

Test Report



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

Equipment Under Test: Bluetooth v.2.1 + EDR module

Model: WT41u-A
WT41u-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

Issued by:

A blue ink signature of Emil Haverinen.

Emil Haverinen
Testing Engineer

Date: 20 October 2016

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Rauno Repo
Testing Engineer

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Equipment Under Test (EUT)

Trade mark:	Silicon Labs
Model:	WT41u-A, WT41u-E
Type:	Bluetooth v.2.1 + EDR module
Serial no:	-
FCC ID:	QOQWT41U
IC:	5123A-WT41U

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:	1.217149464 MHz (3 Mbps / ch low)
Maximum peak conducted output power:	18.04 dBm (normal conditions)
Transmission technique:	FHSS
Modulation:	GFSK, $\pi/4$ DQPSK, 8DPSK
Integral antenna gain (WT41u-A):	0 dBi
External antenna gain (WT41u-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
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Samples

One sample from both models was used in tests.

Disclaimer

This document is issued by the Company under its General Conditions of service accessible at [http://www.sgs.com/terms and conditions.htm](http://www.sgs.com/terms_and_conditions.htm). attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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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 an RF connector instead of the chip antenna used by the A -variant. Conducted measurements were performed with 1 (power setting 46) 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 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 = $20\log(\Delta)$, $\Delta(\text{duty cycle}) = 2.915 \text{ ms} / 100 \text{ ms} = 0.02915$

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:

WT41u-A: 255, 46 / 255, 82 (Basic data rate / Enhanced data rate)

WT41u-E: 255, 44 / 255, 82 (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.

Conducted Emission Mains FCC Part 15 Class B with ENV216

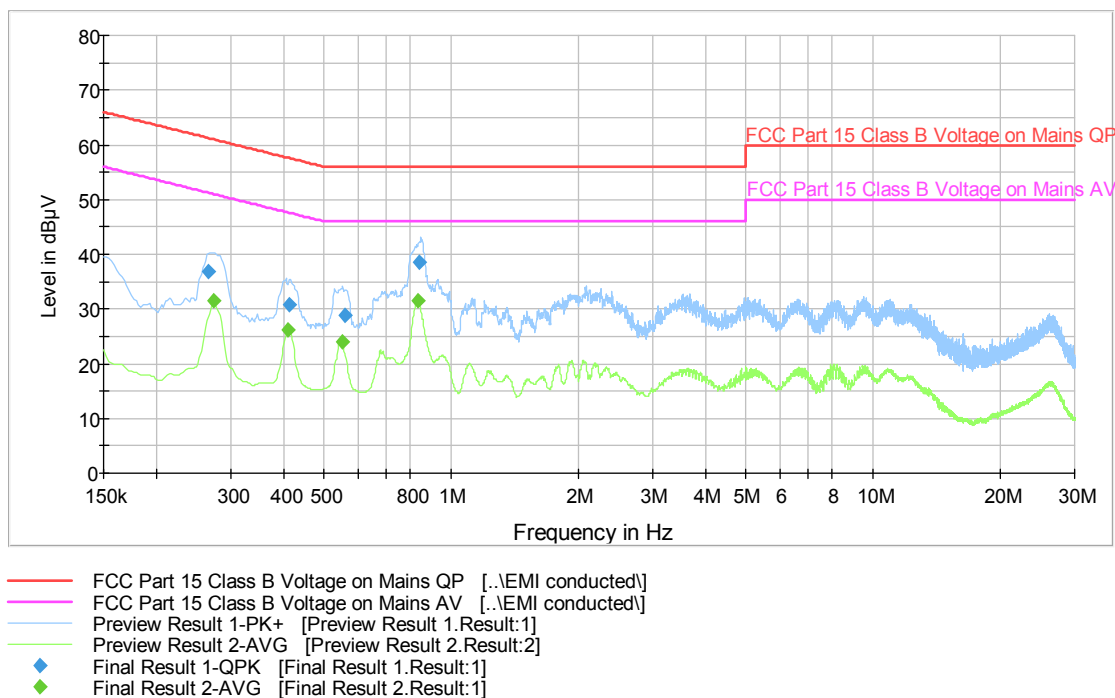


Figure 1: Measurement results from AC-mains with peak and average detectors

Conducted Emissions on Power Supply Lines

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	36.9	1000.0	9.000	On	L1	9.8	24.4	61.2
0.412250	30.8	1000.0	9.000	On	N	10.2	26.8	57.6
0.562000	28.8	1000.0	9.000	On	N	10.2	27.2	56.0
0.840000	38.5	1000.0	9.000	On	N	10.3	17.5	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)
0.273250	31.4	1000.0	9.000	On	L1	9.8	19.6	51.0
0.411500	26.2	1000.0	9.000	On	N	10.2	21.4	47.6
0.552500	24.0	1000.0	9.000	On	N	10.3	22.0	46.0
0.835750	31.5	1000.0	9.000	On	N	10.3	14.5	46.0

Maximum Peak Conducted Output Power**Maximum Peak Conducted Output Power**

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 13 October 2016
Temperature: 21 °C
Humidity: 33 % RH
Measurement uncertainty: $\pm 2.87\text{dB}$ 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	17.74	30	12.26	PASS
Mid	17.25	30	12.75	PASS
High	16.31	30	13.69	PASS

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

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	11.16	30	18.84	PASS
Mid	10.19	30	19.81	PASS
High	8.21	30	21.79	PASS

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

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	11.43	30	18.57	PASS
Mid	10.24	30	19.76	PASS
High	8.60	30	21.40	PASS

Maximum Peak Conducted Output Power

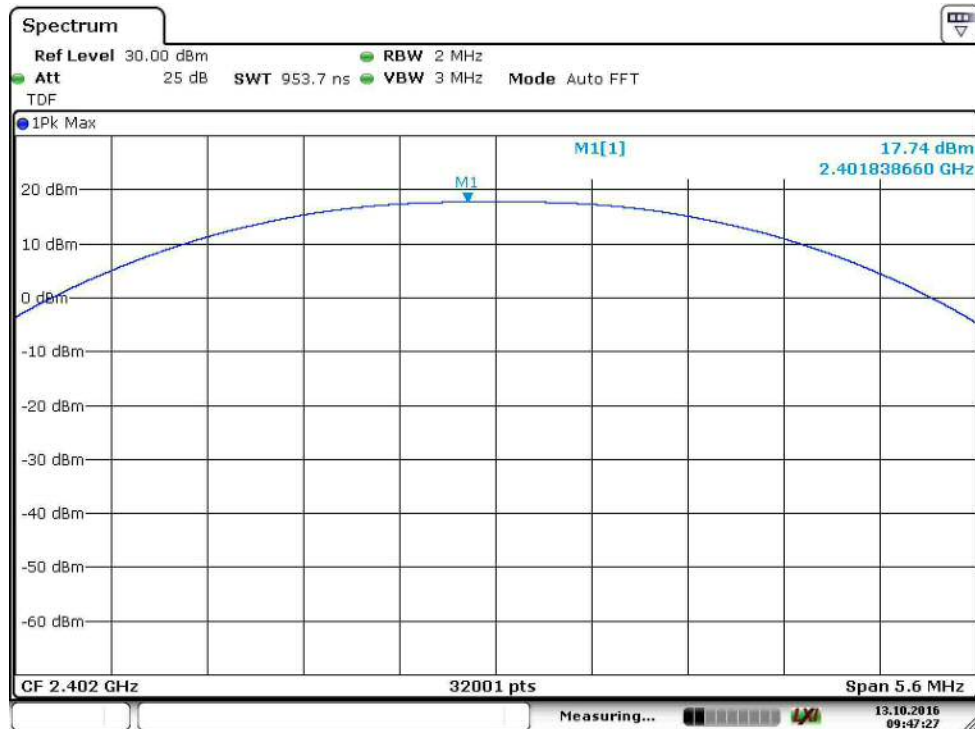


Figure 2. Maximum peak output power channel low (1 Mbps)

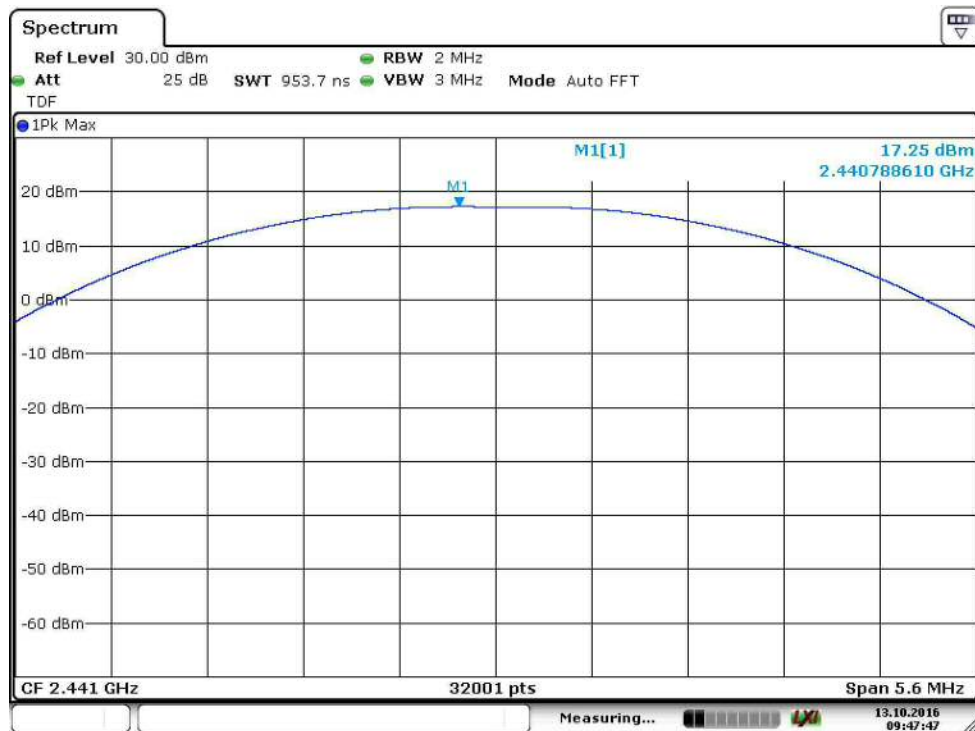


Figure 3. Maximum peak output power channel mid (1 Mbps)

Maximum Peak Conducted Output Power

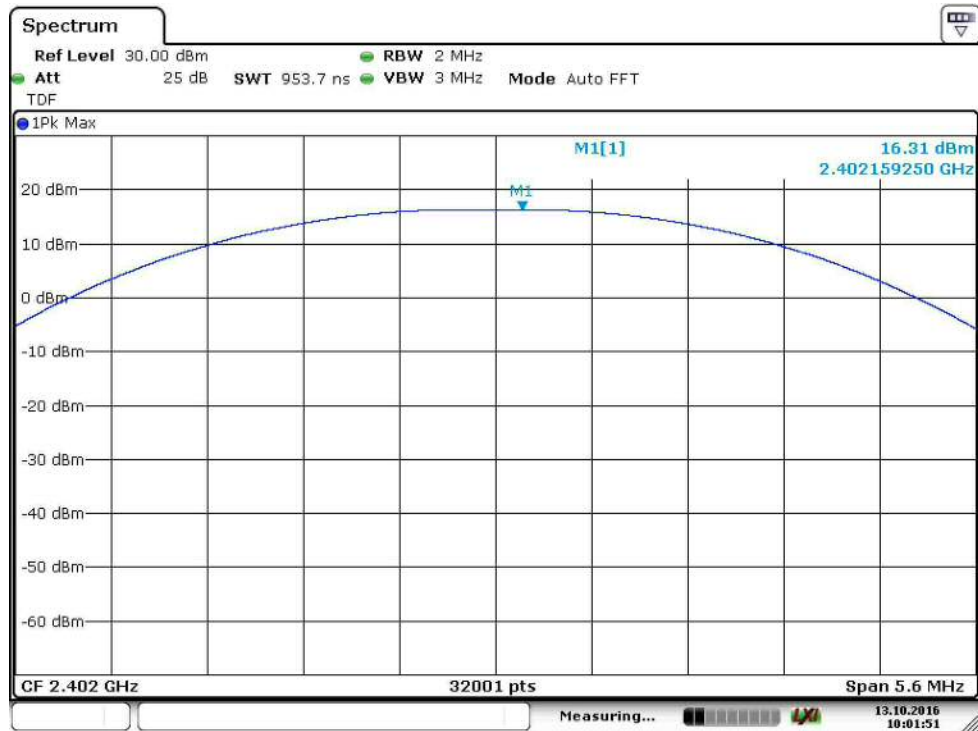


Figure 4. Maximum peak output power channel high (1 Mbps)

