Test Report

FINAS
Finnish Accreditation Service
T004 (EN ISO/IEC 17025)

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

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

Date: 17.08.2011

Issued by:

Jari Merikari
Technical Manager

Date: 17.08.2011

Checked by:

Ari Honkala
Product Line Manager

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Equipment Under Test (EUT)

Bluetooth module	
Model:	BLE112-E
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	☐
Mobile Device (Human body distance > 20cm)	☒
Portable Device (Human body distance < 20cm)	☐

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:	2.59 dBm
Transmission technique:	Digital Transmission
Modulation:	GFSK
Antenna connector type	RF pin 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

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

☐ Testing Location / address: FCC registration number: **90598**	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
☒ Testing Location / address: FCC registration number: **178986** Industry Canada registration number: **8708A-2**	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

Maximum Peak Conducted Output Power

Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	25.5.2011	
Humidity:	22 %	
Temperature:	35 °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	1.94	30	28.06	PASS
Mid	2.44	30	27.56	PASS
High	2.59	30	27.41	PASS

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

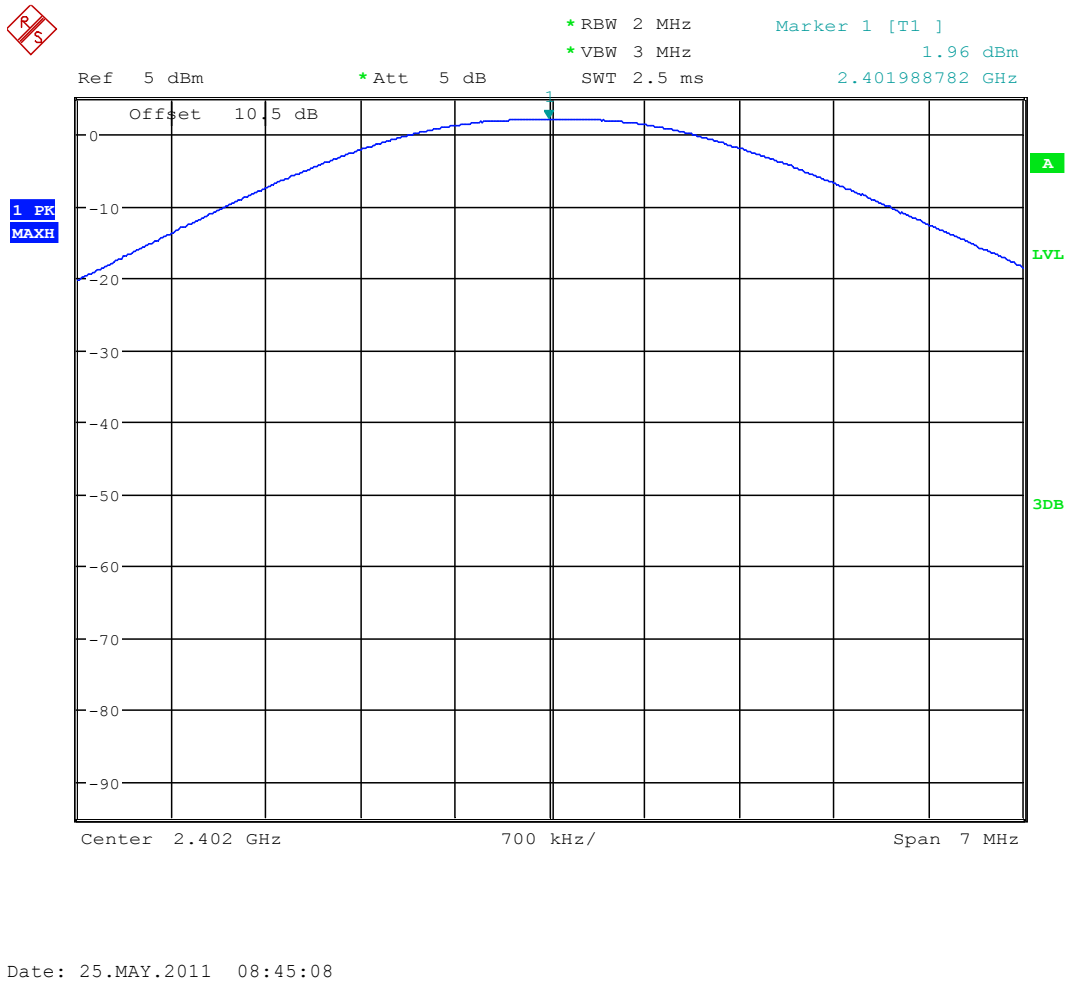

Figure 1. Channel LOW.

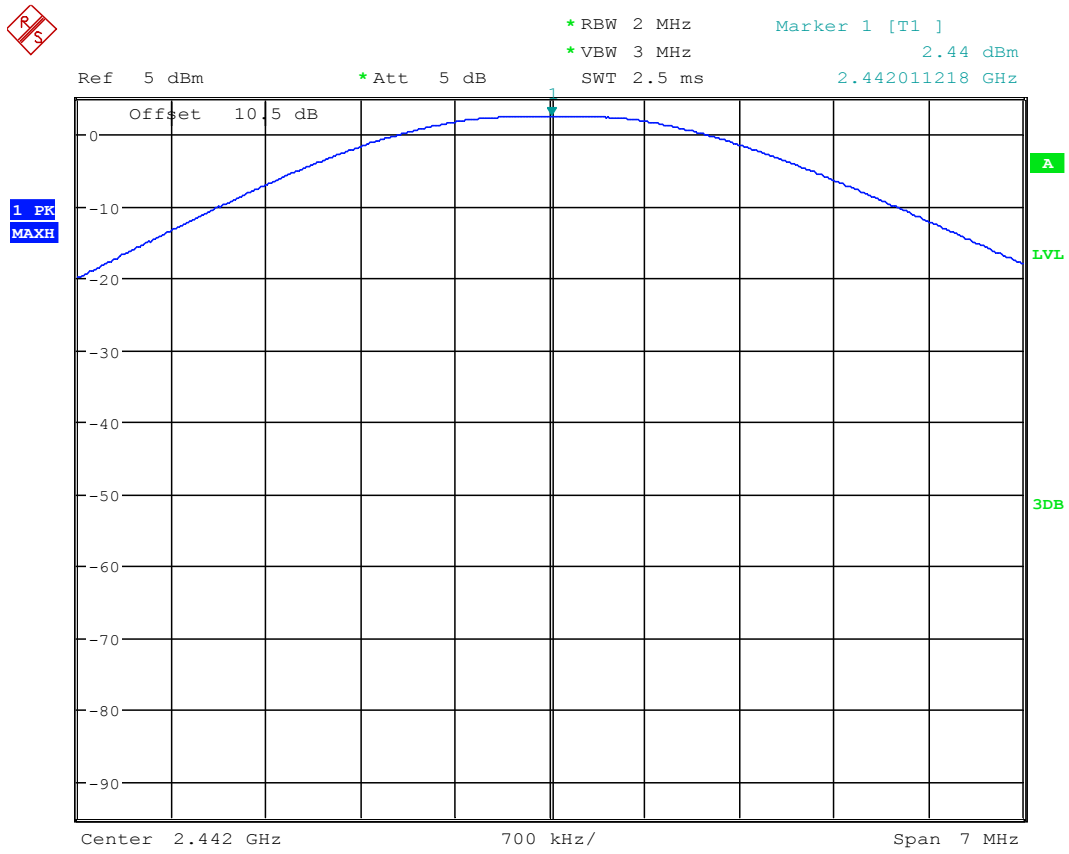

Figure 2. Channel MID.

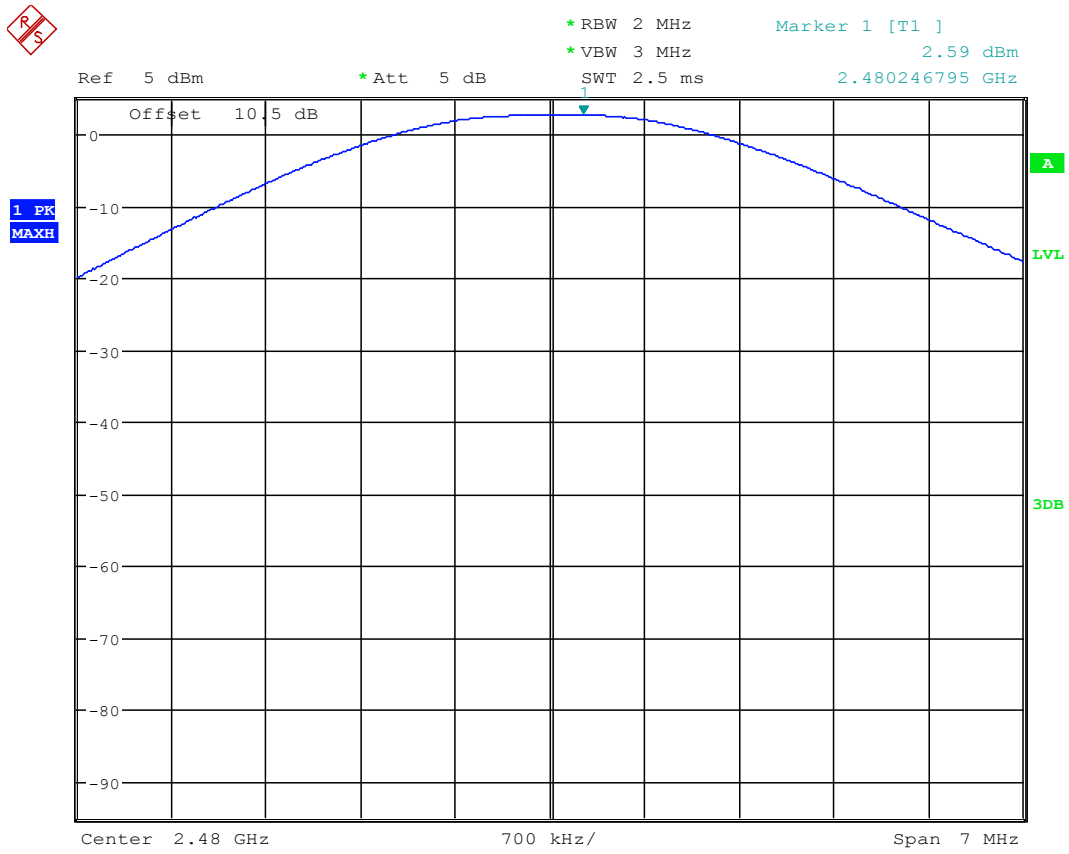

Figure 3. Channel HIGH.

Transmitter Radiated Emissions 30 – 1000 MHz

Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	26.5.2011	
Humidity:	40 %	
Temperature:	23.0 °C	
Measurement uncertainty	± 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.

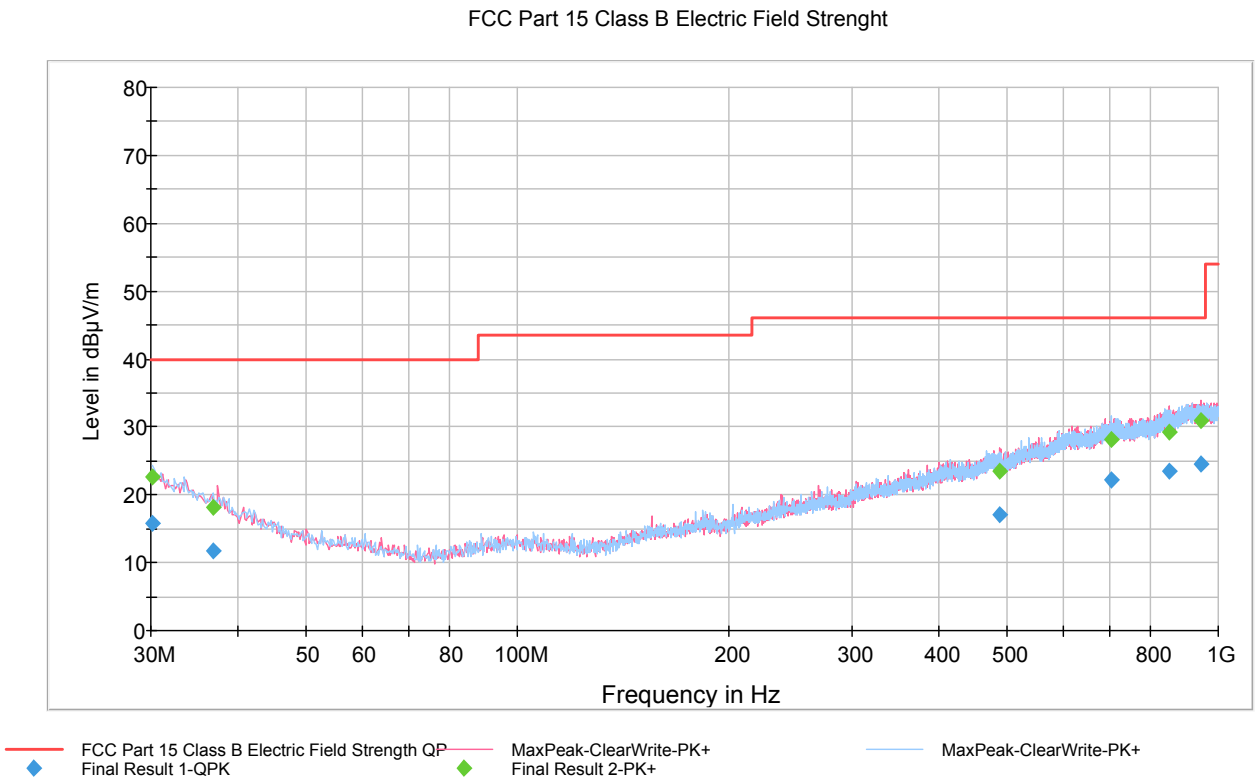

Figure 4. Measured curve with peak-detector. Channel LOW.

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
30.180000	15.8	15000.0	120.000	304.0	H	195.0	19.1	24.2	40.0	
36.896250	11.8	15000.0	120.000	354.0	V	286.0	15.3	28.2	40.0	
487.701250	17.2	15000.0	120.000	175.0	V	94.0	21.6	28.8	46.0	
701.570000	22.1	15000.0	120.000	354.0	H	15.0	25.6	23.9	46.0	
852.531250	23.5	15000.0	120.000	325.0	V	345.0	26.9	22.5	46.0	
945.916250	24.5	15000.0	120.000	175.0	V	15.0	28.0	21.5	46.0	

Table 1. Final results.

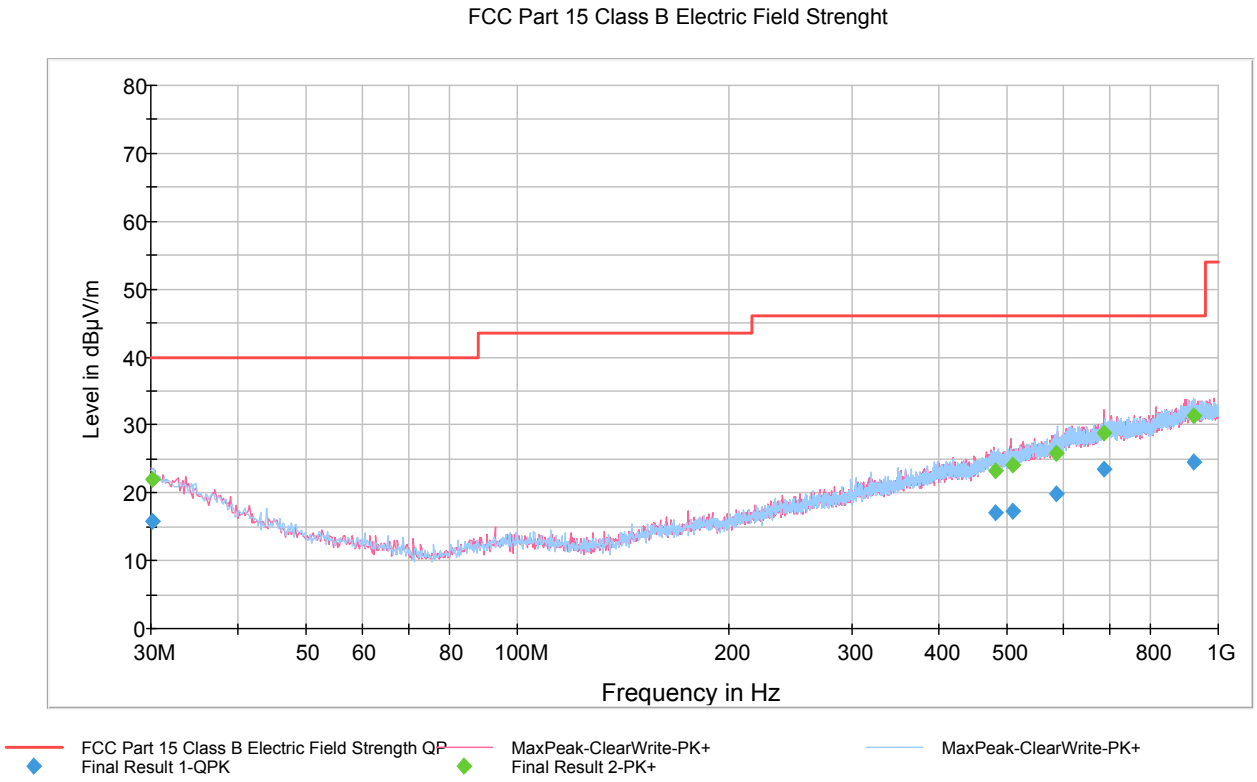

Figure 5. Measured curve with peak-detector. Channel MID.

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
30.100000	15.8	15000.0	120.000	129.0	H	195.0	19.1	24.2	40.0	
479.565000	17.1	15000.0	120.000	100.0	V	92.0	21.6	28.9	46.0	
508.298750	17.3	15000.0	120.000	325.0	V	24.0	21.6	28.7	46.0	
587.817500	19.7	15000.0	120.000	175.0	H	76.0	23.5	26.3	46.0	
687.197500	23.5	15000.0	120.000	388.0	V	285.0	25.3	22.5	46.0	
920.461250	24.6	15000.0	120.000	129.0	H	14.0	28.1	21.4	46.0	

Table 2. Final results.

