# FCC Measurement/Technical Report on

# SARA-R410

# FCC ID: XPY2AGQN4NNN
# IC: 8595A-2AGQN4NNN

FCC Part 27
**Test Report Reference:** MDE_UBLOX_1901_FCCd_REV01

**Test Laboratory:**
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Note:
The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the test laboratory.

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# 1 APPLIED STANDARDS AND TEST SUMMARY

## 1.1 APPLIED STANDARDS

**Type of Authorization**
Certification for a cellular mobile device.

**Applicable FCC Rules**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 27, (10/1/18 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

Part 27; Miscellaneous Wireless Communications Services
Subpart C – Technical standards

§ 27.50 – Power and duty cycle limits
§ 27.53 – Emission limits
§ 27.54 – Frequency stability

The tests were selected and performed with reference to:

- FCC Public Notice 971168 applying "Measurement guidance for certification of licensed digital transmitters" 971168 D01 v03r01, 2018-04-09
- ANSI C63.26: 2015

**Summary Test Results:**

**The EUT complied with all performed tests as listed in chapter 1.3 Measurement Summary / Signatures.**

## 1.2 FCC-IC CORRELATION TABLE

### Correlation of measurement requirements for Cellular Mobile Devices from FCC and ISED Canada

| Measurement | FCC reference | ISED reference |
|---|---|---|
| RF Output Power | § 2.1046<br>§ 27.50 | RSS-GEN Issue 5, 6.12<br>RSS-130 Issue 2, 4.6.2/4.6.3<br>RSS-139 Issue 3, 6.5<br>RSS-199 Issue 3, 4.4 |
| Peak to Average-Ratio | § 27.50 | RSS-130 Issue 2: 4.6.1<br>RSS 139 Issue 3: 6.5<br>RSS-199 Issue 3, 4.4 |
| Emission and Occupied bandwidth | § 2.1049 | RSS-GEN Issue 5, 6.7 |
| Spurious Emission at Antenna Terminals | § 2.1051<br>§ 27.53 | RSS-GEN Issue 5, 6.13<br>RSS-130 Issue 2: 4.7.1/4.7.2<br>RSS-139 Issue 3, 6.6<br>RSS-199 Issue 3, 4.5 |
| Band Edge Compliance | § 2.1051<br>§ 27.53 | RSS-GEN Issue 5, 6.13<br>RSS-130 Issue 2: 4.7.1/4.7.2<br>RSS-139 Issue 3, 6.6<br>RSS-199 Issue 3, 4.5 |
| Frequency stability | § 2.1055<br>§ 27.54 | RSS-GEN Issue 5, 6.11<br>RSS-130 Issue 2: 4.5<br>RSS-139 Issue 3: 6.4<br>RSS-199 Issue 3, 4.3 |
| Field strength of spurious radiation | § 2.1053<br>§ 27.53 | RSS-GEN Issue 5, 6.13<br>RSS-130 Issue 2: 4.7.1/4.7.2<br>RSS-139 Issue 3: 6.6<br>RSS-199 Issue 3, 4.5 |

## 1.3 MEASUREMENT SUMMARY / SIGNATURES

**47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1046 § 27.50**

RF Output Power

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| **OP-Mode**<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | **Setup** | **FCC** | **IC** |
|---|---|---|---|
| CAT-M1, eFDD 12 16QAM, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |

## 47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1046 § 27.50

RF Output Power

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 3, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 6, conducted | S01_AB01 | Passed | Passed |

## 47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1055 § 27.54

Frequency stability

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |

## 47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1051 § 27.53

Spurious emissions at antenna terminals

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |

## 47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1053 § 27.53

Field strength of spurious radiation

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, mid channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, low channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, mid channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |

**47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1053 § 27.53**

Field strength of spurious radiation

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 1, radiated | S01_AB01 | Passed | Passed |

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Emission and occupied bandwidth

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| CAT-M1, eFDD 12 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |

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Emission and occupied bandwidth

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| **OP-Mode**<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | **Setup** | **FCC** | **IC** |
|---|---|---|---|
| NB-IoT, eFDD 4 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |

**47 CFR CHAPTER I FCC PART 27 Subpart C § 2.1051 § 27.53**

Band edge compliance

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| **OP-Mode**<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | **Setup** | **FCC** | **IC** |
|---|---|---|---|
| CAT-M1, eFDD 12 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |

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Peak to Average Ratio

The measurement was performed according to ANSI C63.26: 2015 **Final Result**

| OP-Mode<br>Technology, Radio Technology, Operating Frequency, ChBW, Ressource Blocks, Measurement method | Setup | FCC | IC |
|---|---|---|---|
| CAT-M1, eFDD 12 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 12 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 13 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, high channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, low channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 16QAM, mid channel, 1.4 MHz, 5, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, high channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, low channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| CAT-M1, eFDD 4 QPSK, mid channel, 1.4 MHz, 6, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 12 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 13 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, high channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, low channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 BPSK, mid channel, 0.2 MHz, 1, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, high channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, low channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |
| NB-IoT, eFDD 4 QPSK, mid channel, 0.2 MHz, 12, conducted | S01_AB01 | Passed | Passed |

N/A: Not applicable
N/P: Not performed

Revision History

| Report version control | | | |
|---|---|---|---|
| **Version** | **Release date** | **Change Description** | **Version validity** |
| initial | 2019-05-10 | -- | invalid |
| REV01 | 2019-05-20 | Hardware Version of the EUT changed | valid |

COMMENT: -

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
B.Sc. Jens Dörwald

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
Phone +49 (0)2102 749 0

# 2 ADMINISTRATIVE DATA

## 2.1 TESTING LABORATORY

| | |
|---|---|
| Company Name: | 7layers GmbH |
| Address: | Borsigstr. 11<br>40880 Ratingen<br>Germany |

The test facility is accredited by the following accreditation organisation:

| | |
|---|---|
| Laboratory accreditation no: | DAkkS D-PL-12140-01-00 |
| FCC Designation Number: | DE0015 |
| FCC Test Firm Registration: | 929146 |
| ISED CAB Identifier | DE0007; ISED#: 3699A |
| Responsible for accreditation scope: | Dipl.-Ing. Marco Kullik |
| Report Template Version: | 2019-02-12 |

## 2.2 PROJECT DATA

| | |
|---|---|
| Responsible for testing and report: | B.Sc. Jens Dörwald |
| Employees who performed the tests: | documented internally at 7Layers |
| Date of Report: | 2019-05-20 |
| Testing Period: | 2019-02-13 to 2019-04-04 |

## 2.3 APPLICANT DATA

| | |
|---|---|
| Company Name: | u-blox AG |
| Address: | Zürcherstrasse 68, 8800 Thalwil<br>Switzerland |
| Contact Person: | Mr. Giulio Comar |

## 2.4 MANUFACTURER DATA

| | |
|---|---|
| Company Name: | please see Applicant Data |
| Address: | |
| Contact Person: | |

# 3 TEST OBJECT DATA

## 3.1 GENERAL EUT DESCRIPTION

| | |
|---|---|
| Kind of Device product description | LTE CAT-M1 & NB-IoT module. |
| Product name | SARA-R410 |
| Type | - |
| **Declared EUT data by the supplier** | |
| General product description | The EUT is LTE CAT-M1 & NB-IoT module. It supports the relevant bands for FCC Approval<br>LTE CAT-M1: eFDD2 / LTE eFDD4 / eFDD5 / eFDD12 / eFDD13 / eFDD25 /eFDD26<br>NB-IoT: eFDD2 / LTE eFDD4 / eFDD5 / eFDD12 / eFDD13 |
| Voltage Level | 3.8 V |
| Voltage Type | DC |

**The main components of the EUT are listed and described in chapter 3.2 EUT Main components.**

## 3.2 EUT MAIN COMPONENTS

| **Sample Name** | **Sample Code** | **Description** |
|---|---|---|
| DE1015105 | ab01 | |
| **Sample Parameter** | **Value** | |
| Serial No. | 352753095787196 | |
| HW Version | 306B01 | |
| SW Version | L0.08.01 | |
| Comment | - | |

NOTE:The short description is used to simplify the identification of the EUT in this test report.

## 3.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

| **Device** | **Details (Manufacturer, Type Model, OUT Code)** | **Description** |
|---|---|---|
| - | - | - |

## 3.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

| Device | Details (Manufacturer, Type Model, HW, SW, S/N) | Description |
|---|---|---|
| - | - | - |

## 3.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

| Setup | Combination of EUTs | Description and Rationale |
|---|---|---|
| S01_AB01 | DE1015105ab01 | radiated & conducted sample |

## 3.6 OPERATING MODES

This chapter describes the operating modes of the EUTs used for testing.

### 3.6.1 TEST CHANNELS

| LTE CAT-M1 eFDD 4 | LOW | MID | HIGH |
|---|---|---|---|
| Channel | 19957 | 20175 | 20393 |
| Frequency [MHz] | 1710.7 | 1732.5 | 1754.3 |

| LTE CAT-M1 eFDD 12 | LOW | MID | HIGH |
|---|---|---|---|
| Channel | 23017 | 23095 | 23173 |
| Frequency [MHz] | 699.7 | 707.5 | 715.3 |

| LTE CAT-M1 eFDD 13 | LOW | MID | HIGH |
|---|---|---|---|
| Channel | 23205 | 23230 | 23255 |
| Frequency [MHz] | 777.7 | 780.3 | 786.3 |

| NB-IoT eFDD 4 | LOW | MID | HIGH |
|---|---|---|---|
| Channel | 19951 | 20325 | 20399 |
| Frequency [MHz] | 1710.7 | 1732.5 | 1754.9 |

| NB-IoT eFDD 12 | LOW | MID | HIGH |
|---|---|---|---|
| Channel | 23011 | 23095 | 23179 |
| Frequency [MHz] | 699.1 | 707.5 | 715.9 |

| NB-IoT eFDD 13 | LOW | MID | HIGH |
|---|---|---|---|
| Channel | 23181 | 23230 | 23279 |
| Frequency [MHz] | 777.1 | 782 | 786.9 |

## 3.7 PRODUCT LABELLING

### 3.7.1 FCC ID LABEL

Please refer to the documentation of the applicant.

### 3.7.2 LOCATION OF THE LABEL ON THE EUT

Please refer to the documentation of the applicant.

# 4 TEST RESULTS

## 4.1 RF OUTPUT POWER

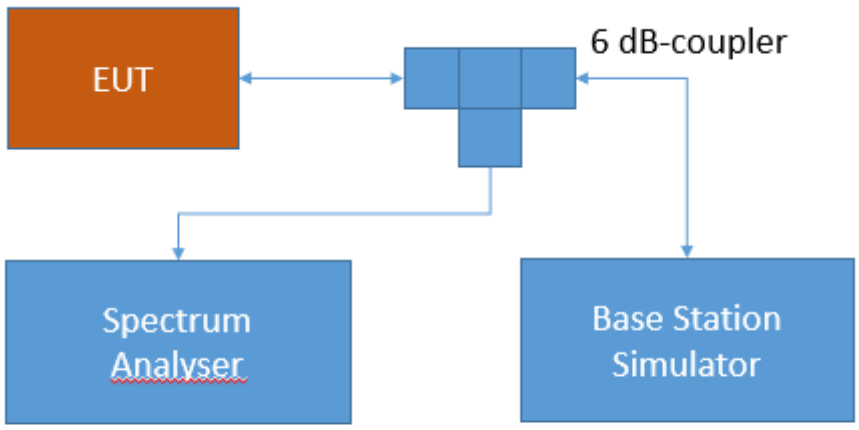
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015

### 4.1.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable RF Output power test case per § 2.1046 and RSS-GEN 6.12. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:




Test Setup FCC Part 22/24/27/90 Cellular;
RF Output power

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 4.1.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§ 27.50 - Power limits and duty cycle**

**Band 13:**

(b) The following power limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

**RSS-130; 4.6.3 Transmitter Output Power**

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

**Band 12:**

c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

**RSS-130; 4.6.3 Transmitter Output Power**

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

**Band 4/10/66:**

d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum.

**RSS-139; 6.5 Transmitter Output Power**

The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt.

**Band 17:**

(c) The following power requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

**RSS-130; 4.6.3 Transmitter Output**

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

**Band 7:**

(h) The following power limits shall apply in the BRS and EBS:

(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

**RSS-199; 4.4 Transmitter output power and equivalent isotropically power (e.i.r.p.)**

The transmitter output power shall be measured in terms of average value.

For mobile subscriber equipment, the e.i.r.p. shall not exceed 2 W. For fixed subscriber equipment, the transmitter output power shall not exceed 2 W and the e.i.r.p. shall be limited to 40 W.

For equipment with multiple antennas, the transmitter output power and e.i.r.p shall be measured according to ANSI C63.26‑2015.

