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Test report

237492-2TRFWL

Date of issue: May 16, 2013

Applicant:

Redline Communications

Product:

Broad-band wireless infrastructure product

Model:

RDL-3000-RMG

FCC ID: QC8-RDL3000RMG

IC Registration number: 4310A-RDL3000RMG

FCC 47 CFR Part 15 Subpart C, §15.247

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

RSS-210, Issue 8 Annex 8, December 2010

Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

Test location

Nemko Canada Inc.
303 River Road
Ottawa, ON, K1V 1H2
Canada
FCC test site registration number: 176392 and IC registered site number: 2040A-4 (3 m semi anechoic chamber)

Telephone +1 613 737 9680
Facsimile +1 613 737 9691
Toll free +1 800 563 6336
Website www.nemko.com

Tested by Andrey Adelberg, Senior Wireless/EMC Specialist

Reviewed by 

Kevin Rose, Wireless/EMC Specialist

May 16, 2013

Date

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Redline Communications
302 Town Center Blvd.
Markham, Ontario,
Canada, L3R 0E8

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
RSS-210, Issue 8 Annex 8	Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

1.3 Test methods

Guidance for compliance measurements on DTS operating under 15.247	558074 D01 Meas Guidance v02 (October 4, 2012)
Emissions testing of transmitters with multiple outputs in the same band (MIMO)	662911 D01 Multiple Transmitter Output v01r02 (September 26, 2012)
AC power-line conducted emission measurements	ANSI C63.4-2009, Clause 7

1.4 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.

1.5 Exclusions

None

1.6 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 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]

Notes: [1] 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

[2] The EUT requires a professional installation.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(b)(4)	Maximum conducted output power	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 IC RSS-GEN, Issue 3, test results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
6.1	Receiver spurious emissions limits (radiated)	Not applicable
6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable
7.2.4	AC power lines conducted emission limits	Pass

Notes: [1] According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 IC RSS-210, Issue 8, test results

Part	Test description	Verdict
A8.1	Frequency hopping systems	
A8.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
A8.1 (b)	Minimum channel spacing for frequency hopping systems	Not applicable
A8.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
A8.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
A8.2	Digital modulation systems	
A8.2 (a)	Minimum 6 dB bandwidth	Pass
A8.2 (b)	Maximum power spectral density	Pass
A8.3	Hybrid systems	
A8.3 (1)	Digital modulation turned off	Not applicable
A8.3 (2)	Frequency hopping turned off	Not applicable
A8.4	Transmitter output power and e.i.r.p. requirements	
A8.4 (1)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
A8.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.4 (3)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
A8.4 (4)	Systems employing digital modulation techniques	Pass
A8.4 (5)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
A8.4 (6)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
A8.5	Out-of-band emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	January 21, 2013
Nemko sample ID number	1

3.2 EUT information

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

3.3 Technical information

Operating band	5725–5850 MHz
Operating frequency	5727.5–5847.5 MHz (5 MHz channel), 5730–5845 MHz (10 MHz channel) and 5735–5840 MHz (20 MHz channel)
Modulation type	OFDM using 64-QAM, 16-QAM, QPSK and BPSK modulation for sub-carriers
Occupied bandwidth (99 %)	4.17 MHz (5 MHz channel); 8.20 MHz (10 MHz channel); 16.35 MHz (20 MHz channel)
Emission designator	W7D
Power requirements	48 V_{DC} PoE via 120 V_{AC}, 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

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

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

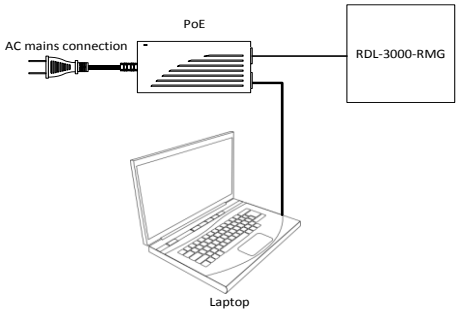


Diagram 3.6-1: *Setup diagram*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

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

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

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 ±5 %, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 “Uncertainty in EMC measurements.” Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

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	Mar. 09/13
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power supply	California Inst.	3001I	FA001021	1 year	May 08/13
Bilog antenna	Sunol	JB3	FA002108	1 year	Feb. 21/14
Horn antenna #2	EMCO	3115	FA000825	1 year	Feb. 21/14
1–18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	July 03/13
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Jan. 16/14
18–26 GHz pre-amplifier	Narda	BBS-1826N612	FA001550	—	VOU
Horn antenna 18–26.5 GHz	Electro-metrics	SH-50/60-1	FA000479	—	VOU
Horn antenna 26.5–40 GHz	Electro-metrics	SH-50/60-2	FA000485	—	VOU
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR

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

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 7.2.4 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:
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 µH/50 Ω 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:
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is 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 2. The tighter limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 Ω/50 µH line impedance stabilization network (LISN).

Table 8.1-1: *Conducted emissions limit*

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - Decreases with the logarithm of the frequency.

8.1.2 Test summary

Test date	January 25, 2013	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1003 mbar	**Relative humidity**	32 %

8.1.3 Observations/special notes

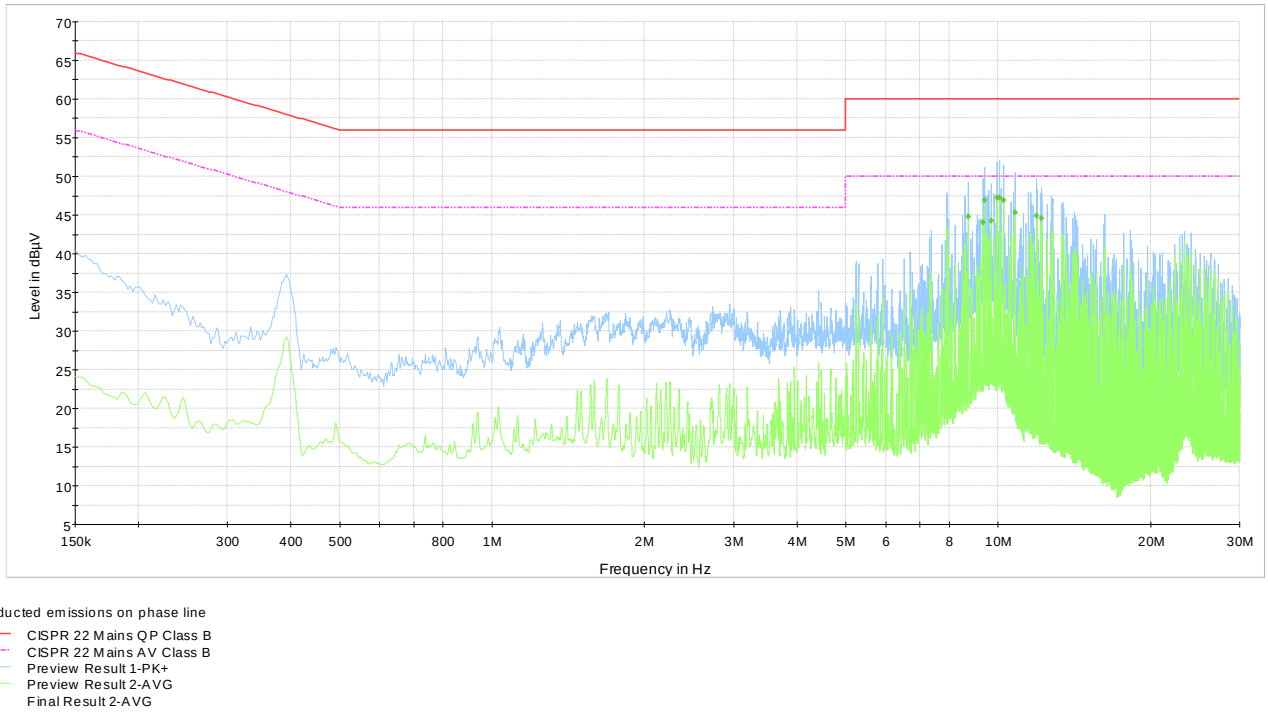
The EUT was set up as tabletop configuration.

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

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

Receiver settings for preview measurements: Peak and Average detector (Max hold), RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms
Receiver settings for final measurements: Q-Peak and Average detector, RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms

8.1.4 Test data

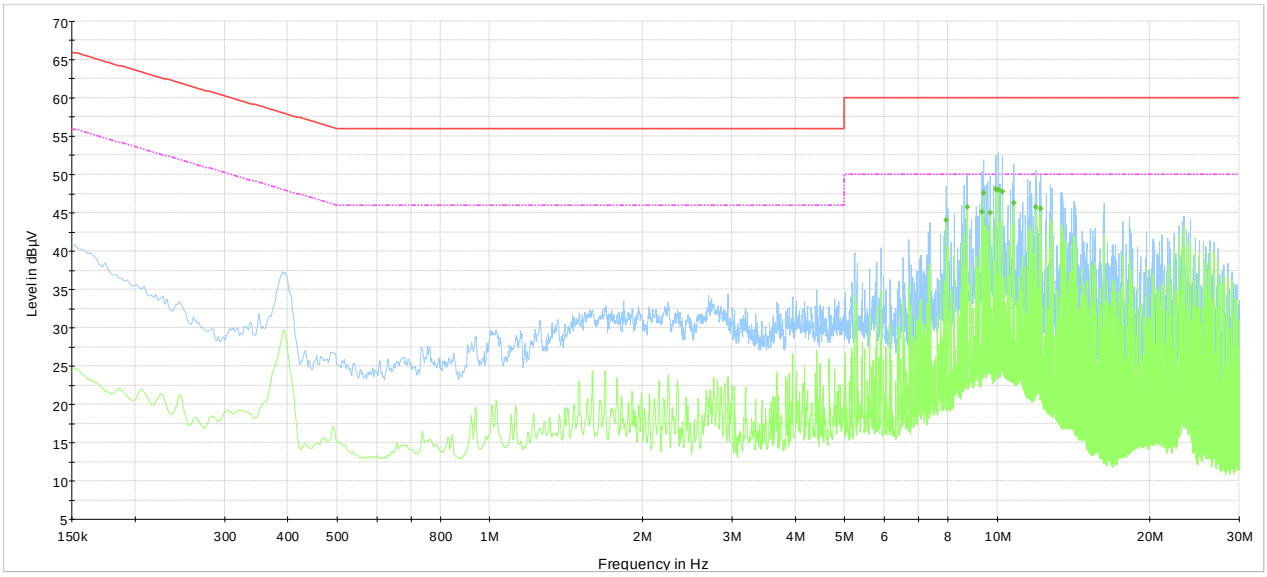


Plot 8.1-1: *Conducted emissions on phase line*

Table 8.1-2: *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

8.1.4 Test data, continued



Plot 8.1-2: *Conducted emissions on neutral line*

Table 8.1-3: *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

8.2 FCC 15.247(a)(2) and RSS-210 A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.2.1 Definitions and limits

FCC and IC:

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2.2 Test summary

Test date	January 31, 2013	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1005 mbar	**Relative humidity**	32 %

8.2.3 Observations/special notes

Measurements were performed with peak detector using RBW = 1–5 % of DTS BW (no wider than 100 kHz). VBW was set three times RBW.

