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Test report

267625-1TRFWL

Date of issue: October 23, 2014

Applicant:

BLiNQ Networks Inc.

Product:

Hub Module and RBM Module

Model:

HX-1200

Model variant:

RX-1200

FCC ID:

ROR00000004

Specifications:

- FCC Part 90, Subpart Z
  Private land mobile radio services. Wireless broadband services in the 3650–3700 MHz band
- RSS-197 Issue 1, February 2010
  Wireless broadband access equipment operating in the band 3650–3700 MHz

Test location

Company name:	Nemko Canada Inc.
Address:	303 River Road
City:	Ottawa
Province:	Ontario
Postal code:	K1V 1H2
Country:	Canada
Telephone:	+1 613 737 9680
Facsimile:	+1 613 737 9691
Toll free:	+1 800 563 6336
Website:	www.nemko.com
Site number:	FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by:	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by:	Kevin Rose, Wireless/EMC Specialist
Date:	October 23, 2014
Signature:	

Limits of responsibility

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

Copyright notification

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Section 1. Report summary

1.1 Applicant

Company name:	BLiNQ Networks Inc.
Address:	400 March Road, Suite 240
City:	Ottawa
Province/State:	ON
Postal/Zip code:	K2K 3H4
Country:	Canada

1.2 Manufacturer

Company name:	Lloyd Douglas Solutions
Address:	130 Iber Road
City:	Ottawa
Province/State:	ON
Postal/Zip code:	K2S 1E9
Country:	Canada

1.3 Test specifications

FCC Part 90, Subpart Z	Private land mobile radio services. Wireless broadband services in the 3650–3700 MHZ band
RSS-197 Issue 1, February 2010	Wireless Broadband Access Equipment Operating in the band 3650–3700 MHz

1.4 Test procedure

965270 D01 Pwr Meas Part 90 Z Equipment v01 (4/15/2010)	Compliance Measurement Guidance for Wireless Broadband Services Operating in the 3650–3700 MHz Band

1.5 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.

1.6 Exclusions

None

1.7 Test report revision history

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

Section 2. Summary of test results

2.1 RSS-Gen, Issue 3, test results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
4.7	Transmitter frequency stability	Pass
6.1	Receiver spurious emissions limits (radiated)	Not applicable
6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable

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.

2.2 RSS-197, Issue 1, tests results

Part	Test description	Verdict
5.1	Types of modulation	Pass[1]
5.2	Channel bandwidth	Pass
5.3	Transmitter frequency stability	Pass
5.6	Transmitter output power and Equivalent Isotropically Radiated Power (e.i.r.p.)	Pass
5.7	Transmitter unwanted emissions	Pass
5.8	Receiver unwanted emissions	See section 6 of RSS-Gen

Notes: [1] The EUT is a using a digital modulation

2.3 FCC Part 90, tests results

Clause	Test description	Verdict
90.209	Occupied bandwidth	Pass
90.210(b)	Emission mask	Pass
90.213(a)	Frequency stability	Pass
90.1321	Power and antenna limits	Pass
90.1323	Emission limits	Pass

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 5, 2013
Nemko sample ID number	1, 2

3.2 EUT information

Product name	Hub Module and RBM Module
Model	HX-1200 (Hub)
Model variant	RX-1200 (Remote Backhaul Module or RBM)
Part number	HX2-3658-E (Hub) and RX2-3658-I (RBM)

3.3 Technical information

Operating band	3650–3700 MHz
Operating frequencies	3660–3690 MHz
Modulation type	OFDM using QPSK, 16-QAM, 64-QAM and 256-QAM modulations
Channel bandwidth	20 MHz
Occupied bandwidth (99 %)	18.37 MHz
Emission designator	W7D
Power requirements	48 V_{DC}
MIMO type	2 × 2 with completely uncorrelated type of signal
Antenna information	Hub antenna: Plasma Antennas, Cross-polarized MN: SP-4642, 17 dBi gain RBM antenna: Phoenix Antenna Systems, Cross-polarized MN: 3300-3800-D-16-30-DS-T0-Blinq, 16 dBi gain

3.4 Product description and theory of operation

The BLiNQ Networks X-1200 system operates in the sub 6 GHz licensed frequency bands and is designed for Non-Line-of-Sight (NLOS) operation by incorporating advanced Physical Layer (PHY) and Media Access Control (MAC) layer algorithms and techniques.
Hub Module (HM): A sector controller that controls several Remote Backhaul Modules (RBMs). Hub Modules feature 4 RF connectors for an external user defined sectored antenna. Remote Backhaul Module (RBM): A subscriber unit that is installed outdoors on customer premises, including public infrastructure assets such as light and utility poles in mobile backhaul applications. RBMs feature an integrated antenna.
The X-1200 system delivers 8 b/s/Hz spectral efficiency. The system is designed for use in multiple applications that includes mobile backhaul, optical fibre cable extension and corporate and enterprise data backhaul services by providing over 200 Mbps of throughput in a 20 MHz channel.

3.5 EUT exercise details

The EUT was controlled from laptop via Ethernet using Putty telnet session.

3.6 EUT setup diagram

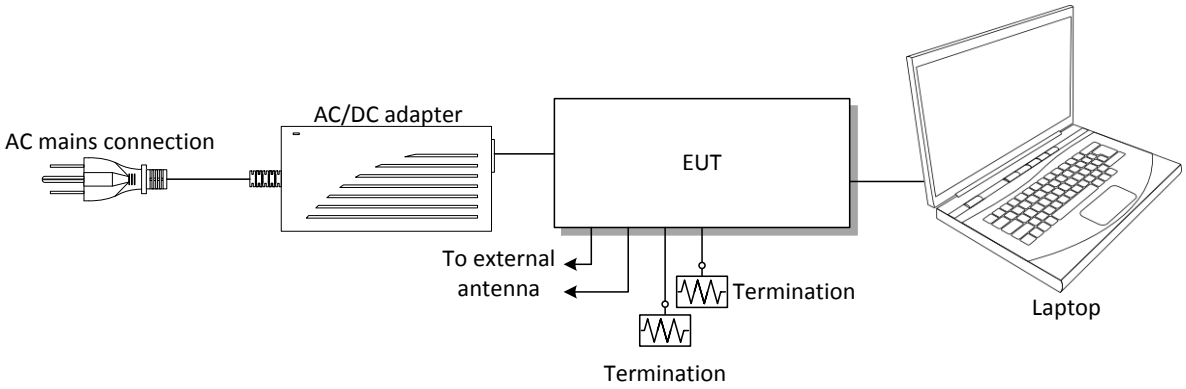

Figure 3.6-1: *Setup diagram*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
Power supply	Mean Well	CLG-100-48	RB07131940
Laptop	Dell Latitude	D630C	FA002364

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. 18/15
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power source	California Instruments	3001i	FA001021	1 year	June 27/15
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Oct. 24/14
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Jan. 27/15
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Mar. 10/15
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	2 year	Sept. 06/14
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 23/15
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Multimeter	Fluke	16	FA001831	1 year	Feb. 04/15

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

Section 8. Testing data

8.1 FCC 90.209 and RSS-Gen 4.6.1 Occupied bandwidth

8.1.1 Definitions and limits

FCC
The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

IC:
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.

