SGS

Test Report

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

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test:	Bluetooth smart ready module
Type/ Model:	BT121
Manufacturer:	Silicon Laboratories Finland Oy PO. BOX 120 FI-02631 ESPOO FINLAND
Customer:	Silicon Laboratories Finland Oy PO. BOX 120 FI-02631 ESPOO FINLAND
FCC Rule Part: KDB:	15.247: 2014 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems DA 00-705 (March 30, 2000)

Date:	June 8, 2015	Date:	June 8, 2015
Issued by:	Niko Kotsalo Testing Engineer	Checked by:	Rauno Repo Testing Engineer

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Equipment Under Test (EUT)

Bluetooth Smart Ready Module	
Type/ Model:	BT121
Serial Number:	-
FCC ID:	QOQBT121
IC:	5123A-BGTBT121

BT121 is a Bluetooth smart ready module that supports Bluetooth Classic and Bluetooth Smart. This report contains only the Classic Bluetooth test results.

Two samples were used in testing. A sample that had an integrated antenna for radiated RF emission testing and a sample that had integral antenna removed and replaced with SMA female connector for conducted RF tests. Modules were connected to their own evaluation boards during the tests.

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 :	2402 – 2480 MHz
Channels:	79
Channel separation:	1 MHz
Conducted power:	11.04 dBm
Transmission technique:	FHSS
Modulation:	GFSK, π/4 DQPSK, 8DPSK
Integrated antenna gain:	1 dBi

Power Supply

Operating voltage range:	2.2 – 3.6 VDC

Disclaimer

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only. This document cannot be reproduced except in full, without prior approval of the Company.

SUMMARY OF TESTING

Test Specification	Description of Test	Result
§15.207(a) / RSS-GEN 7.2.2	Conducted Emissions on Power Supply Lines	**PASS**
§15.247(b)(1) / RSS-210 8.4	Maximum Peak Conducted Output Power	**PASS**
15.247(a)(1) / RSS-210 A8.1	Hopping Channel Carrier Frequency Separation	**PASS**
§15.247(a)(1)(iii) / RSS-210 A8.1	Number of Hopping Frequencies	**PASS**
§15.247(a)(1)(iii) / RSS-210 A8.1	Average Time of Occupancy of Hopping Frequency	**PASS**
§15.247(a)(1) / RSS-210 A8.1	20 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**
§15.209 / RSS-GEN 7.2.3.2	Unintentional Radiated Emissions	**PASS**

EUT Test Conditions during Testing

The EUT was configured into the wanted channel and was in continuous transmit mode during all the tests.

Following channels were used during the tests:

Channel	Frequency/ MHz
LOW (CH 1)	2402
MID (CH 40)	2441
HIGH (CH 79)	2480

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

Conducted Emissions In The Frequency Range 150 kHz - 30 MHz.

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	28.5.2015	
Temperature:	20 °C	
Humidity:	40 % RH	
Barometric pressure:	1008.7 hPa	
Measurement uncertainty:	± 2.9 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.207 (a)

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 power supply through the LISN.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

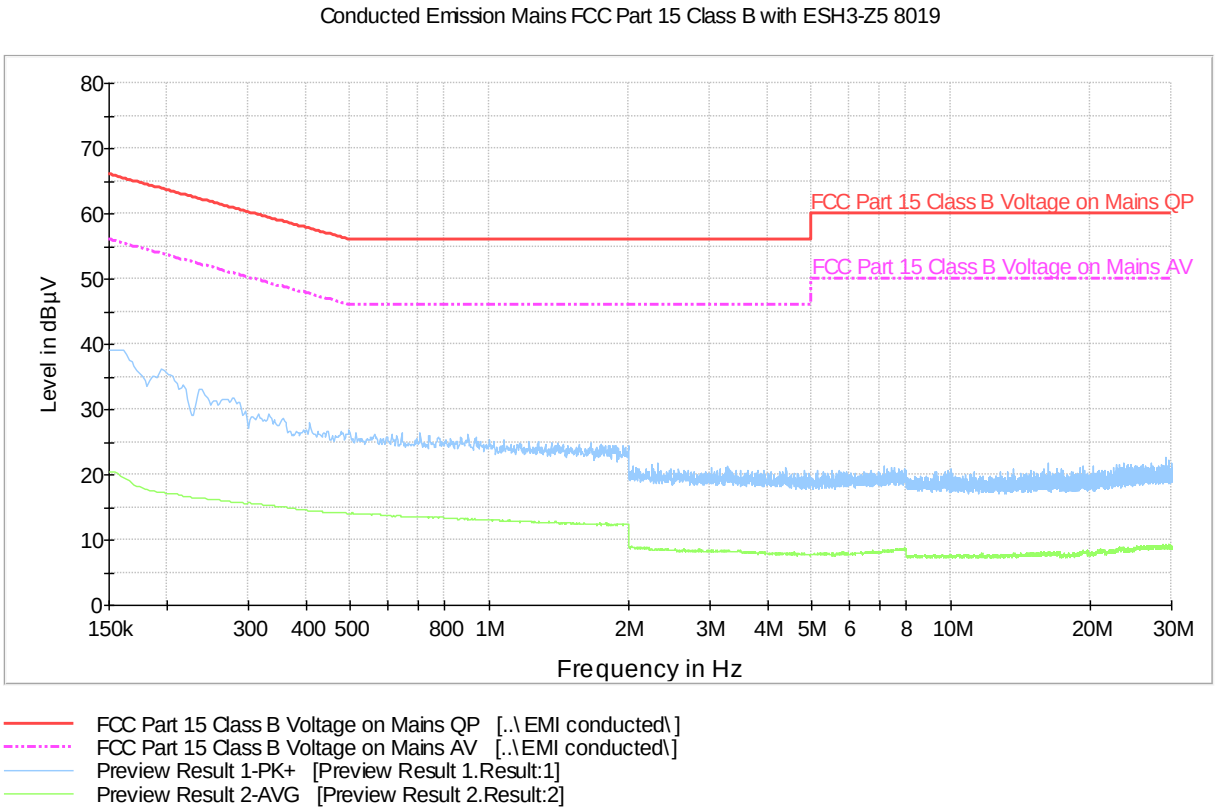

Figure 1. The measured curves with peak- and average detector

Final measurements from the worst frequencies

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

Maximum Peak Conducted Output Power

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	12.5.2015	
Humidity:	25 %	
Temperature:	21 °C	
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, employing at least 75 channels limit is 1.0 Watt. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signalling 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:

1 Mbps

Channel	Conducted Power [dBm]	Limit [dBm]	Result
Low	11.04	30	PASS
Mid	10.75	30	PASS
High	10.78	30	PASS

2 Mbps

Channel	Conducted Power [dBm]	Limit [dBm]	Result
Low	10.17	30	PASS
Mid	9.90	30	PASS
High	9.98	30	PASS

3 Mbps

Channel	Conducted Power [dBm]	Limit [dBm]	Result
Low	10.65	30	PASS
Mid	10.38	30	PASS
High	10.39	30	PASS

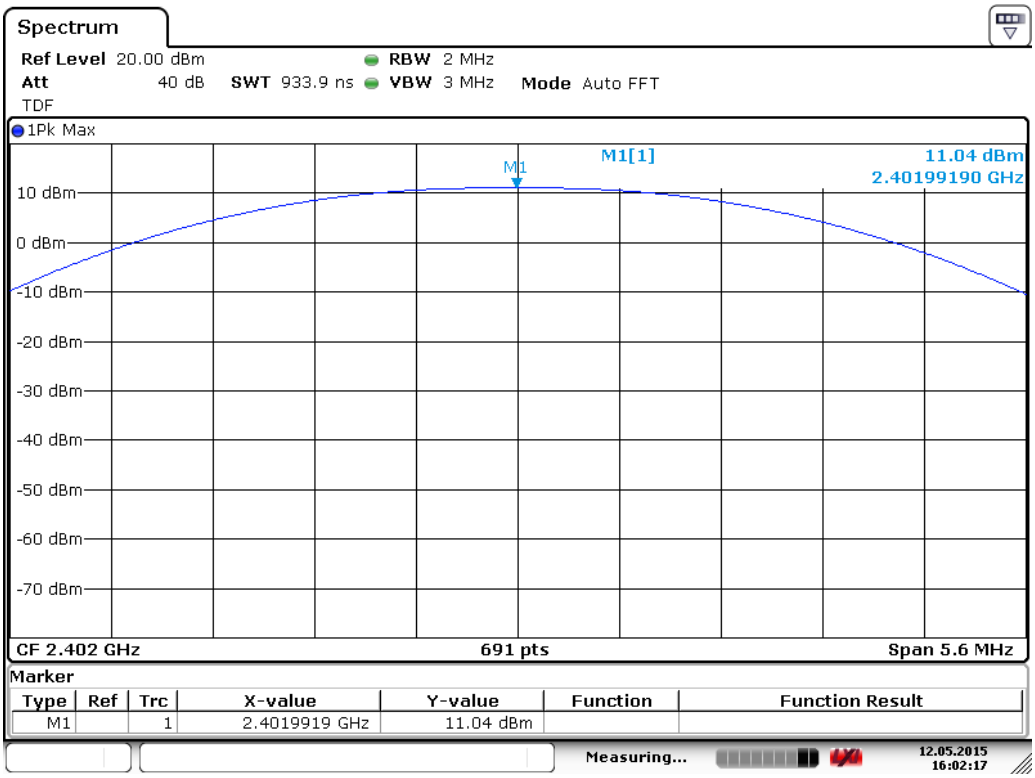

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Figure 2. 1 Mbps Channel LOW.

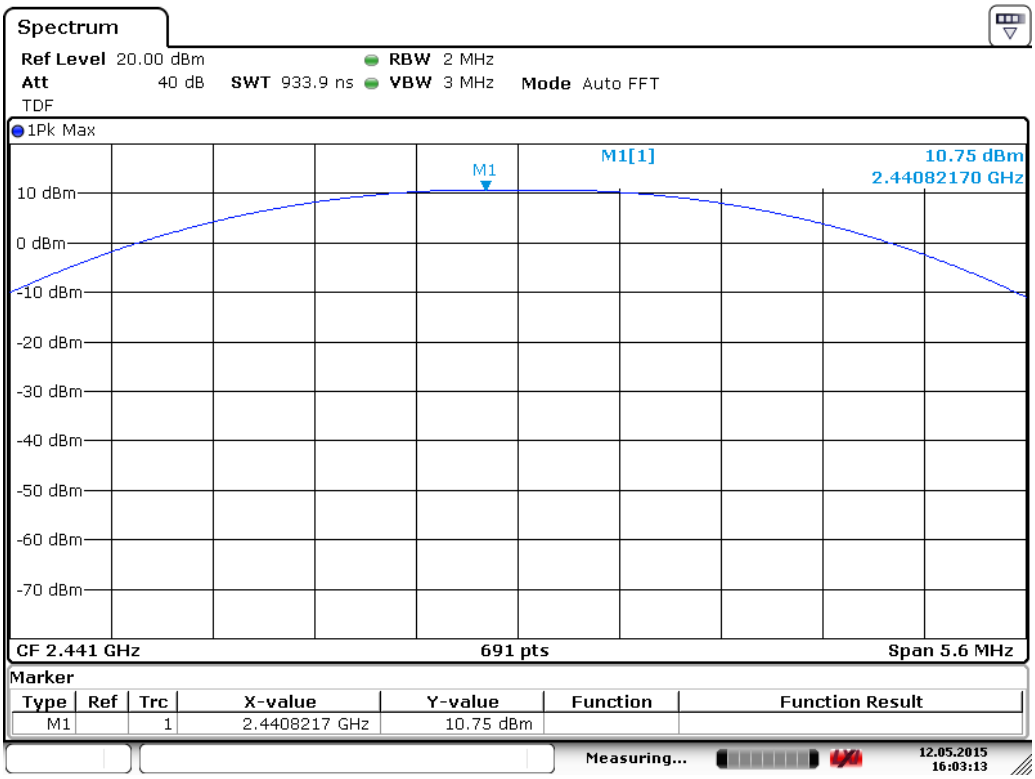

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Figure 3. 1 Mbps Channel MID.

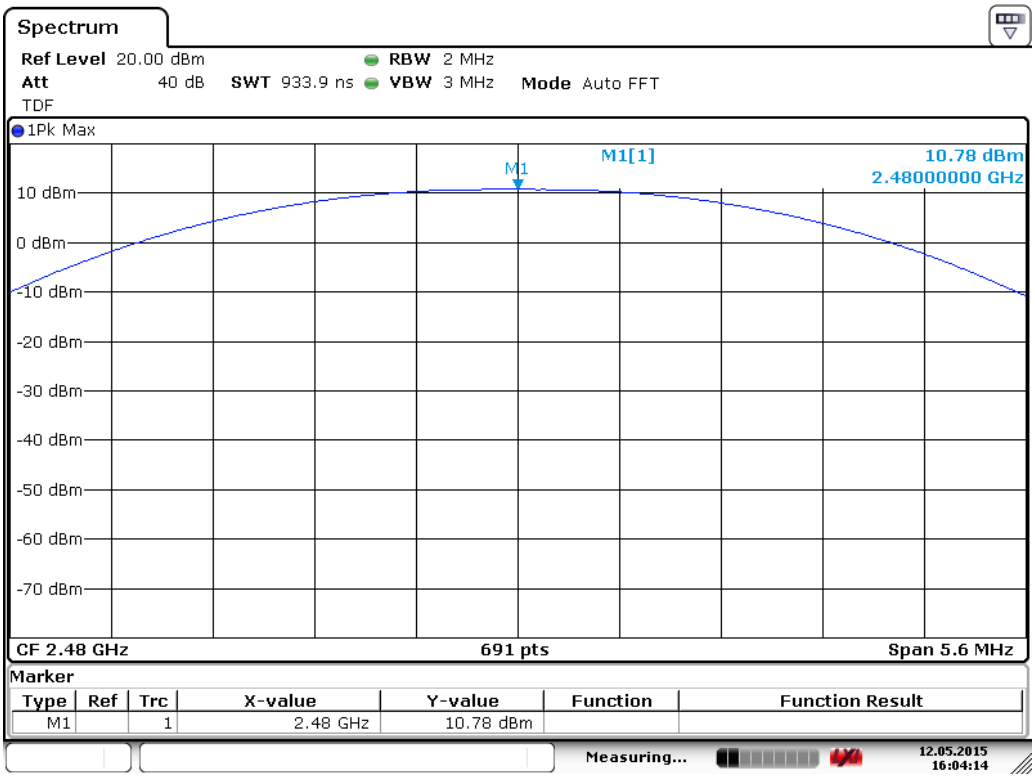

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Figure 4. 1 Mbps Channel HIGH.

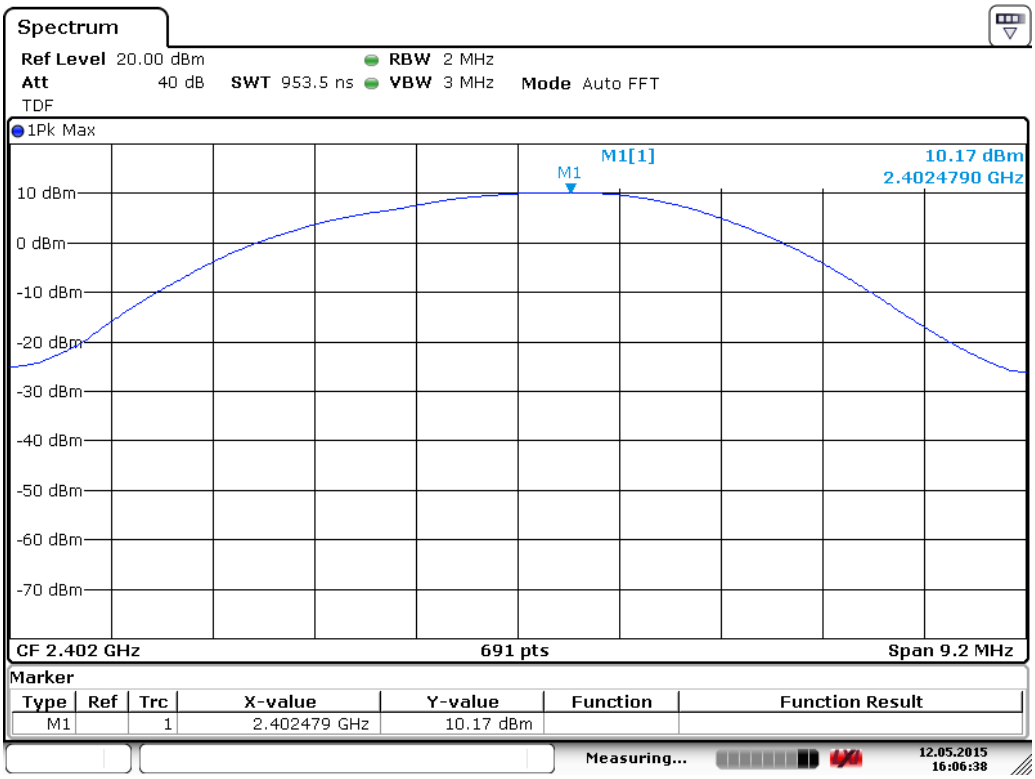

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Figure 5. 2 Mbps Channel LOW.

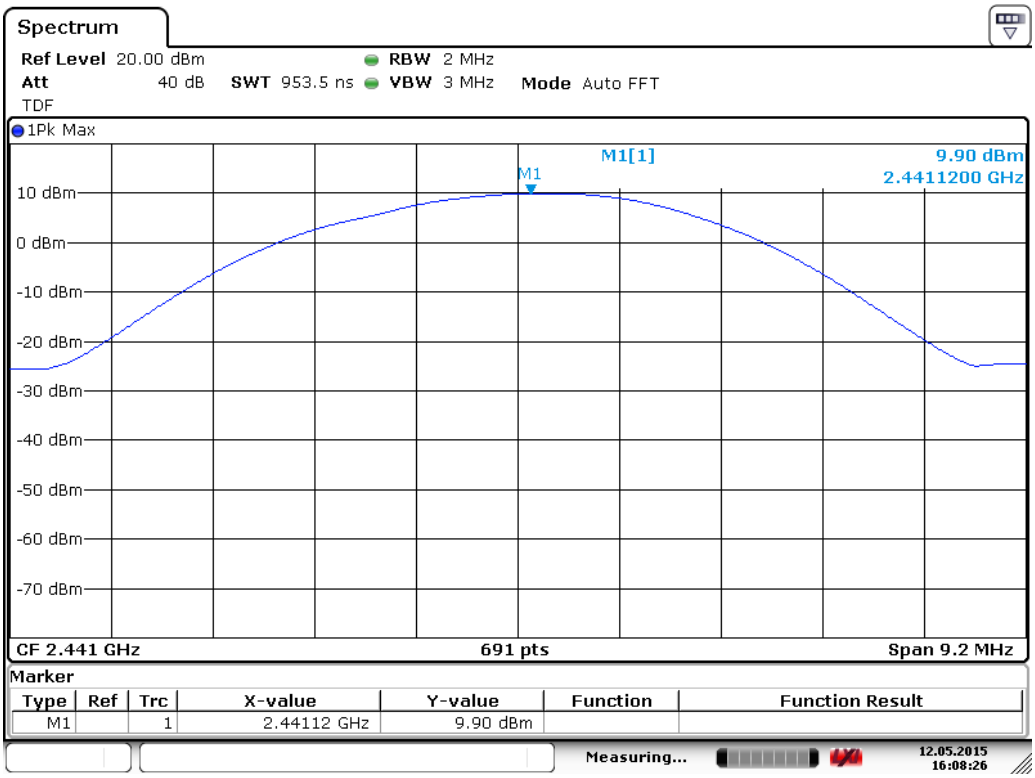

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Figure 6. 2 Mbps Channel MID.

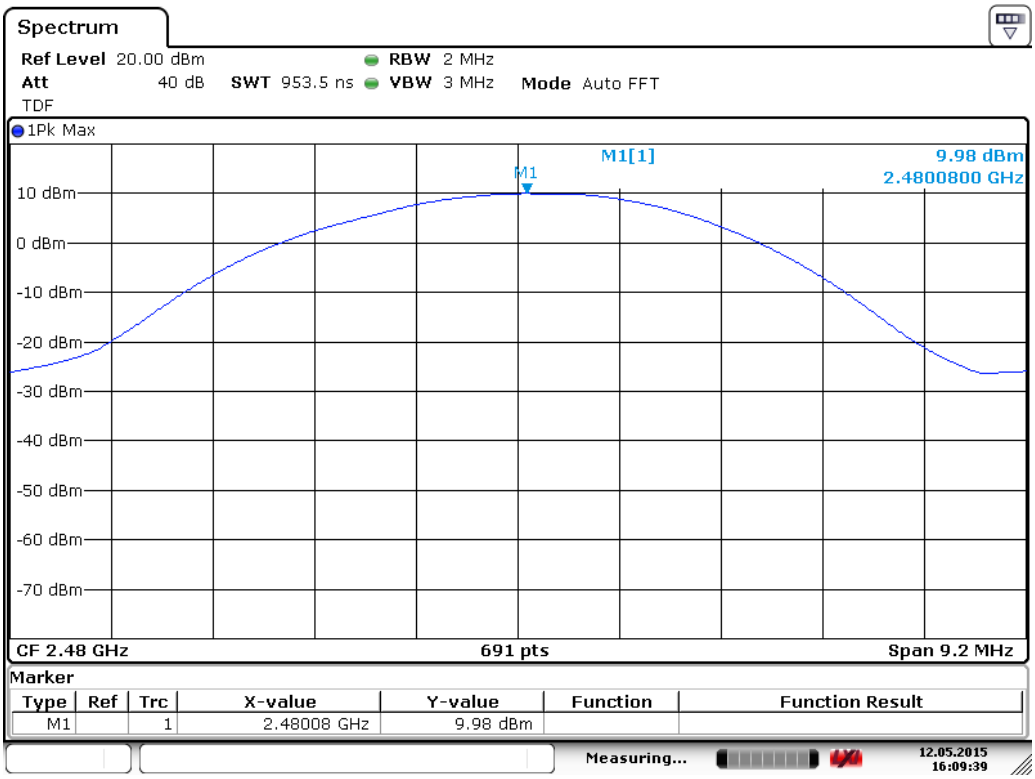

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Figure 7. 2 Mbps Channel HIGH.

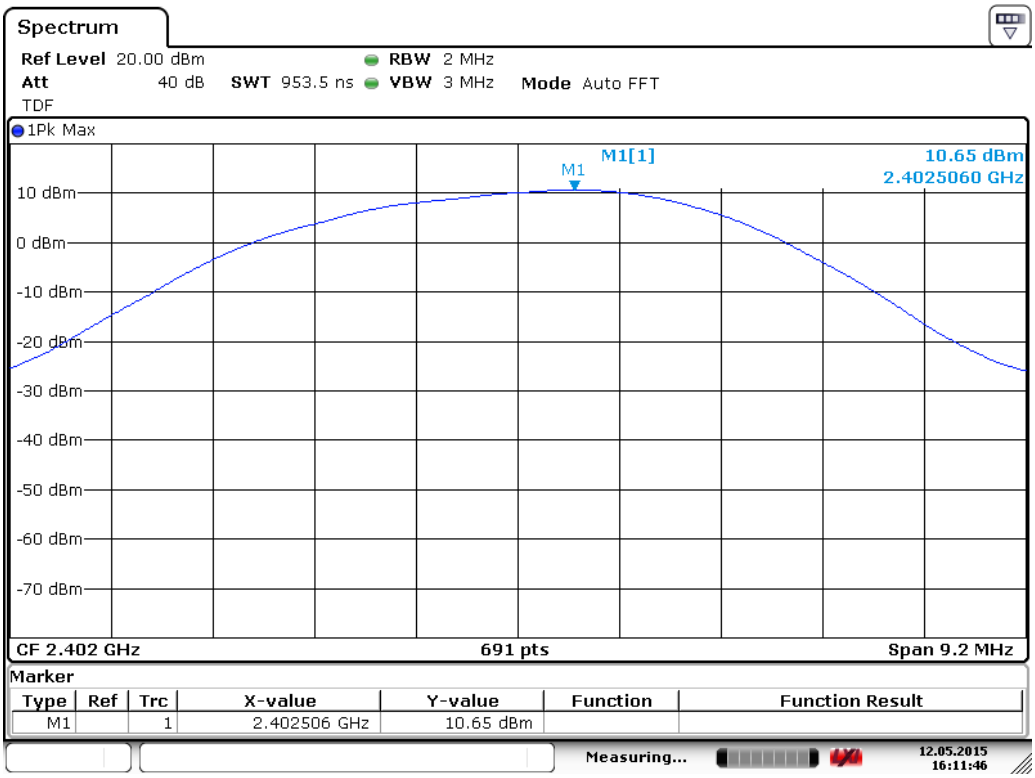

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Figure 8. 3 Mbps Channel LOW.

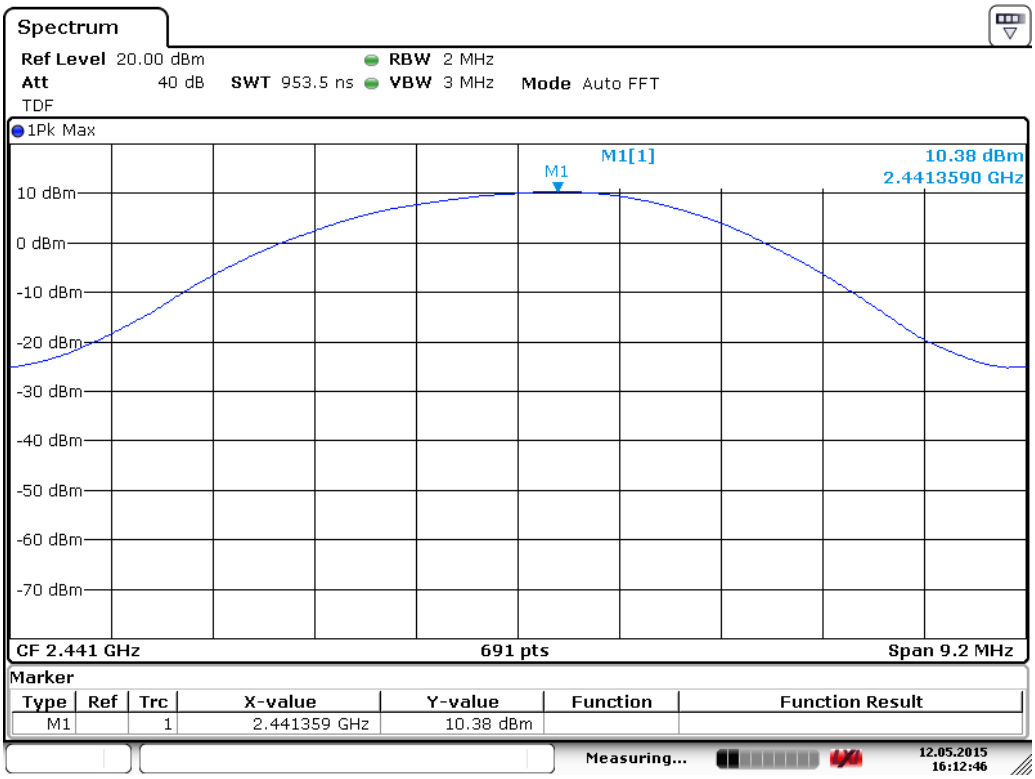

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Figure 9. 3 Mbps Channel MID.

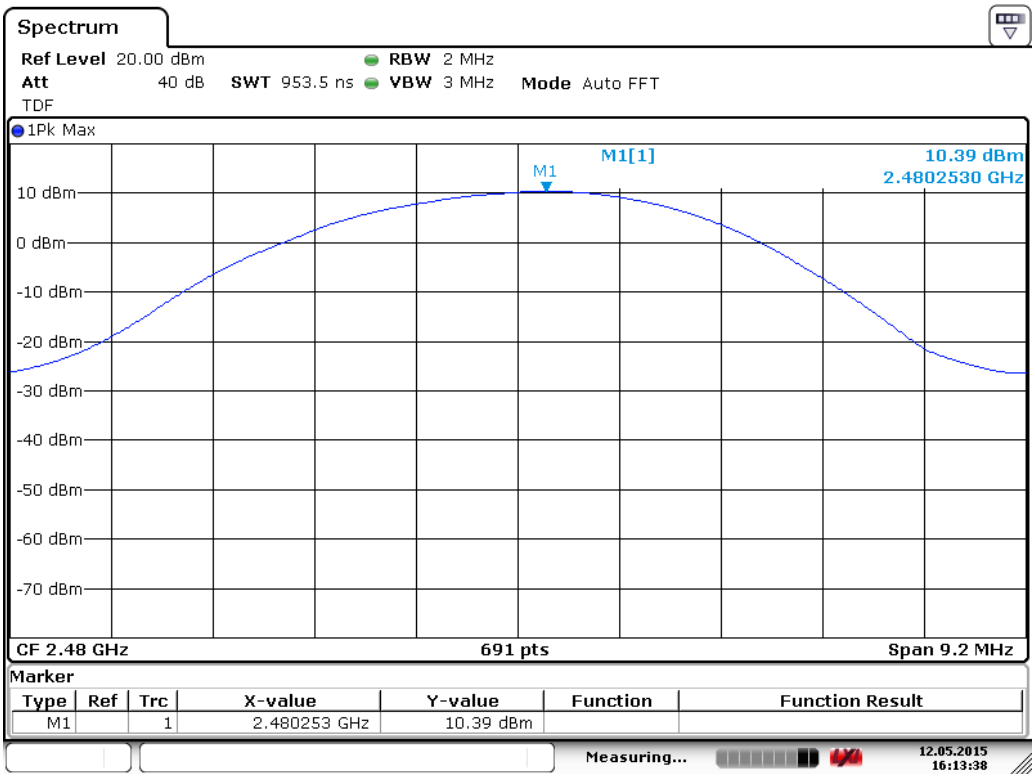


Figure 10. 3 Mbps Channel HIGH.

Transmitter Radiated Emissions 30 MHz to 26.5 GHz

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	13.5 – 14.5.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % 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.

Measurements were done with 1 Mbps (worst case) with intergated and external antenna.

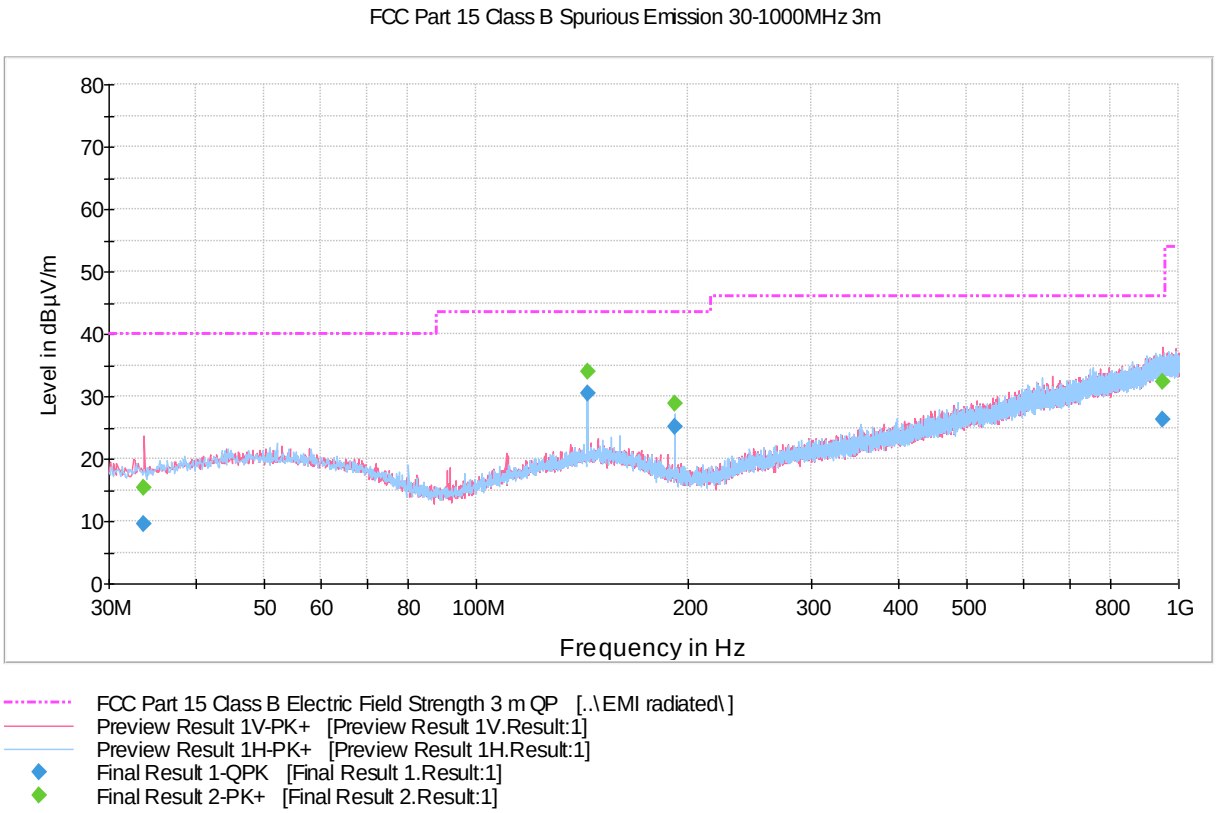


Figure 11. Measured curve with peak-detector. 1 Mbps Channel LOW.

