

RADIO TEST REPORT

No. 605178R-2

EQUIPMENT UNDER TEST

Equipment: Tag
Type / model: T301-A
Manufacturer: Ekahau Inc.
Tested by request of: Ekahau Inc

SUMMARY

The equipment complies with the requirements of the following standards:

FCC, Part 15, Subpart B (2005) and Subpart C (2005);

RSS-210, Issue 6 (September 2005); RSS-Gen, Issue 1 (September 2005).

Industry Canada listed test facility No. IC 3481



Date of issue: 2006-12-06



Tested by: 
Martin Karlsson

Approved by: 
Björn Utermöhl



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1 CLIENT INFORMATION

The EUT has been tested by request of

Company: Ekaha Inc.
Tallberginkatu 2
00180 Helsinki
FINLAND
Name of contact: Arttu Huhtiniemi

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT according to the manufacturer/client declaration

Equipment: Tag
Type / Model: T301-A
Brand name: --
Serial number: --
Manufacturer: Ekahau Inc.
Rating/Supplying voltage: Battery operated
3,0 V Lithium CR2
Rating RF output power: 2dBm
Antenna gain: 1,5 dBi
External antenna connector: None
Operating temperature range: -20 to +55 °C
Frequency range: 2400 - 2483,5 MHz
Number of channels: 11
Modulation characteristics: DSSS (QPSK)
Stand by mode supported: Yes
Low channel = 1 2412 MHz
Mid channel = 6 2437 MHz
High channel = 11 2462 MHz

2.2 Additional information about the EUT

The EUT were temporarily equipped with an antenna connector (standard SMA) for the conducted measurements.



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2.3 Test specifications

2.4 Standards

FCC 47 CFR part 15 (2005) Subpart B – Unintentional radiators
FCC 47 CFR part 15 (2005) Subpart C – Intentional Radiators; §15.247 Operation within the bands 902-928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz.

Measurements methods according to ANSI C63.4-2003

RSS-210, Issue 6 (September 2005): Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment.

RSS-Gen, Issue 1 (September 2005): General Requirements and Information for the Certification of Radiocommunication Equipment.

2.5 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standards.

2.6 Test set-up

Measurement set-up radiated spurious emissions test is described in corresponding section. During other tests the EUT was connected to the spectrum analyser by cable.

2.7 Operating environment

If not additionally specified, the tests were performed under the following environmental conditions:

Air temperature: 23 °C
Relative humidity: 33 %



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3 TEST SUMMARY

The results in this report apply only to the sample tested.

FCC reference	Test	Result	Note
15.247(b)	Peak output power	Pass	
15.247(a)	6 dB Bandwidth	Pass	
15.247(a)	Carrier frequency separation	NA	
15.247(a)	Number of hopping frequencies (channels)	NA	
15.247(a)	Time of occupancy (dwell time)	NA	
15.215	Band edge compliance	Pass	
15.247(e)	Power spectral density	Pass	
15.205 15.209 15.247(d) 15.109	Out of band spurious emissions, radiated	Pass	
15.209 15.247(d)	Out of band spurious emissions, conducted	NA	
15.107 15.207	Conducted emission at AC port	NA	

NT = Not Tested

NA = Not Applicable



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4 PEAK OUTPUT POWER

4.1 Test protocol

Date of test: 2006-11-15

Spectrum analyzer settings:

Span: 60 MHz
 RBW: 10 MHz
 VBW: 10 MHz
 Sweep time: Auto
 Detector: Peak
 Trace: Max Hold

QPSK modulation, 11 Mbps data rate

Test conditions	Peak Output Power [dBm]			Limit [dBm]
	2412 MHz	2437 MHz	2462 MHz	
V _{nom} 3 V DC	-3,0	-2,3	-1,2	30

Measurement results are corrected for attenuation in the set-up configuration. The antenna gain was not included in the correction factor.


In the following graphs no ref level offset were used for compensating the attenuation in the measuring setup. The attenuation in the measuring setup was 0.6 dB.

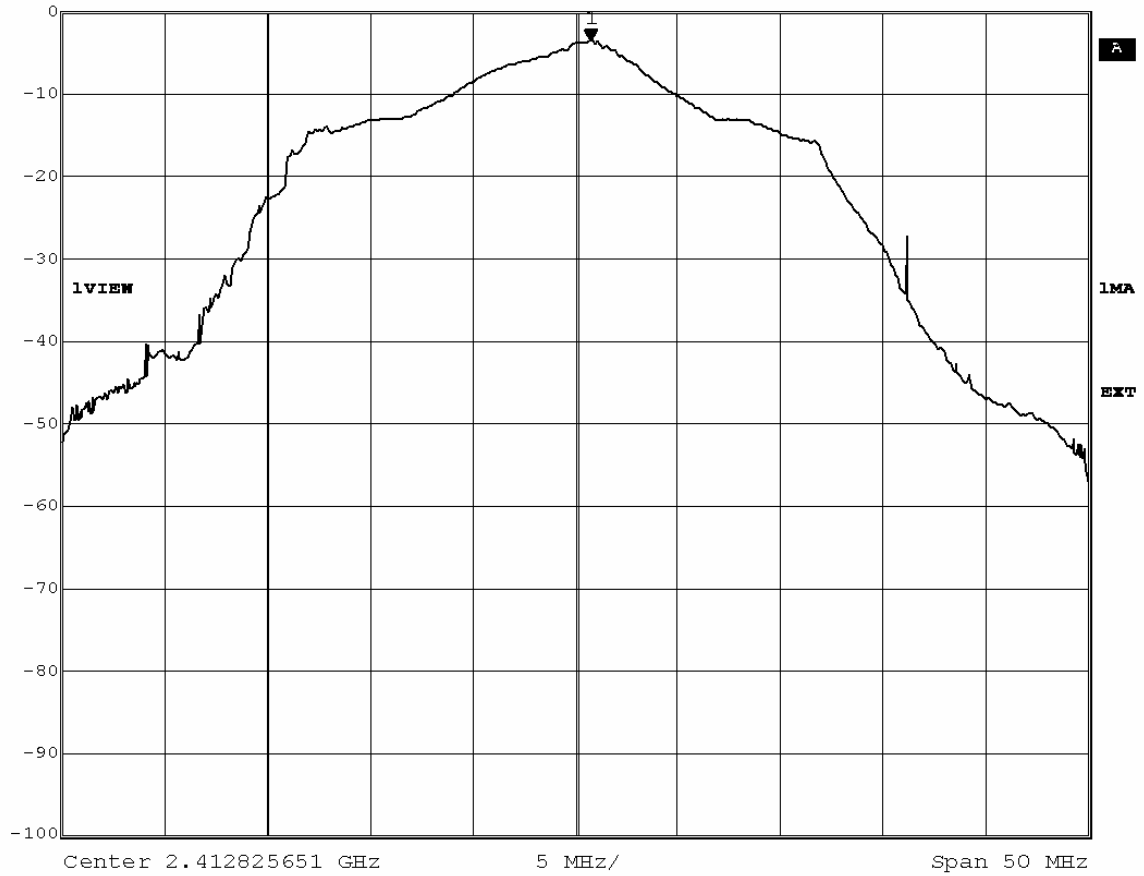


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Channel 1, peak power, QPSK, 11 Mbps data rate

	Marker 1 [T1]	RBW	10 MHz	RF Att	10 dB	
	Ref Lvl	-3.60 dBm	VBW	10 MHz	Mixer	-20 dBm
	0 dBm	2.41357715 GHz	SWT	5 ms	Unit	dBm




Date: 15.NOV.2006 09:57:25

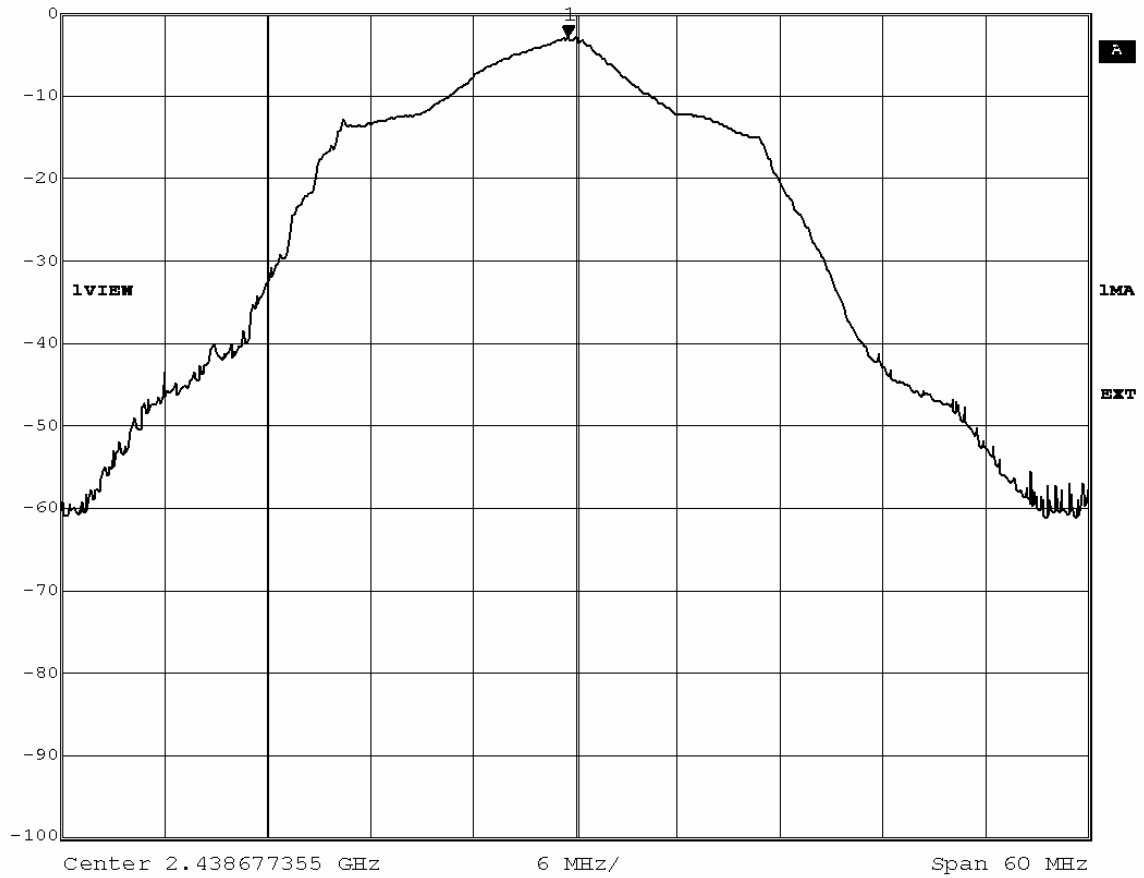


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Channel 6, peak power, QPSK, 11 Mbps data rate

	Marker 1 [T1]	RBW	10 MHz	RF Att	10 dB	
	Ref Lvl	-2.86 dBm	VBW	10 MHz	Mixer	-20 dBm
	0 dBm	2.43825651 GHz	SWT	5 ms	Unit	dBm



