

# Test Report



## INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C and INDUSTRY CANADA REQUIREMENTS

Equipment Under Test: Bluetooth module  
Model: BLE112-N  
Type: -  
Manufacturer: Bluegiga Oy  
Sinikalliontie 5 A  
FI-02630 ESPOO  
Finland  
Customer: Bluegiga Oy  
Sinikalliontie 5 A  
FI-02630 ESPOO  
Finland  
FCC Rule Part: 15.247: 2010  
IC Rule Part: RSS-210, Issue 8, 2010  
RSS-GEN Issue 2, 2007

Date: 17.08.2011

Issued by:

A handwritten signature in blue ink, appearing to read "J. Merikari".

Jari Merikari  
Technical Manager

Date: 17.08.2011

Checked by:

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Ari Honkala  
Product Line Manager

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## Equipment Under Test (EUT)

Bluetooth module  
 Model: BLE112-N  
 Type: -  
 Serial no: -  
 HW version:  
 SW version: 1.0  
 FCC ID number: QOQBLE112  
 Industry Canada number: 5123A-BGTBLE112

## Description of the EUT

The EUT is a Bluetooth low energy single mode module targeted for low power sensors and accessories. Device can be used with batteries or from DC power supply.

## Classification of the device

Fixed device	<input type="checkbox"/>
Mobile Device (Human body distance > 20cm)	<input checked="" type="checkbox"/>
Portable Device (Human body distance < 20cm)	<input type="checkbox"/>

## Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing

## Ratings and declarations

Operating Frequency Range (OFR): 2402 – 2480 MHz  
 Channels: 40  
 Channel separation: 2 MHz  
 Channel bandwidth: 1.25 MHz  
 Effective conducted power: 0.58 dBm  
 Transmission technique: Digital Transmission  
 Modulation: GFSK  
 Antenna connector type: U.FL connector  
 Antenna gain: 2.14 dBi

## Power Supply

Battery operated  
 Operating voltage range: 2,0 – 3,6 VDC  
 Normal input voltage: 3.0 V coin battery or 2 x 1,5V AAA batteries  
 Tested by using external power supply and 3.0 VDC voltage level

### **Mechanical Size of the EUT**

Height: 2,03 mm	Width: 12,05 mm	Depth: 18,10 mm
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### **Peripherals**

#### **Peripheral**

DC power supply Thandar TS3021S.

### **Samples**

All tests were performed to one sample. No modifications were done during the tests.

**Disclaimer**

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## SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.247(b)(3) / RSS-210 A8.4	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-210 A8.2	6 dB Bandwidth	PASS
§15.247(e) / RSS-210 A8.2	Power Spectral Density	PASS
RSS-GEN 4.6.1	99% Occupied Bandwidth	PASS
§15.247(d) / RSS-210 A8.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	PASS
§15.209(a), §15.247(d) / RSS-210 A8.5	Radiated Emissions Within The Restricted Bands	PASS
§15.109 / RSS-GEN 7.2.3.2	Unintentional Radiated Emissions	PASS
§15.207 / RSS-GEN 7.2.2	Conducted emissions	PASS

### EUT Test Conditions During Testing

The EUT was in continuous transmit mode during all the tests.

The hopping was stopped and the EUT was configured into the wanted channel. Normal modulation and duty cycle was applied in all the tests.

Following channels were used during the tests when the hopping was stopped:

Channel LOW (CH 0) = 2402 MHz

Channel MID (CH 20) = 2442 MHz

Channel HIGH (CH 39) = 2480 MHz

### Test Facility

<input type="checkbox"/> Testing Location / address: FCC registration number: <b>90598</b>	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
<input checked="" type="checkbox"/> Testing Location / address: FCC registration number: <b>178986</b> Industry Canada registration number: <b>8708A-2</b>	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

### Maximum Peak Conducted Output Power

**Standard:** ANSI C63.10 (2009)  
**Tested by:** JJM  
**Date:** 27.5.2011  
**Humidity:** 30 %  
**Temperature:** 23 °C  
**Measurement uncertainty** ± 2,87dB Level of confidence 95 % (k = 2)

#### FCC Rule: 15.247(b)(3)

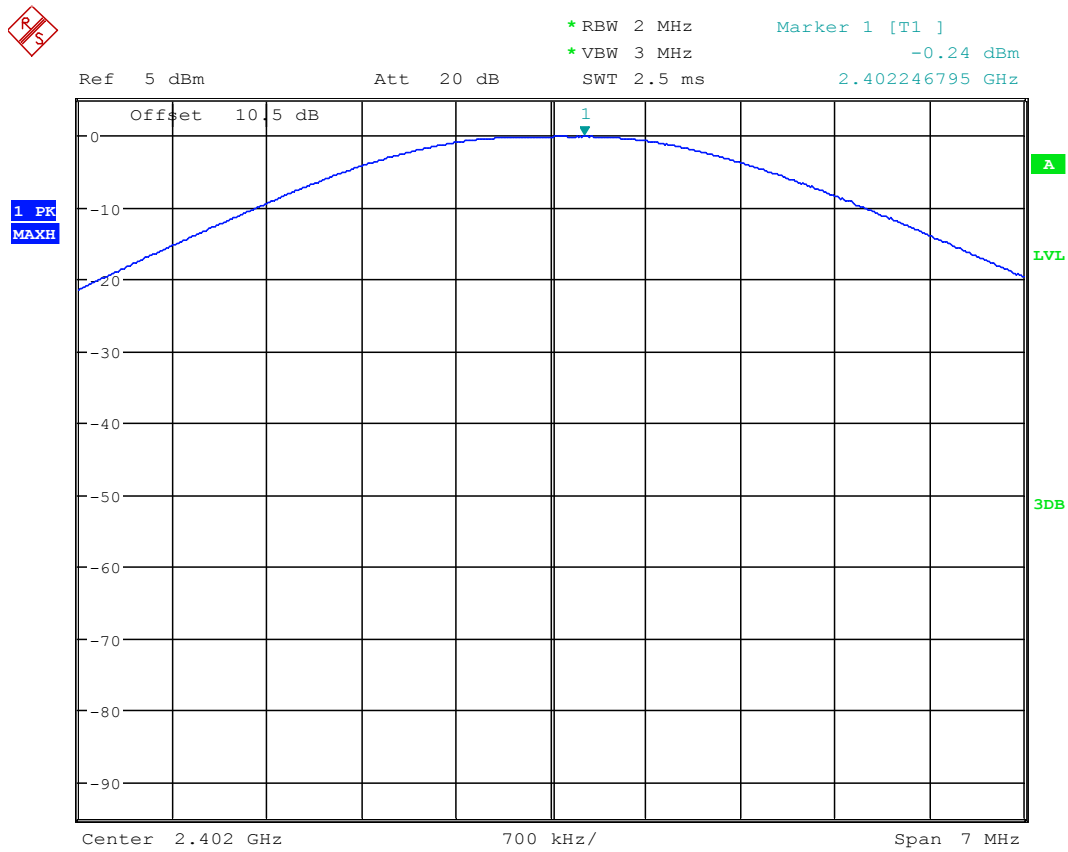
For systems using digital modulation in the 2400-2483.5 MHz bands the limit is 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

#### Results:

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	-0.24	30	30.24	PASS
Mid	0.26	30	29.74	PASS
High	0.58	30	29.42	PASS

The attenuation of the measurement cable and the attenuator was added as an offset 10.5 dB to correct the measurement result.

## Conducted Output Power Test

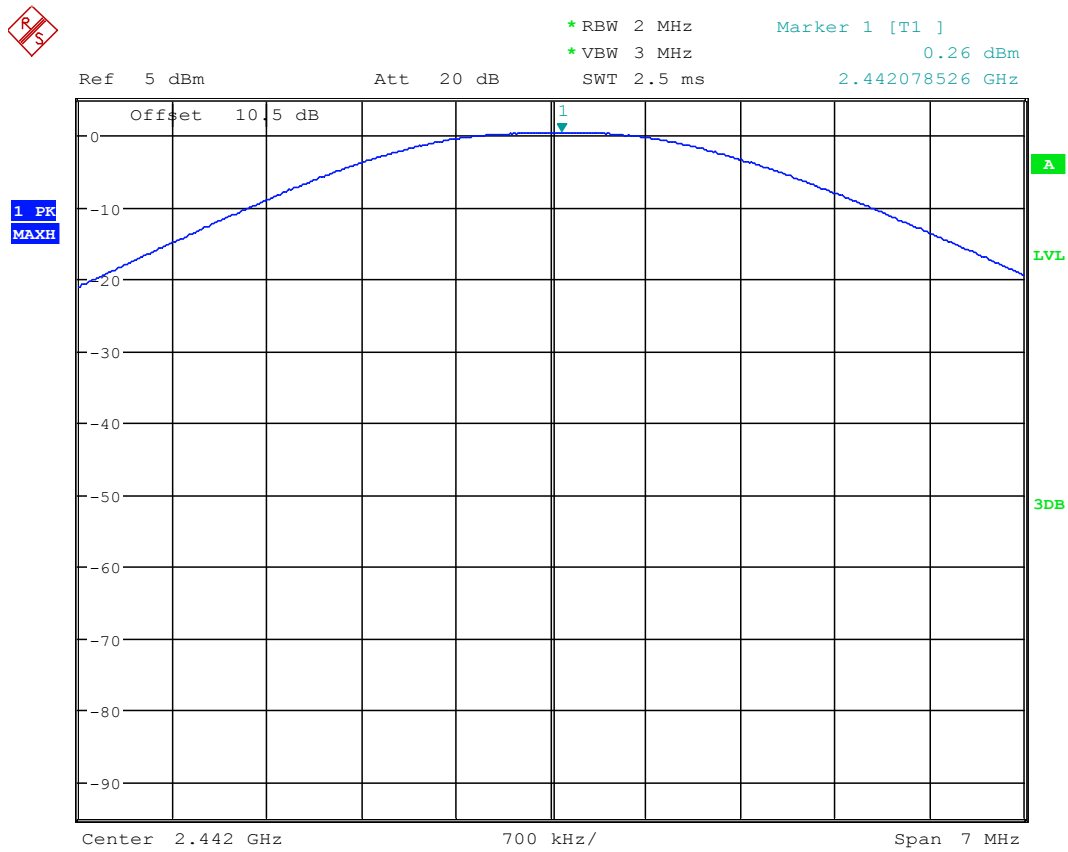


Date: 27.MAY.2011 08:03:56

Figure 1. Channel LOW.



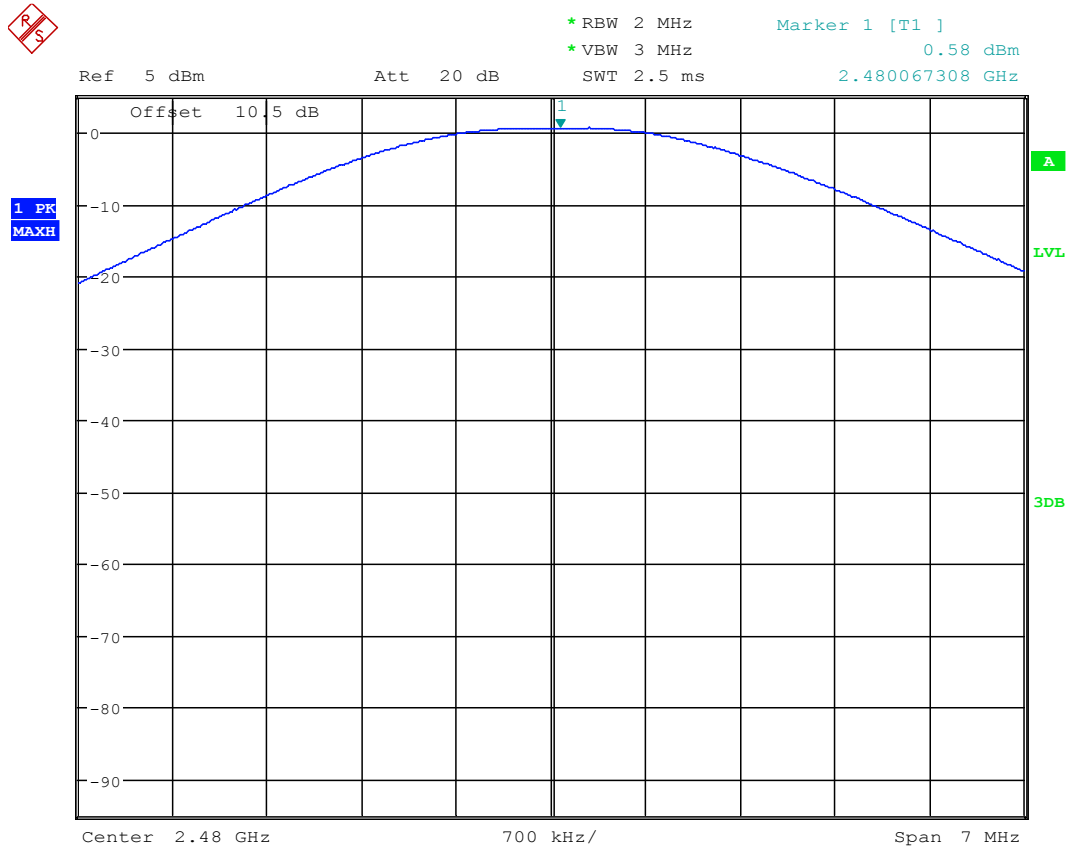
## Conducted Output Power Test



Date: 27.MAY.2011 08:05:04

**Figure 2.** Channel MID.

## Conducted Output Power Test



Date: 27.MAY.2011 08:05:56

Figure 3. Channel HIGH.

**Transmitter Radiated Emissions 30 – 1000 MHz**

<b>Standard:</b>	ANSI C63.10	(2009)
<b>Tested by:</b>	JJM	
<b>Date:</b>	30.5.2011	
<b>Humidity:</b>	37 %	
<b>Temperature:</b>	21.0 °C	
<b>Measurement uncertainty</b>	± 4.51 dB	Level of confidence 95 % (k = 2)

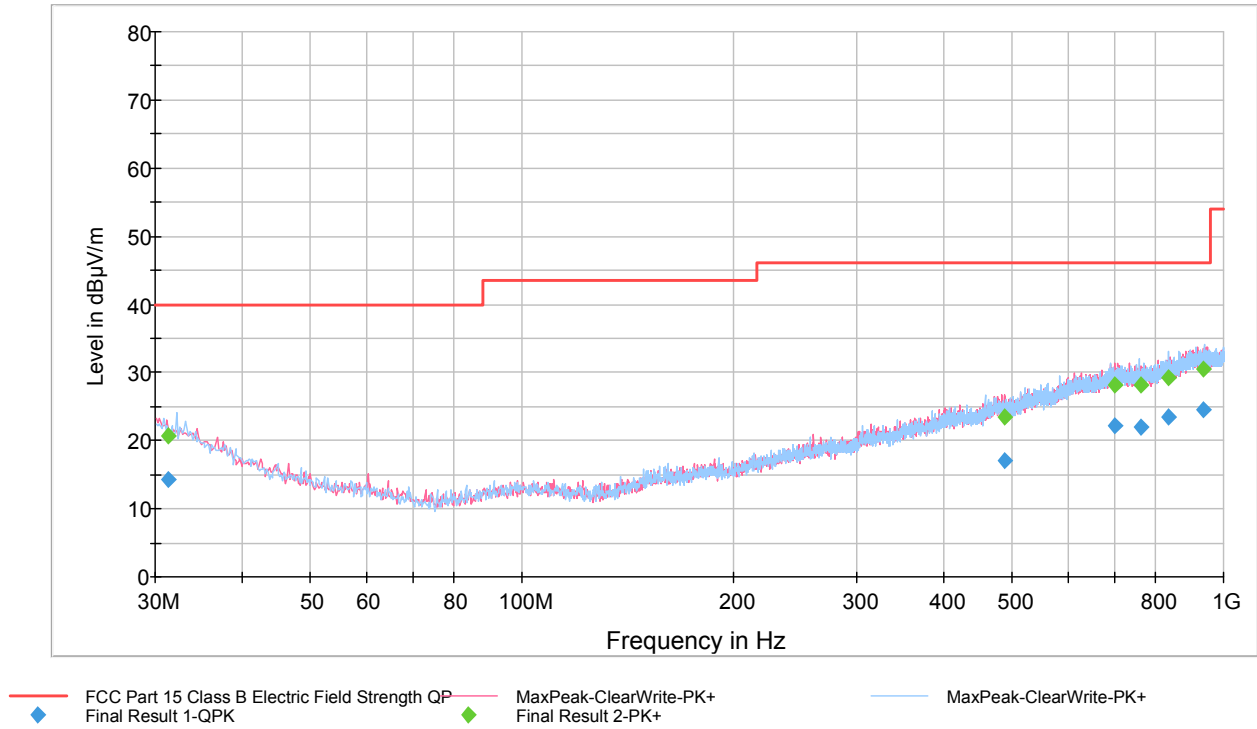
**FCC Rule: 15.247(d), 15.209(a)**

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

The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables). The QuasiPeak value is the measured value corrected with the correction factor.

**Measured Peak Values In The Frequency Range 30 MHz - 1000 MHz.**

FCC Part 15 Class B Electric Field Strength



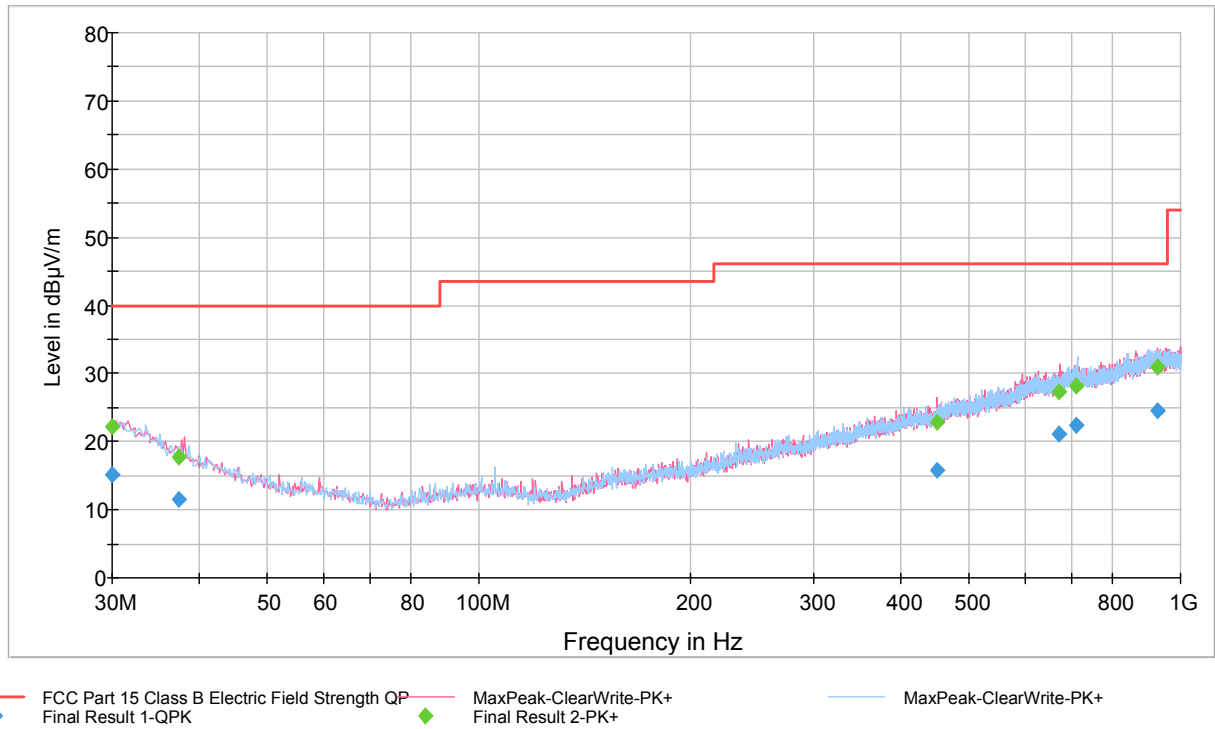
**Figure 4.** Measured curve with peak-detector. Channel LOW.