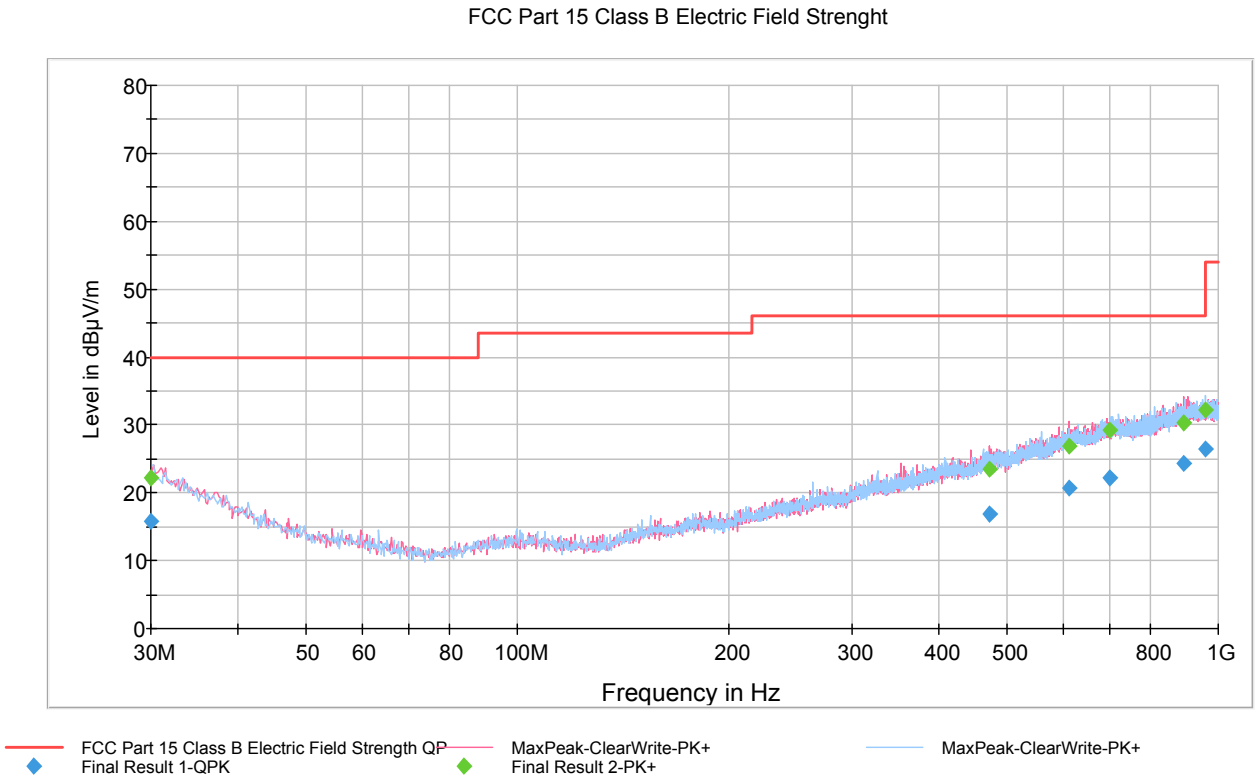

Figure 6. Measured curve with peak-detector. Channel HIGH.

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
30.060000	15.9	15000.0	120.000	354.0	H	90.0	19.1	24.1	40.0	
472.655000	16.9	15000.0	120.000	237.0	V	20.0	21.5	29.1	46.0	
613.303750	20.8	15000.0	120.000	400.0	V	254.0	24.3	25.2	46.0	
701.105000	22.1	15000.0	120.000	161.0	H	14.0	25.6	23.9	46.0	
891.056250	24.3	15000.0	120.000	325.0	V	166.0	27.8	21.7	46.0	
960.018750	26.5	15000.0	120.000	100.0	H	285.0	28.4	27.5	54.0	

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.

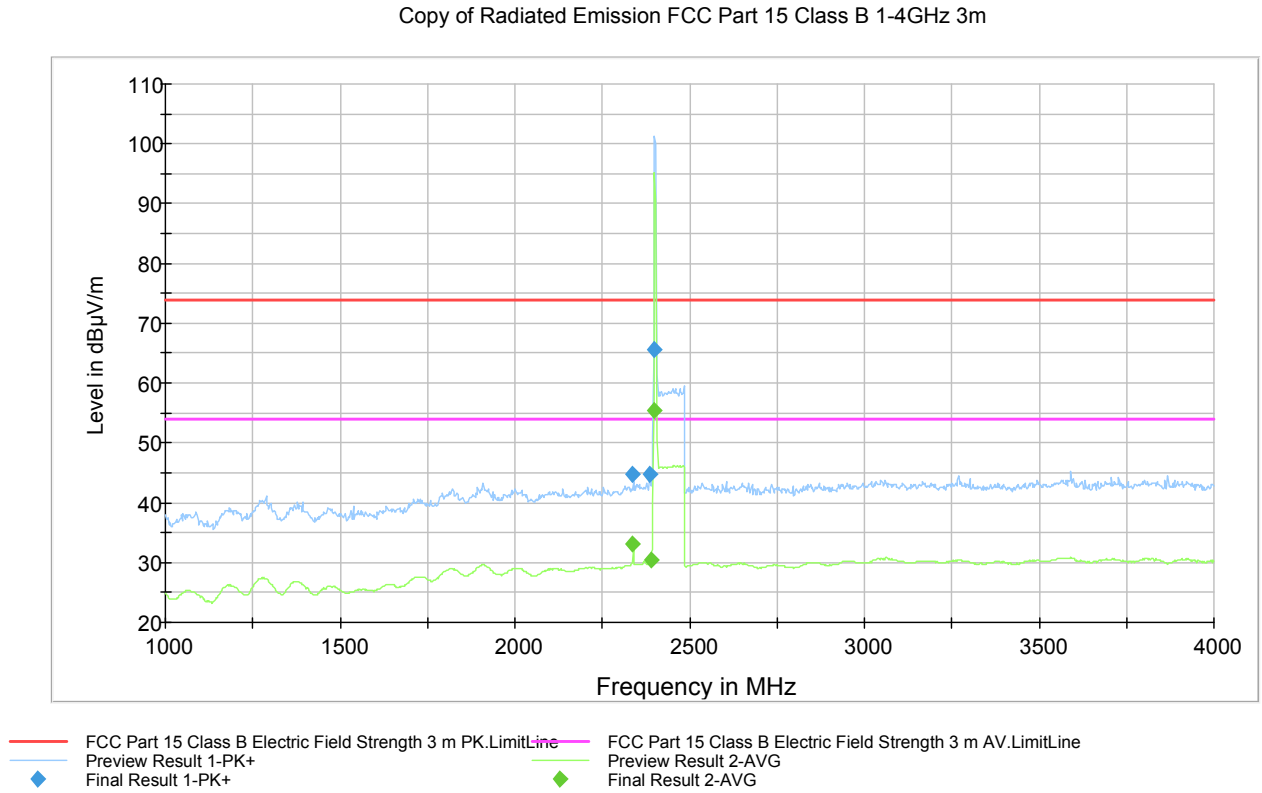

Figure 7. Measured curve with peak- and average detector. Channel LOW.

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
2338.150000	44.8	1000.0	1000.000	195.0	H	77.0	4.2	29.1	73.9	
2386.800000	44.8	1000.0	1000.000	209.0	H	283.0	4.4	29.1	73.9	
2400.000000	65.7	1000.0	1000.000	200.0	H	280.0	4.4	8.2	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	33.0	1000.0	1000.000	204.0	H	118.0	4.2	20.9	53.9	
2390.000000	30.4	1000.0	1000.000	203.0	H	291.0	4.4	23.5	53.9	
2399.400000	55.3	1000.0	1000.000	208.0	H	276.0	4.4	-1.4	53.9	

Table 5. Final Average results..

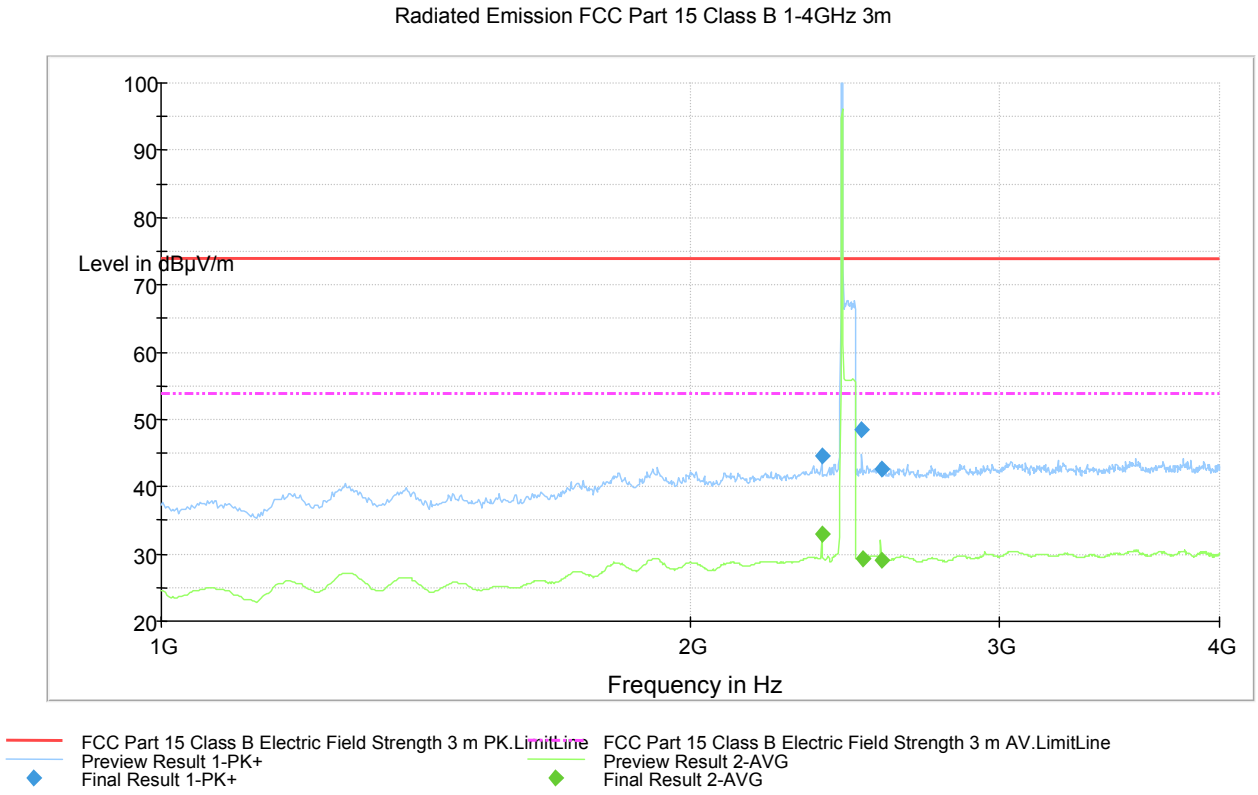

Figure 8. Measured curve with peak- and average detector. Channel MID.

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
2376.450000	44.5	1000.0	1000.000	207.0	H	304.0	4.4	29.4	73.9	
2504.150000	48.4	1000.0	1000.000	175.0	H	90.0	4.7	25.5	73.9	
2572.250000	42.6	1000.0	1000.000	221.0	H	259.0	4.8	31.3	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	33.0	1000.0	1000.000	205.0	H	294.0	4.4	20.9	53.9	
2505.950000	29.4	1000.0	1000.000	175.0	H	86.0	4.7	24.5	53.9	
2569.650000	29.1	1000.0	1000.000	200.0	H	272.0	4.8	24.8	53.9	

Table 7. Final Average results.

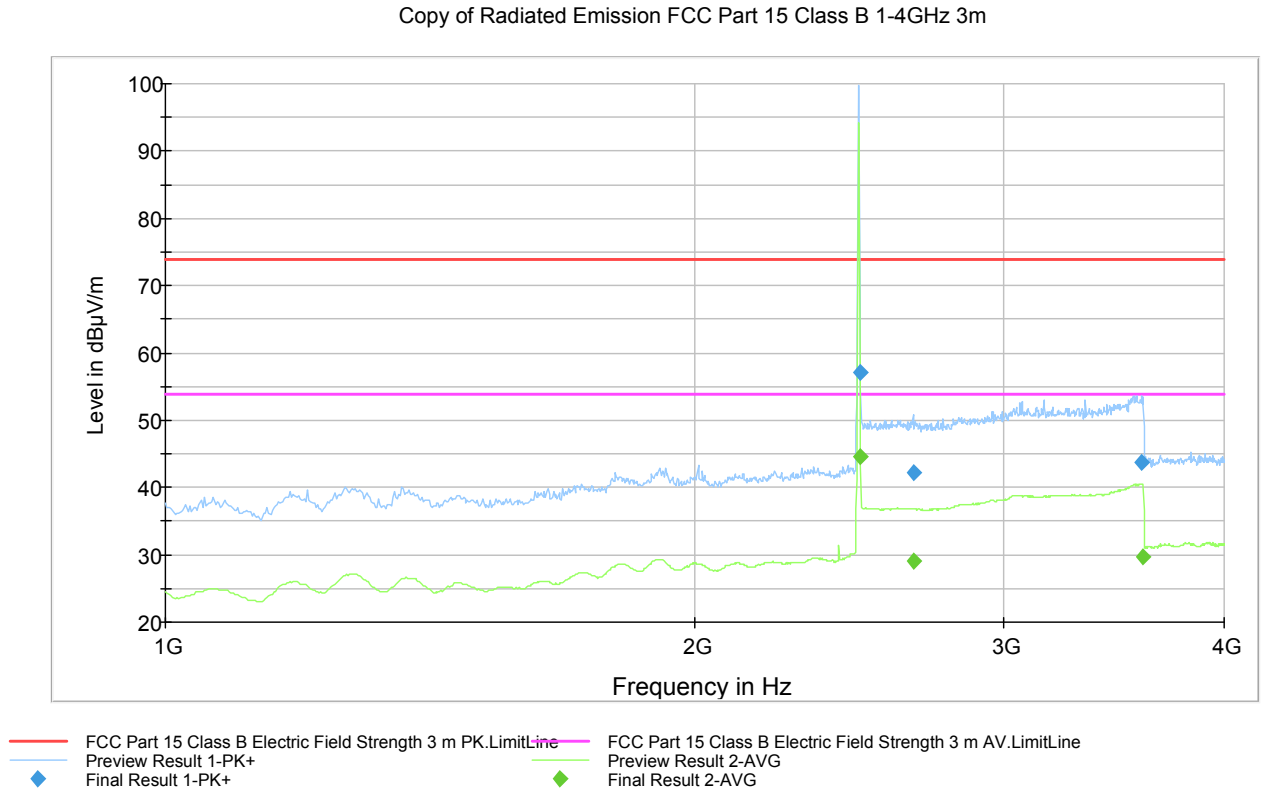

Figure 9. Measured curve with peak- and average detector. Channel HIGH.

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	57.0	1000.0	1000.000	188.0	H	270.0	4.7	16.9	73.9	
2666.350000	42.3	1000.0	1000.000	195.0	H	294.0	4.9	31.6	73.9	
3591.850000	43.7	1000.0	1000.000	163.0	H	63.0	6.9	30.2	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	44.7	1000.0	1000.000	195.0	H	255.0	4.7	9.2	53.9	
2663.950000	29.0	1000.0	1000.000	213.0	H	300.0	4.9	25.0	53.9	
3595.850000	29.8	1000.0	1000.000	166.0	H	285.0	6.9	24.1	53.9	

Table 9. Final Average results.

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

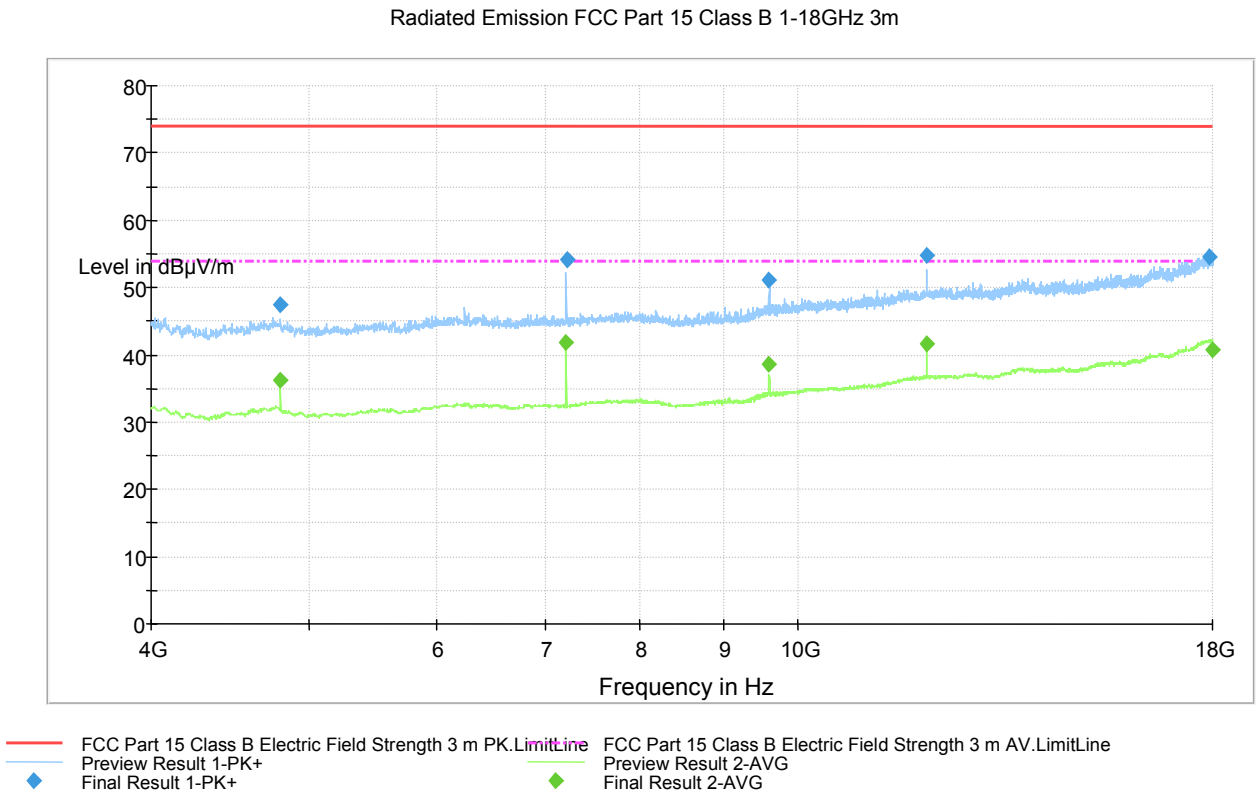

Figure 10. Measured curve with peak- and average detector. Channel LOW.

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
4806.150000	47.4	1000.0	1000.000	198.0	V	182.0	10.5	26.5	73.9	
7206.750000	54.0	1000.0	1000.000	173.0	V	2.0	12.3	19.9	73.9	
9607.350000	51.1	1000.0	1000.000	165.0	V	161.0	15.2	22.8	73.9	
12011.350000	54.8	1000.0	1000.000	100.0	H	43.0	18.8	19.1	73.9	
17935.650000	54.5	1000.0	1000.000	114.0	V	35.0	25.8	19.5	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	36.3	1000.0	1000.000	199.0	V	192.0	10.5	17.6	53.9	
7205.550000	41.7	1000.0	1000.000	101.0	V	130.0	12.3	12.2	53.9	
9607.250000	38.6	1000.0	1000.000	106.0	V	151.0	15.2	15.3	53.9	
12008.950000	41.7	1000.0	1000.000	100.0	H	44.0	18.8	12.2	53.9	
17998.850000	40.7	1000.0	1000.000	153.0	V	355	25.8	13.2	53.9	

Table 11. Final Average results.

