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Compliance test report ID **196334-7TRFWL**

Date of issue
July 12, 2012

FCC 47 CFR Part 15 Subpart E, §15.407

Unlicensed National Information Infrastructure Devices

Applicant **Redline Communications**
Product **Broad-band wireless infrastructure product**
Model **RDL-3000-RMA**
FCC ID **QC8-RDL3000RMA**

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

SCC Accredited LAB
LAB Accrédité CCN

Test location

Nemko Canada Inc.
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Test site FCC ID: 176392 (3 m semi anechoic chamber)

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Tested by Andrey Adelberg, Senior Wireless/EMC Specialist

Reviewed by Kevin Rose, Wireless/EMC Specialist

July 12, 2012
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

Table of Contents

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 E, Chapter 15.407

Unlicensed National Information Infrastructure Devices

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

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

See “Summary of test results” for full details.

1.4 Exclusions

None

1.5 Test report revision history

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

Section 2 Summary of test results

2.1 FCC Part 15 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]
§15.31(m)	Number of operating frequencies	Pass[2]
§15.203	Antenna requirement	Pass[3]

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] Since the frequency band was wider than 10 MHz, three channels (1 near top, 1 near middle and 1 near bottom) were selected for the testing.
[3] The antenna used with this EUT is non-detachable.

2.2 FCC Part 15 Subpart E, test results

Part	Test description	Verdict
15.403(i)	Emission bandwidth	Pass
15.407(a)(2)	Maximum conducted transmit output power	Pass
15.407(a)(2)	Peak power spectral density	Pass
15.407(a)(6)	Peak excursion measurement	Pass
15.407(b)	Spurious emissions	Pass
15.407(g)	Frequency stability	Pass

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	January 17, 2012
Nemko sample ID number	3

3.2 EUT information

Product name	Broad-band wireless infrastructure product
Model	RDL-3000-RMA
Serial number	117PC11510007

3.3 Technical information

Operating band	5250–5350 MHz
Operating frequency	5 MHz Channel: 5252.5–5345 MHz 10 MHz Channel: 5255–5342.5 MHz 20 MHz Channel: 5260–5337.5 MHz
Modulation type	OFDM using 64-QAM, 16-QAM, QPSK and BPSK modulation for sub-carriers
Occupied bandwidth	5, 10 and 20 MHz
Emission designator	W7D
Power requirements	48 V_{DC} PoE via 120 V_{AC}, 60 Hz
Antenna information	Redline 4.9–6.1 GHz Dual Polarization/ Dual Slant Subscriber Antenna, 19 dBi, M/N: 30-00328-00

3.4 Product description and theory of operation

The EUT is a 2×2 MIMO point-to-point (PTP) carrier grade broadband wireless infrastructure product, designed to operate in the 5250–5350 MHz band.

3.5 EUT exercise details

The EUT was in a continuous transmitting mode with random data frames. The modulation, channel bandwidth and channel frequency was changed using a Web-based interface of the Ethernet port.

3.6 EUT setup diagram

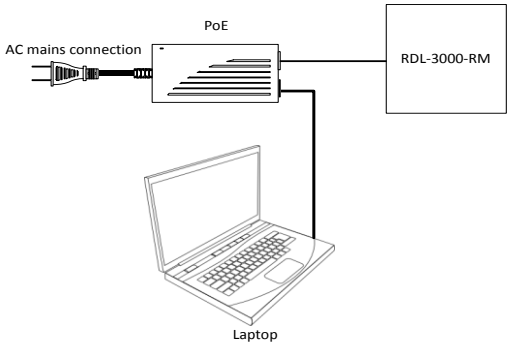


Diagram 3.6-1: Setup diagram

3.7 Support equipment

Description	Brand name	Model/Part number	Serial number	Rev.
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: 86–106 kPa

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

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 09/12
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power Source	California Instruments	5001ix	FA001770	1 year	May 03/12
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	April 27/12
Biconical antenna	Sunol	BC2	FA002078	1 year	Jan. 04/13
Log periodic antenna	Sunol	LP5	FA002077	1 year	Dec. 28/12
Horn antenna #1	EMCO	3115	FA000649	1 year	Mar. 08/12
1–18 GHz pre-amplifier	JCA	JCA118-503	FA002091	1 year	Aug. 15/12
Horn antenna 18–26.5 GHz	Electro-metrics	SH-50/60-1	FA000479	—	VOU
18–26 GHz pre-amplifier	Narda	BBS-1826N612	FA001550	—	VOU
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
18.0 – 40.0 GHz Horn Antenna	EMCO	3116	FA001847	1 year	May 20/12
26 – 40.0 GHz Amplifier	NARDA	DBL-2640N610	FA001556	—	VOU
LISN	Rohde & Schwarz	ENV216	FA002023	1 year	Nov. 18/12
Note: NCR - no calibration required, VOU - verify on use					

Section 8 Testing data

8.1 Clause 15.207(a) Conducted limits

8.1.1 Definitions and limits

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.

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
* - Decreases with the logarithm of the frequency.		

8.1.2 Test summary

Test date	February 2, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	24 °C	**Air pressure**	1002 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.

Receiver/spectrum analyzer settings

Preview measurements – Receiver:
Peak and Average detector (Max hold), RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms
Final measurements – Receiver:
Q-Peak and Average detector, RBW = 9 kHz, VBW = 30 kHz, Measurement time = 100 ms

Measurement details

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

8.1.4 Test data

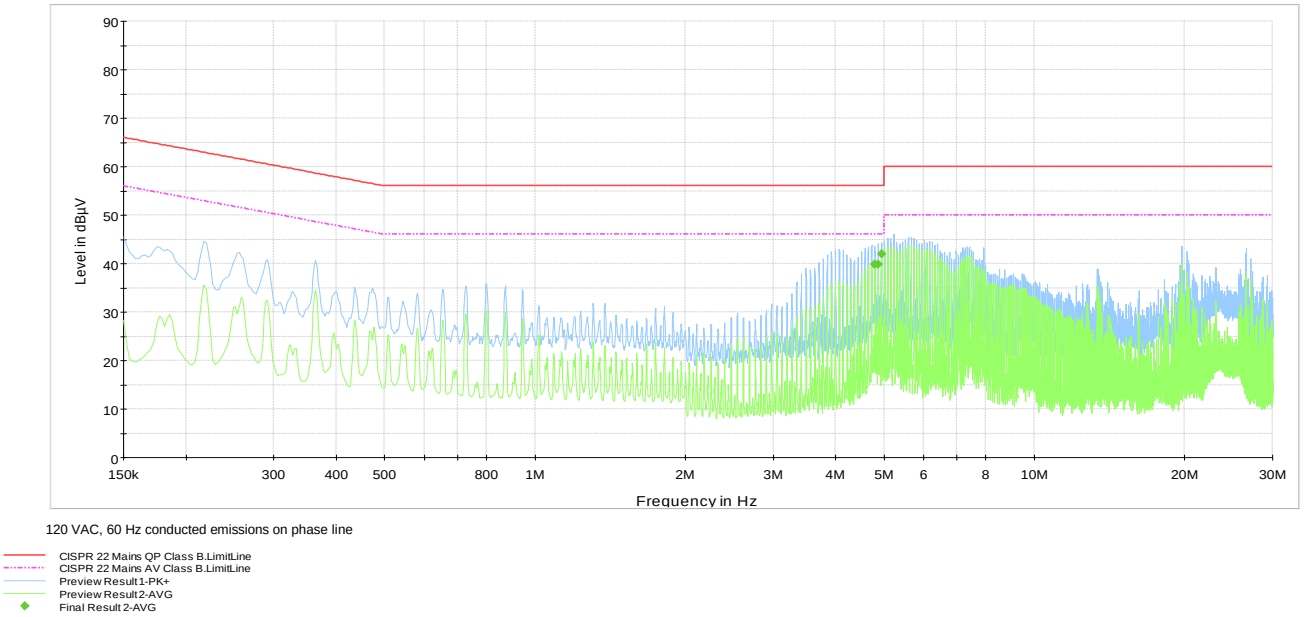
Table 8.1-2: Average conducted emissions results

Frequency (MHz)	Average result (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Conductor	Correction (dB)	Margin (dB)	Limit (dBµV)
4.796250	39.9	100.0	9.000	On	L1	10.3	6.1	46.0
4.868250	39.9	100.0	9.000	On	L1	10.3	6.1	46.0
4.942500	41.9	100.0	9.000	On	L1	10.2	4.1	46.0

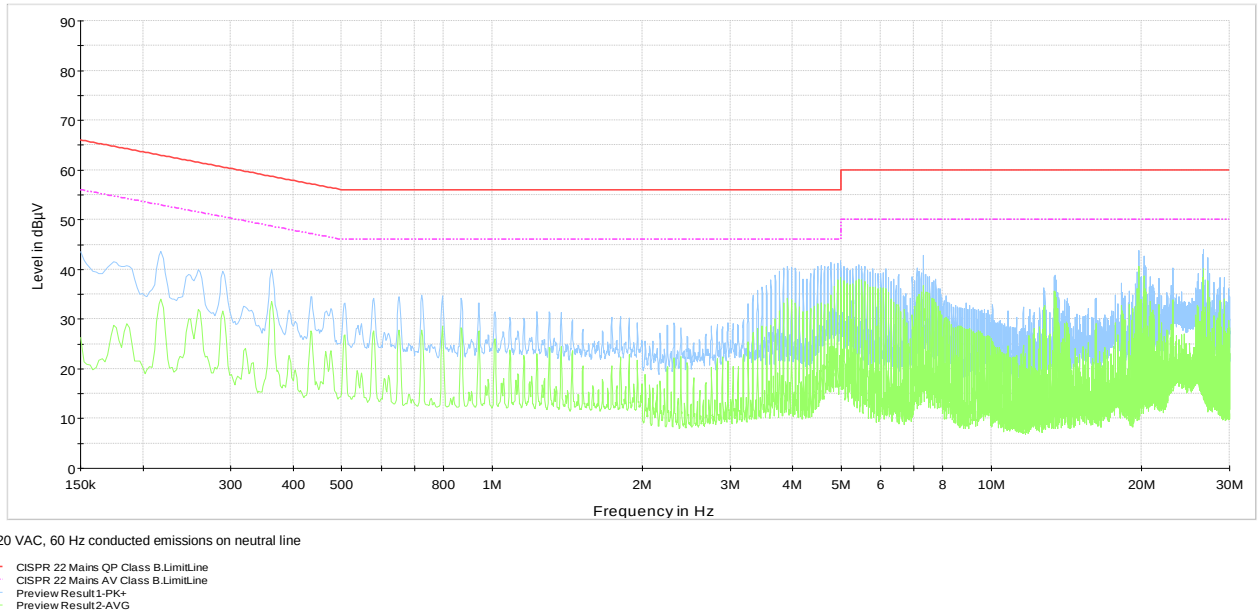
Sample calculation:
Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)
Result (dBµV) = XX dBµV (reading from receiver) + XX dB (Correction factor)

Example:
43.5 dBµV = 23.2 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

8.1.4 Test data



Plot 8.1-1: Conducted emissions on phase line



Plot 8.1-2: Conducted emissions on neutral line

8.2 Clause 15.403(i) Emission bandwidth

8.2.1 Definitions and limits

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

8.2.2 Test summary

Test date	February 7, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1002 mbar	**Relative humidity**	31 %

8.2.3 Observations/special notes

5 MHz and 10 MHz channel measurements were performed with peak detector using 100 kHz RBW. VBW was set wider than RBW.
20 MHz channel measurements were performed with peak detector using 300 kHz RBW. VBW was set wider than RBW. The measurements were performed using max-hold function turned on.