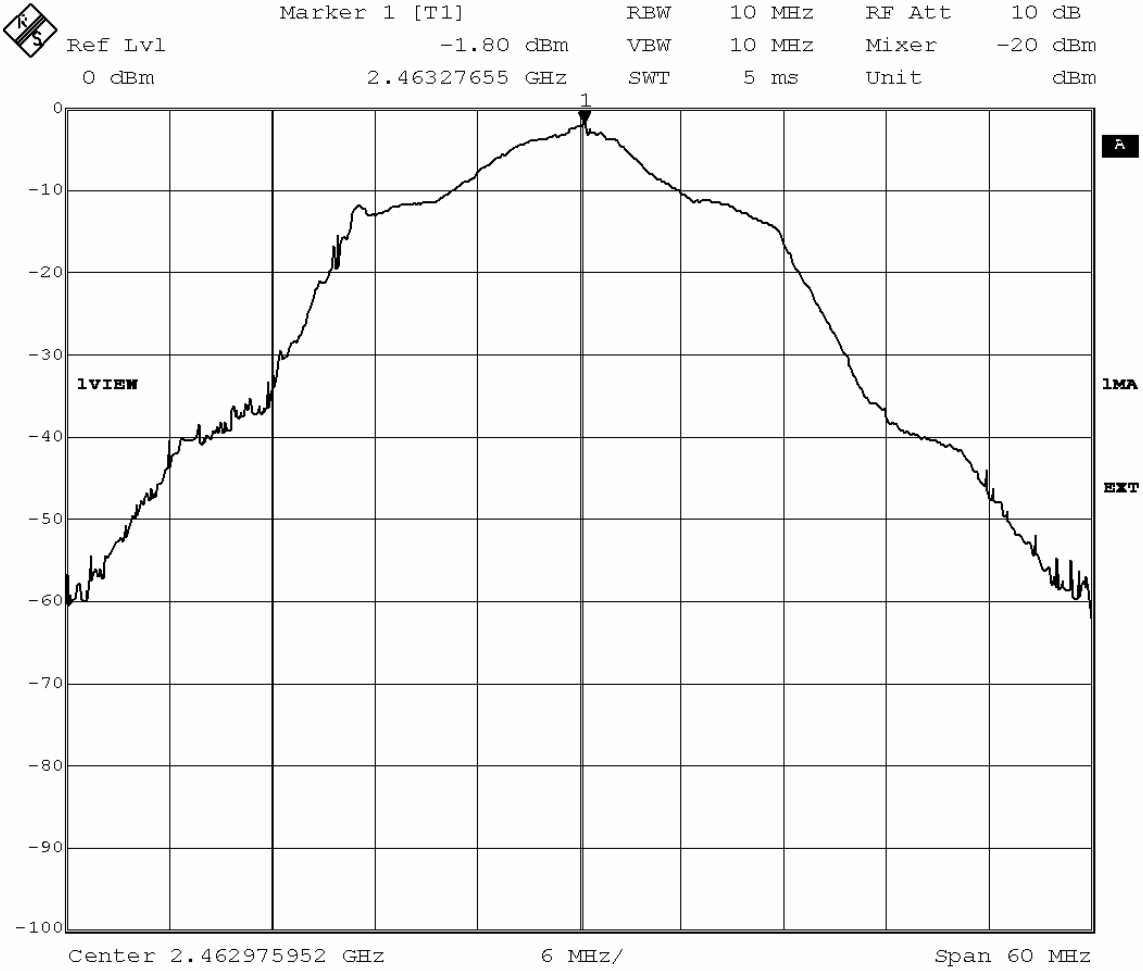
Date: 15.NOV.2006 09:59:10



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Channel 11, peak power, QPSK, 11 Mbps data rate



Date: 15.NOV.2006 10:00:17

5 6 DB BANDWIDTH

5.1 Test protocol

Date of test: 2006-11-15


Spectrum analyser settings:

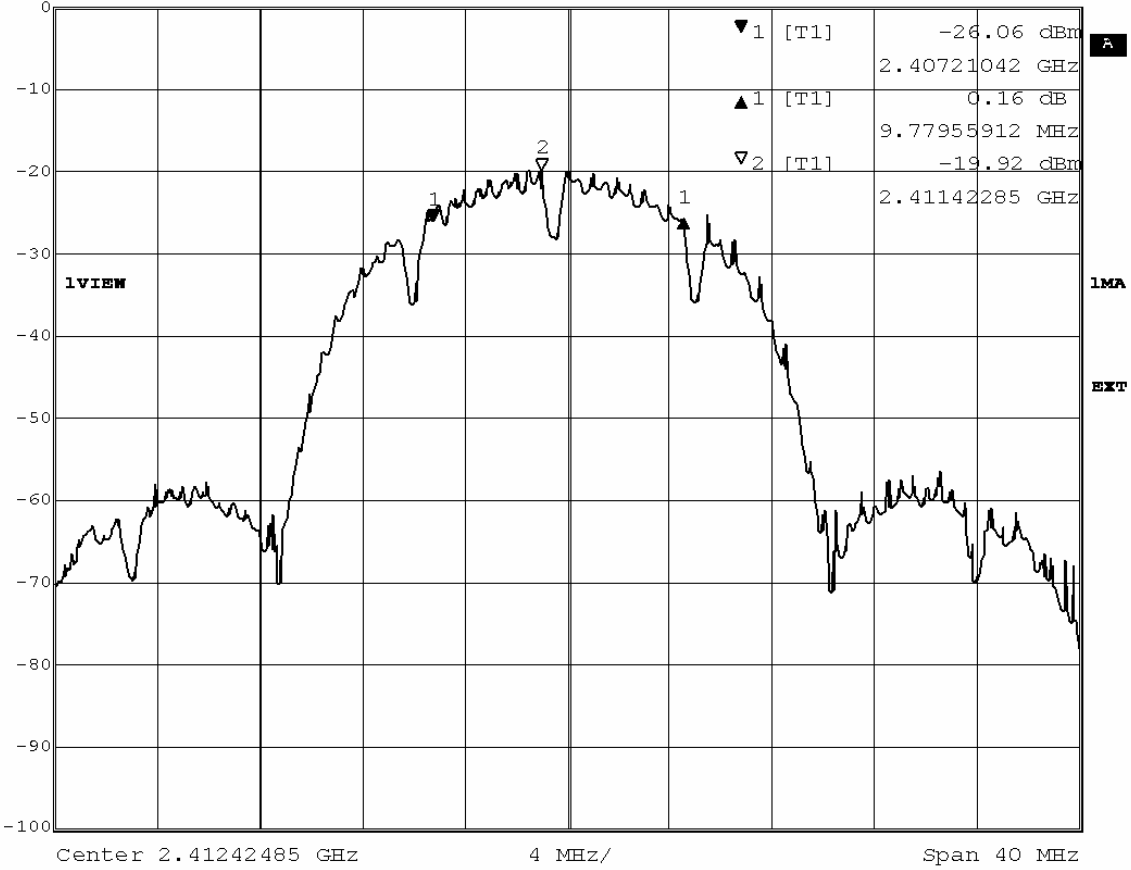
Span: 40 MHz
RBW: 100 kHz
VBW: 300 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

QPSK modulation, 11 Mbps data rate

Channel (MHz)	6 dB Bandwidth (MHz)	Limit value (MHz)
2412	9,8	> 0,5
2437	9,0	
2462	9,8	


Channel 1, 6 dB bandwidth, QPSK, 11 Mbps data rate

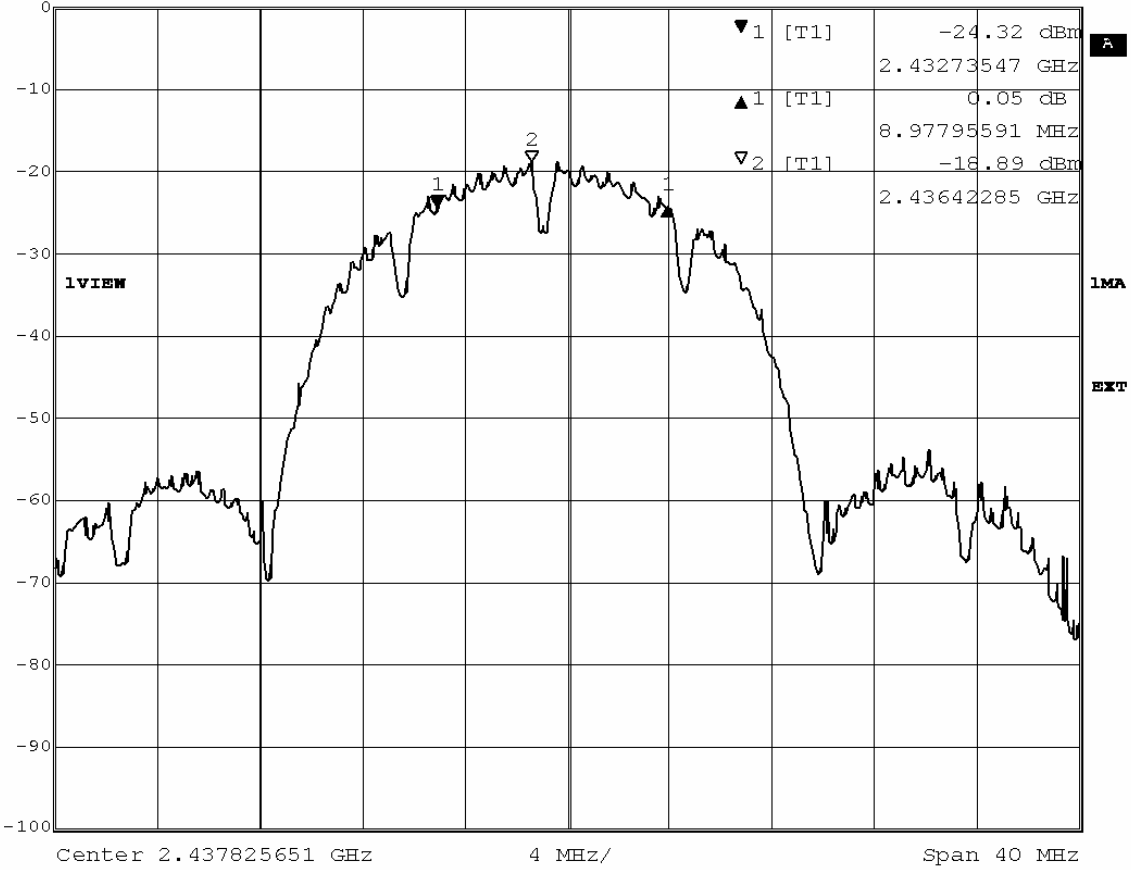
	Delta 1 [T1]	RBW	100 kHz	RF Att	10 dB
Ref Lvl	0.16 dB	VBW	300 kHz	Mixer	-20 dBm
0 dBm	9.77955912 MHz	SWT	10 ms	Unit	dBm