## 4.1.3 TEST PROTOCOL

Ambient temperature: 23 °C
Relative humidity: 34 %

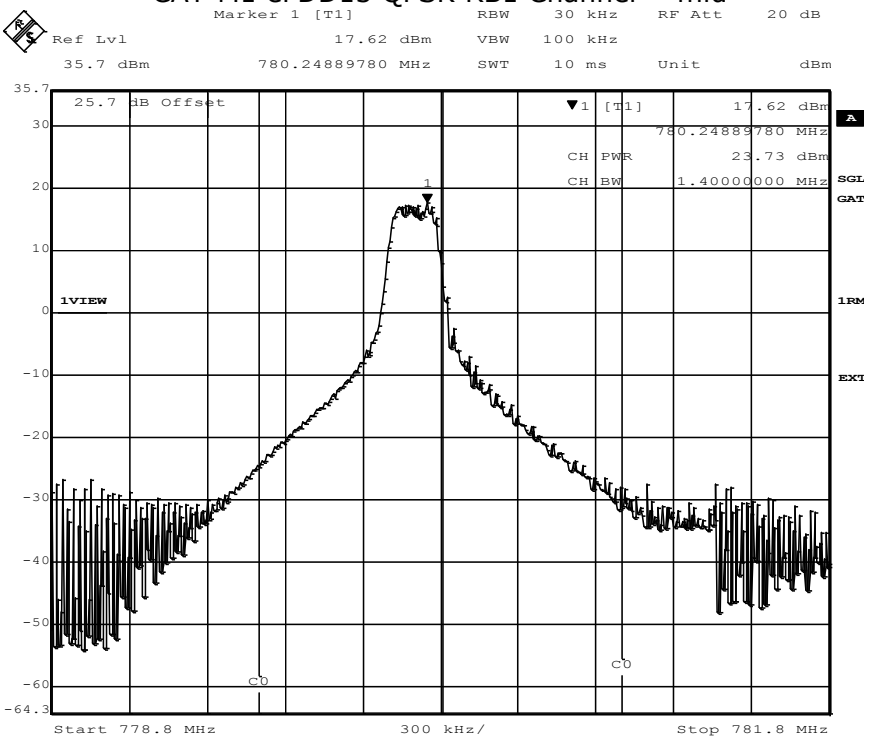
| Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | RMS Conducted Power (dBm) | FCC EIRP Limit (W) | IC EIRP Limit (W) | Maximum Antenna Gain FCC (dBi) | Maximum Antenna Gain IC (dBi) |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 4 QPSK | low | 1 | 1.4 | 21.81 | 1 | 1 | 8.19 | 8.19 |
| CAT-M1 eFDD 4 QPSK | low | 3 | 1.4 | 21.43 | 1 | 1 | 8.57 | 8.57 |
| CAT-M1 eFDD 4 QPSK | low | 6 | 1.4 | 20.43 | 1 | 1 | 9.57 | 9.57 |
| CAT-M1 eFDD 4 QPSK | mid | 1 | 1.4 | 22.34 | 1 | 1 | 7.66 | 7.66 |
| CAT-M1 eFDD 4 QPSK | mid | 3 | 1.4 | 20.85 | 1 | 1 | 9.15 | 9.15 |
| CAT-M1 eFDD 4 QPSK | mid | 6 | 1.4 | 19.84 | 1 | 1 | 10.16 | 10.16 |
| CAT-M1 eFDD 4 QPSK | high | 1 | 1.4 | 22.41 | 1 | 1 | 7.59 | 7.59 |
| CAT-M1 eFDD 4 QPSK | high | 3 | 1.4 | 20.69 | 1 | 1 | 9.31 | 9.31 |
| CAT-M1 eFDD 4 QPSK | high | 6 | 1.4 | 20.44 | 1 | 1 | 9.56 | 9.56 |
| CAT-M1 eFDD 4 16QAM | low | 1 | 1.4 | 21.68 | 1 | 1 | 8.32 | 8.32 |
| CAT-M1 eFDD 4 16QAM | low | 5 | 1.4 | 20.49 | 1 | 1 | 9.51 | 9.51 |
| CAT-M1 eFDD 4 16QAM | mid | 1 | 1.4 | 21.41 | 1 | 1 | 8.59 | 8.59 |
| CAT-M1 eFDD 4 16QAM | mid | 5 | 1.4 | 19.78 | 1 | 1 | 10.22 | 10.22 |
| CAT-M1 eFDD 4 16QAM | high | 1 | 1.4 | 20.60 | 1 | 1 | 9.40 | 9.40 |
| CAT-M1 eFDD 4 16QAM | high | 5 | 1.4 | 20.10 | 1 | 1 | 9.90 | 9.90 |
| CAT-M1 eFDD 12 QPSK | low | 1 | 1.4 | 22.73 | 1 | 1 | 7.27 | 7.27 |
| CAT-M1 eFDD 12 QPSK | low | 3 | 1.4 | 21.64 | 1 | 1 | 8.36 | 8.36 |
| CAT-M1 eFDD 12 QPSK | low | 6 | 1.4 | 20.91 | 1 | 1 | 9.09 | 9.09 |
| CAT-M1 eFDD 12 QPSK | mid | 1 | 1.4 | 22.74 | 1 | 1 | 7.26 | 7.26 |
| CAT-M1 eFDD 12 QPSK | mid | 3 | 1.4 | 21.71 | 1 | 1 | 8.29 | 8.29 |
| CAT-M1 eFDD 12 QPSK | mid | 6 | 1.4 | 20.60 | 1 | 1 | 9.40 | 9.40 |
| CAT-M1 eFDD 12 QPSK | high | 1 | 1.4 | 22.57 | 1 | 1 | 7.43 | 7.43 |
| CAT-M1 eFDD 12 QPSK | high | 3 | 1.4 | 21.15 | 1 | 1 | 8.85 | 8.85 |
| CAT-M1 eFDD 12 QPSK | high | 6 | 1.4 | 21.07 | 1 | 1 | 8.93 | 8.93 |
| CAT-M1 eFDD 12 16QAM | low | 1 | 1.4 | 21.65 | 1 | 1 | 8.35 | 8.35 |
| CAT-M1 eFDD 12 16QAM | low | 5 | 1.4 | 20.80 | 1 | 1 | 9.20 | 9.20 |
| CAT-M1 eFDD 12 16QAM | mid | 1 | 1.4 | 21.46 | 1 | 1 | 8.54 | 8.54 |
| CAT-M1 eFDD 12 16QAM | mid | 5 | 1.4 | 20.77 | 1 | 1 | 9.23 | 9.23 |
| CAT-M1 eFDD 12 16QAM | high | 1 | 1.4 | 22.07 | 1 | 1 | 7.93 | 7.93 |
| CAT-M1 eFDD 12 16QAM | high | 5 | 1.4 | 21.34 | 1 | 1 | 8.66 | 8.66 |
| CAT-M1 eFDD 13 QPSK | low | 1 | 1.4 | 23.59 | 1 | 1 | 6.41 | 6.41 |
| CAT-M1 eFDD 13 QPSK | low | 3 | 1.4 | 22.38 | 1 | 1 | 7.62 | 7.62 |
| CAT-M1 eFDD 13 QPSK | low | 6 | 1.4 | 22.12 | 1 | 1 | 7.88 | 7.88 |
| CAT-M1 eFDD 13 QPSK | mid | 1 | 1.4 | 23.73 | 1 | 1 | 6.27 | 6.27 |
| CAT-M1 eFDD 13 QPSK | mid | 3 | 1.4 | 22.61 | 1 | 1 | 7.39 | 7.39 |
| CAT-M1 eFDD 13 QPSK | mid | 6 | 1.4 | 22.07 | 1 | 1 | 7.93 | 7.93 |
| CAT-M1 eFDD 13 QPSK | high | 1 | 1.4 | 23.75 | 1 | 1 | 6.25 | 6.25 |
| CAT-M1 eFDD 13 QPSK | high | 3 | 1.4 | 22.42 | 1 | 1 | 7.58 | 7.58 |
| CAT-M1 eFDD 13 QPSK | high | 6 | 1.4 | 22.10 | 1 | 1 | 7.90 | 7.90 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 13 16QAM | low | 1 | 1.4 | 23.69 | 1 | 1 | 6.31 | 6.31 |
| CAT-M1 eFDD 13 16QAM | low | 5 | 1.4 | 21.15 | 1 | 1 | 8.85 | 8.85 |
| CAT-M1 eFDD 13 16QAM | mid | 1 | 1.4 | 23.69 | 1 | 1 | 6.31 | 6.31 |
| CAT-M1 eFDD 13 16QAM | mid | 5 | 1.4 | 21.41 | 1 | 1 | 8.59 | 8.59 |
| CAT-M1 eFDD 13 16QAM | high | 1 | 1.4 | 23.73 | 1 | 1 | 6.27 | 6.27 |
| CAT-M1 eFDD 13 16QAM | high | 5 | 1.4 | 21.74 | 1 | 1 | 8.26 | 8.26 |
| NB-IoT eFDD 4 QPSK | low | 1 | 0.2 | 23.55 | 1 | 1 | 6.45 | 6.45 |
| NB-IoT eFDD 4 QPSK | low | 3 | 0.2 | 22.98 | 1 | 1 | 7.02 | 7.02 |
| NB-IoT eFDD 4 QPSK | low | 6 | 0.2 | 21.94 | 1 | 1 | 8.06 | 8.06 |
| NB-IoT eFDD 4 QPSK | low | 12 | 0.2 | 20.79 | 1 | 1 | 9.21 | 9.21 |
| NB-IoT eFDD 4 QPSK | mid | 1 | 0.2 | 23.82 | 1 | 1 | 6.18 | 6.18 |
| NB-IoT eFDD 4 QPSK | mid | 3 | 0.2 | 23.04 | 1 | 1 | 6.96 | 6.96 |
| NB-IoT eFDD 4 QPSK | mid | 6 | 0.2 | 21.87 | 1 | 1 | 8.13 | 8.13 |
| NB-IoT eFDD 4 QPSK | mid | 12 | 0.2 | 20.56 | 1 | 1 | 9.44 | 9.44 |
| NB-IoT eFDD 4 QPSK | high | 1 | 0.2 | 23.73 | 1 | 1 | 6.27 | 6.27 |
| NB-IoT eFDD 4 QPSK | high | 3 | 0.2 | 22.93 | 1 | 1 | 7.07 | 7.07 |
| NB-IoT eFDD 4 QPSK | high | 6 | 0.2 | 21.93 | 1 | 1 | 8.07 | 8.07 |
| NB-IoT eFDD 4 QPSK | high | 12 | 0.2 | 20.51 | 1 | 1 | 9.49 | 9.49 |
| NB-IoT eFDD 4 BPSK | low | 1 | 0.2 | 22.62 | 1 | 1 | 7.38 | 7.38 |
| NB-IoT eFDD 4 BPSK | mid | 1 | 0.2 | 23.30 | 1 | 1 | 6.70 | 6.70 |
| NB-IoT eFDD 4 BPSK | high | 1 | 0.2 | 22.95 | 1 | 1 | 7.05 | 7.05 |
| NB-IoT eFDD 12 QPSK | low | 1 | 0.2 | 22.34 | 1 | 1 | 7.66 | 7.66 |
| NB-IoT eFDD 12 QPSK | low | 3 | 0.2 | 24.11 | 1 | 1 | 5.89 | 5.89 |
| NB-IoT eFDD 12 QPSK | low | 6 | 0.2 | 22.00 | 1 | 1 | 8.00 | 8.00 |
| NB-IoT eFDD 12 QPSK | low | 12 | 0.2 | 21.21 | 1 | 1 | 8.79 | 8.79 |
| NB-IoT eFDD 12 QPSK | mid | 1 | 0.2 | 22.51 | 1 | 1 | 7.49 | 7.49 |
| NB-IoT eFDD 12 QPSK | mid | 3 | 0.2 | 24.00 | 1 | 1 | 6.00 | 6.00 |
| NB-IoT eFDD 12 QPSK | mid | 6 | 0.2 | 21.83 | 1 | 1 | 8.17 | 8.17 |
| NB-IoT eFDD 12 QPSK | mid | 12 | 0.2 | 21.04 | 1 | 1 | 8.96 | 8.96 |
| NB-IoT eFDD 12 QPSK | high | 1 | 0.2 | 23.36 | 1 | 1 | 6.64 | 6.64 |
| NB-IoT eFDD 12 QPSK | high | 3 | 0.2 | 23.06 | 1 | 1 | 6.94 | 6.94 |
| NB-IoT eFDD 12 QPSK | high | 6 | 0.2 | 21.95 | 1 | 1 | 8.05 | 8.05 |
| NB-IoT eFDD 12 QPSK | high | 12 | 0.2 | 21.19 | 1 | 1 | 8.81 | 8.81 |
| NB-IoT eFDD 12 BPSK | low | 1 | 0.2 | 21.54 | 1 | 1 | 8.46 | 8.46 |
| NB-IoT eFDD 12 BPSK | mid | 1 | 0.2 | 21.64 | 1 | 1 | 8.36 | 8.36 |
| NB-IoT eFDD 12 BPSK | high | 1 | 0.2 | 21.66 | 1 | 1 | 8.34 | 8.34 |
| NB-IoT eFDD 13 QPSK | low | 1 | 0.2 | 24.34 | 1 | 1 | 5.66 | 5.66 |
| NB-IoT eFDD 13 QPSK | low | 3 | 0.2 | 23.41 | 1 | 1 | 6.59 | 6.59 |
| NB-IoT eFDD 13 QPSK | low | 6 | 0.2 | 22.16 | 1 | 1 | 7.84 | 7.84 |
| NB-IoT eFDD 13 QPSK | low | 12 | 0.2 | 21.04 | 1 | 1 | 8.96 | 8.96 |
| NB-IoT eFDD 13 QPSK | mid | 1 | 0.2 | 24.24 | 1 | 1 | 5.76 | 5.76 |
| NB-IoT eFDD 13 QPSK | mid | 3 | 0.2 | 23.40 | 1 | 1 | 6.60 | 6.60 |
| NB-IoT eFDD 13 QPSK | mid | 6 | 0.2 | 22.19 | 1 | 1 | 7.81 | 7.81 |
| NB-IoT eFDD 13 QPSK | mid | 12 | 0.2 | 20.94 | 1 | 1 | 9.06 | 9.06 |
| NB-IoT eFDD 13 QPSK | high | 1 | 0.2 | 24.30 | 1 | 1 | 5.70 | 5.70 |
| NB-IoT eFDD 13 QPSK | high | 3 | 0.2 | 23.52 | 1 | 1 | 6.48 | 6.48 |
| NB-IoT eFDD 13 QPSK | high | 6 | 0.2 | 22.18 | 1 | 1 | 7.82 | 7.82 |
| NB-IoT eFDD 13 QPSK | high | 12 | 0.2 | 20.97 | 1 | 1 | 9.03 | 9.03 |
| NB-IoT eFDD 13 BPSK | low | 1 | 0.2 | 21.75 | 1 | 1 | 8.25 | 8.25 |
| NB-IoT eFDD 13 BPSK | mid | 1 | 0.2 | 21.76 | 1 | 1 | 8.24 | 8.24 |
| NB-IoT eFDD 13 BPSK | high | 1 | 0.2 | 21.49 | 1 | 1 | 8.51 | 8.51 |

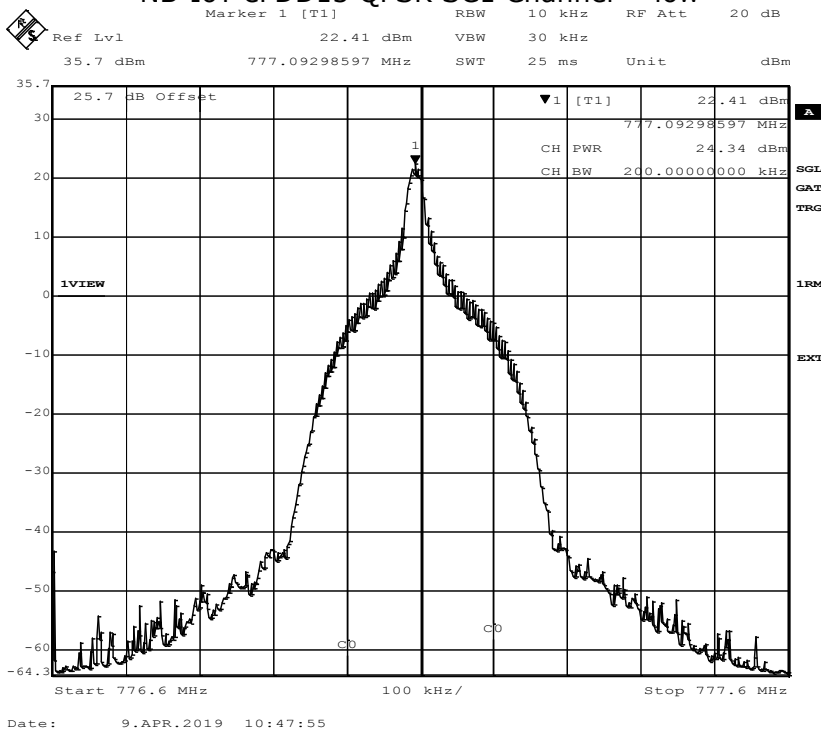
Remark: Please see next sub-clause for the measurement plot.

## 4.1.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD13 QPSK RB1 Channel = mid




NB-IoT eFDD13 QPSK SC1 Channel = low




## 4.1.5 TEST EQUIPMENT USED

- Radio Lab

## 4.2 FREQUENCY STABILITY

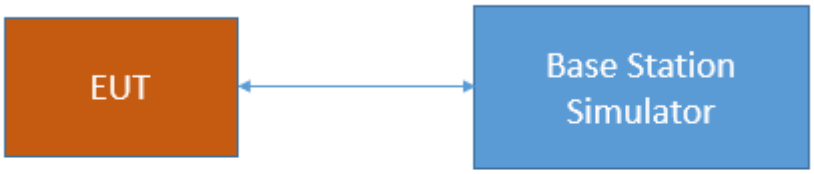
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015

### 4.2.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable frequency stability test case per § 2.1055 and RSS-GEN 6.11. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:




Test Setup FCC Part 22/24/27/90 Cellular;
Frequency stability

The attenuation of the measuring / stimulus path is known for each measured frequency and are considered.

### 4.2.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§ 27.54 - Frequency stability**

**All Bands**

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

**Band 12/13/17:**

**RSS-130; 4.5 Transmitter frequency stability**

For equipment that is capable of transmitting numerous channels simultaneously for different applications (e.g. LTE and narrowband – Internet of Things (IoT)), the occupied bandwidth shall be the bandwidth representing the sum of the occupied bandwidths of these channels.

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

**Band 4/10/66:**

**RSS-139; 6.4 Frequency Stability**

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

**Band 7:**

**RSS-199; 4.3 Transmitter frequency stability**

The transmitter frequency stability limit shall be determined as follows:

a. the frequency offset shall be measured according to the procedure described in RSS-Gen and recorded.

b. using a resolution bandwidth equal to that permitted within the 1 MHz band immediately outside the channel edge, as found in section 4.5, reference points will be selected at the unwanted emission limits, which comply with the attenuation specified in section 4.5 for the type of device under test, on the emission mask of the lowest and highest channels. The frequency at these points shall be recorded as fL and fH respectively.

The applicant shall ensure compliance with frequency stability requirements by showing that fL minus the frequency offset and fH plus the frequency offset is within the frequency range in which the equipment is designed to operate.

