

# Test report

**337322-1TRFWL**

Date of issue: November 13, 2017

Applicant:

**Redline Communications**

Product:

**Broad-band wireless infrastructure product**

Model:

**RDL-3000-RMG**

FCC ID:

**QC8-RDL3000RMG3**

IC Registration number:

**4310A-RDL3000RMG3**

Specifications:

- ◆ **FCC Part 90, Subpart Y**  
Private Land Mobile Radio Services; Regulations governing licensing and use of frequencies in the 4940–4990 MHz band
- ◆ **RSS-111, Issue 5, September 4, 2014**  
Broadband public safety equipment operating in the band 4940–4990 MHz

#### Test location

|               |                                                      |
|---------------|------------------------------------------------------|
| Company name: | Nemko Canada Inc.                                    |
| Address:      | 303 River Road                                       |
| City:         | Ottawa                                               |
| Province:     | Ontario                                              |
| Postal code:  | K1V 1H2                                              |
| Country:      | Canada                                               |
| Telephone:    | +1 613 737 9680                                      |
| Facsimile:    | +1 613 737 9691                                      |
| Toll free:    | +1 800 563 6336                                      |
| Website:      | www.nemko.com                                        |
| Site number:  | FCC: CA2041; IC: 2040A-4 (3 m semi anechoic chamber) |

|              |                                                                                     |
|--------------|-------------------------------------------------------------------------------------|
| Tested by:   | Andrey Adelberg, Senior Wireless/EMC Specialist                                     |
| Reviewed by: | Kevin Rose, Wireless/EMC Specialist                                                 |
| Date:        | November 13, 2017                                                                   |
| Signature:   |  |

#### Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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## Section 1. Report summary

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### 1.1 Applicant and manufacturer

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|                 |                        |
|-----------------|------------------------|
| Company name    | Redline Communications |
| Address         | 302 Town Center Blvd.  |
| City            | Markham                |
| Province/State  | Ontario                |
| Postal/Zip code | L3R 0E8                |
| Country         | Canada                 |

### 1.2 Test specifications

---

|                                  |                                                                                                                      |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------|
| FCC Part 90, Subpart Y           | Private Land Mobile Radio Services; Regulations governing licensing and use of frequencies in the 4940–4990 MHz band |
| RSS-111, Issue 5, September 2014 | Broadband public safety equipment operating in the band 4940–4990 MHz                                                |

### 1.3 Test methods

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|                                                      |                                                                                                           |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| 971168 D01 Power Meas License Digital Systems v02r02 | Measurement guidance for certification of licensed digital transmitters                                   |
| 662911 D01 Multiple Transmitter Output v02r01        | Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc) |

### 1.4 Statement of compliance

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In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

### 1.5 Exclusions

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None

### 1.6 Test report revision history

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| Revision # | Details of changes made to test report |
|------------|----------------------------------------|
| TRF        | Original report issued                 |

## Section 2. Summary of test results

### 2.1 RSS-Gen, Issue 4, test results

| Clause | Test description                         | Verdict        |
|--------|------------------------------------------|----------------|
| 6.6    | Occupied bandwidth                       | Pass           |
| 7.1.2  | Receiver Radiated Limits                 | Not applicable |
| 7.1.3  | Receiver Conducted Limits                | Not applicable |
| 8.8    | AC power lines conducted emission limits | Pass           |

Note: According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

### 2.2 RSS-111, Issue 5, tests results

| Part | Test description                                        | Verdict           |
|------|---------------------------------------------------------|-------------------|
| 5.1  | Types of modulation                                     | Pass <sup>1</sup> |
| 5.2  | Transmitter frequency stability                         | Pass              |
| 5.3  | Equipment's transmit output power and channel bandwidth | Pass              |
| 5.4  | Transmitter peak-to-average power ratio                 | Pass              |
| 5.5  | Transmitter unwanted emissions                          | Pass              |

Notes: <sup>1</sup> The EUT utilizes OFDM method of encoding digital modulations such as BPSK, QPSK, 16-QAM, 64-QAM, 128-QAM, and 256-QAM

### 2.3 FCC Part 90, tests results

| Clause       | Test description                            | Verdict |
|--------------|---------------------------------------------|---------|
| 90.1215(d)   | Occupied bandwidth                          | Pass    |
| 90.1215(a)   | Peak output power                           | Pass    |
| 90.1215(b)   | Peak power spectral density                 | Pass    |
| 90.210(m)    | Spurious emissions at the antenna terminals | Pass    |
| 90.210(m)(6) | Radiated spurious emissions                 | Pass    |
| 90.213(a)    | Frequency stability                         | Pass    |

## Section 3. Equipment under test (EUT) details

### 3.1 Sample information

|                        |                    |
|------------------------|--------------------|
| Receipt date           | September 25, 2017 |
| Nemko sample ID number | 1                  |

### 3.2 EUT information

|               |                                            |
|---------------|--------------------------------------------|
| Product name  | Broad-band wireless infrastructure product |
| Model         | RDL-3000-RMG                               |
| Serial number | 157SC17180008                              |

### 3.3 Technical information

|                     |                                                                                                                                                                                                                                                                                                                     |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operating band      | 4940–4990 MHz                                                                                                                                                                                                                                                                                                       |
| Operating frequency | 5 MHz channel: 4942.5–4987.5 MHz<br>10 MHz channel: 4945–4985 MHz<br>20 MHz channel: 4950–4980 MHz                                                                                                                                                                                                                  |
| Modulation type     | OFDM using 256-QAM, 128-QAM, 64-QAM, 16-QAM, QPSK and BPSK modulation for sub-carriers                                                                                                                                                                                                                              |
| Channel bandwidth   | 5 MHz, 10 MHz and 20 MHz                                                                                                                                                                                                                                                                                            |
| Emission designator | W7D                                                                                                                                                                                                                                                                                                                 |
| Power requirements  | 48 V <sub>DC</sub> PoE via 120 V <sub>AC</sub> , 60 Hz                                                                                                                                                                                                                                                              |
| Antenna information | L-COM HG5158DP-10U omni antenna 10 dBi 5100–5800 MHz<br>Redline AOD-DB-0512-02 omni antenna 10 dBi 4940–5875 MHz<br>Redline 30-00328-50 Dual Polarization Antenna 19 dBi 4900–5875 MHz<br>Redline 30-00362-00 Dual Polarization Antenna 24 dBi 4900–6100 MHz<br>Redline A3FT3204LTPD Parabolic 32 dBi 4900–5875 MHz |

### 3.4 Product description and theory of operation

The EUT is a 2x2 MIMO point-to-multipoint (PMP) and point-to-point (PTP) carrier grade broadband wireless infrastructure product, designed to operate in the 4940–4990 MHz band.

### 3.5 EUT exercise details

The EUT was controlled to transmit at desired frequency and modulation from laptop using web interface at IP address: 192.168.25.2

3.6 EUT setup diagram

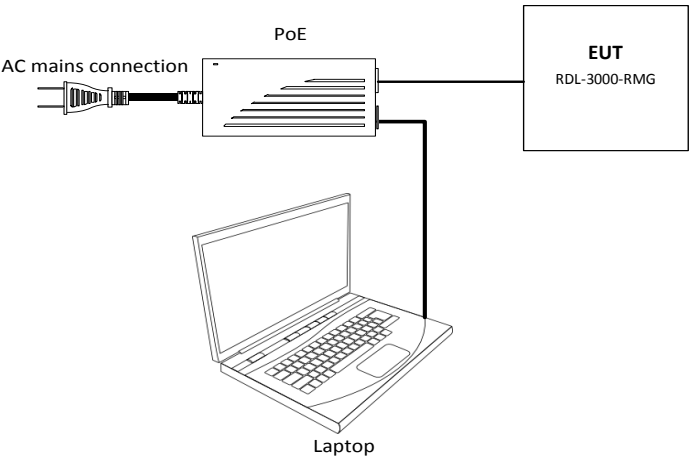


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

| Description | Brand name             | Model/Part number | Serial number |
|-------------|------------------------|-------------------|---------------|
| PoE         | Cincon Electronics Co. | TRG60A-POE-L      | 1127          |

**Section 4. Engineering considerations**

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**4.1 Modifications incorporated in the EUT**

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There were no modifications performed to the EUT during this assessment.

**4.2 Technical judgment**

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None

**4.3 Deviations from laboratory tests procedures**

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No deviations were made from laboratory procedures.



# Section 5. Test conditions

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## 5.1 Atmospheric conditions

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|                   |               |
|-------------------|---------------|
| Temperature       | 15–30 °C      |
| Relative humidity | 20–75 %       |
| Air pressure      | 860–1060 mbar |

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

## 5.2 Power supply range

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The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages  $\pm 5\%$ , for which the equipment was designed.



Section 6. Measurement uncertainty

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of  $K = 2$  with 95% certainty.

| Test name                         | Measurement uncertainty, dB |
|-----------------------------------|-----------------------------|
| All antenna port measurements     | 0.55                        |
| Conducted spurious emissions      | 1.13                        |
| Radiated spurious emissions       | 3.78                        |
| AC power line conducted emissions | 3.55                        |

## Section 7. Test equipment

### 7.1 Test equipment list

**Table 7.1-1: Equipment list**

| Equipment                   | Manufacturer    | Model no.    | Asset no. | Cal cycle | Next cal.  |
|-----------------------------|-----------------|--------------|-----------|-----------|------------|
| 3 m EMI test chamber        | TDK             | SAC-3        | FA002047  | 1 year    | Dec. 1/17  |
| Flush mount turntable       | Sunol           | FM2022       | FA002082  | —         | NCR        |
| Controller                  | Sunol           | SC104V       | FA002060  | —         | NCR        |
| Antenna mast                | Sunol           | TLT2         | FA002061  | —         | NCR        |
| AC Power source             | Chenwa          | 2700M-10k    | FA002716  | —         | VOU        |
| Receiver/spectrum analyzer  | Rohde & Schwarz | ESU 26       | FA002043  | 1 year    | Jan. 31/18 |
| Spectrum analyzer           | Rohde & Schwarz | FSU          | FA001877  | 1 year    | Jul. 18/18 |
| Horn with Preamp (1–18 GHz) | ETS-Lindgren    | 3117-PA      | FA002840  | 1 year    | Nov. 11/17 |
| Bilog antenna (20–3000 MHz) | Sunol           | JB3          | FA002108  | 1 year    | June 27/18 |
| Horn antenna (18–40 GHz)    | EMCO            | 3116         | FA001847  | 1 year    | June 27/18 |
| Pre-amplifier (18–26 GHz)   | Narda           | BBS-1826N612 | FA001550  | —         | VOU        |
| Pre-amplifier (26–40 GHz)   | Narda           | DBL-2640N610 | FA001556  | —         | VOU        |
| LISN                        | Rohde & Schwarz | ENV216       | FA002023  | 1 year    | May 19/18  |
| Temperature chamber         | Thermotron      | SM-16C       | FA001030  | 1 year    | NCR        |

Note: NCR - no calibration required, VOU - verify on use

## Section 8. Testing data

### 8.1 RSS-Gen 8.8 AC power line conducted emissions limits

#### 8.1.1 Definitions and limits

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

**Table 8.1-1: Conducted emissions limit**

| Frequency of emission,<br>MHz | Conducted limit, dB $\mu$ V |           |
|-------------------------------|-----------------------------|-----------|
|                               | Quasi-peak                  | Average** |
| 0.15–0.5                      | 66 to 56*                   | 56 to 46* |
| 0.5–5                         | 56                          | 46        |
| 5–30                          | 60                          | 50        |

Note: \* - The level decreases linearly with the logarithm of the frequency.

\*\* - A linear average detector is required.

#### 8.1.2 Test summary

|               |                    |                   |           |
|---------------|--------------------|-------------------|-----------|
| Test date     | September 26, 2017 | Temperature       | 23 °C     |
| Test engineer | Andrey Adelberg    | Air pressure      | 1010 mbar |
| Verdict       | Pass               | Relative humidity | 36 %      |

### 8.1.3    Observations, settings and special notes

---

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

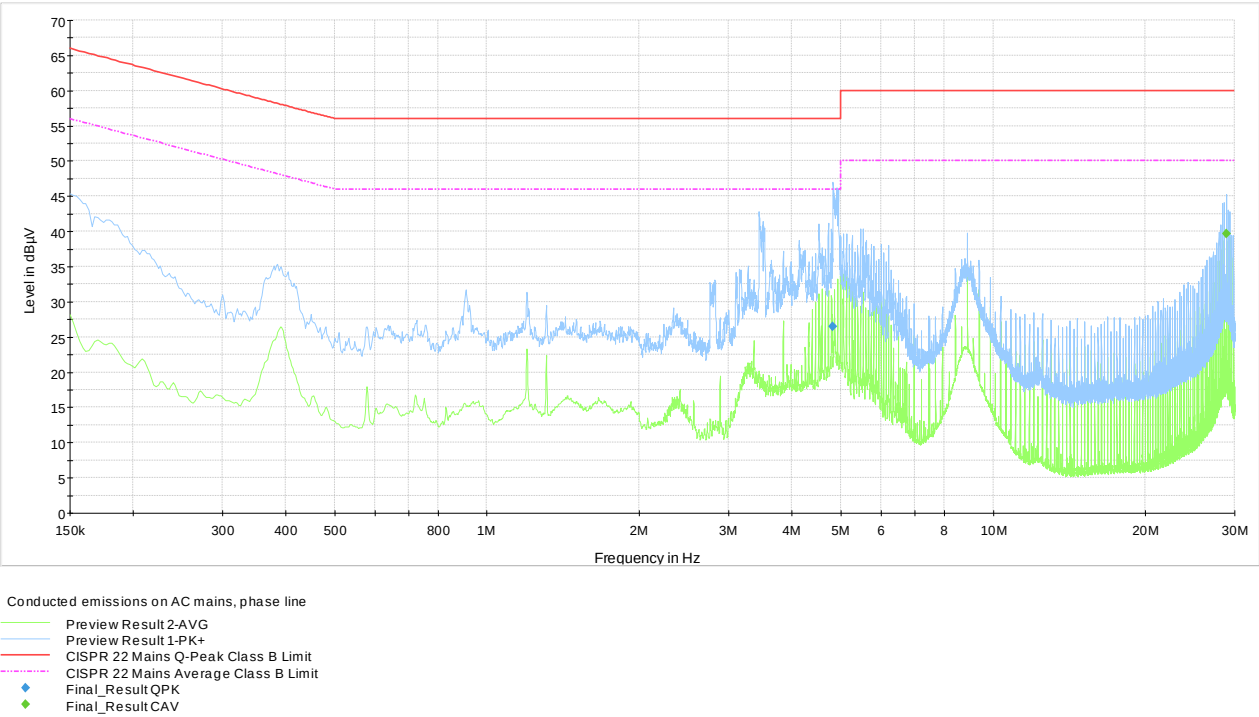
Receiver settings for preview measurements:

|                      |                  |
|----------------------|------------------|
| Resolution bandwidth | 9 kHz            |
| Video bandwidth      | 30 kHz           |
| Detector mode        | Peak and Average |
| Trace mode           | Max Hold         |
| Measurement time     | 1000 ms          |

Receiver settings for final measurements:

|                      |                        |
|----------------------|------------------------|
| Resolution bandwidth | 9 kHz                  |
| Video bandwidth      | 30 kHz                 |
| Detector mode        | Quasi-Peak and Average |
| Trace mode           | Max Hold               |
| Measurement time     | 1000 ms                |

8.1.4 Test data



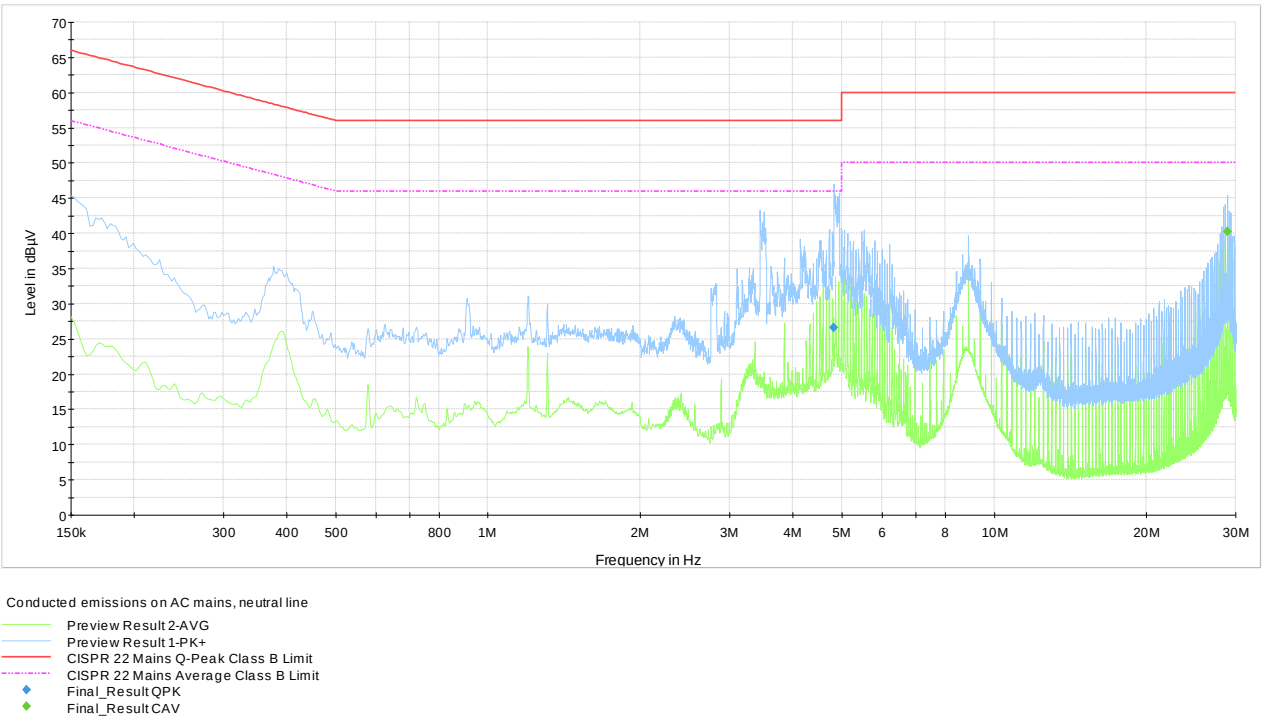
Plot 8.1-1: Conducted emissions on phase line

