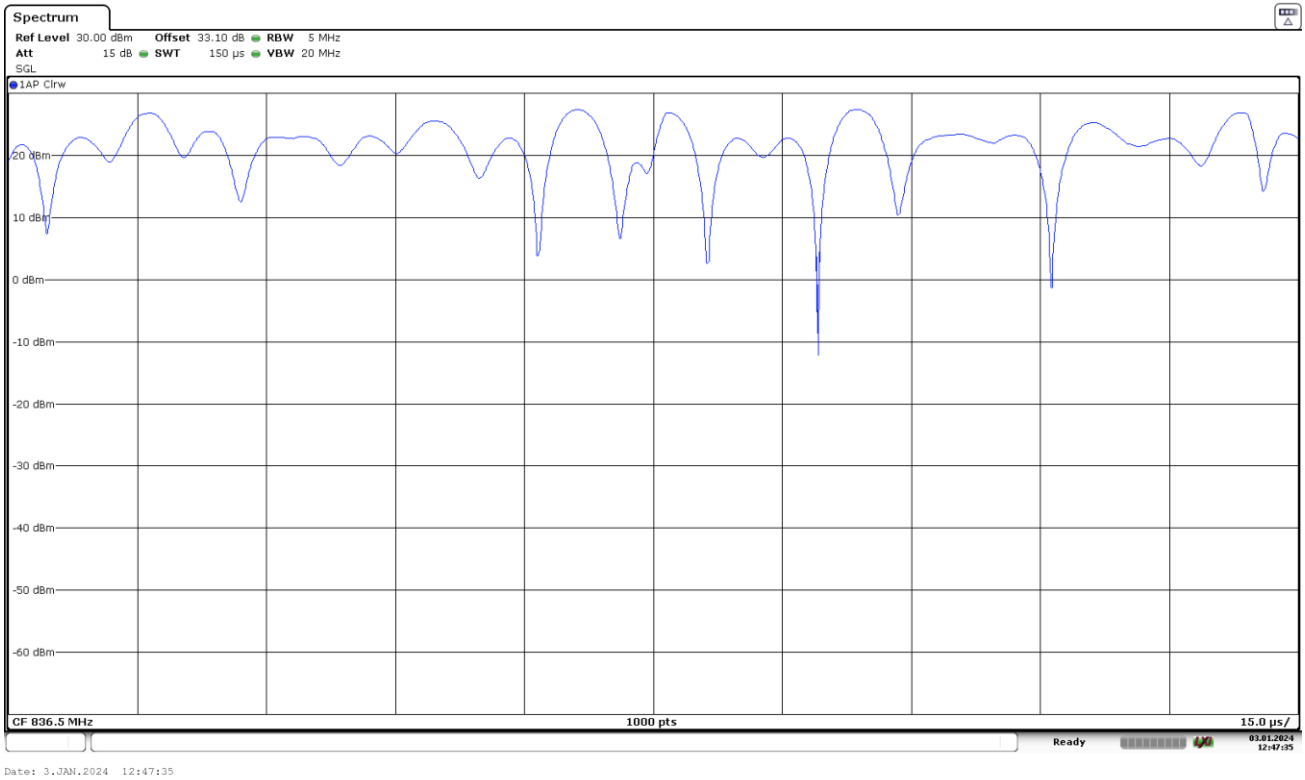
Test Setup



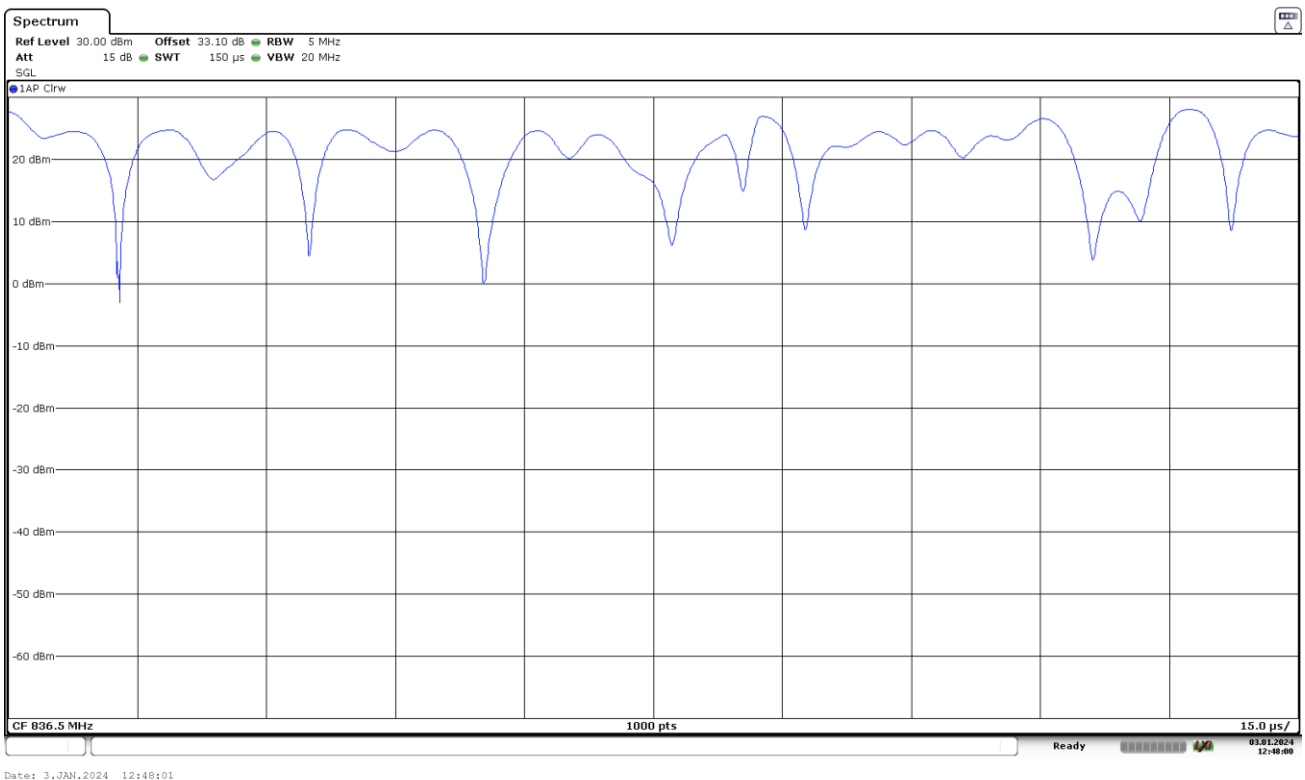
Results

The following plots show the modulation schemes in the EUT.

LTE Cat 1bis Band 5: BW=1.4 MHz. QPSK. RB Size=1. RB Offset=0.



LTE Cat 1bis Band 5: BW=1.4 MHz. 16QAM. RB Size=1. RB Offset=0.



Occupied Bandwidth

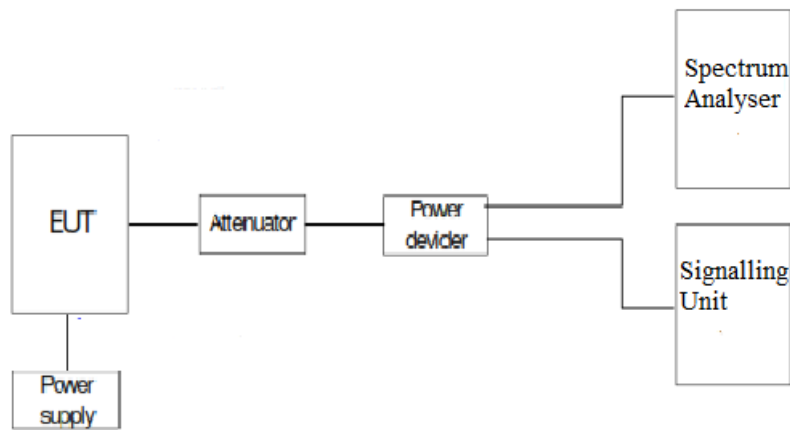
Limits

- * FCC § 2.1049. Measurements required: Occupied bandwidth.
- * RSS-Gen, 6.7: Occupied bandwidth (or 99% emission 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

The worst case of occupied bandwidth corresponds to Resource Block (RB) Size All and Offset 0 regardless the nominal bandwidth selected.

LTE Cat 1bis Band 5:

LTE Cat 1bis Band 5. BW=1.4 MHz. QPSK. RB Size=All. RB Offset=0.

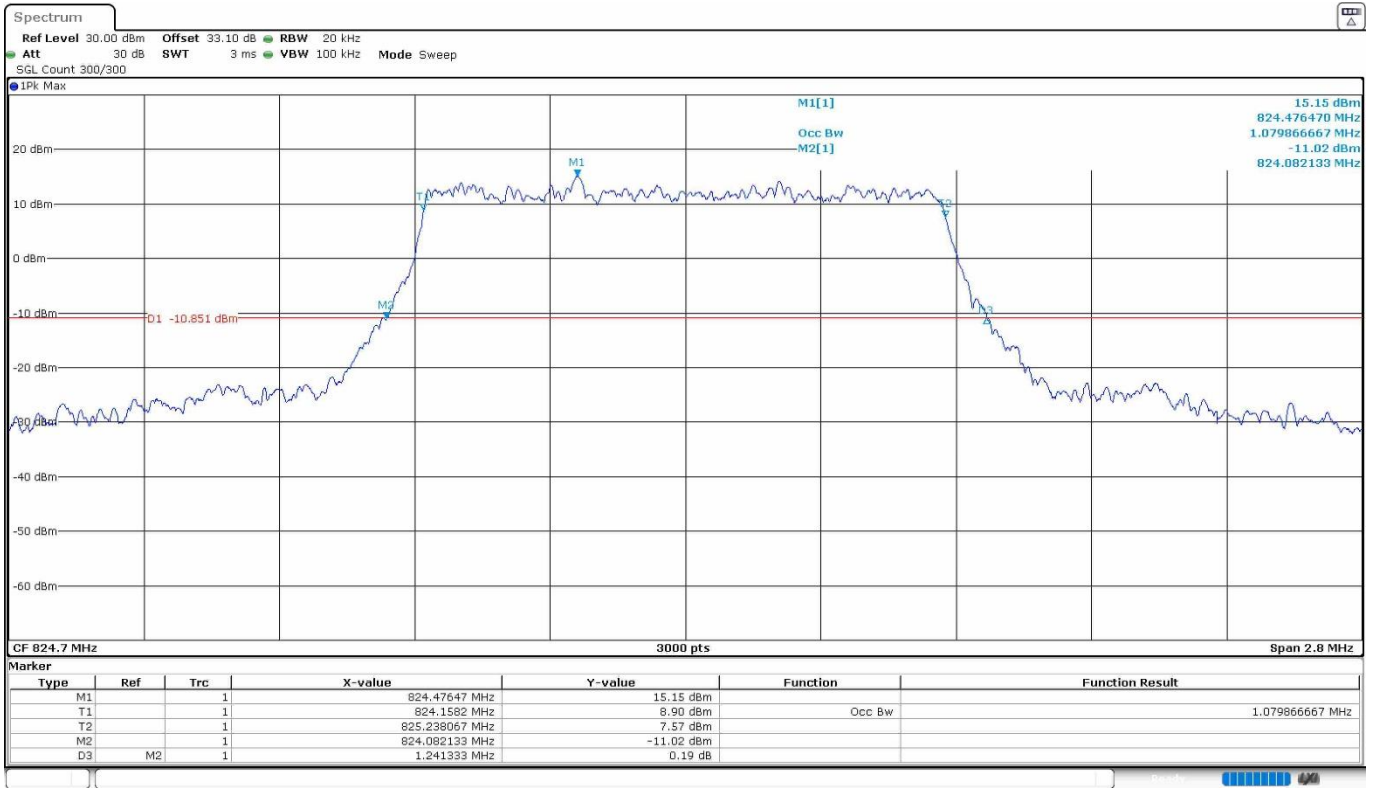
| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 1079.87 | 1083.60 | 1085.47 |
| -26 dBc Bandwidth (kHz) | 1241.33 | 1250.67 | 1283.33 |
| Measurement uncertainty (kHz) | <±3.75 | | |

LTE Cat 1bis Band 5. BW=1.4 MHz. 16QAM. RB Size=All. RB Offset=0.

| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 1083.60 | 1078.93 | 1084.53 |
| -26 dBc Bandwidth (kHz) | 1262.80 | 1236.67 | 1251.60 |
| Measurement uncertainty (kHz) | <±3.75 | | |

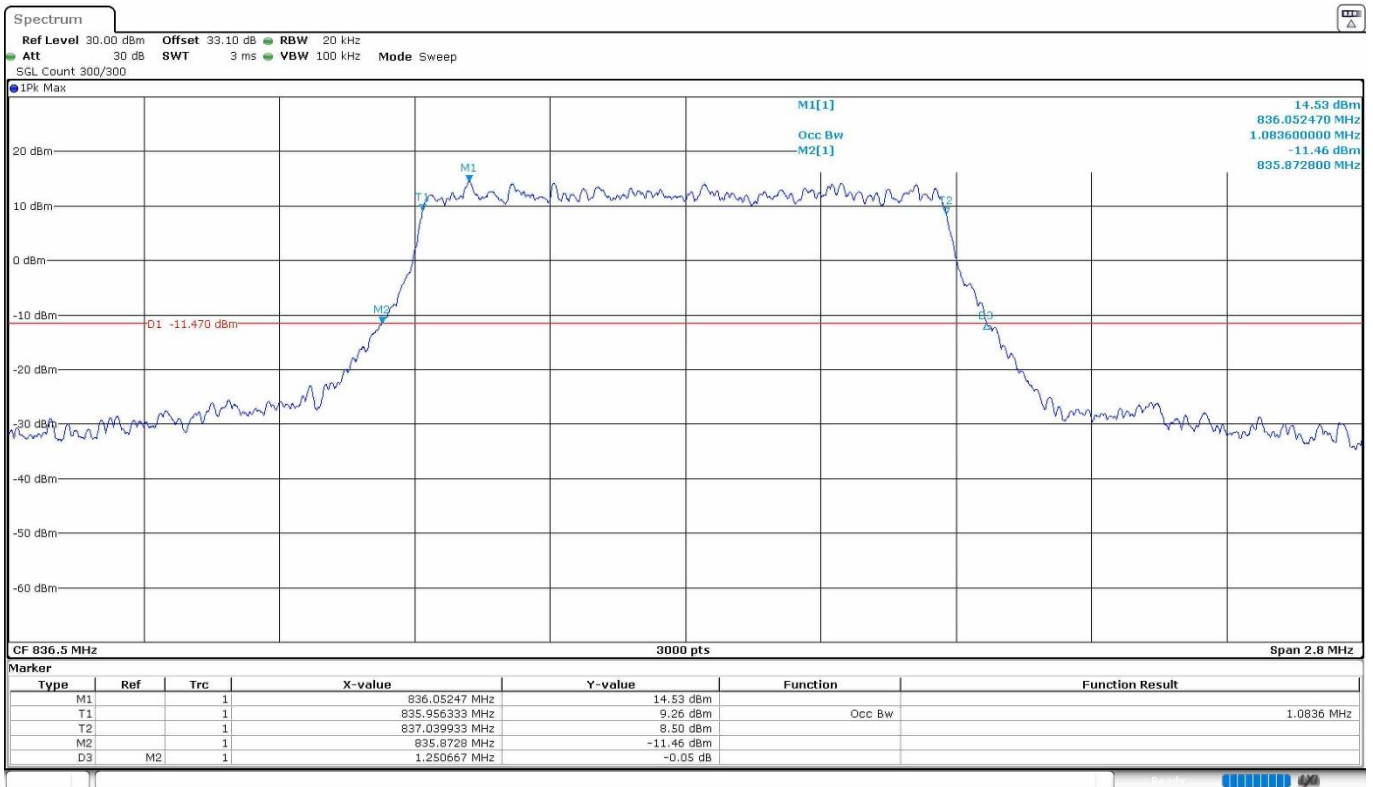
LTE Cat 1bis Band 5. BW=1.4 MHz. QPSK. RB Size=All.

