



Test report No:  
NIE: 64610RRF.003A2

## Partial Test report

REFERENCE STANDARD:  
USA FCC Part 22, Part 90  
CANADA IC RSS-132, RSS-140

|                                         |                                                                                                                                                                                                                                                           |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| (*) Identification of item tested       | nRF9160 IOT Module                                                                                                                                                                                                                                        |
| (*) Trademark                           | nRF91                                                                                                                                                                                                                                                     |
| (*) Model and /or type reference tested | nRF9160                                                                                                                                                                                                                                                   |
| Other identification of the product     | SW version: mfw_nrf9160_1.1.2-148<br>HW version: nRF9160-SICA-B1A<br>FCC ID: 2ANPO00NRF9160<br>IC: 24529-NRF9160<br>IMEI TAC: 35265610                                                                                                                    |
| (*) Features                            | LTE Cat-M1, LTE-NB1, GPS                                                                                                                                                                                                                                  |
| Applicant                               | NORDIC SEMICONDUCTOR ASA<br>Otto Nielsens Vel 12, 7052 Trondheim, Norway                                                                                                                                                                                  |
| Test method requested. standard         | USA FCC Part 22 10-1-19 Edition.<br>USA FCC Part 90 10-1-19 Edition.<br>CANADA IC RSS-132 Issue 3, Jan. 2013.<br>CANADA IC RSS-140 Issue 1, Apr. 2018.<br>ANSI C63.26 – 2015<br>KDB 971168 D01 Power Meas License Digital Systems<br>v03r01, April. 2018. |
| Date of issue                           | Rafael López Martín<br>EMC Consumer & RF Lab. Manager<br><br>RAFAEL LÓPEZ MARTÍN<br>2020.09.02 09:07:03<br>+02'00'                                                   |
| Report template No                      | 2020-08-31                                                                                                                                                                                                                                                |
| (*) Identification of item tested       | FDT08_22<br>(*) "Data provided by the client"                                                                                                                                                                                                             |

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## Competences and guarantees

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## Uncertainty

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

## Data provided by the client

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The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample consists of nRF9160 IOT Module.

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

## Usage of samples

Samples undergoing test have been selected by: the client.

Sample S/01 is composed of the following elements:

| Control N° | Description        | Model   | Serial N°             | Date of reception |
|------------|--------------------|---------|-----------------------|-------------------|
| 64610D/002 | nRF9160 IOT Module | nRF9160 | IMEI: 352656102628230 | 2020/04/14        |

1. Sample S/01 has undergone the following test(s):

All tests indicated in appendix A for GEN2 device.

Auxiliary sample S/02 is composed of the following elements:

| Control N° | Description        | Model   | Serial N°             | Date of reception |
|------------|--------------------|---------|-----------------------|-------------------|
| 59965/011  | nRF9160 IOT Module | nRF9160 | IMEI: 352656100158248 | 2019/03/25        |

1. Sample S/02 has undergone the following test(s):

Auxiliary sample to perform measurements for GEN1 device for conducted RF output power comparison indicated in appendix A.

## Test sample description

|                                               |                           |     |                          |                                     |                                     |                          |                          |
|-----------------------------------------------|---------------------------|-----|--------------------------|-------------------------------------|-------------------------------------|--------------------------|--------------------------|
| Ports..... :                                  | Port name and description |     | Cable                    |                                     |                                     |                          |                          |
|                                               |                           |     | Specified length [m]     | Attached during test                | Shielded                            |                          |                          |
|                                               | LTE RF                    |     | 2                        | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |                          |                          |
|                                               | GPS                       |     | 2                        | <input type="checkbox"/>            | <input type="checkbox"/>            |                          |                          |
|                                               | BTLE                      |     |                          | <input type="checkbox"/>            | <input type="checkbox"/>            |                          |                          |
|                                               |                           |     | <input type="checkbox"/> | <input type="checkbox"/>            |                                     |                          |                          |
| Supplementary information to the ports..... : | N/A                       |     |                          |                                     |                                     |                          |                          |
| Rated power supply .....                      | Voltage and Frequency     |     | Reference poles          |                                     |                                     |                          |                          |
|                                               |                           |     | L1                       | L2                                  | L3                                  | N                        | PE                       |
|                                               | <input type="checkbox"/>  | AC: | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/>           | DC: 3.0-5.5V              |     |                          |                                     |                                     |                          |                          |
| Rated Power .....                             | 1W                        |     |                          |                                     |                                     |                          |                          |
| Clock frequencies.....                        | 32kHz, 32MHz              |     |                          |                                     |                                     |                          |                          |
| Other parameters .....                        | --                        |     |                          |                                     |                                     |                          |                          |
| Software version .....                        | mfw_nrf9160_1.1.2_148     |     |                          |                                     |                                     |                          |                          |
| Hardware version .....                        | nRF9160-SICA-B1A          |     |                          |                                     |                                     |                          |                          |