Table 8.1-2: Quasi-Peak conducted emissions results on phase line

| Frequency, MHz | Q-Peak result, dBµV | Limit, dBµV | Margin, dB | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB |
|----------------|---------------------|-------------|------------|----------------|----------------|--------|----------------|
| 4.827750       | 26.53               | 56.00       | 29.47      | 100            | 9              | ON     | 9.5            |

Table 8.1-3: Average conducted emissions results on phase line

| Frequency, MHz | Average result, dBµV | Limit, dBµV | Margin, dB | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB |
|----------------|----------------------|-------------|------------|----------------|----------------|--------|----------------|
| 28.864000      | 39.65                | 50.00       | 10.35      | 100            | 9              | ON     | 10.1           |



Plot 8.1-2: Conducted emissions on neutral line

Table 8.1-4: Quasi-Peak conducted emissions results on neutral line

| Frequency, MHz | Q-Peak result, dBµV | Limit, dBµV | Margin, dB | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB |
|----------------|---------------------|-------------|------------|----------------|----------------|--------|----------------|
| 4.827750       | 26.65               | 56.00       | 29.35      | 100            | 9              | ON     | 9.5            |

Table 8.1-5: Average conducted emissions results on neutral line

| Frequency, MHz | Average result, dBµV | Limit, dBµV | Margin, dB | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB |
|----------------|----------------------|-------------|------------|----------------|----------------|--------|----------------|
| 28.864000      | 40.23                | 50.00       | 9.77       | 100            | 9              | ON     | 10.2           |

## 8.2 FCC 90.1215(d) and RSS-Gen 6.6 Occupied bandwidth

### 8.2.1 Definitions and limits

#### FCC

d) The peak power spectral density is measured as conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of one MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

#### ISED:

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 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.

### 8.2.2 Test summary

|                |                    |                    |           |
|----------------|--------------------|--------------------|-----------|
| Test date:     | September 26, 2017 | Temperature:       | 23 °C     |
| Test engineer: | Andrey Adelberg    | Air pressure:      | 1006 mbar |
| Verdict:       | Pass               | Relative humidity: | 34 %      |

### 8.2.3 Observations, settings and special notes

Spectrum analyser settings:

|                       |                                                                                                            |
|-----------------------|------------------------------------------------------------------------------------------------------------|
| Resolution bandwidth: | 100 kHz <i>for 5 MHz channel</i><br>200 kHz <i>for 10 MHz channel</i><br>500 kHz <i>for 20 MHz channel</i> |
| Video bandwidth:      | ≥3 × RBW                                                                                                   |
| Frequency span:       | 10 MHz <i>for 5 MHz channel</i><br>20 MHz <i>for 10 MHz channel</i><br>50 MHz <i>for 20 MHz channel</i>    |
| Detector mode:        | Peak                                                                                                       |
| Trace mode:           | Max Hold                                                                                                   |



## 8.2.4 Test data

**Table 8.2-1:** Channel names description

| Channel name | 5-MHz channel, MHz | 10-MHz channel, MHz | 20-MHz channel, MHz |
|--------------|--------------------|---------------------|---------------------|
| Low          | 4942.5             | 4945.0              | 4950.0              |
| Mid          | 4965.0             | 4965.0              | 4965.0              |
| High         | 4987.5             | 4985.0              | 4980.0              |

**Table 8.2-2:** 26 dB bandwidth results for Ant 1

| Channel | 5-MHz channel, MHz | 10-MHz channel, MHz | 20-MHz channel, MHz |
|---------|--------------------|---------------------|---------------------|
| Low     | 4.82               | 9.49                | 19.63               |
| Mid     | 4.82               | 9.68                | 19.55               |
| High    | 4.79               | 9.49                | 19.55               |

**Table 8.2-3:** 26 dB bandwidth results for Ant 2

| Channel | 5-MHz channel, MHz | 10-MHz channel, MHz | 20-MHz channel, MHz |
|---------|--------------------|---------------------|---------------------|
| Low     | 4.81               | 9.68                | 19.23               |
| Mid     | 4.81               | 9.55                | 19.39               |
| High    | 4.79               | 9.62                | 19.39               |

**Table 8.2-4:** 99% bandwidth results for Ant 1

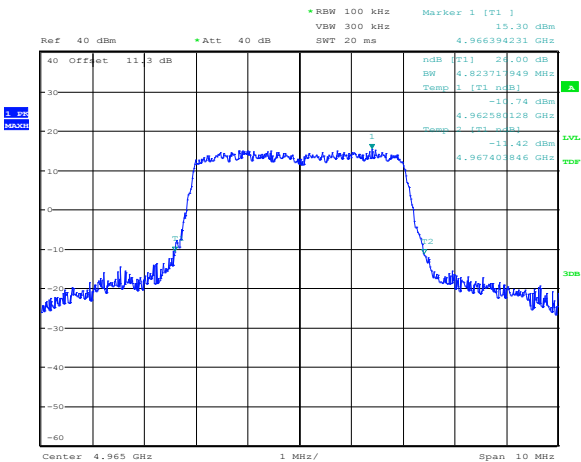
| Channel | 5-MHz channel, MHz | 10-MHz channel, MHz | 20-MHz channel, MHz |
|---------|--------------------|---------------------|---------------------|
| Low     | 4.15               | 8.27                | 16.75               |
| Mid     | 4.13               | 8.30                | 16.67               |
| High    | 4.15               | 8.30                | 16.67               |

**Table 8.2-5:** 99% bandwidth results for Ant 2

| Channel | 5-MHz channel, MHz | 10-MHz channel, MHz | 20-MHz channel, MHz |
|---------|--------------------|---------------------|---------------------|
| Low     | 4.15               | 8.30                | 16.75               |
| Mid     | 4.15               | 8.30                | 16.75               |
| High    | 4.13               | 8.27                | 16.67               |

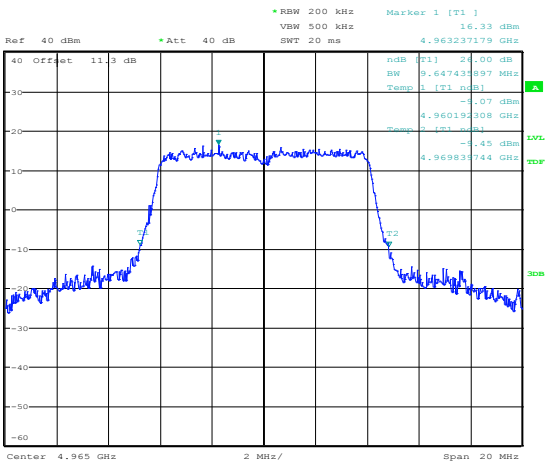
Section 8  
Test name  
Specification

Testing data  
FCC 90.1215(d) and RSS-Gen Clause 6.6 Occupied bandwidth  
FCC Part 90, Subpart Y and RSS-Gen, Issue 4



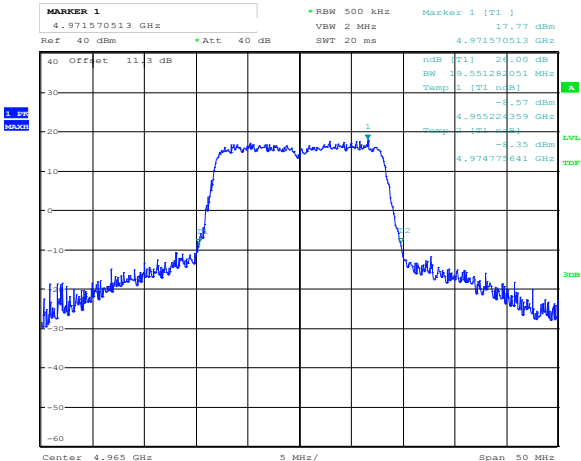
Date: 26.SEP.2017 16:38:29

Figure 8.2-1: 26 dB bandwidth for 5 MHz channel, sample plot



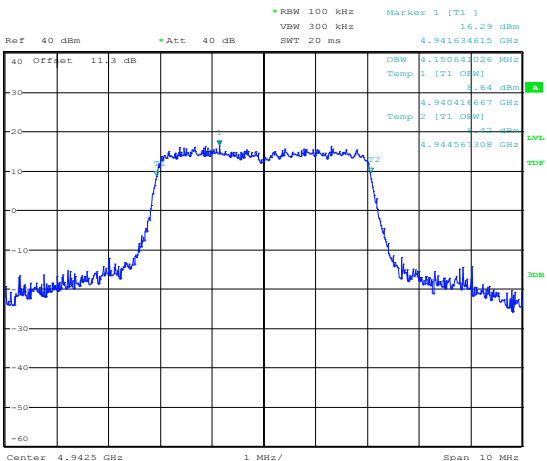
Date: 26.SEP.2017 16:30:02

Figure 8.2-2: 26 dB bandwidth for 10 MHz channel, sample plot



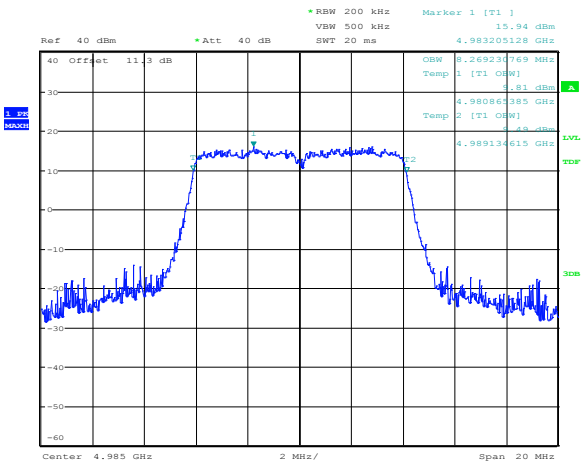
Date: 26.SEP.2017 16:29:02

Figure 8.2-3: 26 dB bandwidth for 20 MHz channel, sample plot



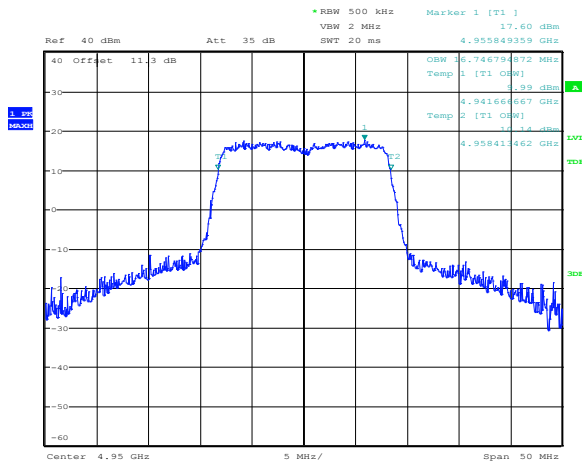
Date: 26.SEP.2017 16:36:39

Figure 8.2-4: 99 % occupied bandwidth for 5 MHz channel, sample plot



Date: 26.SEP.2017 16:35:07

Figure 8.2-5: 99 % occupied bandwidth for 10 MHz channel, sample plot



Date: 26.SEP.2017 16:23:16

Figure 8.2-6: 99 % occupied bandwidth for 20 MHz channel, sample plot

## 8.3 FCC 90.213(a) and RSS-111 Clause 5.2 Transmitter frequency stability

### 8.3.1 Definitions and limits

**FCC:**

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

**Table 8.3-1: Minimum frequency stability**

| Frequency range (MHz) | Fixed and base stations ( $\pm$ ppm) | Mobile stations ( $\pm$ ppm) |                              |
|-----------------------|--------------------------------------|------------------------------|------------------------------|
|                       |                                      | Over 2 watts output power    | 2 watts or less output power |
| Below 25              | 100                                  | 100                          | 200                          |
| 25–50                 | 20                                   | 20                           | 50                           |
| 72–76                 | 5                                    |                              | 50                           |
| 150–174               | 5                                    | 5                            | 50                           |
| 216–220               | 1.0                                  |                              | 1.0                          |
| 220–222               | 0.1                                  | 1.5                          | 1.5                          |
| 421–512               | 2.5                                  | 5                            | 5                            |
| 806–809               | 1.0                                  | 1.5                          | 1.5                          |
| 809–824               | 1.5                                  | 2.5                          | 2.5                          |
| 851–854               | 1.0                                  | 1.5                          | 1.5                          |
| 854–869               | 1.5                                  | 2.5                          | 2.5                          |
| 896–901               | 0.1                                  | 1.5                          | 1.5                          |
| 902–928               | 2.5                                  | 2.5                          | 2.5                          |
| 929–930               | 1.5                                  |                              |                              |
| 935–940               | 0.1                                  | 1.5                          | 1.5                          |
| 1427–1435             | 300                                  | 300                          | 300                          |
| Above 2450            |                                      |                              |                              |

**ISED:**

The applicant shall ensure frequency stability by showing that the occupied bandwidth is maintained within the band of operation when tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

### 8.3.2 Test summary

|                |                    |                    |           |
|----------------|--------------------|--------------------|-----------|
| Test date:     | September 27, 2017 | Temperature:       | 22 °C     |
| Test engineer: | Andrey Adelberg    | Air pressure:      | 1010 mbar |
| Verdict:       | Pass               | Relative humidity: | 32 %      |

### 8.3.3 Observations, settings and special notes

Spectrum analyser settings:

|                       |        |
|-----------------------|--------|
| Resolution bandwidth: | 30 Hz  |
| Video bandwidth:      | 100 Hz |
| Detector mode:        | Peak   |

### 8.3.4 Test data

**Table 8.3-2: Frequency drift measurement**

| Temperature, °C | Voltage       | Nominal frequency, GHz | Frequency measured, GHz | Offset, kHz |
|-----------------|---------------|------------------------|-------------------------|-------------|
| 50              | Nominal       | 4.965000000            | 4.965097474             | 97.474      |
| 40              | Nominal       | 4.965000000            | 4.965100112             | 100.112     |
| 30              | Nominal       | 4.965000000            | 4.965104609             | 104.609     |
| 20              | Nominal +15 % | 4.965000000            | 4.965109933             | 109.932     |
| 20              | Nominal       | 4.965000000            | 4.965115256             | 115.256     |
| 20              | Nominal -15 % | 4.965000000            | 4.965119636             | 119.636     |
| 10              | Nominal       | 4.965000000            | 4.965124016             | 124.016     |
| 0               | Nominal       | 4.965000000            | 4.965133266             | 133.266     |
| -10             | Nominal       | 4.965000000            | 4.965137144             | 137.144     |
| -20             | Nominal       | 4.965000000            | 4.965134696             | 134.696     |
| -30             | Nominal       | 4.965000000            | 4.965128968             | 128.968     |

## 8.4 FCC 90.1215(a) and RSS-111 Clause 5.3 Transmit output power and PSD

### 8.4.1 Definitions and limits

#### FCC:

(a) The transmitting power of stations operating in the 4940–4990 MHz band must not exceed the maximum limits given in Table 8.4-1 below

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power or spectral density. Corresponding reduction in the maximum conducted output power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

(b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

#### ISED:

Equipment is classified as either a low-power or high-power device according to its maximum transmitted power and its channel bandwidth as described in the section below. The equipment's occupied bandwidth shall not exceed its channel bandwidth. The transmitted power of low-power and high-power devices shall not exceed the maximum limits corresponding to the equipment type given in Table 8.4-1 below.

**Table 8.4-1: Channel bandwidth and power limits**

| Channel bandwidth, MHz | Output power (P) for low-power device, dBm | Output power (P) for high-power device, dBm |
|------------------------|--------------------------------------------|---------------------------------------------|
| 1                      | $P \leq 7$                                 | $7 < P \leq 20$                             |
| 5                      | $P \leq 14$                                | $14 < P \leq 27$                            |
| 10                     | $P \leq 17$                                | $17 < P \leq 30$                            |
| 15                     | $P \leq 18.8$                              | $18.8 < P \leq 31.8$                        |
| 20                     | $P \leq 20$                                | $20 < P \leq 33$                            |

High- and low-power devices are also limited to a maximum power spectral density of 21 dBm/MHz and 8 dBm/MHz respectively. Devices using channel bandwidths other than those listed in Table 1 are permitted; however, the channel bandwidth shall not exceed 20 MHz and the devices shall comply with the maximum power spectral density limits of 21 dBm/MHz for high-power transmitters and 8 dBm/MHz for low-power transmitters.

