SGS

Test Report

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

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

Equipment Under Test:	Bluetooth v.2.1 + EDR module
Model:	WT11u-A WT11u-E
Brand:	Silicon Labs
Customer / Manufacturer:	Silicon Laboratories Finland Oy Bertel Jungin aukio 3 FI-02600 Espoo FINLAND
FCC Rule Part:	15.247:2015
IC Rule Part:	RSS-247, Issue 1, 2015 RSS-GEN Issue 4, 2014
KDB:	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems DA 00-705 (March 30, 2000)

Date:	20 October 2016	Date:	20 October 2016
Issued by:		Checked by:	
	Emil Haverinen Testing Engineer		Rauno Repo Testing Engineer

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Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	WT11u-A, WT11u-E
Type:	Bluetooth v.2.1 + EDR module
Serial no:	-
FCC ID:	QOQWT11U
IC:	5123A-WT11U

Description of the EUT

The equipment under test is a Bluetooth v.2.1 + EDR module.

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 GHz
Channels:	79
Channel separation:	1 MHz
99% Channel bandwidth:	1.221211837 MHz (3 Mbps / ch high)
Maximum peak conducted output power:	18.04 dBm (normal conditions)
Transmission technique:	FHSS
Modulation:	GFSK, π/4 DQPSK, 8DPSK
Integral antenna gain (WT11u-A):	0.5 dBi
External antenna gain (WT11u-E):	2.14 dBi

Power Supply

Operating voltage range:	3.0 – 3.6 VDC, tested with 3.3 VDC

Mechanical Size of the EUT

Height: 3.35 mm	Width: 14.00 mm	Depth: 35.30 mm

Samples

One sample from both models was used in tests.

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 8.8	Conducted Emissions on Power Supply Lines	**PASS**
§15.247(b)(1) / RSS-247 5.4(2)	Maximum Peak Conducted Output Power	**PASS**
15.247(a)(1) / RSS-247 5.1(2)	Hopping Channel Carrier Frequency Separation	**PASS**
§15.247(a)(1)(iii) / RSS-247 5.1(4)	Number of Hopping Frequencies	**PASS**
§15.247(a)(1)(iii) / RSS-247 5.1(4)	Average Time of Occupancy of Hopping Frequency	**PASS**
§15.247(a)(1) / RSS-247 5.1(2)	20 dB Bandwidth	**PASS**
RSS-GEN 6.6	99 % Occupied Bandwidth	**PASS**
§15.247(d) / RSS-247 5.5	100 kHz Bandwidth of Frequency Band Edges and Conducted Spurious Emissions	**PASS**
§15.209(a), §15.247(d) / RSS-247 5.5	Radiated Emissions Within The Restricted Bands	**PASS**

Explanations:
PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
N/A Not Applicable
N/T Not Tested

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

EUT Test Conditions during Testing

The EUT was in continuous transmit mode during all the tests. When necessary the hopping was stopped and the EUT was configured into the wanted channel. Normal modulation was applied in all the tests.

The radiated measurements were performed to both models separately. The A -variant of the EUT was using its normal chip antenna and the E -variant was fitted with antenna and short RF cable adapter provided by the manufacturer. Radiated measurements were performed only with 1 Mbps data rate (highest power).

The conducted measurements were performed only to E -variant because the only difference between the modules is that the E -variant has and RF connector instead of the chip antenna used by the A -variant. Conducted measurements were performed with 1(power setting 51) and 3 Mbps data rates.

During conducted emissions on AC power supply lines test, the EUT was powered from Flextronics LPS 0012ADU00 AC/DC power supply. Supply voltage and frequency of 115 V / 60 Hz was used. The supply provides 5.2 VDC / 2.4 A output which was used to supply evaluation board of the EUT. Evaluation board regulates voltage to 3.3 V which is supplied to the EUT. In other tests the power was supplied from the laboratory power supply.

Both models were connected to their supportive evaluation boards while the tests were performed.

Average values for transmitter radiated emissions were calculated from measured peak pulse amplitude and by determining the duty cycle correction factor of the pulse modulation as described in ANSI 63.10 clause 7.5.

The duty cycle correction expressed in dB was determined as follows:

Duty cycle correction = 20log (Δ), Δ(duty cycle) = 2.916 ms / 100 ms = 0.02916

Pulse repetition time is >100 ms

Calculated duty cycle correction for the EUT = -30.7 dB

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

Channel Low = 2402 MHz
Channel Mid = 2441 MHz
Channel High = 2480 MHz

Power settings during the tests:

WT11u-A: 255, 51 / 255, 83 (Basic data rate / Enhanced data rate)
WT11u-E: 255, 46 / 255, 83 (Basic data rate / Enhanced data rate 2DH5 + 3DH5)

Packet settings during the tests:

Basic data rate: 15, 339 (type, size)
Enhanced data rate 2DH5: 30, 679 (type, size)
Enhanced data rate 3DH5: 31, 1021 (type, size)

Conducted Emissions on Power Supply Lines

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	14 October 2016	
Temperature:	22 °C	
Humidity:	31 % RH	
Measurement uncertainty:	± 2.9 dB	Level of confidence 95 % (k = 2)

FCC Rule: §15.207 (a)
RSS-GEN 8.8

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.

Table 1: Conducted emission limits

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.

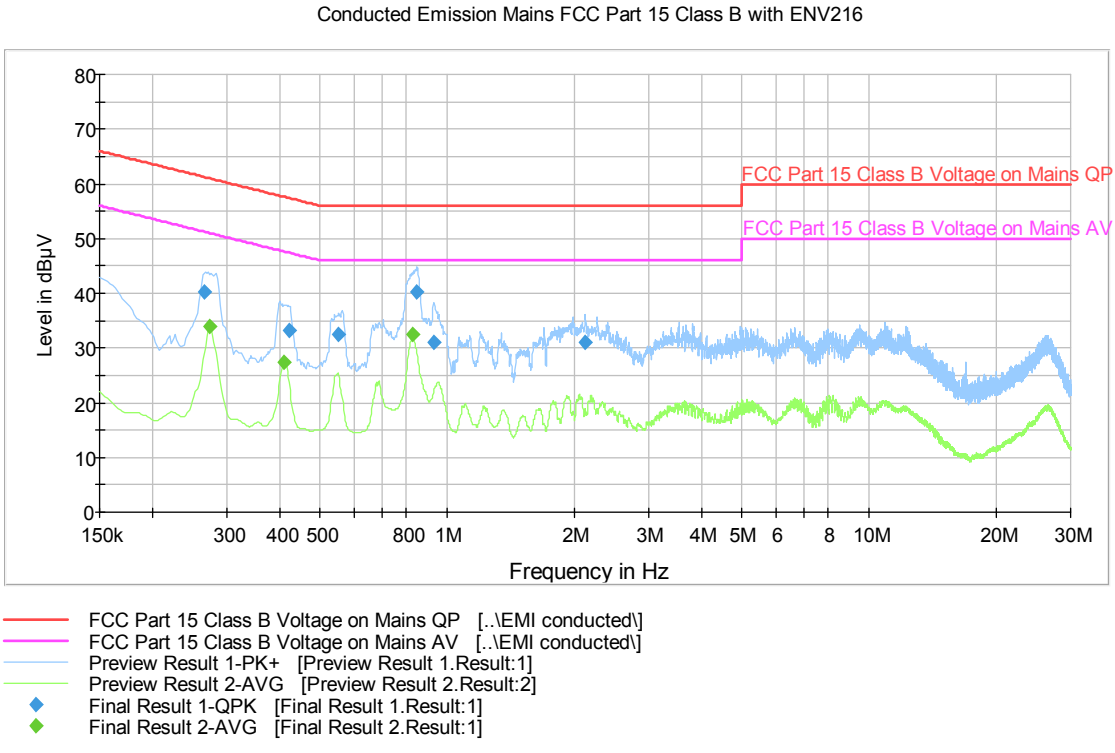


Figure 1: Measurement results from AC-mains with peak and average detectors

Table 2: Final quasi peak measurements from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.266250	40.1	1000.0	9.000	On	L1	9.8	21.1	61.2
0.422500	33.3	1000.0	9.000	On	L1	10.1	24.1	57.4
0.553500	32.5	1000.0	9.000	On	N	10.3	23.5	56.0
0.849000	40.3	1000.0	9.000	On	N	10.3	15.7	56.0
0.930250	31.1	1000.0	9.000	On	N	10.3	24.9	56.0
2.124250	31.1	1000.0	9.000	On	N	10.4	24.9	56.0

Table 3: Final average measurements from the worst frequencies

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.274250	34.0	1000.0	9.000	On	L1	9.8	16.9	51.0
0.410500	27.5	1000.0	9.000	On	L1	10.1	20.2	47.6
0.826750	32.4	1000.0	9.000	On	N	10.3	13.6	46.0

Maximum Peak Conducted Output Power

Standard:	ANSI C63.10	(2013)
Tested by:	RRE / EHA	
Date:	8 August 2016 - 6 October 2016	
Temperature:	22 - 23 °C	
Humidity:	30 - 52 % RH	
Measurement uncertainty:	± 2.87dB	Level of confidence 95 % (k = 2)

FCC Rule: §15.247(b)(1)
RSS-247: 5.4(2)

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.

Test results:

Table 4: Maximum conducted output power (1 Mbps, GFSK modulation)

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	17.89	30	12.11	PASS
Mid	**18.04**	30	11.96	PASS
High	17.34	30	12.66	PASS

Table 5: Maximum conducted output power (2 Mbps, π/4 DQPSK modulation)

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	**11.35**	30	18.65	PASS
Mid	11.13	30	18.87	PASS
High	10.18	30	19.82	PASS

Table 6: Maximum conducted output power (3 Mbps, 8DPSK modulation)

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	**11.78**	30	18.22	PASS
Mid	11.53	30	18.47	PASS
High	10.43	30	19.57	PASS

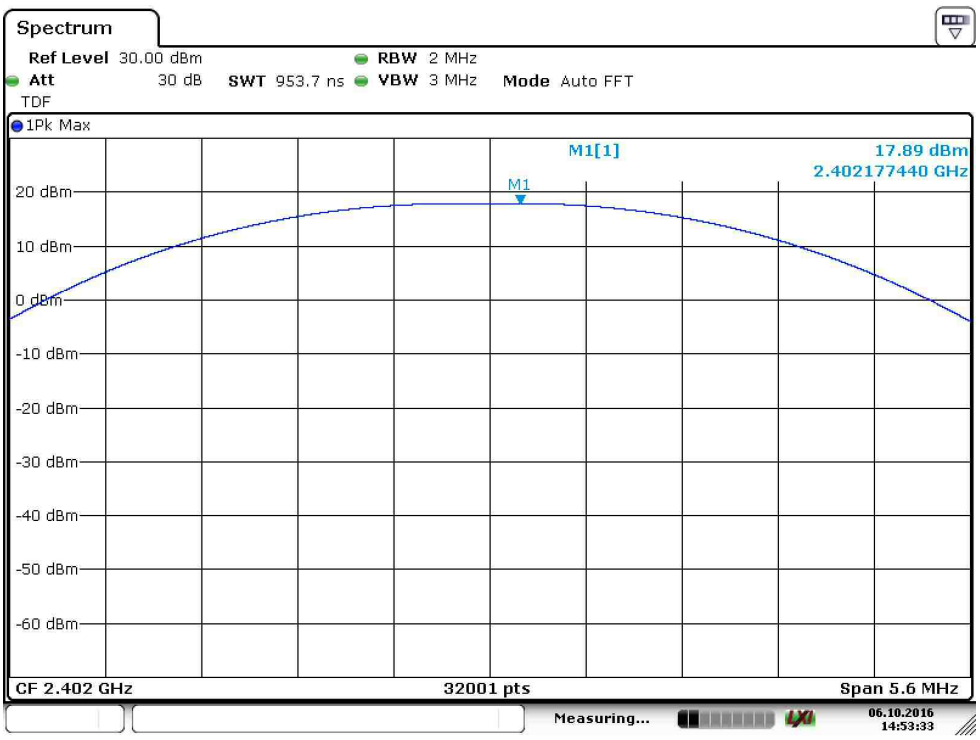


Figure 2. Maximum peak output power channel low (1 Mbps)

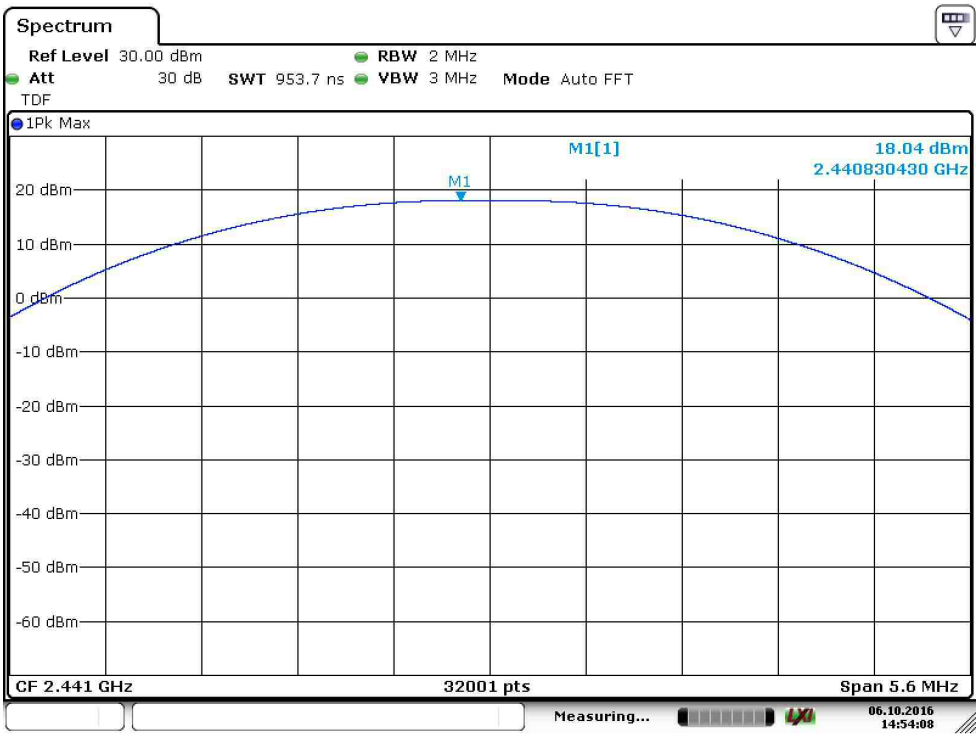


Figure 3. Maximum peak output power channel mid (1 Mbps)

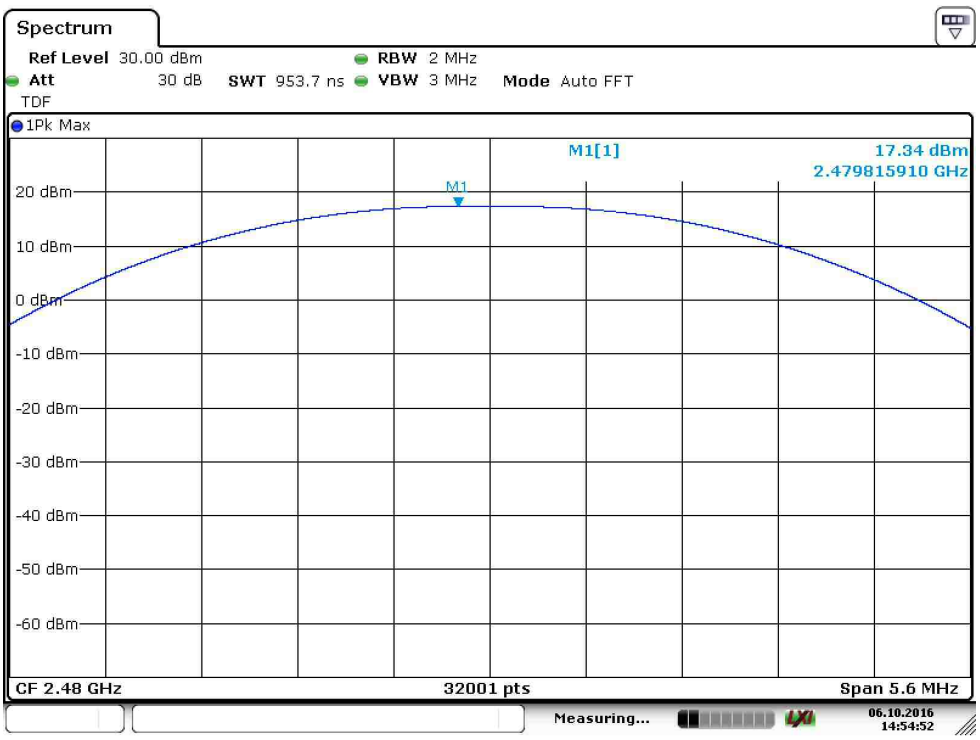


Figure 4. Maximum peak output power channel high (1 Mbps)