|                                               |                                     |                                                                      |              |
|-----------------------------------------------|-------------------------------------|----------------------------------------------------------------------|--------------|
| Dimensions in cm (L x W x D).....:            | 11x16x1.1mm                         |                                                                      |              |
| Mounting position .....                       | <input type="checkbox"/>            | Table top equipment                                                  |              |
|                                               | <input type="checkbox"/>            | Wall/Ceiling mounted equipment                                       |              |
|                                               | <input type="checkbox"/>            | Floor standing equipment                                             |              |
|                                               | <input type="checkbox"/>            | Hand-held equipment                                                  |              |
|                                               | <input checked="" type="checkbox"/> | Other: SMD Module                                                    |              |
| Modules/parts.....:                           | Module/parts of test item           | Type                                                                 | Manufacturer |
|                                               | N/A                                 |                                                                      |              |
| Accessories (not part of the test item) ..... | Description                         | Type                                                                 | Manufacturer |
|                                               | N/A                                 |                                                                      |              |
| Documents as provided by the applicant.....:  | Description                         | File name                                                            | Issue date   |
|                                               | User manual                         | 4418_1315-v1.2<br>/2020-04-30-<br>nRF9160_Objective_<br>Product_Spec | 30-Apr-2020  |
|                                               | Cover markings                      | nRF9160_SiP<br>marking                                               | 15-Jun-2020  |
|                                               |                                     |                                                                      |              |

Copy of marking plate:



## Identification of the client

NORDIC SEMICONDUCTOR ASA  
Otto Nielsens Vei 12, 7052 Trondheim, NORWAY

## Testing period and place

|               |                                        |
|---------------|----------------------------------------|
| Test Location | DEKRA Testing and Certification S.A.U. |
| Date (start)  | 2020-05-11                             |
| Date (finish) | 2020-05-18                             |

## Document history

| Report number  | Date       | Description                                                                                                                                                                                                                                                                                                                                               |
|----------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 64610RRF.003   | 2020-07-09 | First release.                                                                                                                                                                                                                                                                                                                                            |
| 64610RRF.003A1 | 2020-08-03 | Second release: The RF output power and Radiated emissions results of LTE Cat M1 band 14 were added.<br>This modification test report cancels and replaces the test report 64610RRF.003                                                                                                                                                                   |
| 64610RRF.003A2 | 2020-08-31 | Third release: modification of sw and hw version and DC voltage range declared by manufacturer in "Test sample description". Correction on Vnom voltage value in "Test conditions". Inclusion of conducted RF output power comparison between GEN2 and GEN1 devices.<br>This modification test report cancels and replaces the test report 64610RRF.001A1 |

## Environmental conditions

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

|                   |                                     |
|-------------------|-------------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C        |
| Relative humidity | Min. = 20 %<br>Max. = 75 %          |
| Air pressure      | Min. = 860 mbar<br>Max. = 1060 mbar |

In the semianechoic chamber, the following limits were not exceeded during the test.

|                   |                                     |
|-------------------|-------------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C        |
| Relative humidity | Min. = 20 %<br>Max. = 75 %          |
| Air pressure      | Min. = 860 mbar<br>Max. = 1060 mbar |

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

|                   |                                     |
|-------------------|-------------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C        |
| Relative humidity | Min. = 20 %<br>Max. = 35 %          |
| Air pressure      | Min. = 860 mbar<br>Max. = 1060 mbar |

## Remarks and comments

The tests have been performed by the technical personnel: José Manuel Jimenez, Cristina Calle and Nicolás Salguero.

Used instrumentation:

### Conducted Measurements

|                                                                 | Last Cal. date | Cal. due date |
|-----------------------------------------------------------------|----------------|---------------|
| 1. DC power supply R&S NGPE 40/40                               | 2018/02        | 2021/02       |
| 2. Universal Radio communication Tester ROHDE AND SCHWARZ CMW50 | 2020/04        | 2021/04       |