#### 5.3.1 Equipment with multiple transmitters

For equipment with an antenna system that works with multiple transmitters, with different information transmitted by each transmitter to each receiver, the total power of the device shall be calculated as the sum of the powers from all the transmitters and it shall not be higher than the power limit specified in Table 1 for high-power devices according to the equipment's channel bandwidth.

### 8.4.2 Test summary

|                |                    |                    |           |
|----------------|--------------------|--------------------|-----------|
| Test date:     | September 26, 2017 | Temperature:       | 22 °C     |
| Test engineer: | Andrey Adelberg    | Air pressure:      | 1010 mbar |
| Verdict:       | Pass               | Relative humidity: | 31 %      |

### 8.4.3 Observations settings and special notes

EUT is considered High power device. The transmit power was measured using RMS power meter

The transmitter power spectral density (PSD) was measured over a bandwidth of 1 MHz, with the power measured as per above. A resolution bandwidth less than the measurement bandwidth can be used provided that the measured power is integrated to show total power over the measurement bandwidth. Spectrum analyser settings:

|                       |          |
|-----------------------|----------|
| Resolution bandwidth: | 1 MHz    |
| Video bandwidth:      | 3 MHz    |
| Detector mode:        | Peak     |
| Trace mode:           | Max Hold |

### 8.4.4 Test data

**Table 8.4-2:** Output power and EIRP measurements results for 5 MHz channel, 10 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 1.6 Mbps     | 4942.5          | 20.87                 | 20.00                 | 23.47                | 27.00                    | 3.53                     | 10.00              | 33.47      | 53.00            | 19.53            |
|                   | 4965.0          | 20.52                 | 20.36                 | 23.45                | 27.00                    | 3.55                     | 10.00              | 33.45      | 53.00            | 19.55            |
|                   | 4987.5          | 20.70                 | 20.63                 | 23.68                | 27.00                    | 3.32                     | 10.00              | 33.68      | 53.00            | 19.32            |
| 256-QAM 46.6 Mbps | 4942.5          | 20.82                 | 20.12                 | 23.49                | 27.00                    | 3.51                     | 10.00              | 33.49      | 53.00            | 19.51            |
|                   | 4965.0          | 20.55                 | 20.48                 | 23.53                | 27.00                    | 3.47                     | 10.00              | 33.53      | 53.00            | 19.47            |
|                   | 4987.5          | 20.71                 | 20.64                 | 23.69                | 27.00                    | 3.31                     | 10.00              | 33.69      | 53.00            | 19.31            |

**Table 8.4-3:** Output power and EIRP measurements results for 5 MHz channel, 19 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 1.6 Mbps     | 4942.5          | 20.87                 | 20.00                 | 23.47                | 27.00                    | 3.53                     | 19.00              | 42.47      | 53.00            | 10.53            |
|                   | 4965.0          | 20.52                 | 20.36                 | 23.45                | 27.00                    | 3.55                     | 19.00              | 42.45      | 53.00            | 10.55            |
|                   | 4987.5          | 20.70                 | 20.63                 | 23.68                | 27.00                    | 3.32                     | 19.00              | 42.68      | 53.00            | 10.32            |
| 256-QAM 46.6 Mbps | 4942.5          | 20.82                 | 20.12                 | 23.49                | 27.00                    | 3.51                     | 19.00              | 42.49      | 53.00            | 10.51            |
|                   | 4965.0          | 20.55                 | 20.48                 | 23.53                | 27.00                    | 3.47                     | 19.00              | 42.53      | 53.00            | 10.47            |
|                   | 4987.5          | 20.71                 | 20.64                 | 23.69                | 27.00                    | 3.31                     | 19.00              | 42.69      | 53.00            | 10.31            |

**Table 8.4-4:** Output power and EIRP measurements results for 5 MHz channel, 24 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 1.6 Mbps     | 4942.5          | 20.87                 | 20.00                 | 23.47                | 27.00                    | 3.53                     | 24.00              | 47.47      | 53.00            | 5.53             |
|                   | 4965.0          | 20.52                 | 20.36                 | 23.45                | 27.00                    | 3.55                     | 24.00              | 47.45      | 53.00            | 5.55             |
|                   | 4987.5          | 20.70                 | 20.63                 | 23.68                | 27.00                    | 3.32                     | 24.00              | 47.68      | 53.00            | 5.32             |
| 256-QAM 46.6 Mbps | 4942.5          | 20.82                 | 20.12                 | 23.49                | 27.00                    | 3.51                     | 24.00              | 47.49      | 53.00            | 5.51             |
|                   | 4965.0          | 20.55                 | 20.48                 | 23.53                | 27.00                    | 3.47                     | 24.00              | 47.53      | 53.00            | 5.47             |
|                   | 4987.5          | 20.71                 | 20.64                 | 23.69                | 27.00                    | 3.31                     | 24.00              | 47.69      | 53.00            | 5.31             |

**Table 8.4-5:** Output power and EIRP measurements results for 5 MHz channel, 32 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 1.6 Mbps     | 4942.5          | 17.98                 | 17.20                 | 20.62                | 21.00                    | 0.38                     | 32.00              | 52.62      | 53.00            | 0.38             |
|                   | 4965.0          | 17.52                 | 17.62                 | 20.58                | 21.00                    | 0.42                     | 32.00              | 52.58      | 53.00            | 0.42             |
|                   | 4987.5          | 18.50                 | 17.37                 | 20.98                | 21.00                    | 0.02                     | 32.00              | 52.98      | 53.00            | 0.02             |
| 256-QAM 46.6 Mbps | 4942.5          | 18.00                 | 17.30                 | 20.67                | 21.00                    | 0.33                     | 32.00              | 52.67      | 53.00            | 0.33             |
|                   | 4965.0          | 17.54                 | 17.68                 | 20.62                | 21.00                    | 0.38                     | 32.00              | 52.62      | 53.00            | 0.38             |
|                   | 4987.5          | 18.52                 | 17.33                 | 20.98                | 21.00                    | 0.02                     | 32.00              | 52.98      | 53.00            | 0.02             |

Note: Output power limit was calculated as follows: 27 dBm – (32 dBi – 26 dBi) = 21 dBm

**Table 8.4-6:** Output power and EIRP measurements results for 10 MHz channel, 10 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 3.3 Mbps     | 4945.0          | 22.59                 | 22.77                 | 25.69                | 30.00                    | 4.31                     | 10.00              | 35.69      | 56.00            | 20.31            |
|                   | 4965.0          | 22.22                 | 22.20                 | 25.22                | 30.00                    | 4.78                     | 10.00              | 35.22      | 56.00            | 20.78            |
|                   | 4985.0          | 22.16                 | 22.24                 | 25.21                | 30.00                    | 4.79                     | 10.00              | 35.21      | 56.00            | 20.79            |
| 256-QAM 93.3 Mbps | 4945.0          | 22.62                 | 22.64                 | 25.64                | 30.00                    | 4.36                     | 10.00              | 35.64      | 56.00            | 20.36            |
|                   | 4965.0          | 22.31                 | 22.11                 | 25.22                | 30.00                    | 4.78                     | 10.00              | 35.22      | 56.00            | 20.78            |
|                   | 4985.0          | 22.18                 | 22.25                 | 25.23                | 30.00                    | 4.77                     | 10.00              | 35.23      | 56.00            | 20.77            |

**Table 8.4-7:** Output power and EIRP measurements results for 10 MHz channel, 19 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 3.3 Mbps     | 4945.0          | 22.59                 | 22.77                 | 25.69                | 30.00                    | 4.31                     | 19.00              | 44.69      | 56.00            | 11.31            |
|                   | 4965.0          | 22.22                 | 22.20                 | 25.22                | 30.00                    | 4.78                     | 19.00              | 44.22      | 56.00            | 11.78            |
|                   | 4985.0          | 22.16                 | 22.24                 | 25.21                | 30.00                    | 4.79                     | 19.00              | 44.21      | 56.00            | 11.79            |
| 256-QAM 93.3 Mbps | 4945.0          | 22.62                 | 22.64                 | 25.64                | 30.00                    | 4.36                     | 19.00              | 44.64      | 56.00            | 11.36            |
|                   | 4965.0          | 22.31                 | 22.11                 | 25.22                | 30.00                    | 4.78                     | 19.00              | 44.22      | 56.00            | 11.78            |
|                   | 4985.0          | 22.18                 | 22.25                 | 25.23                | 30.00                    | 4.77                     | 19.00              | 44.23      | 56.00            | 11.77            |

**Table 8.4-8:** Output power and EIRP measurements results for 10 MHz channel, 24 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 3.3 Mbps     | 4945.0          | 22.59                 | 22.77                 | 25.69                | 30.00                    | 4.31                     | 24.00              | 49.69      | 56.00            | 6.31             |
|                   | 4965.0          | 22.22                 | 22.20                 | 25.22                | 30.00                    | 4.78                     | 24.00              | 49.22      | 56.00            | 6.78             |
|                   | 4985.0          | 22.16                 | 22.24                 | 25.21                | 30.00                    | 4.79                     | 24.00              | 49.21      | 56.00            | 6.79             |
| 256-QAM 93.3 Mbps | 4945.0          | 22.62                 | 22.64                 | 25.64                | 30.00                    | 4.36                     | 24.00              | 49.64      | 56.00            | 6.36             |
|                   | 4965.0          | 22.31                 | 22.11                 | 25.22                | 30.00                    | 4.78                     | 24.00              | 49.22      | 56.00            | 6.78             |
|                   | 4985.0          | 22.18                 | 22.25                 | 25.23                | 30.00                    | 4.77                     | 24.00              | 49.23      | 56.00            | 6.77             |



**Table 8.4-9:** Output power and EIRP measurements results for 10 MHz channel, 32 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|-------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 3.3 Mbps     | 4945.0          | 20.63                 | 19.85                 | 23.27                | 24.00                    | 0.73                     | 32.00              | 55.27      | 56.00            | 0.73             |
|                   | 4965.0          | 20.44                 | 20.48                 | 23.47                | 24.00                    | 0.53                     | 32.00              | 55.47      | 56.00            | 0.53             |
|                   | 4985.0          | 20.46                 | 20.77                 | 23.63                | 24.00                    | 0.37                     | 32.00              | 55.63      | 56.00            | 0.37             |
| 256-QAM 93.3 Mbps | 4945.0          | 20.59                 | 19.85                 | 23.25                | 24.00                    | 0.75                     | 32.00              | 55.25      | 56.00            | 0.75             |
|                   | 4965.0          | 20.51                 | 20.51                 | 23.52                | 24.00                    | 0.48                     | 32.00              | 55.52      | 56.00            | 0.48             |
|                   | 4985.0          | 20.38                 | 20.71                 | 23.56                | 24.00                    | 0.44                     | 32.00              | 55.56      | 56.00            | 0.44             |

Note: Output power limit was calculated as follows: 30 dBm – (32 dBi – 26 dBi) = 24 dBm

**Table 8.4-10:** Output power and EIRP measurements results for 20 MHz channel, 10 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|--------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 6.6 Mbps      | 4950.0          | 22.78                 | 23.07                 | 25.94                | 33.00                    | 7.06                     | 10.00              | 35.94      | 59.00            | 23.06            |
|                    | 4965.0          | 22.44                 | 22.67                 | 25.57                | 33.00                    | 7.43                     | 10.00              | 35.57      | 59.00            | 23.43            |
|                    | 4980.0          | 22.53                 | 22.59                 | 25.57                | 33.00                    | 7.43                     | 10.00              | 35.57      | 59.00            | 23.43            |
| 256-QAM 186.6 Mbps | 4950.0          | 22.73                 | 22.99                 | 25.87                | 33.00                    | 7.13                     | 10.00              | 35.87      | 59.00            | 23.13            |
|                    | 4965.0          | 22.42                 | 22.66                 | 25.55                | 33.00                    | 7.45                     | 10.00              | 35.55      | 59.00            | 23.45            |
|                    | 4980.0          | 22.61                 | 22.57                 | 25.60                | 33.00                    | 7.40                     | 10.00              | 35.60      | 59.00            | 23.40            |

**Table 8.4-11:** Output power and EIRP measurements results for 20 MHz channel, 19 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|--------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 6.6 Mbps      | 4950.0          | 22.78                 | 23.07                 | 25.94                | 33.00                    | 7.06                     | 19.00              | 44.94      | 59.00            | 14.06            |
|                    | 4965.0          | 22.44                 | 22.67                 | 25.57                | 33.00                    | 7.43                     | 19.00              | 44.57      | 59.00            | 14.43            |
|                    | 4980.0          | 22.53                 | 22.59                 | 25.57                | 33.00                    | 7.43                     | 19.00              | 44.57      | 59.00            | 14.43            |
| 256-QAM 186.6 Mbps | 4950.0          | 22.73                 | 22.99                 | 25.87                | 33.00                    | 7.13                     | 19.00              | 44.87      | 59.00            | 14.13            |
|                    | 4965.0          | 22.42                 | 22.66                 | 25.55                | 33.00                    | 7.45                     | 19.00              | 44.55      | 59.00            | 14.45            |
|                    | 4980.0          | 22.61                 | 22.57                 | 25.60                | 33.00                    | 7.40                     | 19.00              | 44.60      | 59.00            | 14.40            |

**Table 8.4-12:** Output power and EIRP measurements results for 20 MHz channel, 24 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|--------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 6.6 Mbps      | 4950.0          | 22.78                 | 23.07                 | 25.94                | 33.00                    | 7.06                     | 24.00              | 49.94      | 59.00            | 9.06             |
|                    | 4965.0          | 22.44                 | 22.67                 | 25.57                | 33.00                    | 7.43                     | 24.00              | 49.57      | 59.00            | 9.43             |
|                    | 4980.0          | 22.53                 | 22.59                 | 25.57                | 33.00                    | 7.43                     | 24.00              | 49.57      | 59.00            | 9.43             |
| 256-QAM 186.6 Mbps | 4950.0          | 22.73                 | 22.99                 | 25.87                | 33.00                    | 7.13                     | 24.00              | 49.87      | 59.00            | 9.13             |
|                    | 4965.0          | 22.42                 | 22.66                 | 25.55                | 33.00                    | 7.45                     | 24.00              | 49.55      | 59.00            | 9.45             |
|                    | 4980.0          | 22.61                 | 22.57                 | 25.60                | 33.00                    | 7.40                     | 24.00              | 49.60      | 59.00            | 9.40             |

**Table 8.4-13:** Output power and EIRP measurements results for 20 MHz channel, 32 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 power (dBm) | Antenna 2 power (dBm) | Combined power (dBm) | Output power limit (dBm) | Output power margin (dB) | Antenna gain (dBi) | EIRP (dBm) | EIRP limit (dBm) | EIRP margin (dB) |
|--------------------|-----------------|-----------------------|-----------------------|----------------------|--------------------------|--------------------------|--------------------|------------|------------------|------------------|
| BPSK 6.6 Mbps      | 4942.5          | 22.78                 | 23.07                 | 25.94                | 27.00                    | 1.06                     | 32.00              | 57.94      | 59.00            | 1.06             |
|                    | 4965.0          | 22.44                 | 22.67                 | 25.57                | 27.00                    | 1.43                     | 32.00              | 57.57      | 59.00            | 1.43             |
|                    | 4987.5          | 22.53                 | 22.59                 | 25.57                | 27.00                    | 1.43                     | 32.00              | 57.57      | 59.00            | 1.43             |
| 256-QAM 186.6 Mbps | 4942.5          | 22.73                 | 22.99                 | 25.87                | 27.00                    | 1.13                     | 32.00              | 57.87      | 59.00            | 1.13             |
|                    | 4965.0          | 22.42                 | 22.66                 | 25.55                | 27.00                    | 1.45                     | 32.00              | 57.55      | 59.00            | 1.45             |
|                    | 4987.5          | 22.61                 | 22.57                 | 25.60                | 27.00                    | 1.40                     | 32.00              | 57.60      | 59.00            | 1.40             |

Note: Output power limit was calculated as follows: 33 dBm – (32 dBi – 26 dBi) = 27 dBm

**Table 8.4-14:** Power spectral density measurements results for 5 MHz channel, 10 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 1.6 Mbps     | 4942.5          | 14.95                   | 14.11                   | 17.56                  | 21.00               | 3.44            | 10.00              | 27.56            | 47.00                  | 19.44              |
|                   | 4965.0          | 14.63                   | 14.52                   | 17.59                  | 21.00               | 3.41            | 10.00              | 27.59            | 47.00                  | 19.41              |
|                   | 4987.5          | 14.86                   | 14.60                   | 17.74                  | 21.00               | 3.26            | 10.00              | 27.74            | 47.00                  | 19.26              |
| 256-QAM 46.6 Mbps | 4942.5          | 14.92                   | 14.18                   | 17.58                  | 21.00               | 3.42            | 10.00              | 27.58            | 47.00                  | 19.42              |
|                   | 4965.0          | 14.59                   | 14.58                   | 17.60                  | 21.00               | 3.40            | 10.00              | 27.60            | 47.00                  | 19.40              |
|                   | 4987.5          | 14.88                   | 14.55                   | 17.73                  | 21.00               | 3.27            | 10.00              | 27.73            | 47.00                  | 19.27              |