8.2.4 Test data

Table 8.2-1: 26 dB bandwidth results for 5 MHz channel

Frequency (MHz)	26 dB bandwidth (MHz)
5252.5	4.96
5300.0	4.86
5345.0	4.84

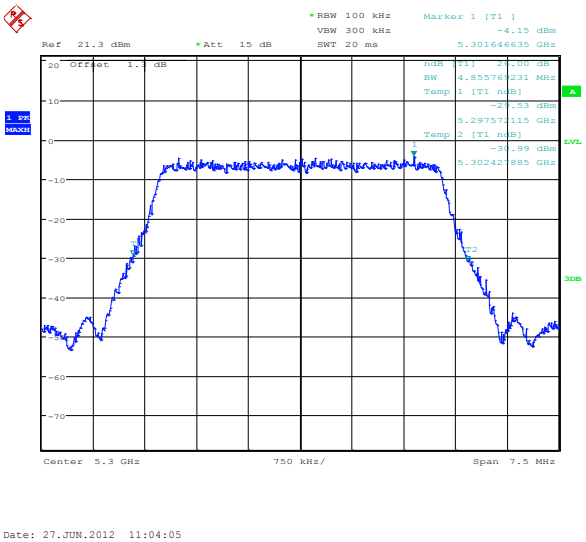
Table 8.2-2: 26 dB bandwidth results for 10 MHz channel

Frequency (MHz)	26 dB bandwidth (MHz)
5255.0	9.59
5300.0	9.74
5342.5	9.49

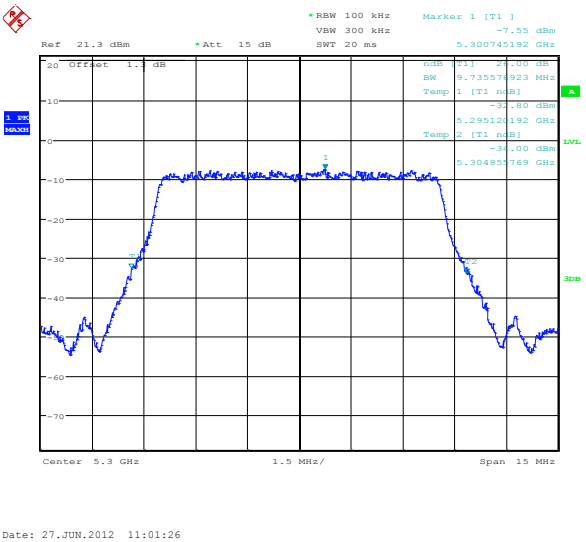
Table 8.2-3: 26 dB bandwidth results for 20 MHz channel

Frequency (MHz)	26 dB bandwidth (MHz)
5260.0	19.71
5300.0	19.71
5337.5	19.76

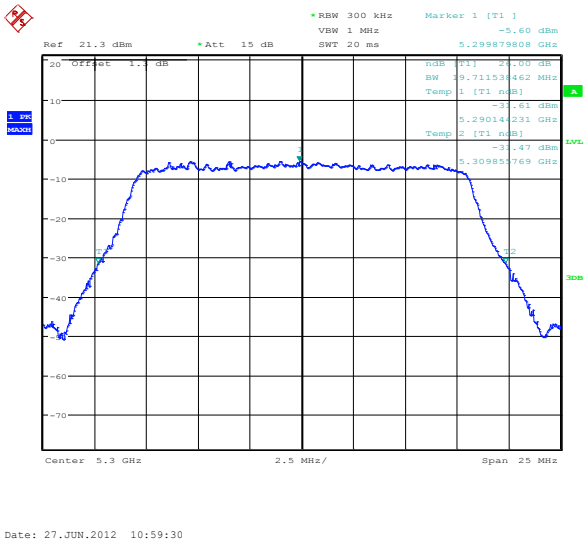
8.2.4 Test data, continued



Plot 8.2-1: Sample plot of 26 dB bandwidth, 5 MHz channel



Plot 8.2-2: Sample plot of 26 dB bandwidth, 10 MHz channel



Plot 8.2-3: Sample plot of 26 dB bandwidth, 20 MHz channel

8.3 Clause 15.407(a)(2) Maximum conducted output power and PPSD limits

8.3.1 Definitions and limits

For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW (24 dBm) or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

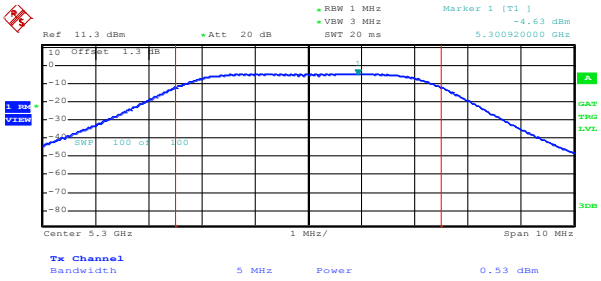
8.3.2 Test summary

Test date	February 3, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	31 %

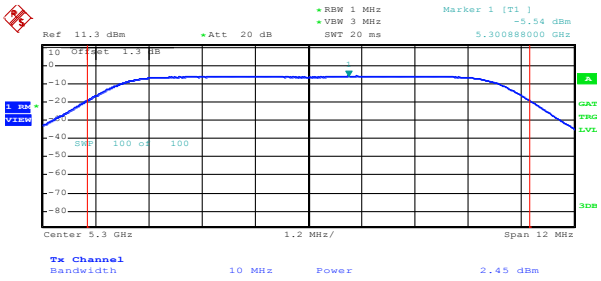
8.3.3 Observations/special notes

Measurement procedure Method SA-2 of 789033 D01 UNII Test Procedures v01 was used for average power measurements. Test duty cycle was 100 % therefore no corrections were applied

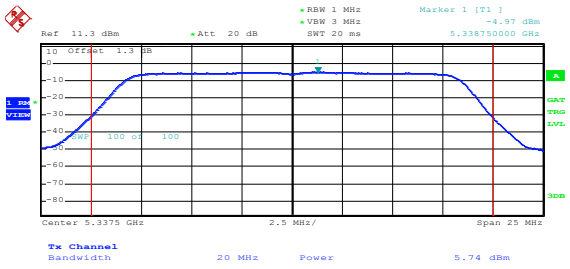
8.3.4 Test data



Plot 8.3-1: Sample plot for output power on 5 MHz channel



Plot 8.3-2: Sample plot for output power on 10 MHz channel



Plot 8.3-3: Sample plot for output power on 20 MHz channel

8.3.4 Test data, continued

Table 8.3-1: Output power and EIRP results for 5 MHz channel

Modulation	Frequency (MHz)	Conducted power, port 1 (dBm)	Conducted power, port 2 (dBm)	Combined power (dBm)	Conducted power limit (dBm)	Margin (dB)	Antenna gain (dBi)	EIRP (dBm)	EIRP limit (dBm)	Margin (dBm)
BPSK	5252.5	-0.24	-0.22	2.78	4.95	2.17	19.00	21.78	23.95	2.17
	5300.0	-0.66	0.72	3.09	4.95	1.86	19.00	22.09	23.95	1.86
	5345.0	-0.41	0.65	3.16	4.95	1.79	19.00	22.16	23.95	1.79
QPSK	5252.5	-0.08	0.32	3.13	4.95	1.82	19.00	22.13	23.95	1.82
	5300.0	-0.19	0.19	3.01	4.95	1.94	19.00	22.01	23.95	1.94
	5345.0	-0.42	0.47	3.06	4.95	1.89	19.00	22.06	23.95	1.89
16-QAM	5252.5	-0.19	0.19	3.01	4.95	1.94	19.00	22.01	23.95	1.94
	5300.0	-0.28	0.10	2.92	4.95	2.03	19.00	21.92	23.95	2.03
	5345.0	0.04	0.38	3.22	4.95	1.73	19.00	22.22	23.95	1.73
64-QAM	5252.5	0.36	-0.50	2.96	4.95	1.99	19.00	21.96	23.95	1.99
	5300.0	-0.15	0.29	3.09	4.95	1.86	19.00	22.09	23.95	1.86
	5345.0	-1.42	0.56	2.69	4.95	2.26	19.00	21.69	23.95	2.26
Conducted output power = $11 + 10 \times \log_{10}(4.96) - (19 - 6) = 4.95$ dBm										

Table 8.3-2: Output power and EIRP results for 10 MHz channel

Modulation	Frequency (MHz)	Conducted power, port 1 (dBm)	Conducted power, port 2 (dBm)	Combined power (dBm)	Conducted power limit (dBm)	Margin (dB)	Antenna gain (dBi)	EIRP (dBm)	EIRP limit (dBm)	Margin (dBm)
BPSK	5255.0	-0.43	0.49	3.06	7.89	4.83	19.00	22.06	26.89	5.11
	5300.0	3.02	2.45	5.75	7.89	2.14	19.00	24.75	26.89	4.80
	5342.5	3.35	2.73	6.06	7.89	1.83	19.00	25.06	26.89	4.73
QPSK	5255.0	-0.46	0.48	3.05	7.89	4.84	19.00	22.05	26.89	4.76
	5300.0	2.97	2.39	5.70	7.89	2.19	19.00	24.70	26.89	4.88
	5342.5	3.22	2.70	5.98	7.89	1.91	19.00	24.98	26.89	4.83
16-QAM	5255.0	-0.49	0.49	3.04	7.89	4.85	19.00	22.04	26.89	4.88
	5300.0	2.97	2.34	5.68	7.89	2.21	19.00	24.68	26.89	4.97
	5342.5	3.31	2.64	6.00	7.89	1.89	19.00	25.00	26.89	4.67
64-QAM	5255.0	-0.50	0.48	3.03	7.89	4.86	19.00	22.03	26.89	4.93
	5300.0	3.12	2.48	5.82	7.89	2.07	19.00	24.82	26.89	4.80
	5342.5	3.34	2.77	6.07	7.89	1.82	19.00	25.07	26.89	5.20
Conducted output power = $11 + 10 \times \log_{10}(9.74) - (19 - 6) = 7.89$ dBm										

Table 8.3-3: Output power and EIRP results for 20 MHz channel

Modulation	Frequency (MHz)	Conducted power, port 1 (dBm)	Conducted power, port 2 (dBm)	Combined power (dBm)	Conducted power limit (dBm)	Margin (dB)	Antenna gain (dBi)	EIRP (dBm)	EIRP limit (dBm)	Margin (dBm)
BPSK	5260.0	0.56	1.32	3.97	10.96	6.99	19.00	22.97	29.96	8.18
	2300.0	5.56	5.68	8.63	10.96	2.33	19.00	27.63	29.96	7.87
	5337.5	5.74	5.11	8.45	10.96	2.51	19.00	27.45	29.96	7.80
QPSK	5260.0	0.52	1.24	3.91	10.96	7.05	19.00	22.91	29.96	7.83
	2300.0	5.48	5.67	8.59	10.96	2.37	19.00	27.59	29.96	7.95
	5337.5	5.88	5.07	8.50	10.96	2.46	19.00	27.50	29.96	7.90
16-QAM	5260.0	0.52	1.22	3.89	10.96	7.07	19.00	22.89	29.96	7.95
	2300.0	5.39	5.62	8.52	10.96	2.44	19.00	27.52	29.96	8.04
	5337.5	5.69	5.11	8.42	10.96	2.54	19.00	27.42	29.96	7.74
64-QAM	5260.0	0.72	1.23	3.99	10.96	6.97	19.00	22.99	29.96	8.00
	2300.0	5.43	5.61	8.53	10.96	2.43	19.00	27.53	29.96	7.87
	5337.5	5.78	5.05	8.44	10.96	2.52	19.00	27.44	29.96	8.27
Conducted output power = $11 + 10 \times \log_{10}(19.76) - (19 - 6) = 10.96$ dBm										