**Final measurements from the worst frequencies**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
31.302500	14.3	15000.0	120.000	338.0	H	108.0	18.4	25.7	40.0	
486.952500	17.2	15000.0	120.000	275.0	V	25.0	21.6	28.8	46.0	
699.467500	22.2	15000.0	120.000	100.0	V	14.0	25.6	23.8	46.0	
760.683750	21.9	15000.0	120.000	275.0	H	94.0	25.5	24.1	46.0	
832.623750	23.4	15000.0	120.000	163.0	H	272.0	26.8	22.6	46.0	
936.900000	24.5	15000.0	120.000	400.0	H	14.0	28.0	21.5	46.0	

**Table 1.** Final results.

FCC Part 15 Class B Electric Field Strength



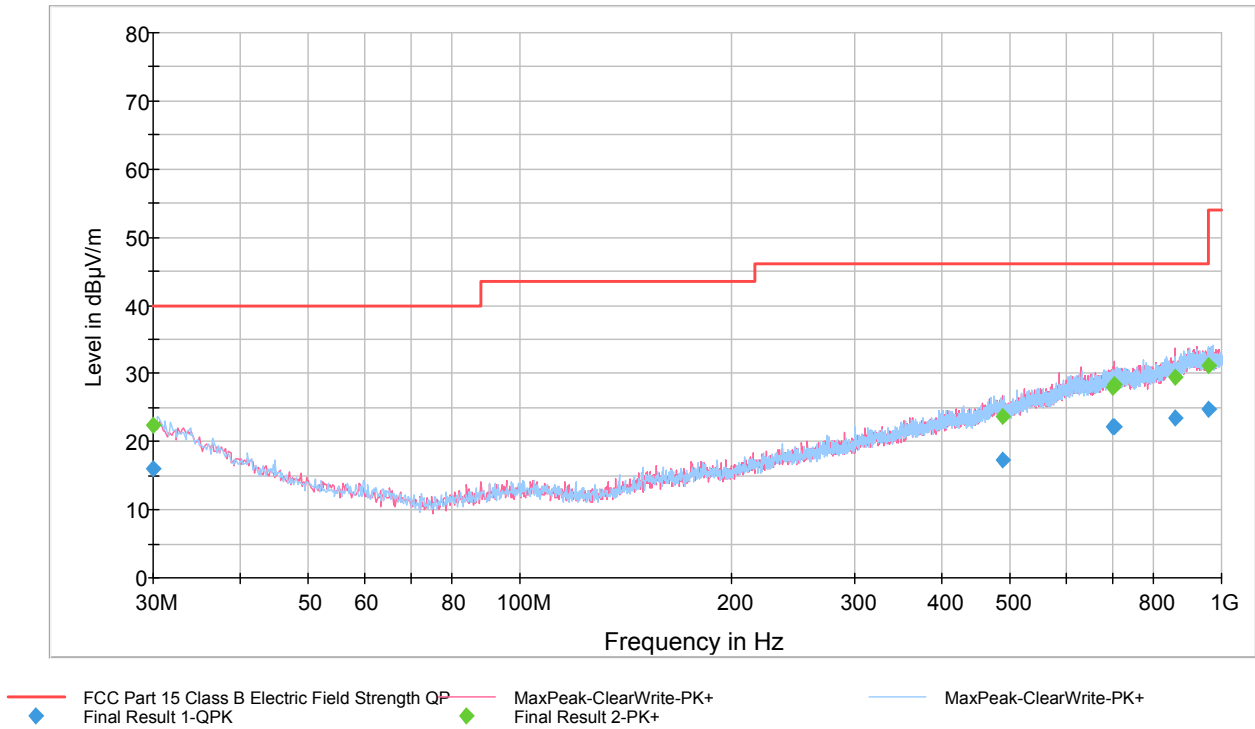
**Figure 5.** Measured curve with peak-detector. Channel MID.

**Final measurements from the worst frequencies**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
30.000000	15.2	15000.0	120.000	100.0	V	14.0	19.2	24.8	40.0	
37.362500	11.6	15000.0	120.000	100.0	V	285.0	15.0	28.4	40.0	
450.407500	15.7	15000.0	120.000	100.0	V	195.0	20.4	30.3	46.0	
672.105000	21.2	15000.0	120.000	100.0	V	292.0	24.7	24.8	46.0	
710.747500	22.3	15000.0	120.000	100.0	V	285.0	25.8	23.7	46.0	
925.907500	24.5	15000.0	120.000	100.0	V	195.0	28.1	21.5	46.0	

**Table 2.** Final results.

FCC Part 15 Class B Electric Field Strenght



**Figure 6.** Measured curve with peak-detector. Channel HIGH.

**Final measurements from the worst frequencies**

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
30.040000	15.9	15000.0	120.000	129.0	H	106.0	19.1	24.1	40.0	
487.968750	17.2	15000.0	120.000	339.0	H	15.0	21.6	28.8	46.0	
700.386250	22.1	15000.0	120.000	175.0	V	166.0	25.6	23.9	46.0	
703.535000	22.2	15000.0	120.000	325.0	V	1.0	25.6	23.8	46.0	
857.908750	23.6	15000.0	120.000	304.0	V	285.0	26.9	22.4	46.0	
958.331250	24.8	15000.0	120.000	250.0	H	285.0	28.3	21.2	46.0	

**Table 3.** Final results.

## Transmitter Radiated Emissions 1 000 – 26 500 MHz

### Measured Peak and Average Values In The Frequency Range 1 000 MHz – 4 000 MHz.

The correction factor in the final result tables contains the sum of the transducers (antenna + amplifier + cables). The Max Peak and Average values are measured values corrected with the correction factor.

Copy of Radiated Emission FCC Part 15 Class B 1-4GHz 3m

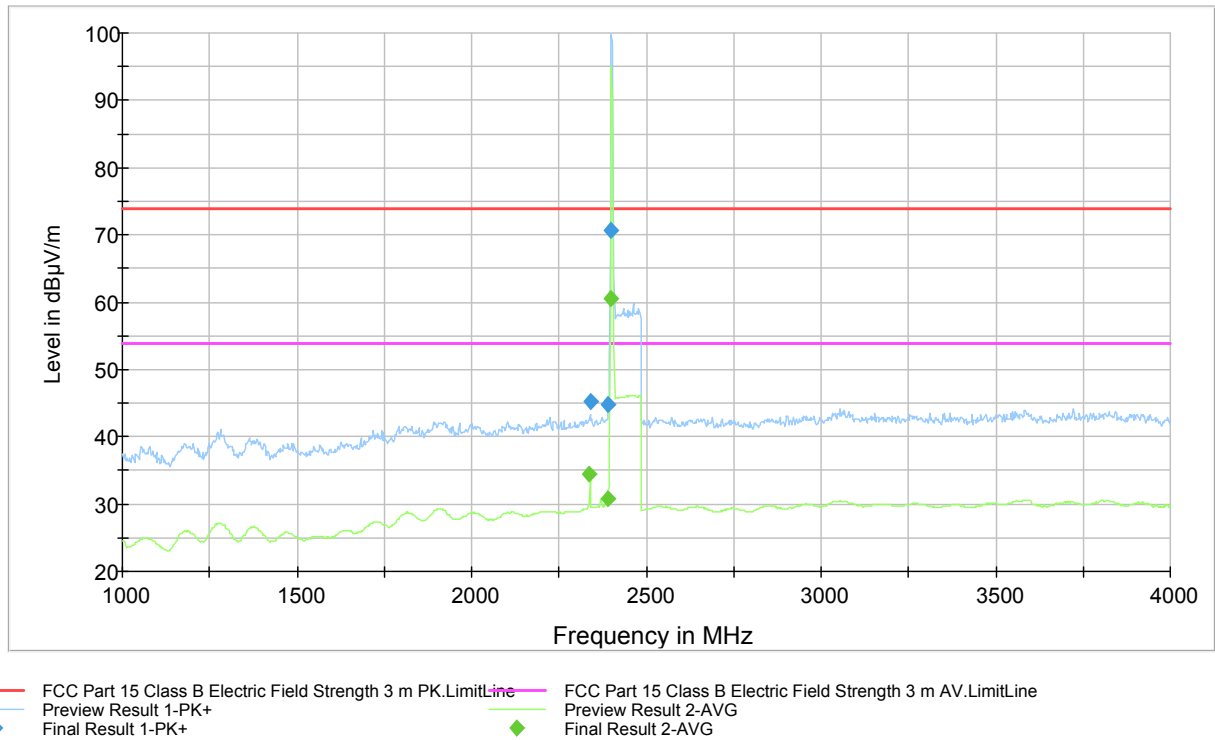


Figure 7. Measured curve with peak- and average detector. Channel LOW.

### Final measurements from the worst frequencies

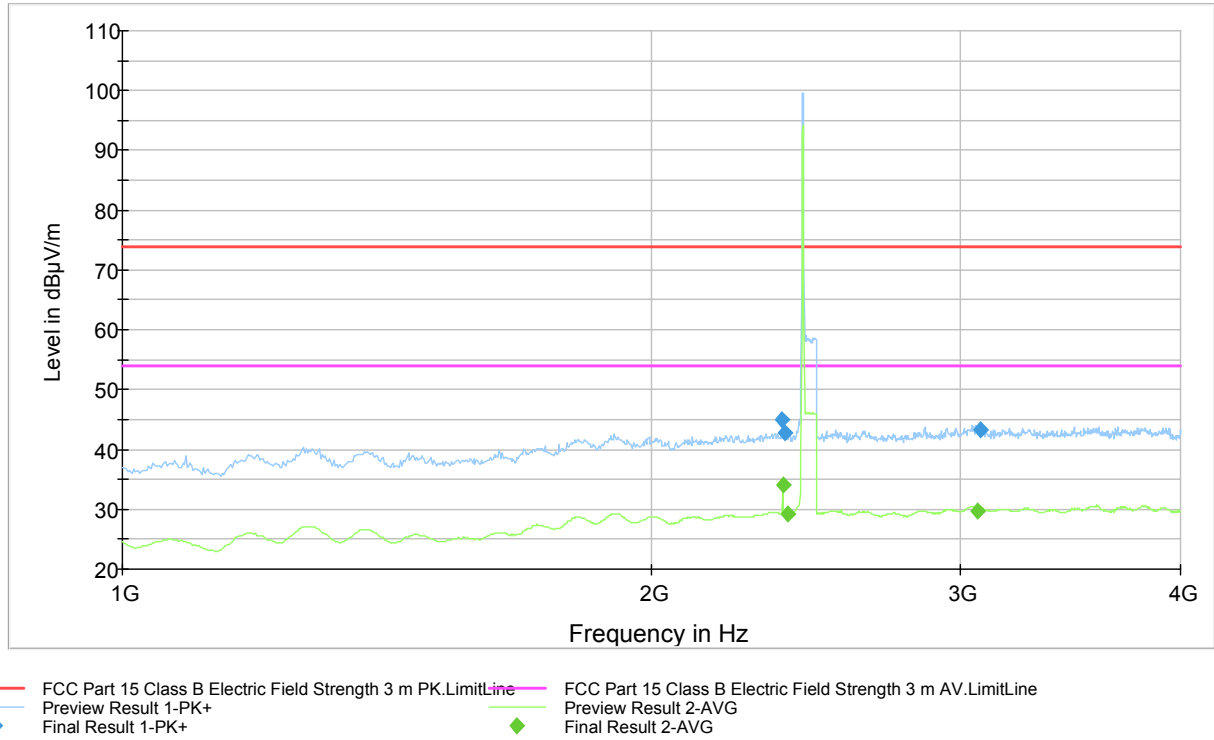
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2338.350000	45.2	1000.0	1000.000	237.0	H	107.0	4.2	28.7	73.9	
2388.000000	44.7	1000.0	1000.000	244.0	H	282.0	4.4	29.2	73.9	
2400.000000	70.6	1000.0	1000.000	205.0	H	290.0	4.4	3.3	73.9	

Table 4. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2337.950000	34.5	1000.0	1000.000	244.0	H	107.0	4.2	19.4	53.9	
2390.000000	30.7	1000.0	1000.000	204.0	H	290.0	4.4	23.2	53.9	
2399.400000	60.4	1000.0	1000.000	211.0	H	289.0	4.4	-6.5	53.9	

Table 5. Final Average results..

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**Figure 8.** Measured curve with peak- and average detector. Channel MID.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2375.850000	45.0	1000.0	1000.000	210.0	H	296.0	4.4	29.0	73.9	
2383.000000	42.8	1000.0	1000.000	105.0	V	95.0	4.4	31.1	73.9	
3079.750000	43.2	1000.0	1000.000	105.0	V	298.0	6.3	30.7	73.9	

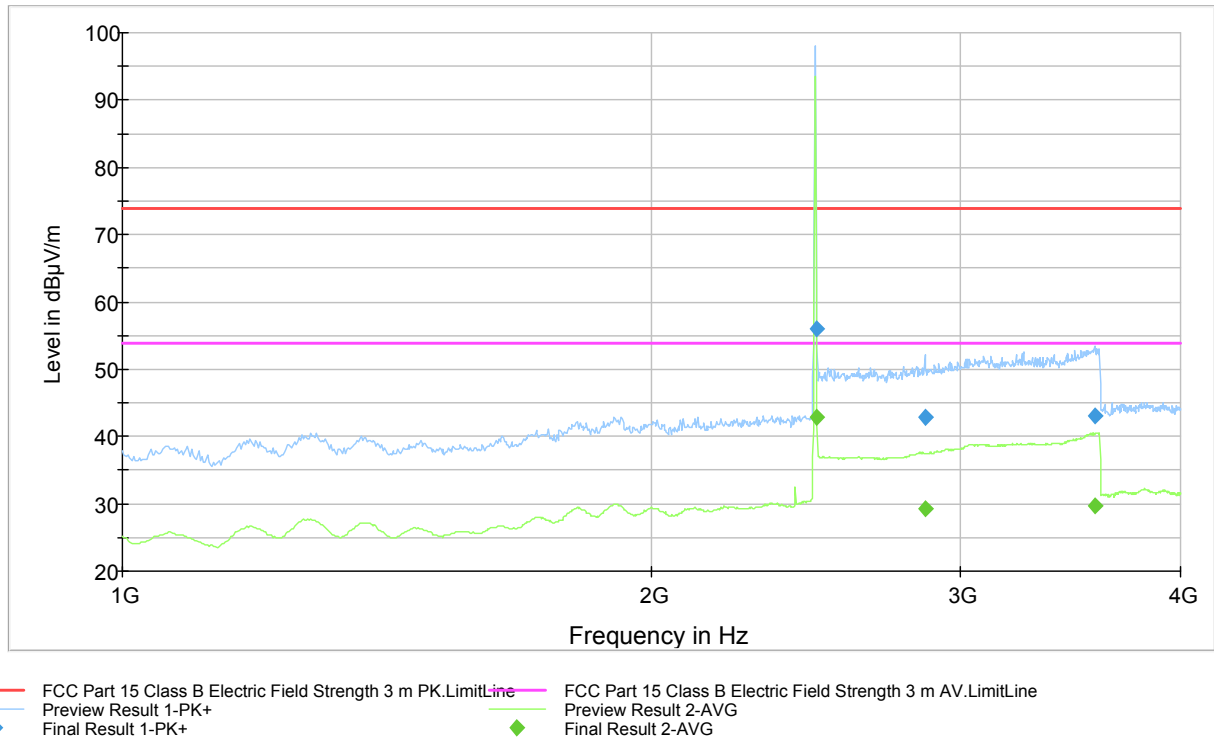
**Table 6.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2376.050000	34.0	1000.0	1000.000	201.0	H	288.0	4.4	19.9	53.9	
2389.800000	29.2	1000.0	1000.000	204.0	H	288.0	4.4	24.7	53.9	
3068.350000	29.7	1000.0	1000.000	118.0	H	335.0	6.2	24.2	53.9	

**Table 7.** Final Average results.



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**Figure 9.** Measured curve with peak- and average detector. Channel HIGH.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2483.500000	55.9	1000.0	1000.000	113.0	H	73.0	4.7	18.0	73.9	
2861.650000	42.9	1000.0	1000.000	175.0	H	45.0	5.4	31.0	73.9	
3572.950000	43.1	1000.0	1000.000	198.0	H	251.0	6.8	30.8	73.9	

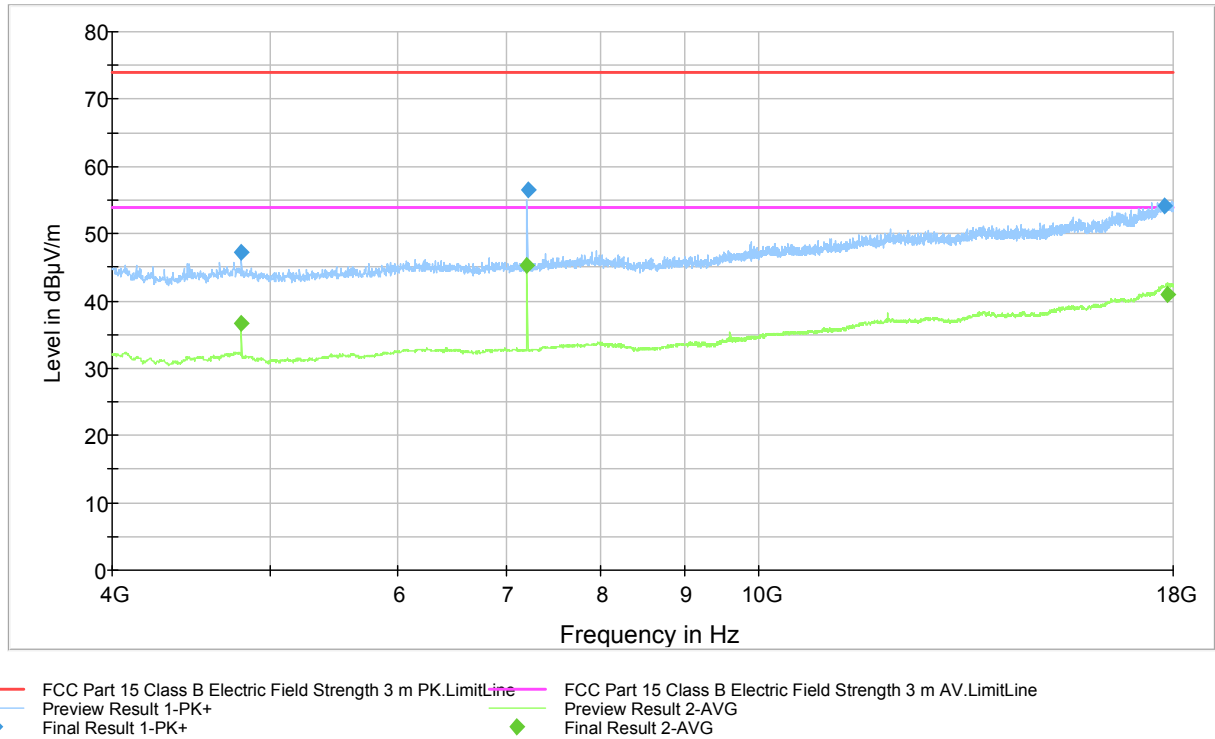
**Table 8.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2483.500000	42.8	1000.0	1000.000	113.0	H	73.0	4.7	11.1	53.9	
2866.450000	29.3	1000.0	1000.000	100.0	H	58.0	5.4	24.6	53.9	
3574.950000	29.7	1000.0	1000.000	196.0	H	228.0	6.9	24.2	53.9	