Final measurements from the worst frequencies

Table 1. Final results.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
33.626000	9.5	1000.0	120.000	185.0	V	137.0	13.2	30.5	40.0	
143.875000	30.4	1000.0	120.000	276.0	H	316.0	14.2	13.1	43.5	
191.716000	25.2	1000.0	120.000	152.0	H	151.0	11.7	18.3	43.5	
949.474000	26.4	1000.0	120.000	100.0	V	0.0	27.5	19.6	46.0	

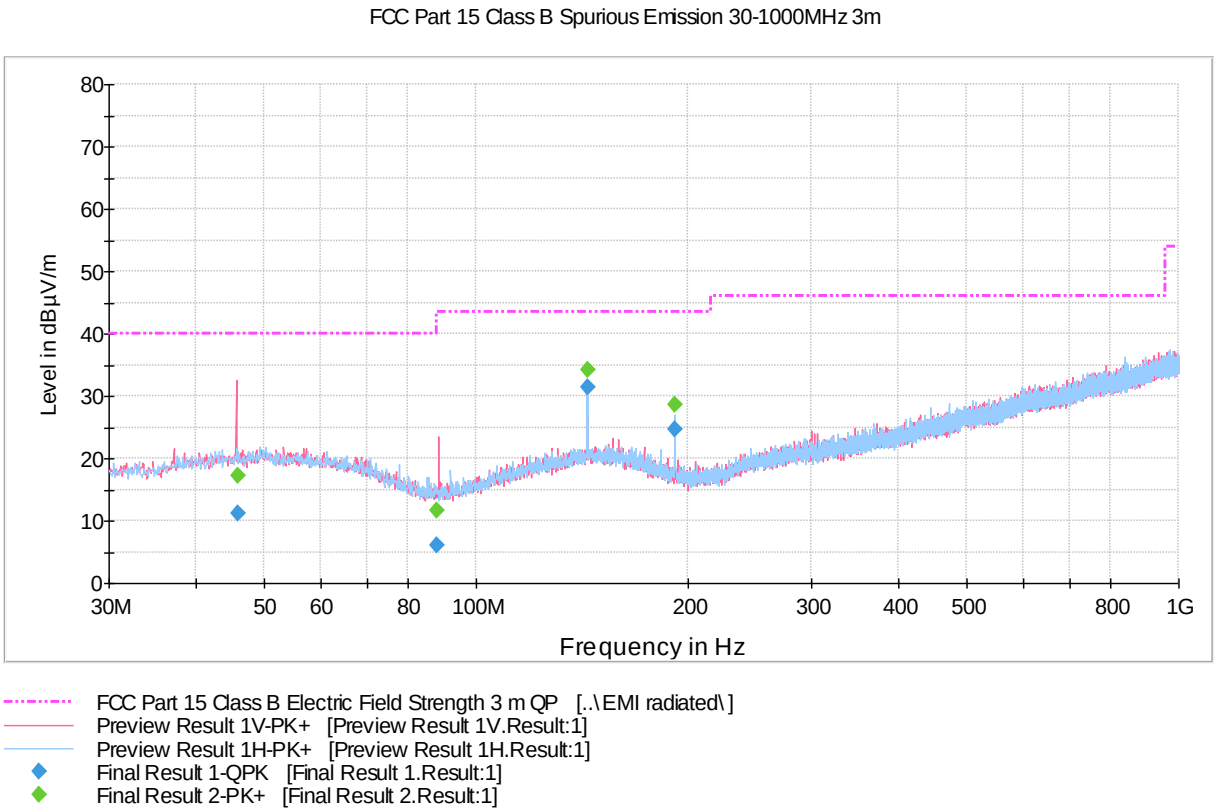


Figure 12. Measured curve with peak-detector. 1 Mbps Channel MID.

Final measurements from the worst frequencies

Table 2. Final results.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
45.900000	11.1	1000.0	120.000	100.0	V	98.0	14.5	28.9	40.0	
87.897000	6.0	1000.0	120.000	310.0	V	152.0	8.7	34.0	40.0	
143.981000	31.4	1000.0	120.000	215.0	H	296.0	14.2	12.1	43.5	
191.930000	24.8	1000.0	120.000	169.0	H	182.0	11.7	18.7	43.5	

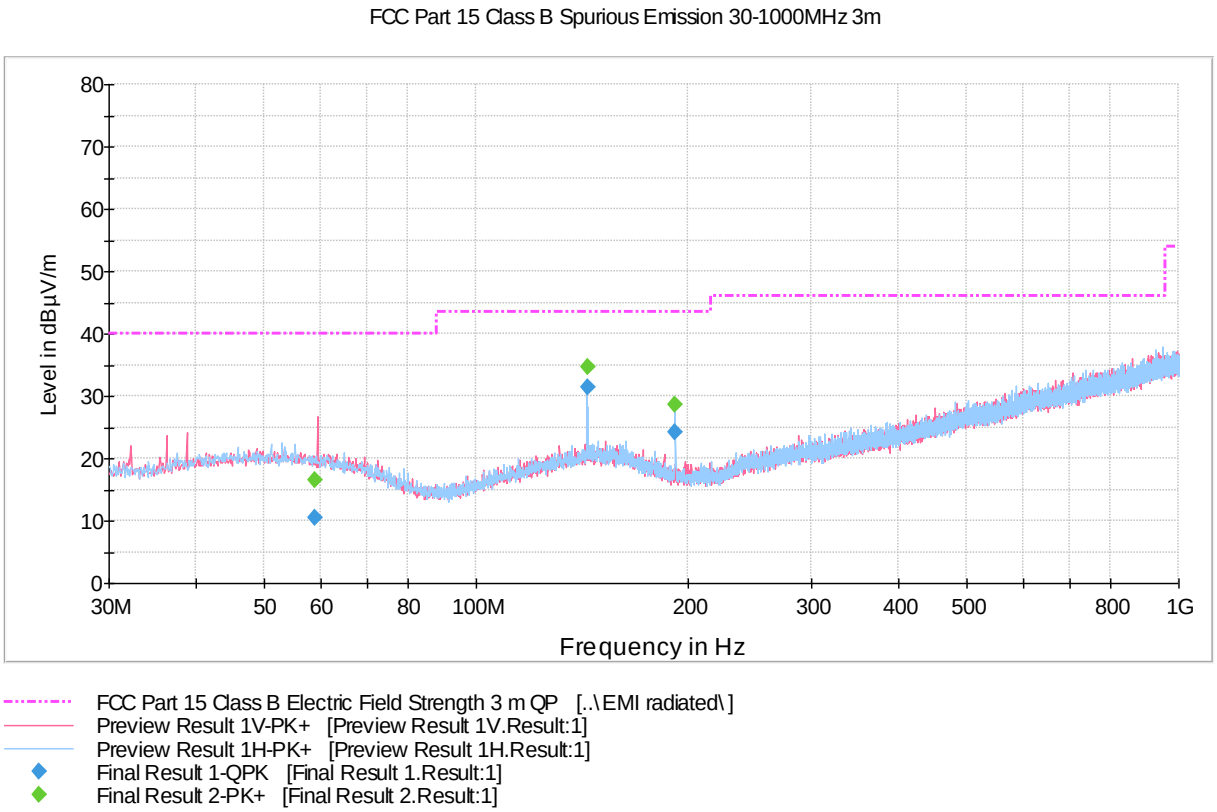


Figure 13. Measured curve with peak-detector. 1 Mbps Channel HIGH.

Final measurements from the worst frequencies

Table 3. Final results.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
59.011000	10.6	1000.0	120.000	400.0	V	320.0	13.9	29.4	40.0	
144.001000	31.4	1000.0	120.000	268.0	H	315.0	14.2	12.1	43.5	
191.670000	24.1	1000.0	120.000	169.0	H	111.0	11.7	19.4	43.5	

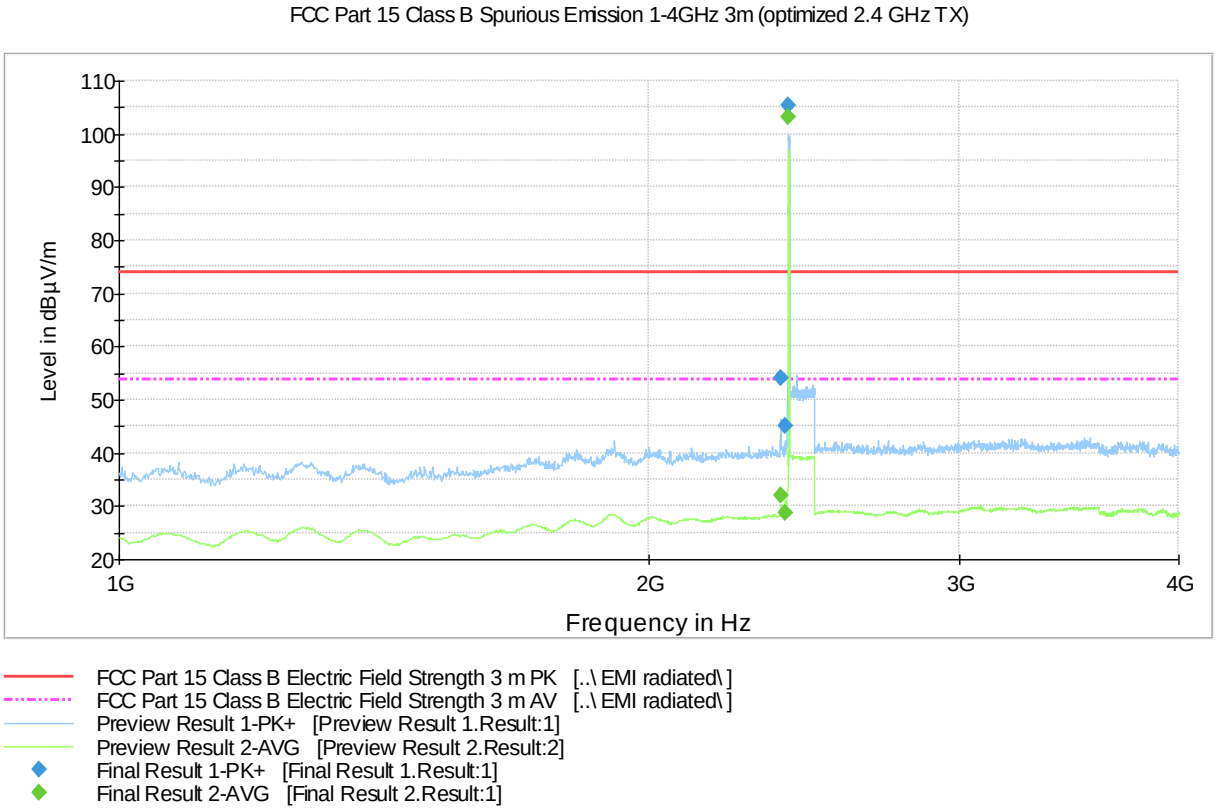


Figure 14. Measured curve with peak- and average detector. 1 Mbps Channel LOW.

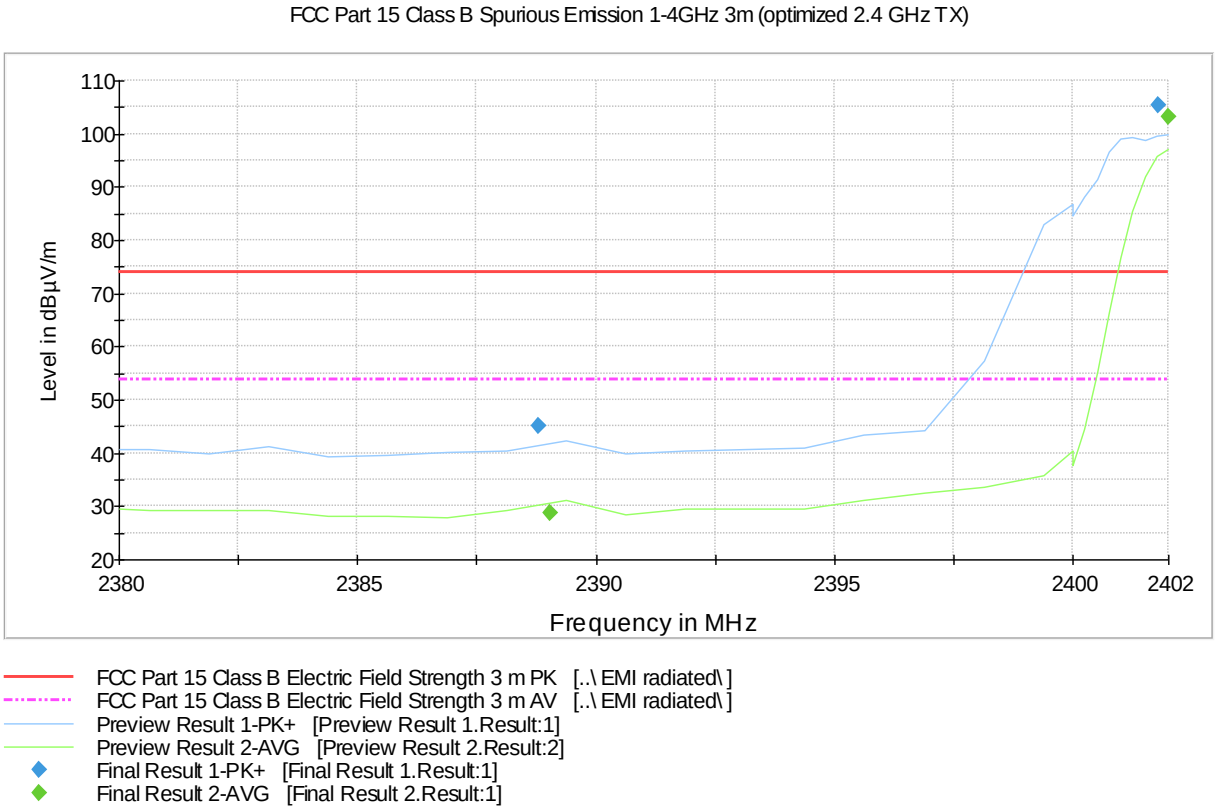


Figure 15. Low channel band edge.

Final measurements from the worst frequencies

Table 4. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2377.025000	54.1	1000.0	1000.000	192.0	H	-4.0	3.7	19.8	73.9	
2388.800000	45.1	1000.0	1000.000	153.0	H	330.0	3.8	28.8	73.9	
2401.800000	105.4	1000.0	1000.000	192.0	H	330.0	3.9	-31.5	73.9	Carrier

Table 5. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2376.875000	32.1	1000.0	1000.000	195.0	H	311.0	3.7	21.8	53.9	
2389.025000	28.8	1000.0	1000.000	185.0	V	117.0	3.8	25.1	53.9	
2402.000000	103.1	1000.0	1000.000	195.0	H	328.0	3.9	-49.2	53.9	Carrier

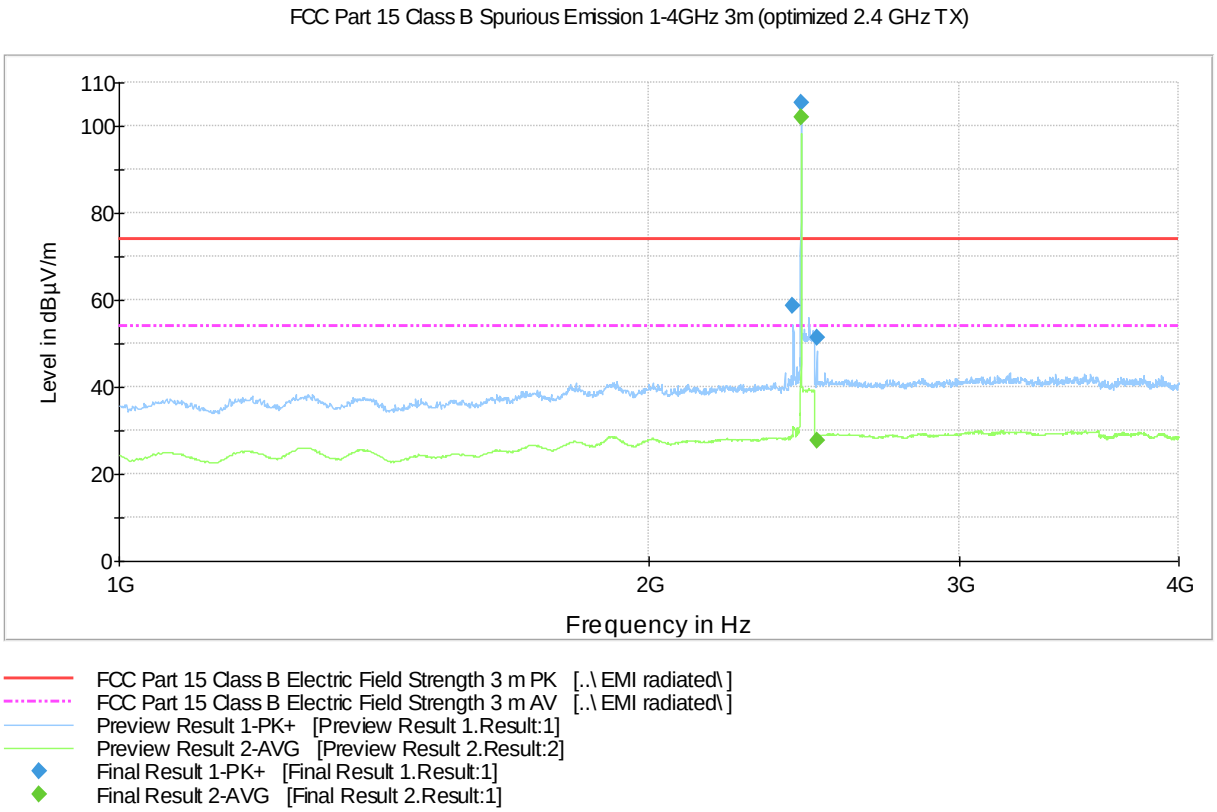


Figure 16. Measured curve with peak- and average detector. 1 Mbps Channel MID.

Final measurements from the worst frequencies

Table 6. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2415.000000	58.7	1000.0	1000.000	184.0	H	323.0	3.9	15.2	73.9	
2441.000000	105.2	1000.0	1000.000	184.0	H	321.0	3.8	-31.3	73.9	Carrier
2492.225000	51.4	1000.0	1000.000	177.0	H	322.0	4.3	22.5	73.9	

Table 7. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2441.000000	102.1	1000.0	1000.000	182.0	H	325.0	3.8	-48.2	53.9	Carrier
2491.425000	27.8	1000.0	1000.000	207.0	H	101.0	4.3	26.1	53.9	

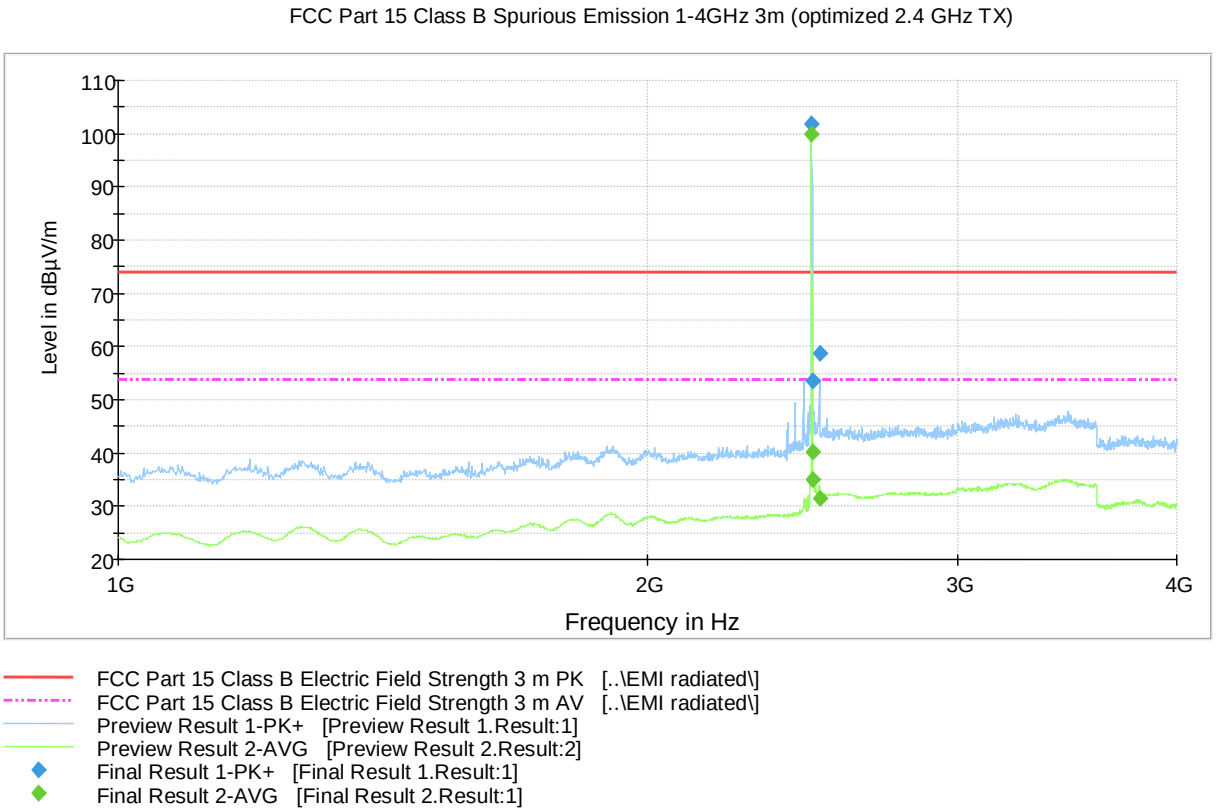


Figure 17. Measured curve with peak- and average detector. 1 Mbps Channel HIGH.

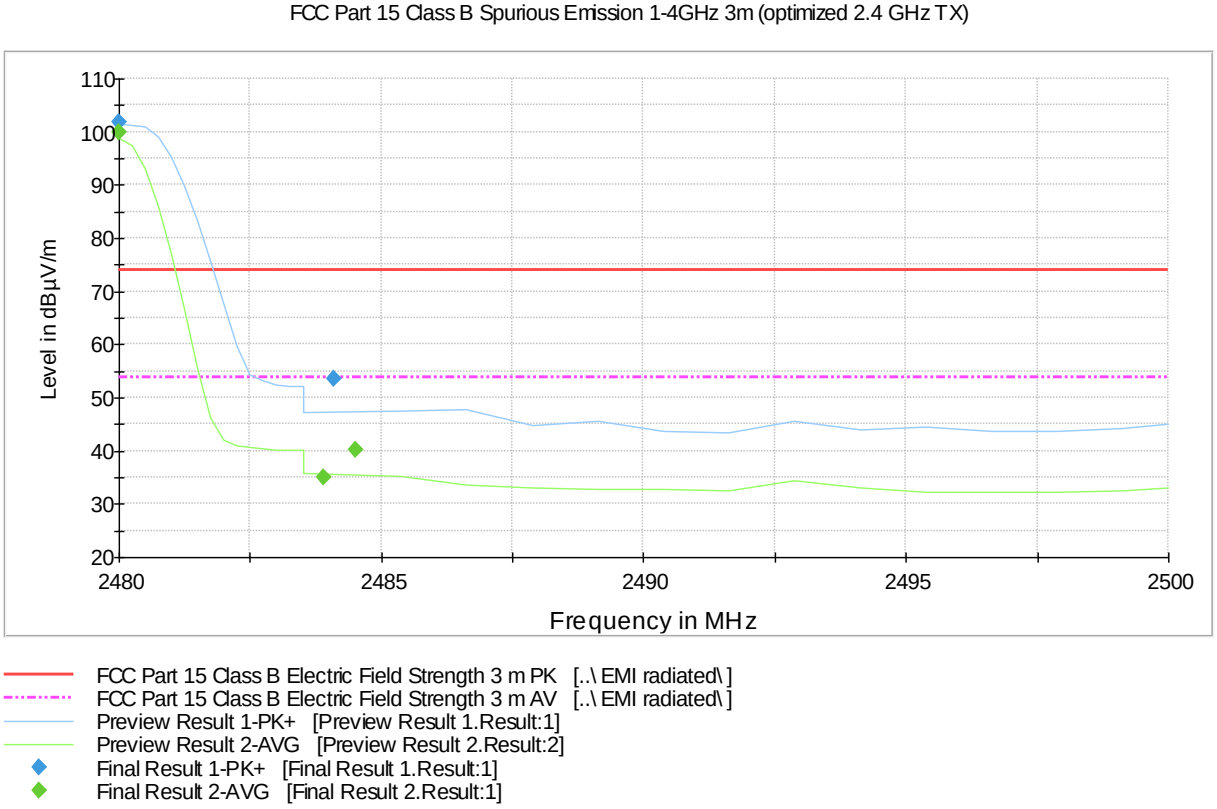


Figure 18. High channel band edge 1 Mbps.

Final measurements from the worst frequencies

Table 8. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2480.000000	101.8	1000.0	1000.000	177.0	H	-3.0	4.2	-27.9	73.9	Carrier
2484.100000	53.4	1000.0	1000.000	226.0	H	2.0	4.2	20.5	73.9	
2505.975000	58.7	1000.0	1000.000	219.0	H	322.0	4.4	15.2	73.9	

Table 9. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2480.000000	100.0	1000.0	1000.000	186.0	H	-5.0	4.2	-46.1	53.9	Carrier
2483.900000	34.9	1000.0	1000.000	178.0	H	1.0	4.2	19.0	53.9	
2484.500000	40.2	1000.0	1000.000	178.0	H	1.0	4.2	13.7	53.9	
2505.775000	31.4	1000.0	1000.000	177.0	H	2.0	4.4	22.5	53.9	

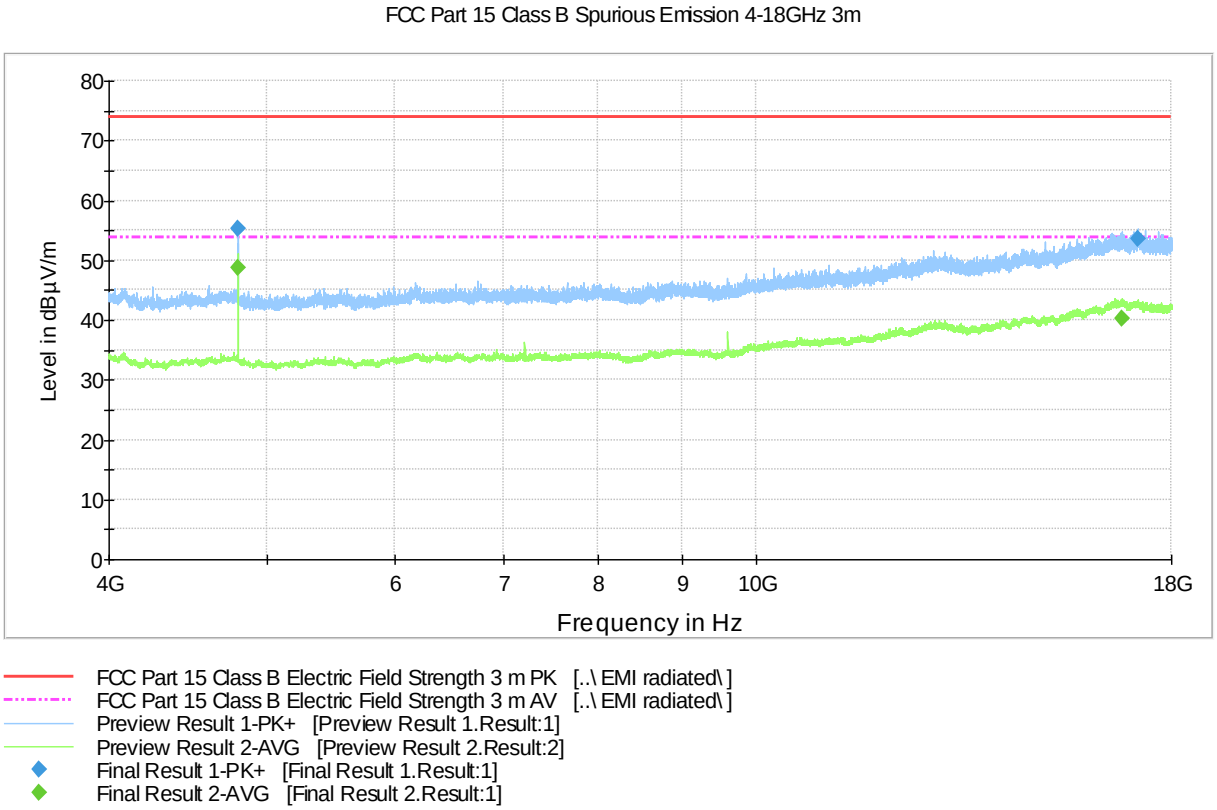


Figure 19. Measured curve with peak- and average detector. 1 Mbps Channel LOW.

Final measurements from the worst frequencies

Table 10. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4804.200000	55.2	1000.0	1000.000	113.0	H	178.0	10.0	18.7	73.9	
17160.500000	53.5	1000.0	1000.000	332.0	V	112.0	25.8	20.4	73.9	

Table 11. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4804.000000	48.8	1000.0	1000.000	100.0	H	174.0	10.0	5.1	53.9	
16781.100000	40.2	1000.0	1000.000	278.0	H	130.0	25.5	13.7	53.9	

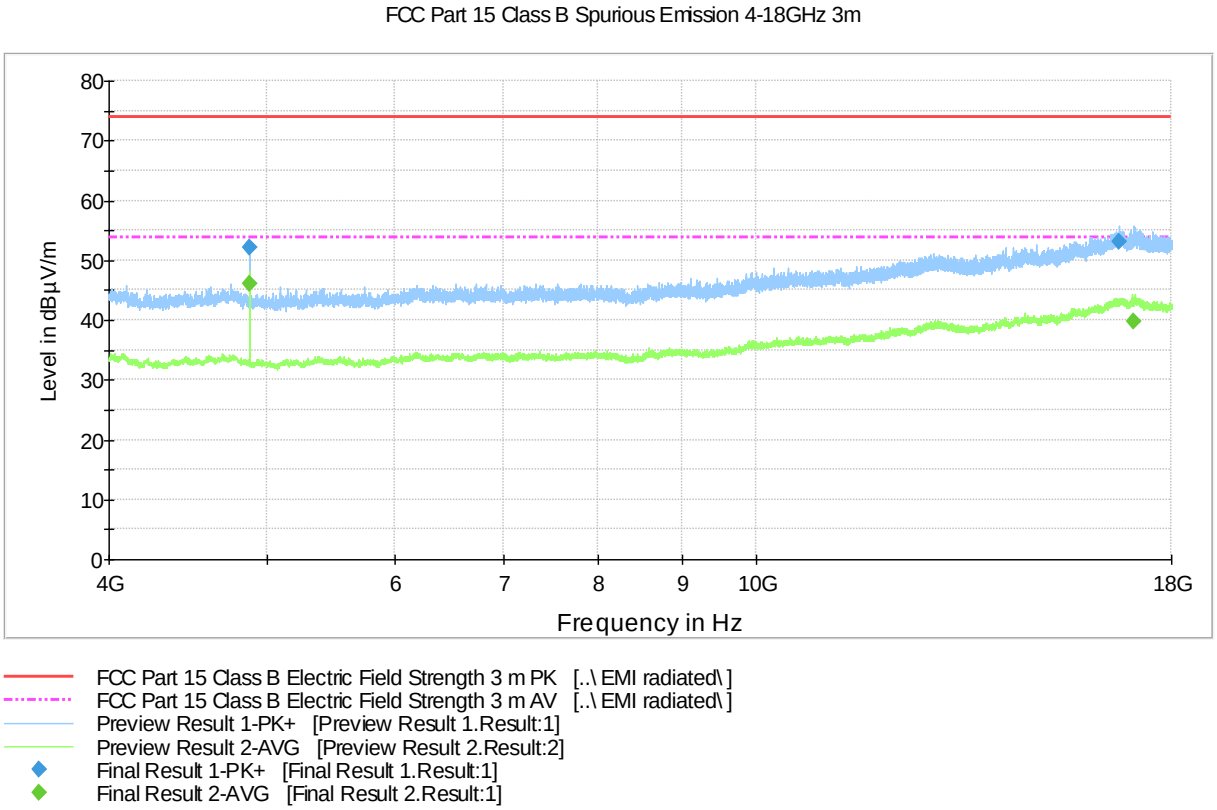


Figure 20. Measured curve with peak- and average detector. 1 Mbps Channel MID.

