

Test Report



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

Equipment Under Test: Heart Rate Belt (Low Energy Bluetooth)

Marketing Name: SUUNTO MOVESENSE

Manufacturer: Suunto Oy
Valimotie 7
FI-01510 VANTAA
FINLAND

Customer: Suunto Oy
Valimotie 7
FI-01510 VANTAA
FINLAND

FCC Rule Part: 15.247: 2013
IC Rule Part: RSS-210, Issue 8, 2010
RSS-GEN Issue 3, 2010

KDB: Guidance for Performing Compliance Measurements
on Digital Transmission Systems (DTS) Operating
Under §15.247 (April 9, 2013)

Date: September 16, 2013

Issued by:


Rauno Repo
Testing Engineer

Date: September 16, 2013

Checked by:


Ari Honkala
Product Line Manager

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Equipment Under Test (EUT)

Heart Rate Belt
Marketing Name: MOVESENSE
Serial Number: -

The EUT is a heart rate belt using Low Energy Bluetooth.

Several samples were used in tests. There were separate units for each channel (low, mid and high) and for conductive measurements there were units with SMA antenna port connectors and wires for external power source.

Classification of the device

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

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing

Ratings and declarations

Low Energy Bluetooth:

Operating Frequency Range (OFR): 2402 – 2480 MHz
Channels: 40
Channel separation: 2 MHz
Conducted power: -1.84 dBm
Transmission technique: Digital transmission
Modulation: V4.0 single mode
Integrated antenna gain: -2.7 dBi max

Power Supply

- Internal battery CR2025.
- Conductive measurements were tested with an external precision laboratory power source

Disclaimer

This test report is issued under SGS Fimko general terms of delivery (available on request and accessible at www.fi.sgs.com). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues defined therein. Unless otherwise stated: (a) the results shown in this document refer only to the sample(s) tested and (b) such sample(s) are retained for three months. This document cannot be reproduced except in full, without prior approval of SGS Fimko.

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SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.207(a) / RSS-GEN 7.2.2	Conducted Emissions on Power Supply Lines	N/A*
§15.247(b)(3) / RSS-210 8.4	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-210 A8.2	6 dB Bandwidth	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

* The EUT is a battery operated device.

EUT Test Conditions during Testing

The EUT was operating in the wanted channel and was modulated in continuous transmit mode during all the tests.

Following channels were used during the tests:

Channel	Frequency/ MHz
LOW (CH 0)	2402
MID (CH 19)	2440
HIGH (CH 39)	2480

Test Facility

<input type="checkbox"/> Testing Location / address: FCC registration number: 90598	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
<input checked="" type="checkbox"/> 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: RRE
Date: 13.9.2013
Temperature: 22 °C
Humidity: 48 % RH
Measurement uncertainty ± 2.87dB Level of confidence 95 % (k = 2)

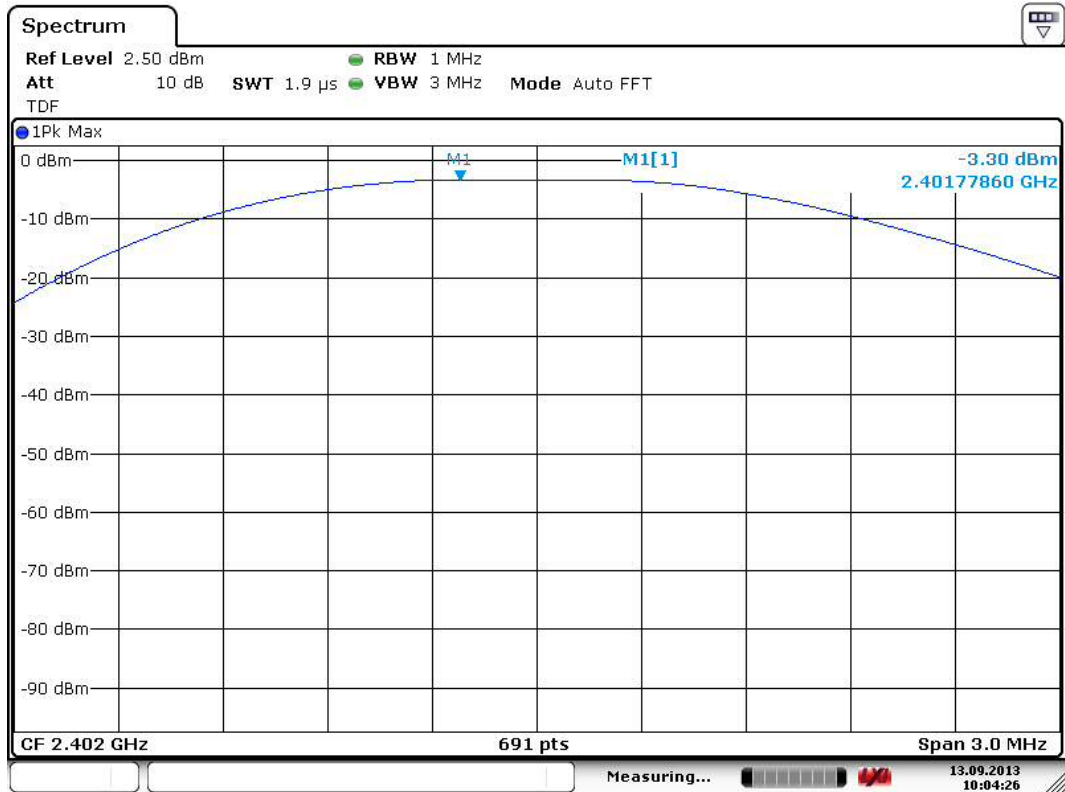
FCC Rule: 15.247(b) (1)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing less than 75 hopping channels the limit is 0.125 watts (=20.969 dBm). Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

Results:

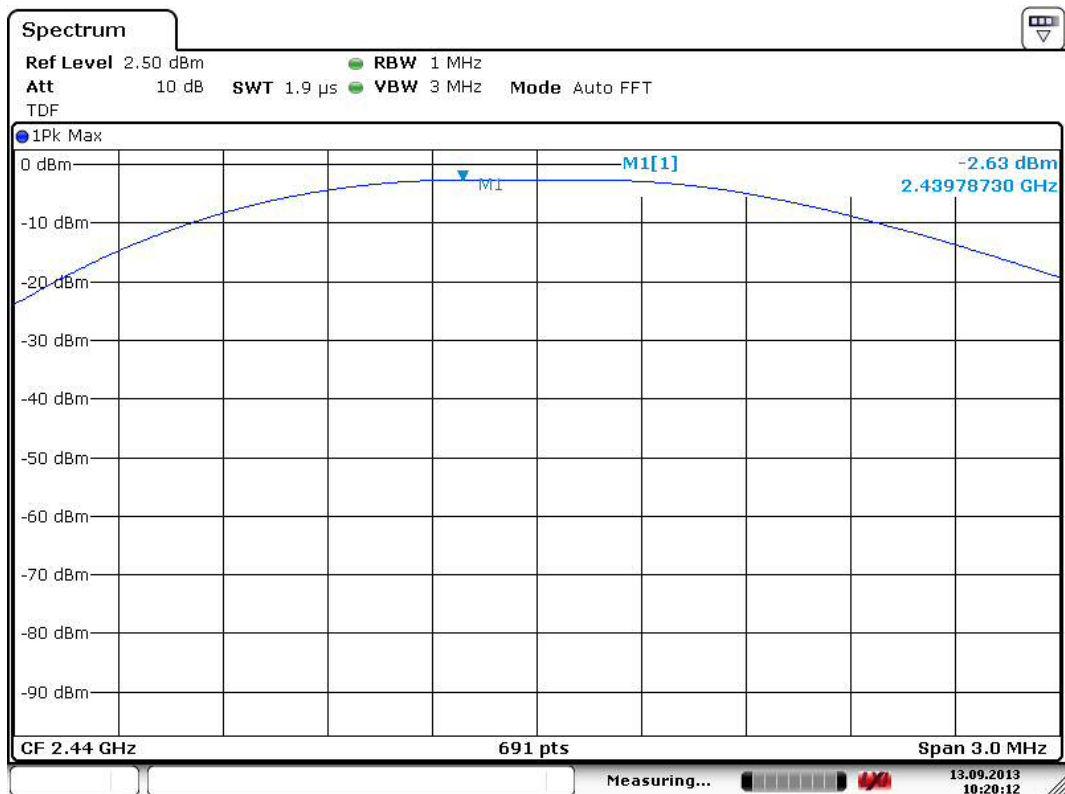
Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	-3.30	20.969	24.27	PASS
Mid	-2.63	20.969	23.33	PASS
High	-1.84	20.969	22.81	PASS

Maximum Peak Conducted Output Power



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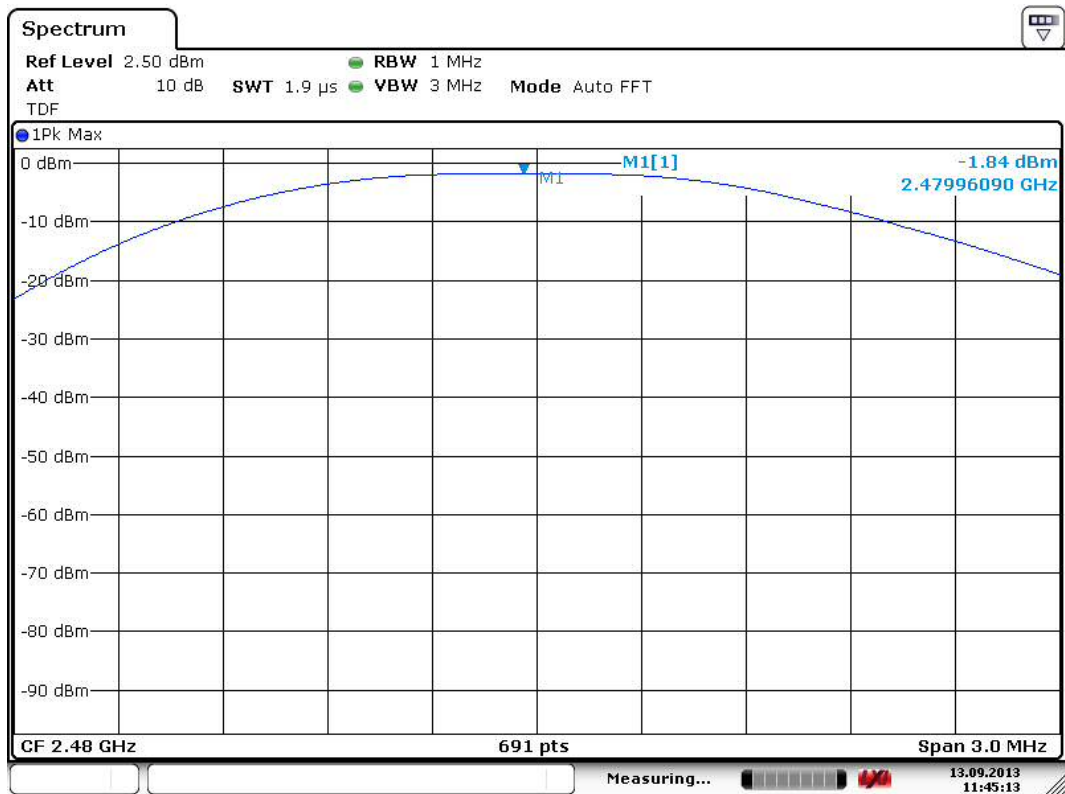
Figure 1. Channel LOW.



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Figure 2. Channel MID.

Maximum Peak Conducted Output Power



Date: 13.SEP.2013 11:45:14

Figure 3. Channel HIGH.

Transmitter Radiated Emissions 30 MHz to 26.5 GHz

Standard:	ANSI C63.10	(2009)
Tested by:	RRE	
Date:	11. – 12.9.2013	
Temperature:	20 - 21 °C	
Humidity:	56 - 57 % RH	
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 result value is the measured value corrected with the correction factor.

Test results

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m

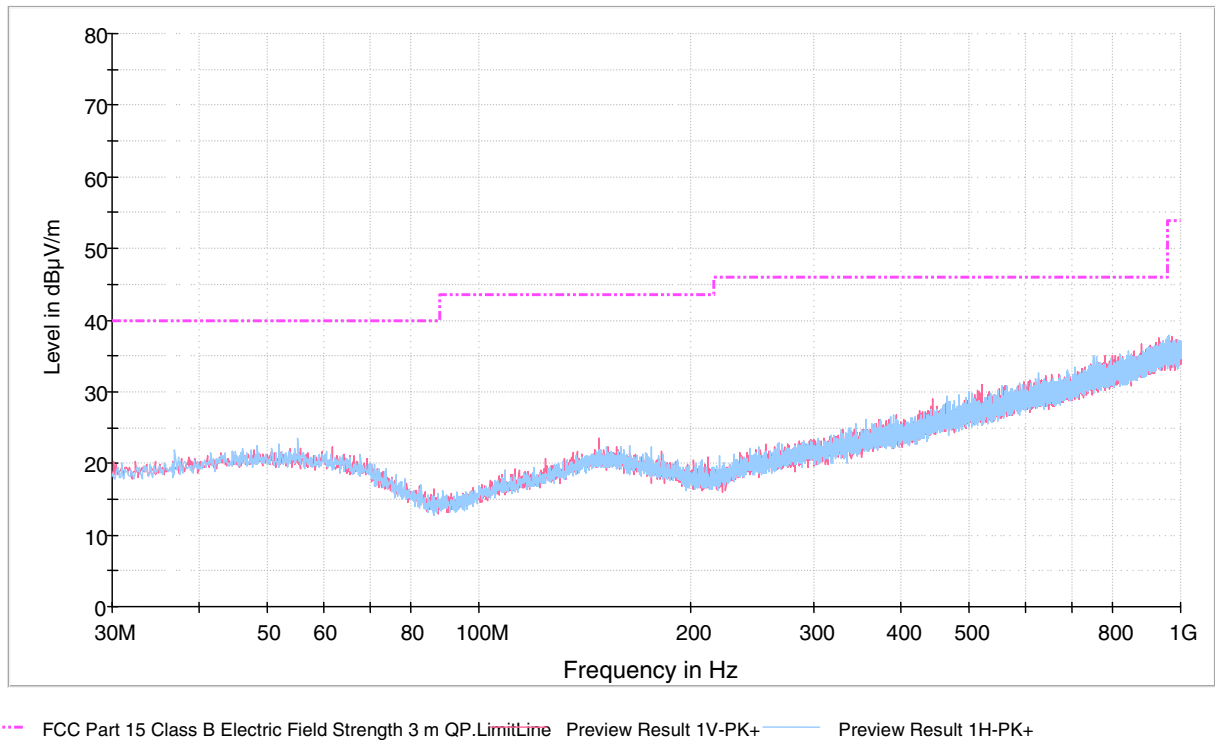
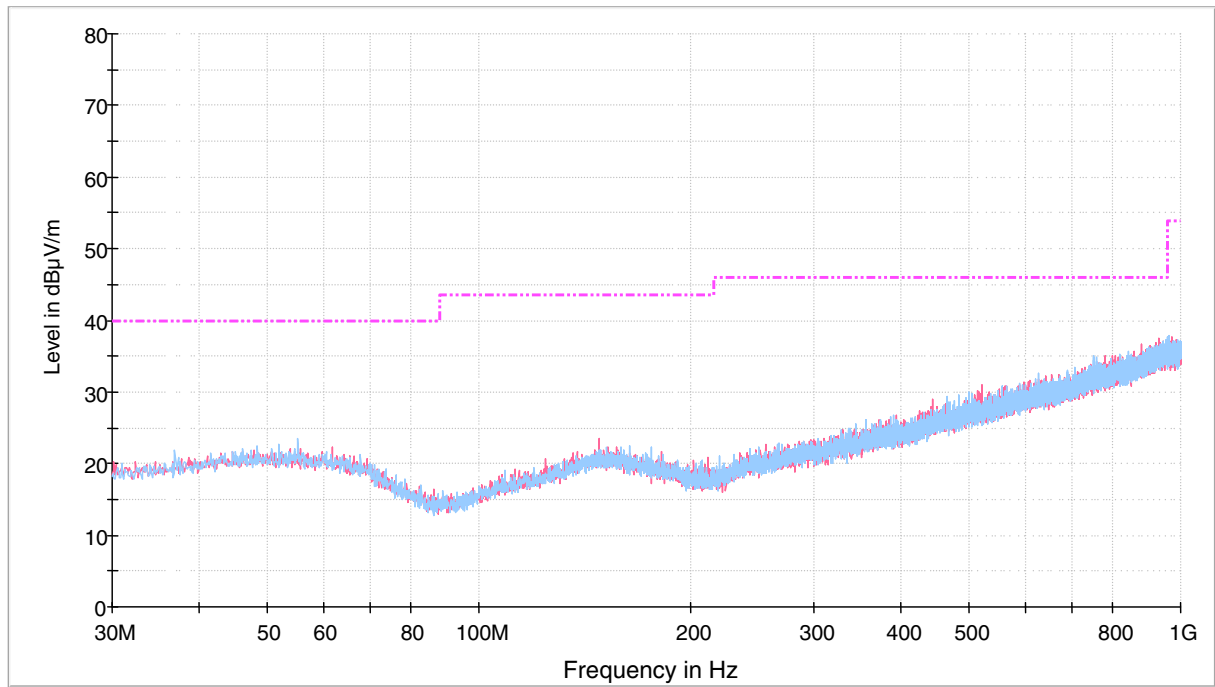