### 4.2.3 TEST PROTOCOL

CAT-M1 eFDD 4

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 4331.25 | 0.7 | 5.3 | passed |
| -30 | 5 | | | 0.6 | 5.4 | passed |
| -30 | 10 | | | 0.8 | 5.6 | passed |
| -20 | 0 | normal | 4331.25 | 0.9 | 5.7 | passed |
| -20 | 5 | | | 0.4 | 5.6 | passed |
| -20 | 10 | | | 0.6 | 5.8 | passed |
| -10 | 0 | normal | 4331.25 | 0.5 | 4.9 | passed |
| -10 | 5 | | | 0.8 | 4.8 | passed |
| -10 | 10 | | | 0.8 | 5.7 | passed |
| 0 | 0 | normal | 4331.25 | 0.9 | 4.3 | passed |
| 0 | 5 | | | 0.4 | 6.2 | passed |
| 0 | 10 | | | 0.7 | 7.3 | passed |
| 10 | 0 | normal | 4331.25 | 0.7 | 4.9 | passed |
| 10 | 5 | | | 1 | 3.4 | passed |
| 10 | 10 | | | 0.8 | 3.6 | passed |
| 20 | 0 | low | 4331.25 | 0.6 | 3.2 | passed |
| 20 | 5 | | | 0.6 | 3.4 | passed |
| 20 | 10 | | | 0.8 | 3.2 | passed |
| 20 | 0 | normal | 4331.25 | 0.6 | 5.4 | passed |
| 20 | 5 | | | 0.4 | 5.3 | passed |
| 20 | 10 | | | 0.8 | 5.6 | passed |
| 20 | 0 | high | 4331.25 | 0.8 | 5.2 | passed |
| 20 | 5 | | | 0.4 | 4.8 | passed |
| 20 | 10 | | | 1 | 5.8 | passed |
| 30 | 0 | normal | 4331.25 | 0.7 | 5.1 | passed |
| 30 | 5 | | | 0.6 | 5 | passed |
| 30 | 10 | | | 1.1 | 4.8 | passed |
| 40 | 0 | normal | 4331.25 | 0.8 | 6.7 | passed |
| 40 | 5 | | | 0.7 | 6.4 | passed |
| 40 | 10 | | | 1 | 5.8 | passed |
| 50 | 0 | normal | 4331.25 | 0.9 | 4.6 | passed |
| 50 | 5 | | | 1.1 | 5.1 | passed |
| 50 | 10 | | | 1.2 | 5.3 | passed |

CAT-M1 eFDD 12

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 1955 | 2.3 | 7.6 | passed |
| -30 | 5 | | | 2.1 | 8.2 | passed |
| -30 | 10 | | | 1.6 | 7.4 | passed |
| -20 | 0 | normal | 1955 | 1.7 | 5.6 | passed |
| -20 | 5 | | | 2.4 | 4.9 | passed |
| -20 | 10 | | | 2 | 5.8 | passed |
| -10 | 0 | normal | 1955 | 3.4 | 7.6 | passed |
| -10 | 5 | | | 1.8 | 7.4 | passed |
| -10 | 10 | | | 2.5 | 7.2 | passed |
| 0 | 0 | normal | 1955 | 1.6 | 6 | passed |
| 0 | 5 | | | 1.5 | 6.3 | passed |
| 0 | 10 | | | 1.8 | 6.7 | passed |
| 10 | 0 | normal | 1955 | 1.9 | 4.9 | passed |
| 10 | 5 | | | 2.4 | 5.6 | passed |
| 10 | 10 | | | 2.3 | 5.3 | passed |
| 20 | 0 | low | 1955 | 2.1 | 4.8 | passed |
| 20 | 5 | | | 1.8 | 5.2 | passed |
| 20 | 10 | | | 2.2 | 4.7 | passed |
| 20 | 0 | normal | 1955 | 1.8 | 4.9 | passed |
| 20 | 5 | | | 1.9 | 5.7 | passed |
| 20 | 10 | | | 2.3 | 5.8 | passed |
| 20 | 0 | high | 1955 | 1.8 | 5.2 | passed |
| 20 | 5 | | | 2.2 | 4.8 | passed |
| 20 | 10 | | | 1.6 | 5 | passed |
| 30 | 0 | normal | 1955 | 2.4 | 6.9 | passed |
| 30 | 5 | | | 2.7 | 6.1 | passed |
| 30 | 10 | | | 2.6 | 7.2 | passed |
| 40 | 0 | normal | 1955 | 2.7 | 9.3 | passed |
| 40 | 5 | | | 2.2 | 7.4 | passed |
| 40 | 10 | | | 2.1 | 8 | passed |
| 50 | 0 | normal | 1955 | 1.7 | 8.1 | passed |
| 50 | 5 | | | 2.5 | 9.2 | passed |
| 50 | 10 | | | 2.4 | 7.3 | passed |

CAT-M1 eFDD13

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 1955 | 0.7 | 4.2 | passed |
| -30 | 5 | | | 1.2 | 3.9 | passed |
| -30 | 10 | | | 1.5 | 3.8 | passed |
| -20 | 0 | normal | 1955 | 0.4 | 4.1 | passed |
| -20 | 5 | | | 1.3 | 4.3 | passed |
| -20 | 10 | | | 1.1 | 4.4 | passed |
| -10 | 0 | normal | 1955 | 1 | 3.7 | passed |
| -10 | 5 | | | 0.8 | 3.8 | passed |
| -10 | 10 | | | 0.9 | 4.2 | passed |
| 0 | 0 | normal | 1955 | 1 | 4.6 | passed |
| 0 | 5 | | | 1.6 | 4.1 | passed |
| 0 | 10 | | | 1.4 | 4.8 | passed |
| 10 | 0 | normal | 1955 | 2.3 | 3.4 | passed |
| 10 | 5 | | | 2.5 | 3.8 | passed |
| 10 | 10 | | | 2.4 | 3.7 | passed |
| 20 | 0 | low | 1955 | 2.2 | 3.6 | passed |
| 20 | 5 | | | 1.4 | 3.8 | passed |
| 20 | 10 | | | 2.5 | 3.7 | passed |
| 20 | 0 | normal | 1955 | 1.3 | 4 | passed |
| 20 | 5 | | | 0.6 | 4.1 | passed |
| 20 | 10 | | | 0.8 | 4.6 | passed |
| 20 | 0 | high | 1955 | 1.2 | 4.2 | passed |
| 20 | 5 | | | 1.4 | 4.6 | passed |
| 20 | 10 | | | 0.8 | 3.8 | passed |
| 30 | 0 | normal | 1955 | 1.2 | 5.1 | passed |
| 30 | 5 | | | 1.4 | 4.6 | passed |
| 30 | 10 | | | 1.4 | 4.7 | passed |
| 40 | 0 | normal | 1955 | 0.8 | 4.9 | passed |
| 40 | 5 | | | 0.6 | 6.2 | passed |
| 40 | 10 | | | 0.9 | 4.9 | passed |
| 50 | 0 | normal | 1955 | 1 | 3.3 | passed |
| 50 | 5 | | | 1.1 | 4.8 | passed |
| 50 | 10 | | | 0.8 | 3.7 | passed |

NB-IoT eFDD4

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 4331.25 | -2.8 | 9.9 | passed |
| -30 | 5 | | | -1 | 9.7 | passed |
| -30 | 10 | | | -0.3 | 12.5 | passed |
| -20 | 0 | normal | 4331.25 | -2.1 | 11.4 | passed |
| -20 | 5 | | | -1.7 | 11.6 | passed |
| -20 | 10 | | | -1.8 | 9.8 | passed |
| -10 | 0 | normal | 4331.25 | -2.1 | 10.6 | passed |
| -10 | 5 | | | -1.4 | 9.4 | passed |
| -10 | 10 | | | -1.9 | 8.7 | passed |
| 0 | 0 | normal | 4331.25 | -1.7 | 11.3 | passed |
| 0 | 5 | | | -2.2 | 11.2 | passed |
| 0 | 10 | | | -2.3 | 12.7 | passed |
| 10 | 0 | normal | 4331.25 | -1.8 | 9.2 | passed |
| 10 | 5 | | | -1.6 | 11.7 | passed |
| 10 | 10 | | | -3.1 | 10.2 | passed |
| 20 | 0 | low | 4331.25 | -2.2 | 8.6 | passed |
| 20 | 5 | | | -1.8 | 10.7 | passed |
| 20 | 10 | | | -2.8 | 11.2 | passed |
| 20 | 0 | normal | 4331.25 | -1.7 | 10.4 | passed |
| 20 | 5 | | | -1.8 | 10.9 | passed |
| 20 | 10 | | | -1.4 | 11.4 | passed |
| 20 | 0 | high | 4331.25 | -1.8 | 10.4 | passed |
| 20 | 5 | | | -1.6 | 11.8 | passed |
| 20 | 10 | | | -0.8 | 10.2 | passed |
| 30 | 0 | normal | 4331.25 | -0.5 | 11.3 | passed |
| 30 | 5 | | | -0.3 | 10.7 | passed |
| 30 | 10 | | | 1.2 | 12.8 | passed |
| 40 | 0 | normal | 4331.25 | -0.4 | 8.4 | passed |
| 40 | 5 | | | 0.5 | 10 | passed |
| 40 | 10 | | | -0.3 | 9.1 | passed |
| 50 | 0 | normal | 4331.25 | -0.1 | 10.2 | passed |
| 50 | 5 | | | 0.5 | 10.1 | passed |
| 50 | 10 | | | -0.2 | 9.1 | passed |

NB-IoT eFDD12

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 1955 | -3 | -7.1 | passed |
| -30 | 5 | | | -1.8 | -9.2 | passed |
| -30 | 10 | | | -2.4 | -5.6 | passed |
| -20 | 0 | normal | 1955 | -2.1 | -5.4 | passed |
| -20 | 5 | | | -2.6 | -6.8 | passed |
| -20 | 10 | | | -3.2 | -7.2 | passed |
| -10 | 0 | normal | 1955 | -1.7 | -9.1 | passed |
| -10 | 5 | | | -1.8 | -5.8 | passed |
| -10 | 10 | | | -2.5 | -8.6 | passed |
| 0 | 0 | normal | 1955 | -2.3 | -8.2 | passed |
| 0 | 5 | | | -2.6 | -7.3 | passed |
| 0 | 10 | | | -3.4 | -8.4 | passed |
| 10 | 0 | normal | 1955 | -3.1 | -6.1 | passed |
| 10 | 5 | | | -1.9 | -7.7 | passed |
| 10 | 10 | | | -2.1 | -6.9 | passed |
| 20 | 0 | low | 1955 | -2.6 | -5.8 | passed |
| 20 | 5 | | | -2.4 | -6.2 | passed |
| 20 | 10 | | | -3.2 | -7.4 | passed |
| 20 | 0 | normal | 1955 | -2.3 | -4.8 | passed |
| 20 | 5 | | | -1.8 | -8.3 | passed |
| 20 | 10 | | | -2.6 | -7.3 | passed |
| 20 | 0 | high | 1955 | -2.2 | -8.2 | passed |
| 20 | 5 | | | -1.8 | -6.4 | passed |
| 20 | 10 | | | -3.1 | -8.1 | passed |
| 30 | 0 | normal | 1955 | -0.8 | -5.9 | passed |
| 30 | 5 | | | -1.4 | -5.7 | passed |
| 30 | 10 | | | -1.6 | -6.2 | passed |
| 40 | 0 | normal | 1955 | -2.1 | -8.3 | passed |
| 40 | 5 | | | -2.4 | -7.6 | passed |
| 40 | 10 | | | -2.3 | -9.1 | passed |
| 50 | 0 | normal | 1955 | -2.7 | -6.2 | passed |
| 50 | 5 | | | -2.3 | -6.8 | passed |
| 50 | 10 | | | -3.2 | -6.7 | passed |

NB-IoT eFDD13

| Temp. °C | Duration min | Voltage | Limit Hz | Freq. error Average (Hz) | Freq. error Max. (Hz) | Verdict |
|---|---|---|---|---|---|---|
| -30 | 0 | normal | 1955 | -1.1 | -7 | passed |
| -30 | 5 | | | -1.3 | -8.2 | passed |
| -30 | 10 | | | -1.8 | -7.3 | passed |
| -20 | 0 | normal | 1955 | -1.4 | -7.6 | passed |
| -20 | 5 | | | -2.1 | -8.1 | passed |
| -20 | 10 | | | -1.6 | -8.6 | passed |
| -10 | 0 | normal | 1955 | -1.7 | -8.4 | passed |
| -10 | 5 | | | -0.9 | -8.6 | passed |
| -10 | 10 | | | -1.3 | -7.9 | passed |
| 0 | 0 | normal | 1955 | -1.6 | -7.4 | passed |
| 0 | 5 | | | -1.8 | -7.6 | passed |
| 0 | 10 | | | -1.4 | -7.1 | passed |
| 10 | 0 | normal | 1955 | -2.2 | -7.3 | passed |
| 10 | 5 | | | -1.9 | -7.8 | passed |
| 10 | 10 | | | -1.6 | -8.3 | passed |
| 20 | 0 | low | 1955 | -1.8 | -7.2 | passed |
| 20 | 5 | | | -2.2 | -7.4 | passed |
| 20 | 10 | | | -0.16 | -7.4 | passed |
| 20 | 0 | normal | 1955 | -0.9 | -8.2 | passed |
| 20 | 5 | | | -0.8 | -8.3 | passed |
| 20 | 10 | | | -1.2 | -8.5 | passed |
| 20 | 0 | high | 1955 | -0.8 | -8.2 | passed |
| 20 | 5 | | | -1.2 | -7.8 | passed |
| 20 | 10 | | | -0.9 | -8.1 | passed |
| 30 | 0 | normal | 1955 | -1.3 | -7.2 | passed |
| 30 | 5 | | | -1.2 | -7.9 | passed |
| 30 | 10 | | | -1.6 | -7.4 | passed |
| 40 | 0 | normal | 1955 | -1.4 | -6.9 | passed |
| 40 | 5 | | | -1.3 | -6.8 | passed |
| 40 | 10 | | | -1.8 | -8.4 | passed |
| 50 | 0 | normal | 1955 | -2.3 | -7.6 | passed |
| 50 | 5 | | | -2.1 | -8.9 | passed |
| 50 | 10 | | | -2.1 | -7.4 | passed |

### 4.2.4 TEST EQUIPMENT USED

- Radio Lab

## 4.3 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

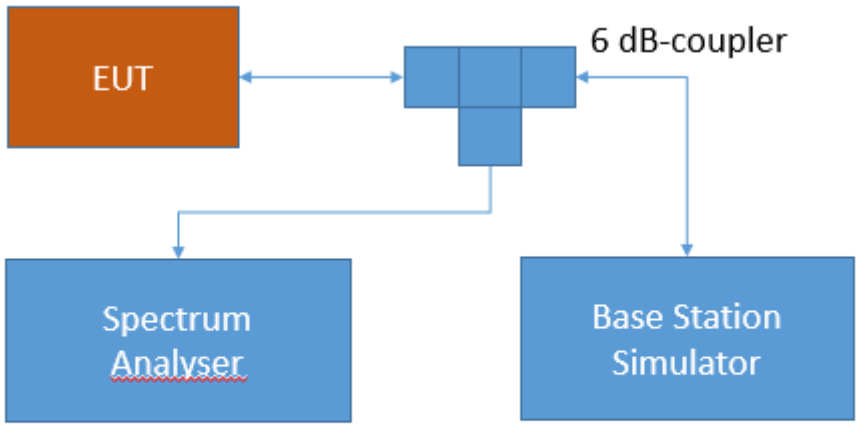
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015

### 4.3.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2.1051 and RSS-GEN 6.13. The limit comes from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:




Test Setup FCC Part 22/24/27/90 Cellular;
Spurious Emissions at antenna terminal

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 4.3.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated

under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§27.53 – Emission limits**

**Band 13**

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

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

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

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

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 12:**

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

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 4/10/66:**

(h) *AWS emission limits*— (1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.