Final measurements from the worst frequencies

Table 12. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4882.000000	52.2	1000.0	1000.000	100.0	H	174.0	10.0	21.7	73.9	
16723.600000	53.0	1000.0	1000.000	227.0	V	345.0	25.3	20.9	73.9	

Table 13. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4882.000000	46.0	1000.0	1000.000	100.0	H	178.0	10.0	7.9	53.9	
17048.700000	39.9	1000.0	1000.000	266.0	V	170.0	25.7	14.0	53.9	

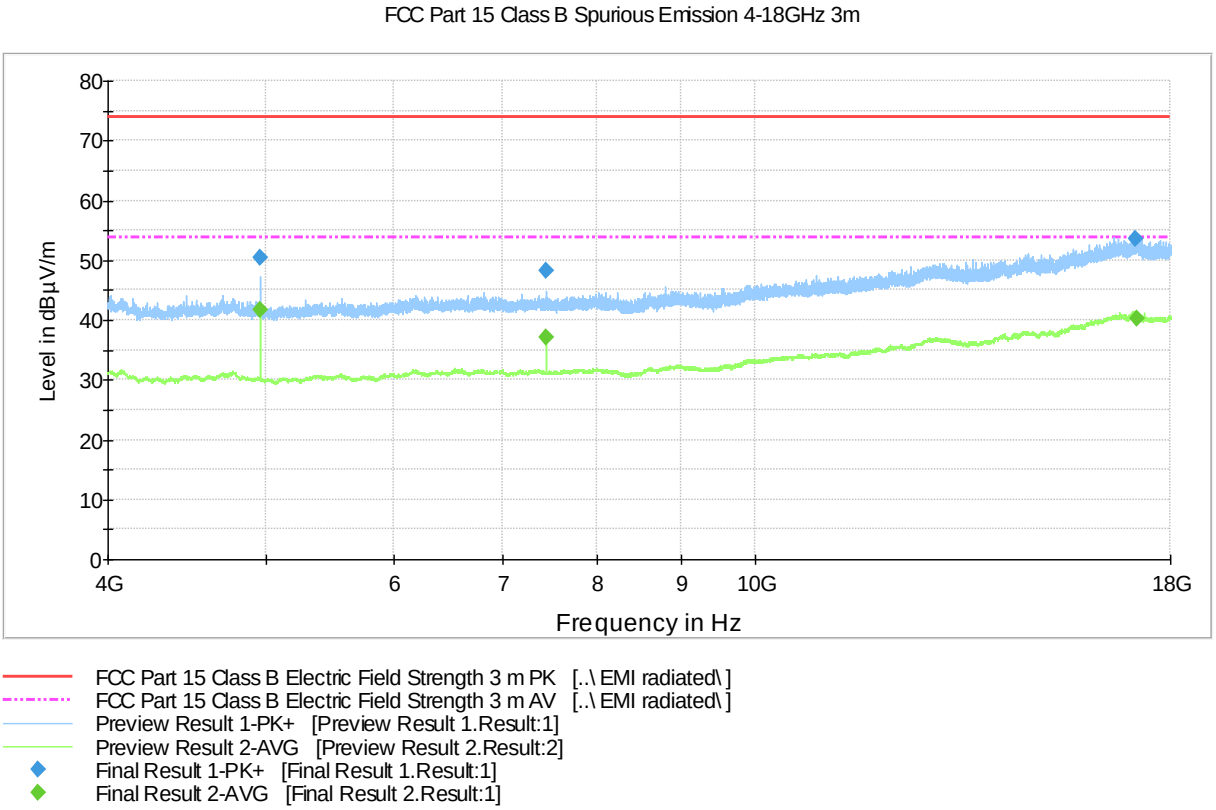


Figure 21. Measured curve with peak- and average detector. 1 Mbps Channel HIGH.

Final measurements from the worst frequencies

Table 14. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4960.300000	50.4	1000.0	1000.000	185.0	V	206.0	9.9	23.5	73.9	
7440.400000	48.2	1000.0	1000.000	100.0	V	8.0	12.3	25.7	73.9	
17141.500000	53.5	1000.0	1000.000	377.0	V	321.0	25.9	20.4	73.9	

Table 15. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
4960.100000	41.6	1000.0	1000.000	183.0	V	205.0	9.9	12.3	53.9	
7439.800000	37.1	1000.0	1000.000	100.0	V	8.0	12.3	16.8	53.9	
17168.500000	40.3	1000.0	1000.000	121.0	V	-4.0	25.8	13.6	53.9	

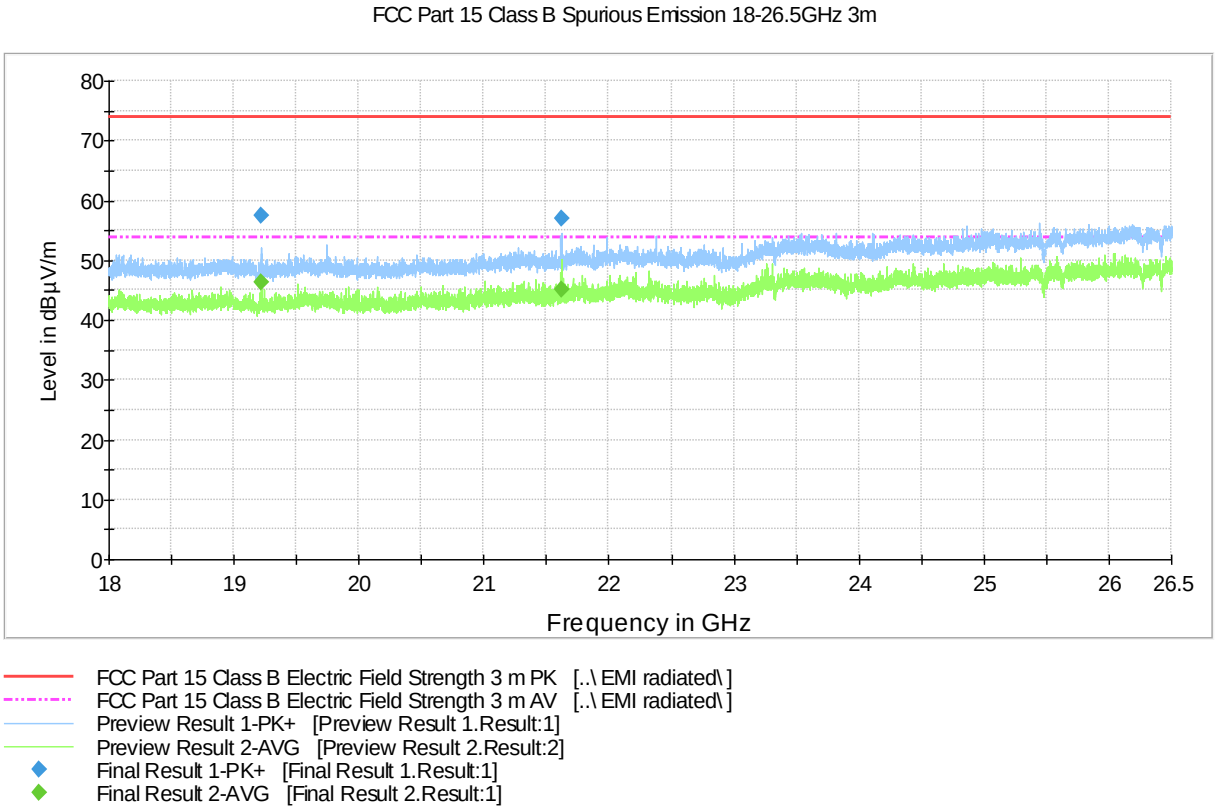


Figure 22. Measured curve with peak- and average detector. 1 Mbps Channel LOW.

Final measurements from the worst frequencies

Table 16. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19217.250000	57.6	1000.0	1000.000	100.0	H	63.0	25.3	16.3	73.9	
21619.300000	56.9	1000.0	1000.000	105.0	H	63.0	27.8	17.0	73.9	

Table 17. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19214.850000	46.2	1000.0	1000.000	100.0	H	63.0	25.3	7.7	53.9	
21619.100000	45.0	1000.0	1000.000	100.0	H	63.0	27.8	8.9	53.9	

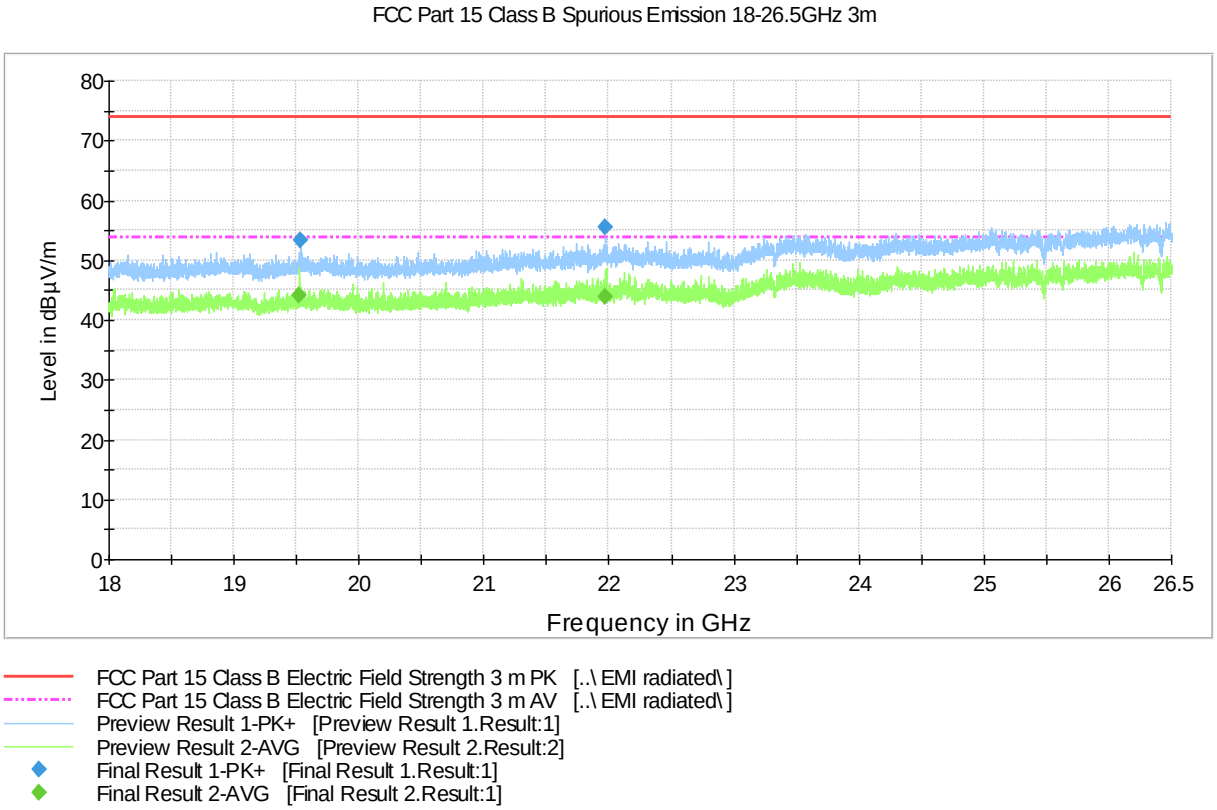


Figure 23. Measured curve with peak- and average detector. 1 Mbps Channel MID.

Final measurements from the worst frequencies

Table 18. Final Max Peak results.

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19527.950000	53.4	1000.0	1000.000	100.0	H	68.0	26.0	20.5	73.9	
21967.250000	55.5	1000.0	1000.000	130.0	H	74.0	28.5	18.4	73.9	

Table 19. Final Average results.

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
19526.800000	44.2	1000.0	1000.000	100.0	H	61.0	26.0	9.7	53.9	
21970.150000	43.9	1000.0	1000.000	114.0	V	319.0	28.5	10.0	53.9	

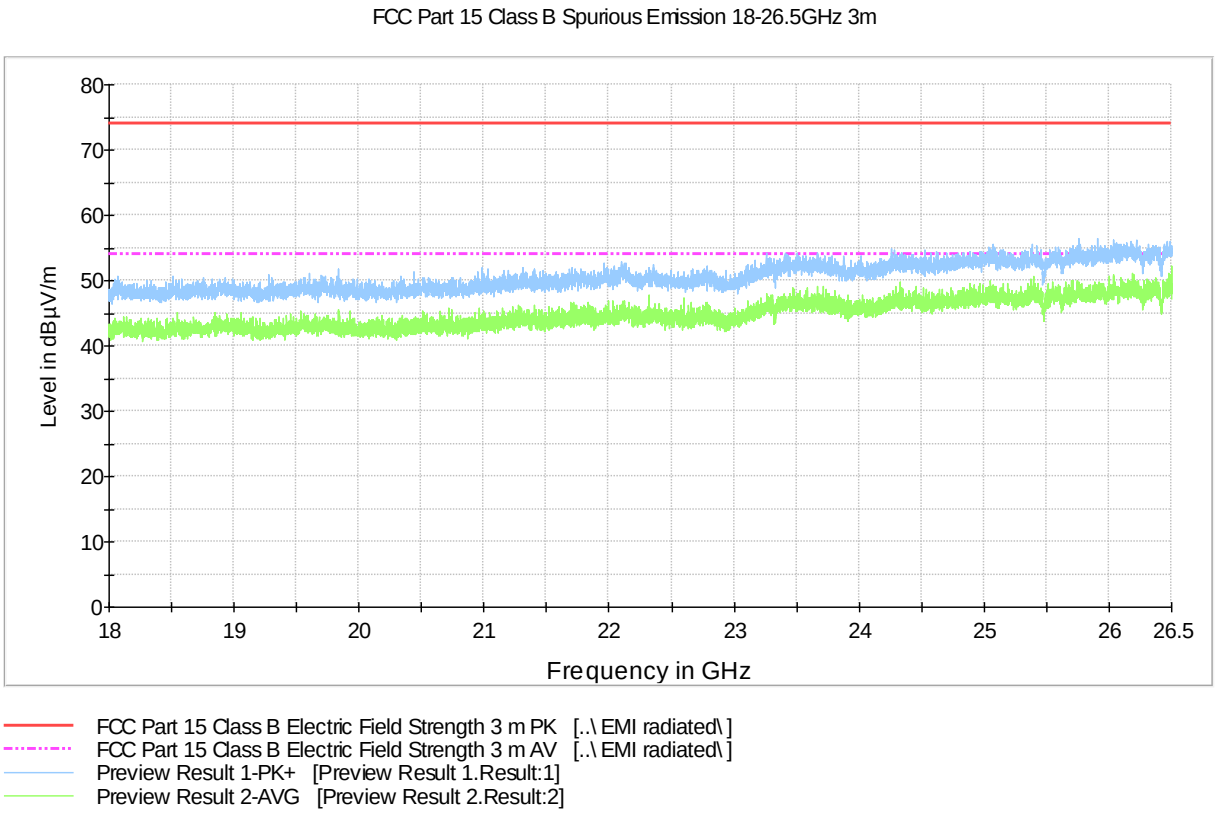


Figure 24. Measured curve with peak- and average detector. 1 Mbps Channel HIGH.

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:	NKO	
Date:	14.5.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % RH	

FCC Rule: 15.247 (d)

Data rate 1 Mbps

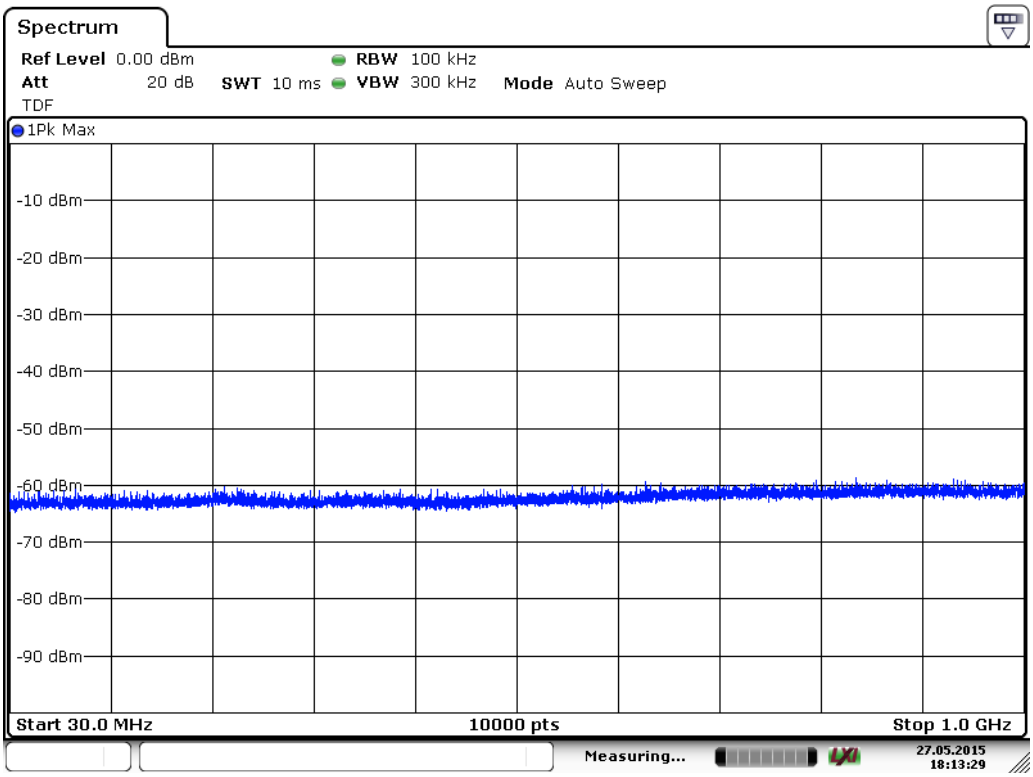
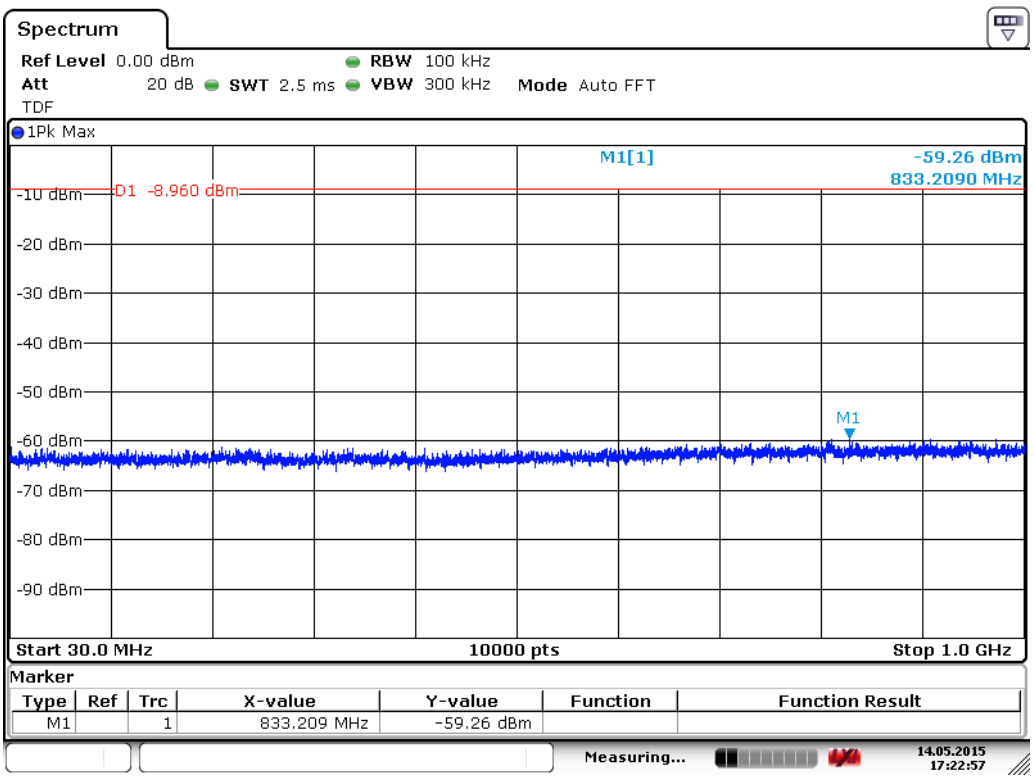
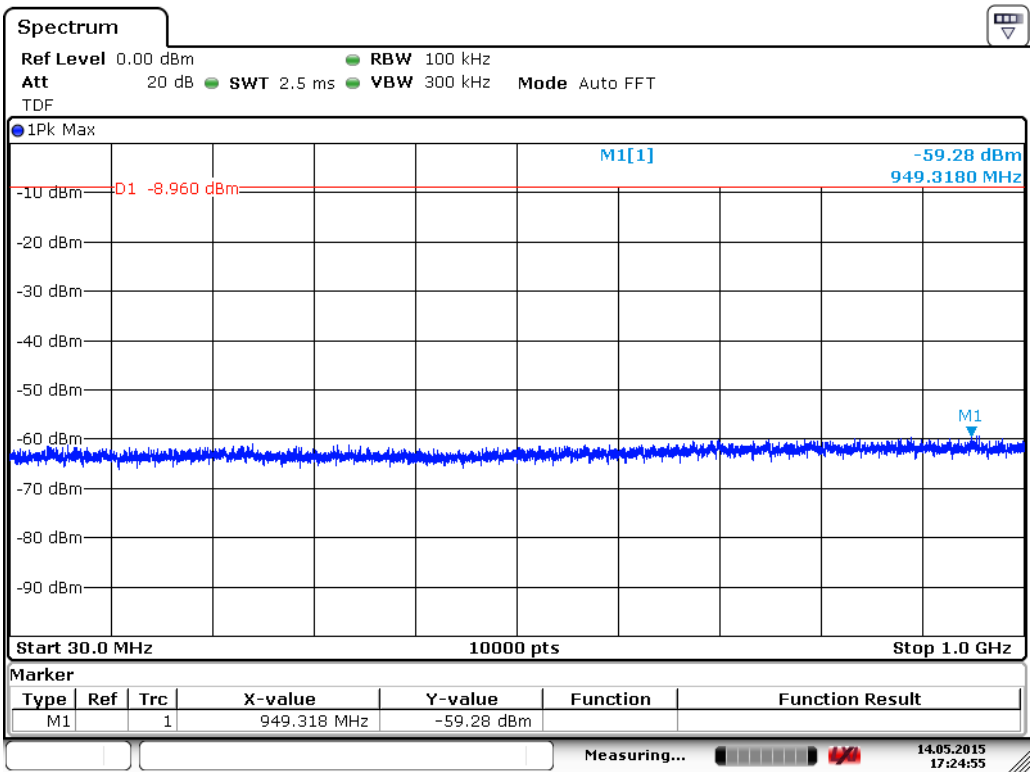


Figure 25. Low channel conducted emission 30 MHz to 1000 MHz (1 Mbps).



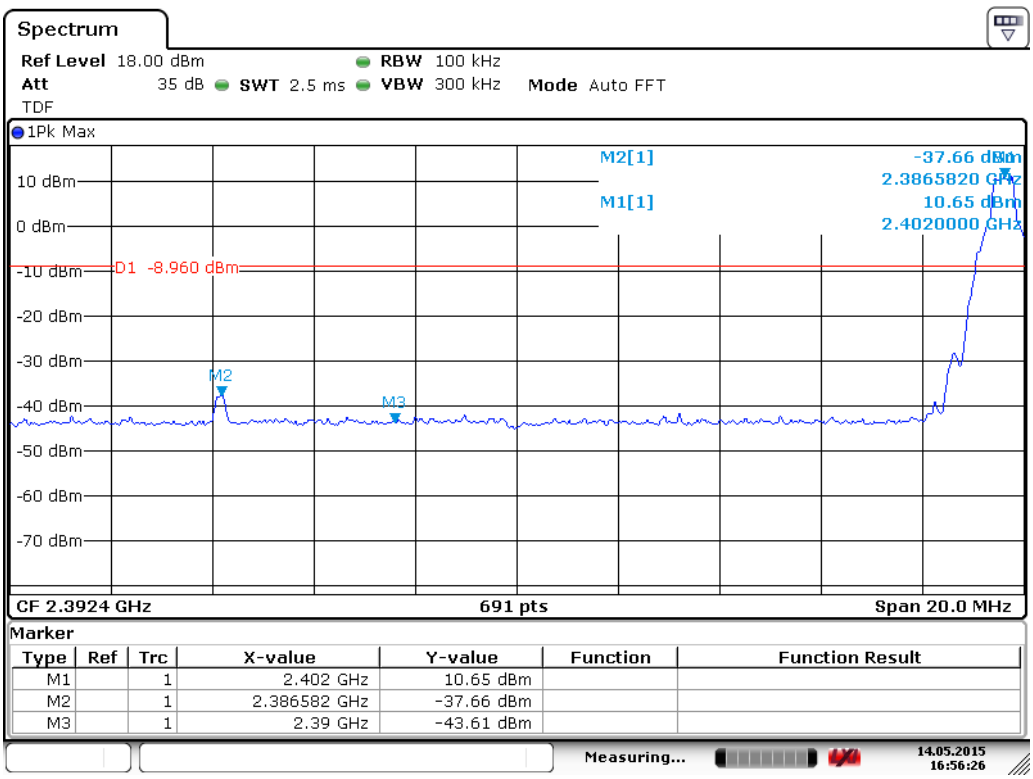
Date: 14.MAY.2015 17:22:57

Figure 26. Mid channel conducted emission 30 MHz to 1000 MHz (1 Mbps).



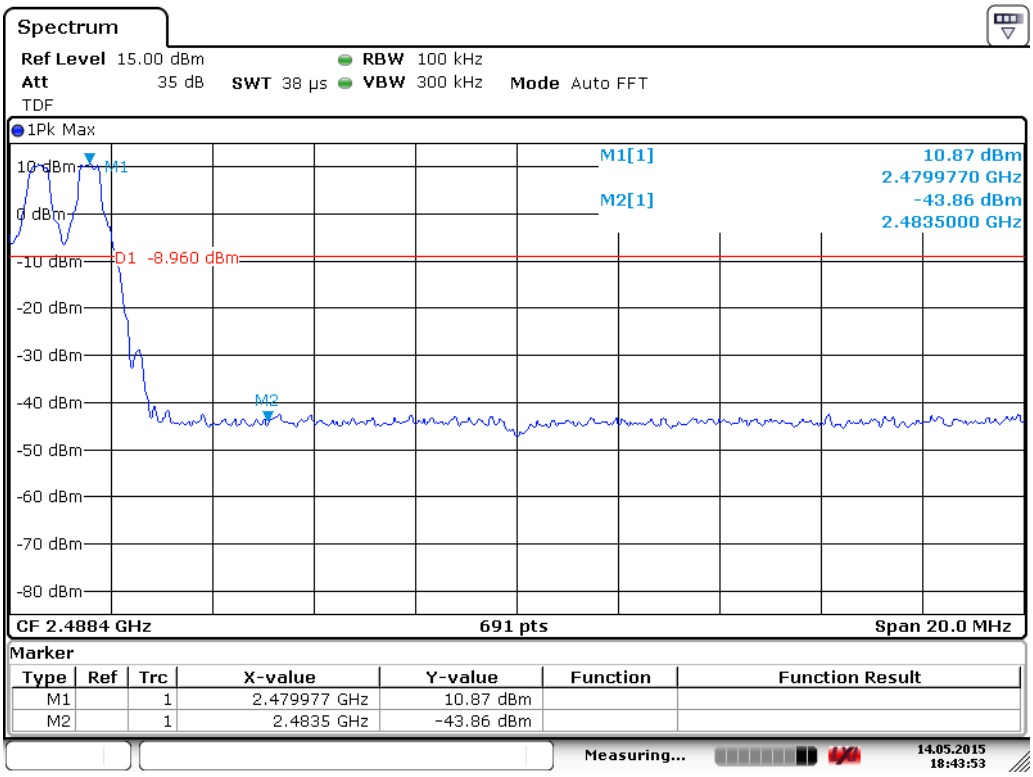
Date: 14.MAY.2015 17:24:55

Figure 27. High channel conducted emission 30 MHz to 1000 MHz (1 Mbps).



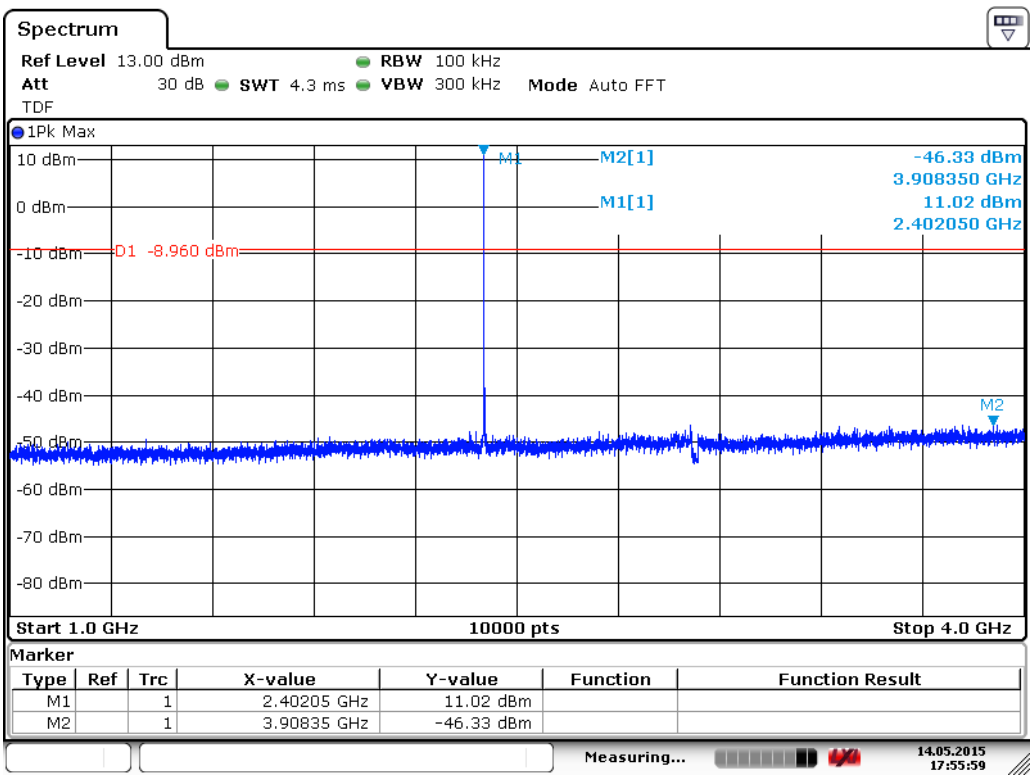
Date: 14.MAY.2015 16:56:26

Figure 28. Conducted emission at low band edge hopping enabled (1 Mbps).



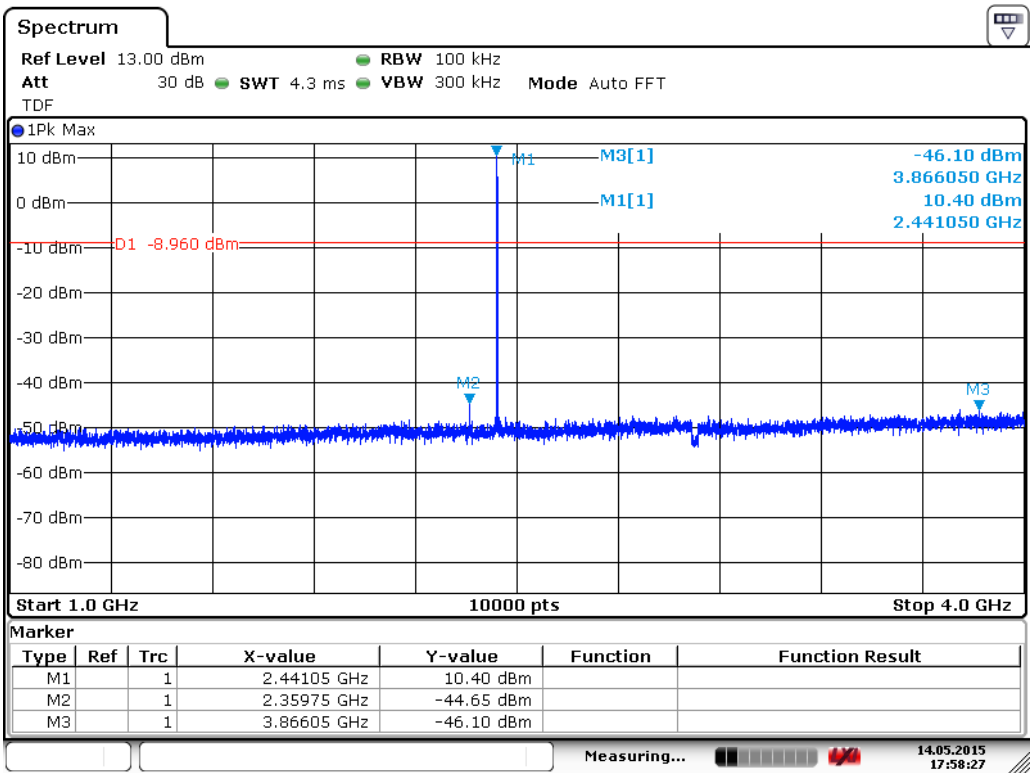
Date: 14.MAY.2015 18:43:54

Figure 29. Conducted emission at high band edge hopping enabled (1 Mbps).



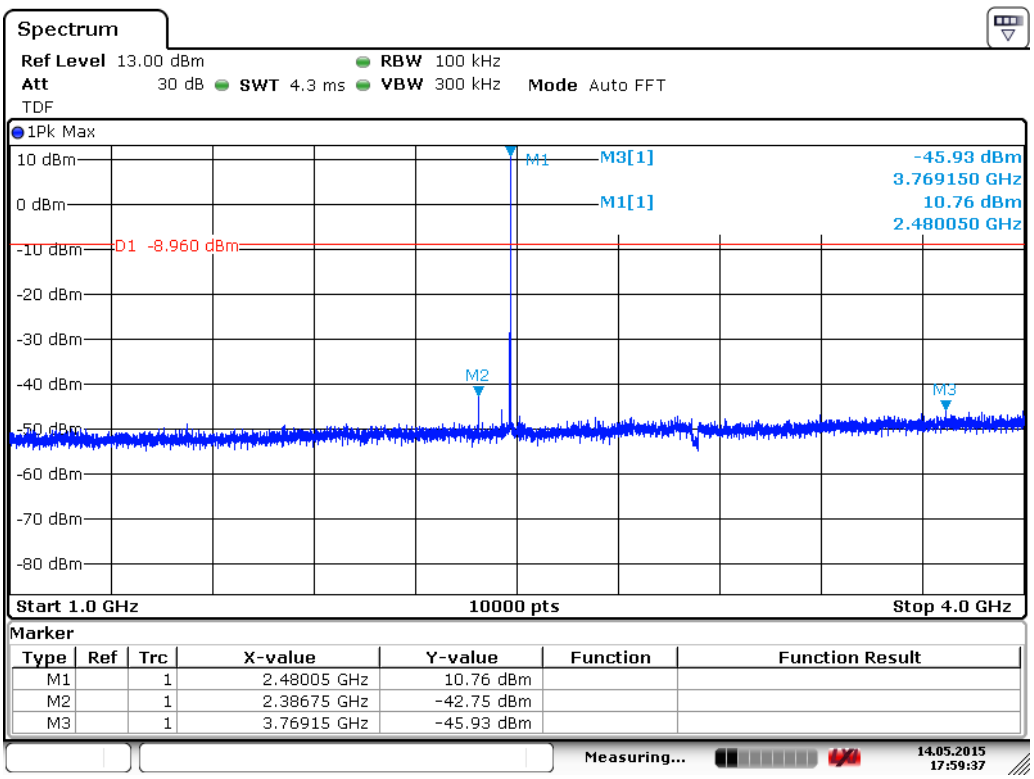
Date: 14.MAY.2015 17:56:00

Figure 30. Low channel conducted emission 1 GHz to 4 GHz (1 Mbps).



