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Test report

291050-1TRFWL

Date of issue: August 12, 2015

Applicant:

Redline Communications, Inc.

Product:

White Space Fixed TVBD

Model:

RDL-3000-RMF

FCC ID:

QC8-RDL3000RMF

Specification:

FCC 47 CFR Part 15 Subpart H - **partial**

Television Band Devices

www.nemko.com

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

FCC 15 Subpart H.docx; Date: May 2013



Test location

| | |
|--------------|--|
| Company name | Nemko Canada Inc. |
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| City | Ottawa |
| Province | Ontario |
| Postal code | K1V 1H2 |
| Country | Canada |
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| Toll free | +1 800 563 6336 |
| Website | www.nemko.com |
| Site number | FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber) |

| | |
|-------------|---|
| Tested by | Andrey Adelberg, Senior Wireless/EMC Specialist |
| Reviewed by | Kevin Rose, Wireless/EMC Specialist |
| Date | August 12, 2015 |
| 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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

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

1.2 Test specifications

FCC 47 CFR Part 15, Subpart H Television Band Devices

1.3 Statement of compliance

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.

1.4 Exclusions

As per Quote no.: Q10282346 as part of C2PC only radiated spurious emissions were performed.

1.5 Test report revision history

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

Section 2. Summary of test results

2.1 FCC Part 15, general requirements test results

| Part | Test description | Verdict |
|------------|---------------------------|-------------------|
| §15.207(a) | Conducted limits | Not tested |
| §15.31(e) | Variation of power source | Not tested |
| §15.203 | Antenna requirement | Pass ¹ |

Notes: ¹The Antennas are professionally installed.

2.2 FCC Part 15 Subpart H, test results

| Part | Test description | Verdict |
|------------------|--|------------|
| §15.709(a)(1) | Maximum conducted output power for fixed TVBDs | Not tested |
| §15.709(a)(5)(i) | Power spectral density for fixed TVBDs | Not tested |
| §15.709(c)(1)(i) | Adjacent channel power for fixed TVBDs | Not tested |
| §15.709(c)(3) | Radiated spurious emissions from TVBDs | Pass |
| §15.709(c)(4) | Emissions in the band 602–620 MHz | Pass |
| §15.709(c)(5) | AC power line conducted limits | Not tested |

Note: As per Quote no.: Q10282346 as part of C2PC only radiated spurious emissions were performed.

Section 3. Equipment under test (EUT) details

3.1 Sample information

| | |
|------------------------|---------------|
| Receipt date | July 20, 2015 |
| Nemko sample ID number | 133-000790 |

3.2 EUT information

| | |
|---------------|------------------------|
| Product name | White Space Fixed TVBD |
| Model | RDL-3000-RMF |
| Serial number | 156PC13030002 |

3.3 Technical information

| | |
|---------------------|--|
| Operating band | 470–698 MHz |
| Operating frequency | 473–598.5 MHz and 623.5–695 MHz |
| Modulation type | BPSK, 256-QAM |
| Emission designator | W7D |
| Power requirements | 120 V _{AC} 60 Hz |
| Antenna information | <ul style="list-style-type: none">Redline AFD-DB-600-2ft-01 – Panel antenna, 11 dBi, 48 degrees, 470–698 MHz, dual poleRedline AFS-DBG-60090-01 – Sector antenna, 11 dBi, 90 degrees, 470–698 MHz, dual poleRedline eLTE-MT-8dBi-Int-Ant – Panel antenna, 8 dBi, 68–88 degrees, 470–698 MHz, dual pole |

3.4 Product description and theory of operation

The RDL-3000-RMF UHF 2x2 MIMO broadband radio provides high capacity, long range communications links. Operating in 470–698 MHz band, the RDL-3000-RMF is configured via firmware options and electronic product keys.