### Radiated Measurements

|                                                                    | Last Cal. date | Cal. due date |
|--------------------------------------------------------------------|----------------|---------------|
| 1. Semianechoic Absorber Lined Chamber ETS FACT3 200STP            | N.A.           | N.A.          |
| 2. Hibrid Bilog antenna SUNOL SCIENCES CORPORATION JB6             | 2017/09        | 2020/09       |
| 3. Broadband Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D         | 2019/11        | 2022/11       |
| 4. Signal and Spectrum Analyser ROHDE AND SCHWARZ FSV40            | 2019/09        | 2021/09       |
| 5. EMI Test Receiver 9kHz – 7GHz ROHDE AND SCHWARZ ESR7            | 2019/10        | 2021/10       |
| 6. RF pre-amplifier, G>40dB, 1-18 GHz BONN ELEKTRONIK BLMA 0118-1M | 2020/05        | 2021/05       |
| 7. Universal Radio communication Tester ROHDE AND SCHWARZ CMW50    | 2020/04        | 2021/04       |

## Testing verdicts

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

## Summary

### 1. LTE cat Band 26

| FCC PART 22/IC RSS-132 PARAGRAPH                                                                                                                                                                                   |         |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------|
| Requirement – Test case                                                                                                                                                                                            | Verdict | Remark |
| Clause 22.913/RSS-132 Clause 5.4: RF output power                                                                                                                                                                  | P       | (2)    |
| Clause 2.1047/RSS-132 Clause 5.2: Modulation characteristics                                                                                                                                                       | NM      | (1)    |
| Clause 22.355/RSS-132 Clause 5.3: Frequency stability                                                                                                                                                              | NM      | (1)    |
| Clause 2.1049: Occupied Bandwidth                                                                                                                                                                                  | NM      | (1)    |
| Clause 22.917/RSS-132 Clause 5.5: Spurious emissions at antenna terminals                                                                                                                                          | NM      | (1)    |
| Clause 22.917/RSS-132 Clause 5.5: Radiated emissions                                                                                                                                                               | P       | (2)    |
| <u>Supplementary information and remarks:</u><br>(1) Test not requested.<br>(2) Peak-to-average power ratio (PAPR) was not tested. Only RF Output Power and Radiated emissions tests were tested in the worst case |         |        |

| FCC PART 90 PARAGRAPH                                                                                                                                            |         |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------|
| Requirement – Test case                                                                                                                                          | Verdict | Remark |
| Clause 90.635 (b): RF output power                                                                                                                               | P       | (2)    |
| Clause 2.1047: Modulation characteristics                                                                                                                        | NM      | (1)    |
| Clause 90.213 Frequency stability                                                                                                                                | NM      | (1)    |
| Clause 2.1049: Occupied Bandwidth                                                                                                                                | NM      | (1)    |
| Clause 90.691 Spurious emissions at antenna terminals (Emission mask requirements for EA-based systems)                                                          | NM      | (1)    |
| Clause 90.691: Radiated emissions                                                                                                                                | P       | (2)    |
| <u>Supplementary information and remarks:</u><br>(1) Test not requested.<br>(2) Only RF Output Power and Radiated emissions tests were tested in the worst case. |         |        |

## 2. LTE cat Band 14

| FCC PART 90 /IC RSS-140 PARAGRAPH                                                                                                                                |         |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------|
| Requirement – Test case                                                                                                                                          | Verdict | Remark |
| Clause 90.542 (a) (7) RSS-140 Clause 4.3: RF output power                                                                                                        | P       | (2)    |
| Clause 2.1047/RSS-140 Clause 4.1: Modulation characteristics                                                                                                     | NM      | (1)    |
| Clause 90.213/RSS-140 Clause 4.2: Frequency stability                                                                                                            | NM      | (1)    |
| Clause 2.1049: Occupied Bandwidth                                                                                                                                | NM      | (1)    |
| Clause 90.543 (e) (2) (3) & (5) /RSS-140 Clause 4.4: Spurious emissions at antenna terminals                                                                     | NM      | (1)    |
| Clause 90.543 (e) (2) (3) & (f)/RSS-140 Clause 4.4: Radiated emissions                                                                                           | P       | (2)    |
| <u>Supplementary information and remarks:</u><br>(1) Test not requested.<br>(2) Only RF Output Power and Radiated emissions tests were tested in the worst case. |         |        |

## **Appendix A: Test results for FCC Part 22 & 90 / RSS-132 & RSS-140**

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## TEST CONDITIONS

Power supply (V):

Vnominal = 3.8 Vdc

Type of power supply = DC Voltage from external power supply

Type of antenna = Integral antenna.

Declared Gain for antenna = +2.6 dBi.