8.2.4 Test data

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

Modulation	Frequency, MHz	6 dB bandwidth, MHz	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
QPSK	5727.5	4.10	0.50	3.60
	5790.0	4.10	0.50	3.60
	5847.5	4.08	0.50	3.58
16-QAM	5727.5	4.11	0.50	3.61
	5790.0	4.10	0.50	3.60
	5847.5	4.08	0.50	3.58
64-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

8.2.4 Test data, continued

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

Modulation	Frequency, MHz	6 dB bandwidth, MHz	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
QPSK	5730.0	8.20	0.50	7.70
	5790.0	8.13	0.50	7.63
	5845.0	8.14	0.50	7.64
16-QAM	5730.0	8.20	0.50	7.70
	5790.0	8.13	0.50	7.63
	5845.0	8.15	0.50	7.65
64-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	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
QPSK	5735.0	16.46	0.50	15.96
	5790.0	16.45	0.50	15.95
	5840.0	16.46	0.50	15.96
16-QAM	5735.0	16.43	0.50	15.93
	5790.0	16.46	0.50	15.96
	5840.0	16.47	0.50	15.97
64-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

8.2.4 Test data, continued

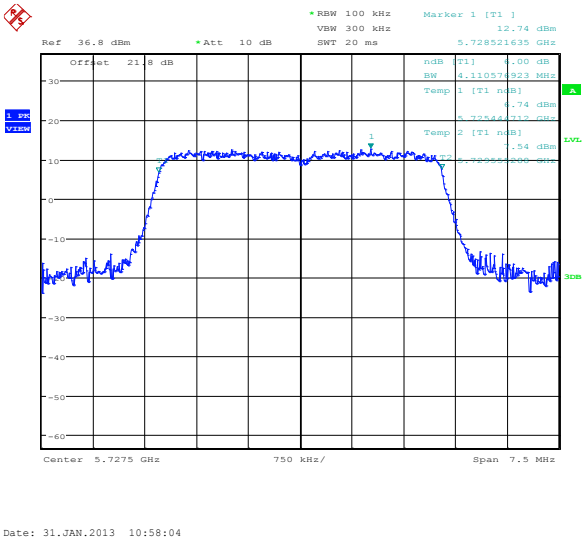


Diagram 8.2-1: *6 dB bandwidth sample plot for 5 MHz channel*

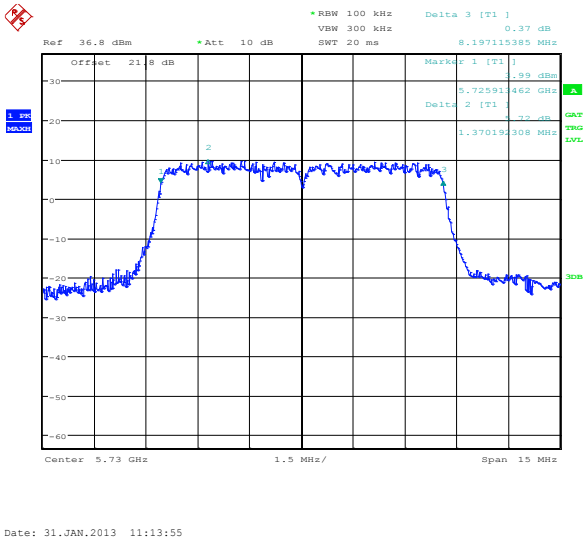


Diagram 8.2-2: *6 dB bandwidth sample plot for 10 MHz channel*

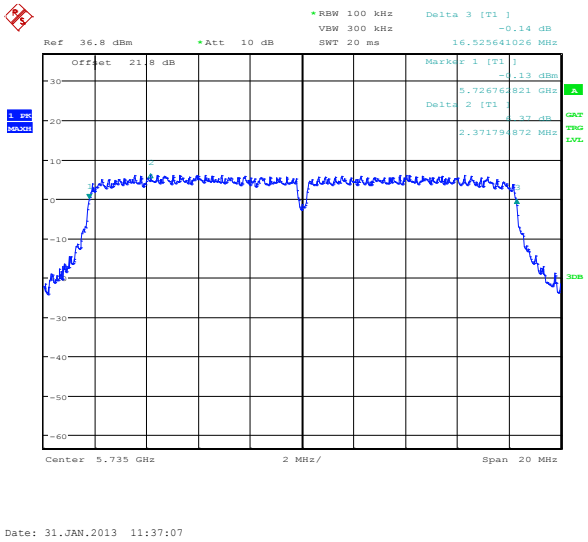


Diagram 8.2-3: *6 dB bandwidth sample plot for 20 MHz channel*

8.3 RSS-Gen 4.6.1 Occupied bandwidth

8.3.1 Definitions and limits

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent emission bandwidth, as calculated or measured.

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

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

8.3.2 Test summary

Test date	January 31, 2013	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1004 mbar	**Relative humidity**	33 %

8.3.3 Observations/special notes

Measurements were performed with peak detector using RBW ≥ 1 % of span; VBW was set three times RBW.

8.3.4 Test data

Table 8.3-1: *99 % bandwidth results for 5 MHz channel*

Frequency, MHz	99 % bandwidth, MHz
5727.5	4.17
5790.0	4.13
5847.5	4.14

Table 8.3-2: *99 % bandwidth results for 10 MHz channel*

Frequency, MHz	99 % bandwidth, MHz
5730.0	8.17
5790.0	8.17
5845.0	8.20

Table 8.3-3: *99 % bandwidth results for 20 MHz channel*

Frequency, MHz	99 % bandwidth, MHz
5735.0	16.35
5790.0	16.35
5840.0	16.35

8.3.4 Test data, continued

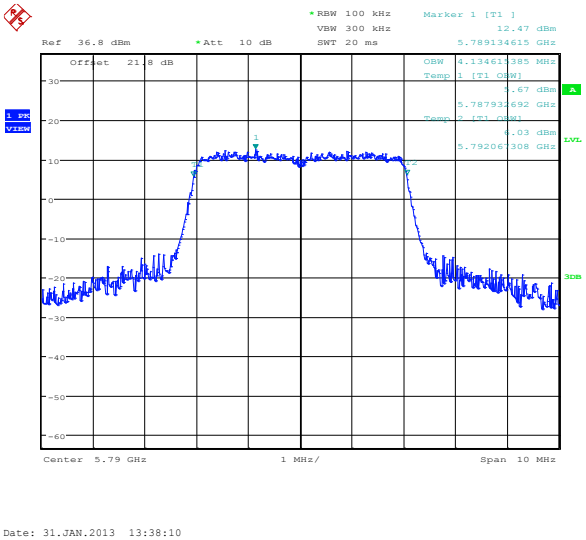


Diagram 8.3-1: *99 % bandwidth sample plot for 5 MHz channel*

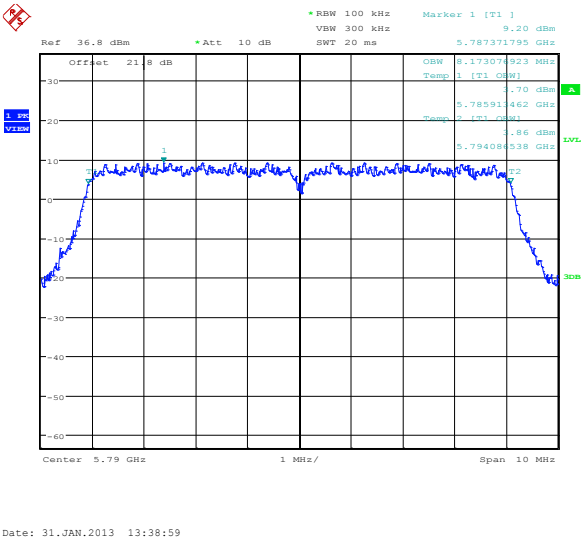


Diagram 8.3-2: *99 % bandwidth sample plot for 10 MHz channel*

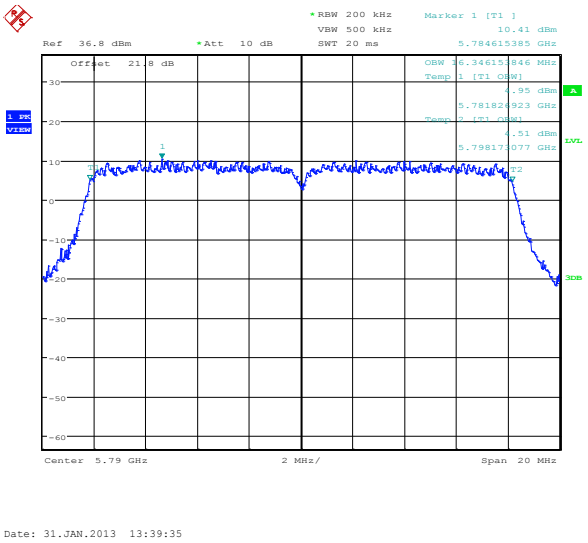


Diagram 8.3-3: *99 % bandwidth sample plot for 20 MHz channel*

8.4 FCC 15.247(b) and RSS-210 A8.4 (4) Transmitter output power and e.i.r.p. requirements

8.4.1 Definitions and limits

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

IC:

A8.4 (4) Transmitter Output Power and e.i.r.p. Requirements for systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands

For systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz, the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section A8.4(5), the e.i.r.p. shall not exceed 4 W.
As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power (see RSS-Gen).

8.4.2 Test summary

Test date	February 1, 2013	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1003 mbar	**Relative humidity**	32 %

8.4.3 Observations/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 dBm – (10 dBi – 6 dBi) = 26 dBm; for 19 dBi antenna: 30 dBm – (19 dBi – 6 dBi) = 17 dBm and for 32 dBi antenna: 30 dBm – (32 dBi – 6 dBi) = 4 dBm.