8.1.2 Test summary

Test date:	November 13, 2013	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1006 mbar
Verdict:	Pass	Relative humidity:	33 %

8.1.3 Observations settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	≥ 1 % of span
Video bandwidth:	≥3 × RBW
Frequency span:	30 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-1: *99 % bandwidth results for chain 0*

Modulation	Frequency, MHz	99 % bandwidth, MHz
QPSK	3660	18.22
	3675	18.22
	3690	18.22
256-QAM	3660	18.27
	3675	18.27
	3690	18.27

Table 8.1-2: *99 % bandwidth results for chain 1*

Modulation	Frequency, MHz	99 % bandwidth, MHz
QPSK	3660	18.32
	3675	18.37
	3690	18.32
256-QAM	3660	18.32
	3675	18.32
	3690	18.32

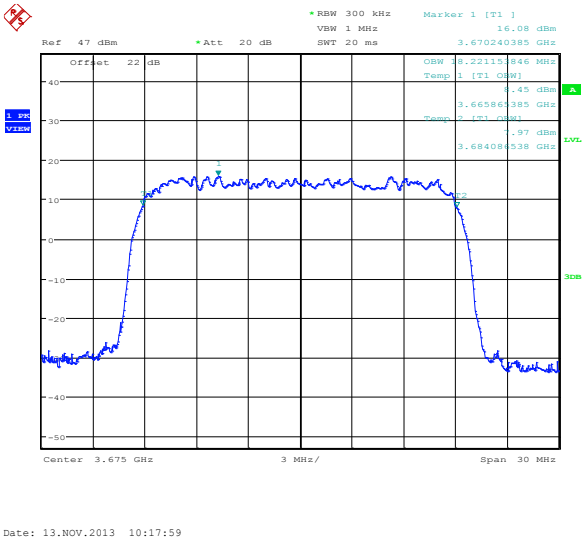

Figure 8.1-1: *99 % bandwidth, QPSK modulation sample*

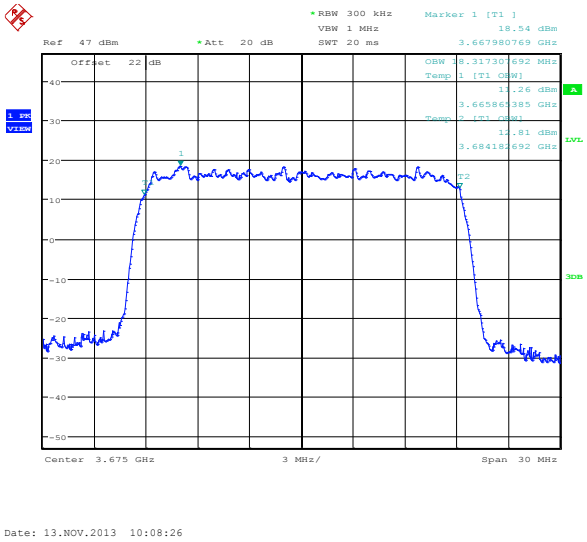

Figure 8.1-2: *99 % bandwidth, 256-QAM modulation sample*

8.2 FCC 90.213(a) and RSS-197 Clause 5.3 Transmitter frequency stability

8.2.1 Definitions and limits

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

Table 8.2-1: *Minimum frequency stability*

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

IC:
The frequency offset shall be measured according to the procedure described in RSS-Gen and recorded;
Using a resolution bandwidth of 1% of the occupied bandwidth, a reference point at the unwanted emission level specified in Section 5.7 on the emission mask of the lowest and highest channel shall be selected, and the frequency at these points shall be recorded as f_L and f_H respectively.

The applicant shall ensure frequency stability by showing that f_L minus the frequency offset and f_H plus the frequency offset shall be within the 3650–3700 MHz band.

8.2.2 Test summary

Test date:	November 13, 2013	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1006 mbar
Verdict:	Pass	Relative humidity:	33 %

8.2.3 Observations settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	20 kHz
Video bandwidth:	50 kHz
Frequency span:	2 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.2.4 Test data

Table 8.2-2: *Frequency drift measurement*

Test conditions	Frequency, GHz	Drift, Hz
+50 °C, Nominal	3.660000000	-2
+40 °C, Nominal	3.660000002	0
+30 °C, Nominal	3.660000002	0
+20 °C, +15 %	3.660000002	0
+20 °C, Nominal	3.660000002	*Reference*
+20 °C, −15 %	3.660000002	0
+10 °C, Nominal	3.660016028	16026
0 °C, Nominal	3.660000002	0
−10 °C, Nominal	3.660000002	0
−20 °C, Nominal	3.660016028	16026
−30 °C, Nominal	3.660016028	16026

Table 8.2-3: *Frequency stability at lower band edge for Hub*

Chain	Modulation	Lower cross point (f_L), GHz	Max negative drift, Hz	Drifted cross point, GHz	Limit (band edge), GHz	Margin, kHz
0	QPSK	3.650766026	2	3.650766024	3.650000000	766.024
0	256-QAM	3.650884615	2	3.650884613	3.650000000	884.613
1	QPSK	3.650602564	2	3.650602562	3.650000000	602.562
1	256-QAM	3.650916667	2	3.650916665	3.650000000	916.665

Table 8.2-4: *Frequency stability at lower band edge for RBM*

Chain	Modulation	Lower cross point (f_L), GHz	Max negative drift, Hz	Drifted cross point, GHz	Limit (band edge), GHz	Margin, kHz
0	QPSK	3.650471154	2	3.650471152	3.650000000	471.152
0	256-QAM	3.650548077	2	3.650548075	3.650000000	548.075
1	QPSK	3.650548077	2	3.650548075	3.650000000	548.075
1	256-QAM	3.650634615	2	3.650634613	3.650000000	634.613

Table 8.2-5: *Frequency stability at upper band edge for Hub*

Chain	Modulation	Upper cross point (f_H), GHz	Max positive drift, Hz	Drifted cross point, GHz	Limit (band edge), GHz	Margin, kHz
0	QPSK	3.699346154	16026	3.699362180	3.700000000	637.820
0	256-QAM	3.699076923	16026	3.699092949	3.700000000	907.051
1	QPSK	3.699352564	16026	3.699368590	3.700000000	631.410
1	256-QAM	3.699317308	16026	3.699333334	3.700000000	666.666

Table 8.2-6: *Frequency stability at upper band edge for RBM*

Chain	Modulation	Upper cross point (f_H), GHz	Max positive drift, Hz	Drifted cross point, GHz	Limit (band edge), GHz	Margin, kHz
0	QPSK	3.699451923	16026	3.699467949	3.700000000	532.051
0	256-QAM	3.699477564	16026	3.699493590	3.700000000	506.410
1	QPSK	3.699451923	16026	3.699467949	3.700000000	532.051
1	256-QAM	3.699480769	16026	3.699496795	3.700000000	503.205

