

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test: BLE Smart Tag

Model: CFXBLE-1

Manufacturer: Confidex Ltd
Lumpeenkatu 6
FI-33900 TAMPERE
FINLAND

Customer: Confidex Ltd
Lumpeenkatu 6
FI-33900 TAMPERE
FINLAND

FCC Rule Part: 15.247: 2016
IC Rule Part: RSS-247, Issue 2, 2017
RSS-GEN Issue 4, 2014

KDB: Guidance for Performing Compliance
Measurements on Digital Transmission Systems
(DTS) Operating Under §15.247 (April 8, 2016)

Date: 27 September 2017

Issued by:

Pekka Kälviäinen
Testing Engineer

Date: 27 September 2017

Checked by:

Rauno Repo
Testing Engineer

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Equipment Under Test (EUT)

BLE Smart Tag
Model: CFXBLE-1
Serial no: DTM-00002 (radiated tests)
DTM-0005 (conducted tests)
FCC ID: 2AMK9-CFXBLE-1
IC: 22897-CFXBLE-1

Description of the EUT

The EUT is a smart tag watch with Bluetooth Low Energy capabilities. The smart tag uses replaceable CR2477 batteries as a power source and it does not have any I/O ports for connecting ancillary equipment.

Classification of the device

Fixed device ☐
Mobile Device (Human body distance > 20cm) ☐
Portable Device (Human body distance < 20cm) ☒

Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

Ratings and Declarations

Operating Frequency Range (OFR): 2402 - 2480 MHz
Channels: 40
Channel separation: 2 MHz
99% Channel bandwidth: 1.079594790 MHz (high channel)
Effective conducted power: 0.74 dBm (peak)
Transmission technique: DSSS
Modulation: GFSK
Antenna gain: 2.15 dBi

Power Supply

Operating voltage range: 3.0 VDC (2 x CR2477 batteries in parallel)

Mechanical Size of the EUT

56 mm x 54 mm x 19 mm

Samples

Two samples were used in tests. One with RF connector replacing antenna for conducted measurements. Both samples were tested with special firmware made for testing purposes.

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	N/A ⁽¹⁾
§15.247(b)(3) / RSS-247 5.4(d)	Maximum Peak Conducted Output Power	PASS
§15.247(a)(2) / RSS-247 5.2(a)	6 dB Bandwidth	PASS
§15.247(e) / RSS-247 5.2(b)	Power Spectral Density	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

1) The EUT cannot be connected to public network, no input/output ports.

EUT Test Conditions

The EUT was in continuous transmit mode during all the tests. The hopping was stopped and the EUT was configured into the wanted channel using software provided by the manufacturer. Normal modulation and duty cycle was applied in all the tests.

The EUT was tested without wristband.

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

Channel Low (Ch 0) = 2402 MHz

Channel Mid (Ch 19) = 2440 MHz

Channel High (Ch 39) = 2480 MHz

Test Facility

<input type="checkbox"/> Testing Location / address: FCC registration number: 90598	SGS Fimko Ltd Särkiniementie 3 FI-00210, HELSINKI FINLAND
<input checked="" type="checkbox"/> Testing Location / address: FCC registration number: 178986 Industry Canada registration number: 8708A-2	SGS Fimko Ltd Karakaarenkuja 4 FI-02610, ESPOO FINLAND

TEST RESULTS

Maximum Peak Conducted Output Power

Standard: ANSI C63.10
Tested by: PKA
Date: 14 July 2017
Temperature: 23 °C
Humidity: 35 % RH
Measurement uncertainty: $\pm 2.87\text{dB}$

Level of confidence 95 % (k = 2)

FCC Rule: 15.247(b)(3)
RSS-247 5.4(4d)

For systems using digital modulation in the 2400-2483.5 MHz bands the limit is 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

Measured values are peak values.

Results:

Maximum conducted output power

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	0.71	30	29.29	PASS
Mid	0.74	30	29.26	PASS
High	0.64	30	29.36	PASS