8.3.4 Test data, continued

Table 8.3-4: PPSD results for 5 MHz channel

Modulation	Frequency (MHz)	Conducted PPSD, port 1 (dBm/MHz)	Conducted PPSD, port 2 (dBm/MHz)	Combined PPSD (dBm/MHz)	PPSD limit (dBm/MHz)	Margin (dB)	Antenna gain (dBi)	PPSD EIRP (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
BPSK	5252.5	-5.78	-5.26	-2.50	-2.00	0.50	19.00	16.50	17.00	0.50
	5300.0	-5.82	-4.51	-2.11	-2.00	0.11	19.00	16.89	17.00	0.11
	5345.0	-5.65	-4.45	-2.00	-2.00	0.00	19.00	17.00	17.00	0.00
QPSK	5252.5	-5.30	-4.91	-2.09	-2.00	0.09	19.00	16.91	17.00	0.09
	5300.0	-5.38	-5.01	-2.18	-2.00	0.18	19.00	16.82	17.00	0.18
	5345.0	-6.41	-4.76	-2.50	-2.00	0.50	19.00	16.50	17.00	0.50
16-QAM	5252.5	-5.41	-5.06	-2.22	-2.00	0.22	19.00	16.78	17.00	0.22
	5300.0	-5.48	-5.14	-2.30	-2.00	0.30	19.00	16.70	17.00	0.30
	5345.0	-5.18	-4.86	-2.01	-2.00	0.01	19.00	16.99	17.00	0.01
64-QAM	5252.5	-4.96	-5.72	-2.31	-2.00	0.31	19.00	16.69	17.00	0.31
	5300.0	-5.34	-4.90	-2.10	-2.00	0.10	19.00	16.90	17.00	0.10
	5345.0	-6.58	-4.62	-2.48	-2.00	0.48	19.00	16.52	17.00	0.48
PPSD limit = 11 − (19 − 6) = −2 dBm/MHz										

Table 8.3-5: PPSD results for 10 MHz channel

Modulation	Frequency (MHz)	Conducted PPSD, port 1 (dBm/MHz)	Conducted PPSD, port 2 (dBm/MHz)	Combined PPSD (dBm/MHz)	PPSD limit (dBm/MHz)	Margin (dB)	Antenna gain (dBi)	PPSD EIRP (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
BPSK	5255.0	-8.66	-7.78	-5.19	-2.00	3.19	19.00	13.81	17.00	3.19
	5300.0	-4.96	-5.54	-2.23	-2.00	0.23	19.00	16.77	17.00	0.23
	5342.5	-4.82	-5.35	-2.07	-2.00	0.07	19.00	16.93	17.00	0.07
QPSK	5255.0	-8.72	-7.73	-5.19	-2.00	3.19	19.00	13.81	17.00	3.19
	5300.0	-5.03	-5.61	-2.30	-2.00	0.30	19.00	16.70	17.00	0.30
	5342.5	-4.89	-5.41	-2.13	-2.00	0.13	19.00	16.87	17.00	0.13
16-QAM	5255.0	-8.74	-7.75	-5.21	-2.00	3.21	19.00	13.79	17.00	3.21
	5300.0	-5.04	-5.66	-2.33	-2.00	0.33	19.00	16.67	17.00	0.33
	5342.5	-4.79	-5.47	-2.11	-2.00	0.11	19.00	16.89	17.00	0.11
64-QAM	5255.0	-8.72	-7.76	-5.20	-2.00	3.20	19.00	13.80	17.00	3.20
	5300.0	-4.89	-5.50	-2.17	-2.00	0.17	19.00	16.83	17.00	0.17
	5342.5	-4.77	-5.30	-2.02	-2.00	0.02	19.00	16.98	17.00	0.02
PPSD limit = 11 − (19 − 6) = −2 dBm/MHz										

Table 8.3-6: PPSD results for 20 MHz channel

Modulation	Frequency (MHz)	Conducted PPSD, port 1 (dBm/MHz)	Conducted PPSD, port 2 (dBm/MHz)	Combined PPSD (dBm/MHz)	PPSD limit (dBm/MHz)	Margin (dB)	Antenna gain (dBi)	PPSD EIRP (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
BPSK	5260.0	-10.35	-9.60	-6.95	-2.00	4.95	19.00	12.05	17.00	4.95
	2300.0	-5.09	-4.96	-2.01	-2.00	0.01	19.00	16.99	17.00	0.01
	5337.5	-4.97	-5.59	-2.26	-2.00	0.26	19.00	16.74	17.00	0.26
QPSK	5260.0	-10.38	-9.70	-7.02	-2.00	5.02	19.00	11.98	17.00	5.02
	2300.0	-5.20	-4.99	-2.08	-2.00	0.08	19.00	16.92	17.00	0.08
	5337.5	-4.85	-5.61	-2.20	-2.00	0.20	19.00	16.80	17.00	0.20
16-QAM	5260.0	-10.42	-9.71	-7.04	-2.00	5.04	19.00	11.96	17.00	5.04
	2300.0	-5.26	-5.05	-2.14	-2.00	0.14	19.00	16.86	17.00	0.14
	5337.5	-5.02	-5.54	-2.26	-2.00	0.26	19.00	16.74	17.00	0.26
64-QAM	5260.0	-9.94	-9.57	-6.74	-2.00	4.74	19.00	12.26	17.00	4.74
	2300.0	-5.25	-5.05	-2.14	-2.00	0.14	19.00	16.86	17.00	0.14
	5337.5	-4.89	-5.71	-2.27	-2.00	0.27	19.00	16.73	17.00	0.27
PPSD limit = 11 − (19 − 6) = −2 dBm/MHz										

8.4 Clause 15.407(b)(2) Undesirable emission limits for transmitters in the 5.25–5.35 GHz band

8.4.1 Definitions and limits

For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz. Devices operating in the 5.25–5.35 GHz band that generate emissions in the 5.15–5.25 GHz band must meet all applicable technical requirements for operation in the 5.15–5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of –27 dBm/MHz in the 5.15–5.25 GHz band.

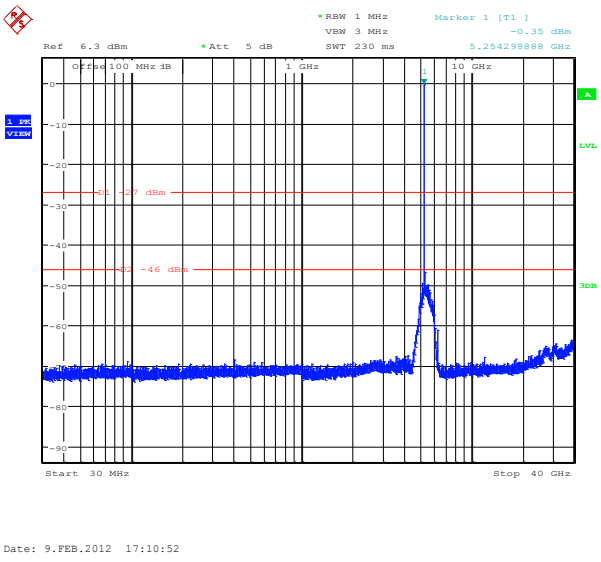
8.4.2 Test summary

Test date	February 6, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	33 %

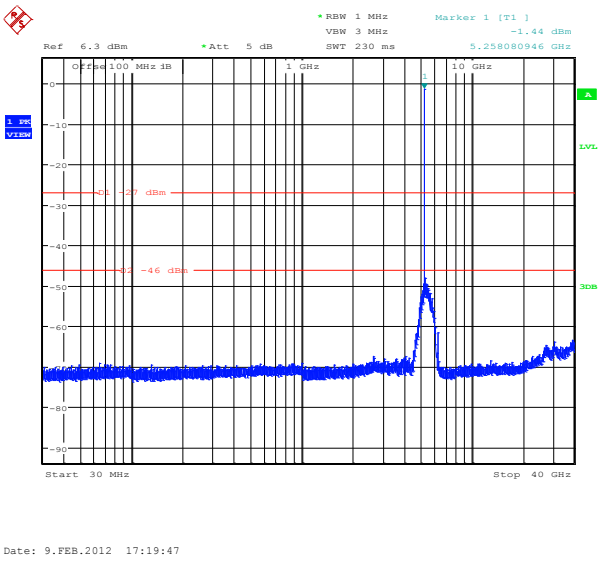
8.4.3 Observations/special notes

- The spectrum was searched from 30 MHz to the 40 GHz.
- All radiated measurements were performed at a distance of 3 m, no spurious emissions were detected more than 10 dB below the limit.
- All measurements were performed:
- within 30–1000 MHz range: using a peak detector with 100 kHz/300 kHz RBW/VBW,
- above 1 GHz: using peak detector with 1 MHz/3 MHz RBW/VBW for peak results
- and using peak detector with 1 MHz/10 Hz RBW/VBW for average results.
- Conducted spurious emissions were performed according to 789033 D01 General UNII Test Procedures v01r01.
- The spurious emissions measurements were performed using max-hold function turned on, using peak procedure.

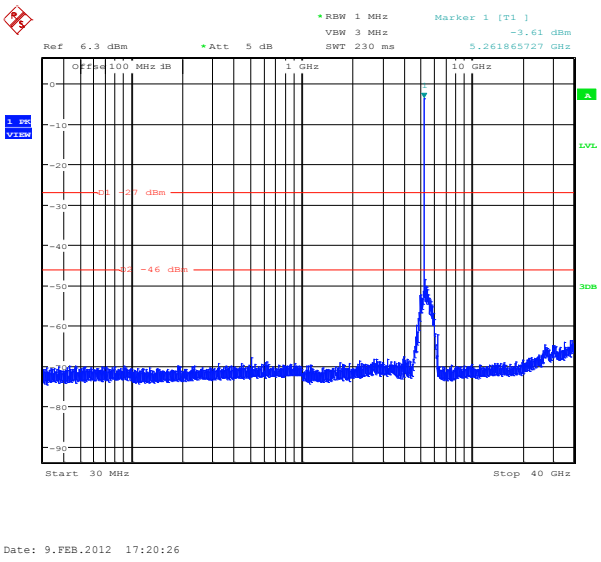
8.4.4 Test data



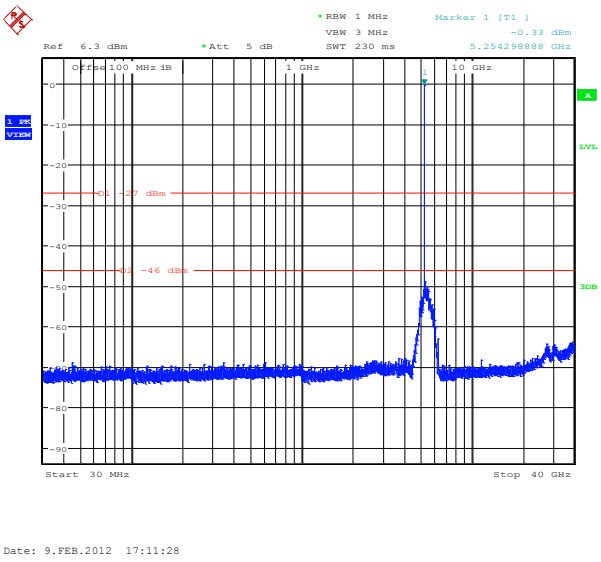
Plot 8.4-1: Conducted spurious emissions at the antenna port 1, 5 MHz channel, low frequency



Plot 8.4-2: Conducted spurious emissions at the antenna port 1, 10 MHz channel, low frequency

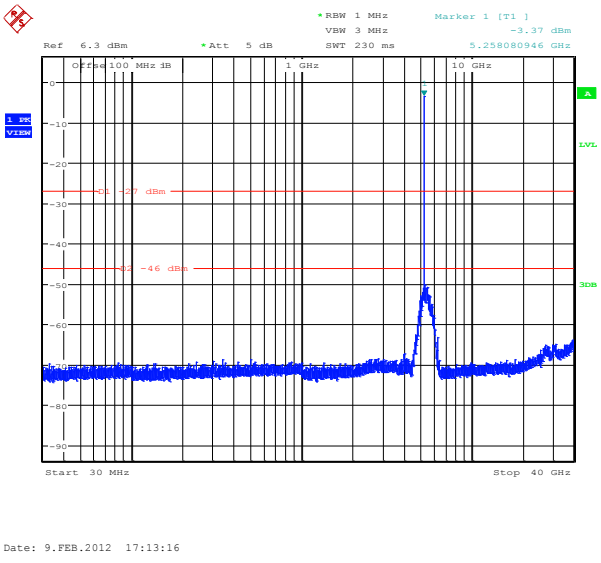


Plot 8.4-3: Conducted spurious emissions at the antenna port 1, 20 MHz channel, low frequency