8.2.4 Test data, continued

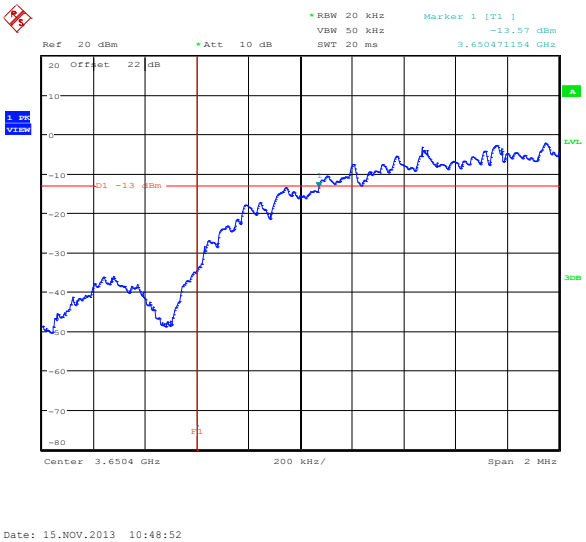

Figure 8.2-1: *Lower cross point (f_L) sample plot for QPSK*

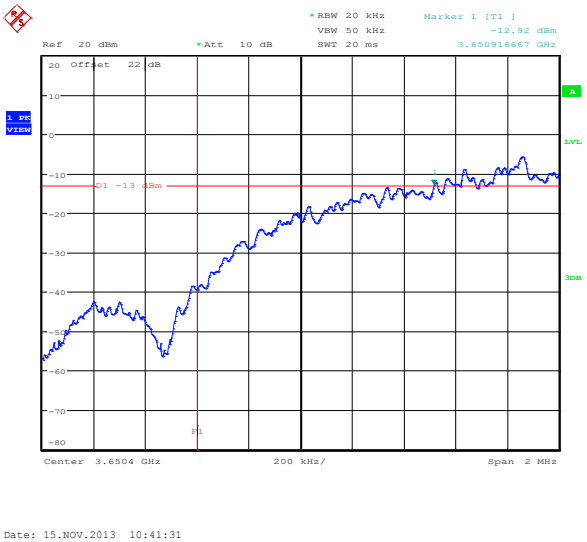

Figure 8.2-2: *Lower cross point (f_L) sample plot for 256-QAM*

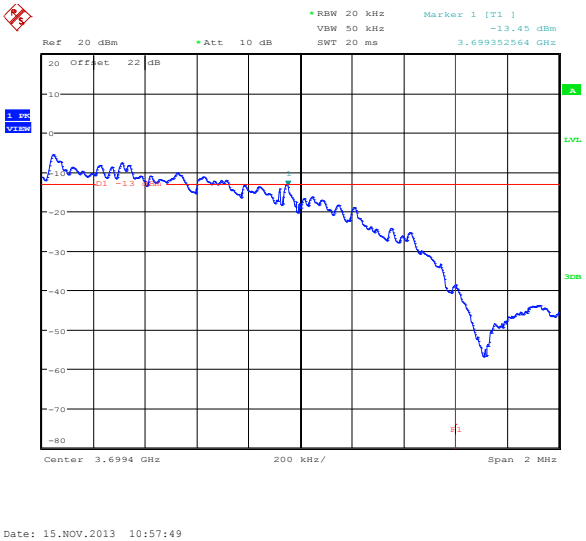

Figure 8.2-3: *Upper cross point (f_H) sample plot for QPSK*

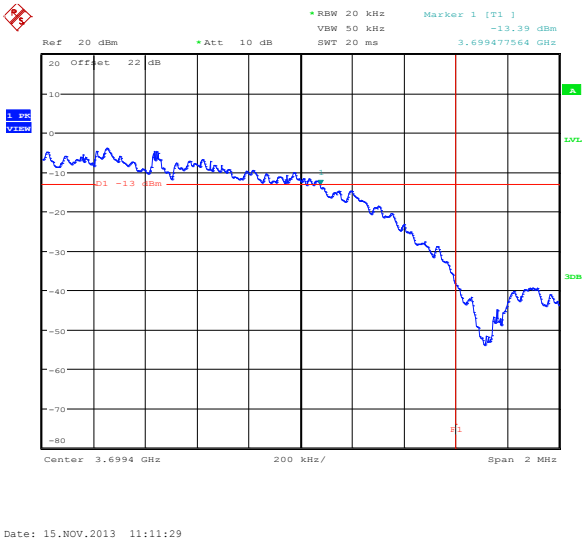

Figure 8.2-4: *Upper cross point (f_H) sample plot for 256-QAM*

8.3 FCC 90.1321(a) and RSS-197 Clause 5.6.2 Transmit output power and PSD

8.3.1 Definitions and limits

FCC:
a) Base and fixed stations are limited to 25 W/25 MHz equivalent isotropically radiated power (EIRP). In any event, the peak EIRP power density shall not exceed 1 W in any one-megahertz slice of spectrum.

(b) In addition to the provisions in paragraph (a) of this section, transmitters operating in the 3650–3700 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(1) Different information must be transmitted to each receiver.

(2) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (a) of this section, as applicable. The directional antenna gain shall be computed as follows:

(i) The directional gain, in dBi, shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain, in dBi, of the individual element or stave having the highest gain.

(ii) A lower value for the directional gain than that calculated in paragraph (b)(2)(i) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beam-forming.

(3) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels and if transmitted beams overlap, the power shall be reduced to ensure that the aggregate power from the overlapping beams does not exceed the limit specified in paragraph (b)(2) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (b)(2) of this section by more than 8 dB.

(4) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (b)(2) of this section.

IC:
5.6.2 The maximum transmitter output power density of equipment, other than mobile and portable equipment, shall not exceed 1 W in any 1 MHz bandwidth.

5.6.3 In addition, equipment, other than mobile and portable equipment, employing antenna systems that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers, shall comply with the requirements in SRSP-303.65.

8.3.2 Test summary

Test date:	July 23, 2014	Temperature:	24 °C
Test engineer:	Andrey Adelberg	Air pressure:	1005 mbar
Verdict:	Pass	Relative humidity:	31 %

8.3.3 Observations settings and special notes

Cable loss of 1 dB was added to the total antenna gain calculation as follows: (Hub) 17 dBi – 1 dB = 16 dBi and (RBM) 16 dBi – 1 dB = 15 dBi
Spectrum analyser settings for output power and power spectral density measurements:

Span:	40 MHz
Resolution bandwidth:	1 MHz
Video bandwidth:	≥ 3 times the RBW
Detector mode:	RMS
Trace mode:	Averaging over 100 sweeps
Output power integration BW:	25 MHz

8.3.4 Test data

Table 8.3-1: *EIRP measurements results for Hub at chain 0*

Modulation	Frequency, MHz	Peak output power, dBm/25 MHz	Antenna gain, dBi	EIRP, dBm/25 MHz	EIRP limit, dBm/25 MHz	Margin, dB
16-QAM	3660	24.78	16.00	40.78	43.98	3.20
	3680	24.92	16.00	40.92	43.98	3.06
	3690	24.98	16.00	40.98	43.98	3.00
256-QAM	3660	25.06	16.00	41.06	43.98	2.92
	3680	25.17	16.00	41.17	43.98	2.81
	3690	25.08	16.00	41.08	43.98	2.90

Table 8.3-2: *EIRP measurements results for RBM at chain 0*

Modulation	Frequency, MHz	Peak output power, dBm/25 MHz	Antenna gain, dBi	EIRP, dBm/25 MHz	EIRP limit, dBm/25 MHz	Margin, dB
16-QAM	3660	24.78	15.00	39.78	43.98	4.20
	3680	24.92	15.00	39.92	43.98	4.06
	3690	24.98	15.00	39.98	43.98	4.00
256-QAM	3660	25.06	15.00	40.06	43.98	3.92
	3680	25.17	15.00	40.17	43.98	3.81
	3690	25.08	15.00	40.08	43.98	3.90

Table 8.3-3: *PSD EIRP measurements for Hub results at chain 0*

Modulation	Frequency, MHz	PSD, dBm/MHz	Antenna gain, dBi	PSD EIRP, dBm/MHz	PSD EIRP limit, dBm/MHz	Margin, dB
16-QAM	3660	13.71	16.00	29.71	30.00	0.29
	3680	13.74	16.00	29.74	30.00	0.26
	3690	13.85	16.00	29.85	30.00	0.15
256-QAM	3660	13.90	16.00	29.90	30.00	0.10
	3680	13.92	16.00	29.92	30.00	0.08
	3690	13.92	16.00	29.92	30.00	0.08

8.3.4 Test data, continued

Table 8.3-4: *PSD EIRP measurements for RBM results at chain 0*

Modulation	Frequency, MHz	PSD, dBm/MHz	Antenna gain, dBi	PSD EIRP, dBm/MHz	PSD EIRP limit, dBm/MHz	Margin, dB
16-QAM	3660	13.71	15.00	28.71	30.00	1.29
	3680	13.74	15.00	28.74	30.00	1.26
	3690	13.85	15.00	28.85	30.00	1.15
256-QAM	3660	13.90	15.00	28.90	30.00	1.10
	3680	13.92	15.00	28.92	30.00	1.08
	3690	13.92	15.00	28.92	30.00	1.08

Table 8.3-5: *EIRP measurements results for Hub at chain 1*

Modulation	Frequency, MHz	Peak output power, dBm/25 MHz	Antenna gain, dBi	EIRP, dBm/25 MHz	EIRP limit, dBm/25 MHz	Margin, dB
16-QAM	3660	25.15	16.00	41.15	43.98	2.83
	3680	25.20	16.00	41.20	43.98	2.78
	3690	25.17	16.00	41.17	43.98	2.81
256-QAM	3660	25.29	16.00	41.29	43.98	2.69
	3680	25.00	16.00	41.00	43.98	2.98
	3690	25.37	16.00	41.37	43.98	2.61