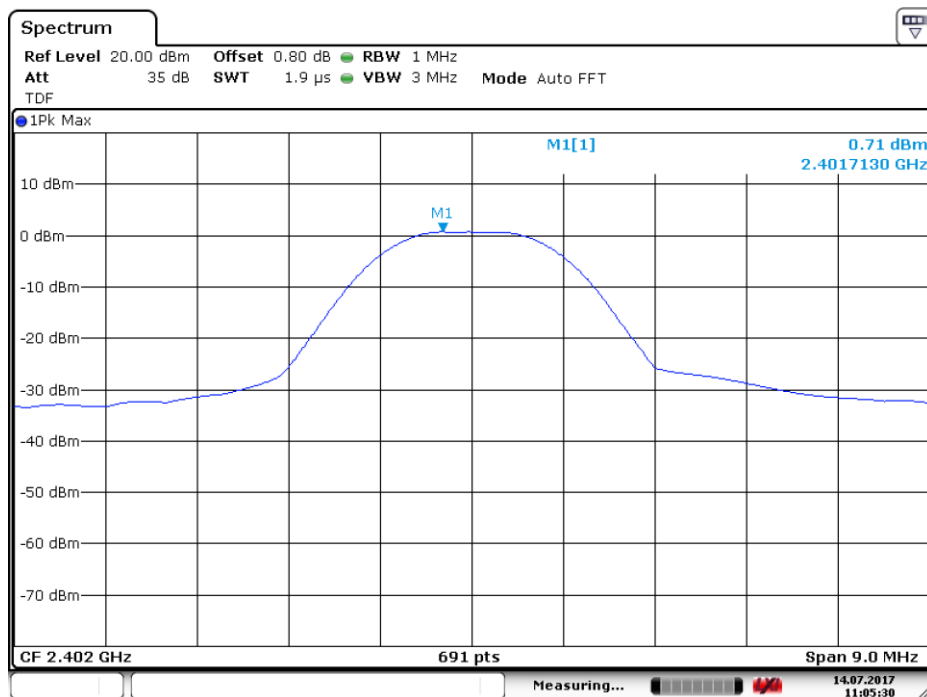


Figure 1: Conducted power (ch low)

Maximum Peak Conducted Output Power

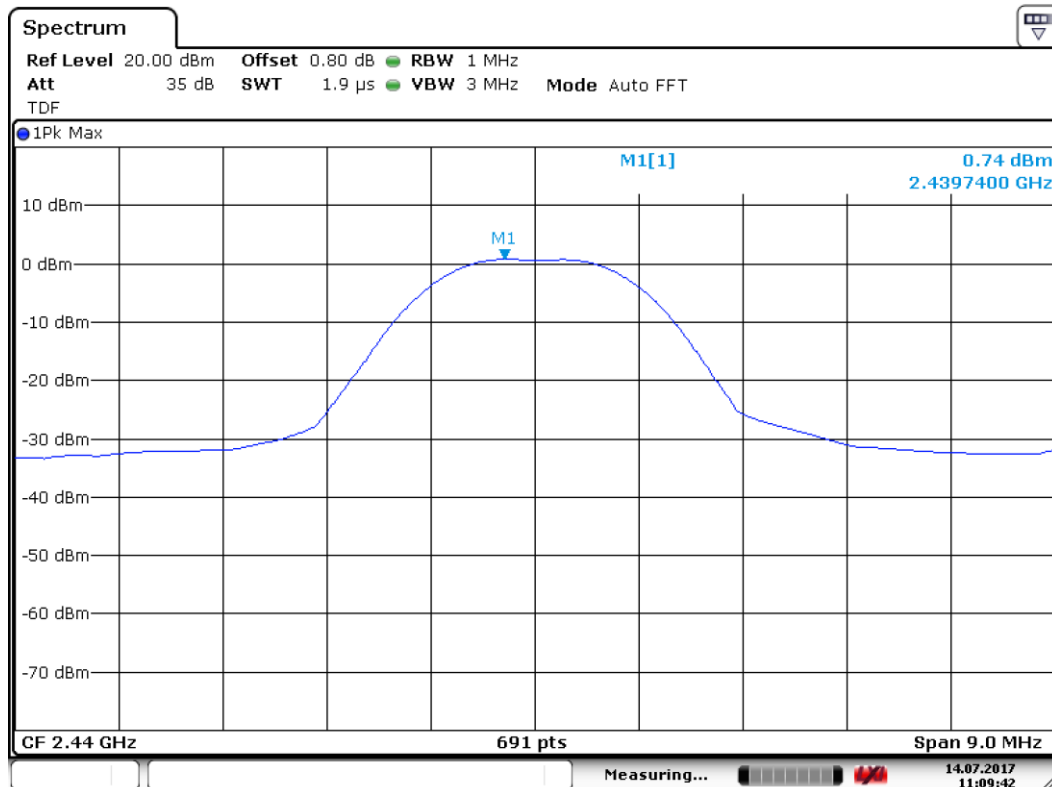


Figure 2: Conducted power (ch mid)