Combined average output power was calculated as follows:

$$P_{combined} = 10 \times log_{10}\left(\left(10^{P_{ch0}/10}\right) + \left(10^{P_{ch1}/10}\right)\right)$$

EIRP was calculated as follows:

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

8.4.4 Test data

Table 8.4-1: *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	18.42	18.41	21.43	26.00	4.57	10.00	31.43	36.00	4.57
	5790.0	22.34	22.18	25.27	26.00	0.73	10.00	35.27	36.00	0.73
	5847.5	20.25	20.55	23.41	26.00	2.59	10.00	33.41	36.00	2.59
QPSK	5727.5	18.42	18.40	21.42	26.00	4.58	10.00	31.42	36.00	4.58
	5790.0	22.29	22.18	25.25	26.00	0.75	10.00	35.25	36.00	0.75
	5847.5	20.29	20.50	23.41	26.00	2.59	10.00	33.41	36.00	2.59
16-QAM	5727.5	18.43	18.40	21.43	26.00	4.57	10.00	31.43	36.00	4.57
	5790.0	22.27	22.17	25.23	26.00	0.77	10.00	35.23	36.00	0.77
	5847.5	20.31	20.48	23.41	26.00	2.59	10.00	33.41	36.00	2.59
64-QAM	5727.5	18.43	18.40	21.43	26.00	4.57	10.00	31.43	36.00	4.57
	5790.0	22.26	22.18	25.23	26.00	0.77	10.00	35.23	36.00	0.77
	5847.5	20.28	20.44	23.37	26.00	2.63	10.00	33.37	36.00	2.63

Table 8.4-2: *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	13.35	13.35	16.36	17.00	0.64	19.00	35.36	36.00	0.64
	5790.0	13.77	13.33	16.57	17.00	0.43	19.00	35.57	36.00	0.43
	5847.5	13.57	14.35	16.99	17.00	0.01	19.00	35.99	36.00	0.01
QPSK	5727.5	13.96	13.45	16.72	17.00	0.28	19.00	35.72	36.00	0.28
	5790.0	13.77	13.33	16.57	17.00	0.43	19.00	35.57	36.00	0.43
	5847.5	13.54	14.10	16.84	17.00	0.16	19.00	35.84	36.00	0.16
16-QAM	5727.5	13.89	13.34	16.63	17.00	0.37	19.00	35.63	36.00	0.37
	5790.0	13.77	13.34	16.57	17.00	0.43	19.00	35.57	36.00	0.43
	5847.5	13.55	14.10	16.84	17.00	0.16	19.00	35.84	36.00	0.16
64-QAM	5727.5	13.91	13.33	16.64	17.00	0.36	19.00	35.64	36.00	0.36
	5790.0	13.77	13.33	16.57	17.00	0.43	19.00	35.57	36.00	0.43
	5847.5	13.45	14.41	16.97	17.00	0.03	19.00	35.97	36.00	0.03

Table 8.4-3: *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	0.68	1.10	3.91	4.00	0.09	32.00	35.91	36.00	0.09
	5790.0	0.77	0.92	3.86	4.00	0.14	32.00	35.86	36.00	0.14
	5847.5	0.54	0.98	3.78	4.00	0.22	32.00	35.78	36.00	0.22
QPSK	5727.5	0.84	1.10	3.98	4.00	0.02	32.00	35.98	36.00	0.02
	5790.0	0.78	0.91	3.86	4.00	0.14	32.00	35.86	36.00	0.14
	5847.5	0.54	0.94	3.75	4.00	0.25	32.00	35.75	36.00	0.25
16-QAM	5727.5	0.82	1.10	3.97	4.00	0.03	32.00	35.97	36.00	0.03
	5790.0	0.79	0.92	3.87	4.00	0.13	32.00	35.87	36.00	0.13
	5847.5	0.53	0.93	3.74	4.00	0.26	32.00	35.74	36.00	0.26
64-QAM	5727.5	0.86	1.10	3.99	4.00	0.01	32.00	35.99	36.00	0.01
	5790.0	0.75	0.92	3.85	4.00	0.15	32.00	35.85	36.00	0.15
	5847.5	0.51	0.93	3.74	4.00	0.26	32.00	35.74	36.00	0.26

8.4.4 Test data, continued

Table 8.4-4: *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	21.15	20.70	23.94	26.00	2.06	10.00	33.94	36.00	2.06
	5790.0	22.33	22.39	25.37	26.00	0.63	10.00	35.37	36.00	0.63
	5845.0	20.34	20.31	23.34	26.00	2.66	10.00	33.34	36.00	2.66
QPSK	5730.0	21.19	20.69	23.96	26.00	2.04	10.00	33.96	36.00	2.04
	5790.0	22.33	22.39	25.37	26.00	0.63	10.00	35.37	36.00	0.63
	5845.0	20.35	20.35	23.36	26.00	2.64	10.00	33.36	36.00	2.64
16-QAM	5730.0	21.12	20.69	23.92	26.00	2.08	10.00	33.92	36.00	2.08
	5790.0	22.30	22.40	25.36	26.00	0.64	10.00	35.36	36.00	0.64
	5845.0	20.36	20.26	23.32	26.00	2.68	10.00	33.32	36.00	2.68
64-QAM	5730.0	21.07	20.68	23.89	26.00	2.11	10.00	33.89	36.00	2.11
	5790.0	22.24	22.42	25.34	26.00	0.66	10.00	35.34	36.00	0.66
	5845.0	20.35	20.26	23.32	26.00	2.68	10.00	33.32	36.00	2.68

Table 8.4-5: *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	14.29	13.57	16.96	17.00	0.04	19.00	35.96	36.00	0.04
	5790.0	14.00	13.64	16.83	17.00	0.17	19.00	35.83	36.00	0.17
	5845.0	13.49	13.75	16.63	17.00	0.37	19.00	35.63	36.00	0.37
QPSK	5730.0	14.28	13.60	16.96	17.00	0.04	19.00	35.96	36.00	0.04
	5790.0	13.99	13.63	16.82	17.00	0.18	19.00	35.82	36.00	0.18
	5845.0	13.50	13.34	16.43	17.00	0.57	19.00	35.43	36.00	0.57
16-QAM	5730.0	14.35	13.59	17.00	17.00	0.00	19.00	36.00	36.00	0.00
	5790.0	14.00	13.56	16.80	17.00	0.20	19.00	35.80	36.00	0.20
	5845.0	13.57	13.33	16.46	17.00	0.54	19.00	35.46	36.00	0.54
64-QAM	5730.0	14.23	13.61	16.94	17.00	0.06	19.00	35.94	36.00	0.06
	5790.0	14.00	13.52	16.78	17.00	0.22	19.00	35.78	36.00	0.22
	5845.0	13.50	13.27	16.40	17.00	0.60	19.00	35.40	36.00	0.60

Table 8.4-6: *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	1.11	0.43	3.79	4.00	0.21	32.00	35.79	36.00	0.21
	5790.0	0.84	1.06	3.96	4.00	0.04	32.00	35.96	36.00	0.04
	5845.0	0.37	1.39	3.92	4.00	0.08	32.00	35.92	36.00	0.08
QPSK	5730.0	1.12	0.44	3.80	4.00	0.20	32.00	35.80	36.00	0.20
	5790.0	0.64	1.08	3.88	4.00	0.12	32.00	35.88	36.00	0.12
	5845.0	0.39	0.96	3.69	4.00	0.31	32.00	35.69	36.00	0.31
16-QAM	5730.0	1.14	0.45	3.82	4.00	0.18	32.00	35.82	36.00	0.18
	5790.0	0.81	1.07	3.95	4.00	0.05	32.00	35.95	36.00	0.05
	5845.0	0.42	0.92	3.69	4.00	0.31	32.00	35.69	36.00	0.31
64-QAM	5730.0	1.11	0.48	3.82	4.00	0.18	32.00	35.82	36.00	0.18
	5790.0	0.77	1.06	3.93	4.00	0.07	32.00	35.93	36.00	0.07
	5845.0	0.47	0.90	3.70	4.00	0.30	32.00	35.70	36.00	0.30

8.4.4 Test data, continued

Table 8.4-7: *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	22.30	22.74	25.54	26.00	0.46	10.00	35.54	36.00	0.46
	5790.0	22.59	22.72	25.67	26.00	0.33	10.00	35.67	36.00	0.33
	5840.0	21.53	21.65	24.60	26.00	1.40	10.00	34.60	36.00	1.40
QPSK	5735.0	22.31	22.76	25.55	26.00	0.45	10.00	35.55	36.00	0.45
	5790.0	22.66	22.72	25.70	26.00	0.30	10.00	35.70	36.00	0.30
	5840.0	21.63	21.66	24.66	26.00	1.34	10.00	34.66	36.00	1.34
16-QAM	5735.0	22.30	22.79	25.56	26.00	0.44	10.00	35.56	36.00	0.44
	5790.0	22.76	22.74	25.76	26.00	0.24	10.00	35.76	36.00	0.24
	5840.0	21.56	21.67	24.63	26.00	1.37	10.00	34.63	36.00	1.37
64-QAM	5735.0	22.29	22.73	25.53	26.00	0.47	10.00	35.53	36.00	0.47
	5790.0	22.77	22.77	25.78	26.00	0.22	10.00	35.78	36.00	0.22
	5840.0	21.53	21.67	24.61	26.00	1.39	10.00	34.61	36.00	1.39

Table 8.4-8: *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	13.45	13.94	16.71	17.00	0.29	19.00	35.71	36.00	0.29
	5790.0	14.19	13.79	17.00	17.00	0.00	19.00	36.00	36.00	0.00
	5840.0	13.92	13.49	16.72	17.00	0.28	19.00	35.72	36.00	0.28
QPSK	5735.0	13.55	13.91	16.74	17.00	0.26	19.00	35.74	36.00	0.26
	5790.0	14.18	13.78	16.99	17.00	0.01	19.00	35.99	36.00	0.01
	5840.0	13.93	13.51	16.74	17.00	0.26	19.00	35.74	36.00	0.26
16-QAM	5735.0	13.54	13.88	16.72	17.00	0.28	19.00	35.72	36.00	0.28
	5790.0	14.12	13.77	16.96	17.00	0.04	19.00	35.96	36.00	0.04
	5840.0	13.36	13.50	16.44	17.00	0.56	19.00	35.44	36.00	0.56
64-QAM	5735.0	13.50	13.89	16.71	17.00	0.29	19.00	35.71	36.00	0.29
	5790.0	14.15	13.80	16.99	17.00	0.01	19.00	35.99	36.00	0.01
	5840.0	13.98	13.50	16.76	17.00	0.24	19.00	35.76	36.00	0.24