Table 8.3-6: *EIRP measurements results for RBM at chain 1*

Modulation	Frequency, MHz	Peak output power, dBm/25 MHz	Antenna gain, dBi	EIRP, dBm/25 MHz	EIRP limit, dBm/25 MHz	Margin, dB
16-QAM	3660	25.15	15.00	40.15	43.98	3.83
	3680	25.20	15.00	40.20	43.98	3.78
	3690	25.17	15.00	40.17	43.98	3.81
256-QAM	3660	25.29	15.00	40.29	43.98	3.69
	3680	25.00	15.00	40.00	43.98	3.98
	3690	25.37	15.00	40.37	43.98	3.61

Table 8.3-7: *PSD EIRP measurements for Hub results at chain 1*

Modulation	Frequency, MHz	PSD, dBm/MHz	Antenna gain, dBi	PSD EIRP, dBm/MHz	PSD EIRP limit, dBm/MHz	Margin, dB
16-QAM	3660	13.72	16.00	29.72	30.00	0.28
	3680	13.87	16.00	29.87	30.00	0.13
	3690	13.75	16.00	29.75	30.00	0.25
256-QAM	3660	13.79	16.00	29.79	30.00	0.21
	3680	13.63	16.00	29.63	30.00	0.37
	3690	13.96	16.00	29.96	30.00	0.04

Table 8.3-8: *PSD EIRP measurements for RBM results at chain 1*

Modulation	Frequency, MHz	PSD, dBm/MHz	Antenna gain, dBi	PSD EIRP, dBm/MHz	PSD EIRP limit, dBm/MHz	Margin, dB
16-QAM	3660	13.72	15.00	28.72	30.00	1.28
	3680	13.87	15.00	28.87	30.00	1.13
	3690	13.75	15.00	28.75	30.00	1.25
256-QAM	3660	13.79	15.00	28.79	30.00	1.21
	3680	13.63	15.00	28.63	30.00	1.37
	3690	13.96	15.00	28.96	30.00	1.04

8.3.4 Test data, continued

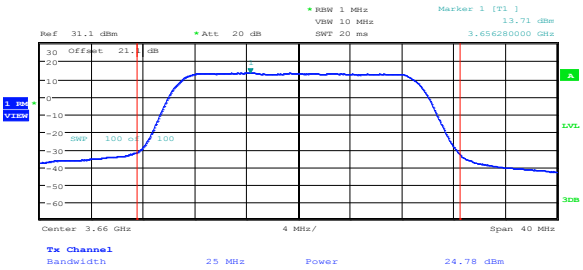

Figure 8.3-1: *Peak output power and PSD sample plot at ch0 with QPSK*

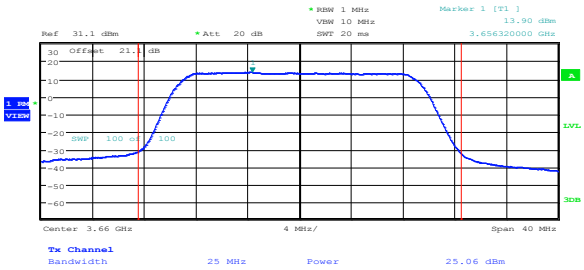

Figure 8.3-2: *Peak output power and PSD sample plot at ch0 with 256-QAM*

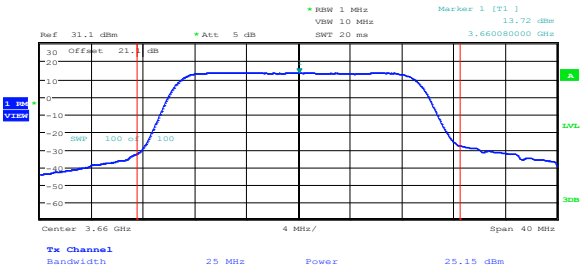

Figure 8.3-3: *Peak output power and PSD sample plot at ch1 with QPSK*

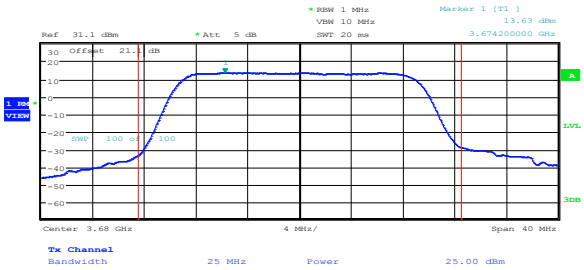

Figure 8.3-4: *Peak output power and PSD sample plot at ch1 with 256-QAM*

8.4 FCC 90.210(b) Emission mask

8.4.1 Definitions and limits

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

8.4.2 Test summary

Test date:	July 23, 2014	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	33 %

8.4.3 Observations settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 kHz
Video bandwidth:	1 MHz
Detector mode:	RMS
Trace mode:	Power averaging over 100 sweeps