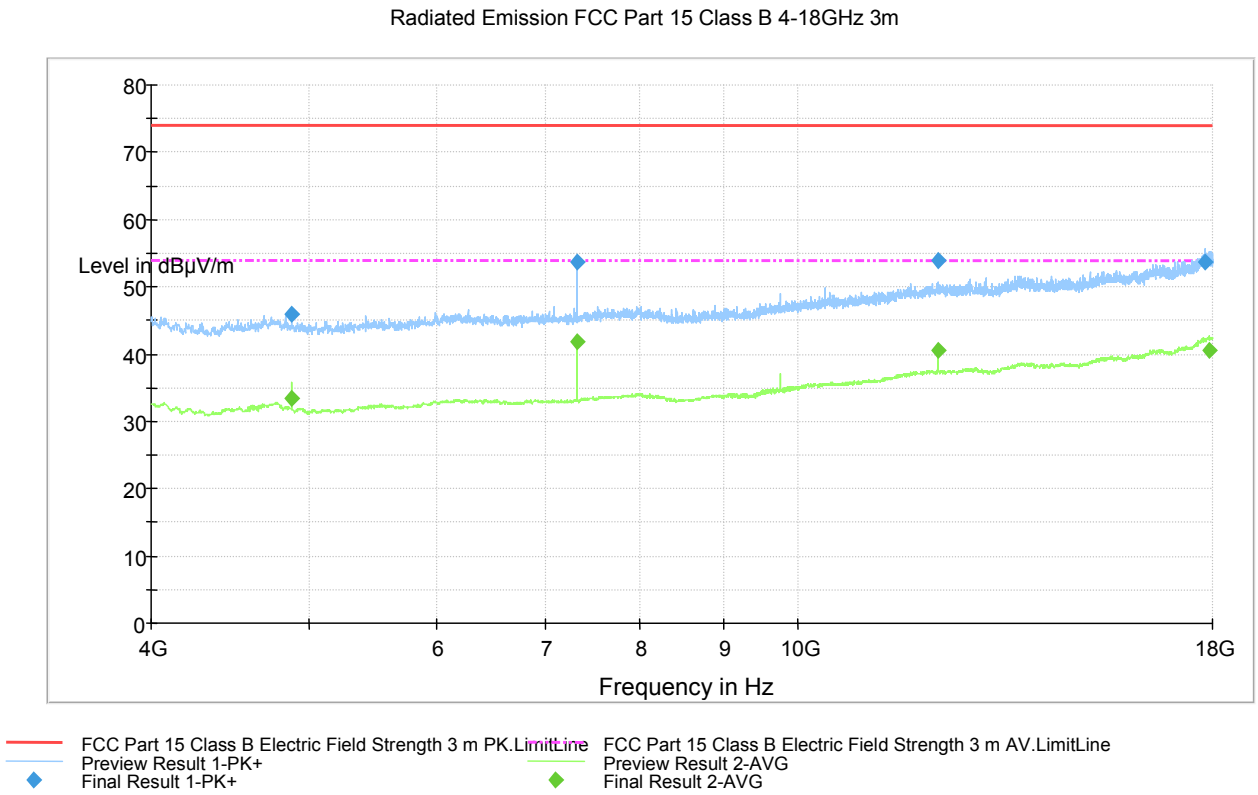

Figure 11. Measured curve with peak- and average detector. Channel MID.

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
4882.250000	45.9	1000.0	1000.000	228.0	V	162.0	10.5	28.0	73.9	
7319.350000	53.7	1000.0	1000.000	177.0	V	8.0	12.5	20.2	73.9	
12201.350000	53.9	1000.0	1000.000	100.0	H	331.0	19.1	20.0	73.9	
17801.950000	53.6	1000.0	1000.000	100.0	V	2.0	25.6	20.3	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	33.3	1000.0	1000.000	147.0	V	145.0	10.5	20.6	53.9	
7319.550000	41.9	1000.0	1000.000	177.0	V	5.0	12.5	12.0	53.9	
12198.950000	40.6	1000.0	1000.000	100.0	H	330.0	19.1	13.3	53.9	
17916.750000	40.6	1000.0	1000.000	100.0	V	25.0	25.8	13.3	53.9	

Table 13. Final Average results.

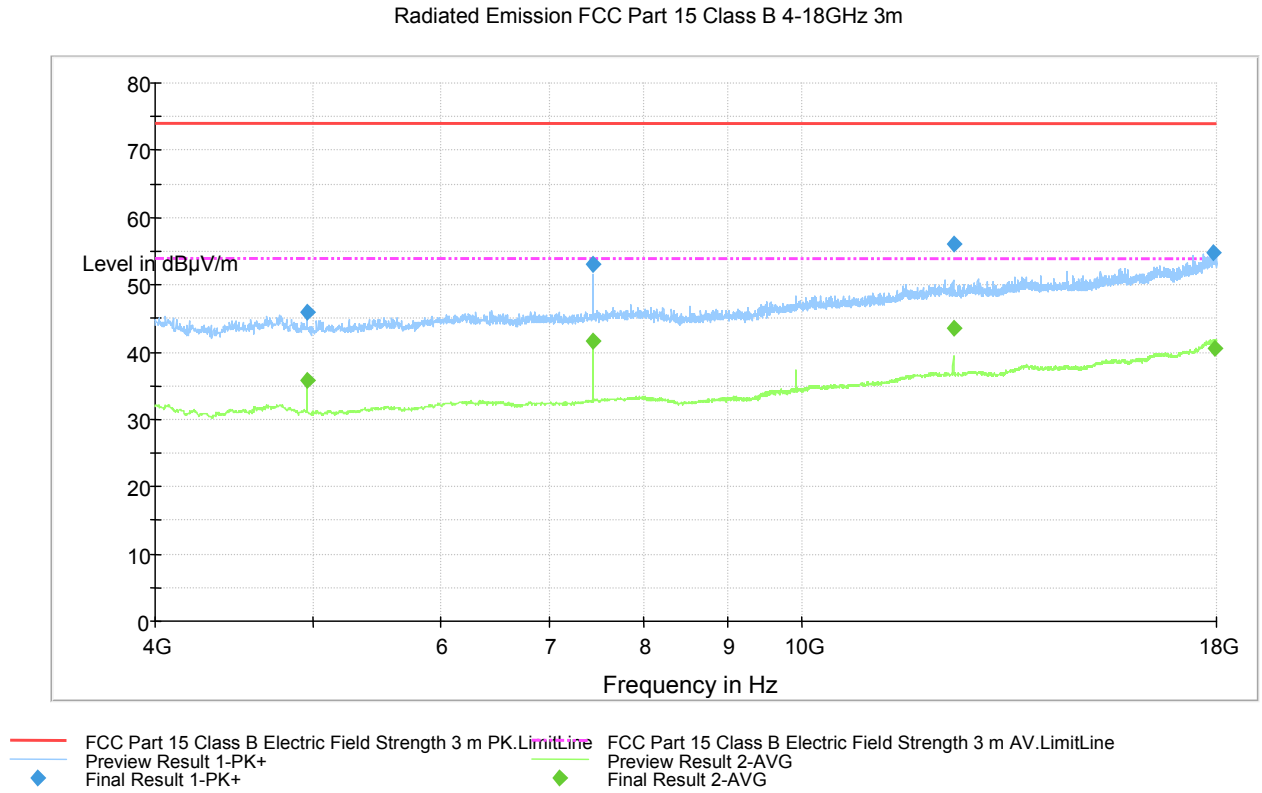

Figure 12. Measured curve with peak- and average detector. Channel HIGH.

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
4962.450000	45.9	1000.0	1000.000	182.0	V	189.0	10.4	28.0	73.9	
7439.350000	53.0	1000.0	1000.000	173.0	V	0.0	12.8	20.9	73.9	
12398.950000	56.1	1000.0	1000.000	100.0	H	41.0	19.2	17.8	73.9	
17924.150000	54.7	1000.0	1000.000	226.0	V	207.0	25.8	19.2	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	35.7	1000.0	1000.000	196.0	V	192.0	10.4	18.2	53.9	
7439.550000	41.5	1000.0	1000.000	177.0	V	-2.0	12.8	12.4	53.9	
12398.950000	43.5	1000.0	1000.000	100.0	H	42.0	19.2	10.4	53.9	
17963.150000	40.5	1000.0	1000.000	100.0	V	35.0	25.8	13.4	53.9	

Table 15. Final Average results.

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

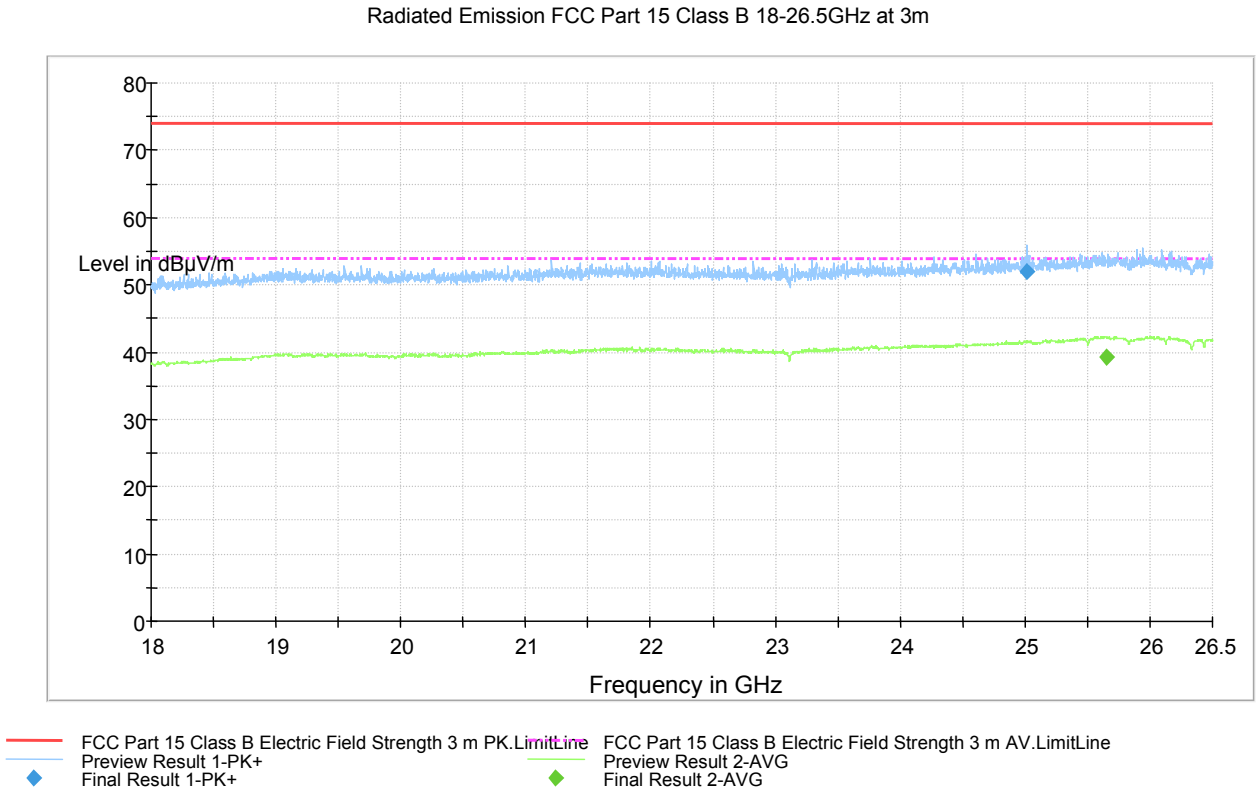

Figure 13. Measured curve with peak- and average detector. Channel LOW.

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
25014.650000	52.0	1000.0	1000.000	135.0	V	357	27.1	21.9	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
25653.750000	39.2	1000.0	1000.000	112.0	V	17.0	27.9	14.7	53.9	

Table 17. Final Average results.

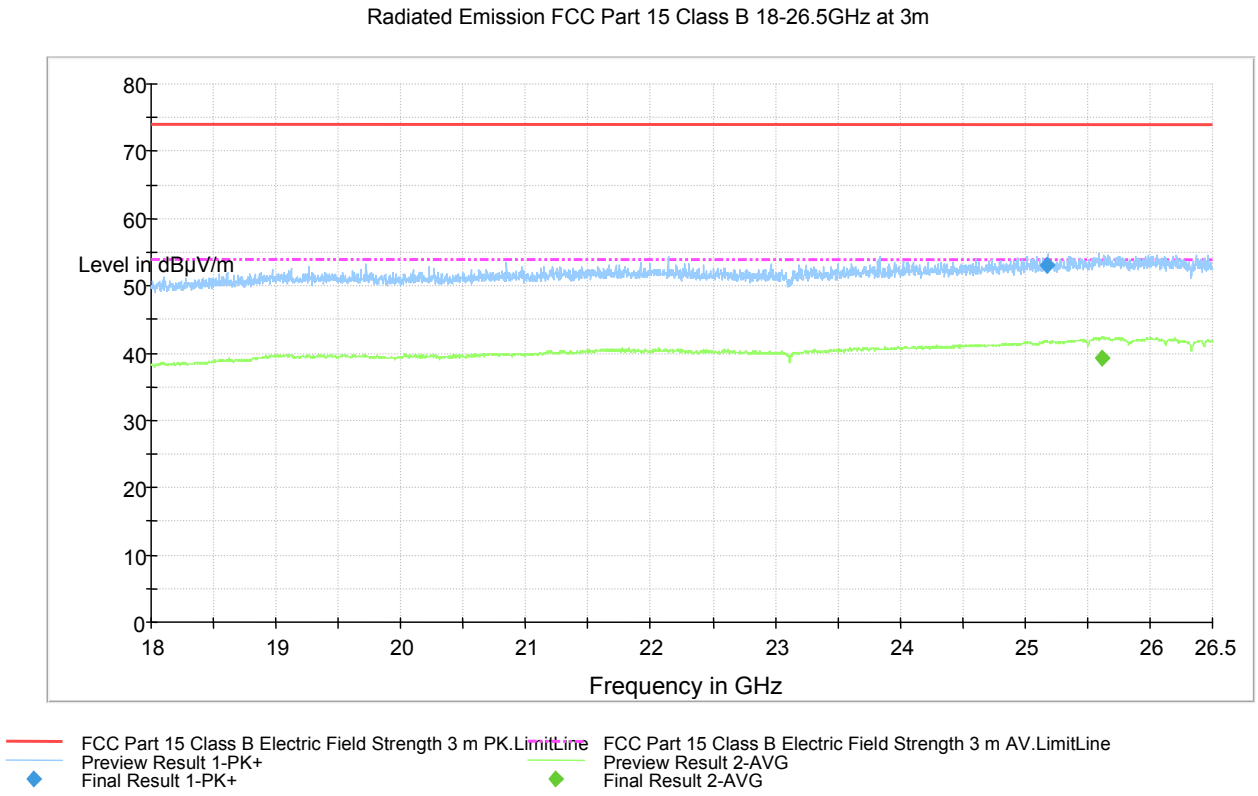

Figure 14. Measured curve with peak- and average detector. Channel MID.

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
25178.750000	53.0	1000.0	1000.000	133.0	V	0.0	27.3	20.9	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
25617.750000	39.2	1000.0	1000.000	118.0	V	22.0	27.9	14.7	53.9	

Table 19. Final Average results.

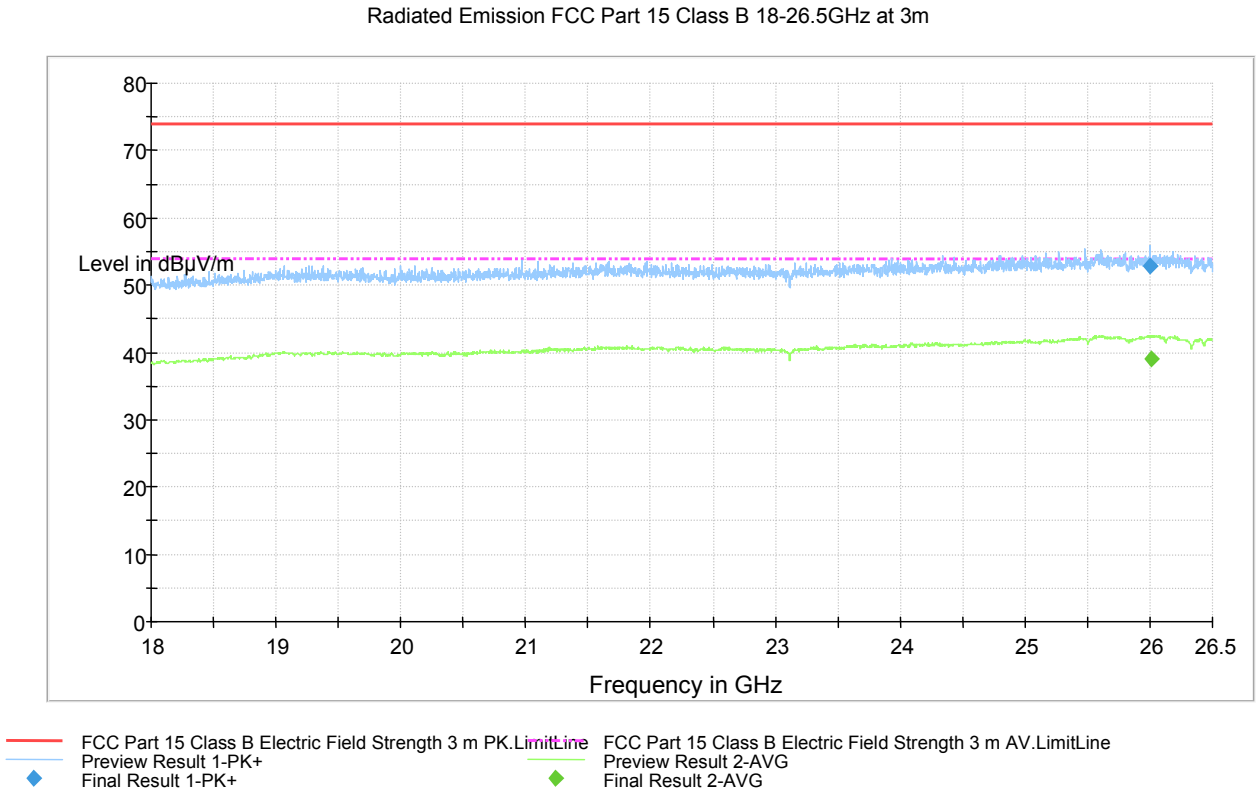

Figure 15. Measured curve with peak- and average detector. Channel HIGH.

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
25995.950000	52.7	1000.0	1000.000	124.0	V	22.0	28.0	21.2	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
26008.050000	39.0	1000.0	1000.000	100.0	V	22.0	28.0	14.9	53.9	

Table 21. Final Average results.

Radiated band edge measurement results

Band edge measurements were performed by using scanning mode of the receiver and 1 MHz bandwidth (6dB filter) and using auto attenuation and auto pre-amplifier.