**RSS-139; 6.6 Transmitter Unwanted Emissions**

Equipment shall comply with the limits in (i) and (ii) below.

i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

**Band 7:**

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

**RSS-199; 4.5 Transmitter unwanted emissions**

In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

b. for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

$40 + 10 \log_{10} p$ from the channel edges to 5 MHz away

$43 + 10 \log_{10} p$ between 5 MHz and X MHz from the channel edges, and

$55 + 10 \log_{10} p$ at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than $43 + 10 \log_{10} p$ on all frequencies between 2490.5 MHz and 2496 MHz, and $55 + 10 \log_{10} p$ at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

**Band 17:**

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

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

## 4.3.3 TEST PROTOCOL

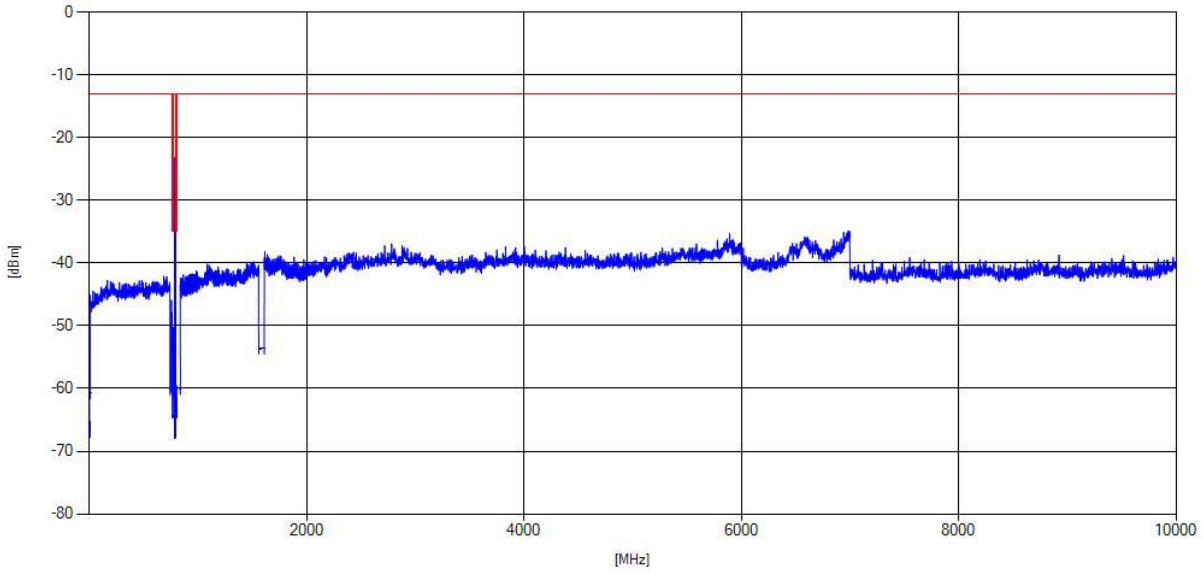
Ambient temperature: 23 °C Relative humidity: 34 %

| Radio Technology | CH | Detector | Trace | Resolution Bandwidth /kHz | Frequency /MHz | Peak Value /dBm | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 4 QPSK | low | rms | maxhold | 5 | 1709.75 | -32.62 | -17.5 | 15.12 |
| CAT-M1 eFDD 4 QPSK | mid | - | - | - | - | - | -13 | >20 |
| CAT-M1 eFDD 4 QPSK | high | rms | maxhold | 5 | 1755.05 | -35.96 | -17.5 | 17.46 |
| CAT-M1 eFDD 12 QPSK | low | rms | maxhold | 30 | 697.97 | -33.95 | -13 | 20.95 |
| CAT-M1 eFDD 12 QPSK | mid | - | - | - | - | - | -13 | >20 |
| CAT-M1 eFDD 12 QPSK | high | rms | maxhold | 30 | 716 | -24.26 | -13 | 11.26 |
| CAT-M1 eFDD 13 QPSK | low | rms | maxhold | 10 | 774.66 | -50.42 | -35 | 15.42 |
| CAT-M1 eFDD 13 QPSK | low | rms | maxhold | 100 | 775.86 | -29.34 | -13 | 16.34 |
| CAT-M1 eFDD 13 QPSK | mid | - | - | - | - | - | -13 | >20 |
| CAT-M1 eFDD 13 QPSK | high | rms | maxhold | 30 | 787.00 | -25.16 | -13 | 12.16 |
| CAT-M1 eFDD 13 QPSK | high | rms | maxhold | 100 | 787.15 | -23.19 | -13 | 10.19 |
| NB-IoT eFDD 4 QPSK | low | rms | maxhold | 2 | 1709.99 | -17.32 | -13 | 4.32 |
| NB-IoT eFDD 4 QPSK | mid | - | - | - | - | - | -13 | >20 |
| NB-IoT eFDD 4 QPSK | high | rms | maxhold | 2 | 1755.09 | -24.00 | -13 | 11.00 |
| NB-IoT eFDD 12 QPSK | low | - | - | - | - | - | -13 | >20 |
| NB-IoT eFDD 12 QPSK | mid | - | - | - | - | - | -13 | >20 |
| NB-IoT eFDD 12 QPSK | high | rms | maxhold | 30 | 716.00 | -20.41 | -13 | 7.41 |
| NB-IoT eFDD 13 QPSK | low | - | - | - | - | - | -13 | >20 |
| NB-IoT eFDD 13 QPSK | mid | - | - | - | - | - | -13 | >20 |
| NB-IoT eFDD 13 QPSK | high | - | - | - | - | - | -13 | >20 |

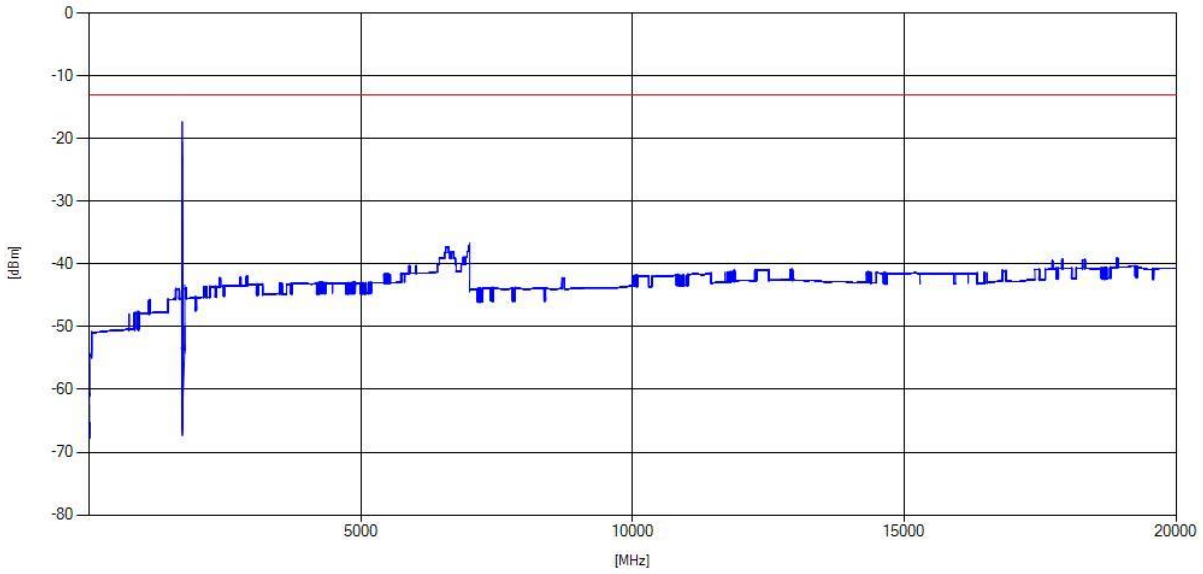
Remark: Please see next sub-clause for the measurement plot.

### 4.3.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD13 Channel = high




NB-IoT eFDD4 Channel = low




### 4.3.5 TEST EQUIPMENT USED

- Radio Lab

## 4.4 FIELD STRENGTH OF SPURIOUS RADIATION

Standard **FCC PART 27 Subpart C**

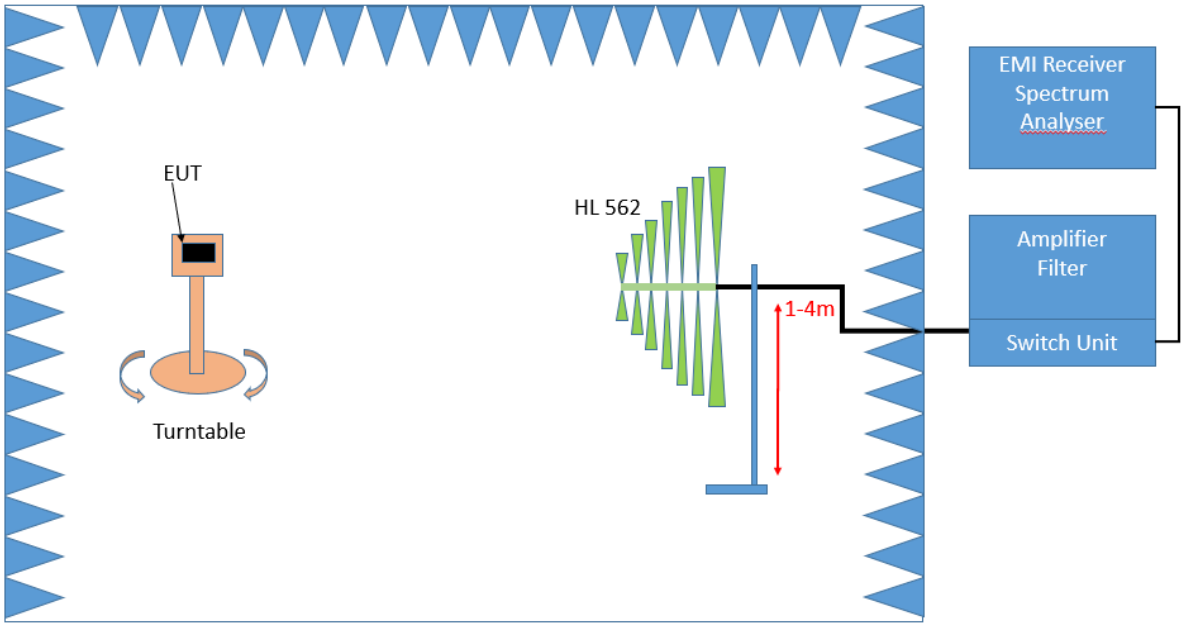
**The test was performed according to:**
ANSI C63.26: 2015

### 4.4.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053 and RSS-GEN 6.13. The limit and requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

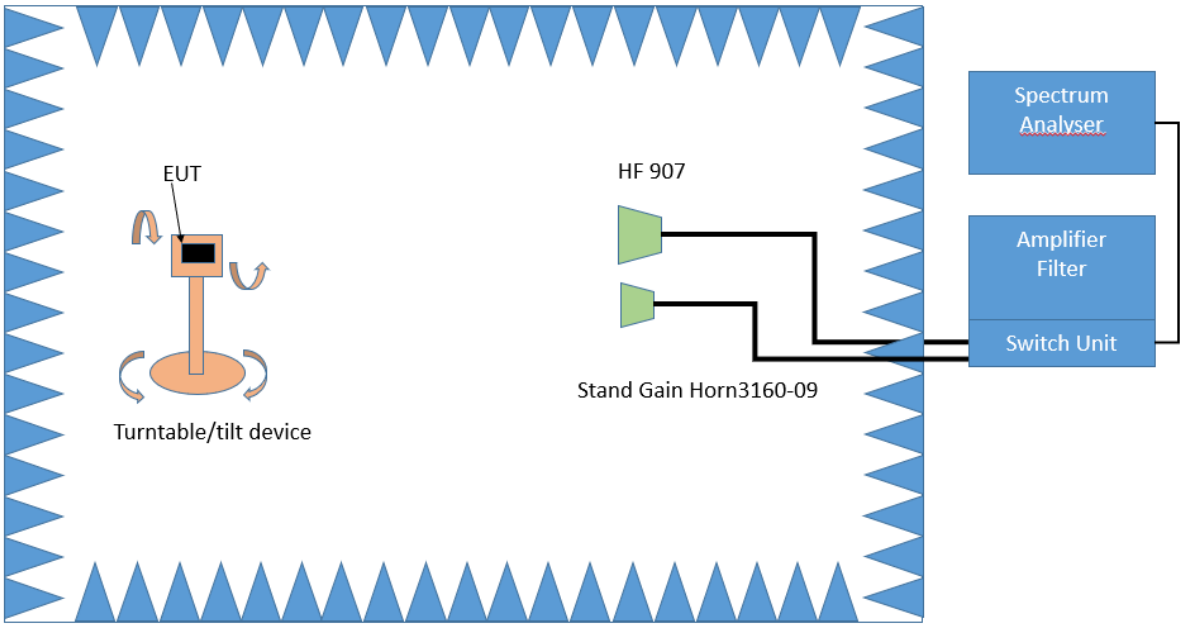
The EUT was connected to the test setup according to the following diagram:

Frequency Range: 30 MHz – 1 GHz:




Test Setup; Spurious Emission Radiated (SAC), 30 MHz- 1GHz

Frequency Range: 1 GHz – 26.5 GHz




Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

The test set-up was made in accordance to the general provisions of ANSI C63.26 in a typical installation configuration. The Equipment Under Test (EUT) was set up on a non-conductive table 1.0 x 2.0 m² in the semi-anechoic chamber. The influence of the EUT support table that is used between 30–1000 MHz was evaluated.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

**1. Measurement above 30 MHz and up to 1 GHz**

**Step 1:** Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 3 m
- Detector: Peak
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Height variation range: 1 – 3 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

**Step 2:** Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak
- Measured frequencies: in step 1 determined frequencies
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: coupled
- Turntable angle range: ± 45 ° around the determined value
- Height variation range: ± 100 cm around the determined value
- Antenna Polarisation: max. value determined in step 1

**Step 3:** Final measurement with RMS detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: RMQ
- Measured frequencies: in step 1 determined frequencies
- RBW: 100 kHz
- VBW: 300 kHz
- Sweep time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

**3. Measurement above 1 GHz**
The following modifications apply to the measurement procedure for the frequency range above 1 GHz:
**Step 1:**
The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
All steps were performed with one height (1.5 m) of the receiving antenna only.
The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 90 °.
The turn table step size (azimuth angle) for the preliminary measurement is 45 °.
- Antenna distance: 3 m
- Detector: Peak
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled
- Turntable angle range: –180° to 90°
- Turntable step size: 90°
- Polarisation: Horizontal + Vertical

**Step 2:**
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled

**Step 3:**
Spectrum analyser settings for step 3:
- Detector: RMS
- Measured frequencies: in step 1 determined frequencies
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 s

## 4.4.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1053; Measurement required: Field strength of spurious radiation:**

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate.

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§27.53 – Emission limits**

**Band 13**

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

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

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

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

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 12:**

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

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 4/10/66:**

(h) *AWS emission limits*—(1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.

**RSS-139; 6.6 Transmitter Unwanted Emissions**

Equipment shall comply with the limits in (i) and (ii) below.

i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

**Band 7:**

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

**RSS-199; 4.5 Transmitter unwanted emissions**

In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

b. for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

$40 + 10 \log_{10} p$ from the channel edges to 5 MHz away

$43 + 10 \log_{10} p$ between 5 MHz and X MHz from the channel edges, and

$55 + 10 \log_{10} p$ at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than $43 + 10 \log_{10} p$ on all frequencies between 2490.5 MHz and 2496 MHz, and $55 + 10 \log_{10} p$ at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

**Band 17:**

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

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100

kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In attenuated addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

## 4.4.3 TEST PROTOCOL

Ambient temperature: 22 °C Relative humidity: 32 %

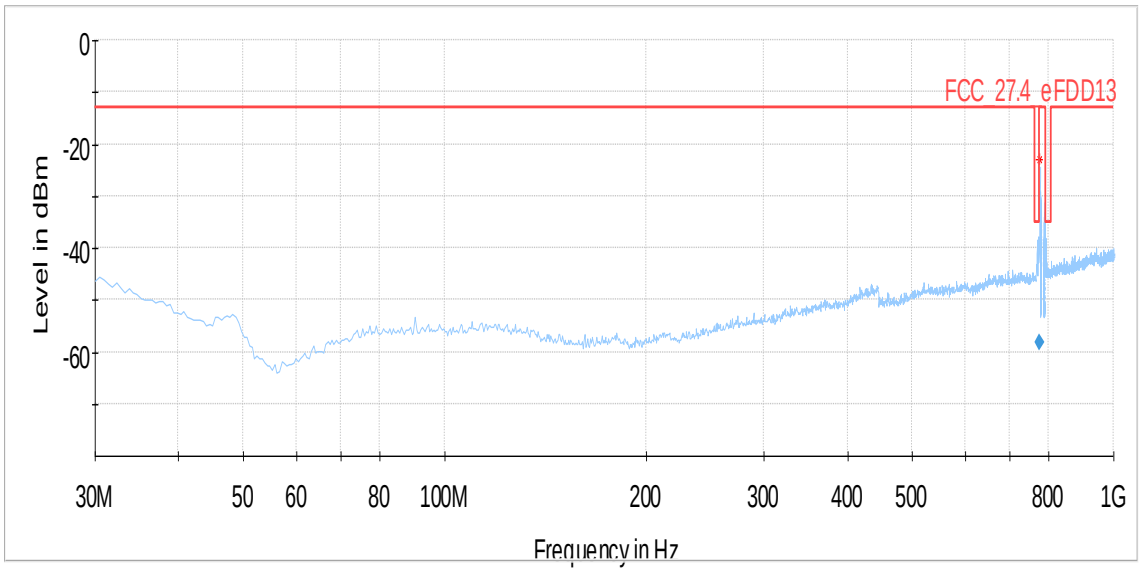
| Radio Technology | CH | Detector | Trace | Resolution Bandwidth /kHz | Frequency /MHz | Peak Value /dBm | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 4 QPSK | low | rms | maxhold | 3 | 1709.00 | -28.43 | -19.7 | 8.43 |
| CAT-M1 eFDD 4 QPSK | mid | - | - | - | - | - | - | >20 |
| CAT-M1 eFDD 4 QPSK | high | rms | maxhold | 3 | 1756 | -29.52 | -19.7 | 9.82 |
| CAT-M1 eFDD 12 QPSK | low | - | - | - | - | - | - | >20 |
| CAT-M1 eFDD 12 QPSK | mid | - | - | - | - | - | - | >20 |
| CAT-M1 eFDD 12 QPSK | high | - | - | - | - | - | - | >20 |
| CAT-M1 eFDD 13 QPSK | low | rms | maxhold | 1000 | 1562.87 | -49.0 | -40.0 | 9.0 |
| CAT-M1 eFDD 13 QPSK | mid | rms | maxhold | 1000 | 1559.60 | -43.7 | -40.0 | 3.74 |
| CAT-M1 eFDD 13 QPSK | high | rms | maxhold | 1000 | 1564.73 | -42.5 | -40.0 | 2.50 |
| NB-IoT eFDD 4 QPSK | low | - | - | - | - | - | - | >20 |
| NB-IoT eFDD 4 QPSK | mid | - | - | - | - | - | - | >20 |
| NB-IoT eFDD 4 QPSK | high | - | - | - | - | - | - | >20 |
| NB-IoT eFDD 12 QPSK | low | - | - | - | - | - | - | >20 |
| NB-IoT eFDD 12 QPSK | mid | - | - | - | - | - | - | >20 |
| NB-IoT eFDD 12 QPSK | high | rms | maxhold | 5 | 716.00 | -21.04 | -17.5 | 3.54 |
| NB-IoT eFDD 13 QPSK | low | peak | maxhold | 1000 | 1554.00 | -43.77 | -40 | 3.77 |
| NB-IoT eFDD 13 QPSK | mid | rms | maxhold | 1000 | 1563.80 | -52.3 | -40 | 12.34 |
| NB-IoT eFDD 13 QPSK | high | rms | maxhold | 30 | 787.01 | -18.23 | -13 | 5.23 |
| NB-IoT eFDD 13 QPSK | high | peak | maxhold | 1000 | 1571.73 | -46.30 | -40 | 6.3 |

Remark: Please see next sub-clause for the measurement plot.