**Table 8.4-15:** Power spectral density measurements results for 5 MHz channel, 19 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 1.6 Mbps     | 4942.5          | 14.95                   | 14.11                   | 17.56                  | 21.00               | 3.44            | 19.00              | 36.56            | 47.00                  | 10.44              |
|                   | 4965.0          | 14.63                   | 14.52                   | 17.59                  | 21.00               | 3.41            | 19.00              | 36.59            | 47.00                  | 10.41              |
|                   | 4987.5          | 14.86                   | 14.60                   | 17.74                  | 21.00               | 3.26            | 19.00              | 36.74            | 47.00                  | 10.26              |
| 256-QAM 46.6 Mbps | 4942.5          | 14.92                   | 14.18                   | 17.58                  | 21.00               | 3.42            | 19.00              | 36.58            | 47.00                  | 10.42              |
|                   | 4965.0          | 14.59                   | 14.58                   | 17.60                  | 21.00               | 3.40            | 19.00              | 36.60            | 47.00                  | 10.40              |
|                   | 4987.5          | 14.88                   | 14.55                   | 17.73                  | 21.00               | 3.27            | 19.00              | 36.73            | 47.00                  | 10.27              |

**Table 8.4-16:** Power spectral density measurements results for 5 MHz channel, 24 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 1.6 Mbps     | 4942.5          | 14.95                   | 14.11                   | 17.56                  | 21.00               | 3.44            | 24.00              | 41.56            | 47.00                  | 5.44               |
|                   | 4965.0          | 14.63                   | 14.52                   | 17.59                  | 21.00               | 3.41            | 24.00              | 41.59            | 47.00                  | 5.41               |
|                   | 4987.5          | 14.86                   | 14.60                   | 17.74                  | 21.00               | 3.26            | 24.00              | 41.74            | 47.00                  | 5.26               |
| 256-QAM 46.6 Mbps | 4942.5          | 14.92                   | 14.18                   | 17.58                  | 21.00               | 3.42            | 24.00              | 41.58            | 47.00                  | 5.42               |
|                   | 4965.0          | 14.59                   | 14.58                   | 17.60                  | 21.00               | 3.40            | 24.00              | 41.60            | 47.00                  | 5.40               |
|                   | 4987.5          | 14.88                   | 14.55                   | 17.73                  | 21.00               | 3.27            | 24.00              | 41.73            | 47.00                  | 5.27               |

**Table 8.4-17:** Power spectral density measurements results for 5 MHz channel, 32 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 1.6 Mbps     | 4942.5          | 12.01                   | 11.20                   | 14.63                  | 15.00               | 0.37            | 32.00              | 46.63            | 47.00                  | 0.37               |
|                   | 4965.0          | 11.63                   | 11.77                   | 14.71                  | 15.00               | 0.29            | 32.00              | 46.71            | 47.00                  | 0.29               |
|                   | 4987.5          | 12.35                   | 11.39                   | 14.91                  | 15.00               | 0.09            | 32.00              | 46.91            | 47.00                  | 0.09               |
| 256-QAM 46.6 Mbps | 4942.5          | 12.10                   | 11.18                   | 14.67                  | 15.00               | 0.33            | 32.00              | 46.67            | 47.00                  | 0.33               |
|                   | 4965.0          | 11.64                   | 11.63                   | 14.65                  | 15.00               | 0.35            | 32.00              | 46.65            | 47.00                  | 0.35               |
|                   | 4987.5          | 12.42                   | 11.41                   | 14.95                  | 15.00               | 0.05            | 32.00              | 46.95            | 47.00                  | 0.05               |

Note: PSD limit was calculated as follows: 21 dBm/MHz – (32 dBi – 26 dBi) = 15 dBm/MHz

**Table 8.4-18:** Power spectral density measurements results for 10 MHz channel, 10 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 3.3 Mbps     | 4945.0          | 13.78                   | 14.05                   | 16.93                  | 21.00               | 4.07            | 10.00              | 26.93            | 47.00                  | 20.07              |
|                   | 4965.0          | 13.36                   | 13.29                   | 16.34                  | 21.00               | 4.66            | 10.00              | 26.34            | 47.00                  | 20.66              |
|                   | 4985.0          | 13.45                   | 13.47                   | 16.47                  | 21.00               | 4.53            | 10.00              | 26.47            | 47.00                  | 20.53              |
| 256-QAM 93.3 Mbps | 4945.0          | 13.73                   | 13.99                   | 16.87                  | 21.00               | 4.13            | 10.00              | 26.87            | 47.00                  | 20.13              |
|                   | 4965.0          | 13.35                   | 13.33                   | 16.35                  | 21.00               | 4.65            | 10.00              | 26.35            | 47.00                  | 20.65              |
|                   | 4985.0          | 13.52                   | 13.50                   | 16.52                  | 21.00               | 4.48            | 10.00              | 26.52            | 47.00                  | 20.48              |

**Table 8.4-19:** Power spectral density measurements results for 10 MHz channel, 19 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 3.3 Mbps     | 4945.0          | 13.78                   | 14.05                   | 16.93                  | 21.00               | 4.07            | 19.00              | 35.93            | 47.00                  | 11.07              |
|                   | 4965.0          | 13.36                   | 13.29                   | 16.34                  | 21.00               | 4.66            | 19.00              | 35.34            | 47.00                  | 11.66              |
|                   | 4985.0          | 13.45                   | 13.47                   | 16.47                  | 21.00               | 4.53            | 19.00              | 35.47            | 47.00                  | 11.53              |
| 256-QAM 93.3 Mbps | 4945.0          | 13.73                   | 13.99                   | 16.87                  | 21.00               | 4.13            | 19.00              | 35.87            | 47.00                  | 11.13              |
|                   | 4965.0          | 13.35                   | 13.33                   | 16.35                  | 21.00               | 4.65            | 19.00              | 35.35            | 47.00                  | 11.65              |
|                   | 4985.0          | 13.52                   | 13.50                   | 16.52                  | 21.00               | 4.48            | 19.00              | 35.52            | 47.00                  | 11.48              |

**Table 8.4-20:** Power spectral density measurements results for 10 MHz channel, 24 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 3.3 Mbps     | 4945.0          | 13.78                   | 14.05                   | 16.93                  | 21.00               | 4.07            | 24.00              | 40.93            | 47.00                  | 6.07               |
|                   | 4965.0          | 13.36                   | 13.29                   | 16.34                  | 21.00               | 4.66            | 24.00              | 40.34            | 47.00                  | 6.66               |
|                   | 4985.0          | 13.45                   | 13.47                   | 16.47                  | 21.00               | 4.53            | 24.00              | 40.47            | 47.00                  | 6.53               |
| 256-QAM 93.3 Mbps | 4945.0          | 13.73                   | 13.99                   | 16.87                  | 21.00               | 4.13            | 24.00              | 40.87            | 47.00                  | 6.13               |
|                   | 4965.0          | 13.35                   | 13.33                   | 16.35                  | 21.00               | 4.65            | 24.00              | 40.35            | 47.00                  | 6.65               |
|                   | 4985.0          | 13.52                   | 13.50                   | 16.52                  | 21.00               | 4.48            | 24.00              | 40.52            | 47.00                  | 6.48               |

**Table 8.4-21:** Power spectral density measurements results for 10 MHz channel, 32 dBi antenna

| Modulation        | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|-------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 3.3 Mbps     | 4945.0          | 11.86                   | 11.12                   | 14.52                  | 15.00               | 0.48            | 32.00              | 46.52            | 47.00                  | 0.48               |
|                   | 4965.0          | 11.59                   | 11.62                   | 14.62                  | 15.00               | 0.38            | 32.00              | 46.62            | 47.00                  | 0.38               |
|                   | 4985.0          | 11.69                   | 12.05                   | 14.88                  | 15.00               | 0.12            | 32.00              | 46.88            | 47.00                  | 0.12               |
| 256-QAM 93.3 Mbps | 4945.0          | 11.93                   | 11.11                   | 14.55                  | 15.00               | 0.45            | 32.00              | 46.55            | 47.00                  | 0.45               |
|                   | 4965.0          | 11.65                   | 11.70                   | 14.69                  | 15.00               | 0.31            | 32.00              | 46.69            | 47.00                  | 0.31               |
|                   | 4985.0          | 11.58                   | 12.12                   | 14.87                  | 15.00               | 0.13            | 32.00              | 46.87            | 47.00                  | 0.13               |

Note: PSD limit was calculated as follows: 21 dBm/MHz – (32 dBi – 26 dBi) = 15 dBm/MHz

**Table 8.4-22:** Power spectral density measurements results for 20 MHz channel, 10 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|--------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 6.6 Mbps      | 4950.0          | 10.92                   | 11.35                   | 14.15                  | 21.00               | 6.85            | 10.00              | 24.15            | 47.00                  | 22.85              |
|                    | 4965.0          | 10.76                   | 10.98                   | 13.88                  | 21.00               | 7.12            | 10.00              | 23.88            | 47.00                  | 23.12              |
|                    | 4980.0          | 10.91                   | 10.93                   | 13.93                  | 21.00               | 7.07            | 10.00              | 23.93            | 47.00                  | 23.07              |
| 256-QAM 186.6 Mbps | 4950.0          | 11.02                   | 11.22                   | 14.13                  | 21.00               | 6.87            | 10.00              | 24.13            | 47.00                  | 22.87              |
|                    | 4965.0          | 10.76                   | 11.01                   | 13.90                  | 21.00               | 7.10            | 10.00              | 23.90            | 47.00                  | 23.10              |
|                    | 4980.0          | 10.88                   | 10.87                   | 13.89                  | 21.00               | 7.11            | 10.00              | 23.89            | 47.00                  | 23.11              |

**Table 8.4-23:** Power spectral density measurements results for 20 MHz channel, 19 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|--------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 6.6 Mbps      | 4950.0          | 10.92                   | 11.35                   | 14.15                  | 21.00               | 6.85            | 19.00              | 33.15            | 47.00                  | 13.85              |
|                    | 4965.0          | 10.76                   | 10.98                   | 13.88                  | 21.00               | 7.12            | 19.00              | 32.88            | 47.00                  | 14.12              |
|                    | 4980.0          | 10.91                   | 10.93                   | 13.93                  | 21.00               | 7.07            | 19.00              | 32.93            | 47.00                  | 14.07              |
| 256-QAM 186.6 Mbps | 4950.0          | 11.02                   | 11.22                   | 14.13                  | 21.00               | 6.87            | 19.00              | 33.13            | 47.00                  | 13.87              |
|                    | 4965.0          | 10.76                   | 11.01                   | 13.90                  | 21.00               | 7.10            | 19.00              | 32.90            | 47.00                  | 14.10              |
|                    | 4980.0          | 10.88                   | 10.87                   | 13.89                  | 21.00               | 7.11            | 19.00              | 32.89            | 47.00                  | 14.11              |

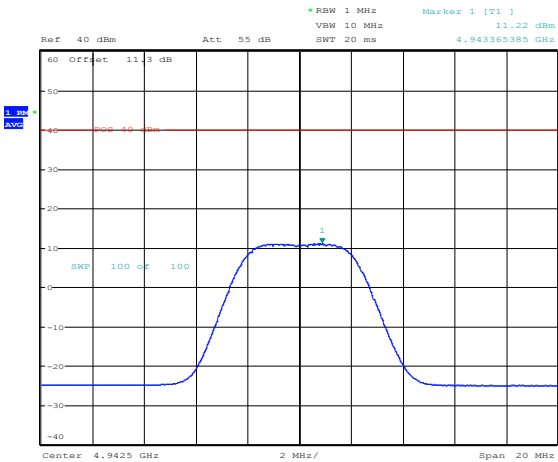
**Table 8.4-24:** Power spectral density measurements results for 20 MHz channel, 24 dBi antenna

| Modulation         | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|--------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 6.6 Mbps      | 4950.0          | 10.92                   | 11.35                   | 14.15                  | 21.00               | 6.85            | 24.00              | 38.15            | 47.00                  | 8.85               |
|                    | 4965.0          | 10.76                   | 10.98                   | 13.88                  | 21.00               | 7.12            | 24.00              | 37.88            | 47.00                  | 9.12               |
|                    | 4980.0          | 10.91                   | 10.93                   | 13.93                  | 21.00               | 7.07            | 24.00              | 37.93            | 47.00                  | 9.07               |
| 256-QAM 186.6 Mbps | 4950.0          | 11.02                   | 11.22                   | 14.13                  | 21.00               | 6.87            | 24.00              | 38.13            | 47.00                  | 8.87               |
|                    | 4965.0          | 10.76                   | 11.01                   | 13.90                  | 21.00               | 7.10            | 24.00              | 37.90            | 47.00                  | 9.10               |
|                    | 4980.0          | 10.88                   | 10.87                   | 13.89                  | 21.00               | 7.11            | 24.00              | 37.89            | 47.00                  | 9.11               |

Table 8.4-25: Power spectral density measurements results for 20 MHz channel, 32 dBi antenna

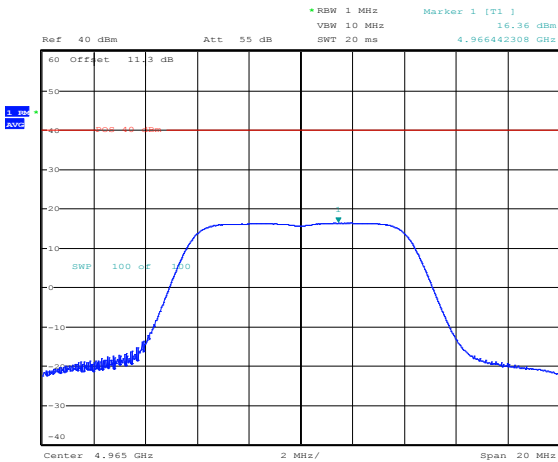
| Modulation         | Frequency (MHz) | Antenna 1 PSD (dBm/MHz) | Antenna 2 PSD (dBm/MHz) | Combined PSD (dBm/MHz) | PSD limit (dBm/MHz) | PSD margin (dB) | Antenna gain (dBi) | EIRPSD (dBm/MHz) | EIRPSD limit (dBm/MHz) | EIRPSD margin (dB) |
|--------------------|-----------------|-------------------------|-------------------------|------------------------|---------------------|-----------------|--------------------|------------------|------------------------|--------------------|
| BPSK 6.6 Mbps      | 4950.0          | 10.92                   | 11.35                   | 14.15                  | 15.00               | 0.85            | 32.00              | 46.15            | 47.00                  | 0.85               |
|                    | 4965.0          | 10.76                   | 10.98                   | 13.88                  | 15.00               | 1.12            | 32.00              | 45.88            | 47.00                  | 1.12               |
|                    | 4980.0          | 10.91                   | 10.93                   | 13.93                  | 15.00               | 1.07            | 32.00              | 45.93            | 47.00                  | 1.07               |
| 256-QAM 186.6 Mbps | 4950.0          | 11.02                   | 11.22                   | 14.13                  | 15.00               | 0.87            | 32.00              | 46.13            | 47.00                  | 0.87               |
|                    | 4965.0          | 10.76                   | 11.01                   | 13.90                  | 15.00               | 1.10            | 32.00              | 45.90            | 47.00                  | 1.10               |
|                    | 4980.0          | 10.88                   | 10.87                   | 13.89                  | 15.00               | 1.11            | 32.00              | 45.89            | 47.00                  | 1.11               |

Note: PSD limit was calculated as follows: 21 dBm/MHz – (32 dBi – 26 dBi) = 15 dBm/MHz



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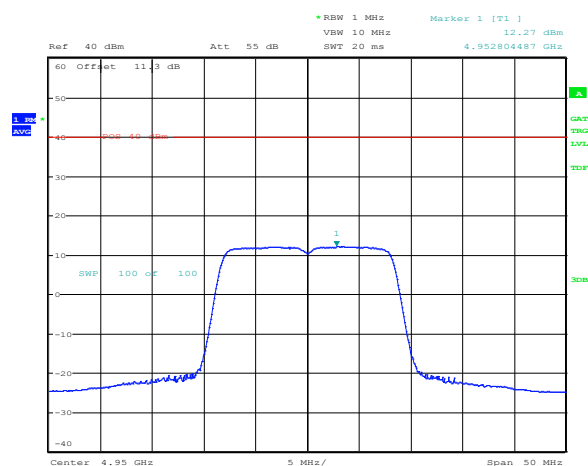
Figure 8.4-1: PSD for 5 MHz channel, sample plot



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Figure 8.4-2: 26 dB bandwidth for 10 MHz channel, sample plot

Testing data  
FCC 90.1215(a) and RSS-111 Clause 5.3 Transmit output power and PSD  
FCC Part 90, Subpart Y and RSS-111, Issue 5



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**Figure 8.4-3: PSD for 20 MHz channel, sample plot**

## 8.5 FCC 90.1215(e) and RSS-111 Clause 5.4 Transmitter Peak to Average Power Ratio (PAPR)

### 8.5.1 Definitions and limits

**FCC:**

The ratio of the peak excursion of the modulation envelope to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

**ISED:**

The 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.