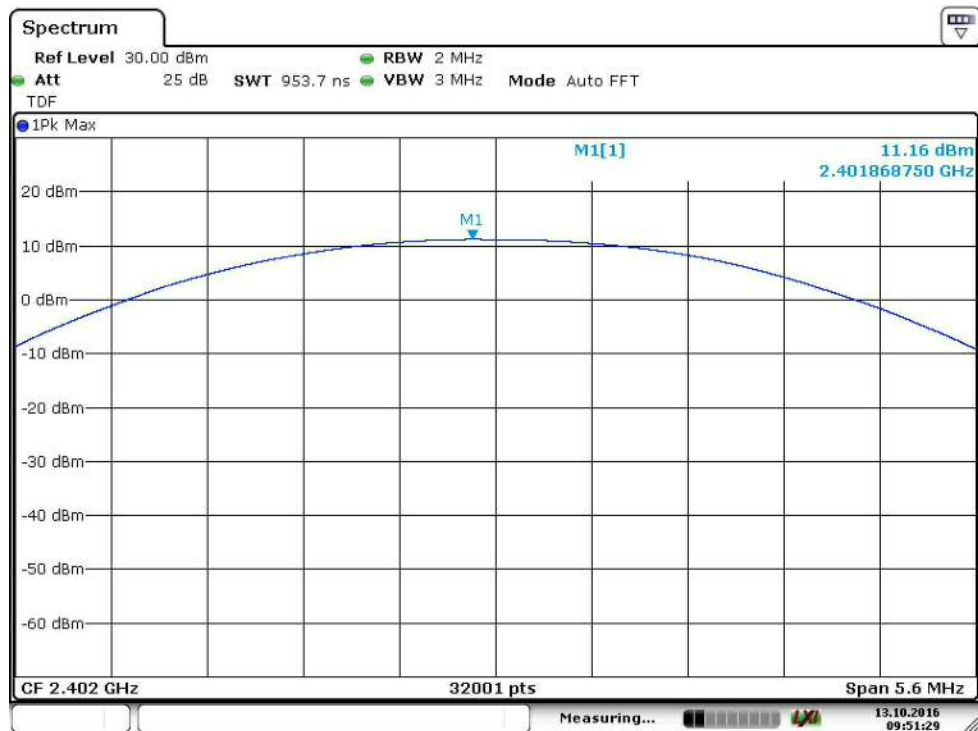


Figure 5. Maximum peak output power channel low (2 Mbps)

Maximum Peak Conducted Output Power

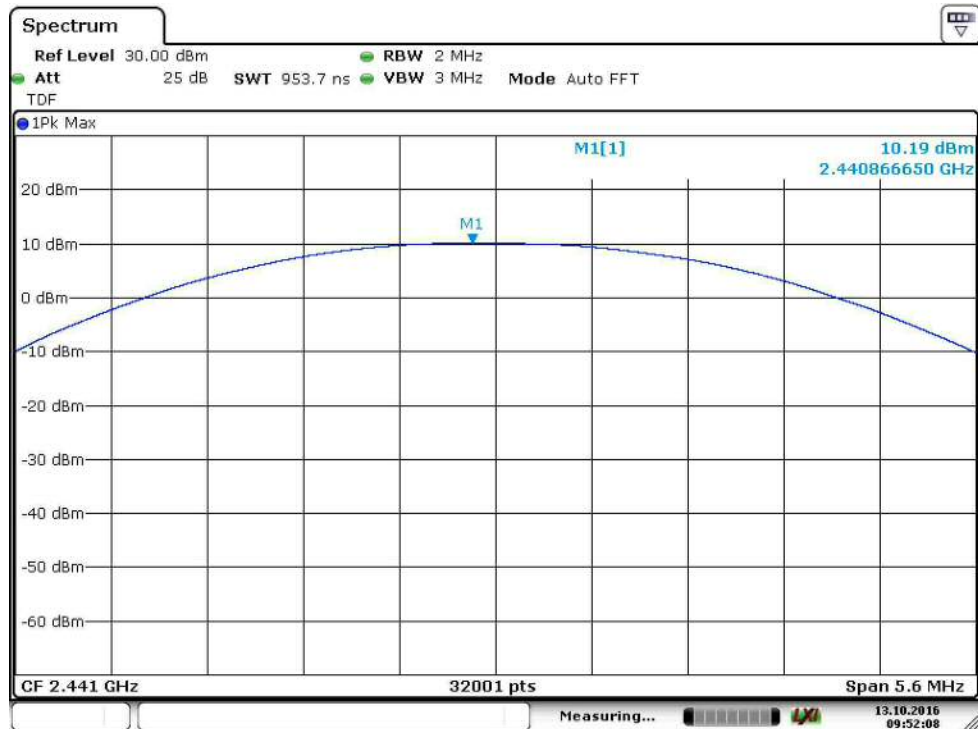


Figure 6. Maximum peak output power channel mid (2 Mbps)

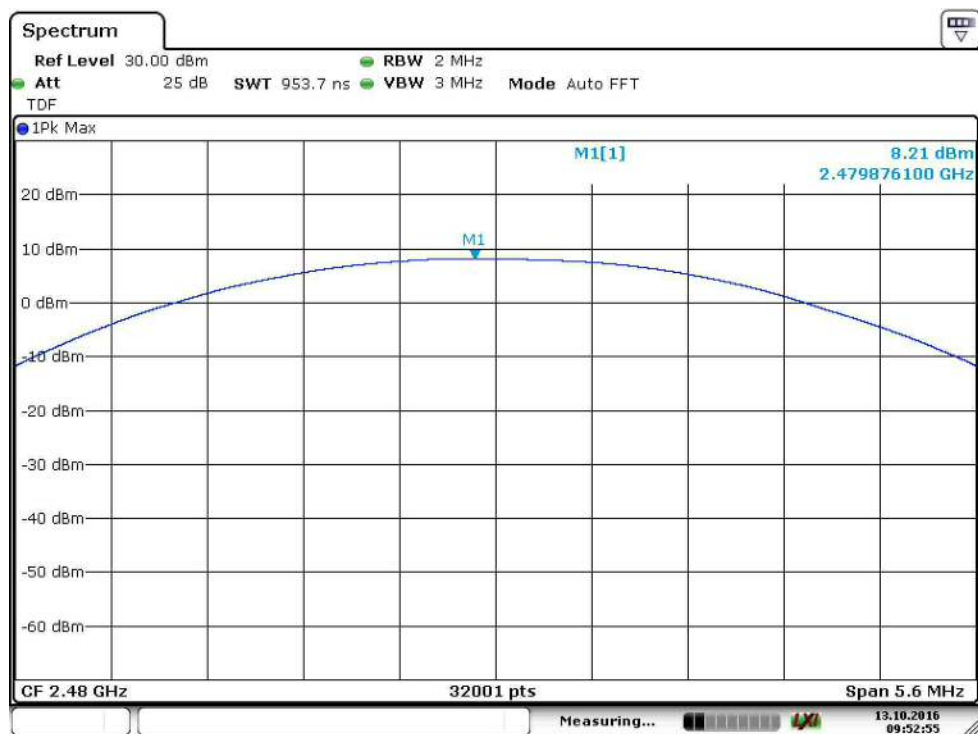


Figure 7. Maximum peak output power channel high (2 Mbps)

Maximum Peak Conducted Output Power

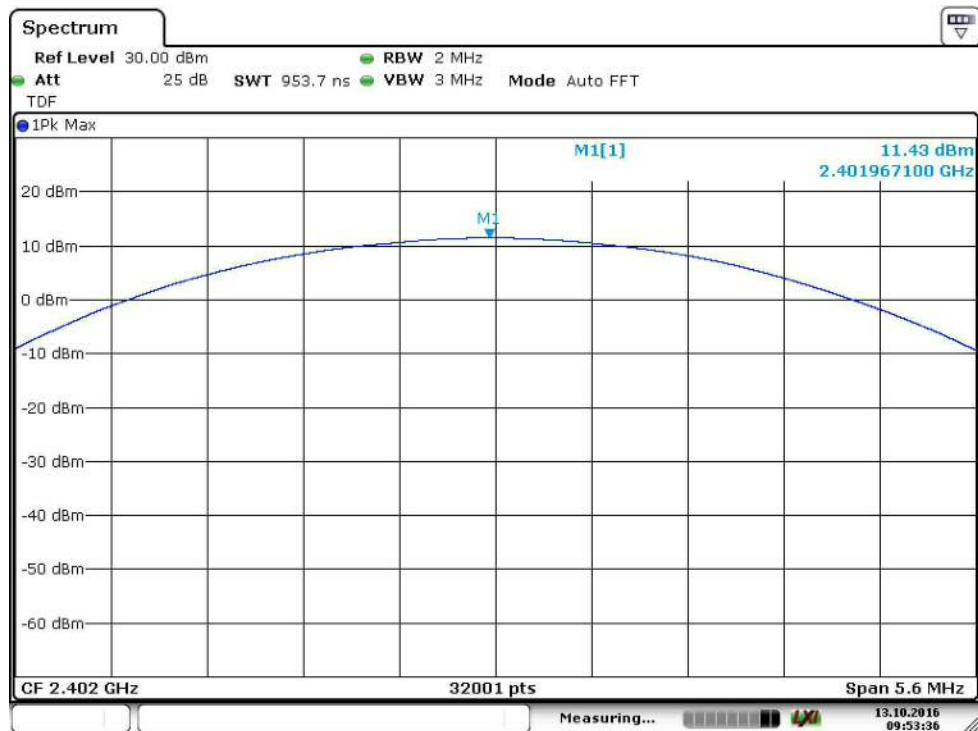


Figure 8. Maximum peak output power channel low (3 Mbps)

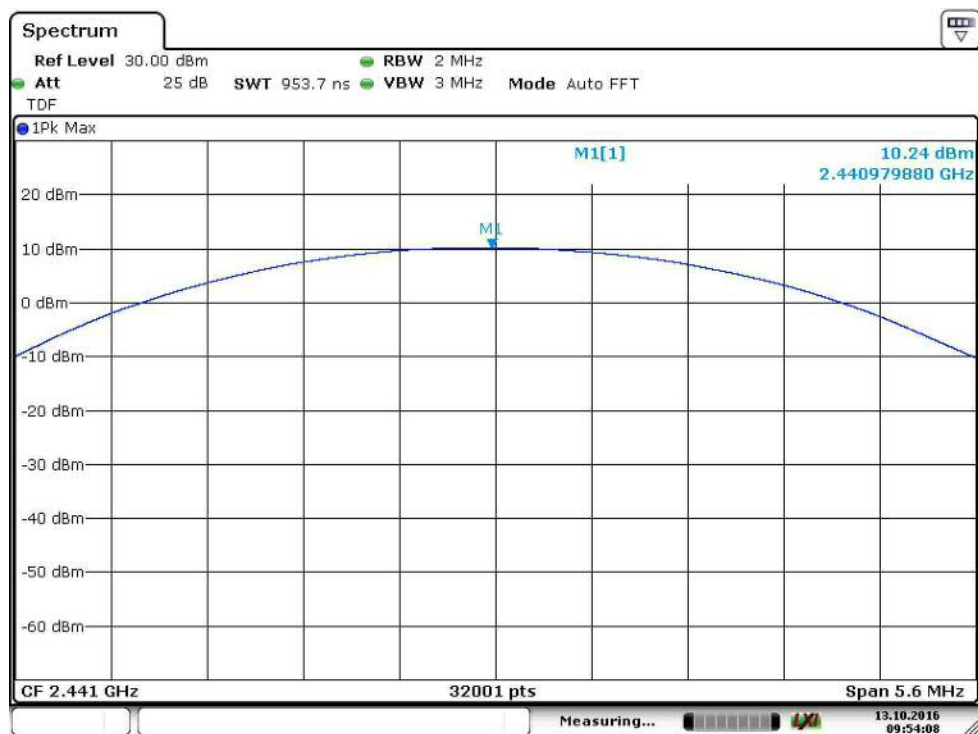


Figure 9. Maximum peak output power channel mid (3 Mbps)

Maximum Peak Conducted Output Power

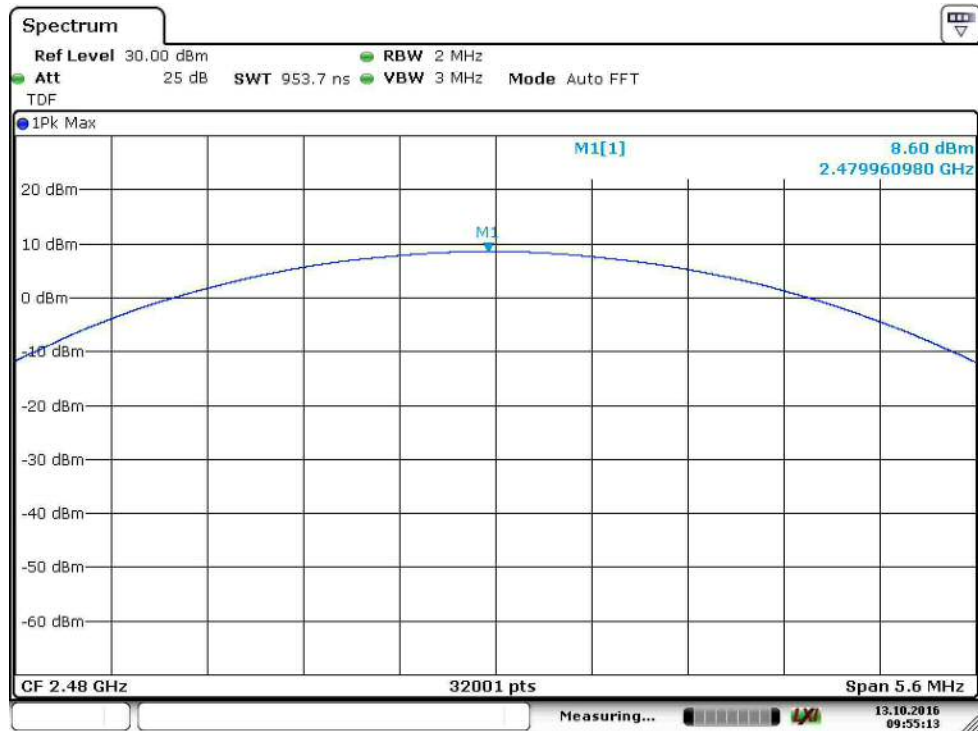


Figure 10. Maximum peak output power channel high (3 Mbps)