3.5 EUT exercise details

Web GUI to control the unit was used by tuning to IP address: 192.168.25.2

3.6 EUT setup diagram

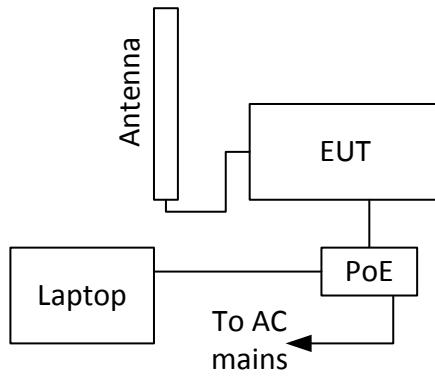


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

| Description | Brand name | Model/Part number | Serial number |
|-------------|------------------------------|-------------------|---------------|
| PoE | CINCON Electronics Co., Ltd. | TRG60A-POE-L | 003641 |

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

C2PC with existing power settings: +16 dBm for channels 35 (598.5 MHz) and 39 (623.5 MHz) and +18 dBm for all others

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

| | |
|-------------------|---------------|
| 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

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

6.1 Uncertainty of measurement

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 | Feb. 25/16 |
| Flush mount turntable | Sunol | FM2022 | FA002082 | — | NCR |
| Controller | Sunol | SC104V | FA002060 | — | NCR |
| Antenna mast | Sunol | TLT2 | FA002061 | — | NCR |
| Power source | California Instruments | 5001ix | FA002494 | 1 year | Jan. 22 /16 |
| Receiver/spectrum analyzer | Rohde & Schwarz | ESU 26 | FA002043 | 1 year | Jan. 07/16 |
| Bilog antenna (20–3000 MHz) | Sunol | JB3 | FA002108 | 1 year | Apr. 12/16 |
| Horn antenna (1–18 GHz) | EMCO | 3115 | FA000825 | 1 year | Apr. 01/16 |
| Pre-amplifier (1–18 GHz) | JCA | JCA118-503 | FA002091 | 1 year | May 05/16 |

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 15.709(c)(3) Radiated spurious emissions beyond the television channels

8.1.1 Definitions and limits

At frequencies beyond the television channels immediately adjacent to the channel in which the TVBD is operating, the radiated emissions from TVBDs shall meet the requirements of § 15.209.

Table 8.1-1: FCC §15.209 Radiated emission limits

| Frequency, MHz | Field strength of emissions µV/m | Field strength of emissions dBµV/m | Measurement distance m |
|-------------------|-------------------------------------|---------------------------------------|---------------------------|
| 0.009–0.490 | 2400/F | 67.6 – 20 × log ₁₀ (F) | 300 |
| 0.490–1.705 | 24000/F | 87.6 – 20 × log ₁₀ (F) | 30 |
| 1.705–30.0 | 30 | 29.5 | 30 |
| 30–88 | 100 | 40.0 | 3 |
| 88–216 | 150 | 43.5 | 3 |
| 216–960 | 200 | 46.0 | 3 |
| above 960 | 500 | 54.0 | 3 |

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

8.1.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | July 21, 2015 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1006 mbar |
| Verdict: | Pass | Relative humidity: | 32 % |

8.1.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

EUT was set to transmit with 100 % duty cycle.

Radiated measurements were performed at a distance of 3 m.

Spectrum analyser settings for radiated measurements below 1 GHz:

| | |
|-----------------------|--------------------|
| Resolution bandwidth: | 120 kHz |
| Video bandwidth: | 300 kHz |
| Detector mode: | Peak or Quasi-peak |
| Trace mode: | Max Hold |

Spectrum analyser settings for peak radiated measurements above 1 GHz:

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

Spectrum analyser settings for average radiated measurements above 1 GHz:

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

8.1.4 Test data

Table 8.1-2: Radiated spurious emissions measurements beyond band edges

| Antenna | Channel | Frequency, MHz | Peak field strength, dB μ V/m | Peak* limit, dB μ V/m | Margin, dB | Average field strength, dB μ V/m | Average limit, dB μ V/m | Margin, dB |
|----------------------|---------|----------------|-----------------------------------|---------------------------|------------|--------------------------------------|-----------------------------|------------|
| AFS-DBG-60090-01 | Low | 34.62 | 37.14 | 40.00 | 2.86 | N/A | N/A | N/A |
| | Low | 90.35 | 42.65 | 43.50 | 0.85 | N/A | N/A | N/A |
| | Low | 215.57 | 39.96 | 43.50 | 3.54 | N/A | N/A | N/A |
| | Low | 298.79 | 41.02 | 46.00 | 4.98 | N/A | N/A | N/A |
| | Low | 725.04 | 42.16 | 46.00 | 3.84 | N/A | N/A | N/A |
| | Low | 1418.00 | 52.61 | 74.00 | 21.39 | 43.57 | 54.00 | 10.43 |
| | High | 34.64 | 33.75 | 40.00 | 6.25 | N/A | N/A | N/A |
| | High | 90.35 | 39.20 | 43.50 | 4.30 | N/A | N/A | N/A |
| | High | 151.58 | 37.48 | 43.50 | 6.02 | N/A | N/A | N/A |
| | High | 215.57 | 38.70 | 43.50 | 4.80 | N/A | N/A | N/A |
| | High | 287.45 | 41.09 | 46.00 | 4.91 | N/A | N/A | N/A |
| | High | 455.05 | 42.24 | 46.00 | 3.76 | N/A | N/A | N/A |
| | High | 1171.00 | 49.08 | 74.00 | 24.92 | 37.20 | 54.00 | 16.80 |
| | High | 2085.50 | 52.57 | 74.00 | 21.43 | 44.78 | 54.00 | 9.22 |
| AFD-DB-600-2ft-01 | Low | 47.68 | 38.68 | 40.00 | 1.32 | N/A | N/A | N/A |
| | Low | 155.60 | 42.83 | 43.50 | 0.67 | N/A | N/A | N/A |
| | Low | 359.29 | 41.20 | 46.00 | 4.80 | N/A | N/A | N/A |
| | Low | 725.04 | 43.07 | 46.00 | 2.93 | N/A | N/A | N/A |
| | Low | 1418.00 | 53.09 | 74.00 | 20.91 | 40.22 | 54.00 | 13.78 |
| | High | 90.37 | 39.21 | 43.50 | 4.29 | N/A | N/A | N/A |
| | High | 287.45 | 39.87 | 46.00 | 6.13 | N/A | N/A | N/A |
| | High | 359.29 | 40.60 | 46.00 | 5.40 | N/A | N/A | N/A |
| | High | 455.05 | 41.59 | 46.00 | 4.41 | N/A | N/A | N/A |
| | High | 2085.50 | 53.88 | 74.00 | 20.12 | 37.49 | 54.00 | 16.51 |
| eLTE-MT-8dBi-Int-Ant | Low | 88.89 | 37.79 | 43.50 | 5.71 | N/A | N/A | N/A |
| | Low | 149.99 | 42.39 | 43.50 | 1.11 | N/A | N/A | N/A |
| | Low | 199.59 | 36.63 | 43.50 | 6.87 | N/A | N/A | N/A |
| | Low | 831.79 | 40.07 | 46.00 | 5.93 | N/A | N/A | N/A |
| | High | 47.79 | 36.66 | 40.00 | 3.34 | N/A | N/A | N/A |
| | High | 122.61 | 36.61 | 43.50 | 6.89 | N/A | N/A | N/A |
| | High | 151.55 | 41.08 | 43.50 | 2.42 | N/A | N/A | N/A |
| | High | 503.00 | 39.34 | 46.00 | 6.66 | N/A | N/A | N/A |
| | High | 655.04 | 41.50 | 46.00 | 4.50 | N/A | N/A | N/A |

Note: * for frequencies below 1 GHz, the limit is Quasi-Peak.