Date: 15.NOV.2006 10:13:36


Channel 6, 6 dB bandwidth, QPSK, 11 Mbps data rate

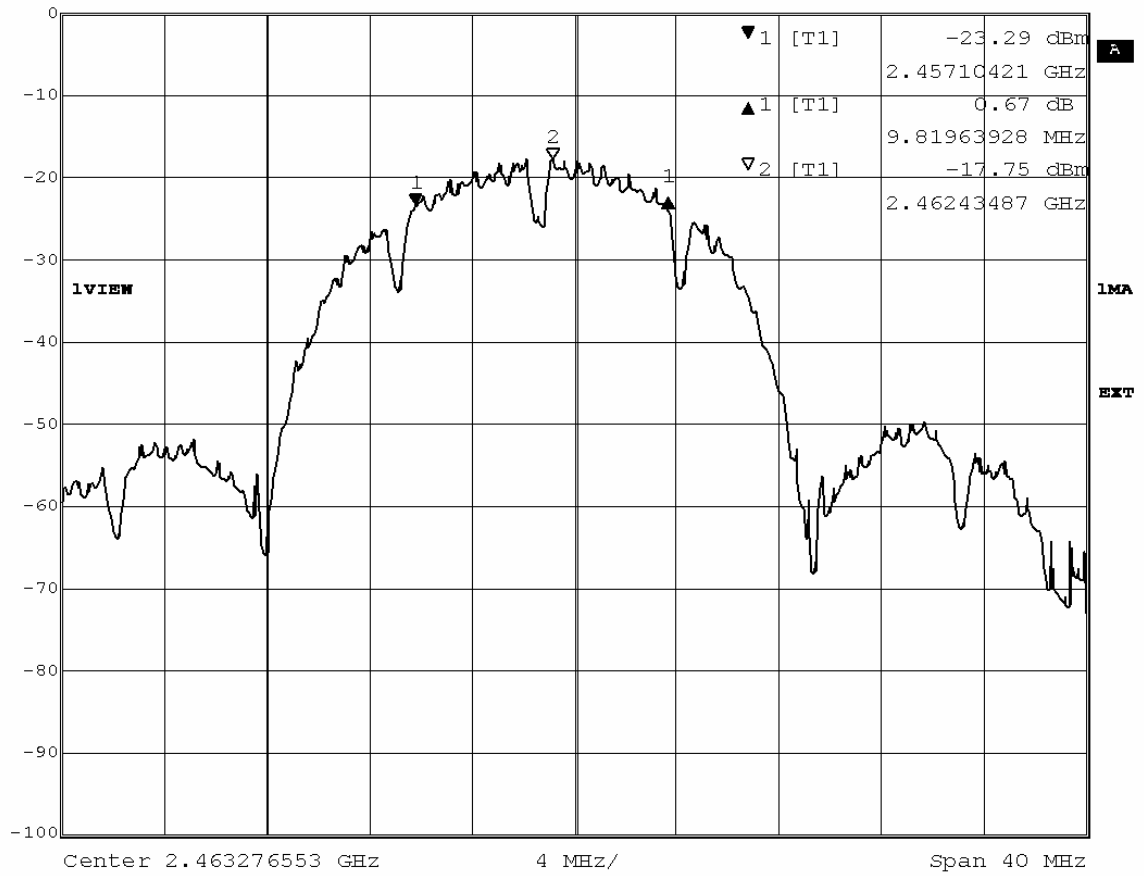
	Delta 1 [T1]	RBW	100 kHz	RF Att	10 dB
Ref Lvl	0.05 dB	VBW	300 kHz	Mixer	-20 dBm
0 dBm	8.97795591 MHz	SWT	10 ms	Unit	dBm



Date: 15.NOV.2006 10:09:54

Channel 11, 6 dB bandwidth, QPSK, 11 Mbps data rate

	Delta 1 [T1]	RBW	100 kHz	RF Att	10 dB
Ref Lvl	0.67 dB	VBW	300 kHz	Mixer	-20 dBm
0 dBm	9.81963928 MHz	SWT	10 ms	Unit	dBm



Date: 15.NOV.2006 10:06:21

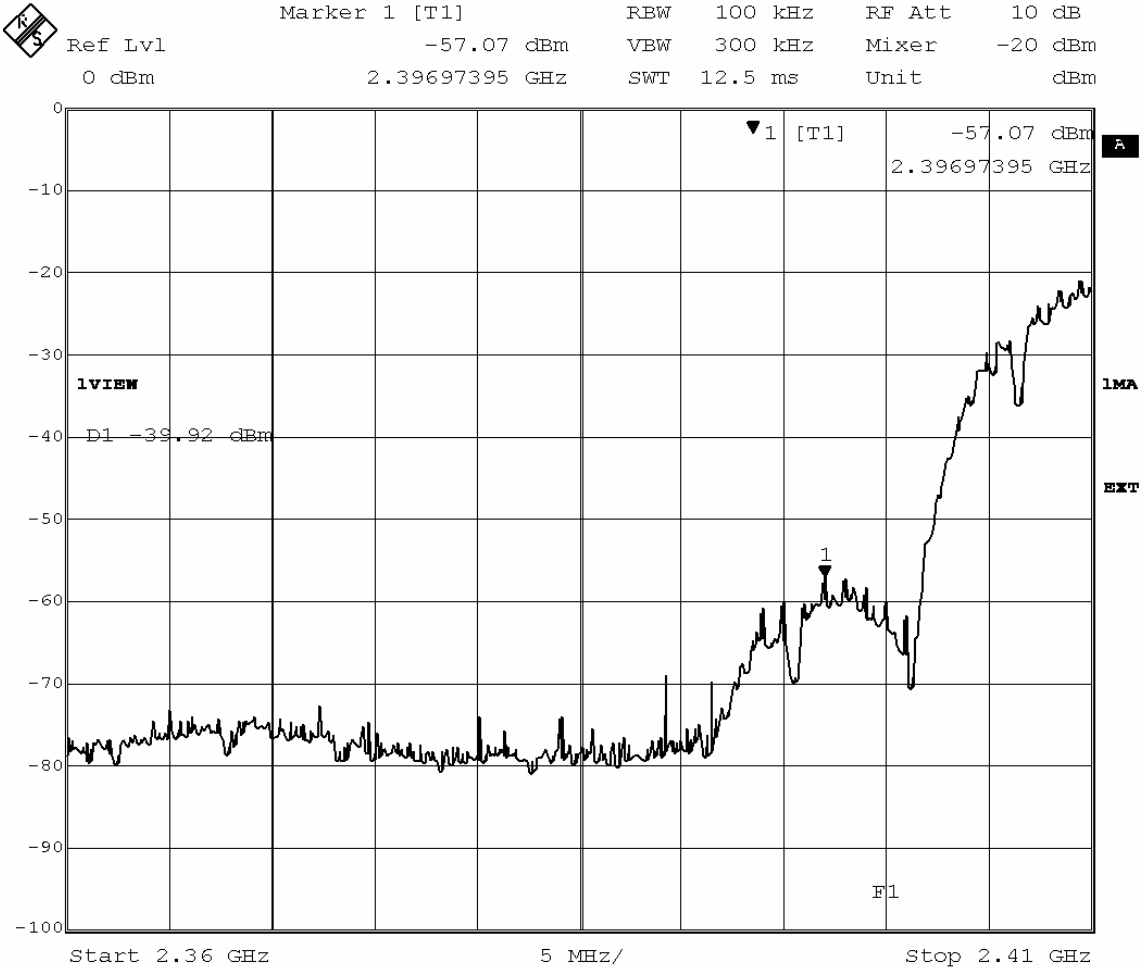
6 BAND EDGE COMPLIANCE, CONDUCTED

6.1 Test protocol

Date of test: 2006-11-15

Band edge compliance at low channel


Channel 1, Band edge compliance, QPSK, 11 Mbps data rate

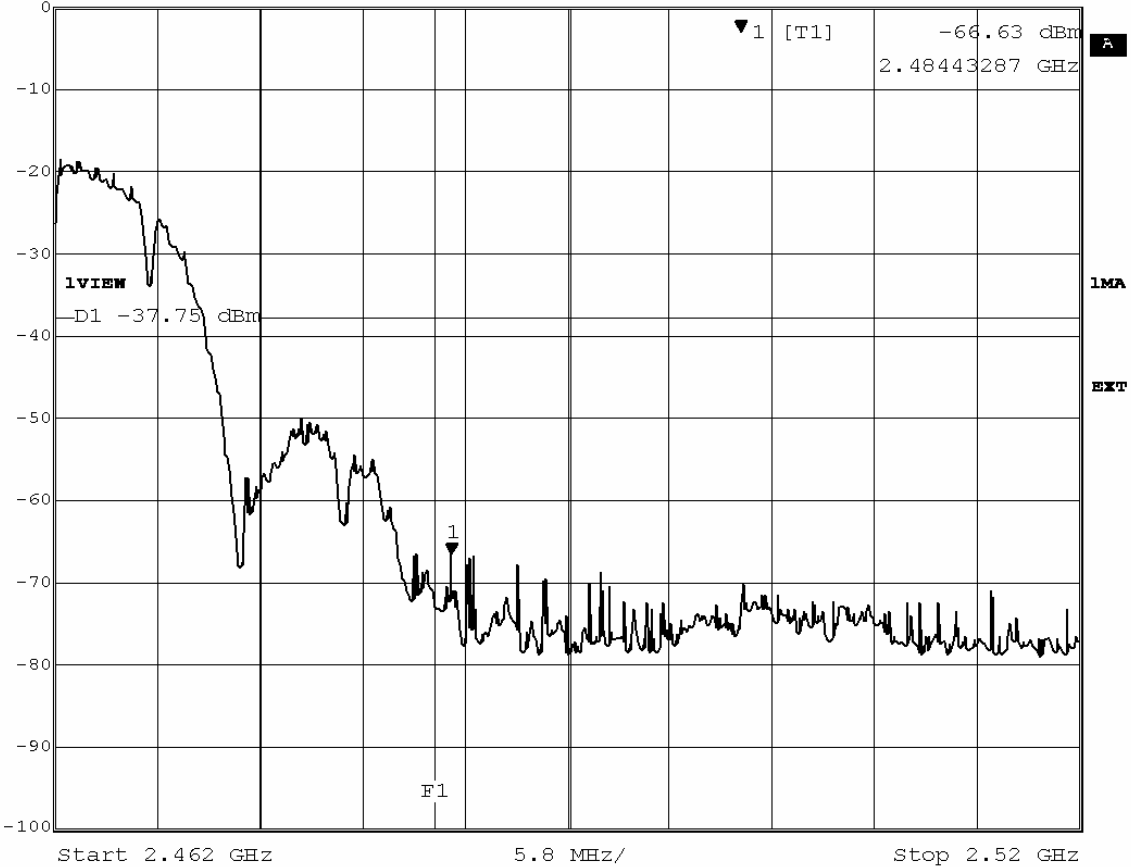


Date: 15.NOV.2006 10:20:42

Band edge compliance at high channel

Channel 11, Band edge compliance, QPSK, 11 Mbps data rate

	Marker 1 [T1]	RBW 100 kHz	RF Att 10 dB
	Ref Lvl -66.63 dBm	VBW 300 kHz	Mixer -20 dBm
	0 dBm	2.48443287 GHz	SWT 14.5 ms



Date: 15.NOV.2006 10:29:47

7 POWER SPECTRAL DENSITY

7.1 Test protocol

Date of test: 2006-11-15

Spectrum analyzer settings:


Span: 40 MHz
RBW: 3 kHz
VBW: 10 kHz
Sweep time: Auto
Detector: Peak
Trace: Max Hold