TEST FREQUENCIES:

### 788-798MHz Band:

LTE Band 14. QPSK, 16QAM MODULATIONS:

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

### 814-824MHz Band:

LTE. QPSK AND 16QAM MODULATION (BAND 26)

|         | Channel (Frequency, MHz) |                |                |             |             |
|---------|--------------------------|----------------|----------------|-------------|-------------|
|         | BW = 1.4 MHz             | BW = 3 MHz     | BW = 5 MHz     | BW = 10 MHz | BW = 15 MHz |
| Lowest  | 26697 (814.70)           | 26705 (815.5)  | 26715 (816.5)  | ---         | ---         |
| Middle  | 26740 (819)              | 26740 (819)    | 26740 (819)    | 26740 (819) | ---         |
| Highest | 26783 (823.30)           | 26775 (822.50) | 26765 (821.50) | ---         | ---         |

### Cross-rule channel (824MHz):

LTE. QPSK AND 16QAM MODULATION (BAND 26)

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

## **824-849MHz Band:**

### LTE. QPSK AND 16QAM MODULATION (BAND 5)

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

### LTE. QPSK AND 16QAM MODULATION (BAND 26)

|         | Channel (Frequency, MHz) |                |                |                |                |
|---------|--------------------------|----------------|----------------|----------------|----------------|
|         | BW = 1.4 MHz             | BW = 3 MHz     | BW = 5 MHz     | BW = 10 MHz    | BW = 15 MHz    |
| Lowest  | 26797 (824.70)           | 26805 (825.50) | 26815 (826.50) | 26840 (829.00) | 26865 (831.50) |
| Middle  | 26915 (836.50)           | 26915 (836.50) | 26915 (836.50) | 26915 (836.50) | 26915 (836.50) |
| Highest | 27033 (848.30)           | 27025 (847.50) | 27015 (846.50) | 26990 (844.00) | 26965 (841.50) |

NOTE: Band 26 is completely included in band 5, so the channels of band 5 were tested to give conformity to the assigned block.

## RF Output Power

### SPECIFICATION

FCC §90.542 (a) (6) (7):

(a)(6) Control stations and mobile stations transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 30 watts ERP.

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

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

FCC §2.1046 and §22.913. The Effective Radiated Power (E.R.P.) of mobile transmitter and auxiliary test transmitter must not exceed 7 Watts (38.45 dBm E.R.P.).

RSS-132. Clause 5.4. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts (38.45 dBm E.R.P.).

FCC §90.635. The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

### METHOD

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMU200 and CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

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

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

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

### TEST SETUP

Conducted average power.



## RESULTS

### MAXIMUM OUTPUT POWER (CONDUCTED).

#### **788-798 MHz Band:**

Preliminary measurements determined the narrow band = 1 and nominal bandwidth of 5 MHz as the worst case. The results in the next tables shows the results for this configuration.

Narrow band = 1

| BANDWIDTH (MHz) | CHANNEL | FREQUENCY (MHz) | MODULATION | RB SIZE | RB OFFSET | AVERAGE POWER (dBm) | Maximum effective radiated power E.I.R.P. (dBm) | Maximum effective radiated power E.R.P. (dBm) |
|-----------------|---------|-----------------|------------|---------|-----------|---------------------|-------------------------------------------------|-----------------------------------------------|
| 5               | 23305   | 790.5           | QPSK       | 1       | 5         | 23.23               | 25.83                                           | 23.68                                         |
|                 |         |                 | 16-QAM     | 1       | 5         | 22.65               | 25.25                                           | 23.10                                         |
|                 | 23330   | 793             | QPSK       | 1       | 5         | 23.26               | 25.86                                           | 23.71                                         |
|                 |         |                 | 16-QAM     | 1       | 5         | 22.73               | 25.33                                           | 23.18                                         |
|                 | 23355   | 795.5           | QPSK       | 1       | 5         | 23.23               | 25.83                                           | 23.68                                         |
|                 |         |                 | 16-QAM     | 1       | 5         | 22.80               | 25.40                                           | 23.25                                         |

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

Verdict: PASS

#### **LTE. BAND 788-798 MHz.**

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

|                                                                      |      |
|----------------------------------------------------------------------|------|
| Maximum conducted output power difference between GEN2 and GEN1 (dB) | 0.23 |
|----------------------------------------------------------------------|------|

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

### 814-824 MHz Band:

Preliminary measurements determined the narrow band = 1 and nominal bandwidth of 5 MHz as the worst case. The results in the next tables shows the results for this configuration.