Hopping Channel Carrier Frequencies Separation

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 13 October 2016
Temperature: 21 °C
Humidity: 33 % 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)	996.380 kHz	546.399 kHz	PASS
3 Mbps (8DPSK)	999.030 kHz	836.099 kHz	PASS

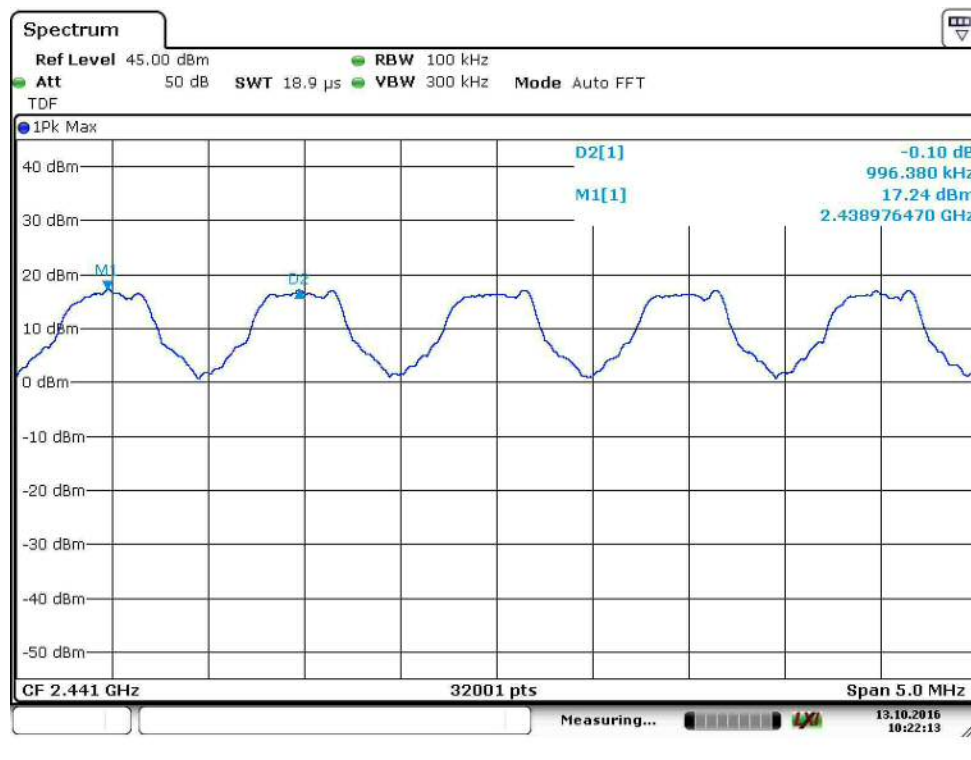


Figure 11: Channel frequency separation 1 Mbps

Hopping Channel Carrier Frequencies Separation

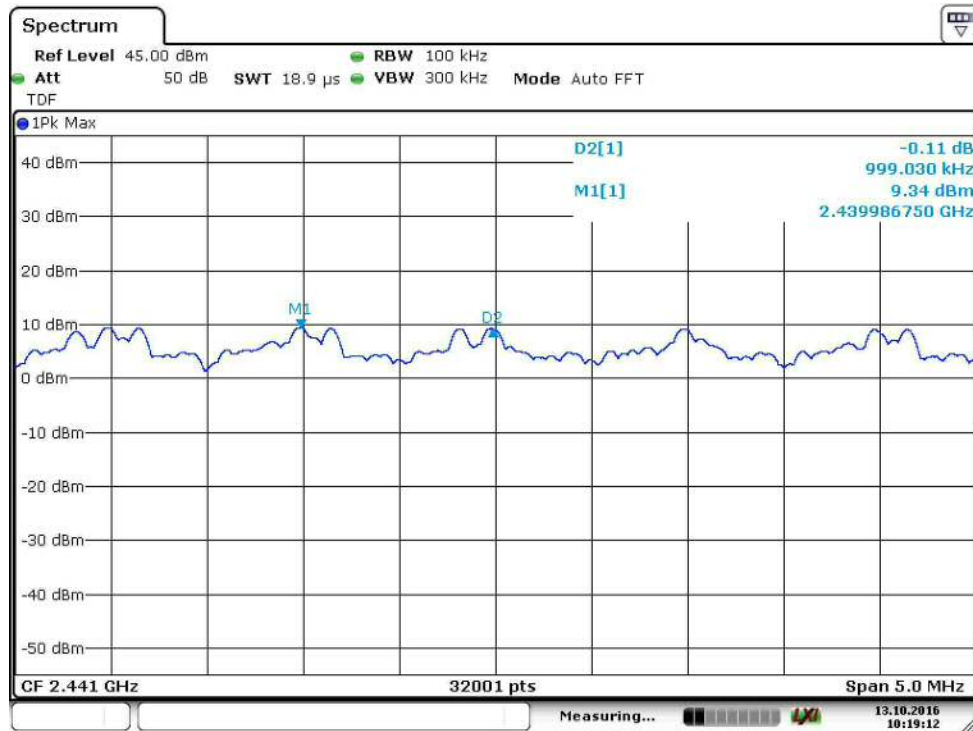


Figure 12: Channel frequency separation 3 Mbps

Number of Hopping Frequencies

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 13 October 2016
Temperature: 21 °C
Humidity: 33 % 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.

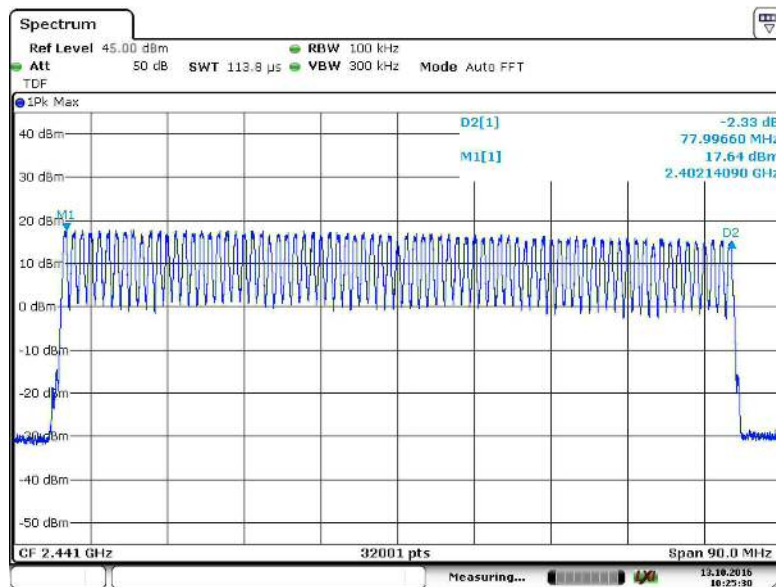


Figure 13. 79 hopping channels 1 Mbps

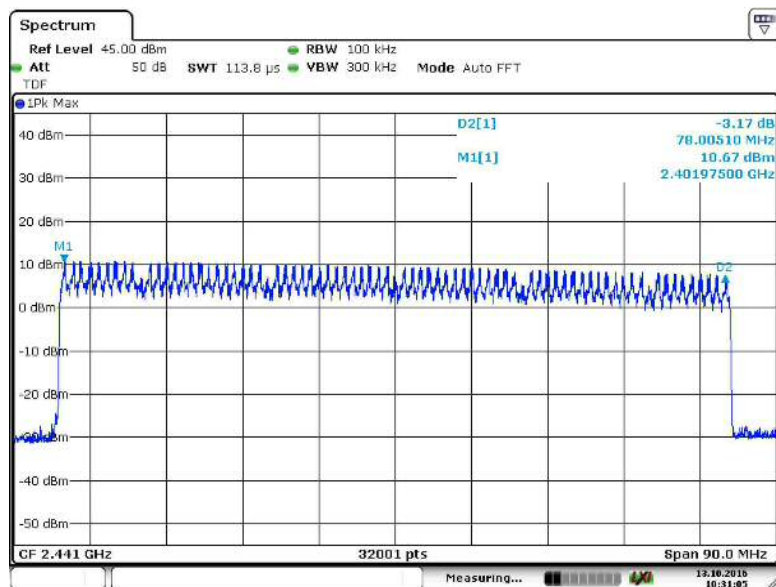


Figure 14: 79 hopping channels 3 Mbps

Average Time of Occupancy of Hopping Frequency

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 13 October 2016
Temperature: 21 °C
Humidity: 33 % 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 = 297.8 ms

Number of transmission cycles in measurement period = 31.6 / 0.2978 = 106.1

Time of occupancy = (single duration) x (repetition) = 2.915 ms x 106.1 = 309.28 ms

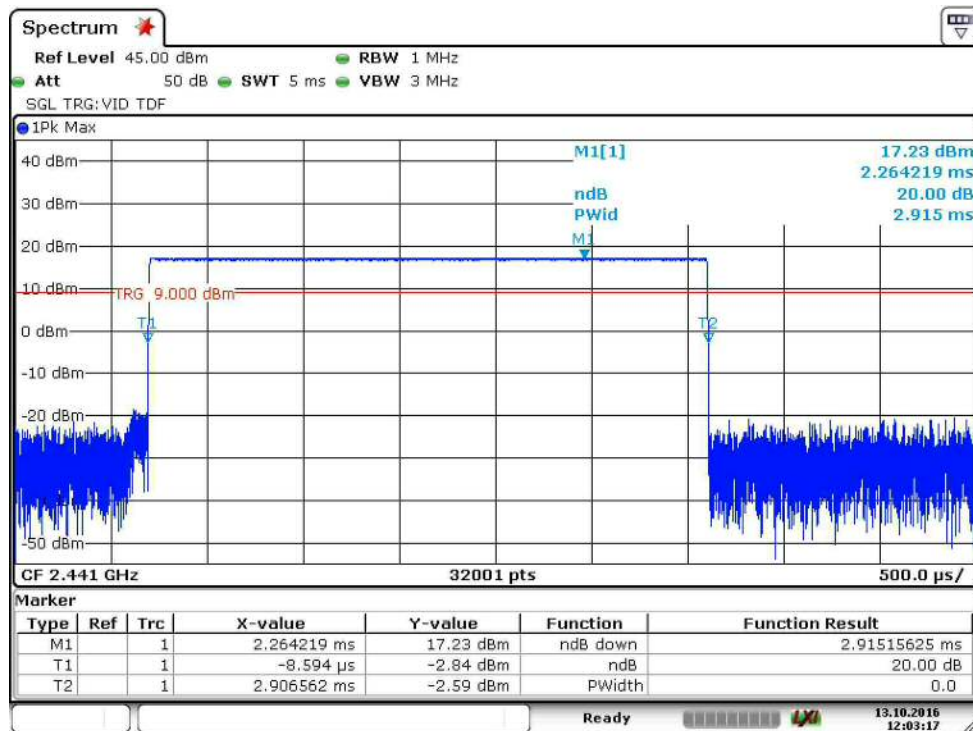


Figure 15: Duration of one transmission

Average Time of Occupancy of Hopping Frequency

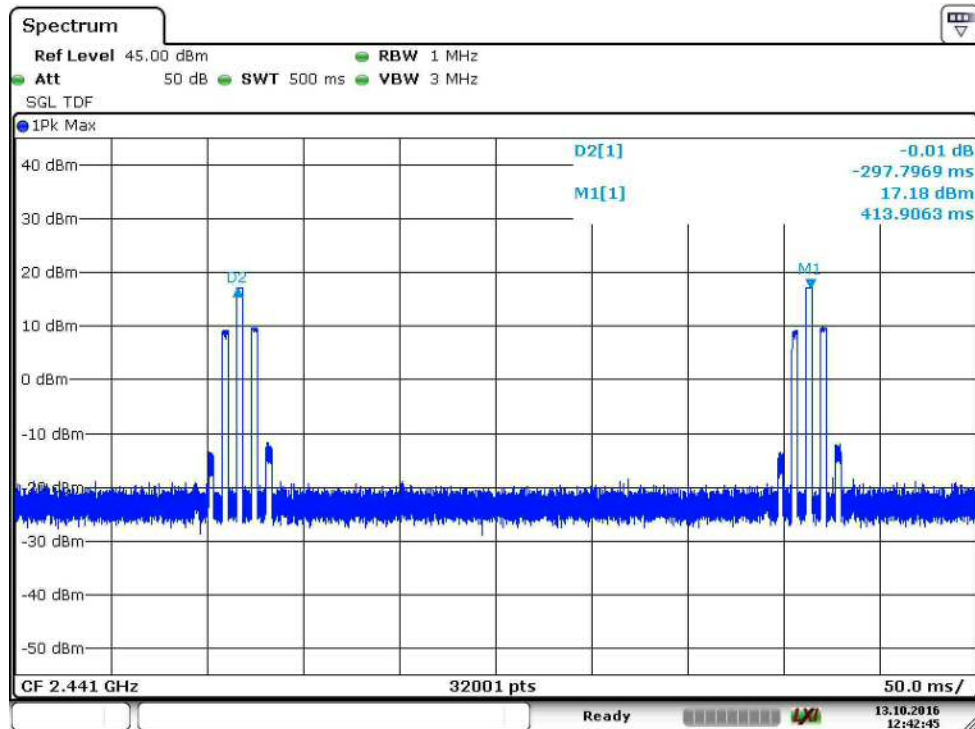


Figure 16: Channel transmission repetition rate

20 dB Bandwidth

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 13 October 2016
Temperature: 21 °C
Humidity: 33 % 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	817.849	1211.712
Mid	818.162	1254.148
High	819.599	1213.275