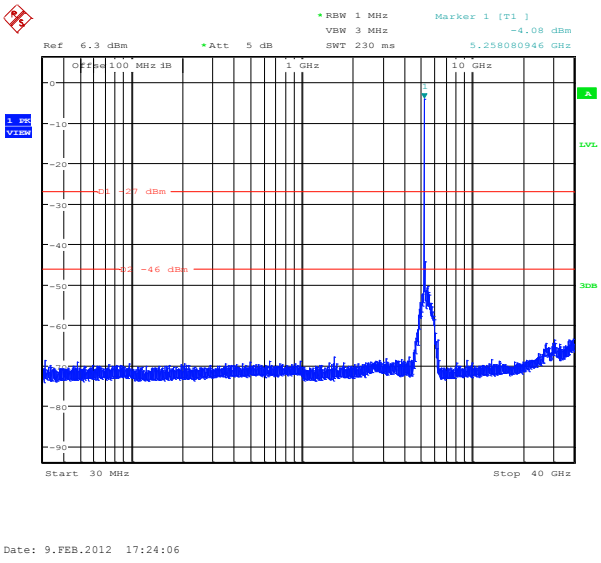


Plot 8.4-4: Conducted spurious emissions at the antenna port 2, 5 MHz channel, low frequency

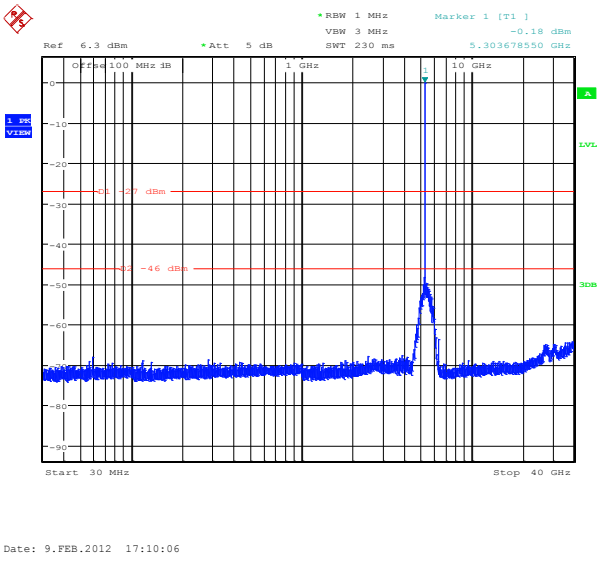
8.4.4 Test data, continued



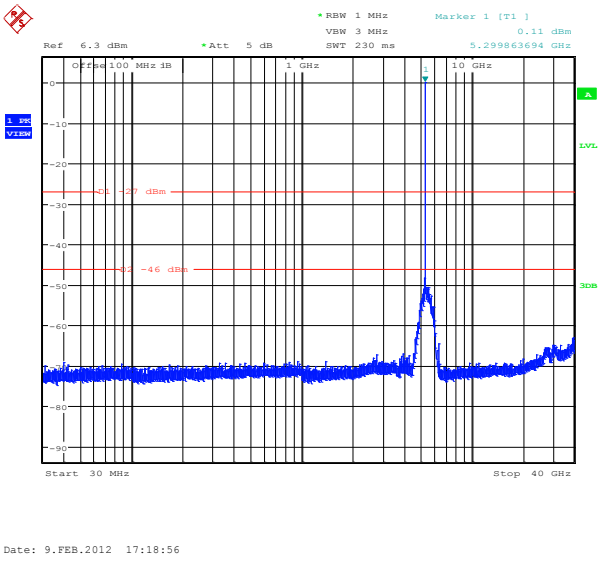
Plot 8.4-5: Conducted spurious emissions at the antenna port 2, 10 MHz channel, low frequency



Plot 8.4-6: Conducted spurious emissions at the antenna port 2, 20 MHz channel, low frequency

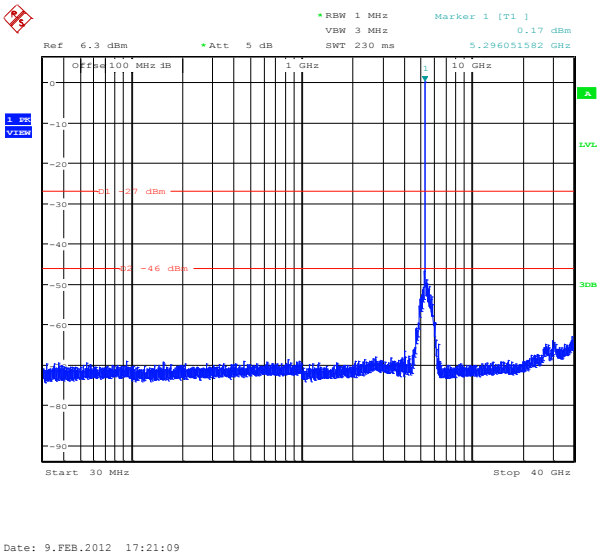


Plot 8.4-7: Conducted spurious emissions at the antenna port 1, 5 MHz channel, mid frequency

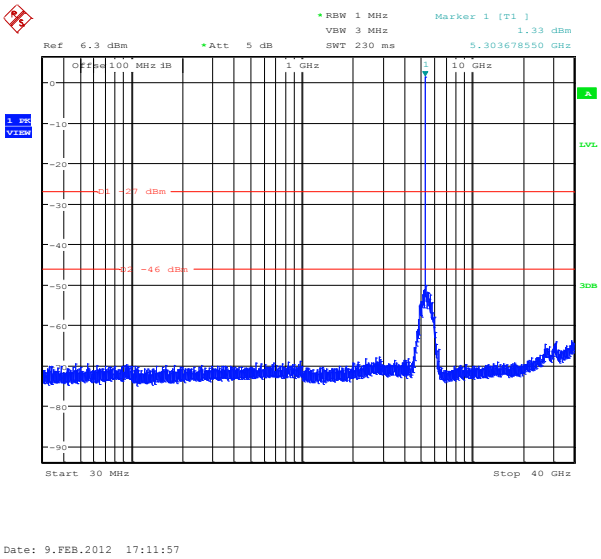


Plot 8.4-8: Conducted spurious emissions at the antenna port 1, 10 MHz channel, mid frequency

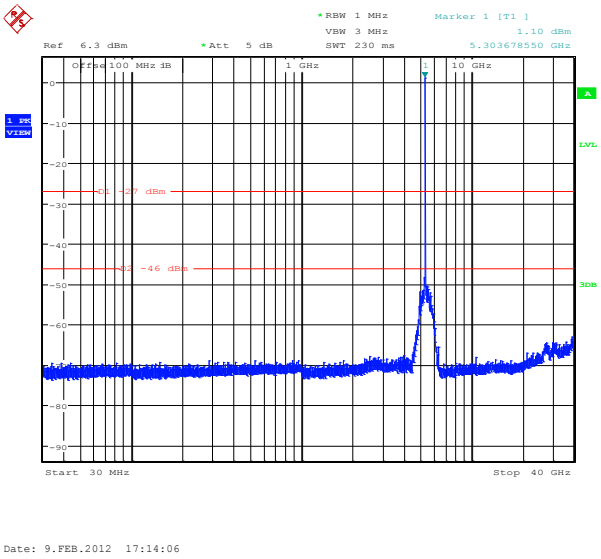
8.4.4 Test data, continued



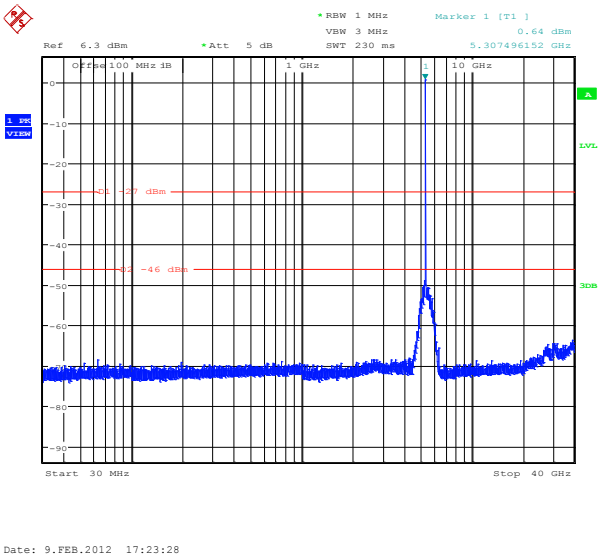
Plot 8.4-9: Conducted spurious emissions at the antenna port 1, 20 MHz channel, mid frequency



Plot 8.4-10: Conducted spurious emissions at the antenna port 2, 5 MHz channel, mid frequency

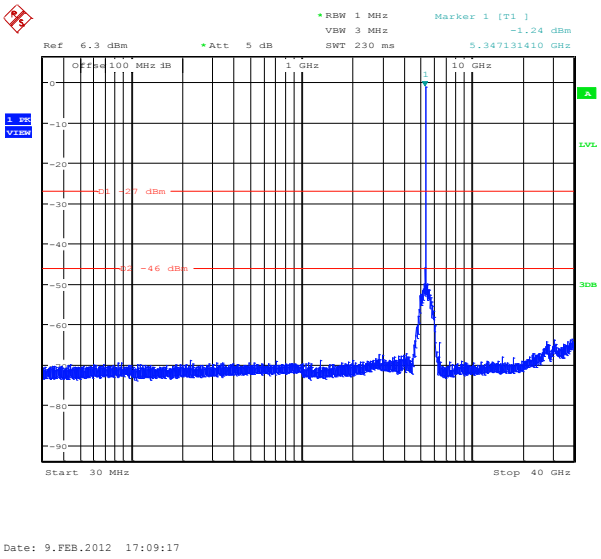


Plot 8.4-11: Conducted spurious emissions at the antenna port 2, 10 MHz channel, mid frequency

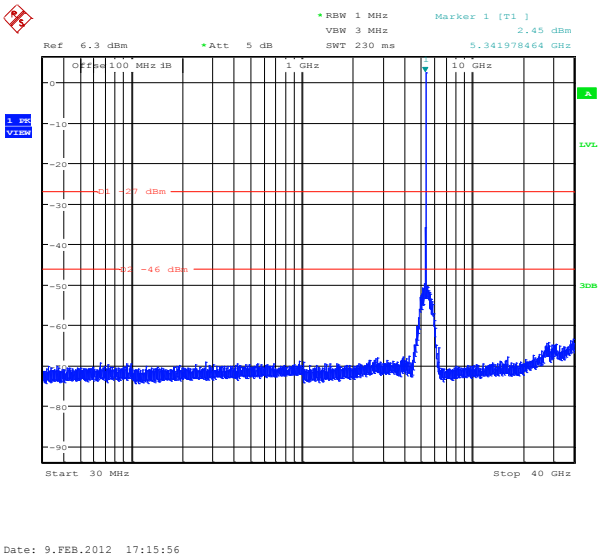


Plot 8.4-12: Conducted spurious emissions at the antenna port 2, 20 MHz channel, mid frequency