8.4.4 Test data

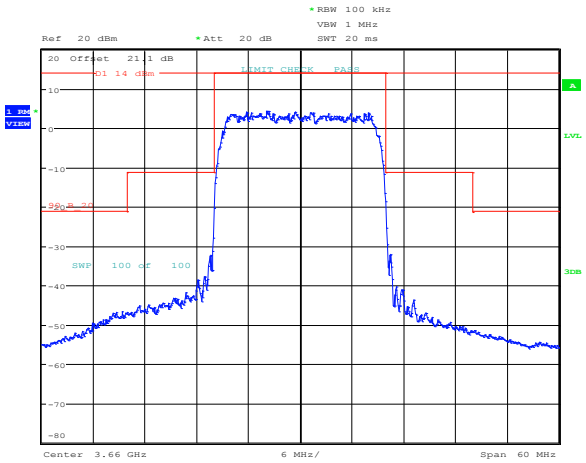

Figure 8.4-1: *Emission mask at ch0 with QPSK, low channel*

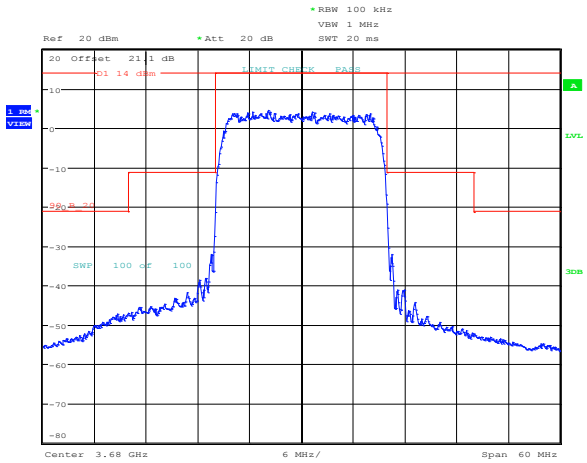

Figure 8.4-2: *Emission mask at ch0 with QPSK, mid channel*

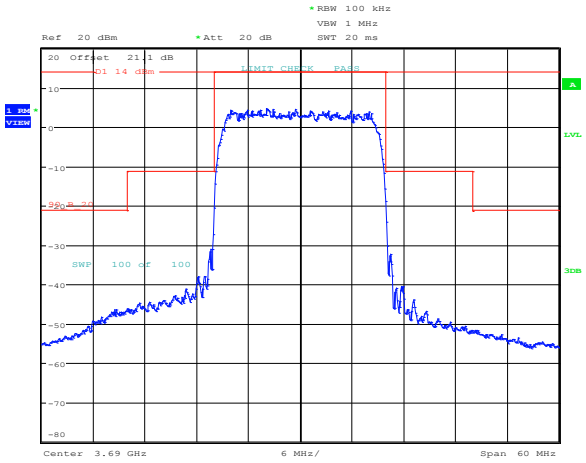

Figure 8.4-3: *Emission mask at ch0 with QPSK, high channel*

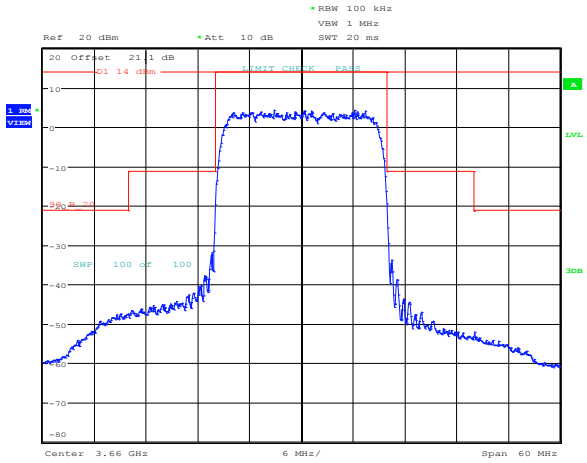

Figure 8.4-4: *Emission mask at ch1 with QPSK, low channel*

8.4.4 Test data, continued

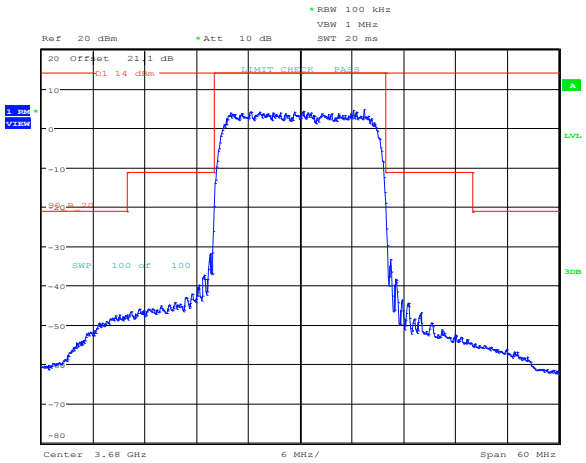

Figure 8.4-5: *Emission mask at ch1 with QPSK, mid channel*

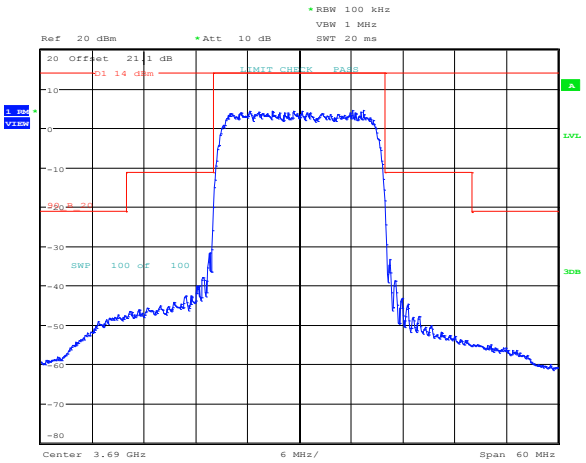

Figure 8.4-6: *Emission mask at ch1 with QPSK, high channel*

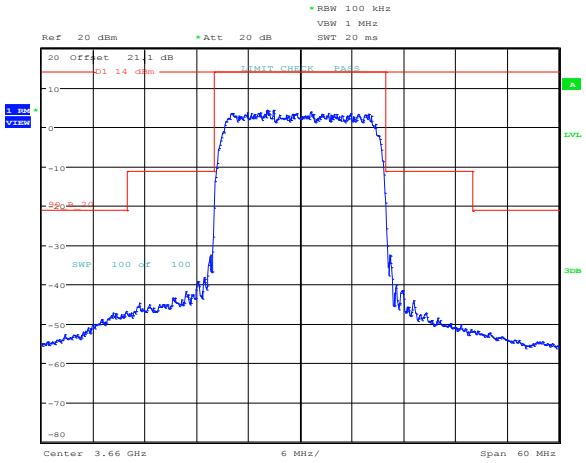

Figure 8.4-7: *Emission mask at ch0 with 256-QAM, low channel*

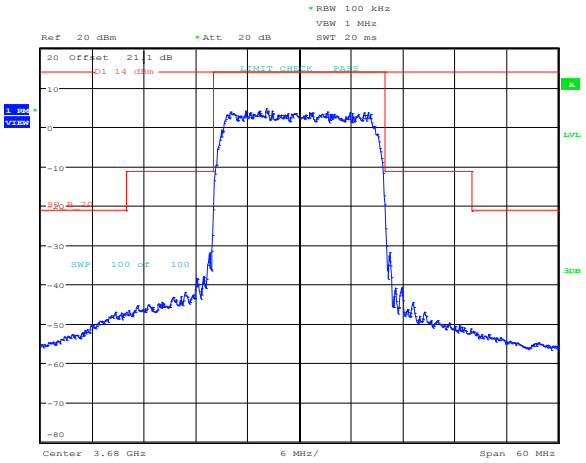

Figure 8.4-8: *Emission mask at ch0 with 256-QAM, mid channel*

8.4.4 Test data, continued

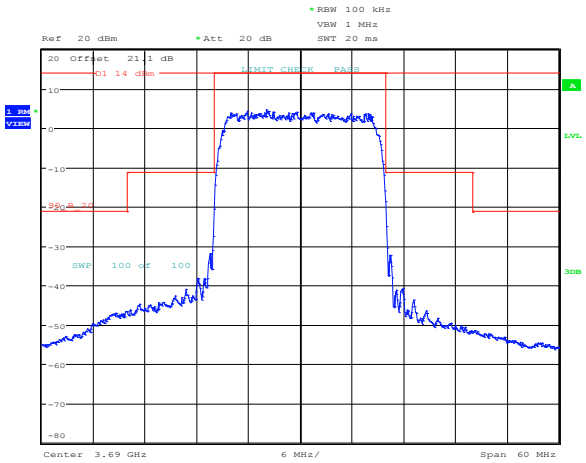

Figure 8.4-9: *Emission mask at cho with 256-QAM, high channel*

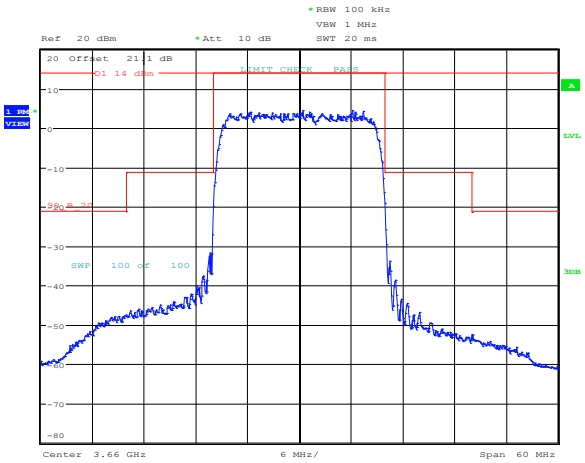

Figure 8.4-10: *Emission mask at ch1 with 256-QAM, low channel*

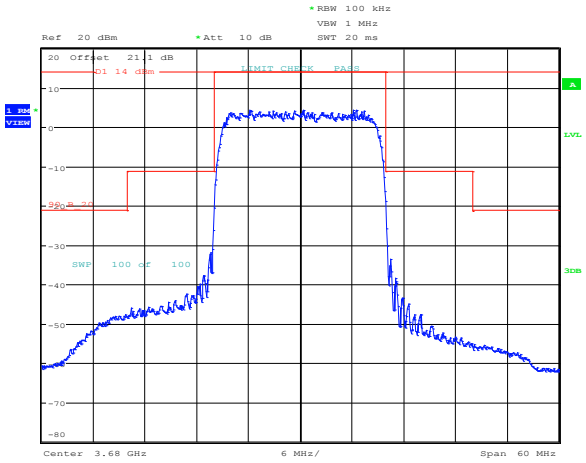

Figure 8.4-11: *Emission mask at ch1 with 256-QAM, mid channel*

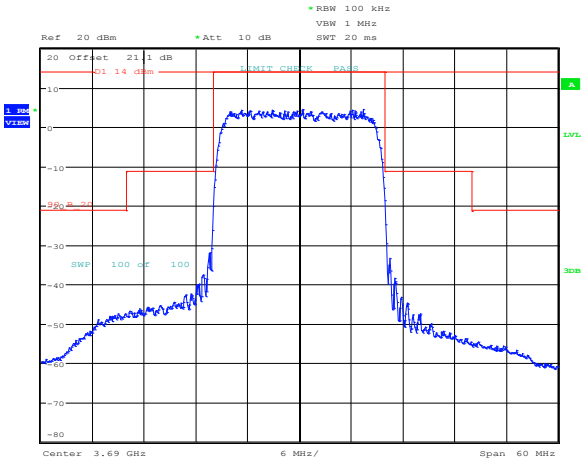

Figure 8.4-12: *Emission mask at ch1 with 256-QAM, high channel*

8.5 FCC 90.1323 and RSS-197 Clause 5.7 Transmitter unwanted emissions

8.5.1 Definitions and limits

FCC:
(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

IC:
The unwanted emissions shall be measured at the frequencies of the highest and lowest channel of all bandwidths and types of modulation that the equipment can operate with a resolution bandwidth of 1 MHz or less, but at least 1% of the occupied bandwidth of the transmitter, provided that the measured power is integrated over a 1 MHz bandwidth.