**Table 9.** Final Average results.

**Measured Peak and Average Values In The Frequency Range 4 000 MHz – 18 000 MHz.**

Copy of Radiated Emission FCC Part 15 Class B 1-18GHz 3m



**Figure 10.** Measured curve with peak- and average detector. Channel LOW.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4805.750000	47.2	1000.0	1000.000	175.0	V	99.0	10.5	26.7	73.9	
7206.750000	56.6	1000.0	1000.000	100.0	H	60.0	12.3	17.3	73.9	
17792.850000	54.1	1000.0	1000.000	137.0	H	4.0	25.5	19.8	73.9	

**Table 10.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4806.150000	36.6	1000.0	1000.000	100.0	V	103.0	10.5	17.3	53.9	
7205.550000	45.4	1000.0	1000.000	100.0	H	60.0	12.3	8.5	53.9	
17867.550000	40.9	1000.0	1000.000	100.0	V	0.0	25.7	13.0	53.9	

**Table 11.** Final Average results.

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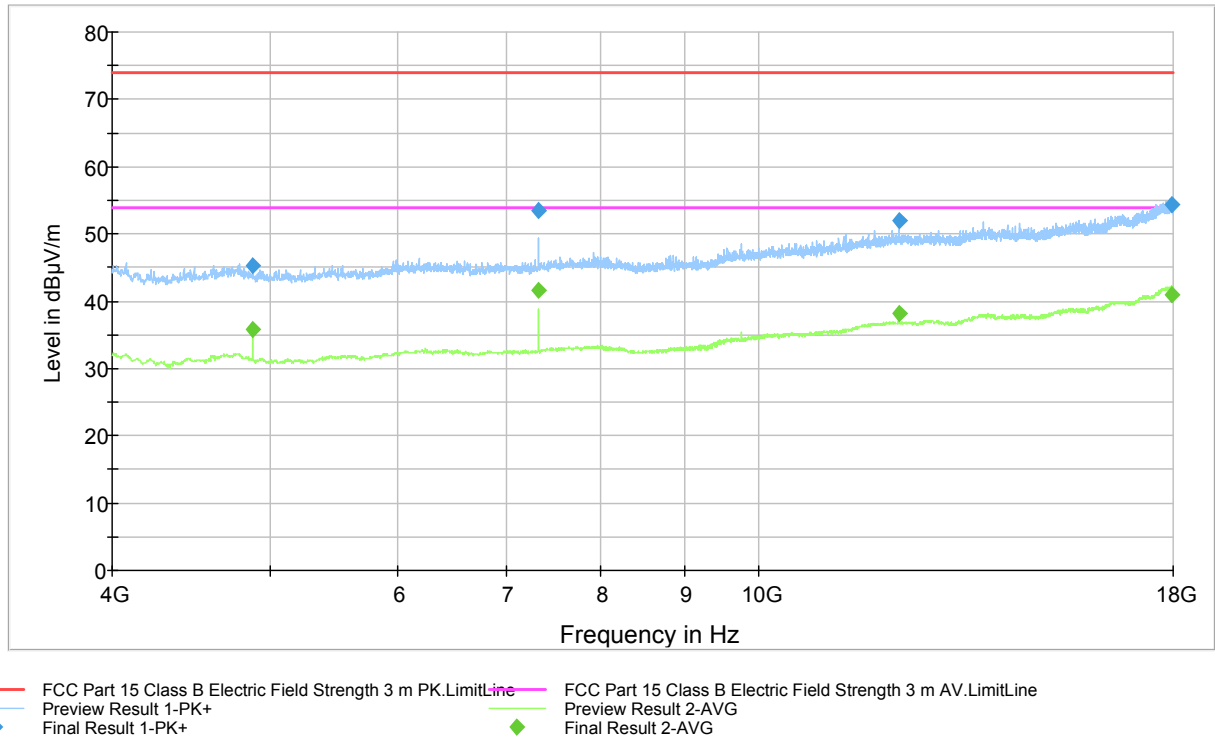


Figure 11. Measured curve with peak- and average detector. Channel MID.

Final measurements from the worst frequencies

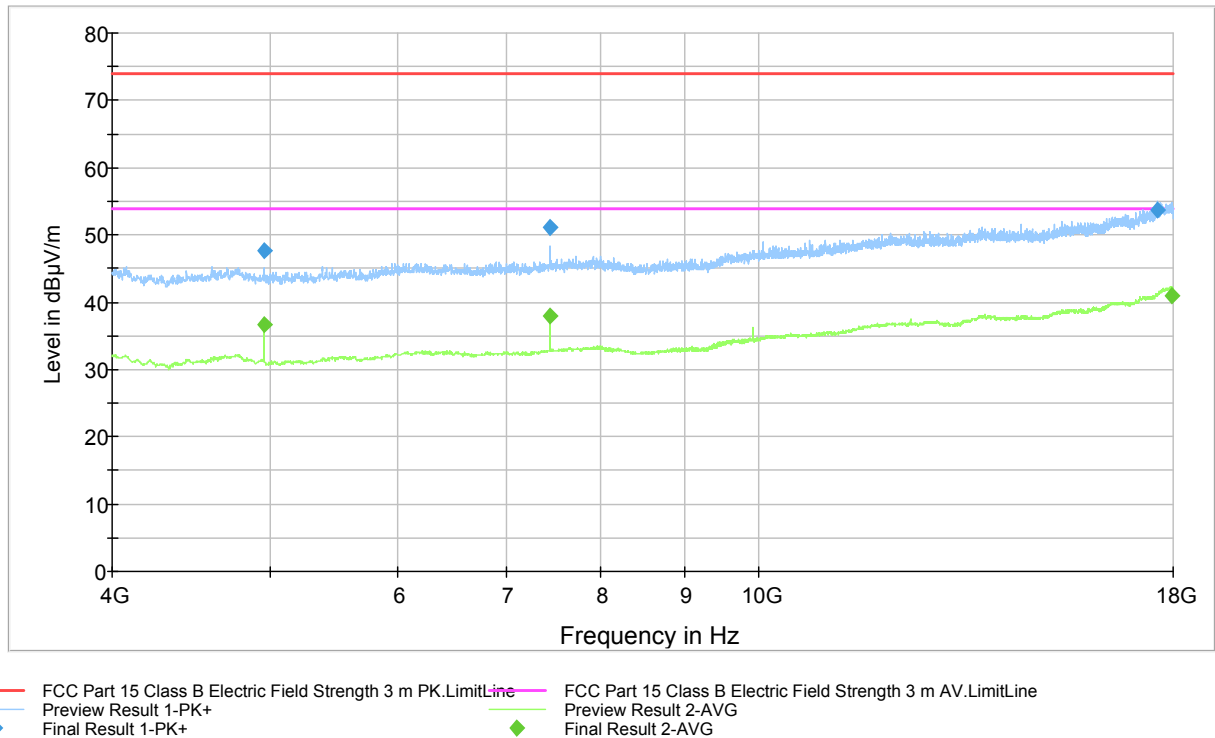
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4884.650000	45.3	1000.0	1000.000	269.0	V	64.0	10.5	28.6	73.9	
7320.950000	53.4	1000.0	1000.000	100.0	H	62.0	12.5	20.5	73.9	
12201.350000	51.9	1000.0	1000.000	178.0	V	326.0	19.1	22.0	73.9	
17950.950000	54.3	1000.0	1000.000	175.0	V	13.0	25.8	19.6	73.9	

Table 12. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4882.050000	35.9	1000.0	1000.000	205.0	V	91.0	10.5	18.0	53.9	
7319.550000	41.7	1000.0	1000.000	100.0	H	62.0	12.5	12.2	53.9	
12198.950000	38.1	1000.0	1000.000	169.0	V	332.0	19.1	15.8	53.9	
17963.650000	40.9	1000.0	1000.000	125.0	V	9.0	25.8	13.0	53.9	

Table 13. Final Average results.

Copy of Radiated Emission FCC Part 15 Class B 1-18GHz 3m



**Figure 12.** Measured curve with peak- and average detector. Channel HIGH.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4961.850000	47.7	1000.0	1000.000	207.0	V	261.0	10.4	26.2	73.9	
7439.350000	51.0	1000.0	1000.000	100.0	H	62.0	12.8	22.9	73.9	
17609.850000	53.7	1000.0	1000.000	134.0	H	220.0	24.9	20.2	73.9	

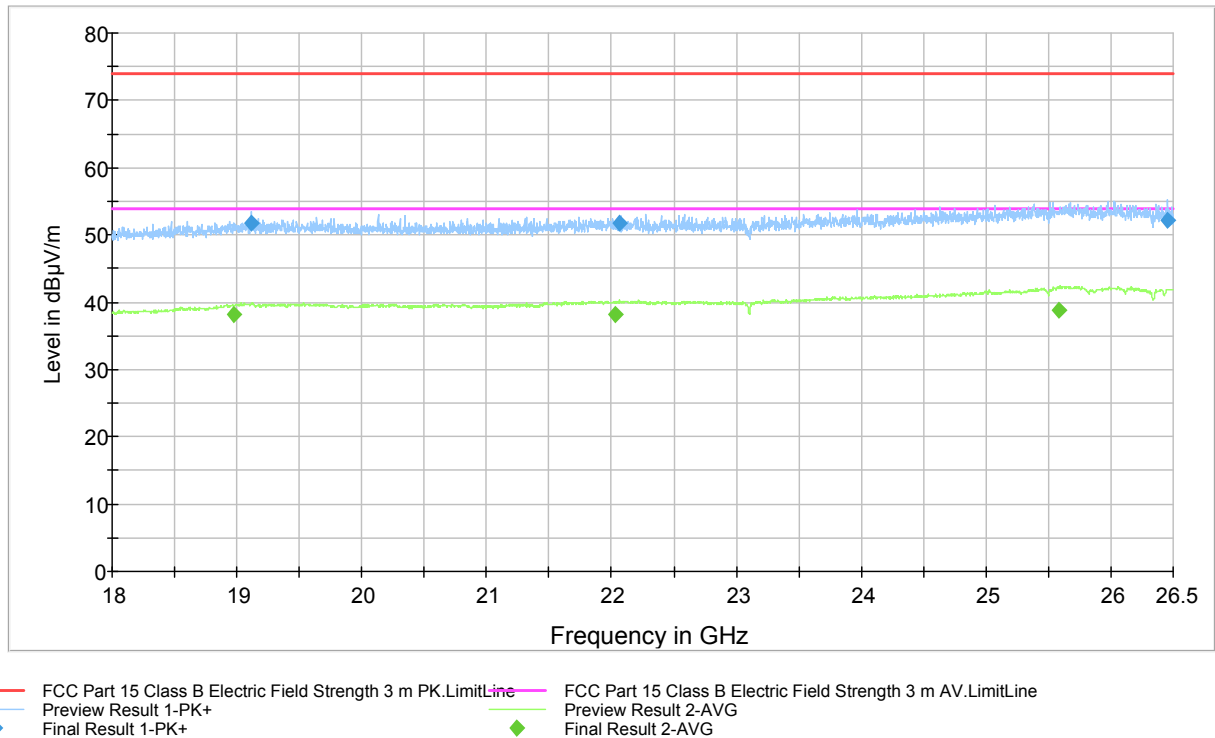
**Table 14.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4962.050000	36.6	1000.0	1000.000	184.0	V	265.0	10.4	17.3	53.9	
7439.550000	37.9	1000.0	1000.000	100.0	H	61.0	12.8	16.0	53.9	
17958.350000	40.9	1000.0	1000.000	100.0	V	0.0	25.8	13.0	53.9	

**Table 15.** Final Average results.

**Measured Peak and Average Values In The Frequency Range 18 000 MHz – 26 500 MHz.**

Copy of Radiated Emission FCC Part 15 Class B 18-26.5GHz at 3m



**Figure 13.** Measured curve with peak- and average detector. Channel LOW.

**Final measurements from the worst frequencies**

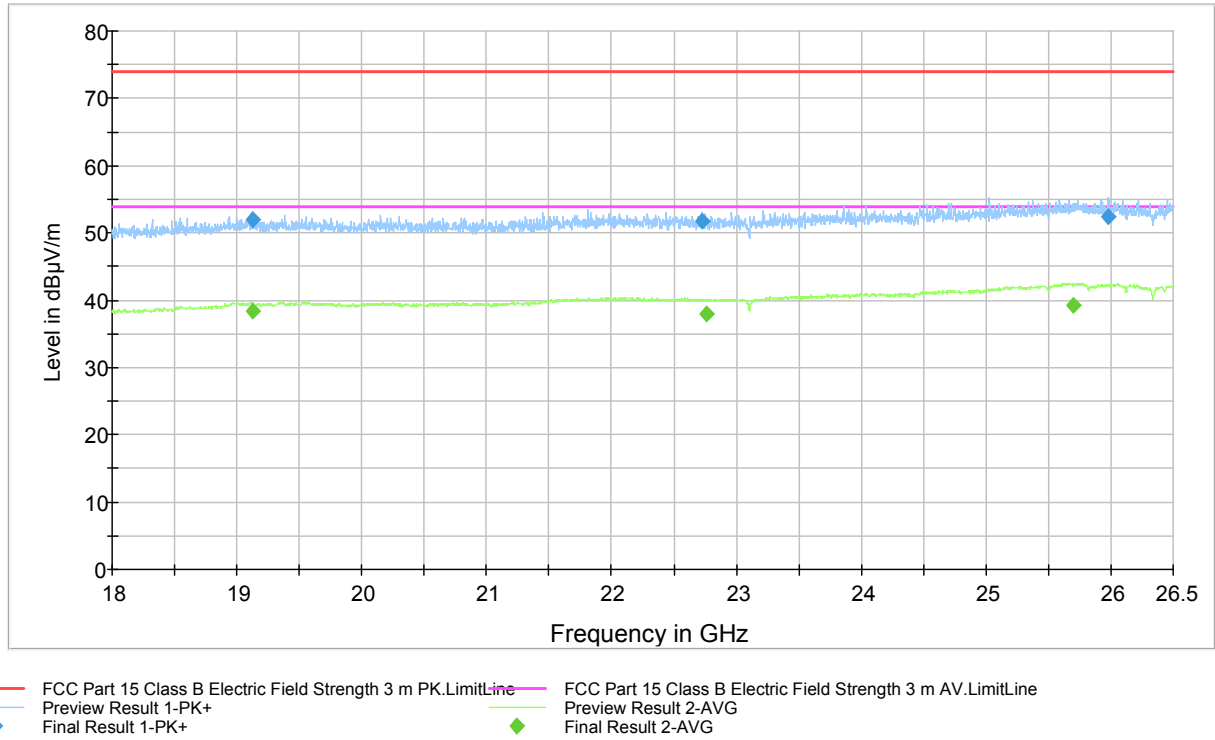
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19114.950000	51.8	1000.0	1000.000	112.0	V	0.0	23.7	22.1	73.9	
22066.150000	51.7	1000.0	1000.000	131.0	V	8.0	25.5	22.2	73.9	
26454.050000	52.1	1000.0	1000.000	150.0	V	-2.0	28.2	21.8	73.9	

**Table 16.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
18972.250000	38.1	1000.0	1000.000	100.0	V	8.0	23.5	15.8	53.9	
22033.750000	38.1	1000.0	1000.000	100.0	V	15.0	25.4	15.8	53.9	
25584.150000	38.9	1000.0	1000.000	100.0	V	22.0	27.8	15.0	53.9	

**Table 17.** Final Average results.

Copy of Radiated Emission FCC Part 15 Class B 18-26.5GHz at 3m



**Figure 14.** Measured curve with peak- and average detector. Channel MID.

**Final measurements from the worst frequencies**

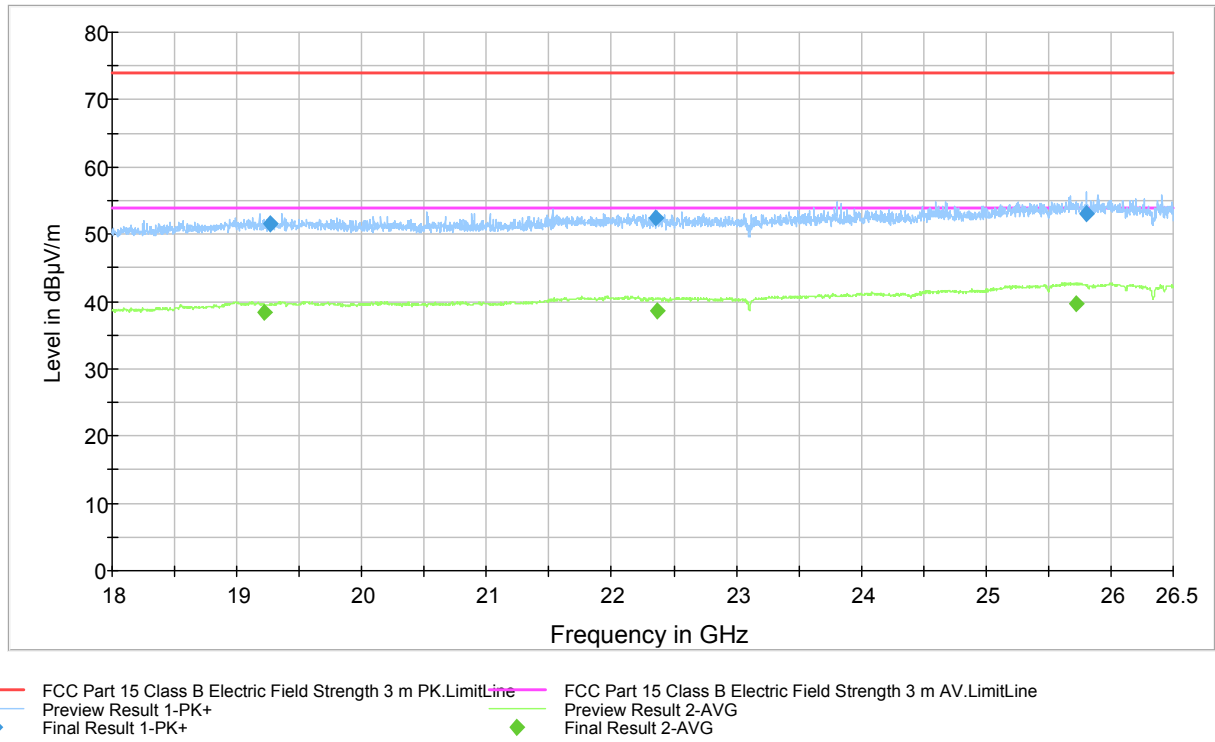
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19127.850000	51.9	1000.0	1000.000	100.0	V	10.0	23.7	22.0	73.9	
22727.150000	51.7	1000.0	1000.000	150.0	V	23.0	25.7	22.2	73.9	
25973.950000	52.4	1000.0	1000.000	115.0	V	22.0	28.0	21.5	73.9	

**Table 18.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19129.250000	38.3	1000.0	1000.000	100.0	V	-4.0	23.7	15.6	53.9	
22761.450000	37.9	1000.0	1000.000	109.0	V	20.0	25.7	16.0	53.9	
25702.950000	39.3	1000.0	1000.000	100.0	V	7.0	28.0	14.6	53.9	

**Table 19.** Final Average results.

Copy of Radiated Emission FCC Part 15 Class B 18-26.5GHz at 3m



**Figure 15.** Measured curve with peak- and average detector. Channel HIGH.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19267.050000	51.6	1000.0	1000.000	143.0	H	122.0	23.7	22.3	73.9	
22360.150000	52.4	1000.0	1000.000	109.0	V	11.0	25.6	21.5	73.9	
25800.650000	53.0	1000.0	1000.000	119.0	V	2.0	28.0	20.9	73.9	