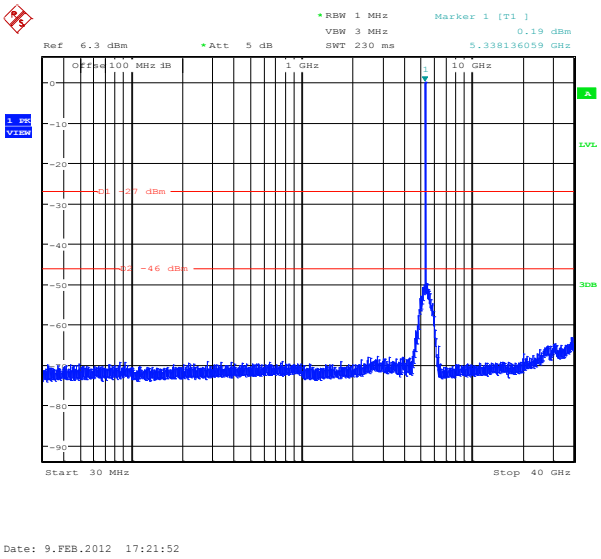
8.4.4 Test data, continued



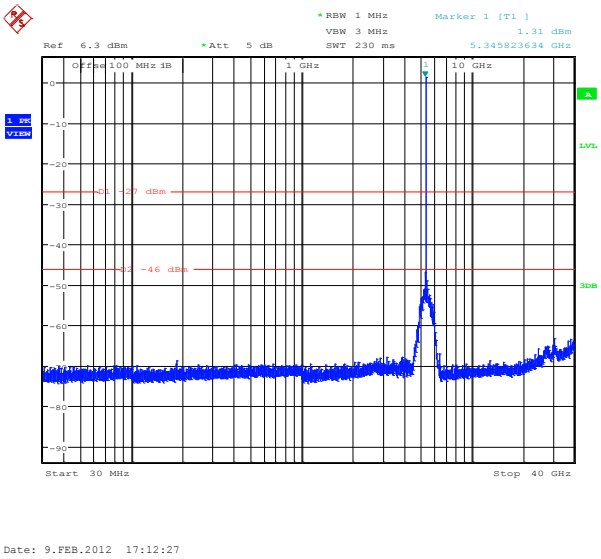
Plot 8.4-13: Conducted spurious emissions at the antenna port 1, 5 MHz channel, high frequency



Plot 8.4-14: Conducted spurious emissions at the antenna port 1, 10 MHz channel, high frequency

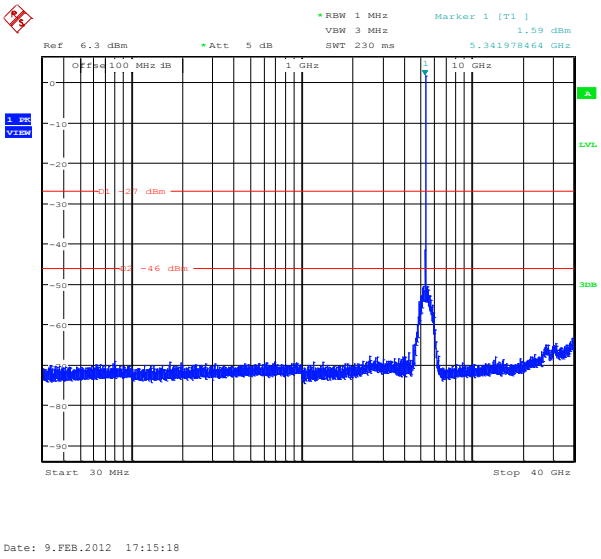


Plot 8.4-15: Conducted spurious emissions at the antenna port 1, 20 MHz channel, high frequency

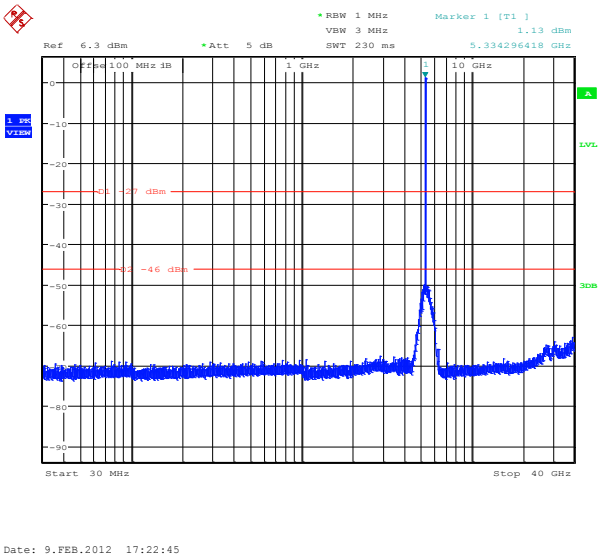


Plot 8.4-16: Conducted spurious emissions at the antenna port 2, 5 MHz channel, high frequency

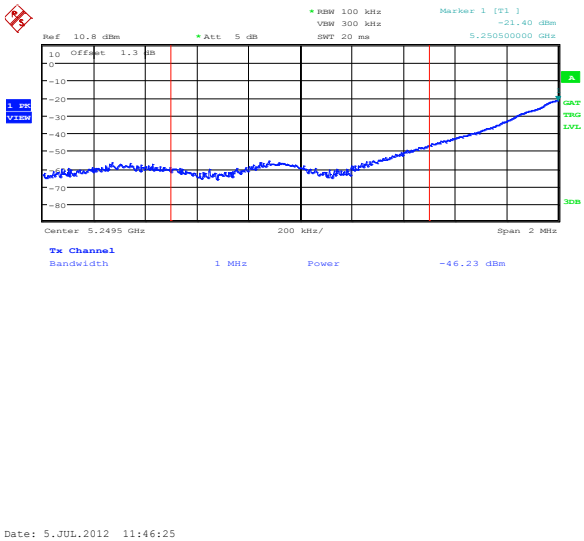
8.4.4 Test data, continued



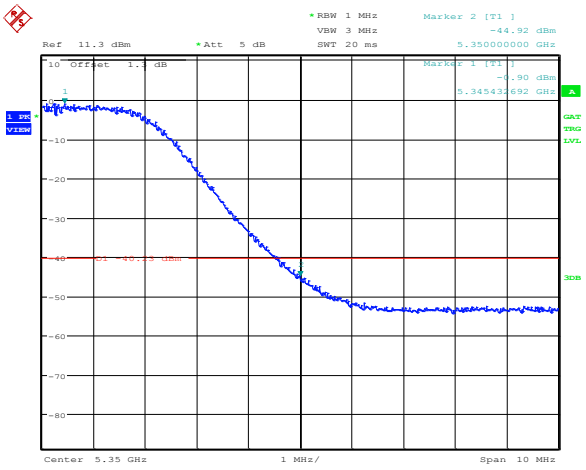
Plot 8.4-17: Conducted spurious emissions at the antenna port 2, 10 MHz channel, high frequency



Plot 8.4-18: Conducted spurious emissions at the antenna port 2, 20 MHz channel, high frequency



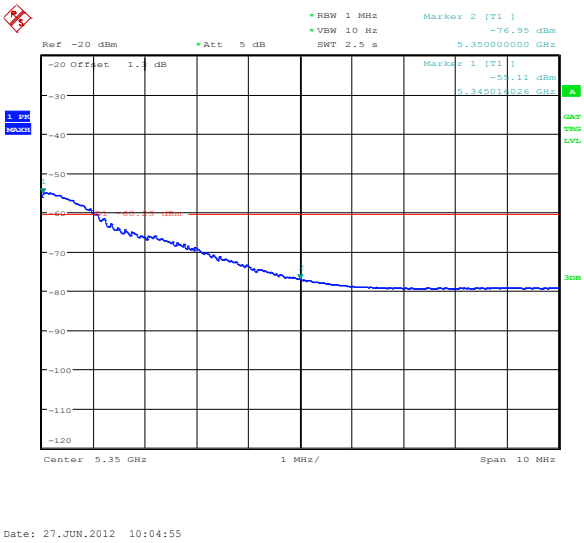
Plot 8.4-19: Conducted lower band edge* at the antenna port 1, 5 MHz channel



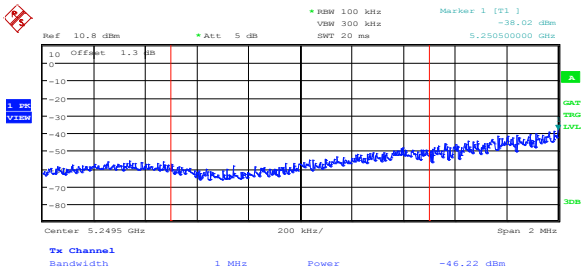
Plot 8.4-20: Conducted upper band edge at the antenna port 1, 5 MHz channel, peak

Note: band edge limit is −27 dBm/MHz EIRP. Considering the fact that antenna gain is 19 dBi, maximum conducted band edge level should be −46 dBm/MHz

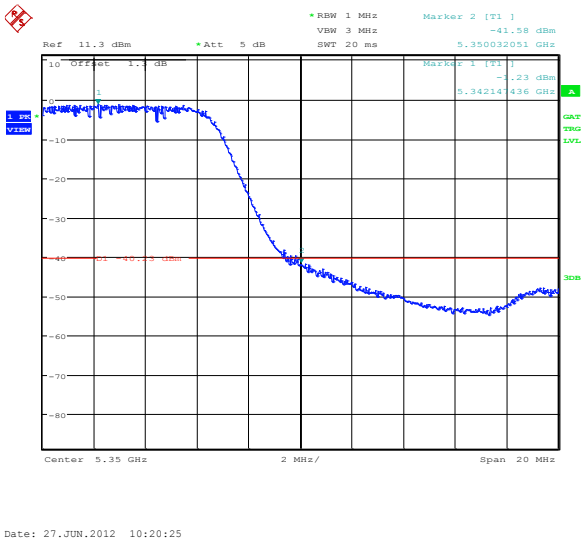
8.4.4 Test data, continued



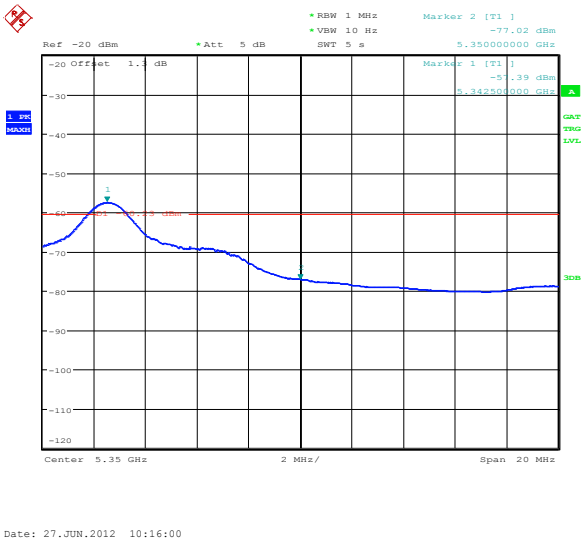
Plot 8.4-21: Conducted upper band edge at the antenna port 1, 5 MHz channel, average



Plot 8.4-22: Conducted lower band edge* at the antenna port 1, 10 MHz channel



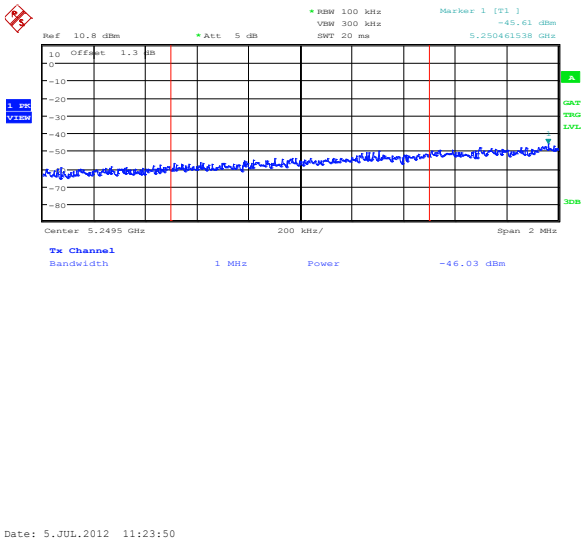
Plot 8.4-23: Conducted upper band edge at the antenna port 1, 10 MHz channel, peak