### 8.5.2 Test summary

|                |                   |                    |           |
|----------------|-------------------|--------------------|-----------|
| Test date:     | November 14, 2016 | Temperature:       | 22 °C     |
| Test engineer: | Andrey Adelberg   | Air pressure:      | 1010 mbar |
| Verdict:       | Pass              | Relative humidity: | 31 %      |

### 8.5.3 Observations settings and special notes

Spectrum analyser settings:

|                       |              |
|-----------------------|--------------|
| Resolution bandwidth: | 1 MHz        |
| Video bandwidth:      | 3 MHz        |
| Detector mode:        | Peak and RMS |
| Trace mode:           | Max Hold     |

### 8.5.4 Test data

**Table 8.5-1: PAPR measurements results for 5 MHz channel**

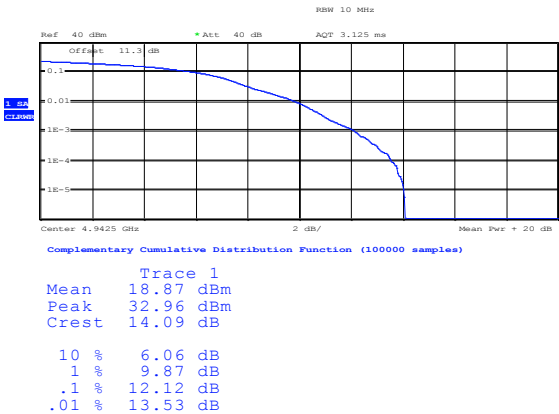
| Antenna port | Frequency, MHz | Ratio, dB | Limit, dB | Margin, dB |
|--------------|----------------|-----------|-----------|------------|
| Antenna 1    | 4942.5         | 12.15     | 13.00     | 0.85       |
|              | 4965.0         | 12.21     | 13.00     | 0.79       |
|              | 4987.5         | 11.41     | 13.00     | 1.59       |
| Antenna 2    | 4942.5         | 12.12     | 13.00     | 0.88       |
|              | 4965.0         | 12.02     | 13.00     | 0.98       |
|              | 4987.5         | 12.21     | 13.00     | 0.79       |

**Table 8.5-2: PAPR measurements results for 10 MHz channel**

| Antenna port | Frequency, MHz | Ratio, dB | Limit, dB | Margin, dB |
|--------------|----------------|-----------|-----------|------------|
| Antenna 1    | 4945.0         | 12.08     | 13.00     | 0.92       |
|              | 4965.0         | 12.56     | 13.00     | 0.44       |
|              | 4985.0         | 12.21     | 13.00     | 0.79       |
| Antenna 2    | 4945.0         | 12.56     | 13.00     | 0.44       |
|              | 4965.0         | 12.60     | 13.00     | 0.40       |
|              | 4985.0         | 12.15     | 13.00     | 0.85       |

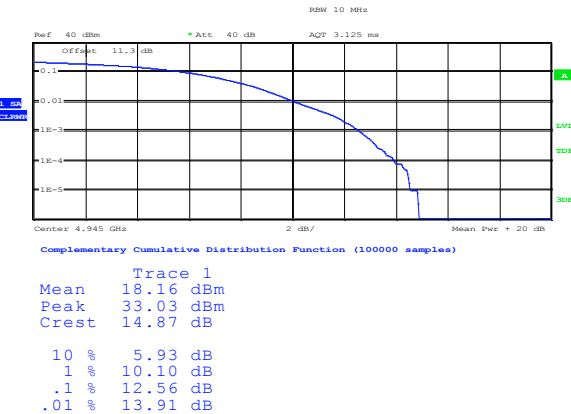
Table 8.5-3: PAPR measurements results for 20 MHz channel

| Antenna port | Frequency, MHz | Ratio, dB | Limit, dB | Margin, dB |
|--------------|----------------|-----------|-----------|------------|
| Antenna 1    | 4950.0         | 12.95     | 13.00     | 0.05       |
|              | 4965.0         | 12.95     | 13.00     | 0.05       |
|              | 4980.0         | 12.95     | 13.00     | 0.05       |
| Antenna 2    | 4950.0         | 12.92     | 13.00     | 0.08       |
|              | 4965.0         | 12.92     | 13.00     | 0.08       |
|              | 4980.0         | 12.85     | 13.00     | 0.15       |



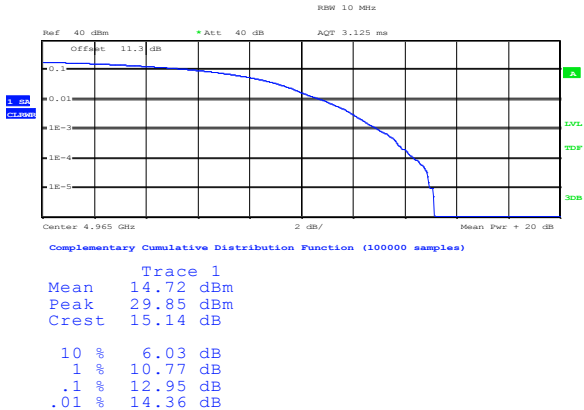
Date: 26.SEP.2017 16:55:32

Figure 8.5-1: PAPR of 0.1% for 5 MHz channel, sample plot



Date: 26.SEP.2017 16:56:16

Figure 8.5-2: PAPR of 0.1% for 10 MHz channel, sample plot



Date: 26.SEP.2017 17:01:42

Figure 8.5-3: PAPR of 0.1% for 20 MHz channel, sample plot



## 8.6 FCC 90.210(m) and RSS-111 Clause 5.5 Transmitter unwanted emissions

### 8.6.1 Definitions and limits

#### FCC:

**Emission Mask M.** For high power transmitters (greater than 20 dBm) operating in the 4940–4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as shown in the Table 8.6-1 *Minimum attenuation high-power transmitter*

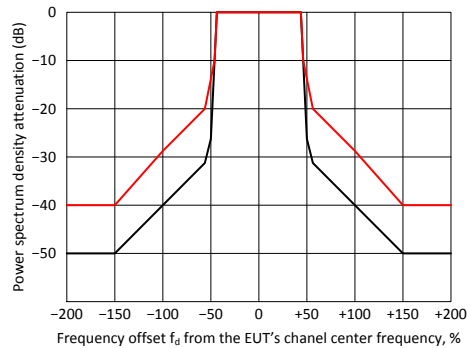
#### ISED:

On any frequency  $f$ , offset from the channel centre frequency  $f_c$  by a separation  $f_d$  (expressed as a percentage of the channel bandwidth), the power spectral density of the unwanted emissions for low- and high-power transmitters shall comply with the limits specified in Table 8.6-1. Figure 8.5–1 shows the emission mask for low- and high-power transmitters. For equipment with multiple transmitters, the unwanted emissions of each transmitter shall comply with the emission limits based on the output power of the transmitter regardless of the total output power of the equipment (i.e. total output power from all the transmitters).

**Table 8.6-1:** Emission mask for low- and high-power transmitters

| Offset Frequency $f_d$<br>(% of the equipment's channel bandwidth) | Minimum attenuation low-power transmitter, dB | Minimum attenuation high-power transmitter, dB |
|--------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|
| $0 < f_d \leq 45$                                                  | 0                                             | 0                                              |
| $45 < f_d \leq 50$                                                 | $219 \times \log_{10}(f_d / 45)$              | $568 \times \log_{10}(f_d / 45)$               |
| $50 < f_d \leq 55$                                                 | $10 + 242 \times \log_{10}(f_d / 50)$         | $26 + 145 \times \log_{10}(f_d / 50)$          |
| $55 < f_d \leq 100$                                                | $20 + 31 \times \log_{10}(f_d / 55)$          | $32 + 31 \times \log_{10}(f_d / 55)$           |
| $100 < f_d \leq 150$                                               | $28 + 68 \times \log_{10}(f_d / 100)$         | $40 + 57 \times \log_{10}(f_d / 100)$          |
| $f_d > 150$                                                        | 40                                            | whichever is less stringent: 50 dBc or -25 dBm |

Notes: \* - Where:  $f_d$  (%) =  $((f - f_c) / \text{channel bandwidth}) \times 100$



Note: Red line is for Low-power transmitter, Black line is for High-power transmitter

**Figure 8.6-1:** Unwanted emission mask for low- and high-power transmitters

### 8.6.2 Test summary

|                |                    |                    |           |
|----------------|--------------------|--------------------|-----------|
| Test date:     | September 27, 2017 | Temperature:       | 22 °C     |
| Test engineer: | Andrey Adelberg    | Air pressure:      | 1010 mbar |
| Verdict:       | Pass               | Relative humidity: | 31 %      |

### 8.6.3 Observations settings and special notes

The 0 dB reference level in the unwanted emission mask is the maximum in-band power spectral density measured in terms of average power in the equipment’s channel bandwidth, using a resolution bandwidth of as close as possible to, without being less than 1 % of the occupied bandwidth, and a video bandwidth of 30 kHz. The unwanted power spectral density emissions are also measured using the same resolution and video bandwidths used in measuring the reference in-band power spectral density.

Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously. Radiated emissions were performed while both antenna connectors were terminated with 50  $\Omega$  load. No spurious emissions were detected above test instrument’s noise floor.

Spectrum analyser for peak conducted measurements within restricted bands below 1 GHz:

|                       |                                                                                        |
|-----------------------|----------------------------------------------------------------------------------------|
| Resolution bandwidth: | 50 kHz (for 5 MHz channel), 100 kHz (for 10 MHz channel), 200 kHz (for 20 MHz channel) |
| Video bandwidth:      | 30 kHz                                                                                 |
| Detector mode:        | RMS                                                                                    |
| Trace mode:           | Max Hold                                                                               |