Table 8.1-3: Radiated spurious emissions measurements at the band edges

| Antenna | Channel | Frequency, MHz | Field strength, dB μ V/m | Limit, dB μ V/m | Margin, dB |
|----------------------|---------|----------------|------------------------------|---------------------|------------|
| AFS-DBG-60090-01 | Low | 470 | 36.81 | 46.00 | 9.19 |
| | High | 698 | 36.58 | 46.00 | 9.42 |
| AFD-DB-600-2ft-01 | Low | 470 | 40.30 | 46.00 | 5.70 |
| | High | 698 | 39.57 | 46.00 | 6.43 |
| eLTE-MT-8dBi-Int-Ant | Low | 470 | 30.53 | 46.00 | 15.47 |
| | High | 698 | 32.80 | 46.00 | 13.20 |

8.2 FCC 15.709(c)(4) Emissions in the band 602–620 MHz

8.2.1 Definitions and limits

Emissions in the band 602–620 MHz must also comply with the following field strength limits at a distance of one meter:

Table 8.2-1: 602–620 MHz band field strength limits

| Frequency, MHz | Field strength, dB μ V/m/120 kHz |
|----------------|--------------------------------------|
| 602–607 | $120 - 5 \times (F - 602)$ |
| 607–608 | 95 |
| 608–614 | 30 |
| 614–615 | 95 |
| 615–620 | $120 - 5 \times (620 - F)$ |

Notes: F is frequency in MHz

8.2.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | August 1, 2015 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1006 mbar |
| Verdict: | Pass | Relative humidity: | 32 % |

8.2.3 Observations, settings and special notes

The spectrum was searched from 602 MHz to the 620 MHz.

Radiated measurements were performed at a distance of 1 m.

In order to eliminate the Spectrum analyzer overloading, notch filter tuned to the fundamental frequency and band pass filter tuned to the required frequency range (602–620 MHz) were used:

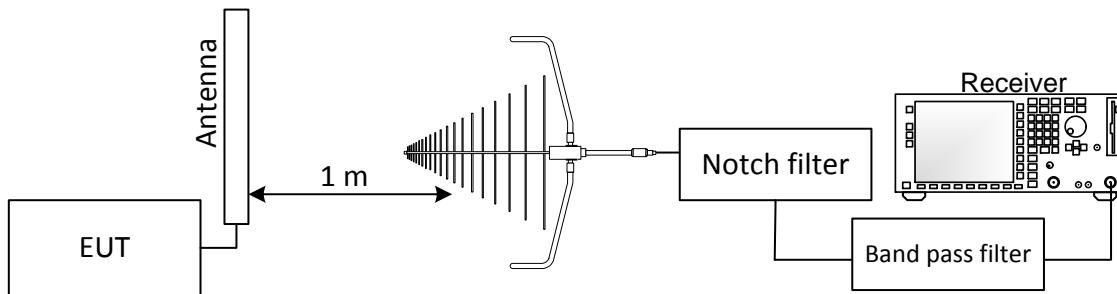
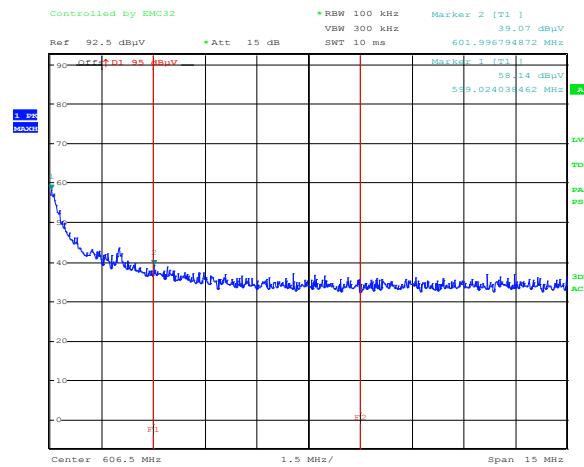


Figure 8.2-1: Setup diagram for 602–620 MHz radiated emissions measurements

Spectrum analyser settings:

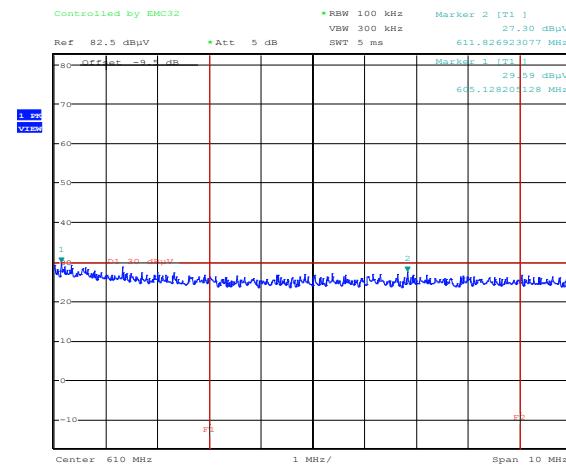
| | |
|-----------------------|----------|
| Resolution bandwidth: | 120 kHz |
| Video bandwidth: | 300 kHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

8.2.4 Test data



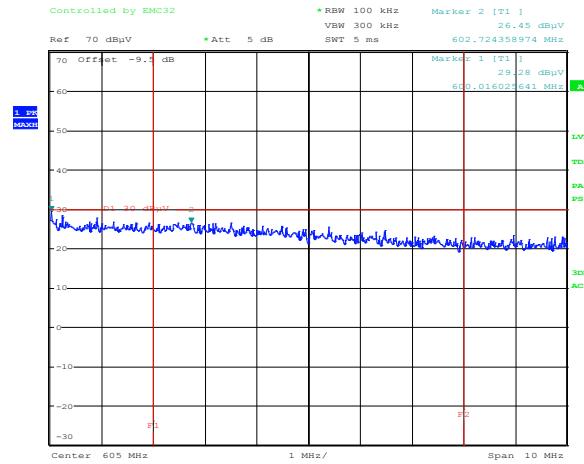
Date: 31.JUL.2015 17:03:39

Figure 8.2-2: Radiated spurious emissions within 602–608 MHz for low channel, AFS-DBG-60090-01 antenna



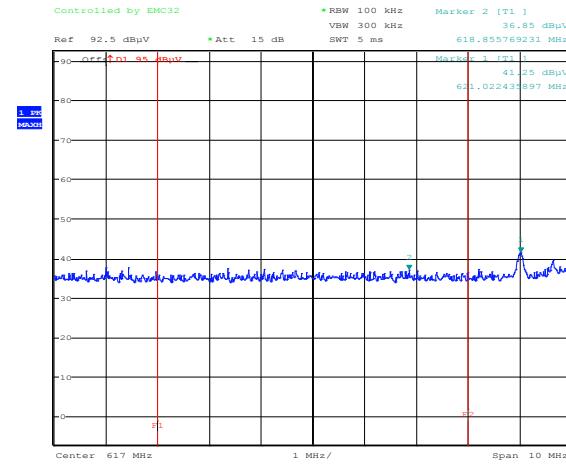
Date: 31.JUL.2015 17:00:30

Figure 8.2-3: Radiated spurious emissions within 608–614 MHz for AFS-DBG-60090-01 antenna, upper band edge



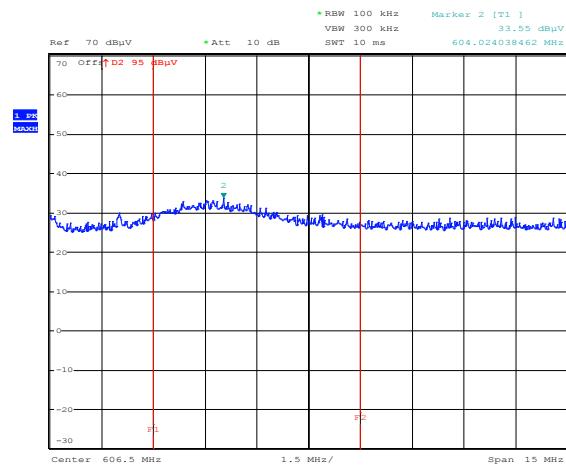
Date: 31.JUL.2015 17:07:32

Figure 8.2-4: Radiated spurious emissions within 608–614 MHz for AFS-DBG-60090-01 antenna, lower band edge