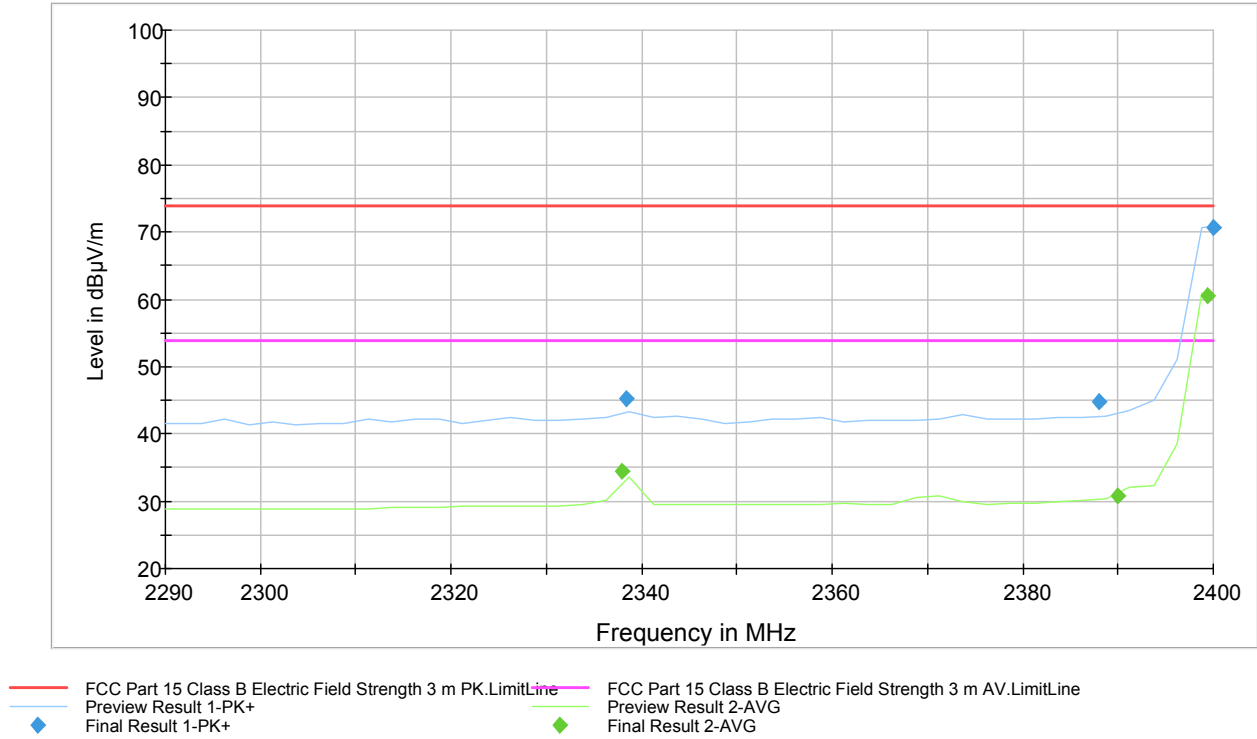
**Table 20.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19220.150000	38.3	1000.0	1000.000	105.0	V	0.0	23.7	15.6	53.9	
22367.050000	38.6	1000.0	1000.000	100.0	V	0.0	25.7	15.3	53.9	
25721.450000	39.6	1000.0	1000.000	100.0	V	-5.0	28.0	14.3	53.9	

**Table 21.** Final Average results.

**Radiated band edge measurement results**

Copy of Radiated Emission FCC Part 15 Class B 1-4GHz 3m



**Figure 16.** Measured curve with peak- and average detector. Lower band edge.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2338.350000	45.2	1000.0	1000.000	237.0	H	107.0	4.2	28.7	73.9	
2388.000000	44.7	1000.0	1000.000	244.0	H	282.0	4.4	29.2	73.9	
2400.000000	70.6	1000.0	1000.000	205.0	H	290.0	4.4	3.3	73.9	

**Table 22.** Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2337.950000	34.5	1000.0	1000.000	244.0	H	107.0	4.2	19.4	53.9	
2390.000000	30.7	1000.0	1000.000	204.0	H	290.0	4.4	23.2	53.9	
2399.400000	60.4	1000.0	1000.000	211.0	H	289.0	4.4	-6.5	53.9	

**Table 23.** Final Average results.



Copy of Radiated Emission FCC Part 15 Class B 1-4GHz 3m

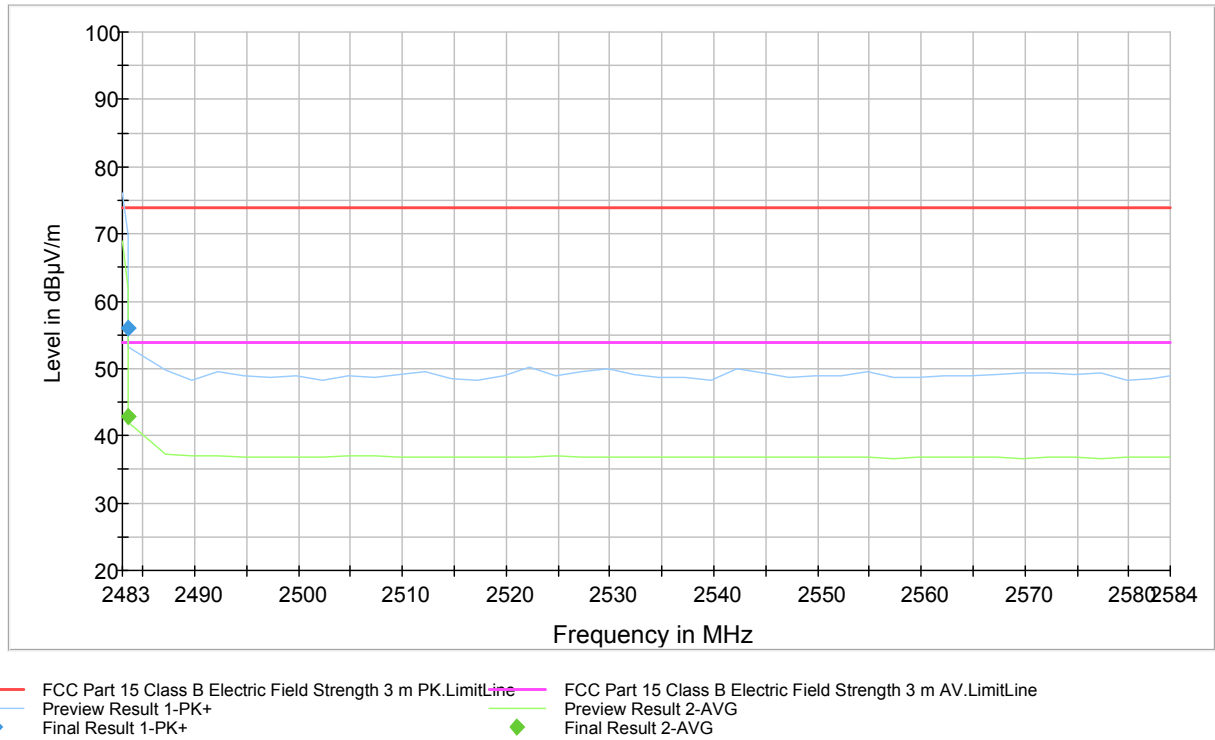


Figure 17. Measured curve with peak- and average detector. Upper band edge.

Final measurements from the worst frequencies

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2483.500000	55.9	1000.0	1000.000	113.0	H	73.0	4.7	18.0	73.9	
2861.650000	42.9	1000.0	1000.000	175.0	H	45.0	5.4	31.0	73.9	
3572.950000	43.1	1000.0	1000.000	198.0	H	251.0	6.8	30.8	73.9	

Table 24. Final Max Peak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2483.500000	42.8	1000.0	1000.000	113.0	H	73.0	4.7	11.1	53.9	
2866.450000	29.3	1000.0	1000.000	100.0	H	58.0	5.4	24.6	53.9	
3574.950000	29.7	1000.0	1000.000	196.0	H	228.0	6.9	24.2	53.9	

Table 25. Final Average results.

## Transmitter Band Edge Measurement and Conducted Spurious Emissions

<b>Standard:</b>	ANSI C63.10	(2009)
<b>Tested by:</b>	JJM	
<b>Date:</b>	27.5.2011	
<b>Humidity:</b>	30 %	
<b>Temperature:</b>	23 °C	
<b>Measurement uncertainty</b>	± 2.87 dB	Level of confidence 95 % (k = 2)

### FCC Rule: 15.247(d), 15.209(a)

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

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-31.03 dBc	-50.14 dBc
<b>Limit: -20dBc</b>	

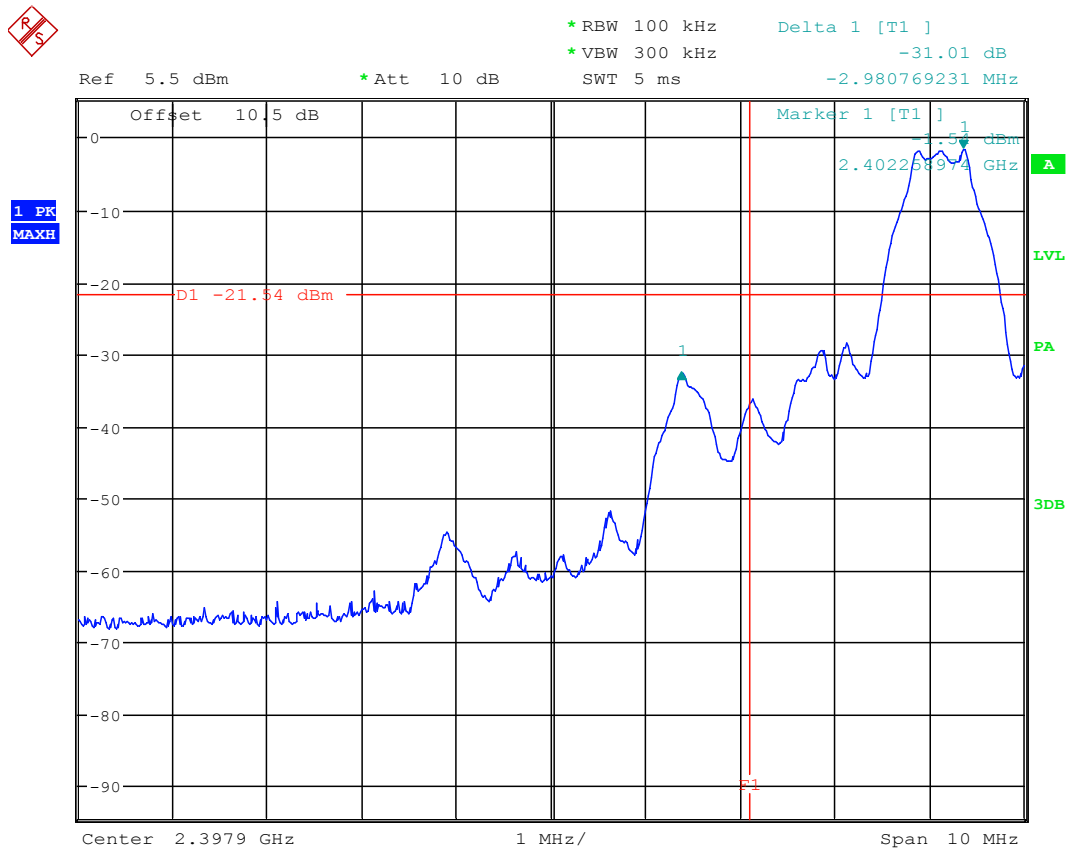
**Table 26.** Band edge attenuation.

Conducted Spurious Emissions				
Channel	Measured Attenuation [dB]	Limit [dBc]	Margin [dB]	Result
Low	-	-20.0	-	-
Mid	-	-20.0	-	-
High	-	-20.0	-	-

**Table 27.** Conducted spurious emissions.

**No significant emissions were detected close to the limit.**

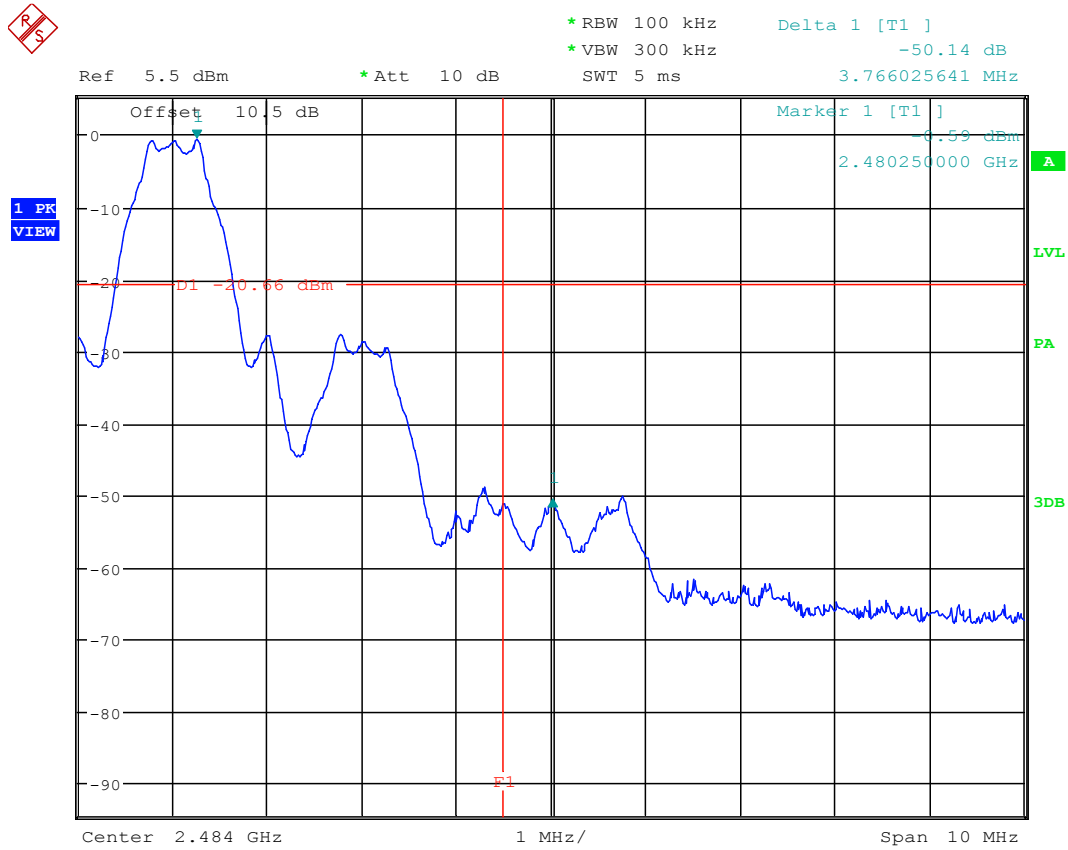
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 12:03:33

**Figure 18.** Lower Band Edge.

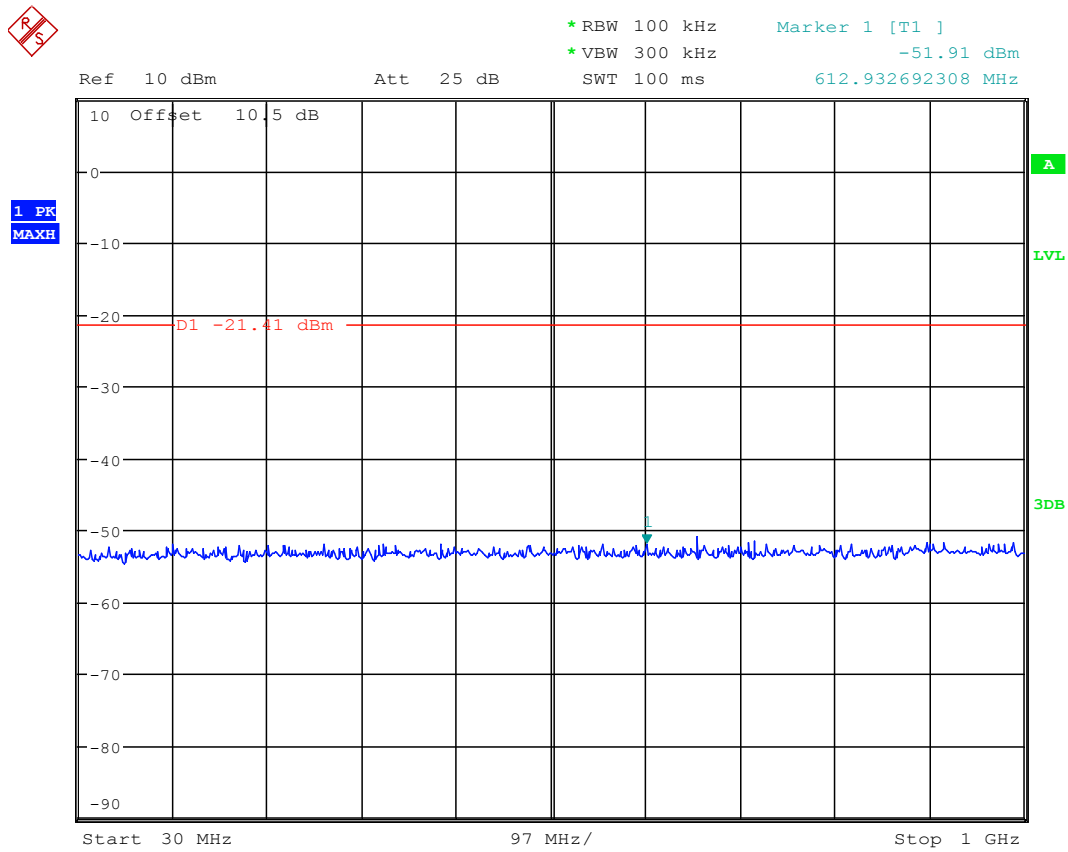
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 12:00:41

**Figure 19.** Upper Band Edge.

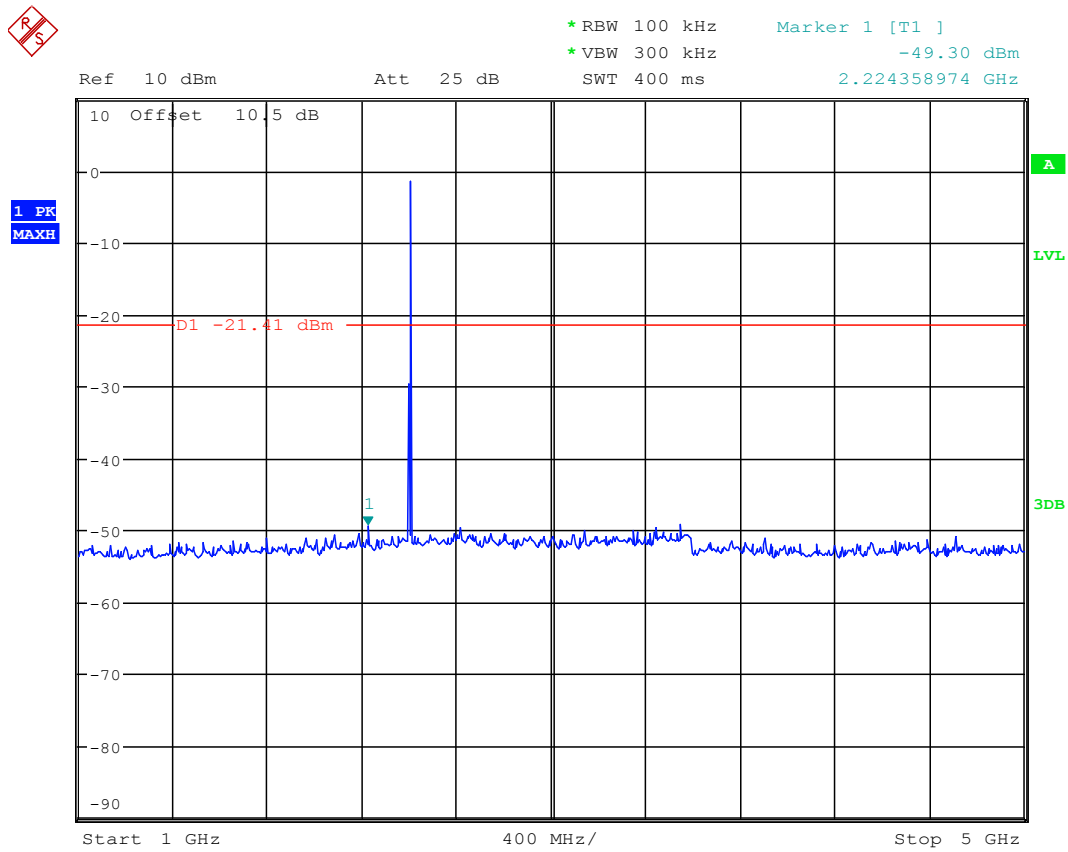
**20dB Bandwidth of the Hopping Channel**