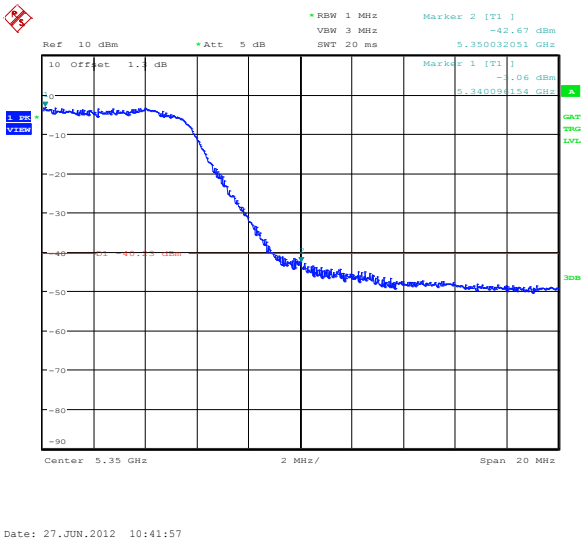
Plot 8.4-24: Conducted upper band edge at the antenna port 1, 10 MHz channel, average

Note: band edge limit is −27 dBm/MHz EIRP. Considering the fact that antenna gain is 19 dBi, maximum conducted band edge level should be −46 dBm/MHz

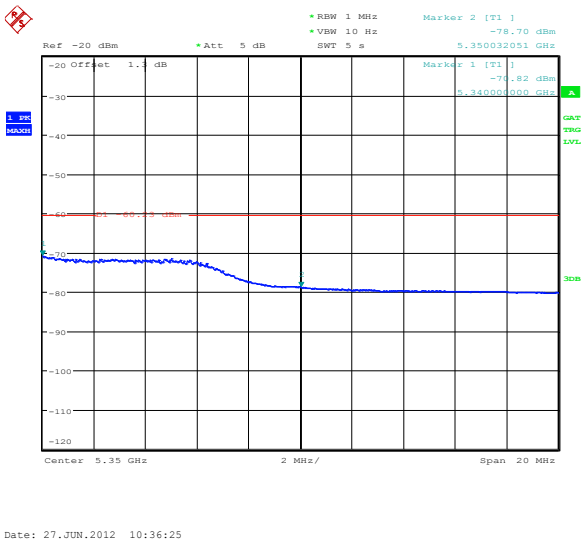
8.4.1 Test data, continued



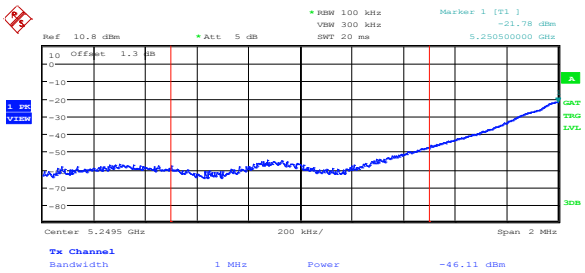
Plot 8.4-25: Conducted lower band edge* at the antenna port 1, 20 MHz channel



Plot 8.4-26: Conducted upper band edge at the antenna port 1, 20 MHz channel, peak



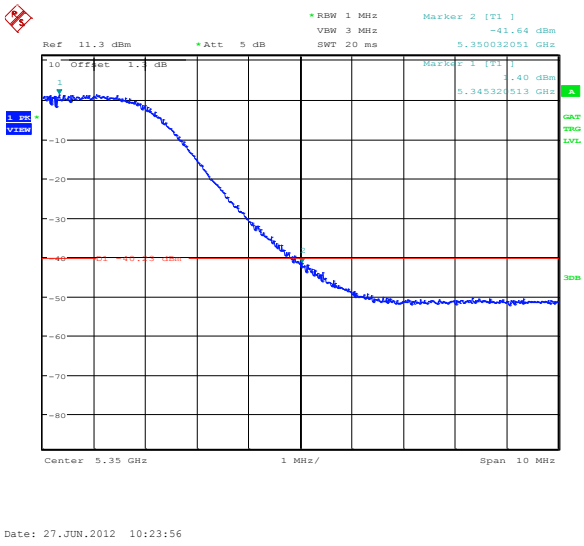
Plot 8.4-27: Conducted upper band edge at the antenna port 1, 20 MHz channel, average



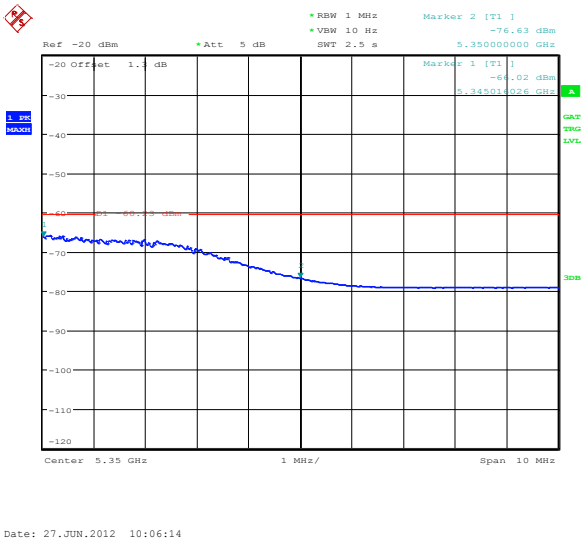
Plot 8.4-28: Conducted lower band edge* at the antenna port 2, 5 MHz channel

Note: band edge limit is −27 dBm/MHz EIRP. Considering the fact that antenna gain is 19 dBi, maximum conducted band edge level should be −46 dBm/MHz

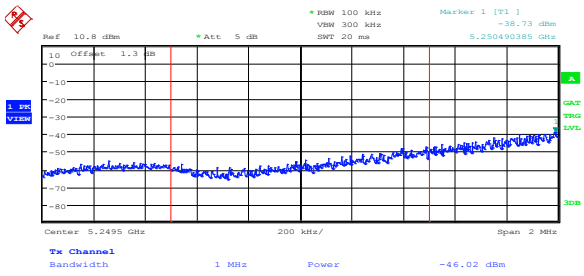
8.4.4 Test data, continued



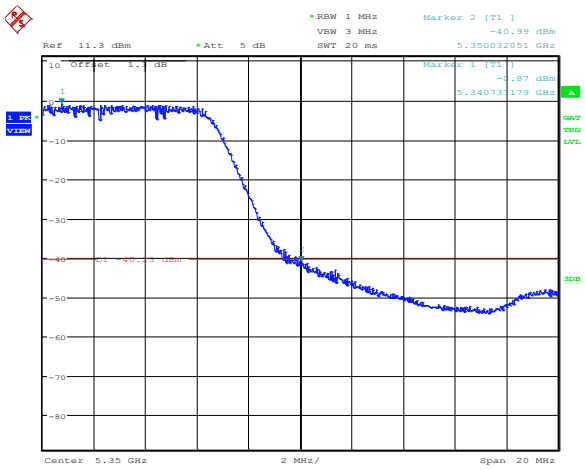
Plot 8.4-29: Conducted upper band edge at the antenna port 2, 5 MHz channel, peak



Plot 8.4-30: Conducted upper band edge at the antenna port 2, 5 MHz channel, average



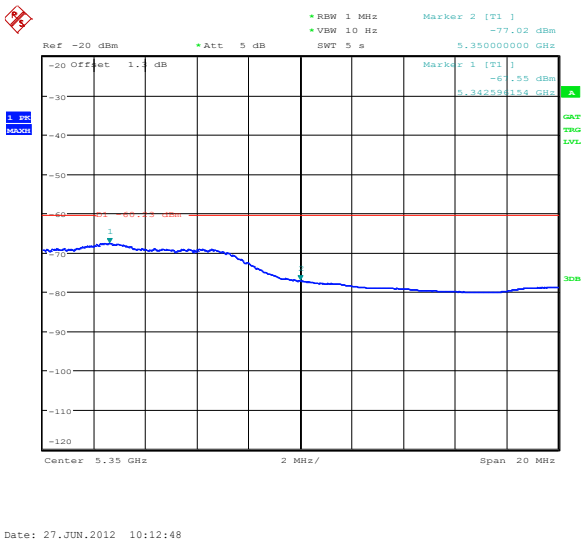
Plot 8.4-31: Conducted lower band edge* at the antenna port 2, 10 MHz channel



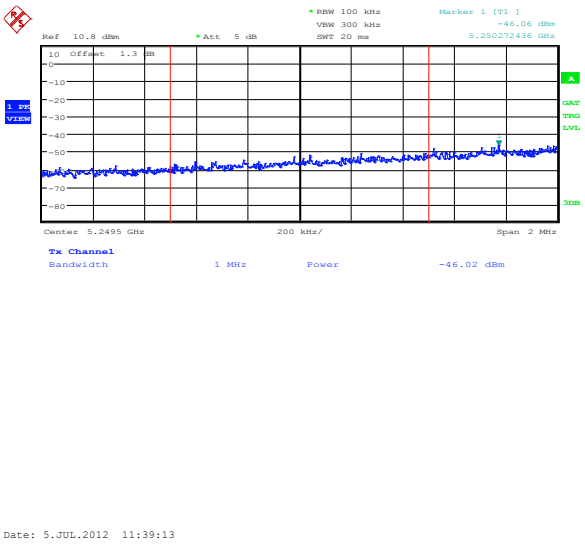
Plot 8.4-32: Conducted upper band edge at the antenna port 2, 10 MHz channel, peak

Note: band edge limit is −27 dBm/MHz EIRP. Considering the fact that antenna gain is 19 dBi, maximum conducted band edge level should be −46 dBm/MHz

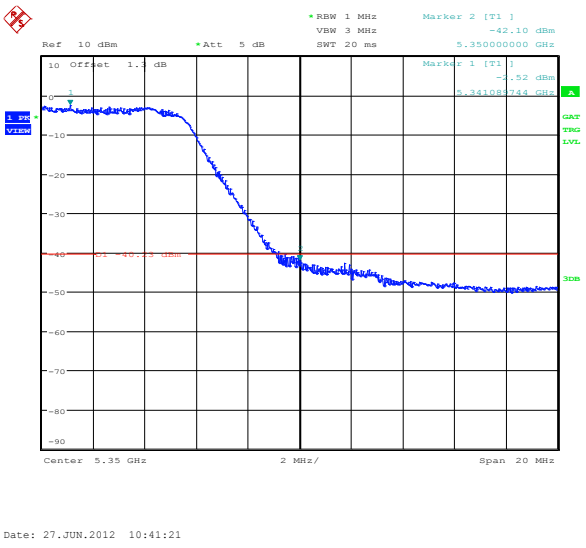
8.4.4 Test data, continued



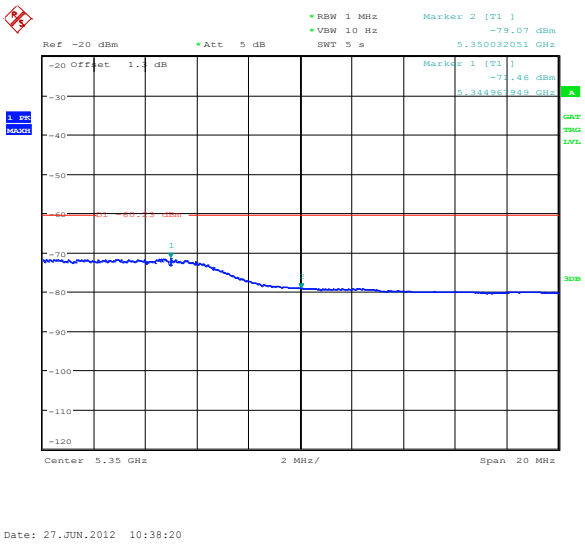
Plot 8.4-33: Conducted upper band edge at the antenna port 2, 10 MHz channel, average



Plot 8.4-34: Conducted lower band edge* at the antenna port 2, 20 MHz channel



Plot 8.4-35: Conducted upper band edge at the antenna port 2, 20 MHz channel, peak



Plot 8.4-36: Conducted upper band edge at the antenna port 2, 20 MHz channel, average