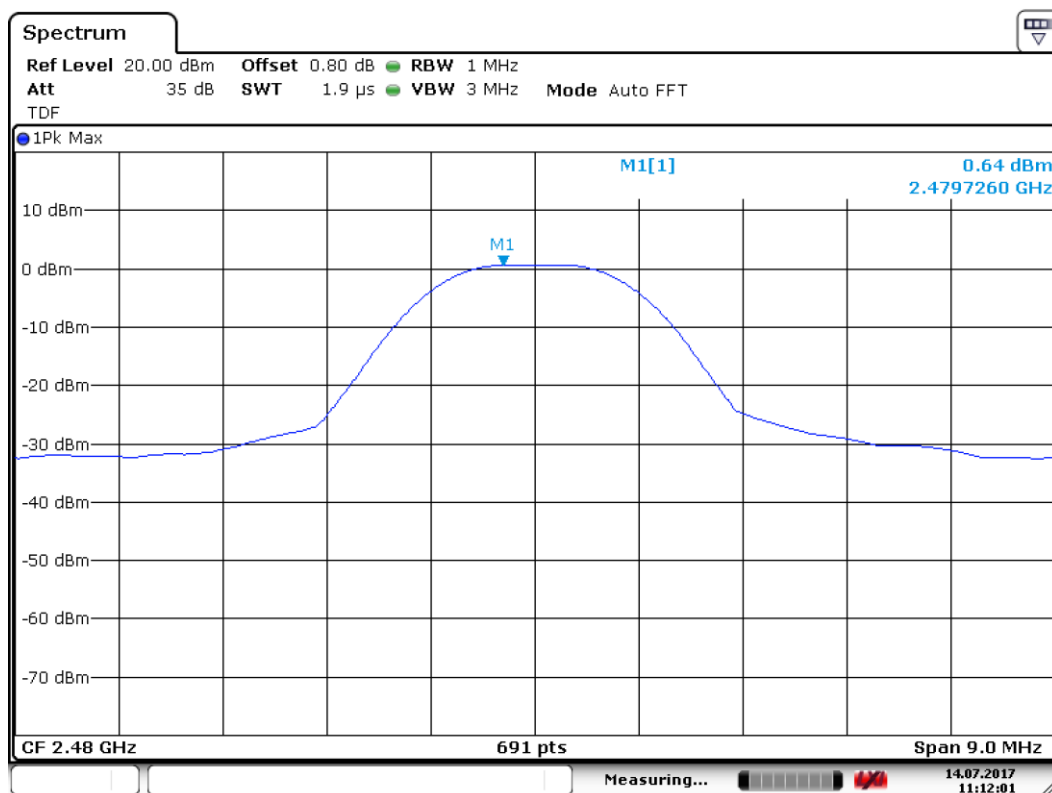


Figure 3: Conducted power (ch high)

Transmitter Radiated Spurious Emissions

Transmitter Radiated Spurious Emissions 9 kHz - 25000 MHz

Standard: ANSI C63.10
Tested by: RRE / PKA
Date: 26 June, 13 July and 26 September 2017
Temperature: 23 °C
Humidity: 23 - 52 % 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. 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).

Table 1: Limits

Frequency range [MHz]	Limit [μ V/m]	Measurement distance	Detector
0.009-0.090	2400/F(kHz)	300	Average
0.090-0.110	2400/F(kHz)	300	Quasi-peak
0.110-0.490	2400/F(kHz)	300	Average
0.490-1.705	24000/F(kHz)	30	Quasi-peak
1.705-30.0	30	30	Quasi-peak

Frequency range [MHz]	Limit [μ V/m]	Limit [dB μ V/m]	Detector
30 - 80	100	40.0	Quasi-peak
88 - 216	150	43.5	Quasi-peak
216 - 960	200	46.0	Quasi-peak
960 - 1000	500	53.9	Quasi-peak
Above 1000	500	53.9	Average
Above 1000	5000	73.9	Peak

Low channel

Table 2: Quasi-peak results (ch low)

No peaks

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
0.009 - 1000	-	1000.0	120.000	-	-	-	-	>10	See table 1

Transmitter Radiated Spurious Emissions

Table 3: Peak results (ch low)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
2384.400000	49.1	1000.0	1000.000	400.0	H	0.0	14.5	24.8	73.9	-
2400.000000	64.1	1000.0	1000.000	248.0	H	172.0	14.7	9.8	73.9	-
4711.500000	48.1	1000.0	1000.000	150.0	H	31.0	8.4	25.8	73.9	-
4804.000000	52.9	1000.0	1000.000	150.0	V	116.0	8.4	21.0	73.9	-