Date: 27.MAY.2011 08:34:23

**Figure 20.** Conducted Spurious Emissions 30 – 1 000 MHz. Channel LOW.

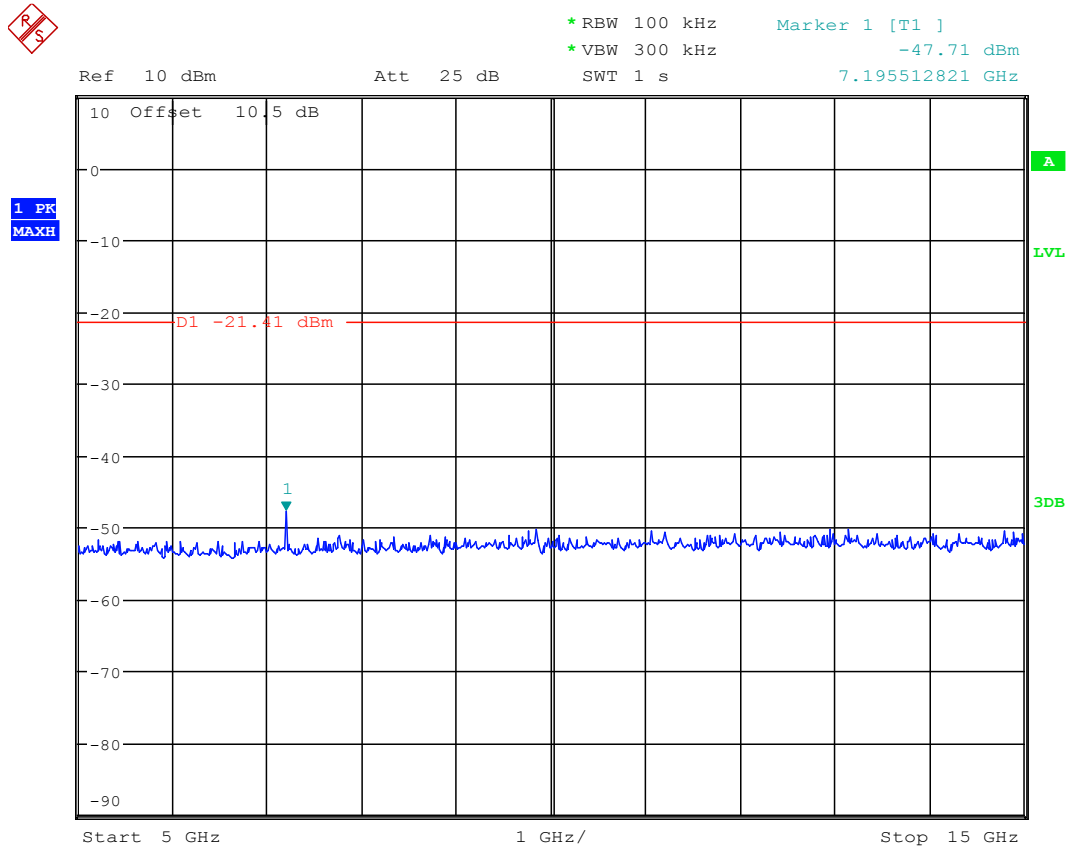
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:36:19

**Figure 21.** Conducted Spurious Emissions 1 000 – 5 000 MHz. Channel LOW.

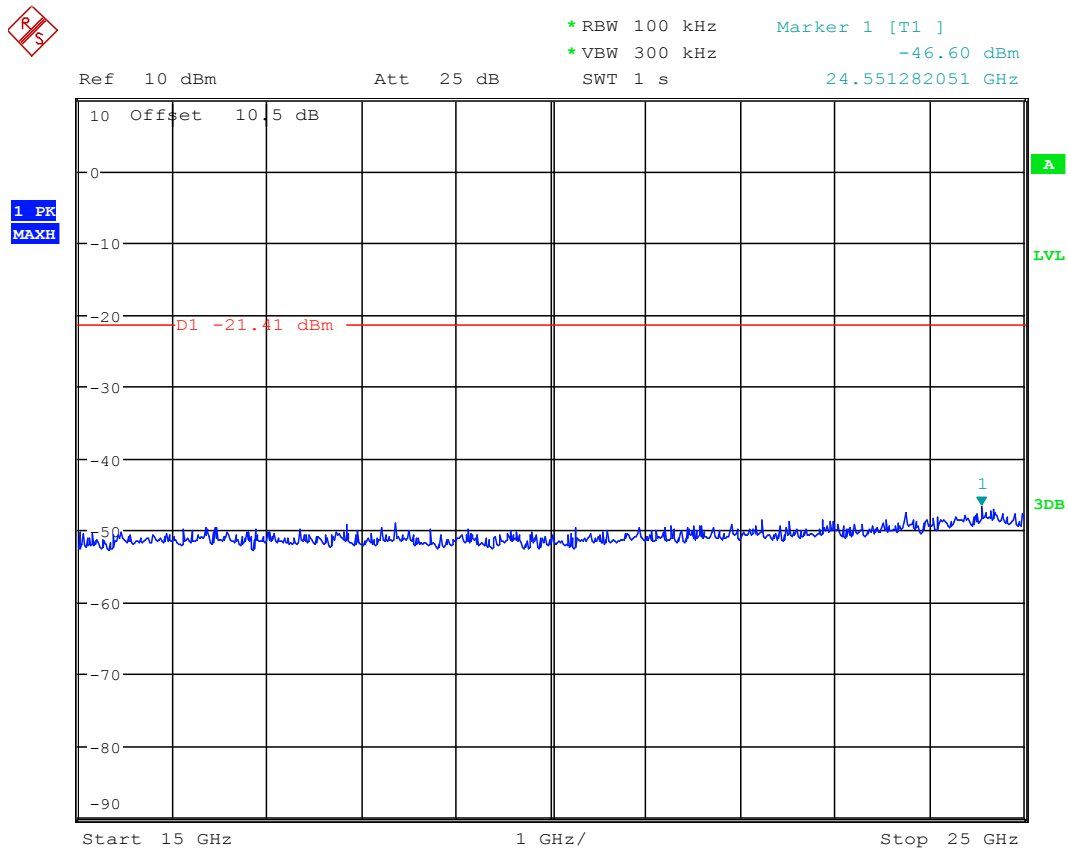
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:37:13

**Figure 22.** Conducted Spurious Emissions 5 000 – 15 000 MHz. Channel LOW.

## 20dB Bandwidth of the Hopping Channel

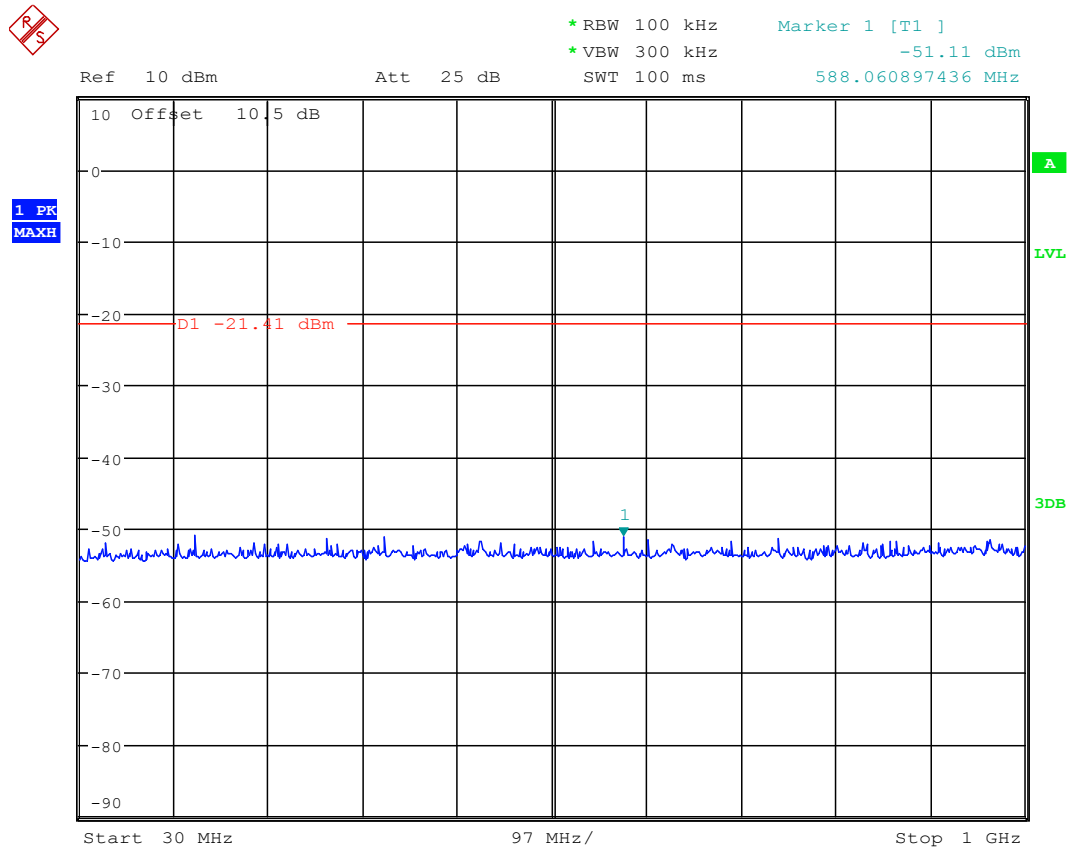


Date: 27.MAY.2011 08:37:42

**Figure 23.** Conducted Spurious Emissions 15 000 – 25 000 MHz. Channel LOW.



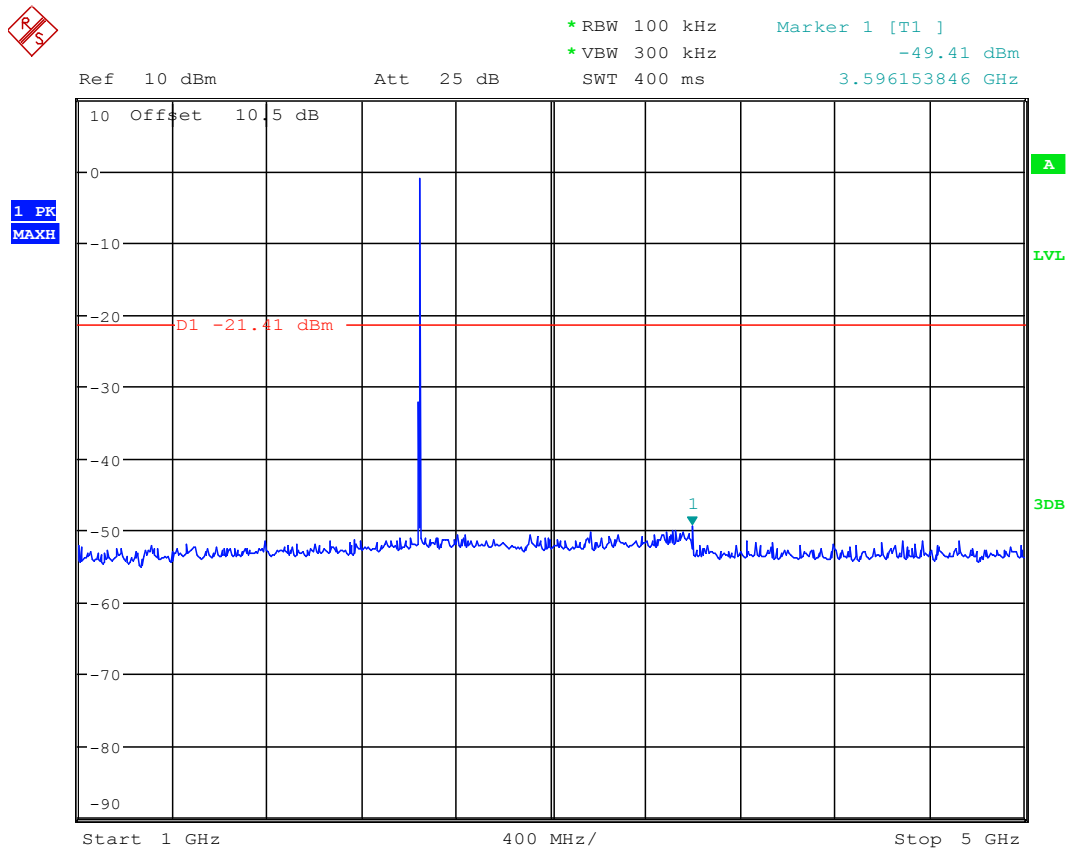
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:41:36

**Figure 24.** Conducted Spurious Emissions 30 – 1 000 MHz. Channel MID.

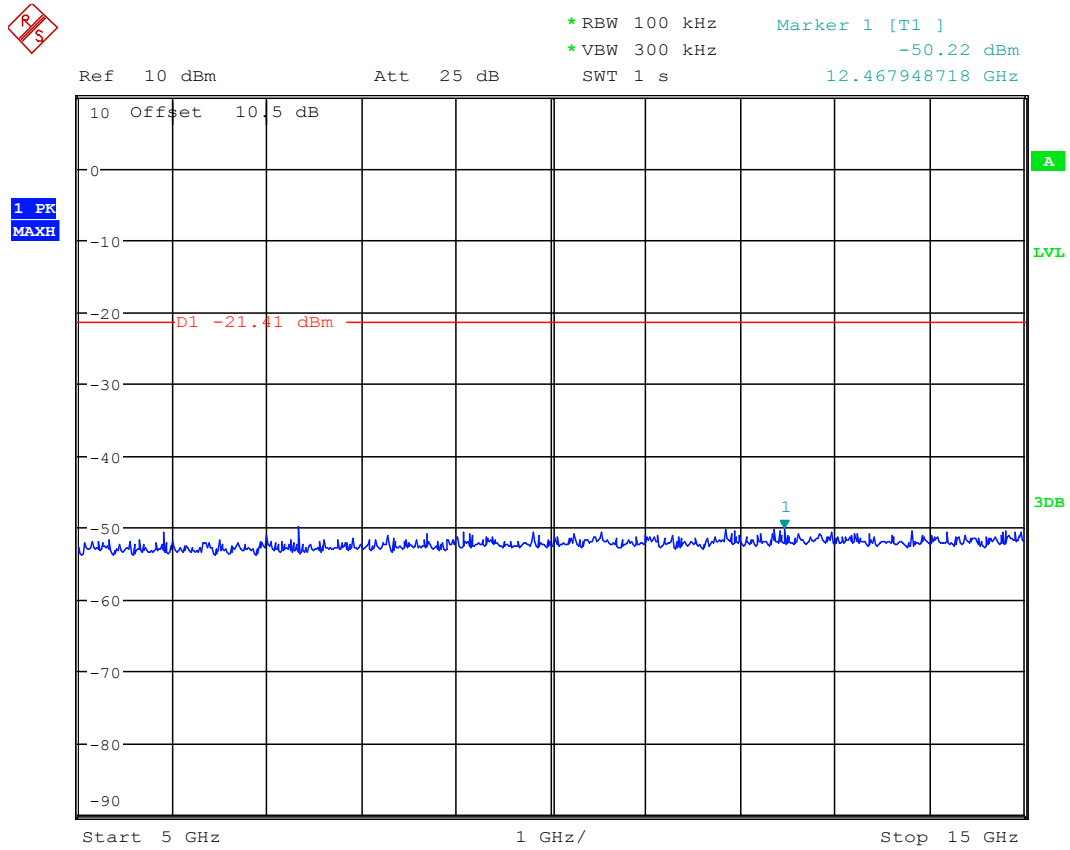
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:42:17

**Figure 25.** Conducted Spurious Emissions 1 000 – 5 000 MHz. Channel MID.

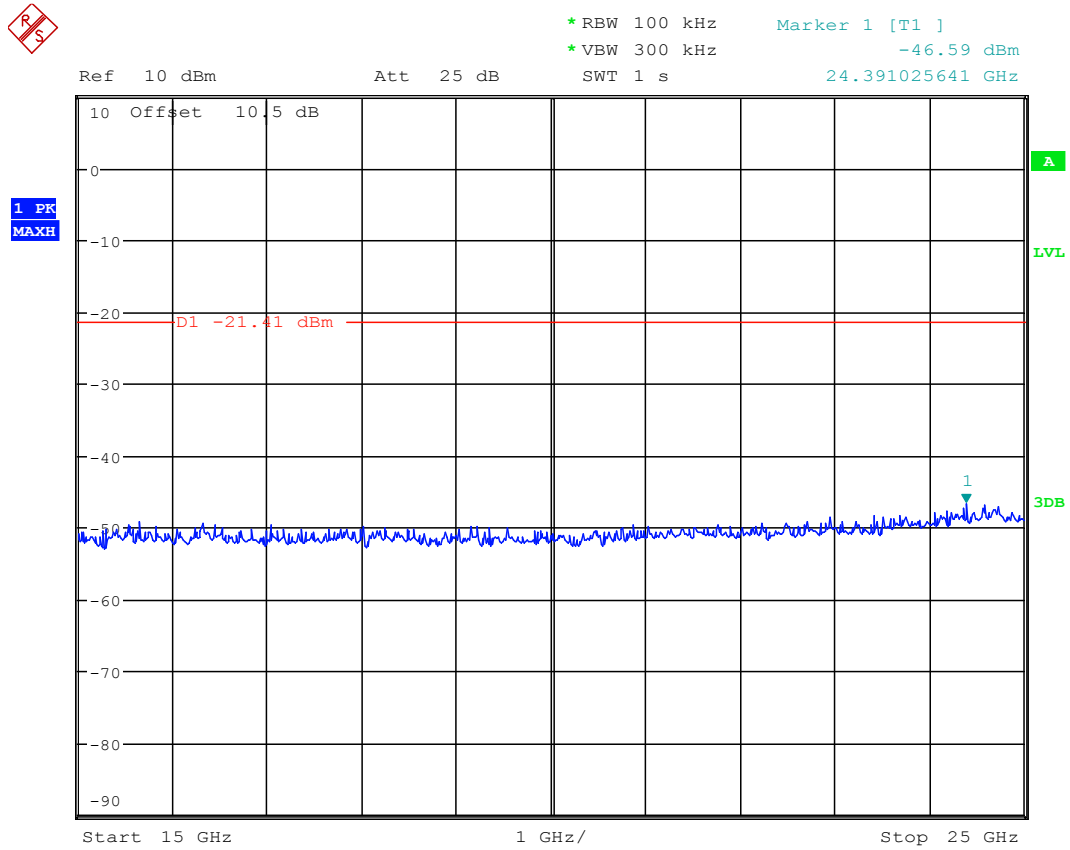
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:43:48