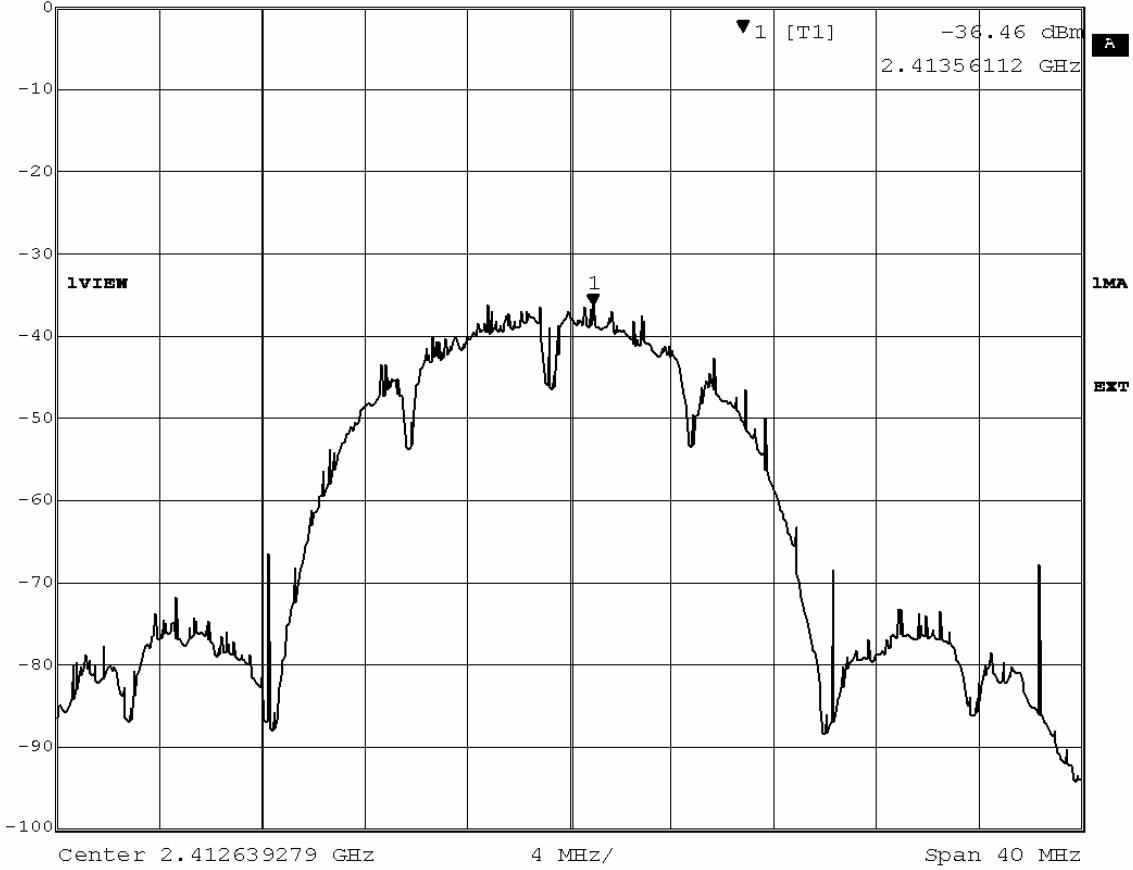
QPSK modulation, 11 Mbps data rate

Channel	Peak Power Spectral Density	Limit value
(MHz)	(dBm)	(dBm)
2412	-35,9	< 8
2437	-33,1	
2462	-31,3	

Measurement results are corrected for attenuation in the set-up configuration.


Channel 1, peak power spectral density

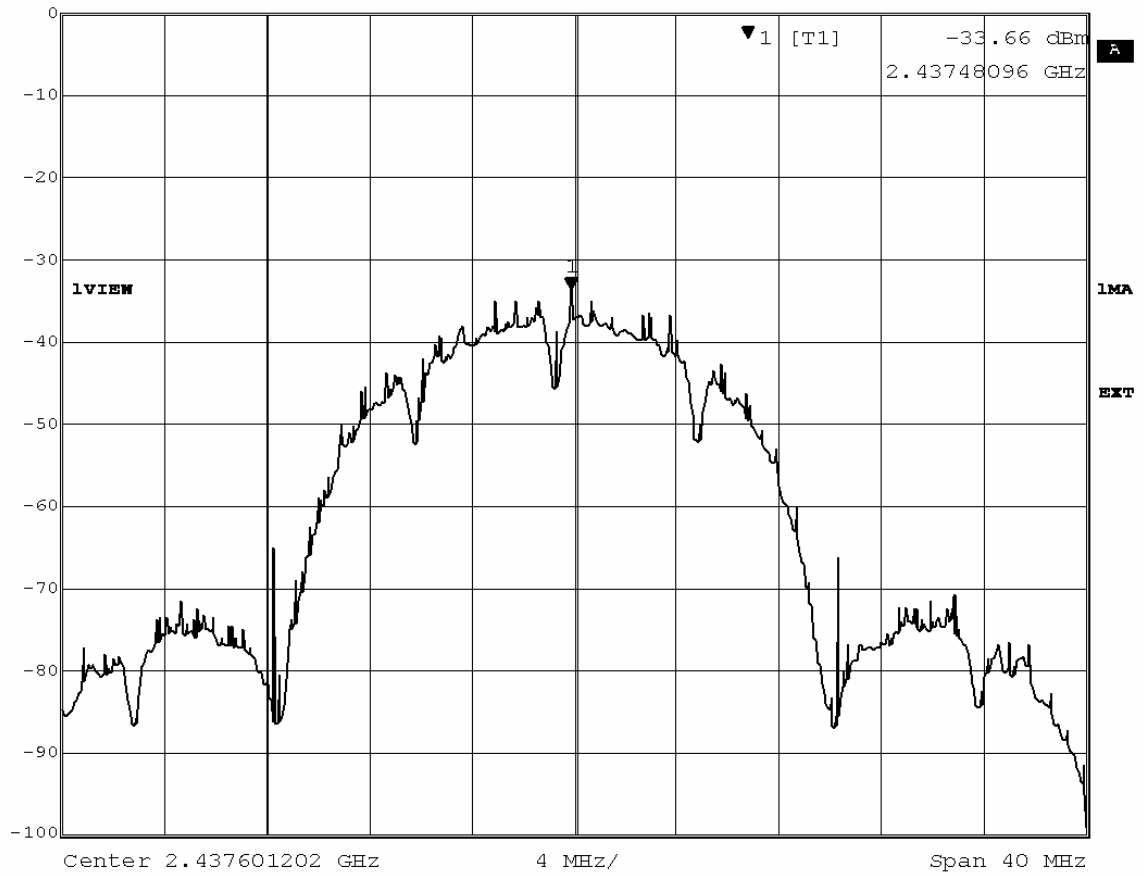
	Marker 1 [T1]	RBW	3 kHz	RF Att	10 dB	
	Ref Lvl	-36.46 dBm	VBW	10 kHz	Mixer	-20 dBm
	0 dBm	2.41356112 GHz	SWT	11.5 s	Unit	dBm



Date: 15.NOV.2006 10:38:17


Channel 6, peak power spectral density

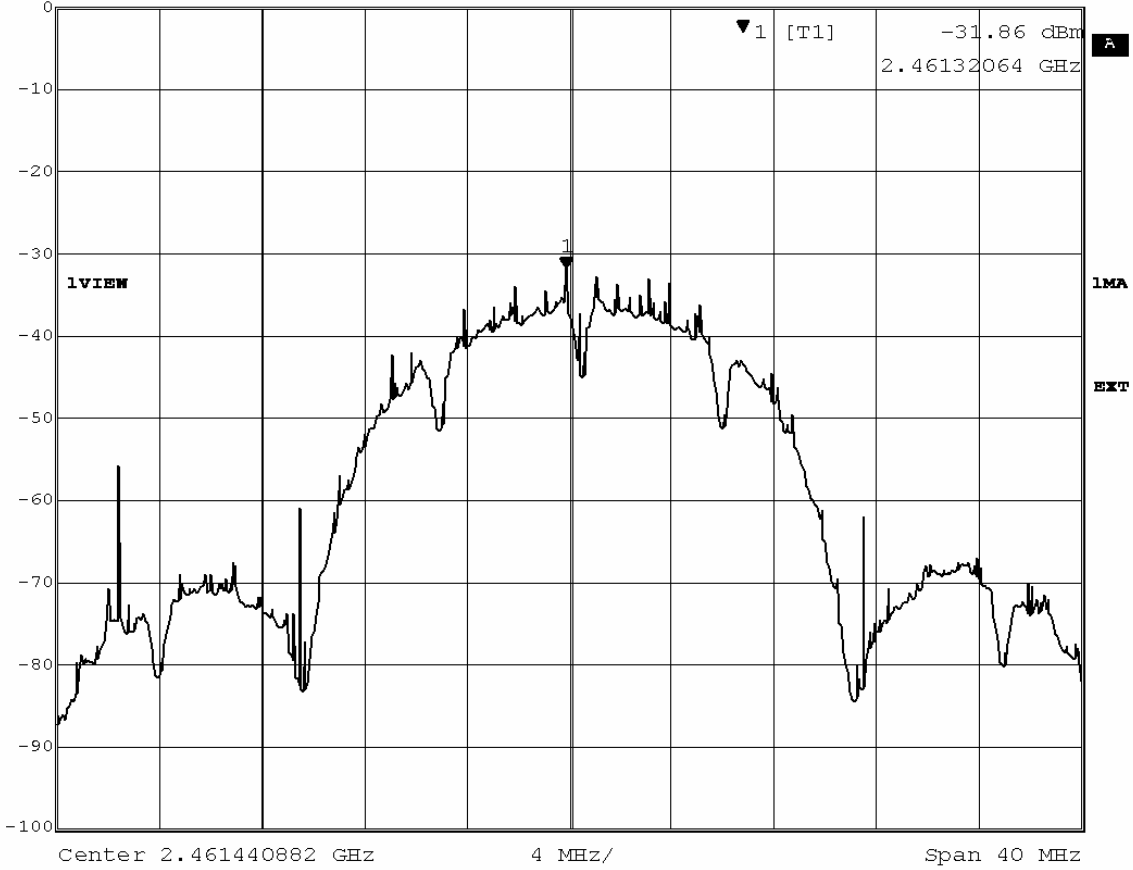
	Marker 1 [T1]	RBW	3 kHz	RF Att	10 dB	
	Ref Lvl	-33.66 dBm	VBW	10 kHz	Mixer	-20 dBm
	0 dBm	2.43748096 GHz	SWT	11.5 s	Unit	dBm



Date: 15.NOV.2006 10:39:47

Channel 11, peak power spectral density

	Marker 1 [T1]	RBW	3 kHz	RF Att	10 dB	
	Ref Lvl	-31.86 dBm	VBW	10 kHz	Mixer	-20 dBm
	0 dBm	2.46132064 GHz	SWT	11.5 s	Unit	dBm



Date: 15.NOV.2006 10:36:15

8 RADIATED SPURIOUS EMISSIONS

8.1 Measurement uncertainty

Radiated disturbance electric field intensity, 30 – 1000 MHz: $\pm 4,6$ dB

Radiated disturbance electric field intensity, 1000 – 25000 MHz: $\pm 6,0$ dB

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.

Measurement uncertainty is calculated in accordance with EA-4/02-1997.
The measurement uncertainty is given with a confidence of 95%.