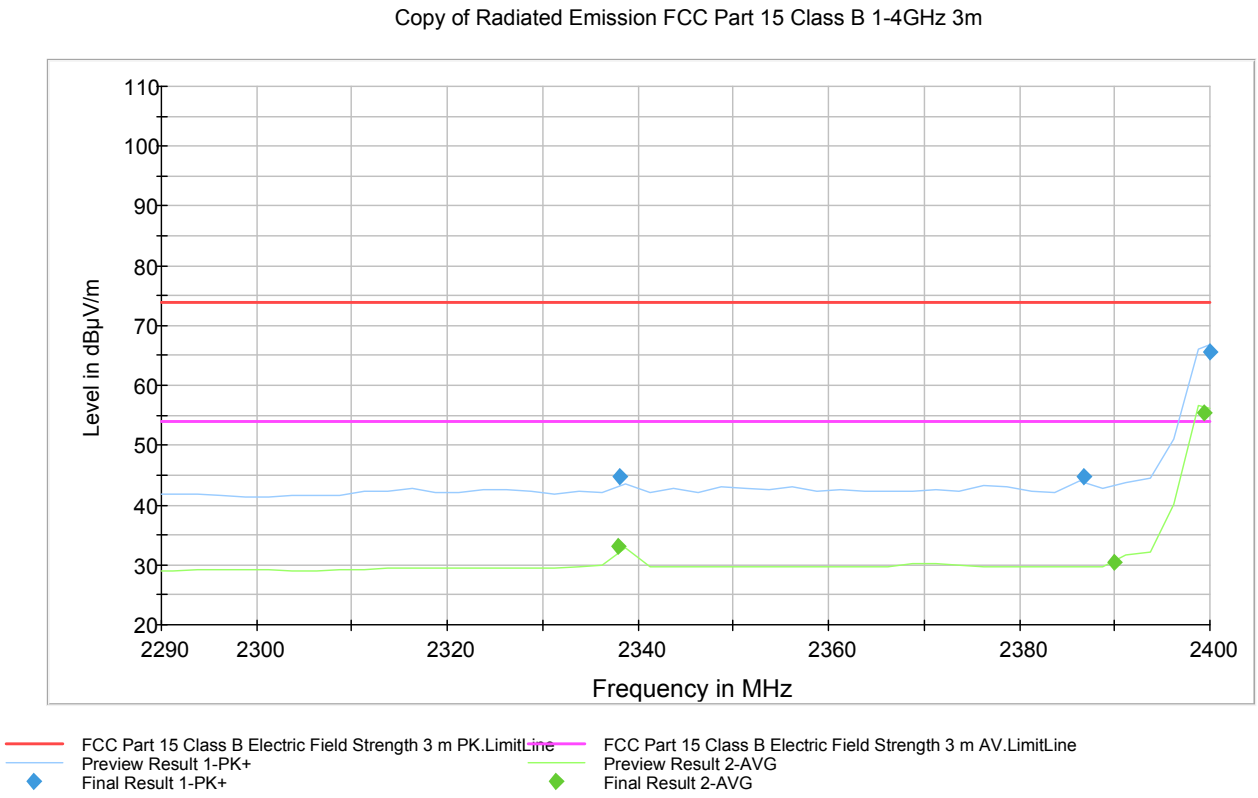

Figure 16. Measured curve with peak- and average detector. Lower band edge.

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
2338.150000	44.8	1000.0	1000.000	195.0	H	77.0	4.2	29.1	73.9	
2386.800000	44.8	1000.0	1000.000	209.0	H	283.0	4.4	29.1	73.9	
2400.000000	65.7	1000.0	1000.000	200.0	H	280.0	4.4	8.2	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	33.0	1000.0	1000.000	204.0	H	118.0	4.2	20.9	53.9	
2390.000000	30.4	1000.0	1000.000	203.0	H	291.0	4.4	23.5	53.9	
2399.400000	55.3	1000.0	1000.000	208.0	H	276.0	4.4	-1.4	53.9	

Table 23. Final Average results.

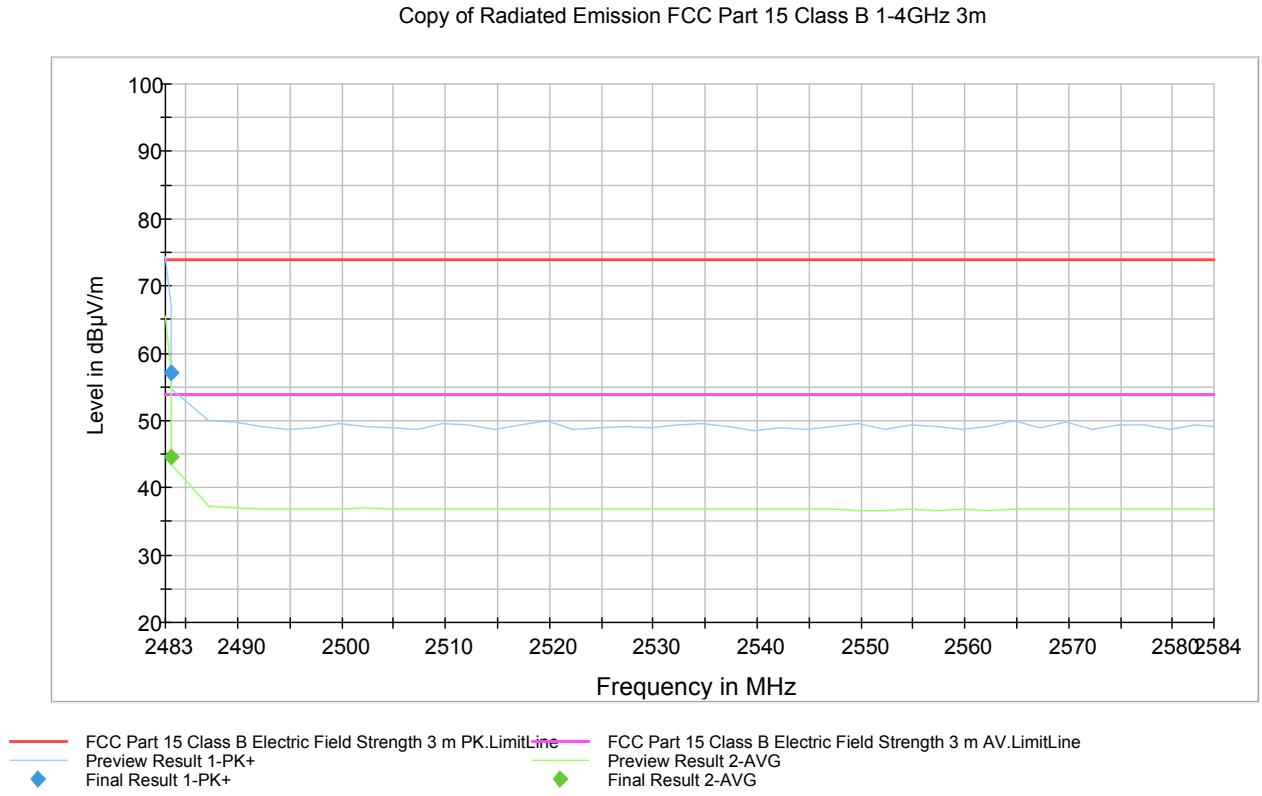

Figure 17. Measured curve with peak- and average detector. Upper band edge

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	57.0	1000.0	1000.000	188.0	H	270.0	4.7	16.9	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	44.7	1000.0	1000.000	195.0	H	255.0	4.7	9.2	53.9	

Table 25. Final Average results.

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Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	26.5.2011	
Humidity:	29 %	
Temperature:	23.8 °C	
Measurement uncertainty	± 2.87dB	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
-37.72 dBc	-46.16 dBc
Limit: -20dBc	

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.

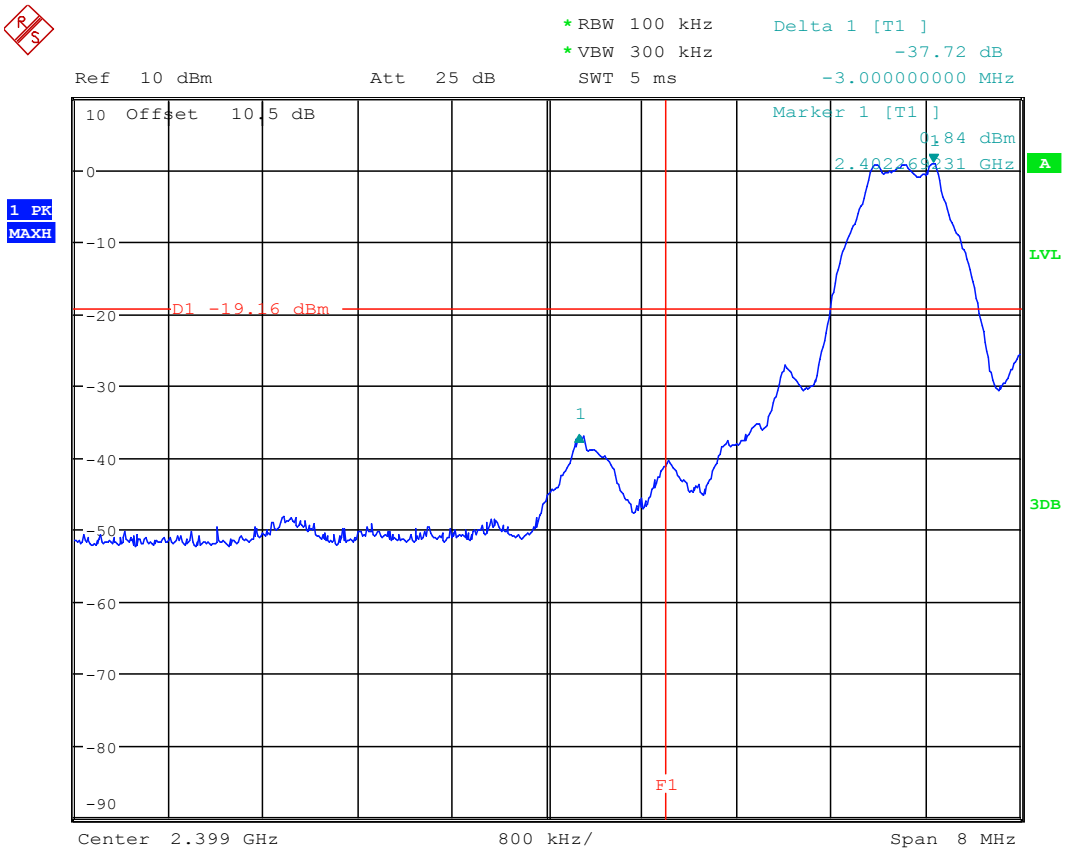

Figure 18. Lower Band Edge.

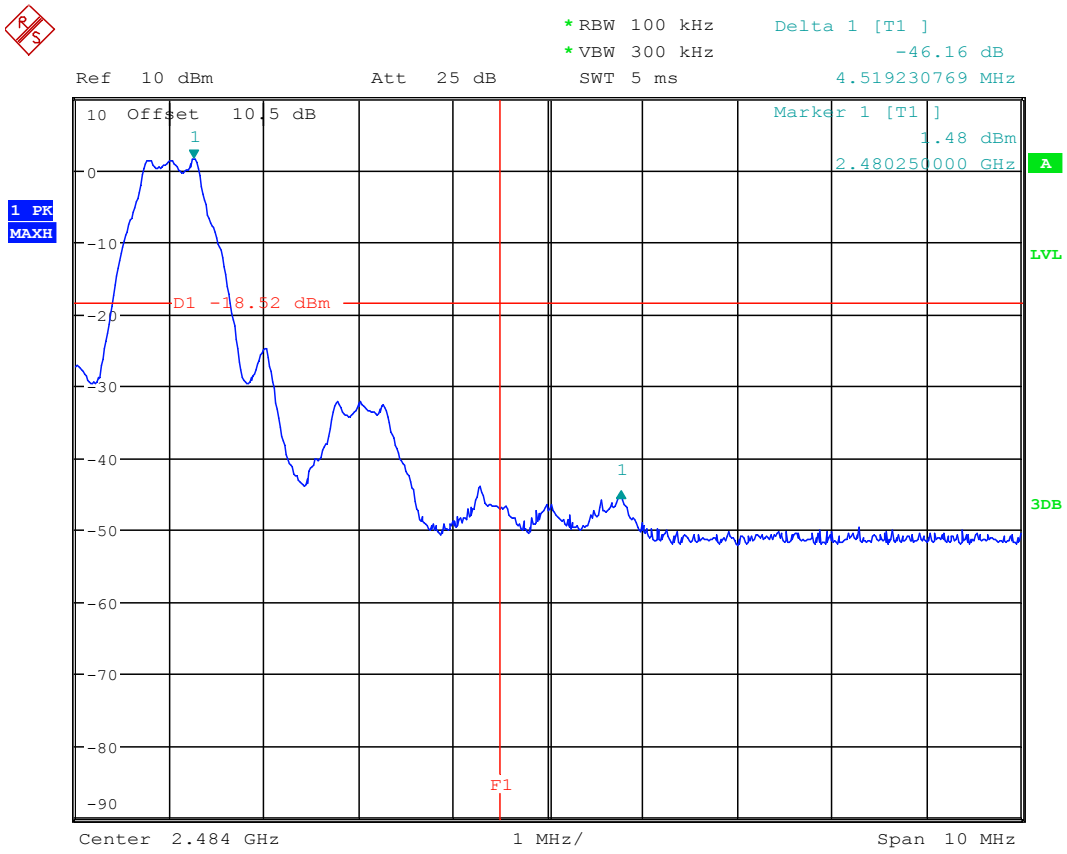

Figure 19. Upper Band Edge.

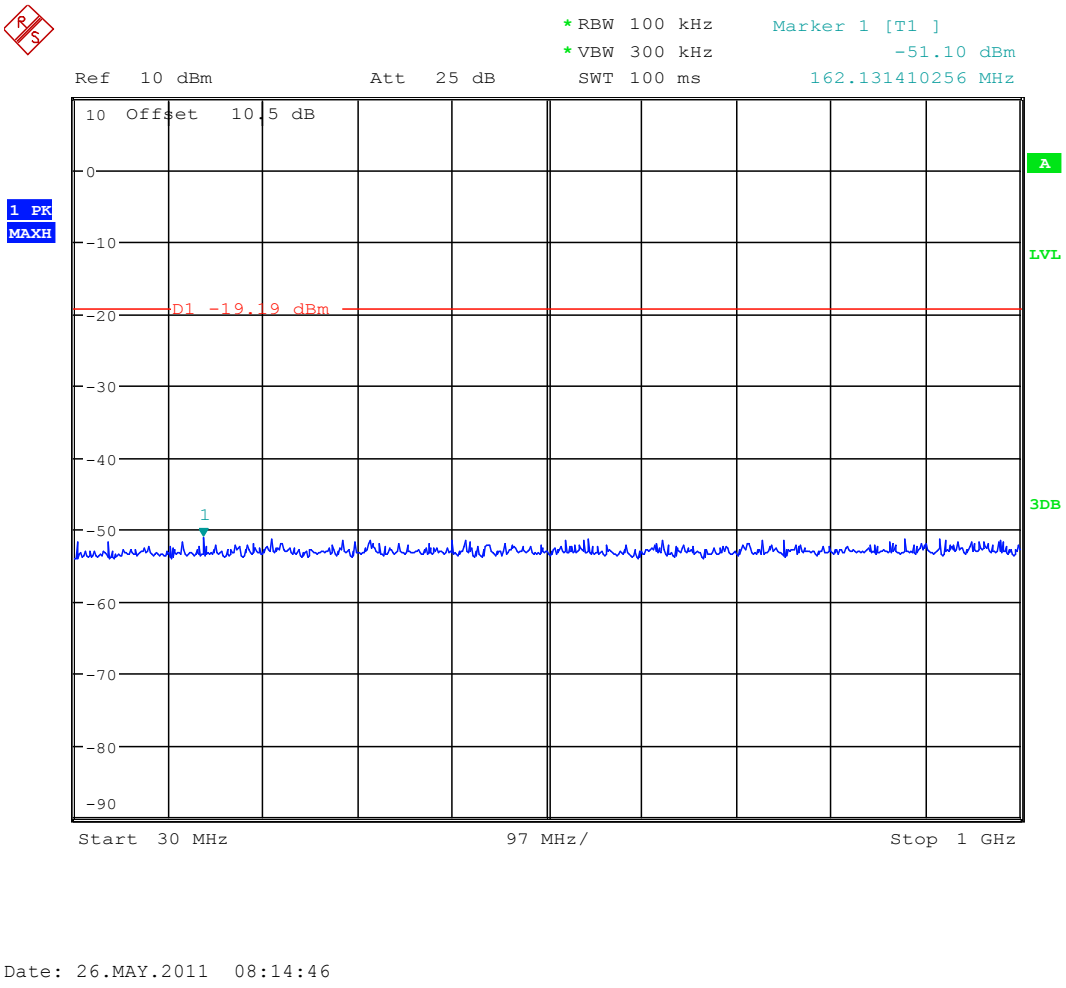

Figure 20. Conducted Spurious Emissions 30 – 1 000 MHz. Channel LOW.

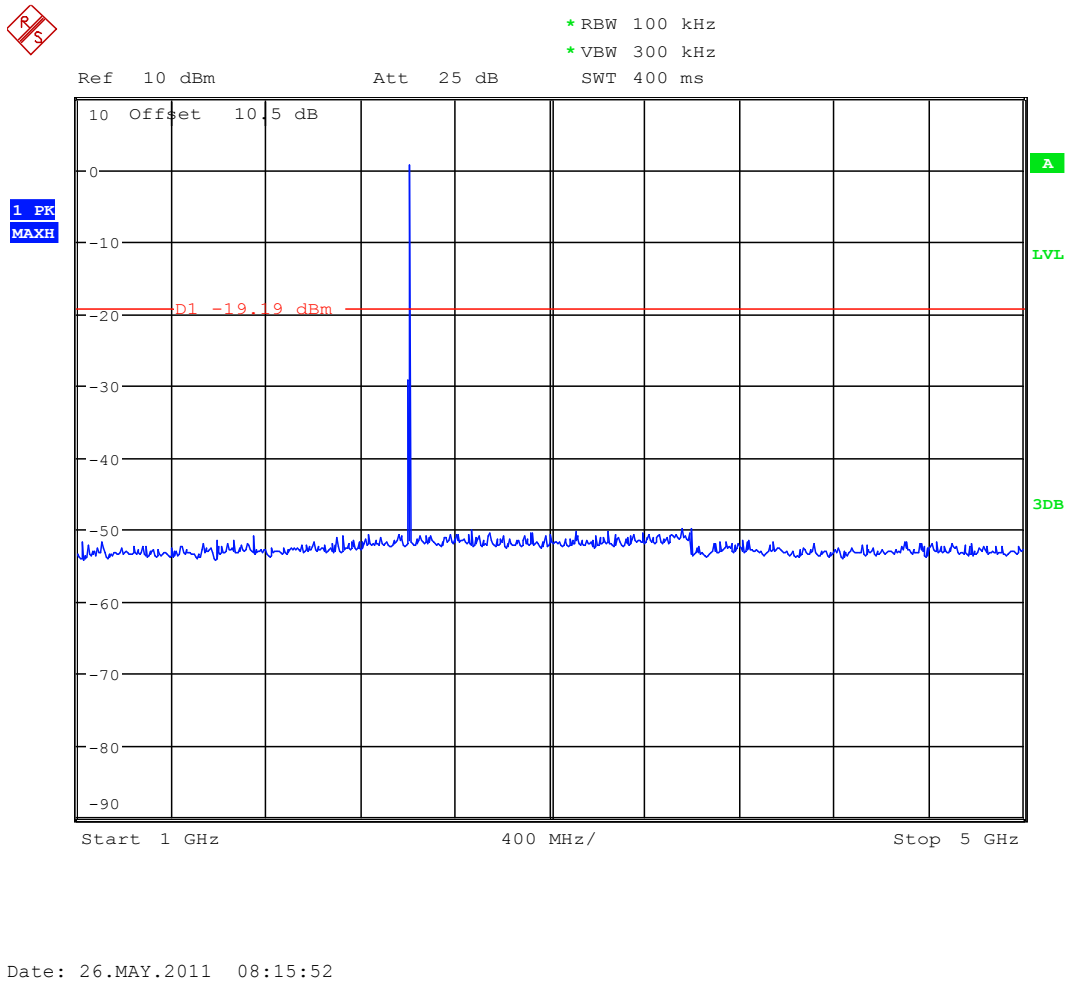

Figure 21. Conducted Spurious Emissions 1 000 – 5 000 MHz. Channel LOW.