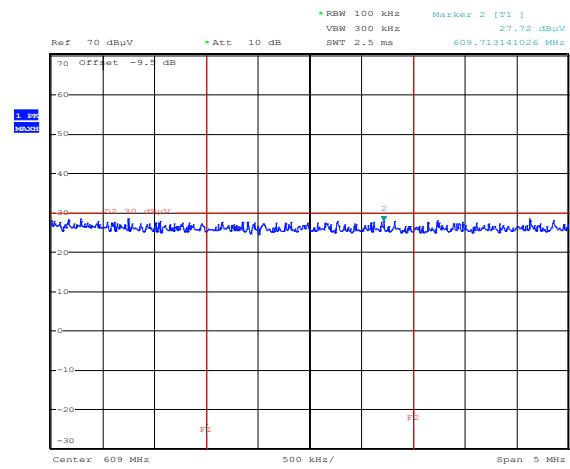
Date: 31.JUL.2015 17:05:32

Figure 8.2-5: Radiated spurious emissions within 614–620 MHz for AFS-DBG-60090-01 antenna



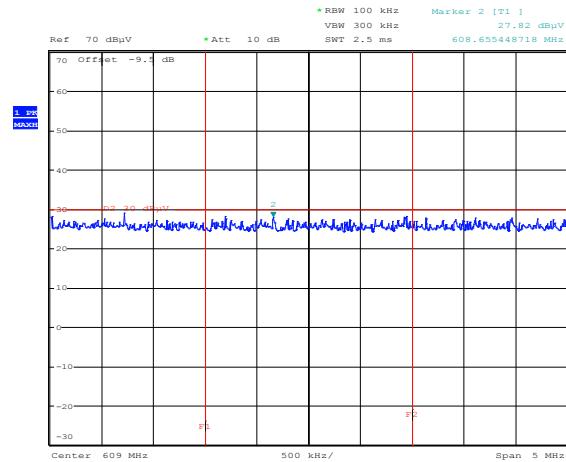
Date: 31.JUL.2015 18:15:57

Figure 8.2-6: Radiated spurious emissions within 602–608 MHz for AFD-DB-600-2ft-01 antenna



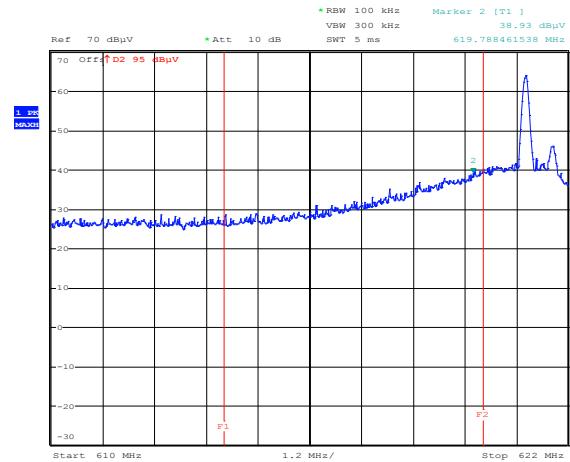
Date: 31.JUL.2015 18:17:58

Figure 8.2-7: Radiated spurious emissions within 608–614 MHz for AFD-DB-600-2ft-01 antenna, upper band edge



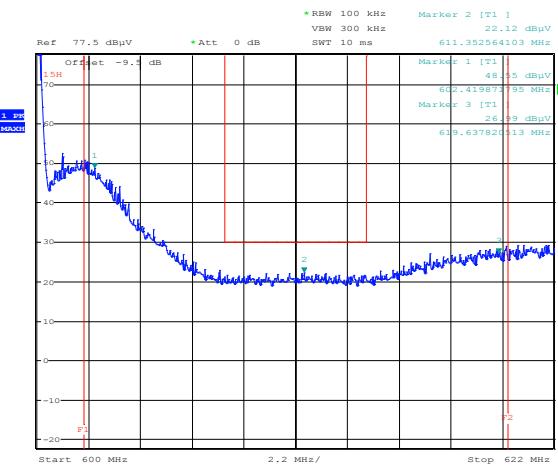
Date: 31.JUL.2015 18:19:33

Figure 8.2-8: Radiated spurious emissions within 608–614 MHz for AFD-DB-600-2ft-01 antenna, lower band edge