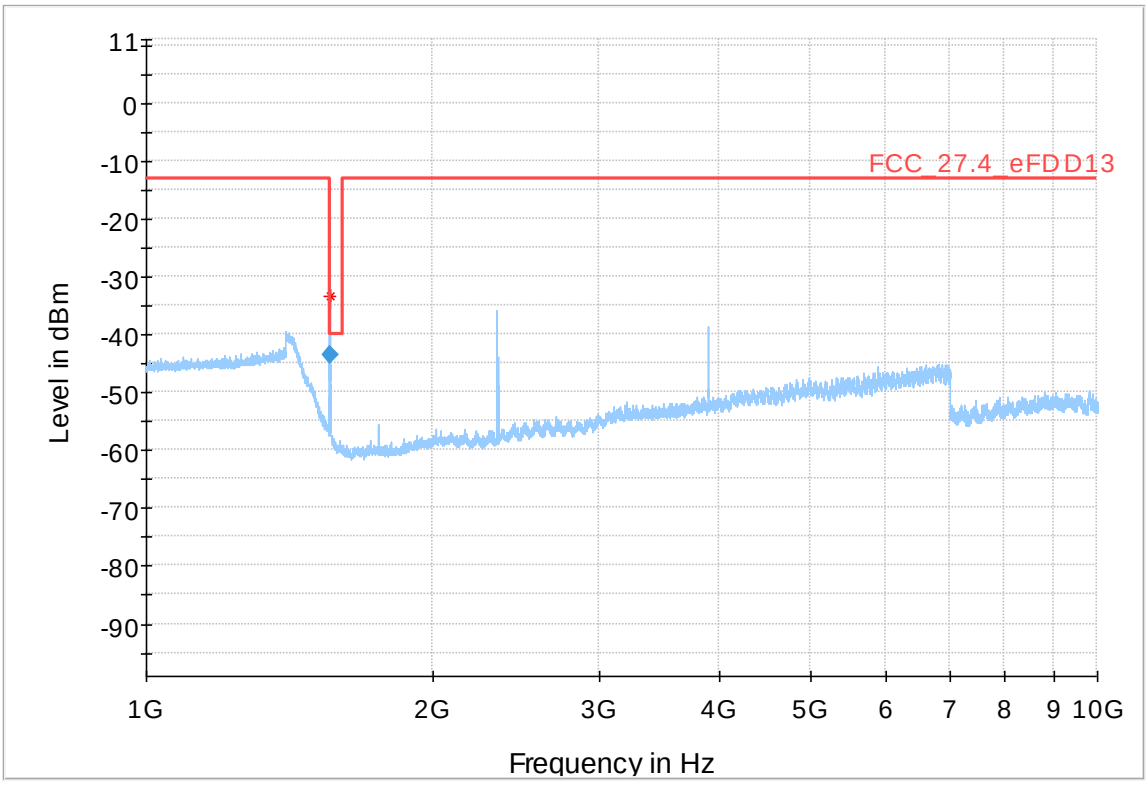
## 4.4.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD13 Channel = mid

30 MHz – 1 GHz

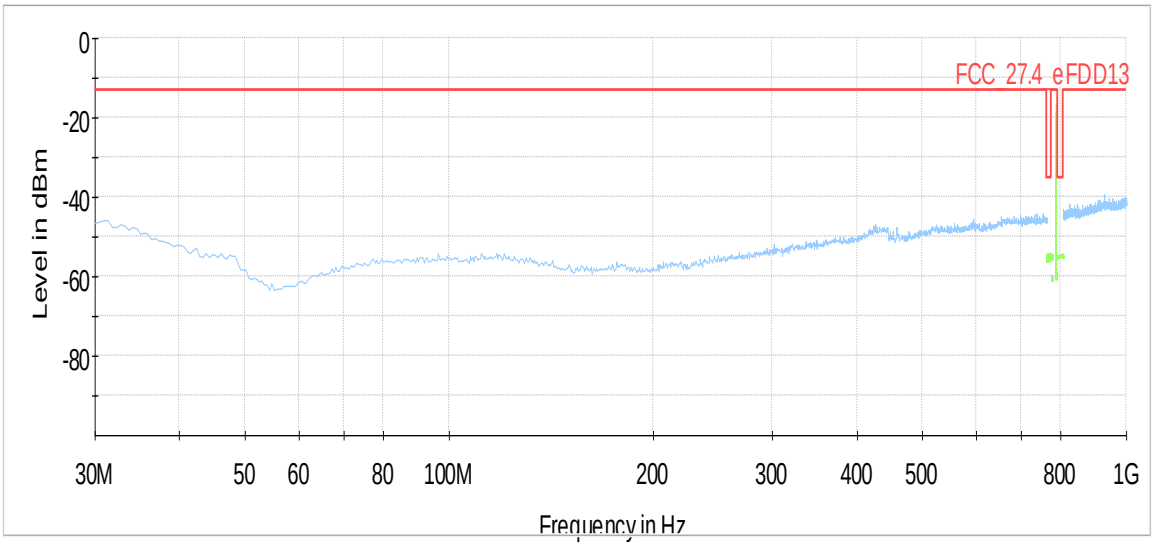



1 GHz – 10 GHz

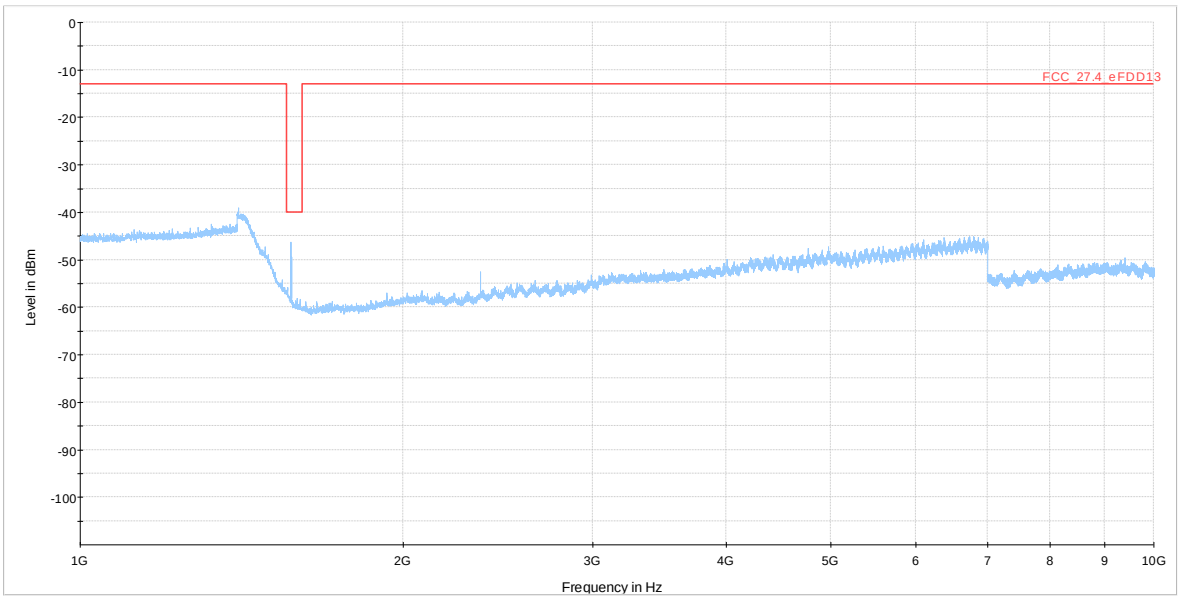



| Frequency (MHz) | MaxPeak (dBm) | Limit (dBm) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Elevation (deg) |
|---|---|---|---|---|---|---|---|---|---|
| 1559.600 | -43.7 | -40.00 | 3.74 | 1000.0 | 1000.000 | 150.0 | V | -41.0 | 80.0 |

NB-IoT eFDD13 Channel = high
30 MHz – 1 GHz




1 GHz – 10 GHz




30 MHz – 1 GHz

## 4.4.5 TEST EQUIPMENT USED

- Radiated Emissions

## 4.5 EMISSION AND OCCUPIED BANDWIDTH

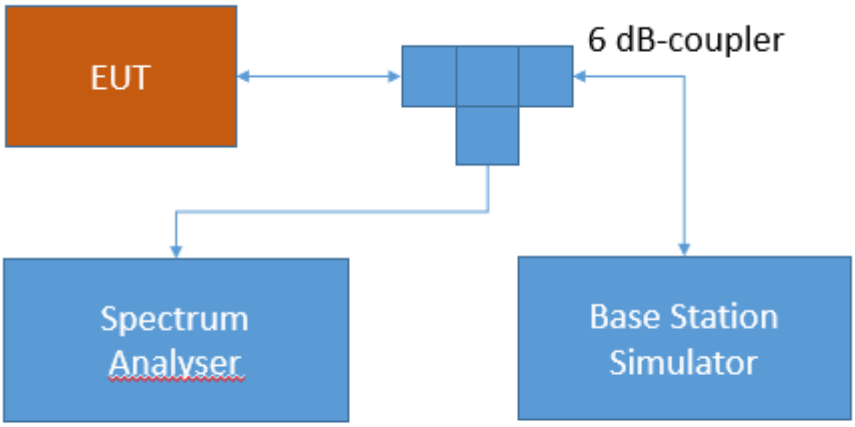
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015

### 4.5.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per FCC §2.1049 and RSS-GEN 6.7. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setups according to the following diagram:




Test Setup FCC Part 22/24/27/90 Cellular;

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 4.5.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1049; Occupied Bandwidth:**

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

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation—when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

**RSS-GEN; 6.7 Occupied Bandwidth**

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

### 4.5.3 TEST PROTOCOL

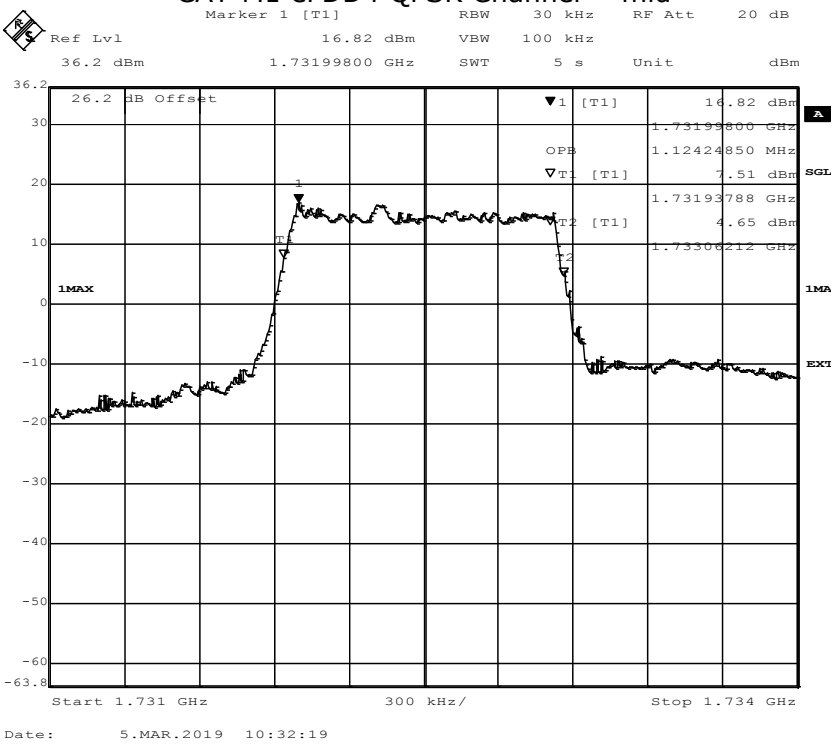
Ambient temperature: 23 °C
Relative humidity: 34 %

| Radio Technology | Channel | Ressource Blocks / Subcarrier | Bandwidth [MHz] | Nominal BW [MHz] | 99 % BW [kHz] |
|---|---|---|---|---|---|
| CAT-M1 eFDD 4 QPSK | low | 6 | 1.4 | 1.4 | 1112.22 |
| CAT-M1 eFDD 4 QPSK | mid | 6 | 1.4 | 1.4 | 1124.25 |
| CAT-M1 eFDD 4 QPSK | high | 6 | 1.4 | 1.4 | 1100.20 |
| CAT-M1 eFDD 4 16QAM | low | 5 | 1.4 | 1.4 | 943.89 |
| CAT-M1 eFDD 4 16QAM | mid | 5 | 1.4 | 1.4 | 955.91 |
| CAT-M1 eFDD 4 16QAM | high | 5 | 1.4 | 1.4 | 961.92 |
| CAT-M1 eFDD 12 QPSK | low | 6 | 1.4 | 1.4 | 1130.26 |
| CAT-M1 eFDD 12 QPSK | mid | 6 | 1.4 | 1.4 | 1106.21 |
| CAT-M1 eFDD 12 QPSK | high | 6 | 1.4 | 1.4 | 1106.21 |
| CAT-M1 eFDD 12 16QAM | low | 5 | 1.4 | 1.4 | 937.88 |
| CAT-M1 eFDD 12 16QAM | mid | 5 | 1.4 | 1.4 | 931.86 |
| CAT-M1 eFDD 12 16QAM | high | 5 | 1.4 | 1.4 | 937.88 |
| CAT-M1 eFDD 13 QPSK | low | 6 | 1.4 | 1.4 | 1148.30 |
| CAT-M1 eFDD 13 QPSK | mid | 6 | 1.4 | 1.4 | 1136.27 |
| CAT-M1 eFDD 13 QPSK | high | 6 | 1.4 | 1.4 | 1130.26 |
| CAT-M1 eFDD 13 16QAM | low | 5 | 1.4 | 1.4 | 961.92 |
| CAT-M1 eFDD 13 16QAM | mid | 5 | 1.4 | 1.4 | 991.98 |
| CAT-M1 eFDD 13 16QAM | high | 5 | 1.4 | 1.4 | 991.98 |
| NB-IoT eFDD 4 QPSK | low | 12 | 0.2 | 0.2 | 192.38 |
| NB-IoT eFDD 4 QPSK | mid | 12 | 0.2 | 0.2 | 188.38 |
| NB-IoT eFDD 4 QPSK | high | 12 | 0.2 | 0.2 | 186.37 |
| NB-IoT eFDD 4 BPSK | low | 1 | 0.2 | 0.2 | 86.17 |
| NB-IoT eFDD 4 BPSK | mid | 1 | 0.2 | 0.2 | 84.17 |
| NB-IoT eFDD 4 BPSK | high | 1 | 0.2 | 0.2 | 96.19 |
| NB-IoT eFDD 12 QPSK | low | 12 | 0.2 | 0.2 | 186.37 |
| NB-IoT eFDD 12 QPSK | mid | 12 | 0.2 | 0.2 | 186.37 |
| NB-IoT eFDD 12 QPSK | high | 12 | 0.2 | 0.2 | 186.37 |
| NB-IoT eFDD 12 BPSK | low | 1 | 0.2 | 0.2 | 78.15 |
| NB-IoT eFDD 12 BPSK | mid | 1 | 0.2 | 0.2 | 80.16 |
| NB-IoT eFDD 12 BPSK | high | 1 | 0.2 | 0.2 | 76.15 |
| NB-IoT eFDD 13 QPSK | low | 12 | 0.2 | 0.2 | 190.38 |
| NB-IoT eFDD 13 QPSK | mid | 12 | 0.2 | 0.2 | 188.37 |
| NB-IoT eFDD 13 QPSK | high | 12 | 0.2 | 0.2 | 186.37 |
| NB-IoT eFDD 13 BPSK | low | 1 | 0.2 | 0.2 | 76.78 |
| NB-IoT eFDD 13 BPSK | mid | 1 | 0.2 | 0.2 | 74.15 |
| NB-IoT eFDD 13 BPSK | high | 1 | 0.2 | 0.2 | 68.13 |

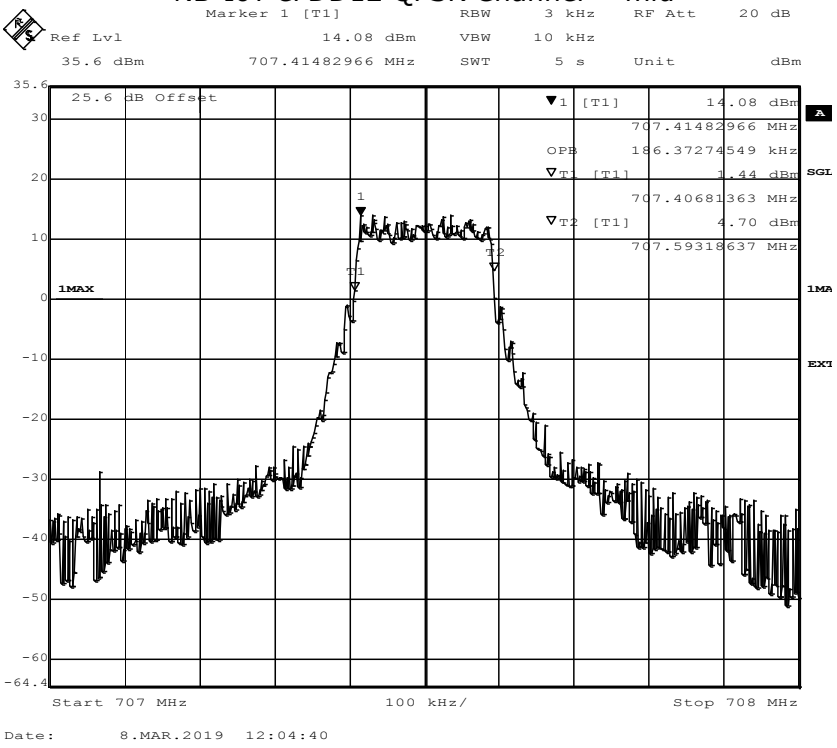
Remark: Please see next sub-clause for the measurement plot.