### 8.6.4 Test data

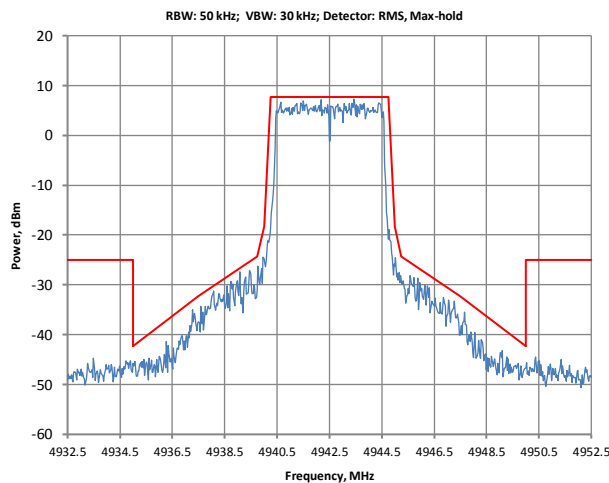


Figure 8.6-2: Emission mask at low channel, Ant1, 5 MHz channel

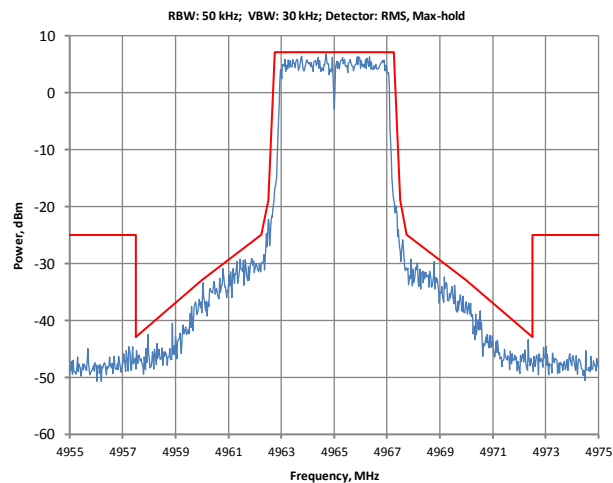


Figure 8.6-3: Emission mask at mid channel, Ant1, 5 MHz channel

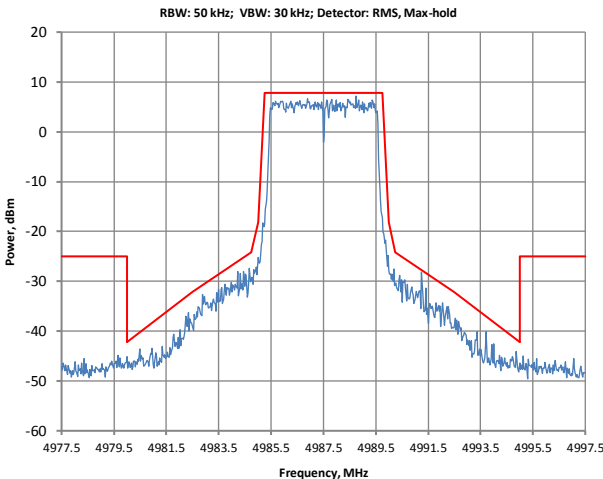


Figure 8.6-4: Emission mask at high channel, Ant1, 5 MHz channel

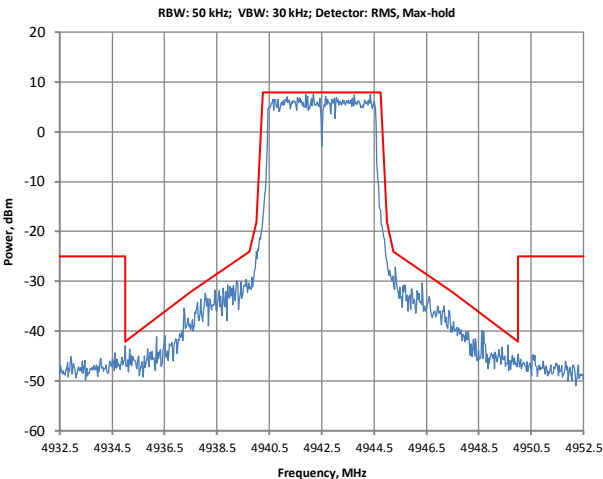


Figure 8.6-5: Emission mask at low channel, Ant2, 5 MHz channel

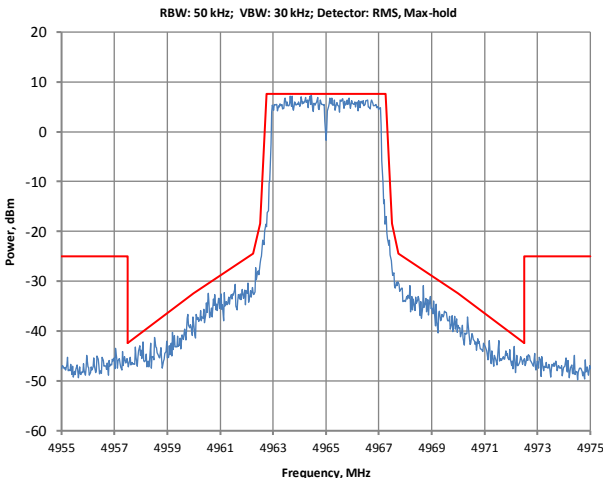


Figure 8.6-6: Emission mask at mid channel, Ant2, 5 MHz channel

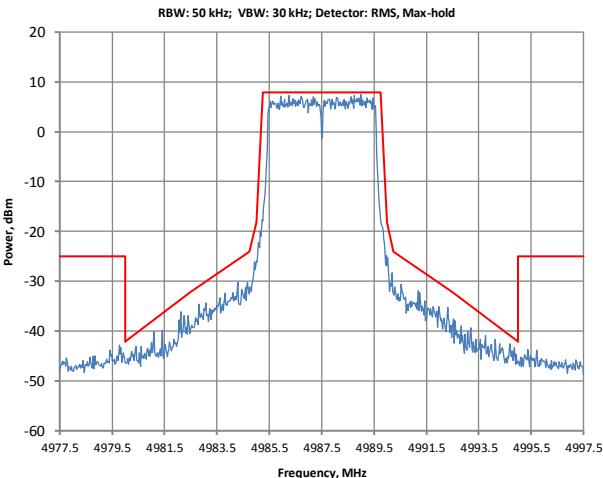


Figure 8.6-7: Emission mask at high channel, Ant2, 5 MHz channel

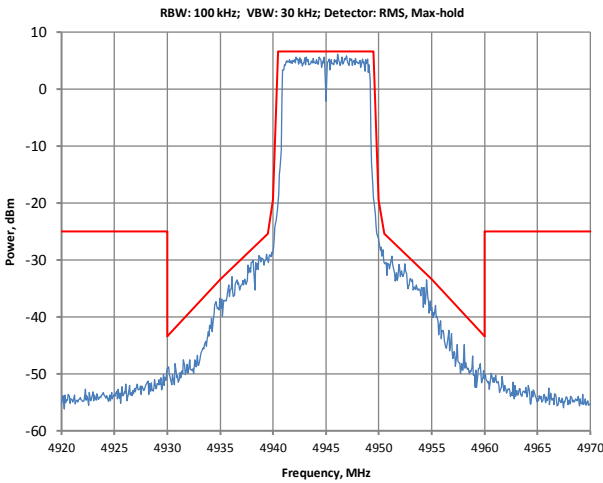


Figure 8.6-8: Emission mask at low channel, Ant1, 10 MHz channel

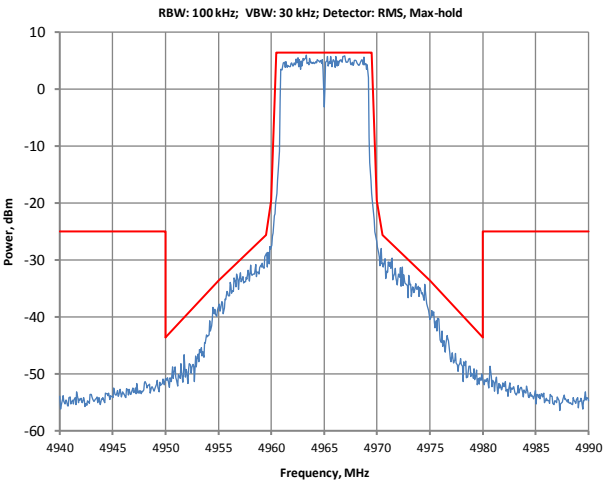


Figure 8.6-9: Emission mask at mid channel, Ant1, 10 MHz channel

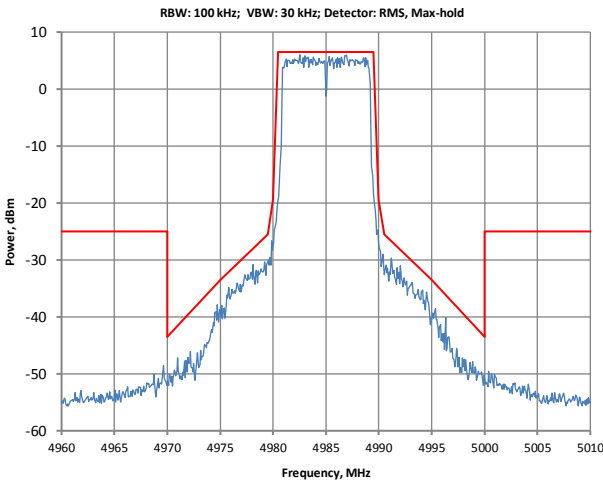


Figure 8.6-10: Emission mask at high channel, Ant1, 10 MHz channel

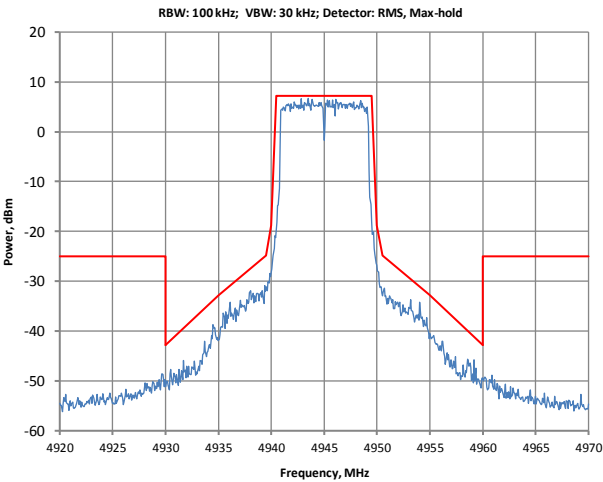


Figure 8.6-11: Emission mask at low channel, Ant2, 10 MHz channel

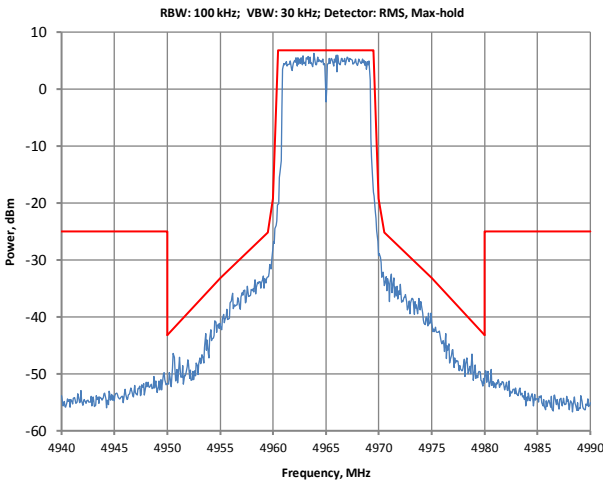


Figure 8.6-12: Emission mask at mid channel, Ant2, 10 MHz channel

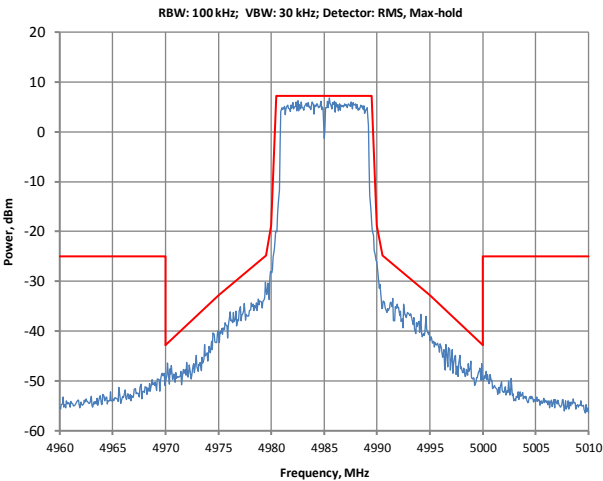


Figure 8.6-13: Emission mask at high channel, Ant2, 10 MHz channel

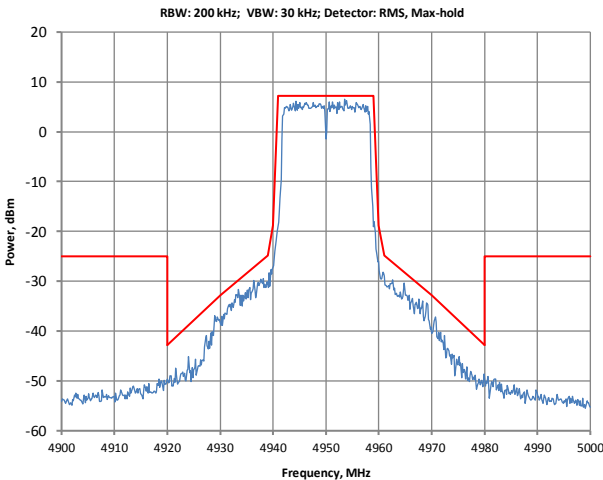


Figure 8.6-14: Emission mask at low channel, Ant1, 20 MHz channel

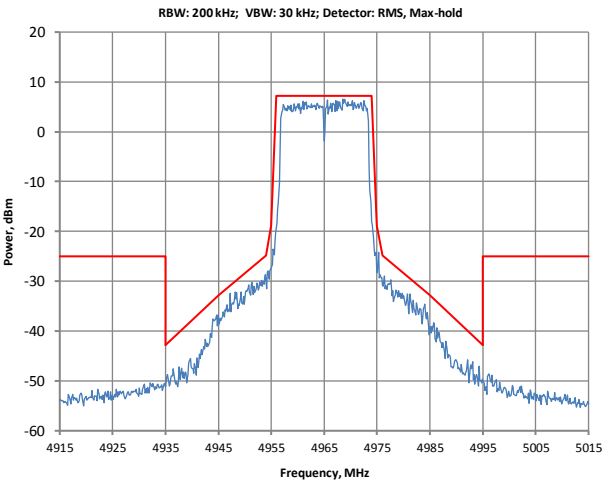


Figure 8.6-15: Emission mask at mid channel, Ant1, 20 MHz channel

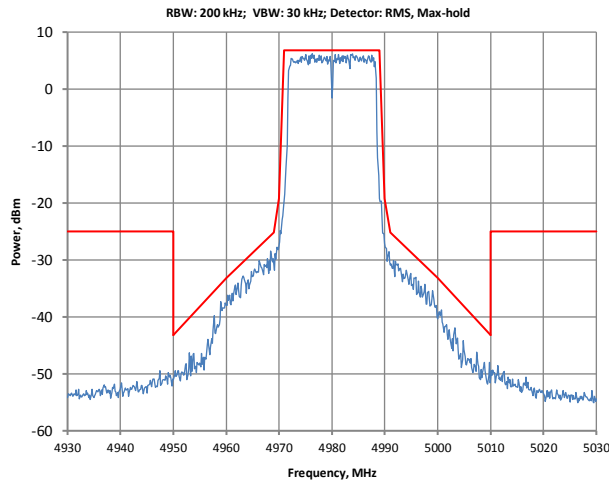


Figure 8.6-16: Emission mask at high channel, Ant1, 20 MHz channel

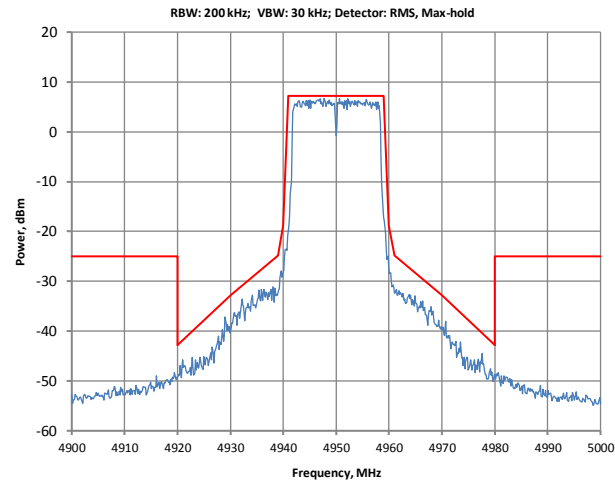


Figure 8.6-17: Emission mask at low channel, Ant2, 20 MHz channel

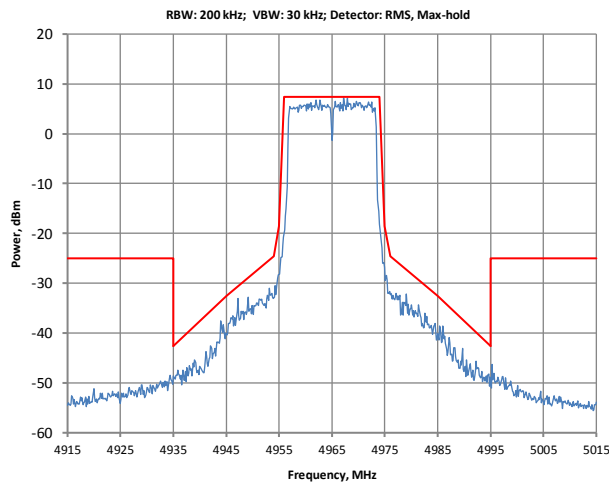


Figure 8.6-18: Emission mask at mid channel, Ant2, 20 MHz channel

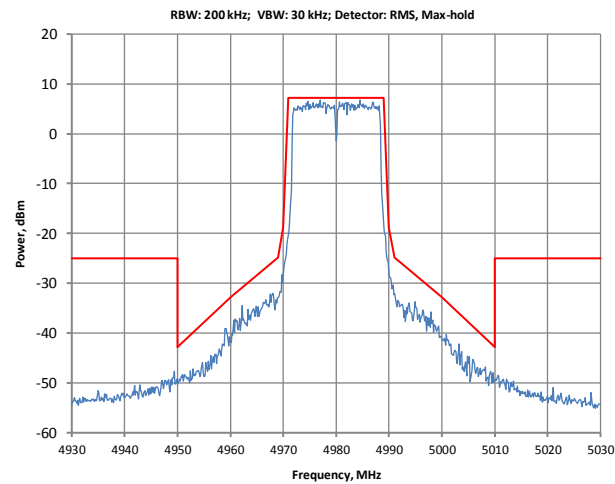
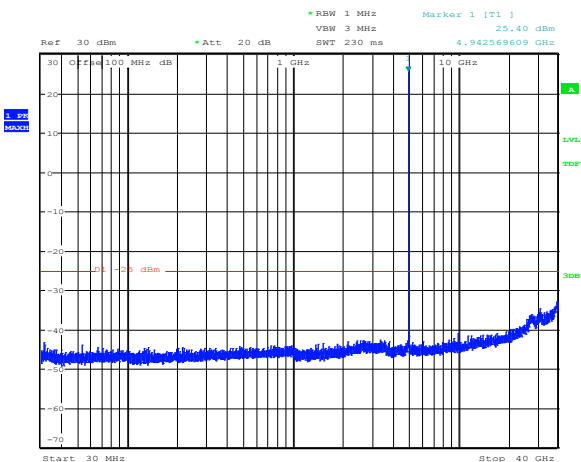
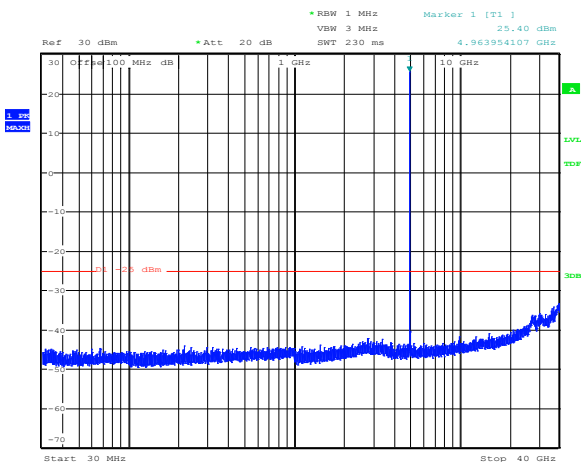