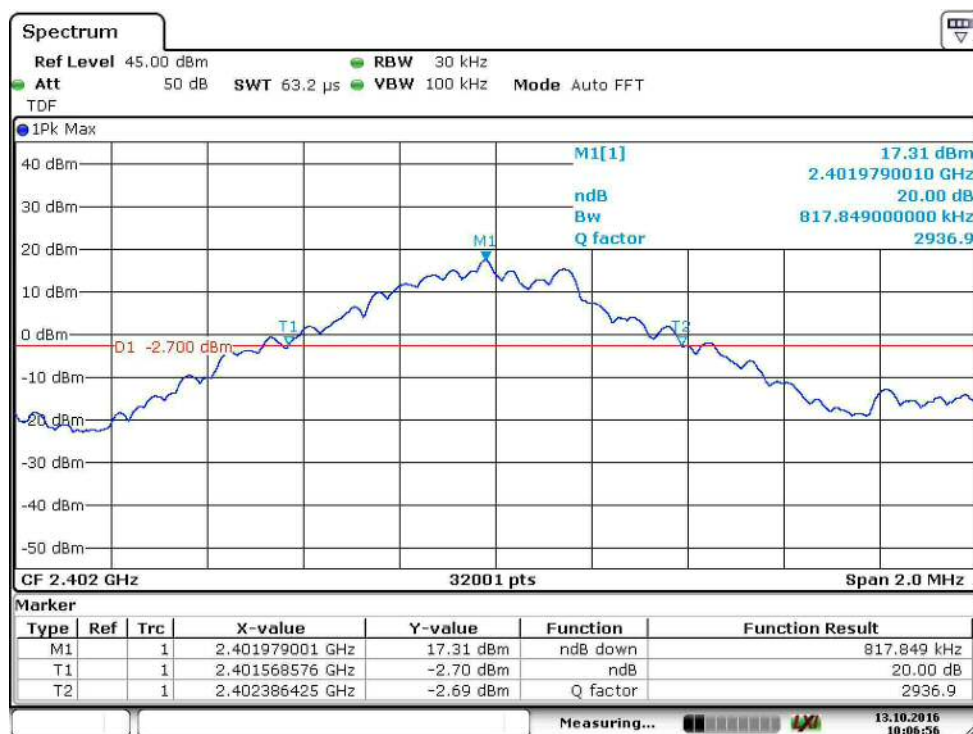


Figure 17: 20 dB bandwidth channel low (1 Mbps)

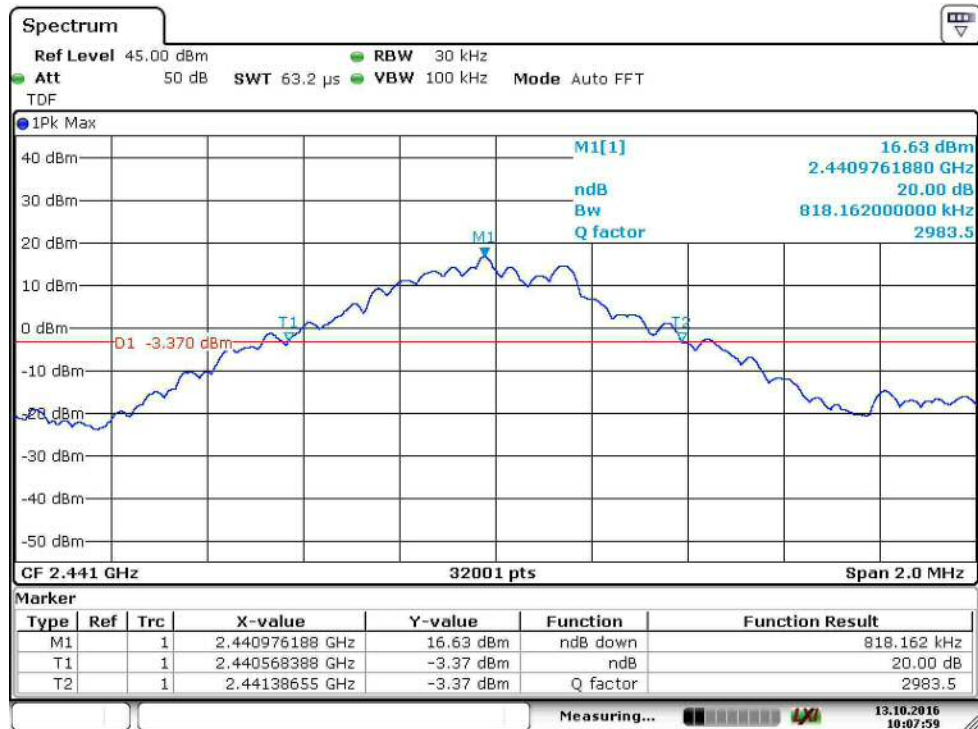


Figure 18: 20 dB bandwidth channel mid (1 Mbps)

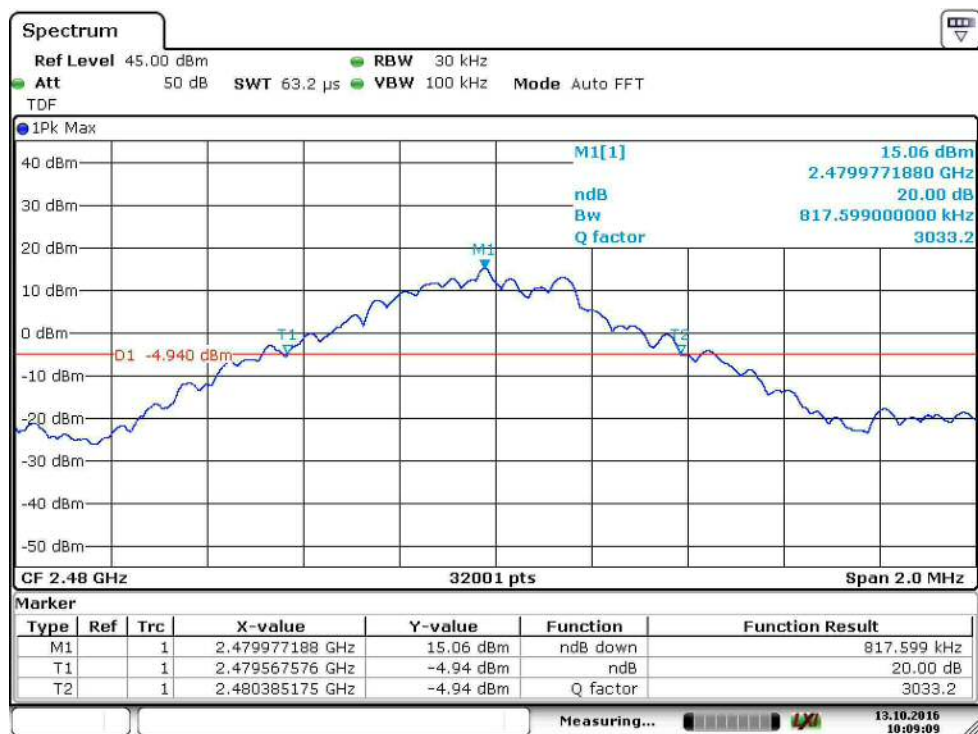


Figure 19: 20 dB bandwidth channel high (1Mbps)

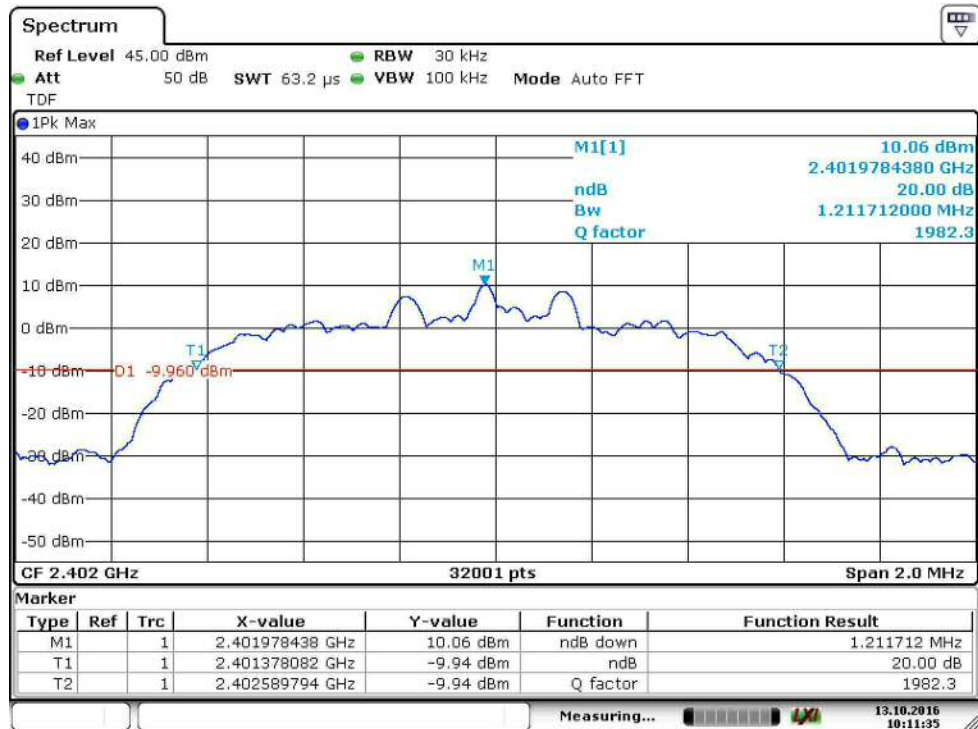


Figure 20: 20 dB bandwidth channel low (3 Mbps)

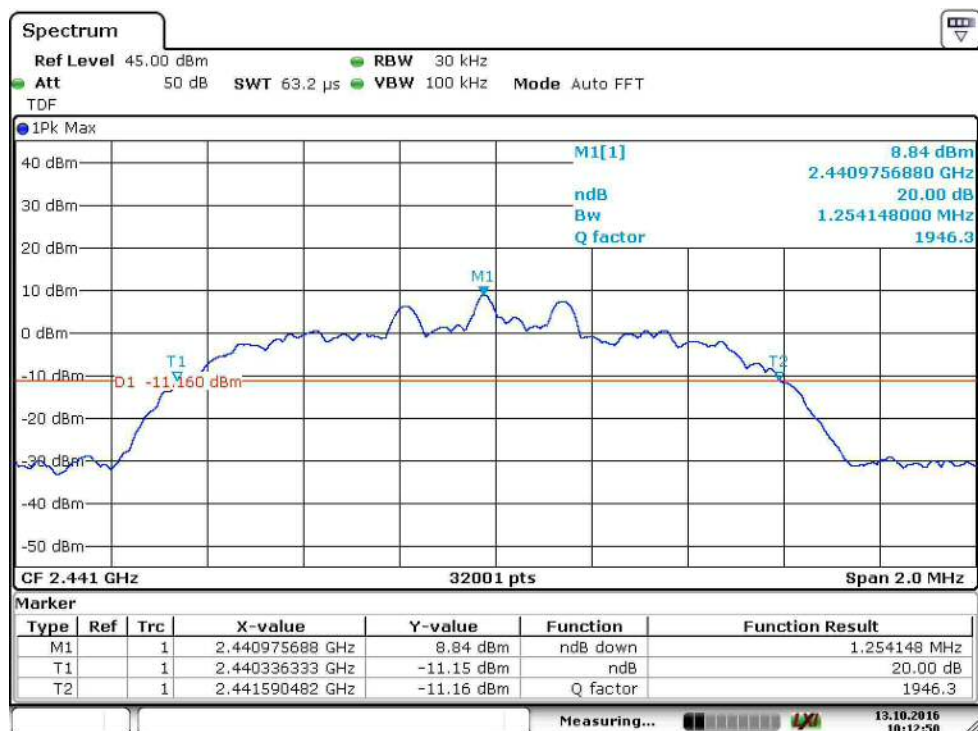


Figure 21: 20 dB bandwidth channel mid (3 Mbps)