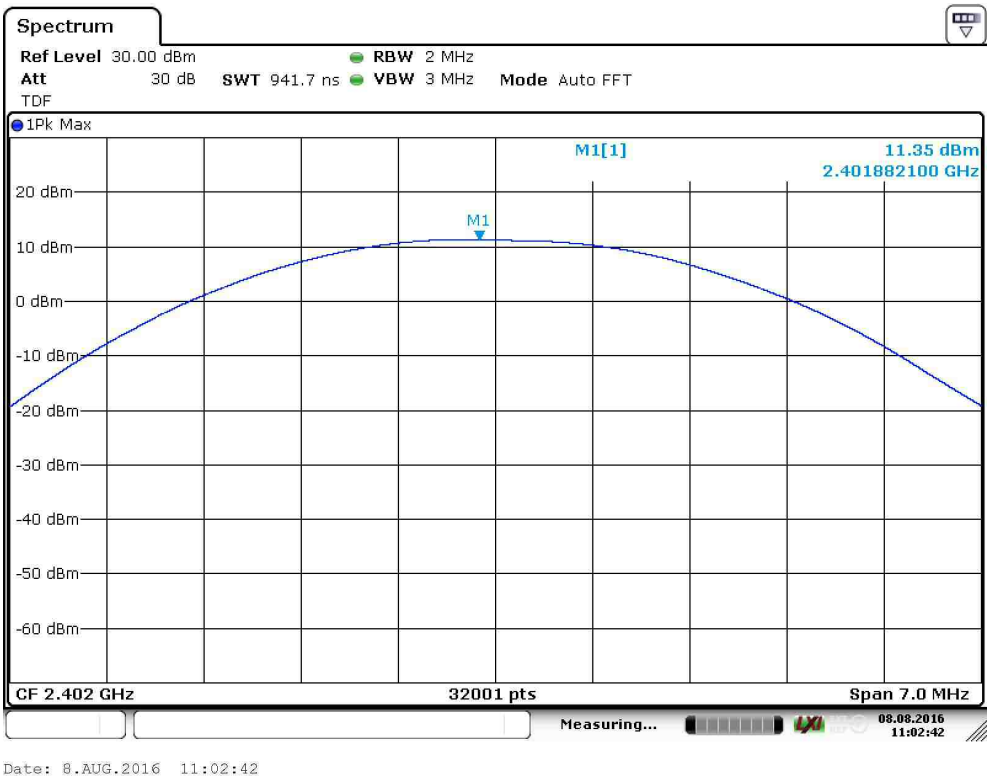


Figure 5. Maximum peak output power channel low (2 Mbps)

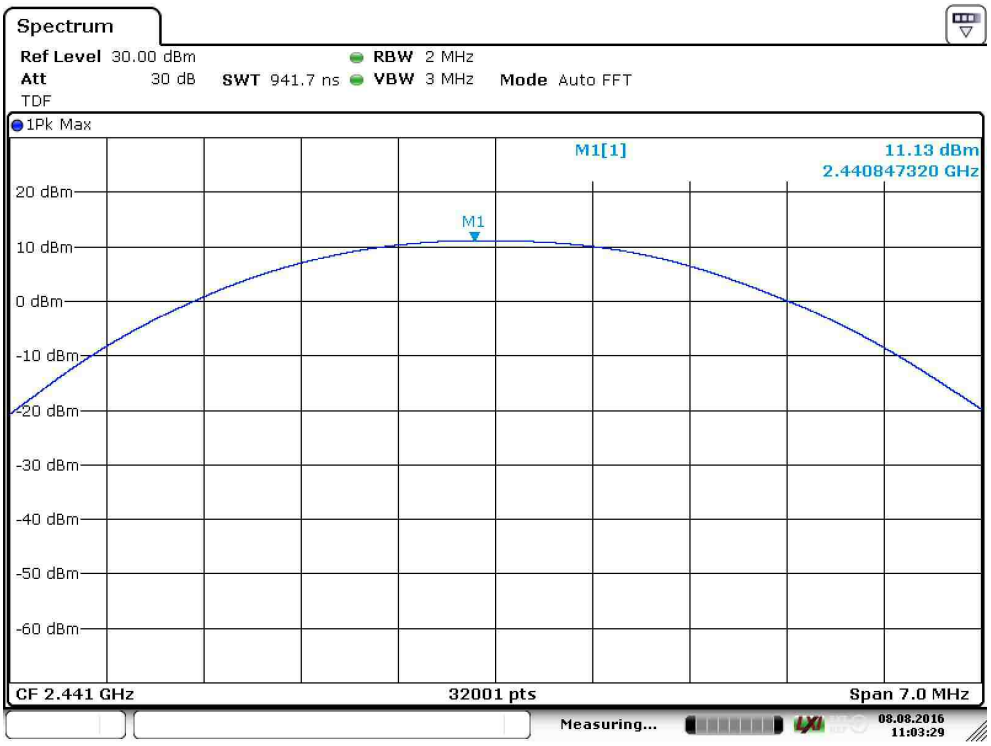


Figure 6. Maximum peak output power channel mid (2 Mbps)

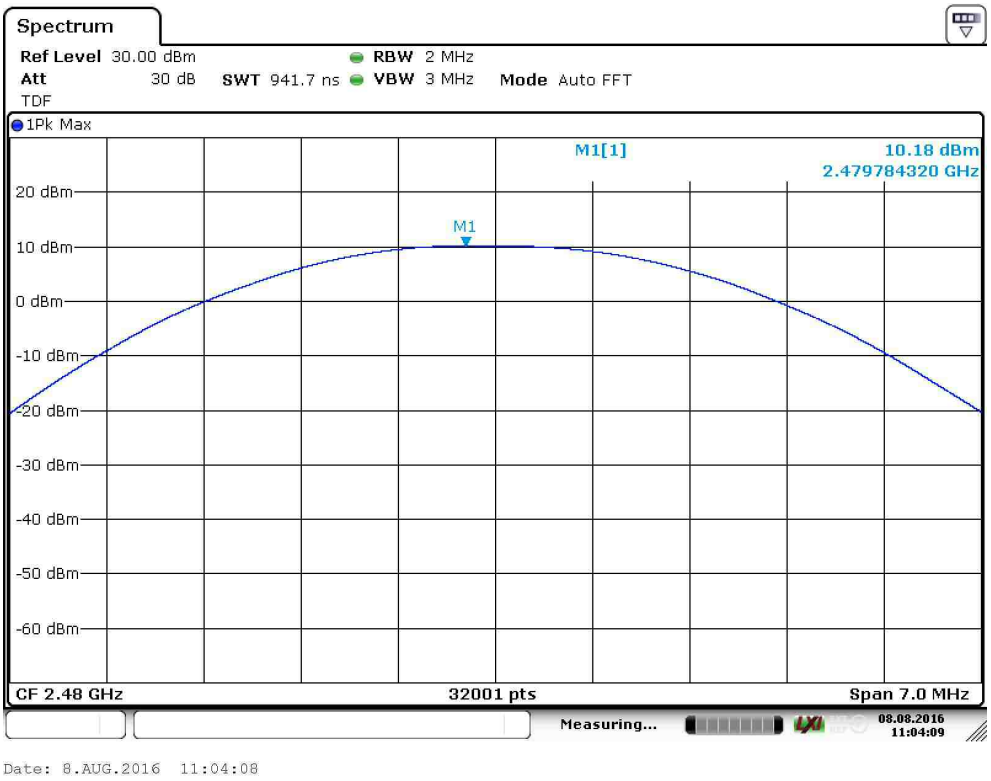


Figure 7. Maximum peak output power channel high (2 Mbps)

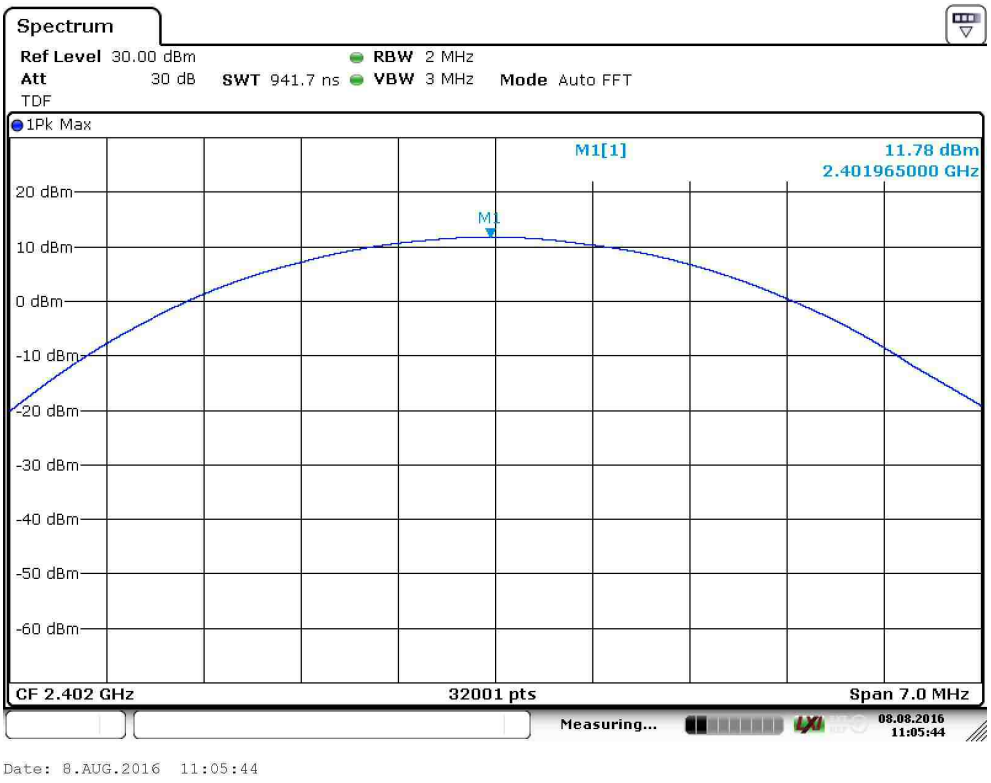


Figure 8. Maximum peak output power channel low (3 Mbps)

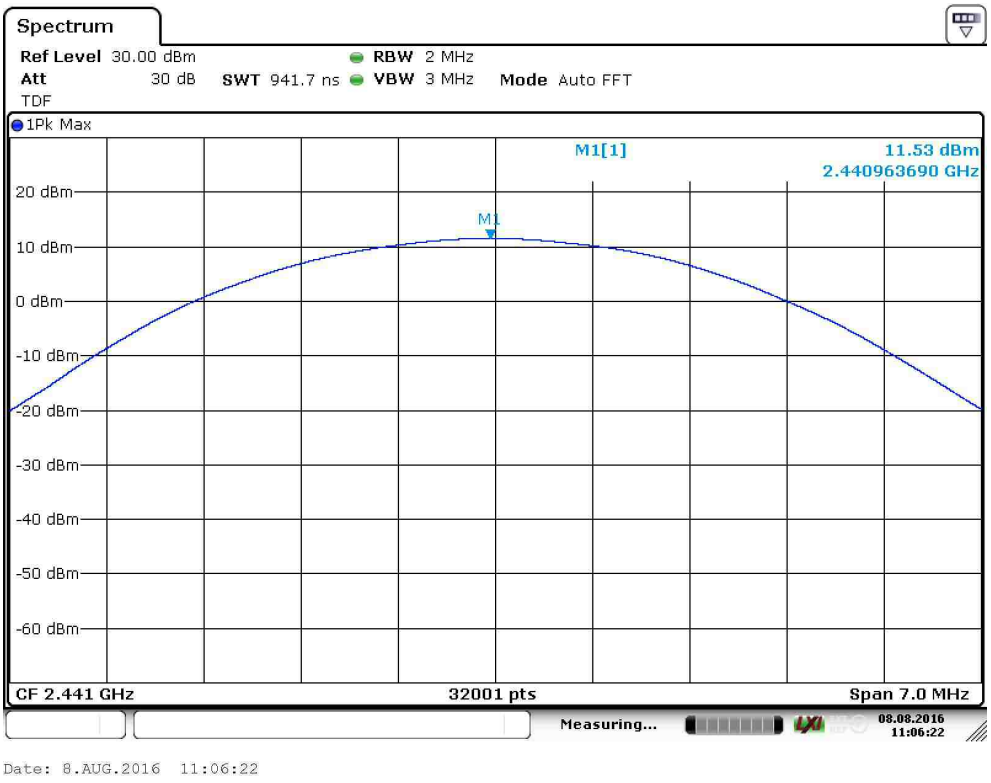


Figure 9. Maximum peak output power channel mid (3 Mbps)

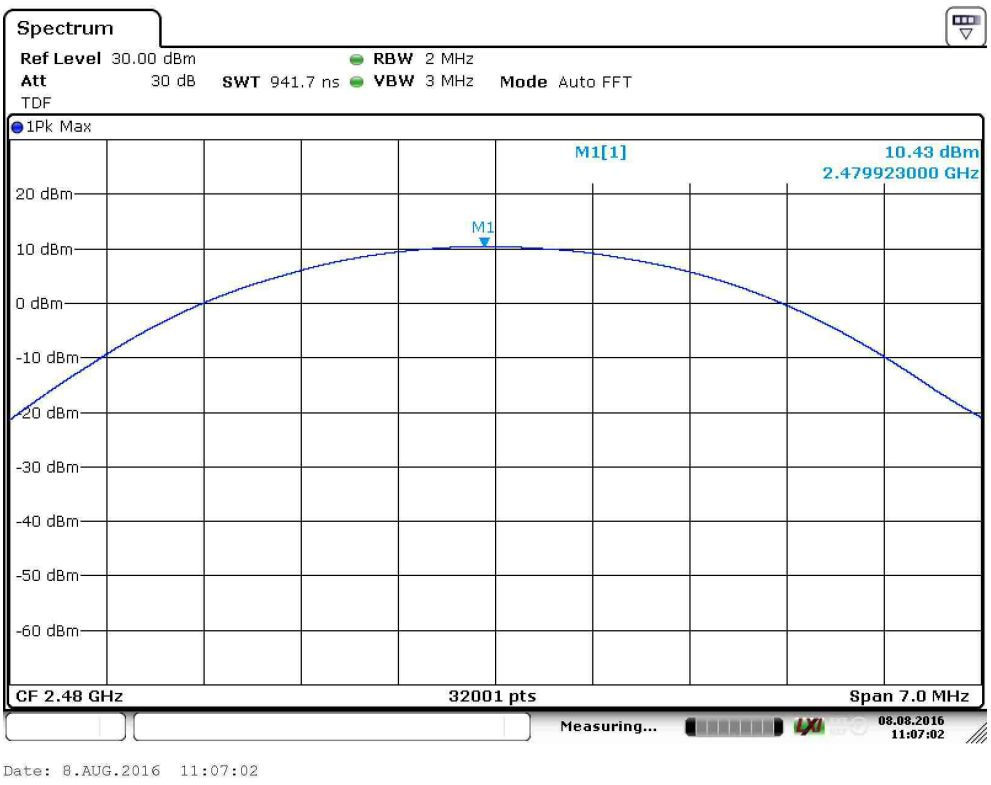


Figure 10. Maximum peak output power channel high (3 Mbps)

Hopping Channel Carrier Frequencies Separation

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	6 October 2016	
Temperature:	23 °C	
Humidity:	30 % RH	

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

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 7: Hopping channel carrier frequencies separation test result

Data rate	Measured separation	Limit	Result
1 Mbps (GFSK)	991.060 kHz	547.191 kHz	PASS
3 Mbps (8DPSK)	1000.12 kHz	835.891 kHz	PASS

