

# Test report

312329-1TRFWL

Date of issue: September 1, 2016

Applicant:

**Redline Communications**

Product:

**Broad-band wireless infrastructure product**

Model:

**RDL-3000-RMG**

FCC ID:

**QC8-RDL3000RMG**

IC Registration number:

**4310A-RDL3000RMG**

Specifications:

- ◆ **FCC 47 CFR Part 15 Subpart E, §15.407**  
Unlicensed National Information Infrastructure Devices

- ◆ **RSS-247, Issue 1, Section 6, May 2015**  
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs)  
and Licence-Exempt Local Area Network (LE-LAN) Devices

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**Test location**

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Site number	FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	David Duchesne, Senior EMC/Wireless Specialist
Review date	September 1, 2016
Reviewer signature	

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**Limits of responsibility**

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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

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### 1.1 Applicant and manufacturer

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Company name	Redline Communications
Address	302 Town Center Blvd., Markham, ON, Canada, L3R 0E8

### 1.2 Test specifications

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FCC 47 CFR Part 15, Subpart E, Clause 15.407	Unlicensed National Information Infrastructure Devices
RSS-247, Issue 1	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

### 1.3 Test methods

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789033 D02 General UNII Test Procedures New Rules v01r02 (April 8, 2016)	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
FCC 16-24 (March 2, 2016)	Memorandum opinion and order for U-NII-3 (5.725–5.85 GHz) band
662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013)	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
662911 D02 MIMO with Cross Polarized Antenna v01 (October 25, 2011)	Emissions testing of transmitters with multiple outputs in the same band (MIMO) with Cross Polarized Antenna
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

### 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 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.31(e)	Variation of power source	Pass <sup>1</sup>
§15.203	Antenna requirement	Pass <sup>2</sup>

Notes: <sup>1</sup> Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

<sup>2</sup> The EUT is a professionally installed equipment.

### 2.2 FCC Part 15 Subpart E, test results

Part	Test description	Verdict
§15.403(i)	Emission bandwidth	Pass
§15.407(a)(1)	Power and density limits within 5.15–5.25 GHz band	Not applicable
§15.407(a)(2)	Power and density limits within 5.25–5.35 GHz and 5.47–5.725 GHz bands	Not applicable
§15.407(a)(3)	Power and density limits within 5.725–5.85 GHz band	Pass
§15.407(b)(1)	Undesirable emission limits for 5.15–5.25 GHz band	Not applicable
§15.407(b)(2)	Undesirable emission limits for 5.25–5.35 GHz band	Not applicable
§15.407(b)(3)	Undesirable emission limits for 5.47–5.725 GHz bands	Not applicable
§15.407(b)(4)	Undesirable emission limits for 5.725–5.85 GHz band	Pass
§15.407(b)(6)	Conducted limits for U-NII devices using an AC power line	Pass
§15.407(e)	Minimum 6 dB bandwidth of U-NII devices within the 5.725–5.85 GHz band	Pass
§15.407(g)	Frequency stability	Pass
§15.407(h)(1) <sup>1</sup>	Transmit power control (TPC)	Not applicable
§15.407(h)(2) <sup>1</sup>	Dynamic Frequency Selection (DFS)	Not applicable

Notes: <sup>1</sup> DFS and TPC requirements are only applicable to 5.25–5.35 GHz and 5.47–5.725 GHz bands

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

Part	Test description	Verdict
6.6	Occupied Bandwidth	Pass
7.1.2 <sup>1</sup>	Receiver radiated emission limits	Not applicable
7.1.3 <sup>1</sup>	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Pass
8.11 <sup>2</sup>	Frequency stability	Pass

Notes: <sup>1</sup> According to sections 5.2 and 5.3 of RSS-Gen, Issue 4: if EUT does not have a stand-alone receiver neither scanner receiver, then it exempt from receiver requirements.

<sup>2</sup> According to section 8.11 of RSS-Gen, Issue 4: if the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required

## 2.4 IC RSS-247, Issue 1, test results

Section	Test description	Verdict
6.1 (1) <sup>1</sup>	Types of Modulation	Pass
6.2.1 (1)	Power limits for 5150–5250 MHz band	Not applicable
6.2.2 (1)	Power limits for 5250–5350 MHz band	Not applicable
6.2.3 (1)	Power limits for 5470–5600 MHz and 5650–5725 MHz bands	Not applicable
6.2.4 (1)	Power limits for 5725–5850 MHz band	Pass
6.2.4 (1)	Minimum 6 dB bandwidth	Pass
6.2.1 (2)	Unwanted emission limits for 5150–5250 MHz band	Not applicable
6.2.2 (2)	Unwanted emission limits for 5250–5350 MHz band	Not applicable
6.2.2 (2)	TPC requirements for devices with a maximum e.i.r.p. greater than 500 mW	Not applicable
6.2.2 (3)	e.i.r.p. at different elevations restrictions for 5250–5350 MHz band	Not applicable
6.2.3 (2)	Unwanted emission limits for 5470–5600 MHz and 5650–5725 MHz bands	Not applicable
6.2.4 (2)	Unwanted emission limits for 5725–5850 MHz band	Pass
6.3	Dynamic Frequency Selection (DFS) for devices operating in the bands 5250–5350 MHz, 5470–5600 MHz and 5650–5725 MHz	Not applicable

Notes: <sup>1</sup>The EUT employs digital modulations, such as: 802.11a, 802.11n HT20 and 802.11n HT40

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

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### 3.1 Sample information

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Receipt date	June 27, 2016
Nemko sample ID number	133-002686

### 3.2 EUT information

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Product name	Broad-band wireless infrastructure product
Model	RDL-3000-RMG
Serial number	149PC12480006

### 3.3 Technical information

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Applicant IC company number	4310A
IC UPN number	RDL3000RMG
All used IC test site(s) Reg. number	2040A-4
RSS number and Issue number	RSS-247 Issue 1, Section 6, May 2015
Frequency band	5725–5850 MHz
Frequency Min (MHz)	5727.5 (5 MHz channel), 5730 (10 MHz channel), 5735 (20 MHz channel)
Frequency Max (MHz)	5847.5 (5 MHz channel), 5845 (10 MHz channel), 5840 (20 MHz channel)
RF power Max (W), Conducted	0.242 (23.84 dBm for 5 MHz channel), 0.244 (23.87 dBm for 10 MHz channel), 0.284 (24.53 dBm for 20 MHz channel),
Field strength, Units @ distance	N/A
Measured BW (kHz) (26 dB)	4690 (5 MHz channel), 9290 (10 MHz channel), 18750 (20 MHz channel)
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	BPSK, QPSK, 16-QAM, 64-QAM, 128-QAM, 256-QAM
Emission classification (F1D, G1D, D1D)	W7D
Transmitter spurious, Units @ distance	45.08 dB $\mu$ V/m (average) at 11.695 GHz @ 3 m
Power requirements	48 V <sub>DC</sub> PoE via 120 V <sub>AC</sub> , 60 Hz
Antenna information	19 dBi Dual Polarization/ Dual Slant Subscriber Antenna 4.9–6.1 GHz, Redline 30-00328-50 10 dBi L-COM HG5158DP-10U, L-COM 32 dBi Redline A3FT3204LTPD Parabolic Antenna, 4.9–5.8 GHz, 4 degree, dual polarity The EUT is professionally installed.

### 3.4 Product description and theory of operation

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The EUT is a 2×2 MIMO point-to-multipoint (PMP) carrier grade broadband wireless infrastructure product, designed to operate in the 5725–5850 MHz band.

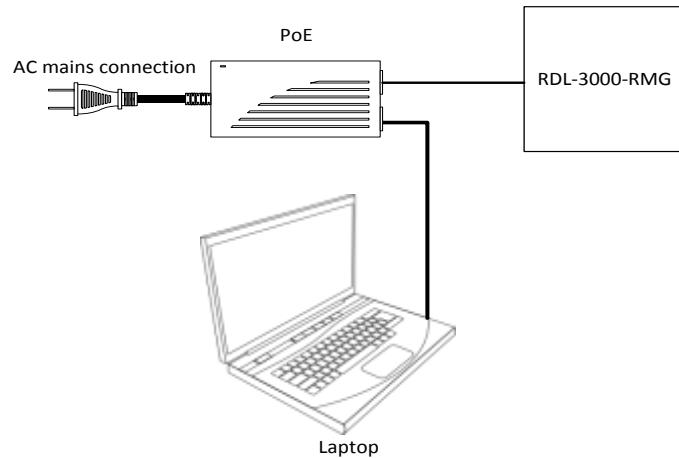
### 3.5 EUT exercise details

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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

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**Figure 3.6-1: Setup diagram**

### 3.7 EUT sub assemblies

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**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

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### 6.1 Uncertainty of measurement

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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. 01/16
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. 07/17
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Apr. 15/17
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Apr. 28/17
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Apr. 26/17
Horn antenna 18–40 GHz	EMCO	3116	FA001847	1 year	Apr. 15/17
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	April 26/17
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	Mar. 08/17
Temperature chamber	Espec	EPX-4H	FA002735	1 year	Jan 26/17

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

## Section 8. Testing data

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### 8.1 FCC 15.403(i) Emission bandwidth

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#### 8.1.1 Definitions and limits

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For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

#### 8.1.2 Test summary

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Test date:	June 30, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1008 mbar
Verdict:	Pass	Relative humidity:	31 %

#### 8.1.3 Observations, settings and special notes

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Spectrum analyser settings:

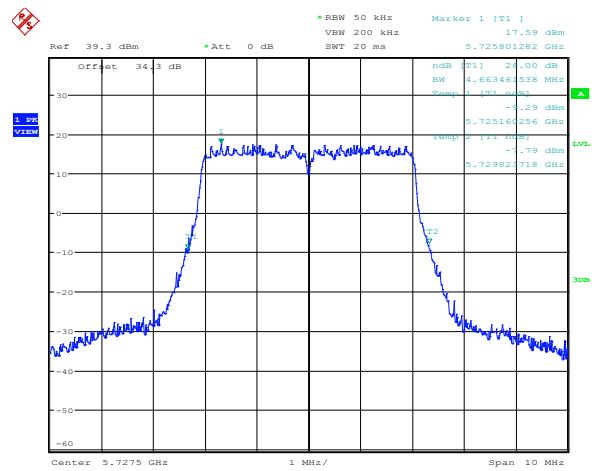
Resolution bandwidth	approximately 1% of the emission bandwidth
Video bandwidth	> RBW
Detector mode	Peak
Trace mode	Max Hold

#### 8.1.4 Test data

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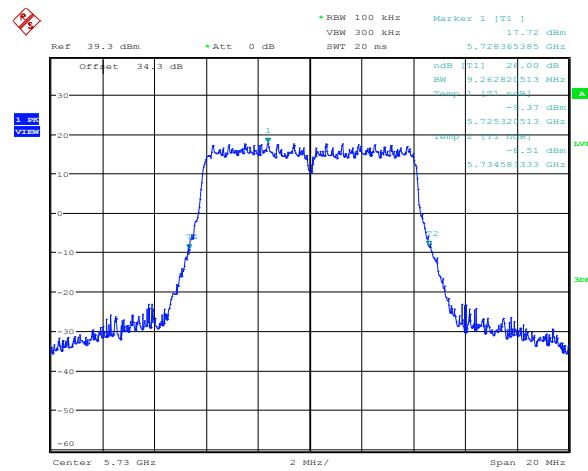
*Table 8.1-1: 26 dB bandwidth results*

Channel bandwidth, MHz	Frequency, MHz	26 dB bandwidth at ch0, MHz	26 dB bandwidth at ch1, MHz
5	5727.5	4.66	4.63
5	5847.5	4.68	4.69
10	5730.0	9.26	9.29
10	5845.0	9.29	9.26
20	5735.0	18.59	18.59
20	5840.0	18.51	18.75



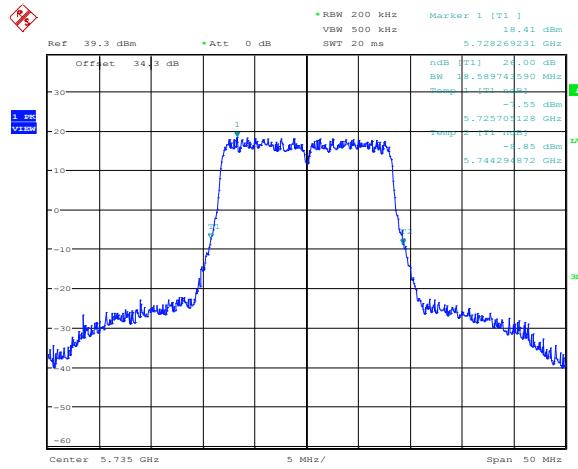
Date: 30.JUN.2016 12:22:12

Figure 8.1-1: 26 dB bandwidth on 5 MHz channel, sample plot



Date: 30.JUN.2016 12:21:27

Figure 8.1-2: 26 dB bandwidth on 10 MHz channel, sample plot



Date: 30.JUN.2016 12:20:36

Figure 8.1-3: 26 dB bandwidth on 20 MHz channel, sample plot

## 8.2 FCC 15.407(e) and RSS-247 6.2.4 (1) Minimum 6 dB bandwidth

### 8.2.1 Definitions and limits

For equipment operating in the band 5725–5850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz.

### 8.2.2 Test summary

Test date:	June 30, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1008 mbar
Verdict:	Pass	Relative humidity:	31 %

### 8.2.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	≥3 × RBW
Detector mode	Peak
Trace mode	Max Hold

### 8.2.4 Test data

**Table 8.2-1: 6 dB bandwidth results for 5 MHz channel**

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
BPSK	5727.5	4.11	0.50	3.61
	5790.0	4.09	0.50	3.59
	5847.5	4.11	0.50	3.61
256-QAM	5727.5	4.11	0.50	3.61
	5790.0	4.09	0.50	3.59
	5847.5	4.10	0.50	3.60

**Table 8.2-2: 6 dB bandwidth results for 10 MHz channel**

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
BPSK	5730.0	8.20	0.50	7.70
	5790.0	8.13	0.50	7.63
	5845.0	8.14	0.50	7.64
256-QAM	5730.0	8.20	0.50	7.70
	5790.0	8.13	0.50	7.63
	5845.0	8.16	0.50	7.66

Table 8.2-3: 6 dB bandwidth results for 20 MHz channel

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
BPSK	5735.0	16.46	0.50	15.96
	5790.0	16.46	0.50	15.96
	5840.0	16.47	0.50	15.97
256-QAM	5735.0	16.53	0.50	16.03
	5790.0	16.45	0.50	15.95
	5840.0	16.47	0.50	15.97

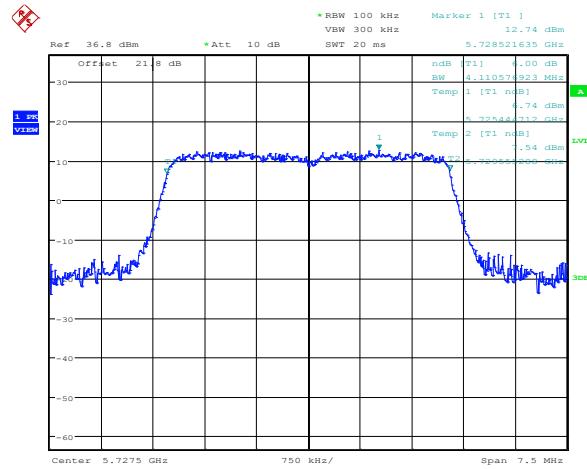


Figure 8.2-1: 6 dB bandwidth on 5 MHz, sample plot

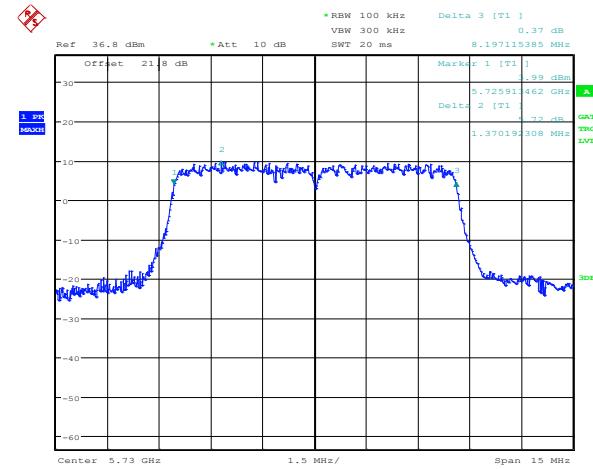


Figure 8.2-2: 6 dB bandwidth on 10 MHz, sample plot

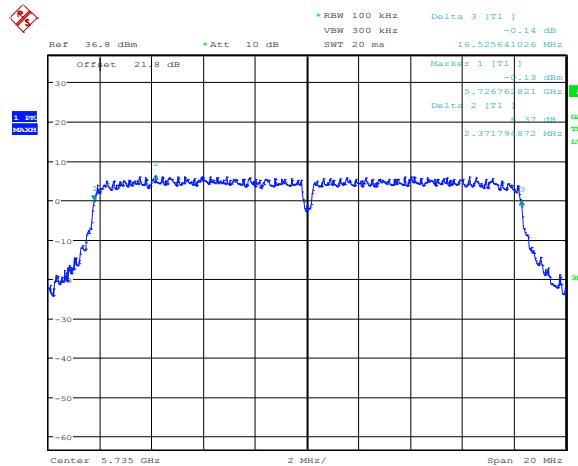


Figure 8.2-3: 6 dB bandwidth on 20 MHz, sample plot

## 8.3 FCC 15.407(a)(3) and RSS-247 6.2.4 (1) 5.725–5.85 GHz band output power and spectral density limits

### 8.3.1 Definitions and limits

**FCC:**

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

**IC:**

The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

### 8.3.2 Test summary

Test date:	June 28, 2016	Temperature:	21 °C
Test engineer:	Andrey Adelberg	Air pressure:	1010 mbar
Verdict:	Pass	Relative humidity:	31 %

### 8.3.3 Observations, settings and special notes

The test was performed according to DTS guidelines section 8.2.1 Option 1: maximum conducted (average) output power using an RMS power averaging detector with trace averaging of the spectrum analyzer.