Narrow band = 1

| BANDWIDTH (MHz) | CHANNEL | FREQUENCY (MHz) | MODULATION | RB SIZE | RB OFFSET | AVERAGE POWER (dBm) | Maximum effective radiated power E.I.R.P. (dBm) | Maximum effective radiated power E.R.P. (dBm) |
|-----------------|---------|-----------------|------------|---------|-----------|---------------------|-------------------------------------------------|-----------------------------------------------|
| 5               | 26715   | 816.5           | QPSK       | 1       | 2         | 23.19               | 25.79                                           | 23.64                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 22.31               | 26.71                                           | 24.56                                         |
|                 | 26740   | 819             | QPSK       | 1       | 2         | 23.23               | 25.83                                           | 23.68                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 22.35               | 26.75                                           | 24.60                                         |
|                 | 26765   | 821.5           | QPSK       | 1       | 2         | 23.38               | 25.98                                           | 23.83                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 22.32               | 26.72                                           | 24.57                                         |

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

Verdict: PASS

GEN2 AND GEN1 OUTPUT POWER COMPARISON (CONDUCTED).

### LTE. BAND 814-824 MHz.

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

|                                                                      |      |
|----------------------------------------------------------------------|------|
| Maximum conducted output power difference between GEN2 and GEN1 (dB) | 0.50 |
|----------------------------------------------------------------------|------|

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

### **Cross-rule channel (824MHz):**

Preliminary measurements determined the narrow band = 1 and nominal bandwidth of 10 MHz as the worst case. The results in the next tables shows the results for this configuration.

| BANDWIDTH (MHz) | CHANNEL | FREQUENCY (MHz) | MODULATION | RB SIZE | RB OFFSET | AVERAGE POWER (dBm) | Maximum effective radiated power E.I.R.P. (dBm) | Maximum effective radiated power E.R.P. (dBm) |
|-----------------|---------|-----------------|------------|---------|-----------|---------------------|-------------------------------------------------|-----------------------------------------------|
| 10              | 26790   | 824             | QPSK       | 1       | 2         | 23.22               | 25.82                                           | 23.67                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 22.36               | 24.96                                           | 22.81                                         |

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

Verdict: PASS

GEN2 AND GEN1 OUTPUT POWER COMPARISON (CONDUCTED).

### **LTE. Cross-rule channel (824 MHz)**

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

|                                                                      |      |
|----------------------------------------------------------------------|------|
| Maximum conducted output power difference between GEN2 and GEN1 (dB) | 0.50 |
|----------------------------------------------------------------------|------|

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

### **824-849MHz Band:**

Preliminary measurements determined the narrow band = 1 and nominal bandwidth of 5 MHz as the worst case. The results in the next tables shows the results for this configuration.

| BANDWIDTH (MHz) | CHANNEL | FREQUENCY (MHz) | MODULATION | RB SIZE | RB OFFSET | AVERAGE POWER (dBm) | Maximum effective radiated power E.I.R.P. (dBm) | Maximum effective radiated power E.R.P. (dBm) |
|-----------------|---------|-----------------|------------|---------|-----------|---------------------|-------------------------------------------------|-----------------------------------------------|
| 5               | 20425   | 826.5           | QPSK       | 1       | 2         | 23.12               | 25.72                                           | 23.57                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 22.36               | 24.96                                           | 22.81                                         |
|                 | 20525   | 836.5           | QPSK       | 1       | 2         | 23.08               | 25.68                                           | 23.53                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 22.16               | 24.76                                           | 22.61                                         |
|                 | 20625   | 846.5           | QPSK       | 1       | 2         | 23.02               | 25.62                                           | 23.47                                         |
|                 |         |                 | 16-QAM     | 1       | 2         | 21.99               | 24.59                                           | 22.44                                         |

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

Verdict: PASS

GEN2 AND GEN1 OUTPUT POWER COMPARISON (CONDUCTED).

### **LTE. BAND 824 - 849 MHz**

The results in the next table shows the maximum difference between GEN2 and GEN1 devices for conducted output power measurements.

|                                                                      |      |
|----------------------------------------------------------------------|------|
| Maximum conducted output power difference between GEN2 and GEN1 (dB) | 0.50 |
|----------------------------------------------------------------------|------|

|                              |        |
|------------------------------|--------|
| Measurement uncertainty (dB) | <±1.58 |
|------------------------------|--------|

## Radiated emissions

### SPECIFICATION

FCC §90.543 (e) (2) (3) (5) (&) (f):

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

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

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

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

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics 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.

RSS-140. Clause 4.4.

The power of any unwanted emission outside the bands 758-768 MHz and 788-798 MHz shall be attenuated below the transmitter output power P in dBW as follows, where p is the transmitter output power in watts:

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

In addition, the equivalent isotropically radiated power (e.i.r.p.) of all emissions, including harmonics in the band 1559-1610 MHz, shall not exceed  $-70$  dBW/MHz for wideband emissions, and  $-80$  dBW/kHz for discrete emissions of less than 700 Hz bandwidth.