Figure 4. Measured curve with peak-detector. Channel LOW.

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m



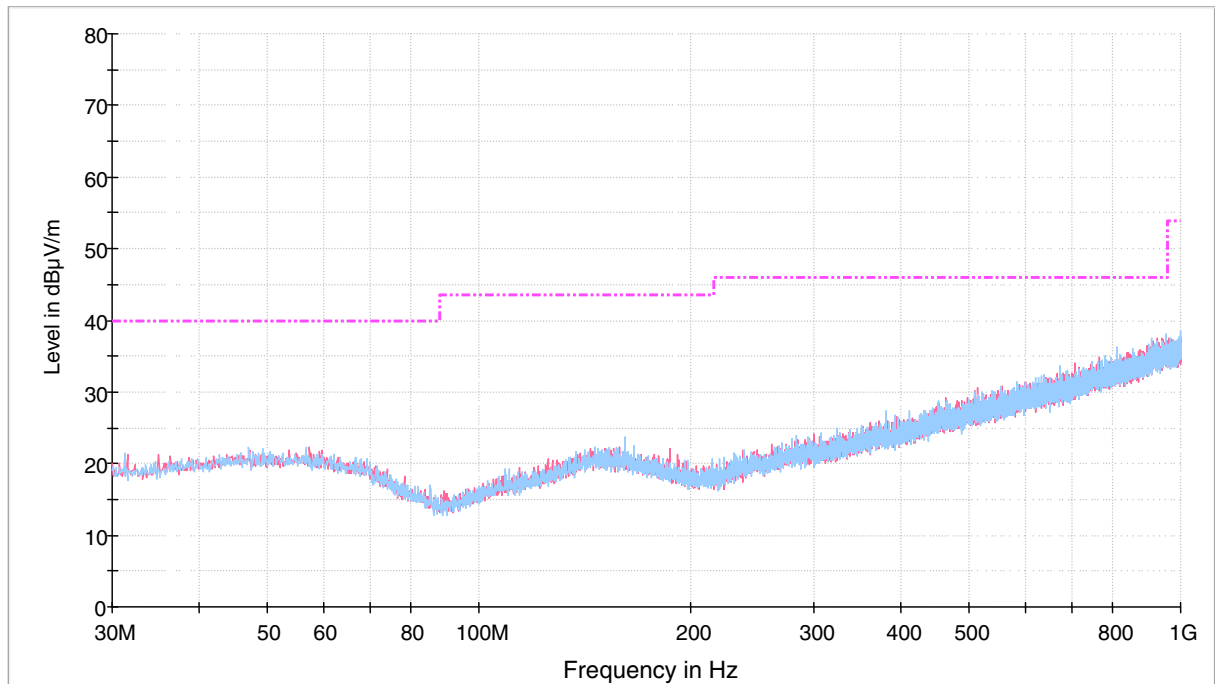
----- FCC Part 15 Class B Electric Field Strength 3 m QP.LimitLine Preview Result 1V-PK+ ——— Preview Result 1H-PK+

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

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

FCC Part 15 Class B Spurious Emission 30-1000MHz 3m



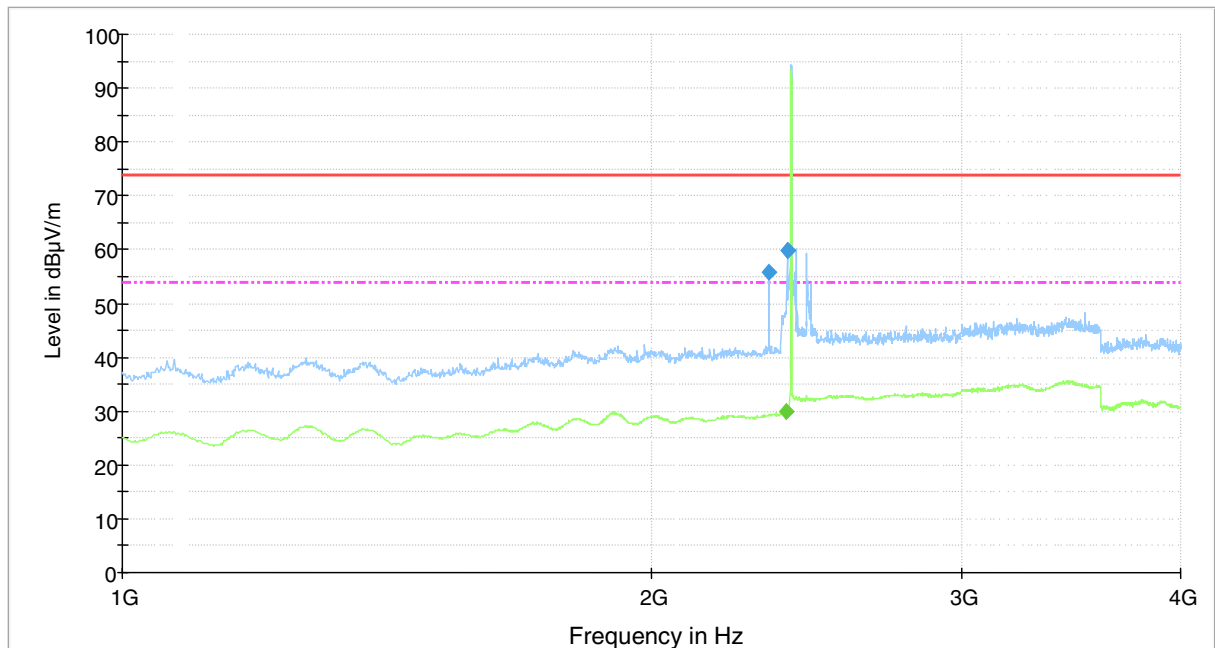
----- FCC Part 15 Class B Electric Field Strength 3 m QP.LimitLine Preview Result 1V-PK+ ——— Preview Result 1H-PK+

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

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

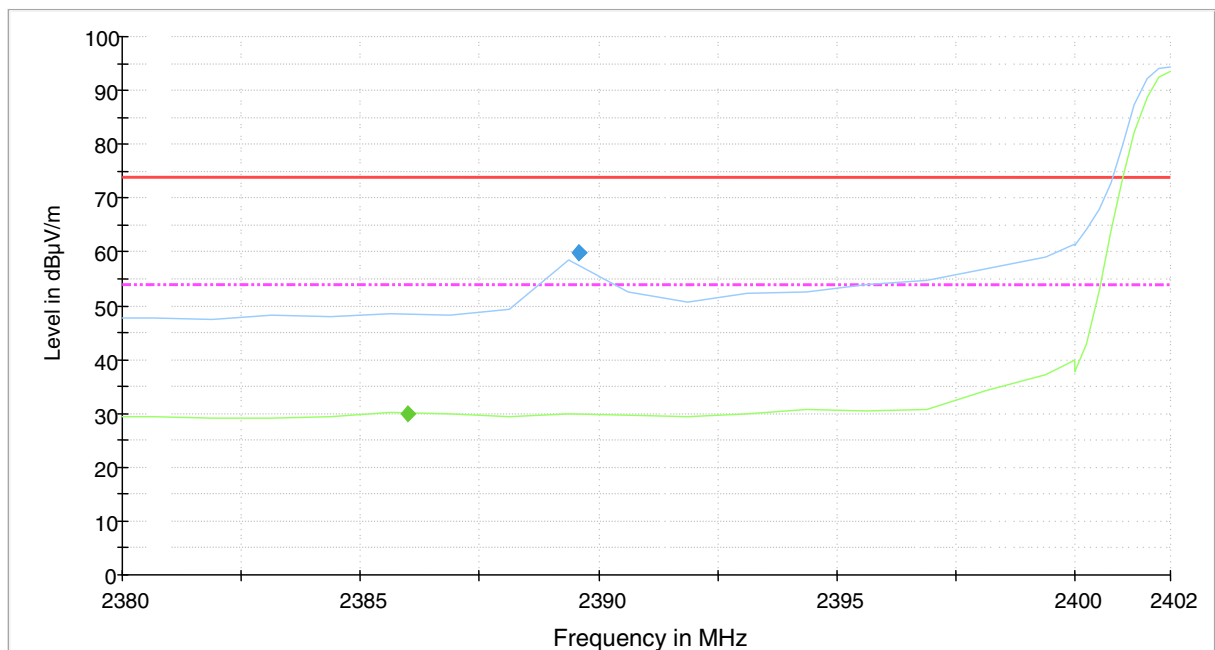
FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



- FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
- Preview Result 1-PK+
- Preview Result 2-AVG
- ◆ Final Result 1-PK+
- ◆ Final Result 2-AVG

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

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



- FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
- Preview Result 1-PK+
- Preview Result 2-AVG
- ◆ Final Result 1-PK+
- ◆ Final Result 2-AVG

Figure 8. Low channel band edge.

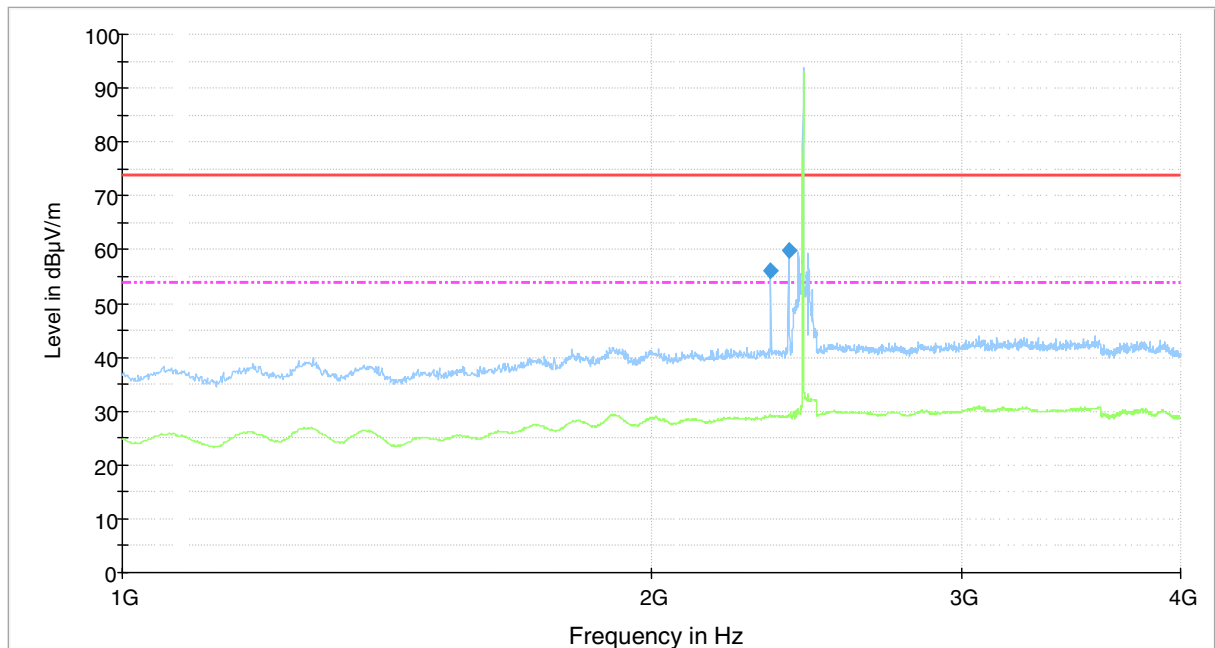
Final measurements from the worst frequencies
Table 1. Final Max Peak results.

Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2332.275000	55.8	1000.0	1000.000	106.0	V	206.0	3.9	18.1	73.9	
2389.575000	59.9	1000.0	1000.000	100.0	V	181.0	4.4	14.0	73.9	
2389.600000	59.9	1000.0	1000.000	100.0	V	181.0	4.4	14.0	73.9	

Table 2. Final Average results.