**Figure 26.** Conducted Spurious Emissions 5 000 – 15 000 MHz. Channel MID.

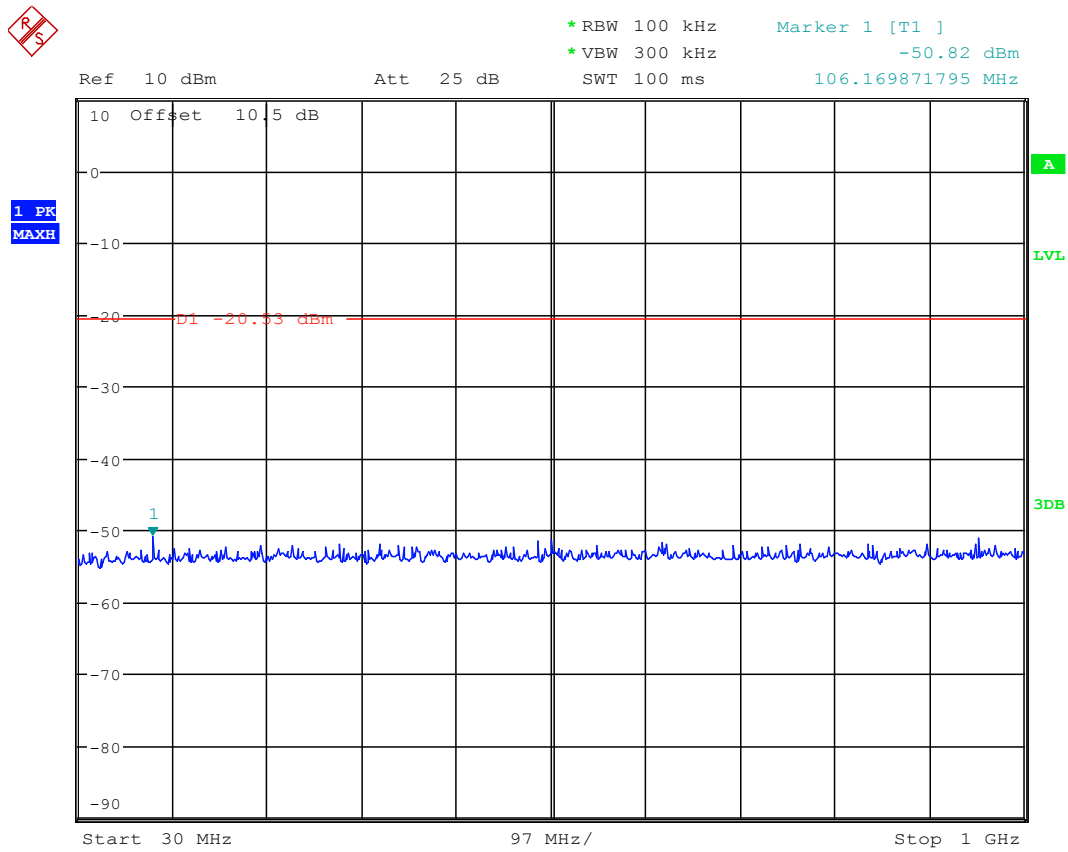
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:44:13

**Figure 27.** Conducted Spurious Emissions 15 000 – 25 000 MHz. Channel MID.

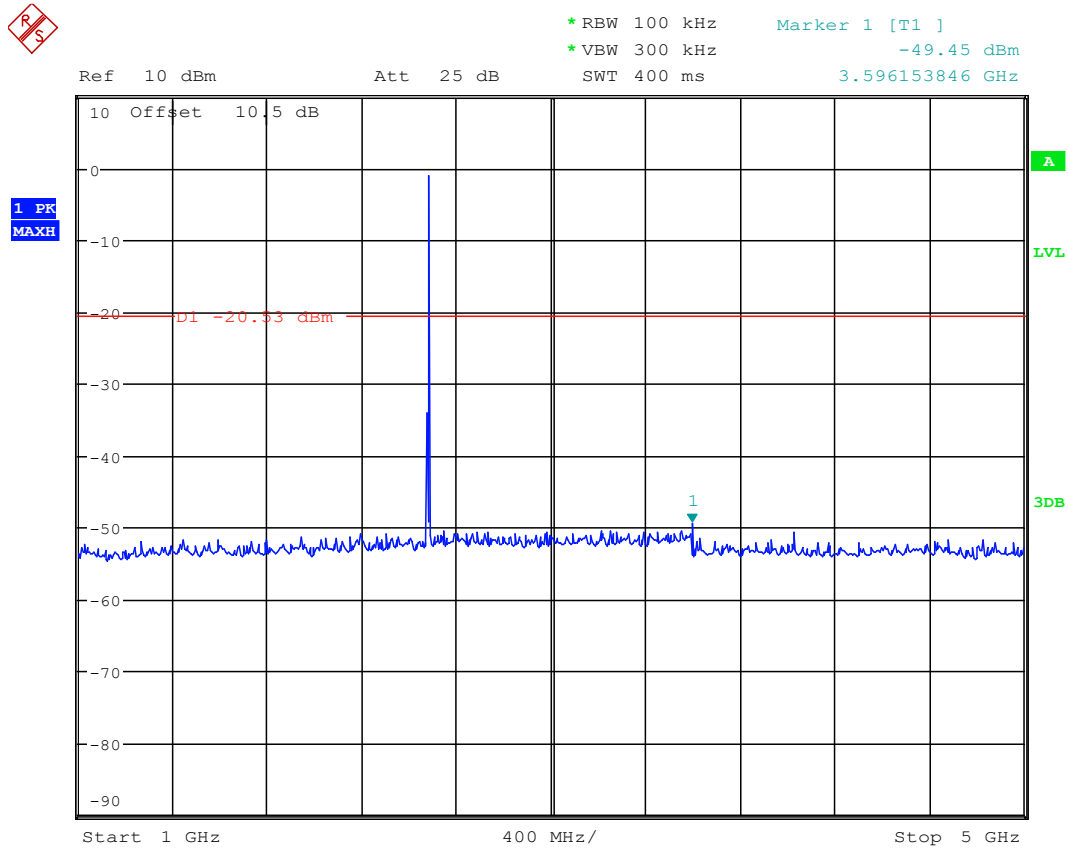
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:45:43

**Figure 28.** Conducted Spurious Emissions 30 – 1 000 MHz. Channel HIGH.

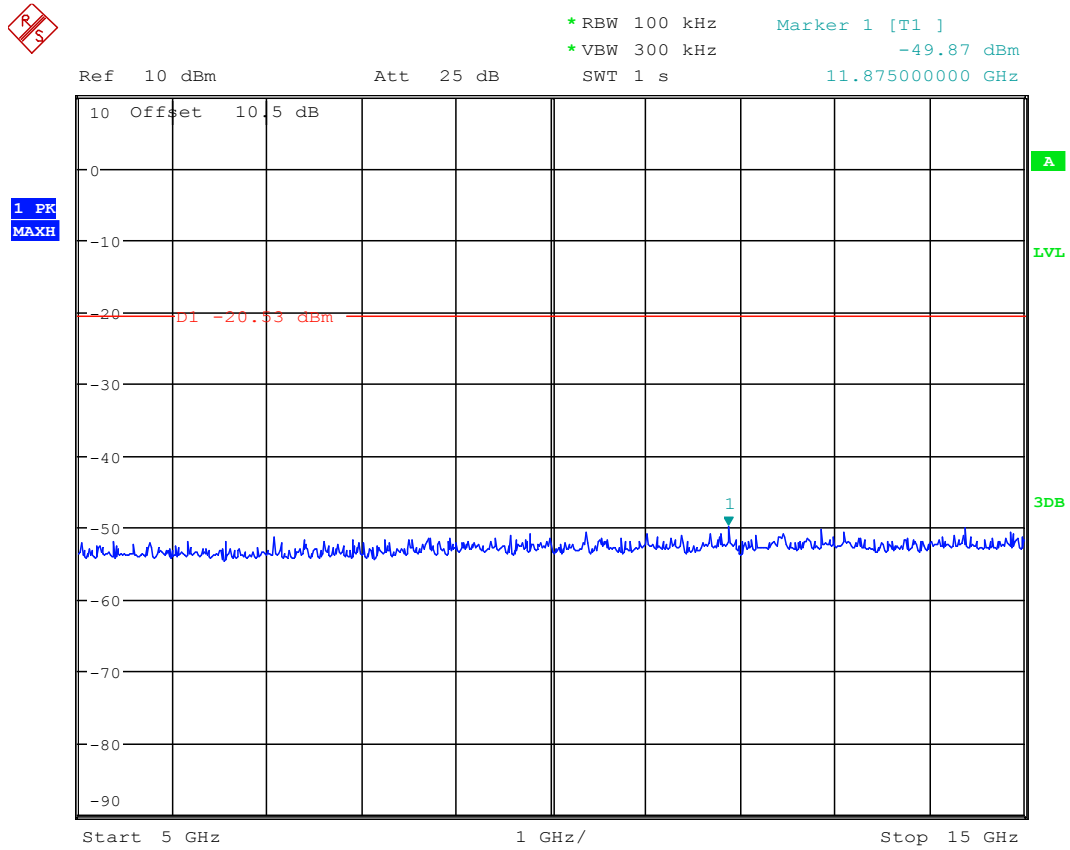
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:46:30

**Figure 29.** Conducted Spurious Emissions 1 000 – 5 000 MHz. Channel HIGH.

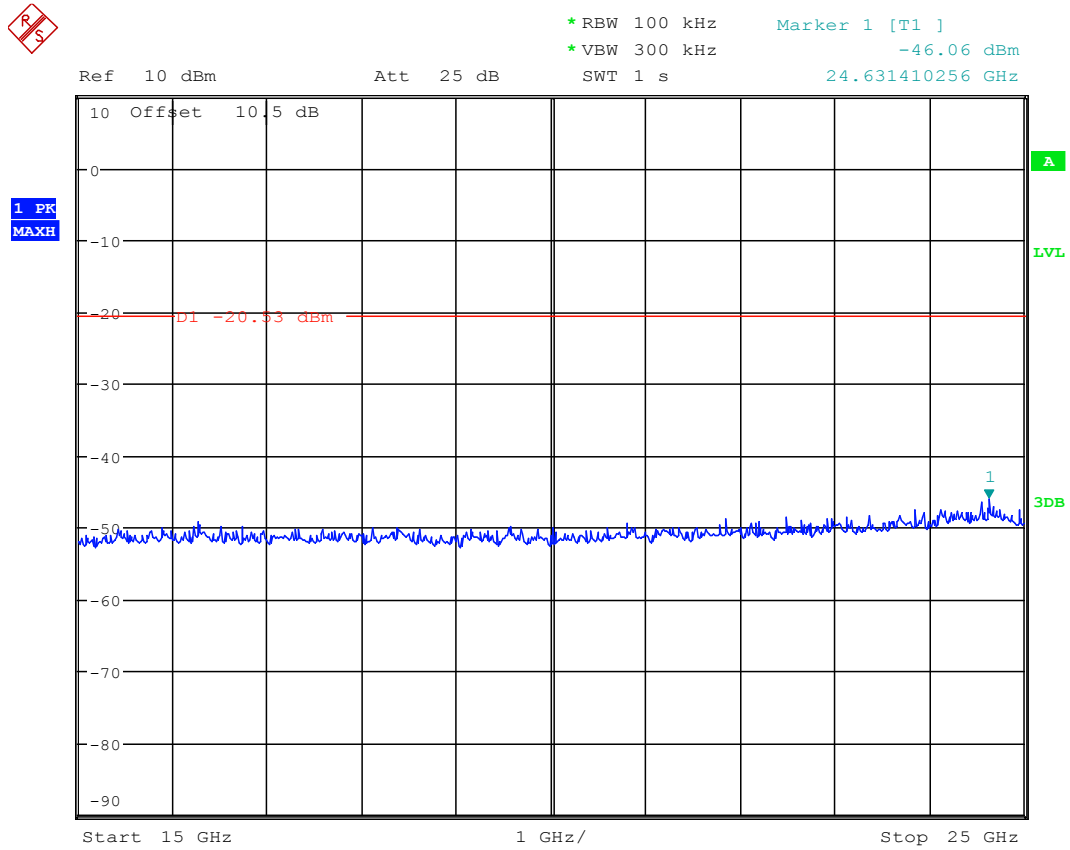
## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:47:06

**Figure 30.** Conducted Spurious Emissions 10 000 – 15 000 MHz. Channel HIGH.

## 20dB Bandwidth of the Hopping Channel



Date: 27.MAY.2011 08:47:43

**Figure 31.** Conducted Spurious Emissions 15 000 – 25 000 MHz. Channel HIGH.



## 6 dB Bandwidth of the Channel

**Standard:** ANSI C63.10 (2009)  
**Tested by:** NTO  
**Date:** 12.7.2011  
**Humidity:** 56 %  
**Temperature:** 22 °C

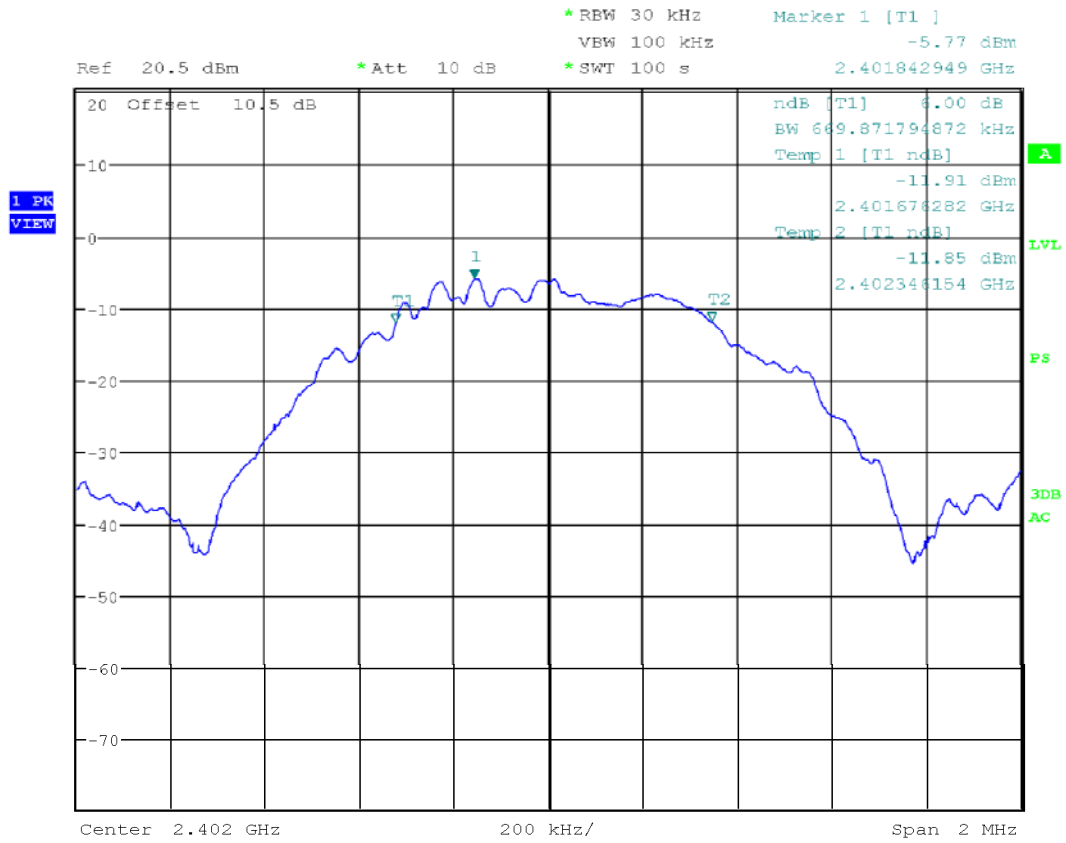
**FCC Rule: 15.247(a)(2)**  
**RSS-210 A8.2**

**Results:**

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	669.872	500
Mid	669.872	
High	673.077	

**Table 28.** 6 dB bandwidth test results.

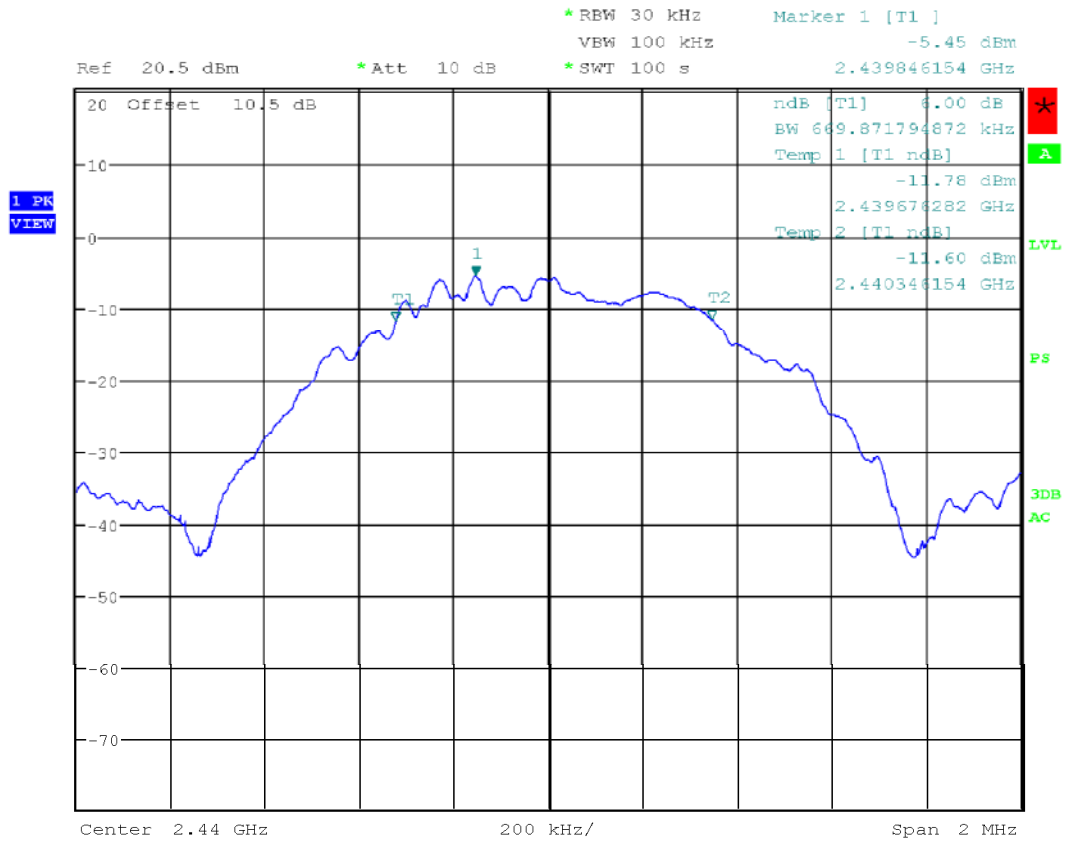
## 6 dB Bandwidth of the Channel



Date: 12.JUL.2011 09:23:22

**Figure 32.** 6 dB bandwidth of the channel LOW.

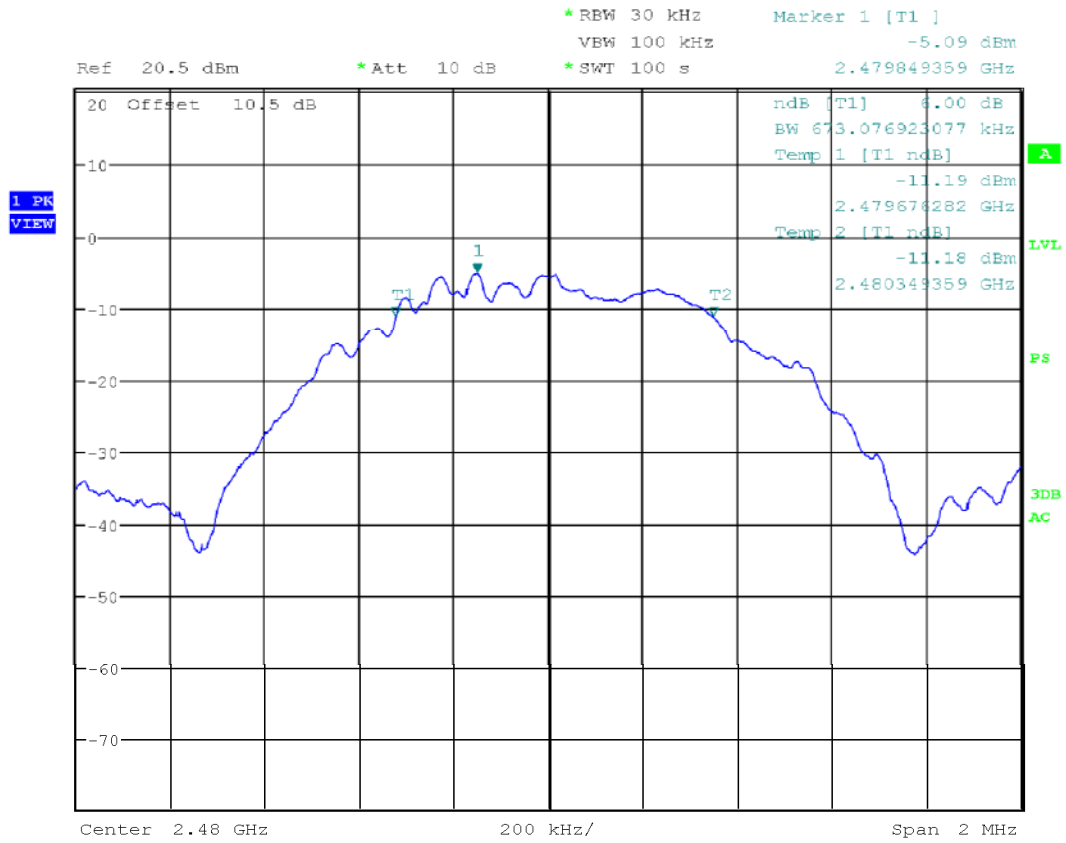
## 6 dB Bandwidth of the Channel



Date: 12.JUL.2011 09:28:15

**Figure 33.** 6 dB bandwidth of the channel MID.

## 6 dB Bandwidth of the Channel



Date: 12.JUL.2011 09:40:17

**Figure 34.** 6 dB bandwidth of the channel HIGH.

**Power Spectral Density**

**Standard:** ANSI C63.10 (2009)  
**Tested by:** NTO  
**Date:** 12.7.2011  
**Humidity:** 56 %  
**Temperature:** 22 °C