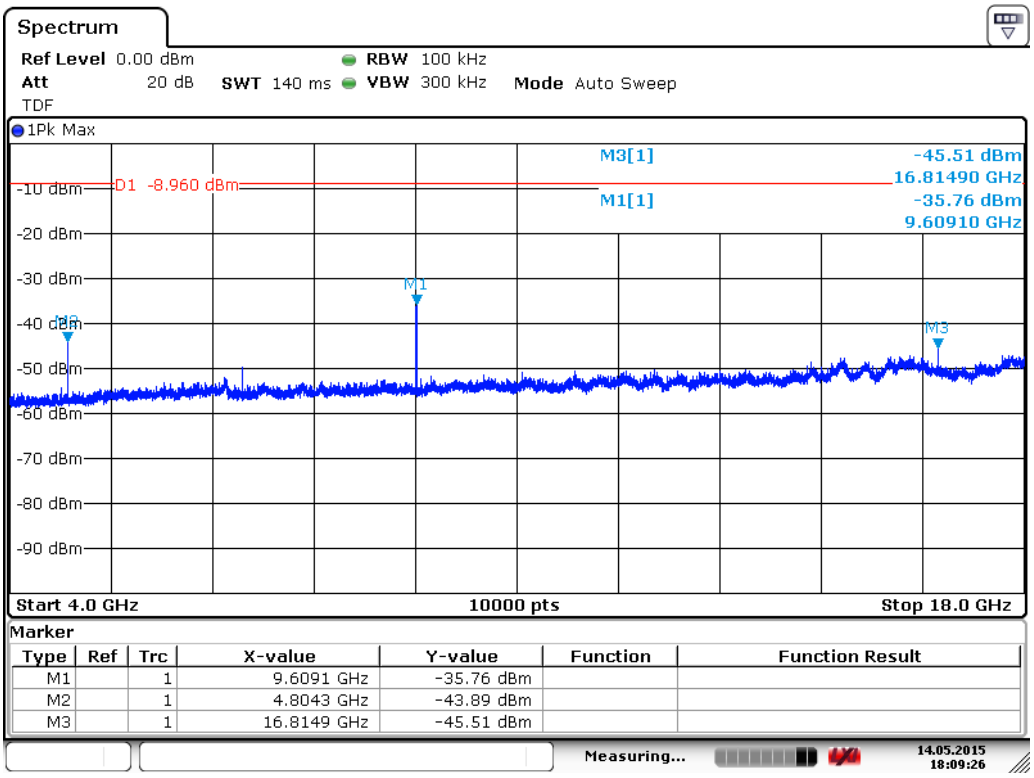
Date: 14.MAY.2015 17:58:27

Figure 31. Mid channel conducted emission 1 GHz to 4 GHz (1 Mbps).



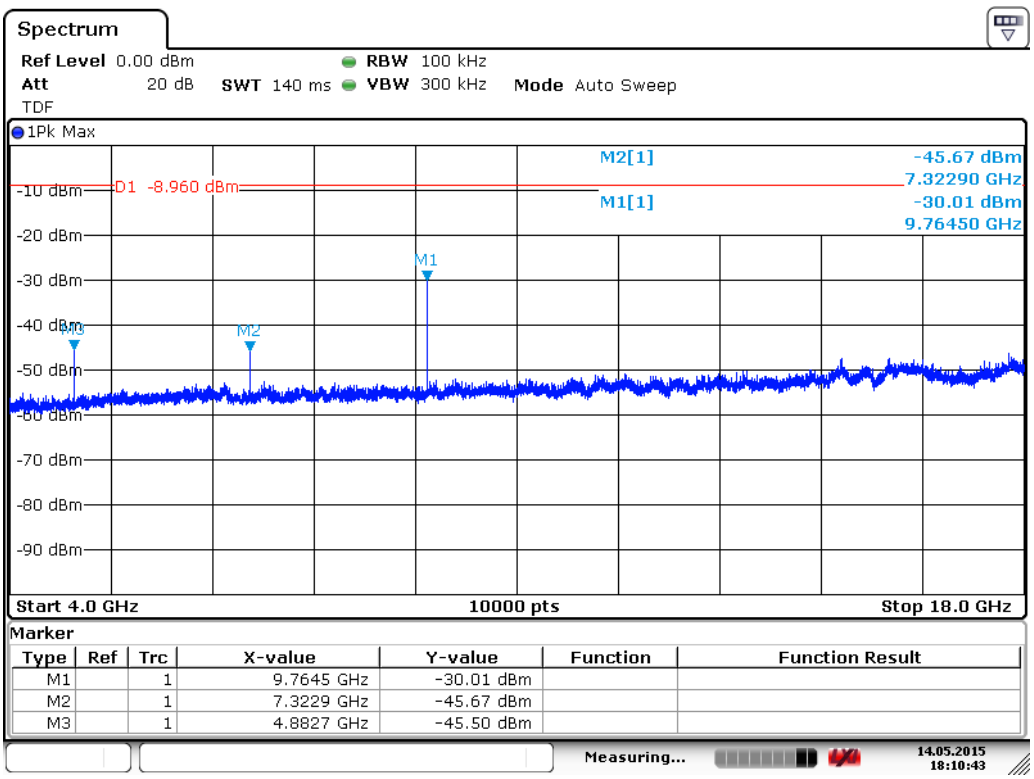
Date: 14.MAY.2015 17:59:37

Figure 32. High channel conducted emission 1 GHz to 4 GHz (1 Mbps).



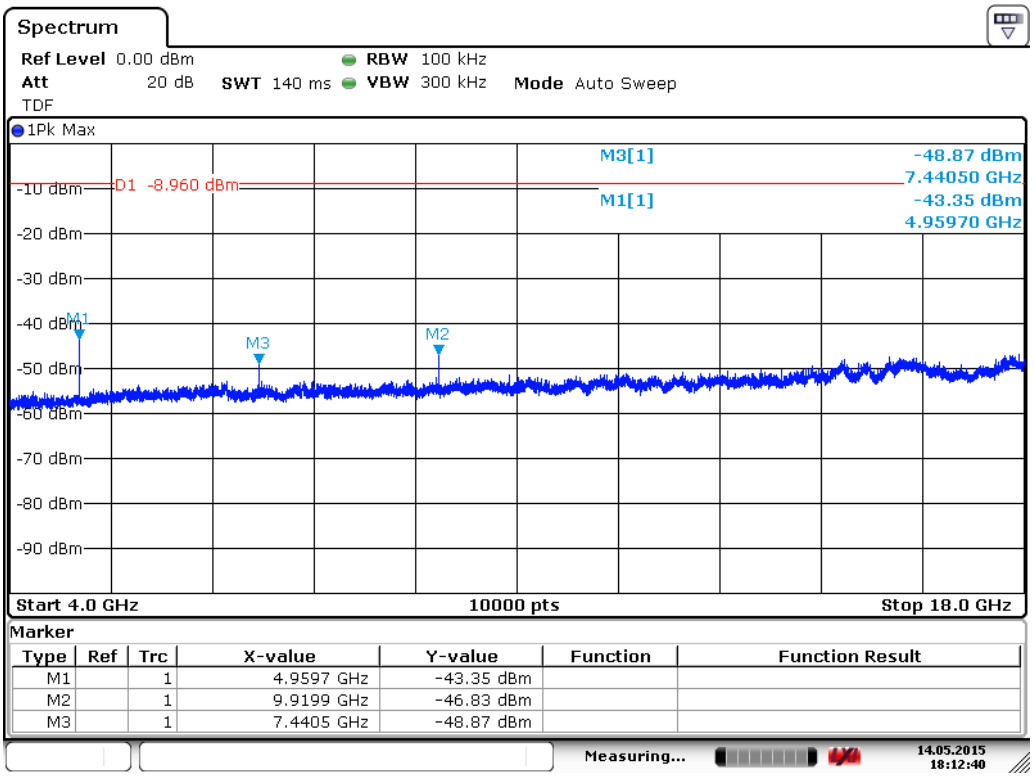
Date: 14.MAY.2015 18:09:26

Figure 33. Low channel conducted emission 4 GHz to 18 GHz (1 Mbps).



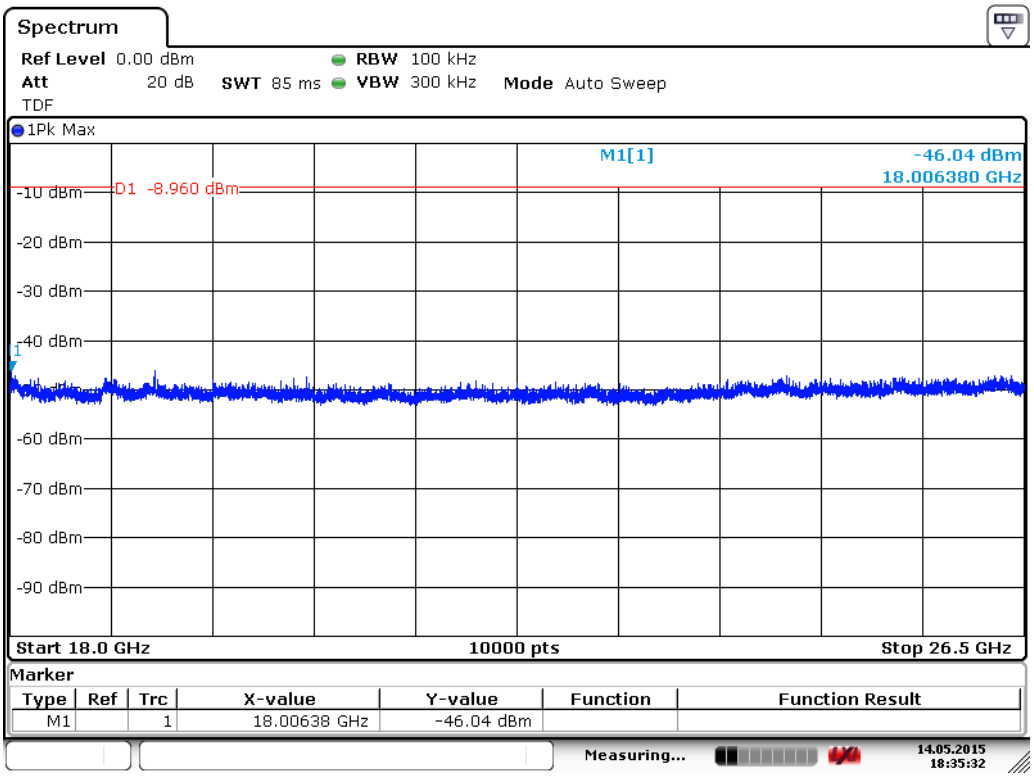
Date: 14.MAY.2015 18:10:43

Figure 34. Mid channel conducted emission 4 GHz to 18 GHz (1 Mbps).



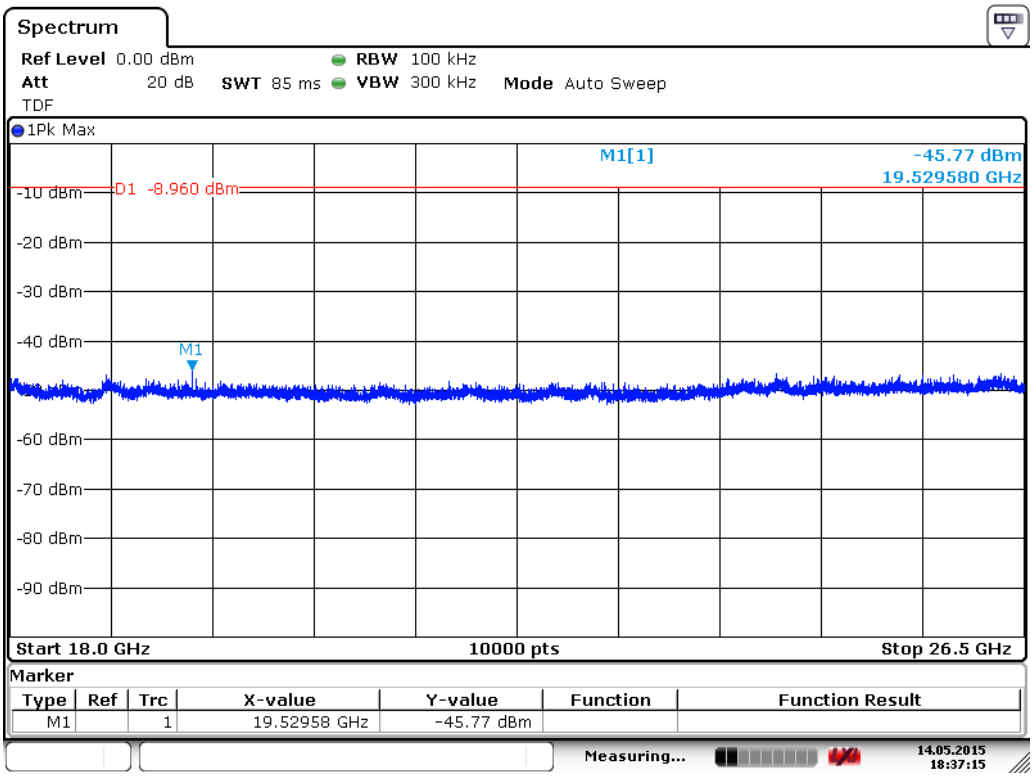
Date: 14.MAY.2015 18:12:40

Figure 35. High channel conducted emission 4 GHz to 18 GHz (1 Mbps).



Date: 14.MAY.2015 18:35:33

Figure 36. Low channel conducted emission 18 GHz to 26.5 GHz (1 Mbps).



Date: 14.MAY.2015 18:37:15

Figure 37. Mid channel conducted emission 18 GHz to 26.5 GHz (1 Mbps).

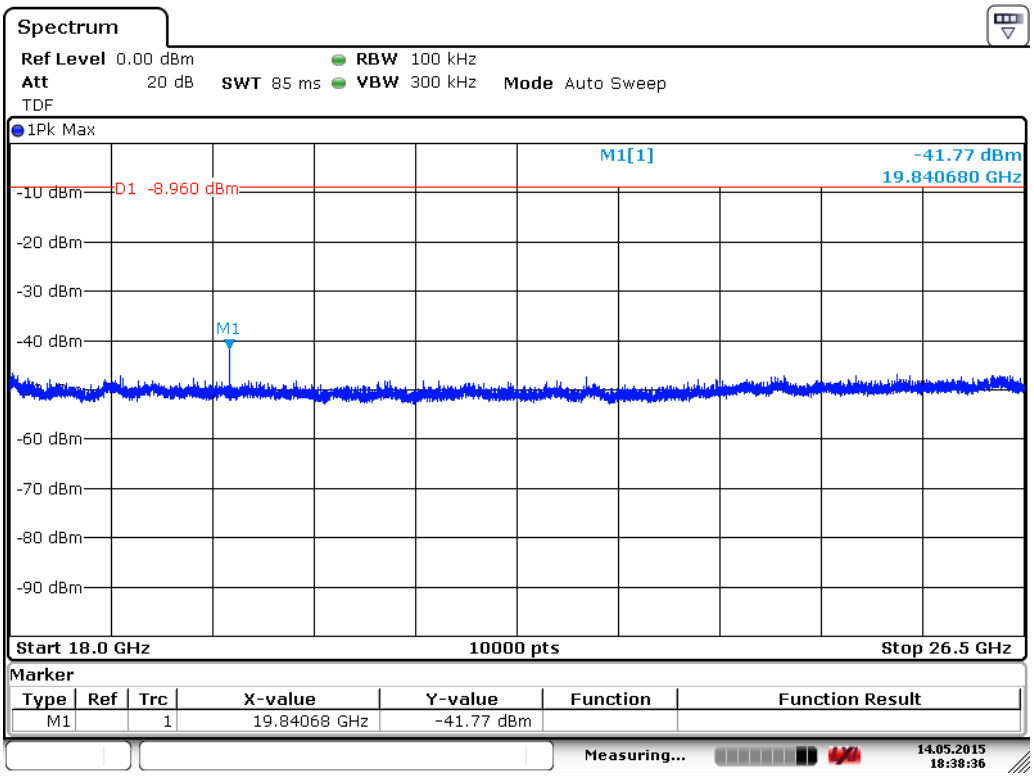
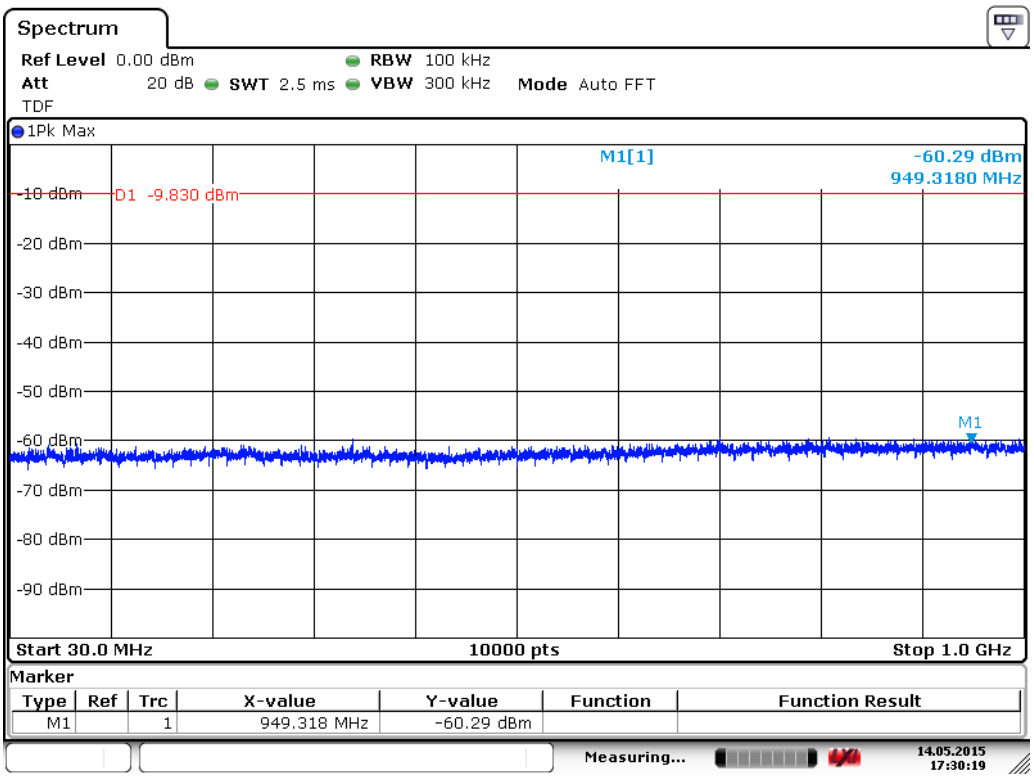


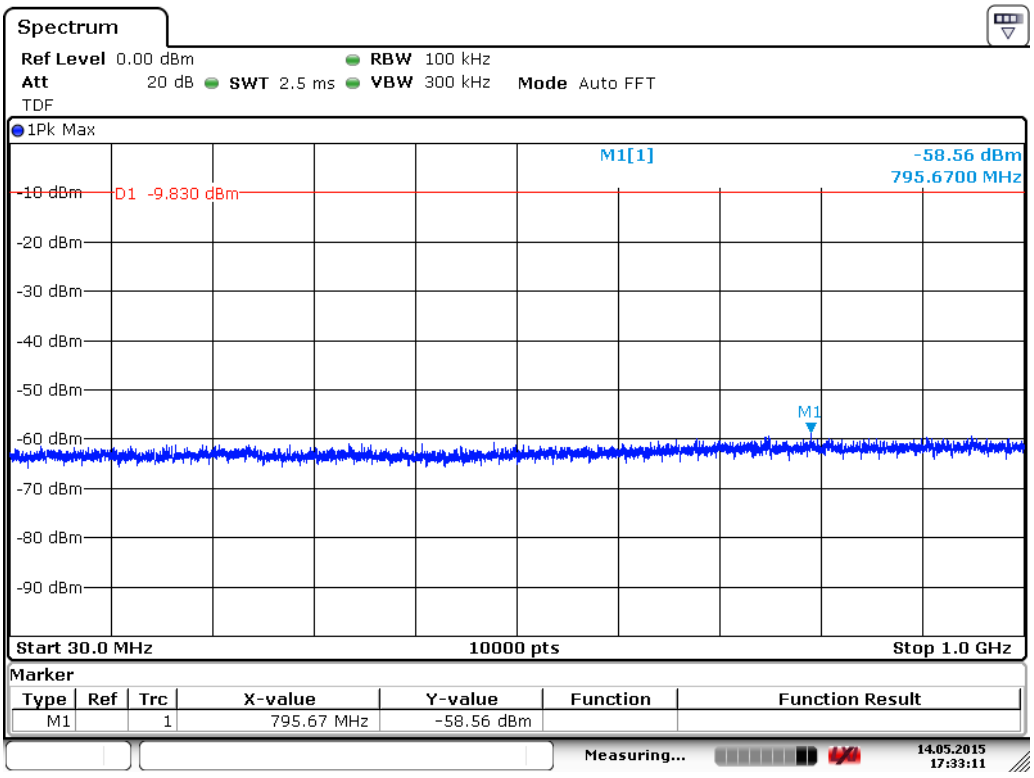
Figure 38. High channel conducted emission 18 GHz to 26.5 GHz (1 Mbps).

Data rate 2 Mbps



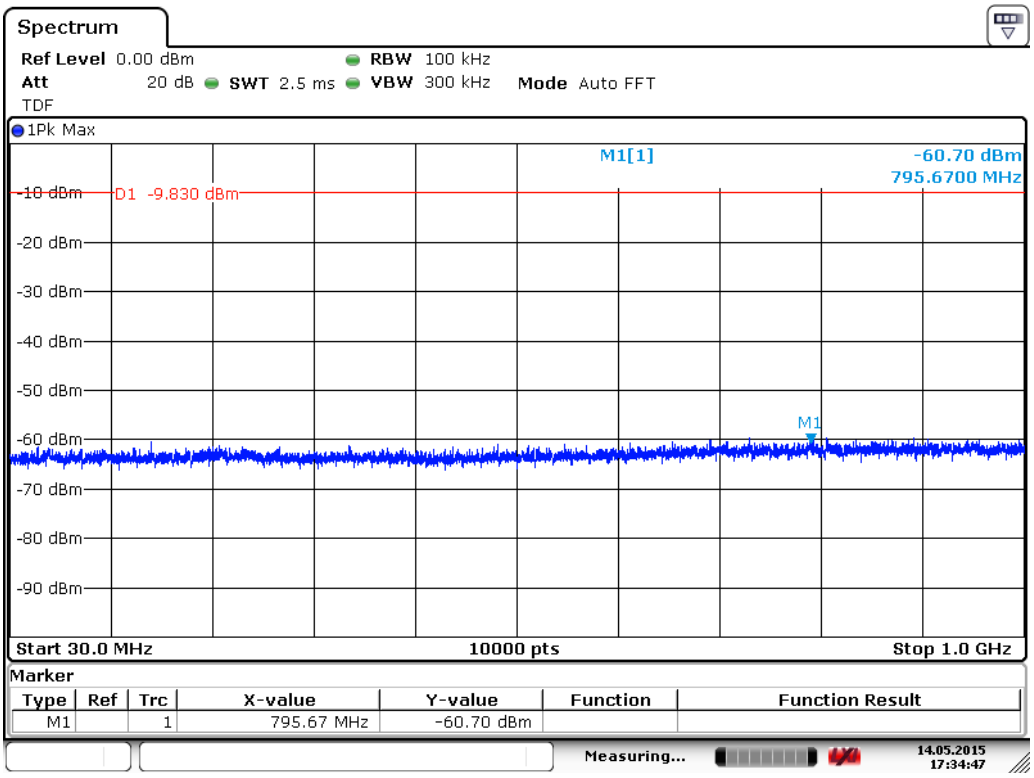
Date: 14.MAY.2015 17:30:19

Figure 39. Low channel conducted emission 30 MHz to 1000 MHz (2 Mbps).



Date: 14.MAY.2015 17:33:11

Figure 40. Mid channel conducted emission 30 MHz to 1000 MHz (2 Mbps).

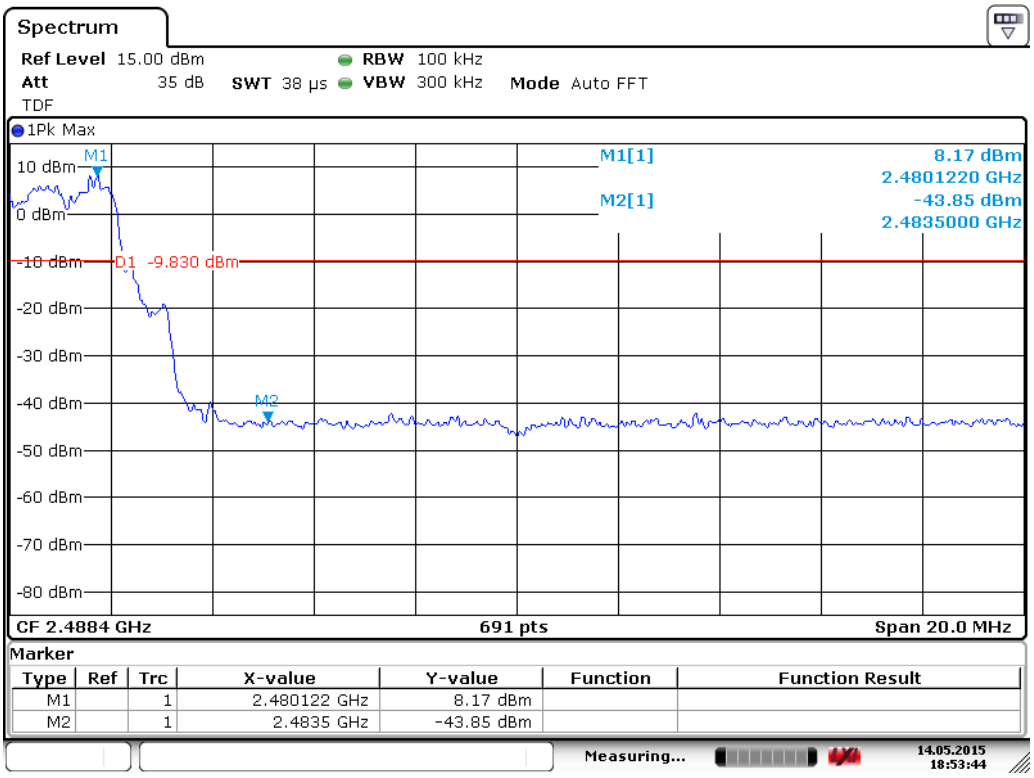


Date: 14.MAY.2015 17:34:48

Figure 41. High channel conducted emission 30 MHz to 1000 MHz (2 Mbps).

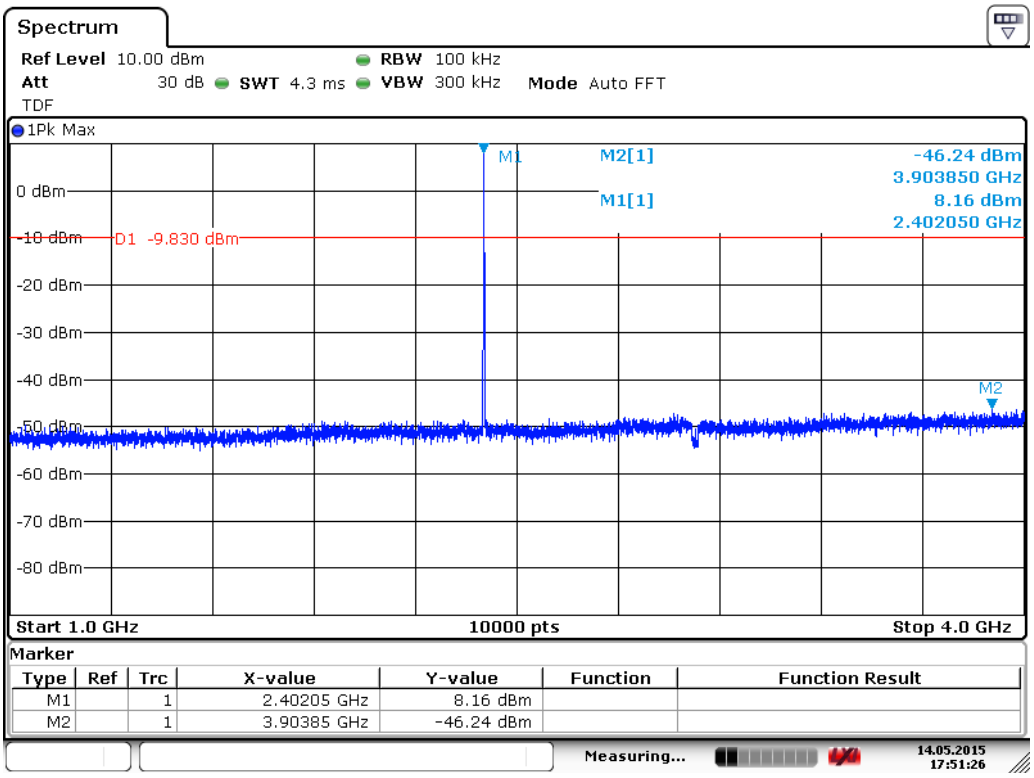
Date: 27.MAY.2015 18:20:22

Figure 42. Low channel conducted emission at low band edge hopping enabled (2 Mbps).



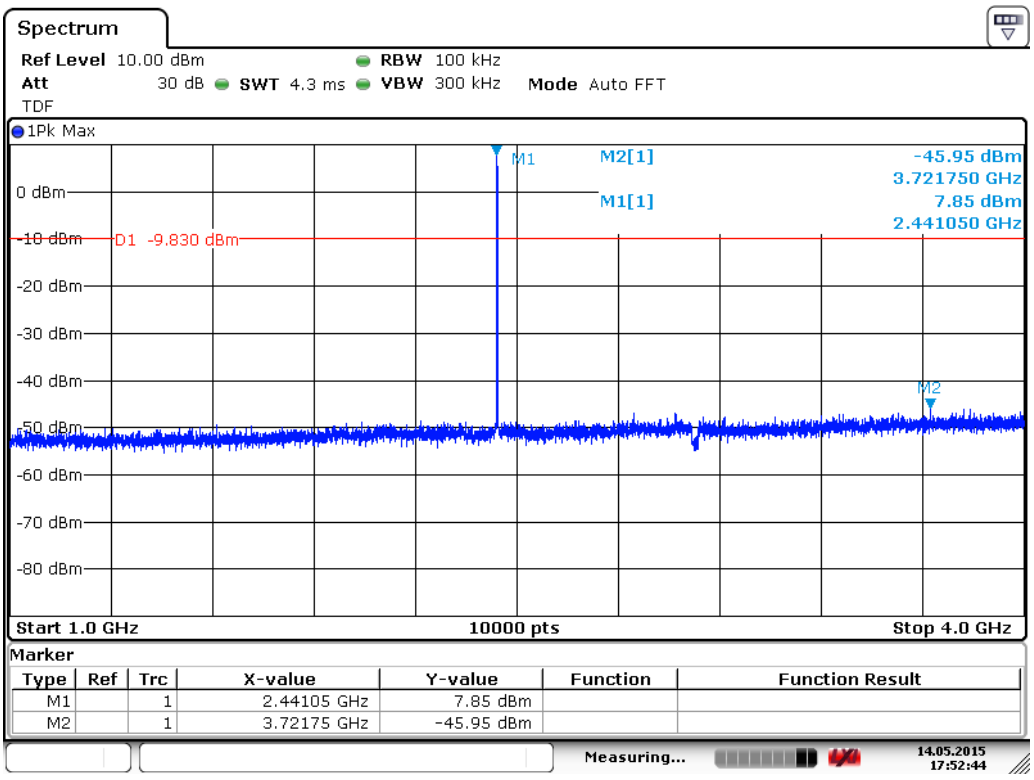
Date: 14.MAY.2015 18:53:44

Figure 43. High channel conducted emission at high band edge hopping enabled (2 Mbps).