Note: band edge limit is −27 dBm/MHz EIRP. Considering the fact that antenna gain is 19 dBi, maximum conducted band edge level should be −46 dBm/MHz

Table 8.4-1: Spurious emissions results

Antenna port / Channel BW	Channel	Frequency, MHz	Peak measurement					Average measurement				
			Level		Limit		Margin	Level		Limit		Margin
			dBm	dBµV/m[1]	dBm[2]	dBµV/m	dB	dBm	dBµV/m[1]	dBm[2]	dBµV/m	dB
Ant 1 / 5 MHz	High	5350	-44.92	69.31	-40.23	74.00	4.69	-76.25	37.98	-60.23	54.00	16.02
Ant 1 / 10 MHz	High	5350	-41.58	72.65	-40.23	74.00	1.35	-77.02	37.21	-60.23	54.00	16.79
Ant 1 / 20 MHz	High	5350	-42.67	71.56	-40.23	74.00	2.44	-78.70	35.53	-60.23	54.00	18.47
Ant 2 / 5 MHz	High	5350	-41.64	72.59	-40.23	74.00	1.41	-76.63	37.60	-60.23	54.00	16.40
Ant 2 / 10 MHz	High	5350	-40.99	73.24	-40.23	74.00	0.76	-77.02	37.21	-60.23	54.00	16.79
Ant 2 / 20 MHz	High	5350	-42.10	72.13	-40.23	74.00	1.87	-79.07	35.16	-60.23	54.00	18.84

Notes: [1] Field strength level [dBµV/m] is calculated as follows: Level [dBm] + 19 [dBi] + 95.23 [dB]
[2] Power conducted equivalent limit [dB] is calculated as follows: Field strength limit [dBµV/m] – 95.23 [dB] – 19 [dBi]

8.5 Clause 15.407(b)(6) Unwanted emissions below 1 GHz

8.5.1 Definitions and limits

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

8.5.2 Test summary

Test date	February 6, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	31 %

8.5.3 Observations/special notes and test data

The spectrum was searched from 30 MHz to 1 GHz for low mid and high channels. All unwanted emissions measurements were performed using a Peak Detector with 100 kHz RBW below 1 GHz at a distance of 3 m.

No spurious emissions originating from RF board were detected.

8.6 Clause 15.407(a)(6) The ratio of the peak excursion of the modulation envelope

8.6.1 Definitions and limits

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

8.6.2 Test summary

Test date	February 7, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	22 °C	**Air pressure**	1002 mbar	**Relative humidity**	31 %

8.6.3 Observations/special notes

The measurements were performed with peak detector using 1 MHz RBW. VBW was set wider than RBW.

8.6.4 Test data

Table 8.6-1: Peak excursion results for 5 MHz channel

Frequency (MHz)	Peak measurement at antenna 1 (dBm/MHz)	Peak measurement at antenna 2 (dBm/MHz)	Combined peak (dBm/MHz)	Combined PSD (dBm/MHz)	Delta (dB)	Limit (dB)	Margin (dB)
5252.5	6.10	5.72	8.92	-2.31	11.24	13.00	1.76
5300.0	6.25	6.47	9.37	-2.10	11.48	13.00	1.52
5345.0	4.71	7.60	9.40	-2.48	11.88	13.00	1.12

Table 8.6-2: Peak excursion results for 10 MHz channel

Frequency (MHz)	Peak measurement at antenna 1 (dBm/MHz)	Peak measurement at antenna 2 (dBm/MHz)	Combined peak (dBm/MHz)	Combined PSD (dBm/MHz)	Delta (dB)	Limit (dB)	Margin (dB)
5255.0	2.63	3.45	6.07	-5.20	11.27	13.00	1.73
5300.0	5.76	5.01	8.41	-2.17	10.59	13.00	2.41
5342.5	6.03	5.48	8.77	-2.02	10.79	13.00	2.21

Table 8.6-3: Peak excursion results for 20 MHz channel

Frequency (MHz)	Peak measurement at antenna 1 (dBm/MHz)	Peak measurement at antenna 2 (dBm/MHz)	Combined peak (dBm/MHz)	Combined PSD (dBm/MHz)	Delta (dB)	Limit (dB)	Margin (dB)
5260.0	-1.31	-0.70	2.02	-6.74	8.76	13.00	4.24
5300.0	3.39	3.29	6.35	-2.14	8.49	13.00	4.51
5337.5	3.58	3.01	6.31	-2.27	8.59	13.00	4.41

8.7 Clause 15.407(g) Frequency stability

8.7.1 Definitions and limits

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

8.7.2 Test summary

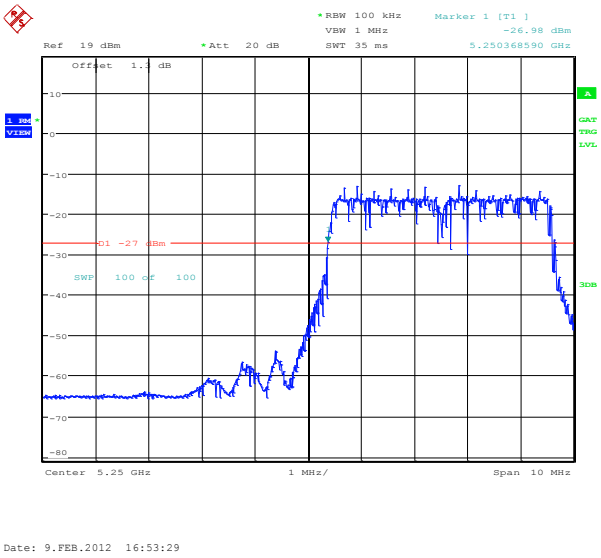
Test date	February 6, 2012	**Test engineer**	Andrey Adelberg	**Verdict**	Pass
Temperature	23 °C	**Air pressure**	1002 mbar	**Relative humidity**	31 %

8.7.3 Observations/special notes

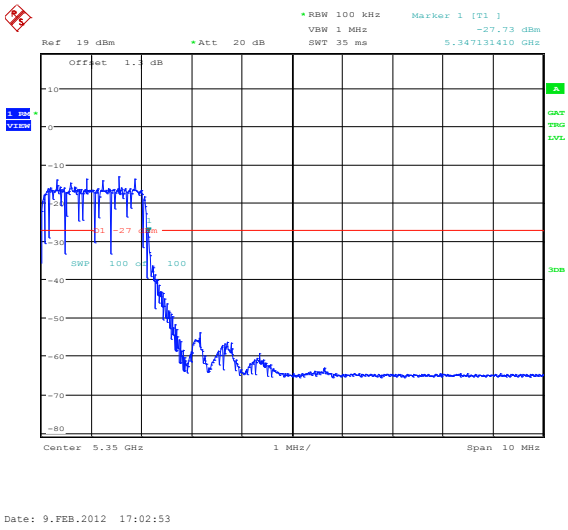
The frequency stability test was performed in the −40 to +60 °C temperature range at 5.25–5.35 GHz frequency range. The input voltage was varied ±15 % at the room temperature.

All modulations and both antenna ports were investigated, only the worst-case results were presented.

8.7.4 Test data

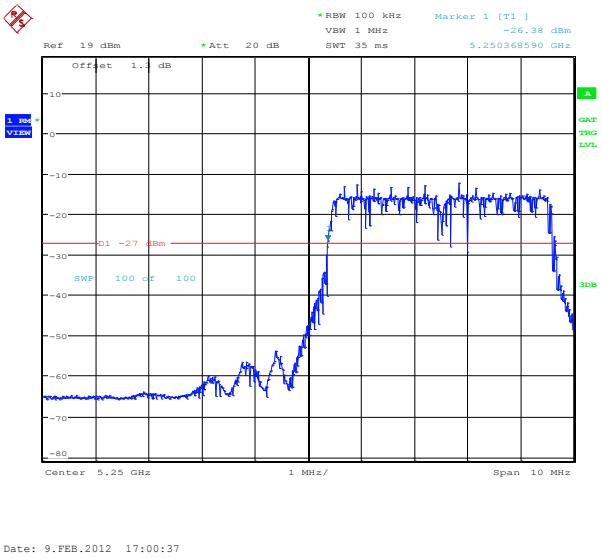


Plot 8.7-1: Lower band edge at the antenna port 1, 5 MHz channel

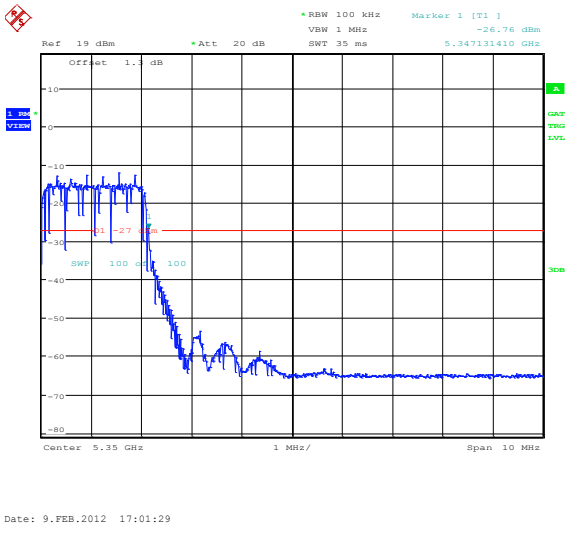


Plot 8.7-2: Upper band edge at the antenna port 1, 5 MHz channel

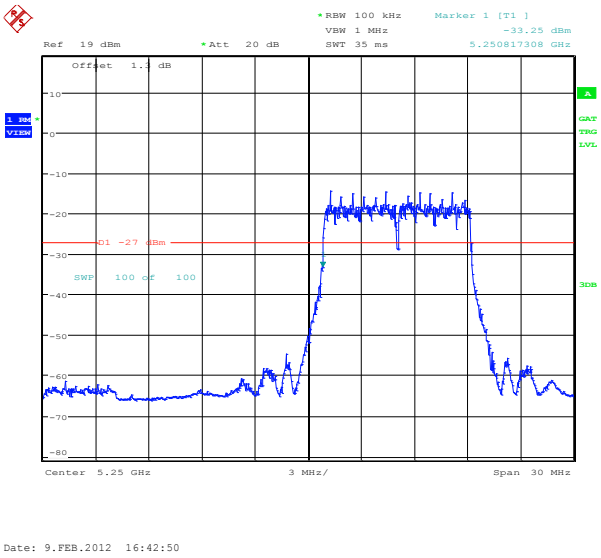
8.7.4 Test data, continued



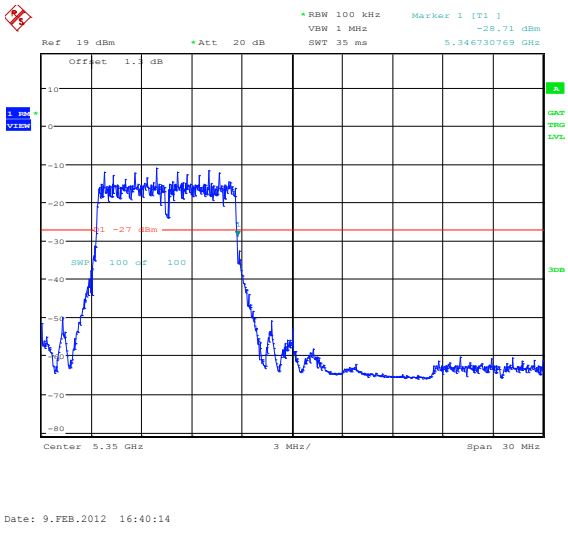
Plot 8.7-3: Lower band edge at the antenna port 2, 5 MHz channel