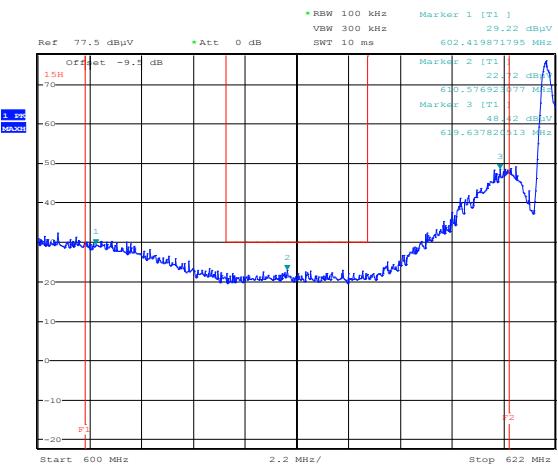
Date: 31.JUL.2015 18:20:37

Figure 8.2-9: Radiated spurious emissions within 614–620 MHz for AFD-DB-600-2ft-01 antenna



Date: 5.AUG.2015 17:38:19

Figure 8.2-10: Radiated spurious emissions within 602–620 MHz for eLTE-MT-8dBi-Int-Ant antenna, lower band edge

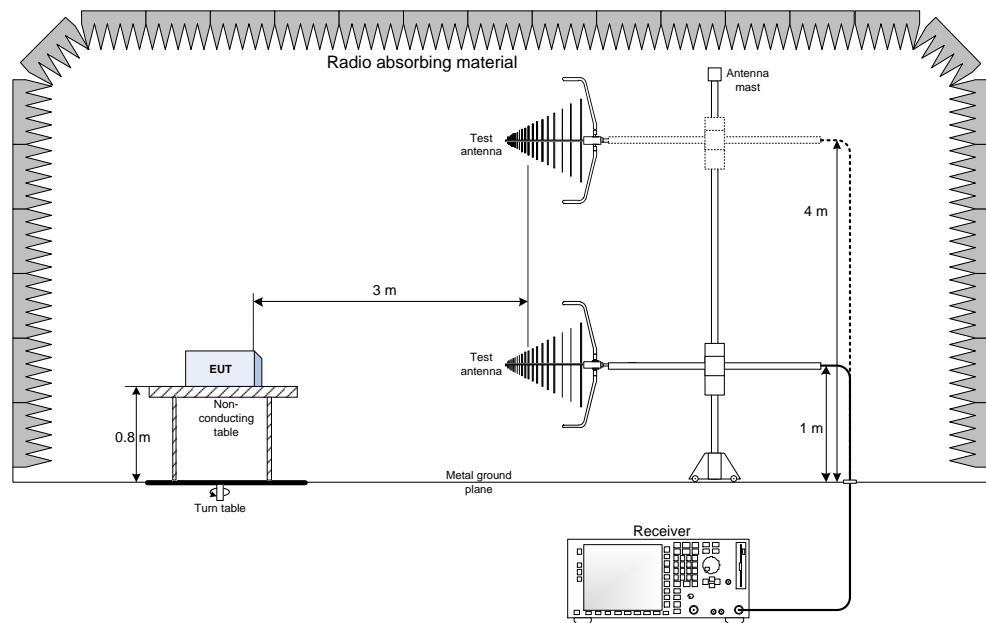


Date: 5.AUG.2015 17:35:01

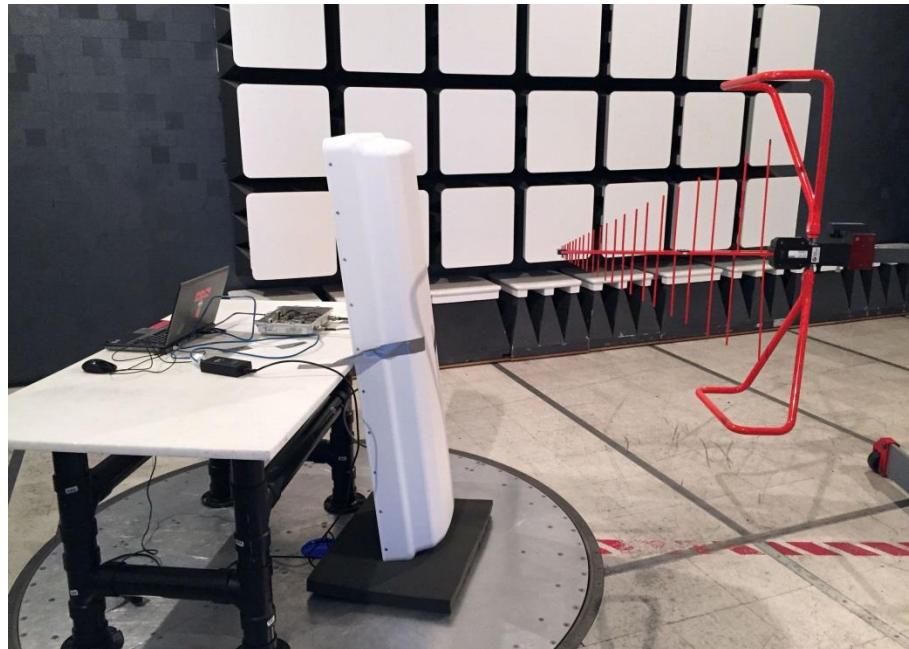