8.2 Test equipment

Equipment	Manufacturer	Type	SEMKO No.
<i>Test site: Semi-anechoic shielded chamber, 5,9 x 8,9 x 6,0 m (W x L x H)</i>			30900
Software:	Rohde & Schwarz	EMC 32	
Measurement receiver:	Rohde & Schwarz	ESCI	12798
Antenna, bilog:	Rohde & Schwarz	HL562	30711
<i>Test site: Radio anechoic shielded chamber, 3,7 x 7,0 x 2,4 m (W x L x H)</i>			12285
Software:	Rohde & Schwarz	ES-K1, V1.70	
Signal analyser:	Rohde & Schwarz	FSIQ 40	12793
Preamplifier:	MITEQ	AFS6/AFS44	12335
Antennas:			
Double Ridge Guide Horn:	EMCO	3115	4936
Horn antenna:	EMCO	3160-08	30099
Horn antenna:	EMCO	3160-09	30101

8.3 Measurement set-up

Test site: Semi-anechoic shielded chamber (30 – 1000 MHz)

The radiated disturbance electric field intensity was measured in a semi-anechoic chamber at a distance of 3 m and the EUT was placed on a non-metallic table, 0,8 m above the reference ground plane. The specified test mode was enabled. Test set-up photos are given below.

An overview sweep with peak detection of the electric field intensity was performed with the measurement receiver in max-hold and with the antenna placed 1,5 m, 2,5 m and 3,5 m above the floor. The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements with quasi-peak detector were carried out.

The EUT was supplied with 3,0 VDC during the test.

Test set-up photos:



Test site: Bluetooth anechoic shielded chamber (1 – 26 GHz)

In the Bluetooth anechoic chamber the EUT was placed on a non-metallic table, 1,4 m above the floor. The radiated disturbance electric field intensity was measured at a distance of 3 m. The specified test mode was enabled.

An overview sweep with peak detection of the electric field intensity was performed with the spectrum analyser in max-hold and with the antenna height adjusted at the level of the EUT center (placed 1,4 m above the floor). The polarisation was horizontal and vertical. The measurements were repeated with the EUT rotated in 90-degree steps.

At the frequencies where high disturbance levels were found a search for max disturbance level was performed. With the EUT and antenna in the worst-case configuration new measurements with peak and average detectors were carried out.

The EUT was supplied by 3 VDC during the test.

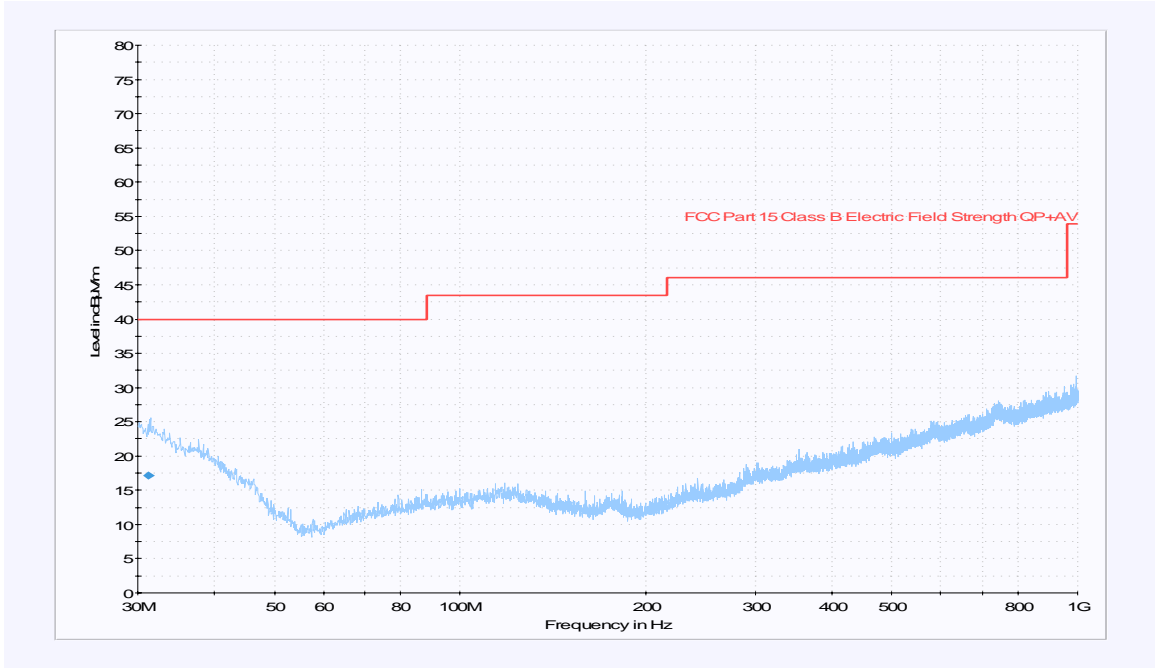


8.4 Test protocol

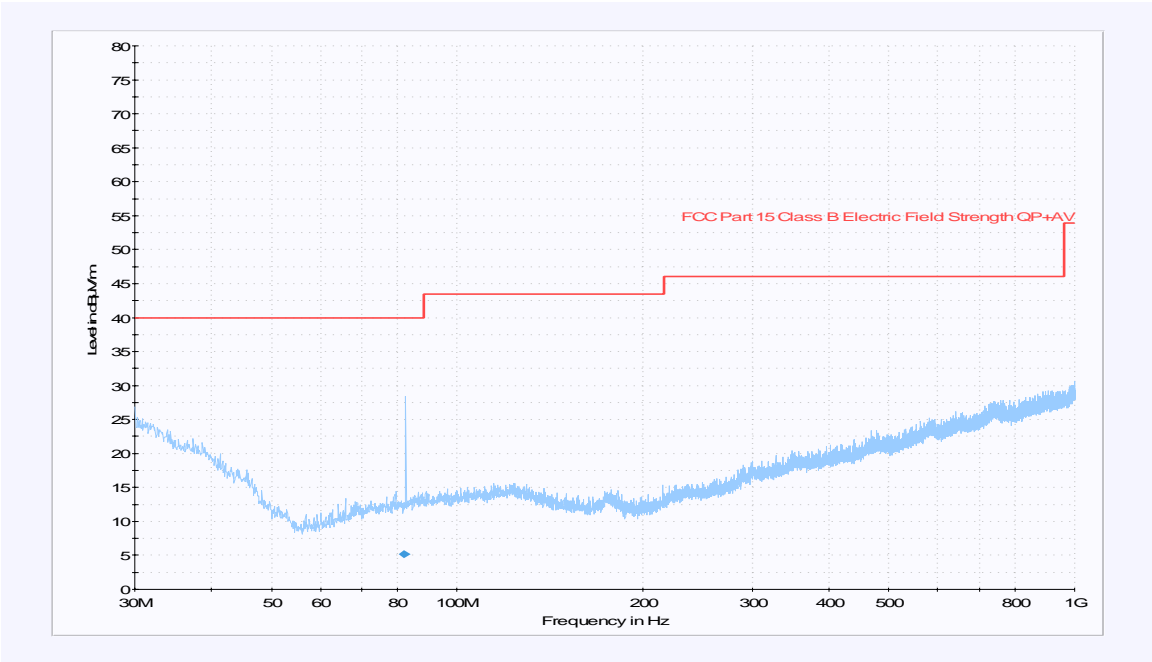
Semi-anechoic shielded chamber

Date of test: 2006-11-14

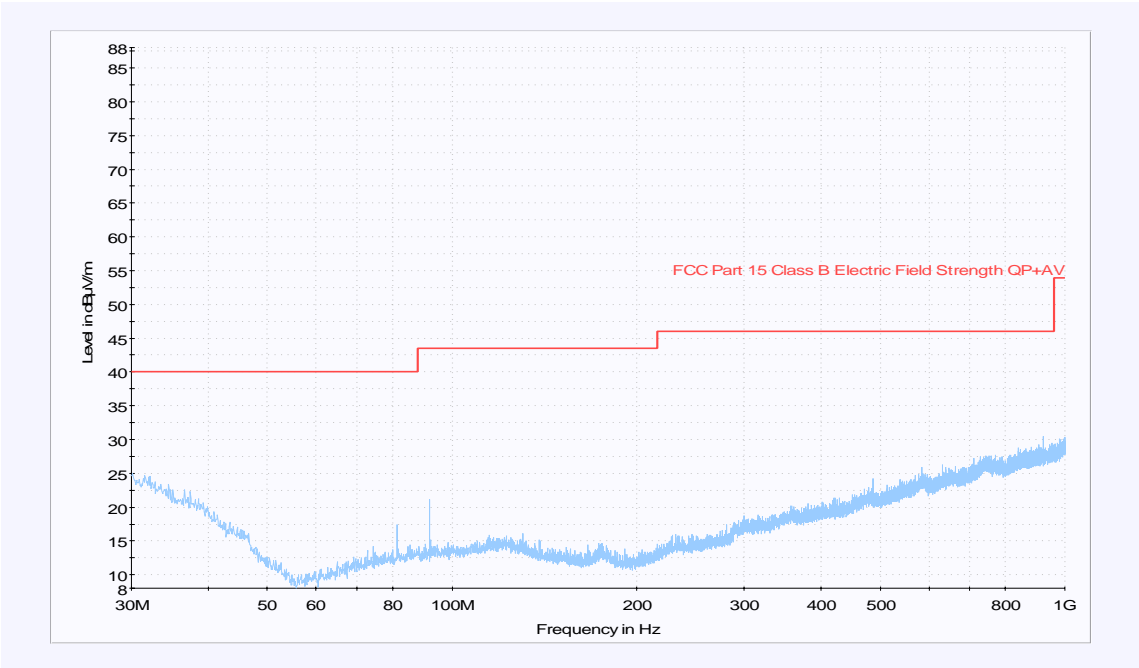
30 – 1000 MHz, max peak at a distance of 3 m on the lowest TX channel



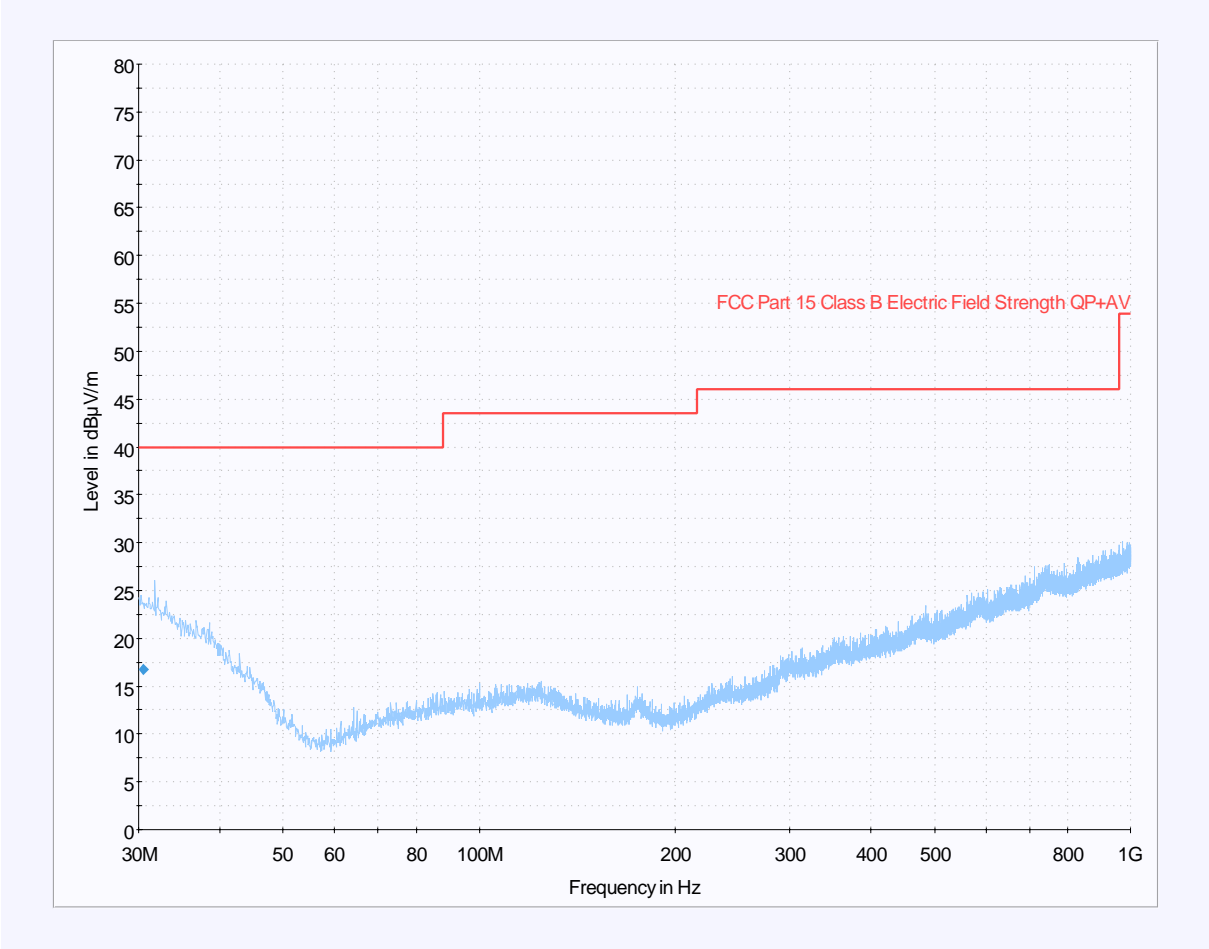
30 – 1000 MHz, max peak at a distance of 3 m on the middle TX channel