Plot 8.7-4: Upper band edge at the antenna port 2, 5 MHz channel

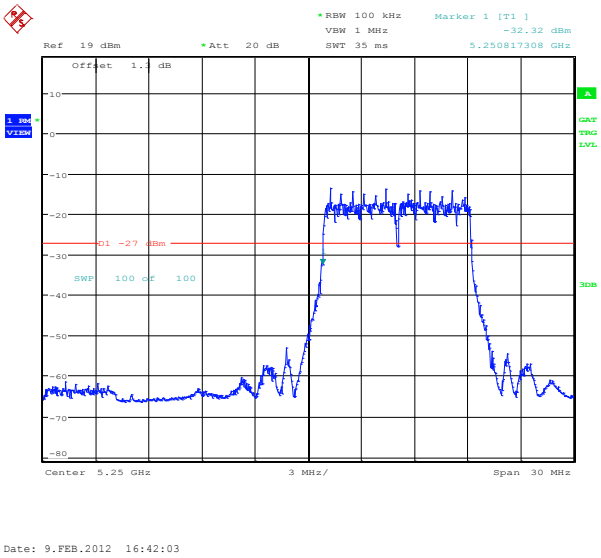


Plot 8.7-5: Lower band edge at the antenna port 1, 10 MHz channel

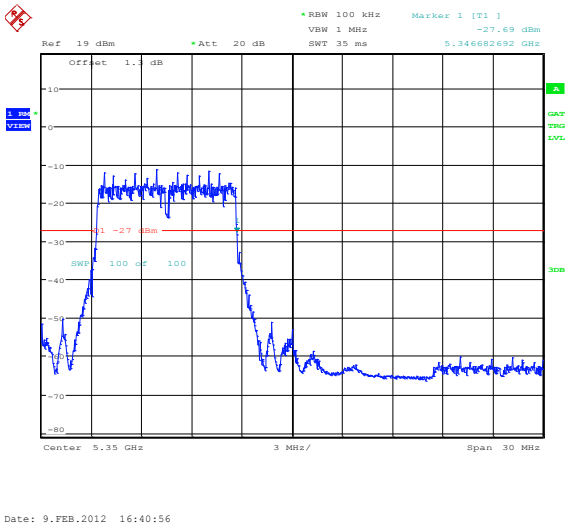


Plot 8.7-6: Upper band edge at the antenna port 1, 10 MHz channel

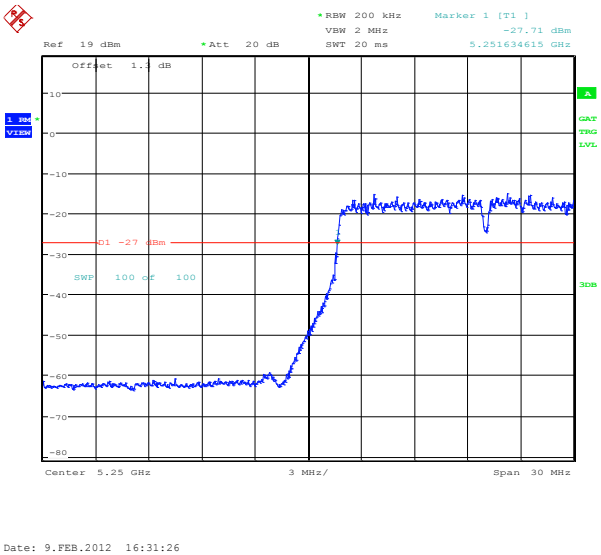
8.7.4 Test data, continued



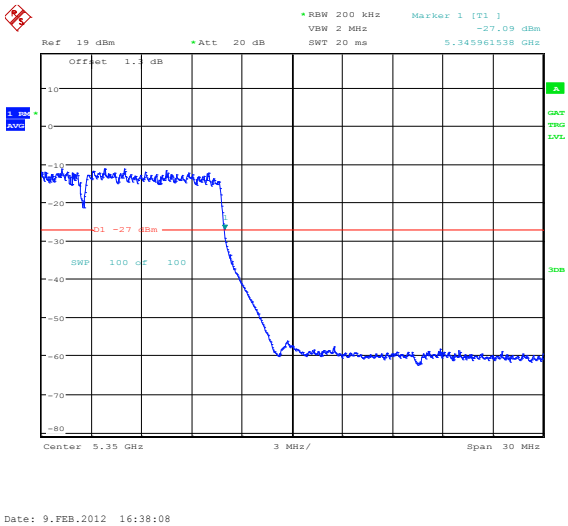
Plot 8.7-7: Lower band edge at the antenna port 2, 10 MHz channel



Plot 8.7-8: Upper band edge at the antenna port 2, 10 MHz channel

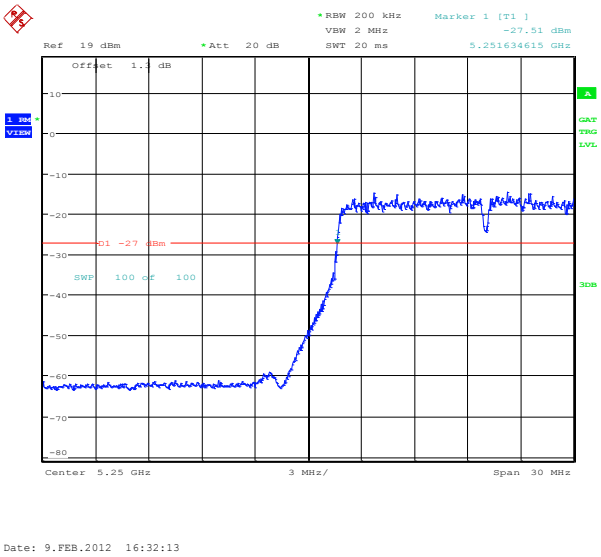


Plot 8.7-9: Lower band edge at the antenna port 1, 20 MHz channel

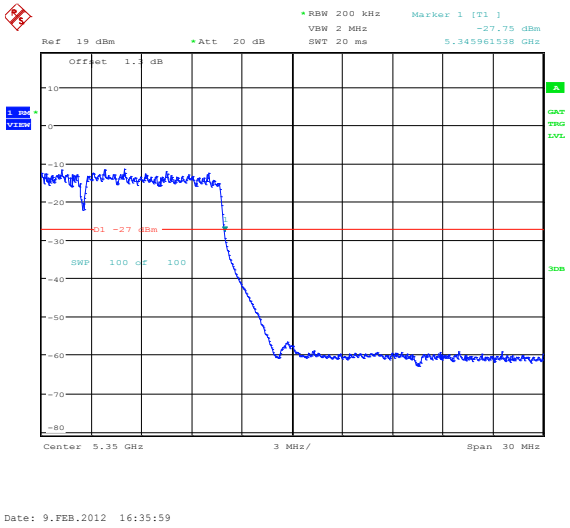


Plot 8.7-10: Upper band edge at the antenna port 1, 20 MHz channel

8.7.4 Test data, continued



Plot 8.7-11: Lower band edge at the antenna port 2, 20 MHz channel



Plot 8.7-12: Upper band edge at the antenna port 2, 20 MHz channel

Table 8.7-1: Frequency offset measurement

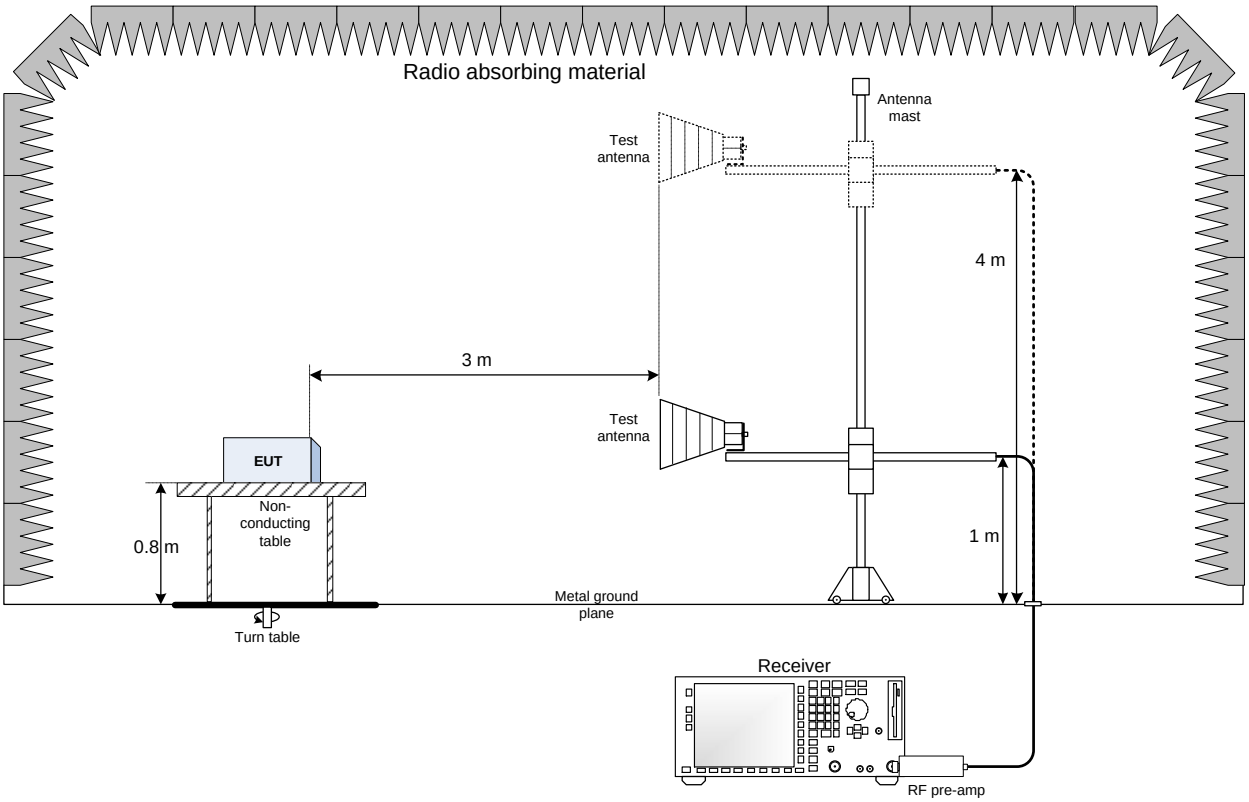
Condition	$F_{measured}$ (GHz)	Offset (Hz)	Offset (ppm)
+60°C, Nominal Voltage	5.299997076	-2924	-0.55
+50°C, Nominal Voltage	5.299990947	-9053	-1.71
+40°C, Nominal Voltage	5.299994106	-5894	-1.11
+30°C, Nominal Voltage	5.299994404	-5596	-1.06
+20°C, +15% Nominal Voltage	5.300005156	5156	0.97
+20°C, Nominal Voltage	5.300000000	Reference	
+20°C, -15% Nominal Voltage	5.300002061	2061	0.39
+10°C, Nominal Voltage	5.300001516	1516	0.29
0°C, Nominal Voltage	5.300004664	4664	0.88
-10°C, Nominal Voltage	5.299992957	-7043	-1.33
-20°C, Nominal Voltage	5.299993534	-6466	-1.22
-30°C, Nominal Voltage	5.299993797	-6203	-1.17
-40°C, Nominal Voltage	5.299991134	-8866	-1.67

Table 8.7-2: Frequency stability calculation

Channel BW (MHz)	Antenna port	f_H & f_L (Hz)	Max offset (Hz)	Drifted f_H & f_L (Hz)	Limit (Hz)	Margin (kHz)
5	1	5250368590	-9053	5250359537	5250000000	359.537
		5347131410	5156	5347136566	5350000000	2863.434
	2	5250368590	-8866	5250359724	5250000000	359.724
		5347131410	5156	5347136566	5350000000	2863.434
10	1	5250817308	-9053	5250808255	5250000000	808.255
		5346730769	5156	5346735925	5350000000	3264.075
	2	5250817306	-9053	5250808253	5250000000	808.253
		5346682692	5156	5346687848	5350000000	3312.152
20	1	5251634615	-9053	5251625562	5250000000	1625.562
		5345961538	5156	5345966694	5350000000	4033.306
	2	5251634615	-9053	5251625562	5250000000	1625.562
		5345961538	5156	5345966694	5350000000	4033.306

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up