EBW (26 dB BW) for 5 MHz channel is 4.78 MHz, for 10 MHz channel is 9.39 MHz and for 20 MHz channel is 18.59 MHz.

For the channel power measurements, span was set to 150 % of EBW: for 5 MHz channel the span was 7.2 MHz, for 10 MHz channel the span was 14 MHz and for 20 MHz channel the span was set to 28 MHz.

Output power calculation for 10 dBi antenna:  $30 \text{ dBm} - (10 \text{ dBi} - 6 \text{ dBi}) = 26 \text{ dBm}$ ; for 19 dBi antenna:  $30 \text{ dBm} - (19 \text{ dBi} - 6 \text{ dBi}) = 17 \text{ dBm}$  and for 32 dBi antenna:  $30 \text{ dBm} - (32 \text{ dBi} - 6 \text{ dBi}) = 4 \text{ dBm}$ .

Combined average output power was calculated as follows:

$$P_{combined} = 10 \times \log_{10} 10^{P_{ch0} / 10} + 10^{P_{ch1} / 10}$$

EIRP was calculated as follows:

$$EIRP = P_{combined} + \text{antenna gain}$$

For antennas with the directional gain greater than 6 dBi, the maximum power spectral density limit was calculated as follows:

For 10 dBi antenna:  $30 \text{ dBm}/500 \text{ kHz} - (10 \text{ dBi} - 6 \text{ dBi}) = 26 \text{ dBm}/500 \text{ kHz}$ ; for 19 dBi antenna:  $30 \text{ dBm}/500 \text{ kHz} - (19 \text{ dBi} - 6 \text{ dBi}) = 17 \text{ dBm}/500 \text{ kHz}$  and for 32 dBi antenna:  $30 \text{ dBm}/500 \text{ kHz} - (32 \text{ dBi} - 6 \text{ dBi}) = 4 \text{ dBm}/500 \text{ kHz}$ .

### 8.3.4 Test data

**Table 8.3-1:** Output power measurements and EIRP calculations results for 5 MHz channel and 10 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5727.5	17.63	17.39	20.52	26.00	5.48	10.00	30.52	36.00	5.48
	5790.0	20.72	20.84	23.79	26.00	2.21	10.00	33.79	36.00	2.21
	5847.5	18.77	19.31	22.06	26.00	3.94	10.00	32.06	36.00	3.94
256-QAM	5727.5	17.64	17.14	20.41	26.00	5.59	10.00	30.41	36.00	5.59
	5790.0	20.77	20.89	23.84	26.00	2.16	10.00	33.84	36.00	2.16
	5847.5	18.82	18.99	21.92	26.00	4.08	10.00	31.92	36.00	4.08

**Table 8.3-2:** Output power measurements and EIRP calculations results for 5 MHz channel and 19 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5727.5	12.67	12.45	15.57	17.00	1.43	19.00	34.57	36.00	1.43
	5790.0	12.42	12.07	15.26	17.00	1.74	19.00	34.26	36.00	1.74
	5847.5	12.08	13.47	15.84	17.00	1.16	19.00	34.84	36.00	1.16
256-QAM	5727.5	12.84	12.13	15.51	17.00	1.49	19.00	34.51	36.00	1.49
	5790.0	12.41	12.22	15.33	17.00	1.67	19.00	34.33	36.00	1.67
	5847.5	12.19	13.00	15.62	17.00	1.38	19.00	34.62	36.00	1.38

**Table 8.3-3:** Output power measurements and EIRP calculations results for 5 MHz channel and 32 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5727.5	0.04	0.21	3.14	4.00	0.86	32.00	35.14	36.00	0.86
	5790.0	-0.71	0.06	2.70	4.00	1.30	32.00	34.70	36.00	1.30
	5847.5	-0.78	0.38	2.85	4.00	1.15	32.00	34.85	36.00	1.15
256-QAM	5727.5	-0.25	0.47	3.14	4.00	0.86	32.00	35.14	36.00	0.86
	5790.0	-0.64	-0.16	2.62	4.00	1.38	32.00	34.62	36.00	1.38
	5847.5	-0.61	-0.18	2.62	4.00	1.38	32.00	34.62	36.00	1.38

**Table 8.3-4:** Output power measurements and EIRP calculations results for 10 MHz channel and 10 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5730.0	19.49	19.40	22.46	26.00	3.54	10.00	32.46	36.00	3.54
	5790.0	20.82	20.83	23.84	26.00	2.16	10.00	33.84	36.00	2.16
	5845.0	18.85	19.98	22.46	26.00	3.54	10.00	32.46	36.00	3.54
256-QAM	5730.0	19.31	19.34	22.34	26.00	3.66	10.00	32.34	36.00	3.66
	5790.0	20.71	20.84	23.79	26.00	2.21	10.00	33.79	36.00	2.21
	5845.0	18.94	18.84	21.90	26.00	4.10	10.00	31.90	36.00	4.10

Table 8.3-5: Output power measurements and EIRP calculations results for 10 MHz channel and 19 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5730.0	12.63	12.33	15.49	17.00	1.51	19.00	34.49	36.00	1.51
	5790.0	12.45	12.09	15.28	17.00	1.72	19.00	34.28	36.00	1.72
	5845.0	12.10	12.49	15.31	17.00	1.69	19.00	34.31	36.00	1.69
256-QAM	5730.0	12.69	12.30	15.51	17.00	1.49	19.00	34.51	36.00	1.49
	5790.0	12.56	11.91	15.26	17.00	1.74	19.00	34.26	36.00	1.74
	5845.0	12.30	12.04	15.18	17.00	1.82	19.00	34.18	36.00	1.82

Table 8.3-6: Output power measurements and EIRP calculations results for 10 MHz channel and 32 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5730.0	-0.52	-0.81	2.35	4.00	1.65	32.00	34.35	36.00	1.65
	5790.0	-0.45	0.35	2.98	4.00	1.02	32.00	34.98	36.00	1.02
	5845.0	-0.69	0.06	2.71	4.00	1.29	32.00	34.71	36.00	1.29
256-QAM	5730.0	-0.56	-0.51	2.48	4.00	1.52	32.00	34.48	36.00	1.52
	5790.0	-0.63	-0.04	2.69	4.00	1.31	32.00	34.69	36.00	1.31
	5845.0	-0.63	-0.06	2.67	4.00	1.33	32.00	34.67	36.00	1.33

Table 8.3-7: Output power measurements and EIRP calculations results for 20 MHz channel and 10 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5735.0	20.80	21.69	24.28	26.00	1.72	10.00	34.28	36.00	1.72
	5790.0	21.47	21.56	24.53	26.00	1.47	10.00	34.53	36.00	1.47
	5840.0	20.30	20.73	23.53	26.00	2.47	10.00	33.53	36.00	2.47
256-QAM	5735.0	21.03	21.80	24.44	26.00	1.56	10.00	34.44	36.00	1.56
	5790.0	21.44	21.49	24.48	26.00	1.52	10.00	34.48	36.00	1.52
	5840.0	20.54	20.77	23.67	26.00	2.33	10.00	33.67	36.00	2.33

Table 8.3-8: Output power measurements and EIRP calculations results for 20 MHz channel and 19 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5735.0	12.05	12.90	15.51	17.00	1.49	19.00	34.51	36.00	1.49
	5790.0	13.11	12.73	15.93	17.00	1.07	19.00	34.93	36.00	1.07
	5840.0	12.93	12.77	15.86	17.00	1.14	19.00	34.86	36.00	1.14
256-QAM	5735.0	12.26	12.95	15.63	17.00	1.37	19.00	34.63	36.00	1.37
	5790.0	13.00	12.71	15.87	17.00	1.13	19.00	34.87	36.00	1.13
	5840.0	12.90	12.74	15.83	17.00	1.17	19.00	34.83	36.00	1.17

Table 8.3-9: Output power measurements and EIRP calculations results for 20 MHz channel and 32 dBi antenna gain

Modulation	Frequency, MHz	Average power on ch0, dBm	Average power on ch1, dBm	Combined average power, dBm	Output power limit, dBm	Output power margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
BPSK	5735.0	-0.03	-0.29	2.85	4.00	1.15	32.00	34.85	36.00	1.15
	5790.0	0.16	-0.54	2.83	4.00	1.17	32.00	34.83	36.00	1.17
	5840.0	0.00	-0.50	2.77	4.00	1.23	32.00	34.77	36.00	1.23
256-QAM	5735.0	-0.03	-0.24	2.88	4.00	1.12	32.00	34.88	36.00	1.12
	5790.0	-0.07	-0.42	2.77	4.00	1.23	32.00	34.77	36.00	1.23
	5840.0	-0.01	-0.51	2.76	4.00	1.24	32.00	34.76	36.00	1.24

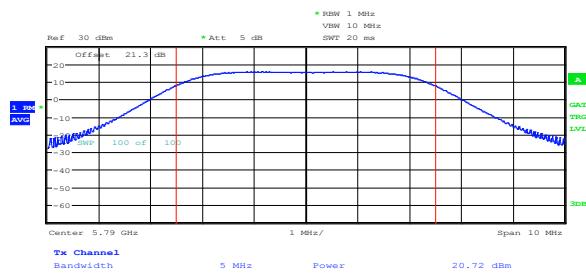


Figure 8.3-1: Sample plot for Power on 5 MHz



Figure 8.3-2: Sample plot for Power on 10 MHz

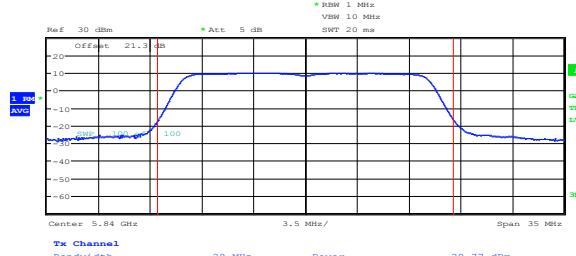


Figure 8.3-3: Sample plot for Power on 20 MHz

Table 8.3-10: PSD measurements results for 5 MHz channel and 10 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5727.5	9.82	12.04	14.08	26.00	11.92
	5790.0	13.12	13.07	16.11	26.00	9.89
	5847.5	10.79	11.01	13.91	26.00	12.09
256-QAM	5727.5	10.12	9.86	13.00	26.00	13.00
	5790.0	13.23	13.05	16.15	26.00	9.85
	5847.5	10.85	11.09	13.98	26.00	12.02

Table 8.3-11: PSD measurements results for 5 MHz channel and 19 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5727.5	5.06	4.86	7.97	17.00	9.03
	5790.0	4.69	4.18	7.45	17.00	9.55
	5847.5	4.06	5.06	7.60	17.00	9.40
256-QAM	5727.5	5.12	4.82	7.98	17.00	9.02
	5790.0	4.74	4.10	7.44	17.00	9.56
	5847.5	4.12	5.16	7.68	17.00	9.32

Table 8.3-12: PSD measurements results for 5 MHz channel and 32 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5727.5	-8.02	-7.41	-4.69	4.00	8.69
	5790.0	-8.35	-7.87	-5.09	4.00	9.09
	5847.5	-8.72	-8.13	-5.40	4.00	9.40
256-QAM	5727.5	-8.08	-7.44	-4.74	4.00	8.74
	5790.0	-8.25	-8.06	-5.14	4.00	9.14
	5847.5	-8.72	-7.93	-5.30	4.00	9.30

Table 8.3-13: PSD measurements results for 10 MHz channel and 10 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5730.0	8.61	8.87	11.75	26.00	14.25
	5790.0	10.08	10.15	13.13	26.00	12.87
	5845.0	8.14	8.50	11.33	26.00	14.67
256-QAM	5730.0	8.73	8.36	11.56	26.00	14.44
	5790.0	10.12	10.11	13.13	26.00	12.87
	5845.0	8.17	8.28	11.24	26.00	14.76

Table 8.3-14: PSD measurements results for 10 MHz channel and 19 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5730.0	1.96	1.60	4.79	17.00	12.21
	5790.0	1.70	1.25	4.49	17.00	12.51
	5845.0	1.45	1.33	4.40	17.00	12.60
256-QAM	5730.0	1.95	1.40	4.69	17.00	12.31
	5790.0	1.68	1.18	4.45	17.00	12.55
	5845.0	1.45	1.31	4.39	17.00	12.61

**Table 8.3-15:** PSD measurements results for 10 MHz channel and 32 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5730.0	-11.05	-11.59	-8.30	4.00	12.30
	5790.0	-11.38	-10.90	-8.12	4.00	12.12
	5845.0	-11.38	-10.88	-8.11	4.00	12.11
256-QAM	5730.0	-11.20	-11.51	-8.34	4.00	12.34
	5790.0	-11.54	-11.16	-8.34	4.00	12.34
	5845.0	-11.39	-10.82	-8.09	4.00	12.09

**Table 8.3-16:** PSD measurements results for 20 MHz channel and 10 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5735.0	7.32	7.92	10.64	26.00	15.36
	5790.0	7.68	7.73	10.72	26.00	15.28
	5840.0	6.78	6.83	9.82	26.00	16.18
256-QAM	5735.0	7.35	7.84	10.61	26.00	15.39
	5790.0	7.79	7.62	10.72	26.00	15.28
	5840.0	6.67	6.94	9.82	26.00	16.18

**Table 8.3-17:** PSD measurements results for 20 MHz channel and 19 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5735.0	-1.58	-1.00	1.73	17.00	15.27
	5790.0	-0.66	-1.12	2.13	17.00	14.87
	5840.0	-1.03	-1.17	1.91	17.00	15.09
256-QAM	5735.0	-1.42	-1.03	1.79	17.00	15.21
	5790.0	-0.75	-1.16	2.06	17.00	14.94
	5840.0	-0.98	-1.10	1.97	17.00	15.03