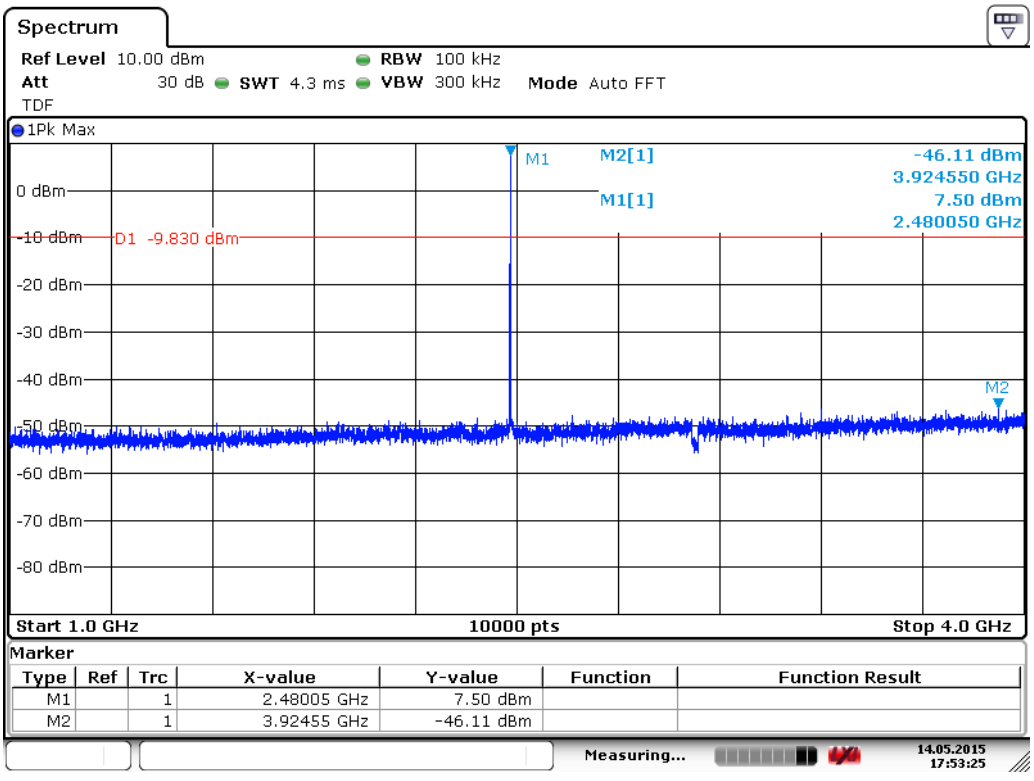
Date: 14.MAY.2015 17:51:26

Figure 44. Low channel conducted emission 1 GHz to 4 GHz (2 Mbps).



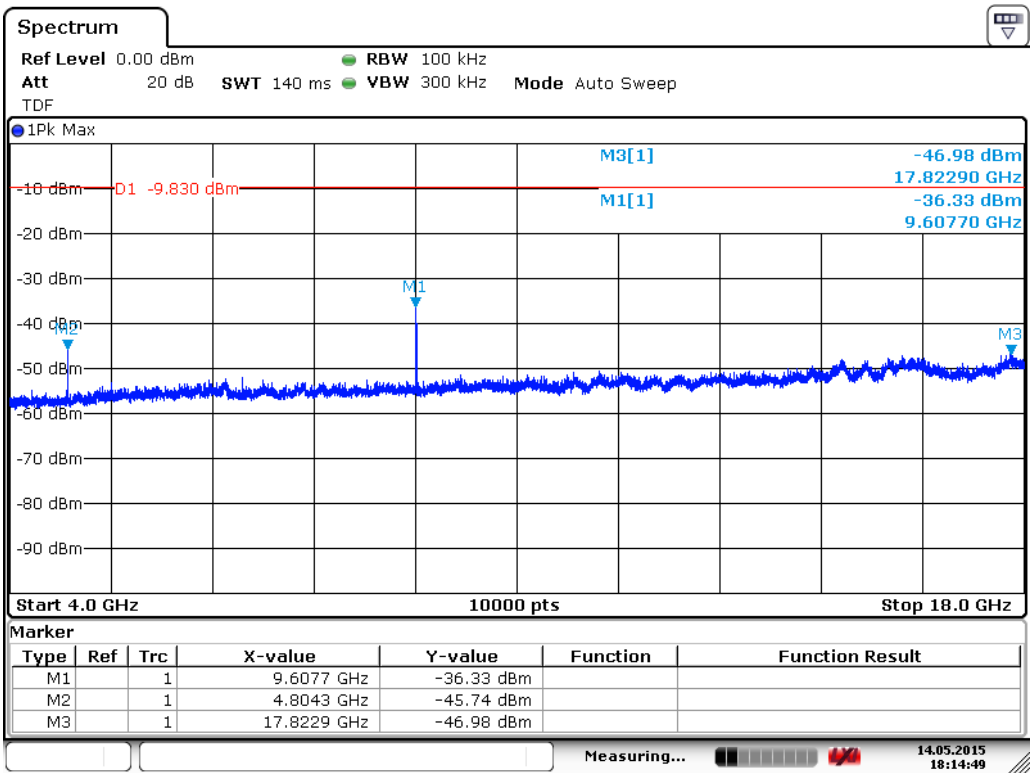
Date: 14.MAY.2015 17:52:44

Figure 45. Mid channel conducted emission 1 GHz to 4 GHz (2 Mbps).



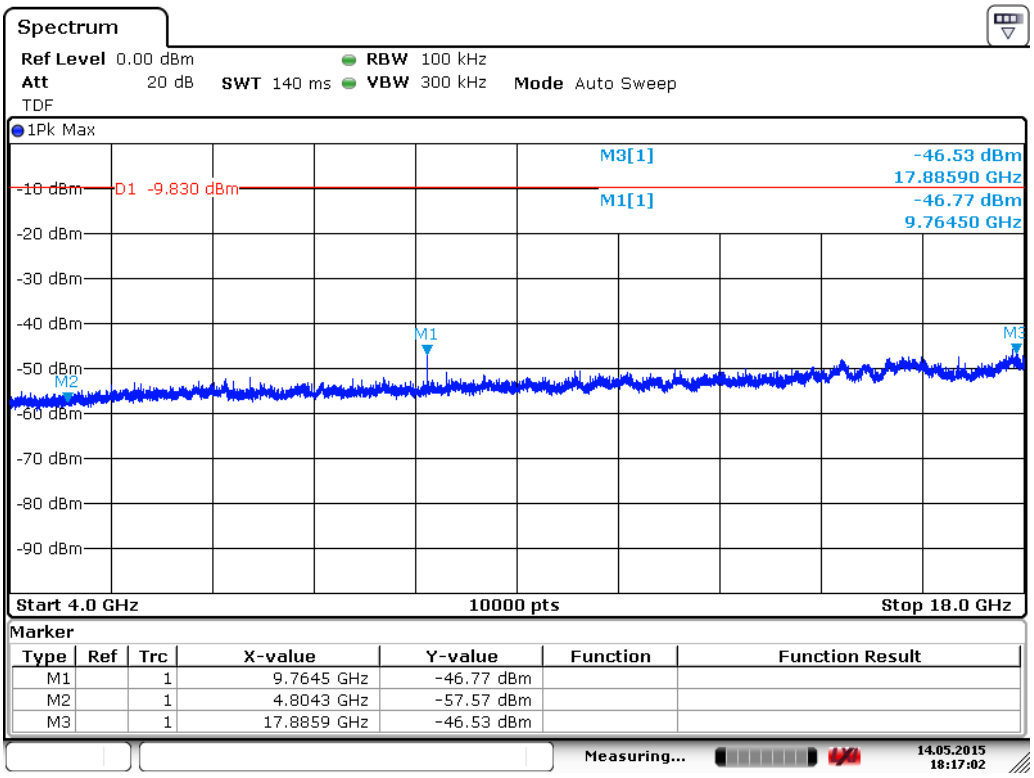
Date: 14.MAY.2015 17:53:25

Figure 46. High channel conducted emission 1 GHz to 4 GHz (2 Mbps).



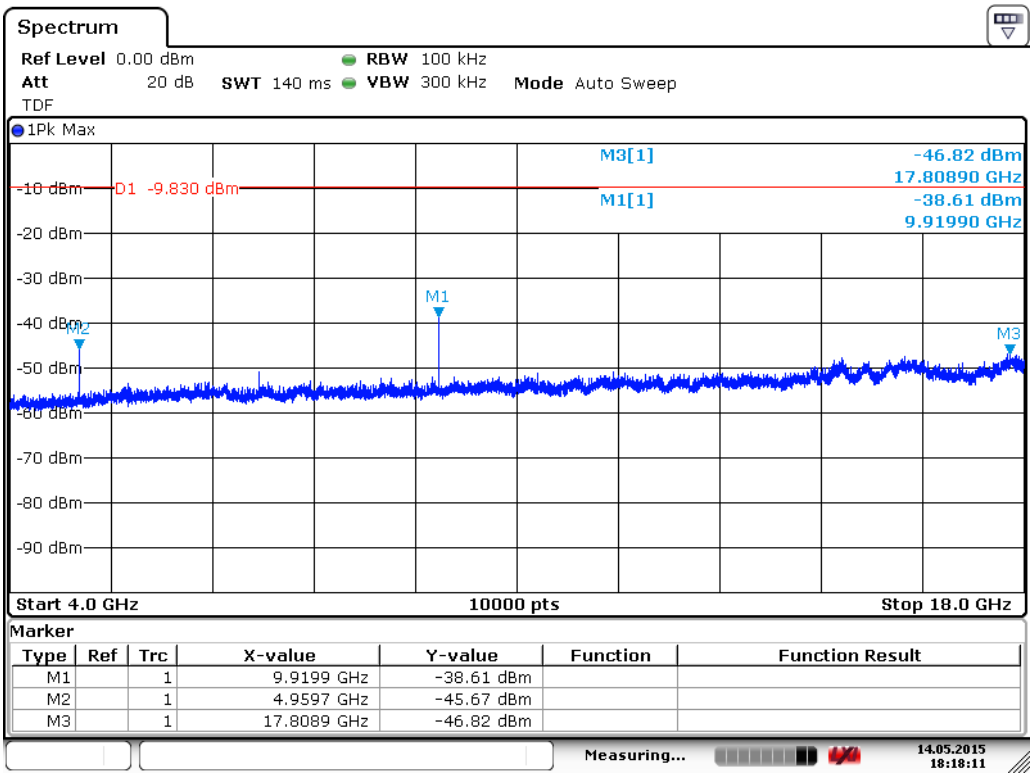
Date: 14.MAY.2015 18:14:49

Figure 47. Low channel conducted emission 4 GHz to 18 GHz (2 Mbps).



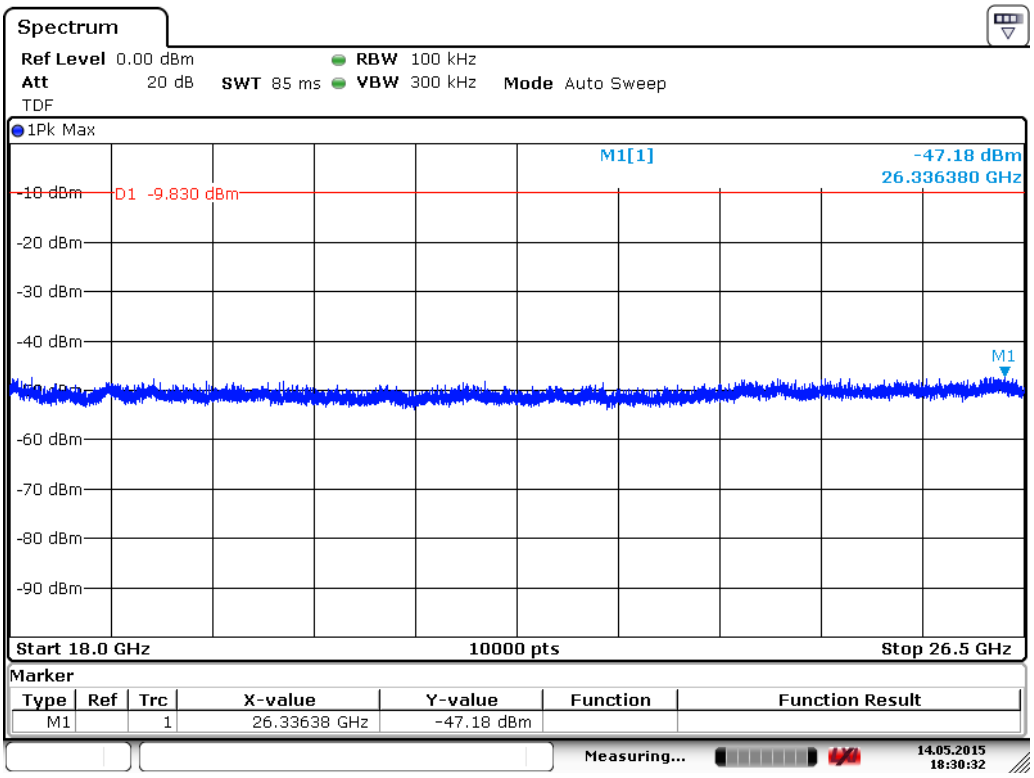
Date: 14.MAY.2015 18:17:03

Figure 48. Mid channel conducted emission 4 GHz to 18 GHz (2 Mbps).



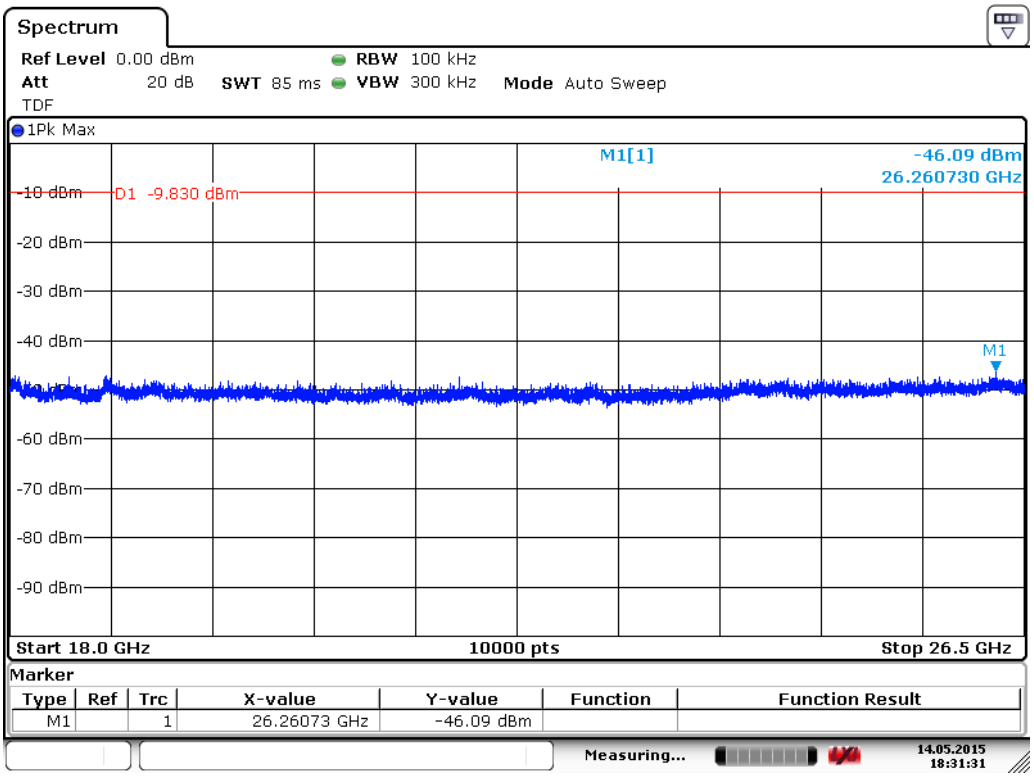
Date: 14.MAY.2015 18:18:12

Figure 49. High channel conducted emission 4 GHz to 18 GHz (2 Mbps).



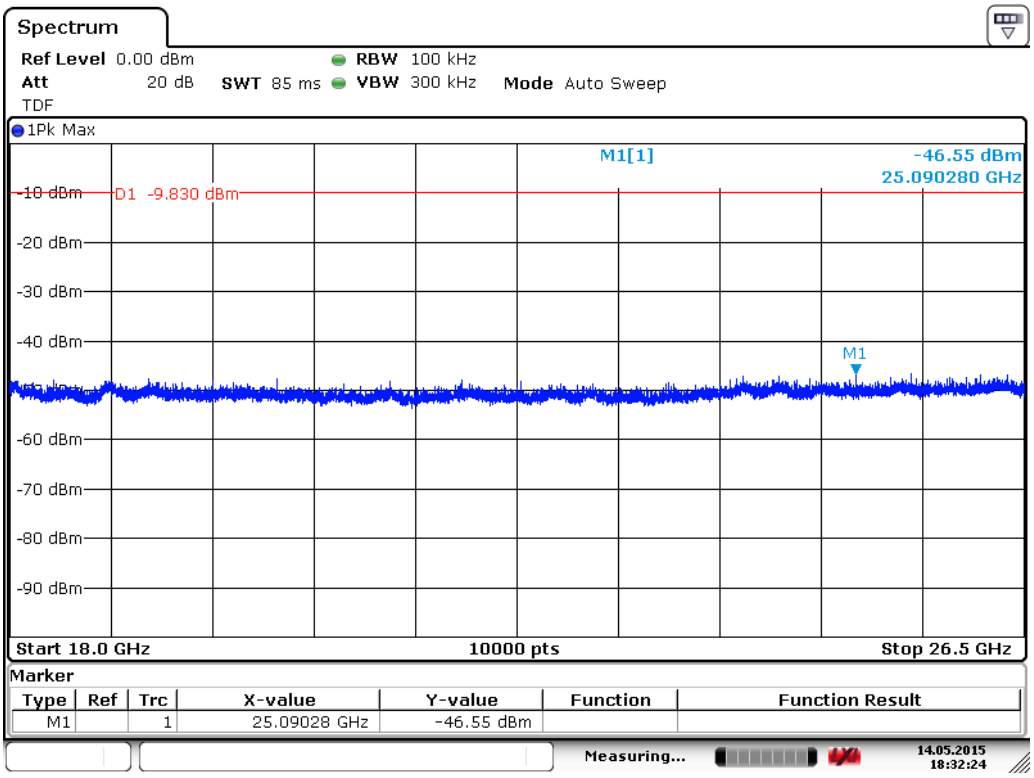
Date: 14.MAY.2015 18:30:32

Figure 50. Low channel conducted emission 18 GHz to 26.5 GHz (2 Mbps).



Date: 14.MAY.2015 18:31:31

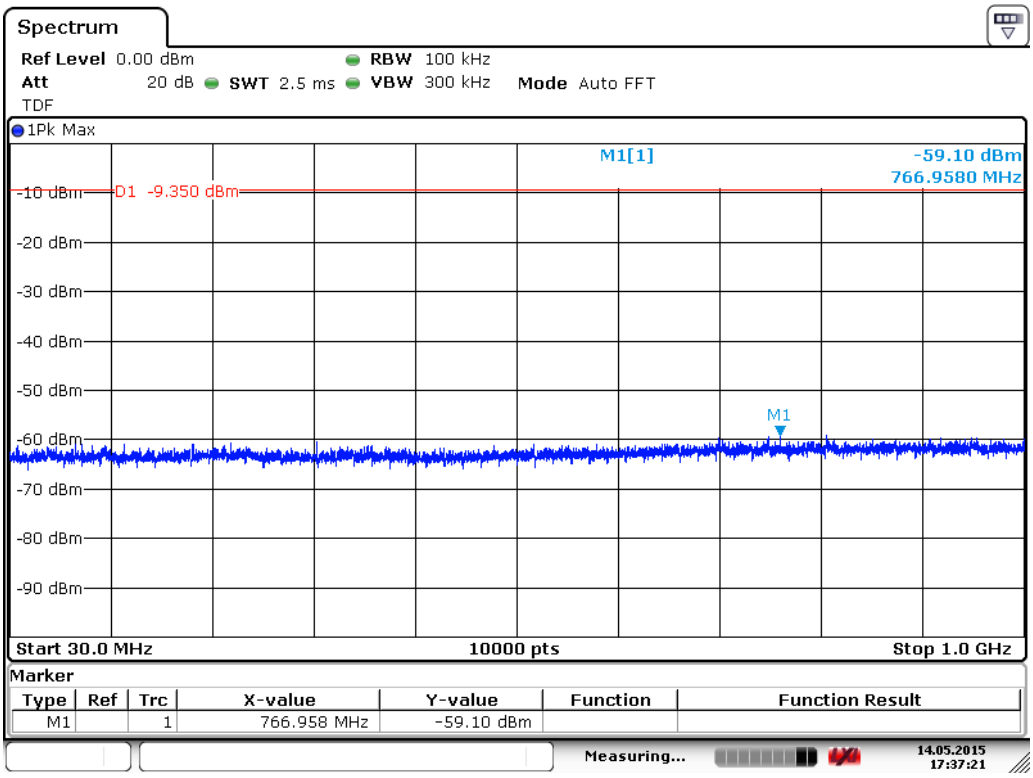
Figure 51. Mid channel conducted emission 18 GHz to 26.5 GHz (2 Mbps).



Date: 14.MAY.2015 18:32:24

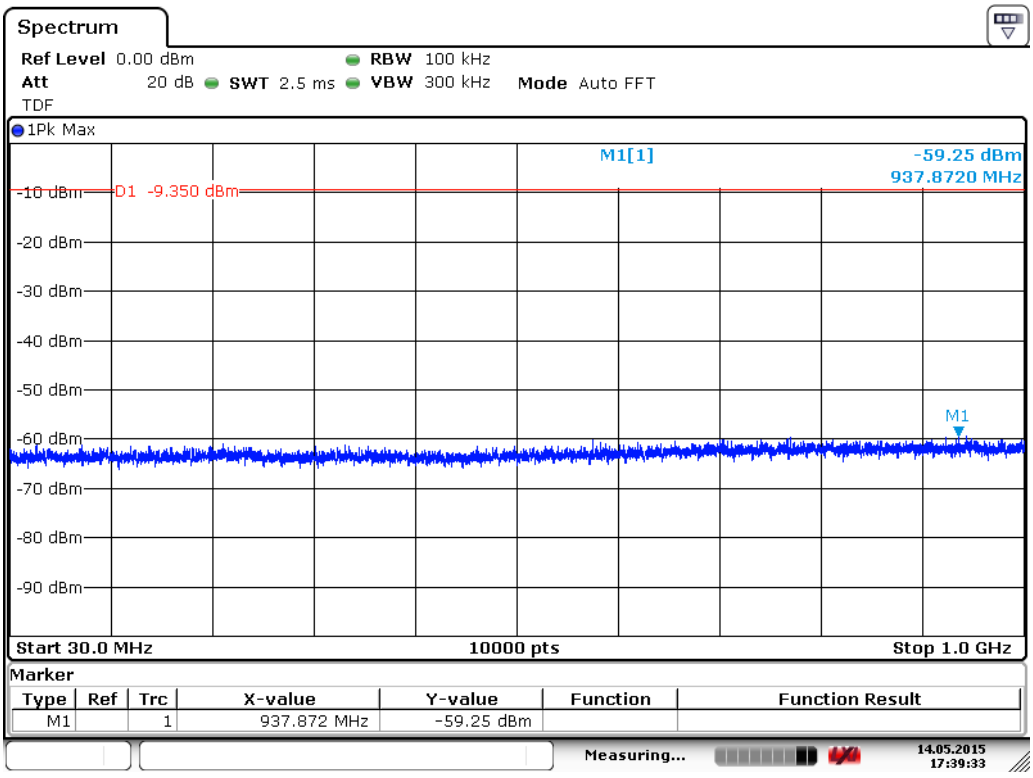
Figure 52. High channel conducted emission 18 GHz to 26.5 GHz (2 Mbps).

Data rate 3 Mbps



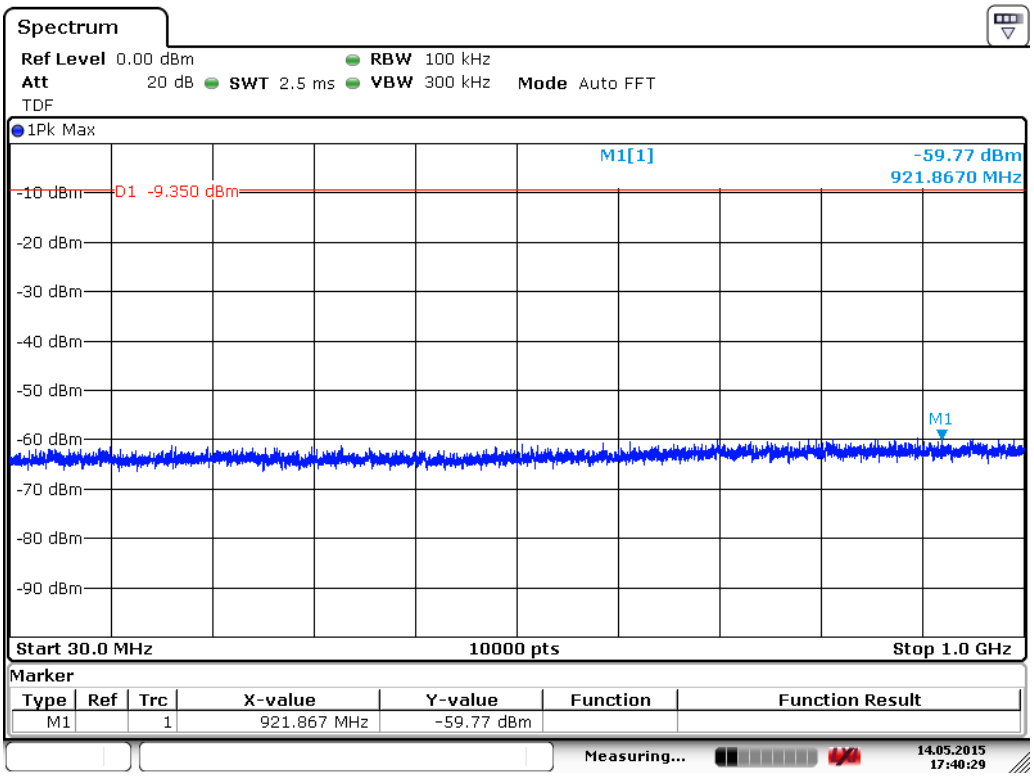
Date: 14.MAY.2015 17:37:21

Figure 53. Low channel conducted emission 30 MHz to 1000 MHz (3 Mbps).



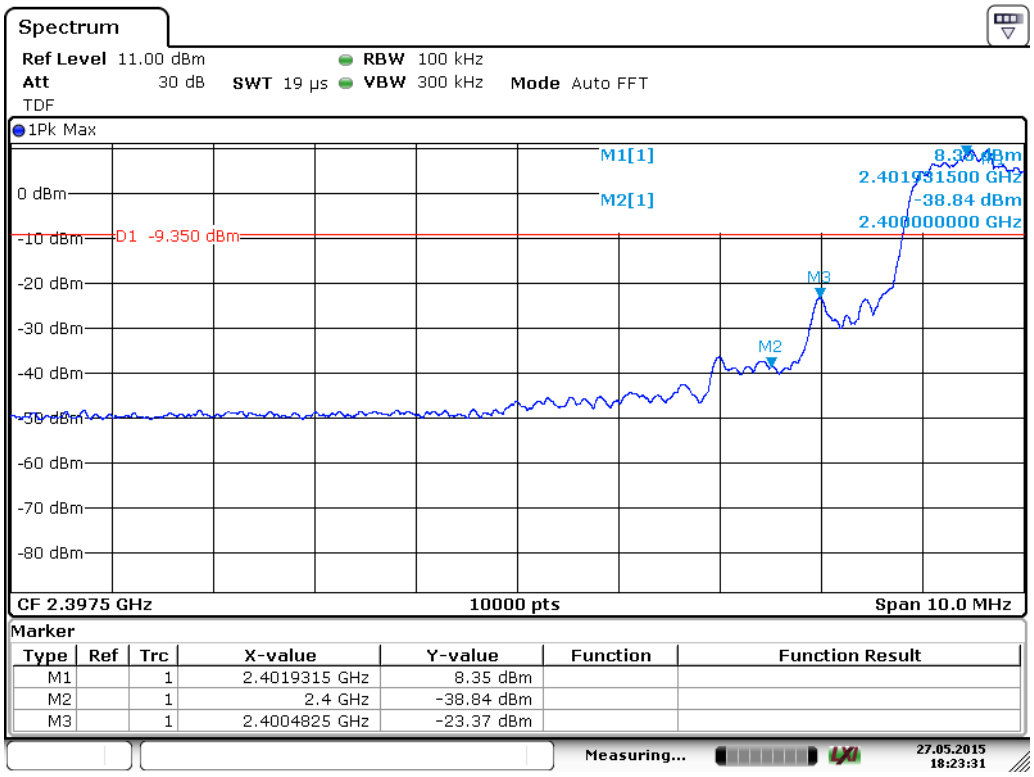
Date: 14.MAY.2015 17:39:34

Figure 54. Mid channel conducted emission 30 MHz to 1000 MHz (3 Mbps).



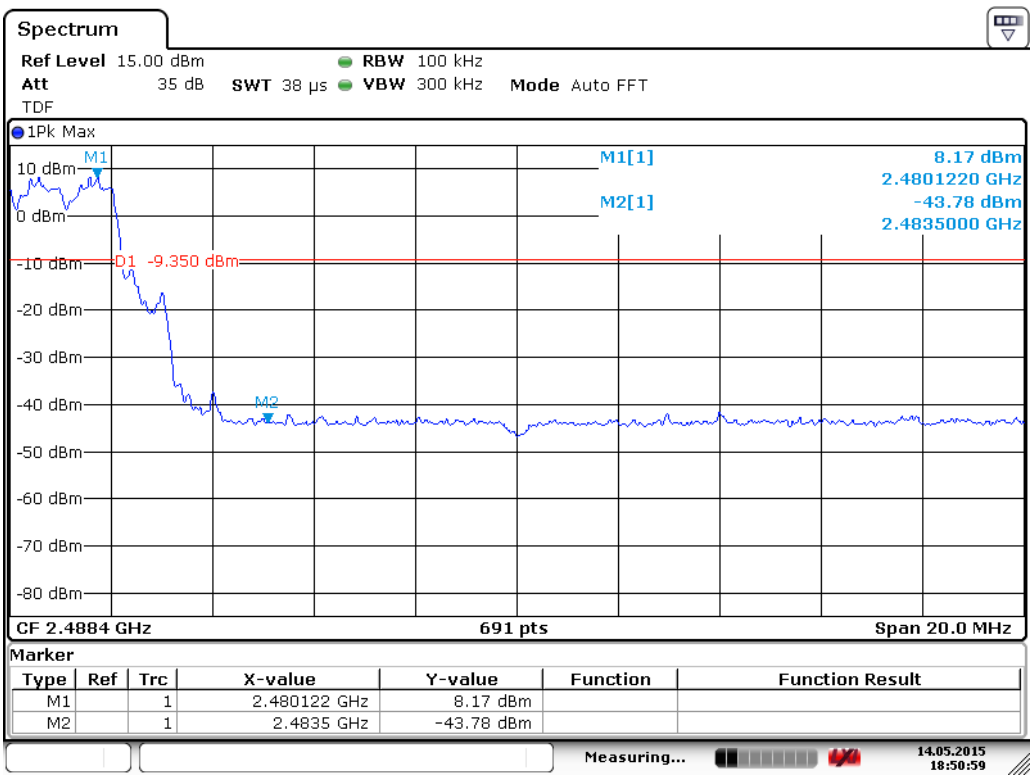
Date: 14.MAY.2015 17:40:30

Figure 55. High channel conducted emission 30 MHz to 1000 MHz (3 Mbps).



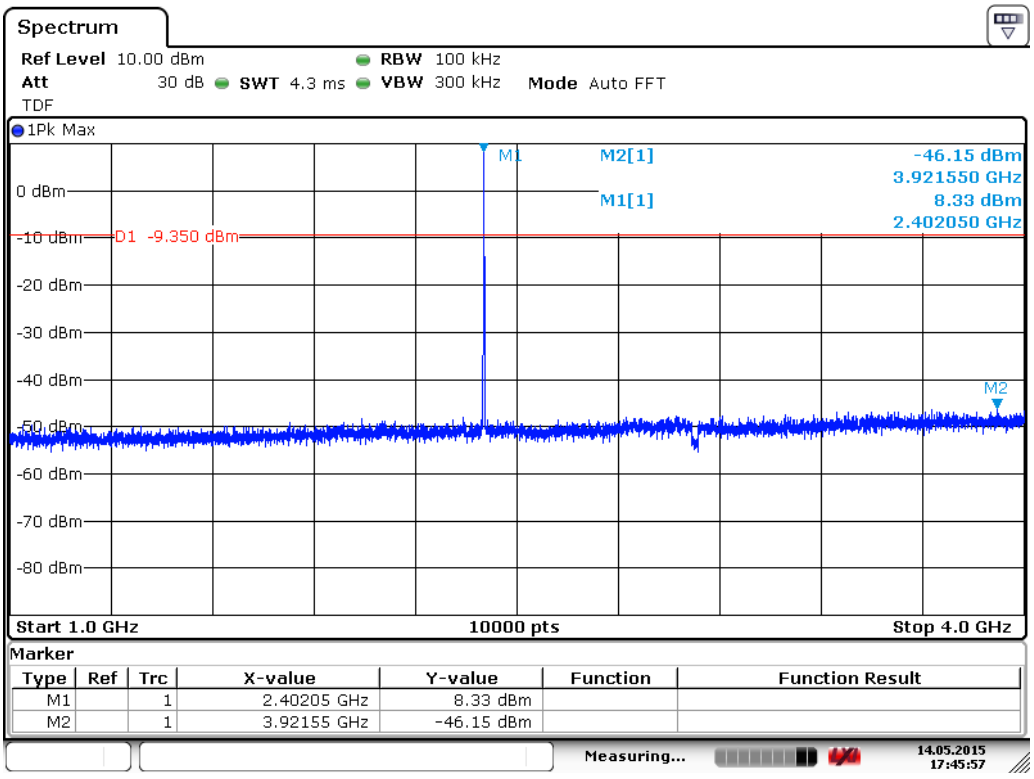
Date: 27.MAY.2015 18:23:31

Figure 56. Low channel conducted emission at low band edge hopping enabled (3 Mbps).