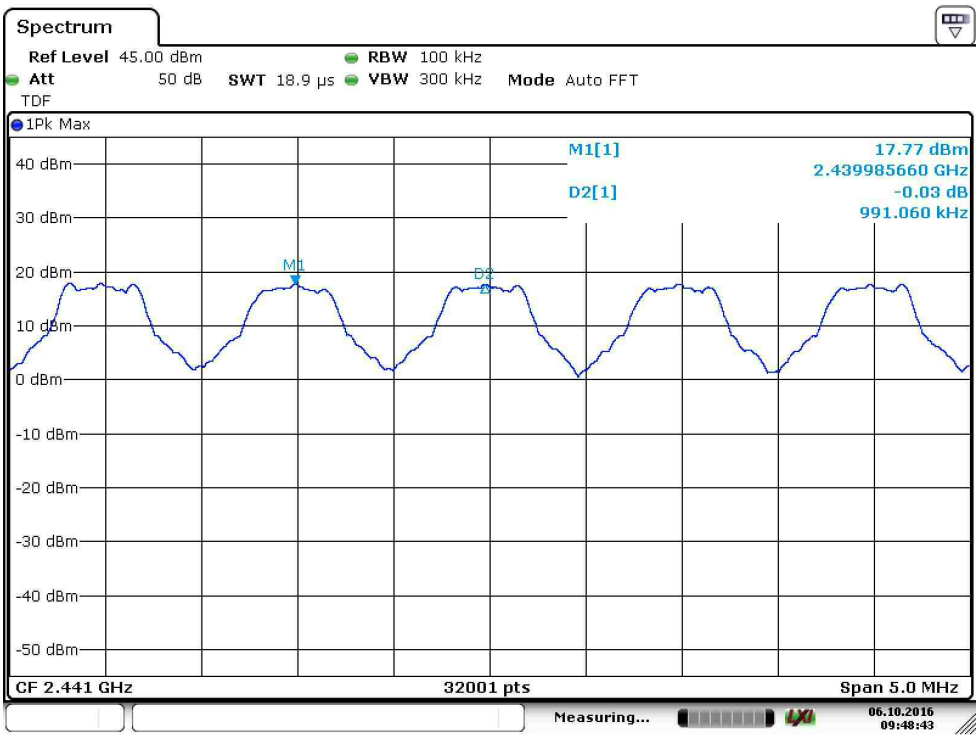


Figure 11: Channel frequency separation 1 Mbps

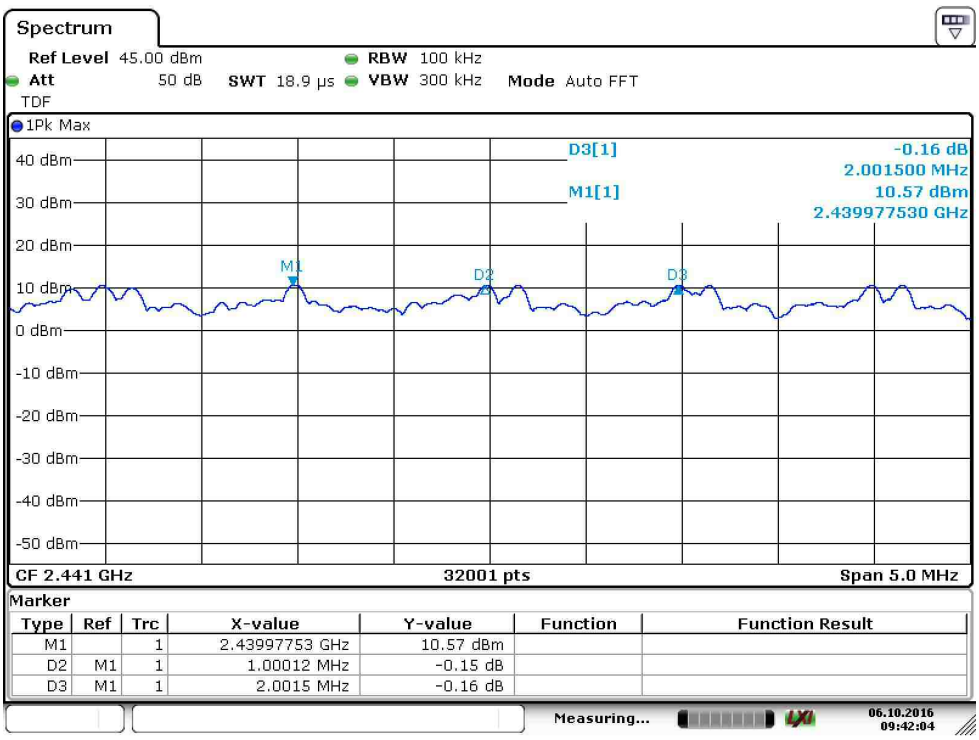


Figure 12: Channel frequency separation 3 Mbps

Number of Hopping Frequencies

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	6 October 2016	
Temperature:	23 °C	
Humidity:	30 % RH	

FCC Rule: §15.247(a)(1)(iii)
RSS-247 5.1(4)

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

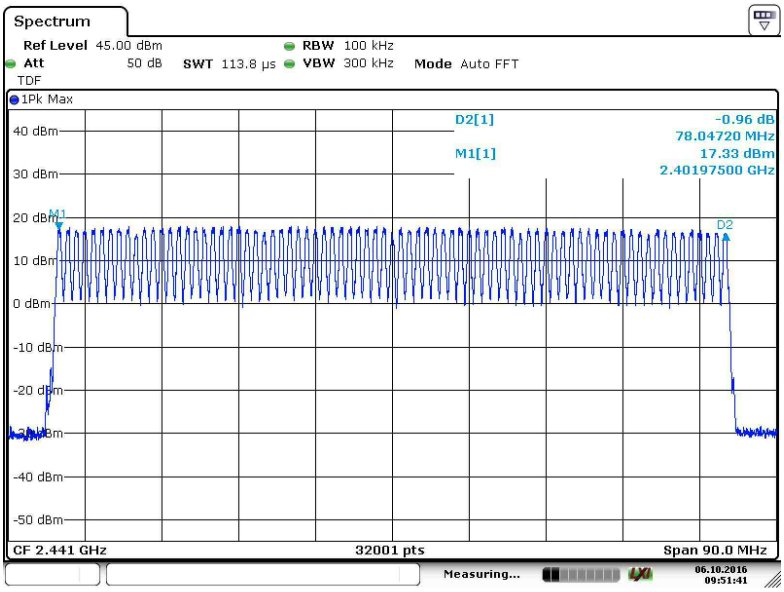


Figure 13. 79 hopping channels 1 Mbps

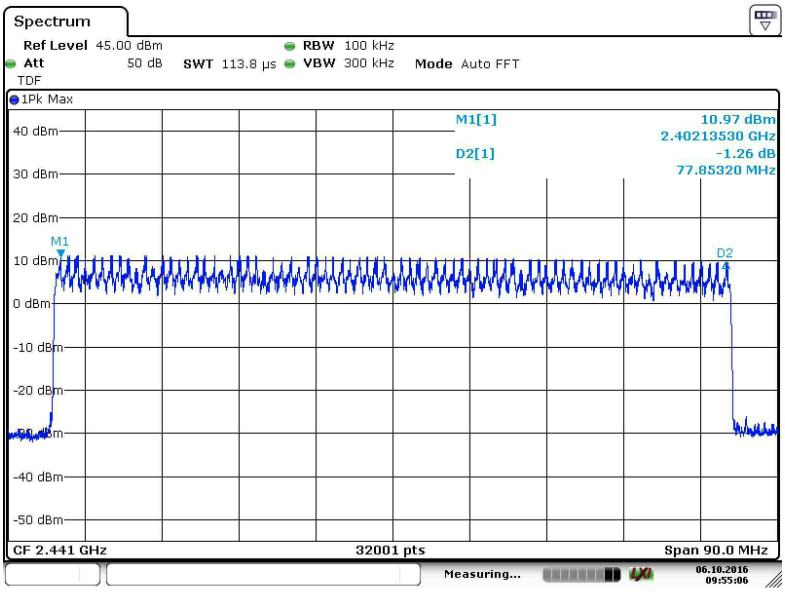


Figure 14: 79 hopping channels 3 Mbps

Average Time of Occupancy of Hopping Frequency

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	6 October 2016	
Temperature:	23 °C	
Humidity:	30 % RH	

FCC Rule: §15.247(a)(1)(iii)
RSS-247 5.1(4)

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 = 296.0 ms
Number of transmission cycles in measurement period = 31.6 / 0.296 = 106.8
Time of occupancy = (single duration) x (repetition) = 2.916 ms x 106.8 = 311.30 ms

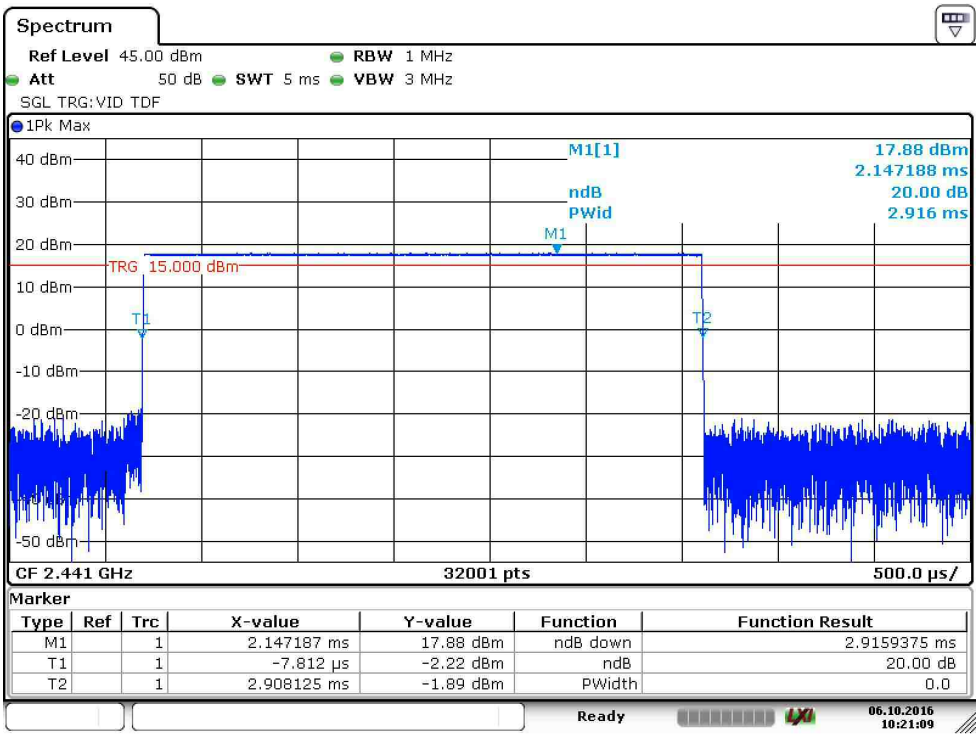


Figure 15: Duration of one transmission

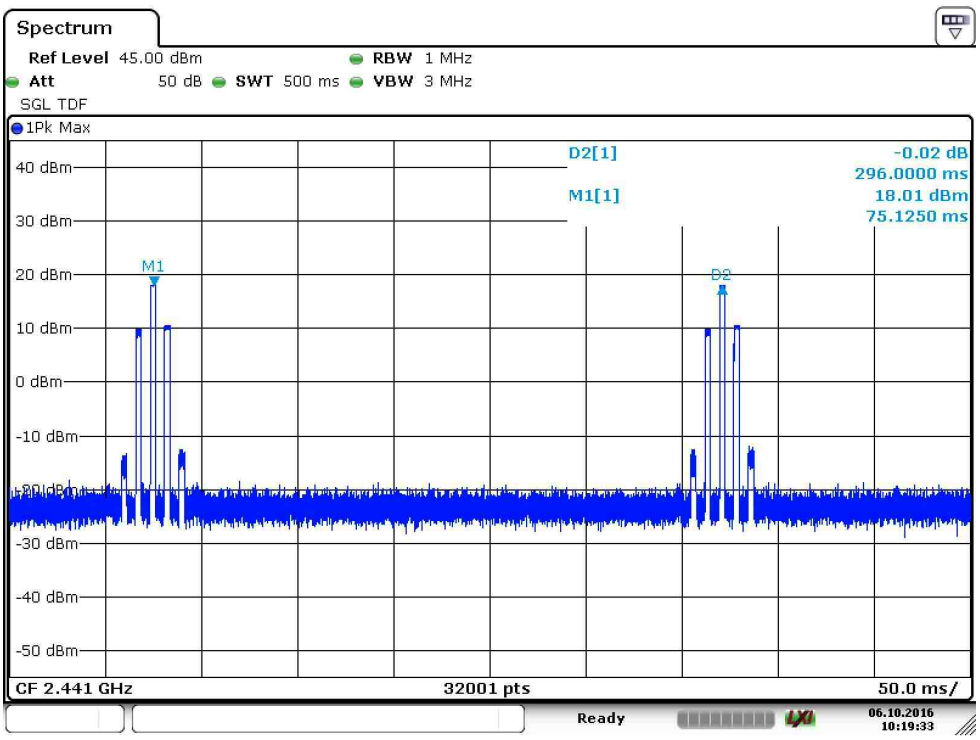


Figure 16: Channel transmission repetition rate

20 dB Bandwidth

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	6 October 2016	
Temperature:	23 °C	
Humidity:	30 % RH	

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

Test result:

Table 8. 20 dB bandwidth test results

Channel	20 dB BW [kHz] 1 Mbps (GFSK)	20 dB BW [kHz] 3 Mbps (8DPSK)
Low	820.787	1212.962
Mid	818.412	1211.087
High	820.537	1253.836

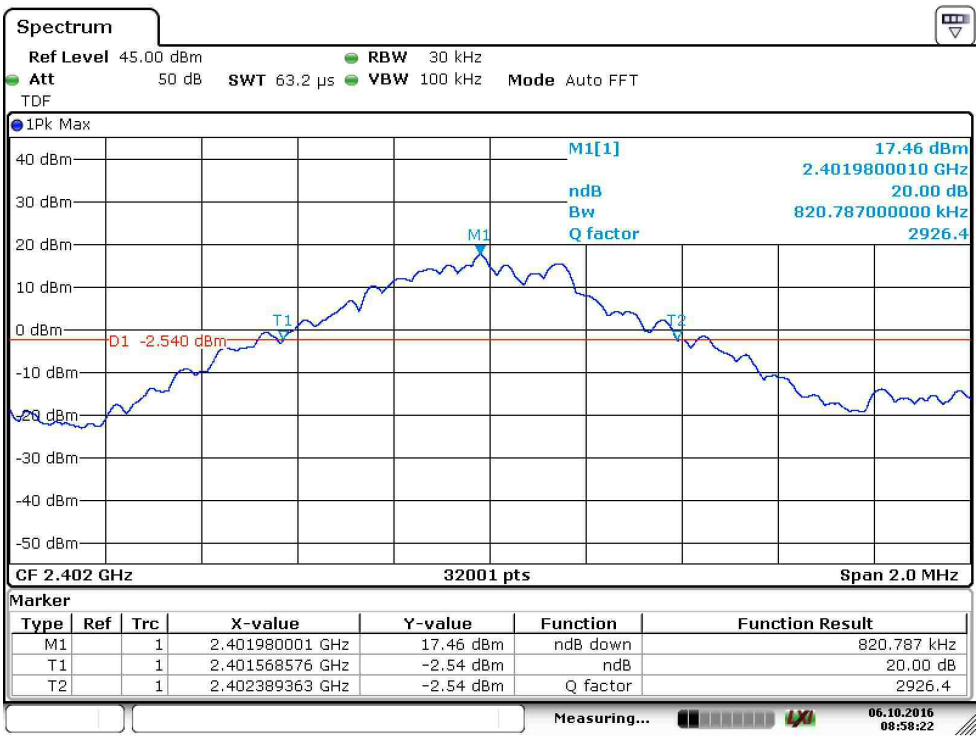


Figure 17: 20 dB bandwidth channel low (1 Mbps)