Frequency (MHz)	Average (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2386.000000	29.8	1000.0	1000.000	162.0	V	181.0	4.3	24.1	53.9	

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine — FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+ — Preview Result 2-AVG
◆ Final Result 1-PK+ ◆ Final Result 2-AVG

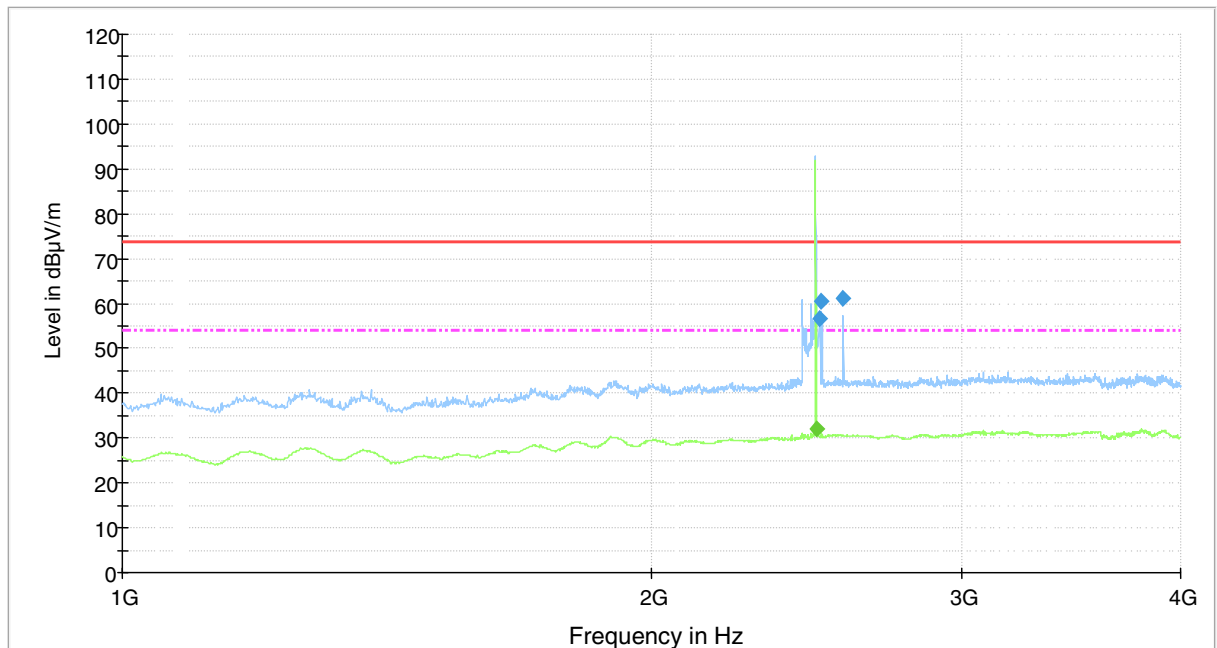
Figure 9. Measured curve with peak- and average detector. Channel MID.

Final measurements from the worst frequencies

Table 3. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2337.675000	56.0	1000.0	1000.000	100.0	V	278.0	3.9	17.9	73.9	
2395.375000	59.9	1000.0	1000.000	198.0	V	181.0	4.4	14.0	73.9	

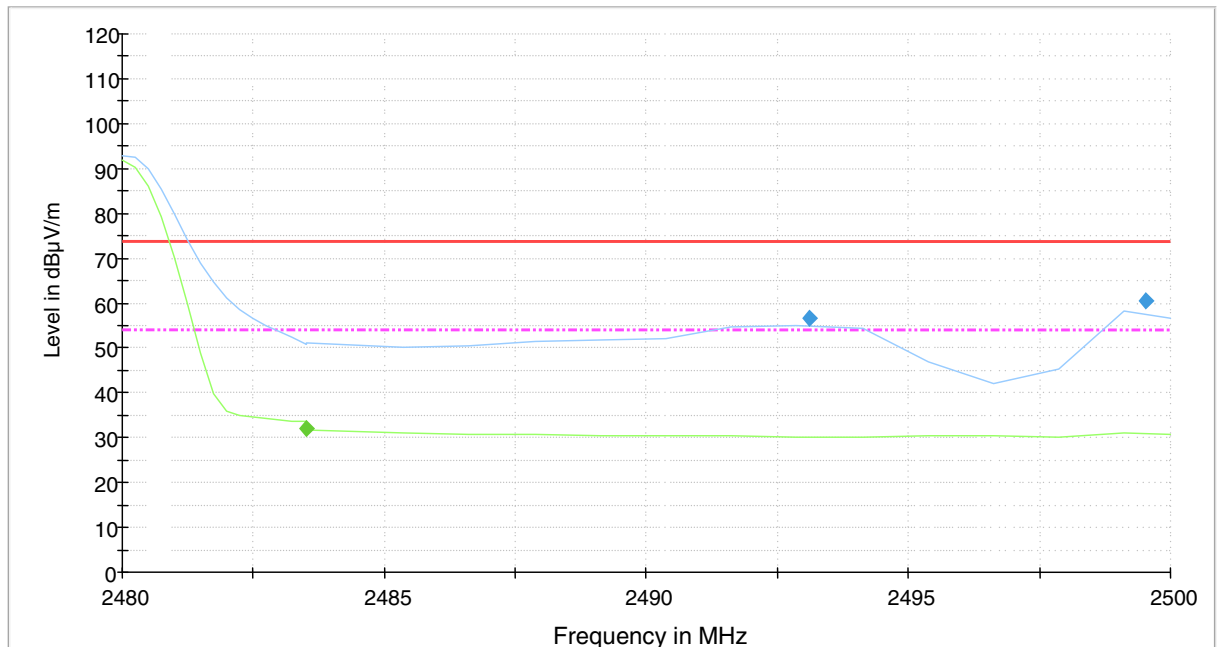
FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



- FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
- ◆ Preview Result 1-PK+
- ◆ Preview Result 2-AVG
- ◆ Final Result 1-PK+
- ◆ Final Result 2-AVG

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

FCC Part 15 Class B Spurious Emission 1-4GHz 3m (optimized 2.4 GHz TX)



- FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
- FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
- ◆ Preview Result 1-PK+
- ◆ Preview Result 2-AVG
- ◆ Final Result 1-PK+
- ◆ Final Result 2-AVG

Figure 11. High channel band edge.

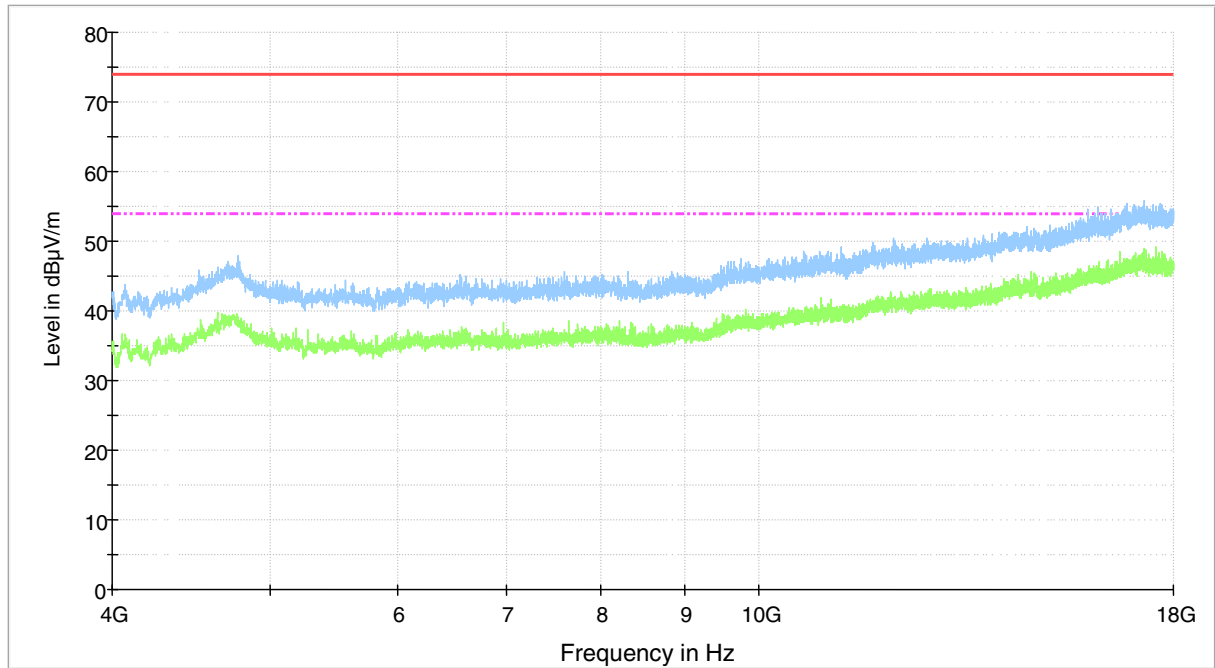
Final measurements from the worst frequencies
Table 4. Final Max Peak results.

Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2493.100000	56.7	1000.0	1000.000	155.0	V	180.0	4.9	17.2	73.9	
2499.525000	60.4	1000.0	1000.000	187.0	V	241.0	4.9	13.5	73.9	
2570.775000	61.0	1000.0	1000.000	207.0	V	60.0	5.1	12.9	73.9	

Table 5. Final Average results.

Frequency (MHz)	Average (dB μ V/m)	Meas. Time 15x(ms)	Bandwidth (kHz)	Height (cm)	Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)	Comment
2483.500000	32.0	1000.0	1000.000	190.0	V	180.0	4.8	21.9	53.9	

FCC Part 15 Class B Spurious Emission 4-18GHz 3m



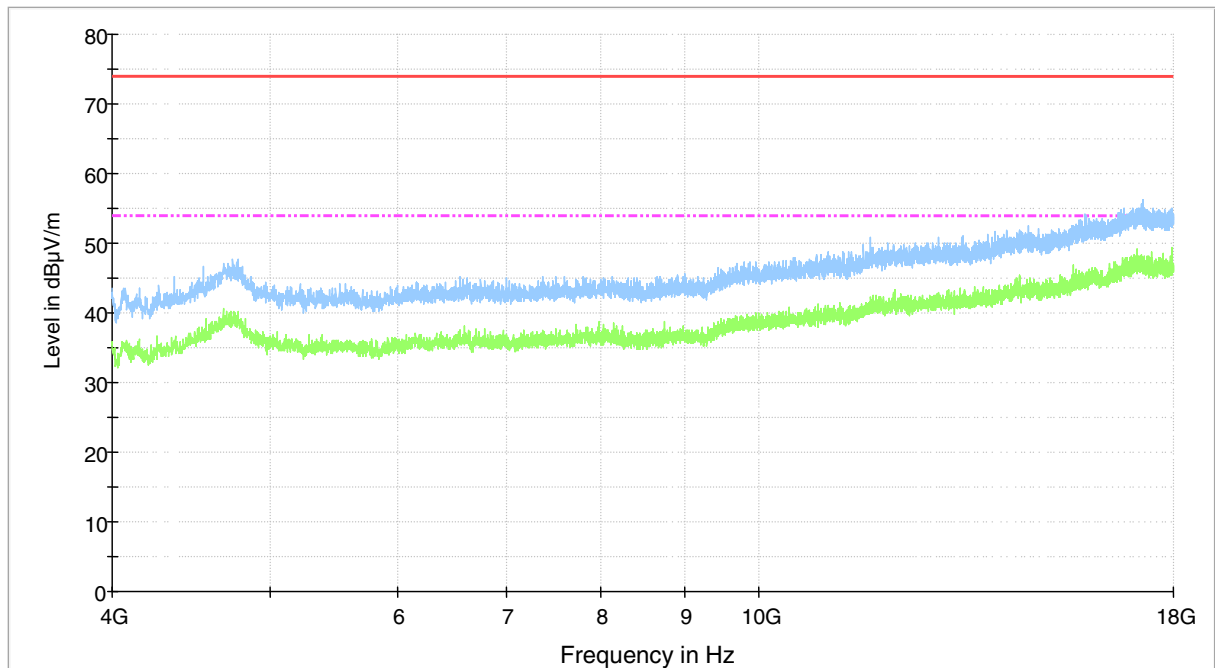
— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
 - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
 — Preview Result 2-AVG

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

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

FCC Part 15 Class B Spurious Emission 4-18GHz 3m



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
 — FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
 — Preview Result 2-AVG

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

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made

FCC Part 15 Class B Spurious Emission 4-18GHz 3m

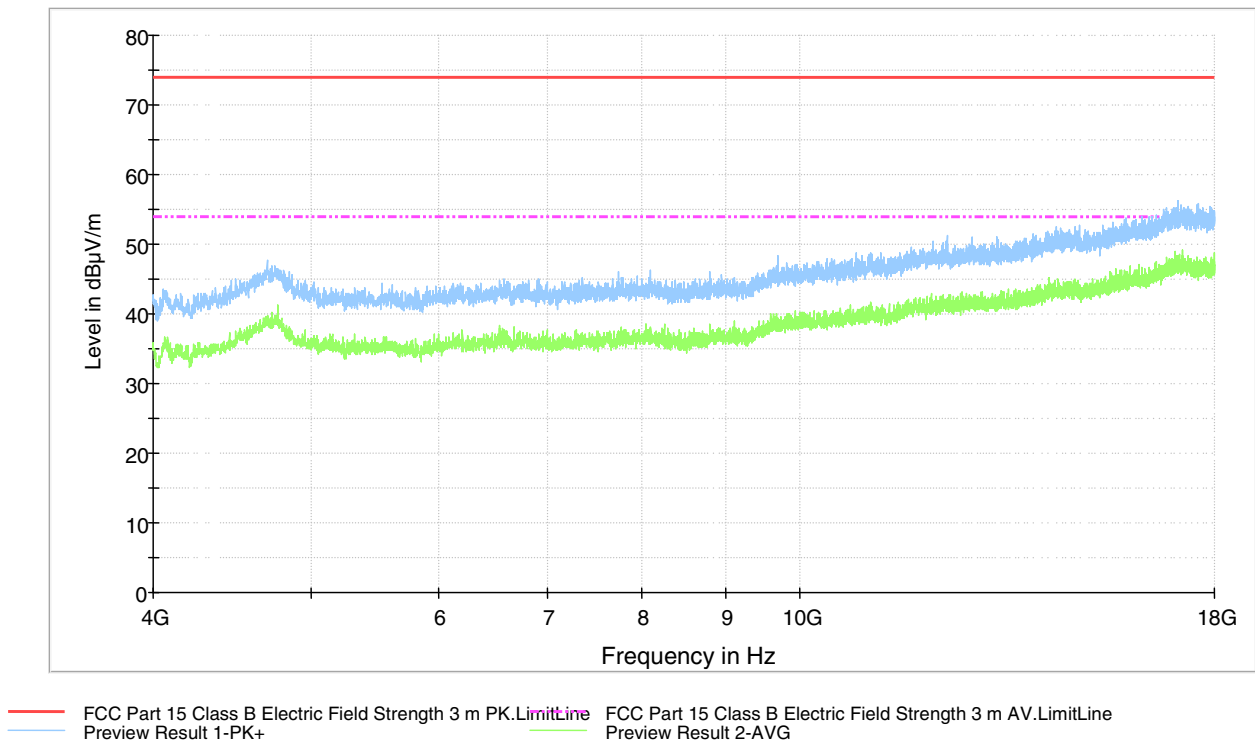
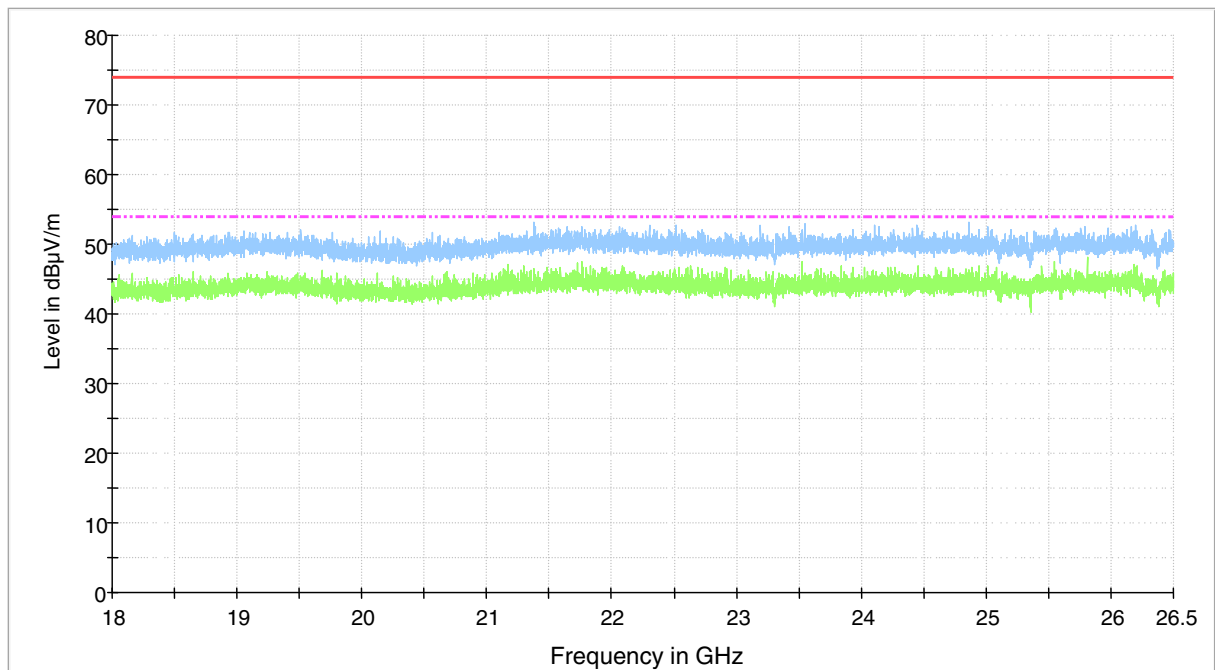


Figure 14. Measured curve with peak- and average detector. Channel HIGH.