Table 8.4-9: *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	1.34	0.60	4.00	4.00	0.00	32.00	36.00	36.00	0.00
	5790.0	1.02	0.37	3.72	4.00	0.28	32.00	35.72	36.00	0.28
	5840.0	0.81	0.33	3.59	4.00	0.41	32.00	35.59	36.00	0.41
QPSK	5735.0	1.33	0.54	3.96	4.00	0.04	32.00	35.96	36.00	0.04
	5790.0	1.03	0.37	3.72	4.00	0.28	32.00	35.72	36.00	0.28
	5840.0	0.72	0.34	3.54	4.00	0.46	32.00	35.54	36.00	0.46
16-QAM	5735.0	1.35	0.55	3.98	4.00	0.02	32.00	35.98	36.00	0.02
	5790.0	1.05	0.36	3.73	4.00	0.27	32.00	35.73	36.00	0.27
	5840.0	0.66	0.33	3.51	4.00	0.49	32.00	35.51	36.00	0.49
64-QAM	5735.0	1.37	0.56	3.99	4.00	0.01	32.00	35.99	36.00	0.01
	5790.0	1.11	0.37	3.77	4.00	0.23	32.00	35.77	36.00	0.23
	5840.0	0.69	0.38	3.55	4.00	0.45	32.00	35.55	36.00	0.45

8.4.4 Test data, continued

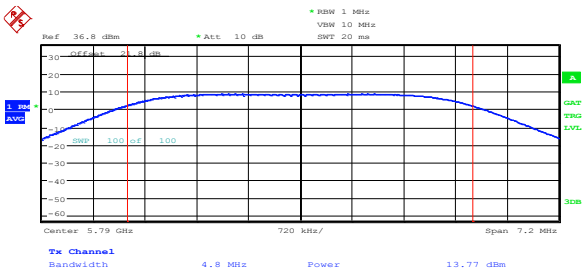


Diagram 8.4-1: *Output power sample plot for 5 MHz channel*

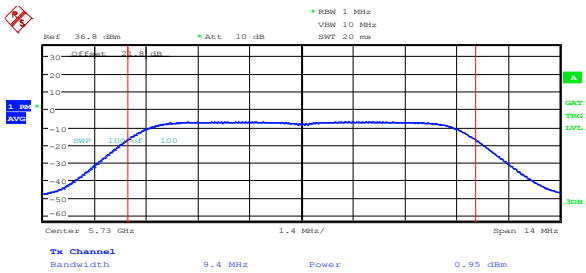


Diagram 8.4-2: *Output power sample plot for 10 MHz channel*

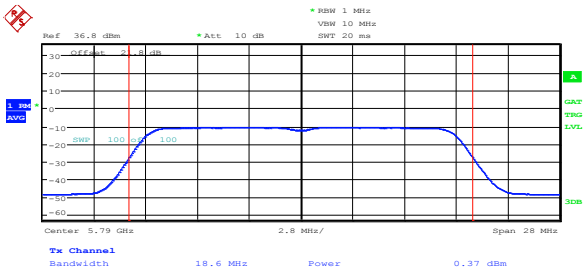


Diagram 8.4-3: *Output power sample plot for 20 MHz channel*

8.5 FCC 15.247(d) and RSS-210 A8.5 Spurious (out-of-band) emissions

8.5.1 Definitions and limits

FCC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

IC:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

Table 8.5-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490*	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705*	24000/F	$87.6 - 20 \times \log_{10}(F)$	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: Applicable only to FCC requirements
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 8.5-2: *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 8.5-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard.

8.5.1 Definitions and limits, continued

Table 8.5-3: *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			

8.5.2 Test summary

Test date	February 4, 2013	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1003 mbar	**Relative humidity**	33 %

8.5.3 Observations/special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously.
Settings for radiated measurements within restricted bands:
For frequencies below 1 GHz, RBW was set to 100 kHz, VBW was 3 times wider than RBW.
Peak detector was used for measurements.
For frequencies above 1 GHz, RBW was set to 1 MHz, VBW was 3 times wider than RBW for peak measurements, and VBW was set to 10 Hz for average measurements. Peak detector was used for measurements.
EUT was set to transmit with 100 % duty cycle.
Conducted spurious emissions were performed on each individual MIMO chain with added 10 × log (total number of chains) {= 3 dB} and antenna gain.
Since fundamental power was tested using average method, the spurious emissions limit is −30 dBc/100 kHz
Only worst case settings were tested.