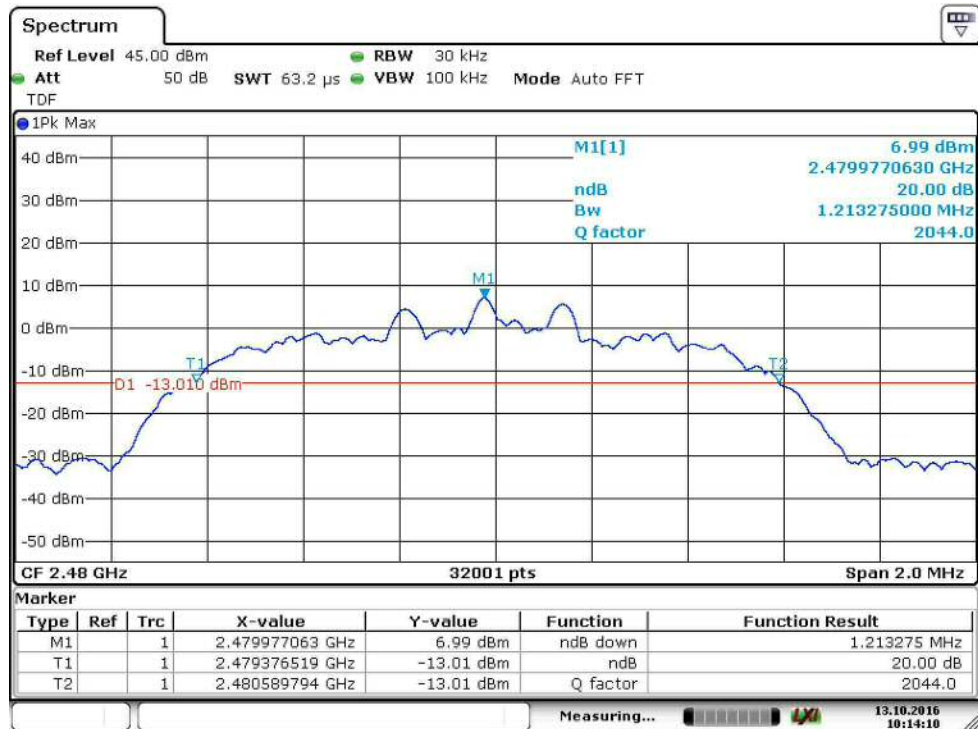


Figure 22: 20 dB bandwidth channel high (3Mbps)

Conducted Spurious Emissions 30 MHz - 26500 MHz and Band Edge

Standard: ANSI C63.10 (2014)
Tested by: RRE / EHA
Date: 8 August 2016 - 13 October 2016
Temperature: 21 - 22 °C
Humidity: 33 - 52 % RH

FCC Rule: §15.247(d)
RSS-247 5.5

Test results:

Conducted spurious emissions channel low (GFSK)

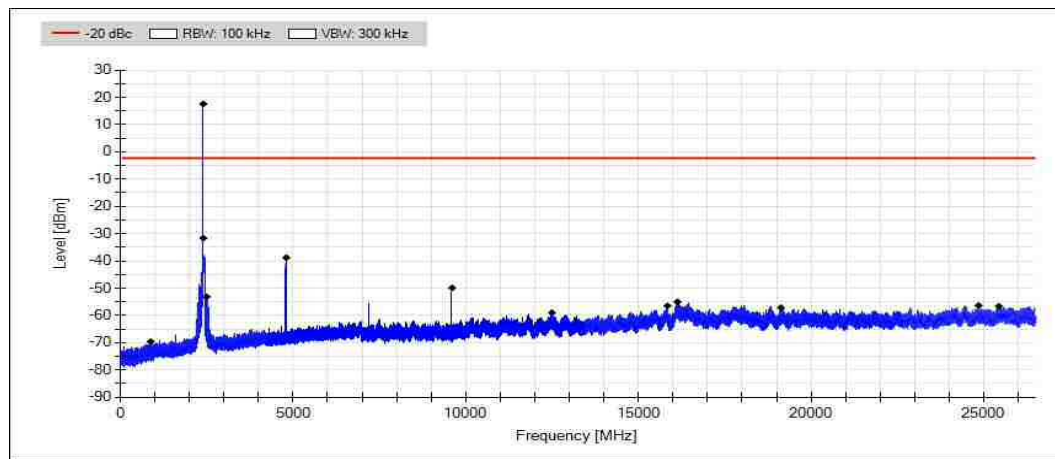


Figure 23: Plot of conducted spurious emissions channel low (1 Mbps)

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

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
880.68	-69.60	-2.36	-67.24	PASS
2399.98	-31.60	-2.36	-29.24	PASS
2402.14	17.64	-	-	Carrier
2498.03	-53.13	-2.36	-50.77	PASS
4804.30	-38.80	-2.36	-36.44	PASS
9608.00	-49.91	-2.36	-47.55	PASS
12492.97	-58.97	-2.36	-56.61	PASS
15836.36	-56.48	-2.36	-54.13	PASS
16130.54	-55.01	-2.36	-52.65	PASS
19125.57	-57.18	-2.36	-54.82	PASS
24847.71	-56.37	-2.36	-54.01	PASS
25429.71	-56.59	-2.36	-54.23	PASS

Conducted spurious emissions channel mid (GFSK)

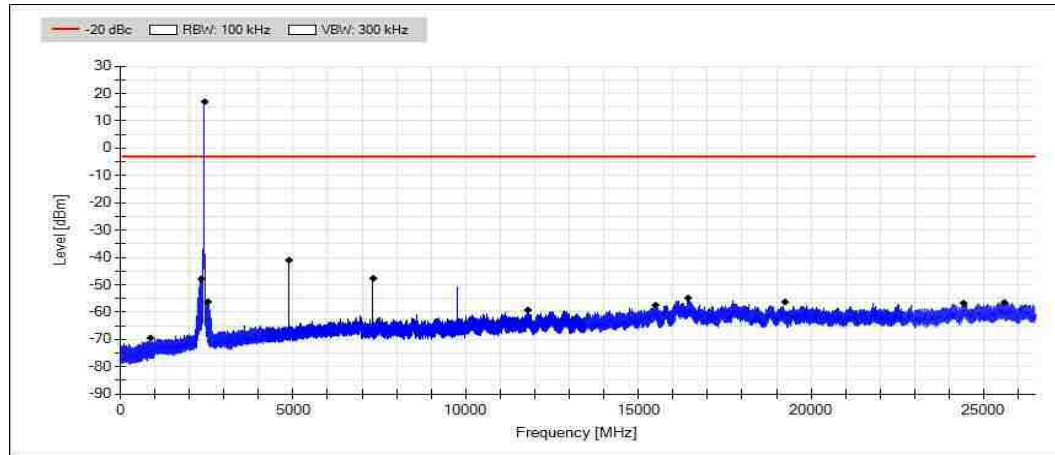


Figure 24: Plot of conducted spurious emissions channel mid (1 Mbps)

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

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
875.34	-69.43	-2.97	-66.45	PASS
2345.16	-47.81	-2.97	-44.84	PASS
2441.14	17.03	-	-	Carrier
2536.98	-56.18	-2.97	-53.21	PASS
4881.93	-40.95	-2.97	-37.98	PASS
7323.47	-47.65	-2.97	-44.67	PASS
11800.93	-59.26	-2.97	-56.29	PASS
15490.44	-57.44	-2.97	-54.47	PASS
16437.10	-54.85	-2.97	-51.87	PASS
19245.01	-56.30	-2.97	-53.32	PASS
24412.16	-56.69	-2.97	-53.72	PASS
25593.49	-56.46	-2.97	-53.49	PASS

Conducted Spurious Emissions and Band Edge

Conducted spurious emissions channel high (GFSK)

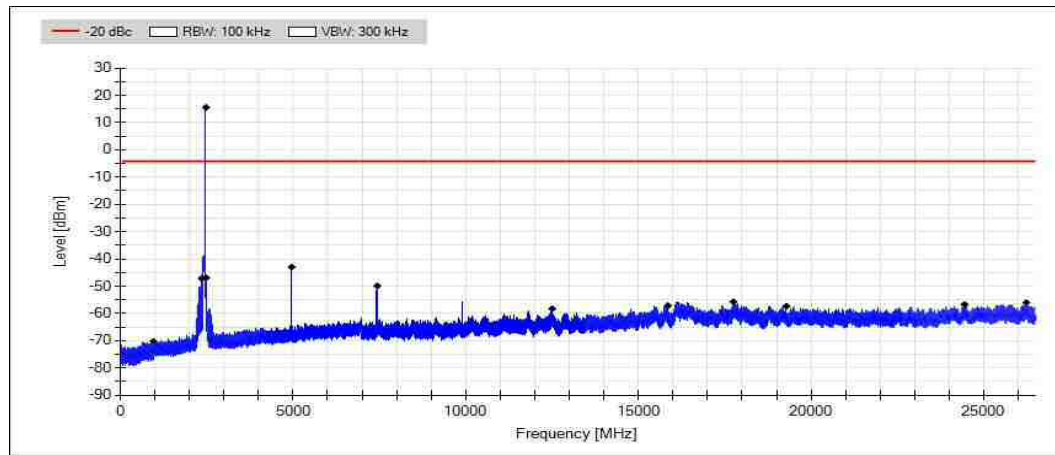


Figure 25: Plot of conducted spurious emissions channel high (1 Mbps)

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

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
953.15	-70.23	-4.41	-65.82	PASS
2351.99	-47.12	-4.41	-42.71	PASS
2480.14	15.59	-	-	Carrier
2486.08	-46.92	-4.41	-42.51	PASS
4960.02	-42.95	-4.41	-38.54	PASS
7440.47	-49.87	-4.41	-45.45	PASS
12502.81	-58.28	-4.41	-53.86	PASS
15853.90	-57.15	-4.41	-52.73	PASS
17747.12	-55.72	-4.41	-51.31	PASS
19284.10	-57.33	-4.41	-52.91	PASS
24443.19	-56.69	-4.41	-52.28	PASS
26227.83	-56.02	-4.41	-51.60	PASS

Conducted Spurious Emissions and Band Edge

Conducted band edge measurements (GFSK)

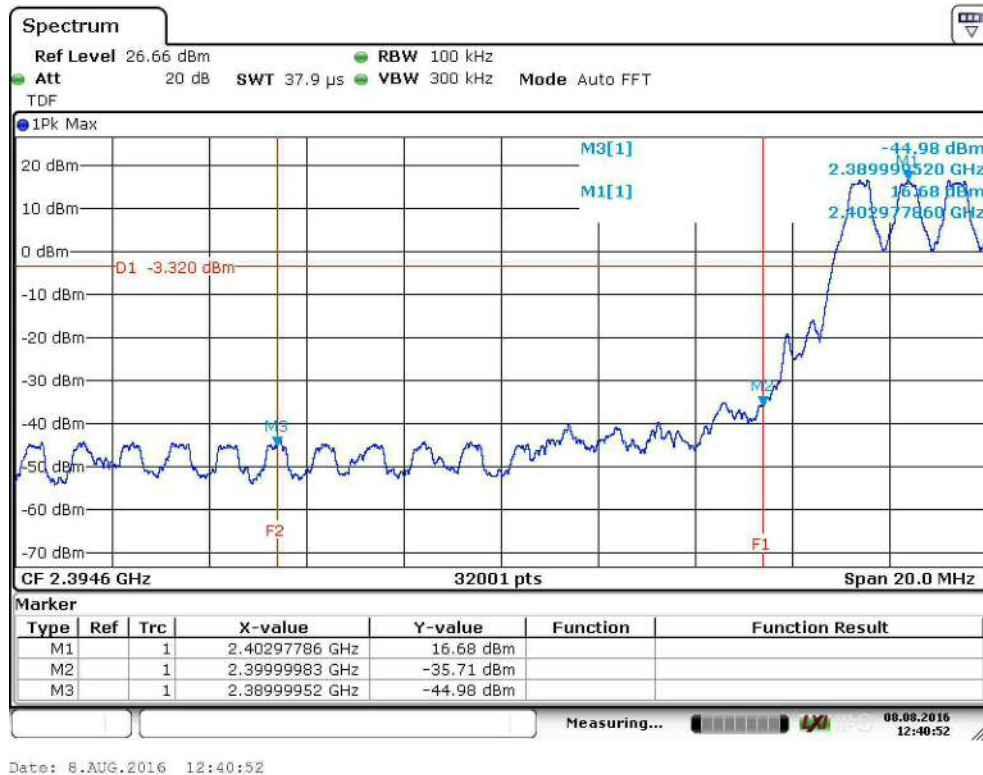


Figure 26: Low channel conducted emission at band edge, hopping (1 Mbps)

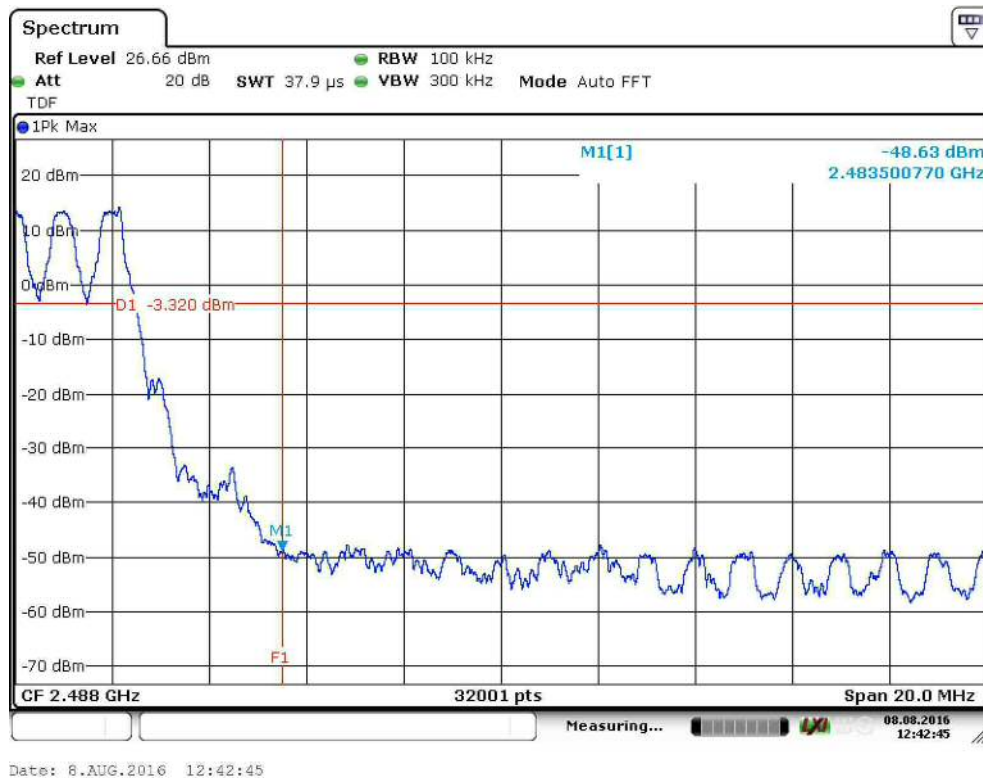


Figure 27: High channel conducted emission at band edge, hopping (1 Mbps)