## 4.5.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD4 QPSK Channel = mid




NB-IoT eFDD12 QPSK Channel = mid




## 4.5.5 TEST EQUIPMENT USED

- Radio Lab

## 4.6 BAND EDGE COMPLIANCE

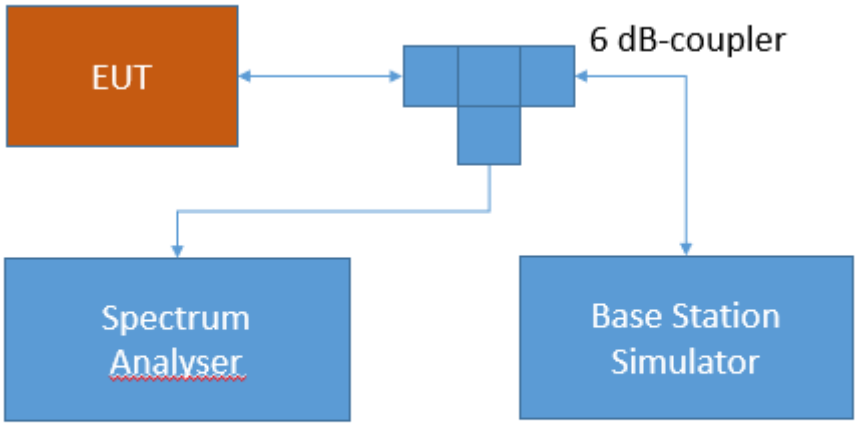
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015

### 4.6.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance to the applicable conducted spurious emission test case per § 2. 1051 and RSS-GEN 6.13. The limit comes from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:




Test Setup FCC Part 22/24/27/90 Cellular;
Band edge compliance

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

### 4.6.2 TEST REQUIREMENTS / LIMITS

**FCC Part 2.1051; Measurement required: Spurious emissions at antenna terminal:**

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated

under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§27.53 - Emission limits**

**Band 13**

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

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

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

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

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 12:**

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

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

**Band 4/10/66:**

(h) *AWS emission limits*— (1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.

**RSS-139; 6.6 Transmitter Unwanted Emissions**

Equipment shall comply with the limits in (i) and (ii) below.

i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 $\log_{10}$ p (watts) dB.

**Band 7:**

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

**RSS-199; 4.5 Transmitter unwanted emissions**

In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

b. for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:

$40 + 10 \log_{10} p$ from the channel edges to 5 MHz away

$43 + 10 \log_{10} p$ between 5 MHz and X MHz from the channel edges, and

$55 + 10 \log_{10} p$ at X MHz and beyond from the channel edges

In addition, the attenuation shall not be less than $43 + 10 \log_{10} p$ on all frequencies between 2490.5 MHz and 2496 MHz, and $55 + 10 \log_{10} p$ at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

**Band 17:**

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

**RSS-130; 4.7.1 General unwanted emissions limits**

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 $\log_{10}$ p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

**RSS-130; 4.7.2 Additional unwanted emissions limits**

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a. the power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:

   i. 76 + 10 $\log_{10}$ p (watts), dB, for base and fixed equipment and

   ii. 65 + 10 $\log_{10}$ p (watts), dB, for mobile and portable equipment

b. the e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

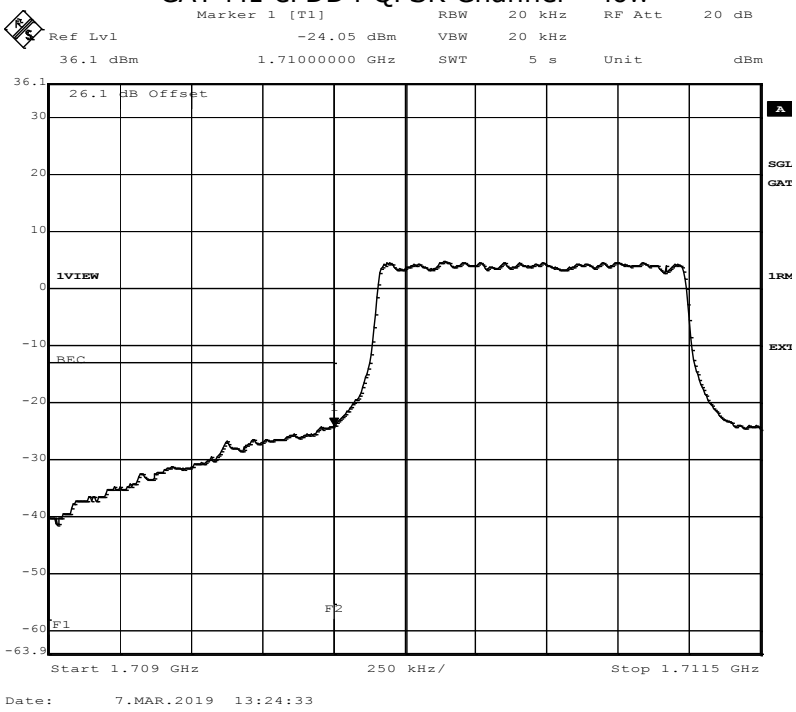
## 4.6.3 TEST PROTOCOL

| Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | Peak [dBm] | Average [dBm] | RMS [dBm] | Limit /dBm | Margin to Limit /dB |
|---|---|---|---|---|---|---|---|---|
| CAT-M1 eFDD 4 QPSK | low | 6 | 1.4 | -15.68 | -25.15 | -24.05 | -13 | 11.05 |
| CAT-M1 eFDD 4 QPSK | high | 6 | 1.4 | -16.58 | -26.21 | -25.15 | -13 | 12.15 |
| CAT-M1 eFDD 4 16QAM | low | 5 | 1.4 | -14.26 | -24.98 | -24.05 | -13 | 11.05 |
| CAT-M1 eFDD 4 16QAM | high | 5 | 1.4 | -16.78 | -27.64 | -26.21 | -13 | 13.21 |
| CAT-M1 eFDD 12 QPSK | low | 6 | 1.4 | -16.12 | -29.08 | -27.30 | -13 | 14.30 |
| CAT-M1 eFDD 12 QPSK | high | 6 | 1.4 | -11.60 | -28.84 | -26.16 | -13 | 13.16 |
| CAT-M1 eFDD 12 16QAM | low | 5 | 1.4 | -12.88 | -27.30 | -25.48 | -13 | 12.48 |
| CAT-M1 eFDD 12 16QAM | high | 5 | 1.4 | -13.61 | -28.84 | -26.71 | -13 | 13.71 |
| CAT-M1 eFDD 13 QPSK | low | 6 | 1.4 | -10.11 | -30.42 | -25.32 | -13 | 12.32 |
| CAT-M1 eFDD 13 QPSK | high | 6 | 1.4 | -17.40 | -31.02 | -27.30 | -13 | 14.30 |
| CAT-M1 eFDD 13 16QAM | low | 5 | 1.4 | -10.68 | -30.72 | -26.90 | -13 | 13.90 |
| CAT-M1 eFDD 13 16QAM | high | 5 | 1.4 | -10.65 | -33.12 | -26.90 | -13 | 13.90 |
| NB-IoT eFDD 4 QPSK | low | 12 | 0.2 | -6.45 | -32.23 | -19.82 | -13 | 6.82 |
| NB-IoT eFDD 4 QPSK | high | 12 | 0.2 | -7.56 | -28.84 | -17.88 | -13 | 4.88 |
| NB-IoT eFDD 4 BPSK | low | 1 | 0.2 | -19.24 | -23.90 | -23.21 | -13 | 10.21 |
| NB-IoT eFDD 4 BPSK | high | 1 | 0.2 | -19.69 | -23.62 | -23.76 | -13 | 10.76 |
| NB-IoT eFDD 12 QPSK | low | 12 | 0.2 | -6.73 | -31.02 | -20.41 | -13 | 7.41 |
| NB-IoT eFDD 12 QPSK | high | 12 | 0.2 | -5.14 | -29.86 | -17.96 | -13 | 4.96 |
| NB-IoT eFDD 12 BPSK | low | 1 | 0.2 | -18.63 | -23.98 | -23.19 | -13 | 10.19 |
| NB-IoT eFDD 12 BPSK | high | 1 | 0.2 | -20.13 | -24.26 | -23.84 | -13 | 10.84 |
| NB-IoT eFDD 13 QPSK | low | 12 | 0.2 | -6.61 | -31.02 | -20.32 | -13 | 7.32 |
| NB-IoT eFDD 13 QPSK | high | 12 | 0.2 | -7.47 | -27.92 | -20.05 | -13 | 7.05 |
| NB-IoT eFDD 13 BPSK | low | 1 | 0.2 | -19.83 | -23.32 | -24.26 | -13 | 11.26 |
| NB-IoT eFDD 13 BPSK | high | 1 | 0.2 | -20.31 | -24.85 | -23.98 | -13 | 10.98 |

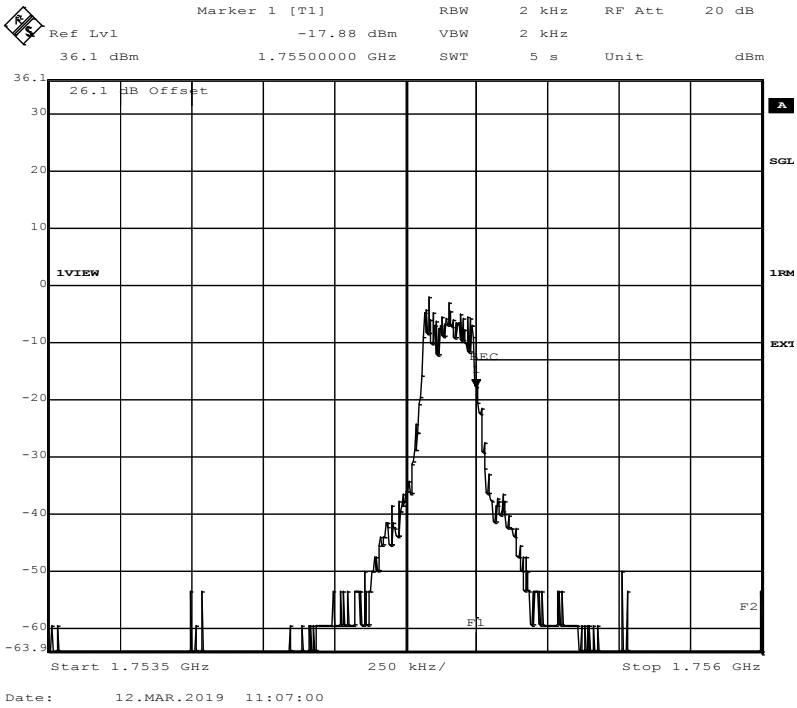
Remark: Please see next sub-clause for the measurement plot.

## 4.6.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD4 QPSK Channel = low




NB-IoT eFDD4 QPSK Channel = high




## 4.6.5 TEST EQUIPMENT USED

- Radio Lab

## 4.7 PEAK TO AVERAGE RATIO

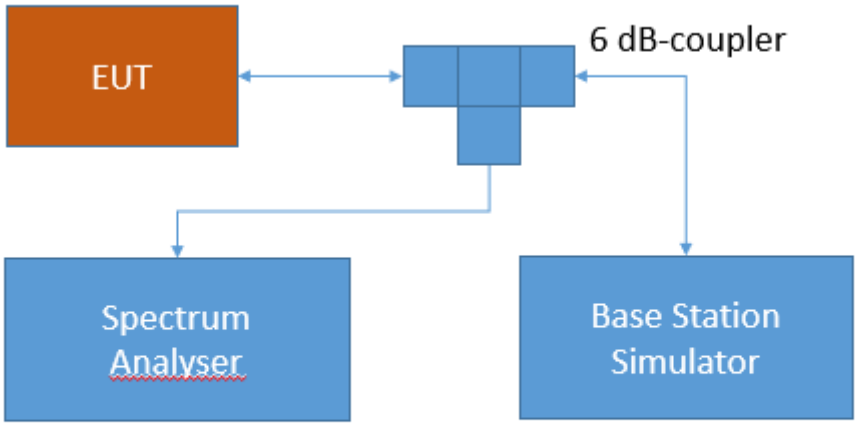
Standard **FCC PART 27 Subpart C**

**The test was performed according to:**
ANSI C63.26: 2015

### 4.7.1 TEST DESCRIPTION

This test case is intended to demonstrate compliance of the EUT to the peak-to-average limits and requirements of the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:




Test Setup FCC Part 22/24/27/90 Cellular;
Peak-average ratio

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams. The internal CCDF (complementary cumulative distribution function) of the spectrum analyser is used for this measurement

### 4.7.2 TEST REQUIREMENTS / LIMITS

**FCC Part 27; Miscellaneous Wireless Communication Services**

**Subpart C – Technical standards**

**§ 27.50 - Power limits and duty cycle**

**Band 13:**

No applicable PAPR limit.

**RSS-130; 4.6.1 General**

The transmitter output power shall be measured in terms of average power. 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 and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

**Band 12:**

No applicable PAPR limit.

**RSS-130; 4.6.1 General**

The transmitter output power shall be measured in terms of average power. 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 and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

**Band 4/10/66:**

d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

**RSS-139; 6.5 Transmitter Output Power**

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.

**Band 17:**

No applicable PAPR limit.

**RSS-130; 4.6.1 General**

The transmitter output power shall be measured in terms of average power. 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 and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

**Band 7:**

No applicable PAPR limit.

**RSS-199; 4.4 Transmitter output power and equivalent isotropicall power (e.i.r.p.)**

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 and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

For equipment with multiple antennas, the transmitter output power and e.i.r.p shall be measured according to ANSI C63.26‑2015.