8.5.4 Test data

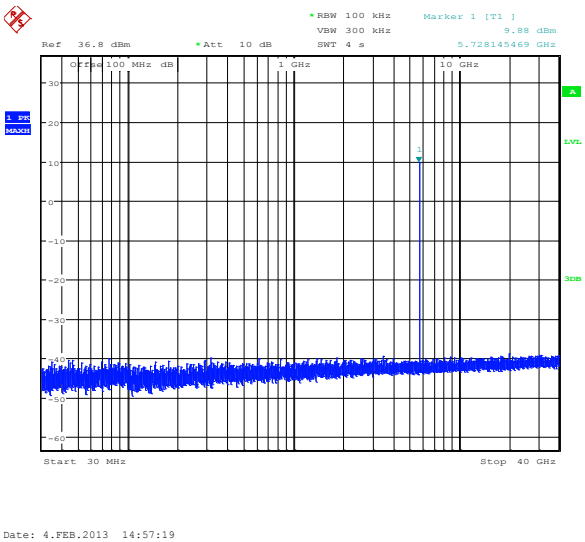


Diagram 8.5-1: *Conducted spurious emissions for ch0, low 5 MHz channel*

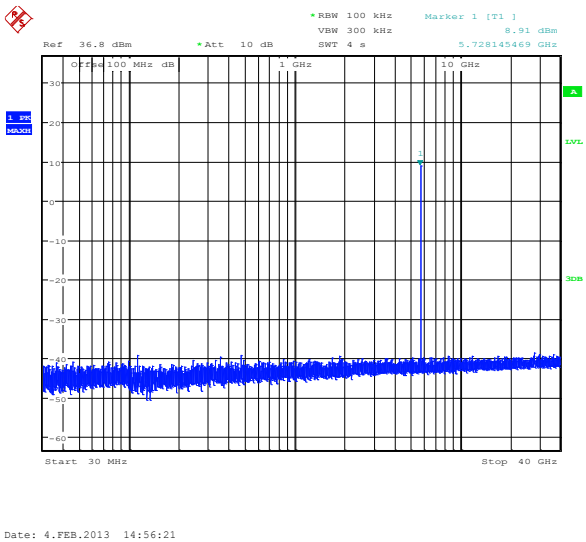


Diagram 8.5-2: *Conducted spurious emissions for ch1, low 5 MHz channel*

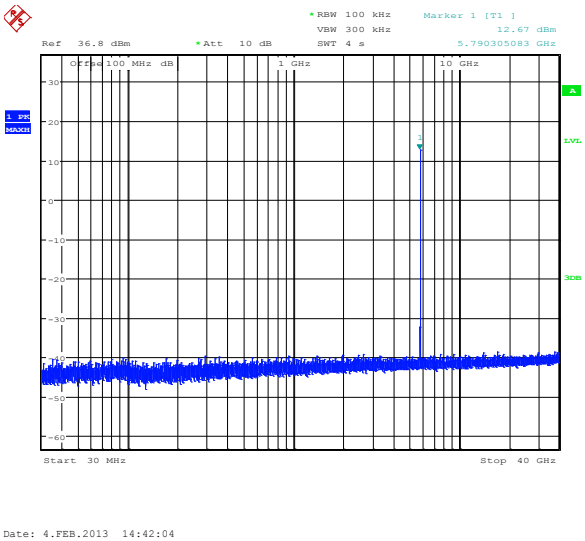


Diagram 8.5-3: *Conducted spurious emissions for ch0, mid 5 MHz channel*

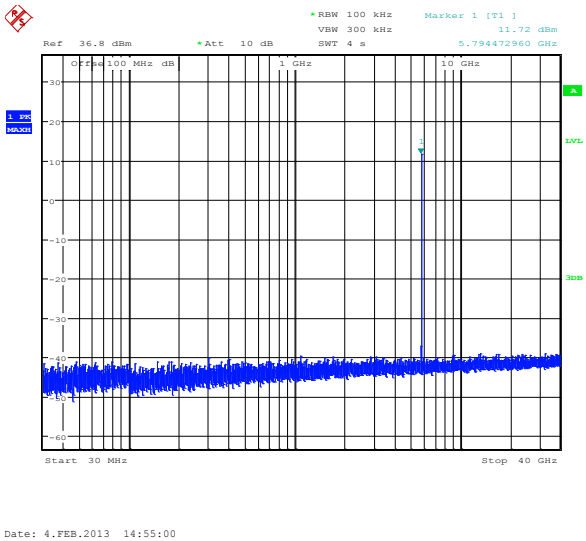


Diagram 8.5-4: *Conducted spurious emissions for ch1, mid 5 MHz channel*

8.5.4 Test data, continued

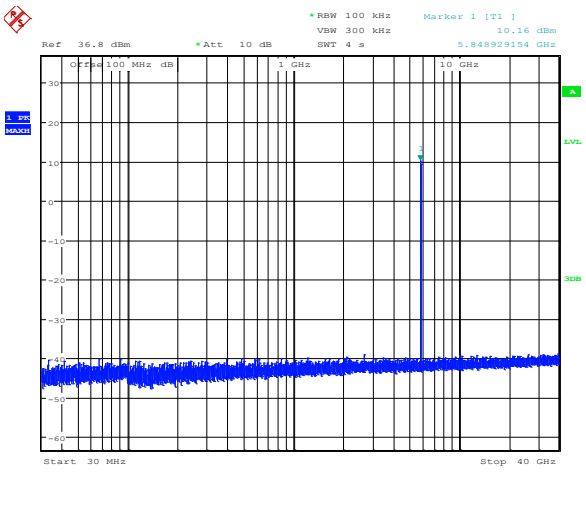


Diagram 8.5-5: *Conducted spurious emissions for ch0, high 5 MHz channel*

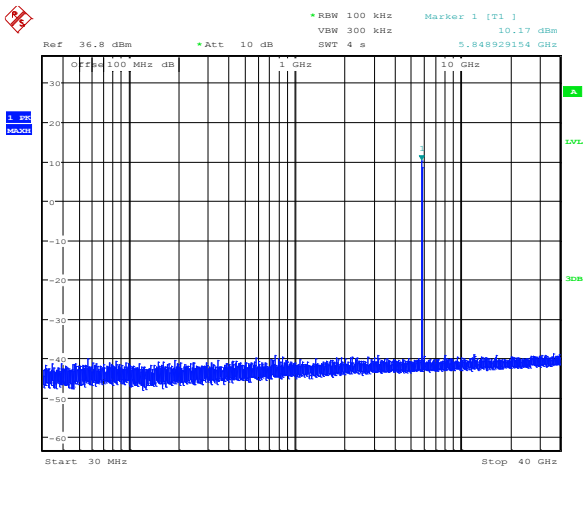


Diagram 8.5-6: *Conducted spurious emissions for ch1, high 5 MHz channel*

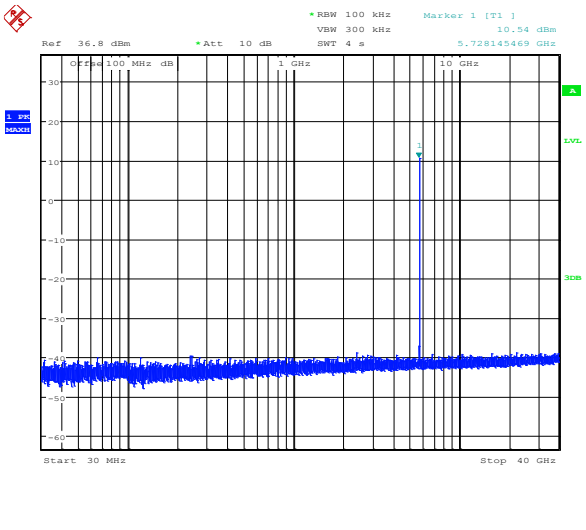


Diagram 8.5-7: *Conducted spurious emissions for ch0, low 10 MHz channel*

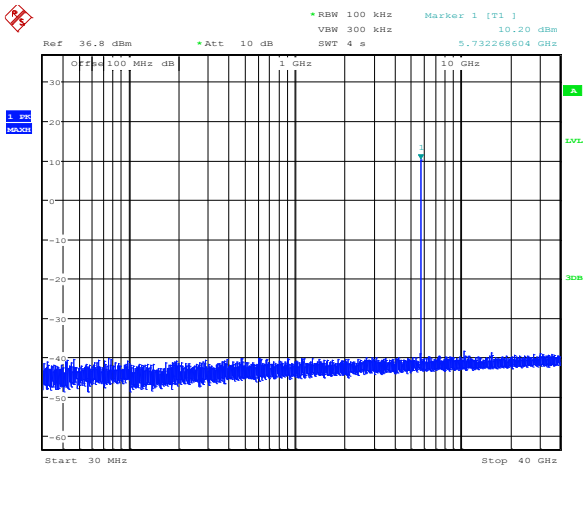


Diagram 8.5-8: *Conducted spurious emissions for ch1, low 10 MHz channel*

8.5.4 Test data, continued

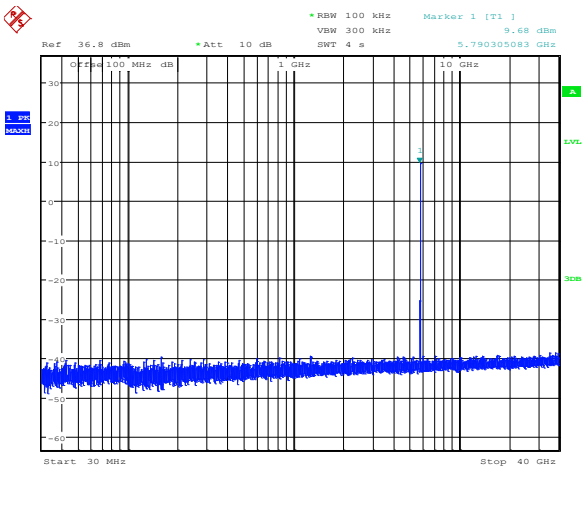


Diagram 8.5-9: *Conducted spurious emissions for ch0, mid 10 MHz channel*

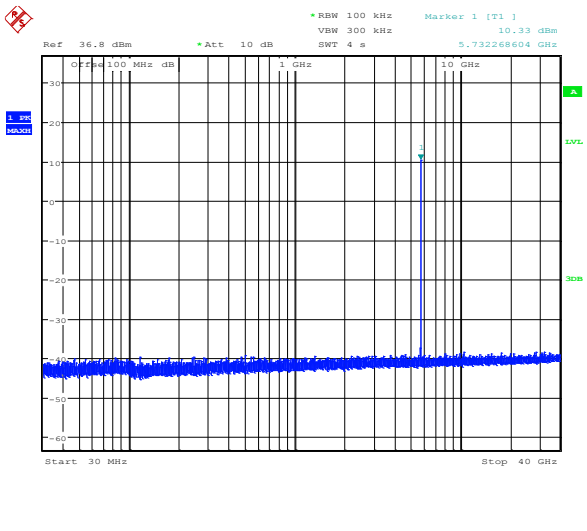


Diagram 8.5-10: *Conducted spurious emissions for ch1, mid 10 MHz channel*

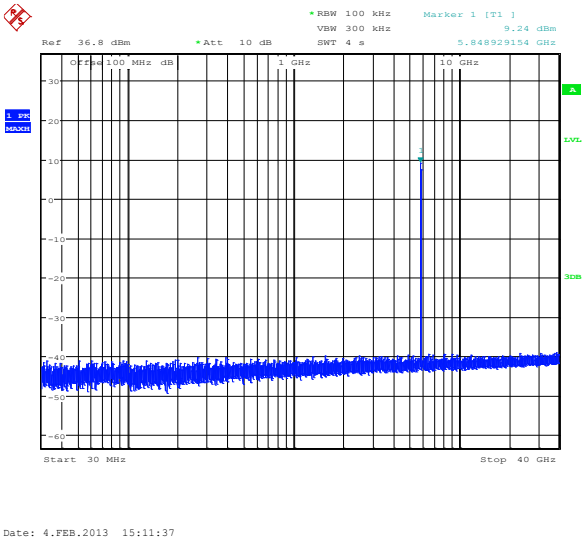


Diagram 8.5-11: *Conducted spurious emissions for ch0, high 10 MHz channel*

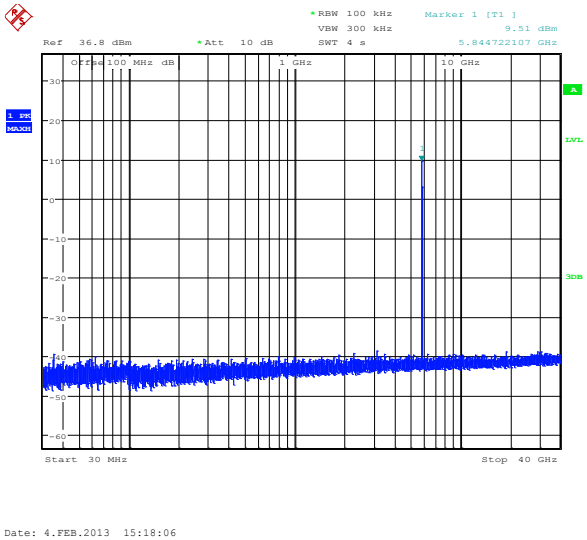


Diagram 8.5-12: *Conducted spurious emissions for ch1, high 10 MHz channel*

8.5.4 Test data, continued

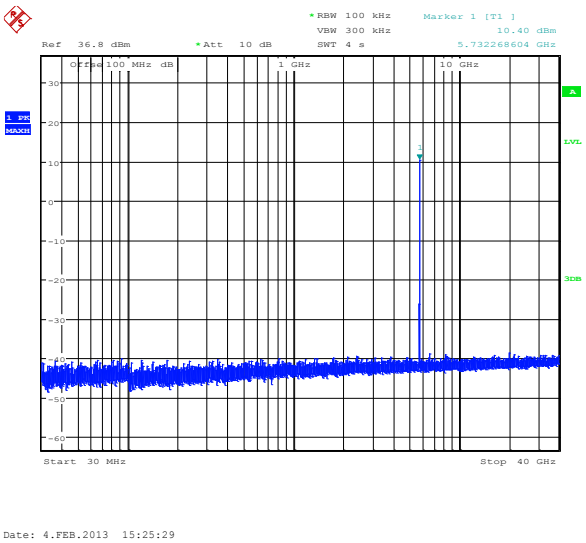


Diagram 8.5-13: *Conducted spurious emissions for ch0, low 20 MHz channel*

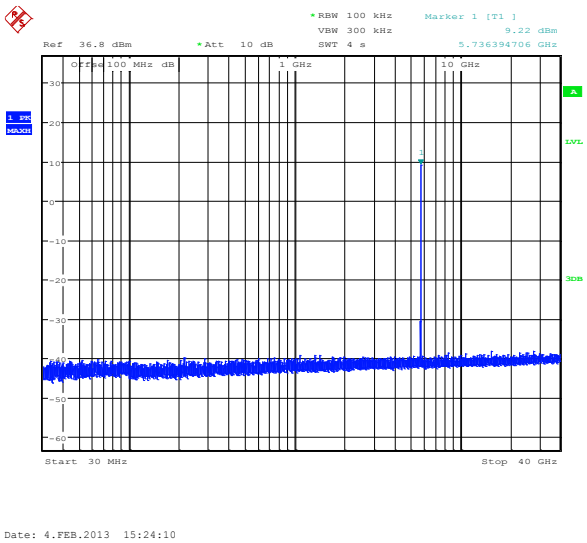


Diagram 8.5-14: *Conducted spurious emissions for ch1, low 20 MHz channel*

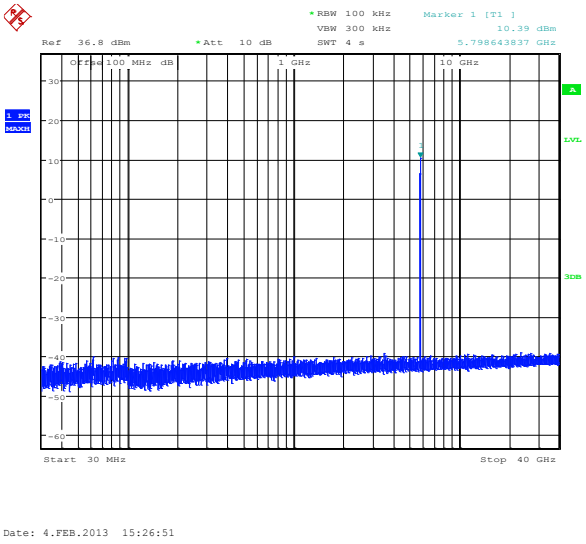


Diagram 8.5-15: *Conducted spurious emissions for ch0, mid 20 MHz channel*

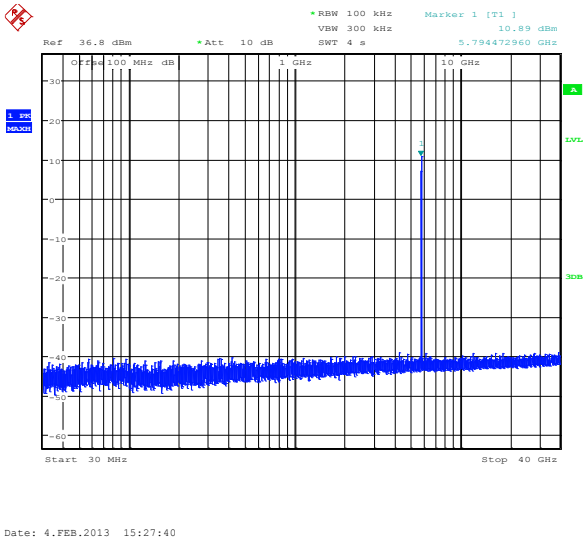