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m



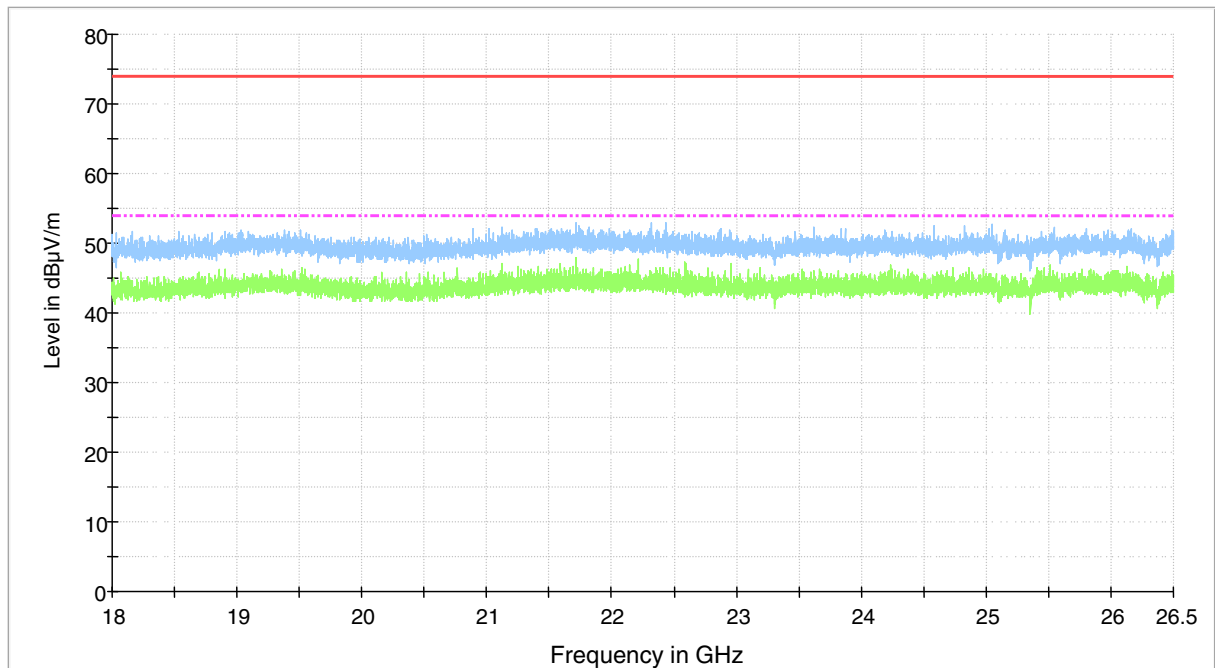
— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
 - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
 — Preview Result 2-AVG

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

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m



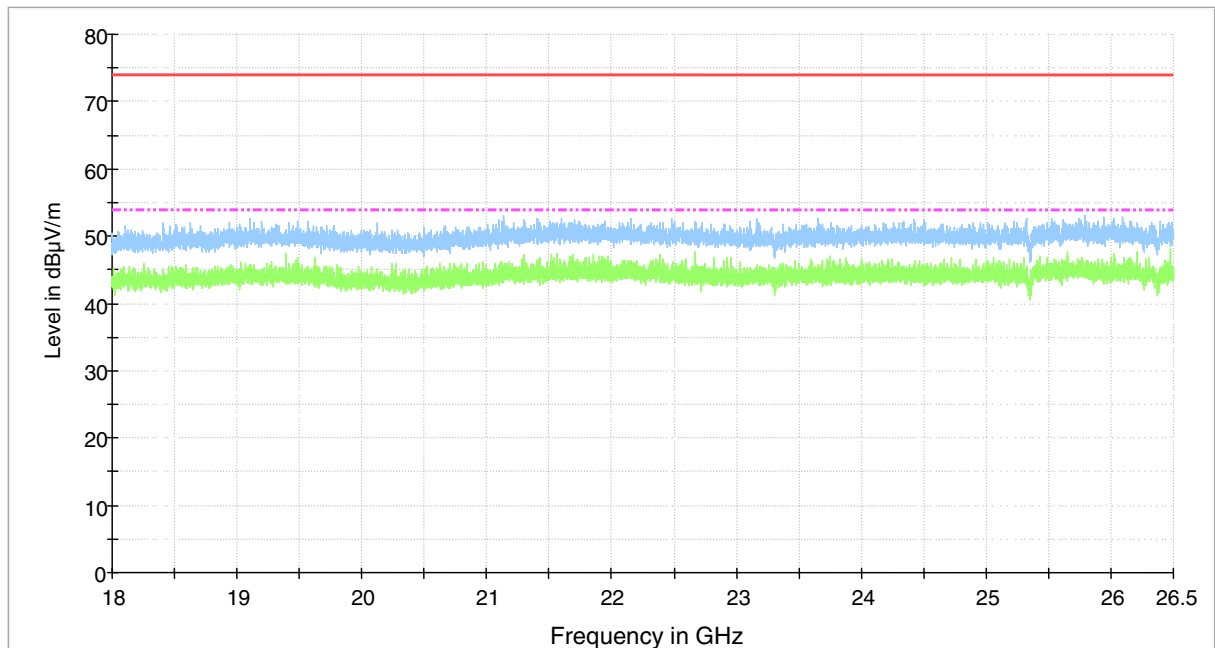
— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
 - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
 — Preview Result 2-AVG

Figure 16. Measured curve with peak- and average detector. Channel MID.

Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

FCC Part 15 Class B Spurious Emission 18-26.5GHz 3m



— FCC Part 15 Class B Electric Field Strength 3 m PK.LimitLine
 - - - FCC Part 15 Class B Electric Field Strength 3 m AV.LimitLine
— Preview Result 1-PK+
 — Preview Result 2-AVG

Figure 17. Measured curve with peak- and average detector. Channel HIGH.

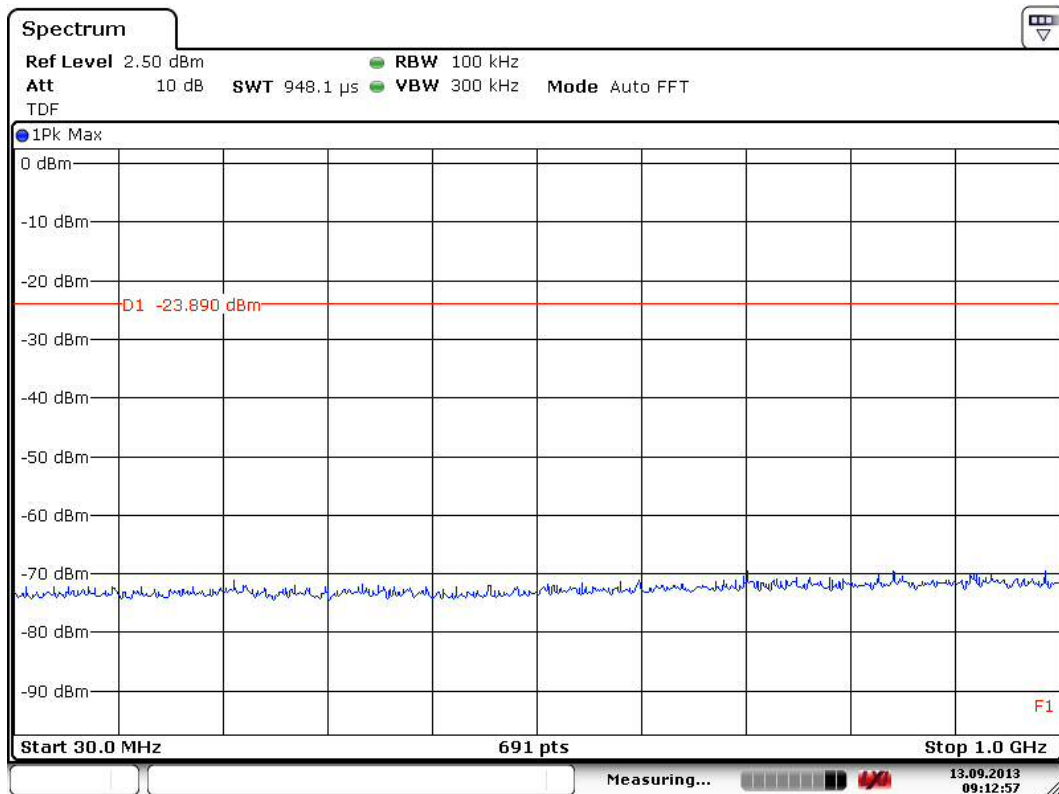
Final measurements from the worst frequencies

Due to the low emission level no final measurements were made.

Conducted Spurious Emissions 30 MHz to 26.5 GHz and Band Edge

Standard: ANSI C63.10 (2009)
Tested by: RRE
Date: 13.9.2013
Temperature: 22 °C
Humidity: 48 % RH

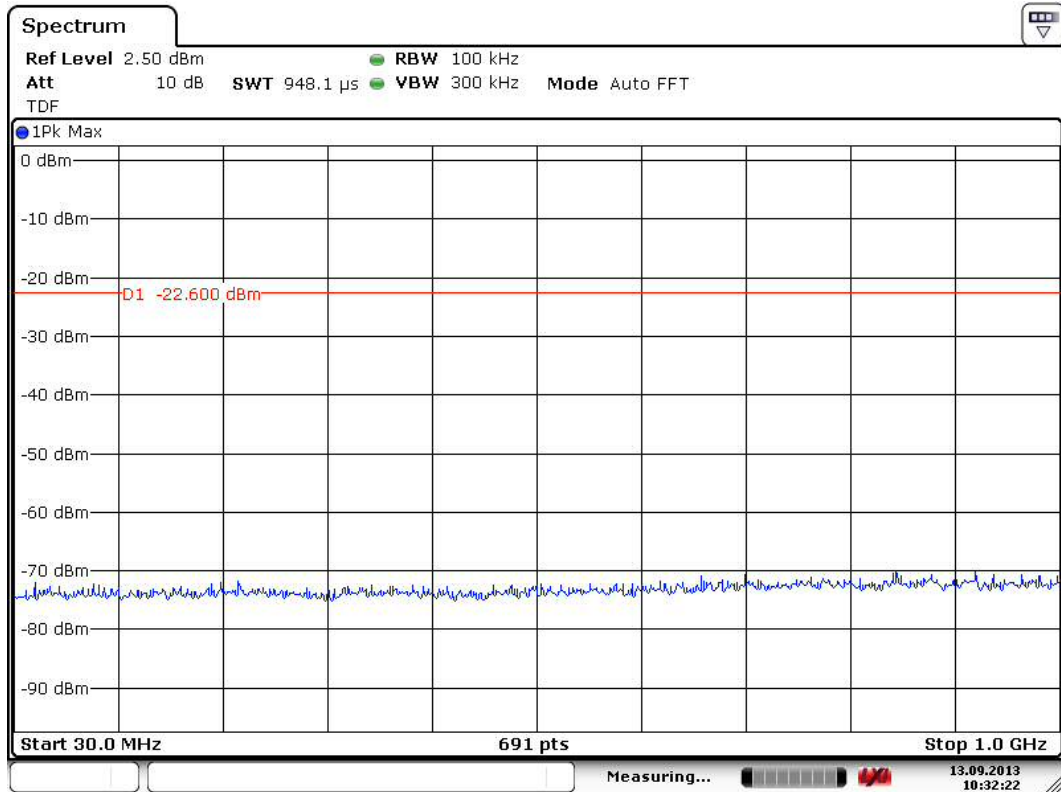
FCC Rule: 15.247 (d)



Date: 13.SEP.2013 09:12:57

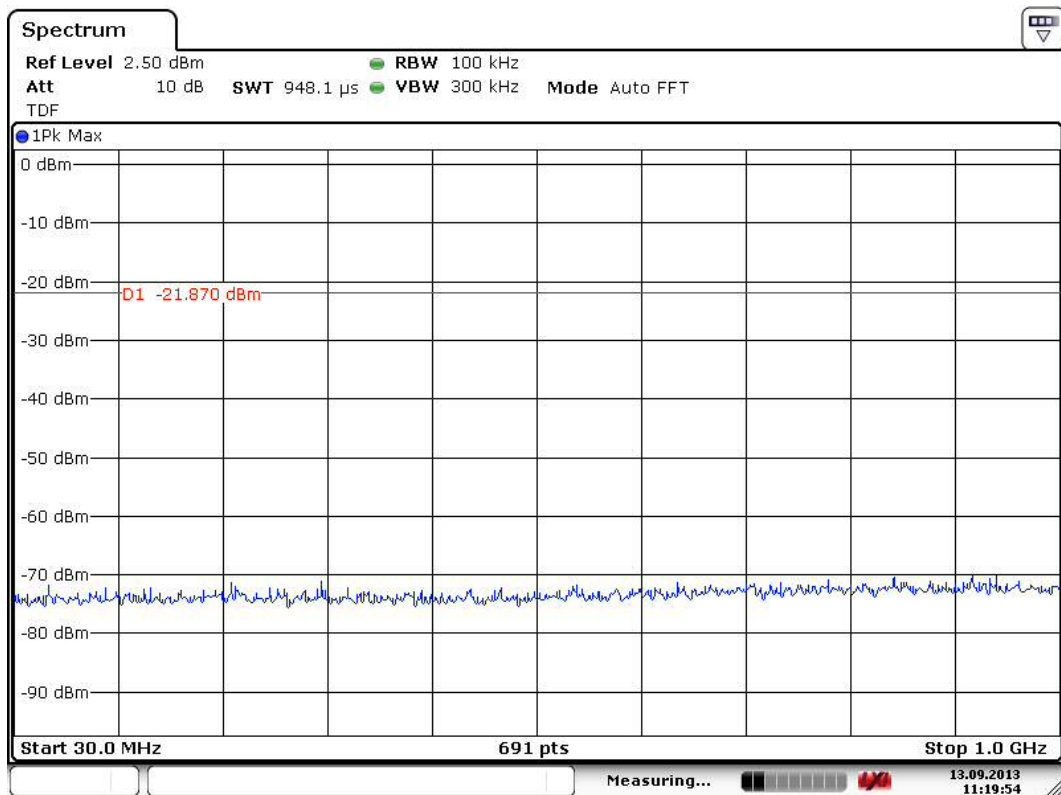
Figure 18. Low channel conductive emission 30 MHz to 1000 MHz.

Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 10:32:22

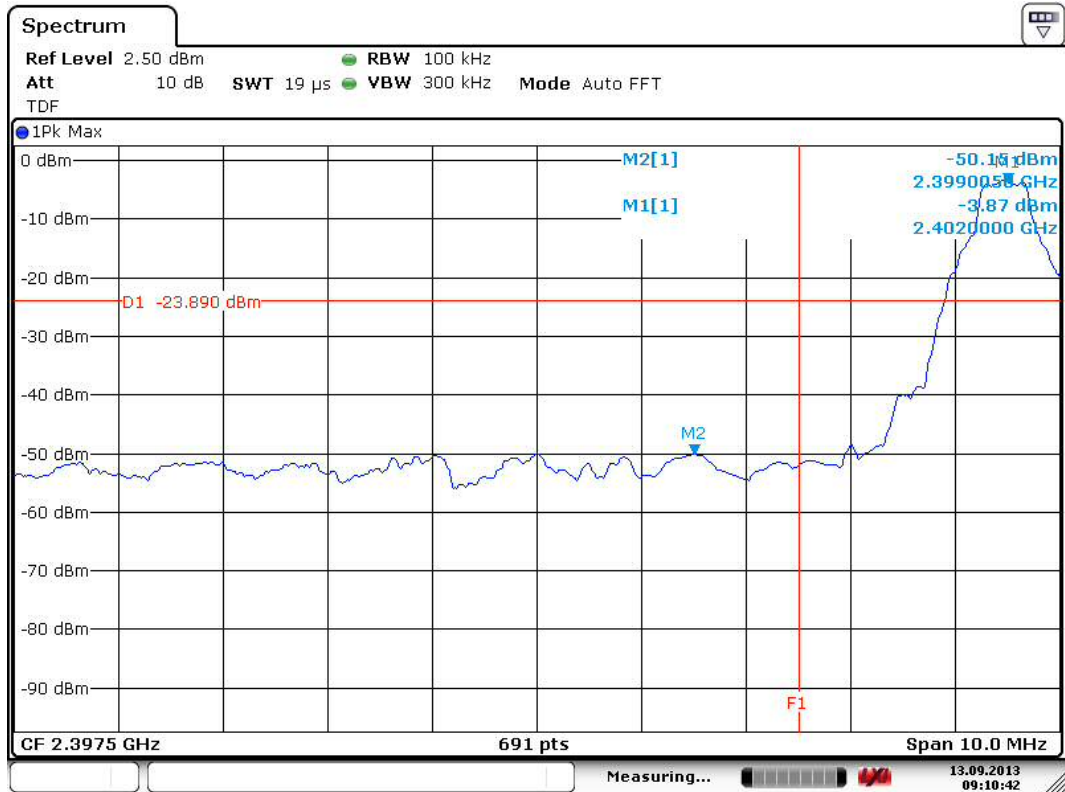
Figure 19. Mid channel conductive emission 30 MHz to 1000 MHz.



Date: 13.SEP.2013 11:19:54

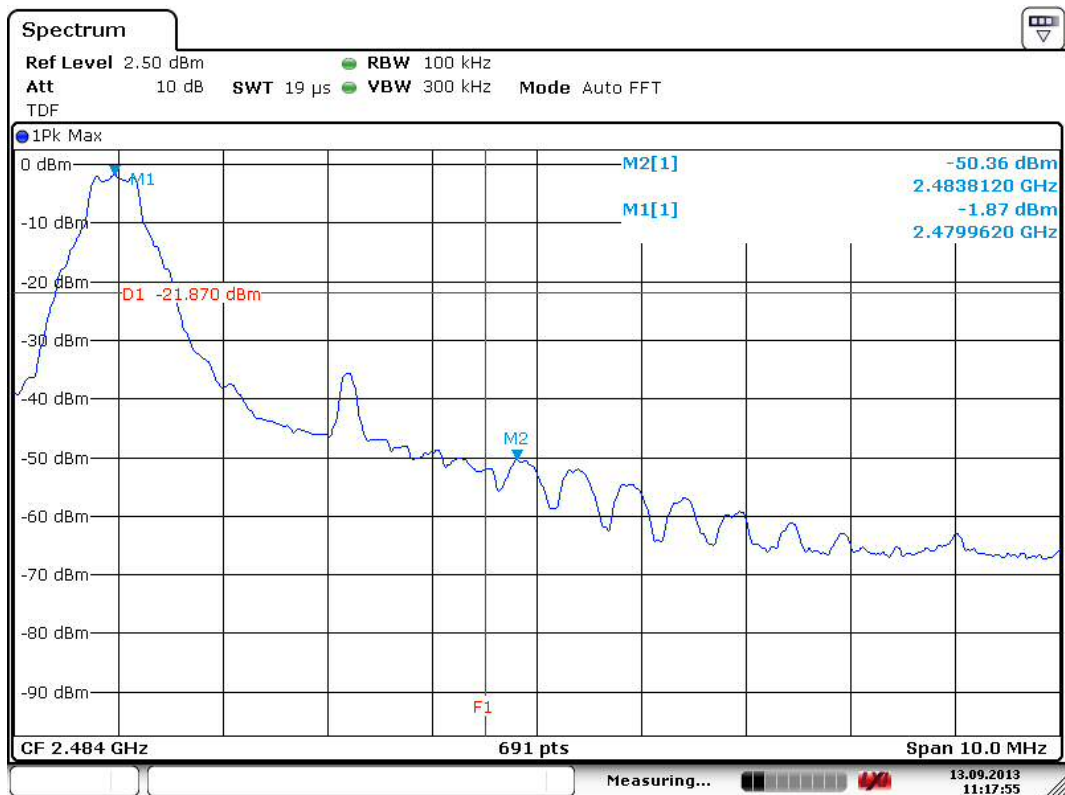
Figure 20. High channel conductive emission 30 MHz to 1000 MHz.

Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 09:10:42

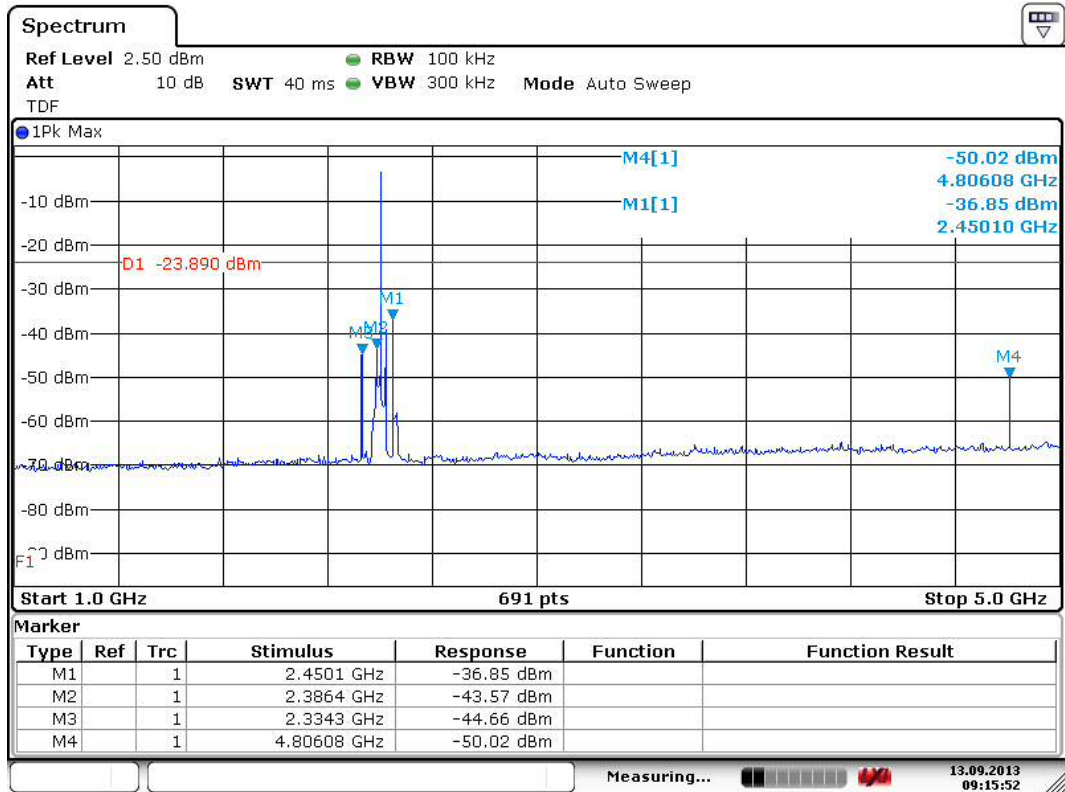
Figure 21. Low channel conductive emission at low band edge.



Date: 13.SEP.2013 11:17:55

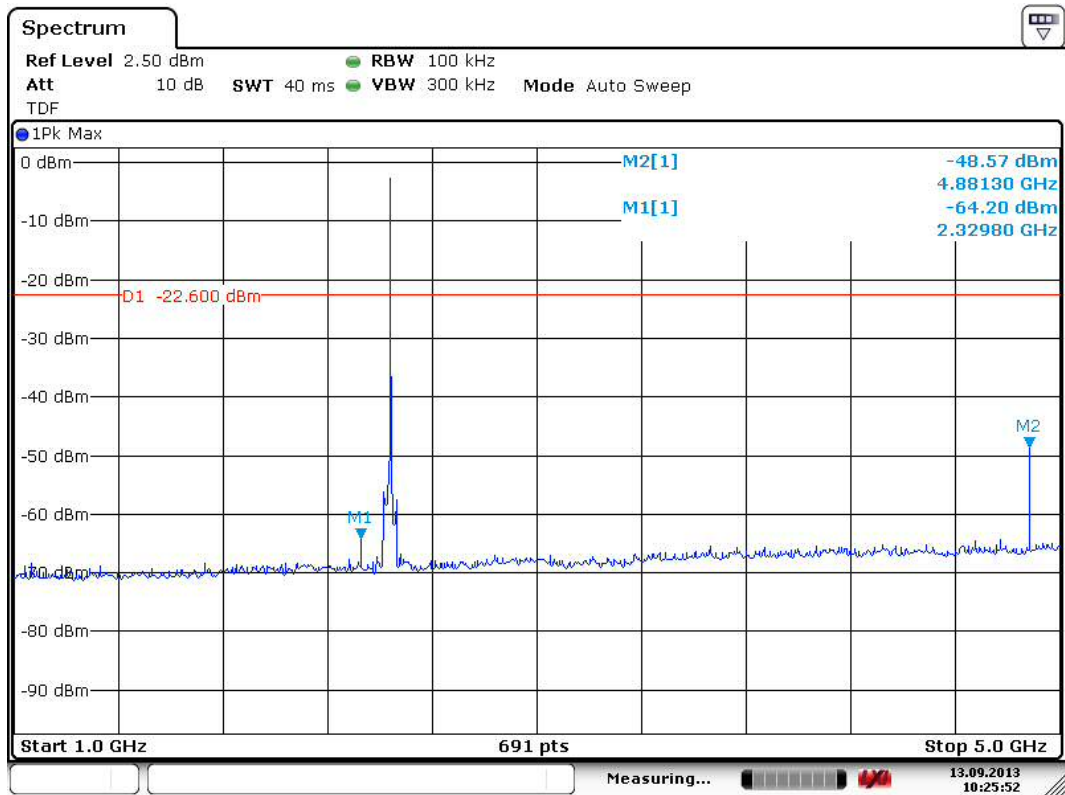
Figure 22. High channel conductive emission at high band edge.

Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 09:15:53

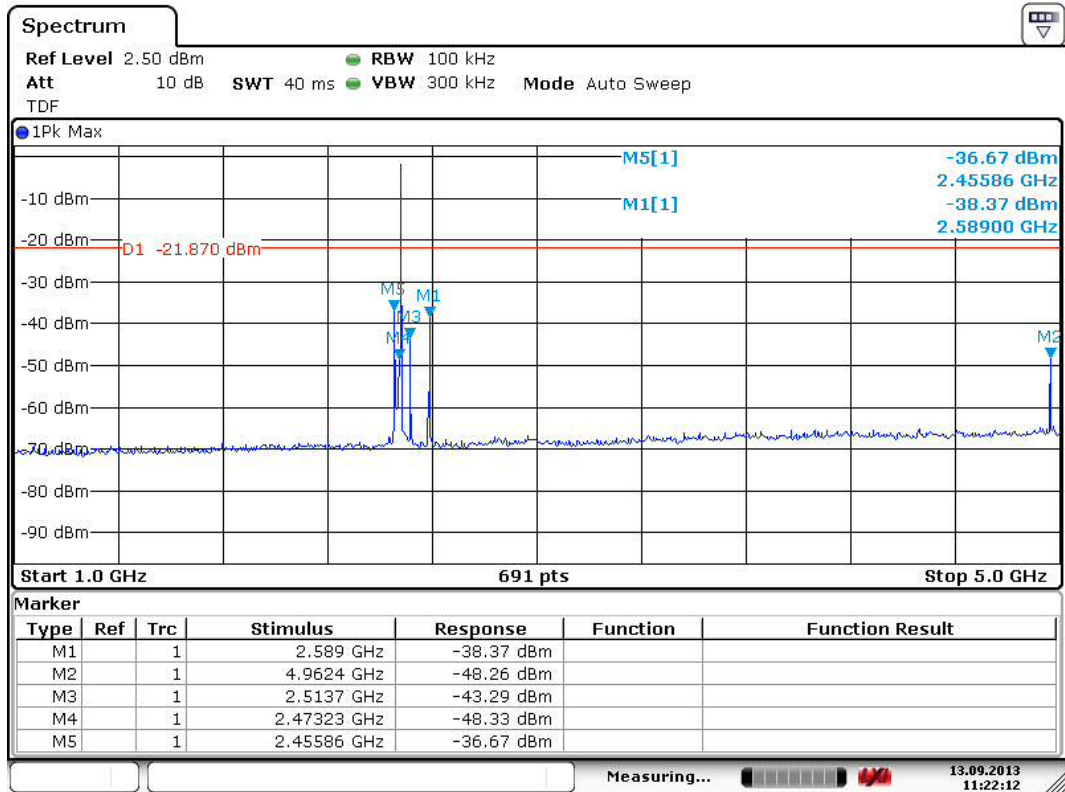
Figure 23. Low channel conductive emission 1 GHz to 5 GHz.