The power of any emissions outside the frequency band 3650–3700 MHz shall be attenuated below the channel transmitter power P (dBW) by 43 + 10 Log (p), where p is measured in watts.

8.5.2 Test summary

Test date:	July 23, 2014	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1006 mbar
Verdict:	Pass	Relative humidity:	31 %

8.5.3 Observations settings and special notes

The 0 dB reference level in the unwanted emission mask is the maximum in-band power spectral density measured in terms of average power in the equipment's channel bandwidth, using a resolution bandwidth of as close as possible to, without being less than 1 % of the occupied bandwidth, and a video bandwidth of 30 kHz. The unwanted power spectral density emissions are also measured using the same resolution and video bandwidths used in measuring the reference in-band power spectral density.
Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously. Radiated emissions were performed while both antenna connectors were terminated with 50 Ω load. No radiated spurious emissions were detected more than 15 dB below the limit.

Spectrum analyser settings for peak conducted measurements:

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

Spectrum analyser settings for band edge measurements:

Resolution bandwidth:	200 kHz (1 % of occupied bandwidth)
Video bandwidth:	2 MHz
Detector mode:	RMS
Trace mode:	Max-hold

8.5.4 Test data

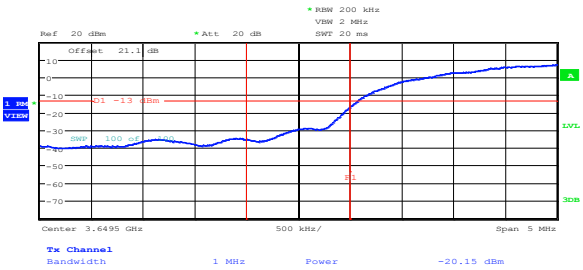