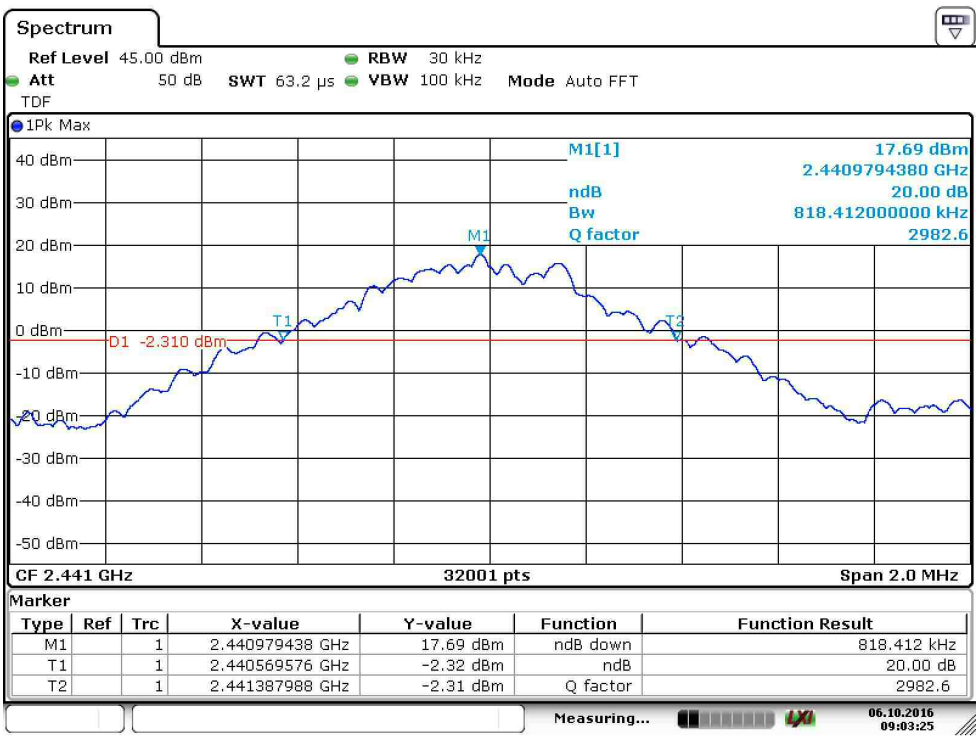


Figure 18: 20 dB bandwidth channel mid (1 Mbps)

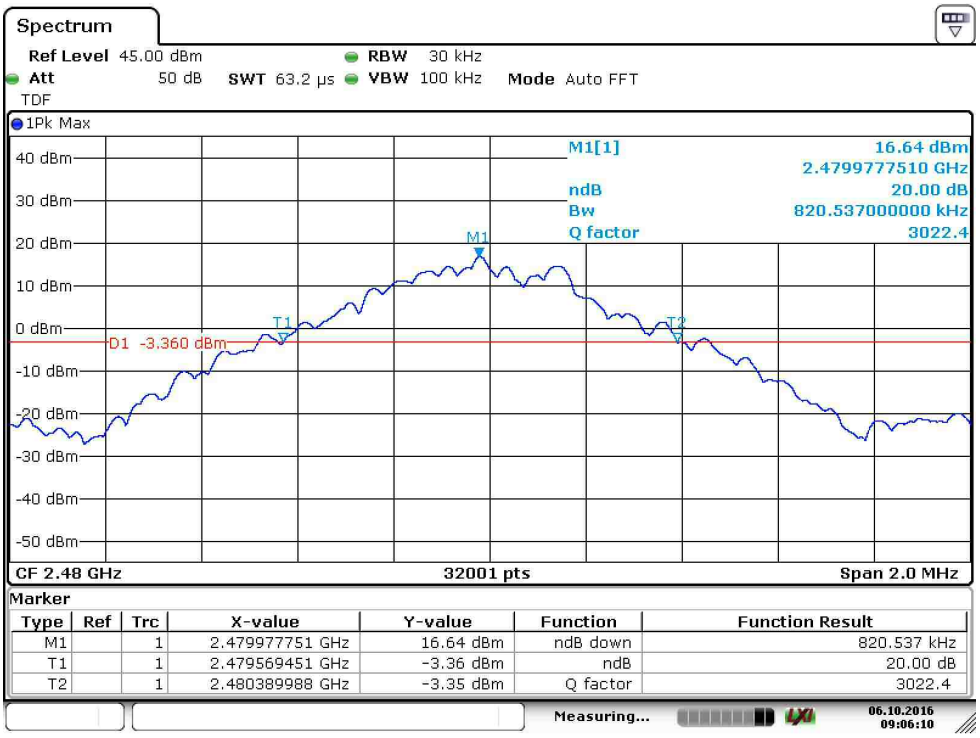


Figure 19: 20 dB bandwidth channel high (1Mbps)

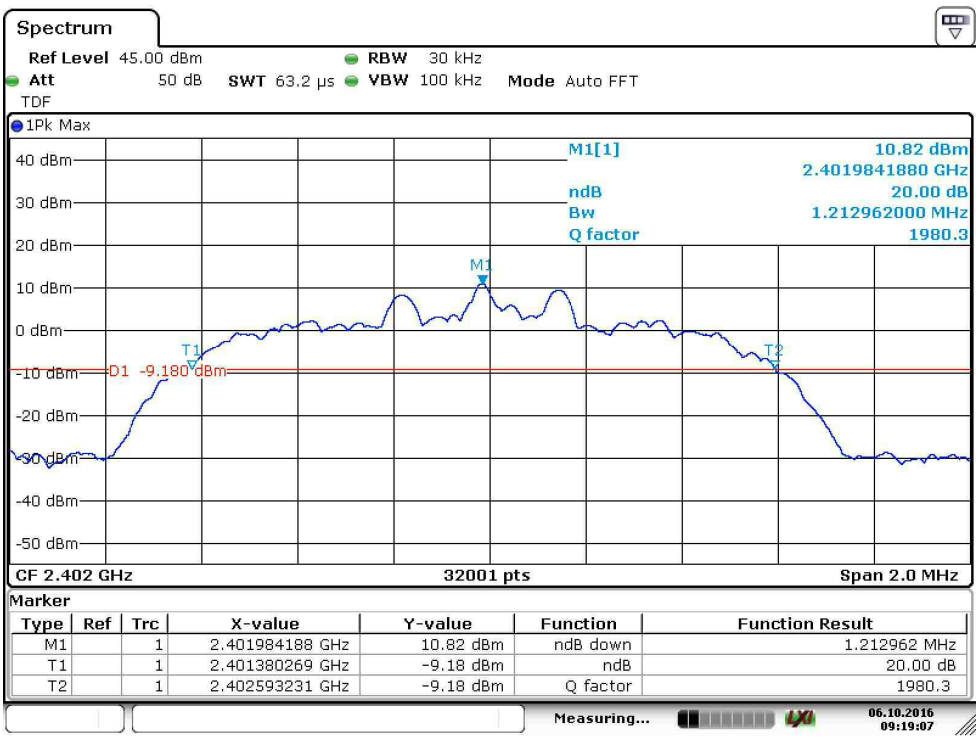


Figure 20: 20 dB bandwidth channel low (3 Mbps)

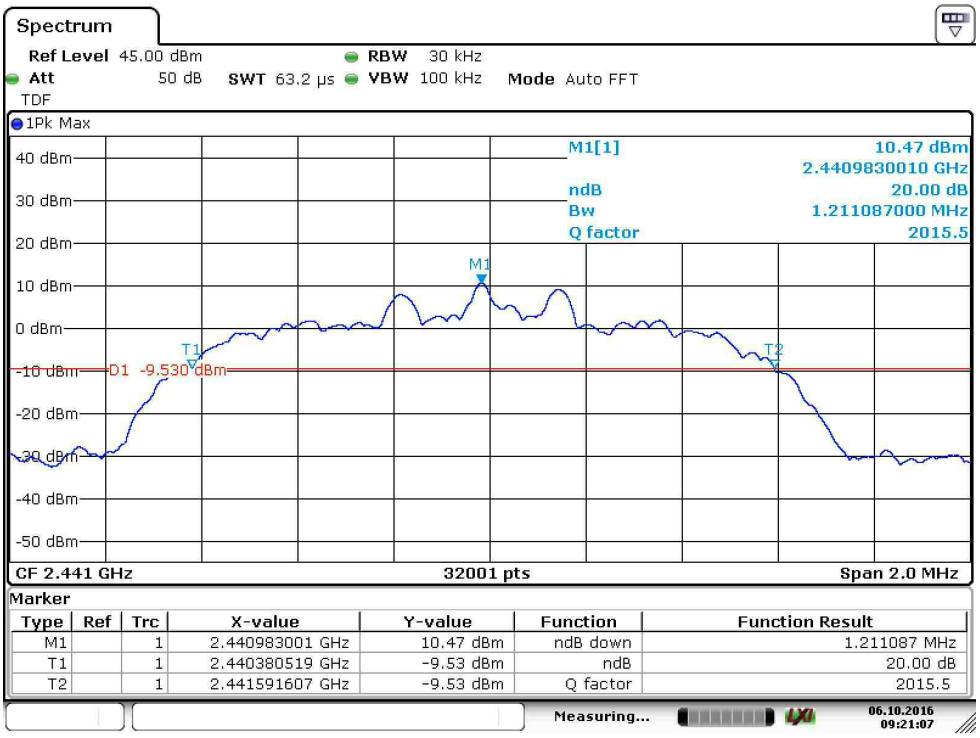


Figure 21: 20 dB bandwidth channel mid (3 Mbps)

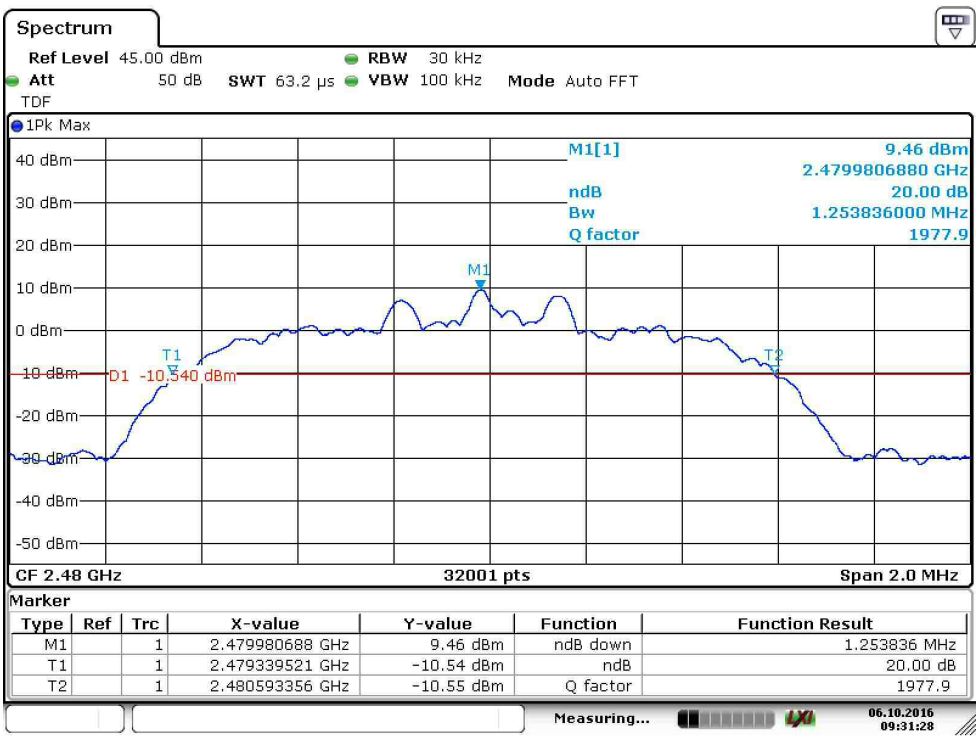


Figure 22: 20 dB bandwidth channel high (3Mbps)

Conducted Spurious Emissions 30 MHz - 26500 MHz and Band Edge

Standard:	ANSI C63.10	(2014)
Tested by:	EHA	
Date:	6 October 2016	
Temperature:	23 °C	
Humidity:	30 % RH	

FCC Rule: §15.247(d)
RSS-247 5.5

Test results:

Conducted spurious emissions channel low (GFSK)

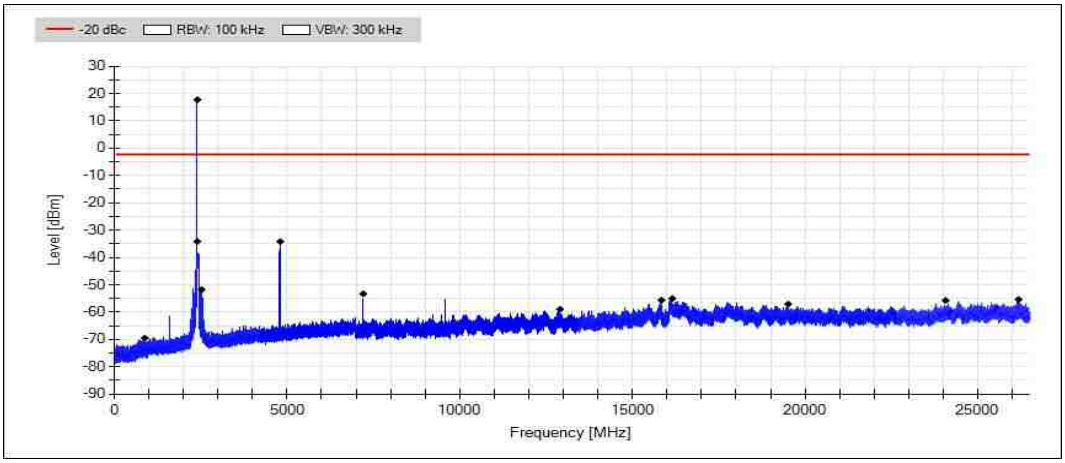


Figure 23: Plot of conducted spurious emissions channel low (1 Mbps)

Table 1: Final results of conducted spurious emissions channel low (1 Mbps)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
883.04	-69.49	-2.24	-67.25	PASS
2399.98	-34.15	-2.24	-31.91	PASS
2402.14	17.76	-	-	Carrier
2530.01	-51.80	-2.24	-49.56	PASS
4804.02	-34.20	-2.24	-31.96	PASS
7206.48	-53.31	-2.24	-51.07	PASS
12902.74	-58.95	-2.24	-56.71	PASS
15835.24	-55.62	-2.24	-53.38	PASS
16157.64	-55.04	-2.24	-52.80	PASS
19507.69	-57.06	-2.24	-54.82	PASS
24069.23	-55.72	-2.24	-53.48	PASS
26178.52	-55.37	-2.24	-53.13	PASS

Conducted spurious emissions channel mid (GFSK)

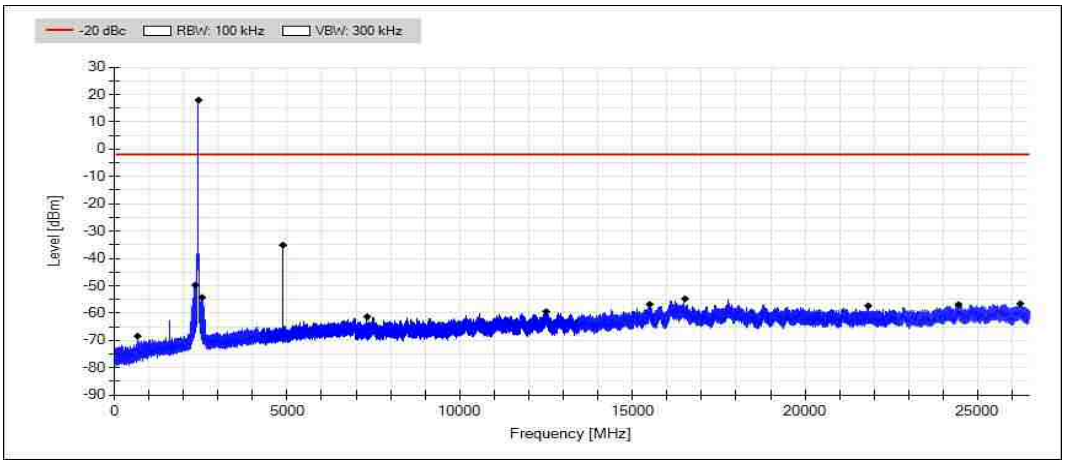


Figure 24: Plot of conducted spurious emissions channel mid (1 Mbps)