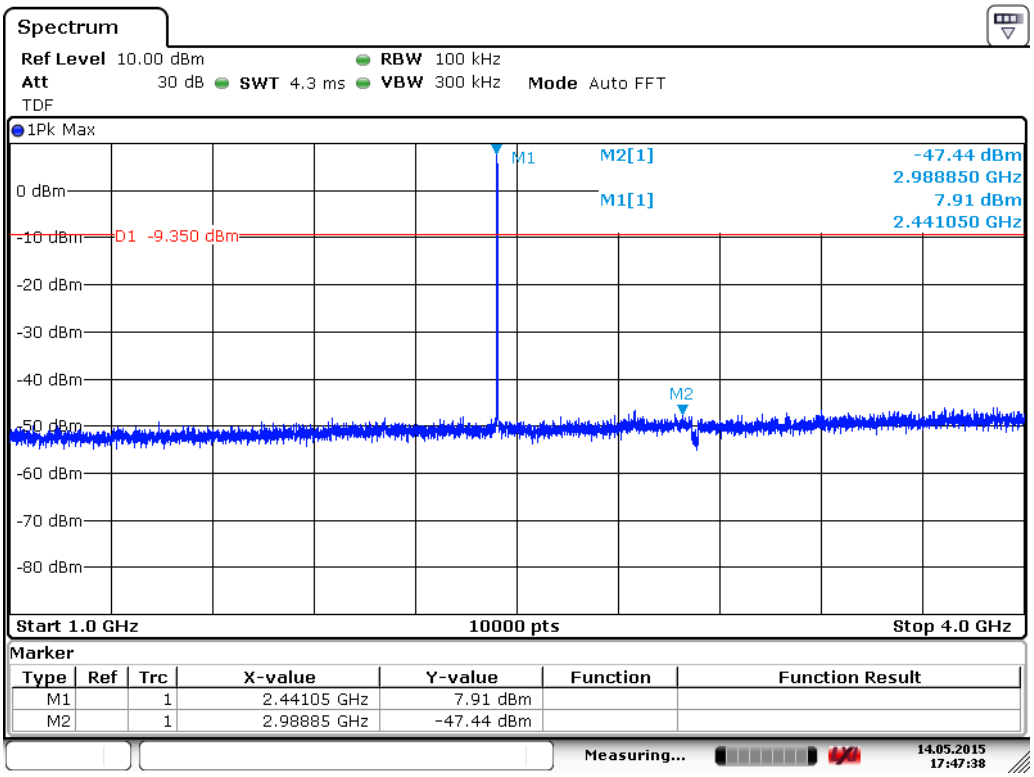
Date: 14.MAY.2015 18:50:59

Figure 57. High channel conducted emission at high band edge hopping enabled (3 Mbps).



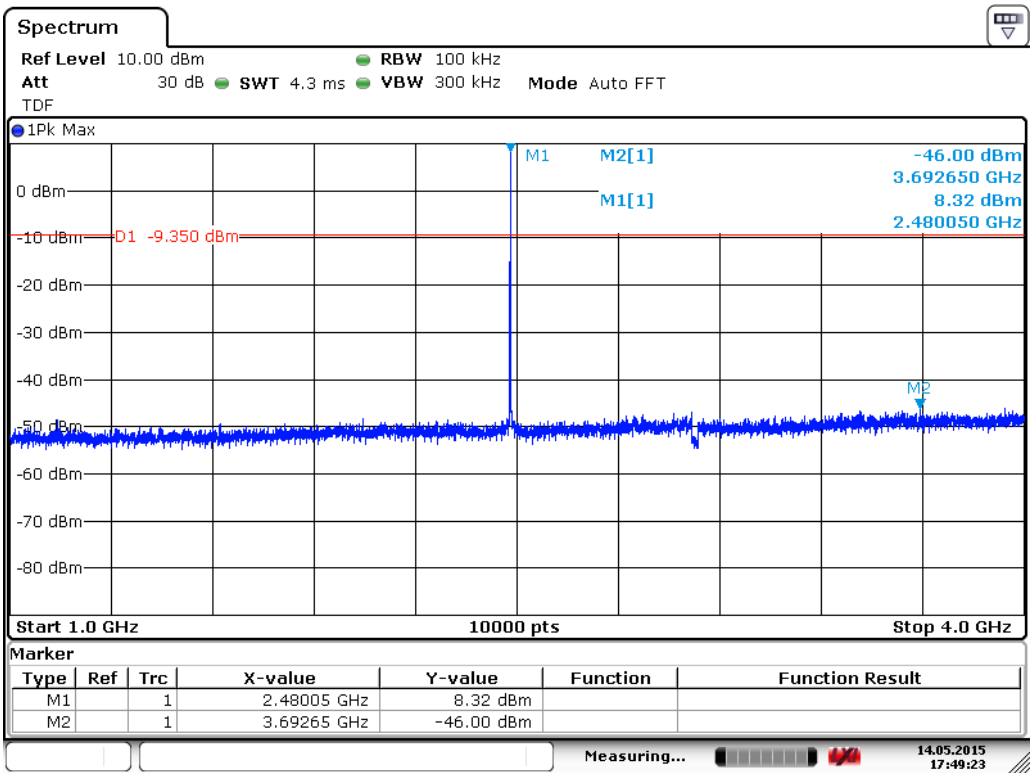
Date: 14.MAY.2015 17:45:58

Figure 58. Low channel conducted emission 1 GHz to 4 GHz (3 Mbps).



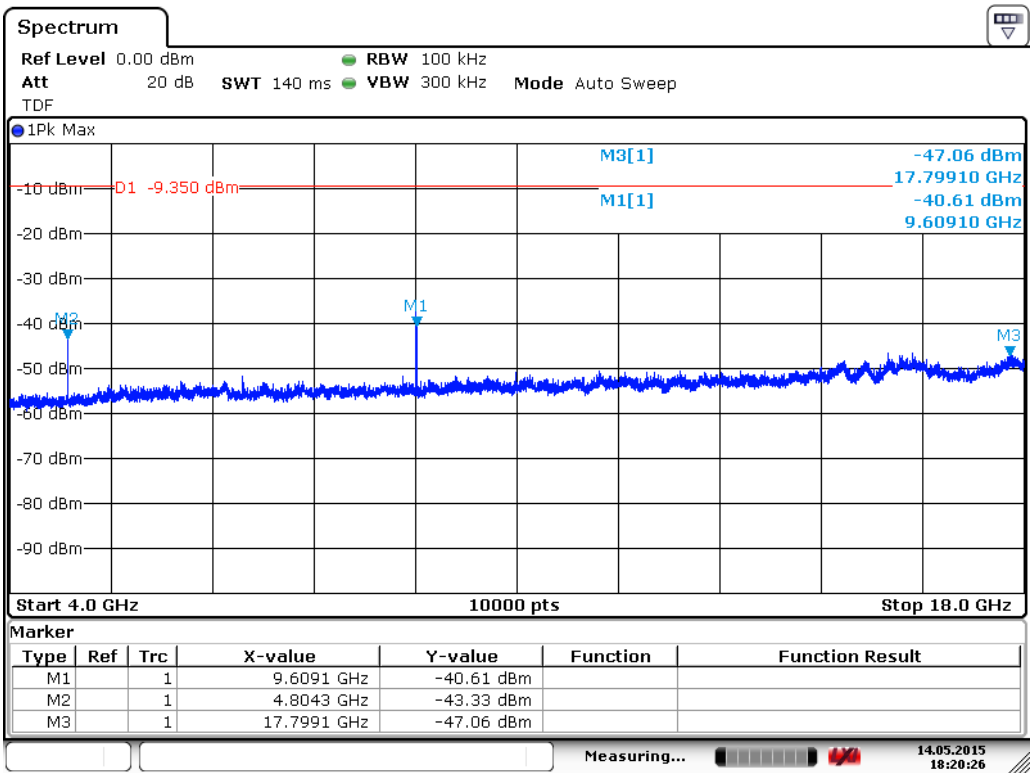
Date: 14.MAY.2015 17:47:38

Figure 59. Mid channel conducted emission 1 GHz to 4 GHz (3 Mbps).



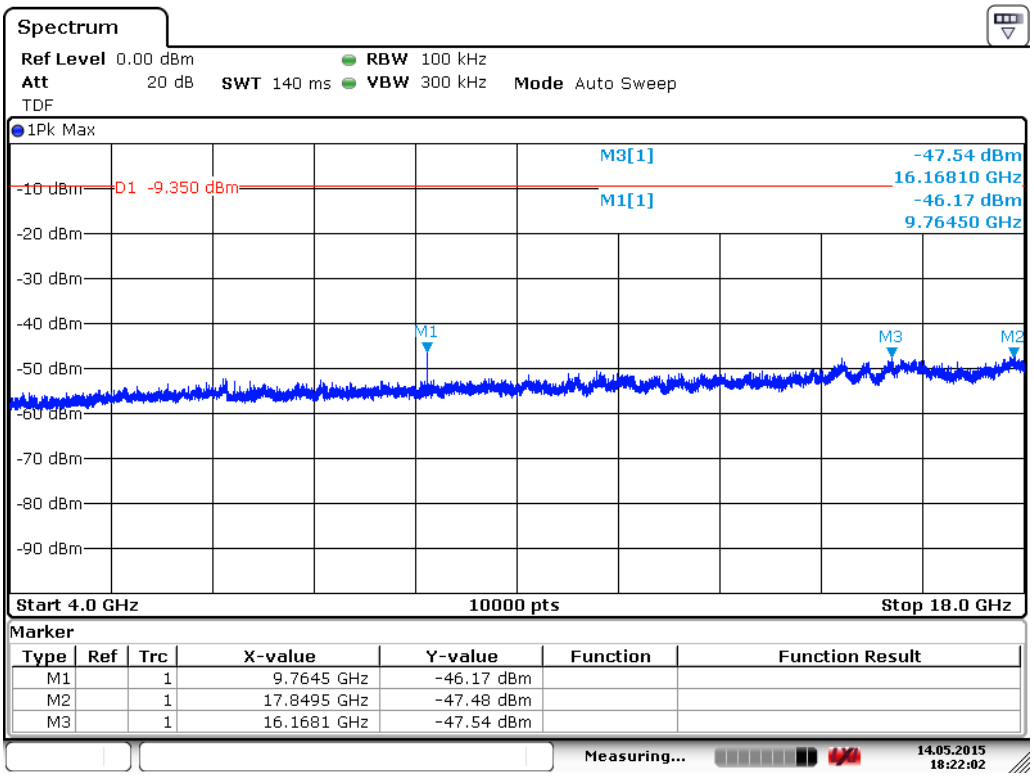
Date: 14.MAY.2015 17:49:24

Figure 60. High channel conducted emission 1 GHz to 4 GHz (3 Mbps).



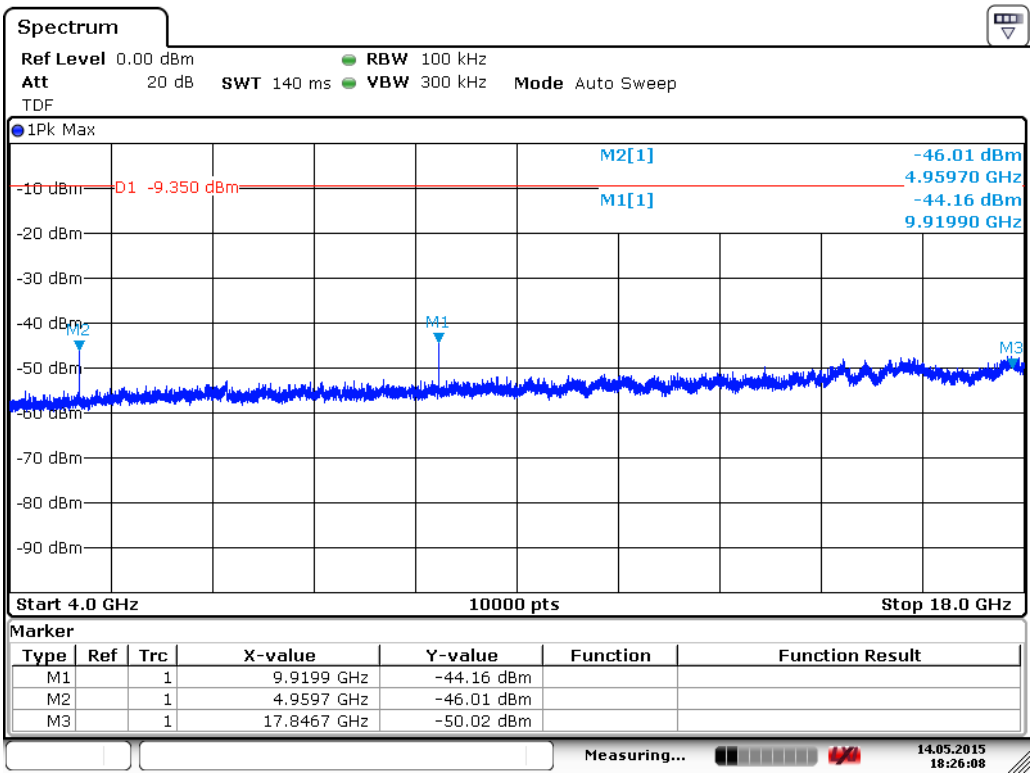
Date: 14.MAY.2015 18:20:26

Figure 61. Low channel conducted emission 4 GHz to 18 GHz (3 Mbps).



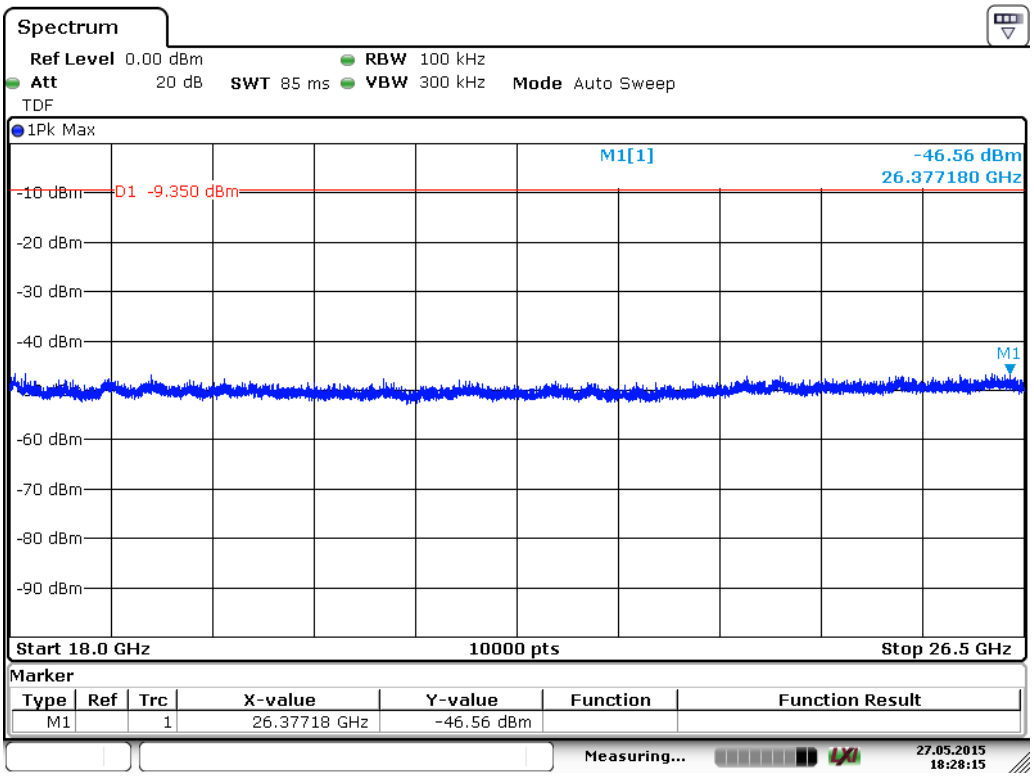
Date: 14.MAY.2015 18:22:02

Figure 62. Mid channel conducted emission 4 GHz to 18 GHz (3 Mbps).



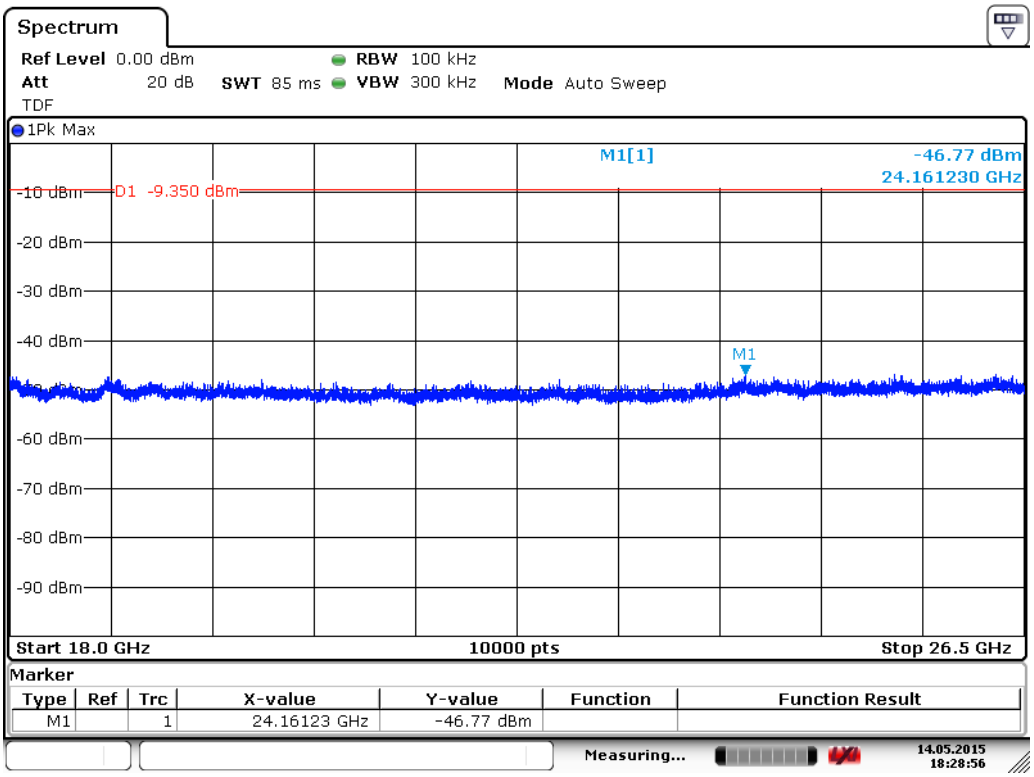
Date: 14.MAY.2015 18:26:08

Figure 63. High channel conducted emission 4 GHz to 18 GHz (3 Mbps).



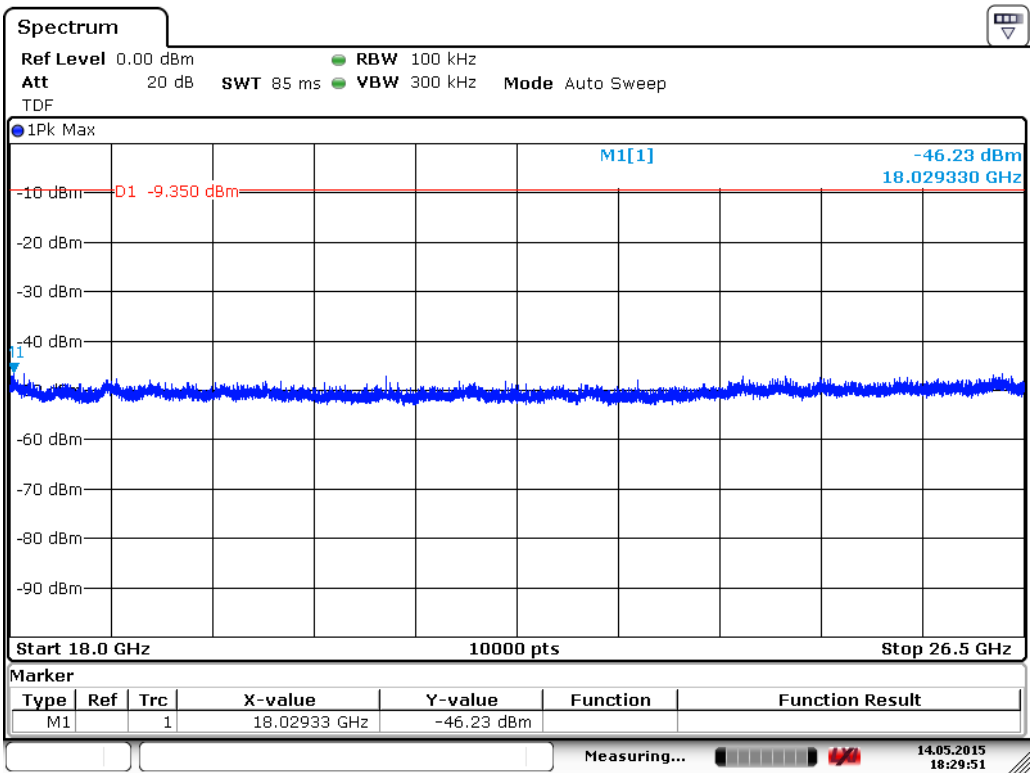
Date: 27.MAY.2015 18:28:15

Figure 64. Low channel conducted emission 18 GHz to 26.5 GHz (3 Mbps).



Date: 14.MAY.2015 18:28:56

Figure 65. Mid channel conducted emission 18 GHz to 26.5 GHz (3 Mbps).



Date: 14.MAY.2015 18:29:51

Figure 66. High channel conducted emission 18 GHz to 26.5 GHz (3 Mbps).

20 dB Bandwidth of the Hopping Channel

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	5.6.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % RH	

FCC Rule: §15.247(a)(1)
RSS-247 5.1(2)

Results:

1 Mbps

Table 20. 20 dB bandwidth test results 1 Mbps.

Channel	20 dB BW [kHz]
Low	1107.1
Mid	1107.1
High	1114.3

2 Mbps

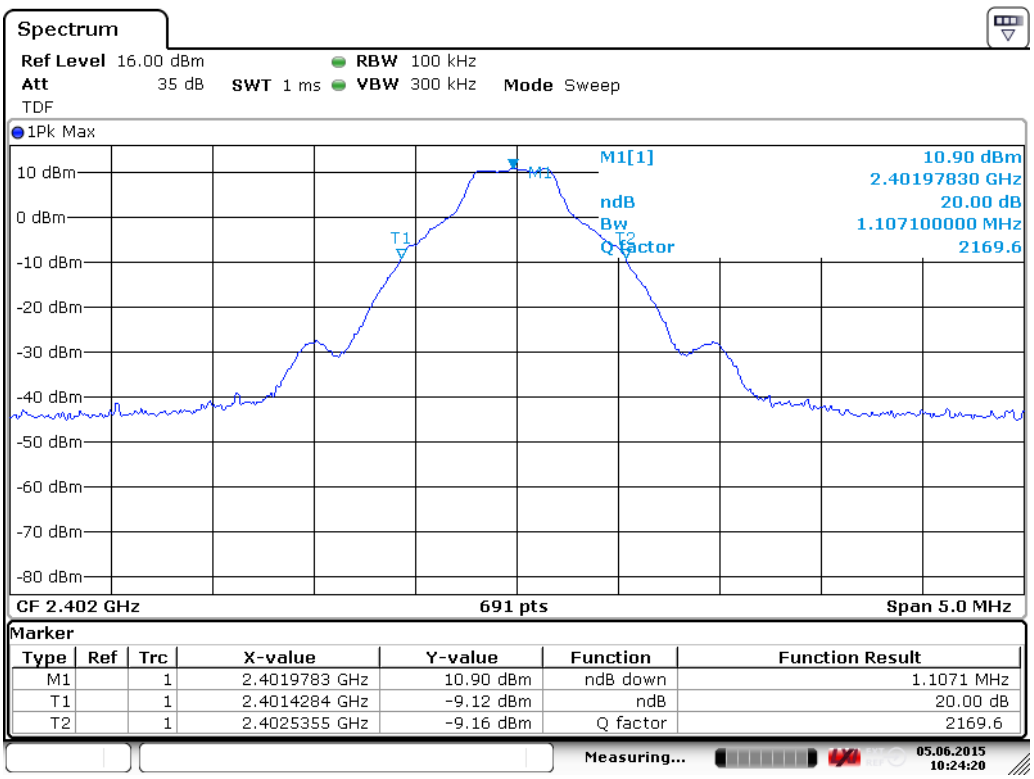
Table 21. 20 dB bandwidth test results 2 Mbps

Channel	20 dB BW [kHz]
Low	1418.2
Mid	1418.2
High	1425.5

3 Mbps

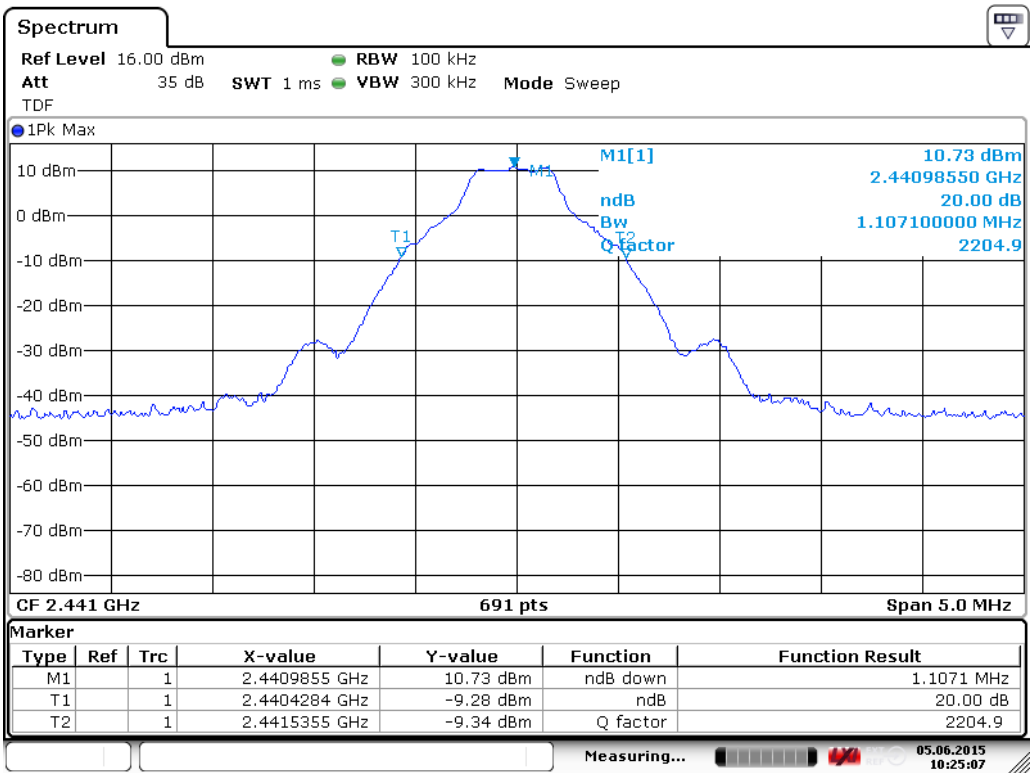
Table 22. 20 dB bandwidth test results 3 Mbps

Channel	20 dB BW [kHz]
Low	1411.0
Mid	1403.8
High	1411.0



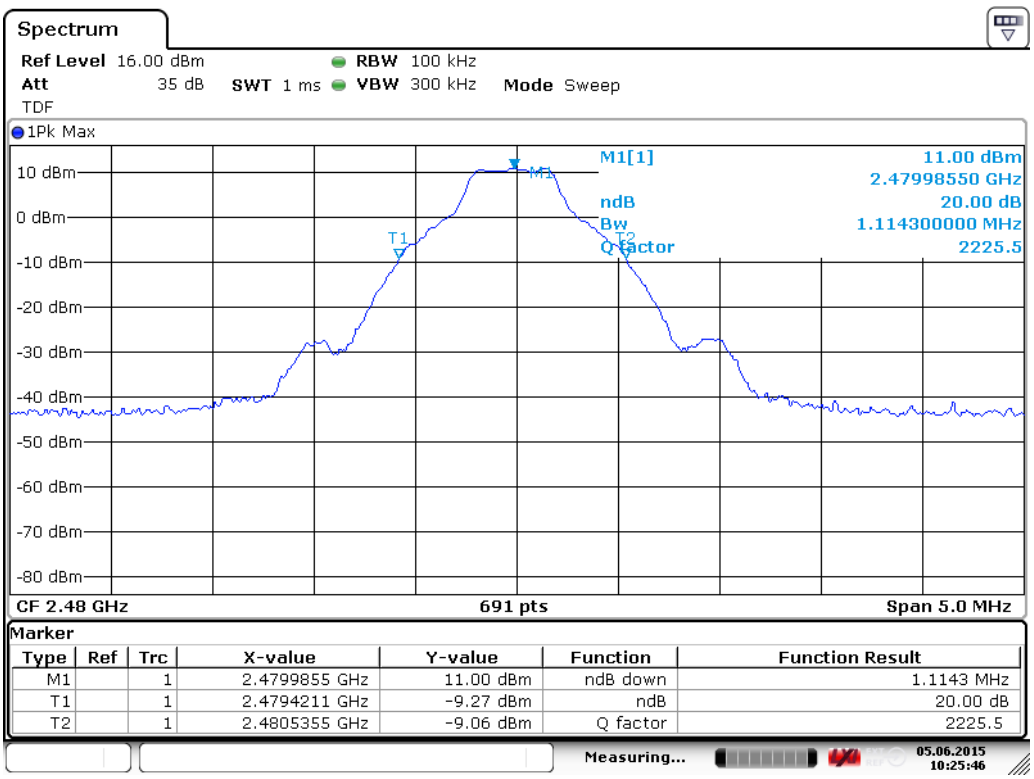
Date: 5.JUN.2015 10:24:20

Figure 67. 20 dB channel BW. 1 Mbps Channel LOW.



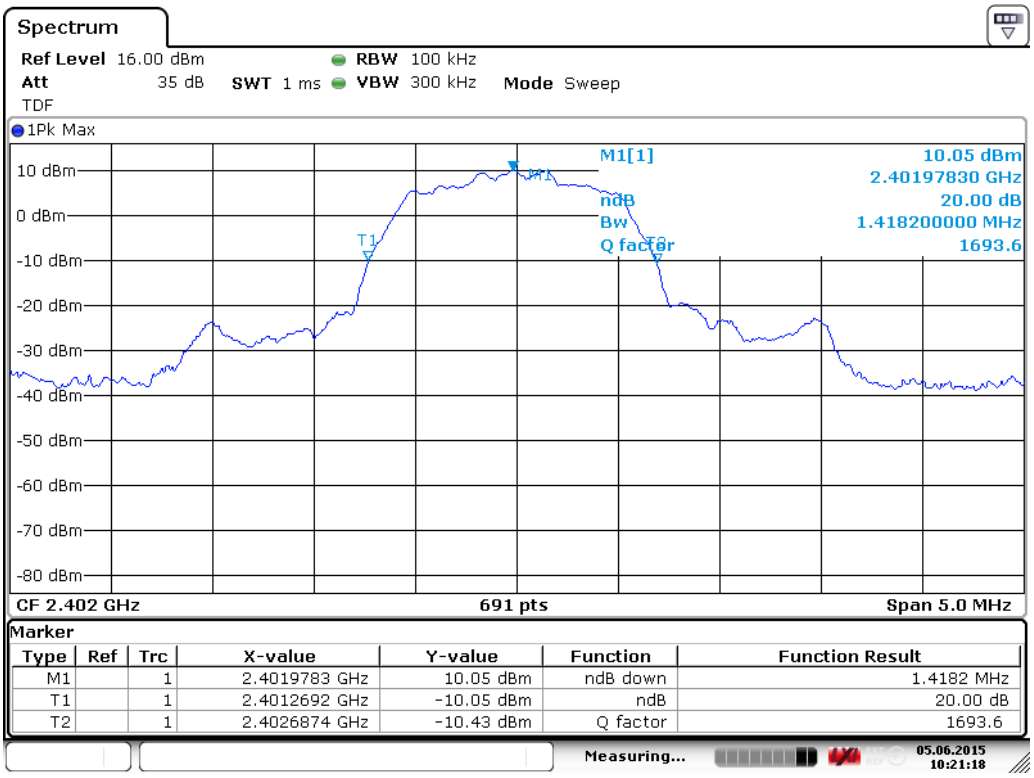
Date: 5.JUN.2015 10:25:07

Figure 68. 20 dB channel BW. 1 Mbps Channel MID.



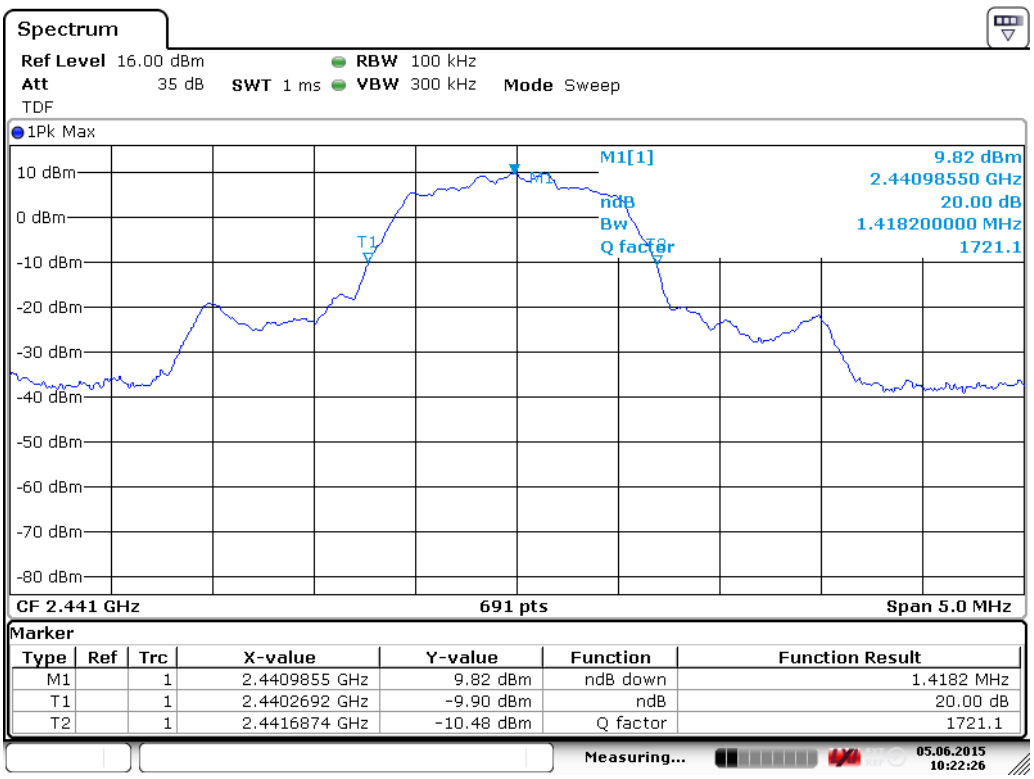
Date: 5.JUN.2015 10:25:46

Figure 69. 20 dB channel BW. 1 Mbps Channel HIGH.