Table 4: Average results (ch low)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
2386.000000	36.9	1000.0	1000.000	269.0	H	180.0	14.5	17.0	53.9	-
2400.000000	44.0	1000.0	1000.000	244.0	H	173.0	14.7	9.9	53.9	-
4804.000000	43.9	1000.0	1000.000	150.0	V	111.0	8.4	10.0	53.9	-
7205.400000	34.4	1000.0	1000.000	150.0	V	332.0	12.4	19.5	53.9	-

Middle channel

Table 5: Quasi-peak results (ch mid)

No peaks

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
0.009 - 1000	-	1000.0	120.000	-	-	-	-	>10	See table 1

Table 6: Peak results (ch mid)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
4879.575000	50.8	1000.0	1000.000	100.0	V	240.0	8.4	23.1	73.9	-

Table 7: Average results (ch mid)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
4879.975000	41.2	1000.0	1000.000	207.0	V	98.0	8.4	12.8	53.9	-

High channel

Table 8: Quasi-peak results (ch high)

No peaks

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
0.009 - 1000	-	1000.0	120.000	-	-	-	-	>10	See table 1

Table 9: Peak results (ch high)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
2483.500000	57.7	1000.0	1000.000	252.0	H	178.0	14.7	16.2	73.9	-
4960.425000	49.7	1000.0	1000.000	168.0	V	64.0	8.3	24.2	73.9	-

Transmitter Radiated Spurious Emissions

Table 10: Average results (ch high)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)	Comment
2487.900000	40.8	1000.0	1000.000	254.0	H	178.0	14.8	13.1	53.9	-
4959.975000	42.3	1000.0	1000.000	196.0	V	60.0	8.3	11.6	53.9	-

Radiated Band Edge results

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

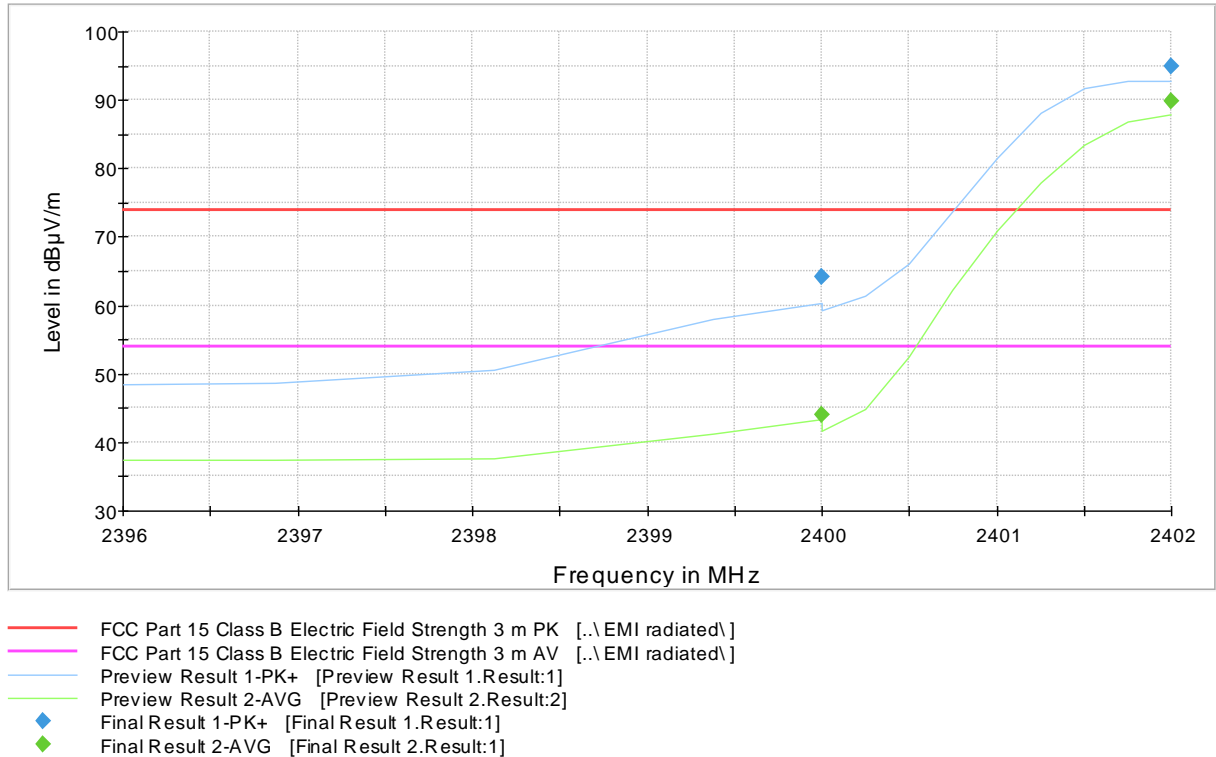


Figure 4: Radiated Band Edge measurement graph (ch low)