Table 2: Final results of conducted spurious emissions channel mid (1 Mbps)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
674.59	-68.40	-2.04	-66.37	PASS
2345.03	-49.73	-2.04	-47.69	PASS
2441.14	17.96	-	-	Carrier
2536.84	-54.24	-2.04	-52.21	PASS
4882.02	-35.11	-2.04	-33.07	PASS
7322.44	-61.29	-2.04	-59.26	PASS
12507.13	-59.42	-2.04	-57.38	PASS
15494.84	-56.78	-2.04	-54.74	PASS
16518.37	-54.75	-2.04	-52.71	PASS
21825.58	-57.32	-2.04	-55.28	PASS
24441.50	-56.86	-2.04	-54.82	PASS
26231.34	-56.52	-2.04	-54.48	PASS

Conducted spurious emissions channel high (GFSK)

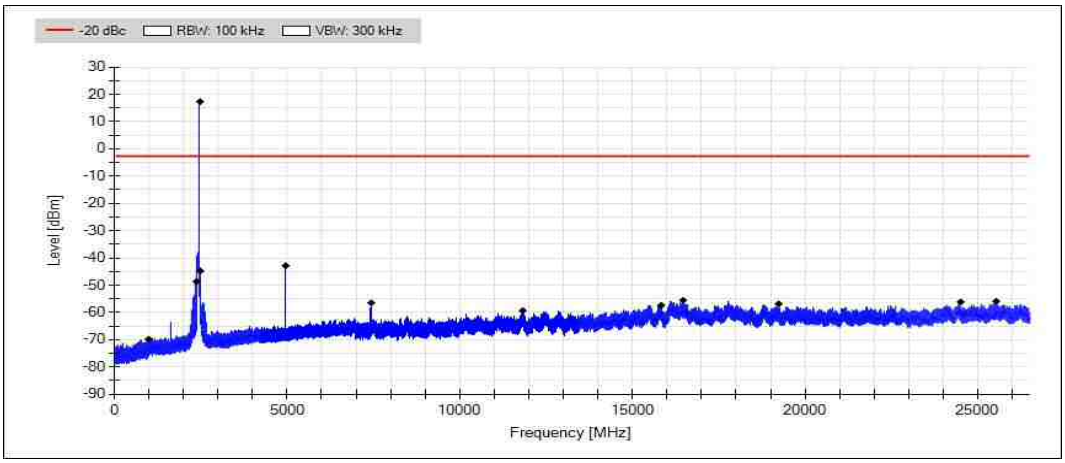


Figure 25: Plot of conducted spurious emissions channel high (1 Mbps)

Table 3: Final results of conducted spurious emissions channel high (1 Mbps)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
993.68	-69.84	-2.64	-67.20	PASS
2384.14	-48.61	-2.64	-45.97	PASS
2480.14	17.36	-	-	Carrier
2485.99	-44.76	-2.64	-42.11	PASS
4959.92	-42.86	-2.64	-40.21	PASS
7440.00	-56.48	-2.64	-53.84	PASS
11823.99	-59.36	-2.64	-56.72	PASS
15831.77	-57.40	-2.64	-54.76	PASS
16467.94	-55.55	-2.64	-52.90	PASS
19232.07	-56.86	-2.64	-54.22	PASS
24501.31	-56.14	-2.64	-53.50	PASS
25528.29	-55.89	-2.64	-53.24	PASS

Conducted spurious emissions channel low (8DPSK)

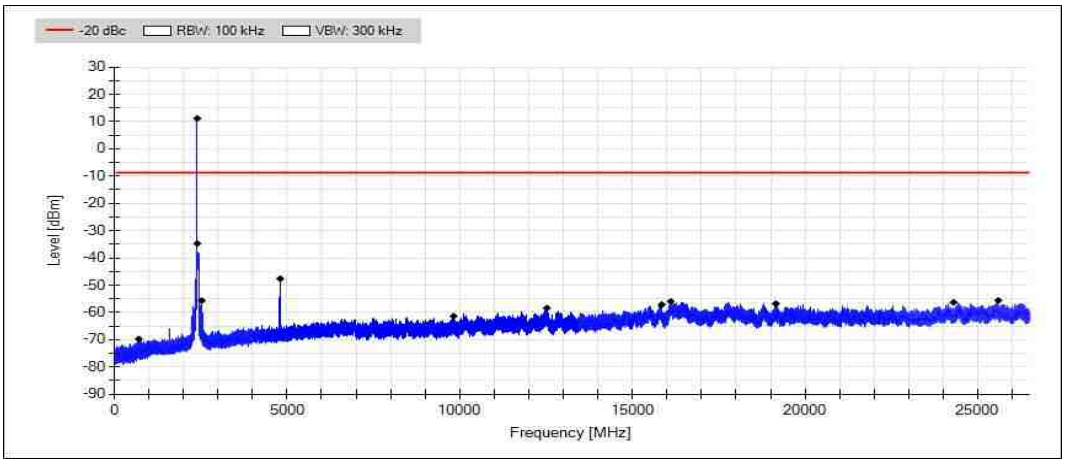


Figure 26: Plot of conducted spurious emissions channel low (3 Mbps)

Table 4: Final results of conducted spurious emissions channel low (3 Mbps)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
706.51	-69.70	-8.83	-60.87	PASS
2399.93	-34.73	-8.83	-25.90	PASS
2401.81	11.17	-	-	Carrier
2529.82	-55.68	-8.83	-46.85	PASS
4804.02	-47.64	-8.83	-38.81	PASS
9820.52	-61.38	-8.83	-52.55	PASS
12522.03	-58.41	-8.83	-49.58	PASS
15844.90	-57.15	-8.83	-48.32	PASS
16108.42	-55.94	-8.83	-47.11	PASS
19150.79	-56.79	-8.83	-47.96	PASS
24295.54	-56.31	-8.83	-47.48	PASS
25589.74	-55.60	-8.83	-46.77	PASS

Conducted spurious emissions channel mid (8DPSK)

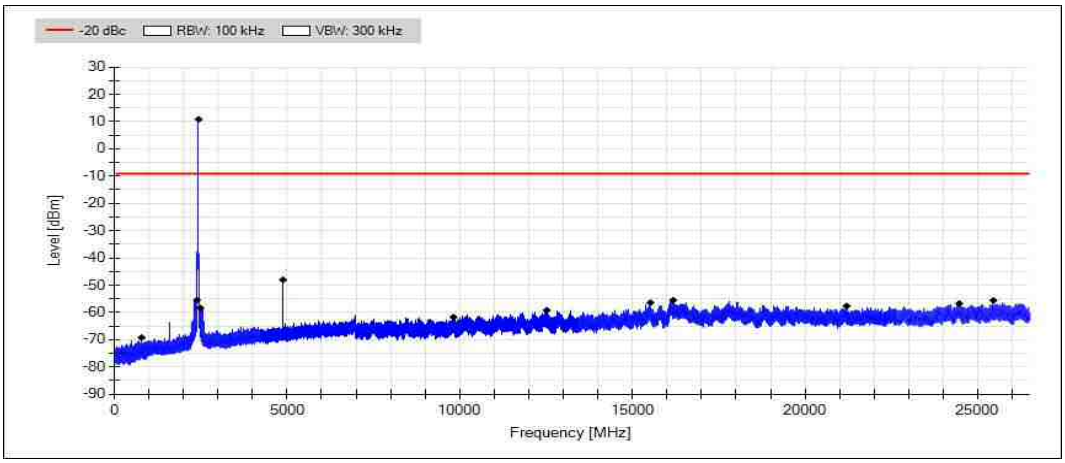


Figure 27: Plot of conducted spurious emissions channel mid (3 Mbps)

Table 5: Final results of conducted spurious emissions channel mid (3 Mbps)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
788.62	-69.22	-9.14	-60.08	PASS
2392.98	-55.48	-9.14	-46.33	PASS
2440.81	10.86	-	-	Carrier
2489.02	-58.36	-9.14	-49.22	PASS
4882.02	-48.06	-9.14	-38.91	PASS
9819.58	-61.72	-9.14	-52.58	PASS
12517.06	-59.20	-9.14	-50.05	PASS
15521.19	-56.41	-9.14	-47.26	PASS
16177.32	-55.51	-9.14	-46.37	PASS
21199.07	-57.63	-9.14	-48.48	PASS
24460.25	-56.72	-9.14	-47.57	PASS
25449.40	-55.60	-9.14	-46.46	PASS

Conducted spurious emissions channel high (8DPSK)

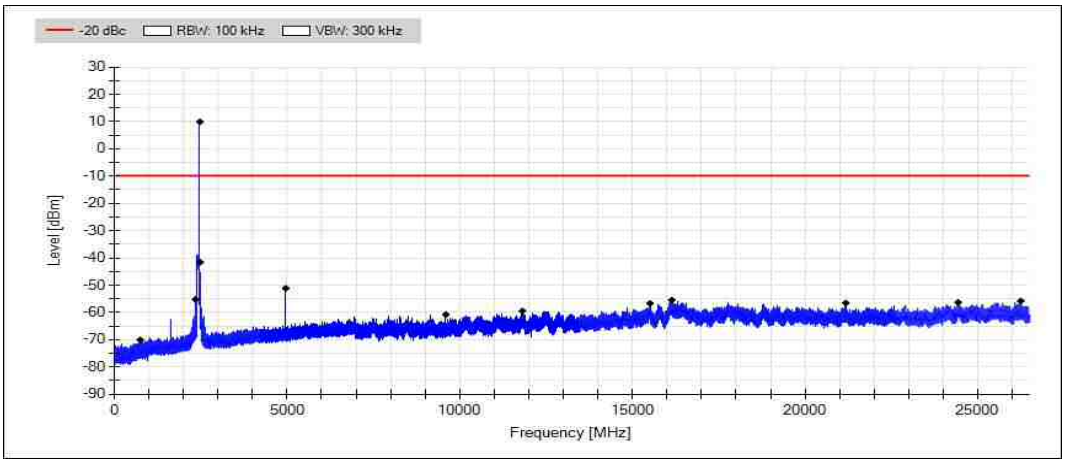


Figure 28: Plot of conducted spurious emissions channel high (3 Mbps)

Table 6: Final results of conducted spurious emissions channel high (3 Mbps)

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
751.34	-70.09	-10.07	-60.02	PASS
2352.03	-55.21	-10.07	-45.13	PASS
2479.81	9.93	-	-	Carrier
2483.52	-41.58	-10.07	-31.51	PASS
4960.30	-51.16	-10.07	-41.08	PASS
9595.15	-60.78	-10.07	-50.71	PASS
11815.18	-59.46	-10.07	-49.39	PASS
15507.31	-56.66	-10.07	-46.58	PASS
16144.42	-55.47	-10.07	-45.39	PASS
21173.20	-56.53	-10.07	-46.45	PASS
24427.53	-56.29	-10.07	-46.21	PASS
26242.55	-55.78	-10.07	-45.71	PASS

Conducted band edge measurements (GFSK)

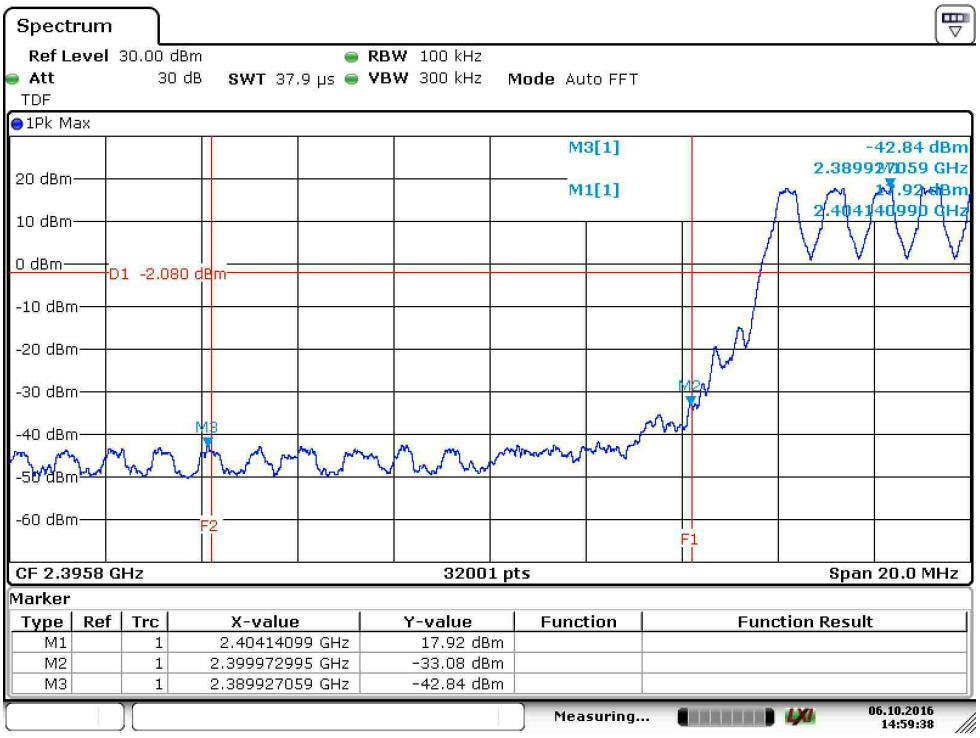


Figure 29: Low channel conducted emission at band edge, hopping (1 Mbps)

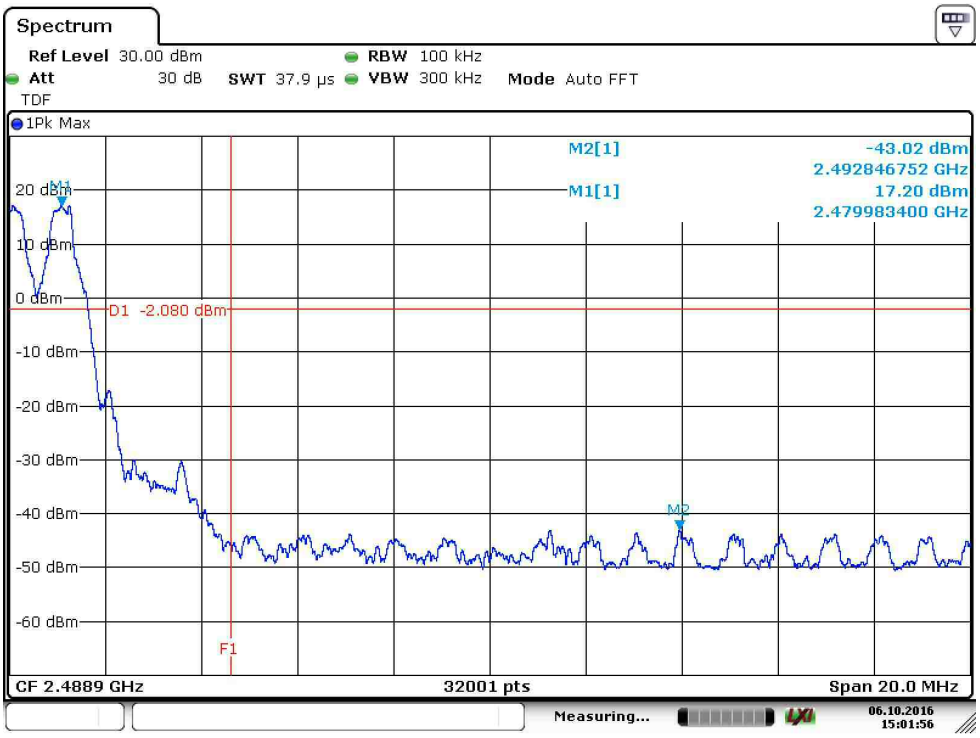


Figure 30: High channel conducted emission at band edge, hopping (1 Mbps)

Conducted band edge measurements (8DPSK)