Figure 8.5-1: *Lower band edge at cho with QPSK*

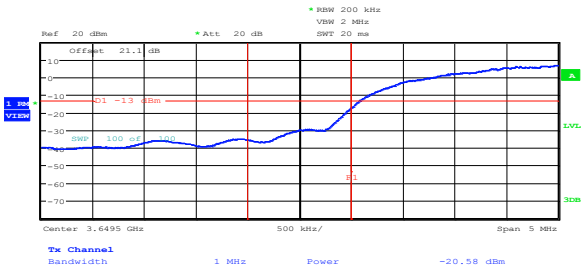

Figure 8.5-2: *Lower band edge at cho with 256-QAM*

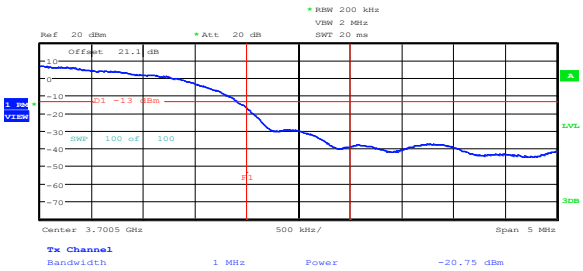

Figure 8.5-3: *Upper band edge at cho with QPSK*

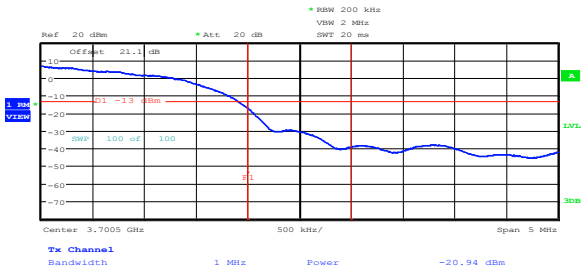

Figure 8.5-4: *Upper band edge at cho with 256-QAM*

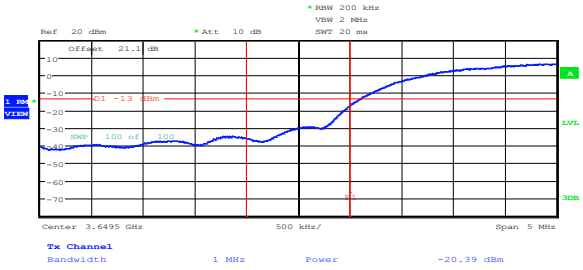

Figure 8.5-5: *Lower band edge at ch1 with QPSK*

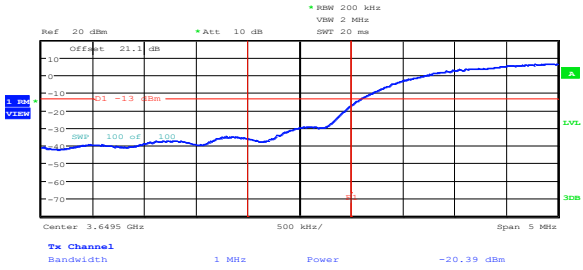

Figure 8.5-6: *Lower band edge at ch1 with 256-QAM*

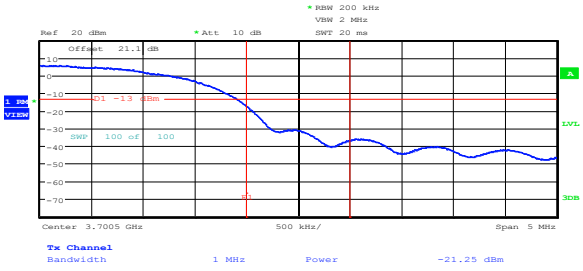

Figure 8.5-7: *Upper band edge at ch1 with QPSK*

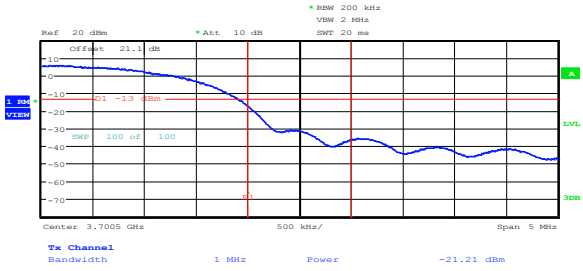

Figure 8.5-8: *Upper band edge at ch1 with 256-QAM*

8.5.4 Test data, continued

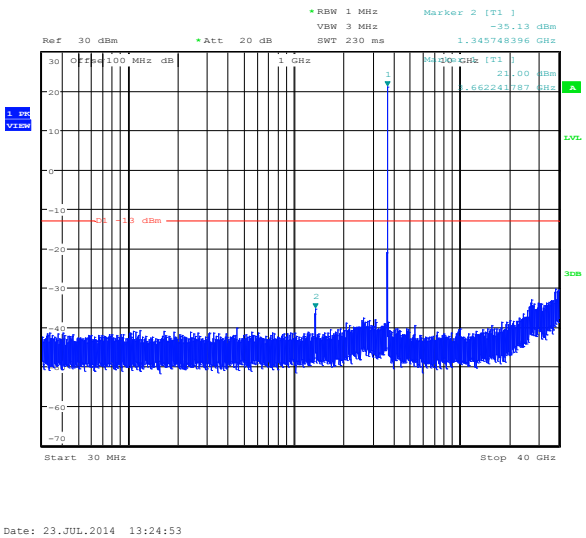

Figure 8.5-9: *Spurious out-of-band emissions at cho with QPSK, low channel*

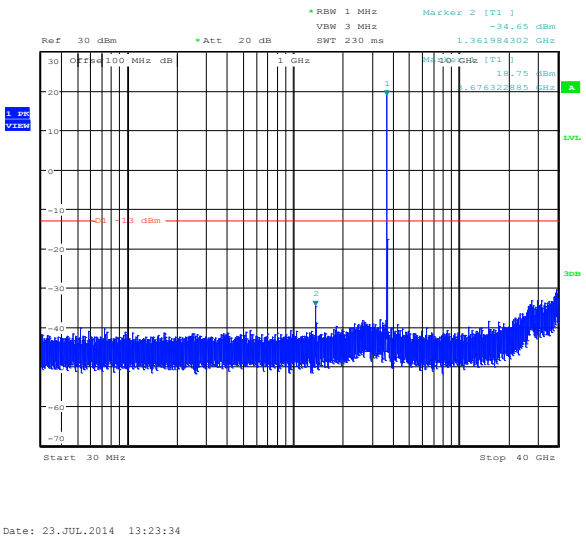

Figure 8.5-10: *Spurious out-of-band emissions at cho with QPSK, mid channel*

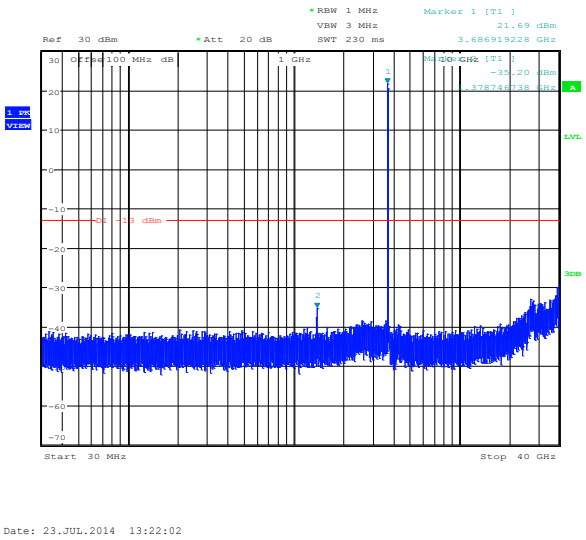

Figure 8.5-11: *Spurious out-of-band emissions at cho with QPSK, high channel*

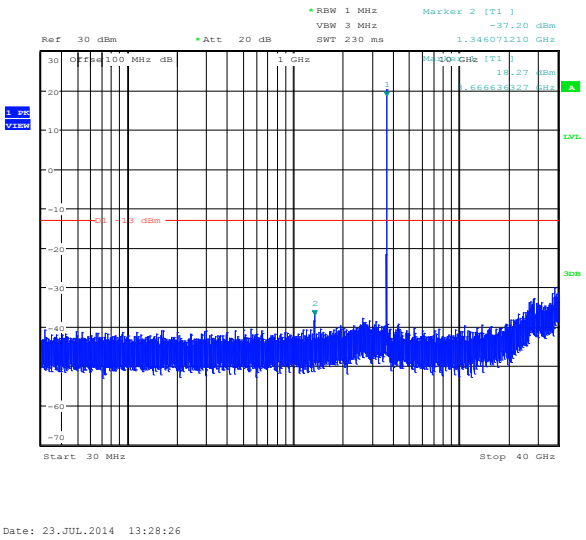

Figure 8.5-12: *Spurious out-of-band emissions at cho with 256-QAM, low channel*

8.5.4 Test data, continued

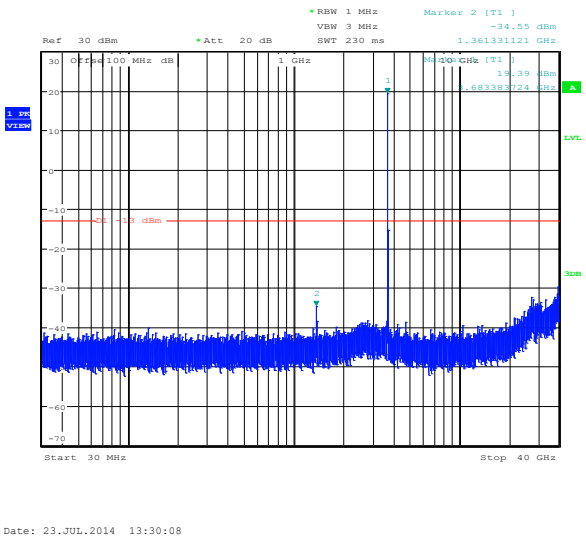

Figure 8.5-13: *Spurious out-of-band emissions at ch0 with 256-QAM, mid channel*

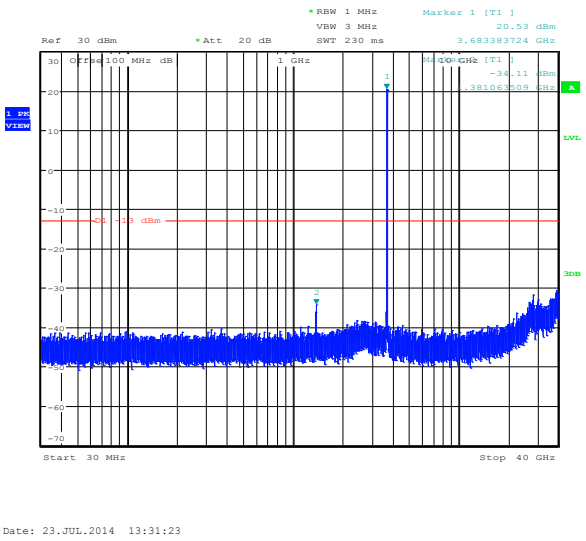

Figure 8.5-14: *Spurious out-of-band emissions at ch0 with 256-QAM, high channel*