Conducted Spurious Emissions and Band Edge

Conducted spurious emissions channel low (8DPSK)

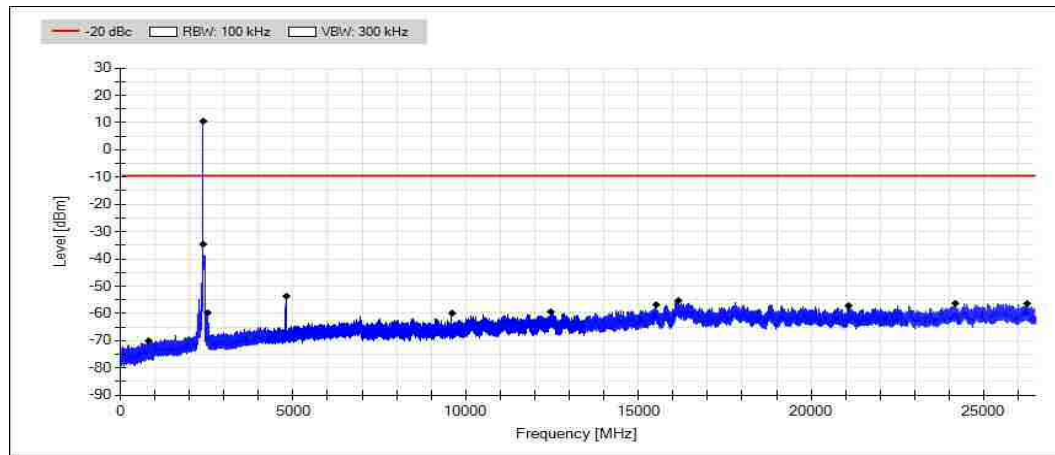


Figure 28: Plot of conducted spurious emissions channel low (3 Mbps)

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

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
816.72	-70.04	-9.48	-60.56	PASS
2399.63	-34.59	-9.48	-25.12	PASS
2401.81	10.52	-	-	Carrier
2530.06	-59.74	-9.48	-50.26	PASS
4804.30	-53.65	-9.48	-44.18	PASS
9608.00	-59.93	-9.48	-50.46	PASS
12463.44	-59.38	-9.48	-49.90	PASS
15515.56	-56.84	-9.48	-47.36	PASS
16153.61	-55.27	-9.48	-45.79	PASS
21080.86	-57.15	-9.48	-47.68	PASS
24174.42	-56.29	-9.48	-46.81	PASS
26250.94	-56.37	-9.48	-46.90	PASS

Conducted Spurious Emissions and Band Edge

Conducted spurious emissions channel mid (8DPSK)

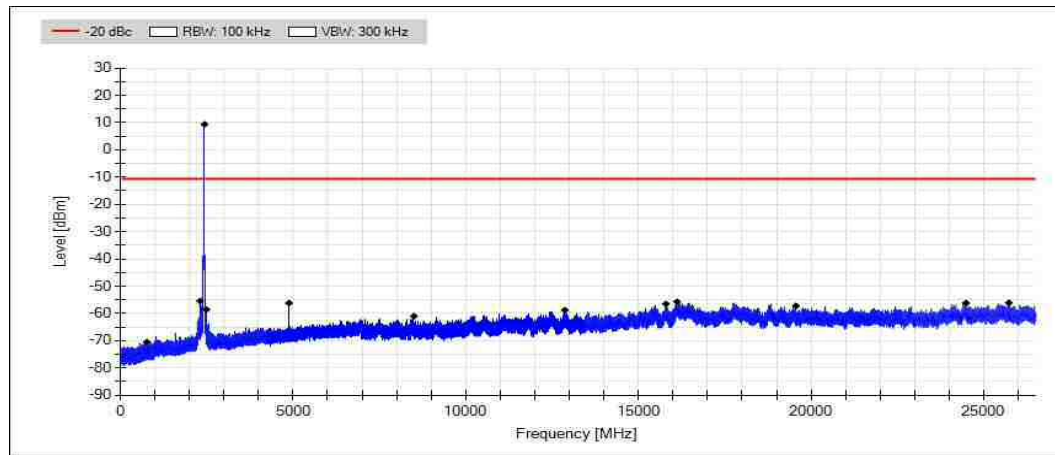


Figure 29: Plot of conducted spurious emissions channel mid (3 Mbps)

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

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
766.65	-70.51	-10.61	-59.90	PASS
2312.96	-55.43	-10.61	-44.83	PASS
2440.81	9.39	-	-	Carrier
2489.12	-58.53	-10.61	-47.92	PASS
4882.30	-56.18	-10.61	-45.58	PASS
8502.06	-61.00	-10.61	-50.39	PASS
12870.11	-58.79	-10.61	-48.19	PASS
15793.24	-56.49	-10.61	-45.89	PASS
16120.14	-55.74	-10.61	-45.13	PASS
19558.50	-57.24	-10.61	-46.63	PASS
24481.91	-56.17	-10.61	-45.56	PASS
25721.83	-56.11	-10.61	-45.50	PASS

Conducted spurious emissions channel high (8DPSK)

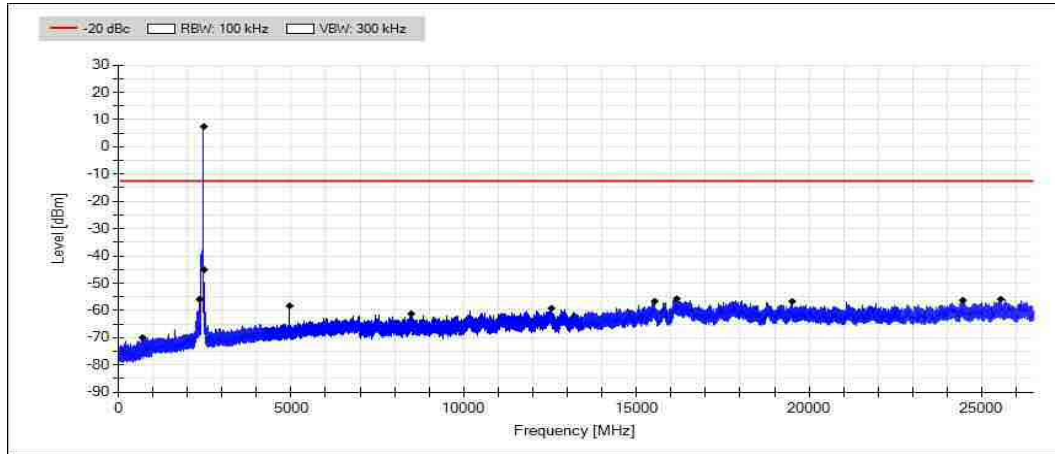


Figure 30: Plot of conducted spurious emissions channel high (3 Mbps)

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

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
706.05	-69.96	-12.53	-57.43	PASS
2351.99	-55.87	-12.53	-43.34	PASS
2479.81	7.47	-	-	Carrier
2483.52	-45.06	-12.53	-32.53	PASS
4960.30	-58.33	-12.53	-45.80	PASS
8476.00	-61.23	-12.53	-48.70	PASS
12538.16	-59.23	-12.53	-46.70	PASS
15529.81	-56.63	-12.53	-44.10	PASS
16167.29	-55.71	-12.53	-43.18	PASS
19509.38	-56.67	-12.53	-44.14	PASS
24452.66	-56.27	-12.53	-43.74	PASS
25547.32	-55.88	-12.53	-43.35	PASS

Conducted Spurious Emissions and Band Edge

Conducted band edge measurements (8DPSK)

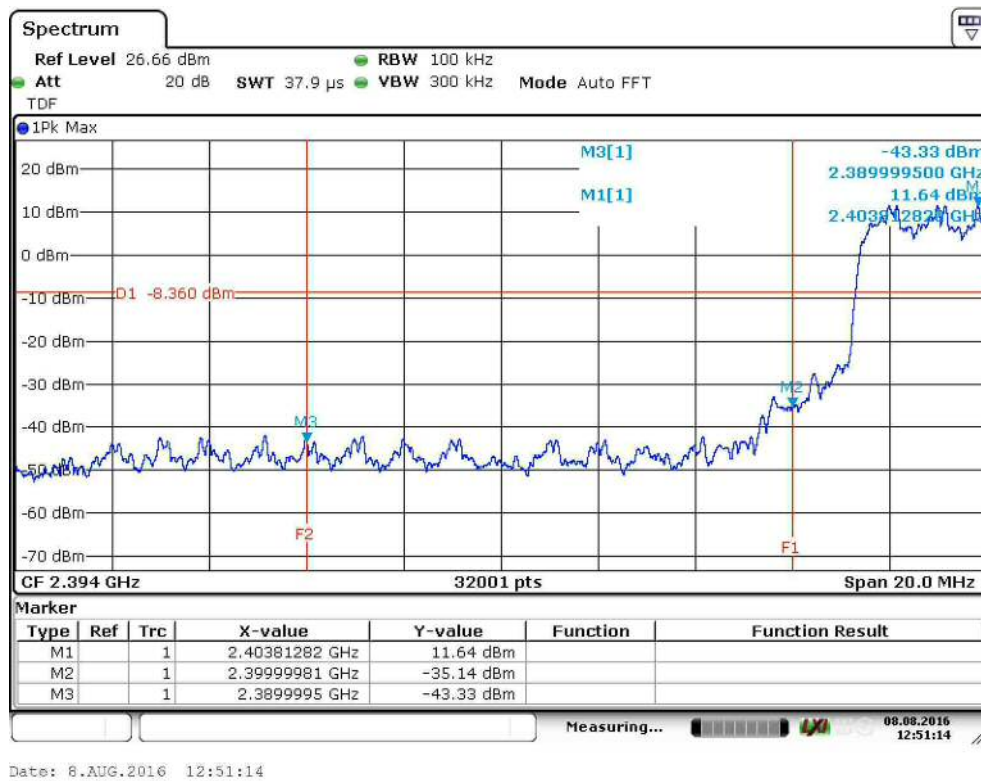


Figure 31: Low channel conducted emission at band edge, hopping (3 Mbps)

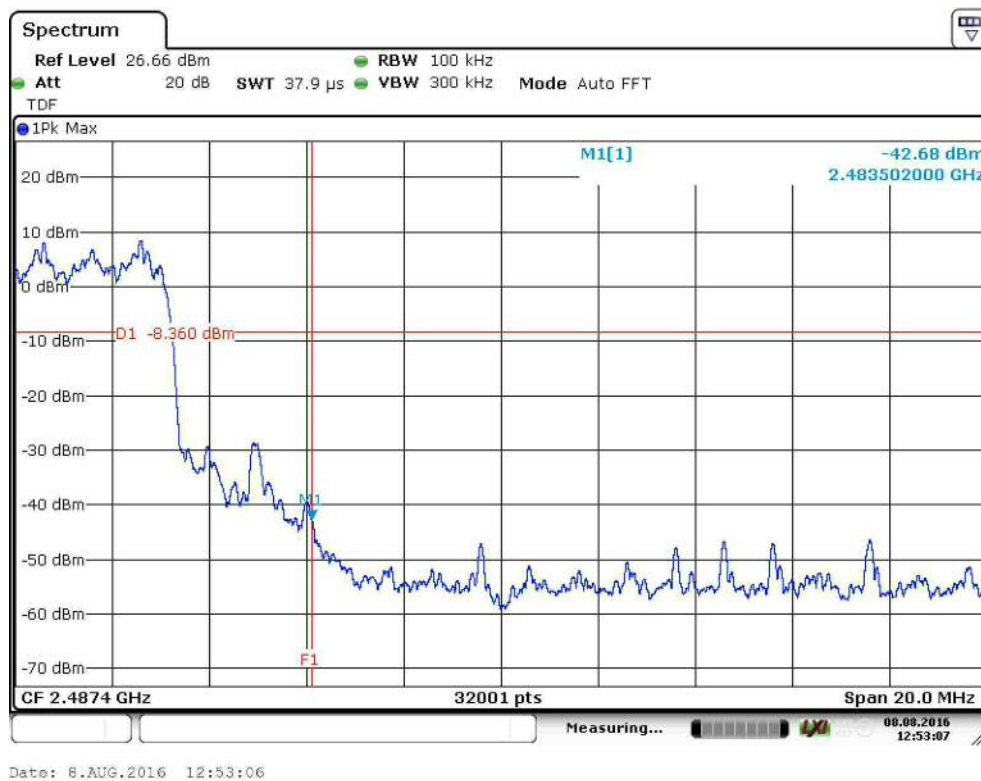


Figure 32: High channel conducted emission at band edge, hopping (3 Mbps)

Transmitter Radiated Spurious Emissions

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.