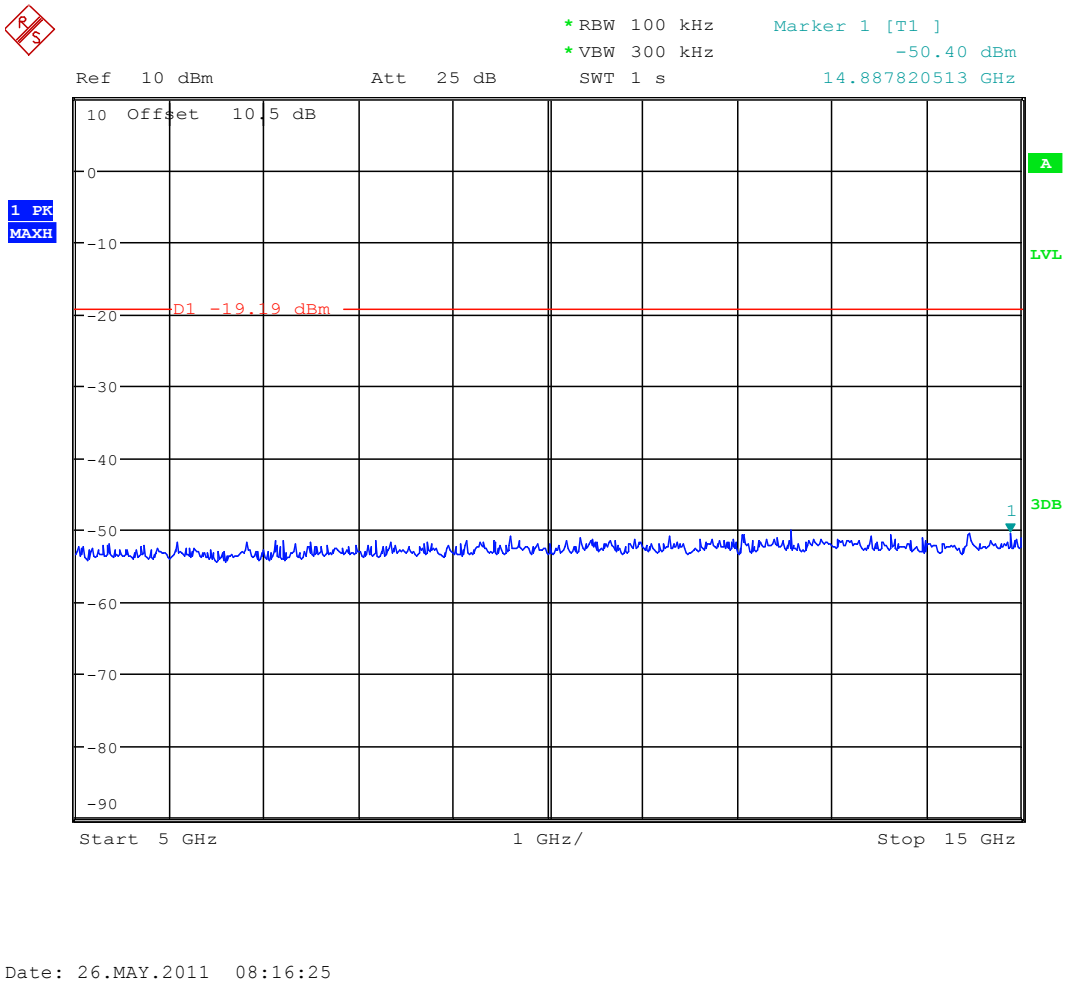

Figure 22. Conducted Spurious Emissions 5 000 – 15 000 MHz. Channel LOW.

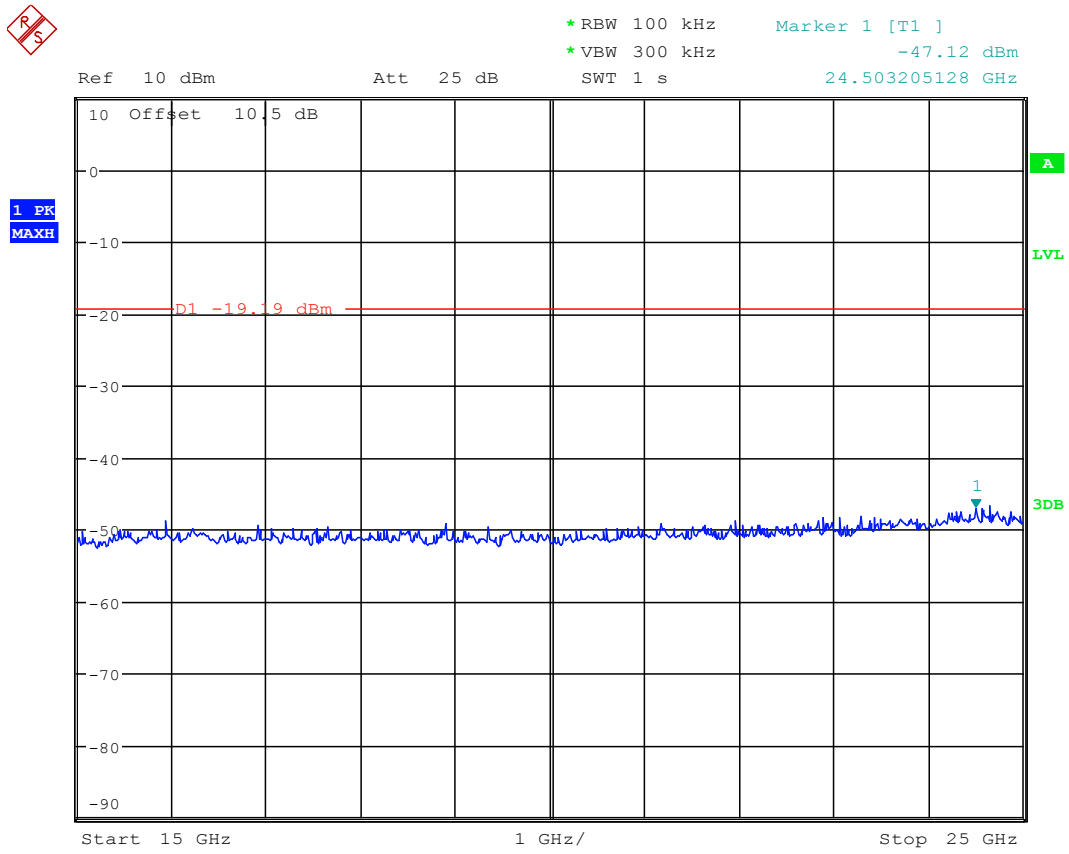

Figure 23. Conducted Spurious Emissions 15 000 – 25 000 MHz. Channel LOW.

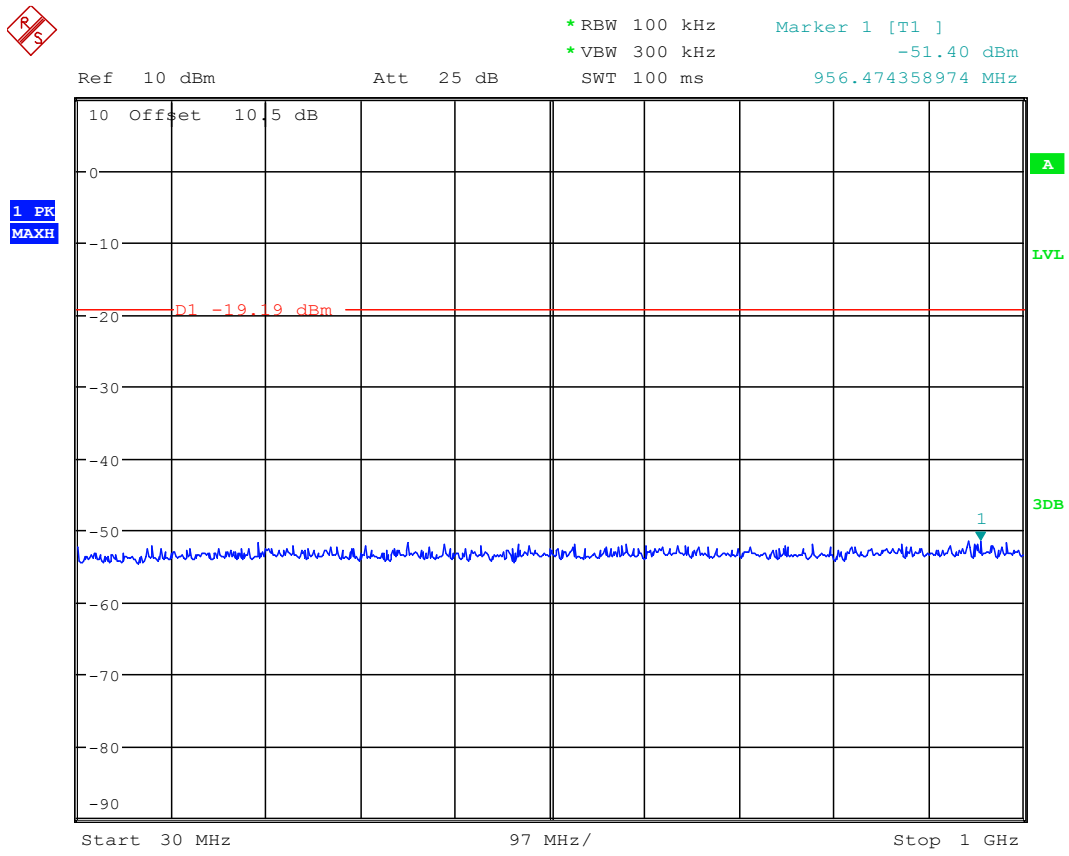

Figure 24. Conducted Spurious Emissions 30 – 1 000 MHz. Channel MID.

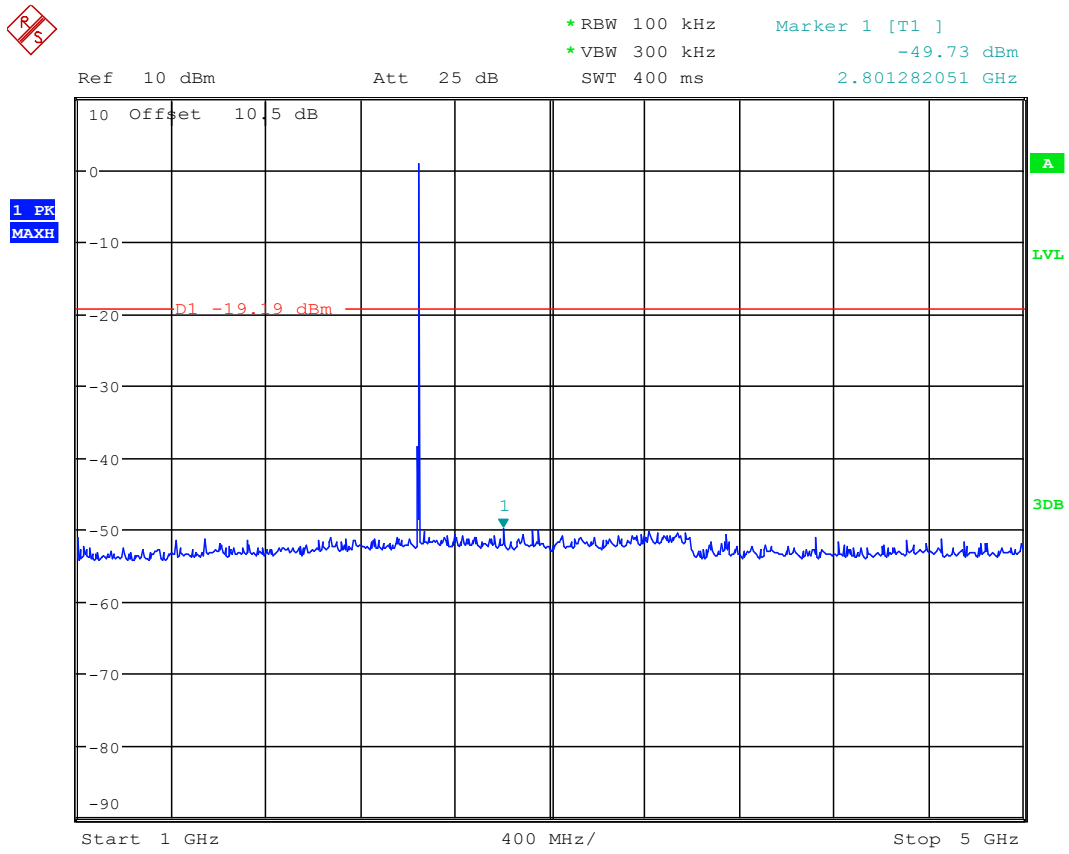

Figure 25. Conducted Spurious Emissions 1 000 – 5 000 MHz. Channel MID.

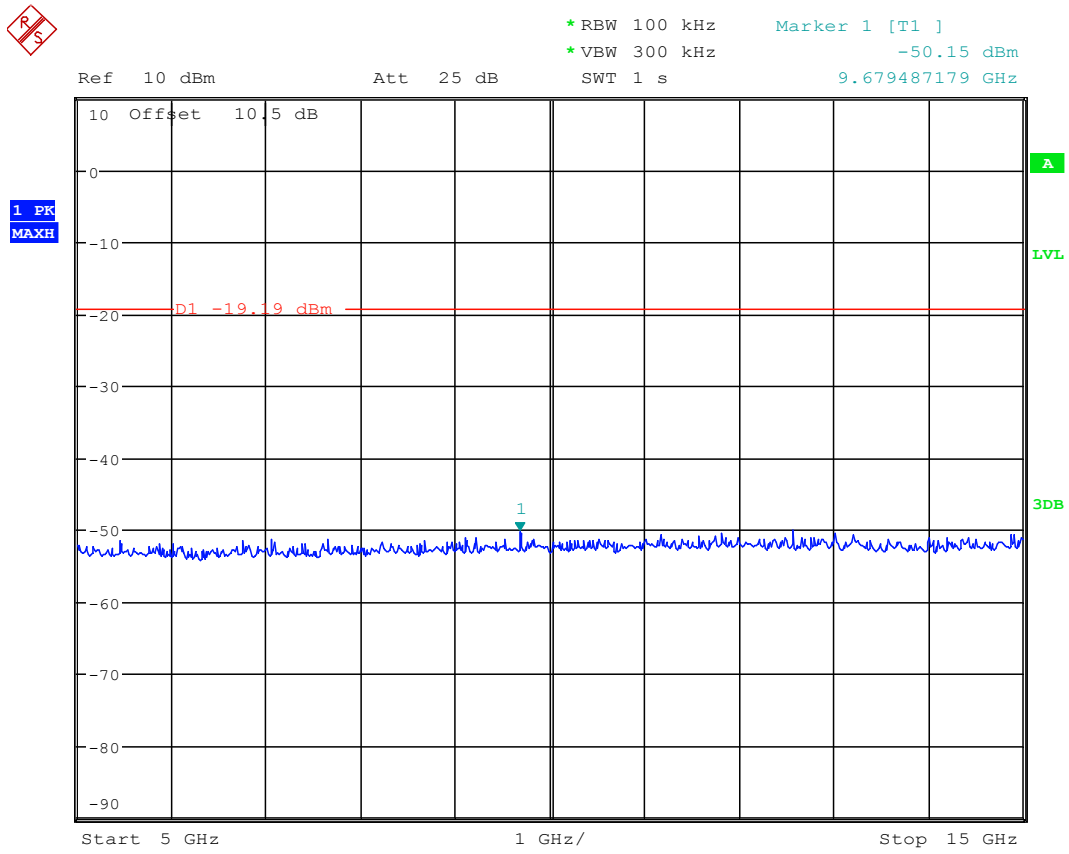

Figure 26. Conducted Spurious Emissions 5 000 – 15 000 MHz. Channel MID.

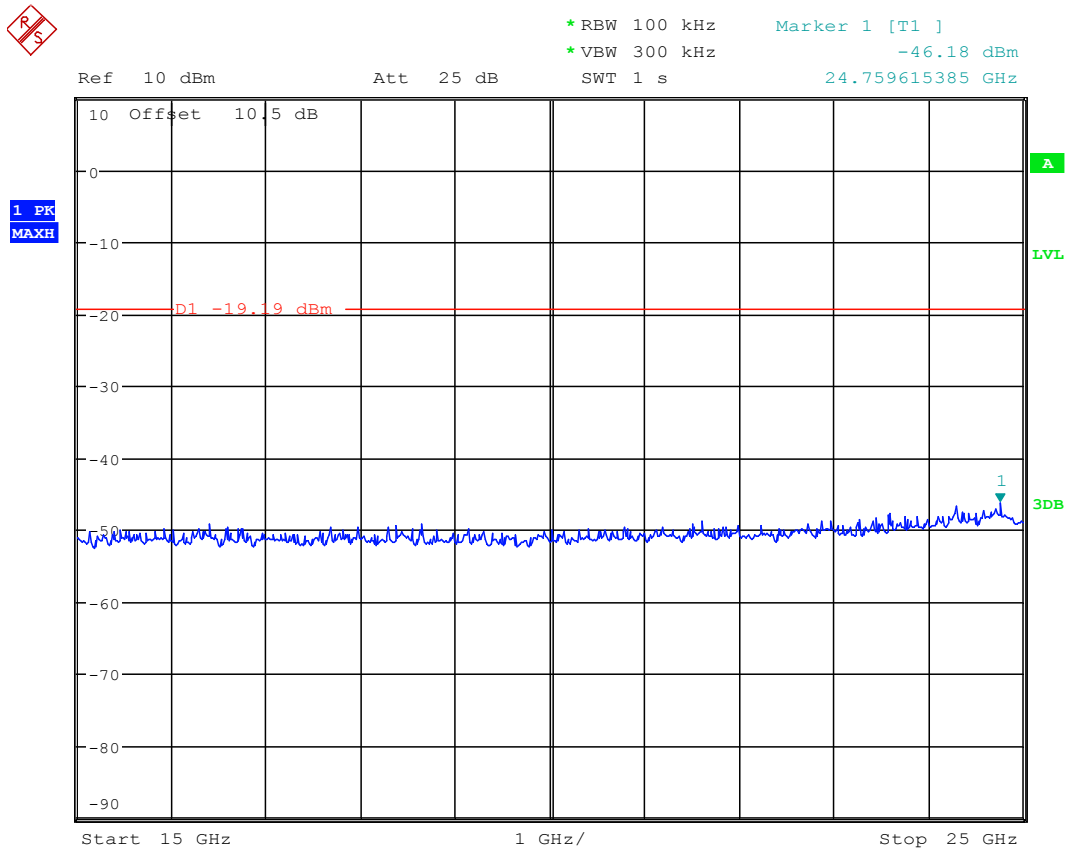

Figure 27. Conducted Spurious Emissions 15 000 – 25 000 MHz. Channel MID.