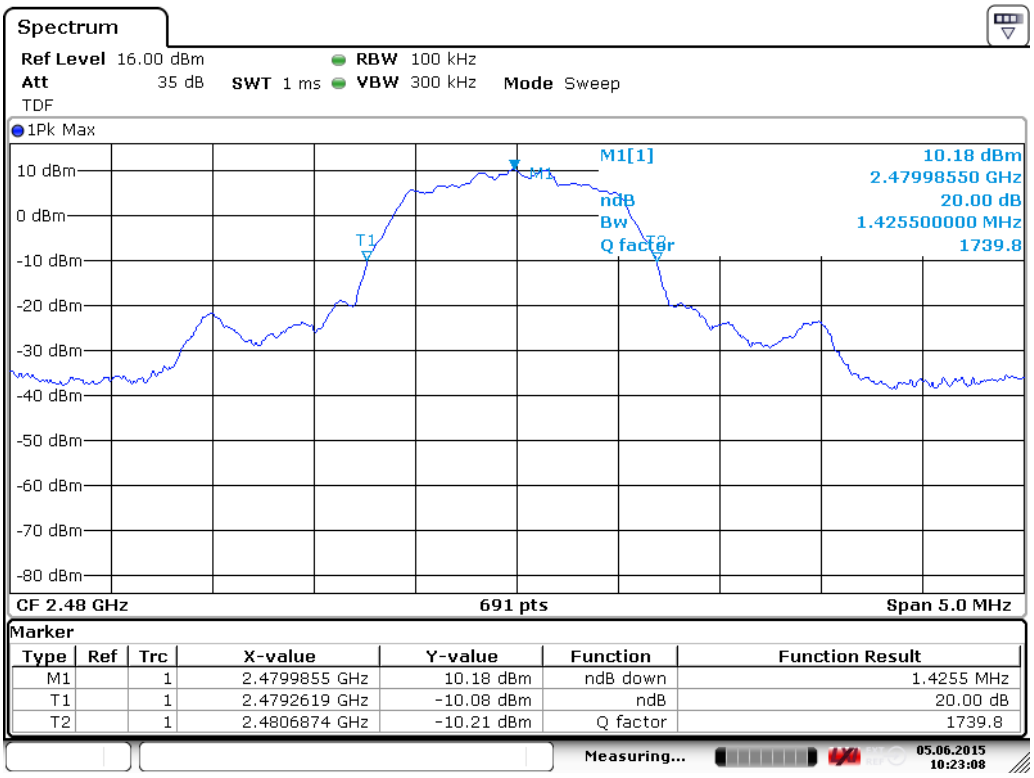
Date: 5.JUN.2015 10:21:18

Figure 70. 20 dB channel BW. 2 Mbps Channel LOW.



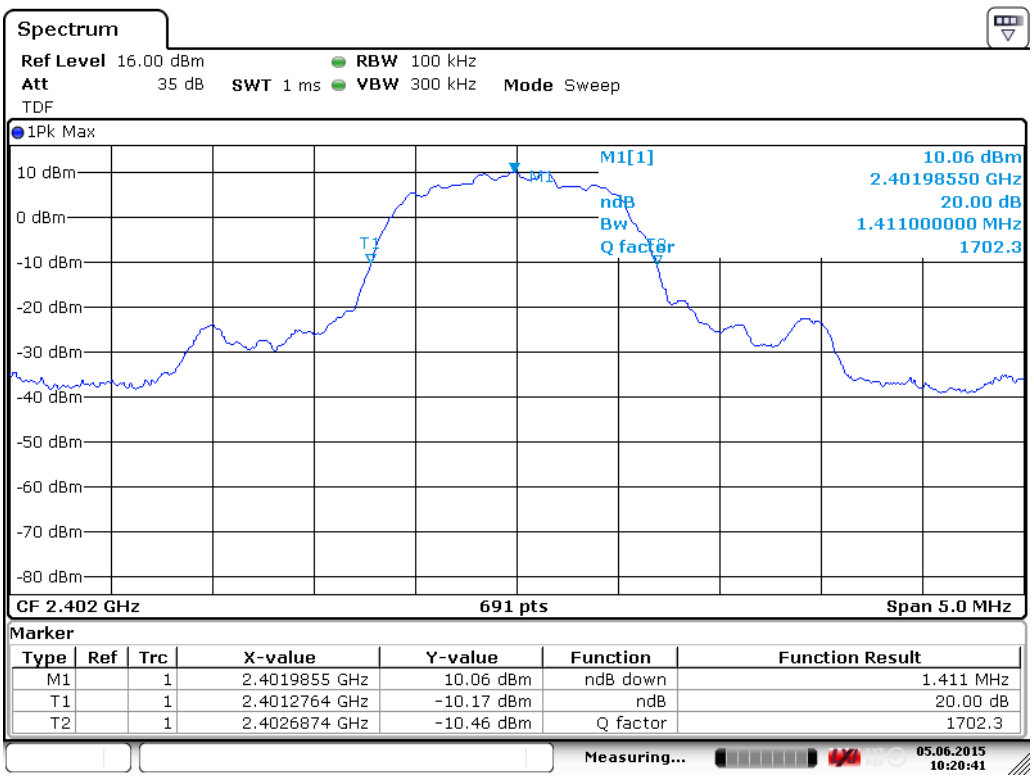
Date: 5.JUN.2015 10:22:27

Figure 71. 20 dB channel BW. 2 Mbps Channel MID.



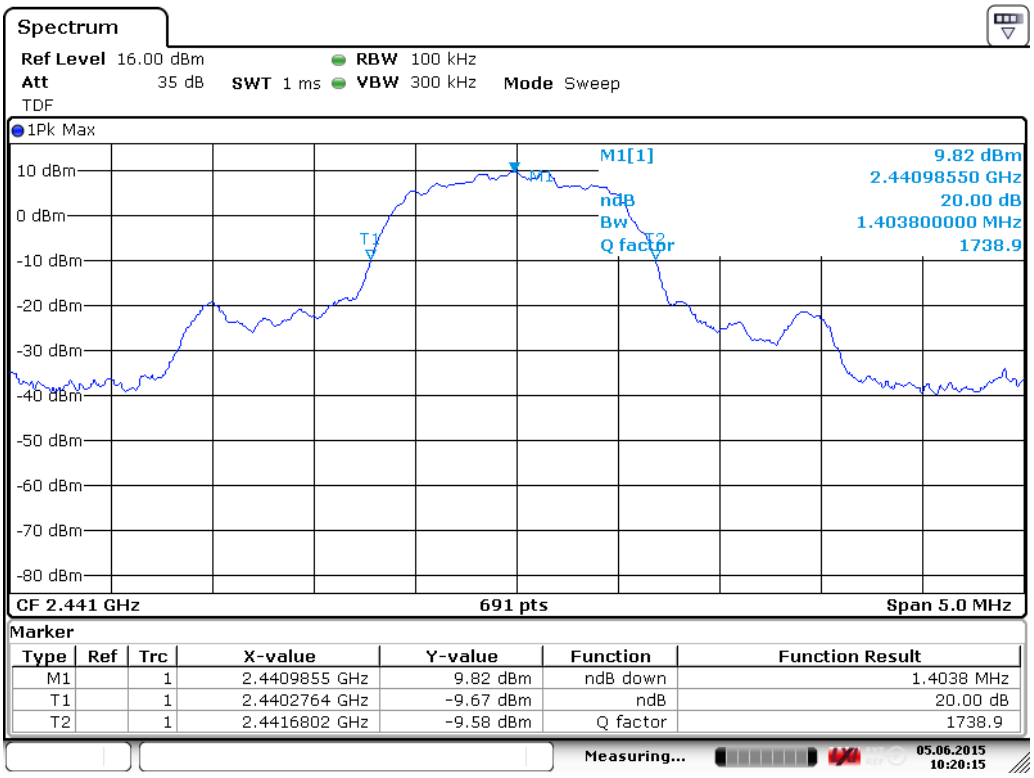
Date: 5.JUN.2015 10:23:08

Figure 72. 20 dB channel BW. 2 Mbps Channel HIGH.



Date: 5.JUN.2015 10:20:42

Figure 73. 20 dB channel BW. 3 Mbps Channel LOW.



Date: 5.JUN.2015 10:20:15

Figure 74. 20 dB channel BW. 3 Mbps Channel MID.

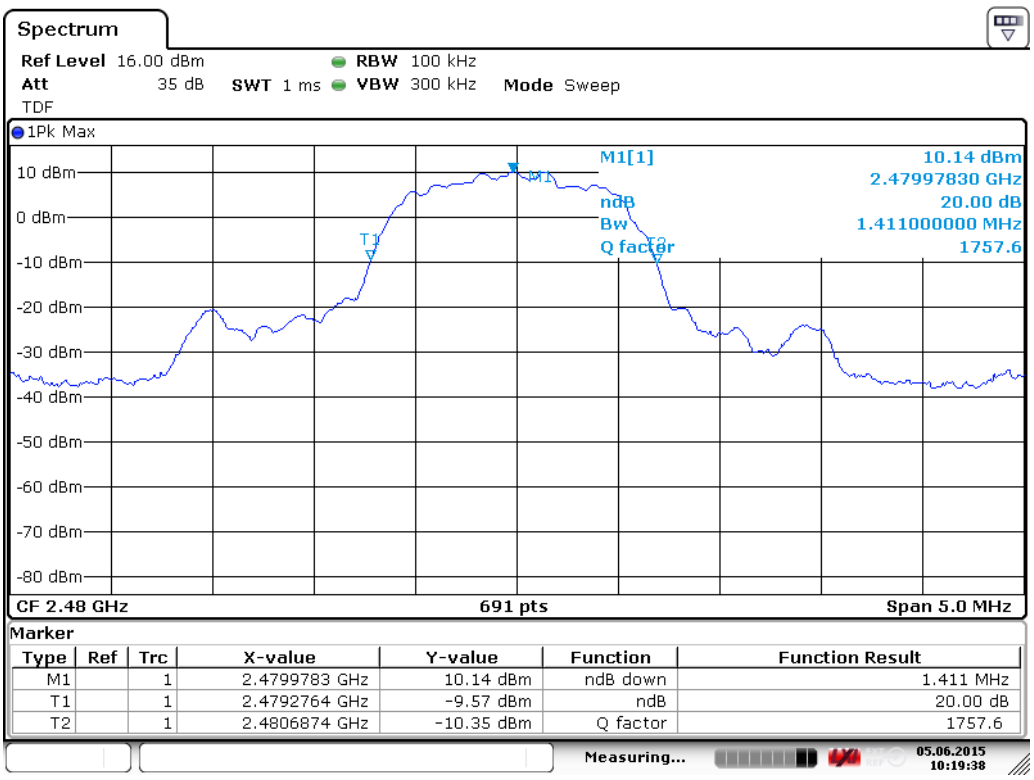


Figure 75. 20 dB channel BW. 3 Mbps Channel HIGH.

Hopping Channel Carrier Frequencies Separation

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	14.5.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % RH	

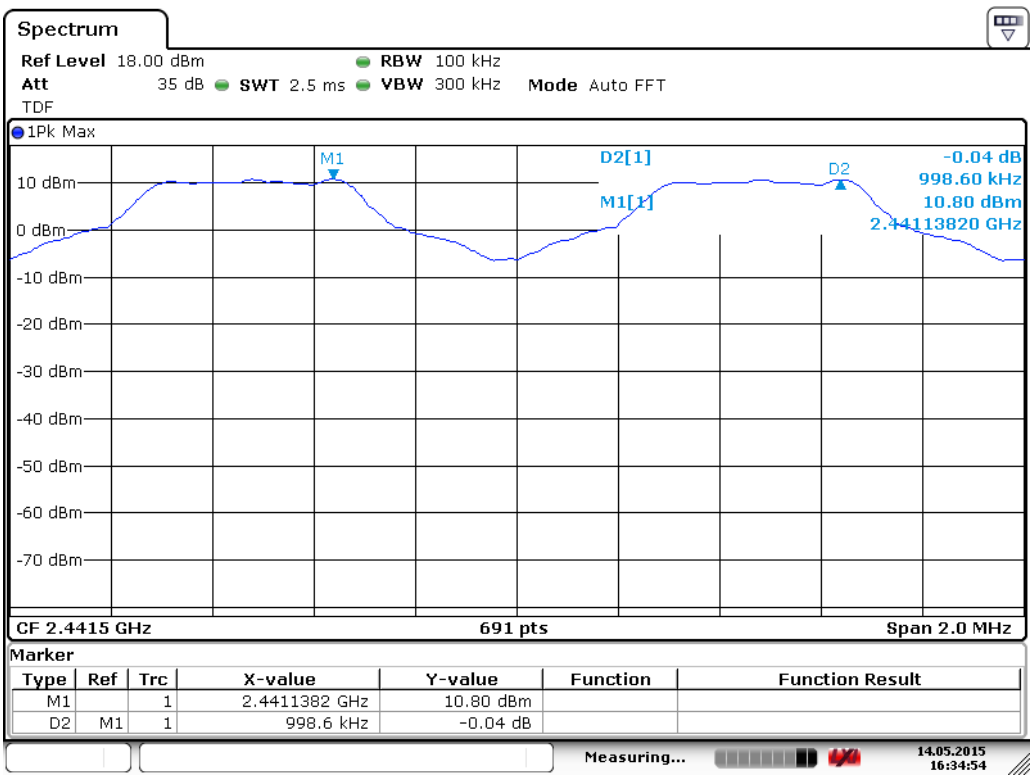
FCC Rule: 15.247(a)(1)

Frequency hopping systems with an output power less than 125mW shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or 2/3 of the 20 dB bandwidth of the hopping channel, whichever is greater.

Test result

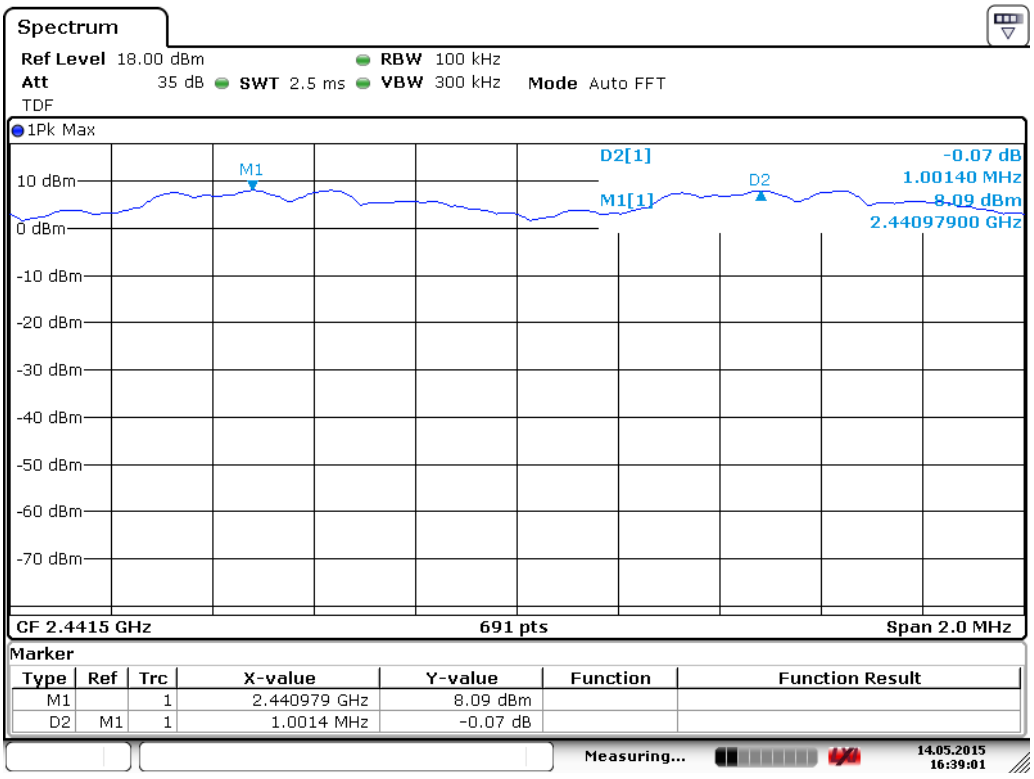
Table 23. Hopping channel carrier frequencies separation test result.

Data rate	Measured separation	Limit	Result
1 Mbps	998.60 kHz	746.58 kHz	PASS
2 Mbps	1001.4 kHz	955.09 kHz	PASS
3 Mbps	1001.4 MHz	945.37 kHz	PASS



Date: 14.MAY.2015 16:34:54

Figure 76. Measured hopping channels carrier frequency separation 1 Mbps.



Date: 14.MAY.2015 16:39:01

Figure 77. Measured hopping channels carrier frequency separation 2 Mbps.

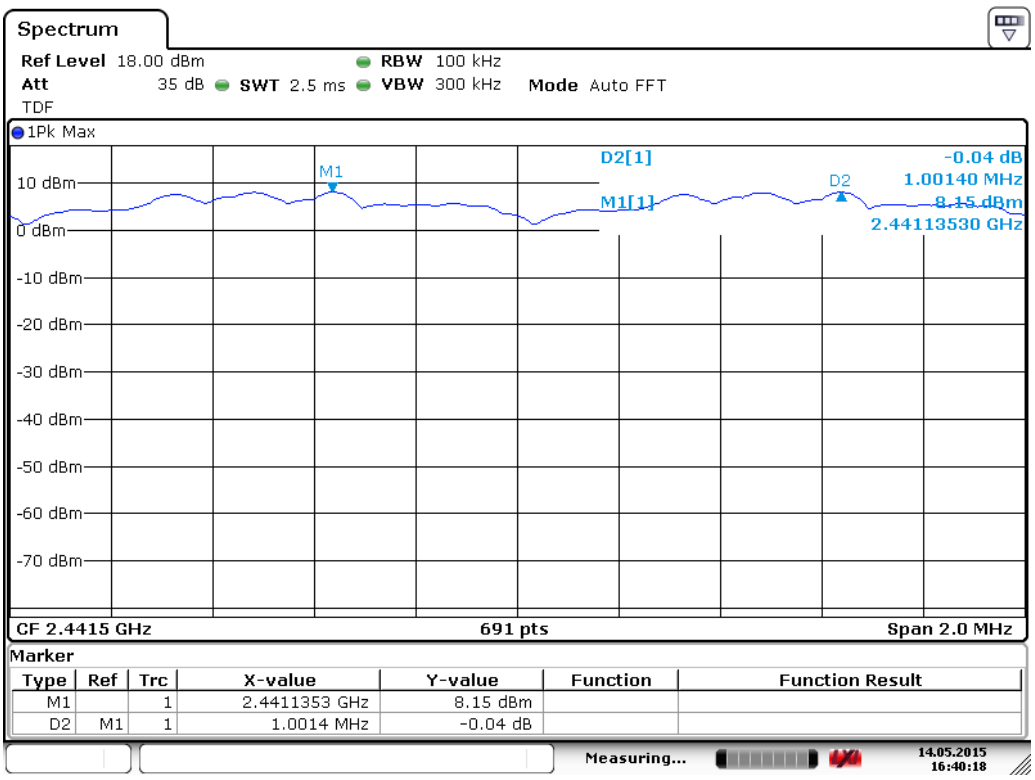


Figure 78. Measured hopping channels carrier frequency separation 3 Mbps.

Number of Hopping Channels

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	14.5.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % RH	

FCC Rule: 15.247(a)(1)(iii)

For frequency hopping systems operating in the 2400 – 2483.5 MHz band shall use at least 15 channels.

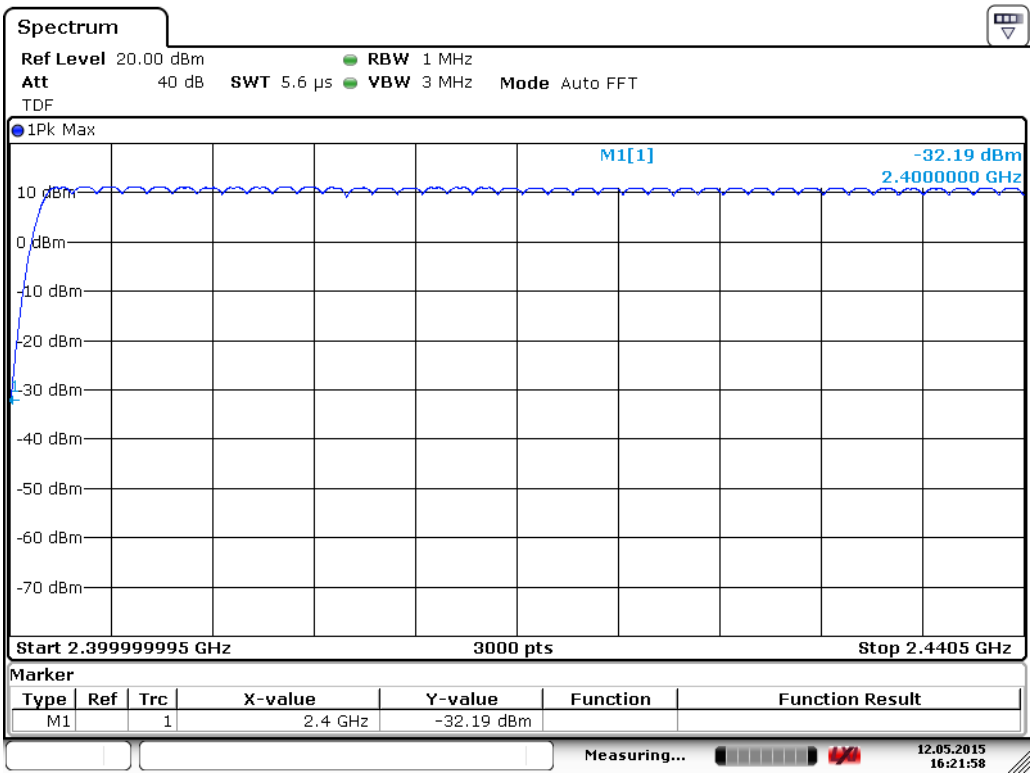
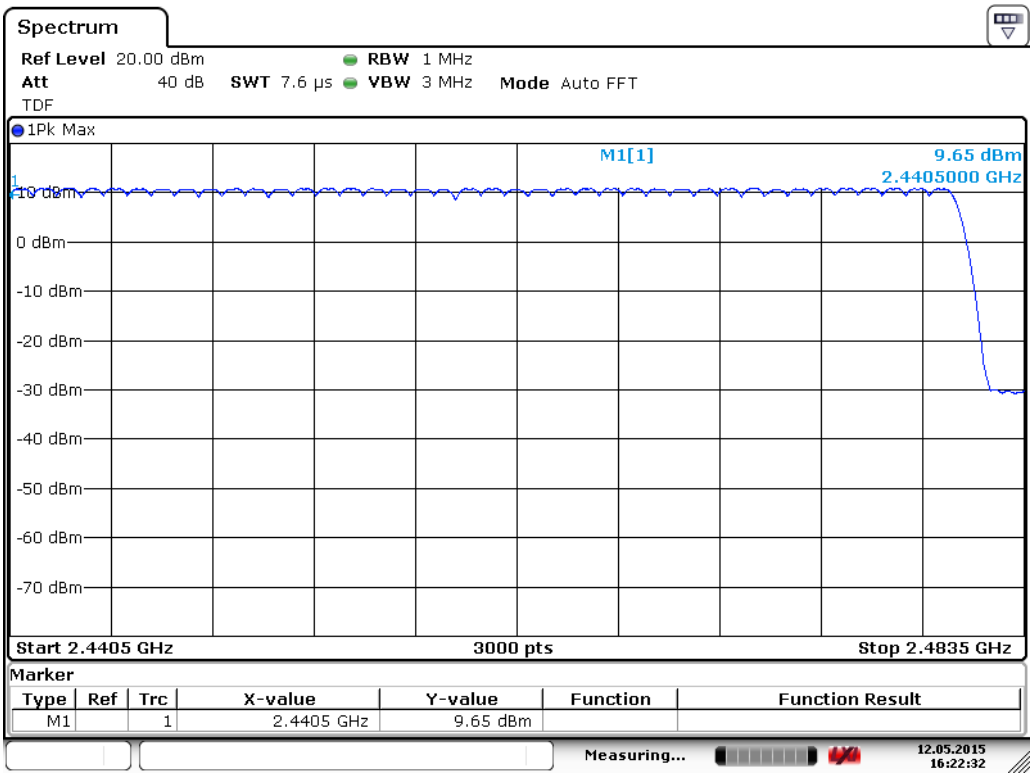
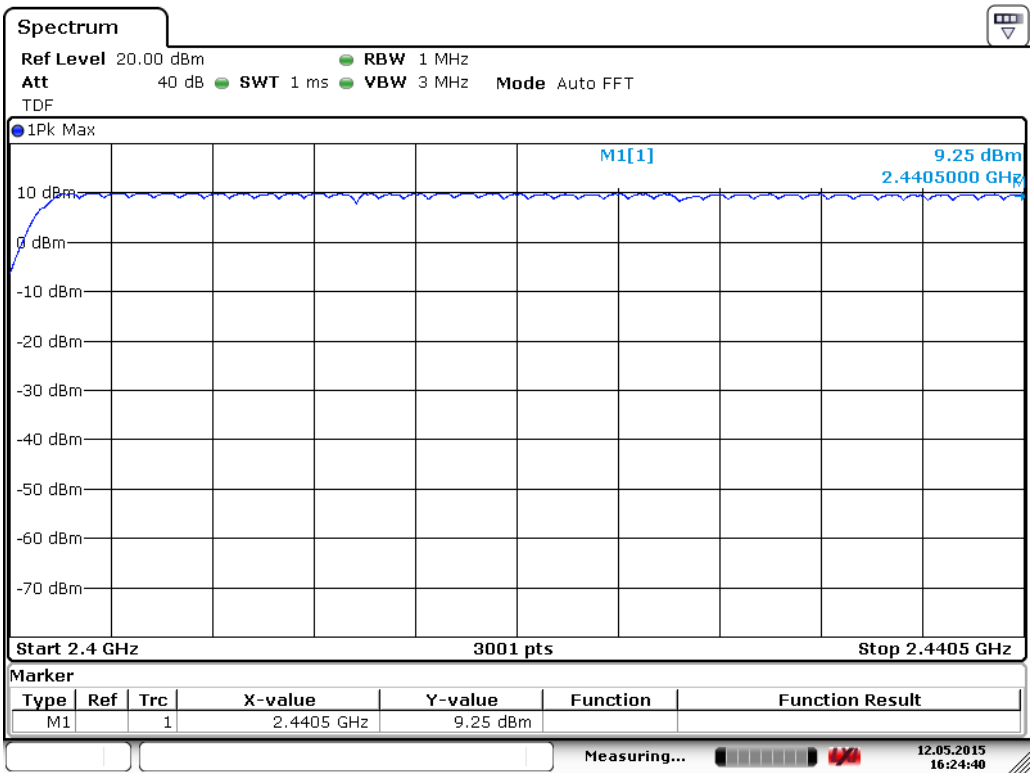


Figure 79. First 39 channels 1 Mbps.



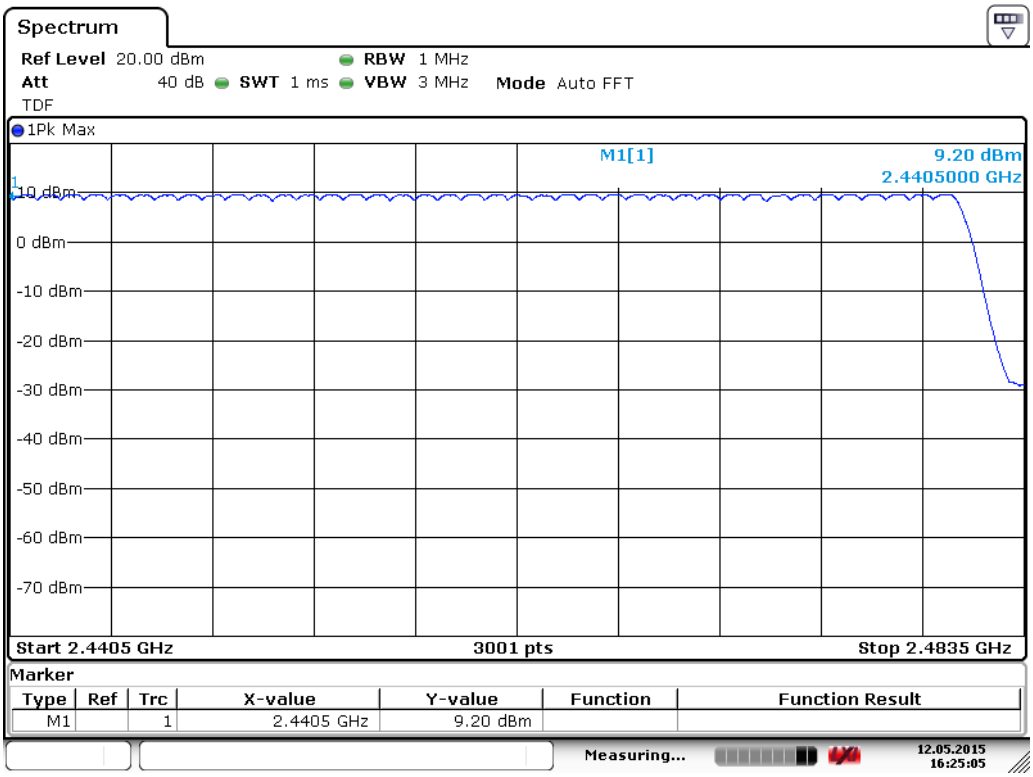
Date: 12.MAY.2015 16:22:31

Figure 80. Second 40 channels 1 Mbps.



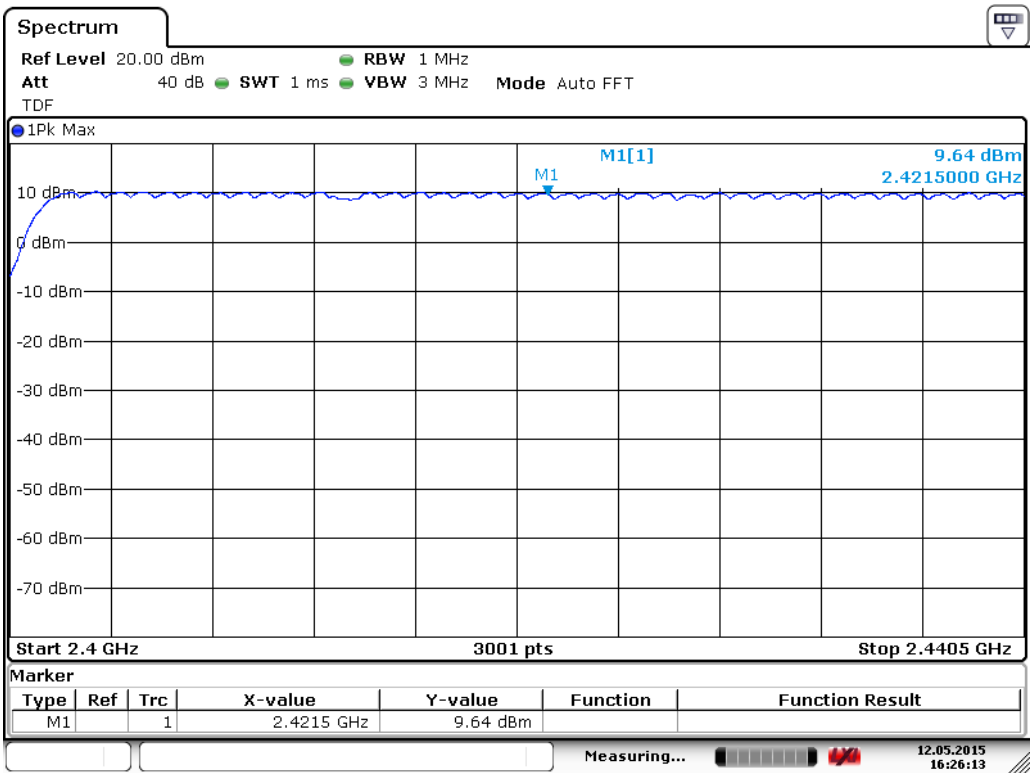
Date: 12.MAY.2015 16:24:40

Figure 81. First 39 channels 2 Mbps.



Date: 12.MAY.2015 16:25:05

Figure 82. Second 40 channels 2 Mbps.



Date: 12.MAY.2015 16:26:13

Figure 83. First 39 channels 3 Mbps.