FCC § 22.917

RSS-132. Clause 5.5.

FCC §2.1051, §90.691

Emission mask requirements for EA-based systems.

For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10}(P)$  decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

## METHOD

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

The EUT was placed on a 1 meter high non-conductive stand at a 3 meter distance from the measuring antenna.

Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum field strength (dB $\mu$ V/m) is measured and recorded.

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

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

Measurement Limit:

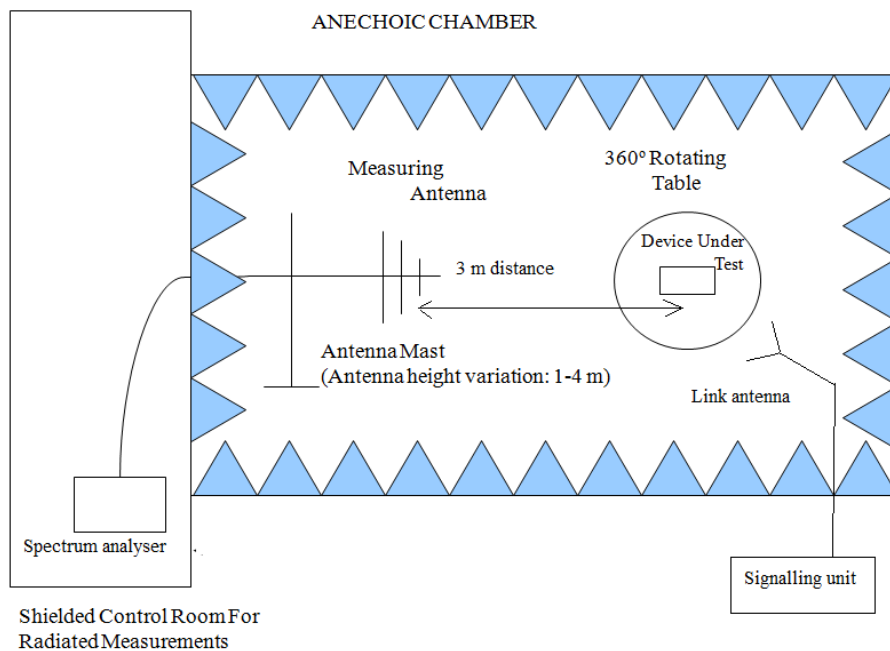
According to specification, the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least  $43 + 10 \log (P)$  dB. P in watts.

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

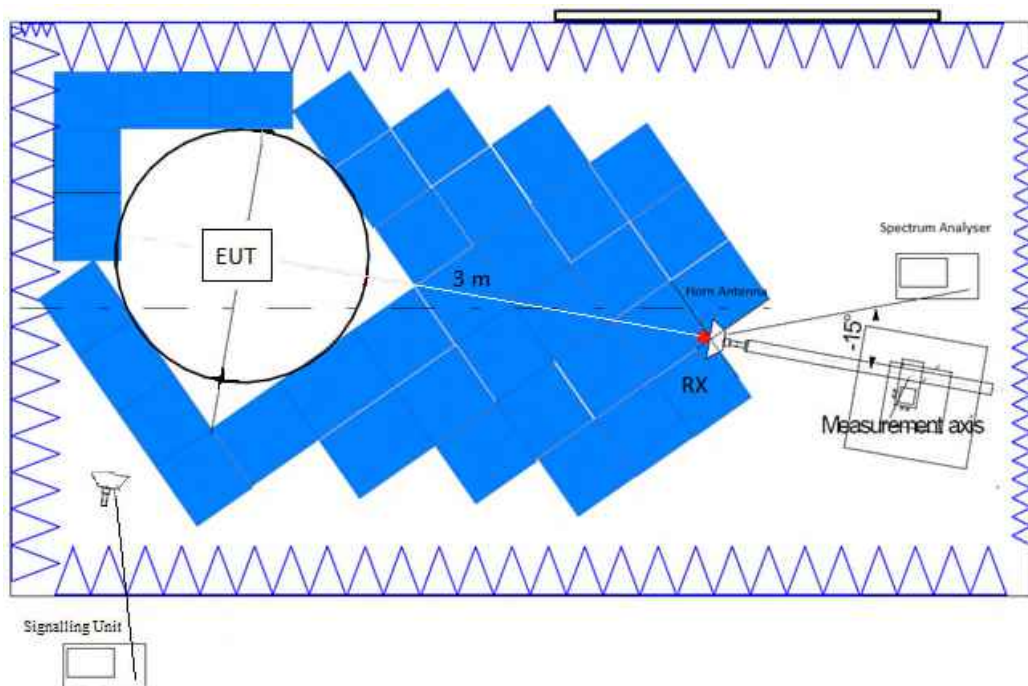
$P_o (dBm) - [43 + 10 \log (P_o \text{ in mwatts}) - 30] = - 13 \text{ dBm}$

## TEST SETUP

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



## RESULTS

### LTE Band 14:

LTE QPSK AND 16QAM MODULATION. BW = 5 MHz, 10 MHz.