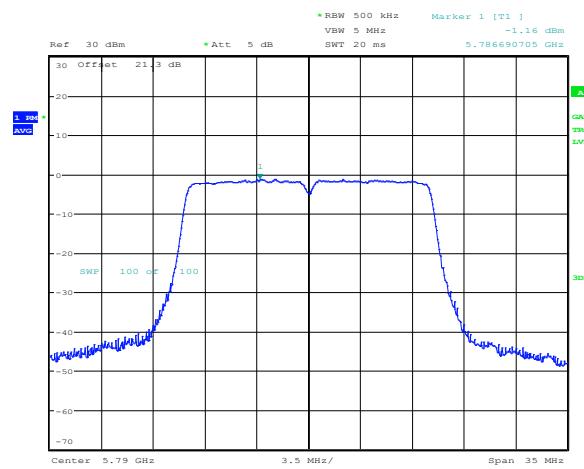
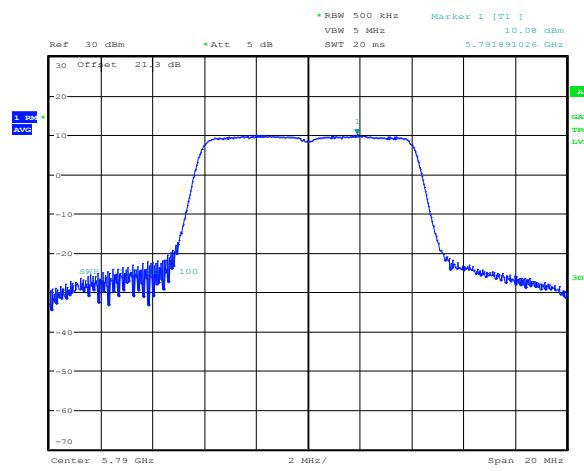
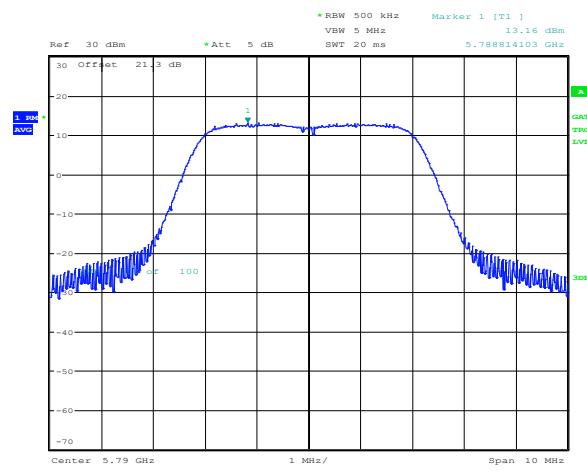
**Table 8.3-18:** PSD measurements results for 20 MHz channel and 32 dBi antenna gain

Modulation	Frequency, MHz	PSD on ch0, dBm/0.5 MHz	PSD on ch1, dBm/0.5 MHz	Combined PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
BPSK	5735.0	-13.65	-14.12	-10.87	4.00	14.87
	5790.0	-13.67	-14.40	-11.01	4.00	15.01
	5840.0	-13.95	-14.39	-11.15	4.00	15.15
256-QAM	5735.0	-13.47	-14.28	-10.85	4.00	14.85
	5790.0	-13.89	-14.34	-11.10	4.00	15.10
	5840.0	-13.98	-14.42	-11.18	4.00	15.18

**Section 8****Test name****Specification****Testing data**

FCC 15.407(a)(3) and RSS-247 6.2.4 (1) 5.725–5.85 GHz band output power and spectral density limits

FCC Part 15 Subpart E and RSS-247 Issue 1



## 8.4 FCC 15.407(b) and RSS-247 6.2.4 (2) Spurious (out-of-band) emissions

### 8.4.1 Definitions and limits

#### FCC:

(4) For transmitters operating in the 5.725–5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of  $-17$  dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of  $-27$  dBm/MHz.  
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.  
(7) The provisions of § 15.205 apply to intentional radiators operating under this section.  
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

#### IC:

For the band 5725–5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed  $-17$  dBm/MHz e.i.r.p.

For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed  $-27$  dBm/MHz.

#### RSS-Gen 8.10 Emissions falling within restricted frequency bands

Restricted bands, identified in Table 8.4-2, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

(a) fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of below;  
(b) unwanted emissions falling into restricted bands of below shall comply with the limits specified in RSS-Gen;  
(c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.

#### FCC 16-24, Memorandum opinion and order, March 2, 2016

(i) All emissions shall be limited to a level of  $-27$  dBm/MHz EIRP at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz EIRP at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz EIRP at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz EIRP at the band edge.

**Table 8.4-1: FCC §15.209 and RSS-Gen – Radiated emission limits**

Frequency, MHz	Field strength of emissions μV/m	Field strength of emissions dBμV/m	Measurement distance, m
0.009–0.490	$2400/F$ ( $F$ in kHz)	$67.6 - 20 \times \log_{10}(F)$ ( $F$ in kHz)	300
0.490–1.705	$24000/F$ ( $F$ in kHz)	$87.6 - 20 \times \log_{10}(F)$ ( $F$ in kHz)	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

**Table 8.4-2: IC restricted frequency bands**

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.4-2 and above 38.6 GHz are designated for low-power license-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

**Table 8.4-3: FCC restricted frequency bands**

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

#### 8.4.2 Test summary

Test date:	June 29, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1007 mbar
Verdict:	Pass	Relative humidity:	31 %

### 8.4.3 Observations, settings and special notes

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The spectrum was searched from 30 MHz to 40 GHz.

Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously. Cabinet radiation was performed while both antenna connectors were terminated with  $50\ \Omega$  load.

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

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

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

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

Spectrum analyser for average conducted measurements within restricted bands above 1 GHz for frequencies where peak results were above the average limit:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Detector mode:	RMS
Trace mode:	Power average
Number of averaging traces:	100

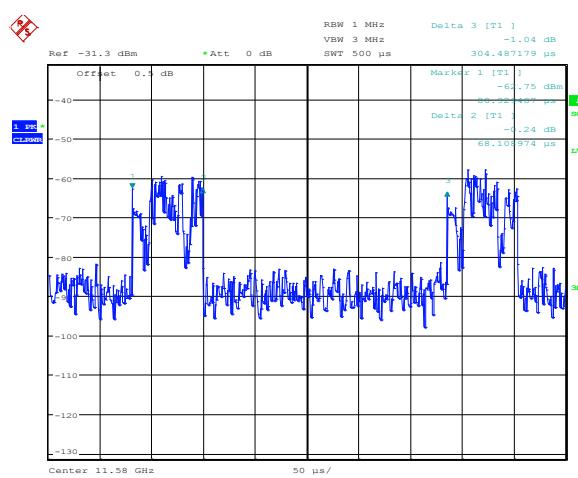
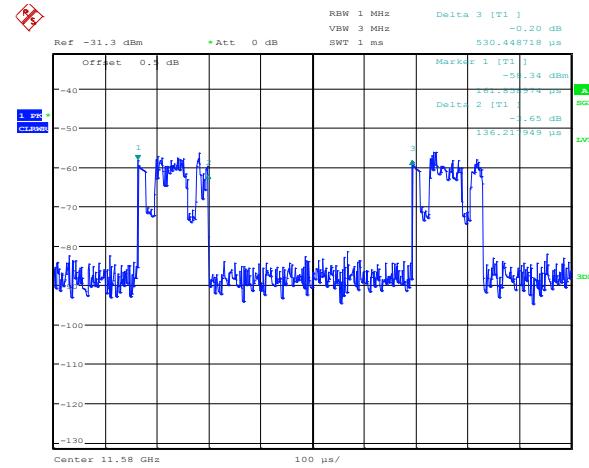
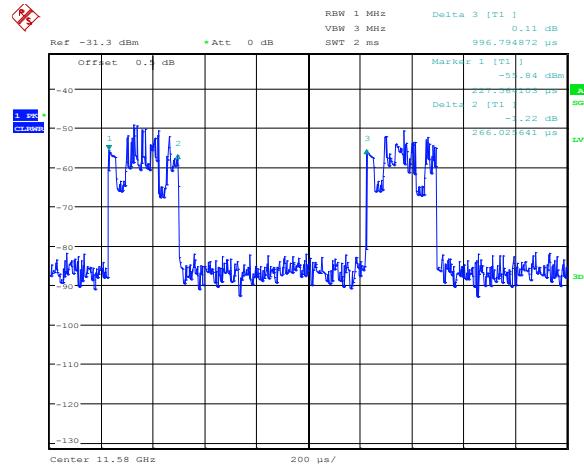
Spectrum analyser for peak conducted measurements outside restricted bands:

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

Conducted emissions measurements outside restricted bands were performed on each individual MIMO chain. The reference level offset was adjusted to include antenna directional gain and a compensation of two antenna ports:

For 10 dBi antenna reference level was offset by 13 dB, for 19 dBi antenna reference level was offset by 22 dB and for 32 dBi antenna reference level was offset by 35 dB

#### 8.4.4 Test data



##### Duty cycle correction factor calculations:

###### For 5 MHz channel

$T_{x_{ON}}$  is 996.03 μs;  $T_{x_{PERIOD}}$  is 996.80 μs; Duty cycle = 27%; Correction Factor =  $20 \times \log_{10} (0.27) = -11.47$  dB

###### For 10 MHz channel

$T_{x_{ON}}$  is 136.20 μs;  $T_{x_{PERIOD}}$  is 530.45 μs; Duty cycle = 26%; Correction Factor =  $20 \times \log_{10} (0.26) = -11.81$  dB

###### For 20 MHz channel

$T_{x_{ON}}$  is 68.11 μs;  $T_{x_{PERIOD}}$  is 304.49 μs; Duty cycle = 22%; Correction Factor =  $20 \times \log_{10} (0.22) = -13.01$  dB

**Table 8.4-4: Conducted spurious emissions measurements within restricted bands, 10 dBi antenna results**

Channel bandwidth, MHz	Channel	Frequency, MHz	Peak level, dBm	Peak limit, dBm	Peak margin, dB	Duty cycle CF, dB	Average level, dBm	Average limit, dBm	Average margin, dB
5	Mid	11.580	-48.12	-34.23	13.89	-11.47	-59.59	-54.23	5.36
10	Mid	11.580	-50.72	-34.23	16.49	-11.81	-62.53	-54.23	8.30
20	Mid	11.580	-48.63	-34.23	14.40	-13.01	-61.64	-54.23	7.41

Note: Average level = Peak level + Duty cycle CF

Peak Limit calculation:

Field strength limit is 74 dB $\mu$ V/m. A correspondent EIRP level at 3 m distance was determined as follows: 74 dB $\mu$ V/m – 95.23 dB = -21.23 dBm. Additional reductions due to number of antenna ports (two ports = 3 dB) and uncorrelated antenna gain of 10 dBi. The final limit is: -21.23 – 3 – 10 = -34.23 dBm

Average Limit calculation:

Peak limit – 20 dB.

**Table 8.4-5: Conducted spurious emissions measurements within restricted bands, 19 dBi antenna results**

Channel bandwidth, MHz	Channel	Frequency, MHz	Peak level, dBm	Peak limit, dBm	Peak margin, dB	Duty cycle CF, dB	Average level, dBm	Average limit, dBm	Average margin, dB
5	Mid	11.580	-63.07	-43.23	19.84	-11.47	-74.54	-63.23	11.31
10	Mid	11.580	-65.97	-43.23	22.74	-11.81	-77.78	-63.23	14.55
20	Mid	11.580	-65.95	-43.23	22.72	-13.01	-78.96	-63.23	15.73

Note: Average level = Peak level + Duty cycle CF

Peak Limit calculation:

Field strength limit is 74 dB $\mu$ V/m. A correspondent EIRP level at 3 m distance was determined as follows: 74 dB $\mu$ V/m – 95.23 dB = -21.23 dBm. Additional reductions due to number of antenna ports (two ports = 3 dB) and uncorrelated antenna gain of 19 dBi. The final limit is: -21.23 – 3 – 19 = -43.23 dBm

Average Limit calculation:

Peak limit – 20 dB.

32 dBi antenna results were more than 20 dB below the limit, due to substantially low power settings.



Figure 8.4-4: Conducted spurious emissions outside restricted bands, 5 MHz low channel, for 10 dBi antenna, cho



Figure 8.4-5: Conducted spurious emissions outside restricted bands, 5 MHz high channel, for 10 dBi antenna, cho



Figure 8.4-6: Conducted spurious emissions outside restricted bands, 5 MHz low channel, for 19 dBi antenna, cho



Figure 8.4-7: Conducted spurious emissions outside restricted bands, 5 MHz high channel, for 19 dBi antenna, cho

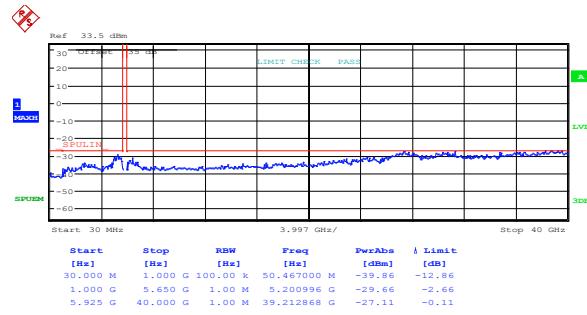


Figure 8.4-8: Conducted spurious emissions outside restricted bands, 5 MHz low channel, for 32 dBi antenna, cho

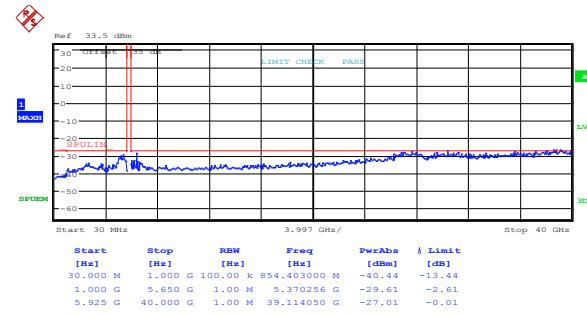


Figure 8.4-9: Conducted spurious emissions outside restricted bands, 5 MHz high channel, for 32 dBi antenna, cho

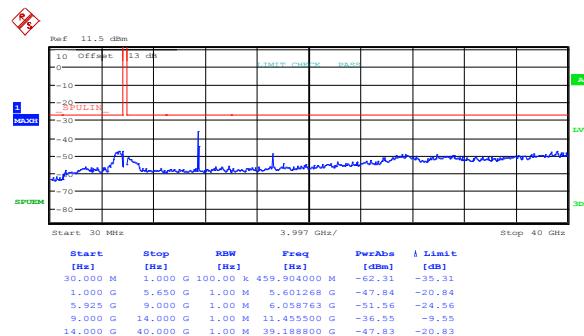


Figure 8.4-10: Conducted spurious emissions outside restricted bands, 10 MHz low channel, for 10 dBi antenna, cho

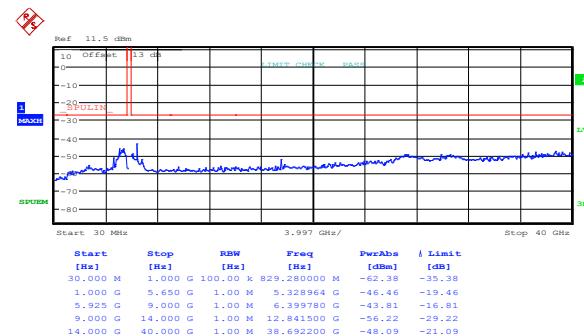


Figure 8.4-11: Conducted spurious emissions outside restricted bands, 10 MHz high channel, for 10 dBi antenna, cho



Figure 8.4-12: Conducted spurious emissions outside restricted bands, 10 MHz low channel, for 19 dBi antenna, cho

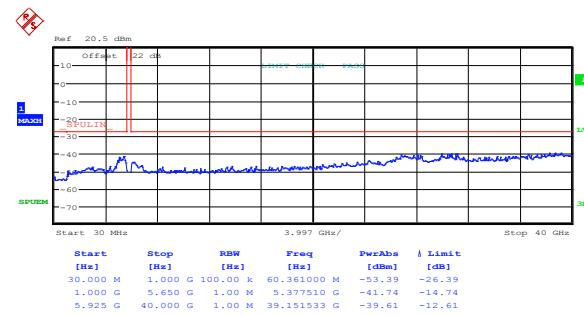


Figure 8.4-13: Conducted spurious emissions outside restricted bands, 10 MHz high channel, for 19 dBi antenna, cho