Diagram 8.5-16: *Conducted spurious emissions for ch1, mid 20 MHz channel*

8.5.4 Test data, continued

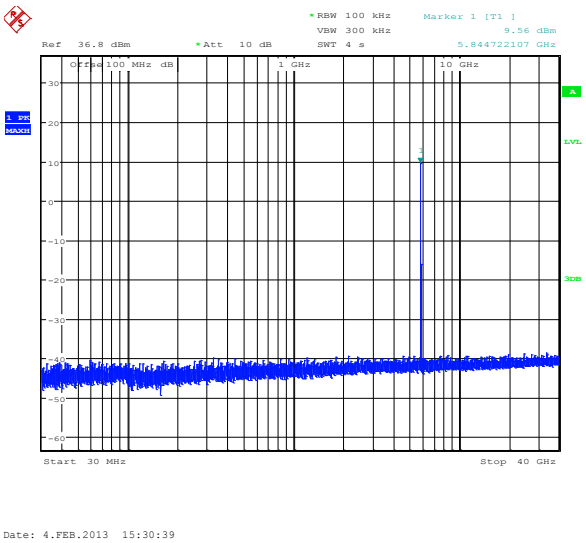


Diagram 8.5-17: *Conducted spurious emissions for ch0, high 20 MHz channel*

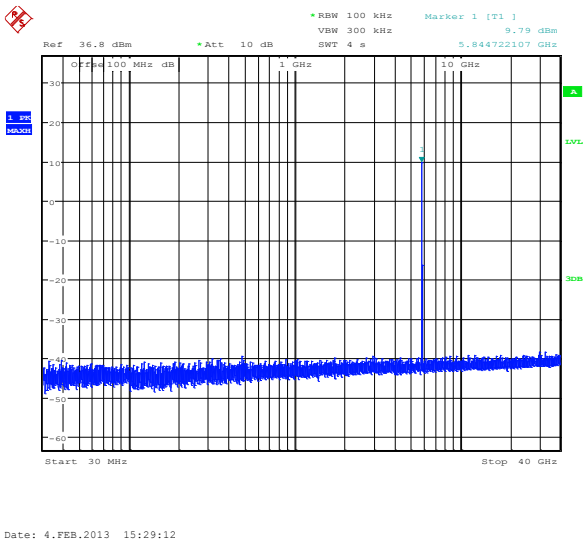


Diagram 8.5-18: *Conducted spurious emissions for ch1, high 20 MHz channel*

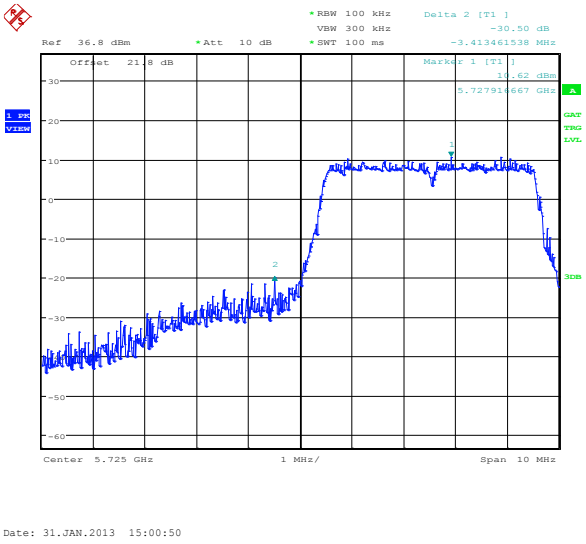


Diagram 8.5-19: *Lower band edge emissions for ch0, 5 MHz channel*

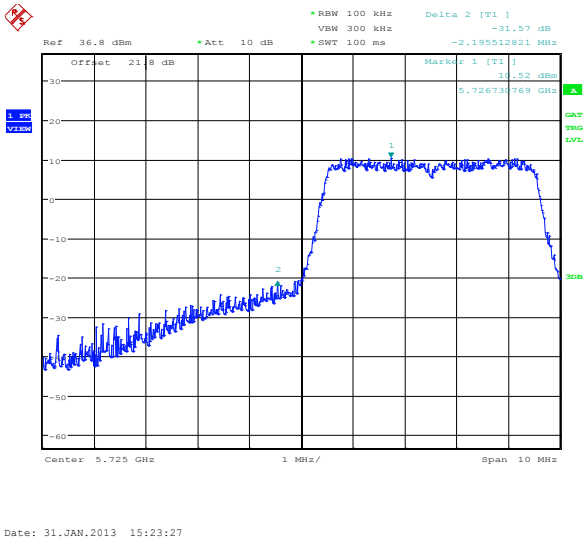


Diagram 8.5-20: *Lower band edge emissions for ch1, 5 MHz channel*

8.5.4 Test data, continued

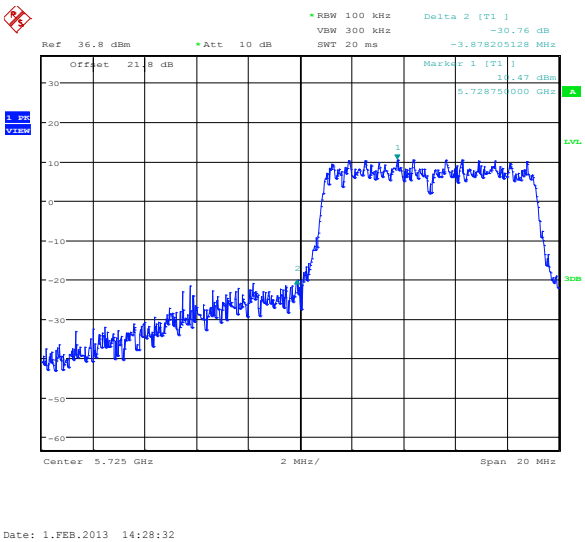


Diagram 8.5-21: *Lower band edge emissions for ch0, 10 MHz channel*

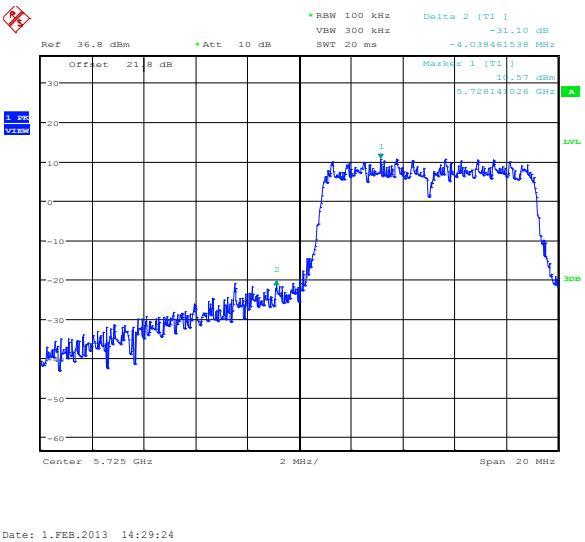


Diagram 8.5-22: *Lower band edge emissions for ch1, 10 MHz channel*

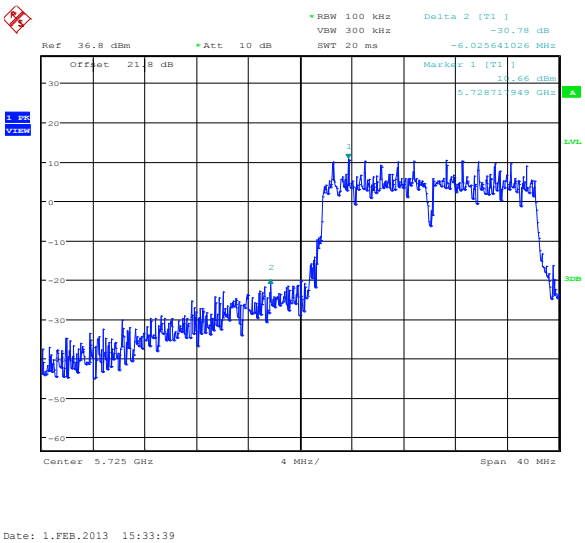


Diagram 8.5-23: *Lower band edge emissions for ch0, 20 MHz channel*

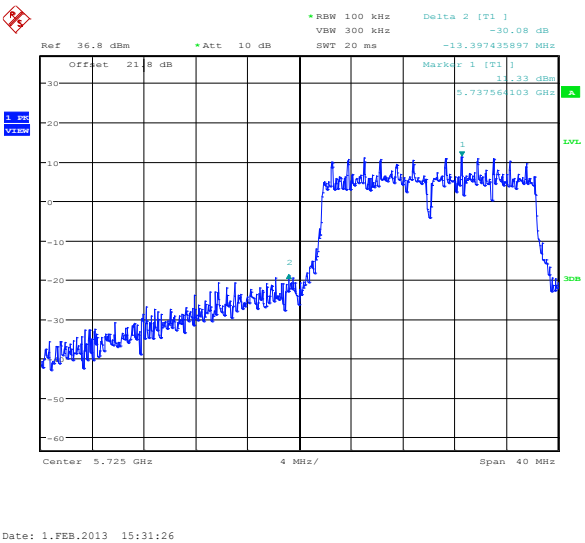


Diagram 8.5-24: *Lower band edge emissions for ch1, 20 MHz channel*

8.5.4 Test data, continued

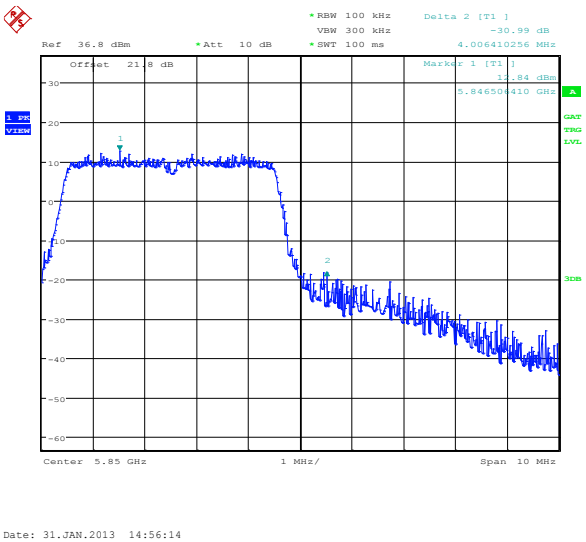


Diagram 8.5-25: *Upper band edge emissions for ch0, 5 MHz channel*

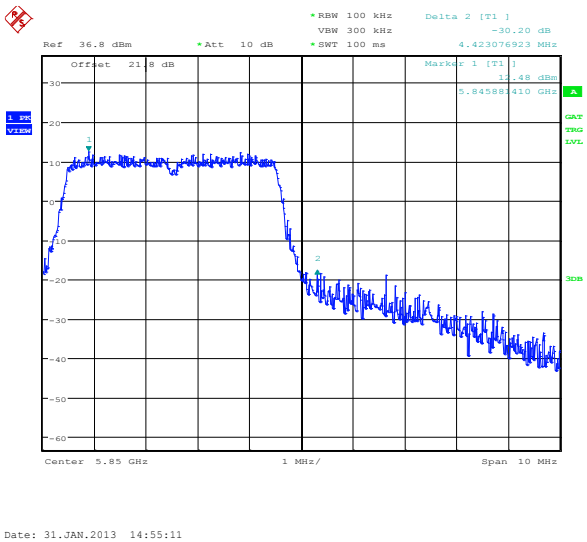


Diagram 8.5-26: *Upper band edge emissions for ch1, 5 MHz channel*

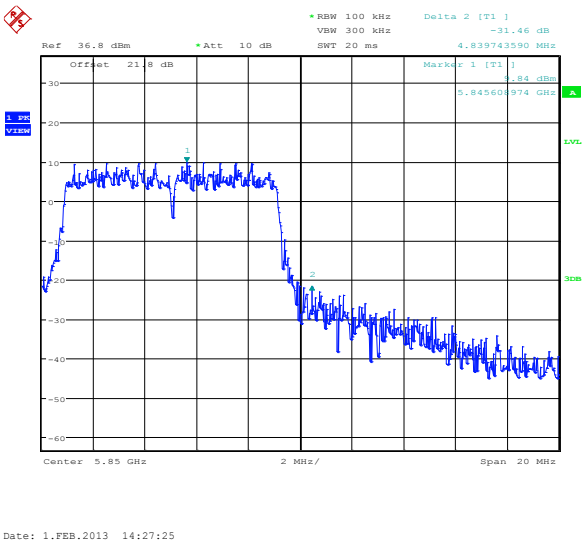


Diagram 8.5-27: *Upper band edge emissions for ch0, 10 MHz channel*

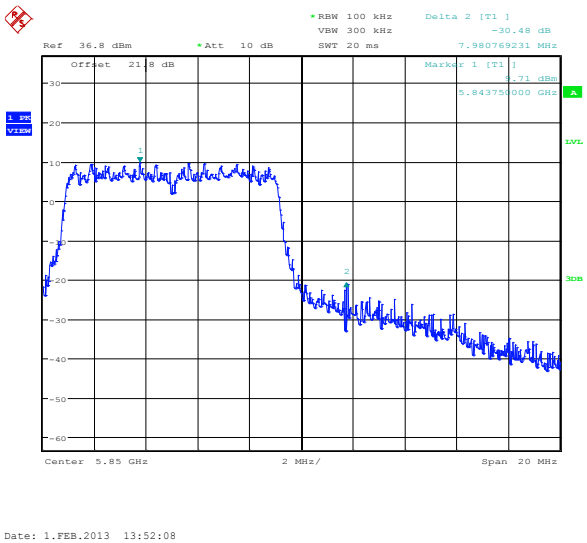


Diagram 8.5-28: *Upper band edge emissions for ch1, 10 MHz channel*

8.5.4 Test data, continued

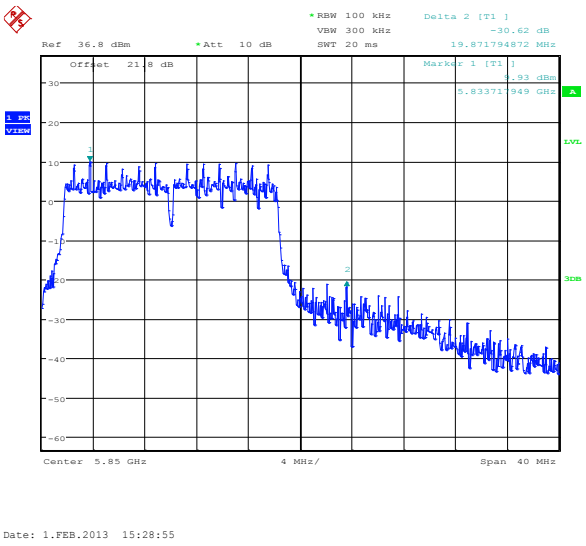


Diagram 8.5-29: *Upper band edge emissions for ch0, 20 MHz channel*

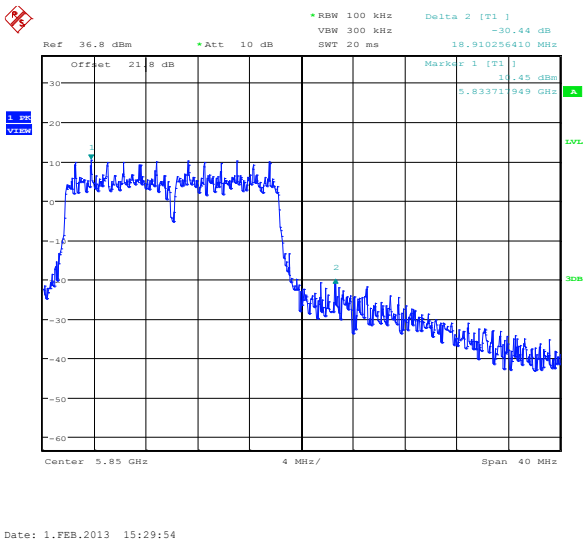


Diagram 8.5-30: *Upper band edge emissions for ch1, 20 MHz channel*

Duty cycle/average factor calculations for restricted bands emissions