A preliminary scan determined the QPSK modulation with 5 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

LTE Band 14. QPSK MODULATION. BW = 5 MHz.

#### **Frequency range 9 KHz - 8 GHz:**

##### 1. CHANNEL: LOWEST

| Spurious frequency (MHz) | Detector | E.R.P. (dBm) | Polarization |
|--------------------------|----------|--------------|--------------|
| 787.43125                | Peak     | -17.86       | H            |
| 787.97445                | Peak     | -20.08       | H            |
| 787.98234                | Peak     | -20.07       | H            |

##### 2. CHANNEL: MIDDLE

No spurious frequencies detected at less than 20 dB below the limit in all the range.

##### 3. CHANNEL: HIGHEST

No spurious frequencies detected at less than 20 dB below the limit in all the range.

#### **Frequency range 769 - 775 MHz:**

##### 1. CHANNEL: LOWEST

No spurious frequencies detected at less than 20 dB below the limit in all the range.

##### 2. CHANNEL: MIDDLE

No spurious frequencies detected at less than 20 dB below the limit in all the range.

##### 3. CHANNEL: HIGHEST

No spurious frequencies detected at less than 20 dB below the limit in all the range.

#### **Frequency range 799 - 806 MHz:**

##### 1. CHANNEL: LOWEST

No spurious frequencies detected at less than 20 dB below the limit in all the range.

##### 2. CHANNEL: MIDDLE

No spurious frequencies detected at less than 20 dB below the limit in all the range.

##### 3. CHANNEL: HIGHEST

No spurious frequencies detected at less than 20 dB below the limit in all the range.

### Frequency range 1559 - 1610 MHz:

#### 1. CHANNEL: LOWEST

| Spurious frequency (MHz) | Detector | E.R.P. (dBm) | Polarization |
|--------------------------|----------|--------------|--------------|
| 1578.12                  | Peak     | -57.81       | H            |
| 1585.01                  | Peak     | -59.89       | H            |

#### 2. CHANNEL: MIDDLE

| Spurious frequency (MHz) | Detector | E.R.P. (dBm) | Polarization |
|--------------------------|----------|--------------|--------------|
| 1581.95                  | Peak     | -57.25       | H            |
| 1590.11                  | Peak     | -57.45       | H            |

#### 3. CHANNEL: HIGHEST

| Spurious frequency (MHz) | Detector | E.R.P. (dBm) | Polarization |
|--------------------------|----------|--------------|--------------|
| 1595.46                  | Peak     | -57.09       | H            |

|                              |                                                                                        |
|------------------------------|----------------------------------------------------------------------------------------|
| Measurement uncertainty (dB) | $<\pm 4.65$ for $f < 1\text{GHz}$<br>$<\pm 4.98$ for $f \geq 1\text{GHz}$ up to 10 GHz |
|------------------------------|----------------------------------------------------------------------------------------|

Verdict: PASS

## **LTE Band 26:**

### **814-824MHz Band:**

LTE QPSK AND 16QAM MODULATION. BW = 1.4 MHz, 3 MHz, 5 MHz, 10 MHz.

A preliminary scan determined the QPSK modulation with 5 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

#### 1. CHANNEL: LOWEST

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

##### **Frequency range 1 GHz-10 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

#### 2. CHANNEL: MIDDLE

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

##### **Frequency range 1 GHz-10 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

#### 3. CHANNEL: HIGHEST

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

##### **Frequency range 1 GHz-10 GHz.**

| Spurious frequency (GHz) | Detector | E.I.R.P.<br>(dBm) | Polarization |
|--------------------------|----------|-------------------|--------------|
| 3.27895                  | Peak     | -32.72            | H            |

|                              |                                                          |
|------------------------------|----------------------------------------------------------|
| Measurement uncertainty (dB) | <±4.65 for f < 1GHz<br><±4.98 for f ≥ 1 GHz up to 10 GHz |
|------------------------------|----------------------------------------------------------|

Verdict: PASS

## **LTE Band 5:**

### **824-849MHz Band:**

LTE QPSK AND 16QAM MODULATION. BW = 1.4 MHz, 3 MHz, 5 MHz, 10 MHz and 15MHz.