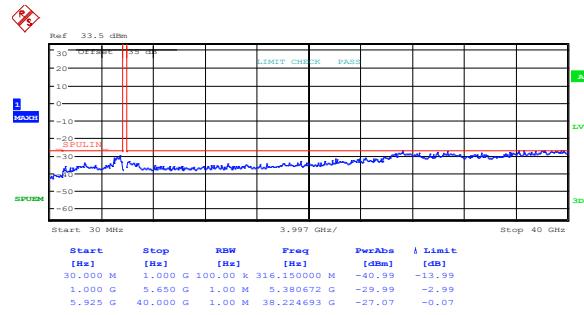


Figure 8.4-14: Conducted spurious emissions outside restricted bands, 10 MHz low channel, for 32 dBi antenna, cho

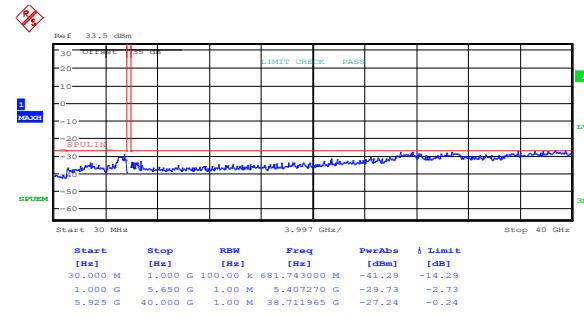


Figure 8.4-15: Conducted spurious emissions outside restricted bands, 10 MHz high channel, for 32 dBi antenna, cho



Figure 8.4-16: Conducted spurious emissions outside restricted bands, 20 MHz low channel, for 10 dBi antenna, cho

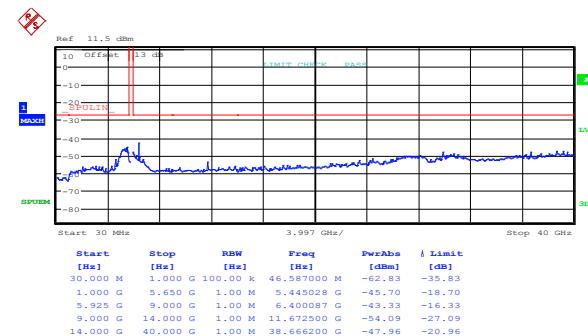


Figure 8.4-17: Conducted spurious emissions outside restricted bands, 20 MHz high channel, for 10 dBi antenna, cho

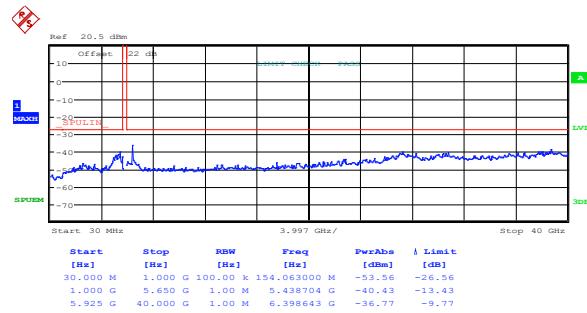


Figure 8.4-18: Conducted spurious emissions outside restricted bands, 20 MHz low channel, for 19 dBi antenna, cho



Figure 8.4-19: Conducted spurious emissions outside restricted bands, 20 MHz high channel, for 19 dBi antenna, cho

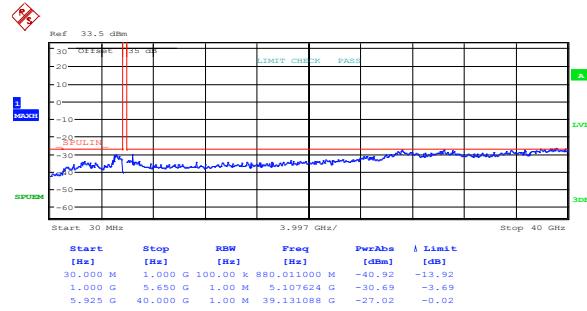


Figure 8.4-20: Conducted spurious emissions outside restricted bands, 20 MHz low channel, for 32 dBi antenna, cho

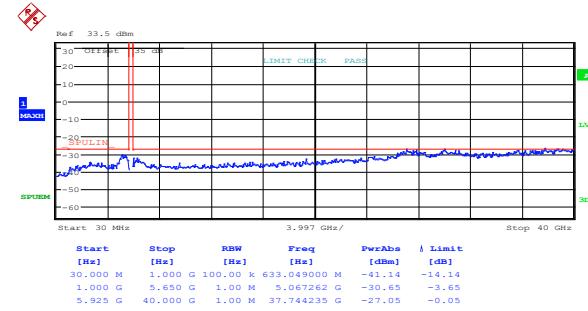


Figure 8.4-21: Conducted spurious emissions outside restricted bands, 20 MHz high channel, for 32 dBi antenna, cho

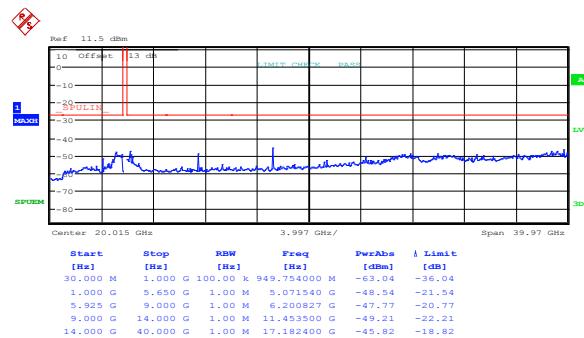


Figure 8.4-22: Conducted spurious emissions outside restricted bands, 5 MHz low channel, for 10 dBi antenna, ch1

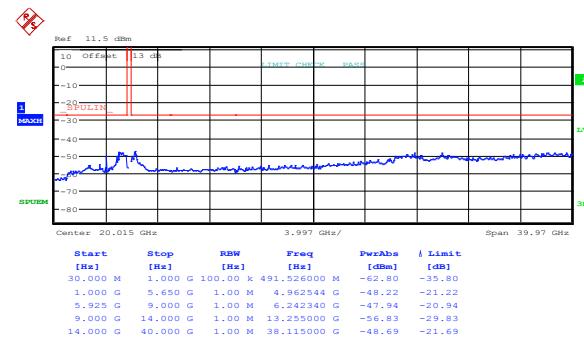


Figure 8.4-23: Conducted spurious emissions outside restricted bands, 5 MHz high channel, for 10 dBi antenna, ch1

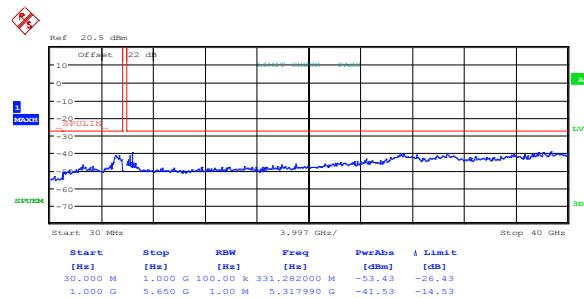


Figure 8.4-24: Conducted spurious emissions outside restricted bands, 5 MHz low channel, for 19 dBi antenna, ch1

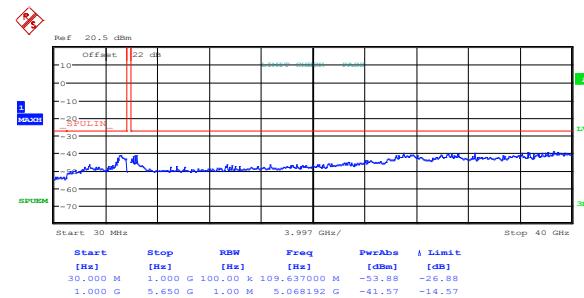


Figure 8.4-25: Conducted spurious emissions outside restricted bands, 5 MHz high channel, for 19 dBi antenna, ch1

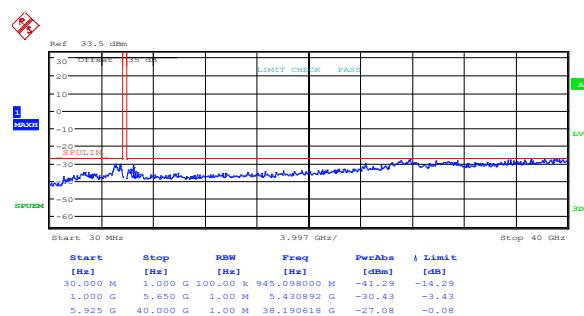


Figure 8.4-26: Conducted spurious emissions outside restricted bands, 5 MHz low channel, for 32 dBi antenna, ch1

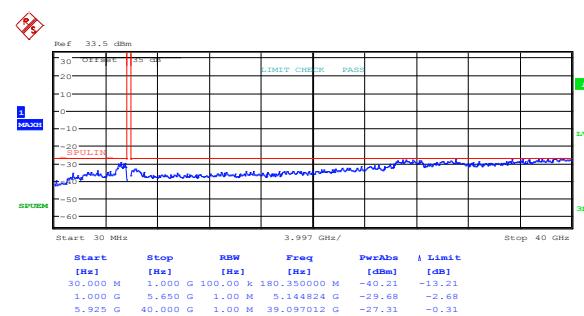


Figure 8.4-27: Conducted spurious emissions outside restricted bands, 5 MHz high channel, for 32 dBi antenna, ch1

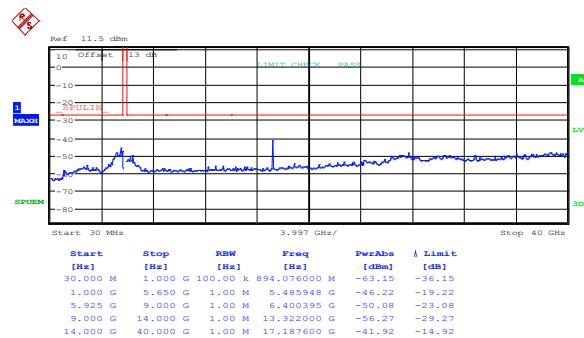


Figure 8.4-28: Conducted spurious emissions outside restricted bands, 10 MHz low channel, for 10 dBi antenna, ch1

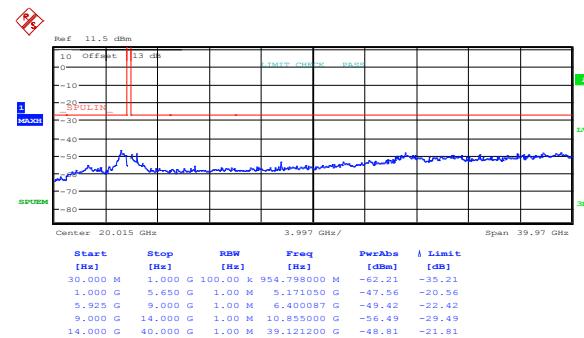


Figure 8.4-29: Conducted spurious emissions outside restricted bands, 10 MHz high channel, for 10 dBi antenna, ch1



Figure 8.4-30: Conducted spurious emissions outside restricted bands, 10 MHz low channel, for 19 dBi antenna, ch1

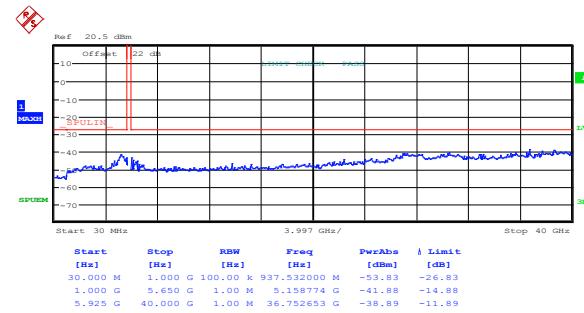


Figure 8.4-31: Conducted spurious emissions outside restricted bands, 10 MHz high channel, for 19 dBi antenna, ch1

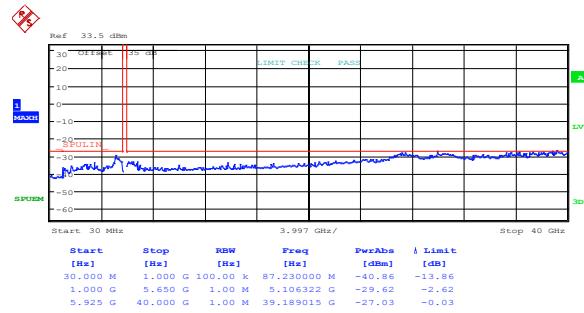


Figure 8.4-32: Conducted spurious emissions outside restricted bands, 10 MHz low channel, for 32 dBi antenna, ch1

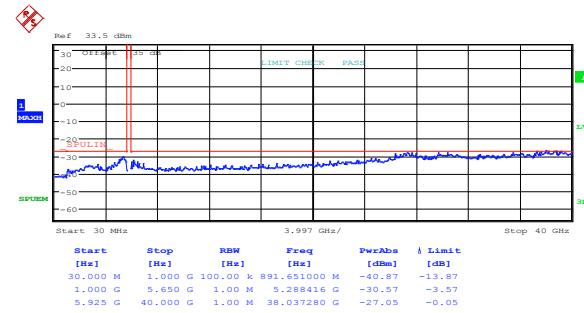


Figure 8.4-33: Conducted spurious emissions outside restricted bands, 10 MHz high channel, for 32 dBi antenna, ch1

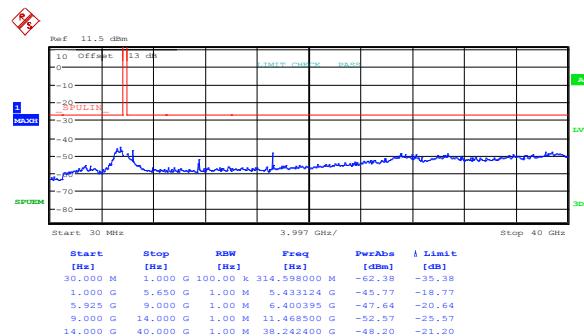


Figure 8.4-34: Conducted spurious emissions outside restricted bands, 20 MHz low channel, for 10 dBi antenna, ch1

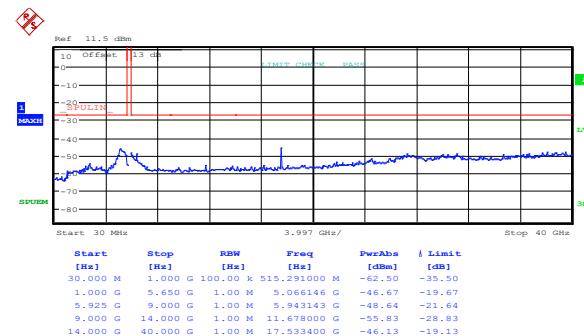


Figure 8.4-35: Conducted spurious emissions outside restricted bands, 20 MHz high channel, for 10 dBi antenna, ch1



Figure 8.4-36: Conducted spurious emissions outside restricted bands, 20 MHz low channel, for 19 dBi antenna, ch1



Figure 8.4-37: Conducted spurious emissions outside restricted bands, 20 MHz high channel, for 19 dBi antenna, ch1

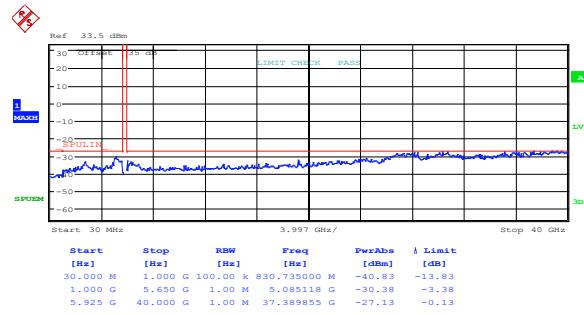


Figure 8.4-38: Conducted spurious emissions outside restricted bands, 20 MHz low channel, for 32 dBi antenna, ch1

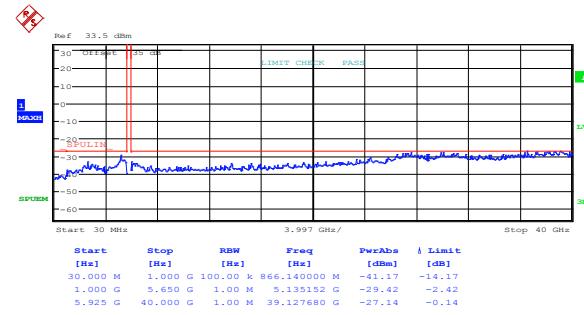


Figure 8.4-39: Conducted spurious emissions outside restricted bands, 20 MHz high channel, for 32 dBi antenna, ch1