Low Channel:



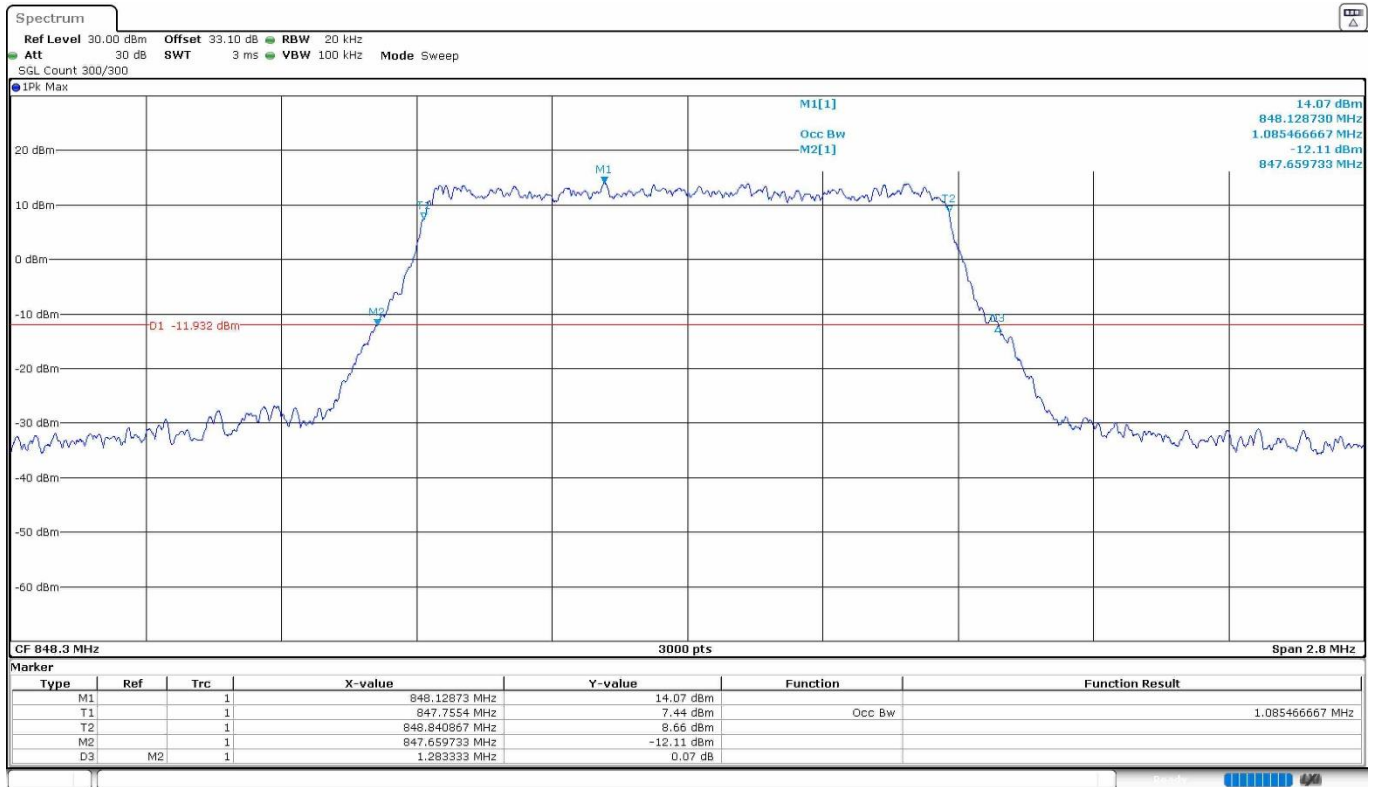
Date: 5. Dec. 2023 13:42:28

Middle Channel:



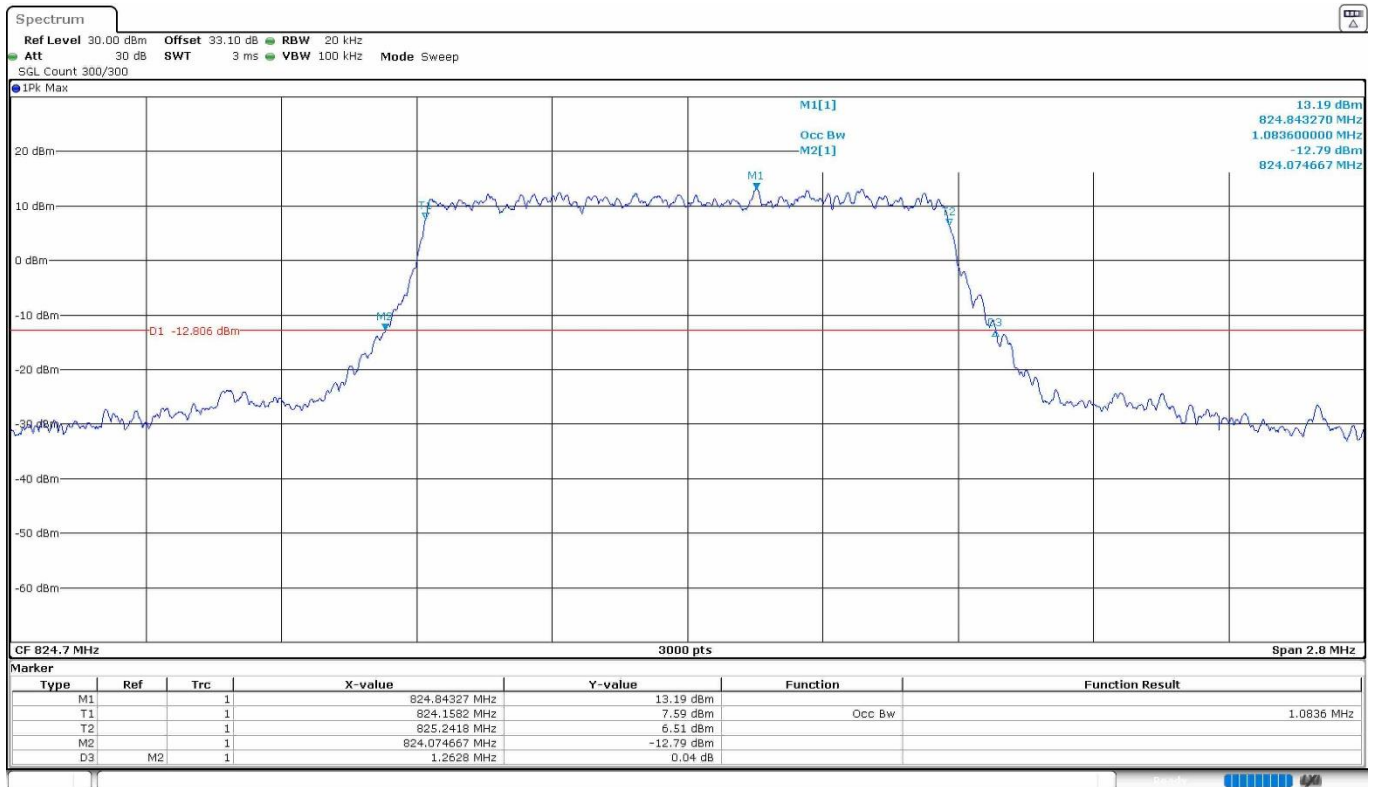
Date: 5. Dec. 2023 13:43:00

High Channel:



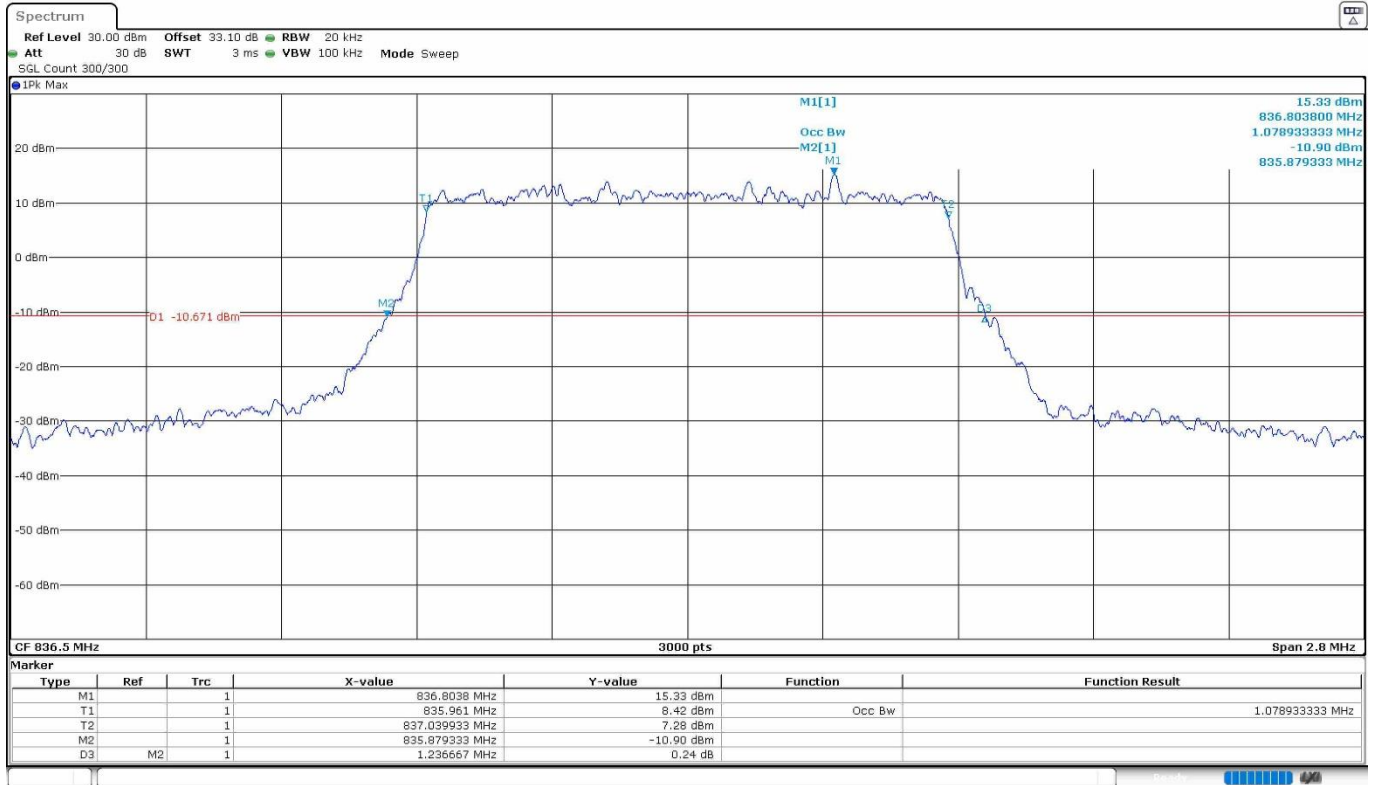
Date: 5, D50, 2023 13:43:00

LTE Cat 1bis Band 5, BW=1.4 MHz. 16QAM. RB Size=All.
 Low Channel:



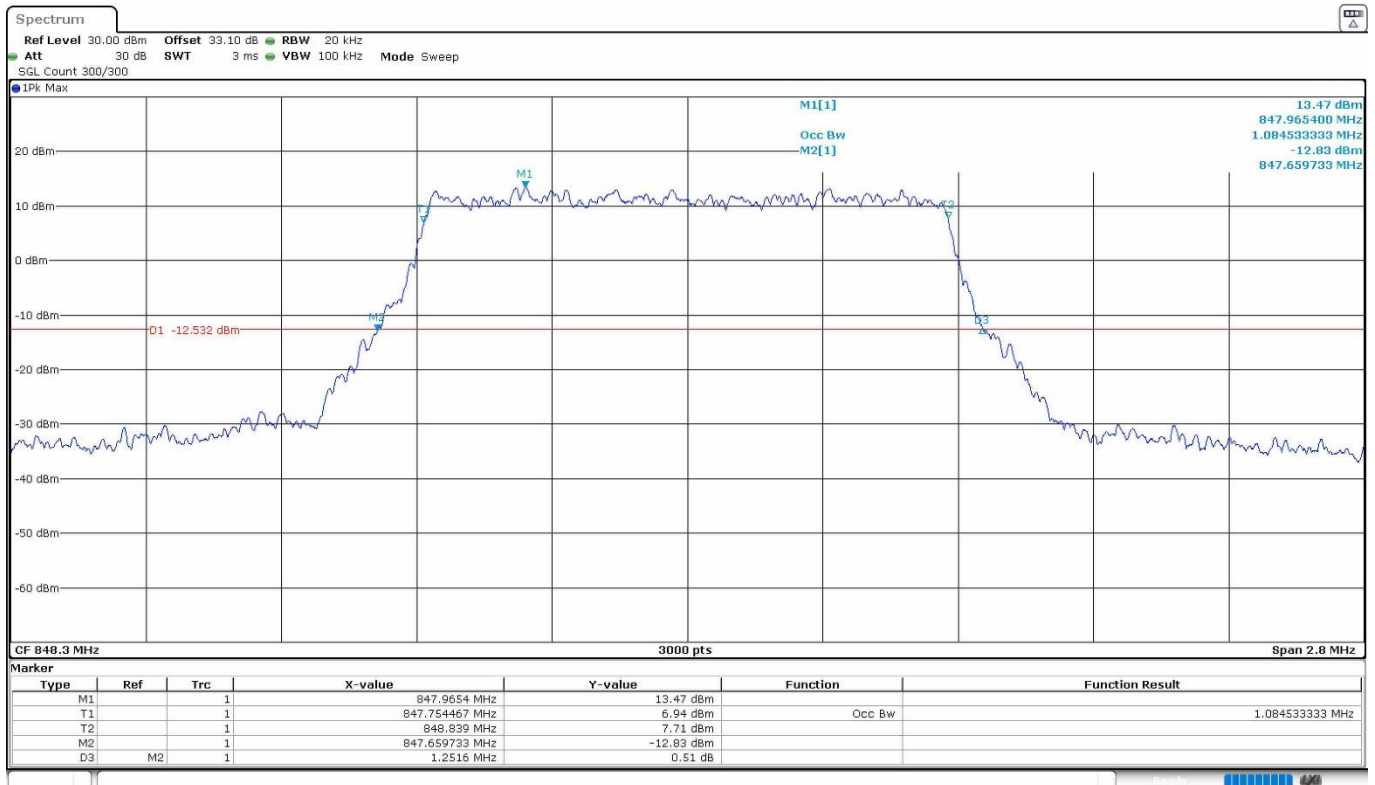
Date: 5, D50, 2023 13:42:43

Middle Channel:



Date: 5, Dec, 2023 13:43:12

High Channel:



Date: 5, Dec, 2023 13:43:43

LTE Cat 1bis Band 5. BW=3 MHz. QPSK. RB Size=All. RB Offset=0.