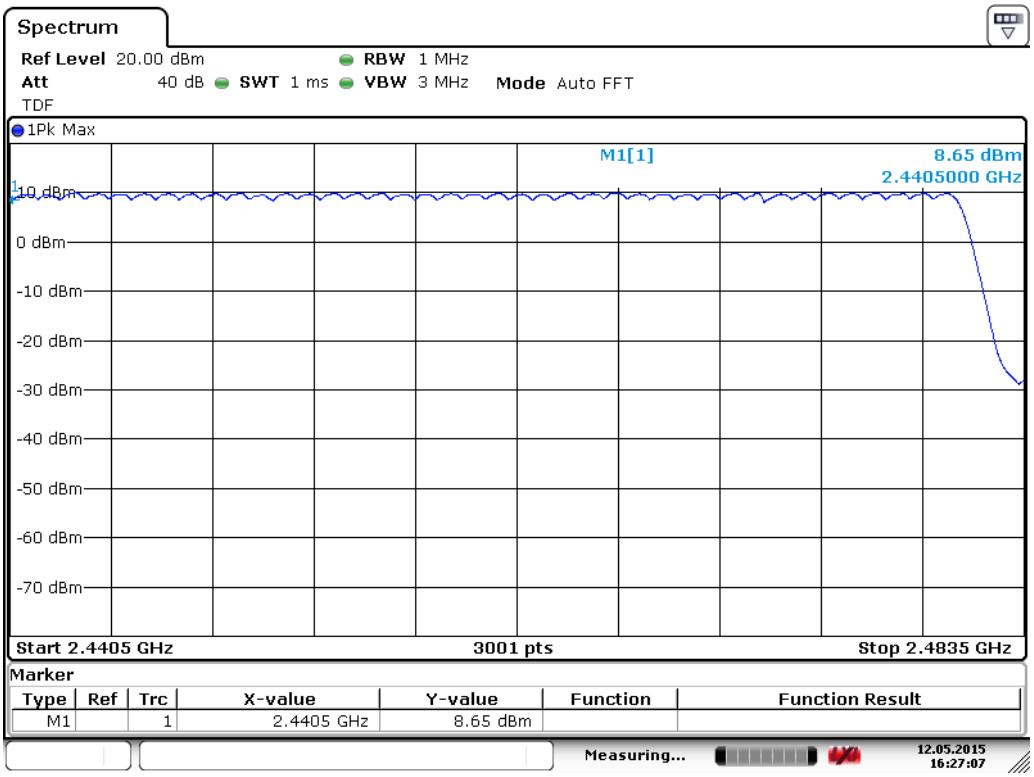


Figure 84. Second 40 channels 3 Mbps.

Average Time of Occupancy of Hopping Frequency

Standard:	ANSI C63.10	(2009)
Tested by:	NKO	
Date:	14.5.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % RH	

FCC Rule: 15.247(a)(1)(iii)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Test was performed in each data rate mode to insure that the all modes are identical.

Time of occupancy calculation:
Number of channels = 79
Measurement period = 0.4 s x 79 = 31.6 s
One channel occupancy time = 303.9 ms
Number of transmission cycles in measurement period = 31.6 / 0.3039 = 103.9
Time of occupancy = (single duration) x (repetition) = 2.8886 ms x 103.9 times = 300.1 ms

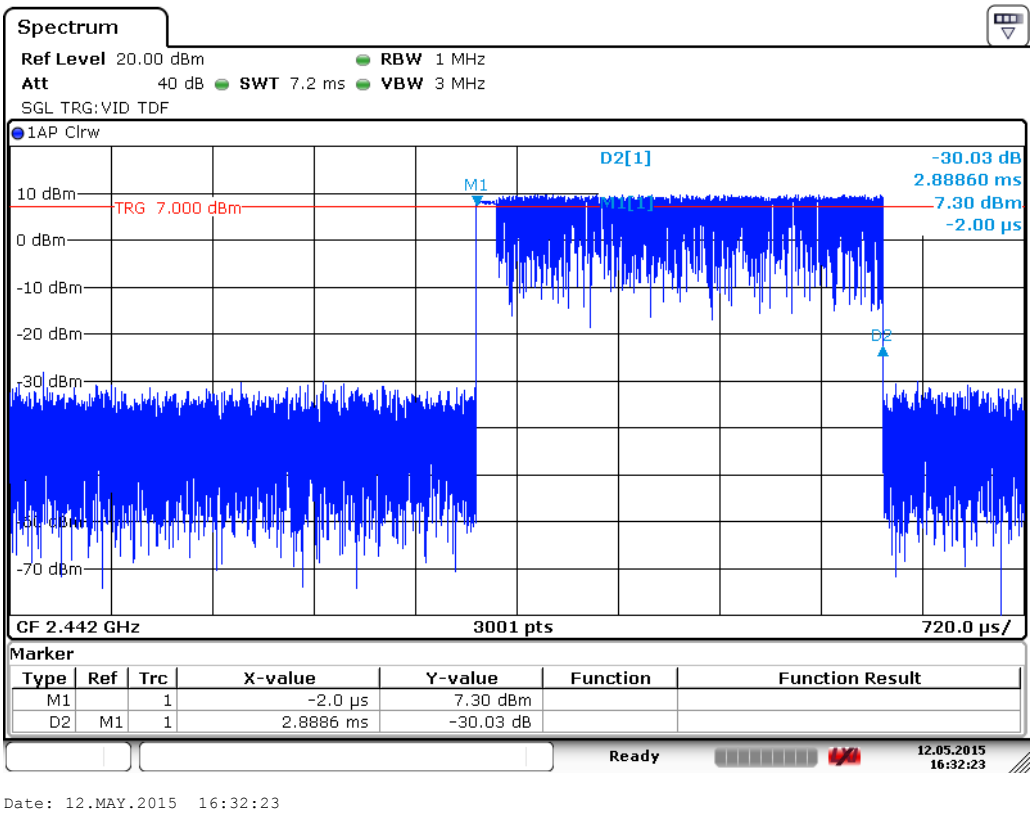


Figure 85. One channel dwell time.

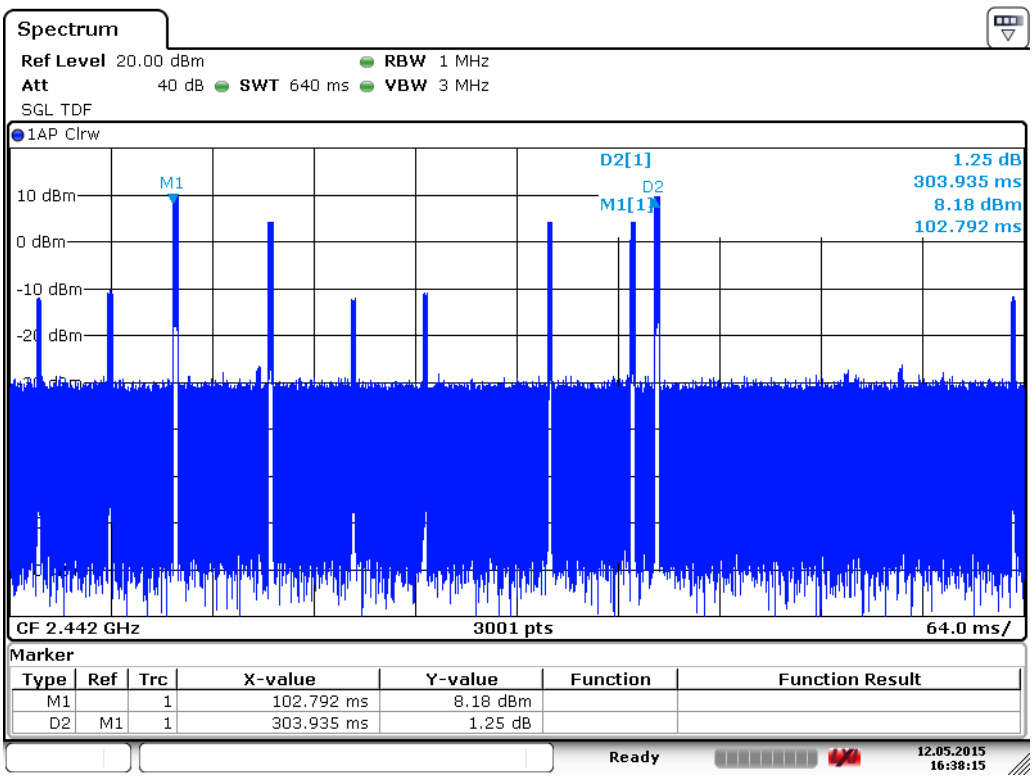


Figure 86. Measured repetition of the channel occupancy

99% Occupied Power Bandwidth

Standard:	RSS-GEN	(2009)
Tested by:	NKO	
Date:	5.6.2015	
Temperature:	21 - 22 °C	
Humidity:	35 - 41 % RH	

RSS-GEN 4.7.

Table 24. Data rate 1 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	0.926193921	-	PASS
Mid	0.926193921	-	PASS
High	0.926193921	-	PASS

Table 25. Data rate 2 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	1.230101302	-	PASS
Mid	1.244573082	-	PASS
High	1.230101302	-	PASS

Table 26. Data rate 3 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	1.230101302	-	PASS
Mid	1.259044863	-	PASS
High	1.230101302	-	PASS

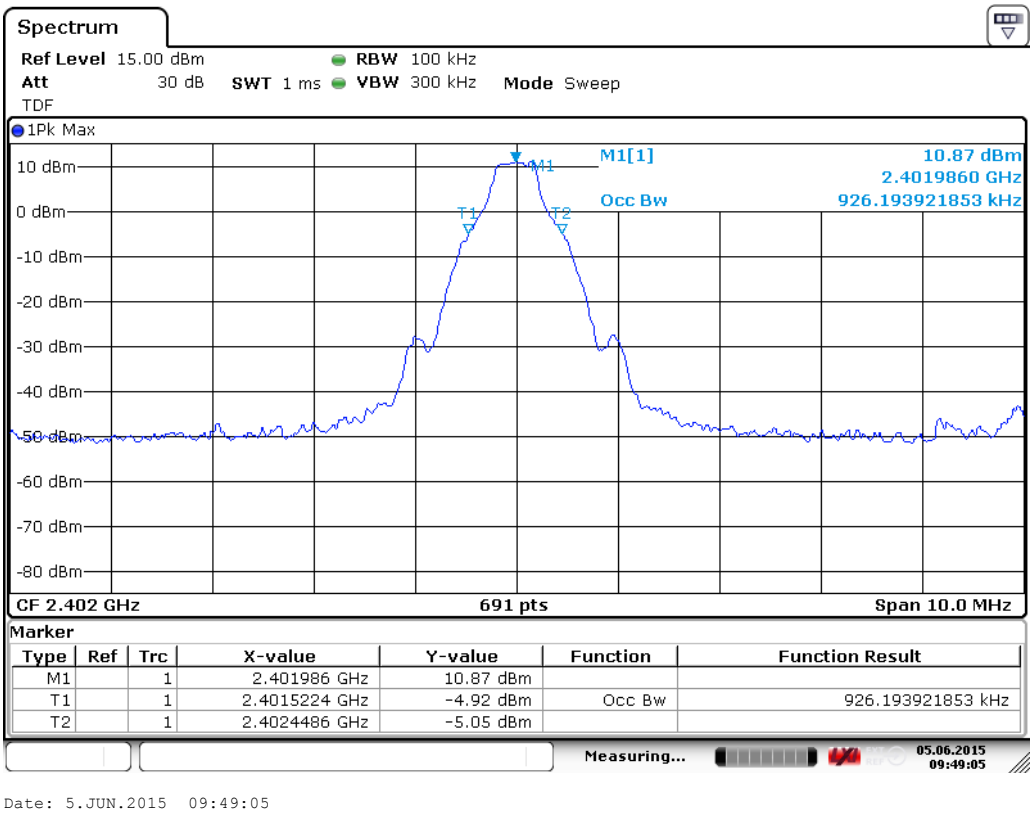
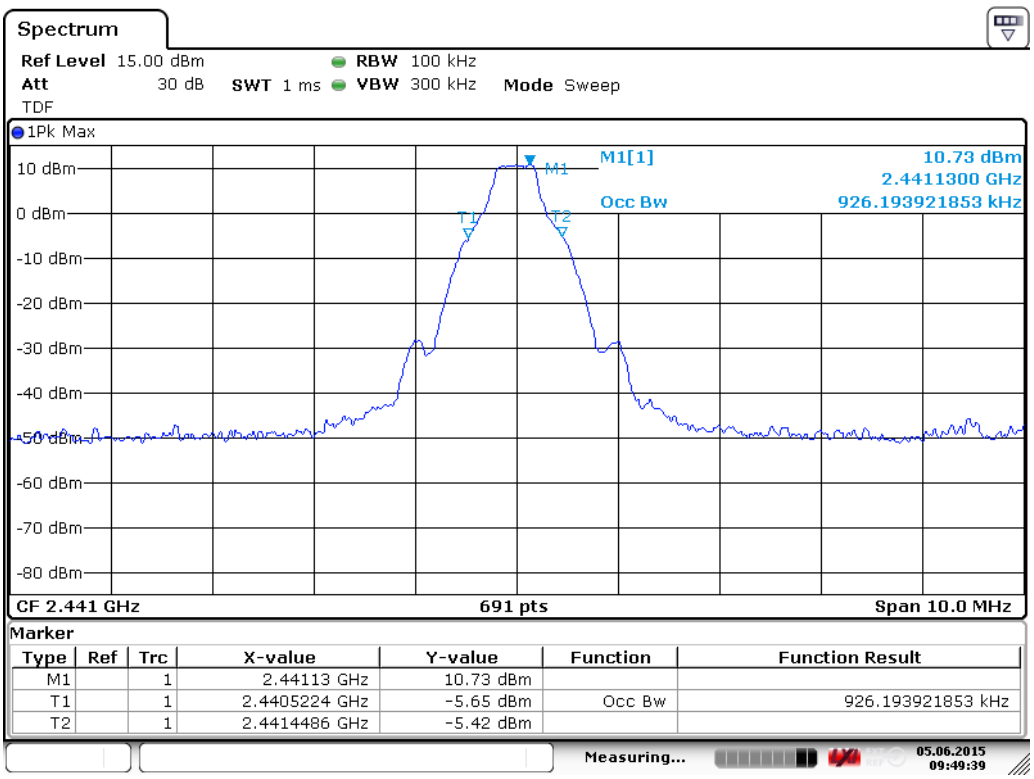
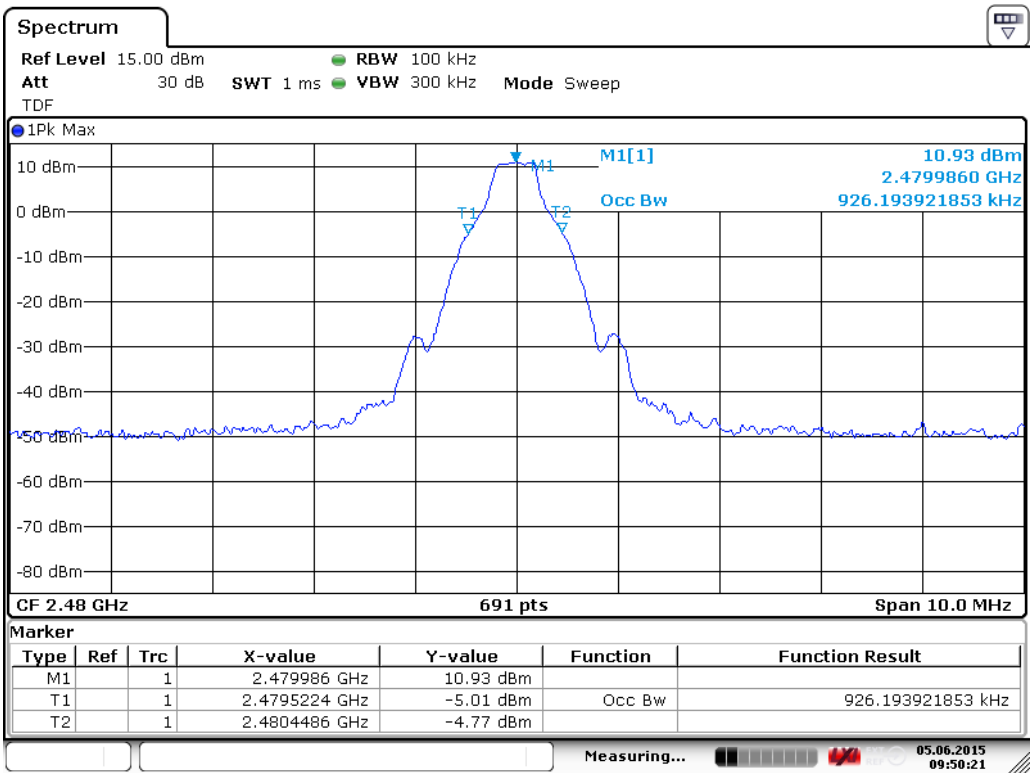


Figure 87. Low channel 99% Occupied Power Bandwidth (1 Mbps).



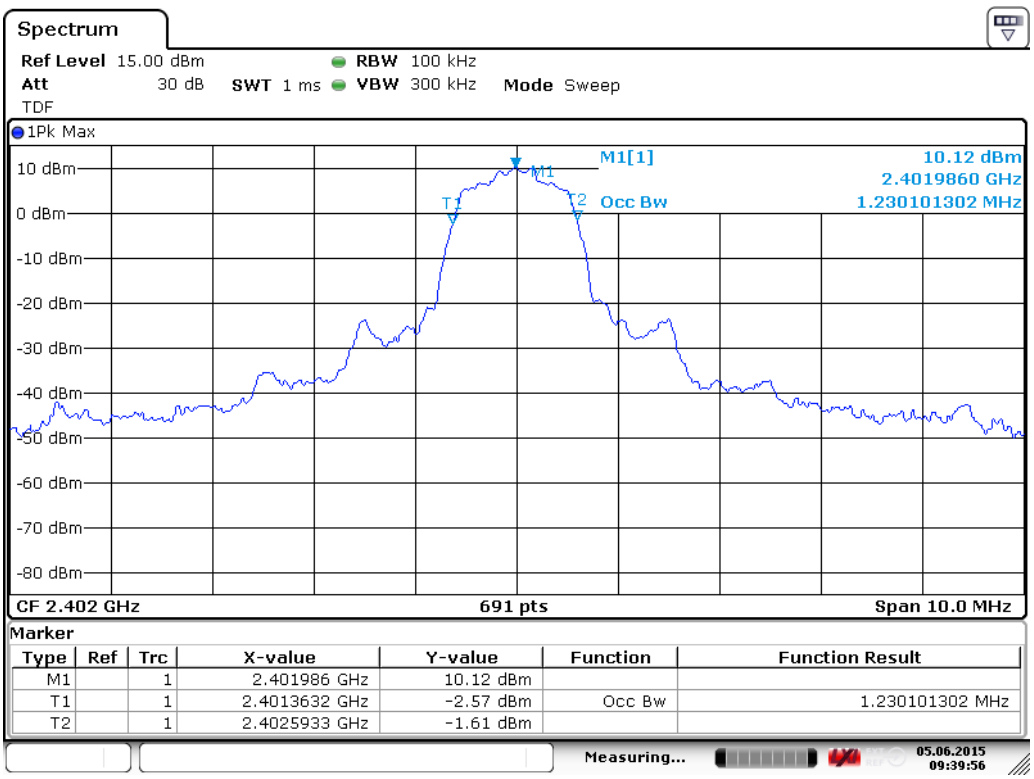
Date: 5.JUN.2015 09:49:39

Figure 88. Mid channel 99% Occupied Power Bandwidth (1 Mbps).



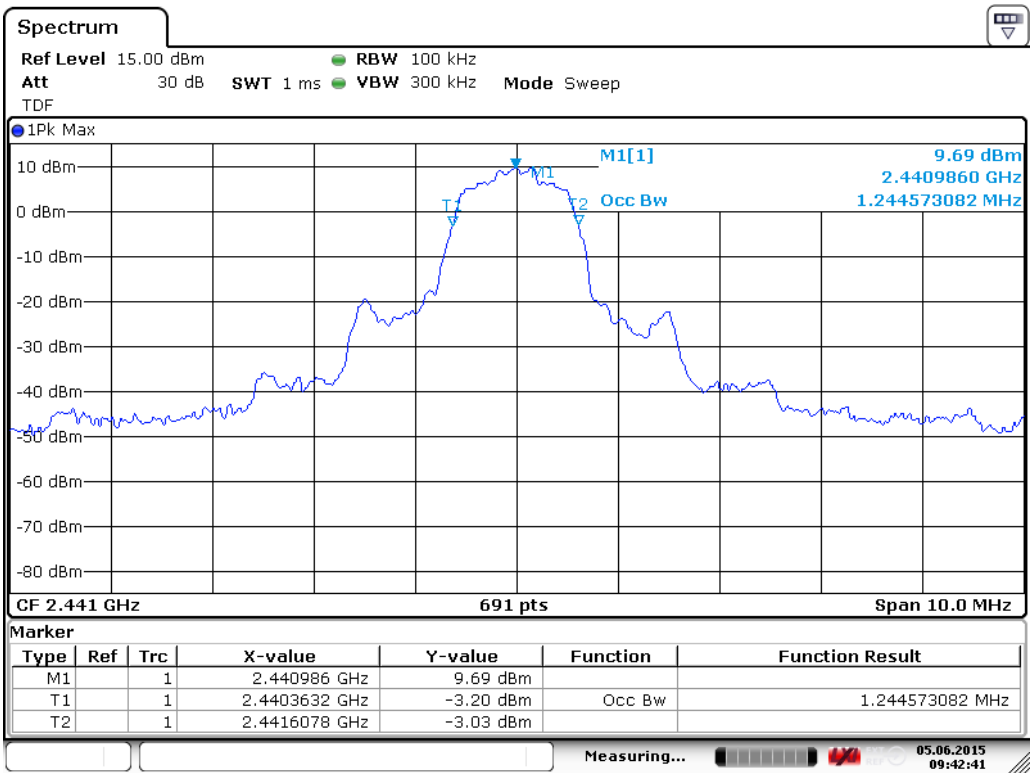
Date: 5.JUN.2015 09:50:21

Figure 89. High channel 99% Occupied Power Bandwidth (1 Mbps).



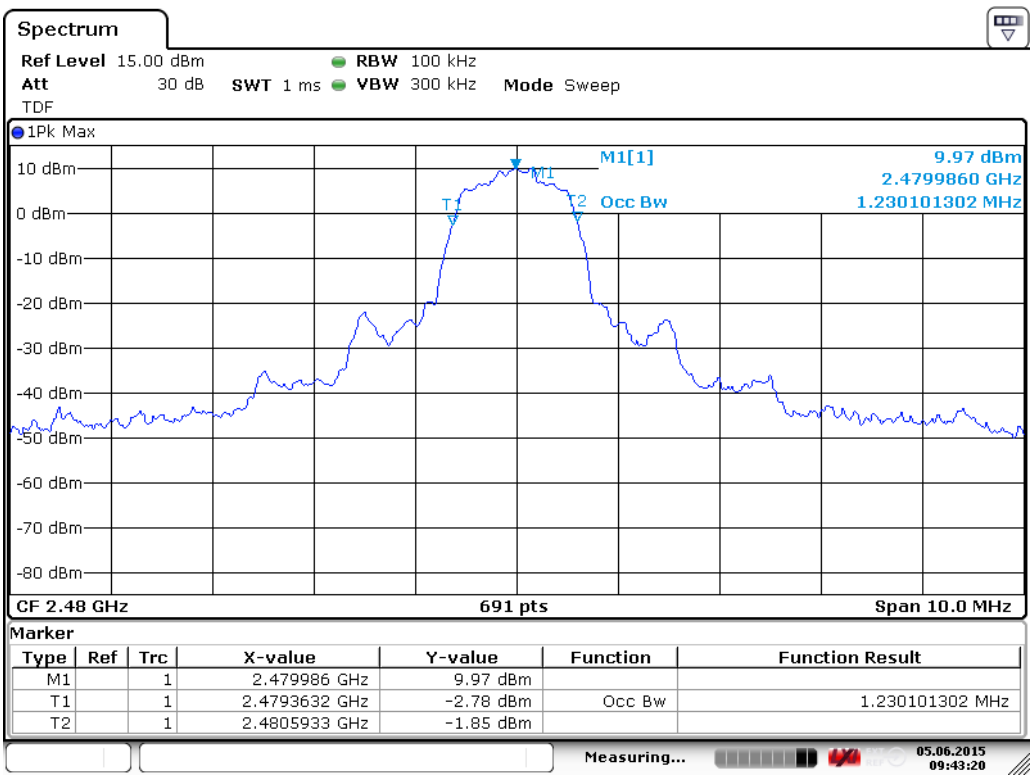
Date: 5.JUN.2015 09:39:56

Figure 90. Low channel 99% Occupied Power Bandwidth (2 Mbps).



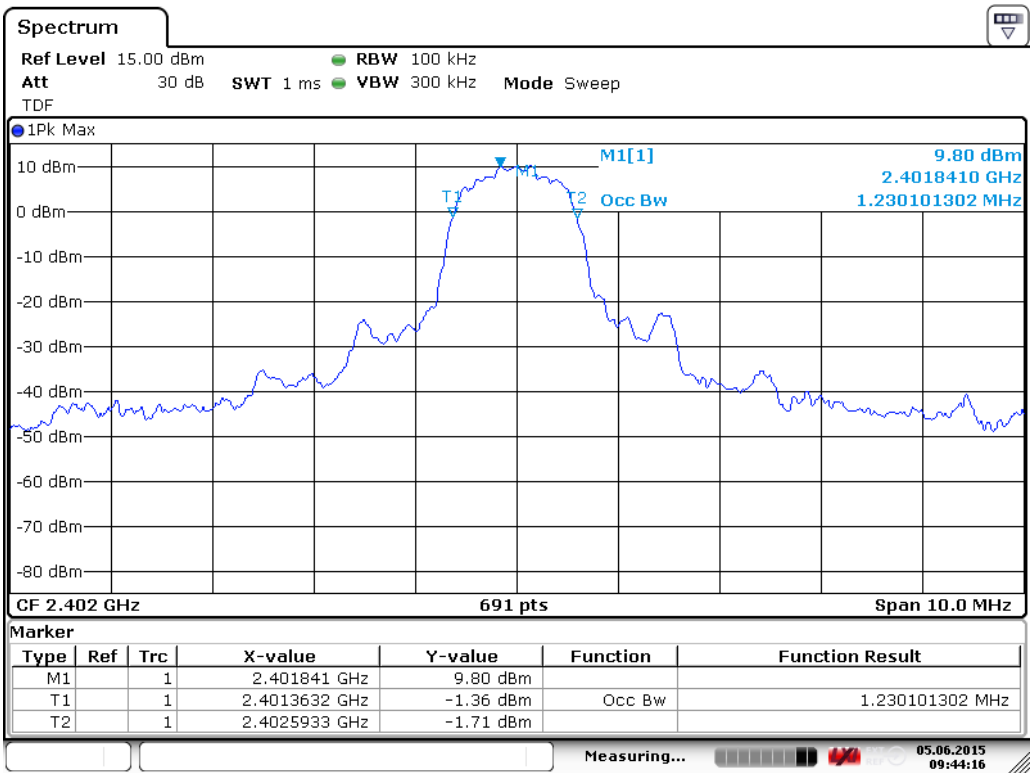
Date: 5.JUN.2015 09:42:41

Figure 91. Mid channel 99% Occupied Power Bandwidth (2 Mbps).



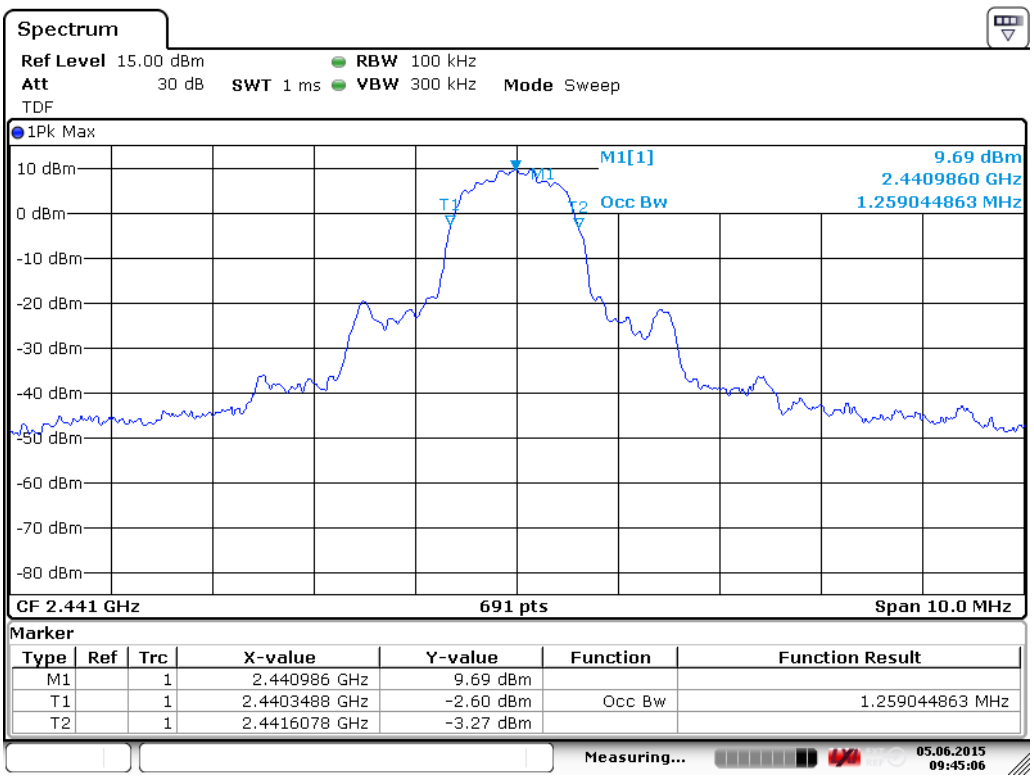
Date: 5.JUN.2015 09:43:20

Figure 92. High channel 99% Occupied Power Bandwidth (2 Mbps).



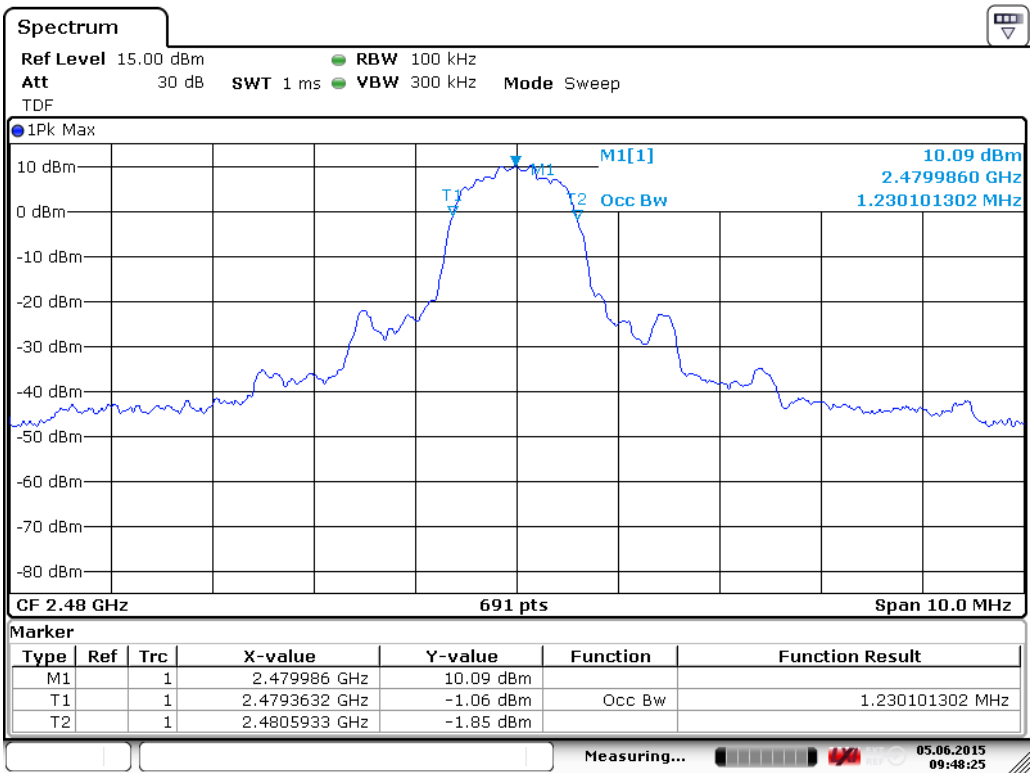
Date: 5.JUN.2015 09:44:16

Figure 93. Low channel 99% Occupied Power Bandwidth (3 Mbps).



Date: 5.JUN.2015 09:45:06

Figure 94. Mid channel 99% Occupied Power Bandwidth (3 Mbps).



Date: 5.JUN.2015 09:48:25

Figure 95. High channel 99% Occupied Power Bandwidth (3 Mbps).

TEST EQUIPMENT

Equipment	Manufacturer	Type	Serial no	Inv.no
TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	100185	8453
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	101068	9093
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-
ANTENNA (30-1000 MHz)	SCHWARZBECK	VULB 9168	8168-503	8911
ANTENNA MAST	DEISEL	MA240	240/455	5017
TURNTABLE	DEISEL	DS420	-	5015
CONTROLLER	COMTEST	HD100	100/457	5018
ANTENNA (1-18 GHz)	EMCO	3117	29617	7293
ANTENNA (18-26.5 GHz)	EMCO	3160- 09	030232-022	7294
PREAMPLIFIER (0.5-26GHz)	HP	83017A	3950M00102	5226
ATTENUATOR 10 dB	HUBER & SUHNER	6810.17B	-	-
HIGH PASS FILTER	WAINWRIGHT	WHKX	10	8267
AC Power Source	CALIFORNIA INSTRUMENTS	5001 iX Series II	58209	7826

All used measurement equipment was calibrated (if required).