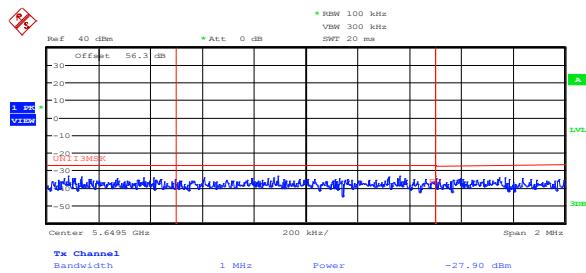


Figure 8.4-40: Conducted lower band edge emissions at 5650 MHz, 5 MHz channel, 32 dBi antenna, cho

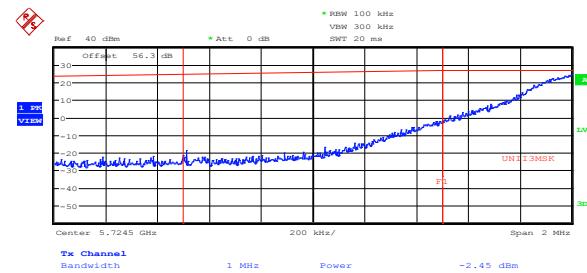


Figure 8.4-41: Conducted lower band edge emissions at 5725 MHz, 5 MHz channel, 32 dBi antenna, cho

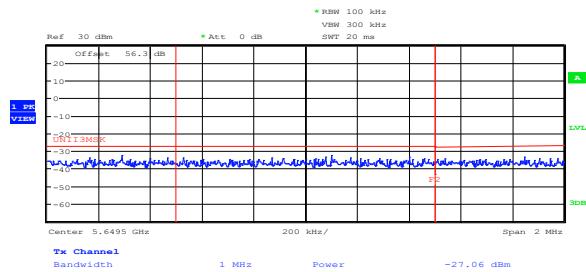


Figure 8.4-42: Conducted lower band edge emissions at 5650 MHz, 10 MHz channel, 32 dBi antenna, cho

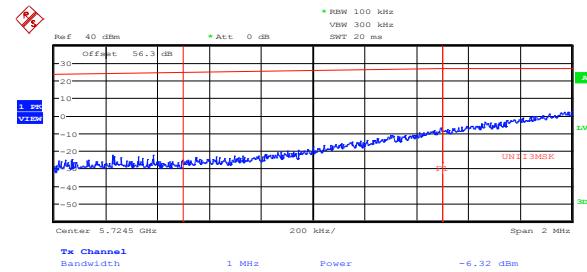


Figure 8.4-43: Conducted lower band edge emissions at 5725 MHz, 10 MHz channel, 32 dBi antenna, cho

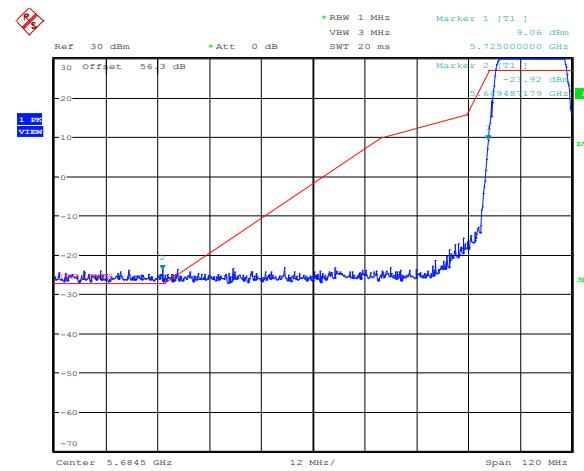
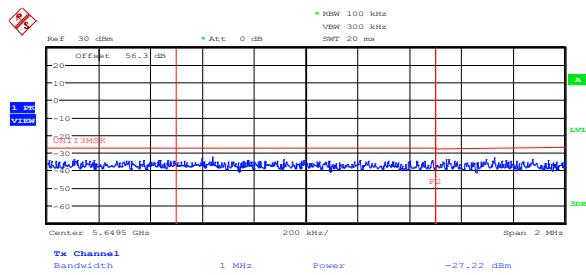
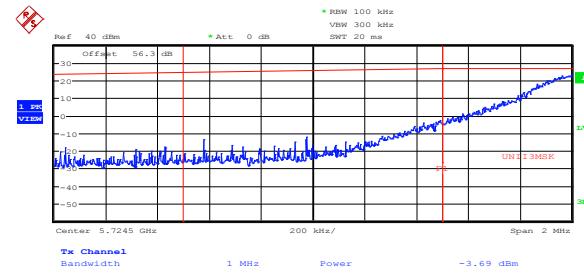
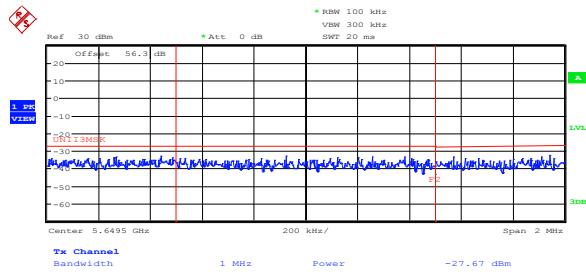


Figure 8.4-44: Conducted lower band edge emissions at 5650 MHz, 20 MHz channel, 32 dBi antenna, cho

Figure 8.4-45: Conducted lower band edge emissions at 5725 MHz, 20 MHz channel, 32 dBi antenna, cho

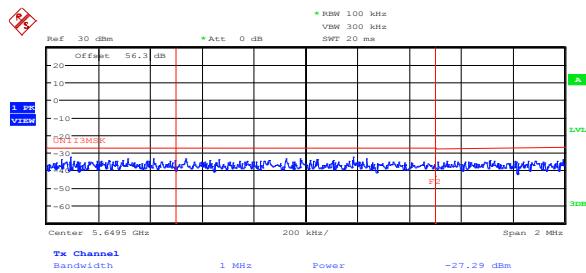


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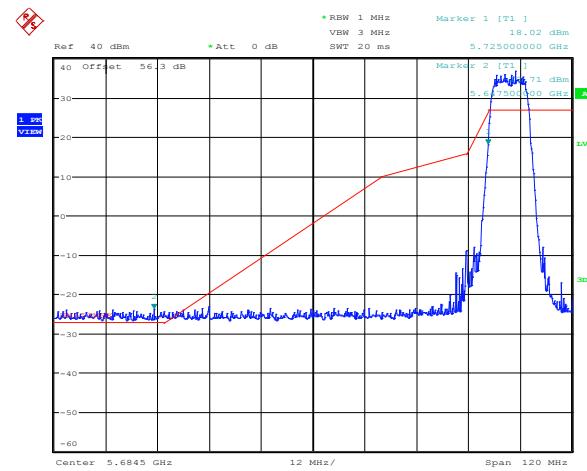
**Section 8**  
**Test name**  
**Specification**

Testing data  
 FCC 15.407(b) and RSS-247 6.2.4 (2) Spurious (out-of-band) emissions  
 FCC Part 15 Subpart E and RSS-247 Issue 1



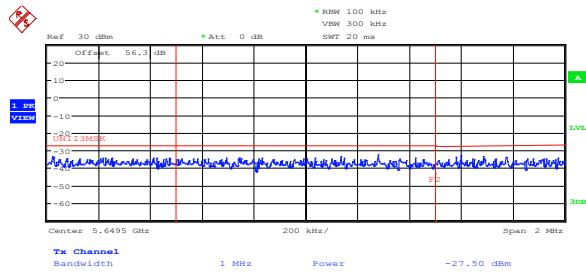
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**Figure 8.4-48:** Conducted lower band edge emissions at 5650 MHz, 10 MHz channel, 32 dBi antenna, ch1



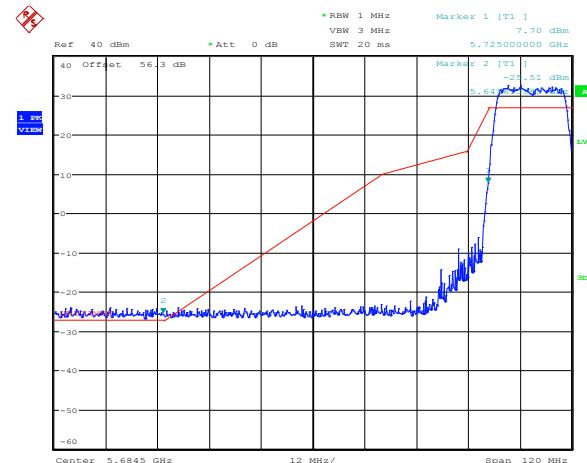
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**Figure 8.4-49:** Conducted lower band edge emissions at 5725 MHz, 10 MHz channel, 32 dBi antenna, ch1



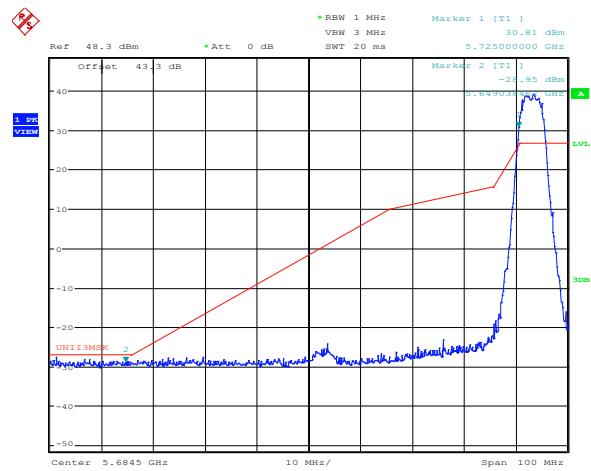
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**Figure 8.4-50:** Conducted lower band edge emissions at 5650 MHz, 20 MHz channel, 32 dBi antenna, ch1



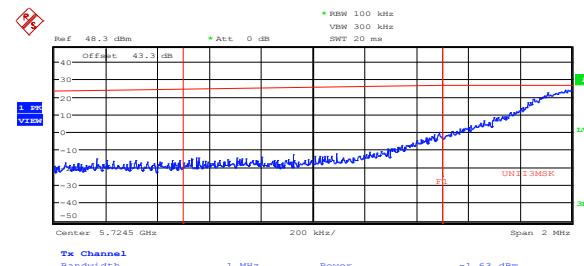
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**Figure 8.4-51:** Conducted lower band edge emissions at 5725 MHz, 20 MHz channel, 32 dBi antenna, ch1



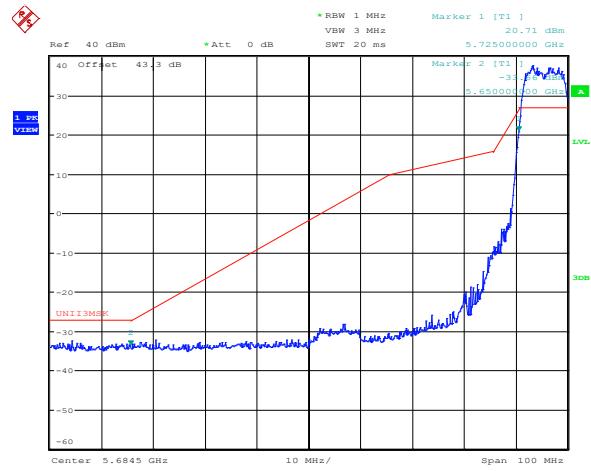
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**Figure 8.4-52:** Conducted lower band edge emissions at 5650 MHz, 5 MHz channel, 19 dBi antenna, cho



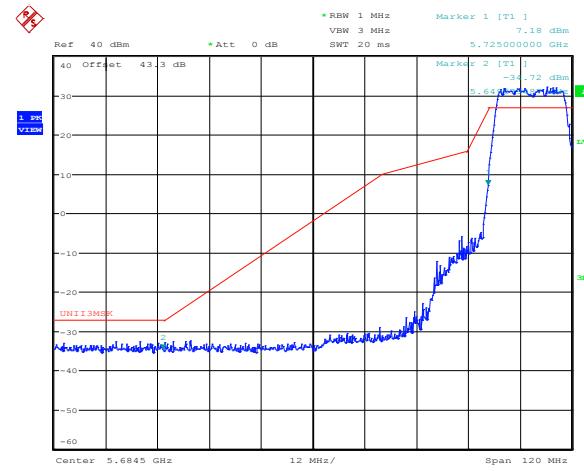
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**Figure 8.4-53:** Conducted lower band edge emissions at 5725 MHz, 5 MHz channel, 19 dBi antenna, cho



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**Figure 8.4-54:** Conducted lower band edge emissions at 5650 MHz and 5725 MHz, 10 MHz channel, 19 dBi antenna, cho

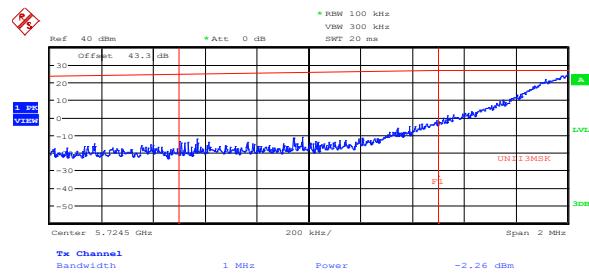


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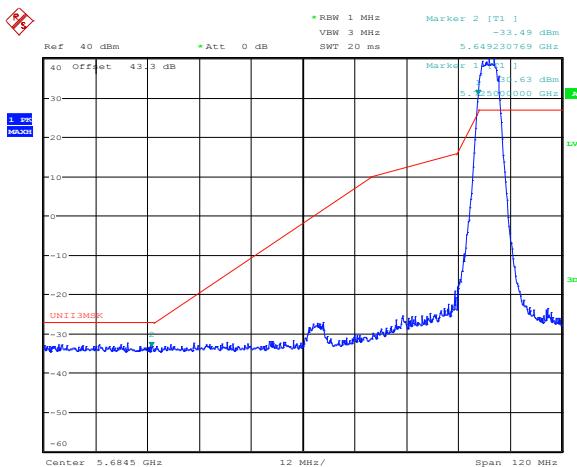
**Figure 8.4-55:** Conducted lower band edge emissions at 5650 MHz and 5725 MHz, 20 MHz channel, 19 dBi antenna, cho

**Section 8**  
**Test name**  
**Specification**

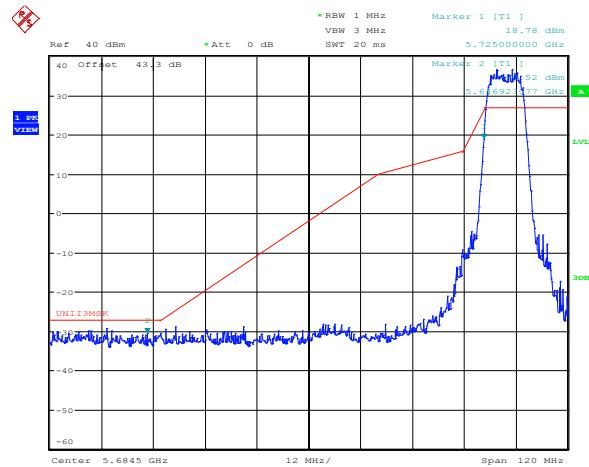
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 FCC Part 15 Subpart E and RSS-247 Issue 1