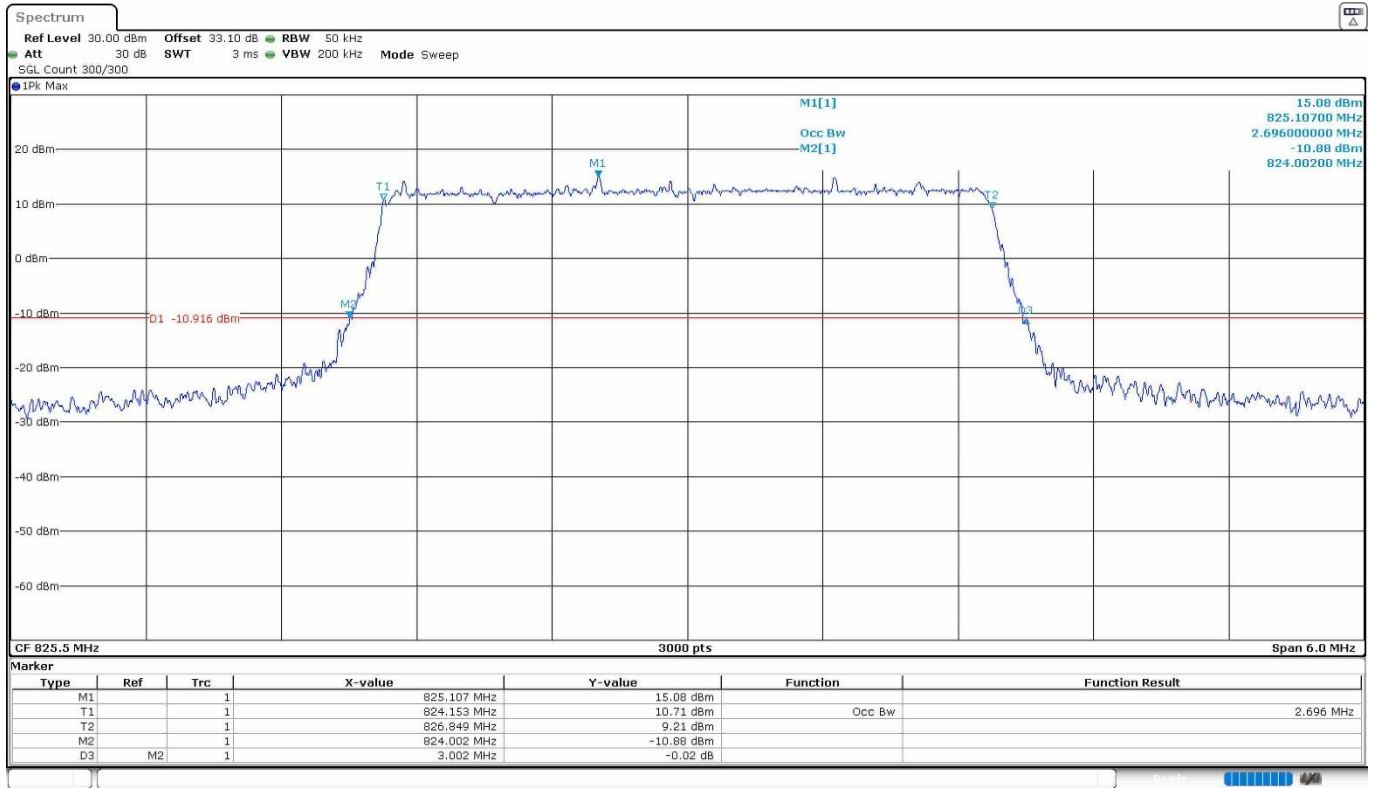
| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 2696.00 | 2698.00 | 2694.00 |
| -26 dBc Bandwidth (kHz) | 3002.00 | 2992.00 | 2996.00 |
| Measurement uncertainty (kHz) | <±3.75 | | |

LTE Cat 1bis Band 5. BW=3 MHz. 16QAM. RB Size=All. RB Offset=0.

| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 2688.00 | 2692.00 | 2692.00 |
| -26 dBc Bandwidth (kHz) | 3002.00 | 2974.00 | 2966.00 |
| Measurement uncertainty (kHz) | <±3.75 | | |

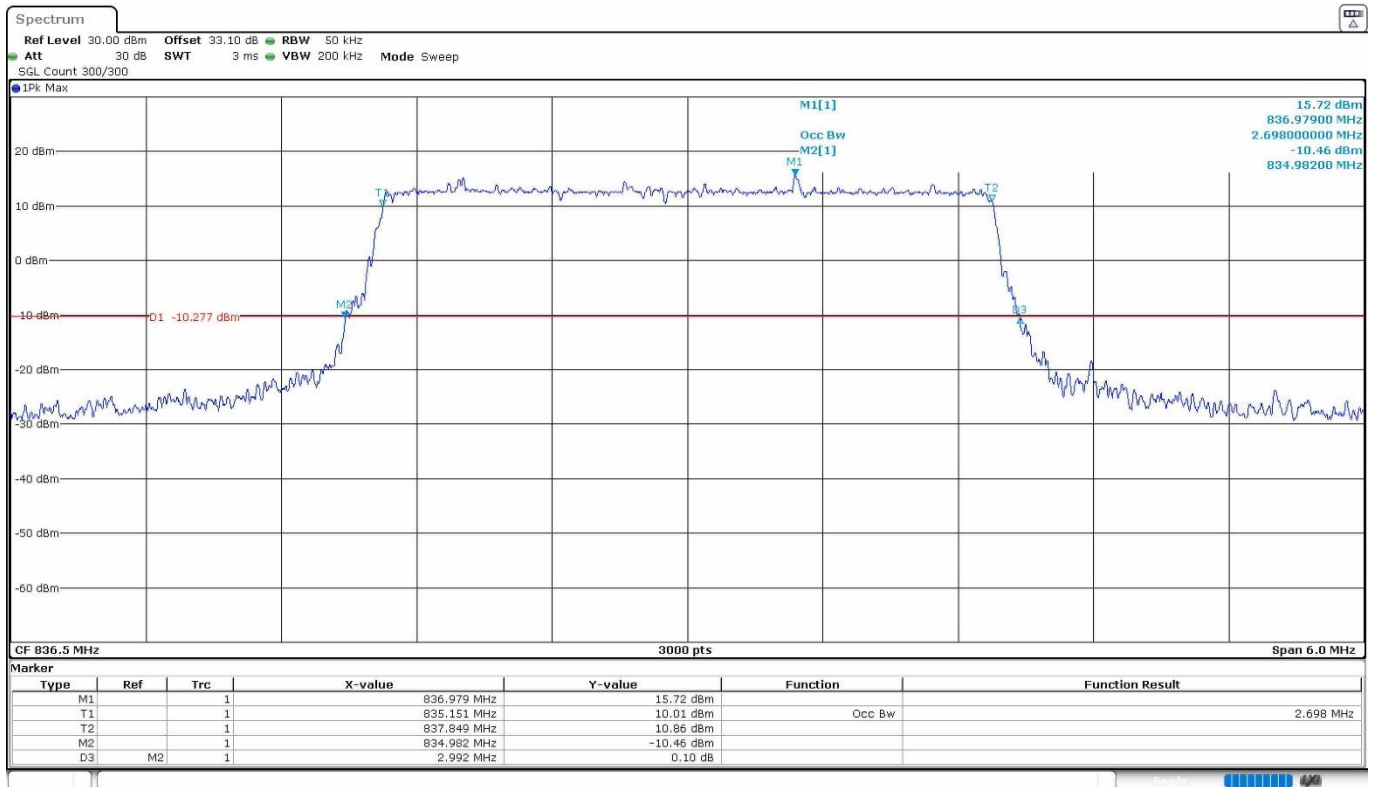
LTE Cat 1bis Band 5. BW=3 MHz. QPSK. RB Size=All.

Low Channel:



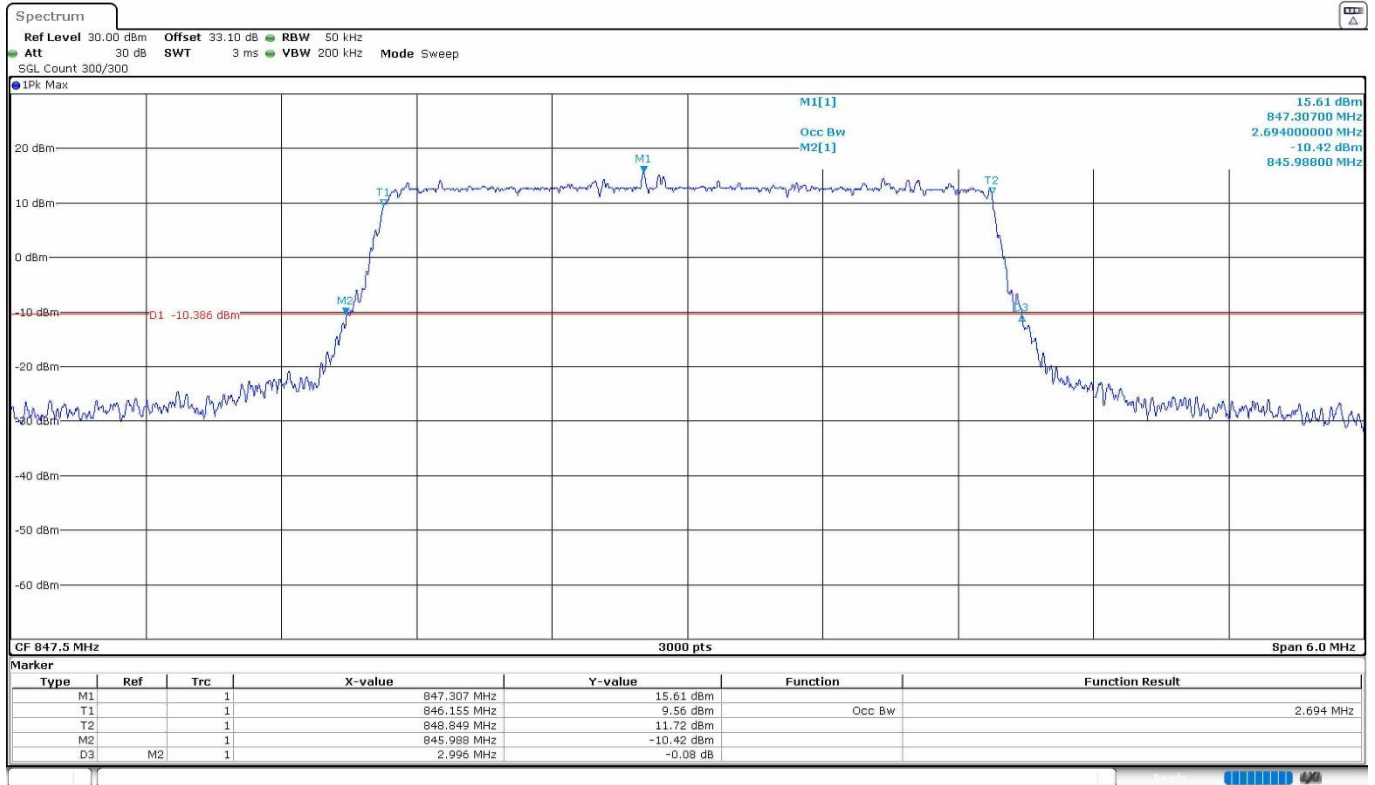
Date: 5. Dec. 2023 13:44:08

Middle Channel:



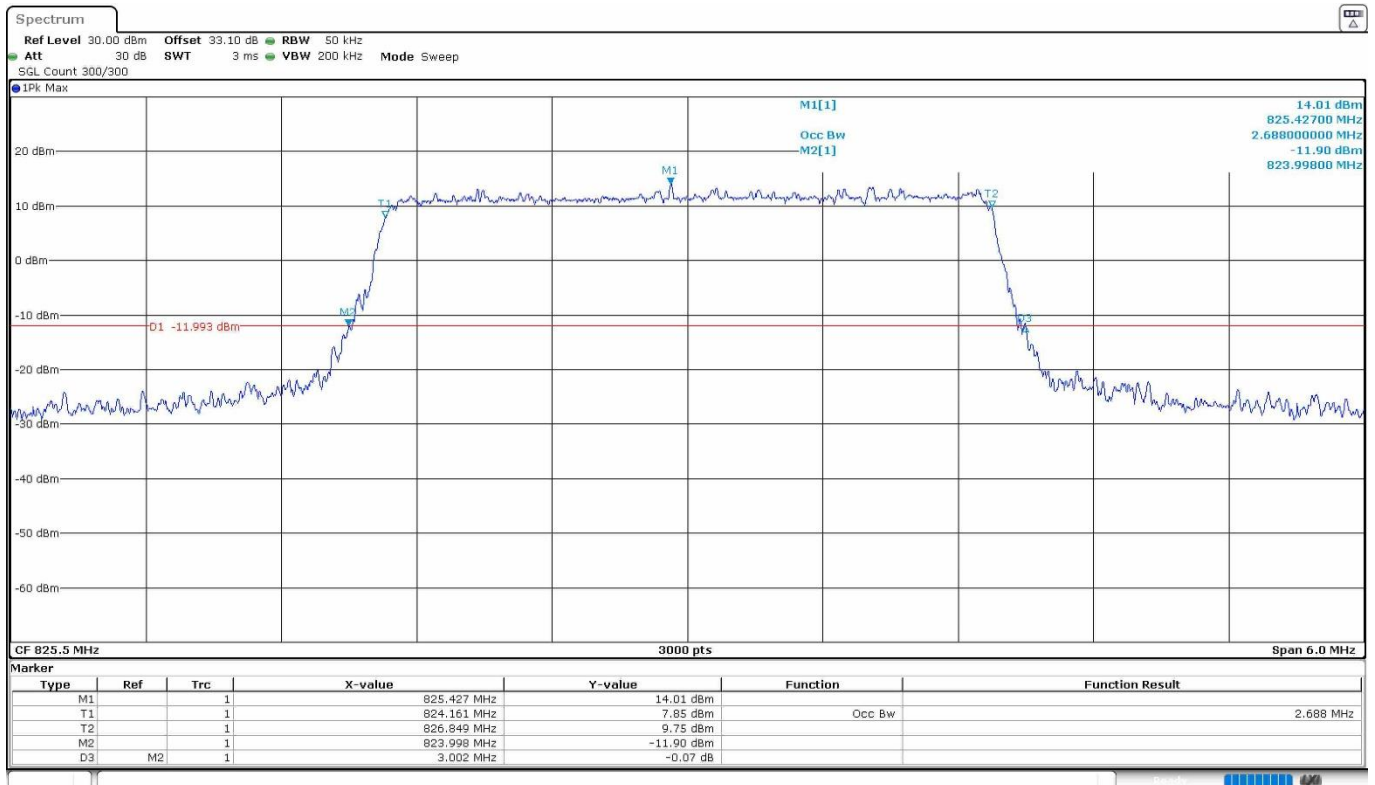
Date: 5. Dec. 2023 13:44:43

High Channel:



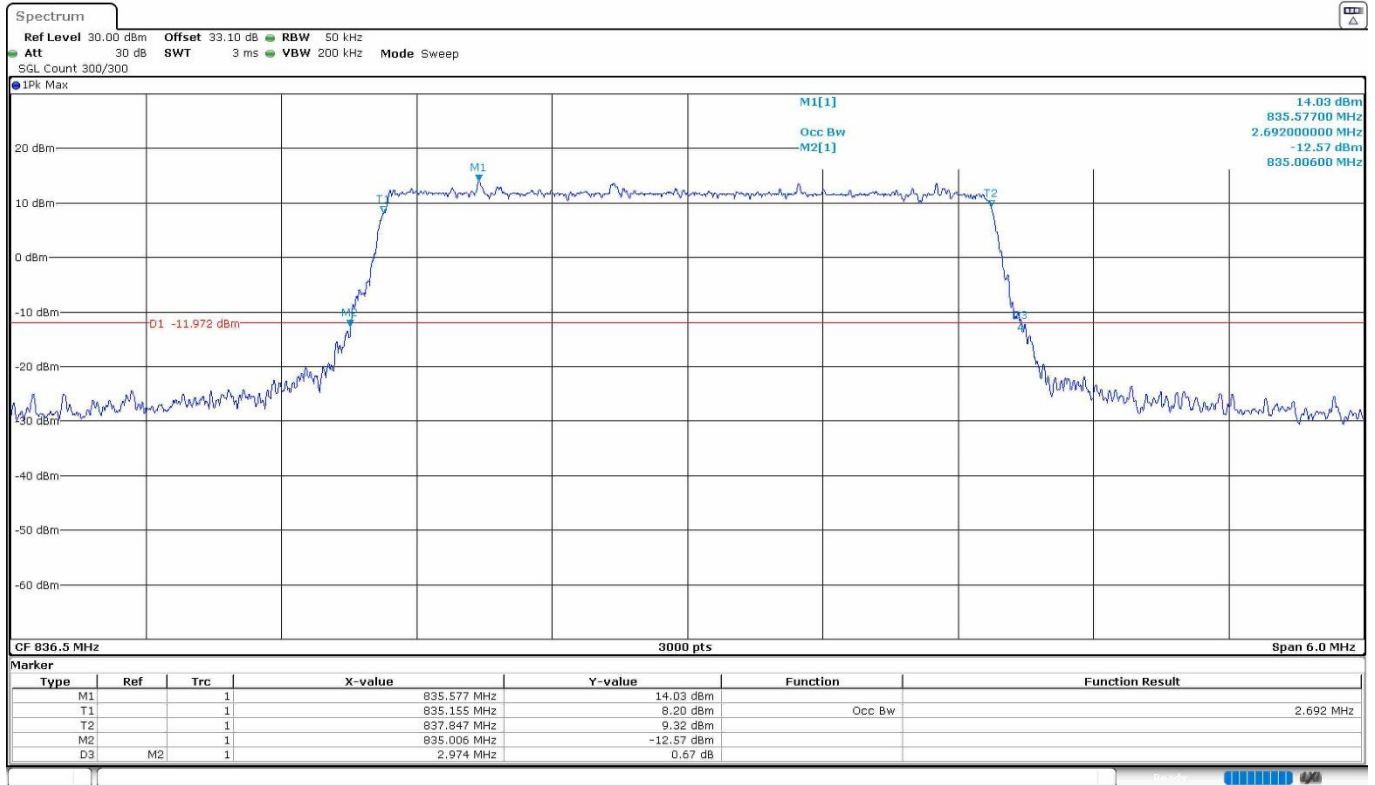
Dated: 5.05.2023 13:45:17

LTE Cat 1bis Band 5. BW=3 MHz. 16QAM. RB Size=All.
 Low Channel:



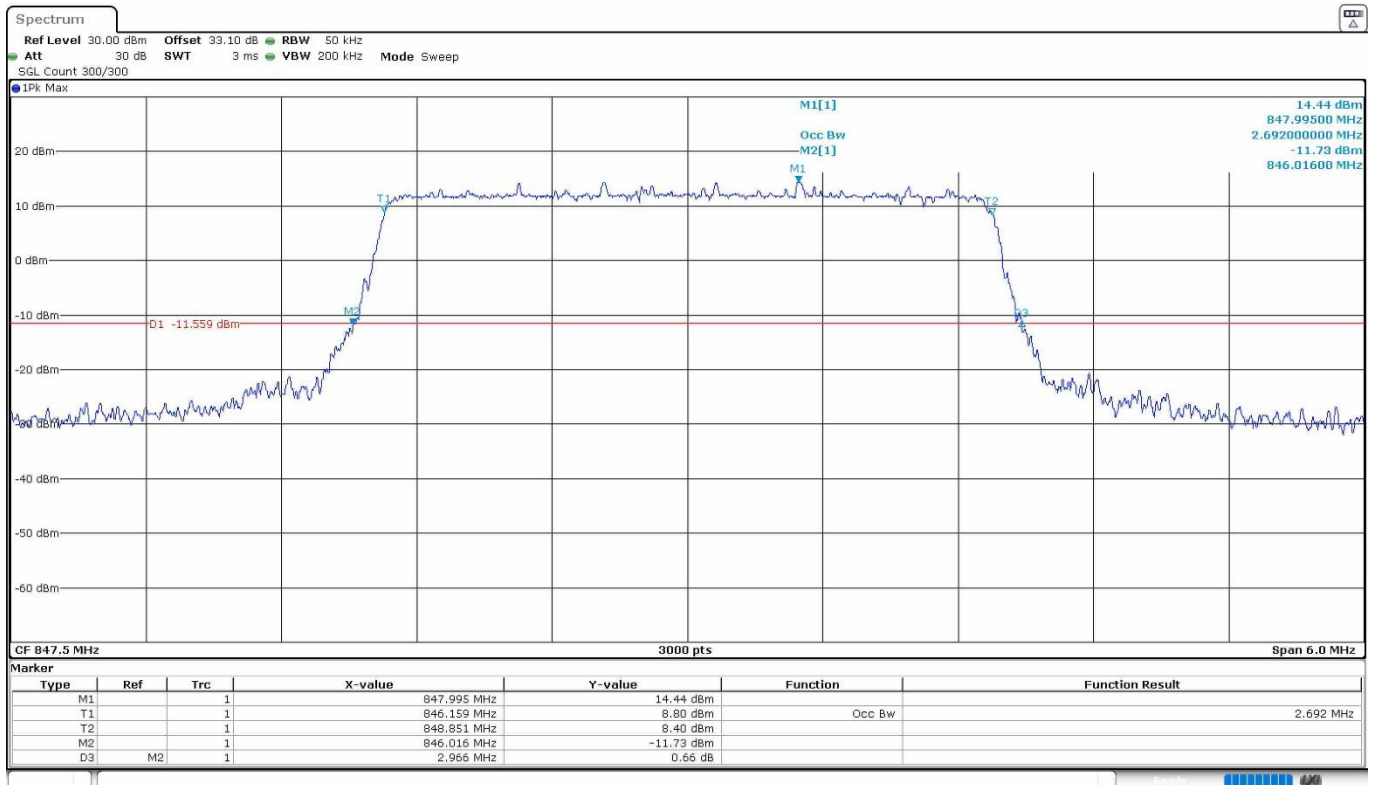
Dated: 5.05.2023 13:44:25

Middle Channel:



Date: 5, Dec, 2023 13:44:58

High Channel:



Date: 5, Dec, 2023 13:45:32

LTE Cat 1bis Band 5. BW=5 MHz. QPSK. RB Size=All. RB Offset=0.

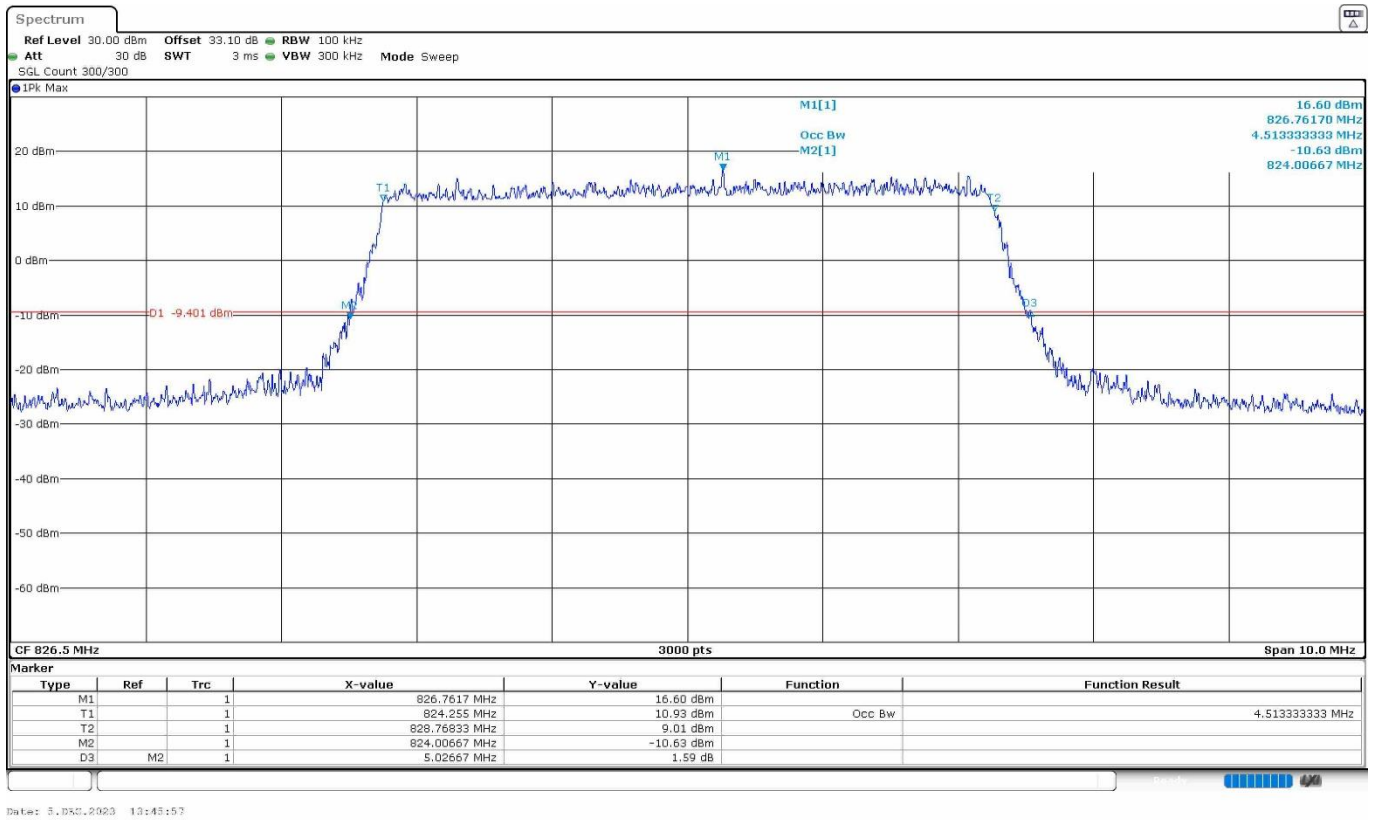
| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 4513.33 | 4500.00 | 4493.33 |
| -26 dBc Bandwidth (kHz) | 5026.67 | 5043.33 | 5006.67 |
| Measurement uncertainty (kHz) | <±3.75 | | |

LTE Cat 1bis Band 5. BW=5 MHz. 16QAM. RB Size=All. RB Offset=0.

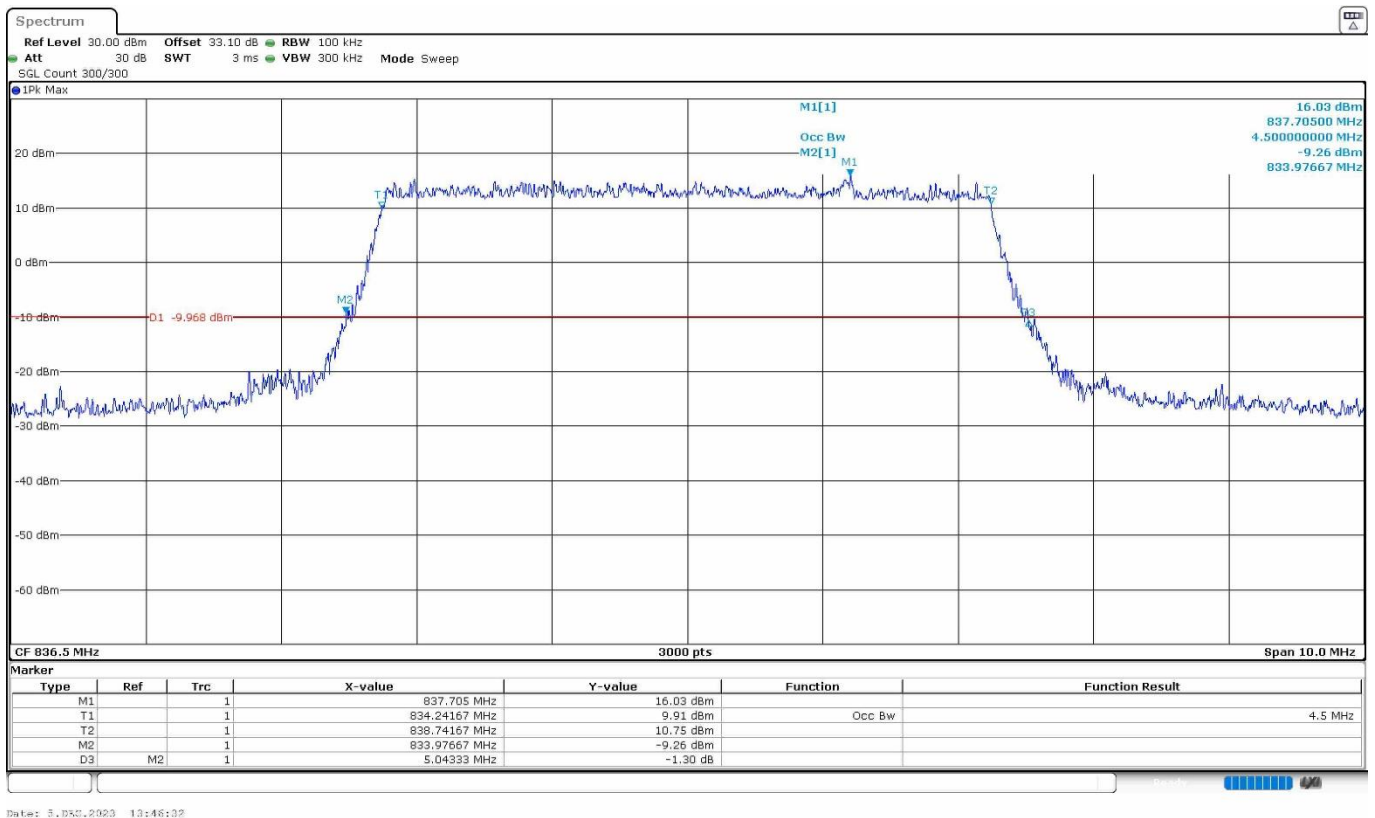
| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 4500.00 | 4503.33 | 4513.33 |
| -26 dBc Bandwidth (kHz) | 5066.67 | 4996.67 | 5033.33 |
| Measurement uncertainty (kHz) | <±3.75 | | |

LTE Cat 1bis Band 5. BW=5 MHz. QPSK. RB Size=All.