Low channel, WT41u-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)
51.465000	11.4	260.0	H	106.0	14.6	28.6	40.0
945.717000	26.6	128.0	H	1.0	27.7	19.4	46.0

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	47.2	166.0	H	143.0	2.8	26.7	73.9
2375.825000	50.9	216.0	H	143.0	8.8	23.0	73.9
2385.800000	36.5	265.0	H	296.0	4.0	37.4	73.9
2400.000000	48.0	397.0	H	299.0	4.1	25.9	73.9
2401.800000	104.5	191.0	H	327.0	9.0	-	-
4803.800000	41.1	299.0	V	332.0	10.4	32.8	73.9
7205.400000	47.6	312.0	V	344.0	12.6	26.3	73.9
9608.600000	40.5	297.0	V	32.0	15.2	33.4	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	20.2	216.0	H	143.0	8.8	33.7	53.9
2385.800000	5.8	265.0	H	296.0	4.0	48.1	53.9
2400.000000	17.3	397.0	H	299.0	4.1	36.6	53.9
4803.800000	10.4	299.0	V	332.0	10.4	43.5	53.9
7205.400000	16.9	312.0	V	344.0	12.6	37.0	53.9

Transmitter Radiated Spurious Emissions

Middle channel, WT41u-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)
55.397000	11.3	327.0	H	155.0	14.4	28.7	40.0
108.818000	8.7	208.0	H	141.0	11.3	34.8	43.5
945.497000	26.6	215.0	V	1.0	27.7	19.4	46.0

Table 11: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBμV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1627.725000	48.6	190.0	H	143.0	3.6	25.3	73.9
2440.800000	104.9	179.0	H	322.0	8.9	-	-
4882.000000	39.7	246.0	V	344.0	10.4	34.2	73.9
9764.700000	35.8	298.0	V	132.0	15.3	38.1	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)
1627.725000	17.9	190.0	H	143.0	3.6	36.0	53.9
4882.000000	9.0	246.0	V	344.0	10.4	44.9	53.9
9764.700000	5.1	298.0	V	132.0	15.3	48.8	53.9

High channel, WT41u-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)
50.227000	11.5	100.0	H	302.0	14.6	28.5	40.0
955.611000	26.7	364.0	H	215.0	27.8	19.3	46.0

Table 14: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBμV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1653.725000	51.7	204.0	H	117.0	4.4	22.2	73.9
2479.800000	107.4	220.0	H	318.0	9.2	-	-
2483.500000	53.9	396.0	H	298.0	4.4	20.0	73.9
2506.625000	52.6	220.0	H	318.0	9.3	21.3	73.9
4959.700000	43.9	232.0	V	354.0	10.4	30.0	73.9
9920.600000	37.6	299.0	V	136.0	16.0	36.3	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)
1653.725000	21.0	204.0	H	117.0	4.4	32.9	53.9
2483.500000	23.2	396.0	H	298.0	4.4	30.7	53.9
2506.625000	21.9	220.0	H	318.0	9.3	32.0	53.9
4959.700000	13.2	232.0	V	354.0	10.4	40.7	53.9
9920.600000	6.9	299.0	V	136.0	16.0	47.0	53.9

Transmitter Radiated Spurious Emissions

Radiated band edge measurement results, WT41u-A

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

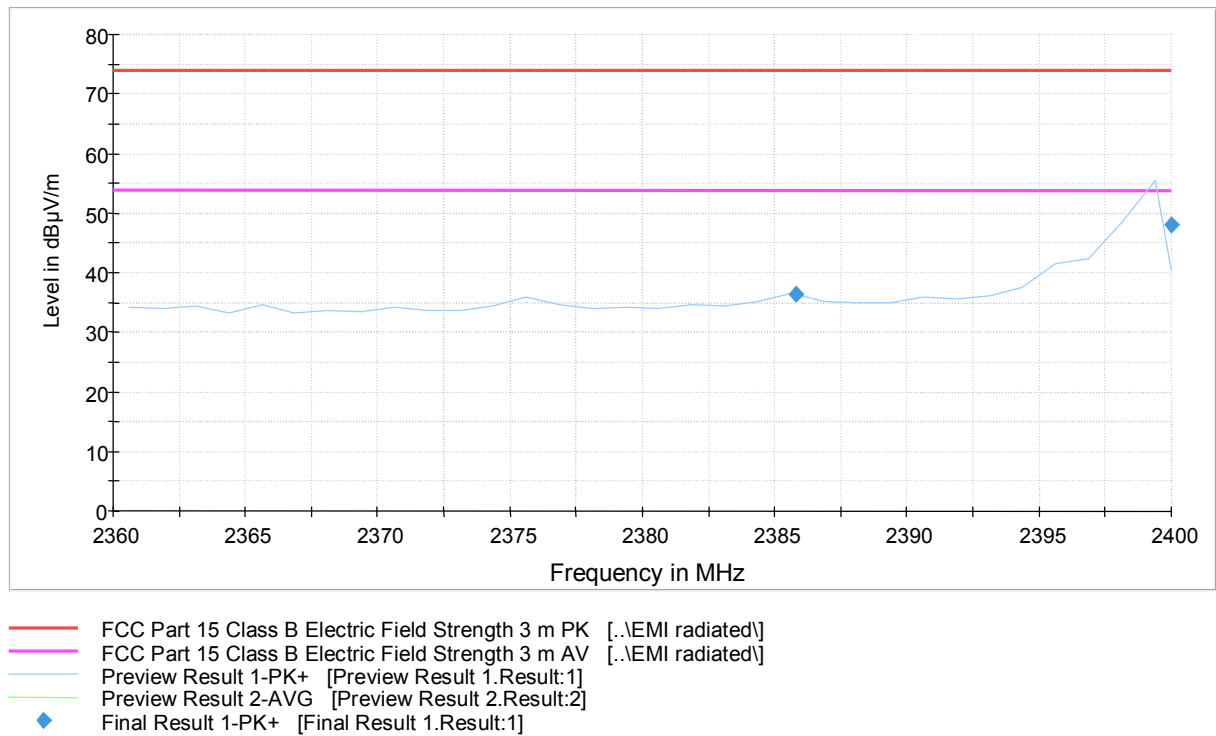


Figure 33. Radiated channel low band edge measured with peak detector (WT41u-A)

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

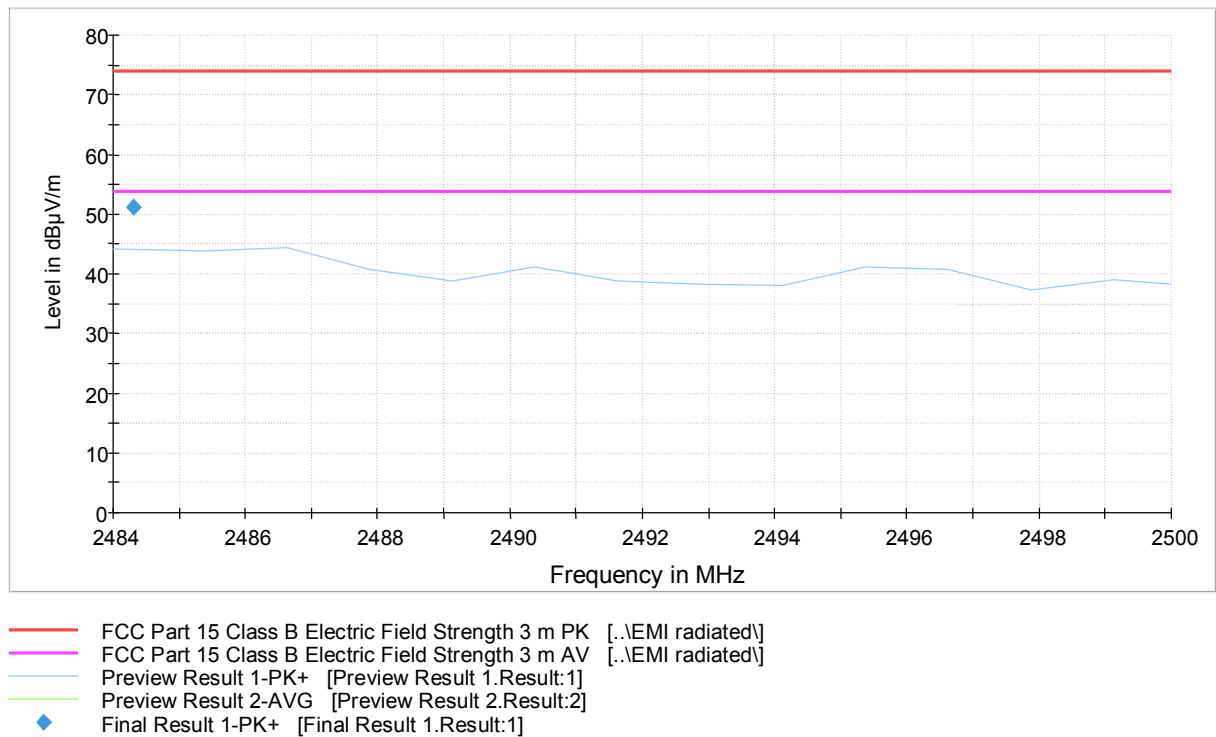


Figure 34. Radiated higher band edge measured with peak detector (WT41u-A)

Transmitter Radiated Spurious Emissions

Low channel, WT41u-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)
255.990000	22.9	120.0	H	303.0	13.7	23.1	46.0
304.005000	25.2	100.0	H	158.0	15.5	20.8	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	45.7	255.0	H	41.0	2.8	28.2	73.9
2306.025000	51.6	229.0	V	53.0	8.4	22.3	73.9
2401.800000	112.4	179.0	V	63.0	9.0	-	-
2365.400000	43.0	150.0	V	152.0	3.7	30.9	73.9
2385.800000	50.2	150.0	V	227.0	4.0	23.7	73.9
2400.000000	69.7	249.0	V	340.0	4.1	4.2	73.9
4804.300000	48.1	150.0	V	273.0	10.4	25.8	73.9
9608.400000	47.7	297.0	V	351.0	15.2	26.2	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)
2306.025000	20.9	229.0	V	53.0	8.4	33.0	53.9
2365.400000	12.3	150.0	V	152.0	3.7	41.6	53.9
2385.800000	19.5	150.0	V	227.0	4.0	34.4	53.9
2400.000000	39.0	249.0	V	340.0	4.1	14.9	53.9
4804.300000	17.4	150.0	V	273.0	10.4	36.5	53.9
9608.400000	17.0	297.0	V	351.0	15.2	36.9	53.9

Middle channel, WT41u-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)
256.030000	22.8	111.0	H	298.0	13.7	23.2	46.0
304.025000	27.1	100.0	H	140.0	15.5	18.9	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)
1627.725000	46.4	400.0	H	41.0	3.6	27.5	73.9
2312.725000	52.0	204.0	V	41.0	8.4	21.9	73.9
2345.025000	52.6	253.0	V	99.0	8.5	21.3	73.9
2440.800000	112.0	191.0	V	296.0	8.9	-	-
4881.700000	47.2	160.0	V	232.0	10.4	26.7	73.9
9763.900000	39.7	299.0	V	164.0	15.3	34.2	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)
2312.725000	21.3	204.0	V	41.0	8.4	32.6	53.9
2345.025000	21.9	253.0	V	99.0	8.5	32.0	53.9
4881.700000	16.5	160.0	V	232.0	10.4	37.4	53.9
9763.900000	9.0	299.0	V	164.0	15.3	44.9	53.9

Transmitter Radiated Spurious Emissions

High channel, WT41u-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)
207.975000	23.4	173.0	H	291.0	11.5	20.1	43.5
303.945000	26.0	111.0	H	316.0	15.5	20.0	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)
1653.575000	48.6	166.0	H	146.0	4.4	25.3	73.9
2292.325000	48.4	191.0	V	55.0	8.3	25.5	73.9
2320.175000	50.2	191.0	V	42.0	8.4	23.7	73.9
2352.075000	52.3	228.0	V	143.0	8.6	21.6	73.9
2384.175000	52.4	241.0	V	101.0	8.9	21.5	73.9
2479.800000	110.8	150.0	V	47.0	9.2	-	-
2495.825000	54.2	248.0	V	143.0	9.3	19.7	73.9
2506.225000	53.9	150.0	V	46.0	9.3	20.0	73.9
4959.700000	47.2	248.0	V	22.0	10.4	26.7	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)
2320.175000	19.5	191.0	V	42.0	8.4	34.4	53.9
2352.075000	21.6	228.0	V	143.0	8.6	32.3	53.9
2384.175000	21.7	241.0	V	101.0	8.9	32.2	53.9
2495.825000	23.5	248.0	V	143.0	9.3	30.4	53.9
2506.225000	23.2	150.0	V	46.0	9.3	30.7	53.9
4959.700000	16.5	248.0	V	22.0	10.4	37.4	53.9