## 4.7.3 TEST PROTOCOL

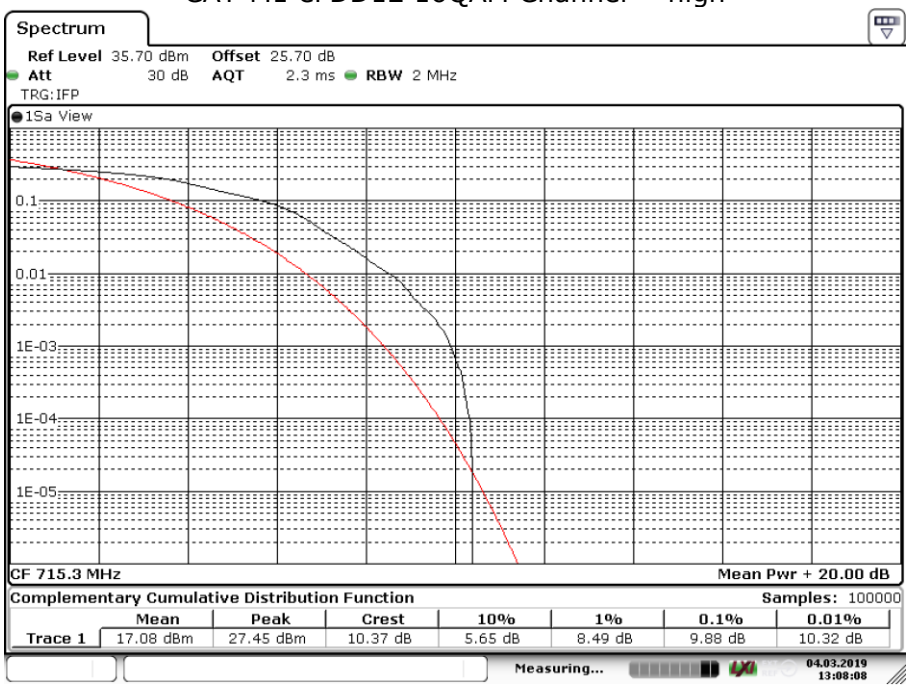
Ambient temperature: 23 °C
Relative humidity: 34 %

| Radio Technology | Channel | Ressource Blocks | Bandwidth [MHz] | Peak to Average Ratio | Limit (IC) [dB] |
|---|---|---|---|---|---|
| CAT-M1 eFDD 4 QPSK | low | 6 | 1.4 | 9.28 | 13 |
| CAT-M1 eFDD 4 QPSK | mid | 6 | 1.4 | 9.19 | 13 |
| CAT-M1 eFDD 4 QPSK | high | 6 | 1.4 | 9.01 | 13 |
| CAT-M1 eFDD 4 16QAM | low | 5 | 1.4 | 10.26 | 13 |
| CAT-M1 eFDD 4 16QAM | mid | 5 | 1.4 | 10.14 | 13 |
| CAT-M1 eFDD 4 16QAM | high | 5 | 1.4 | 9.91 | 13 |
| CAT-M1 eFDD 12 QPSK | low | 6 | 1.4 | 8.93 | 13 |
| CAT-M1 eFDD 12 QPSK | mid | 6 | 1.4 | 8.81 | 13 |
| CAT-M1 eFDD 12 QPSK | high | 6 | 1.4 | 8.84 | 13 |
| CAT-M1 eFDD 12 16QAM | low | 5 | 1.4 | 9.86 | 13 |
| CAT-M1 eFDD 12 16QAM | mid | 5 | 1.4 | 9.83 | 13 |
| CAT-M1 eFDD 12 16QAM | high | 5 | 1.4 | 9.88 | 13 |
| CAT-M1 eFDD 13 QPSK | low | 6 | 1.4 | 9.28 | 13 |
| CAT-M1 eFDD 13 QPSK | mid | 6 | 1.4 | 9.07 | 13 |
| CAT-M1 eFDD 13 QPSK | high | 6 | 1.4 | 9.04 | 13 |
| CAT-M1 eFDD 13 16QAM | low | 5 | 1.4 | 9.74 | 13 |
| CAT-M1 eFDD 13 16QAM | mid | 5 | 1.4 | 9.33 | 13 |
| CAT-M1 eFDD 13 16QAM | high | 5 | 1.4 | 9.30 | 13 |
| NB-IoT eFDD 4 QPSK | low | 12 | 0.2 | 5.86 | 13 |
| NB-IoT eFDD 4 QPSK | mid | 12 | 0.2 | 5.91 | 13 |
| NB-IoT eFDD 4 QPSK | high | 12 | 0.2 | 5.86 | 13 |
| NB-IoT eFDD 4 BPSK | low | 1 | 0.2 | 2.14 | 13 |
| NB-IoT eFDD 4 BPSK | mid | 1 | 0.2 | 2.43 | 13 |
| NB-IoT eFDD 4 BPSK | high | 1 | 0.2 | 2.20 | 13 |
| NB-IoT eFDD 12 QPSK | low | 12 | 0.2 | 6.06 | 13 |
| NB-IoT eFDD 12 QPSK | mid | 12 | 0.2 | 6.00 | 13 |
| NB-IoT eFDD 12 QPSK | high | 12 | 0.2 | 5.71 | 13 |
| NB-IoT eFDD 12 BPSK | low | 1 | 0.2 | 1.80 | 13 |
| NB-IoT eFDD 12 BPSK | mid | 1 | 0.2 | 1.83 | 13 |
| NB-IoT eFDD 12 BPSK | high | 1 | 0.2 | 2.23 | 13 |
| NB-IoT eFDD 13 QPSK | low | 12 | 0.2 | 5.77 | 13 |
| NB-IoT eFDD 13 QPSK | mid | 12 | 0.2 | 5.16 | 13 |
| NB-IoT eFDD 13 QPSK | high | 12 | 0.2 | 5.74 | 13 |
| NB-IoT eFDD 13 BPSK | low | 1 | 0.2 | 1.77 | 13 |
| NB-IoT eFDD 13 BPSK | mid | 1 | 0.2 | 2.06 | 13 |
| NB-IoT eFDD 13 BPSK | high | 1 | 0.2 | 1.68 | 13 |

Remark: Please see next sub-clause for the measurement plot.

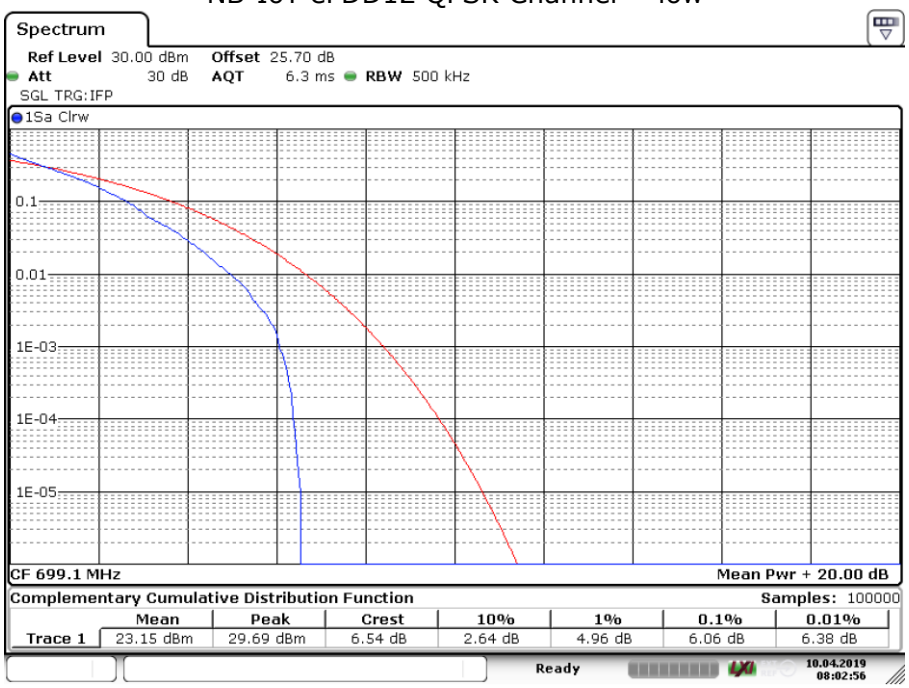
## 4.7.4 MEASUREMENT PLOT (SHOWING THE HIGHEST VALUE, "WORST CASE")

CAT-M1 eFDD12 16QAM Channel = high




Date: 4.MAR.2019 13:08:08

NB-IoT eFDD12 QPSK Channel = low




Date: 10.APR.2019 08:02:56

## 4.7.5 TEST EQUIPMENT USED

- Radio Lab

# 5 TEST EQUIPMENT

1 Radiated Emissions

Lab to perform radiated emission tests

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 1.1 | NRV-Z1 | Sensor Head A | Rohde & Schwarz GmbH & Co. KG | 827753/005 | 2018-07 | 2019-07 |
| 1.2 | MFS | Rubidium Frequency Normal MFS | Datum GmbH | 002 | 2018-10 | 2020-10 |
| 1.3 | Opus10 TPR (8253.00) | ThermoAirpressure Datalogger 13 (Environ) | Lufft Mess- und Regeltechnik GmbH | 13936 | 2017-04 | 2019-04 |
| 1.4 | ESW44 | EMI Test Receiver | Rohde & Schwarz GmbH & Co. KG | 101603 | 2018-05 | 2019-05 |
| 1.5 | Anechoic Chamber | 10.58 x 6.38 x 6.00 m³ | Frankonia | none | 2018-06 | 2020-06 |
| 1.6 | FS-Z60 | Harmonic Mixer 40 - 60 GHz | Rohde & Schwarz Messgerätebau GmbH | 100178 | 2016-12 | 2019-12 |
| 1.7 | FS-Z220 | Harmonic Mixer 140 - 220 GHz | Rohde & Schwarz Messgerätebau GmbH | 101005 | 2017-03 | 2020-03 |
| 1.8 | SGH-05 | Standard Gain / Pyramidal Horn Antenna (140 - 220 GHz) | RPG-Radiometer Physics GmbH | 075 | | |
| 1.9 | HL 562 | Ultralog new biconicals | Rohde & Schwarz | 830547/003 | 2018-07 | 2021-07 |
| 1.10 | 5HC2700/12750-1.5-KK | High Pass Filter | Trilithic | 9942012 | | |
| 1.11 | ASP 1.2/1.8-10 kg | Antenna Mast | Maturo GmbH | - | | |
| 1.12 | Fully Anechoic Room | 8.80m x 4.60m x 4.05m (l x w x h) | Albatross Projects | P26971-647-001-PRB | 2018-06 | 2020-06 |
| 1.13 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2018-04 | 2020-04 |
| 1.14 | NRVD | Power Meter | Rohde & Schwarz GmbH & Co. KG | 828110/016 | 2018-07 | 2019-07 |
| 1.15 | HF 906 | Double-ridged horn | Rohde & Schwarz | 357357/002 | 2018-09 | 2021-09 |
| 1.16 | JS4-18002600-32-5P | Broadband Amplifier 18 GHz - 26 GHz | Miteq | 849785 | | |
| 1.17 | FSW 43 | Spectrum Analyzer | Rohde & Schwarz | 103779 | 2019-02 | 2021-02 |
| 1.18 | 3160-09 | Standard Gain / Pyramidal Horn Antenna 26.5 GHz | EMCO Elektronic GmbH | 00083069 | | |

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 1.19 | SGH-19 | Standard Gain / Pyramidal Horn Antenna (40 - 60 GHz) | RPG-Radiometer Physics GmbH | 093 | | |
| 1.20 | WHKX 7.0/18G-8SS | High Pass Filter | Wainwright | 09 | | |
| 1.21 | 4HC1600/12750-1.5-KK | High Pass Filter | Trilithic | 9942011 | | |
| 1.22 | Chroma 6404 | AC Power Source | Chroma ATE INC. | 64040001304 | | |
| 1.23 | JS4-00102600-42-5A | Broadband Amplifier 30 MHz - 26 GHz | Miteq | 619368 | | |
| 1.24 | TT 1.5 WI | Turn Table | Maturo GmbH | - | | |
| 1.25 | HL 562 Ultralog | Log.-per. Antenna | Rohde & Schwarz | 100609 | 2016-04 | 2019-04 |
| 1.26 | HF 906 | Double-ridged horn | Rohde & Schwarz | 357357/001 | 2018-03 | 2021-03 |
| 1.27 | FS-Z325 | Harmonic Mixer 220 - 325 GHz | Rohde & Schwarz Messgerätebau GmbH | 101006 | 2017-03 | 2020-03 |
| 1.28 | 3160-10 | Standard Gain / Pyramidal Horn Antenna 40 GHz | EMCO Elektronic GmbH | 00086675 | | |
| 1.29 | SGH-08 | Standard Gain / Pyramidal Horn Antenna (90 - 140 GHz) | RPG-Radiometer Physics GmbH | 064 | | |
| 1.30 | SGH-12 | Standard Gain / Pyramidal HornAntenna (60 - 90 GHz) | RPG-Radiometer Physics GmbH | 326 | | |
| 1.31 | 5HC3500/18000-1.2-KK | High Pass Filter | Trilithic | 200035008 | | |
| 1.32 | FS-Z140 | Harmonic Mixer 90 -140 GHz | Rohde & Schwarz Messgerätebau GmbH | 101007 | 2017-02 | 2020-02 |
| 1.33 | HFH2-Z2 | Loop Antenna | Rohde & Schwarz | 829324/006 | 2018-01 | 2021-01 |
| 1.34 | Opus10 THI (8152.00) | ThermoHygro Datalogger 12 (Environ) | Lufft Mess- und Regeltechnik GmbH | 12482 | 2017-03 | 2019-03 |
| 1.35 | ESR 7 | EMI Receiver / Spectrum Analyzer | Rohde & Schwarz | 101424 | 2019-01 | 2020-01 |
| 1.36 | JS4-00101800-35-5P | Broadband Amplifier 30 MHz - 18 GHz | Miteq | 896037 | | |
| 1.37 | AS 620 P | Antenna mast | HD GmbH | 620/37 | | |
| 1.38 | Tilt device Maturo (Rohacell) | Antrieb TD1.5-10kg | Maturo GmbH | TD1.5-10kg/024/3790709 | | |
| 1.39 | SGH-03 | Standard Gain / Pyramidal Horn Antenna (220 - 325 GHz) | RPG-Radiometer Physics GmbH | 060 | | |

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 1.40 | FS-Z90 | Harmonic Mixer 60 - 90 GHz | Rohde & Schwarz Messgerätebau GmbH | 101686 | 2017-03 | 2020-03 |
| 1.41 | ESIB 26 | Spectrum Analyzer | Rohde & Schwarz | 830482/004 | 2018-01 | 2020-01 |
| 1.42 | PAS 2.5 - 10 kg | Antenna Mast | Maturo GmbH | - | | |
| 1.43 | AFS42-00101800-25-S-42 | Broadband Amplifier 25 MHz - 18 GHz | Miteq | 2035324 | | |
| 1.44 | AM 4.0 | Antenna mast | Maturo GmbH | AM4.0/180/1192 0513 | | |
| 1.45 | HF 907 | Double-ridged horn | Rohde & Schwarz | 102444 | 2018-07 | 2021-07 |

2 Radio Lab
Conducted Radio Test Lab

| Ref.No. | Device Name | Description | Manufacturer | Serial Number | Last Calibration | Calibration Due |
|---|---|---|---|---|---|---|
| 2.1 | SMB100A | Signal Generator 9 kHz - 6 GHz | Rohde & Schwarz | 107695 | 2017-07 | 2020-07 |
| 2.2 | MFS | Rubidium Frequency Standard | Datum-Beverly | 5489/001 | 2018-07 | 2019-07 |
| 2.3 | FSV30 | Signal Analyzer 10 Hz - 30 GHz | Rohde & Schwarz | 103005 | 2018-04 | 2020-04 |
| 2.4 | Fluke 177 | Digital Multimeter 03 (Multimeter) | Fluke Europe B.V. | 86670383 | 2018-04 | 2020-04 |
| 2.5 | SMP03 | Signal Generator 2 GHz - 27 GHz | Rohde & Schwarz | 833680/003 | 2017-09 | 2020-09 |
| 2.6 | FSIQ26 | Signal Analyser | Rohde & Schwarz | 840061/005 | 2017-05 | 2019-05 |
| 2.7 | Chroma 6404 | AC Power Source | Chroma ATE INC. | 64040001304 | | |
| 2.8 | VT 4002 | Temperature Chamber | Vötsch | 58566002150010 | 2018-04 | 2020-04 |
| 2.9 | WA1515 | Broadband Power Divider SMA | Weinschel Associates | A855 | | |
| 2.10 | A8455-4 | 4 Way Power Divider (SMA) | | - | | |
| 2.11 | Opus10 THI (8152.00) | ThermoHygro Datalogger 03 (Environ) | Lufft Mess- und Regeltechnik GmbH | 7482 | 2017-03 | 2019-03 |
| 2.12 | SMBV100A | Vector Signal Generator 9 kHz - 6 GHz | Rohde & Schwarz | 259291 | 2016-10 | 2019-10 |

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

# 6 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

## 6.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

| Frequency | | Corr. | LISN insertion loss ESH3-Z5 | cable loss (incl. 10 dB atten-uator) |
|---|---|---|---|---|
| MHz | | dB | dB | dB |
| 0.15 | | 10.1 | 0.1 | 10.0 |
| 5 | | 10.3 | 0.1 | 10.2 |
| 7 | | 10.5 | 0.2 | 10.3 |
| 10 | | 10.5 | 0.2 | 10.3 |
| 12 | | 10.7 | 0.3 | 10.4 |
| 14 | | 10.7 | 0.3 | 10.4 |
| 16 | | 10.8 | 0.4 | 10.4 |
| 18 | | 10.9 | 0.4 | 10.5 |
| 20 | | 10.9 | 0.4 | 10.5 |
| 22 | | 11.1 | 0.5 | 10.6 |
| 24 | | 11.1 | 0.5 | 10.6 |
| 26 | | 11.2 | 0.5 | 10.7 |
| 28 | | 11.2 | 0.5 | 10.7 |
| 30 | | 11.3 | 0.5 | 10.8 |