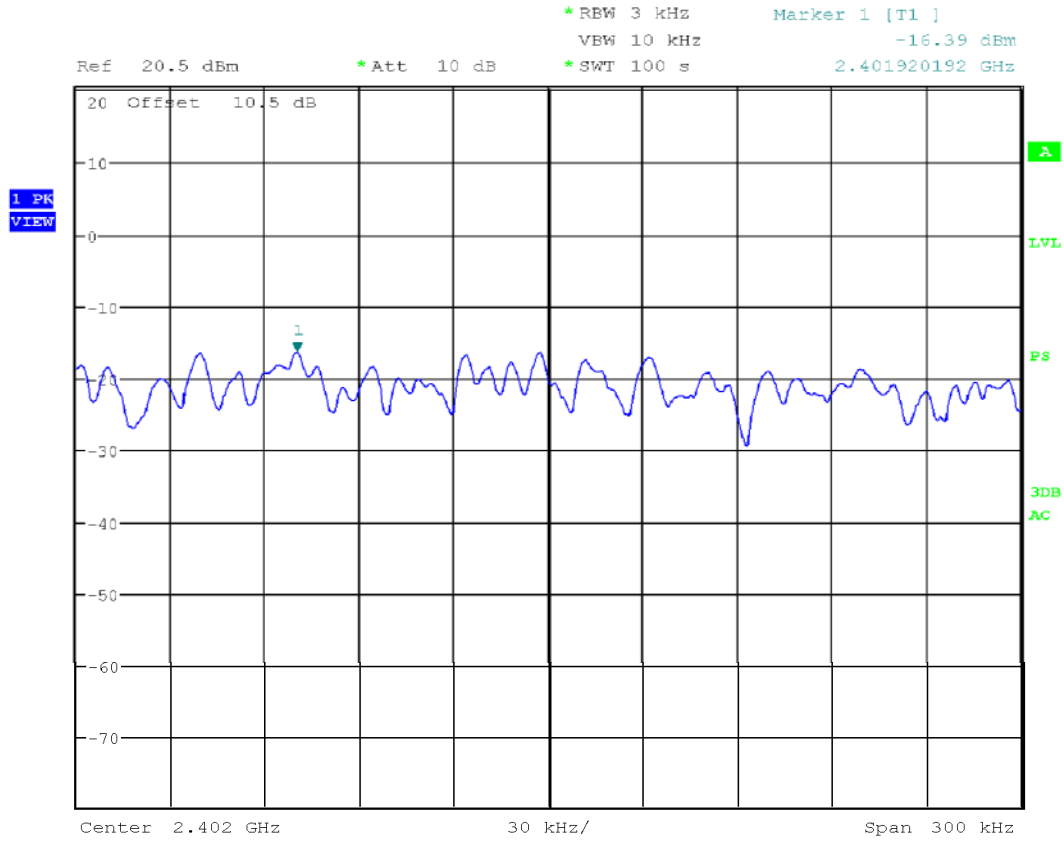
**FCC Rule: 15.247(e)**  
**RSS-210 A8.2**

**Results:**

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	-16.39	+8.00
Mid	-16.09	
High	-15.57	

**Table 29.** Power Spectral Density test results.

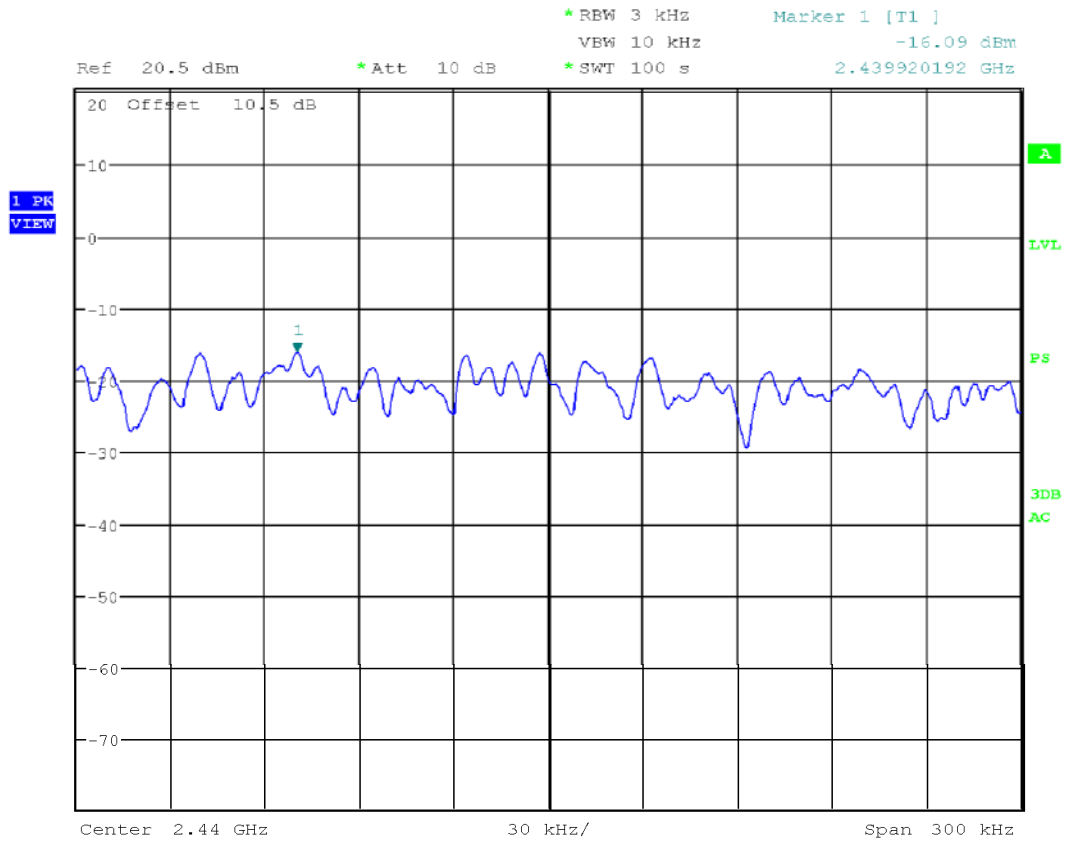
## Power Spectral Density



Date: 12.JUL.2011 10:24:25

**Figure 35.** Power Spectral Density of the channel LOW.

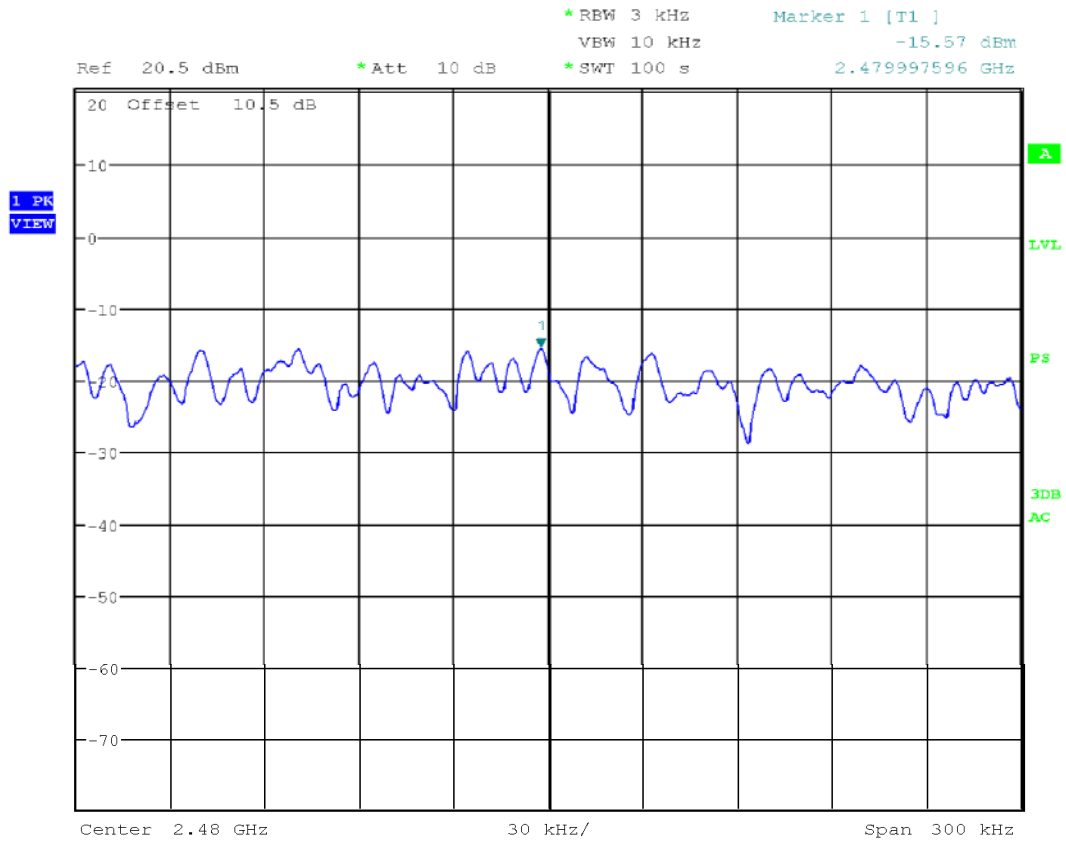
## Power Spectral Density



Date: 12.JUL.2011 10:28:46

**Figure 36.** Power Spectral Density of the channel MID.

## Power Spectral Density



Date: 12.JUL.2011 10:35:58

**Figure 37.** Power Spectral Density of the channel HIGH.



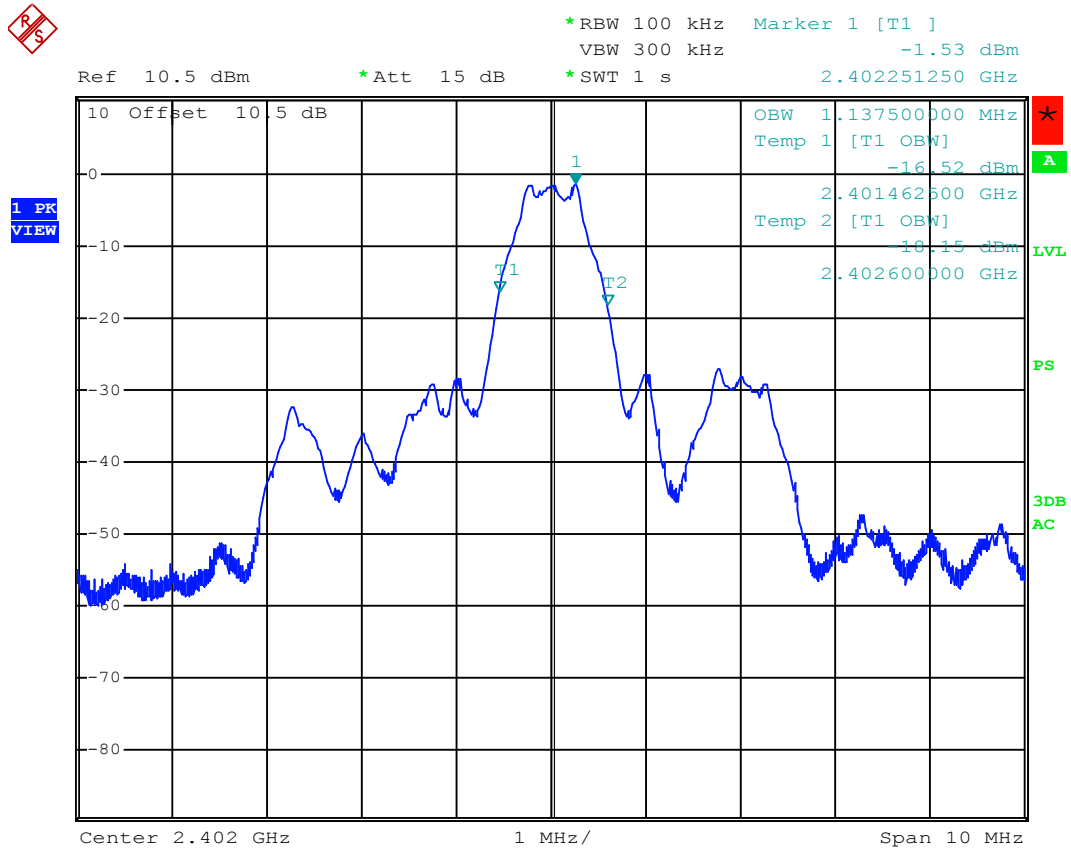
## 99% Occupied Bandwidth

**Standard:** RSS-GEN (2007)  
**Tested by:** JJM  
**Date:** 30.6.2011  
**Humidity:** 51 %  
**Temperature:** 20 °C

### RSS-GEN 4.7

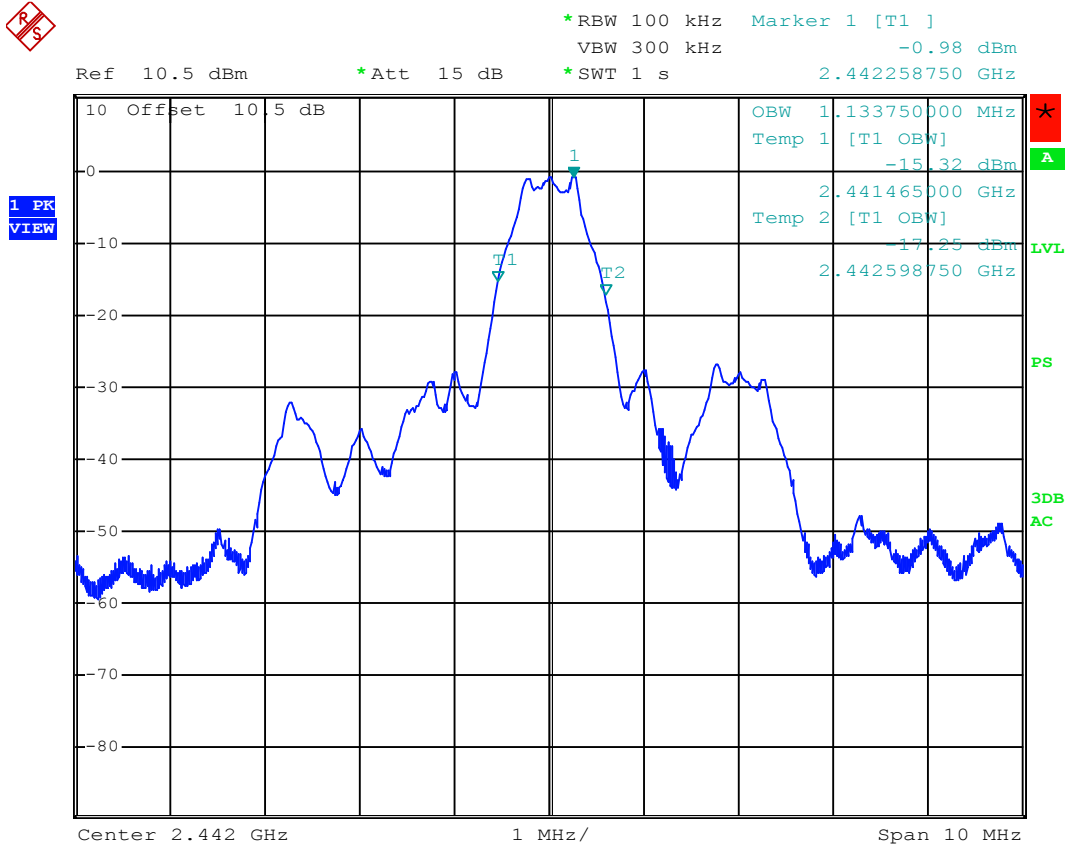
Channel	Limit	99 % BW [MHz]	Result
Low	-	1.13750	PASS
Mid	-	1.13375	PASS
High	-	1.12000	PASS

**Table 30.** 99 % OBW test results.



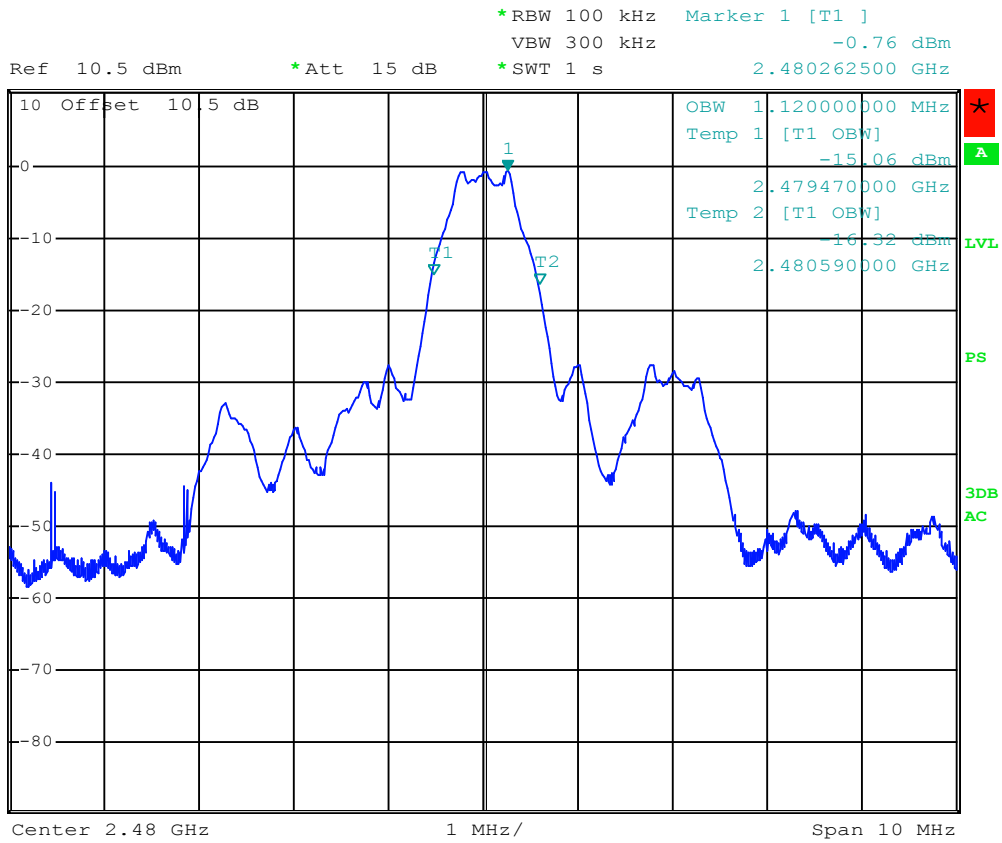
Date: 30.JUN.2011 07:51:49

**Figure 38.** 99 % OBW. Channel low.



Date: 30.JUN.2011 07:56:13

**Figure 39.** 99 % OBW. Channel mid.



Date: 30.JUN.2011 08:10:16

**Figure 40.** 99 % OBW. Channel high.

### Receiver Radiated Emissions 30 – 26 500 MHz

**Standard:** ANSI C63.10 (2009)  
**Tested by:** JJM  
**Date:** 30.5.2011  
**Humidity:** 37 %  
**Temperature:** 21.0 °C  
**Measurement uncertainty** ± 4.51 dB Level of confidence 95 % (k = 2)

#### FCC Rule: 15.109

The EUT was in a receiving mode and measurement was performed on middle channel only.  
 The correction factor in the final result table contains the sum of the transducers (antenna + amplifier + cables).  
 The QuasiPeak value is the measured value corrected with the correction factor.