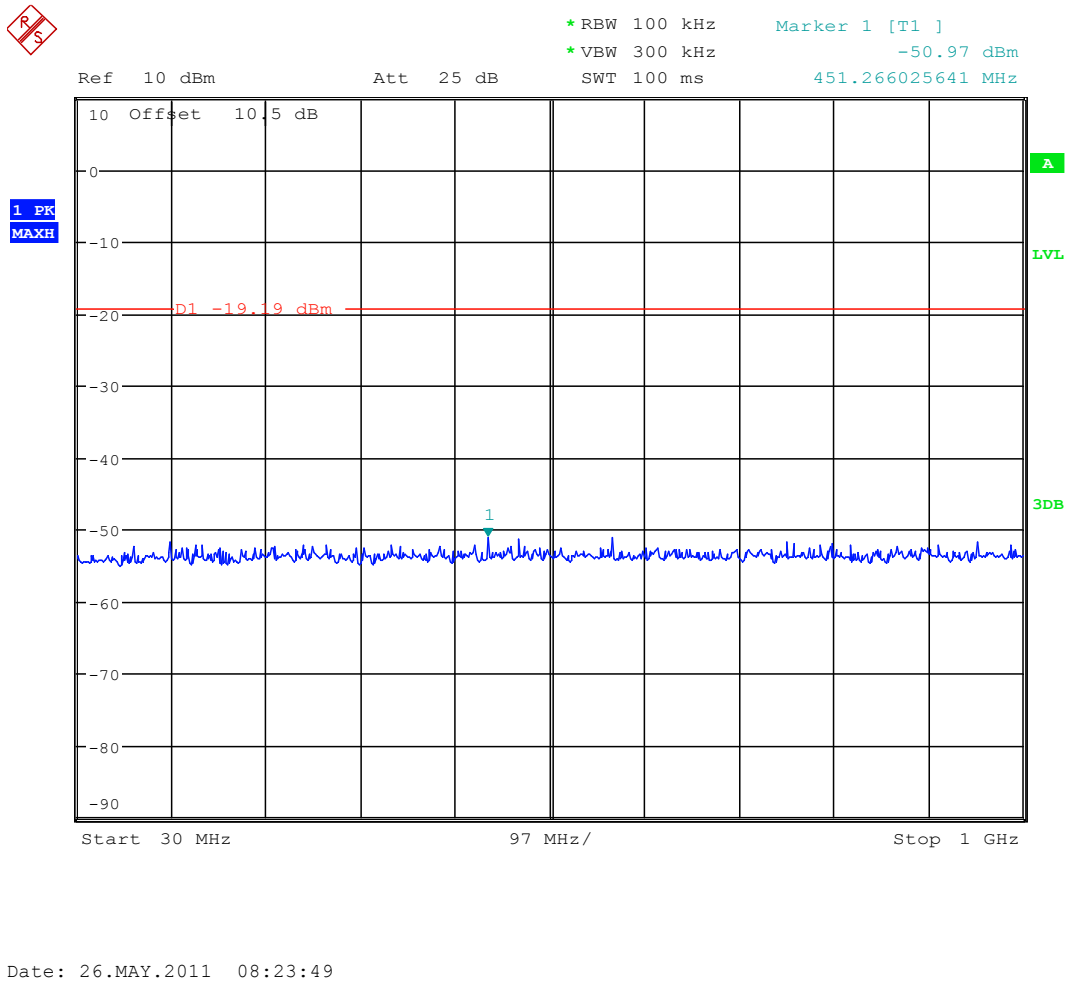

Figure 28. Conducted Spurious Emissions 30 – 1 000 MHz. Channel HIGH.

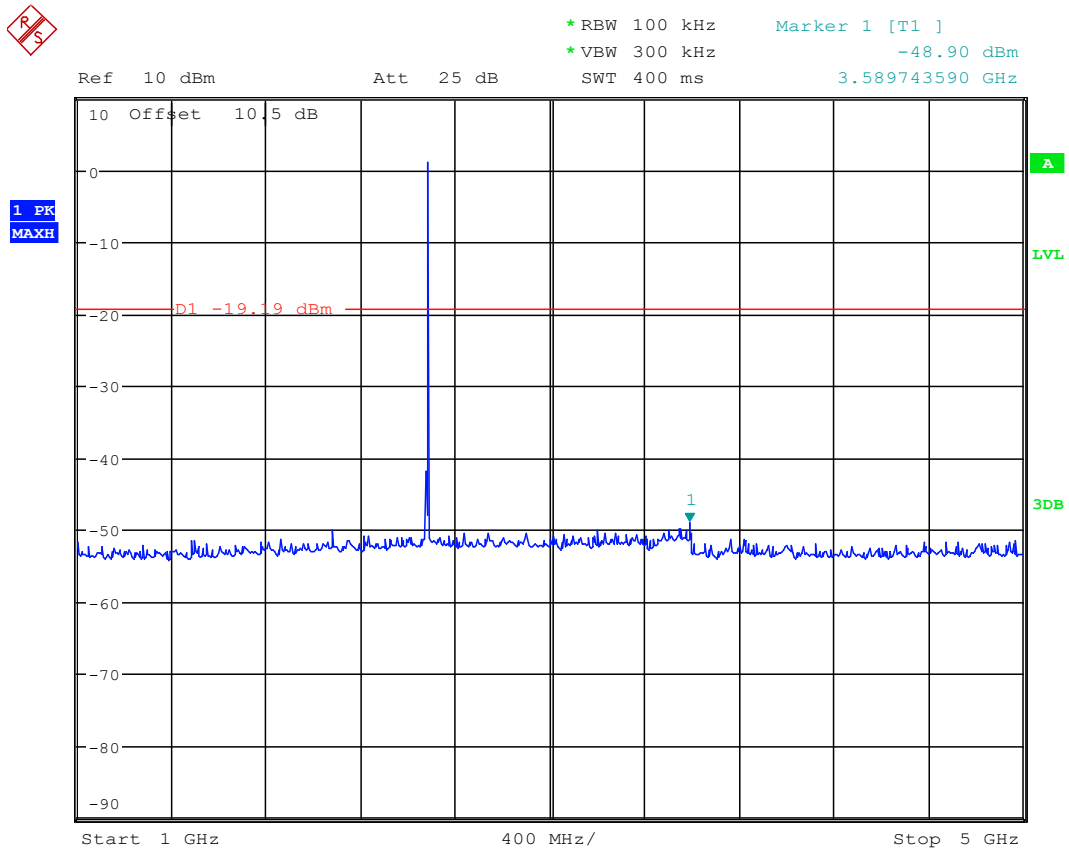

Figure 29. Conducted Spurious Emissions 1 000 – 5 000 MHz. Channel HIGH.

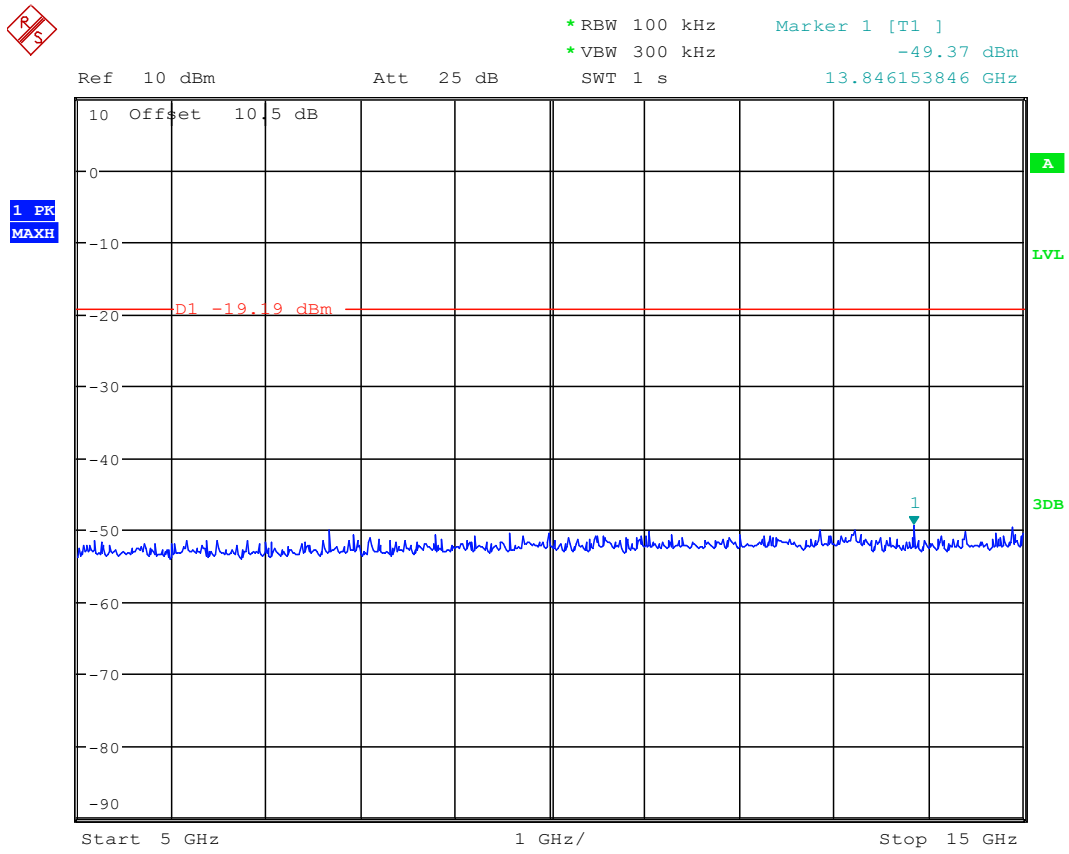

Figure 30. Conducted Spurious Emissions 10 000 – 15 000 MHz. Channel HIGH.

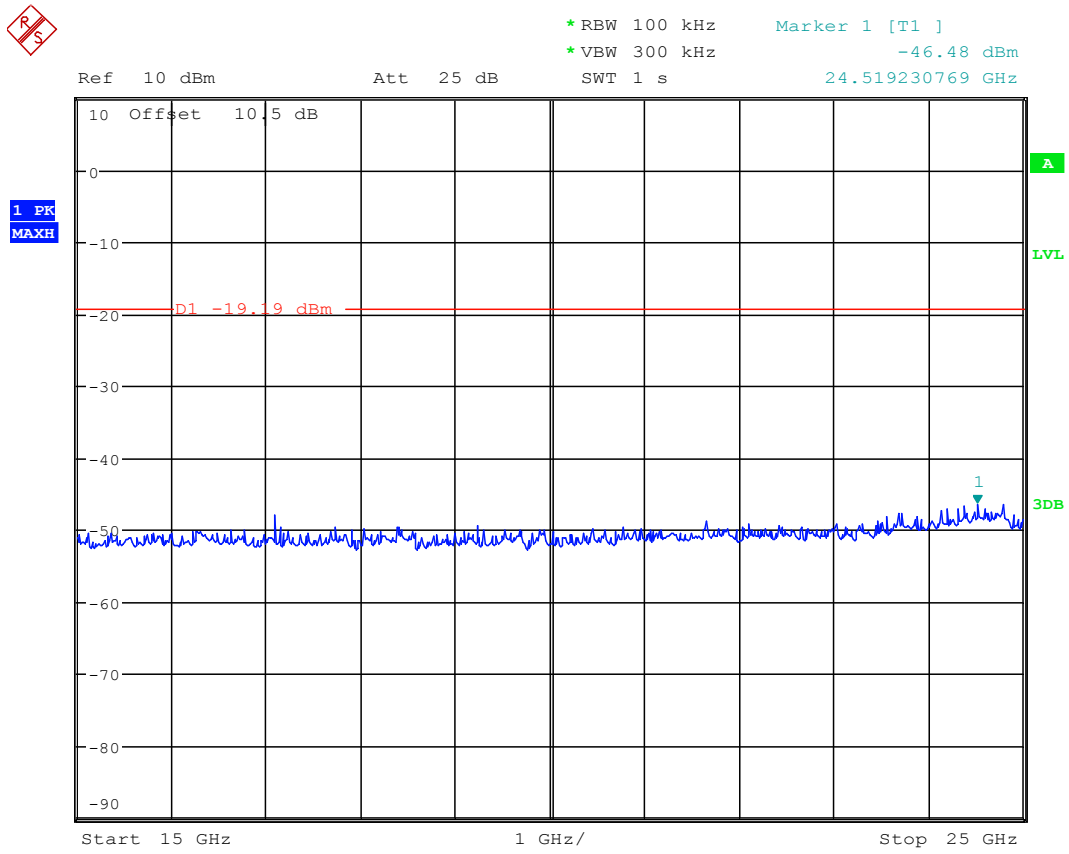

Figure 31. Conducted Spurious Emissions 15 000 – 25 000 MHz. Channel HIGH.

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	666.667	500
Mid	663.462	
High	666.667	

Table 28. 6 dB bandwidth test results.

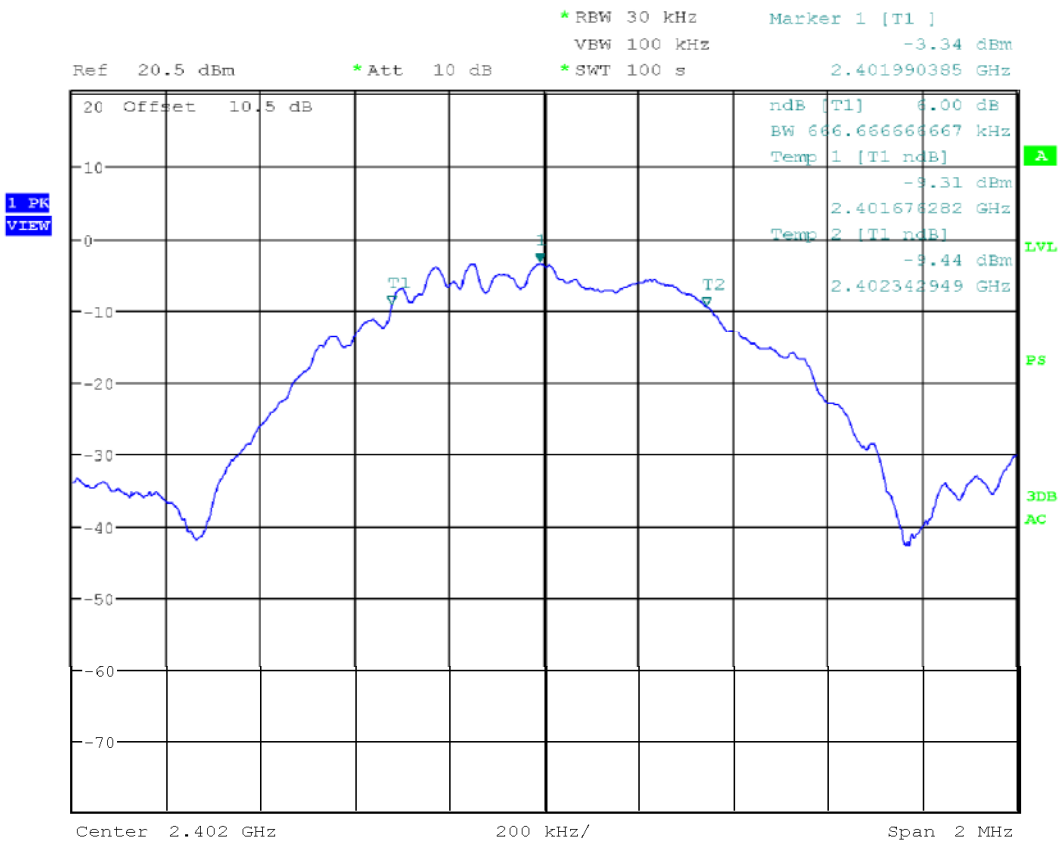

Figure 32. 6 dB bandwidth of the channel LOW.

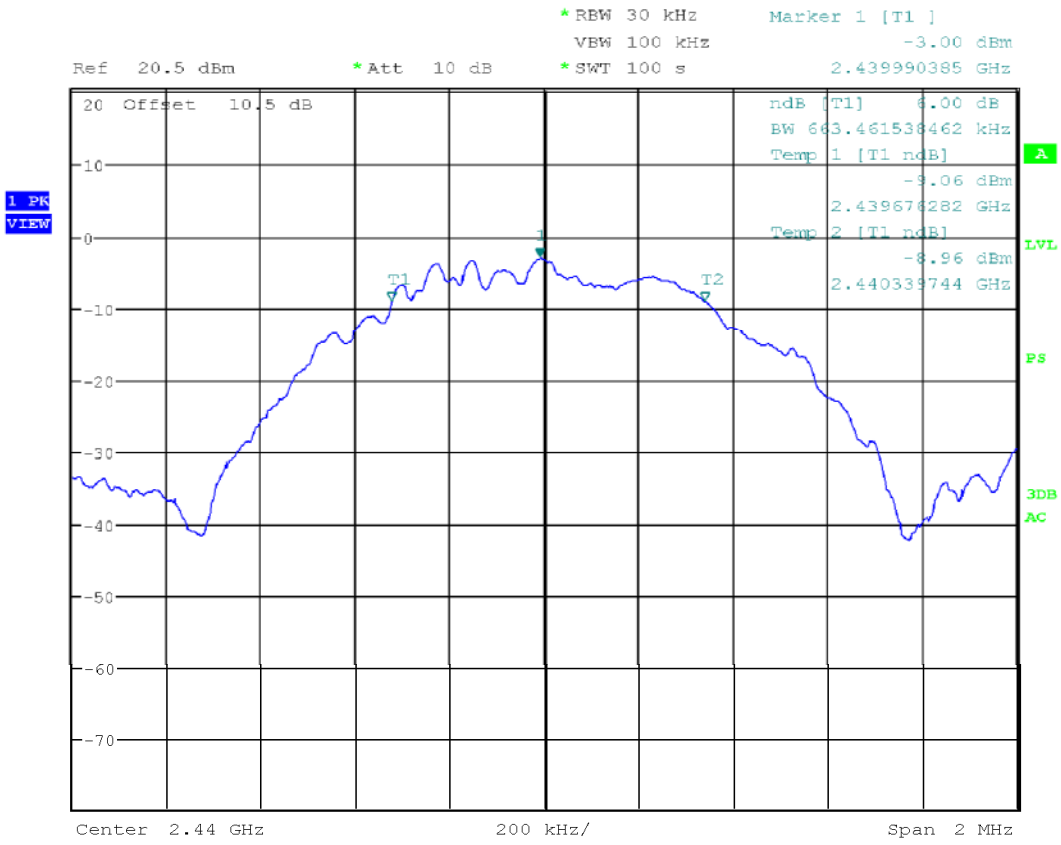

Figure 33. 6 dB bandwidth of the channel MID.