Figure 8.6-19: Emission mask at high channel, Ant2, 20 MHz channel



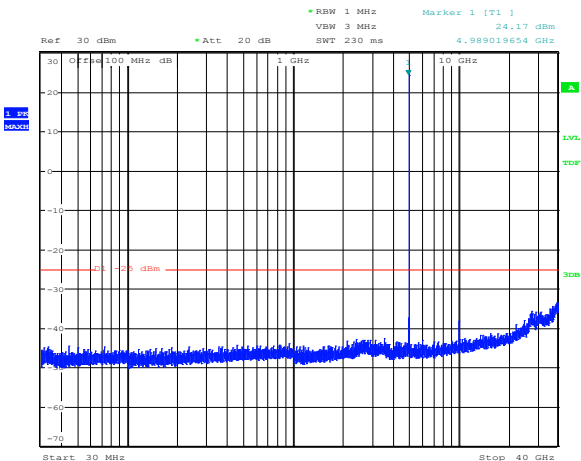
Date: 27.SEP.2017 13:26:50

Figure 8.6-20: Spurious emission at low channel, Ant1, 5 MHz channel



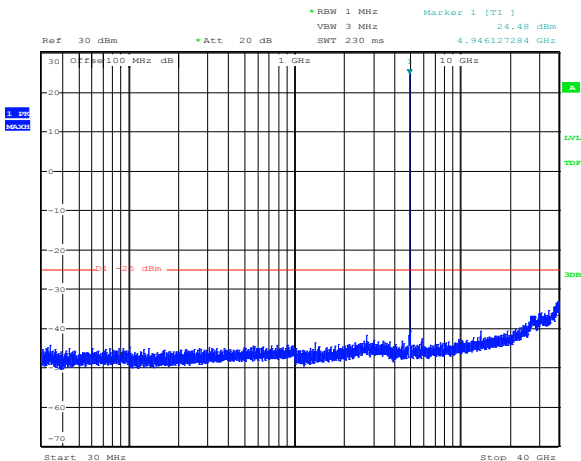
Date: 27.SEP.2017 13:28:33

Figure 8.6-21: Spurious emission at mid channel, Ant1, 5 MHz channel



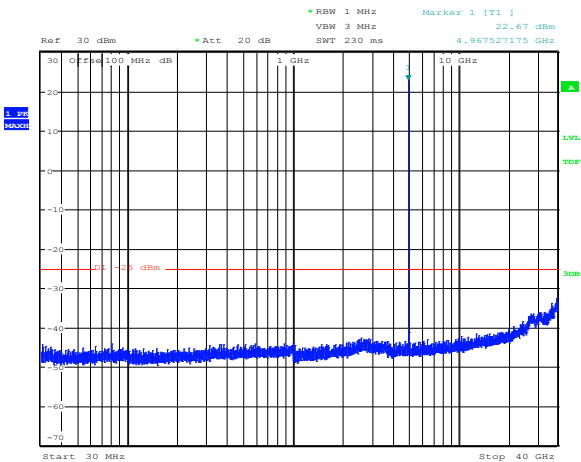
Date: 27.SEP.2017 13:29:17

Figure 8.6-22: Spurious emission at high channel, Ant1, 5 MHz channel



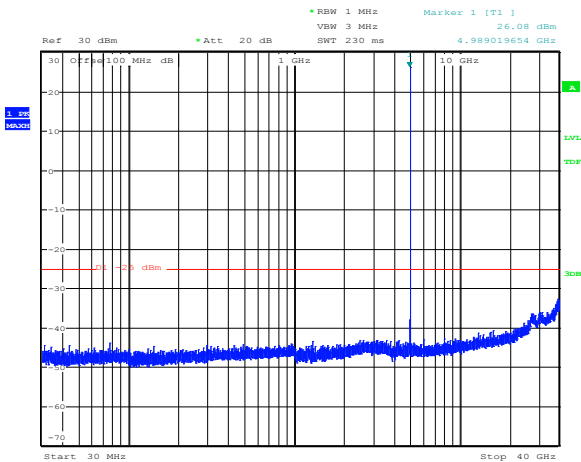
Date: 27.SEP.2017 13:27:30

Figure 8.6-23: Spurious emission at low channel, Ant2, 5 MHz channel



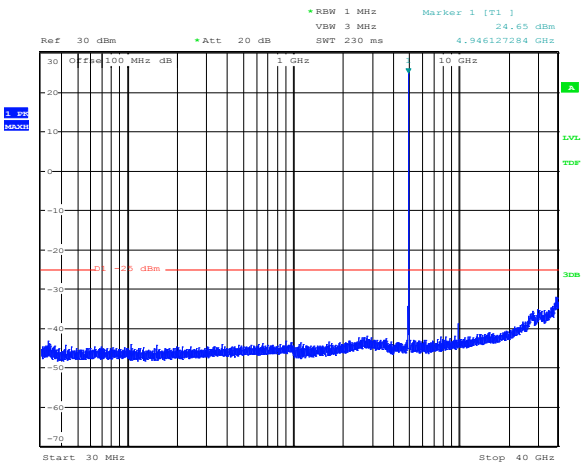
Date: 27.SEP.2017 13:28:01

Figure 8.6-24: Spurious emission at mid channel, Ant2, 5 MHz channel



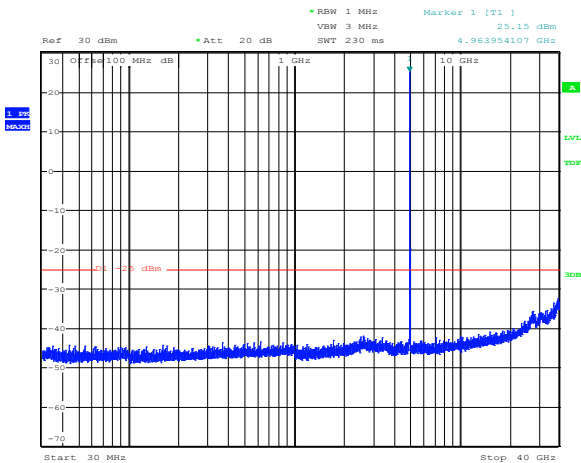
Date: 27.SEP.2017 13:29:47

Figure 8.6-25: Spurious emission at high channel, Ant2, 5 MHz channel



Date: 27.SEP.2017 13:32:23

Figure 8.6-26: Spurious emission at low channel, Ant1, 10 MHz channel



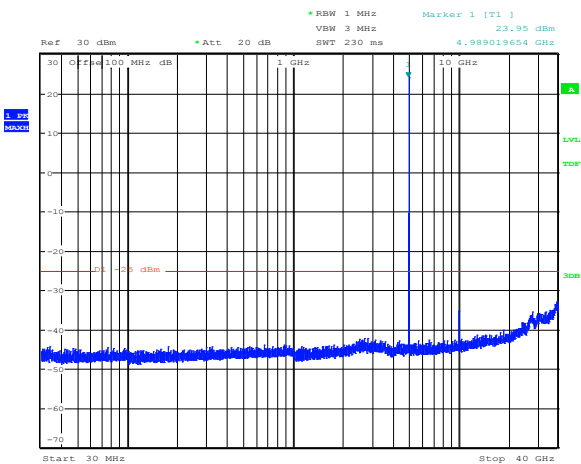
Date: 27.SEP.2017 13:33:18

Figure 8.6-27: Spurious emission at mid channel, Ant1, 10 MHz channel



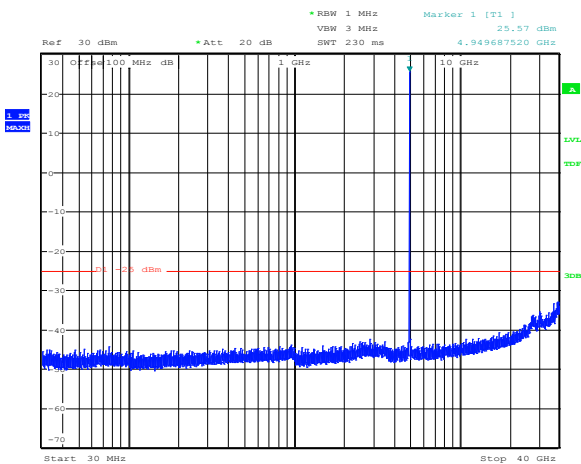
Section 8  
Test name  
Specification

Testing data  
FCC 90.210(m) and RSS-111 Clause 5.5 Transmitter unwanted emissions  
FCC Part 90, Subpart I and RSS-111, Issue 5



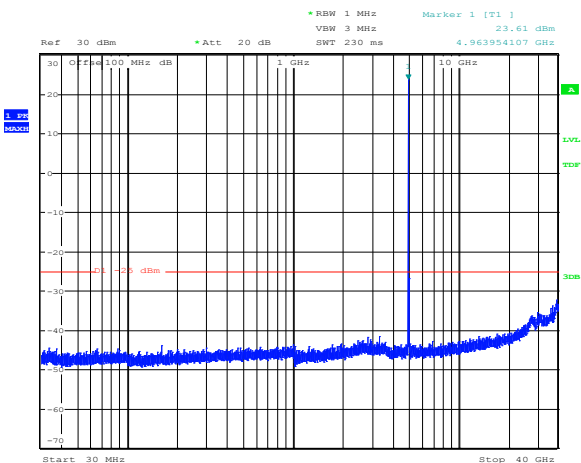
Date: 27.SEP.2017 13:36:04

Figure 8.6-28: Spurious emission at high channel, Ant1, 10 MHz channel



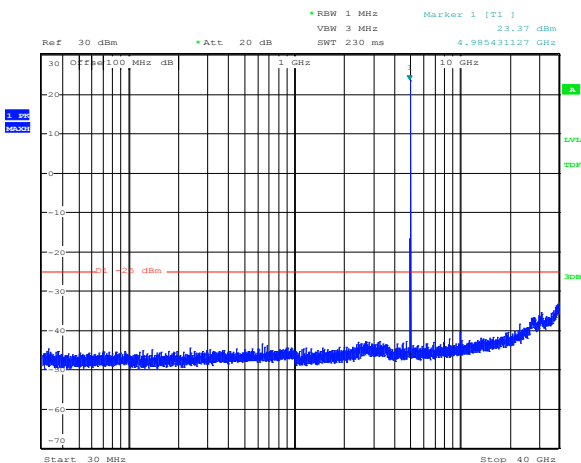
Date: 27.SEP.2017 13:30:37

Figure 8.6-29: Spurious emission at low channel, Ant2, 10 MHz channel



Date: 27.SEP.2017 13:34:18

Figure 8.6-30: Spurious emission at mid channel, Ant2, 10 MHz channel

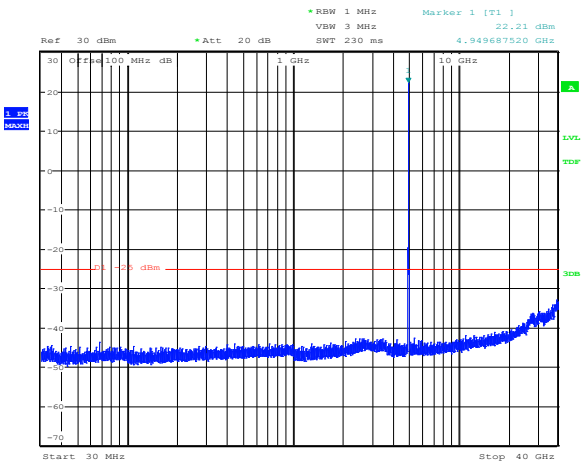


Date: 27.SEP.2017 13:34:56

Figure 8.6-31: Spurious emission at high channel, Ant2, 10 MHz channel

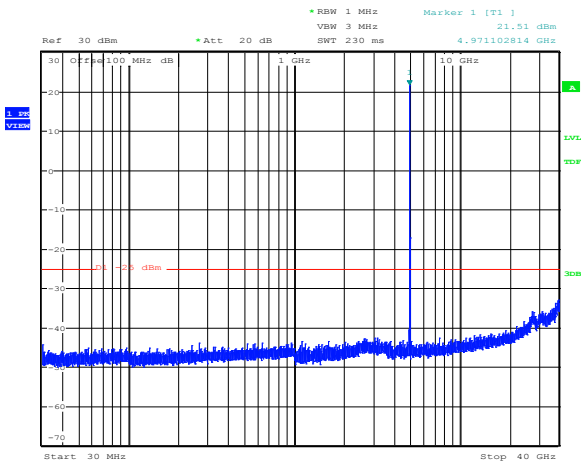
Section 8  
Test name  
Specification

Testing data  
FCC 90.210(m) and RSS-111 Clause 5.5 Transmitter unwanted emissions  
FCC Part 90, Subpart I and RSS-111, Issue 5



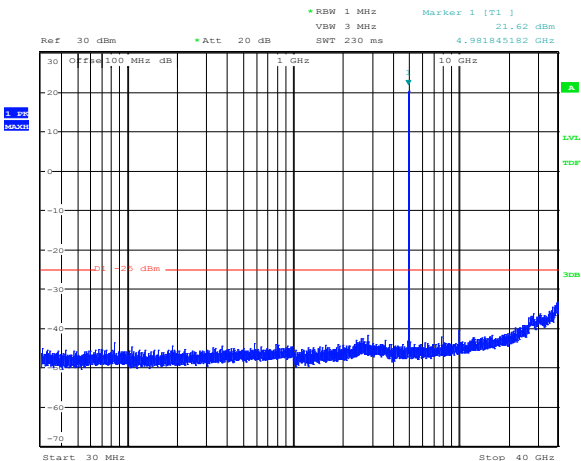
Date: 27.SEP.2017 13:36:55

Figure 8.6-32: Spurious emission at low channel, Ant1, 20 MHz channel



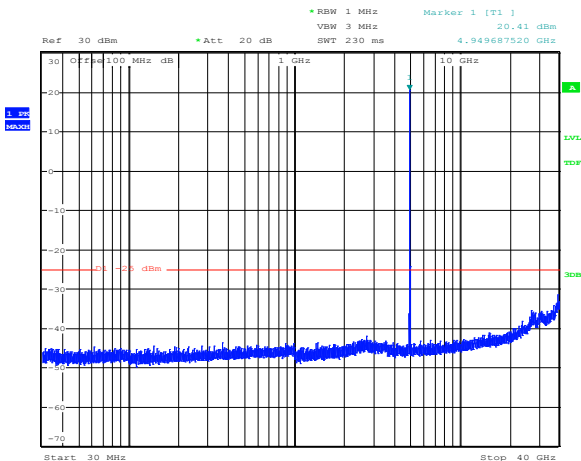
Date: 27.SEP.2017 13:47:20

Figure 8.6-33: Spurious emission at mid channel, Ant1, 20 MHz channel



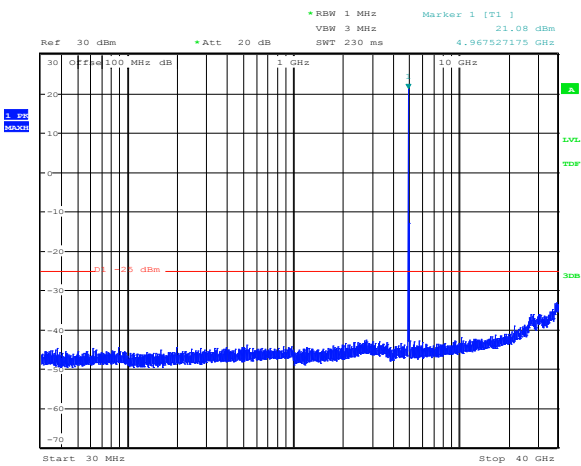
Date: 27.SEP.2017 13:48:14

Figure 8.6-34: Spurious emission at high channel, Ant1, 20 MHz channel



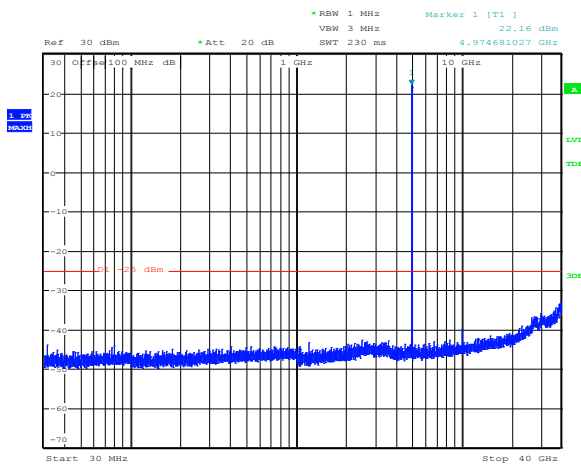
Date: 27.SEP.2017 13:37:34

Figure 8.6-35: Spurious emission at low channel, Ant2, 20 MHz channel



Date: 27.SEP.2017 13:38:05

Figure 8.6-36: Spurious emission at mid channel, Ant2, 20 MHz channel



Date: 27.SEP.2017 13:48:42

Figure 8.6-37: Spurious emission at high channel, Ant2, 20 MHz channel

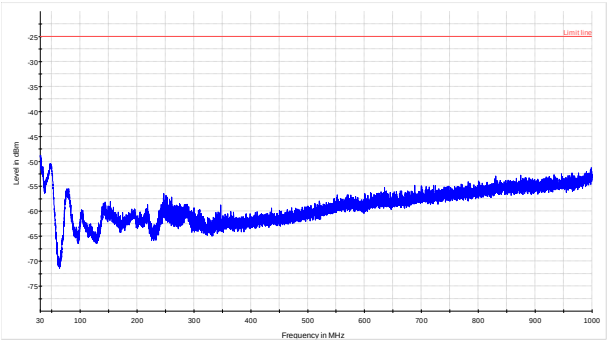


Figure 8.6-38: Cabinet spurious radiation within 30-1000 MHz at low channel, 5 MHz channel, MIMO mode

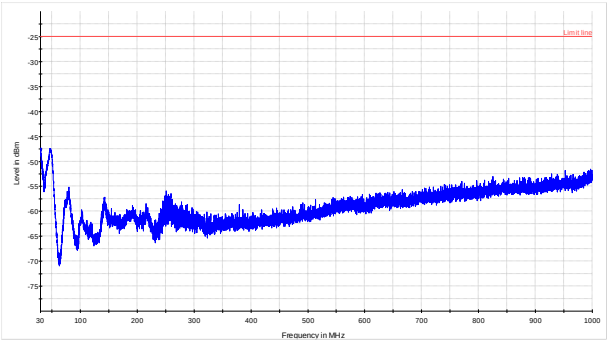


Figure 8.6-39: Cabinet spurious radiation within 30-1000 MHz at mid channel, 5 MHz channel, MIMO mode

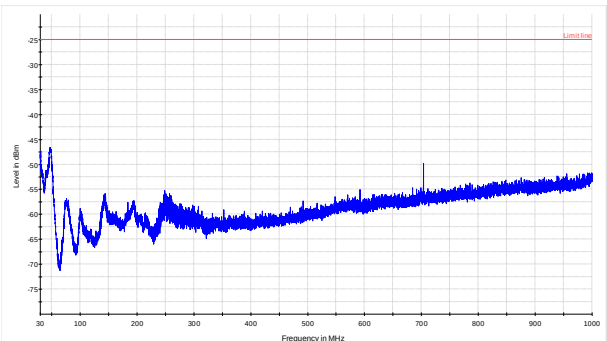


Figure 8.6-40: Cabinet spurious radiation within 30-1000 MHz at high channel, 5 MHz channel, MIMO mode

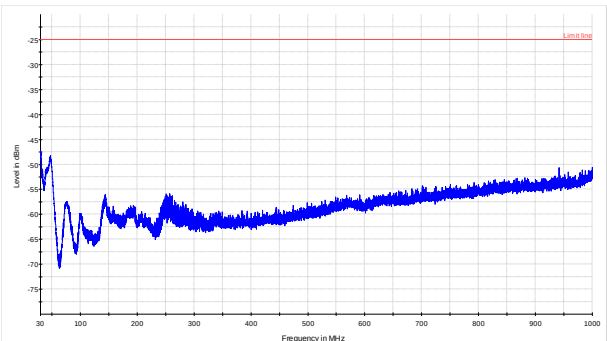


Figure 8.6-41: Cabinet spurious radiation within 30-1000 MHz at low channel, 10 MHz channel, MIMO mode

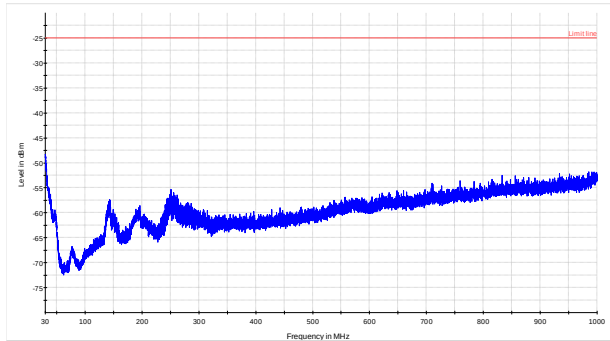


Figure 8.6-42: Cabinet spurious radiation within 30–1000 MHz at mid channel, 10 MHz channel, MIMO mode

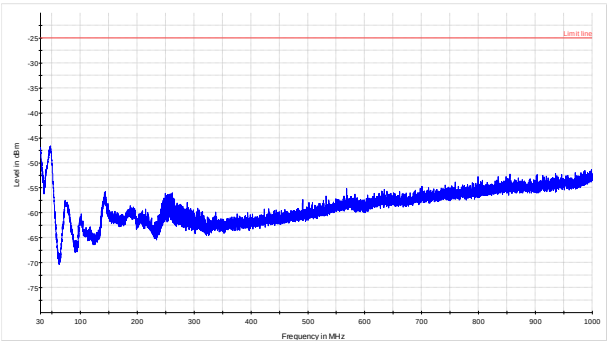


Figure 8.6-43: Cabinet spurious radiation within 30–1000 MHz at high channel, 10 MHz channel, MIMO mode