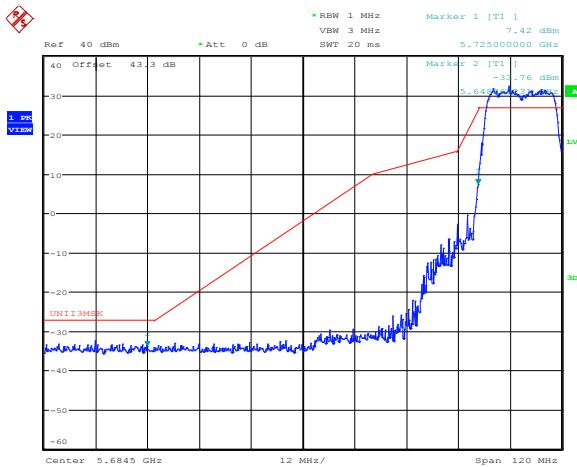
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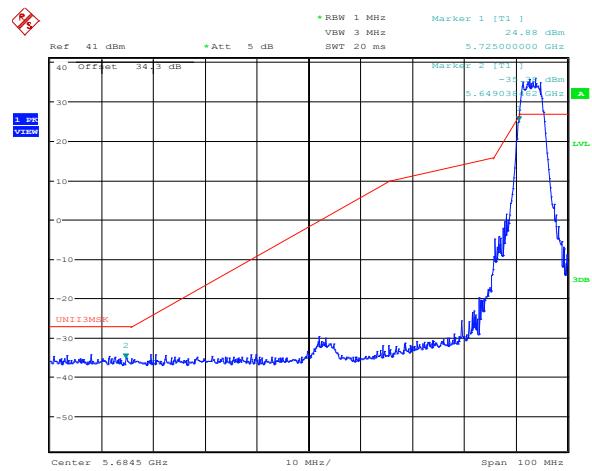
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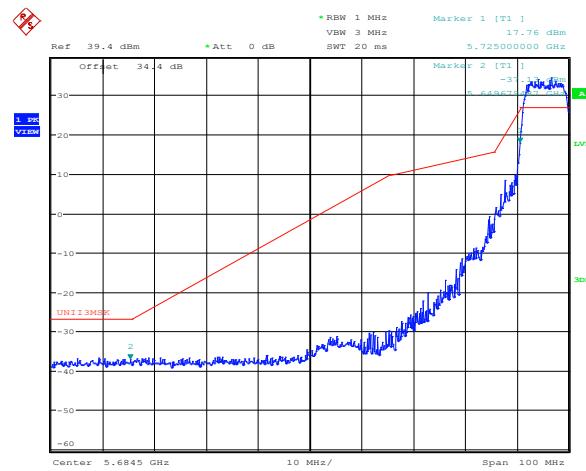
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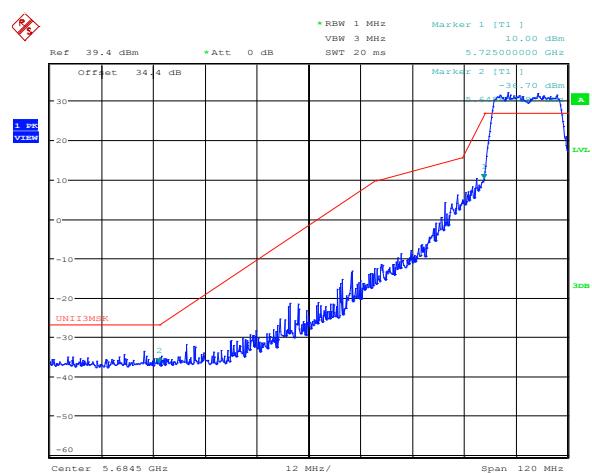
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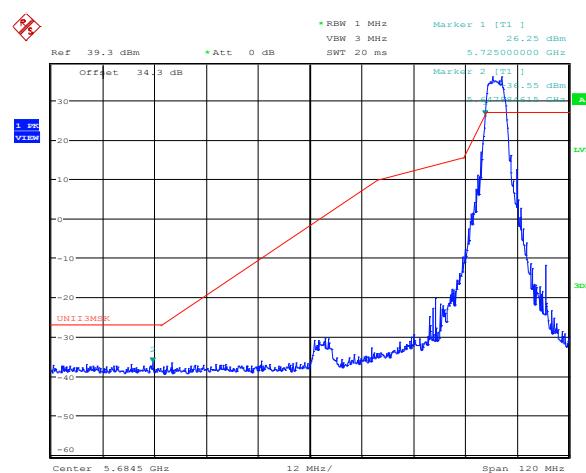
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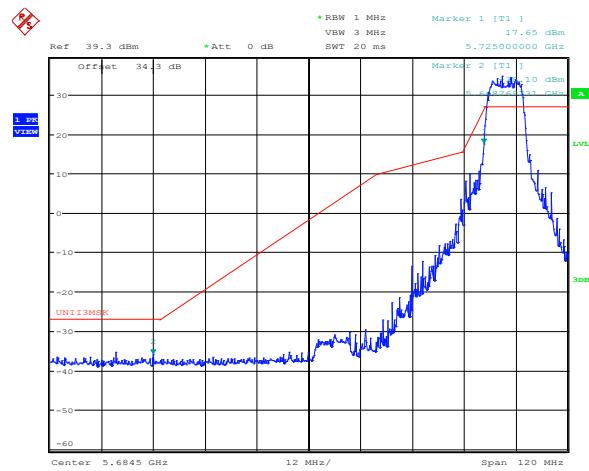
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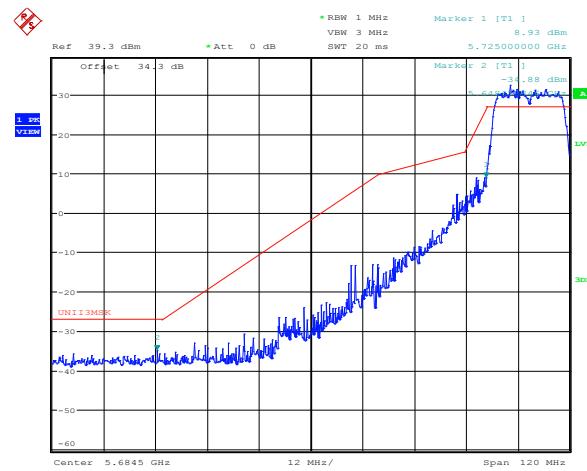


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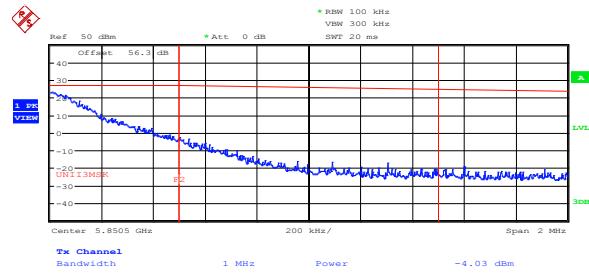
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**Figure 8.4-64:** Conducted lower band edge emissions at 5650 MHz and 5725 MHz, 10 MHz channel, 10 dBi antenna, ch1



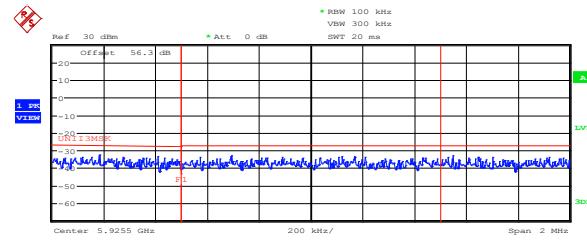
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**Figure 8.4-65:** Conducted lower band edge emissions at 5650 MHz and 5725 MHz, 20 MHz channel, 10 dBi antenna, ch1



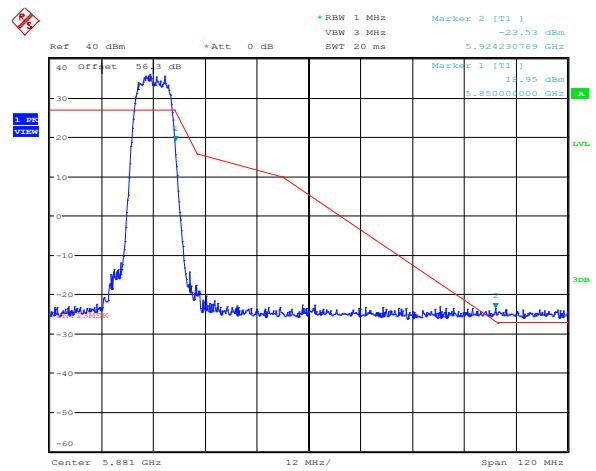
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**Figure 8.4-66:** Conducted upper band edge emissions at 5850 MHz, 5 MHz channel, 32 dBi antenna, cho

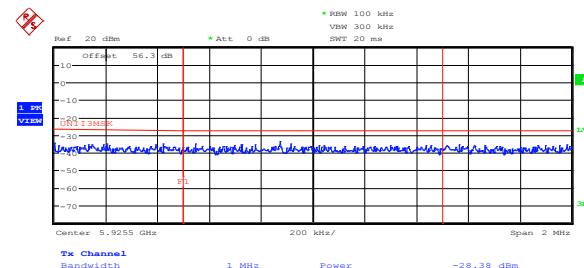


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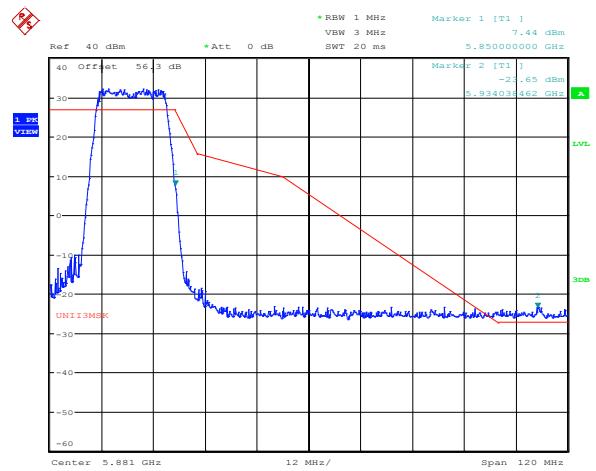
**Figure 8.4-67:** Conducted upper band edge emissions at 5925 MHz, 5 MHz channel, 32 dBi antenna, cho



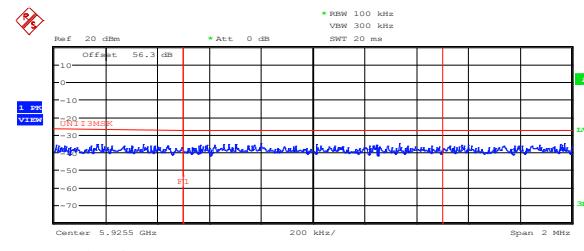
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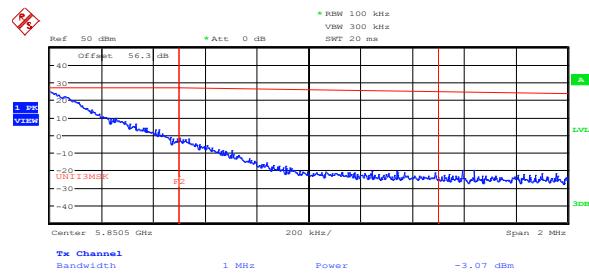
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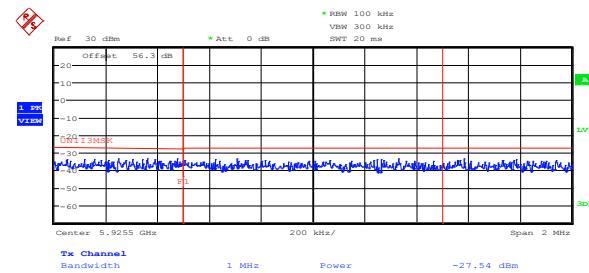


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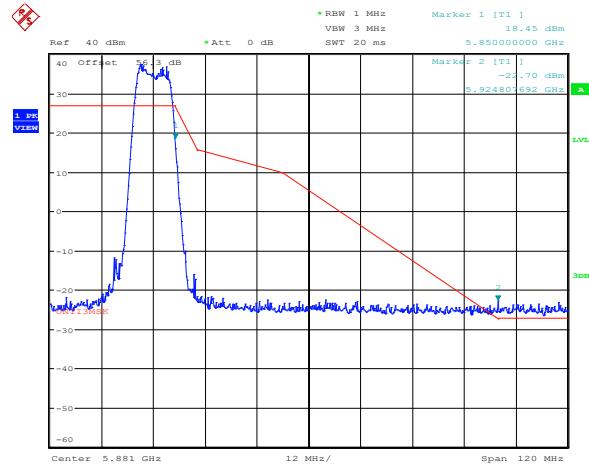
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**Figure 8.4-72:** Conducted upper band edge emissions at 5850 MHz, 5 MHz channel, 32 dBi antenna, ch1



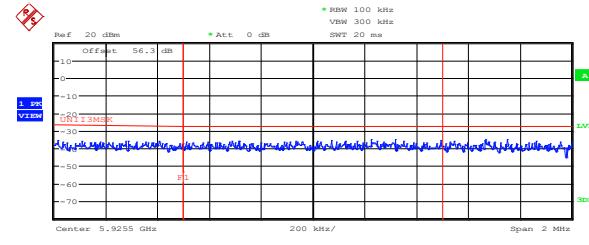
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**Figure 8.4-73:** Conducted upper band edge emissions at 5925 MHz, 5 MHz channel, 32 dBi antenna, ch1



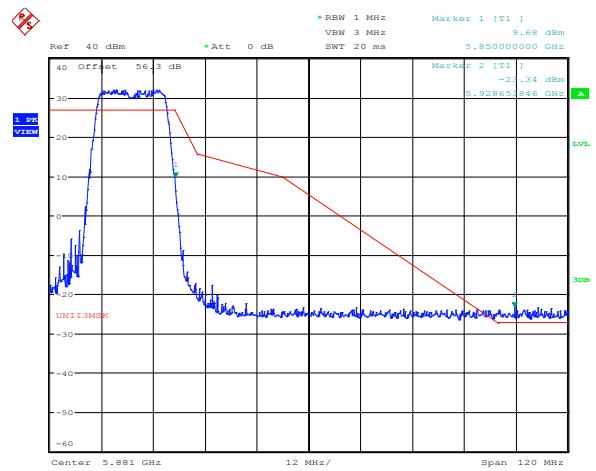
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**Figure 8.4-74:** Conducted upper band edge emissions at 5850 MHz, 10 MHz channel, 32 dBi antenna, ch1



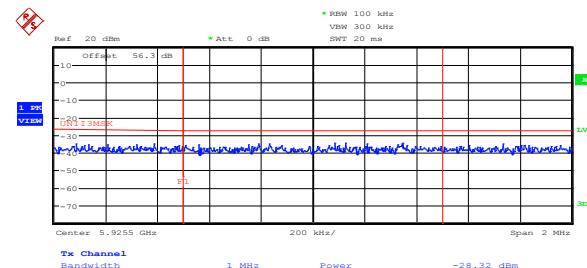
Date: 30.JUN.2016 11:59:48

**Figure 8.4-75:** Conducted upper band edge emissions at 5925 MHz, 10 MHz channel, 32 dBi antenna, ch1



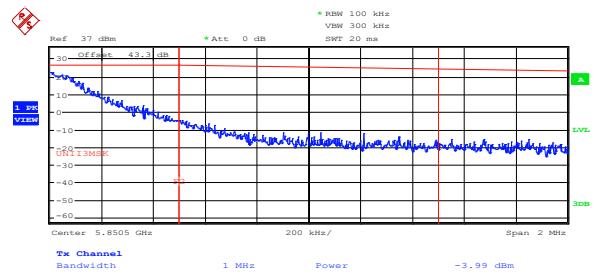
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**Figure 8.4-76:** Conducted upper band edge emissions at 5850 MHz, 20 MHz channel, 32 dBi antenna, ch1



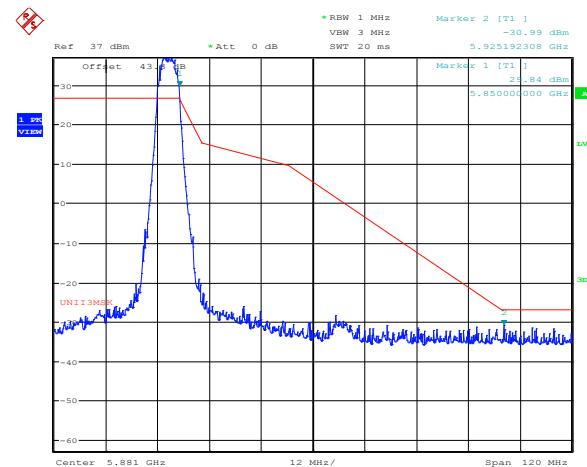
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**Figure 8.4-77:** Conducted upper band edge emissions at 5925 MHz, 20 MHz channel, 32 dBi antenna, ch1