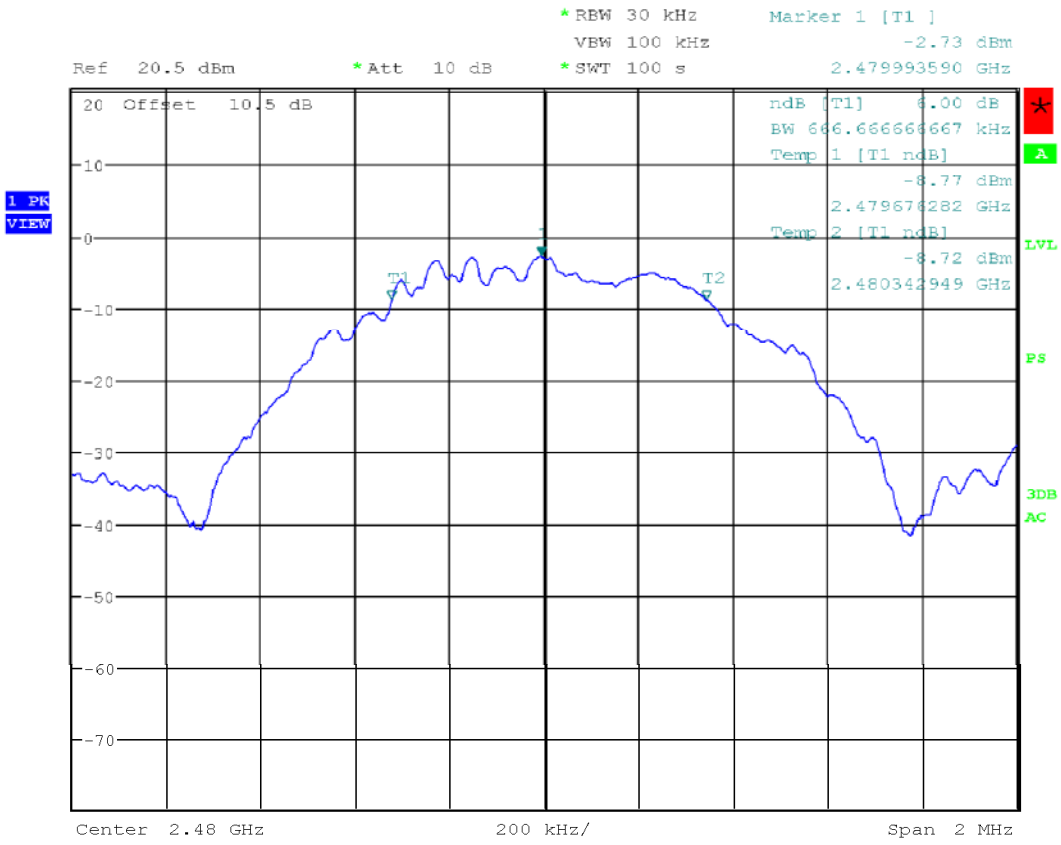

Figure 34. 6 dB bandwidth of the channel HIGH.

Power Spectral Density

Standard:	ANSI C63.10	(2009)
Tested by:	NTO	
Date:	12.7 and 18.7.2011	
Humidity:	52 - 56 %	
Temperature:	21 - 22 °C	

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

Results:

Channel	PSD dBm/3 kHz	Maximum limit [dBm/3kHz]
Low	-14.10	+8.00
Mid	-13.82	
High	-13.48	

Table 29. Power Spectral Density test results.

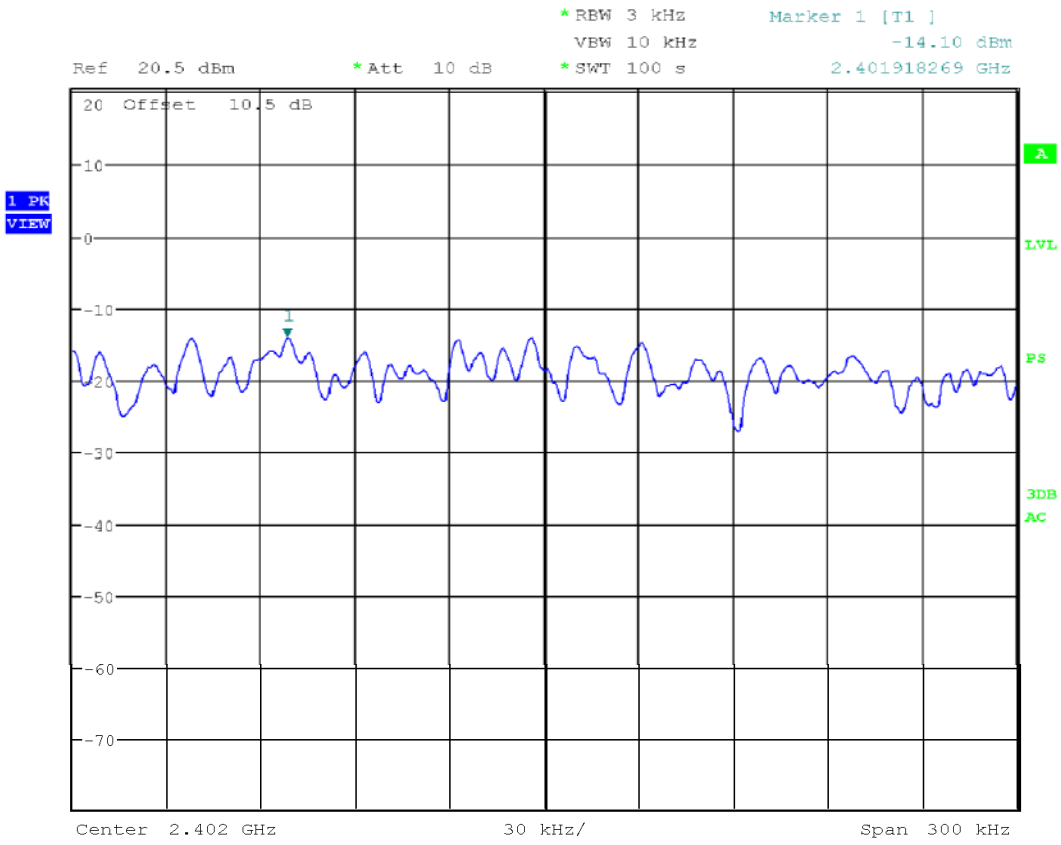

Figure 35. Power Spectral Density of the channel LOW.

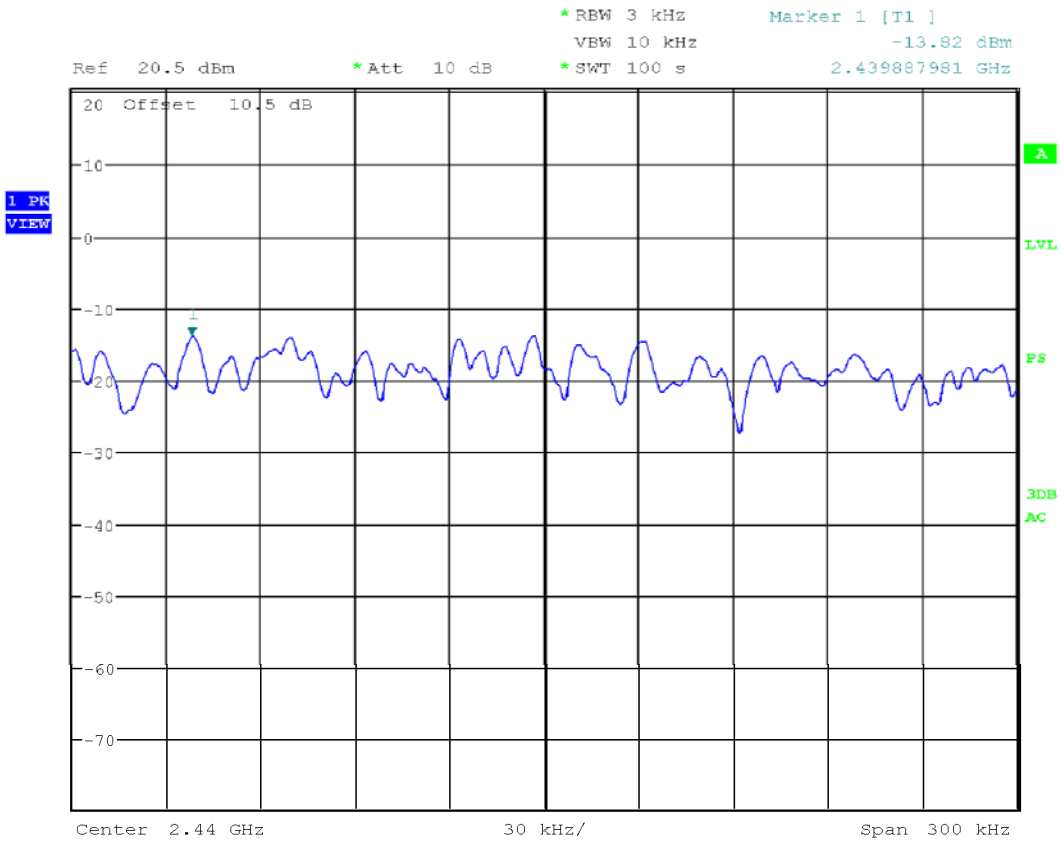

Figure 36. Power Spectral Density of the channel MID.

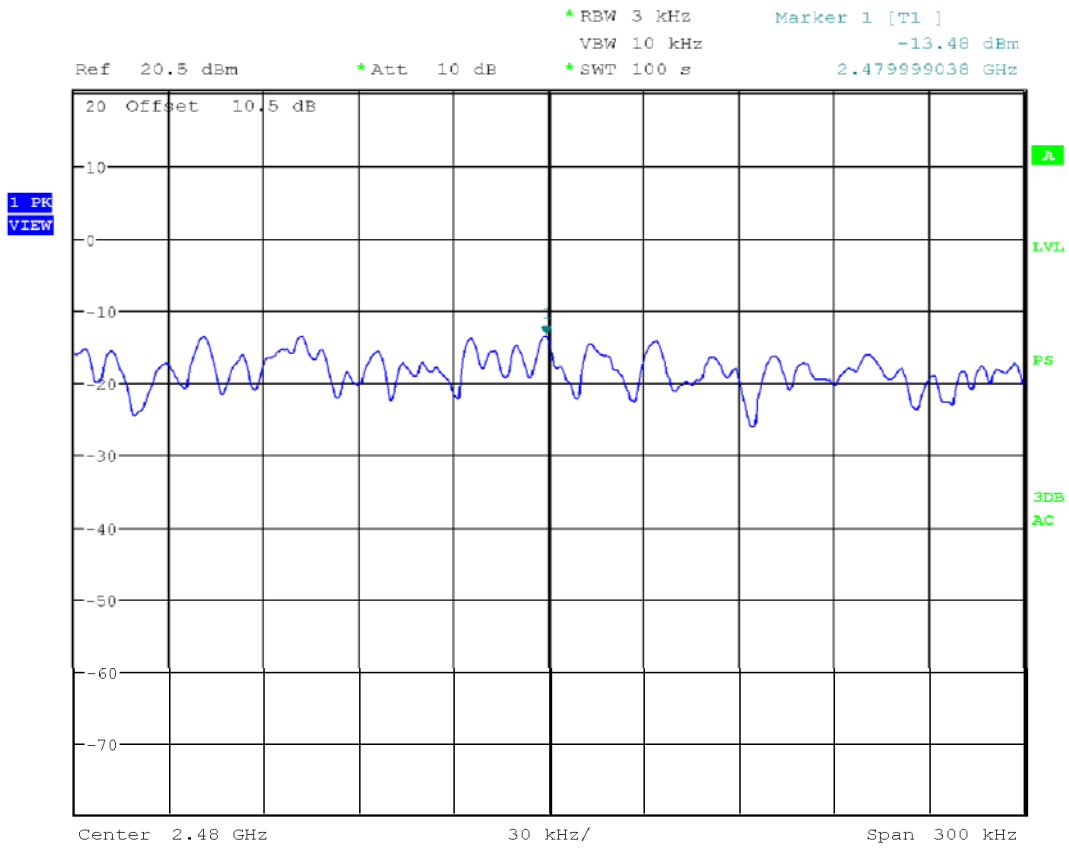

Figure 37. Power Spectral Density of the channel HIGH.

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	-	1.09375	PASS
Mid	-	1.08625	PASS
High	-	1.08500	PASS

Table 30. 99 % OBW test results.

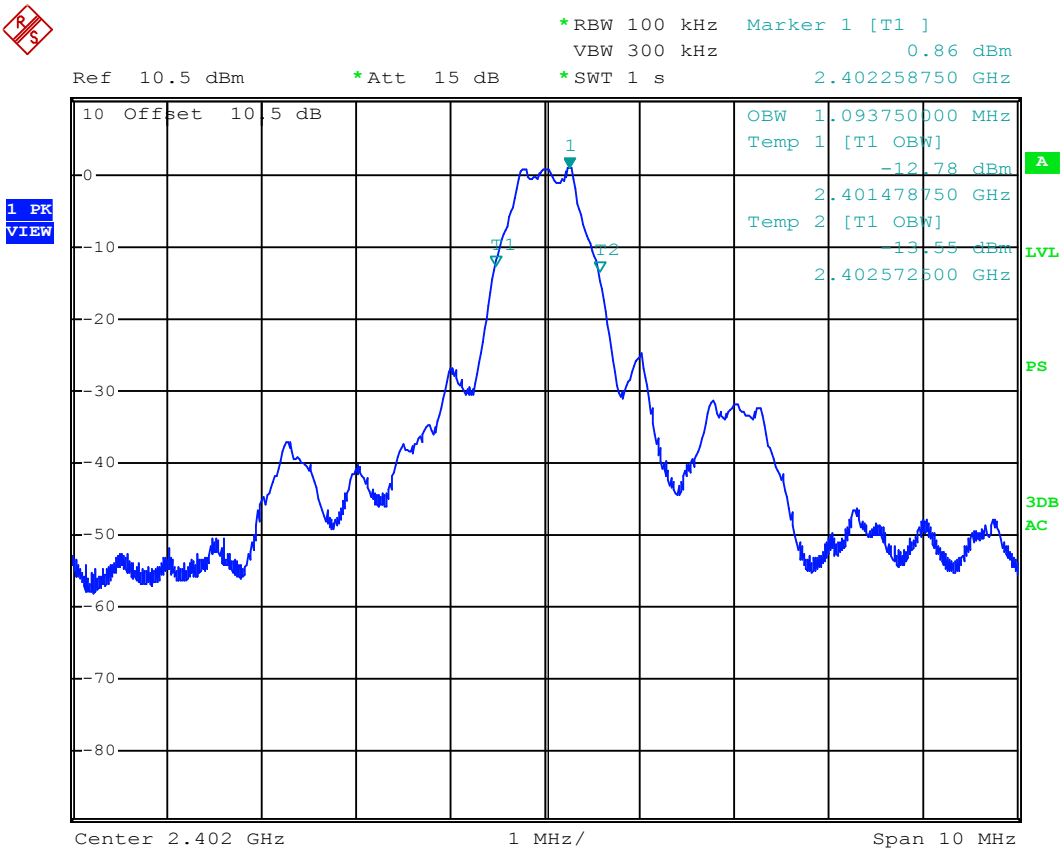

Figure 38. 99 % OBW. Channel low.

99 % Occupied Bandwidth

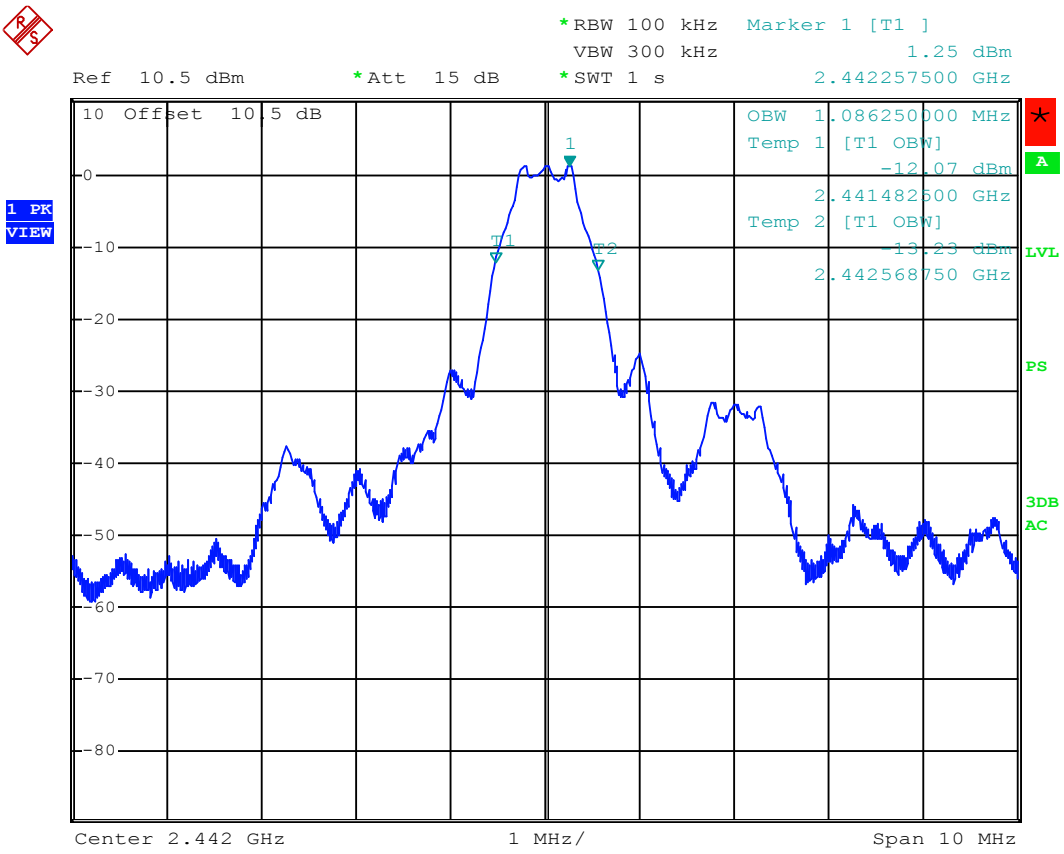

Figure 39. 99 % OBW. Channel mid.