A preliminary scan determined the QPSK modulation with 5 MHz bandwidth as the worst case. The configuration of Resource Blocks which is the worst case for conducted power was used.

The following tables and plots show the results for this configuration.

#### 1. CHANNEL: LOWEST

##### **Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

**Frequency range 1 GHz-10 GHz.**

| Spurious frequency (GHz) | Detector | E.I.R.P.<br>(dBm) | Polarization |
|--------------------------|----------|-------------------|--------------|
| 3.29878                  | Peak     | -32.65            | H            |

**2. CHANNEL: MIDDLE**

**Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

**Frequency range 1 GHz-10 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

**3. CHANNEL: HIGHEST**

**Frequency range 30 MHz-1000 MHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

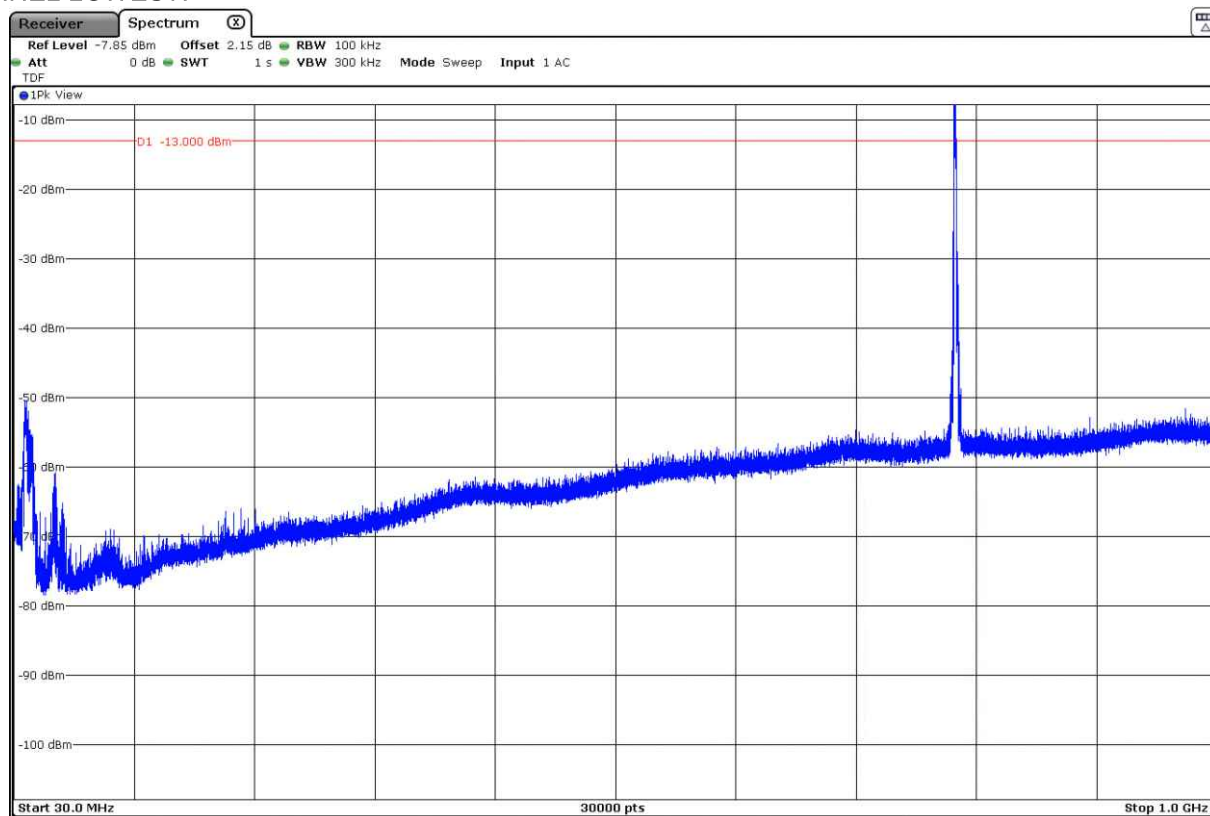
**Frequency range 1 GHz-10 GHz.**

No radiated spurious signals were detected at less than 20 dB respect to the limit.

|                              |                                                                              |
|------------------------------|------------------------------------------------------------------------------|
| Measurement uncertainty (dB) | <±4.65 for $f < 1\text{GHz}$<br><±4.98 for $f \geq 1\text{GHz}$ up to 10 GHz |
|------------------------------|------------------------------------------------------------------------------|

Verdict: PASS

**LTE Band 14:**  
**FREQUENCY RANGE 30 MHz - 1 GHz**  
**CHANNEL LOWEST:**



**CHANNEL MIDDLE:**