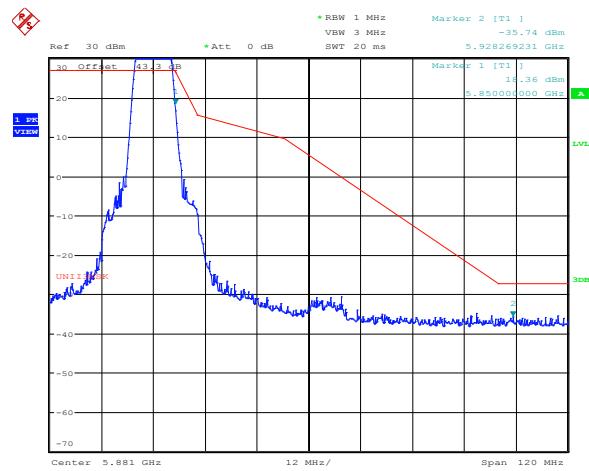
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**Figure 8.4-78:** Conducted upper band edge emissions at 5850 MHz, 5 MHz channel, 19 dBi antenna, cho



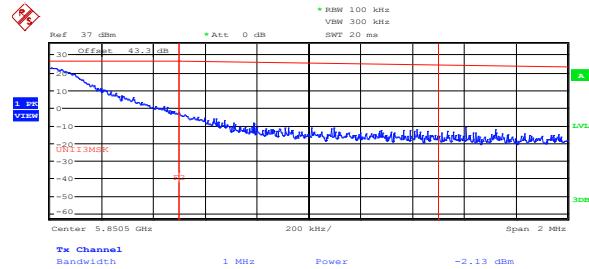
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**Figure 8.4-79:** Conducted upper band edge emissions at 5925 MHz, 5 MHz channel, 19 dBi antenna, cho



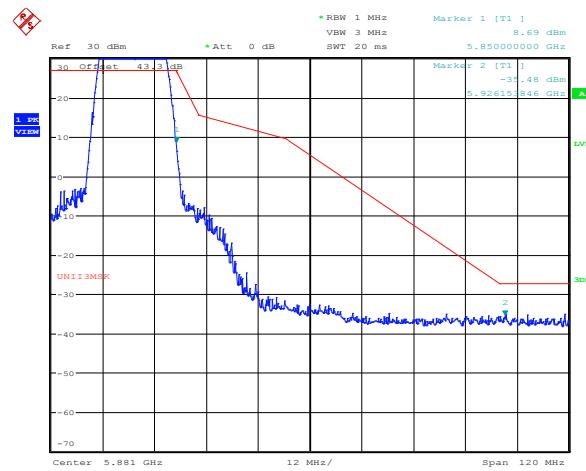
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**Figure 8.4-80:** Conducted upper band edge emissions at 5850 MHz and 5925 MHz, 10 MHz channel, 19 dBi antenna, cho



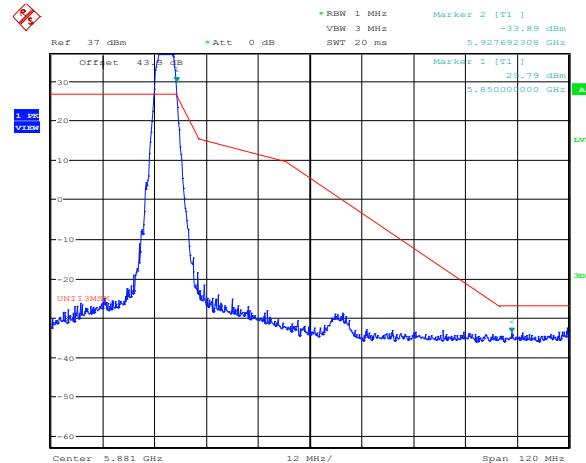
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**Figure 8.4-82:** Conducted upper band edge emissions at 5850 MHz, 5 MHz channel, 19 dBi antenna, ch1



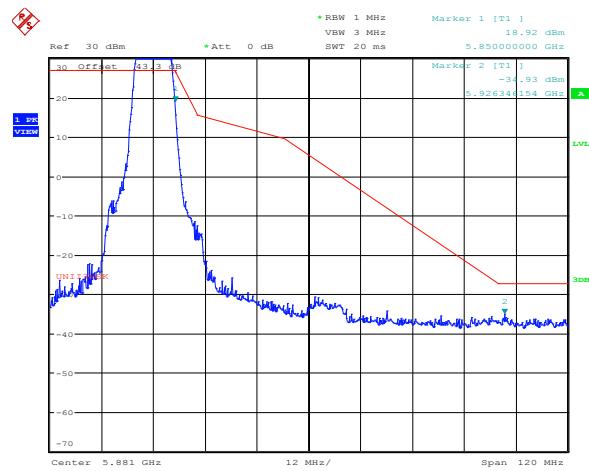
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**Figure 8.4-81:** Conducted upper band edge emissions at 5850 MHz and 5925 MHz, 20 MHz channel, 19 dBi antenna, cho

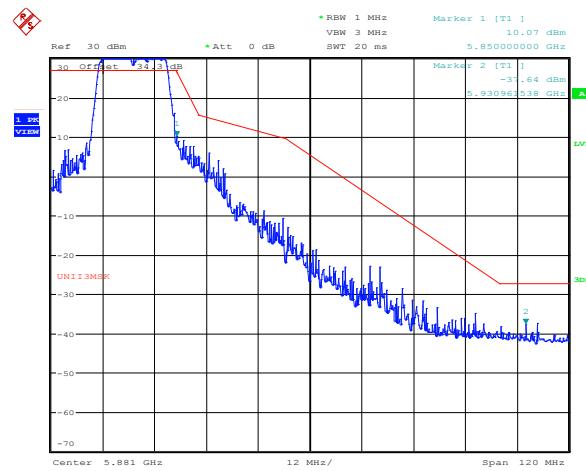


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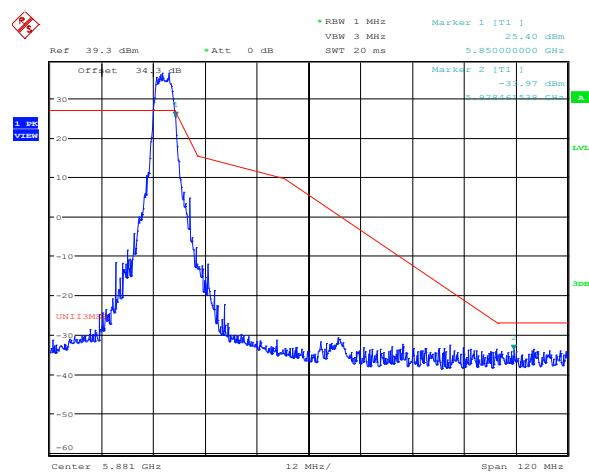
**Figure 8.4-83:** Conducted upper band edge emissions at 5925 MHz, 5 MHz channel, 19 dBi antenna, ch1



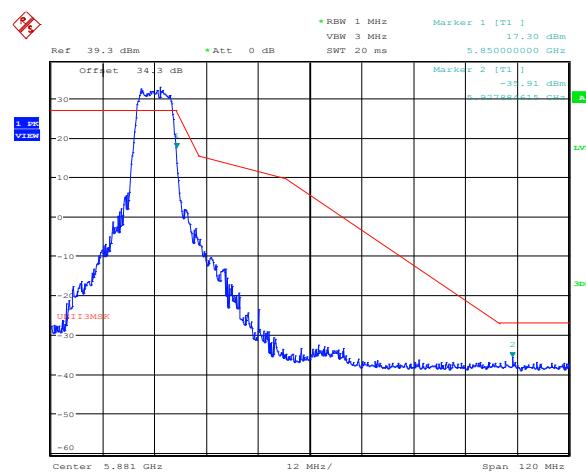
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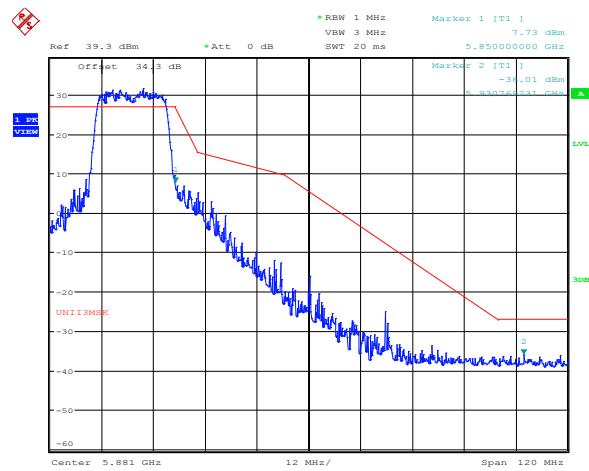
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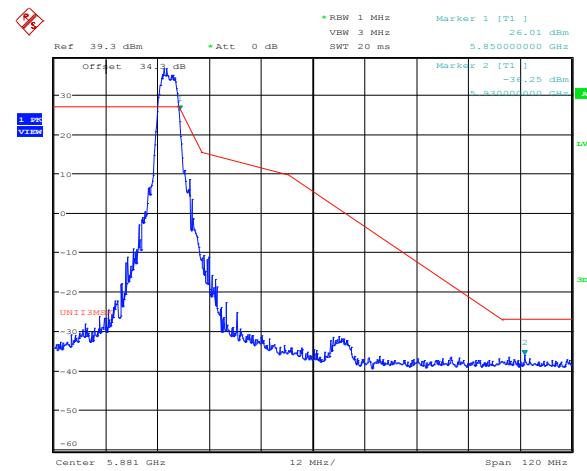
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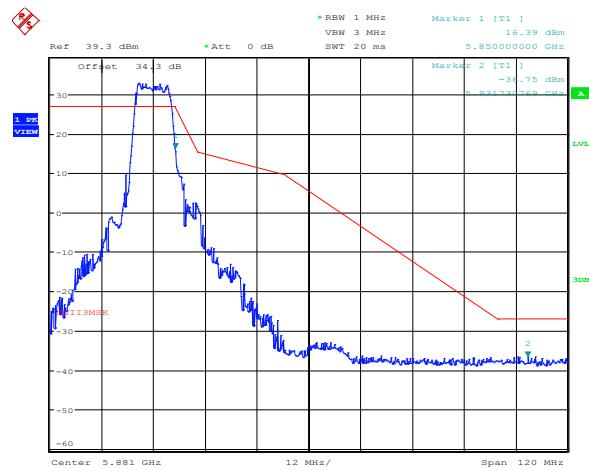
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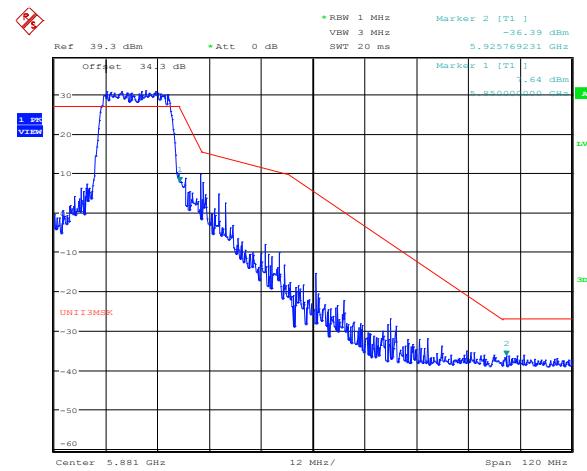
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Date: 30.JUN.2016 11:52:03



Date: 30.JUN.2016 11:55:31



Date: 30.JUN.2016 12:07:53

**Table 8.4-6: Radiated field strength measurement results for 5 MHz channel**

Channel	Frequency, MHz	Peak Field strength, dB $\mu$ V/m	Peak limit, dB $\mu$ V/m	Peak margin, dB	Average factor, dB	Average Field strength, dB $\mu$ V/m	Average limit, dB $\mu$ V/m	Average margin, dB
Low	11.455	54.59	74.00	19.41	11.47	43.12	54.00	10.88
Mid	11.581	56.16	74.00	17.84	11.47	44.69	54.00	9.31
High	11.695	56.55	74.00	17.45	11.47	45.08	54.00	8.92

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

**Table 8.4-7: Radiated field strength measurement results for 10 MHz channel**

Channel	Frequency, MHz	Peak Field strength, dB $\mu$ V/m	Peak limit, dB $\mu$ V/m	Peak margin, dB	Average factor, dB	Average Field strength, dB $\mu$ V/m	Average limit, dB $\mu$ V/m	Average margin, dB
Low	11.462	54.60	74.00	19.40	11.81	42.79	54.00	11.21
Mid	11.579	55.89	74.00	18.11	11.81	44.08	54.00	9.92
High	11.693	52.94	74.00	21.06	11.81	41.13	54.00	12.87

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

**Table 8.4-8: Radiated field strength measurement results for 20 MHz channel**

Channel	Frequency, MHz	Peak Field strength, dB $\mu$ V/m	Peak limit, dB $\mu$ V/m	Peak margin, dB	Average factor, dB	Average Field strength, dB $\mu$ V/m	Average limit, dB $\mu$ V/m	Average margin, dB
Low	11.472	56.39	74.00	17.61	13.01	43.38	54.00	10.62
Mid	11.574	52.43	74.00	21.57	13.01	39.42	54.00	14.58
Mid	17.786	56.55	74.00	17.45	13.01	43.54	54.00	10.46
High	11.689	52.46	74.00	21.54	13.01	39.45	54.00	14.55

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

## 8.5 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

### 8.5.1 Definitions and limits

#### FCC §15.407(6)(b):

Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207

#### FCC §15.207(a):

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that 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 the following table, as measured using a 50  $\mu$ H/50  $\Omega$  line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

#### IC:

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 8.5-1: Conducted emissions limit**

Frequency of emission (MHz)	Quasi-peak	Conducted limit (dB $\mu$ V)	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.

### 8.5.2 Test summary

Test date	June 29, 2016	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	33 %

### 8.5.3 Observations, settings and special notes

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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.

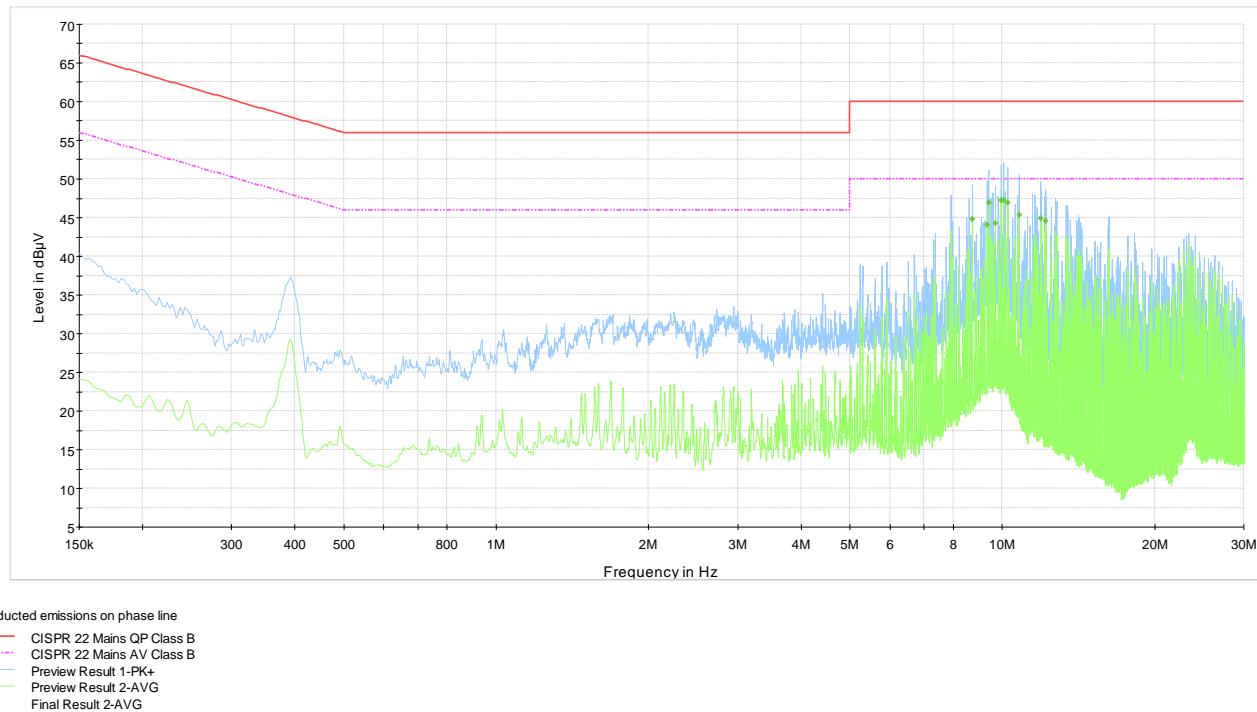
Receiver settings for preview measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average
Trace mode	Max Hold
Measurement time	100 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	100 ms