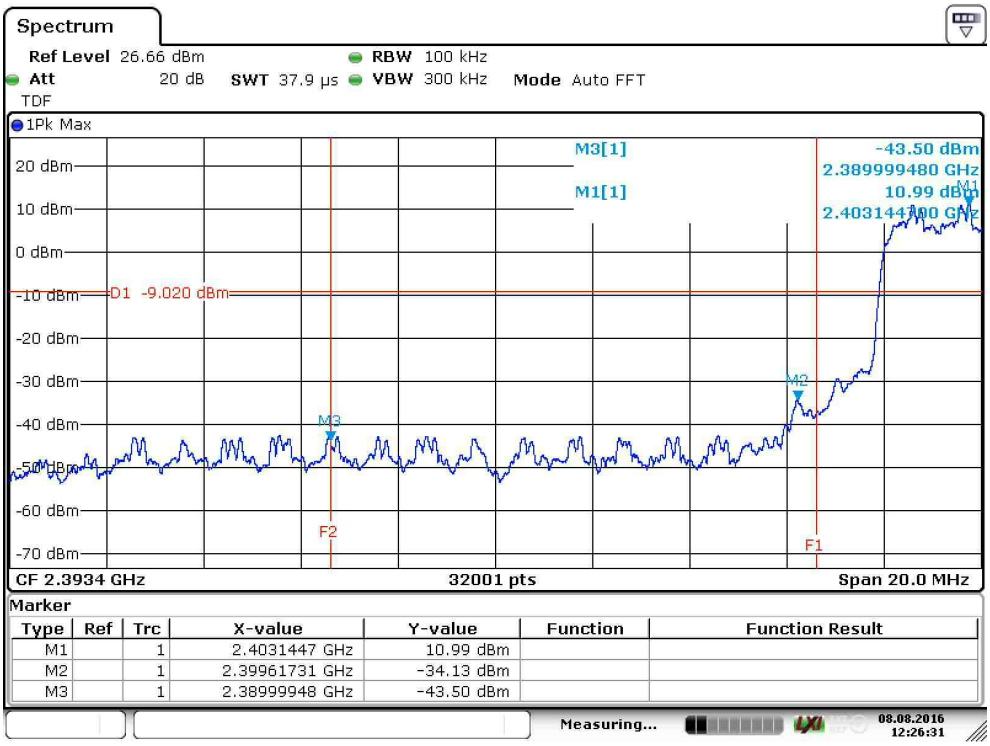


Figure 31: Low channel conducted emission at band edge, hopping (3 Mbps)

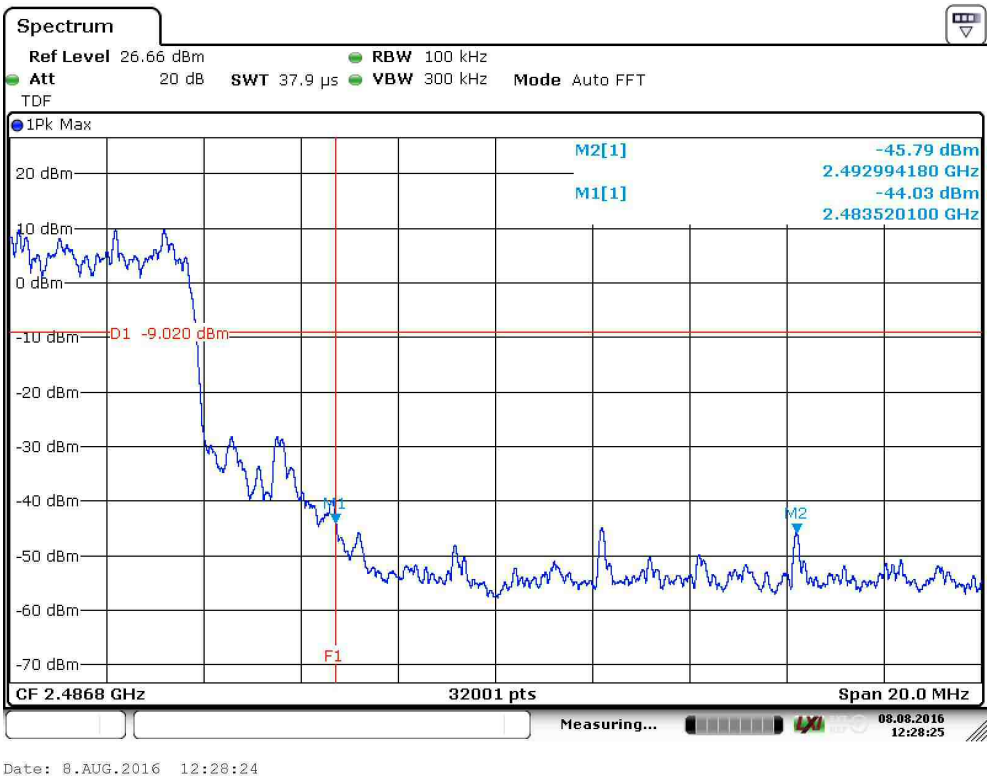


Figure 32: High channel conducted emission at band edge, hopping (3 Mbps)

Transmitter Radiated Emissions 30 MHz - 26500 MHz and Band Edge

Standard:	ANSI C63.10	(2013)
Tested by:	RRE / EHA	
Date:	2 August 2016 - 12 October 2016	
Temperature:	20 - 22 °C	
Humidity:	38 - 54 % RH	
Measurement uncertainty:	± 4.51 dB	Level of confidence 95 % (k = 2)

FCC Rule: §15.247(d), 15.209(a)
RSS-247: 5.5

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).
Duty cycle correction factor (30.7 dB) is embedded to the calculated average result.

Results:

Low channel, WT11u-A

Table 7: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
-	-	-	-	-	-	-	-

Table 8: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1601.675000	44.9	283.0	H	38.0	-3.3	29.0	73.9
2310.075000	48.3	279.0	H	147.0	2.3	25.6	73.9
2338.325000	49.4	379.0	H	37.0	2.5	24.5	73.9
2357.175000	49.1	266.0	H	102.0	2.6	24.8	73.9
2375.625000	53.9	330.0	H	142.0	2.8	20.0	73.9
2375.825000	54.9	242.0	H	102.0	2.8	19.0	73.9
2386.025000	54.3	218.0	H	252.0	4.0	19.6	73.9
2400.000000	72.4	171.0	H	255.0	4.1	1.5	73.9
2401.800000	107.0	242.0	H	114.0	3.0	-	-
4804.200000	58.3	202.0	V	192.0	10.4	15.6	73.9
7205.500000	48.6	150.0	H	124.0	12.6	25.3	73.9
9607.200000	49.1	230.0	H	282.0	15.2	24.8	73.9

Table 9: Average results (ch low)

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2375.825000	24.2	242.0	H	102.0	2.8	29.7	53.9
4804.200000	27.6	202.0	V	192.0	10.4	26.3	53.9

Middle channel, WT11u-A

Table 10: Quasi-peak results (ch mid)

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
-	-	-	-	-	-	-	-

Table 11: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2348.625000	48.9	268.0	H	103.0	2.5	25.0	73.9
2441.150000	109.2	229.0	H	242.0	2.9	-	-
4882.000000	63.0	176.0	V	170.0	10.4	10.9	73.9
9763.100000	48.4	305.0	V	268.0	15.3	25.5	73.9

Table 12: Average results (ch mid)

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2348.625000	18.2	268.0	H	103.0	2.5	35.7	53.9
4882.000000	32.3	176.0	V	170.0	10.4	21.6	53.9
9763.100000	17.7	305.0	V	268.0	15.3	36.2	53.9

High channel, WT11u-A

Table 13: Quasi-peak results (ch high)

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
-	-	-	-	-	-	-	-

Table 14: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2352.075000	50.0	224.0	H	41.0	8.6	23.9	73.9
2480.150000	110.8	229.0	H	240.0	9.2	-	-
2485.775000	57.5	150.0	H	330.0	4.4	16.4	73.9
2505.825000	51.9	207.0	H	143.0	9.3	22.0	73.9
4960.000000	68.2	160.0	V	160.0	10.4	5.7	73.9

Table 15: Average results (ch high)

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2352.075000	19.3	224.0	H	41.0	8.6	34.6	53.9
2485.775000	26.8	150.0	H	330.0	4.4	27.1	53.9
2505.825000	21.2	207.0	H	143.0	9.3	32.7	53.9
4960.000000	37.5	160.0	V	160.0	10.4	16.4	53.9

Radiated band edge measurement results, WT11u-A

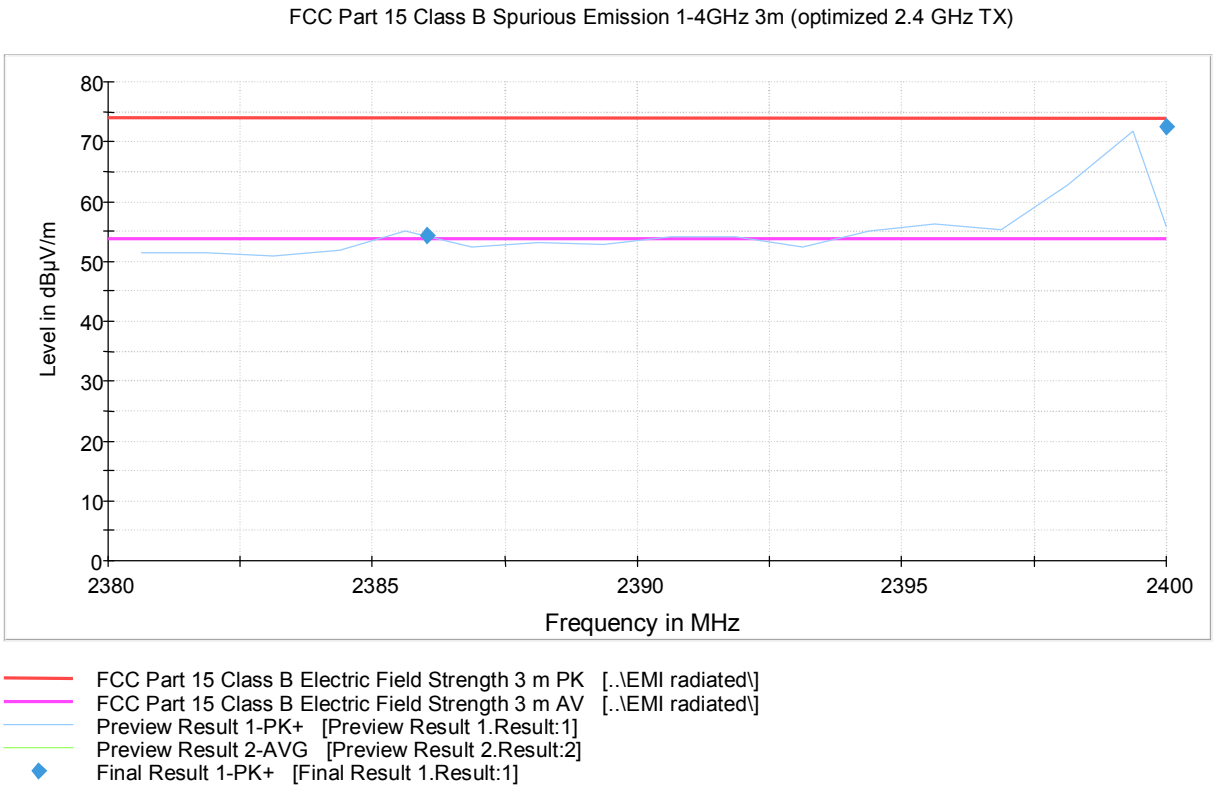


Figure 33. Radiated channel low band edge measured with peak detector (WT11u-A)

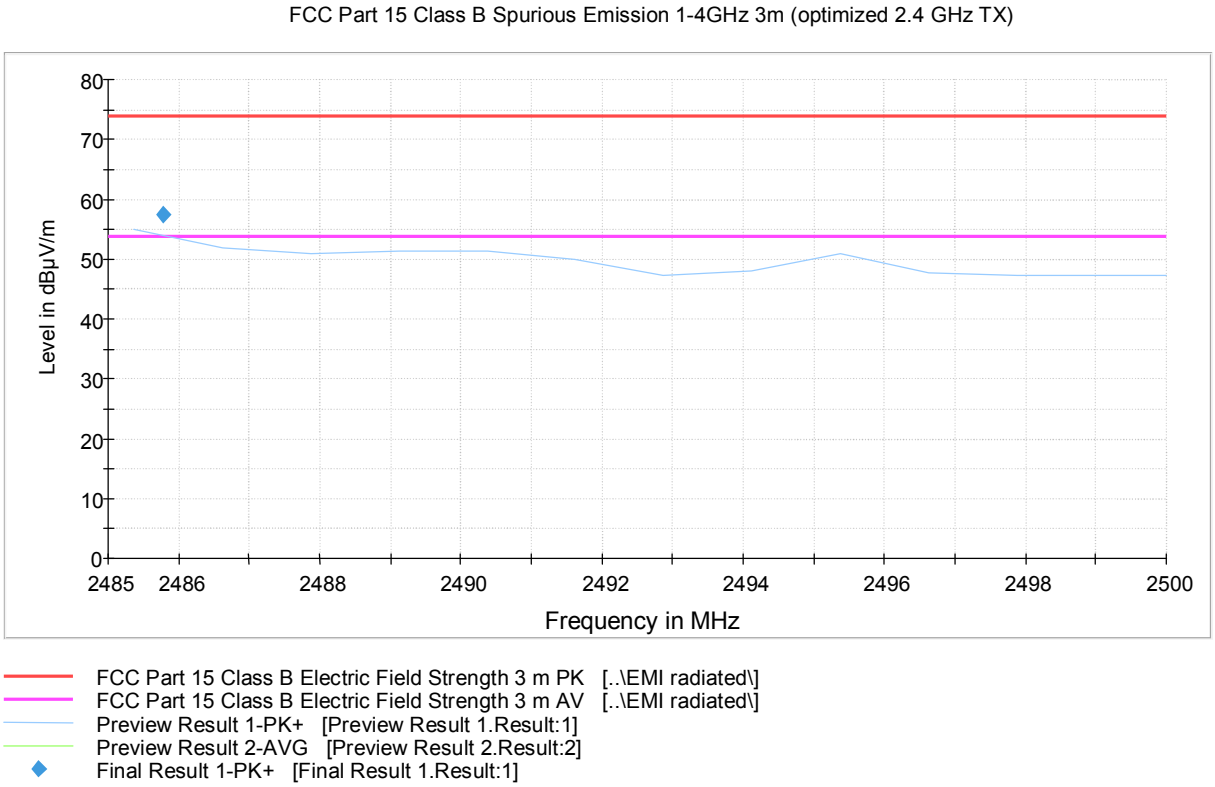


Figure 34. Radiated higher band edge measured with peak detector (WT11u-A)

Low channel, WT11u-E

Table 16: Quasi-peak results (ch low)

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
352.020000	27.7	100.0	H	6.0	16.5	18.3	46.0

Table 17: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1601.675000	46.6	292.0	H	18.0	-3.3	27.3	73.9
2273.975000	50.9	229.0	V	118.0	2.3	23.0	73.9
2306.025000	51.3	203.0	V	135.0	2.3	22.6	73.9
2376.025000	54.8	245.0	V	95.0	2.8	19.1	73.9
2386.025000	54.3	218.0	V	252.0	4.0	19.6	73.9
2400.000000	72.4	171.0	V	255.0	4.1	1.5	73.9
2401.800000	109.9	191.0	V	240.0	3.0	-	-
4803.700000	56.5	305.0	V	354.0	10.4	17.4	73.9
10560.10000	47.3	356.0	V	177.0	16.9	26.6	73.9

Table 18: Average results (ch low)

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2376.025000	24.1	245.0	V	95.0	2.8	29.8	53.9
2386.025000	23.6	218.0	V	252.0	4.0	30.3	53.9
2400.000000	41.7	171.0	V	255.0	4.1	12.2	53.9
4803.700000	25.8	305.0	V	354.0	10.4	28.1	53.9

Middle channel, WT11u-E

Table 19: Quasi-peak results (ch mid)

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
360.093000	26.0	100.0	H	6.0	16.7	20.0	46.0

Table 20: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1627.525000	49.1	337.0	H	142.0	-2.4	24.8	73.9
2312.725000	51.9	252.0	V	97.0	2.4	22.0	73.9
2344.975000	51.4	241.0	V	144.0	2.5	22.5	73.9
2372.875000	48.7	150.0	V	52.0	2.8	25.2	73.9
2440.800000	111.9	215.0	V	223.0	2.9	-	-
2946.725000	70.8	190.0	V	217.0	3.2	3.1	73.9
4881.300000	58.3	150.0	V	18.0	10.4	15.6	73.9

Table 21: Average results (ch mid)

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2946.725000	40.1	190.0	V	217.0	3.2	13.8	53.9
4881.300000	27.6	150.0	V	18.0	10.4	26.3	53.9