**Sample calculation**

$U_{LISN}$ (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

## 6.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

| Frequency | AF HFH-Z2) | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-40 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 0.009 | 20.50 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.01 | 20.45 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.015 | 20.37 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.02 | 20.36 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.025 | 20.38 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.03 | 20.32 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.05 | 20.35 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.08 | 20.30 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.1 | 20.20 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.2 | 20.17 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.3 | 20.14 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.49 | 20.12 | -79.6 | 0.1 | 0.1 | 0.1 | 0.1 | -80 | 300 | 3 |
| 0.490001 | 20.12 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 0.5 | 20.11 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 0.8 | 20.10 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 1 | 20.09 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 2 | 20.08 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 3 | 20.06 | -39.6 | 0.1 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 4 | 20.05 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 5 | 20.05 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 6 | 20.02 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 8 | 19.95 | -39.5 | 0.2 | 0.1 | 0.1 | 0.1 | -40 | 30 | 3 |
| 10 | 19.83 | -39.4 | 0.2 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 12 | 19.71 | -39.4 | 0.2 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 14 | 19.54 | -39.4 | 0.2 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 16 | 19.53 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 18 | 19.50 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 20 | 19.57 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 22 | 19.61 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 24 | 19.61 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 26 | 19.54 | -39.3 | 0.3 | 0.1 | 0.2 | 0.1 | -40 | 30 | 3 |
| 28 | 19.46 | -39.2 | 0.3 | 0.1 | 0.3 | 0.1 | -40 | 30 | 3 |
| 30 | 19.73 | -39.1 | 0.4 | 0.1 | 0.3 | 0.1 | -40 | 30 | 3 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG ($d_{Limit}$/ $d_{used}$)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

## 6.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

**($d_{Limit}$ = 3 m)**

| Frequency | AF R&S HL562 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 30 | 18.6 | 0.6 | 0.29 | 0.04 | 0.23 | 0.02 | 0.0 | 3 | 3 |
| 50 | 6.0 | 0.9 | 0.39 | 0.09 | 0.32 | 0.08 | 0.0 | 3 | 3 |
| 100 | 9.7 | 1.2 | 0.56 | 0.14 | 0.47 | 0.08 | 0.0 | 3 | 3 |
| 150 | 7.9 | 1.6 | 0.73 | 0.20 | 0.59 | 0.12 | 0.0 | 3 | 3 |
| 200 | 7.6 | 1.9 | 0.84 | 0.21 | 0.70 | 0.11 | 0.0 | 3 | 3 |
| 250 | 9.5 | 2.1 | 0.98 | 0.24 | 0.80 | 0.13 | 0.0 | 3 | 3 |
| 300 | 11.0 | 2.3 | 1.04 | 0.26 | 0.89 | 0.15 | 0.0 | 3 | 3 |
| 350 | 12.4 | 2.6 | 1.18 | 0.31 | 0.96 | 0.13 | 0.0 | 3 | 3 |
| 400 | 13.6 | 2.9 | 1.28 | 0.35 | 1.03 | 0.19 | 0.0 | 3 | 3 |
| 450 | 14.7 | 3.1 | 1.39 | 0.38 | 1.11 | 0.22 | 0.0 | 3 | 3 |
| 500 | 15.6 | 3.2 | 1.44 | 0.39 | 1.20 | 0.19 | 0.0 | 3 | 3 |
| 550 | 16.3 | 3.5 | 1.55 | 0.46 | 1.24 | 0.23 | 0.0 | 3 | 3 |
| 600 | 17.2 | 3.5 | 1.59 | 0.43 | 1.29 | 0.23 | 0.0 | 3 | 3 |
| 650 | 18.1 | 3.6 | 1.67 | 0.34 | 1.35 | 0.22 | 0.0 | 3 | 3 |
| 700 | 18.5 | 3.6 | 1.67 | 0.42 | 1.41 | 0.15 | 0.0 | 3 | 3 |
| 750 | 19.1 | 4.1 | 1.87 | 0.54 | 1.46 | 0.25 | 0.0 | 3 | 3 |
| 800 | 19.6 | 4.1 | 1.90 | 0.46 | 1.51 | 0.25 | 0.0 | 3 | 3 |
| 850 | 20.1 | 4.4 | 1.99 | 0.60 | 1.56 | 0.27 | 0.0 | 3 | 3 |
| 900 | 20.8 | 4.7 | 2.14 | 0.60 | 1.63 | 0.29 | 0.0 | 3 | 3 |
| 950 | 21.1 | 4.8 | 2.22 | 0.60 | 1.66 | 0.33 | 0.0 | 3 | 3 |
| 1000 | 21.6 | 4.9 | 2.23 | 0.61 | 1.71 | 0.30 | 0.0 | 3 | 3 |

**($d_{Limit}$ = 10 m)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30 | 18.6 | -9.9 | 0.29 | 0.04 | 0.23 | 0.02 | -10.5 | 10 | 3 |
| 50 | 6.0 | -9.6 | 0.39 | 0.09 | 0.32 | 0.08 | -10.5 | 10 | 3 |
| 100 | 9.7 | -9.2 | 0.56 | 0.14 | 0.47 | 0.08 | -10.5 | 10 | 3 |
| 150 | 7.9 | -8.8 | 0.73 | 0.20 | 0.59 | 0.12 | -10.5 | 10 | 3 |
| 200 | 7.6 | -8.6 | 0.84 | 0.21 | 0.70 | 0.11 | -10.5 | 10 | 3 |
| 250 | 9.5 | -8.3 | 0.98 | 0.24 | 0.80 | 0.13 | -10.5 | 10 | 3 |
| 300 | 11.0 | -8.1 | 1.04 | 0.26 | 0.89 | 0.15 | -10.5 | 10 | 3 |
| 350 | 12.4 | -7.9 | 1.18 | 0.31 | 0.96 | 0.13 | -10.5 | 10 | 3 |
| 400 | 13.6 | -7.6 | 1.28 | 0.35 | 1.03 | 0.19 | -10.5 | 10 | 3 |
| 450 | 14.7 | -7.4 | 1.39 | 0.38 | 1.11 | 0.22 | -10.5 | 10 | 3 |
| 500 | 15.6 | -7.2 | 1.44 | 0.39 | 1.20 | 0.19 | -10.5 | 10 | 3 |
| 550 | 16.3 | -7.0 | 1.55 | 0.46 | 1.24 | 0.23 | -10.5 | 10 | 3 |
| 600 | 17.2 | -6.9 | 1.59 | 0.43 | 1.29 | 0.23 | -10.5 | 10 | 3 |
| 650 | 18.1 | -6.9 | 1.67 | 0.34 | 1.35 | 0.22 | -10.5 | 10 | 3 |
| 700 | 18.5 | -6.8 | 1.67 | 0.42 | 1.41 | 0.15 | -10.5 | 10 | 3 |
| 750 | 19.1 | -6.3 | 1.87 | 0.54 | 1.46 | 0.25 | -10.5 | 10 | 3 |
| 800 | 19.6 | -6.3 | 1.90 | 0.46 | 1.51 | 0.25 | -10.5 | 10 | 3 |
| 850 | 20.1 | -6.0 | 1.99 | 0.60 | 1.56 | 0.27 | -10.5 | 10 | 3 |
| 900 | 20.8 | -5.8 | 2.14 | 0.60 | 1.63 | 0.29 | -10.5 | 10 | 3 |
| 950 | 21.1 | -5.6 | 2.22 | 0.60 | 1.66 | 0.33 | -10.5 | 10 | 3 |
| 1000 | 21.6 | -5.6 | 2.23 | 0.61 | 1.71 | 0.30 | -10.5 | 10 | 3 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG ($d_{Limit}$/ $d_{used}$)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

## 6.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay + cable inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit, atten-uator & pre-amp) | cable loss 4 (to receiver) | | |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | | |
| 1000 | 24.4 | -19.4 | 0.99 | 0.31 | -21.51 | 0.79 | | |
| 2000 | 28.5 | -17.4 | 1.44 | 0.44 | -20.63 | 1.38 | | |
| 3000 | 31.0 | -16.1 | 1.87 | 0.53 | -19.85 | 1.33 | | |
| 4000 | 33.1 | -14.7 | 2.41 | 0.67 | -19.13 | 1.31 | | |
| 5000 | 34.4 | -13.7 | 2.78 | 0.86 | -18.71 | 1.40 | | |
| 6000 | 34.7 | -12.7 | 2.74 | 0.90 | -17.83 | 1.47 | | |
| 7000 | 35.6 | -11.0 | 2.82 | 0.86 | -16.19 | 1.46 | | |

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay inside chamber) | cable loss 2 (inside chamber) | cable loss 3 (outside chamber) | cable loss 4 (switch unit, atten-uator & pre-amp) | cable loss 5 (to receiver) | used for FCC 15.247 |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | |
| 3000 | 31.0 | -23.4 | 0.47 | 1.87 | 0.53 | -27.58 | 1.33 | |
| 4000 | 33.1 | -23.3 | 0.56 | 2.41 | 0.67 | -28.23 | 1.31 | |
| 5000 | 34.4 | -21.7 | 0.61 | 2.78 | 0.86 | -27.35 | 1.40 | |
| 6000 | 34.7 | -21.2 | 0.58 | 2.74 | 0.90 | -26.89 | 1.47 | |
| 7000 | 35.6 | -19.8 | 0.66 | 2.82 | 0.86 | -25.58 | 1.46 | |

| Frequency | AF R&S HF907 | Corr. | cable loss 1 (relay inside chamber) | cable loss 2 (High Pass) | cable loss 3 (pre-amp) | cable loss 4 (inside chamber) | cable loss 5 (outside chamber) | cable loss 6 (to receiver) |
|---|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB | dB |
| 7000 | 35.6 | -57.3 | 0.56 | 1.28 | -62.72 | 2.66 | 0.94 | 1.46 |
| 8000 | 36.3 | -56.3 | 0.69 | 0.71 | -61.49 | 2.84 | 1.00 | 1.53 |
| 9000 | 37.1 | -55.3 | 0.68 | 0.65 | -60.80 | 3.06 | 1.09 | 1.60 |
| 10000 | 37.5 | -56.2 | 0.70 | 0.54 | -61.91 | 3.28 | 1.20 | 1.67 |
| 11000 | 37.5 | -55.3 | 0.80 | 0.61 | -61.40 | 3.43 | 1.27 | 1.70 |
| 12000 | 37.6 | -53.7 | 0.84 | 0.42 | -59.70 | 3.53 | 1.26 | 1.73 |
| 13000 | 38.2 | -53.5 | 0.83 | 0.44 | -59.81 | 3.75 | 1.32 | 1.83 |
| 14000 | 39.9 | -56.3 | 0.91 | 0.53 | -63.03 | 3.91 | 1.40 | 1.77 |
| 15000 | 40.9 | -54.1 | 0.98 | 0.54 | -61.05 | 4.02 | 1.44 | 1.83 |
| 16000 | 41.3 | -54.1 | 1.23 | 0.49 | -61.51 | 4.17 | 1.51 | 1.85 |
| 17000 | 42.8 | -54.4 | 1.36 | 0.76 | -62.36 | 4.34 | 1.53 | 2.00 |
| 18000 | 44.2 | -54.7 | 1.70 | 0.53 | -62.88 | 4.41 | 1.55 | 1.91 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

## 6.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

| Frequency | AF EMCO 3160-09 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (pre-amp) | cable loss 3 (inside chamber) | cable loss 4 (switch unit) | cable loss 5 (to receiver) |
|---|---|---|---|---|---|---|---|
| MHz | dB (1/m) | dB | dB | dB | dB | dB | dB |
| 18000 | 40.2 | -23.5 | 0.72 | -35.85 | 6.20 | 2.81 | 2.65 |
| 18500 | 40.2 | -23.2 | 0.69 | -35.71 | 6.46 | 2.76 | 2.59 |
| 19000 | 40.2 | -22.0 | 0.76 | -35.44 | 6.69 | 3.15 | 2.79 |
| 19500 | 40.3 | -21.3 | 0.74 | -35.07 | 7.04 | 3.11 | 2.91 |
| 20000 | 40.3 | -20.3 | 0.72 | -34.49 | 7.30 | 3.07 | 3.05 |
| 20500 | 40.3 | -19.9 | 0.78 | -34.46 | 7.48 | 3.12 | 3.15 |
| 21000 | 40.3 | -19.1 | 0.87 | -34.07 | 7.61 | 3.20 | 3.33 |
| 21500 | 40.3 | -19.1 | 0.90 | -33.96 | 7.47 | 3.28 | 3.19 |
| 22000 | 40.3 | -18.7 | 0.89 | -33.57 | 7.34 | 3.35 | 3.28 |
| 22500 | 40.4 | -19.0 | 0.87 | -33.66 | 7.06 | 3.75 | 2.94 |
| 23000 | 40.4 | -19.5 | 0.88 | -33.75 | 6.92 | 3.77 | 2.70 |
| 23500 | 40.4 | -19.3 | 0.90 | -33.35 | 6.99 | 3.52 | 2.66 |
| 24000 | 40.4 | -19.8 | 0.88 | -33.99 | 6.88 | 3.88 | 2.58 |
| 24500 | 40.4 | -19.5 | 0.91 | -33.89 | 7.01 | 3.93 | 2.51 |
| 25000 | 40.4 | -19.3 | 0.88 | -33.00 | 6.72 | 3.96 | 2.14 |
| 25500 | 40.5 | -20.4 | 0.89 | -34.07 | 6.90 | 3.66 | 2.22 |
| 26000 | 40.5 | -21.3 | 0.86 | -35.11 | 7.02 | 3.69 | 2.28 |
| 26500 | 40.5 | -21.1 | 0.90 | -35.20 | 7.15 | 3.91 | 2.36 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

## 6.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

| Frequency | AF EMCO 3160-10 | Corr. | cable loss 1 (inside chamber) | cable loss 2 (outside chamber) | cable loss 3 (switch unit) | cable loss 4 (to receiver) | distance corr. (-20 dB/ decade) | $d_{Limit}$ (meas. distance (limit) | $d_{used}$ (meas. distance (used) |
|---|---|---|---|---|---|---|---|---|---|
| GHz | dB (1/m) | dB | dB | dB | dB | dB | dB | m | m |
| 26.5 | 43.4 | -11.2 | 4.4 | | | | -9.5 | 3 | 1.0 |
| 27.0 | 43.4 | -11.2 | 4.4 | | | | -9.5 | 3 | 1.0 |
| 28.0 | 43.4 | -11.1 | 4.5 | | | | -9.5 | 3 | 1.0 |
| 29.0 | 43.5 | -11.0 | 4.6 | | | | -9.5 | 3 | 1.0 |
| 30.0 | 43.5 | -10.9 | 4.7 | | | | -9.5 | 3 | 1.0 |
| 31.0 | 43.5 | -10.8 | 4.7 | | | | -9.5 | 3 | 1.0 |
| 32.0 | 43.5 | -10.7 | 4.8 | | | | -9.5 | 3 | 1.0 |
| 33.0 | 43.6 | -10.7 | 4.9 | | | | -9.5 | 3 | 1.0 |
| 34.0 | 43.6 | -10.6 | 5.0 | | | | -9.5 | 3 | 1.0 |
| 35.0 | 43.6 | -10.5 | 5.1 | | | | -9.5 | 3 | 1.0 |
| 36.0 | 43.6 | -10.4 | 5.1 | | | | -9.5 | 3 | 1.0 |
| 37.0 | 43.7 | -10.3 | 5.2 | | | | -9.5 | 3 | 1.0 |
| 38.0 | 43.7 | -10.2 | 5.3 | | | | -9.5 | 3 | 1.0 |
| 39.0 | 43.7 | -10.2 | 5.4 | | | | -9.5 | 3 | 1.0 |
| 40.0 | 43.8 | -10.1 | 5.5 | | | | -9.5 | 3 | 1.0 |

**Sample calculation**

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG ($d_{Limit}$/ $d_{used}$)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

# 7 SETUP DRAWINGS

# 8 MEASUREMENT UNCERTAINTIES

| Test Case(s) | Parameter | Uncertainty |
|---|---|---|
| - Field strength of spurious radiation | Field Strength | ± 5.5 dB |
| - Emission and Occupied Bandwidth | Power<br>Frequency | ± 2.9 dB<br>± 11.2 kHz |
| - RF Output Power<br>- Peak to Average Ratio | Power | ± 2.2 dB |
| - Band Edge Compliance<br>- Spurious Emissions at Antenna Terminal | Power<br>Frequency | ± 2.2 dB<br>± 11.2 kHz |
| - Frequency Stability | Frequency | ± 25 Hz |

# 9 PHOTO REPORT

Please see separate photo report.