Figure 8.2-11: Radiated spurious emissions within 614–620 MHz for eLTE-MT-8dBi-Int-Ant antenna, upper band edge

Section 9. Block diagrams and photos of test set-ups

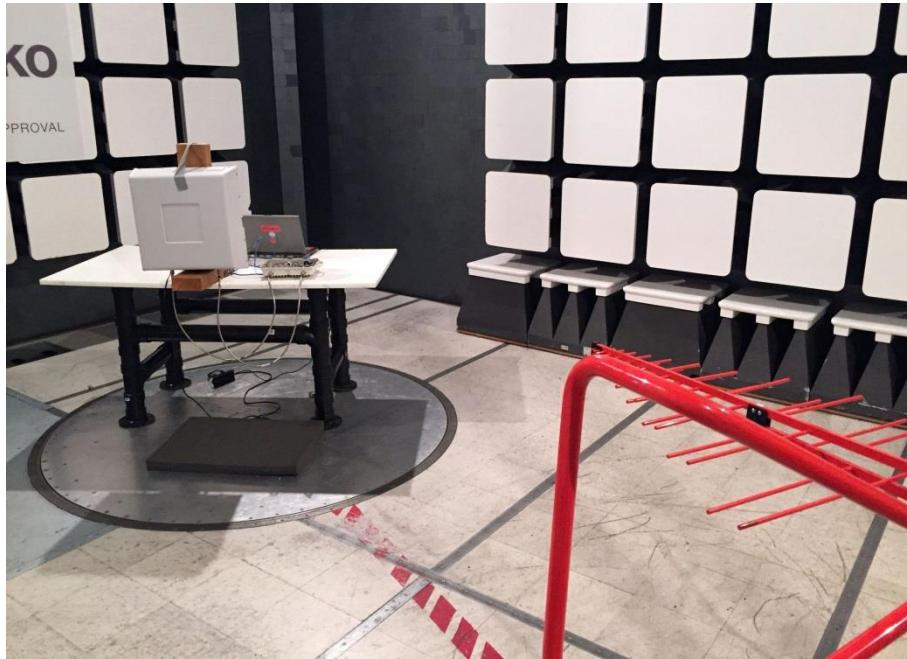
9.1 Block diagram of set-up



9.2 Photo of set-up with AFS-DBG-60090-01 antenna



9.3 Photo of set-up with AFS-DB-600-2ft-01 antenna



9.4 Photo of set-up with eLTE-MT-8dBi-Int-Ant antenna