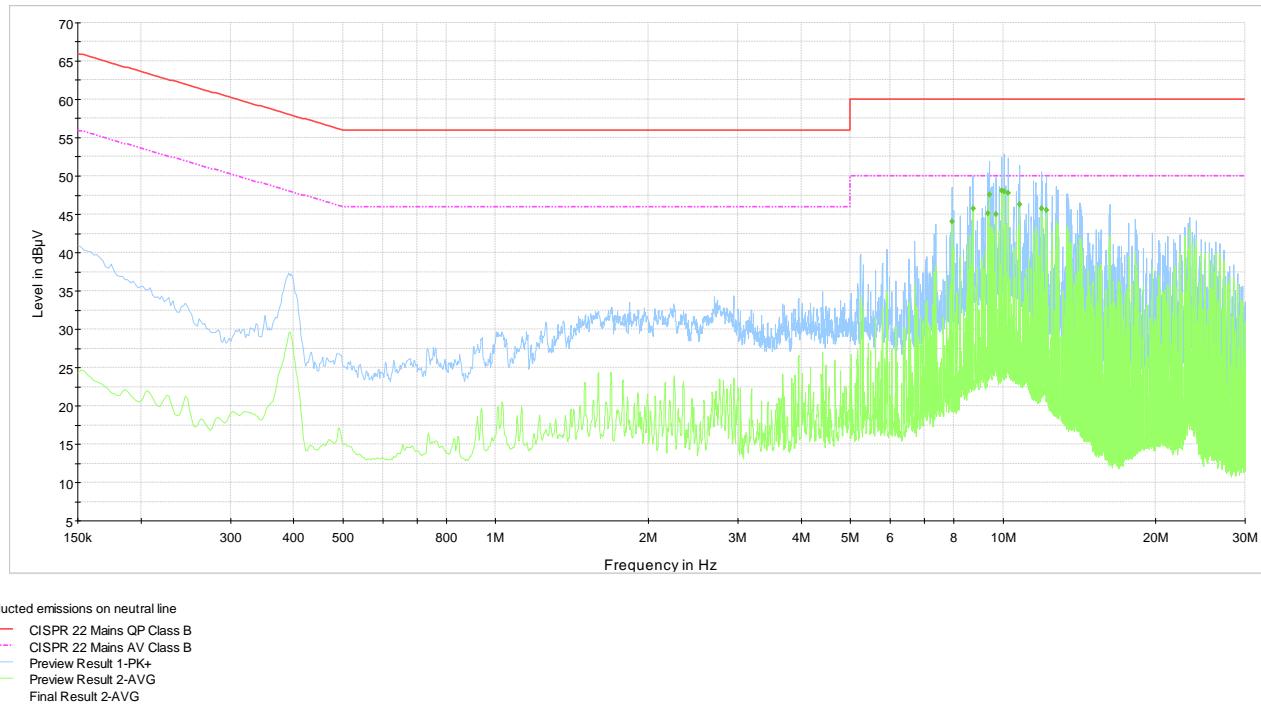
## 8.5.4 Test data



**Plot 8.5-1: Conducted emissions on phase line**

**Table 8.5-2: Average conducted emissions results on phase line**

Frequency, MHz	Average result, dBμV	Meas. Time, ms	Bandwidth, kHz	Filter	Conductor	Correction, dB	Margin, dB	Limit, dBμV
8.718000	44.8	100	9	On	Phase	10.2	5.2	50.0
9.327750	44.1	100	9	On	Phase	10.2	5.9	50.0
9.388500	46.9	100	9	On	Phase	10.2	3.1	50.0
9.694500	44.3	100	9	On	Phase	10.2	5.7	50.0
9.937500	47.2	100	9	On	Phase	10.3	2.8	50.0
10.060750	47.3	100	9	On	Phase	10.3	2.7	50.0
10.243000	46.9	100	9	On	Phase	10.3	3.1	50.0
10.794250	45.3	100	9	On	Phase	10.3	4.7	50.0
11.892250	44.9	100	9	On	Phase	10.4	5.1	50.0
12.198250	44.6	100	9	On	Phase	10.4	5.4	50.0



**Plot 8.5-2: Conducted emissions on neutral line**

**Table 8.5-3: Average conducted emissions results on neutral line**

Frequency, MHz	Average result, dBμV	Meas. Time, ms	Bandwidth, kHz	Filter	Conductor	Correction, dB	Margin, dB	Limit, dBμV
7.923750	44.0	100	9	On	Neutral	10.2	6.0	50.0
8.718000	45.8	100	9	On	Neutral	10.3	4.2	50.0
9.327750	45.2	100	9	On	Neutral	10.3	4.8	50.0
9.388500	47.5	100	9	On	Neutral	10.3	2.5	50.0
9.694500	45.0	100	9	On	Neutral	10.3	5.0	50.0
9.937500	48.1	100	9	On	Neutral	10.3	1.9	50.0
10.060750	48.0	100	9	On	Neutral	10.3	2.0	50.0
10.243000	47.8	100	9	On	Neutral	10.3	2.2	50.0
10.794250	46.3	100	9	On	Neutral	10.4	3.7	50.0
11.892250	45.8	100	9	On	Neutral	10.4	4.2	50.0
12.198250	45.5	100	9	On	Neutral	10.5	4.5	50.0

## 8.6 FCC 15.407(g) and RSS-Gen 8.11 Frequency stability

### 8.6.1 Definitions and limits

Manufacturers of U-NII (IC: LE-LAN) devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

### 8.6.2 Test summary

Test date:	June 28, 2016	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1025 mbar
Verdict:	Pass	Relative humidity:	31 %

### 8.6.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

### 8.6.4 Test data

*Table 8.6-1: Frequency drift measurement*

Test conditions	Frequency, GHz	Drift, Hz
+50 °C, Nominal	5.729952003	80
+40 °C, Nominal	5.729952044	121
+30 °C, Nominal	5.729952079	156
+20 °C, +15 %	5.729951884	-39
+20 °C, Nominal	5.729951923	Reference
+20 °C, -15 %	5.729951999	76
+10 °C, Nominal	5.729952024	101
0 °C, Nominal	5.729952122	199
-10 °C, Nominal	5.72995203	107
-20 °C, Nominal	5.729952245	322
-30 °C, Nominal	5.729952197	274

**Table 8.6-2: Lower band edge drift calculation for cho**

Channel bandwidth, MHz	-26 dBc lower cross point, GHz	Max negative drift, Hz	Drifted lower cross point, GHz	Band edge, GHz	Margin, MHz
5	5.725160256	39	5.725160217	5.725	0.160217
10	5.725320513	39	5.725320474	5.725	0.320474
20	5.725705128	39	5.725705089	5.725	0.705089

Notes: Drifted lower cross point = -26 dBc lower cross point – max negative drift.

**Table 8.6-3: Lower band edge drift calculation for ch1**

Channel bandwidth, MHz	-26 dBc lower cross point, GHz	Max negative drift, Hz	Drifted lower cross point, GHz	Band edge, GHz	Margin, MHz
5	5.725160256	39	5.725160217	5.725	0.160217
10	5.725352564	39	5.725352525	5.725	0.352525
20	5.725705128	39	5.725705089	5.725	0.705089

Notes: Drifted lower cross point = -26 dBc lower cross point – max negative drift.

**Table 8.6-4: Upper band edge drift calculation for cho**

Channel bandwidth, MHz	-26 dBc upper cross point, GHz	Max positive drift, Hz	Drifted upper cross point, GHz	Band edge, GHz	Margin, MHz
5	5.849839744	322	5.849840066	5.850	0.159934
10	5.849615385	322	5.849615707	5.850	0.384293
20	5.849214744	322	5.849215066	5.850	0.784934

Notes: Drifted upper cross point = -26 dBc upper cross point + max positive drift.

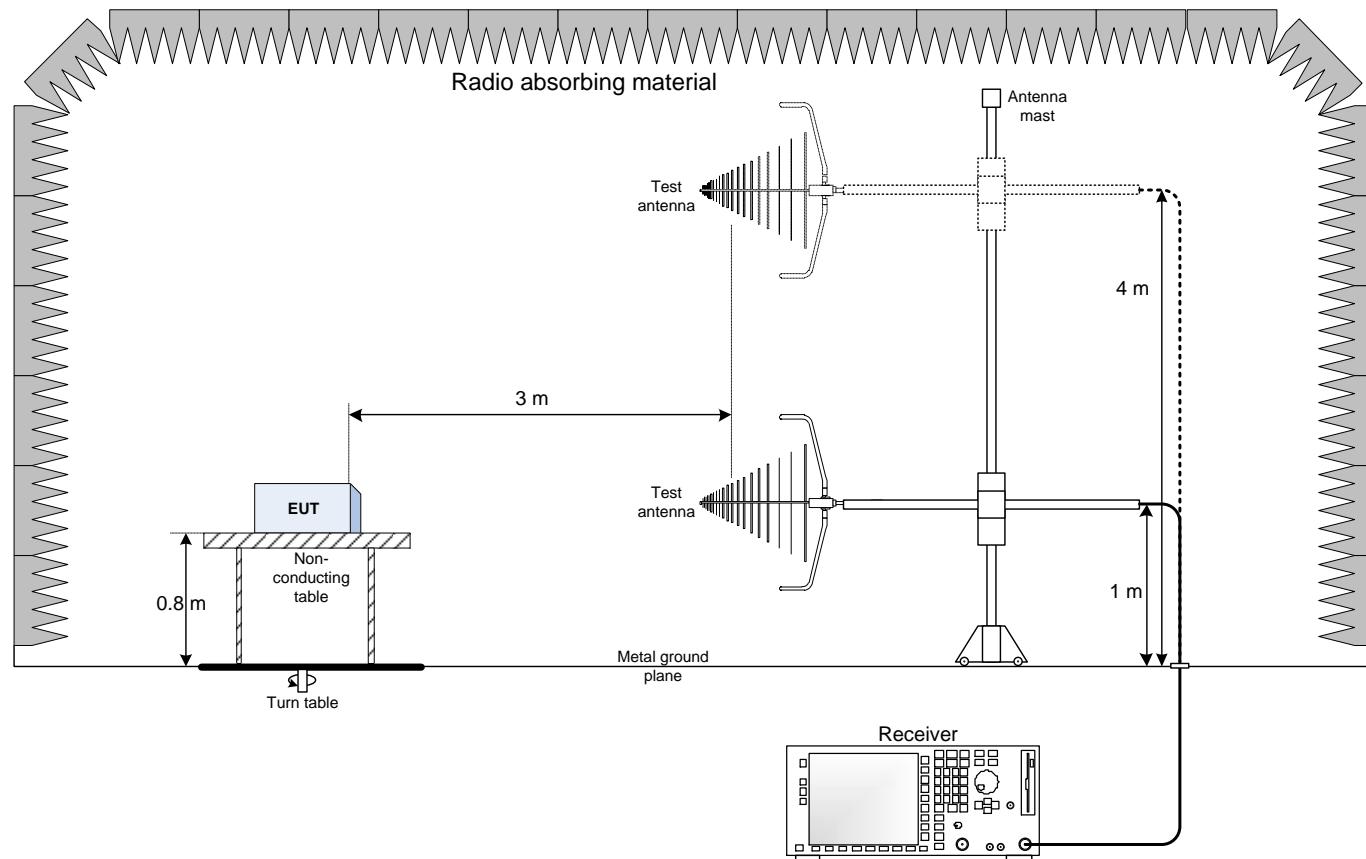
**Table 8.6-5: Upper band edge drift calculation for ch1**

Channel bandwidth, MHz	-26 dBc upper cross point, GHz	Max positive drift, Hz	Drifted upper cross point, GHz	Band edge, GHz	Margin, MHz
5	5.849839744	322	5.849840066	5.850	0.159934
10	5.849647436	322	5.849647758	5.850	0.352242
20	5.849375000	322	5.849375322	5.850	0.624678

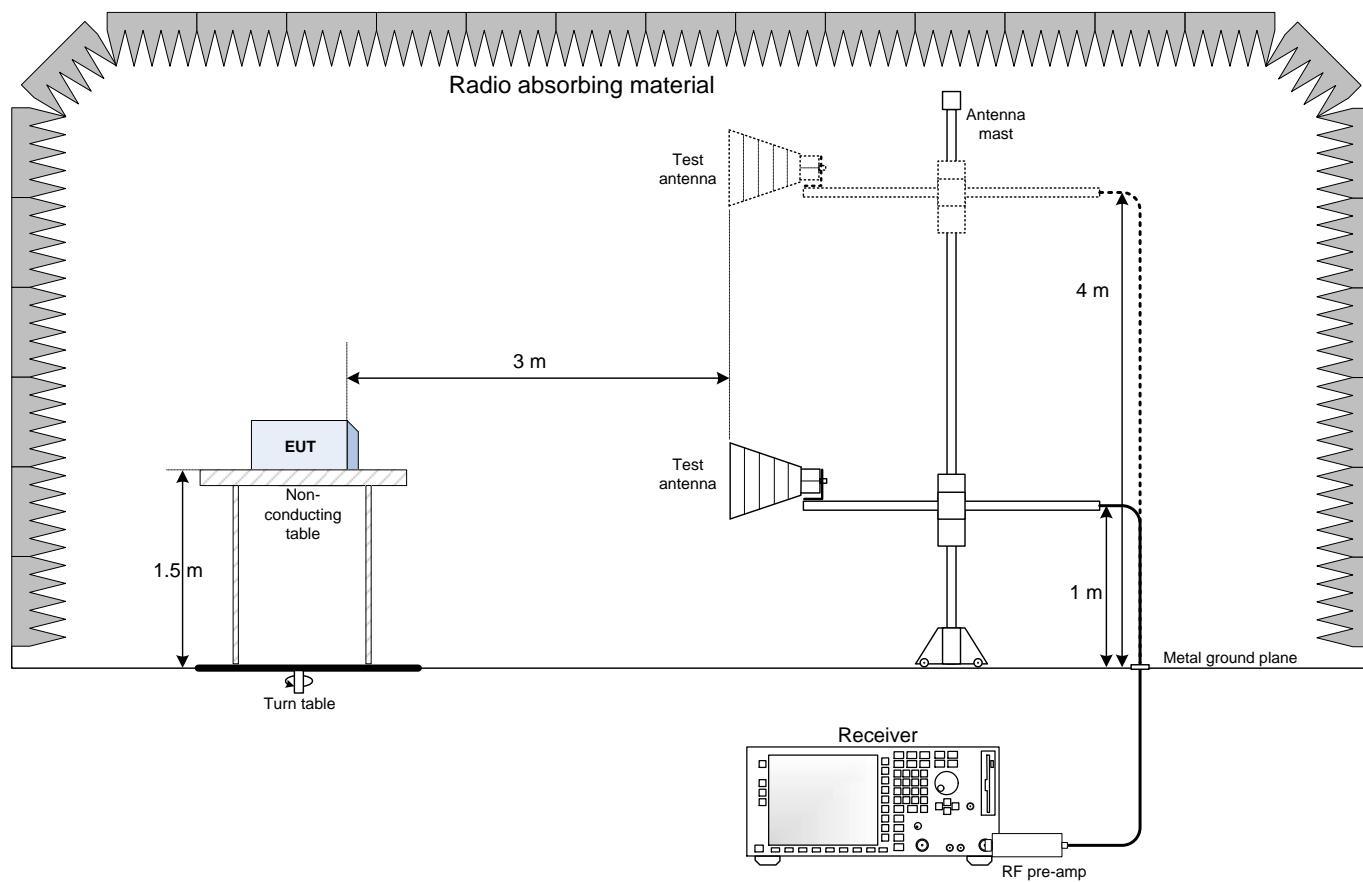
Notes: Drifted upper cross point = -26 dBc upper cross point + max positive drift.

## Section 9. Block diagrams of test set-ups

### 9.1 Radiated emissions set-up for frequencies below 1 GHz



## 9.2 Radiated emissions set-up for frequencies above 1 GHz



## 9.3 Conducted emissions set-up