Date: 13.SEP.2013 10:25:53

Figure 24. Mid channel conductive emission 1 GHz to 5 GHz.

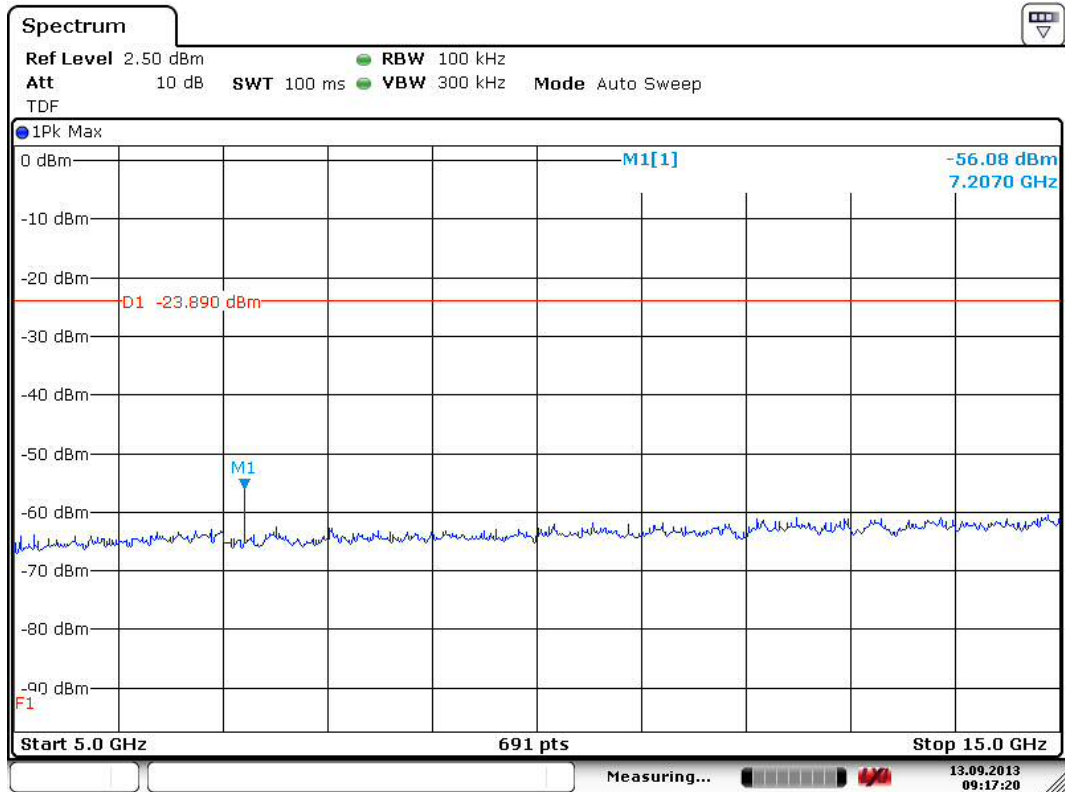
Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 11:22:12

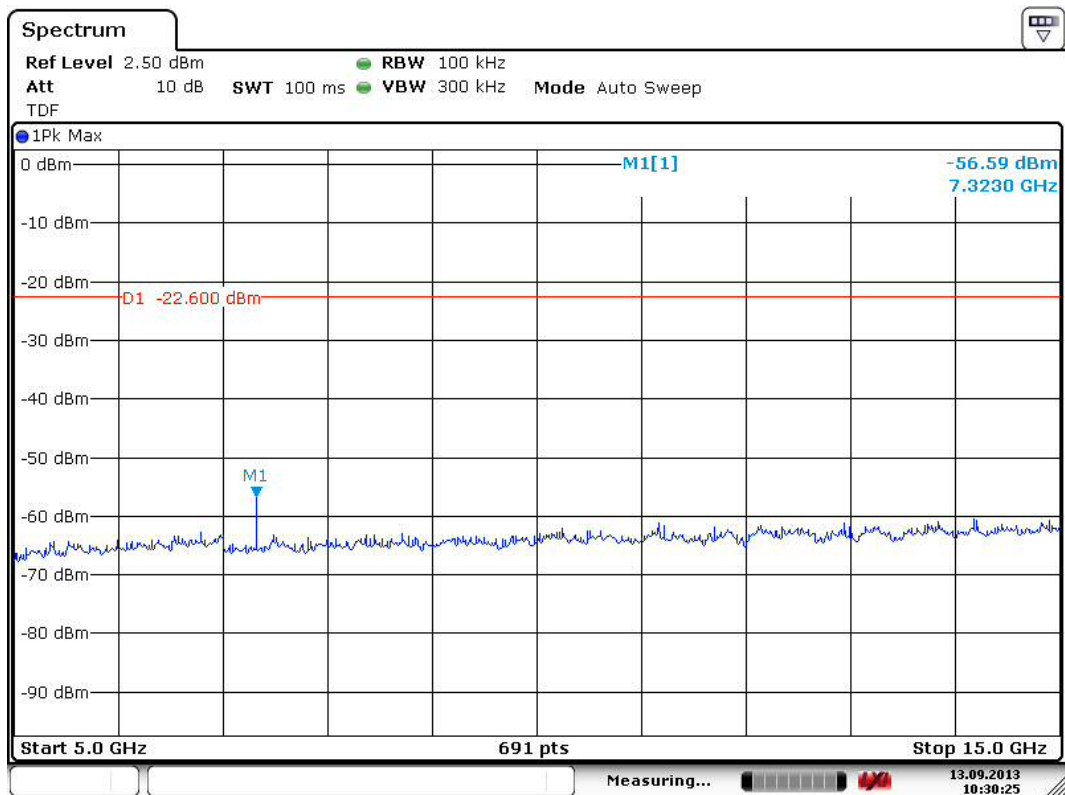
Figure 25. High channel conductive emission 1 GHz to 5 GHz.

Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 09:17:20

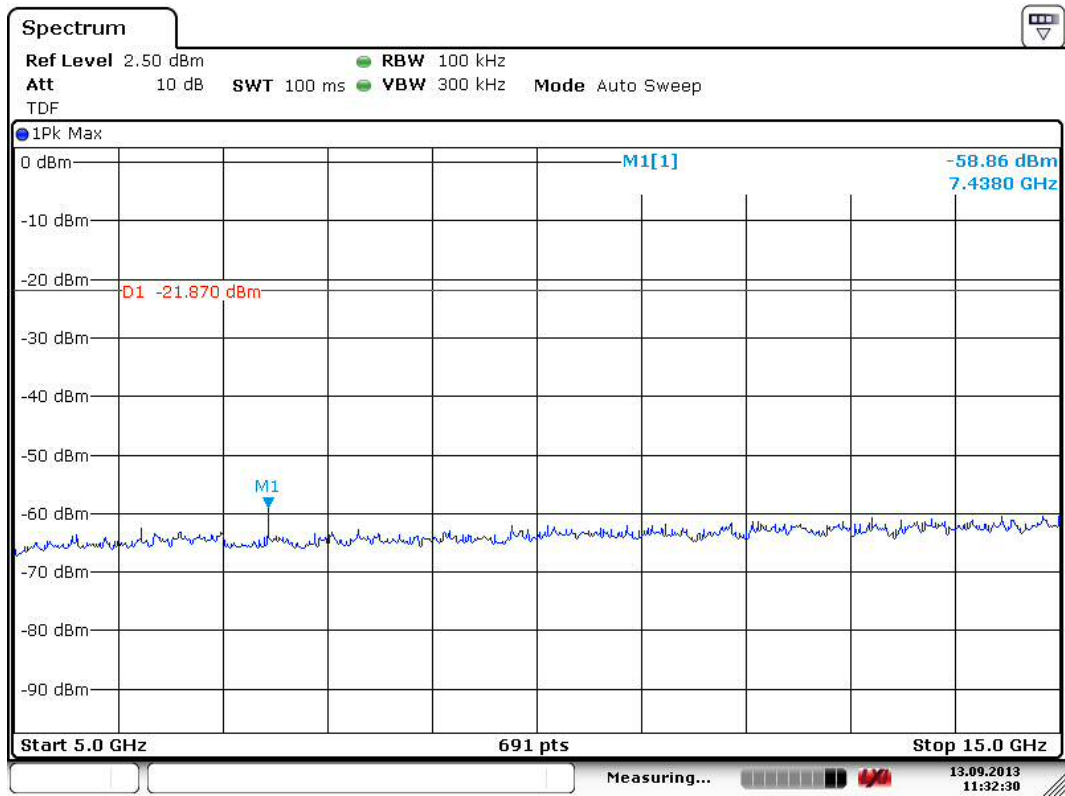
Figure 26. Low channel conductive emission 5 GHz to 15 GHz.



Date: 13.SEP.2013 10:30:25

Figure 27. Mid channel conductive emission 5 GHz to 15 GHz.

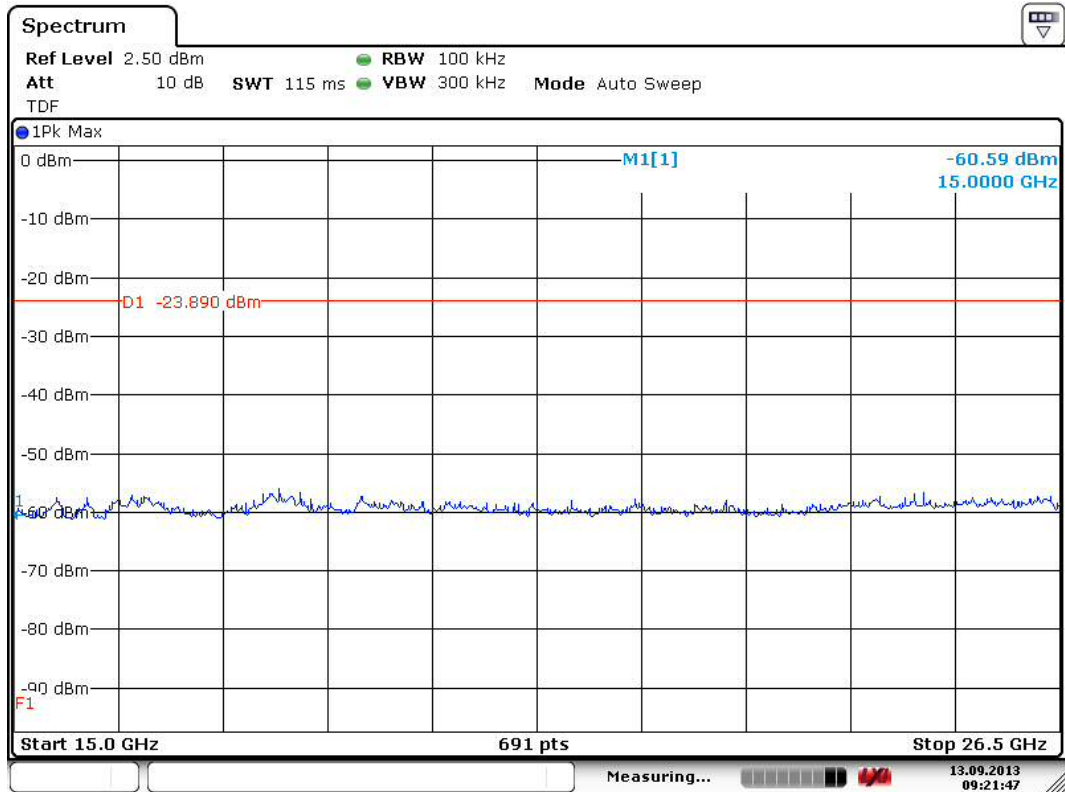
Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 11:32:30

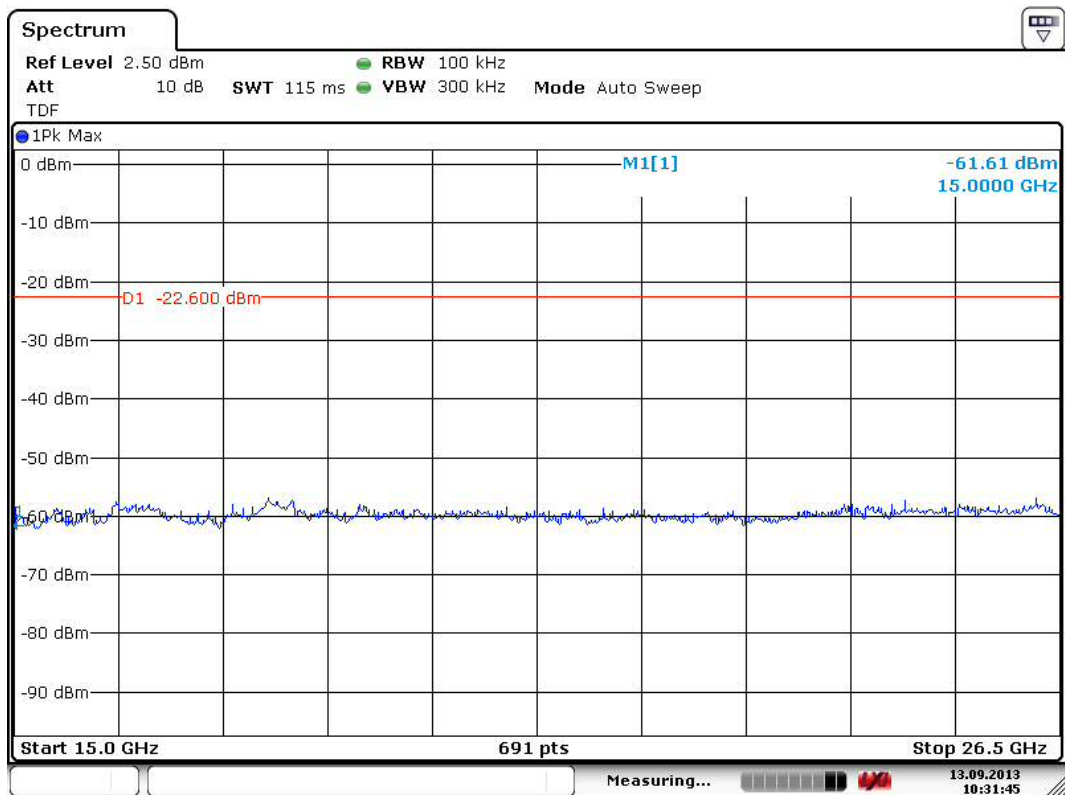
Figure 28. High channel conductive emission 5 GHz to 15 GHz.

Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 09:21:47

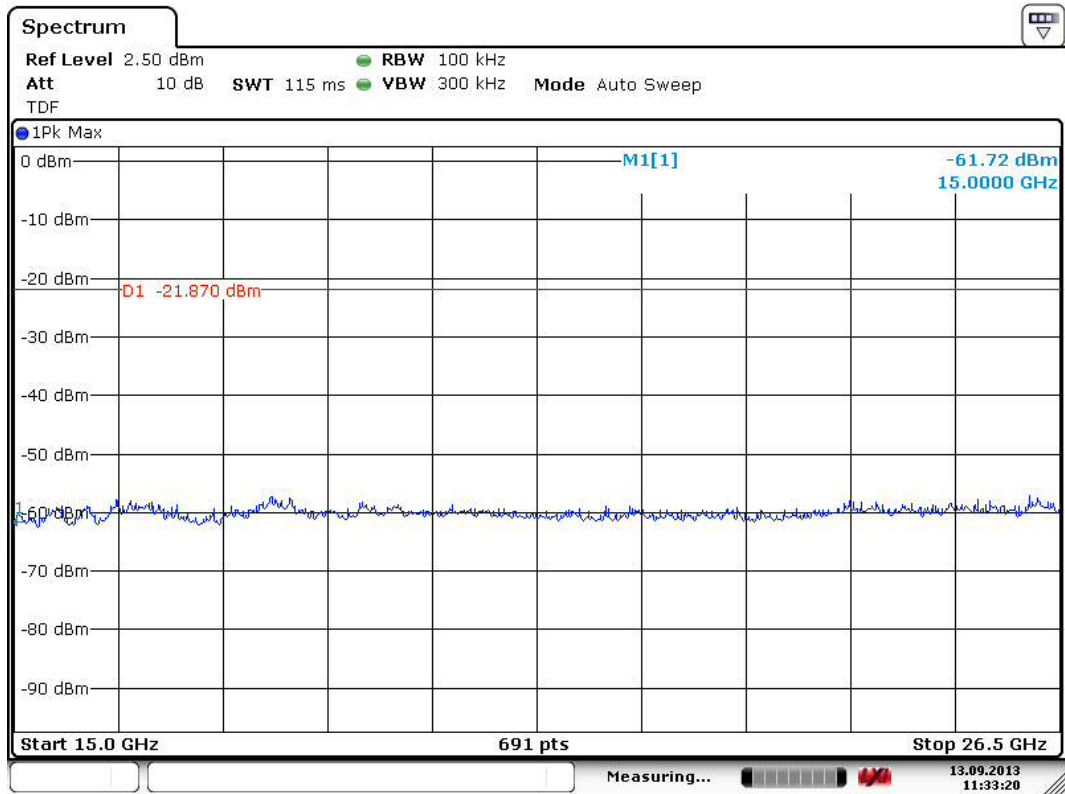
Figure 29. Low channel conductive emission 15 GHz to 26.5 GHz.



Date: 13.SEP.2013 10:31:45

Figure 30. Mid channel conductive emission 15 GHz to 26.5 GHz.

Conducted Spurious Emission 30 MHz to 26.5 GHz and Band Edge



Date: 13.SEP.2013 11:33:21

Figure 31. High channel conductive emission 15 GHz to 26.5 GHz.

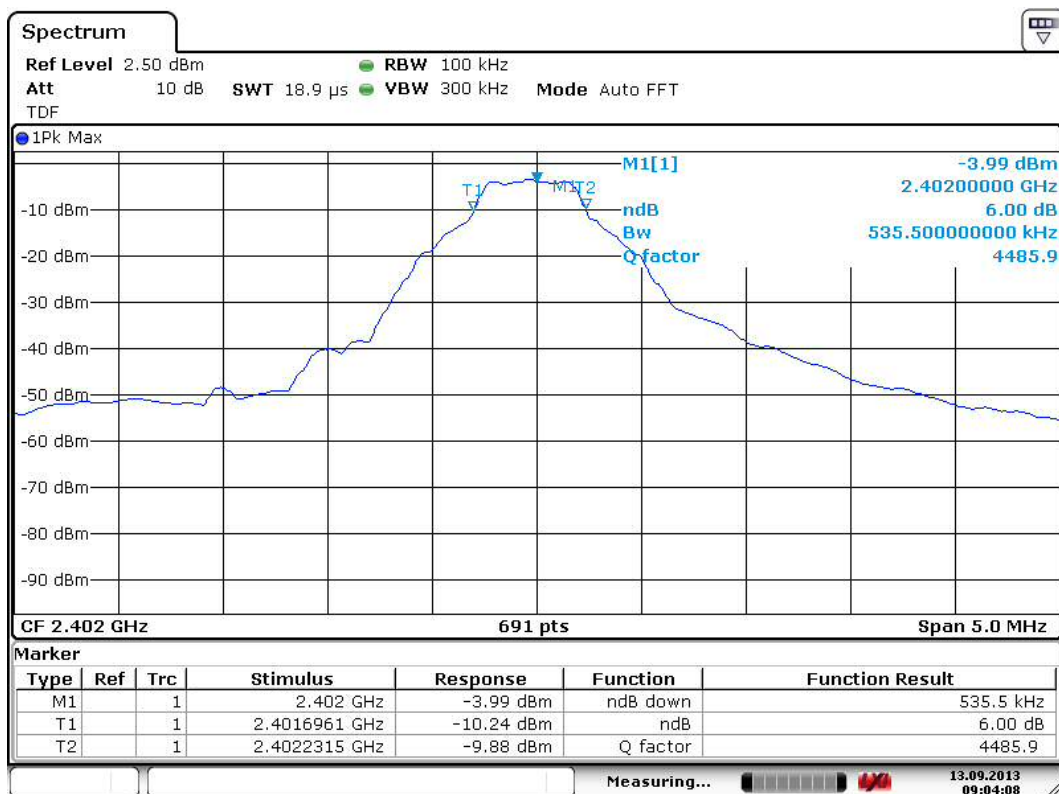
6 dB Bandwidth of the Channel

Standard: ANSI C63.10 (2009)
Tested by: RRE
Date: 13.9.2013
Temperature: 22 °C
Humidity: 48 % RH

FCC Rule: 15.247 (a) (2)

Table 6. 6 dB bandwidth test results

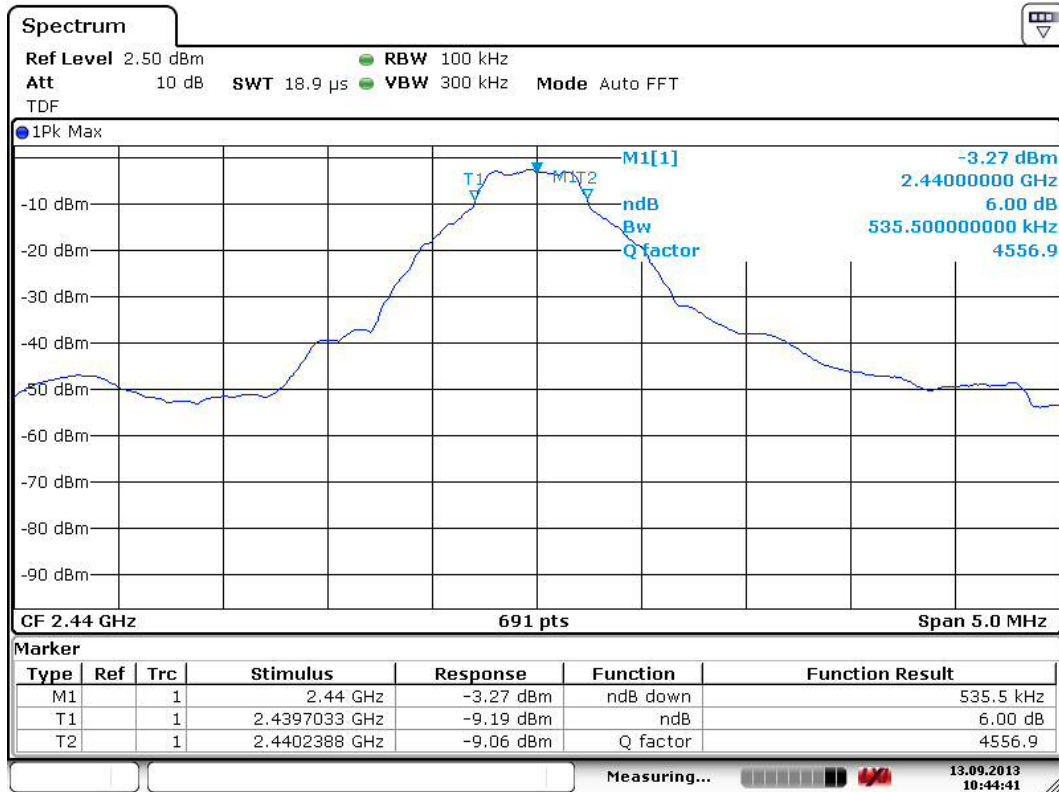
Channel	6 dB BW [kHz]	Result	Minimum limit [kHz]
Low	535.5	PASS	500
Mid	535.5	PASS	
High	535.5	PASS	



Date: 13.SEP.2013 09:04:07

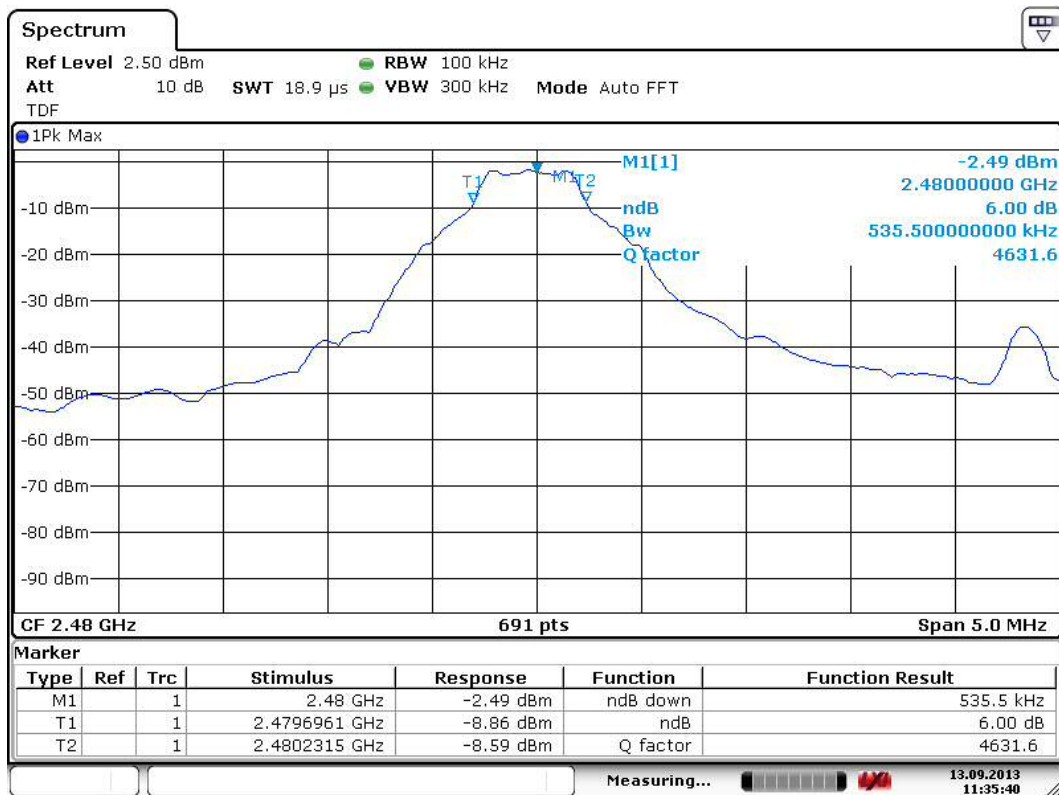
Figure 32. Low channel 6 dB bandwidth.

6 dB Bandwidth of the Channel



Date: 13.SEP.2013 10:44:41

Figure 33. Mid channel 6 dB bandwidth.



Date: 13.SEP.2013 11:35:41

Figure 34. High channel 6 dB bandwidth.

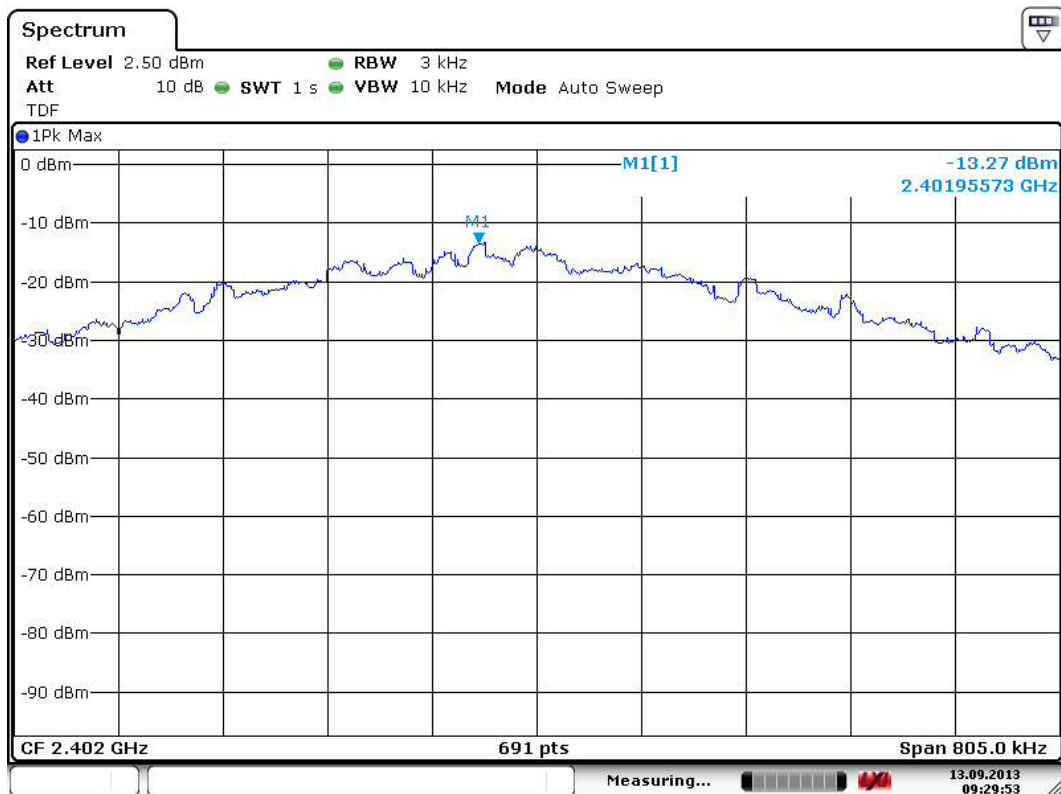
Power Spectral Density

Standard: ANSI C63.10 (2009)
Tested by: RRE
Date: 13.9.2013
Temperature: 22 °C
Humidity: 48 % RH

FCC Rule: 15.247 (e)

Table 7. Power Spectral Density Results.