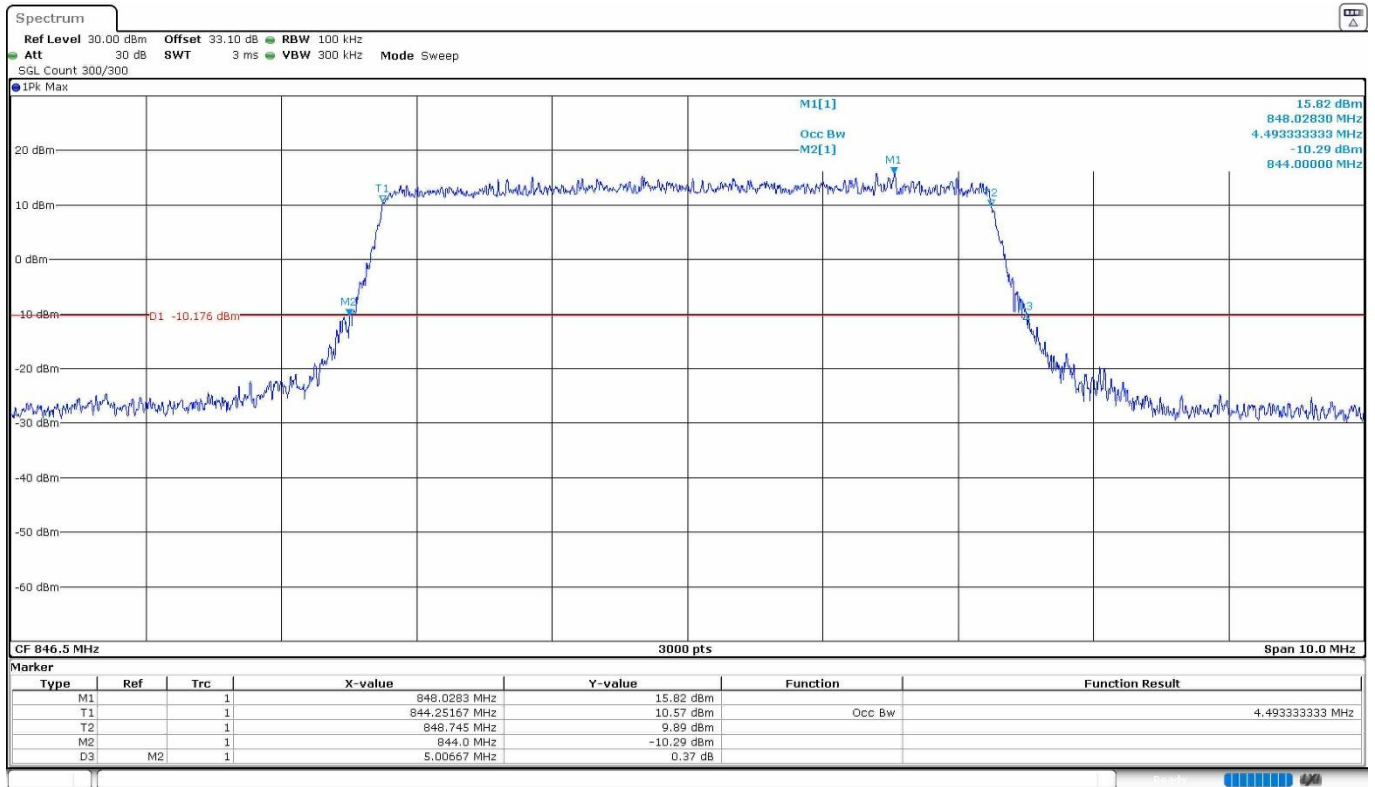
Low Channel:



Middle Channel:

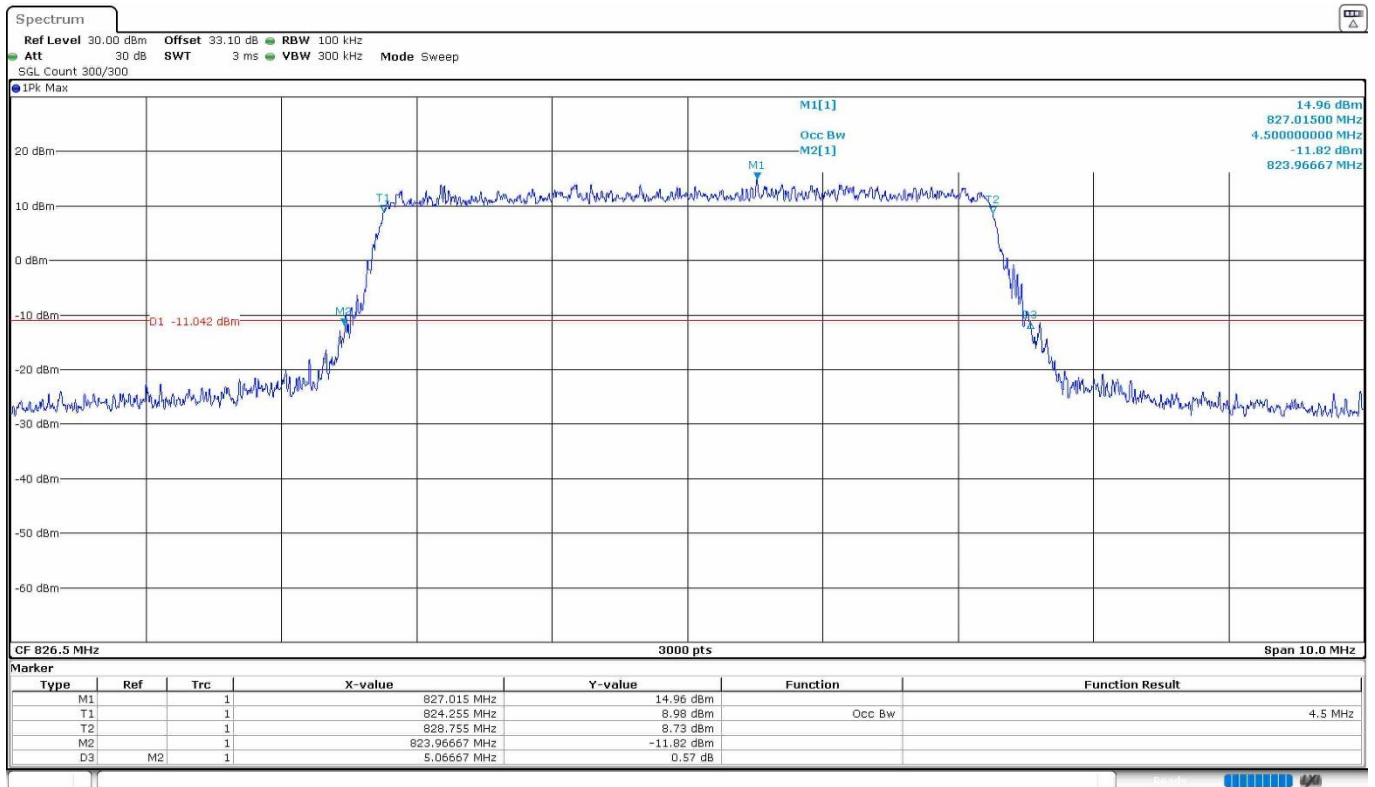


High Channel:



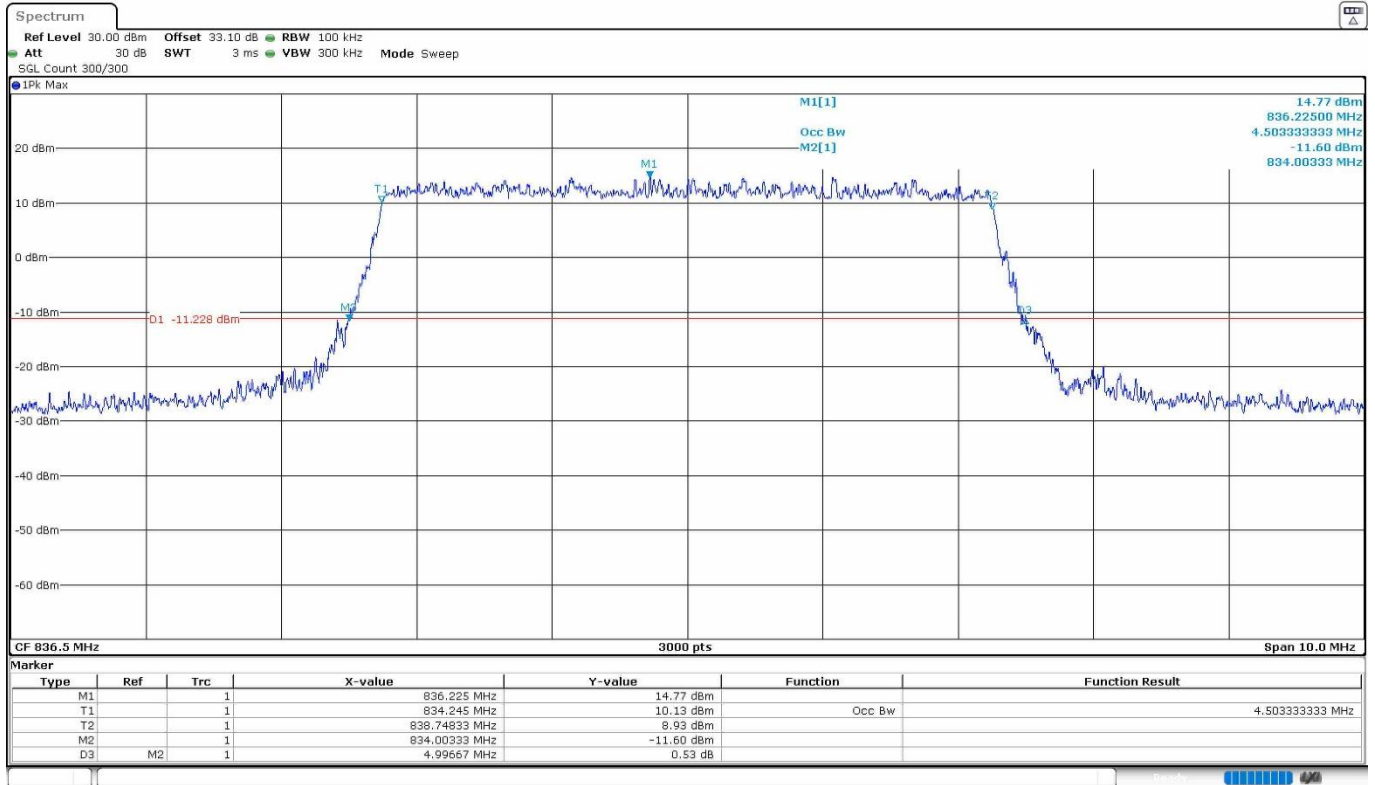
Date: 5.05.2023 13:47:07

LTE Cat 1bis Band 5, BW=5 MHz, 16QAM, RB Size=All.
 Low Channel:



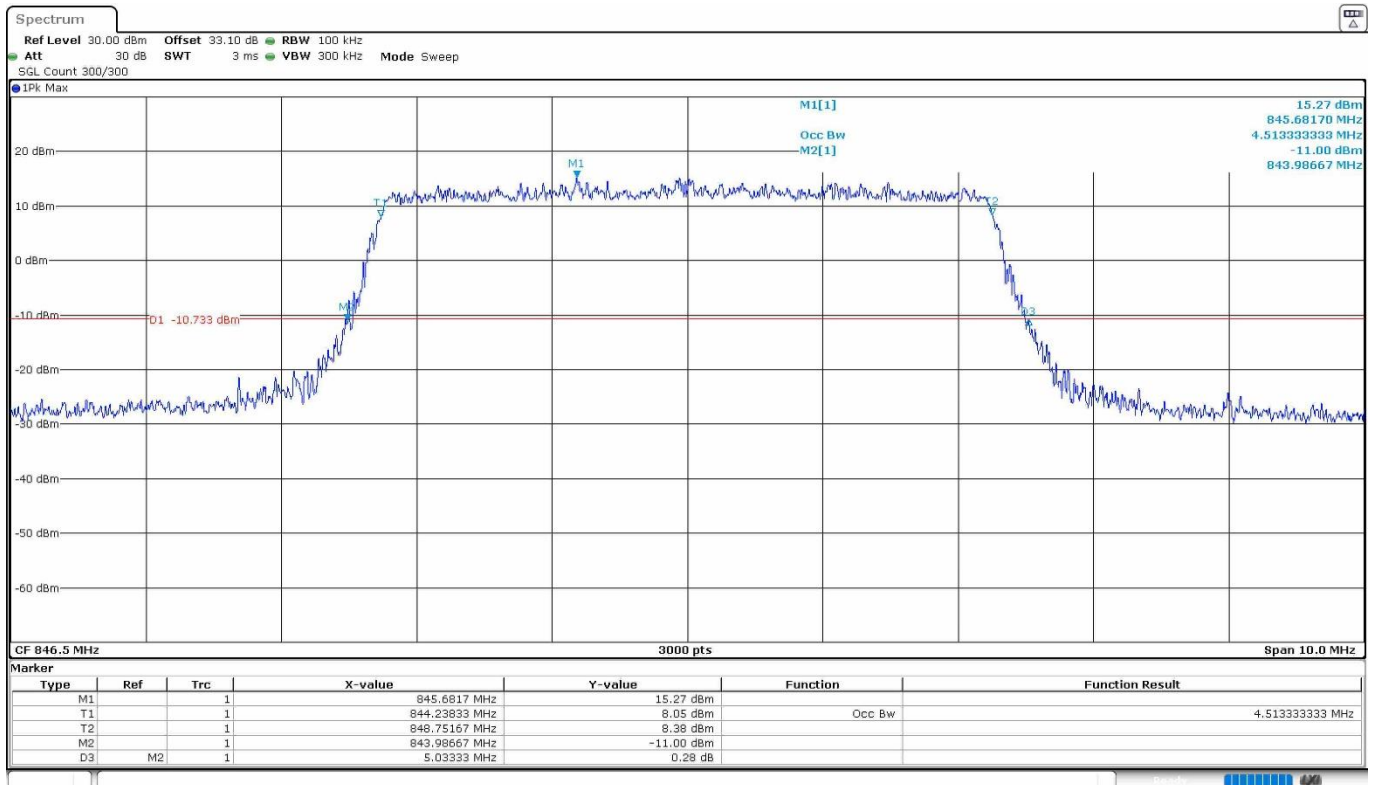
Date: 5.05.2023 13:48:13

Middle Channel:



Date: 5, 05, 2023 13:48:47

High Channel:



Date: 5, 05, 2023 13:47:22

LTE Cat 1bis Band 5. BW=10 MHz. QPSK. RB Size=All. RB Offset=0.

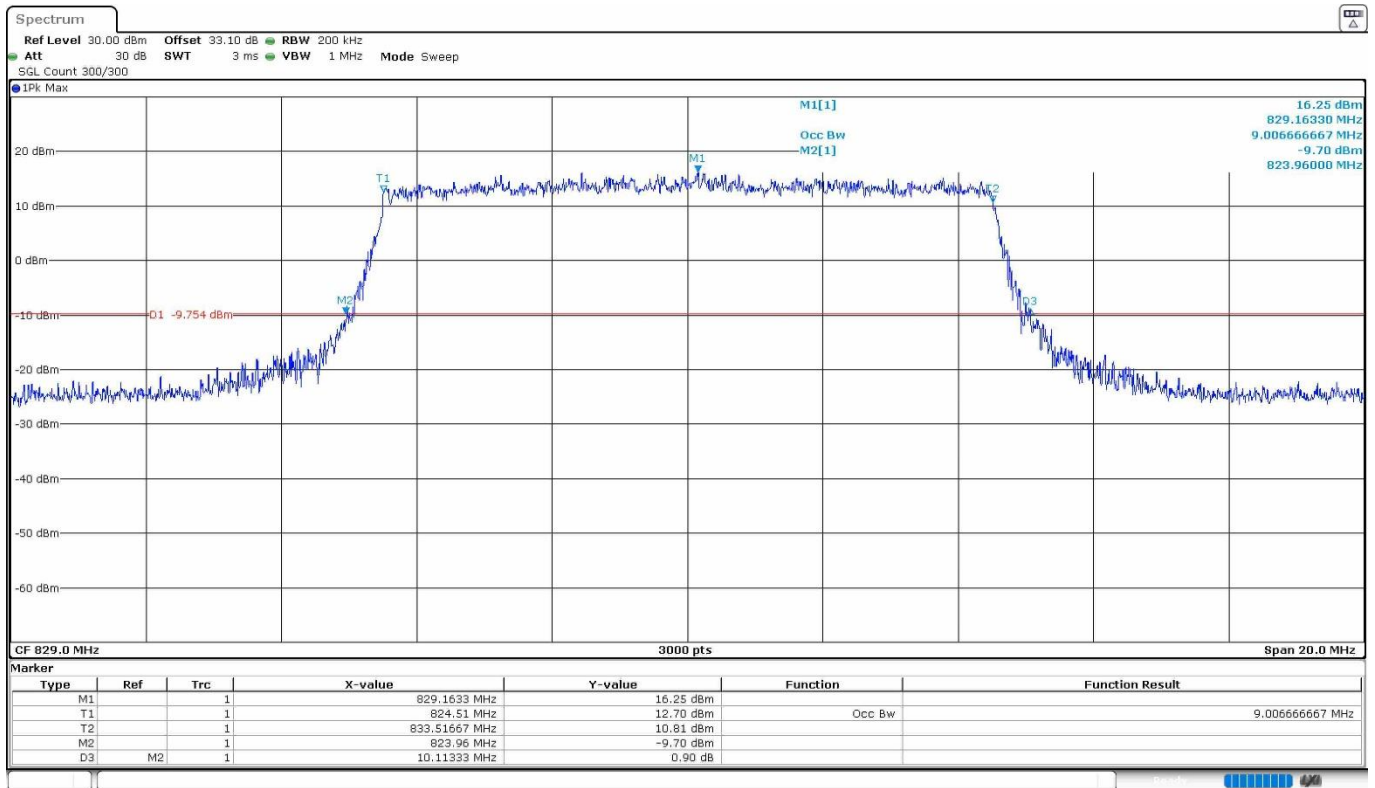
| Channel | Low | Middle | High |
|-------------------------------|----------|----------|----------|
| 99% Occupied Bandwidth (kHz) | 9006.67 | 9006.67 | 8973.33 |
| -26 dBc Bandwidth (kHz) | 10113.33 | 10248.90 | 10107.90 |
| Measurement uncertainty (kHz) | <±3.75 | | |