High channel, WT11u-E

Table 22: Quasi-peak results (ch high)

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
360.211000	25.3	100.0	H	0.0	16.7	20.7	46.0

Table 23: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1410.875000	48.8	191.0	V	234.0	-4.1	25.1	73.9
1653.575000	47.1	333.0	H	47.0	-1.7	26.8	73.9
2287.925000	48.5	345.0	V	30.0	2.3	25.4	73.9
2320.025000	50.5	283.0	V	234.0	2.4	23.4	73.9
2352.075000	49.3	292.0	V	95.0	2.6	24.6	73.9
2386.775000	49.3	281.0	V	116.0	2.9	24.6	73.9
2480.150000	110.7	150.0	V	292.0	3.1	-	-
2483.500000	60.3	150.0	V	275.0	4.4	13.6	73.9
2506.225000	53.3	256.0	V	346.0	3.3	20.6	73.9
4959.600000	60.1	165.0	V	330.0	10.4	13.8	73.9

Table 24: Average results (ch high)

Frequency (MHz)	Average (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.500000	29.6	150.0	V	275.0	4.4	24.3	53.9
2506.225000	22.6	256.0	V	346.0	3.3	31.3	53.9
4959.600000	29.4	165.0	V	330.0	10.4	24.5	53.9

Radiated band edge measurement results, WT11u-E

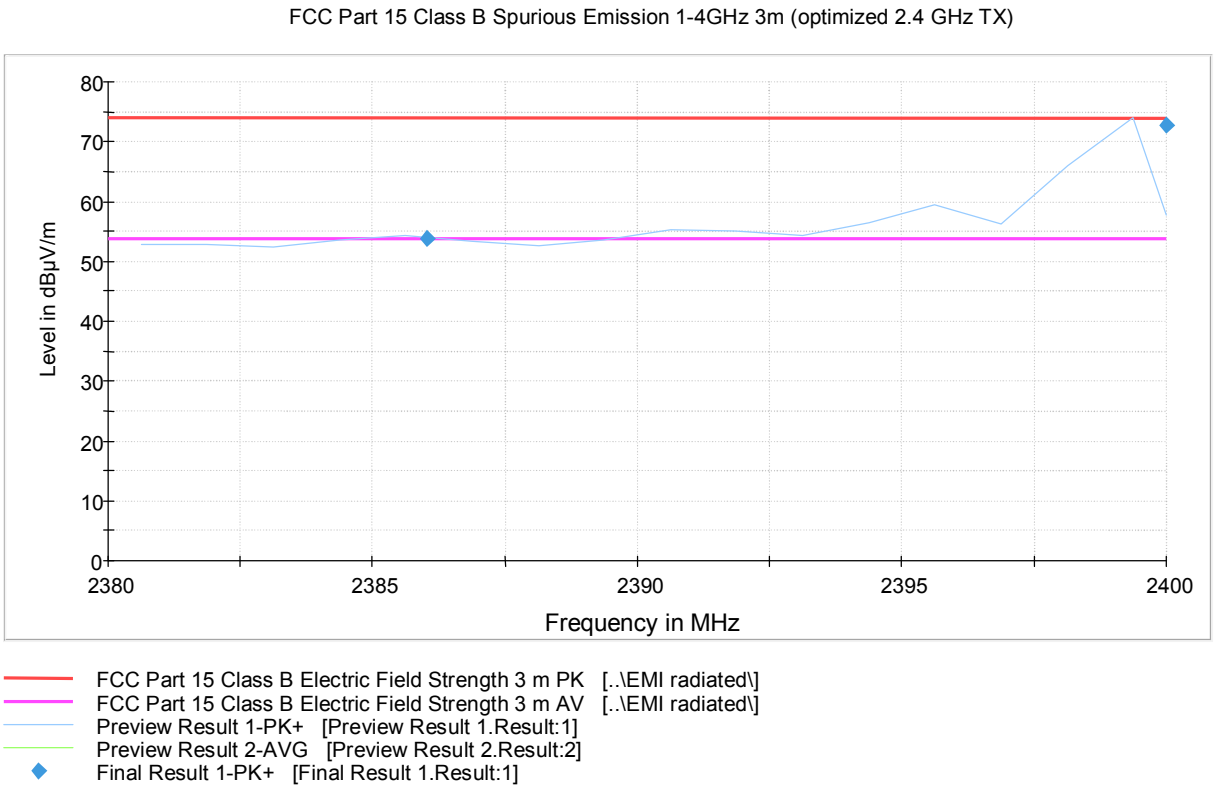


Figure 35. Radiated channel low band edge measured with peak detector (WT11u-E)

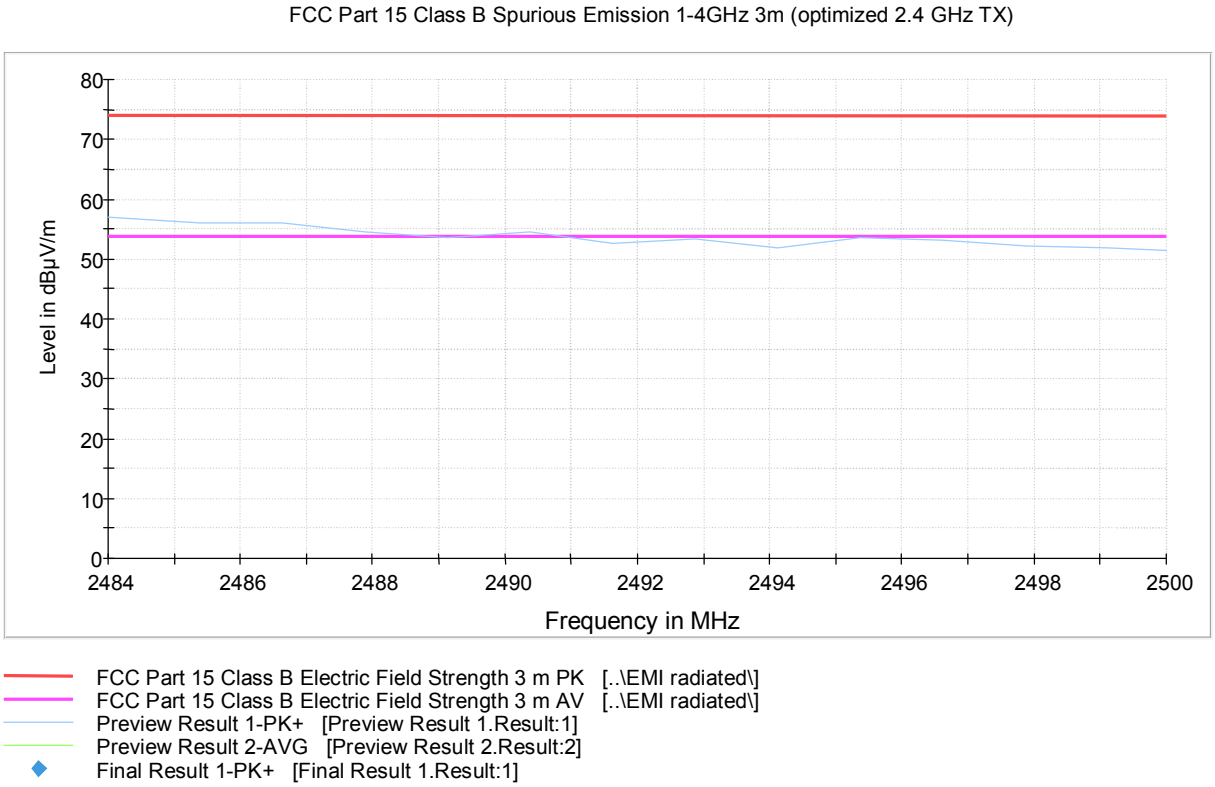


Figure 36. Radiated channel higher band edge measured with peak detector (WT11u-E)

99% Occupied Bandwidth

Standard:	RSS-GEN	(2014)
Tested by:	RRE	
Date:	8 August 2016	
Temperature:	22 °C	
Humidity:	52 % RH	

RSS-GEN 6.6

Table 9. 99% bandwidth test results 1 Mbps

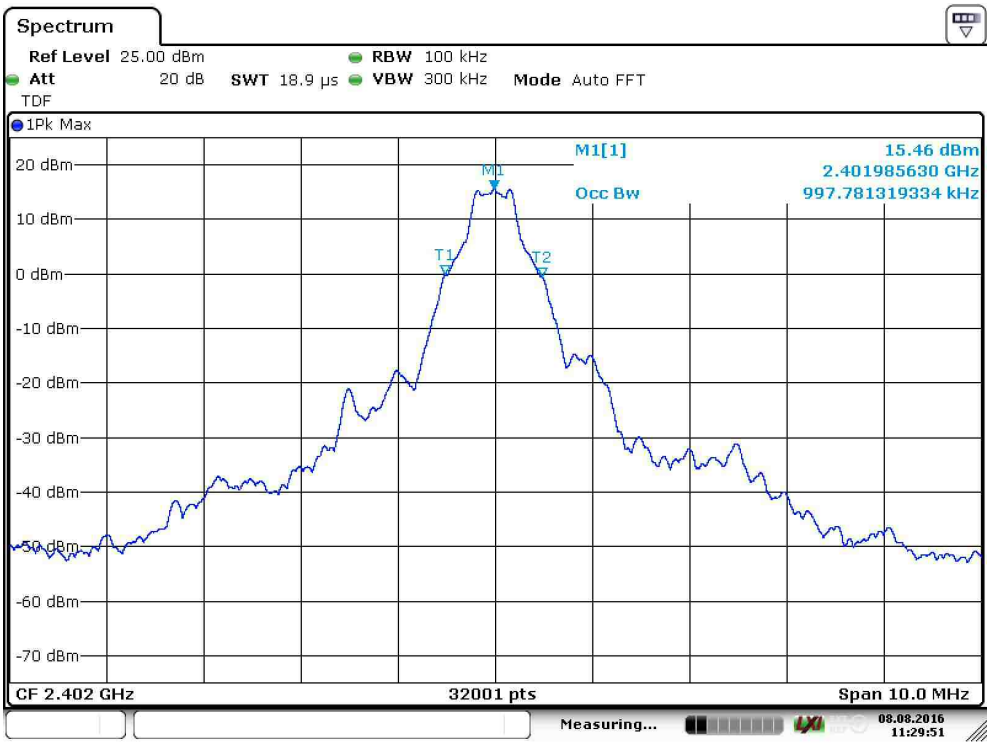
Channel	99% BW [MHz]	Limit	Result
Low	0.997781319334	-	**PASS**
Mid	0.997468829099	-	**PASS**
High	0.974032061498	-	**PASS**

Table 10. 99% bandwidth test results 2 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	1.207462267	-	**PASS**
Mid	1.204962345	-	**PASS**
High	1.209962189	-	**PASS**

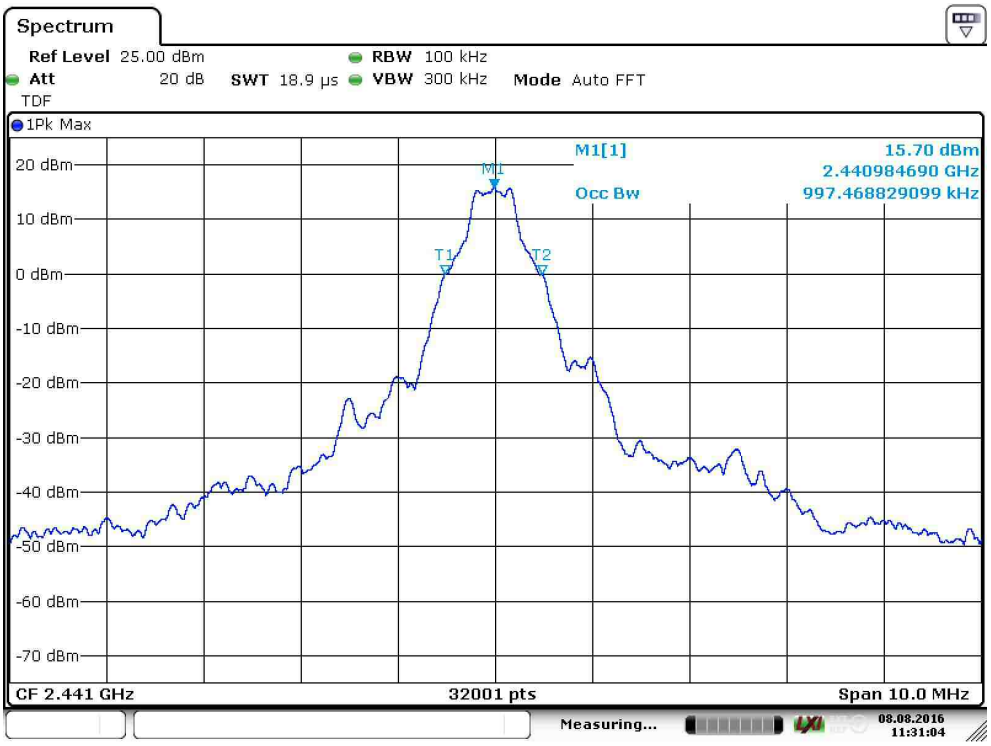
Table 11. 99% bandwidth test results 3 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	1.210587169	-	**PASS**
Mid	1.214649542	-	**PASS**
High	1.221211837	-	**PASS**



Date: 8.AUG.2016 11:29:51

Figure 37. 99 % OBW channel low (1 Mbps).



Date: 8.AUG.2016 11:31:04

Figure 38. 99 % OBW channel mid (1 Mbps).

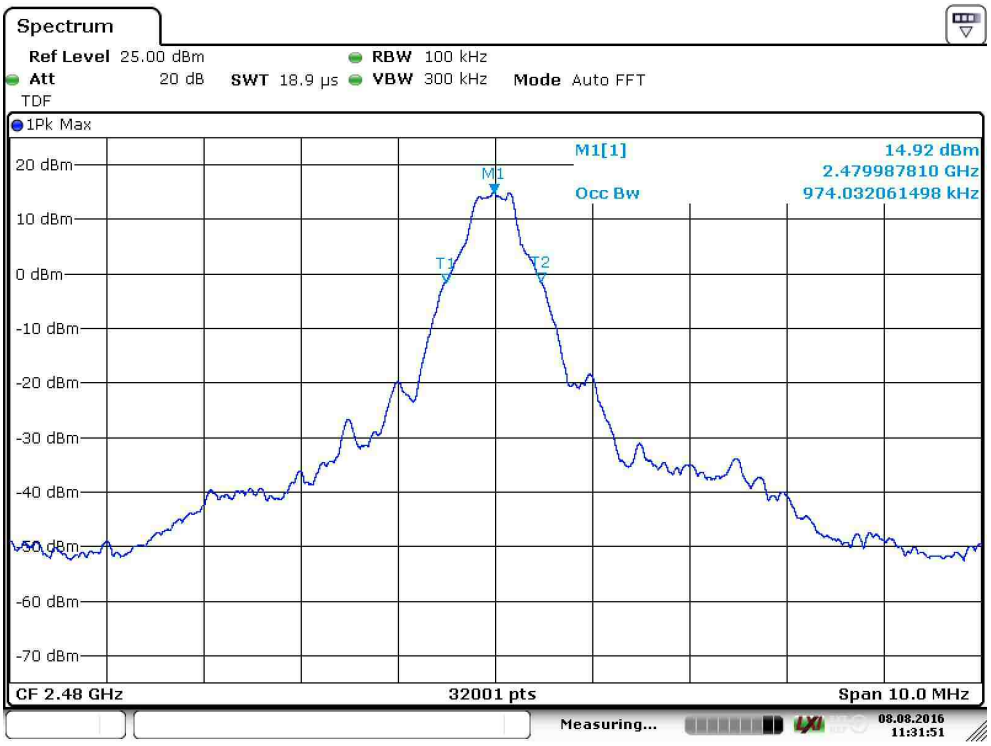


Figure 39. 99 % OBW channel high (1 Mbps).