§15.35(c) permits a duty cycle reduction to the measured field strength (or equivalent power) when pulsed operation is employed. This allowance is only applicable to unwanted emissions that demonstrate the same pulse characteristics as does the fundamental emission (e.g., harmonic emissions). The duty cycle (d.c.) is determined as follows:

For a pulse train ≤ 100 msec:

d.c. = cumulative on time/cumulative off time over the pulse train.

For a pulse train > 100 msec:

d.c. = cumulative on time/100 msec.

See C63.10 for further guidance in determining the applicable duty cycle.

$$Duty cycle/average factor = 20 \times \log_{10}\left(\frac{Tx_{100\,ms}}{100ms}\right)$$

8.5.4 Test data, continued

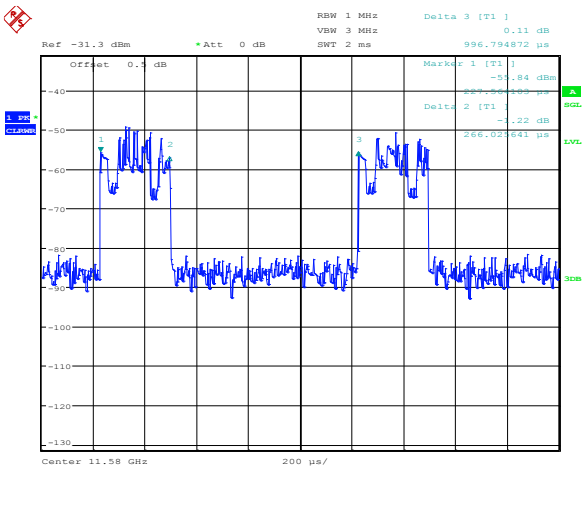


Diagram 8.5-31: *Duty cycle for 5 MHz channel*

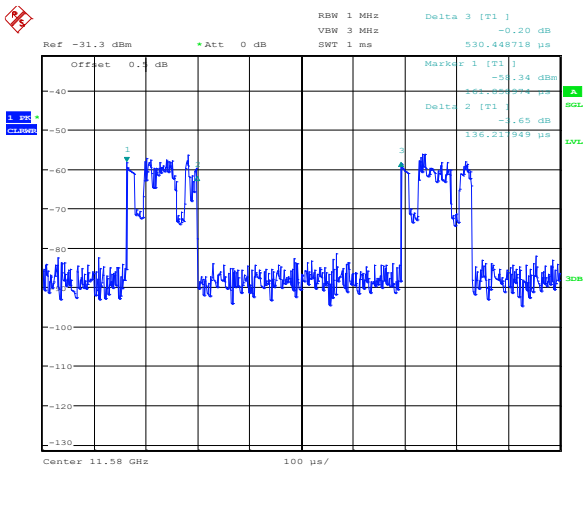


Diagram 8.5-32: *Duty cycle for 10 MHz channel*

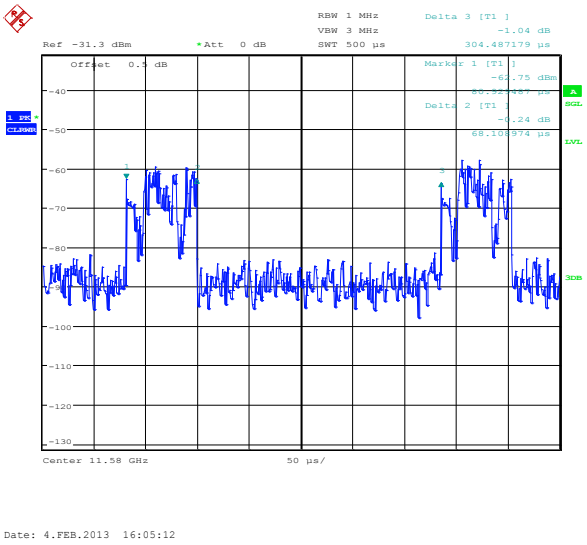


Diagram 8.5-33: *Duty cycle for 20 MHz channel*

Duty cycle correction factor calculations:

For 5 MHz channel

Tx_{ON} is 266.03 µs; Tx_{PERIOD} is 996.80 µs; Duty cycle = 0.27; Correction Factor = $20 \times \text{Log}_{10}$ (0.27) = −11.47 dB

For 10 MHz channel

Tx_{ON} is 136.20 µs; Tx_{PERIOD} is 530.45 µs; Duty cycle = 0.26; Correction Factor = $20 \times \text{Log}_{10}$ (0.26) = −11.81 dB

For 20 MHz channel

Tx_{ON} is 68.11 µs; Tx_{PERIOD} is 304.49 µs; Duty cycle = 0.22; Correction Factor = $20 \times \text{Log}_{10}$ (0.22) = −13.01 dB

8.5.4 Test data, continued

Table 8.5-4: *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 dBµV/m. A correspondent EIRP level at 3 m distance was determined (as per 558074 D01 DTS Meas Guidance v02, Section 10.2.2) as follows: 74 dBµV/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 8.5-5: *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 dBµV/m. A correspondent EIRP level at 3 m distance was determined (as per 558074 D01 DTS Meas Guidance v02, Section 10.2.2) as follows: 74 dBµV/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.