LTE Cat 1bis Band 5. BW=10 MHz. 16QAM. RB Size=All. RB Offset=0.

| Channel | Low | Middle | High |
|-------------------------------|---------|---------|---------|
| 99% Occupied Bandwidth (kHz) | 4626.67 | 4680.00 | 4653.33 |
| -26 dBc Bandwidth (kHz) | 5741.70 | 5781.20 | 5964.30 |
| Measurement uncertainty (kHz) | <±3.75 | | |

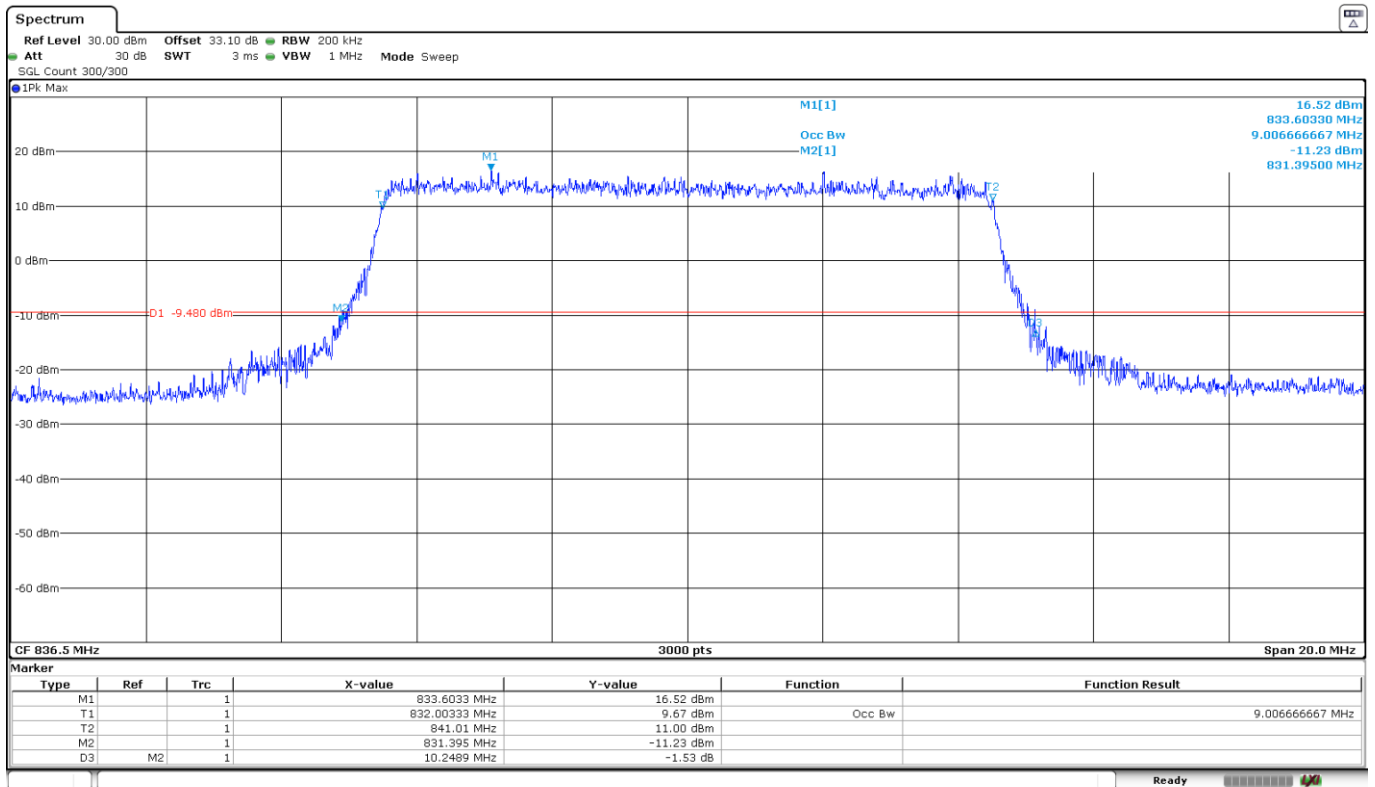
LTE Cat 1bis Band 5. BW=10 MHz. QPSK. RB Size=All.

Low Channel:



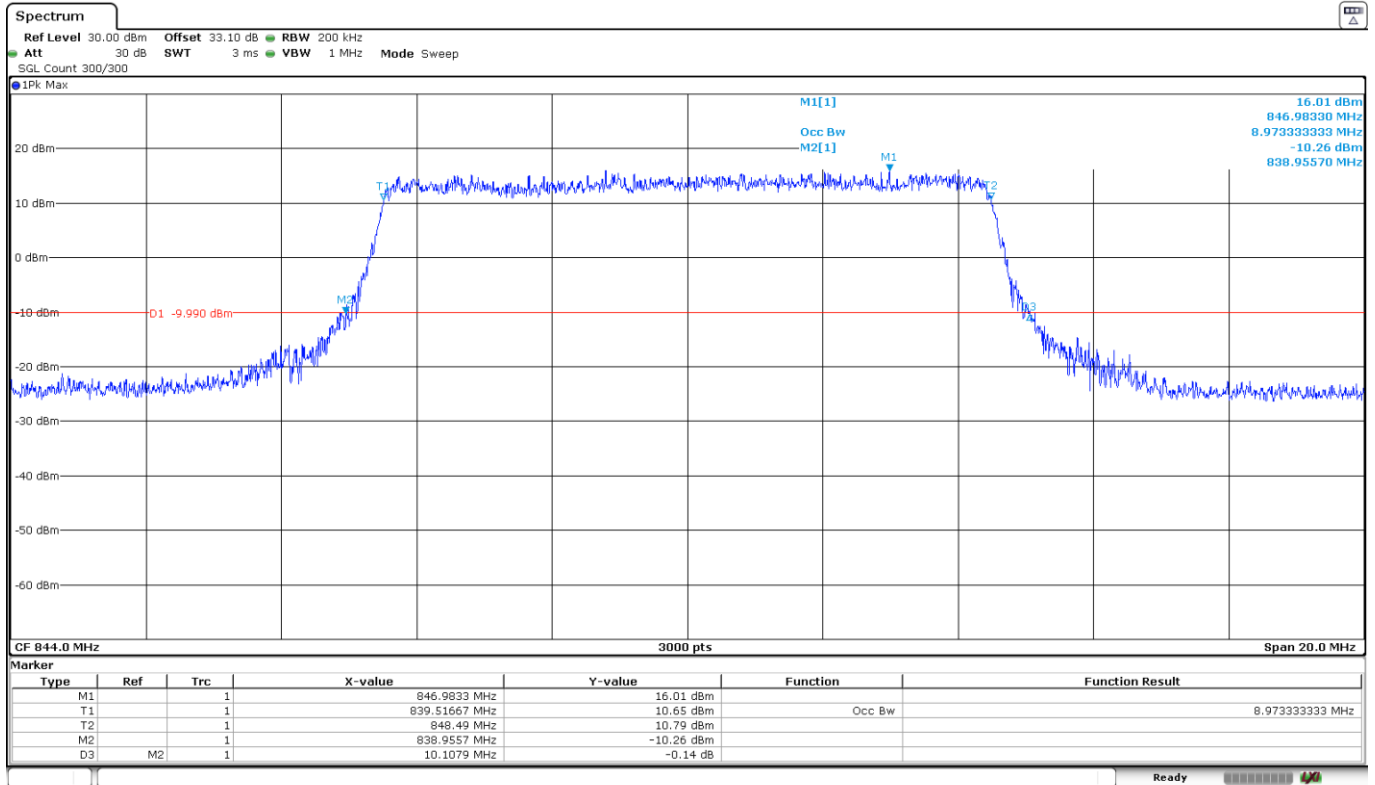
Date: 5. DEC. 2023 13:47:48

Middle Channel:



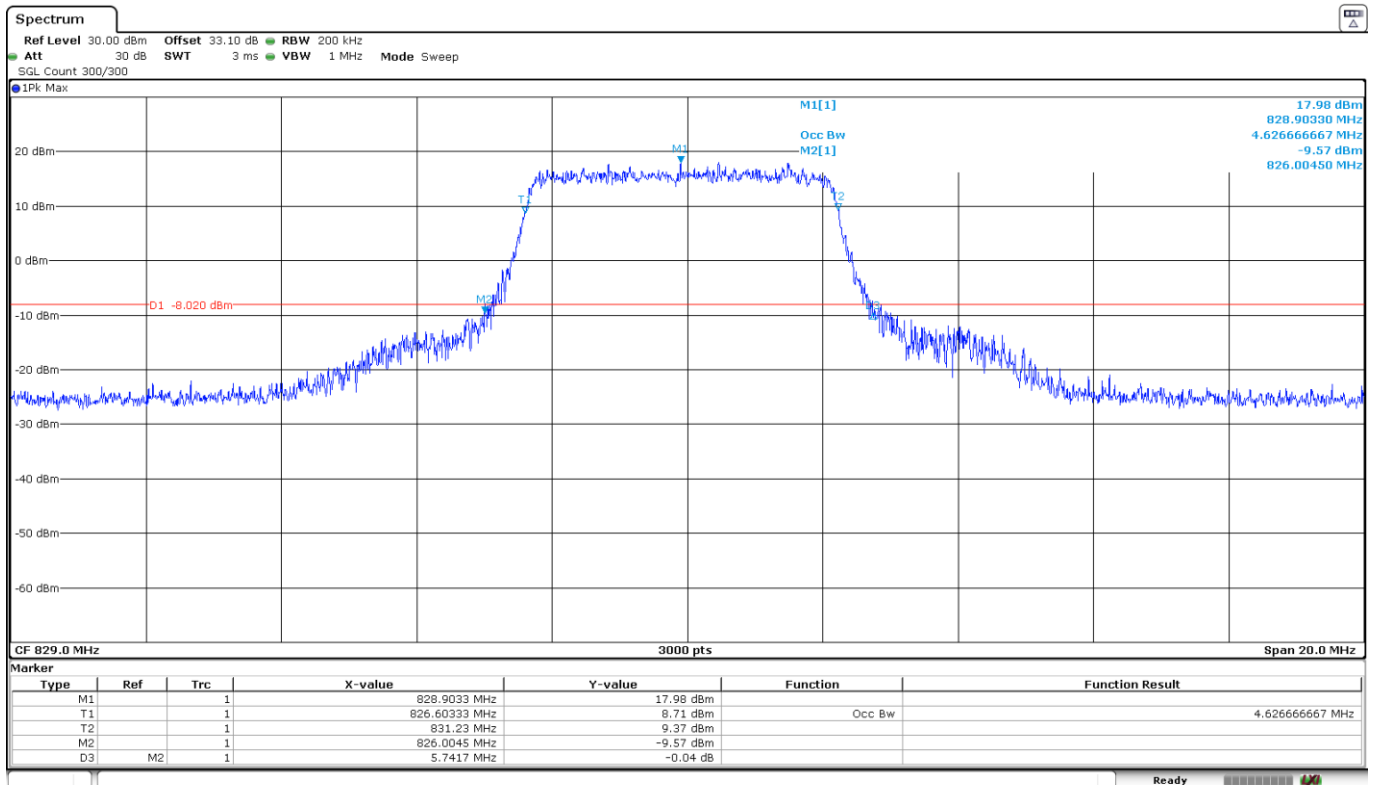
Date: 5. DEC. 2023 14:35:33

High Channel:



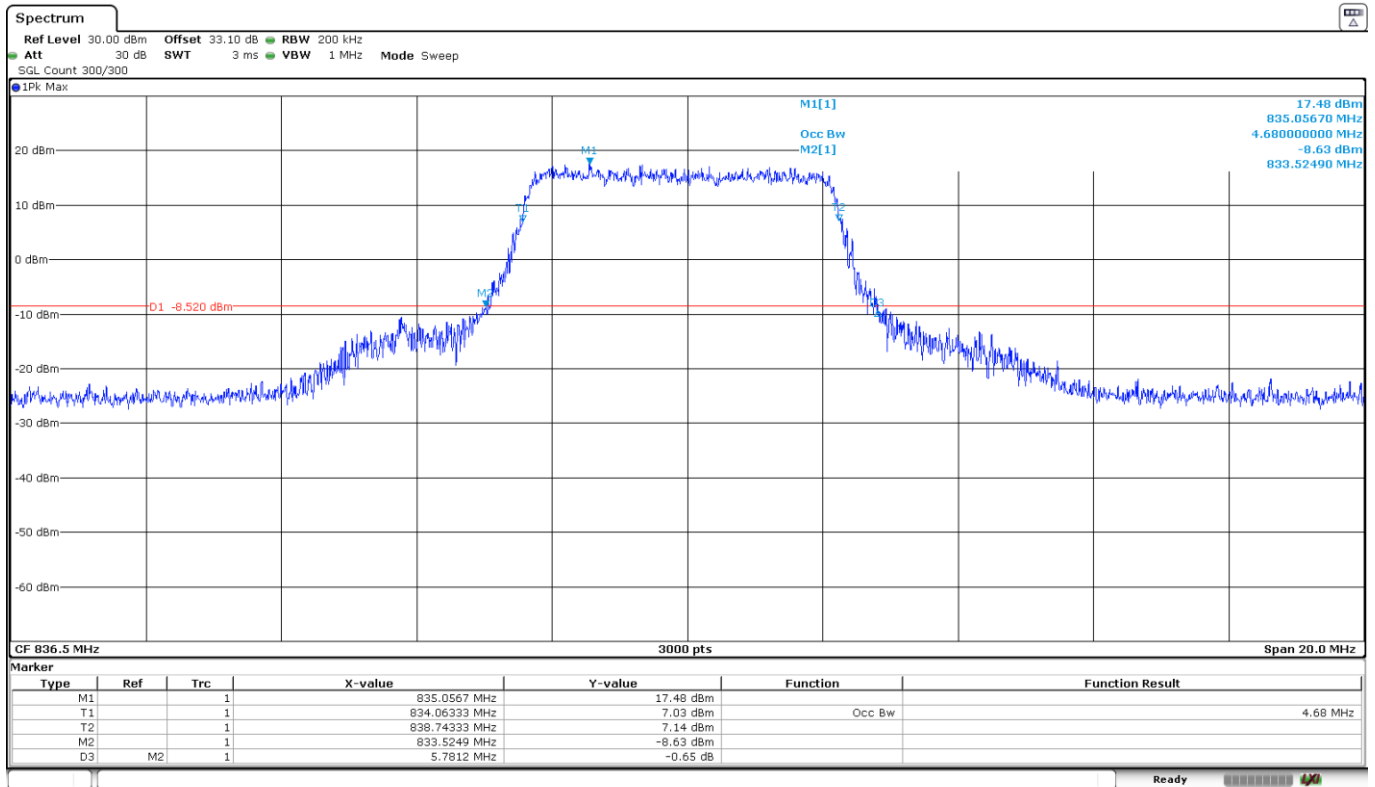
Date: 5, DEC, 2023 14:40:43

LTE Cat 1bis Band 5, BW=10 MHz, 16QAM, RB Size=All.
 Low Channel:



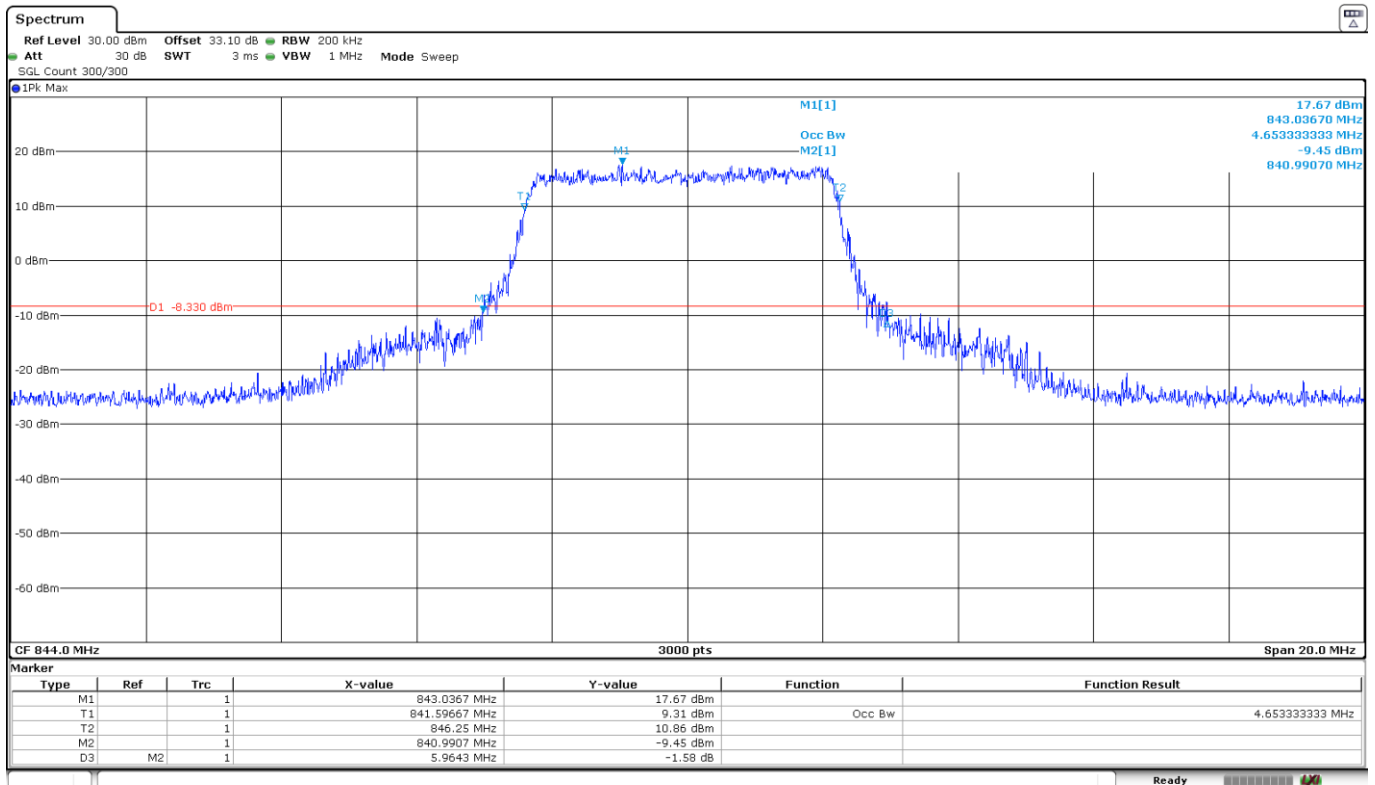
Date: 5, DEC, 2023 14:38:00

Middle Channel:



Date: 5, DEC, 2023 14:25:22

High Channel:



Date: 5, DEC, 2023 14:42:04

Spurious emissions at antenna terminals

Limits

* FCC § 2.1051 and § 22.917:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz 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 employed.

- * RSS-132. 5.5: Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
- i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} P$ (watts).
 - ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} P$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

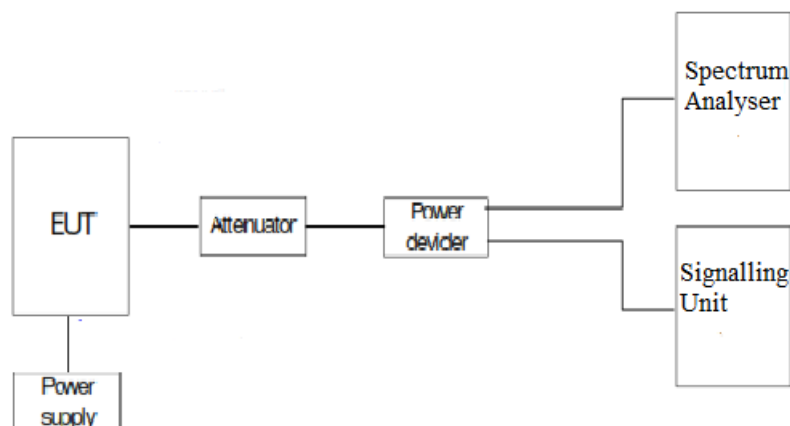
Method

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 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.

Test Setup



Results

LTE Cat 1bis Band 5:

A preliminary scan determined the worst-case:

BW=10 MHz. QPSK. RB Size=1. RB Offset=24.

The next results are for this worst-case configuration.

Frequency range 9 KHz - 10 GHz:

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

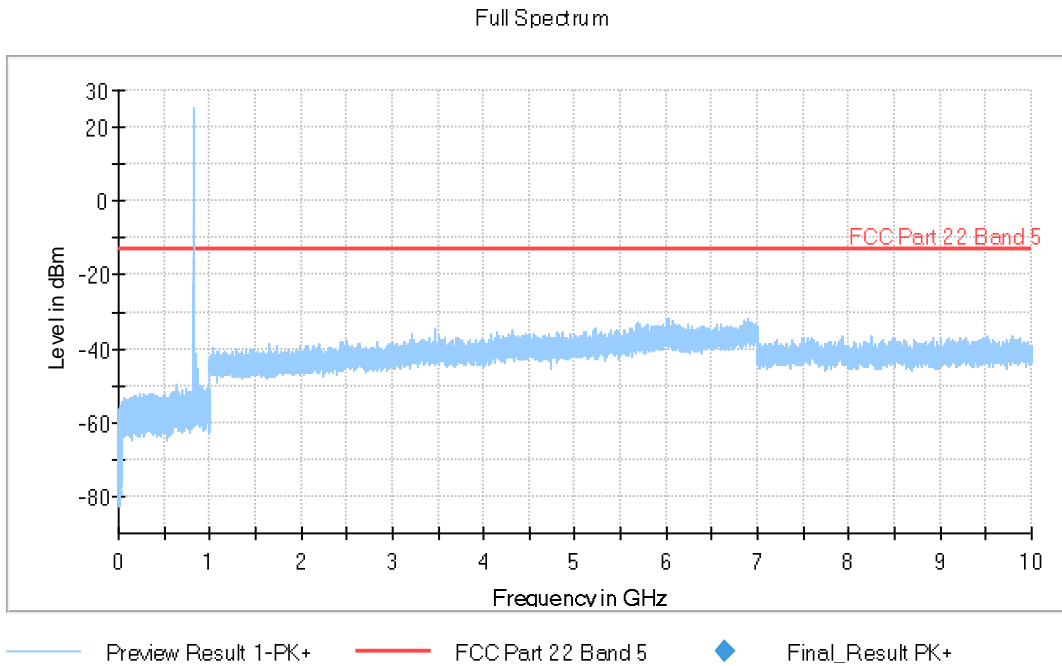
Measurement uncertainty (dB): $<\pm 2.76$

Verdict: PASS

LTE Cat 1bis Band 5: BW=10 MHz. QPSK. RB Size=1. RB Offset=24.

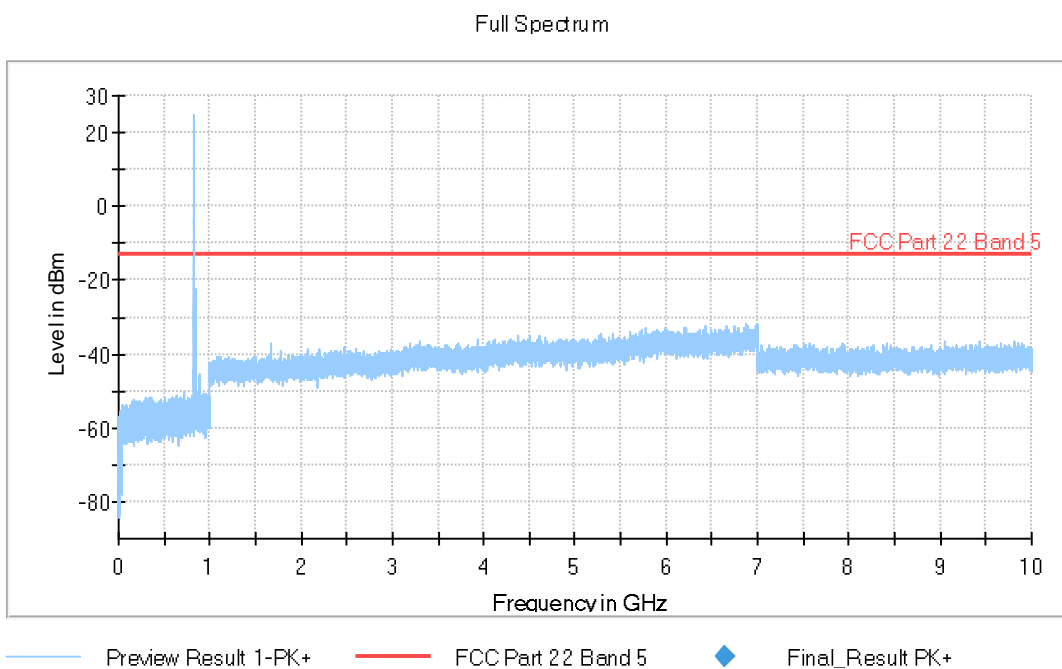
| Subrange | Step Size | Detectors | Bandwidth | Sweep Time | Preamp |
|--------------------|------------|-----------|-----------|------------|--------|
| Receiver: [FSV 40] | | | | | |
| 9 kHz - 150 kHz | 14.1 Hz | PK+ | 300 Hz | Coupled | 0 dB |
| 150 kHz - 30 MHz | 932.812 Hz | PK+ | 10 kHz | Coupled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

Low Channel:



The peak above the limit is the carrier frequency. Downlink is also shown in the graphic.

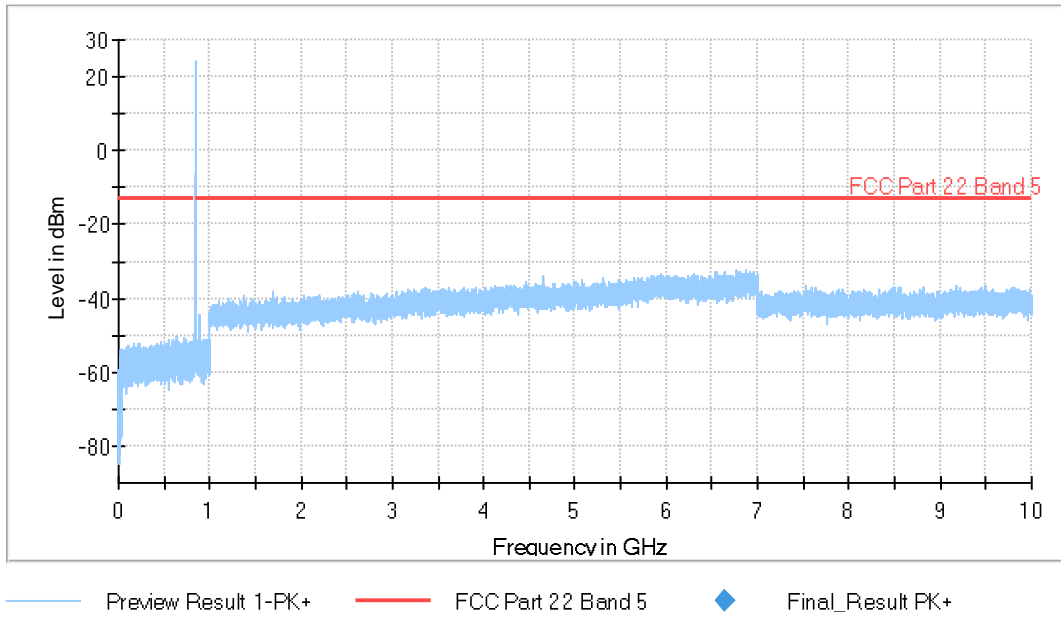
Middle Channel:



The peak above the limit is the carrier frequency. Downlink is also shown in the graphic.

High Channel:

Full Spectrum



The peak above the limit is the carrier frequency. Downlink is also shown in the graphic.

Spurious emissions at antenna terminals at Block Edges

Limits

* FCC § 2.1051 and § 22.917:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz 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 employed.

- * RSS-132. 5.5: Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
- i. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} P$ (watts).
 - ii. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} P$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Method

The EUT RF output connector was connected to a spectrum analyzer 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 splitter.

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

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

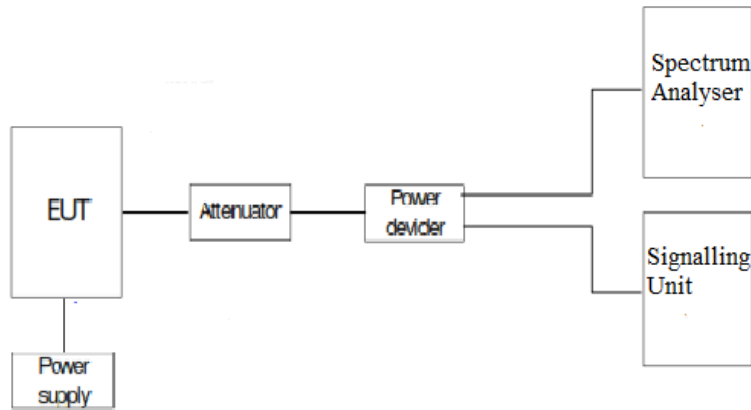
As stated in FCC part 22.917 / RSS-132 Clause 5.5, in the 1 MHz bands immediately outside and adjacent to the frequency block or band a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

Measurement Limit:

At P_o transmitting power, the specified minimum attenuation $43 + 10 \log_{10} p$ (watts) becomes:

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

Test Setup



Results

LTE Cat 1bis Band 5:

Preliminary measurements determined QPSK, BW=3 MHz as the worst case.

| | | | | |
|---|----------------------------------|--------------------------------|--------------------------------|---------------------------------|
| LTE Cat 1bis Band 5. QPSK. | RB=1. Offset=0. BW=1.4 MHz | RB=1. Offset=0. BW=3 MHz | RB=1. Offset=0. BW=5 MHz | RB=1. Offset=0. BW=10 MHz |
| Maximum measured level at <u>Low Block Edge</u> at antenna port (dBm) | -25.26 | -16.23 | -22.27 | -17.36 |

| | | | | |
|---|-------------------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| LTE Cat 1bis Band 5. QPSK. | RB= All. Offset=0. BW=1.4 MHz | RB= All. Offset=0. BW=3 MHz | RB= All. Offset=0. BW=5 MHz | RB= All. Offset=0. BW=10 MHz |
| Maximum measured level at <u>Low Block Edge</u> at antenna port (dBm) | -29.33 | -26.21 | -27.16 | -27.79 |

| | | | | |
|--|------------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| LTE Cat 1bis Band 5. QPSK. | RB=1. Offset=Max. BW=1.4 MHz | RB=1. Offset=Max. BW=3 MHz | RB=1. Offset=Max. BW=5 MHz | RB=1. Offset=Max. BW=10 MHz |
| Maximum measured level at <u>High Block Edge</u> at antenna port (dBm) | -25.19 | -16.19 | -22.46 | -17.31 |

| | | | | |
|--|-------------------------------------|-----------------------------------|-----------------------------------|------------------------------------|
| LTE Cat 1bis Band 5. QPSK. | RB= All. Offset=0. BW=1.4 MHz | RB= All. Offset=0. BW=3 MHz | RB= All. Offset=0. BW=5 MHz | RB= All. Offset=0. BW=10 MHz |
| Maximum measured level at <u>High Block Edge</u> at antenna port (dBm) | -33.06 | -27.75 | -27.20 | -27.88 |