Transmitter Radiated Spurious Emissions

Radiated band edge measurement results, WT41u-E

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

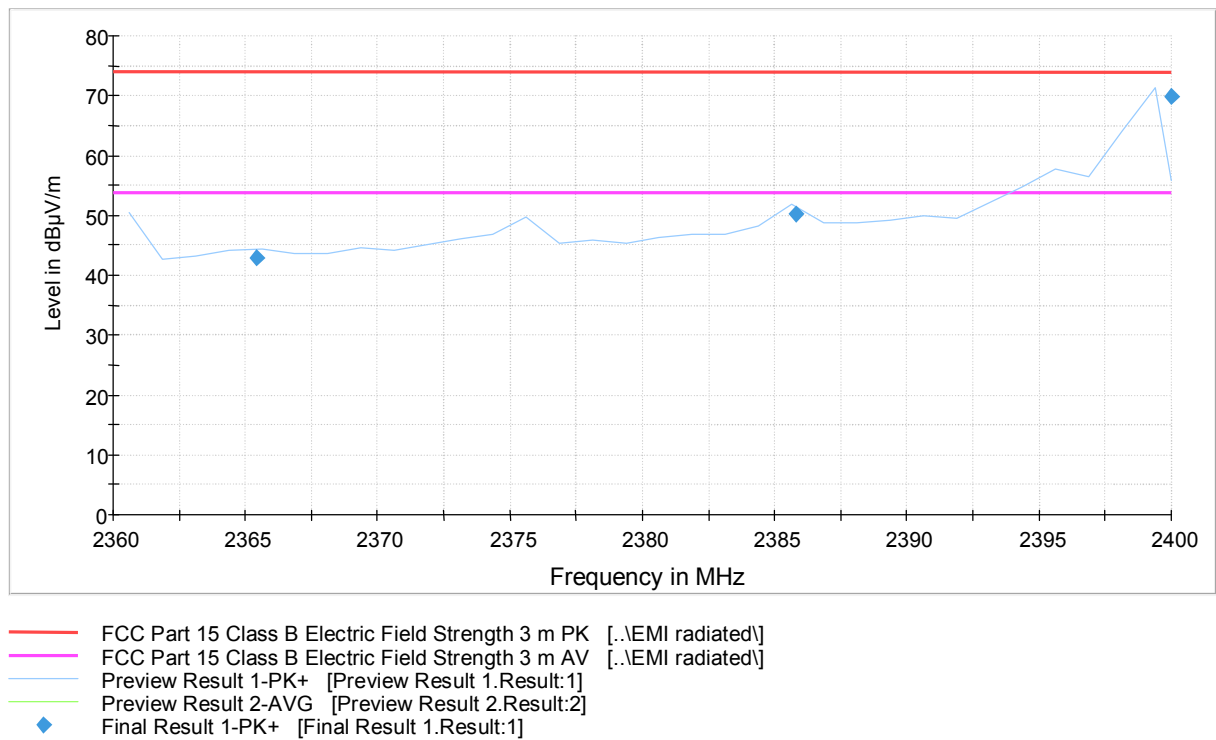


Figure 35. Radiated channel low band edge measured with peak detector (WT41u-E)

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

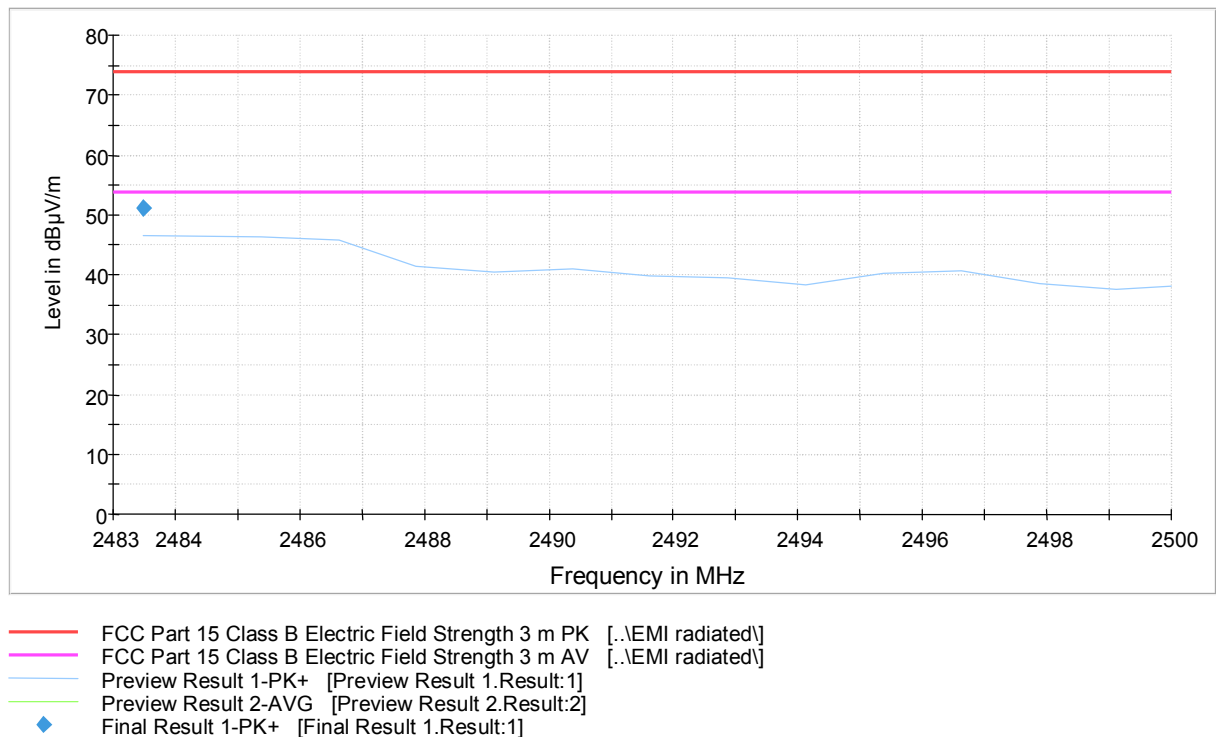


Figure 36. Radiated channel higher band edge measured with peak detector (WT41u-E)

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	0.998718790038	-	PASS
Mid	0.994031436518	-	PASS
High	0.984344239243	-	PASS

Table 10. 99% bandwidth test results 2 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	1.213399581	-	PASS
Mid	1.207462267	-	PASS
High	1.212774601	-	PASS

Table 11. 99% bandwidth test results 3 Mbps

Channel	99% BW [MHz]	Limit	Result
Low	1.217149464	-	PASS
Mid	1.216211993	-	PASS
High	1.214649542	-	PASS



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



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

99 % Occupied Bandwidth

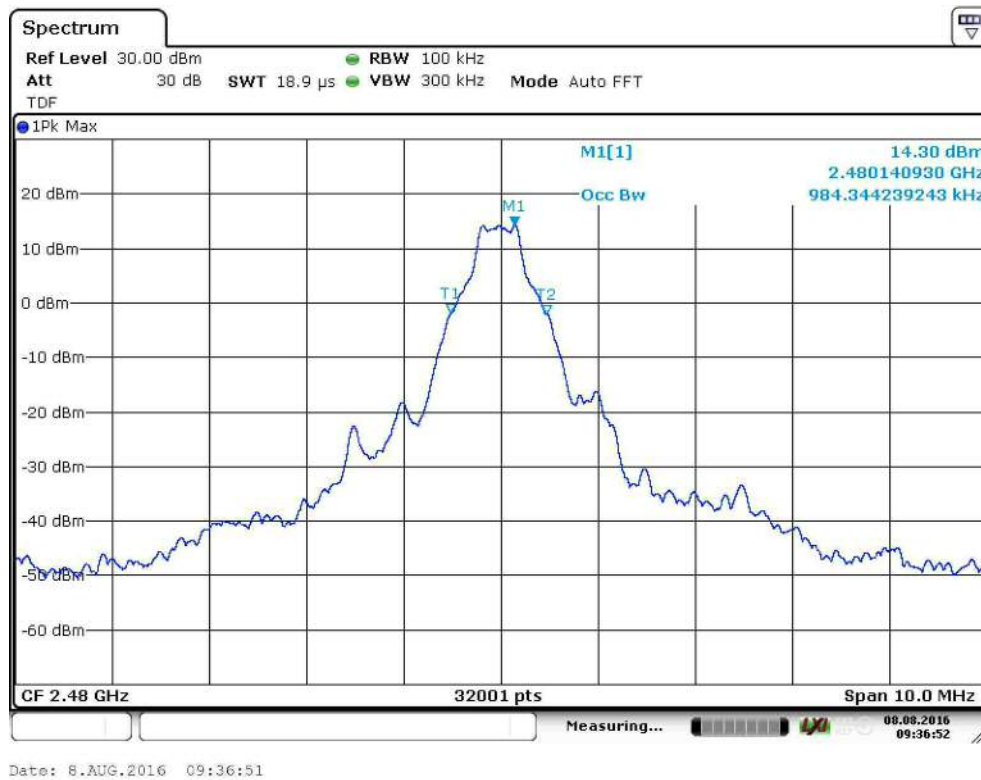


Figure 39. 99 % OBW channel high (1 Mbps)



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

99 % Occupied Bandwidth

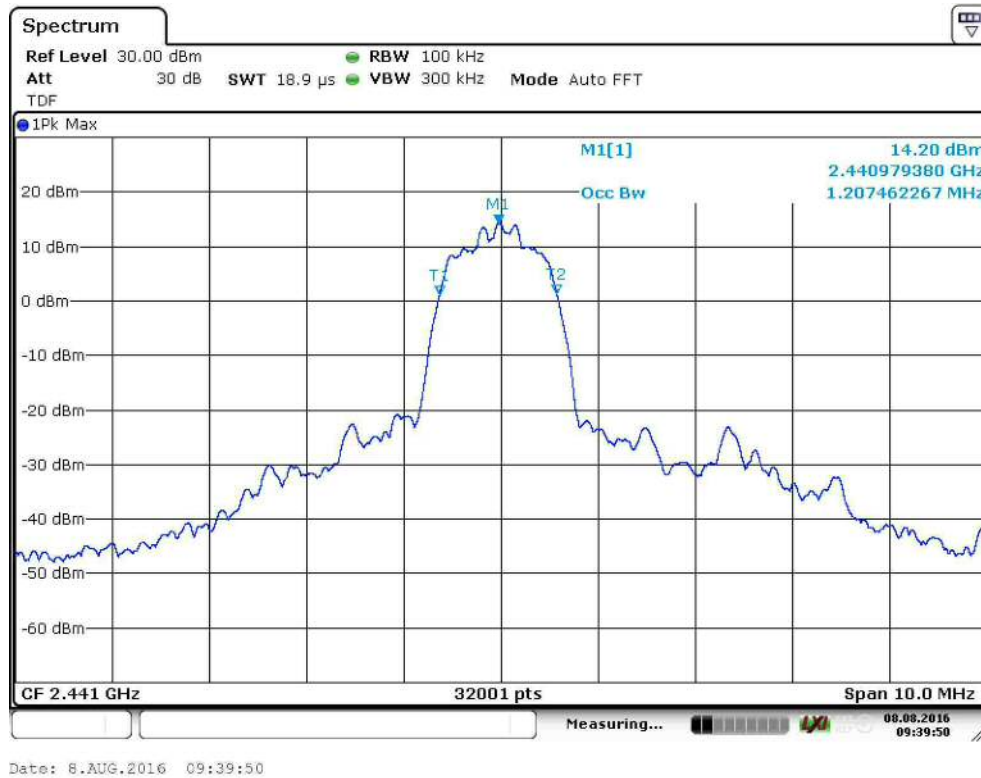


Figure 41. 99 % OBW channel mid (2 Mbps)



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

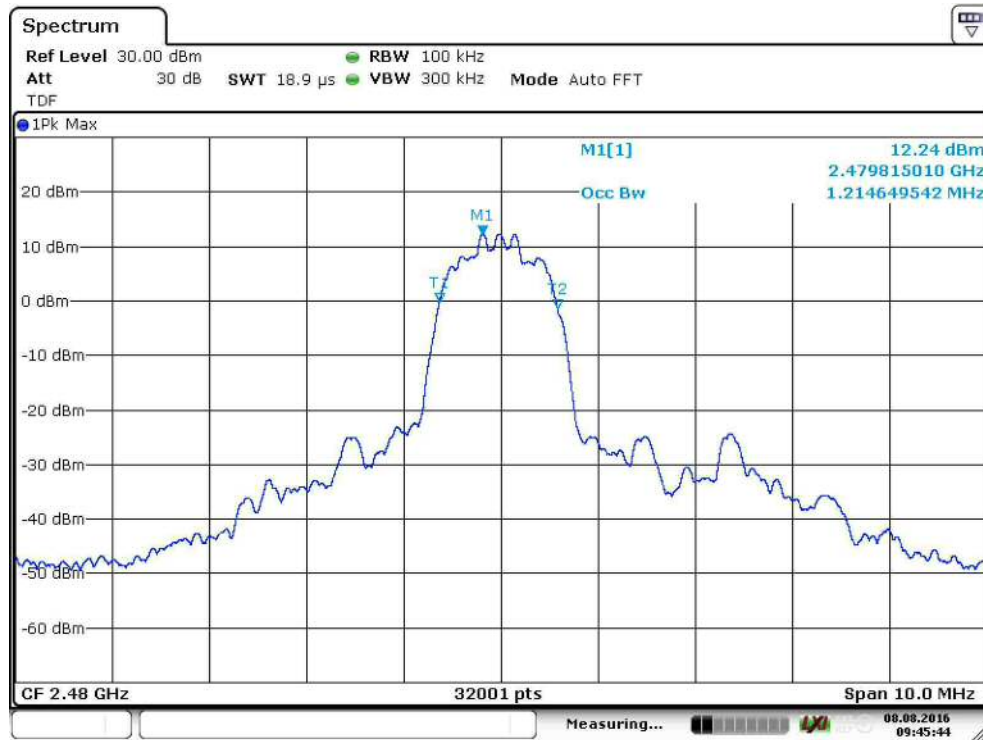
99 % Occupied Bandwidth



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



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



Date: 8.AUG.2016 09:45:44

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	PASTERNAK	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 MICROWAVE	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	-	-