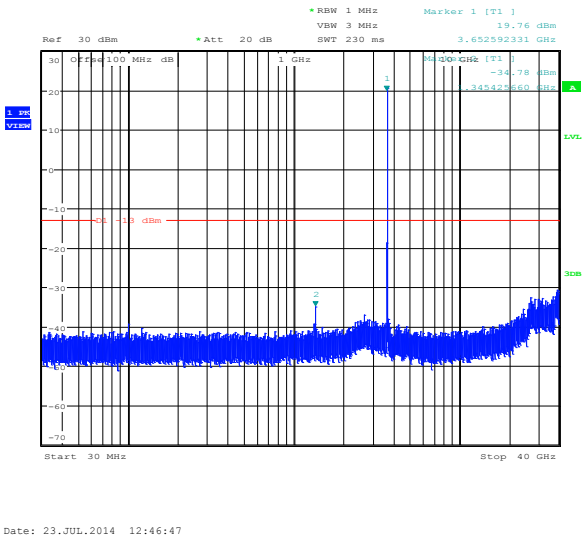

Figure 8.5-15: *Spurious out-of-band emissions at ch1 with QPSK, low channel*

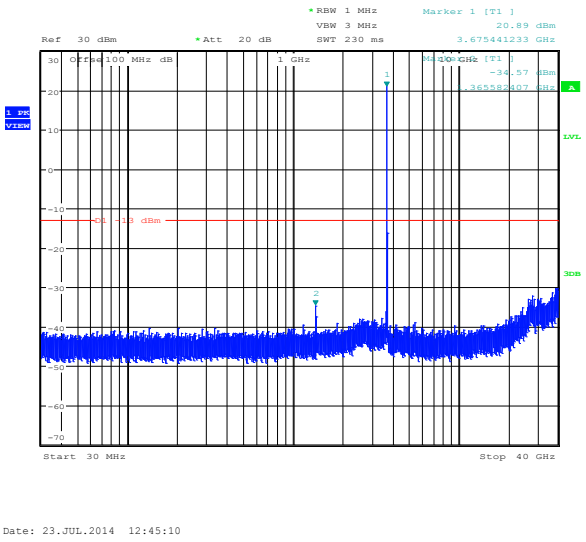

Figure 8.5-16: *Spurious out-of-band emissions at ch1 with QPSK, mid channel*

8.5.4 Test data, continued

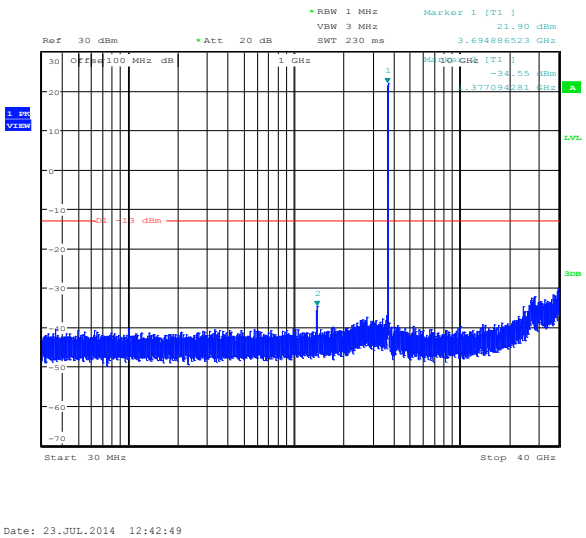

Figure 8.5-17: *Spurious out-of-band emissions at ch1 with QPSK, high channel*

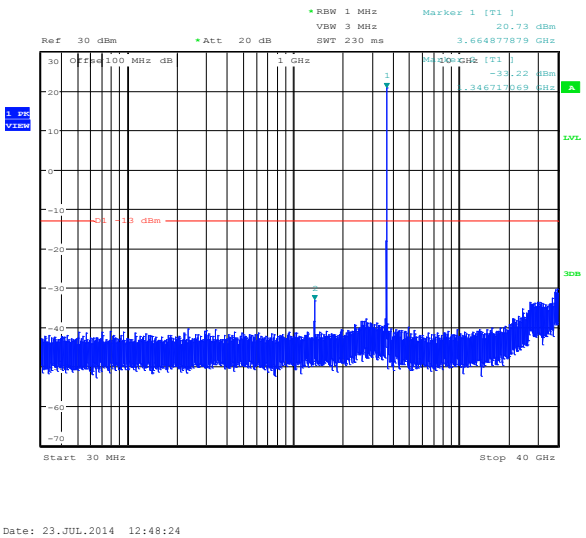

Figure 8.5-18: *Spurious out-of-band emissions at ch1 with 256-QAM, low channel*

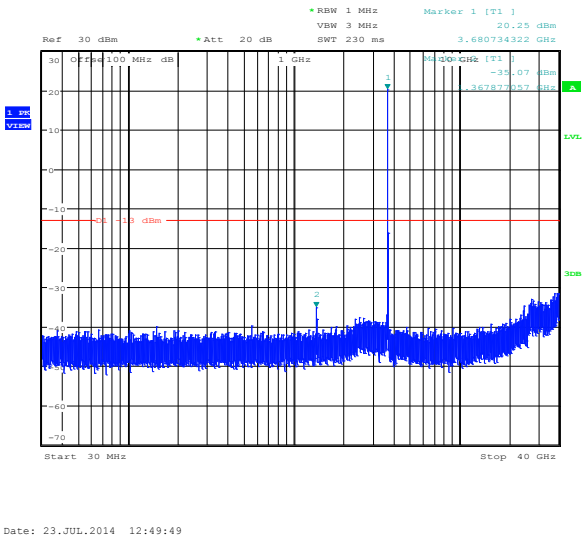

Figure 8.5-19: *Spurious out-of-band emissions at ch1 with 256-QAM, mid channel*

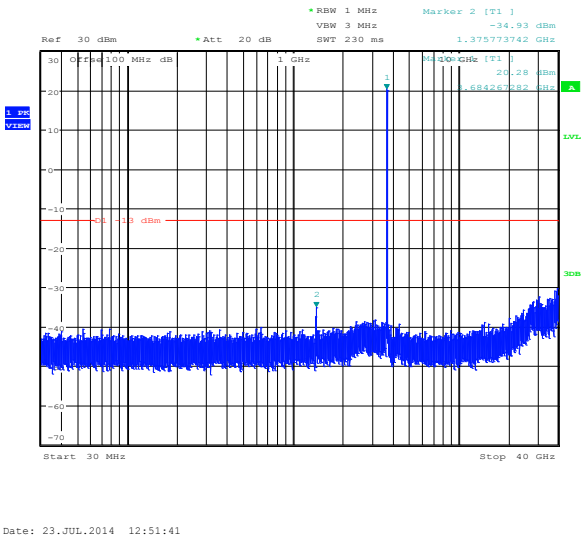

Figure 8.5-20: *Spurious out-of-band emissions at ch1 with 256-QAM, high channel*

8.5.4 Test data, continued

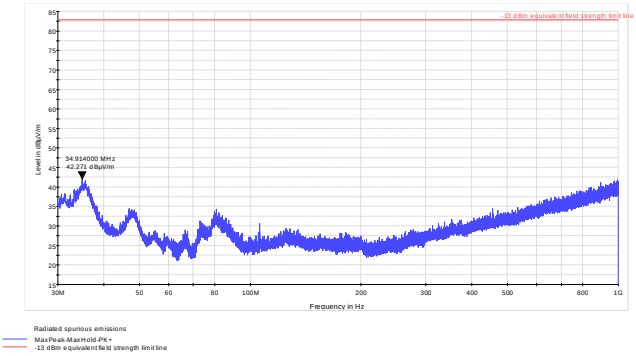

Figure 8.5-21: *Spurious radiated emissions sample plot 30–1000 MHz, Hub*

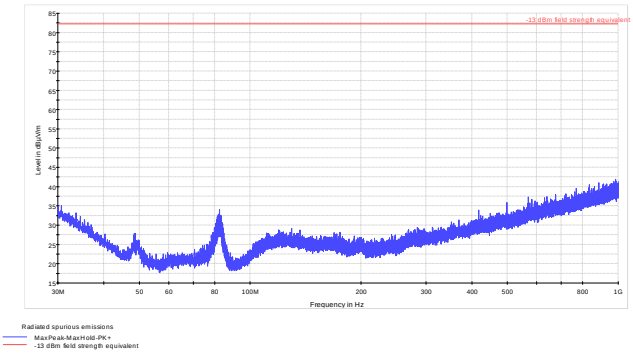

Figure 8.5-22: *Spurious radiated emissions sample plot 30–1000 MHz, BRM*

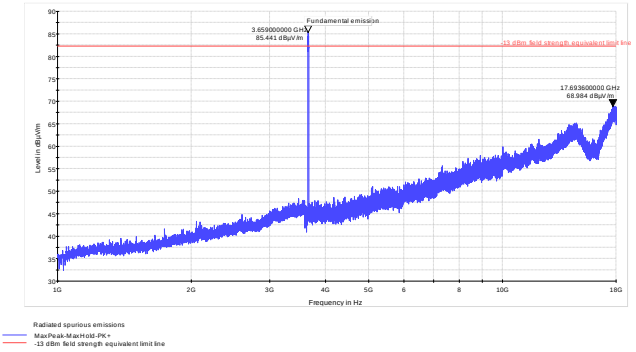

Figure 8.5-23: *Spurious radiated emissions sample plot 1–18 GHz, Hub*

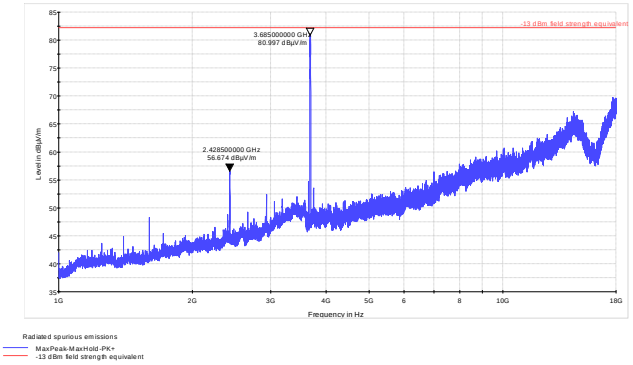

Figure 8.5-24: *Spurious radiated emissions sample plot 1–18 GHz, BRM*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up