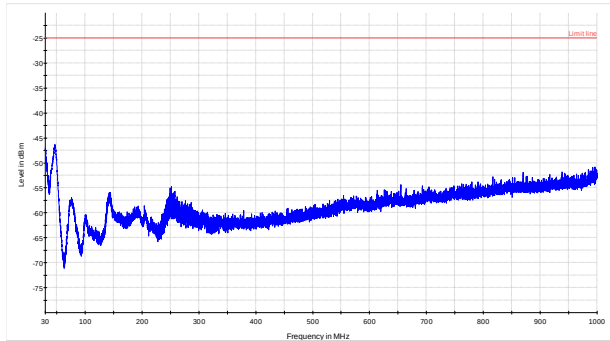


Figure 8.6-44: Cabinet spurious radiation within 30–1000 MHz at low channel, 20 MHz channel, MIMO mode

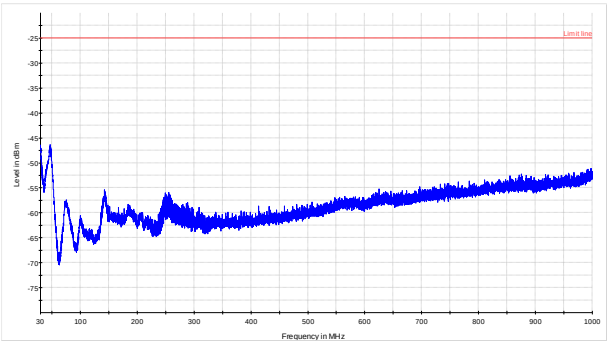


Figure 8.6-45: Cabinet spurious radiation within 30–1000 MHz at mid channel, 20 MHz channel, MIMO mode

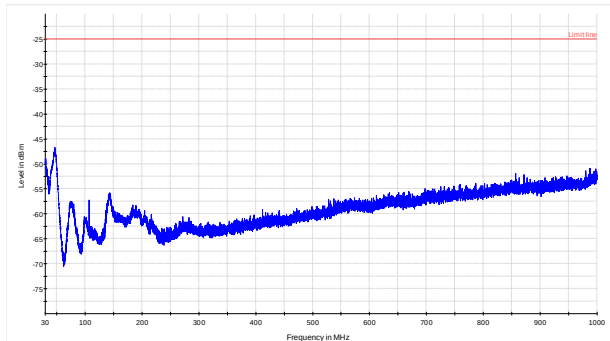


Figure 8.6-46: Cabinet spurious radiation within 30–1000 MHz at high channel, 20 MHz channel, MIMO mode

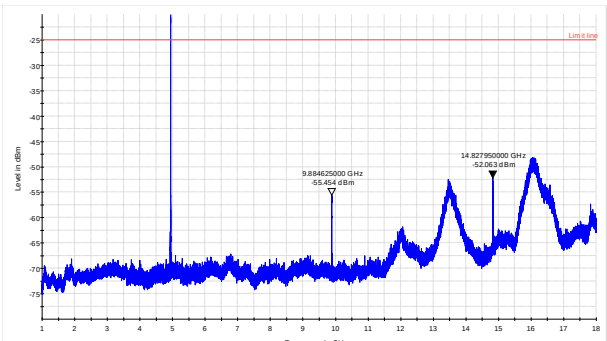


Figure 8.6-47: Cabinet spurious radiation within 1–18 GHz at low channel, 5 MHz channel, MIMO mode

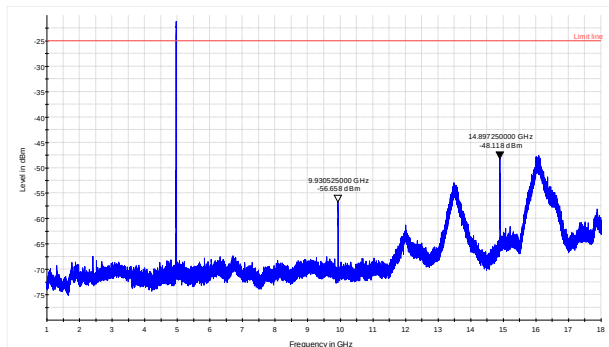


Figure 8.6-48: Cabinet spurious radiation within 1-18 GHz at mid channel, 5 MHz channel, MIMO mode

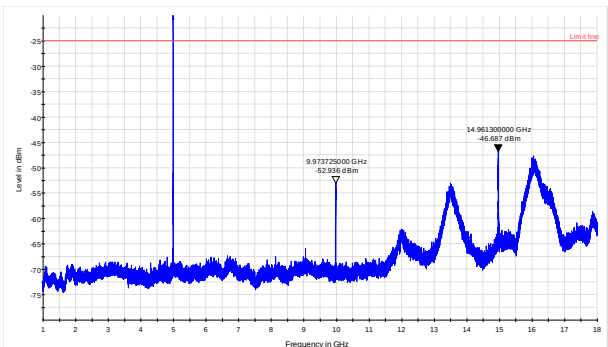


Figure 8.6-49: Cabinet spurious radiation within 1-18 GHz at high channel, 5 MHz channel, MIMO mode

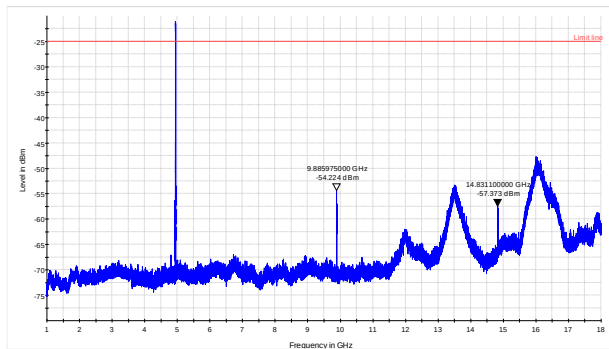


Figure 8.6-50: Cabinet spurious radiation within 1-18 GHz at low channel, 10 MHz channel, MIMO mode

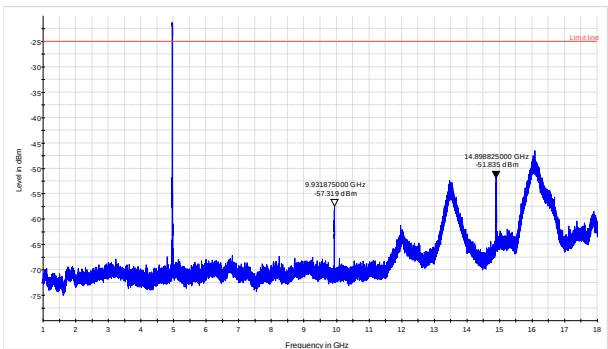


Figure 8.6-51: Cabinet spurious radiation within 1-18 GHz at mid channel, 10 MHz channel, MIMO mode

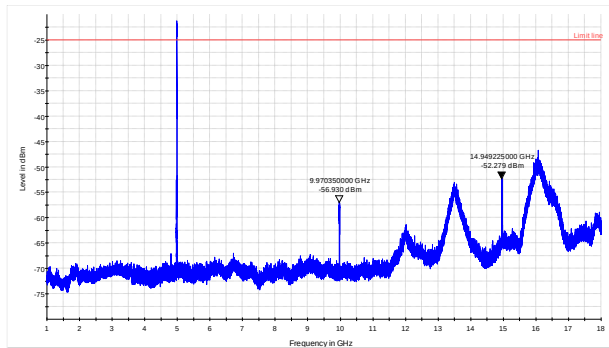


Figure 8.6-52: Cabinet spurious radiation within 1-18 GHz at high channel, 10 MHz channel, MIMO mode

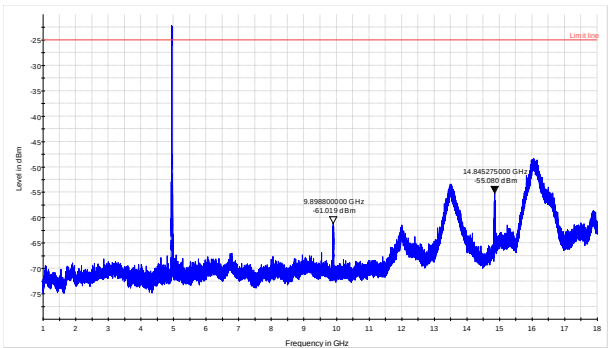


Figure 8.6-53: Cabinet spurious radiation within 1-18 GHz at low channel, 20 MHz channel, MIMO mode

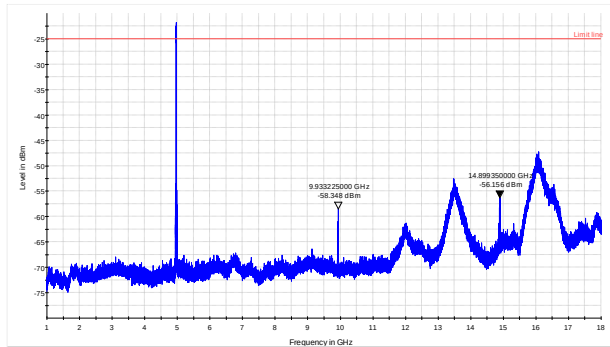


Figure 8.6-54: Cabinet spurious radiation within 1–18 GHz at mid channel, 20 MHz channel, MIMO mode

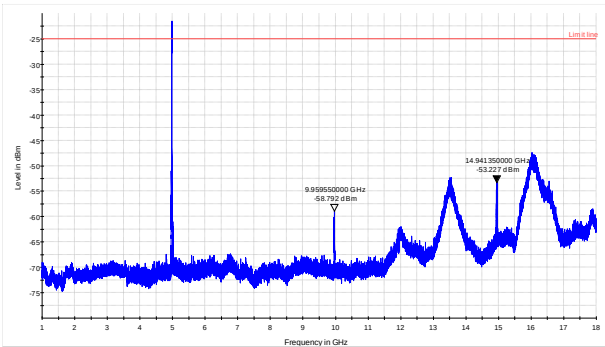
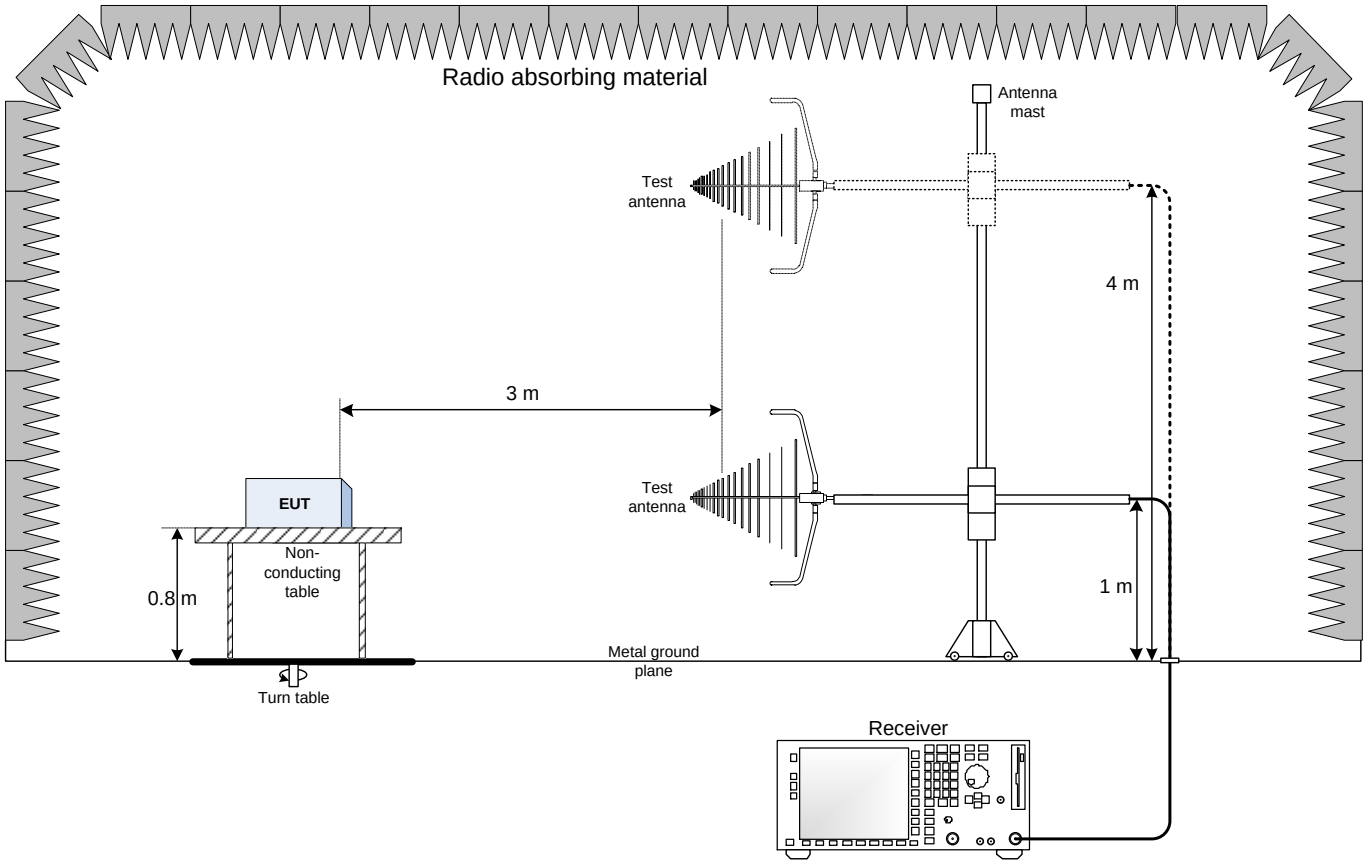


Figure 8.6-55: Cabinet spurious radiation within 1–18 GHz at high channel, 20 MHz channel, MIMO mode

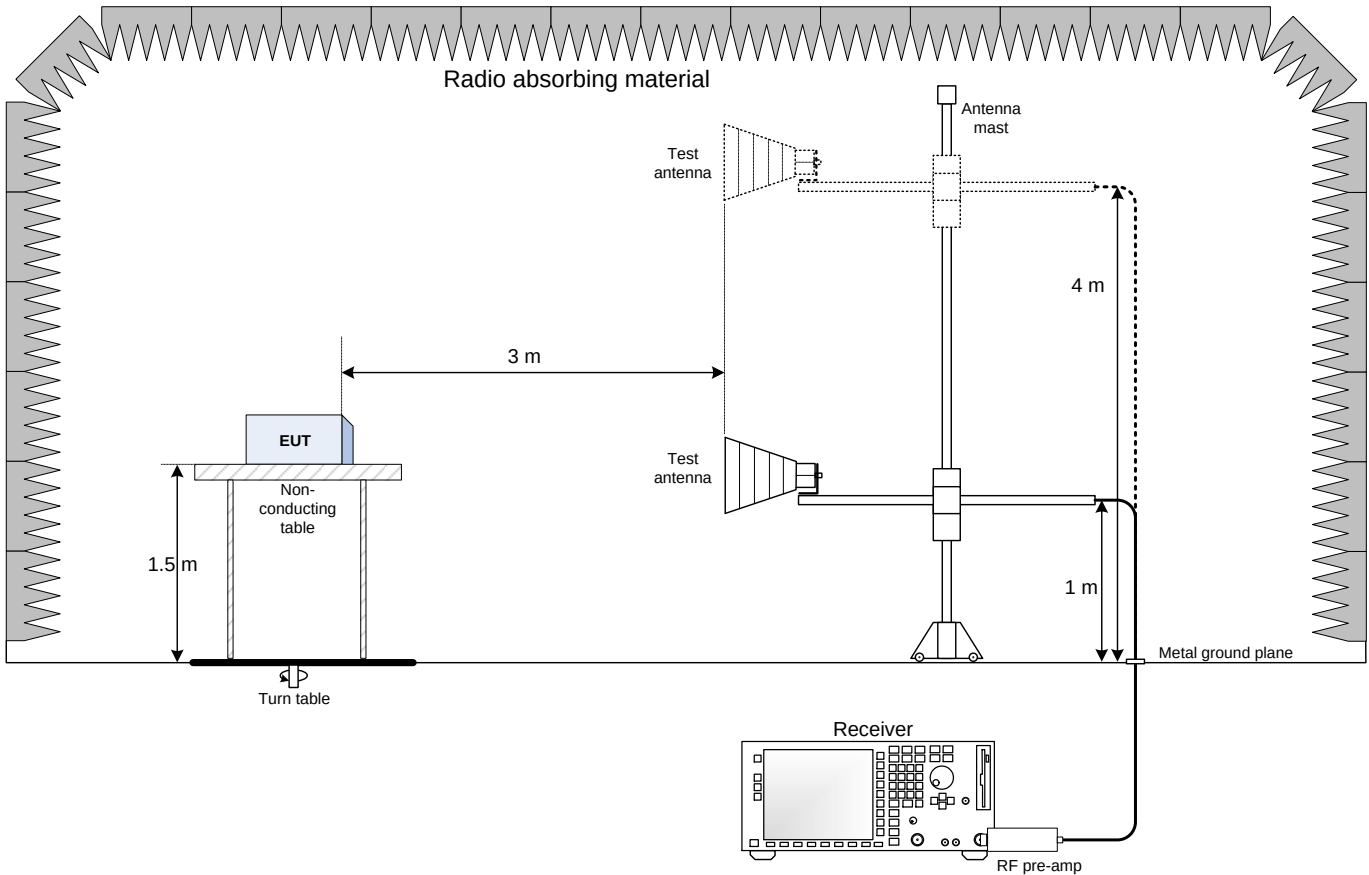
Radiated spurious emissions were also assessed from 18 GHz to 40 GHz. Both antenna ports were terminated with 50  $\Omega$  loads. No spurious emissions higher than 15 dB below the limit were detected.

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions below 1 GHz set-up



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up