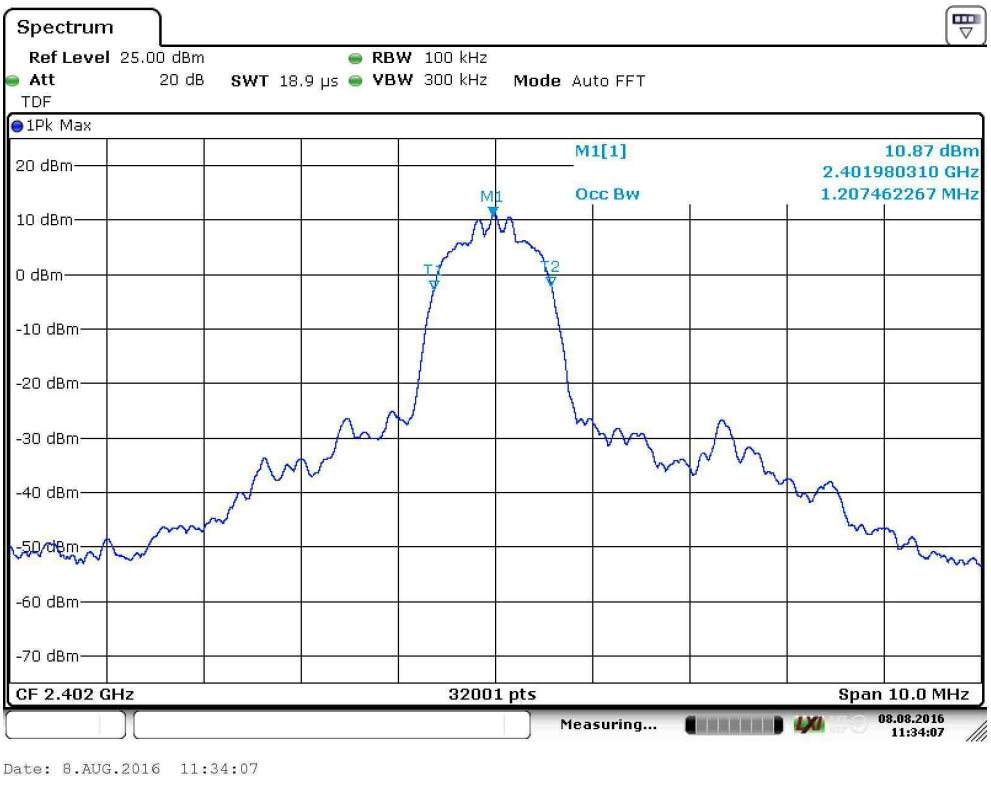


Figure 40. 99 % OBW channel low (2 Mbps).

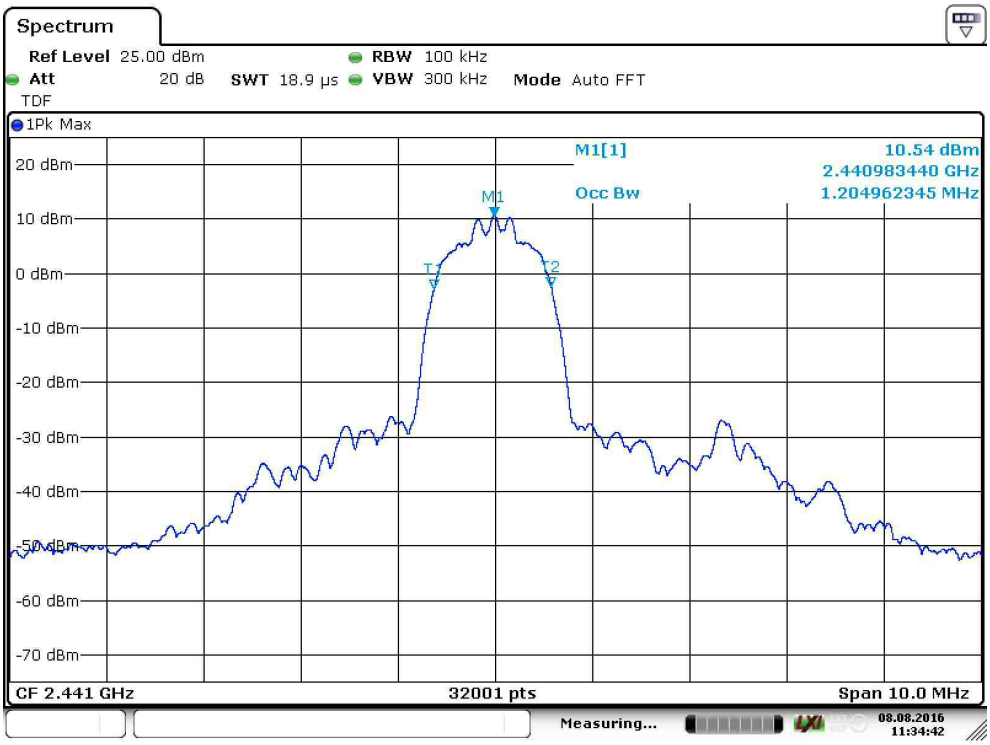


Figure 41. 99 % OBW channel mid (2 Mbps).

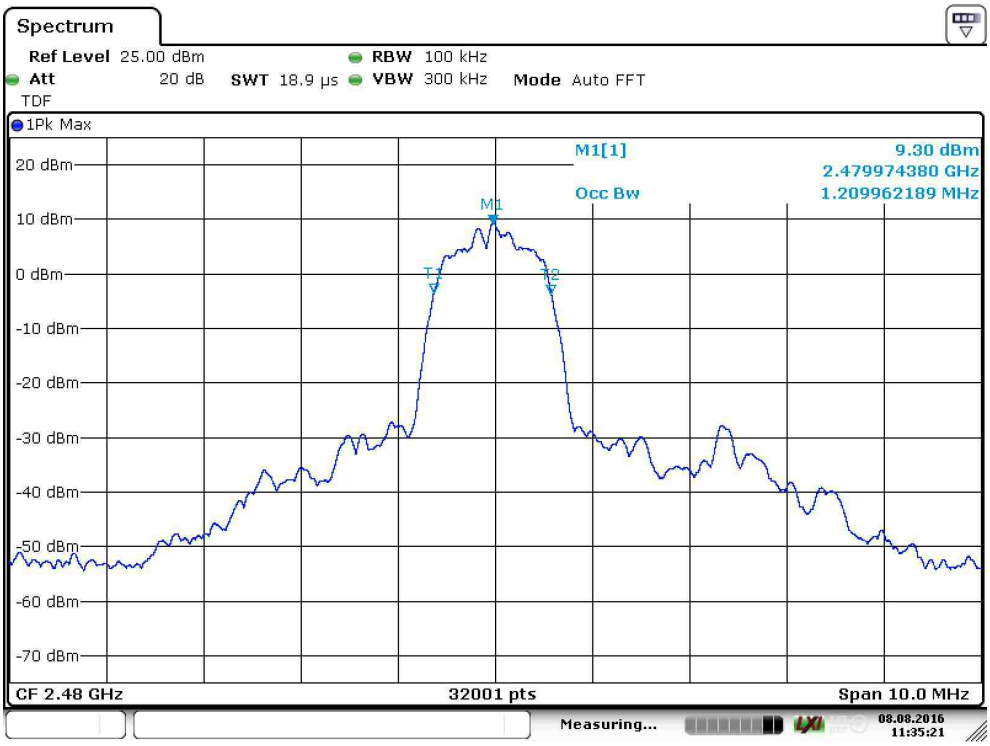


Figure 42. 99 % OBW channel high (2 Mbps).

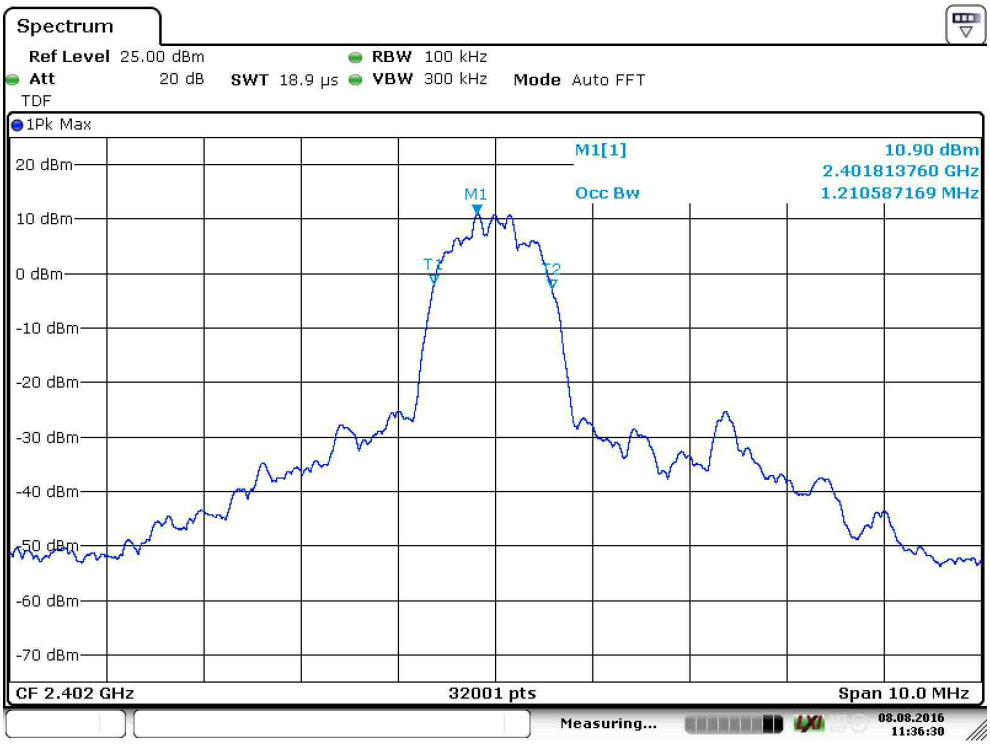


Figure 43. 99 % OBW channel low (3 Mbps).

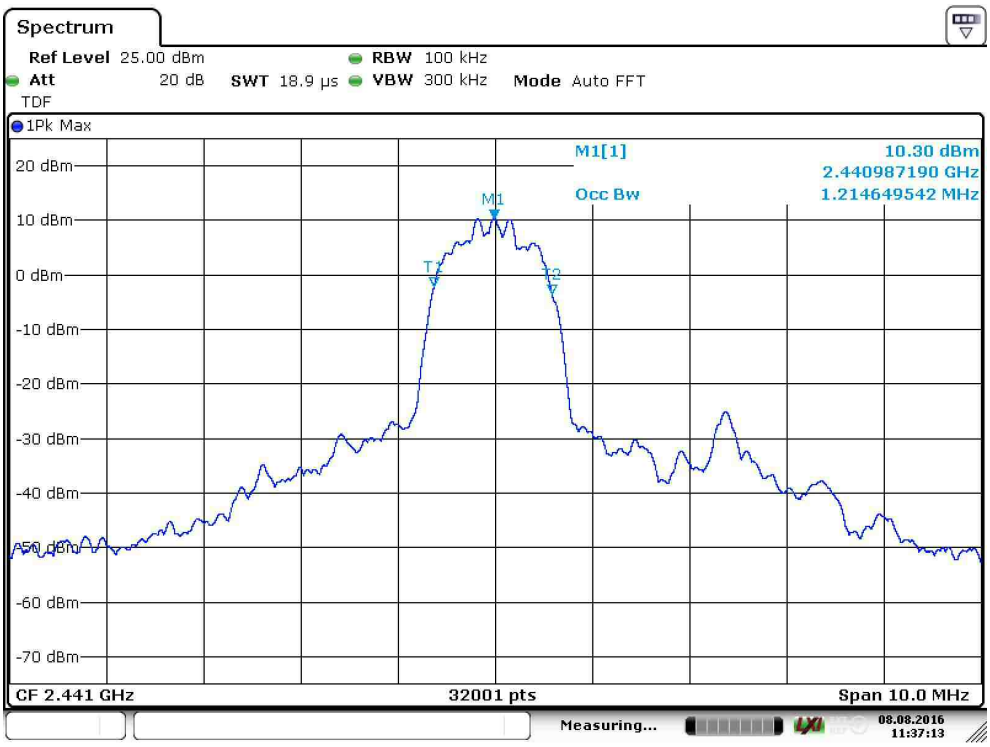


Figure 44. 99 % OBW channel mid (3 Mbps).

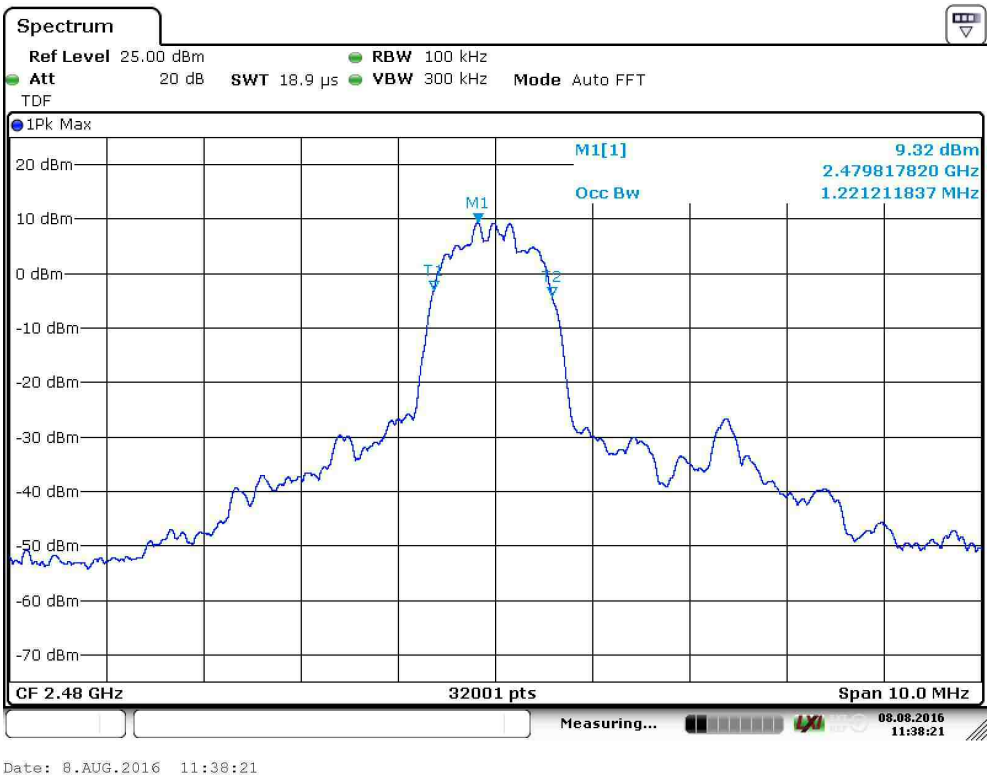


Figure 45. 99 % OBW channel high (3 Mbps).

TEST EQUIPMENT

RF Test Equipment

Equipment	Manufacturer	Type	Inv number	Prev Calib	Next Calib
ATTENUATOR 10 dB	PASTERNACK	PE7090-10	-	2016-04-01	2017-04-01
RF SIGNAL GENERATOR	ANRITSU	MG3694B	9753	2015-10-13	2017-10-13
TURNTABLE	DEISEL	DS 430+upgrade	-	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	10183	-	-
ANTENNA MAST	MATURO	TAM 4.0E	10181	-	-
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2014-11-04	2016-11-04
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-06
ANTENNA	EMCO	3160-09	inv:7294	2016-03-16	2017-03-16
PREAMPLIFIER	ALC MICROWAWE	AWB-2018-40-08	sn:14	2016-08-30	2017-08-30
PREAMPLIFIER	MERCURY SYSTEMS	ALS1826-41-12	-	2016-09-02	2017-09-02
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	8453	2016-06-10	2017-06-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	9093	2016-06-10	2017-06-10
SWITCH UNIT	ROHDE & SCHWARZ	OSP 120	9289	2016-03-14	2019-03-14
RF SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	9288	2014-03-18	2017-03-18
VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	9290	2014-03-13	2017-03-17
ANTENNA	SCHWARZBECK	VULB 9168	8911	2014-11-04	2016-11-04
TEMPERATURE/ HUMIDITY METER	VAISALA	HMT 333	8638	2016-03-01	2017-03-01
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	-	2016-01-22	2017-01-22
MULTIMETER	FLUKE	23	8252	2015-10-20	2016-10-20
PRECISION DC POWER SUPPLY	THANDAR	TS3021S	099609	-	-
AC POWER SOURCE	CALIFORNIA INSTRUMENTS	5001 iX Series II	7826	-	-