30 – 1000 MHz, max peak at a distance of 3 m on the highest TX channel



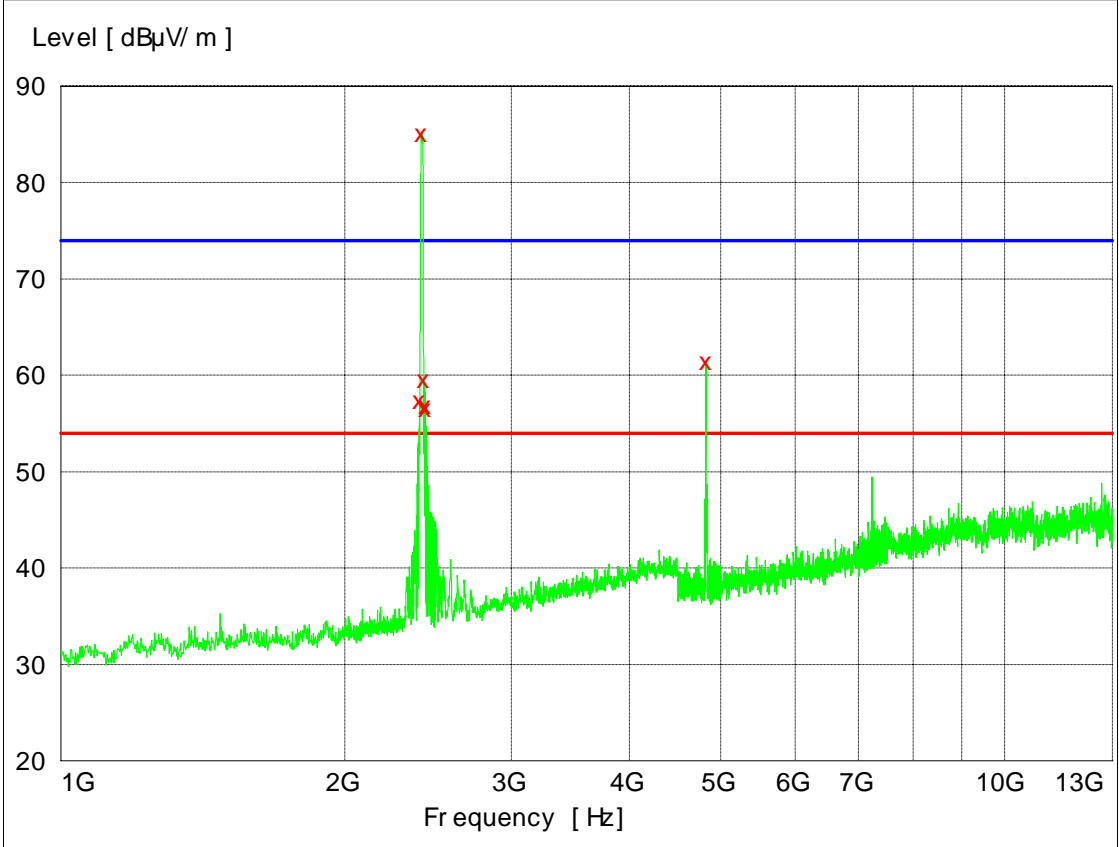
30 – 1000 MHz, max peak at a distance of 3 m in standby/Rx mode



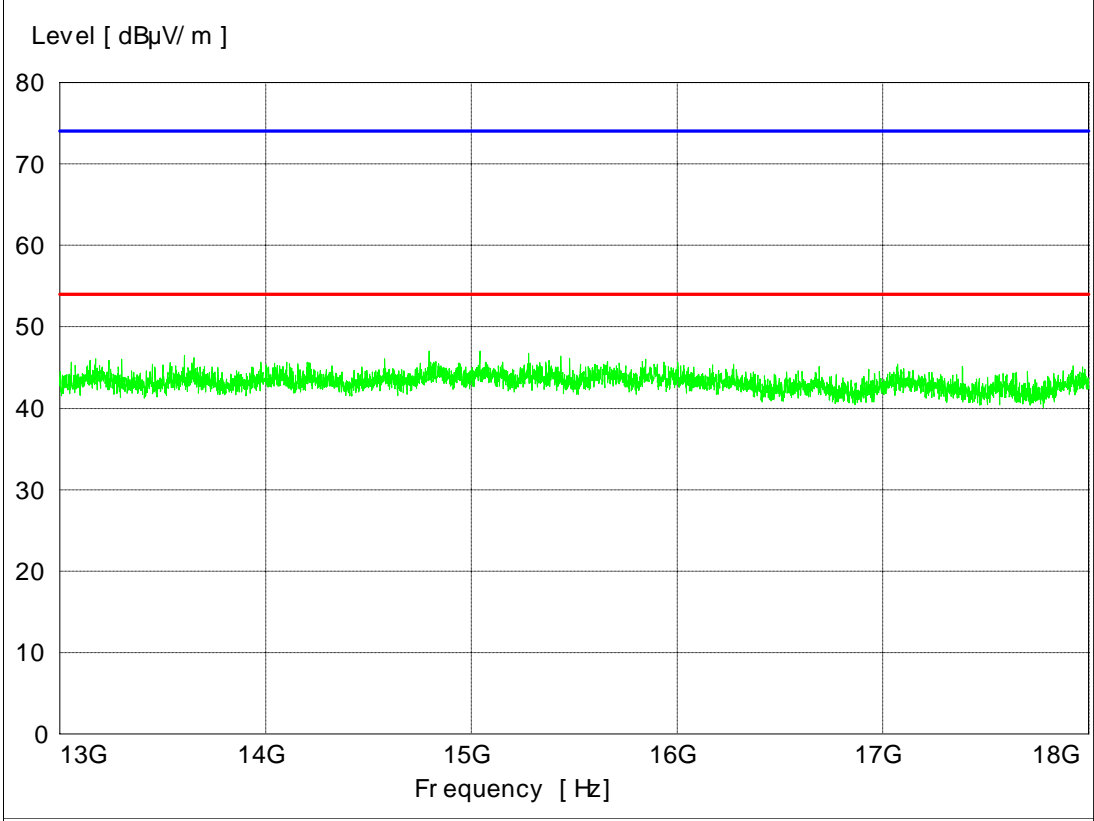
Radio anechoic shielded chamber

Date of test: 2006-11-14

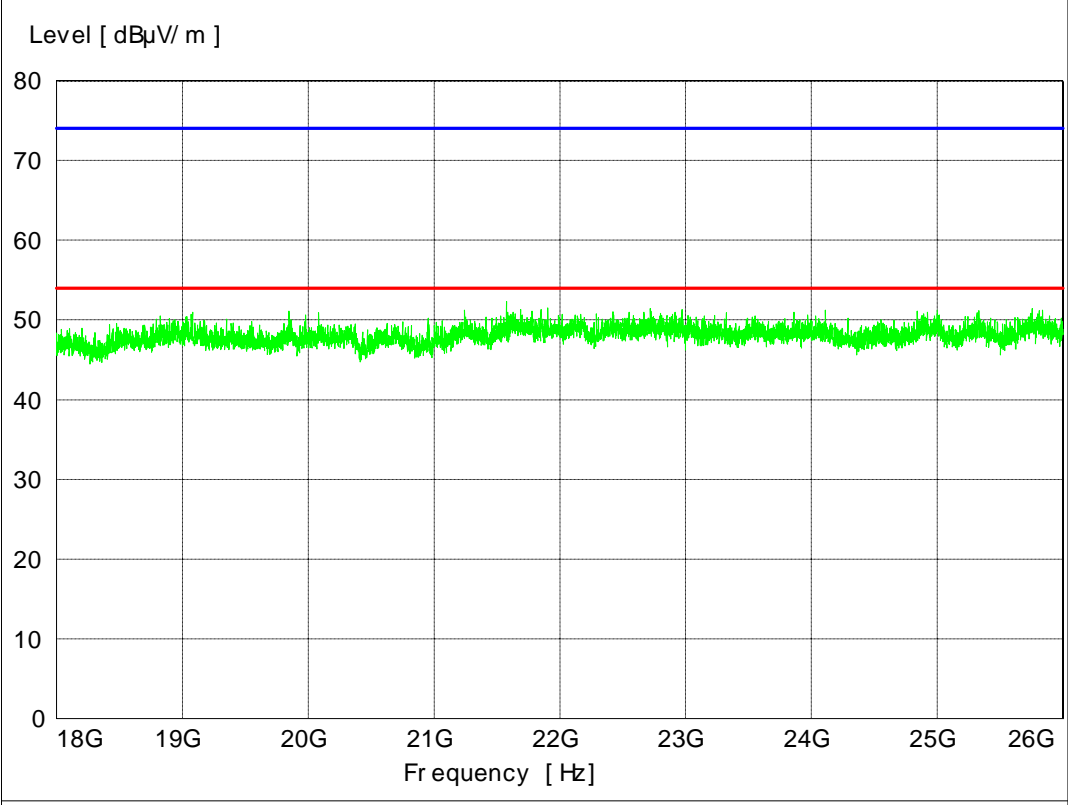
1000 – 13000 MHz, max peak at a distance of 3 m on the lowest TX channel