8.6 FCC 15.247(e) and RSS-210 A8.2(b) Power spectral density for digitally modulated devices

8.6.1 Definitions and limits

FCC:
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

IC:
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds one-second duration. This power spectral density shall be determined in accordance with the provisions of Section A8.4(4); (i.e. the power spectral density shall be determined using the same method for determining the conducted output power).

8.6.2 Test summary

Test date	February 4, 2013	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1003 mbar	**Relative humidity**	31 %

8.6.3 Observations/special notes

The test was performed using method described in section 9.2 Option 2 of the 558074 D01 DTS Meas Guidance v02.
The test was performed at the worst case scenario: 10 dBi antenna configuration (with highest power settings).
The span was selected as follows. For 5 MHz channel 1.5 × DTS channel BW (6 dB BW) is 5.4 MHz, for 10 MHz channel is 11.6 MHz and for 20 MHz channel is 24 MHz.
The RBW was set to 100 kHz. Combined PSD was calculated as follows:

$$PSD_{combined} = 10 \times log_{10}\left(\left(10^{PSD_{ch0}/10}\right) + \left(10^{PSD_{ch1}/10}\right)\right)$$

8.6.4 Test data

Table 8.6-1: *PSD measurements results for 5 MHz channel*

Frequency, MHz	PSD at ch0, dBm/3 kHz	PSD at ch1, dBm/3 kHz	Combined PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
5727.5	-1.52	0.13	2.39	8.00	5.61
5790.0	2.45	3.54	6.04	8.00	1.96
5847.5	0.60	0.98	3.80	8.00	4.20

Table 8.6-2: *PSD measurements results for 10 MHz channel*

Frequency, MHz	PSD at ch0, dBm/3 kHz	PSD at ch1, dBm/3 kHz	Combined PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
5730.0	-0.64	-1.96	1.76	8.00	6.24
5790.0	-0.99	0.13	2.62	8.00	5.38
5845.0	-1.72	-2.46	0.94	8.00	7.06

8.6.4 Test data, continued

Table 8.6-3: *PSD measurements results for 20 MHz channel*

Frequency, MHz	PSD at ch0, dBm/3 kHz	PSD at ch1, dBm/3 kHz	Combined PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
5735.0	-10.07	-9.86	-6.95	8.00	14.95
5790.0	-10.73	-9.55	-7.09	8.00	15.09
5840.0	-10.09	-11.26	-7.63	8.00	15.63

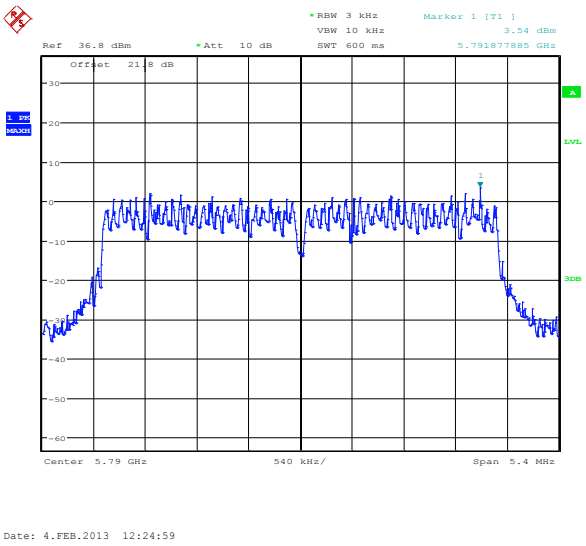


Diagram 8.6-1: *PSD sample plot for 5 MHz channel*

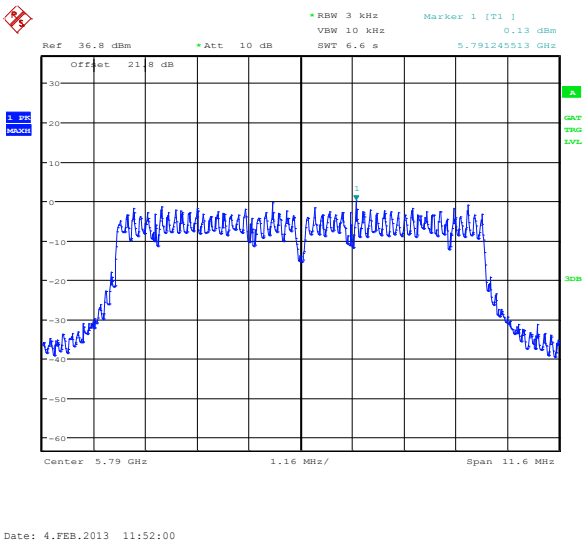


Diagram 8.6-2: *PSD sample plot for 10 MHz channel*

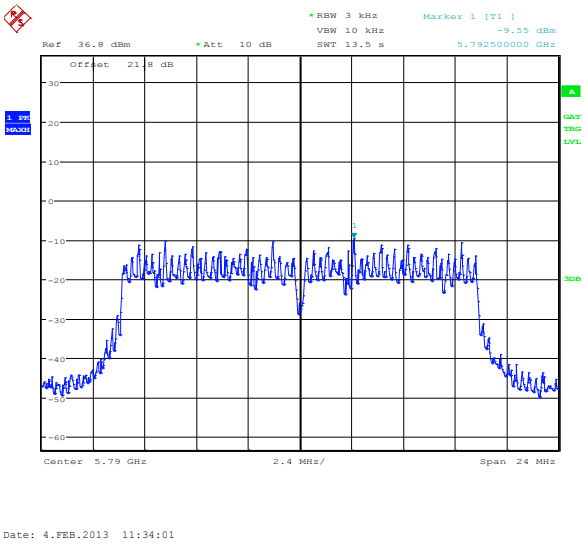
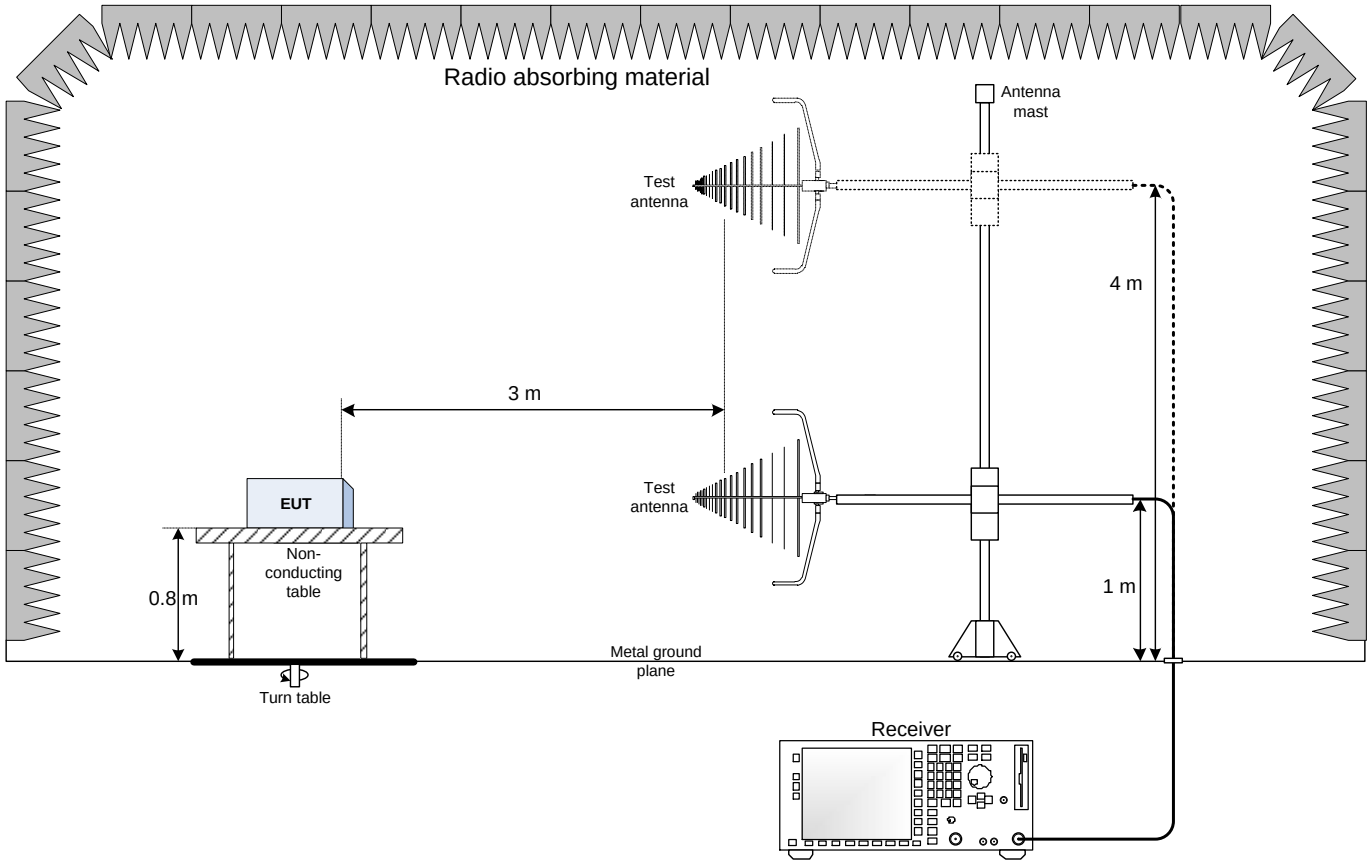


Diagram 8.6-3: *PSD sample plot for 20 MHz channel*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up