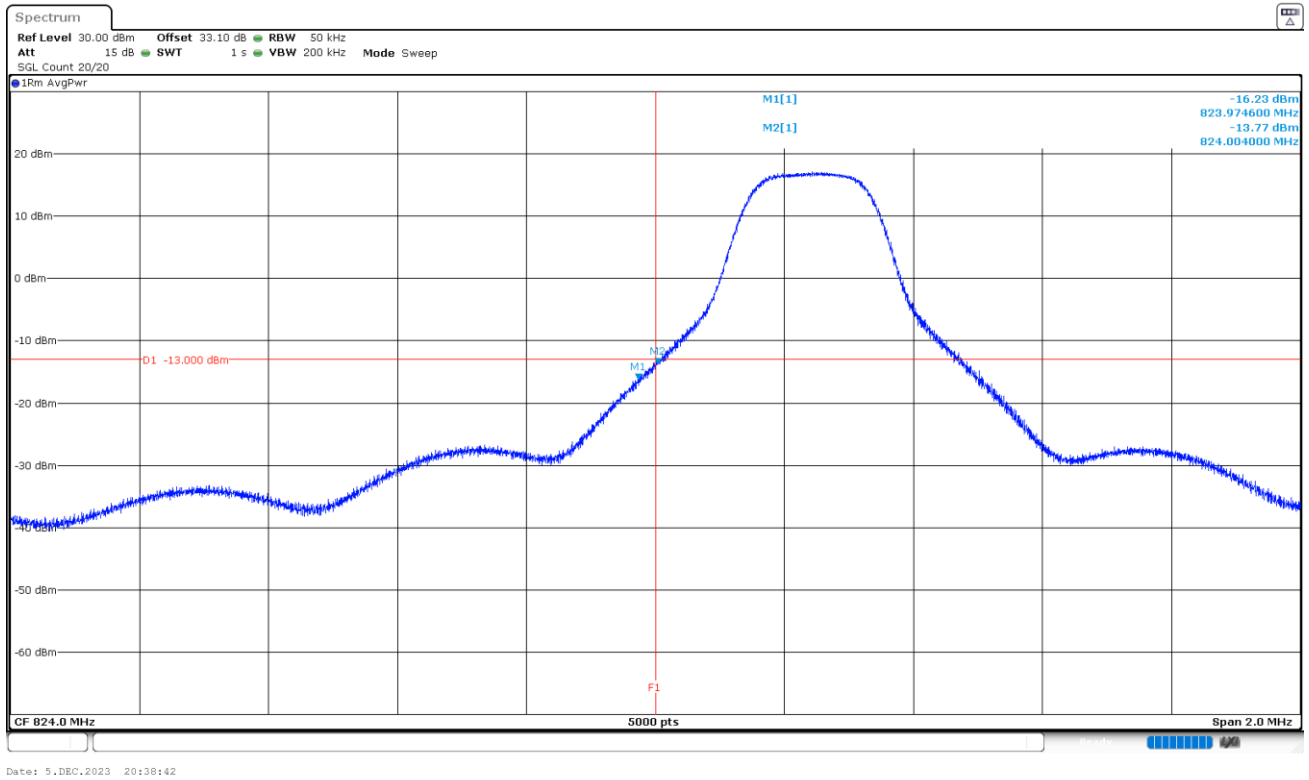
Measurement uncertainty (dB): ± 2.76

Verdict

Pass

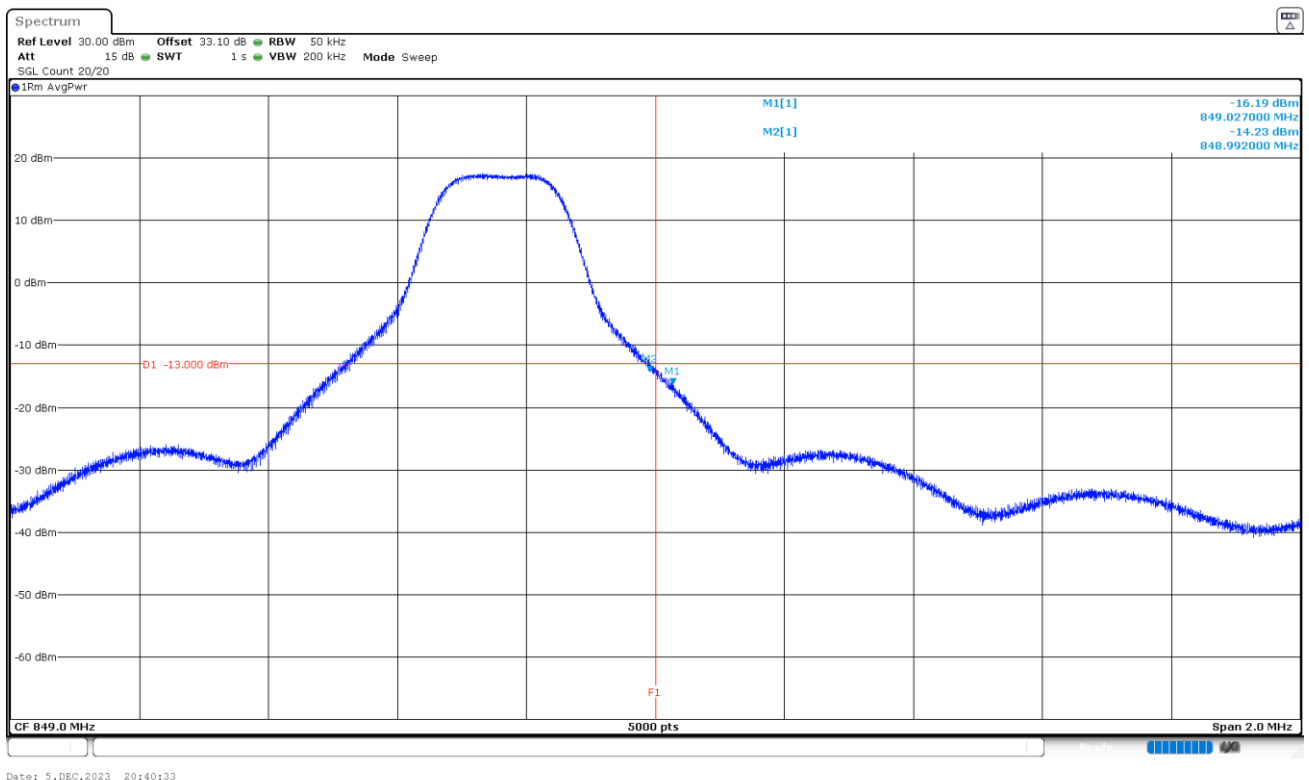
The plots below are for the worst case configuration specified before.

LTE Cat 1bis Band 5. BW=3 MHz. QPSK. RB Size= 1. RB Offset = 0. Low Block Edge:

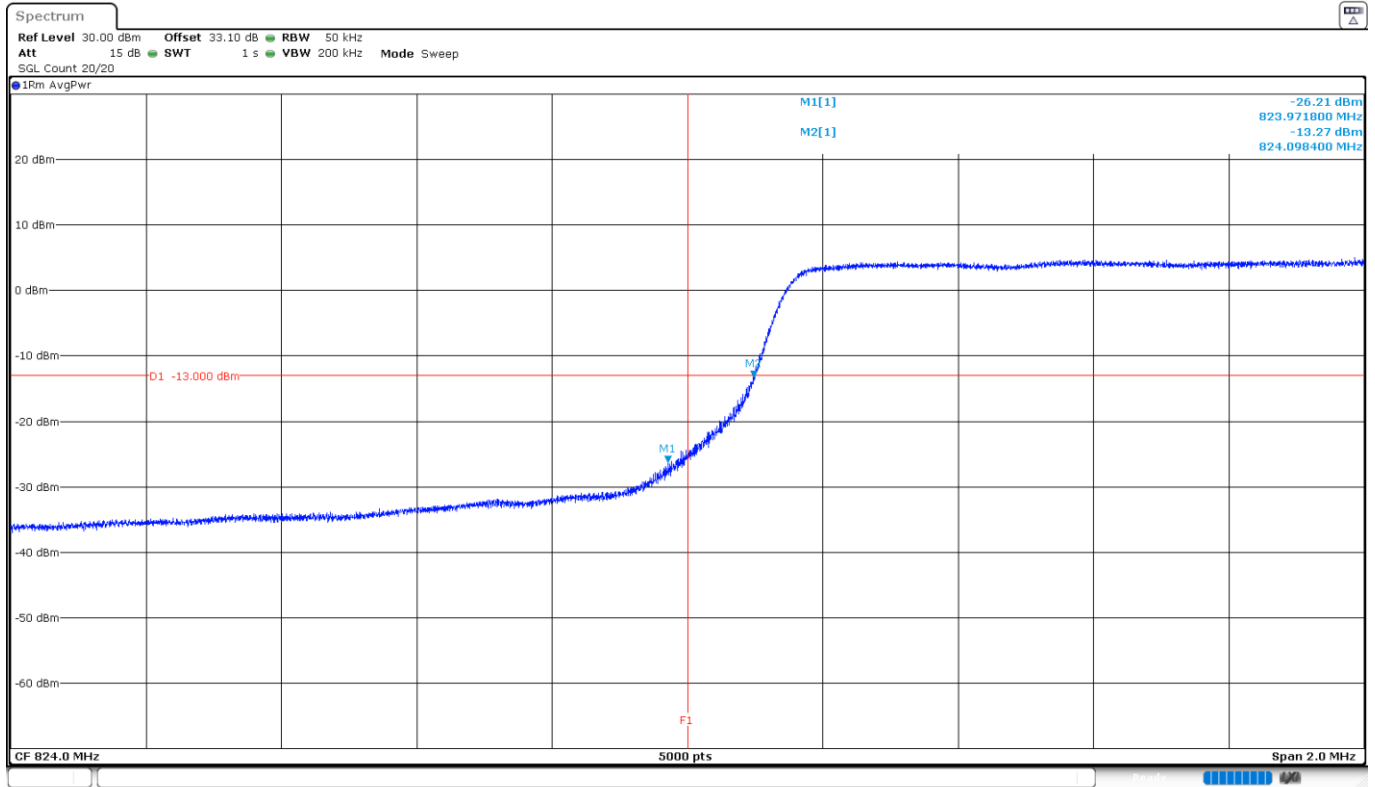


The equipment transmits at the maximum output power.

LTE Cat 1bis Band 5. BW=3 MHz. QPSK. RB Size=1. RB Offset=Max. High Block Edge:



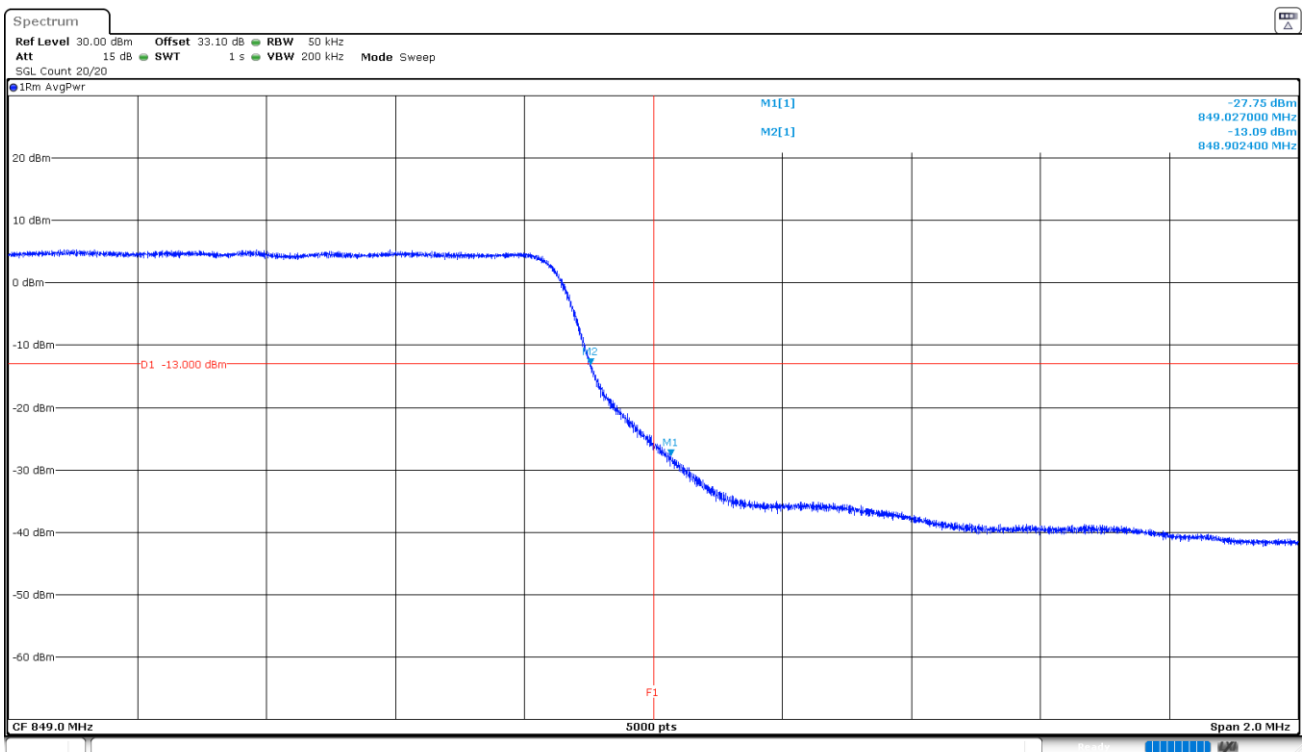
The equipment transmits at the maximum output power.
 LTE Cat 1bis Band 5. BW=3 MHz. QPSK. RB Size=All. RB Offset=0. Low Block Edge:



Date: 5. DEC. 2023 20:39:09

The equipment transmits at the maximum output power.

LTE Cat 1bis Band 5. BW=3 MHz. QPSK. RB Size=All. RB Offset=0. High Block Edge:



Date: 5. DEC. 2023 20:41:00

The equipment transmits at the maximum output power.

Verdict: PASS

Radiated emissions

Limits

* FCC § 2.1051 and § 22.917:

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

Compliance with these rules is based on the use of measurement instrumentation employing a reference bandwidth as follows:

In the spectrum below 1 GHz, instrumentation should employ a reference bandwidth of 100 kHz or greater. In the 1 MHz 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 employed.

- * RSS-132. 5.5: Mobile and base station equipment shall comply with the limits in (i) and (ii) below.
- iii. In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} P$ (watts).
 - iv. After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least $43 + 10 \log_{10} P$ (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Method

The measurement was performed with the EUT inside an anechoic chamber. The spectrum was scanned from 30 MHz to at least the 10th harmonic of the high frequency generated within the equipment.

The EUT was placed on a 80 centimetres high non-conductive stand at a 3 meter distance from the measuring antenna.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the height and polarization of the measuring antenna. The maximum meter reading was recorded.

Measurement Limit:

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:

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

The maximum field strength (dB μ V/m) of each detected emission at less than 20 dB respect to the limit is converted to an equivalent EIRP level (dBm) according to ANSI C63.26 with the formula:

EIRP (dBm) = E (dB μ V/m) + 20 log(D) - 104.8; where D is the measurement distance (in the far field region) in m. D = 3 m