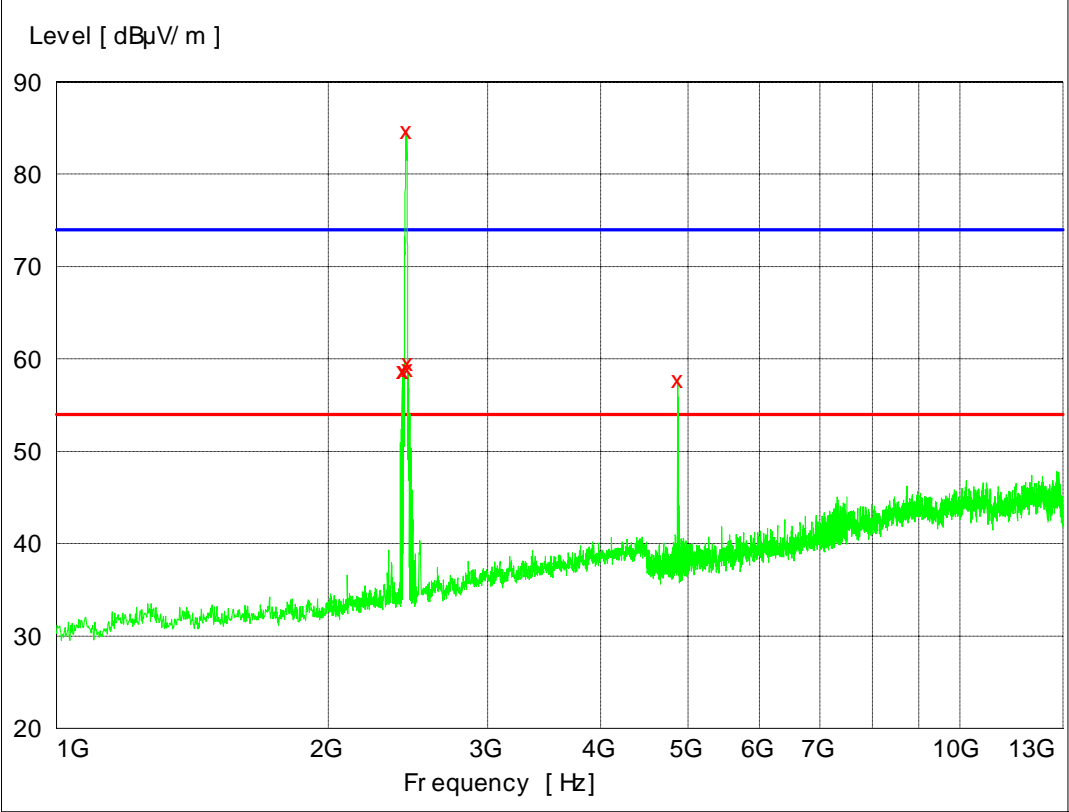
13 – 18 GHz, max peak at a distance of 3 m on the lowest TX channel



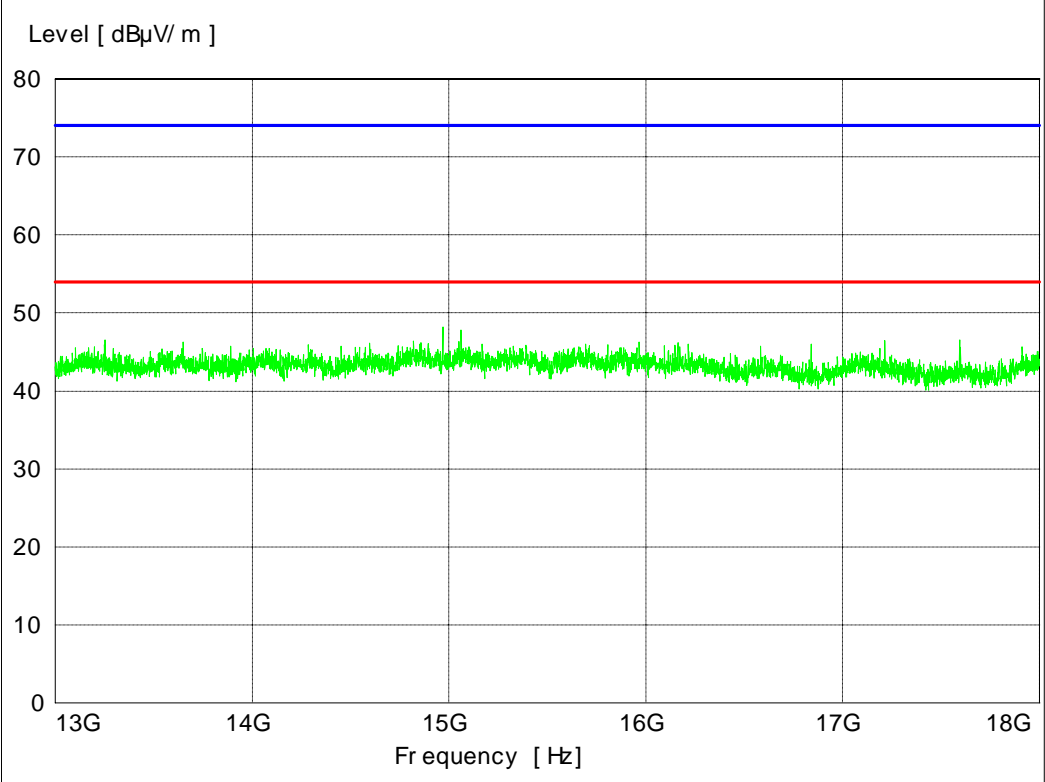
18 – 26 GHz, max peak at a distance of 3 m on the lowest TX channel



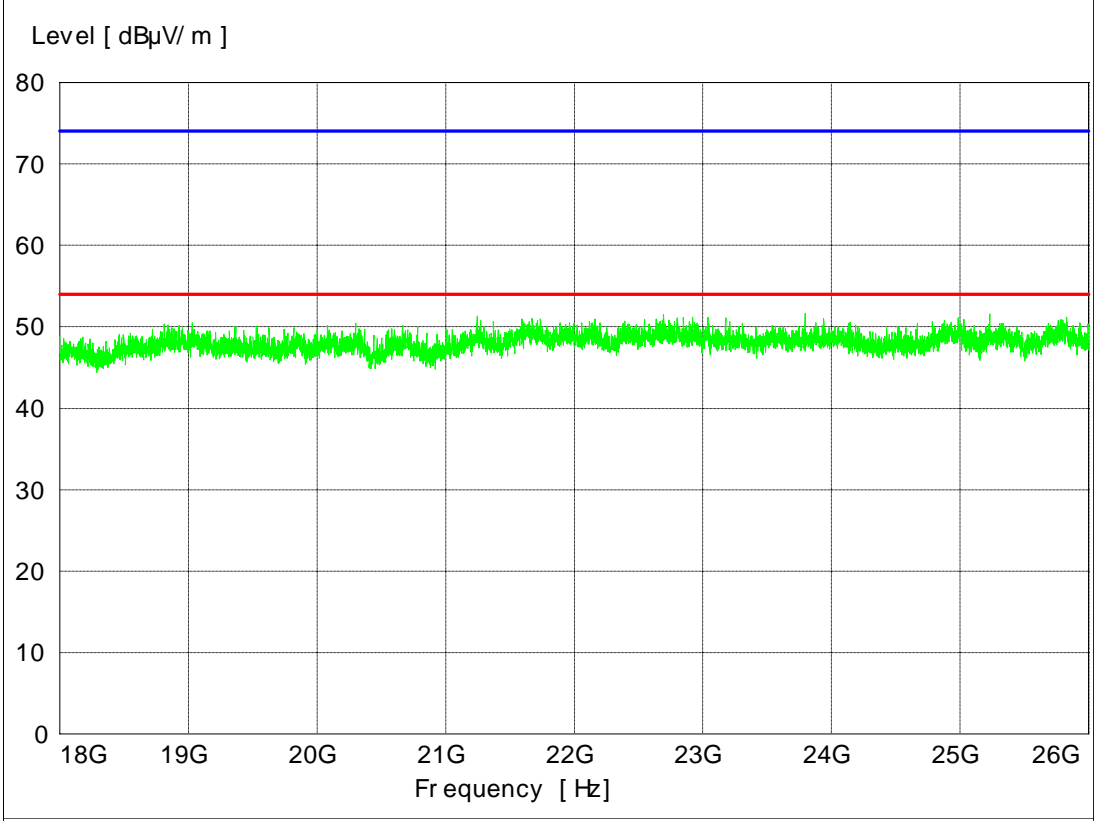
1000 – 13000 MHz, max peak at a distance of 3 m on the middle TX channel



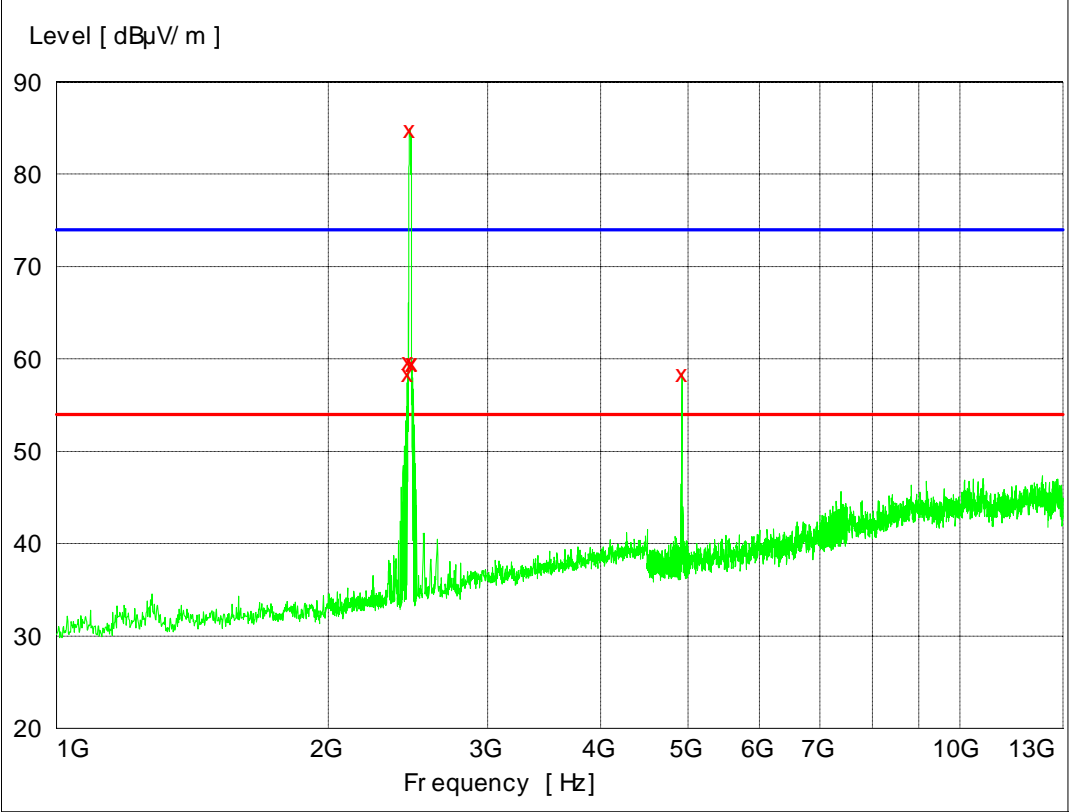
13 – 18 GHz, max peak at a distance of 3 m on the middle TX channel, QPSK, 11 Mbps