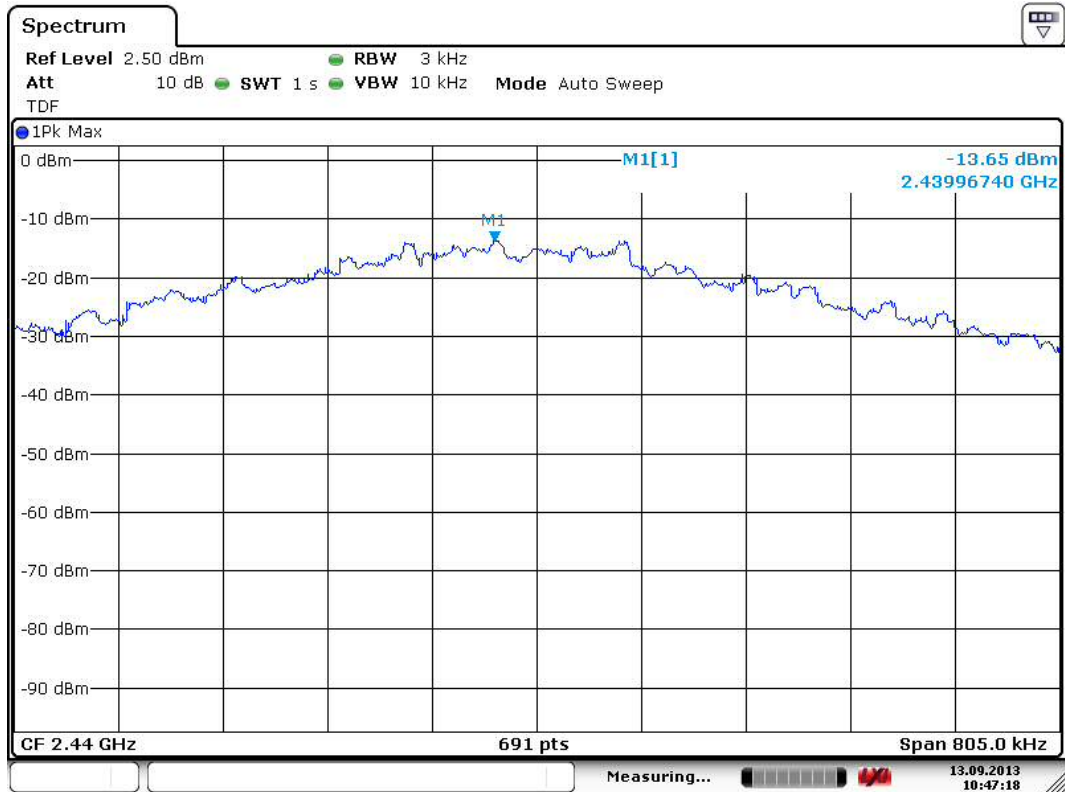
Channel	PSD [dBm/3 kHz]	Result	Maximum limit [dBm/3 kHz]
Low	-13.27	PASS	+8.00
Mid	-13.65	PASS	
High	-12.80	PASS	



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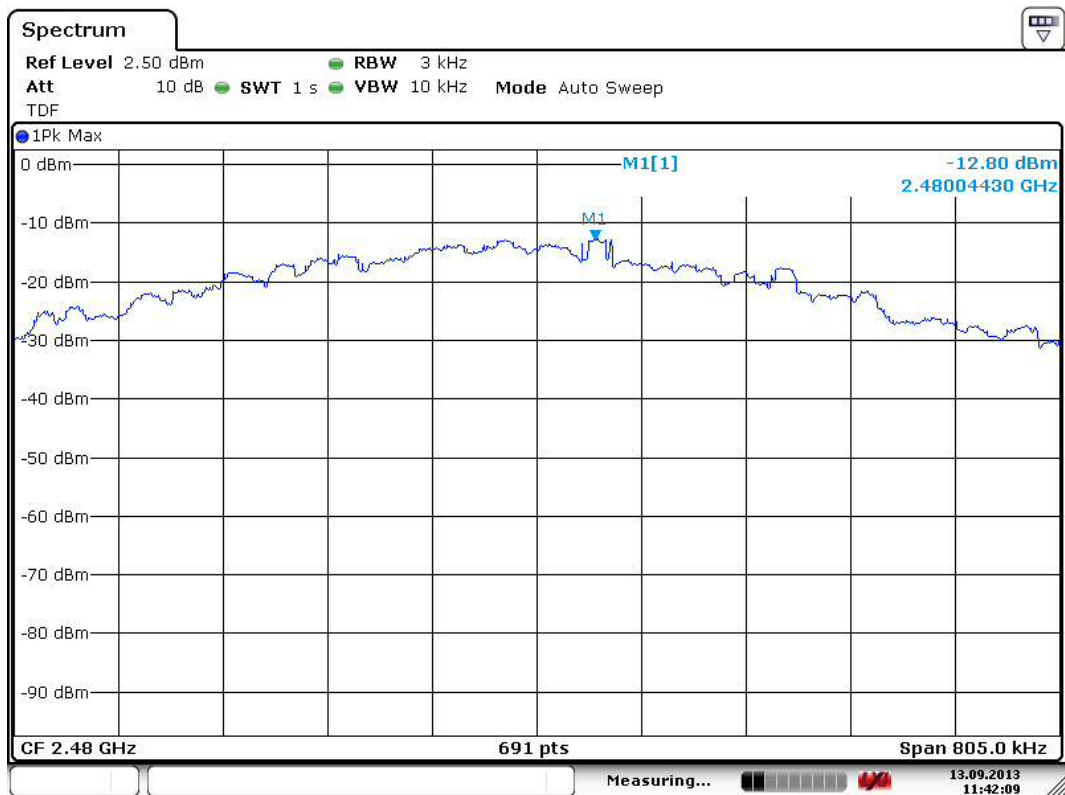
Figure 35. Low channel Power Spectral Density.

Power Spectral Density



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Figure 36. Mid channel Power Spectral Density.



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Figure 37. High channel Power Spectral Density.

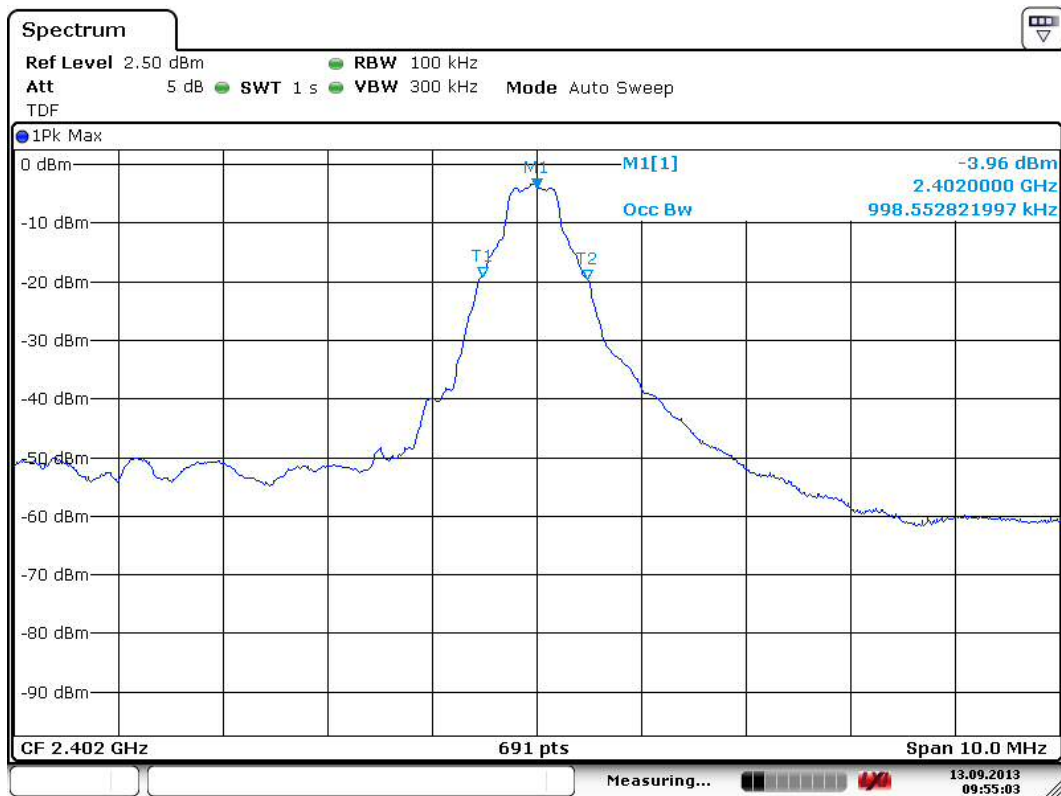
99% Occupied Power Bandwidth

Standard: RSS-GEN (2010)
Tested by: RRE
Date: 13.9.2013
Temperature: 22 °C
Humidity: 48 % RH

RSS-GEN 4.7.

Table 8. 99% Occupied Power Bandwidth results.

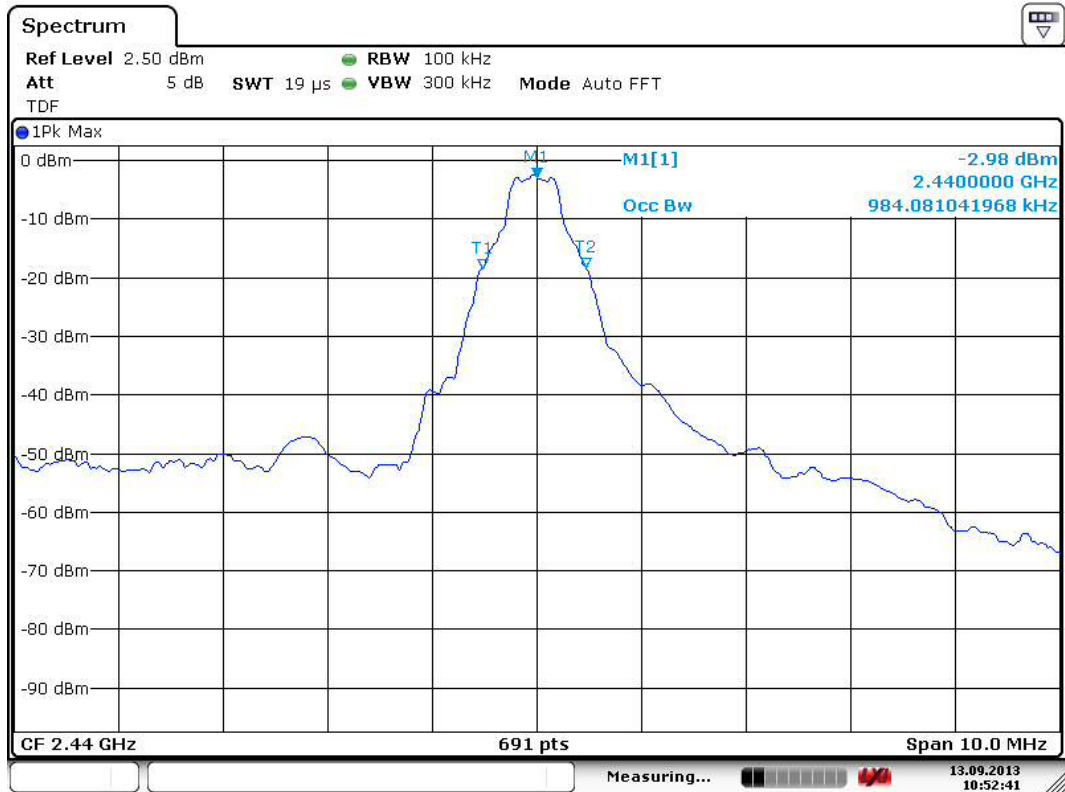
Channel	99% BW [MHz]	Limit	Result
Low	0.998552821997	-	PASS
Mid	0.984081041968	-	PASS
High	0.984081041968	-	PASS



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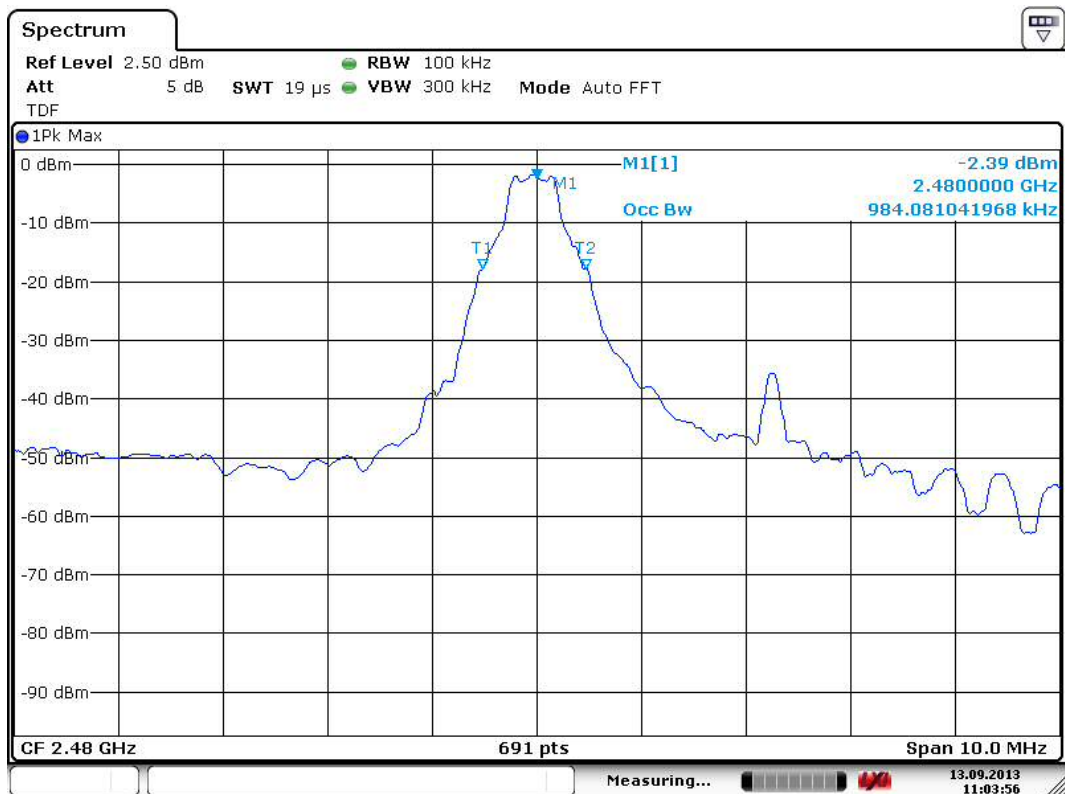
Figure 38. Low channel 99% Occupied Power Bandwidth.

99% Occupied Power Bandwidth



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Figure 39. Mid channel 99% Occupied Power Bandwidth.



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Figure 40. High channel 99% Occupied Power Bandwidth.

LIST OF TEST EQUIPMENT

Manufacturer	Type	Serial no	Inv. no
ROHDE & SCHWARZ			
Signal Analyzer	FSV40	101068	9093
EMI Test receiver	ESU 26	100185	8453
Test software	EMC32	-	-
DAVIS			
Weather station	Vantage Pro	-	5297
EMCO			
Antenna (1 - 18 GHz)	3117	29617	7293
ETS-LINDGREN			
Antenna (18 GHz – 26 GHz)	3160-09	28535	7294
SCHWARZBECK			
Antenna (30 MHz - 1 GHz)	VULB 9168	9168-503	8911
HEWLETT- PACKARD			
Microwave amplifier	83017A	-	5226
HUBER-SUHNER			
Attenuator 10dB	6810.17B	-	-
DEISEL			
Antenna mast	MA 240	240/455	7896
Turntable	DS 430	-	-
WAINWRIGHT			
High Pass Filter	WHKX	10	8267

All used measurement equipment was calibrated (if required).