#### Measured Peak Values In The Frequency Range 30 MHz - 1000 MHz.

FCC Part 15 Class B Electric Field Strength

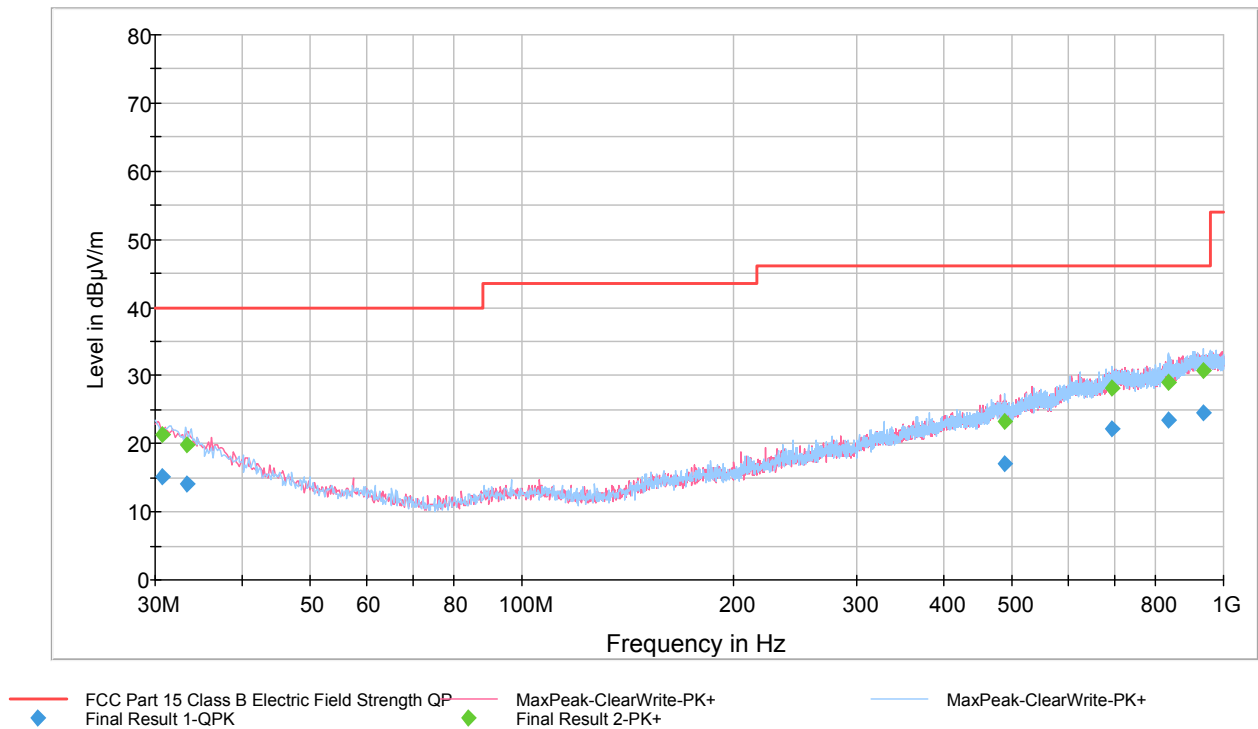


Figure 41. Measured curve with peak-detector.

#### Final measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
30.680000	15.1	15000.0	120.000	371.0	H	272.0	18.8	24.9	40.0	
33.352500	14.0	15000.0	120.000	130.0	H	105.0	17.2	26.0	40.0	
488.153750	17.2	15000.0	120.000	250.0	H	91.0	21.6	28.8	46.0	
694.393750	22.1	15000.0	120.000	338.0	H	26.0	25.5	23.9	46.0	
833.980000	23.4	15000.0	120.000	100.0	H	255.0	26.9	22.6	46.0	
934.303750	24.5	15000.0	120.000	100.0	H	-14.0	28.1	21.5	46.0	

Table 31. Final results.

Measured Peak Values In The Frequency Range 1 000 MHz – 18 000 MHz.

Copy of Radiated Emission FCC Part 15 Class B 1-18GHz 3m

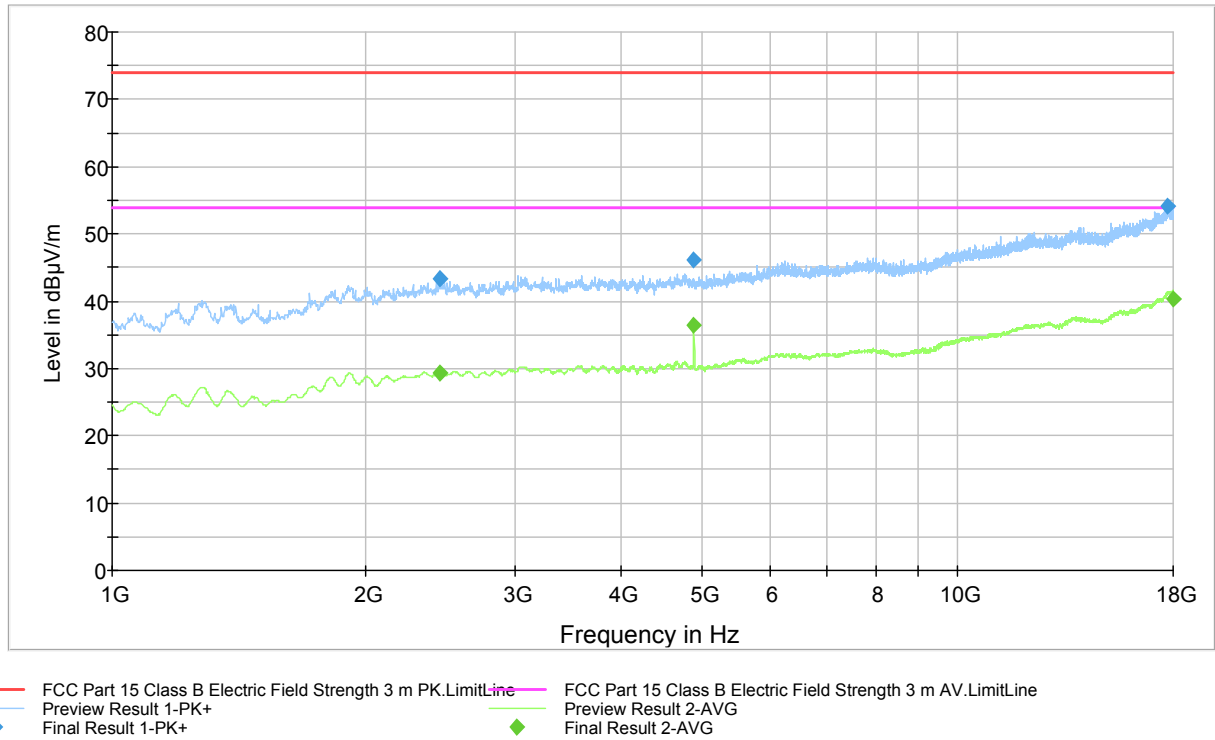


Figure 42. Measured curve with peak-and average detector.

Final measurements from the worst frequencies

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2440.850000	43.4	1000.0	1000.000	119.0	H	190.0	4.6	30.5	73.9	
4882.050000	46.1	1000.0	1000.000	206.0	V	90.0	9.7	27.8	73.9	
17749.950000	54.2	1000.0	1000.000	109.0	V	215.0	24.8	19.7	73.9	

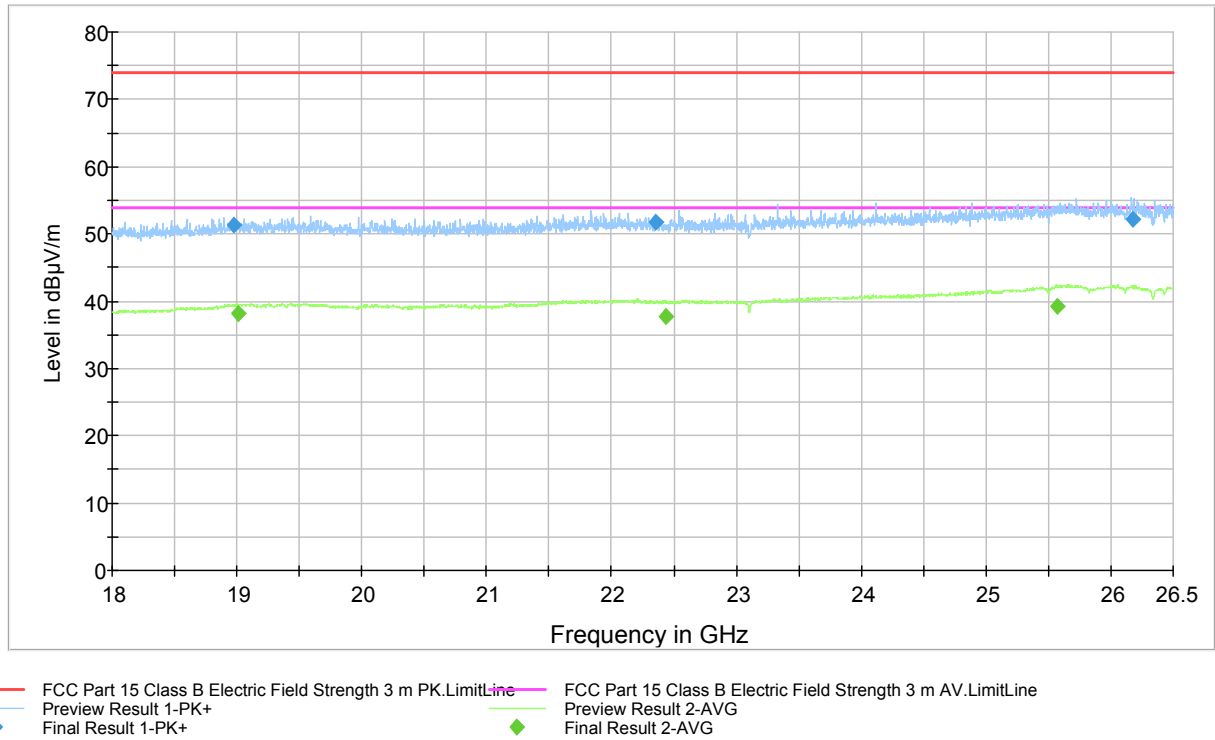
Table 32. Final MaxPeak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2440.850000	29.3	1000.0	1000.000	121.0	H	206.0	4.6	24.6	53.9	
4882.050000	36.3	1000.0	1000.000	207.0	V	89.0	9.7	17.6	53.9	
17967.050000	40.3	1000.0	1000.000	140.0	V	15.0	25.2	13.6	53.9	

Table 33. Final Average results.

**Measured Peak Values In The Frequency Range 18 000 MHz – 26 500 MHz.**

Copy of Radiated Emission FCC Part 15 Class B 18-26.5GHz at 3m



**Figure 43.** Measured curve with peak-and average detector.

**Final measurements from the worst frequencies**

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
18975.150000	51.4	1000.0	1000.000	108.0	V	13.0	23.5	22.5	73.9	
22353.850000	51.8	1000.0	1000.000	136.0	V	15.0	25.6	22.1	73.9	
26171.750000	52.2	1000.0	1000.000	122.0	V	1.0	28.1	21.7	73.9	

**Table 34.** Final MaxPeak results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19006.450000	38.2	1000.0	1000.000	100.0	V	20.0	23.6	15.7	53.9	
22439.050000	37.8	1000.0	1000.000	100.0	V	-2.0	25.7	16.1	53.9	
25567.750000	39.2	1000.0	1000.000	117.0	V	3.0	27.8	14.7	53.9	

**Table 35.** Final Average results.

## Conducted emissions

**Standard:** ANSI C63.10 (2009)  
**Tested by:** JJM  
**Date:** 29.6.2011  
**Humidity:** 49 %  
**Temperature:** 24 °C  
**Measurement uncertainty** ± 2,87 dB Level of confidence 95 % (k = 2)

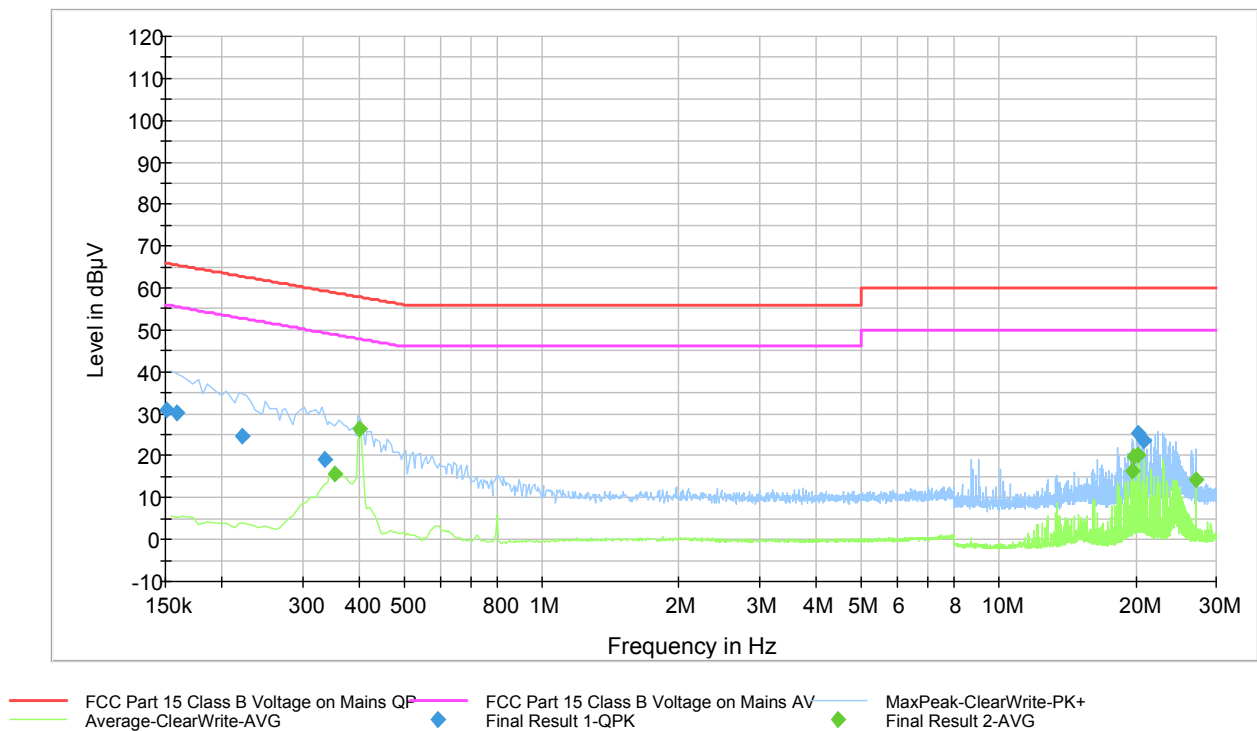
### FCC Rule: 15.207

Conducted disturbance voltage was measured with an artificial main network from 150 kHz to 30 MHz with 4.5 kHz steps and a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors.

During the test the EUT was powered from the separate AC / DC power supply which was connected to the LISN. The supply voltage through the LISN to the power supply was 115 VAC / 60 Hz.

### Test results

FCC Part 15 Class B Voltage on Mains 2-Line-LISN



**Figure 44.** The measured curves with peak- and average-detectors



**Final measurements from the worst frequencies**

Frequency (MHz)	QuasiPeak (dB $\mu$ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dB $\mu$ V)	Comment
0.151501	31.0	15000.0	9.000	GN	L1	10.2	34.9	65.9	
0.159001	30.2	15000.0	9.000	GN	N	10.1	35.3	65.5	
0.220501	24.6	15000.0	9.000	GN	N	10.1	38.2	62.8	
0.334501	19.0	15000.0	9.000	GN	L1	10.2	40.3	59.3	
20.259001	25.4	15000.0	9.000	GN	L1	11.6	34.6	60.0	
20.808001	23.7	15000.0	9.000	GN	L1	11.6	36.3	60.0	

**Table 36.** Final quasi-peak measurements from the worst frequencies

Frequency (MHz)	Average (dB $\mu$ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dB $\mu$ V)	Comment
0.352501	15.6	15000.0	9.000	GN	N	10.1	33.3	48.9	
0.399001	26.2	15000.0	9.000	GN	L1	10.2	21.7	47.9	
19.587001	16.4	15000.0	9.000	GN	L1	11.6	33.6	50.0	
19.708501	19.8	15000.0	9.000	GN	L1	11.6	30.2	50.0	
20.259001	20.0	15000.0	9.000	GN	L1	11.6	30.0	50.0	
27.045001	14.2	15000.0	9.000	GN	L1	11.9	35.8	50.0	

**Table 37.** Final average measurements from the worst frequencies

The correction factor in the final result tables contains the sum of the transducers (cables + transient limiter + LISN).

The QuasiPeak and Average values are the measured values corrected with the correction factor.

**List of test equipments**

<b>Manufacturer</b>	<b>Type</b>	<b>Serial no</b>	<b>Inv. no</b>
<b>ROHDE &amp; SCHWARZ</b>			
EMI Test receiver	ESCI 3	100885	8264
EMI Test receiver	ESU 26	100185	8453
Test software	EMC32	Ver. 8.30.0	-
LISN	ESH2-Z5		4126
Transient limiter	ESH3-Z2		
<b>DAVIS</b>			
Weather station	Vantage Pro	-	5297
<b>EMCO</b>			
Antenna (1 - 18 GHz)	3117	29617	7293
<b>CHASE</b>			
Antenna (30 MHz - 1 GHz)	6141A	4102	7895
<b>HEWLETT- PACKARD</b>			
Microwave amplifier	83017A	-	5226
<b>HUBER-+ SUHNER</b>			
Attenuator 10dB	6810.17B	-	-
<b>DEISEL</b>			
Antenna mast	MA 240 T	240/394/96	5017
Tilt option	KE 220	220/307/96	-
Controller	HD 100	100/413/96	5018
Turntable	DS 420	420/420/96	5015
<b>WAINWRIGHT</b>			
High Pass Filter	WHKX	10	8267