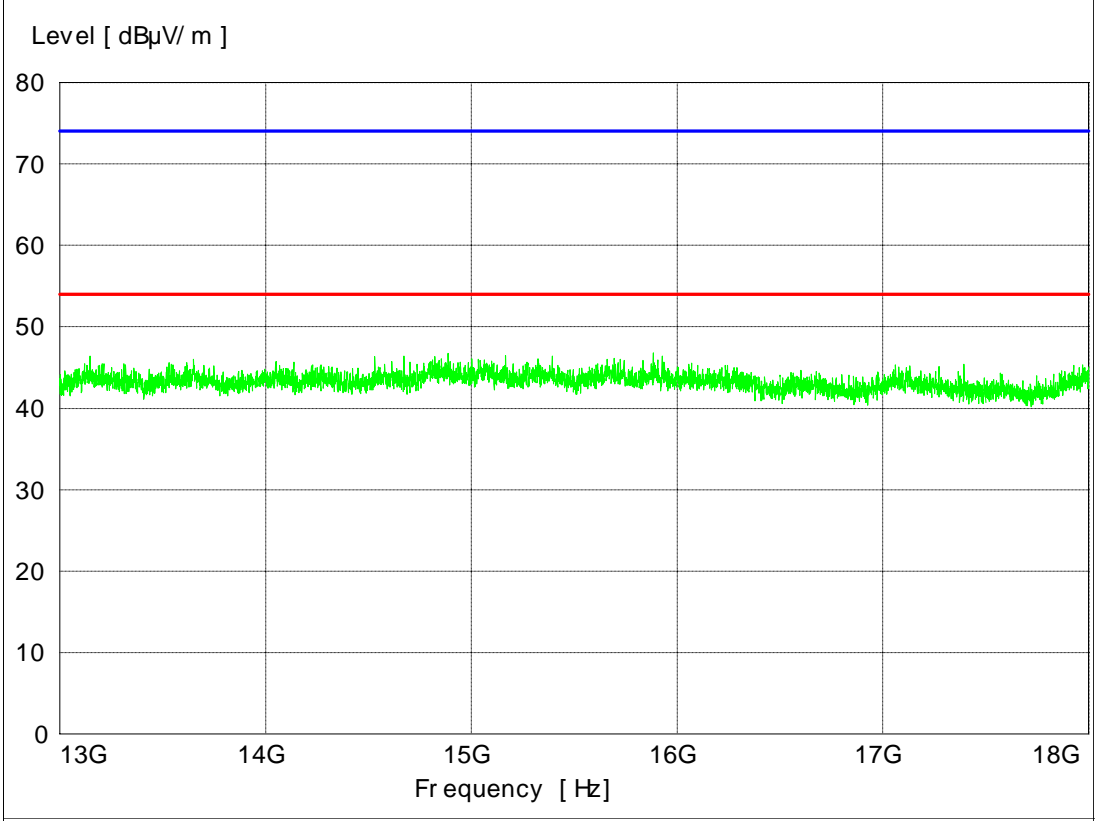
18 – 26 GHz, max peak at a distance of 3 m on the middle TX channel, QPSK, 11 Mbps



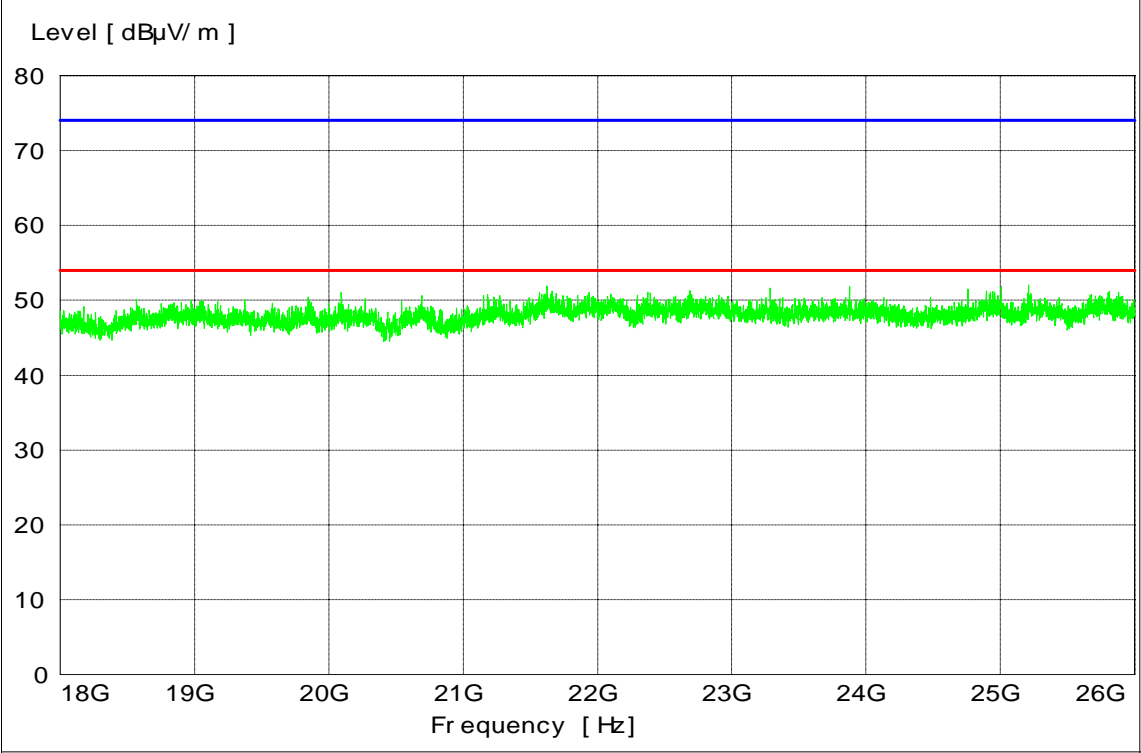
1000 – 13000 MHz, max peak at a distance of 3 m on the highest TX channel



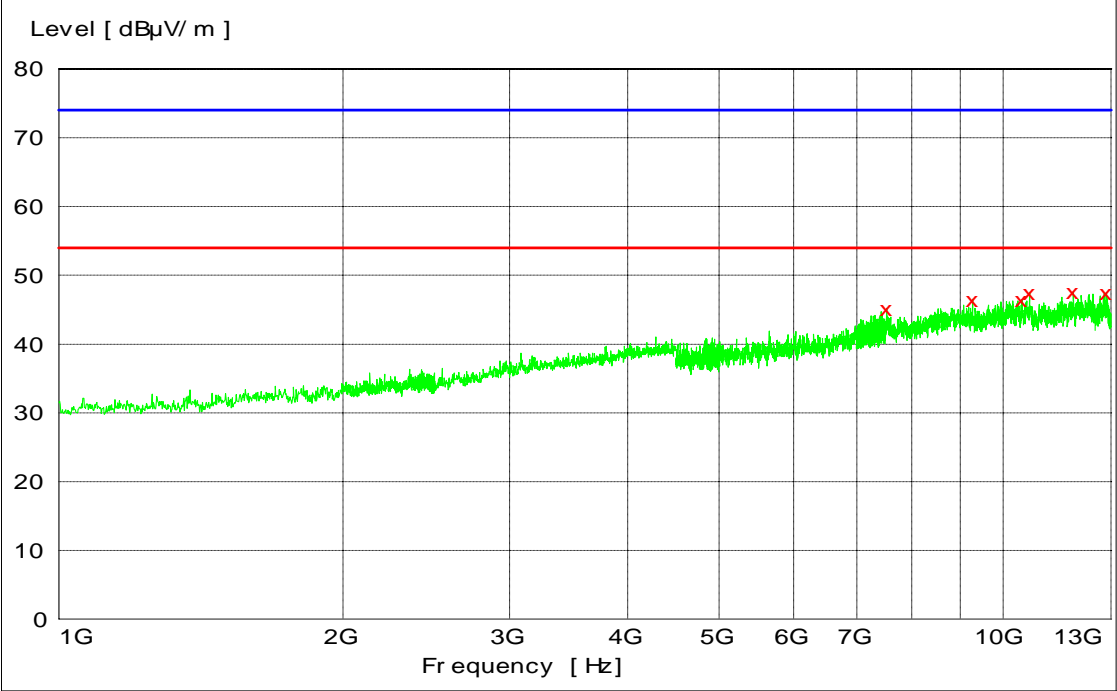
13 – 18 GHz, max peak at a distance of 3 m on the highest TX channel



18 – 26 GHz, max peak at a distance of 3 m on the highest TX channel



1 – 13 GHz, max peak at a distance of 3 m, Standby mode



Data summary

Low channel, 1

Detector Type	Frequency MHz	Measured level dBuV/m	Limit dBuV/m	Bandwidth kHz	Note
QP	31,2	17,1	46	120	
Pk	4824,2	65,2	74	1000	
Avg	4824,2	41,1	54	1000	
Pk	7235,1	55,4	74	1000	
Avg	7235,1	44,9	54	1000	

Middle channel, 6

Detector Type	Frequency MHz	Measured level dBuV/m	Limit dBuV/m	Bandwidth kHz	Note
QP	82,1	5,1	46	120	
Pk	4873,9	63,8	74	1000	
Avg	4873,9	41,1	54	1000	

High channel, 11

Detector Type	Frequency MHz	Measured level dBuV/m	Limit dBuV/m	Bandwidth kHz	Note
QP	92,1	6,1	46	120	
Pk	4924,0	64,3	74	1000	
Avg	4924,0	41,5	54	1000	

Standby/Rx

Detector Type	Frequency MHz	Measured level dBuV/m	Limit dBuV/m	Bandwidth kHz	Note
Pk	30-1000	< 26	--	120	Noise floor
Pk	1000 – 13000		74 (54)	1000	Noise floor

Example calculation:

Measured level [dB μ V/m] = Analyser reading [dB μ V] + cable loss [dB] – preamplifier gain [dB] + antenna factor [1/m]

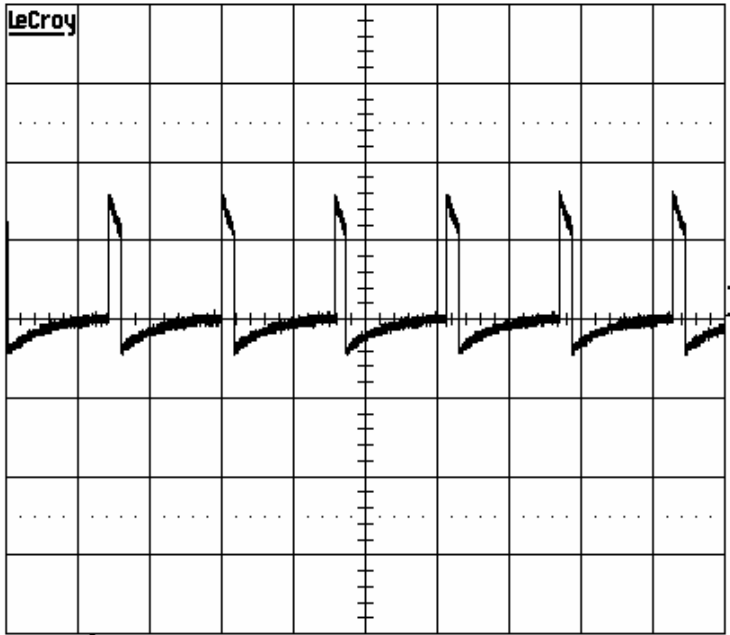
9 DUTY CYCLE

Date of test: 2006-12-07

Duty cycle is approx 10%

7-Dec-06
13:34:34

1
50 ms
0.50 V



50 ms

- 1** .5 V AC
- 2** 50 mV AC
- 3** 50 mV AC
- 4** 50 mV AC



1 AC 0.02 V

100 kS/s

STOPPED

10 APPENDIX I – PHOTOS OF THE EUT