99 % Occupied Bandwidth

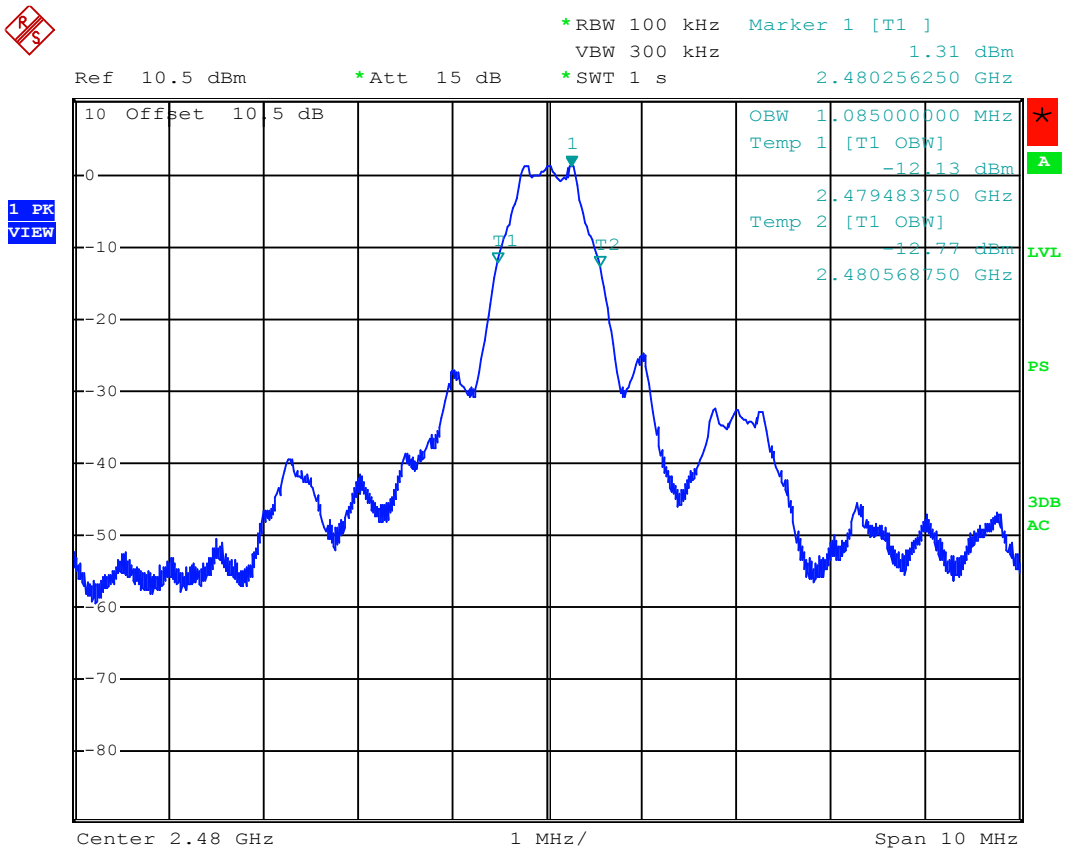

Figure 40. 99 % OBW. Channel high.

Receiver Radiated Emissions 30 – 26 500 MHz

Standard:	ANSI C63.10	(2009)
Tested by:	JJM	
Date:	26.5.2011	
Humidity:	40 %	
Temperature:	23.0 °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.

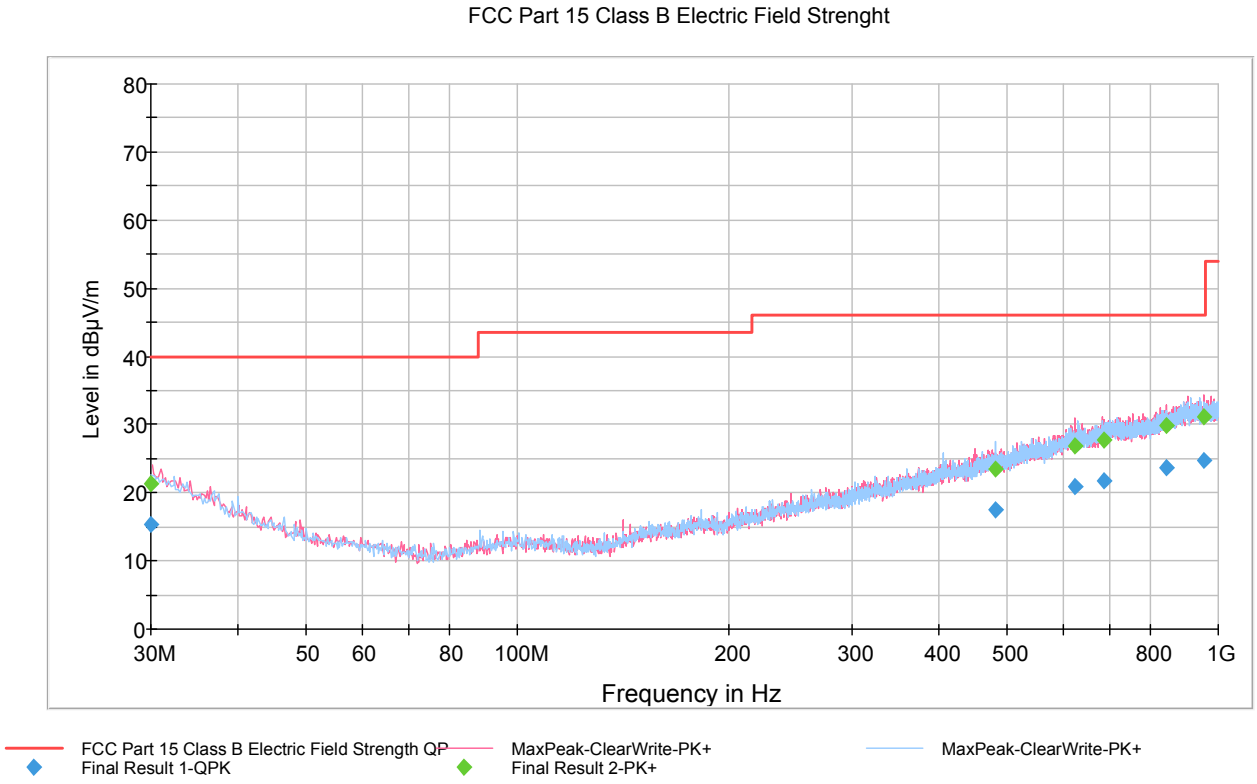

Figure 41. Measured curve with peak-detector.

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
30.000000	15.3	15000.0	120.000	204.0	V	108.0	19.2	24.7	40.0	
479.982500	17.5	15000.0	120.000	175.0	H	256.0	21.6	28.5	46.0	
624.951250	20.9	15000.0	120.000	238.0	V	272.0	24.4	25.1	46.0	
685.082500	21.8	15000.0	120.000	325.0	V	182.0	25.2	24.2	46.0	
841.482500	23.7	15000.0	120.000	130.0	V	15.0	27.0	22.3	46.0	
955.176250	24.7	15000.0	120.000	204.0	V	164.0	28.2	21.3	46.0	

Table 31. Final results.

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

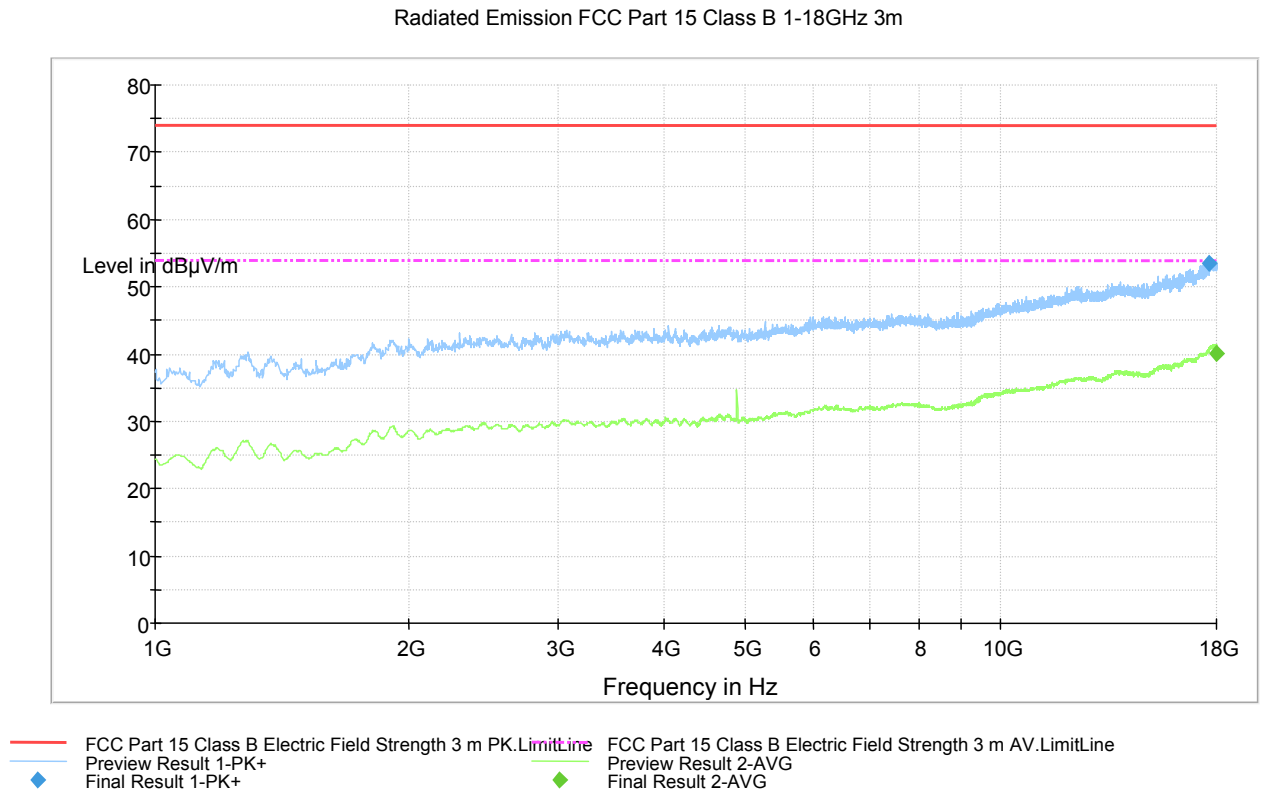

Figure 42. Measured curve with peak-and average detector.

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
17654.750000	53.4	1000.0	1000.000	155.0	V	114.0	24.5	20.5	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
17977.050000	40.2	1000.0	1000.000	100.0	V	14.0	25.2	13.7	53.9	

Table 33. Final Average results.

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

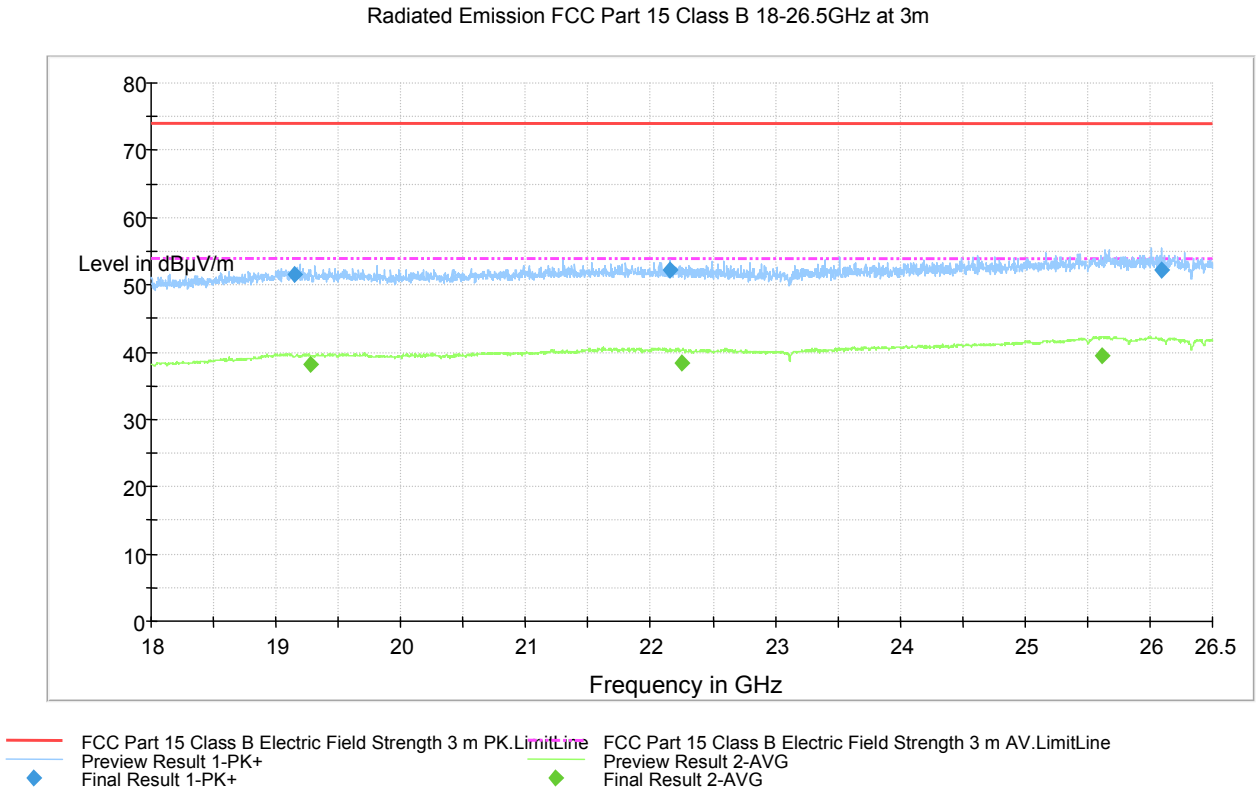

Figure 43. Measured curve with peak-and average detector.

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
19155.250000	51.6	1000.0	1000.000	175.0	V	49.0	23.7	22.3	73.9	
22156.250000	52.1	1000.0	1000.000	175.0	V	101.0	25.6	21.8	73.9	
26090.550000	52.1	1000.0	1000.000	109.0	V	1.0	28.0	21.8	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
19271.650000	38.2	1000.0	1000.000	100.0	V	-4.0	23.7	15.7	53.9	
22248.550000	38.5	1000.0	1000.000	100.0	V	7.0	25.6	15.4	53.9	
25615.850000	39.4	1000.0	1000.000	100.0	V	16.0	27.9	14.5	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

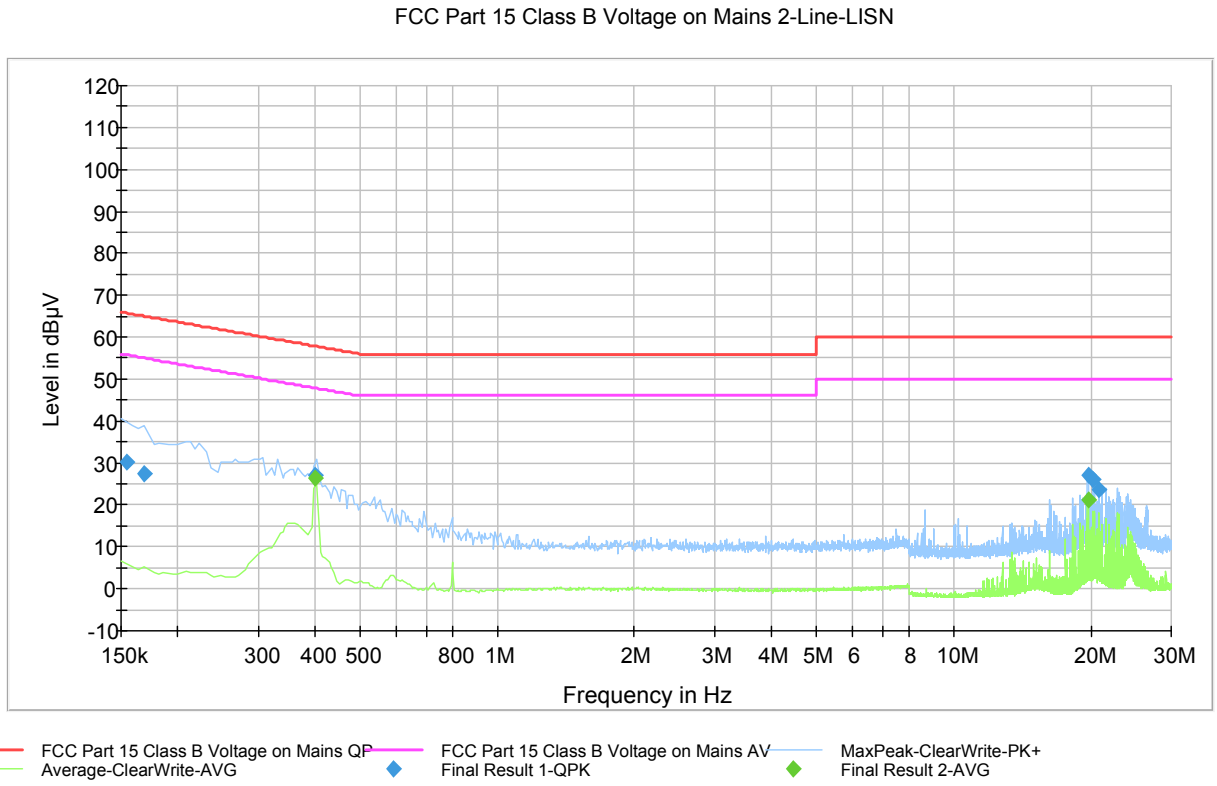

Figure 44. The measured curves with peak- and average-detectors

Final measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.170250	63.6	15000.0	9.000	GND	L1	10.0	15.4	79.0
0.636000	55.1	15000.0	9.000	GND	L1	10.1	17.9	73.0
1.702500	56.5	15000.0	9.000	GND	L2	10.3	16.5	73.0
7.293750	63.0	15000.0	9.000	GND	L2	10.7	10.0	73.0
11.451750	52.7	15000.0	9.000	GND	L2	11.0	20.3	73.0
14.205750	48.9	15000.0	9.000	GND	L2	11.4	24.1	73.0

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

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.399001	26.5	15000.0	9.000	GN	N	10.1	21.4	47.9
19.708501	21.0	15000.0	9.000	GN	L1	11.6	29.0	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

Manufacturer	Type	Serial no	Inv. no
ROHDE & SCHWARZ			
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		
DAVIS			
Weather station	Vantage Pro	-	5297
EMCO			
Antenna (1 - 18 GHz)	3117	29617	7293
CHASE			
Antenna (30 MHz - 1 GHz)	6141A	4102	7895
HEWLETT- PACKARD			
Microwave amplifier	83017A	-	5226
HUBER-+ SUHNER			
Attenuator 10dB	6810.17B	-	-
DEISEL			
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
WAINWRIGHT			
High Pass Filter	WHKX	10	8267