Transmitter Radiated Spurious Emissions

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

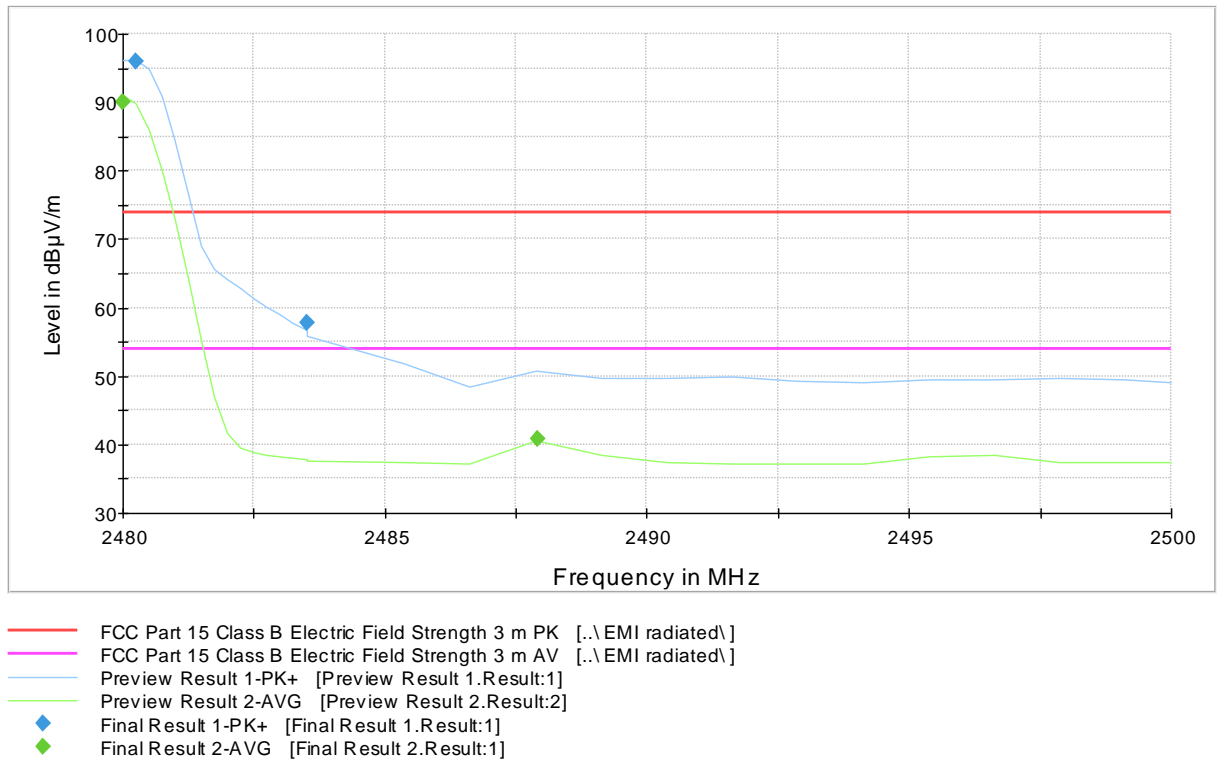


Figure 5: Radiated Band Edge measurement graph (ch high)

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard: ANSI C63.10
Tested by: PKA
Date: 14 July 2017
Temperature: 23 °C
Humidity: 35 % RH
Measurement uncertainty: ± 2.87 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) (see Section 15.205(c)).

Table 11: Band edge attenuation

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
margin > 20 dB	margin > 20dB
Limit: -20dBc	

Table 12: Conducted spurious emissions channel low

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
all	-	-20dBc	>20	PASS

Table 13: Conducted spurious emissions channel mid

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
all	-	-20dBc	>20	PASS

Table 14: Conducted spurious emissions channel high

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
all	-	-20dBc	>20	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

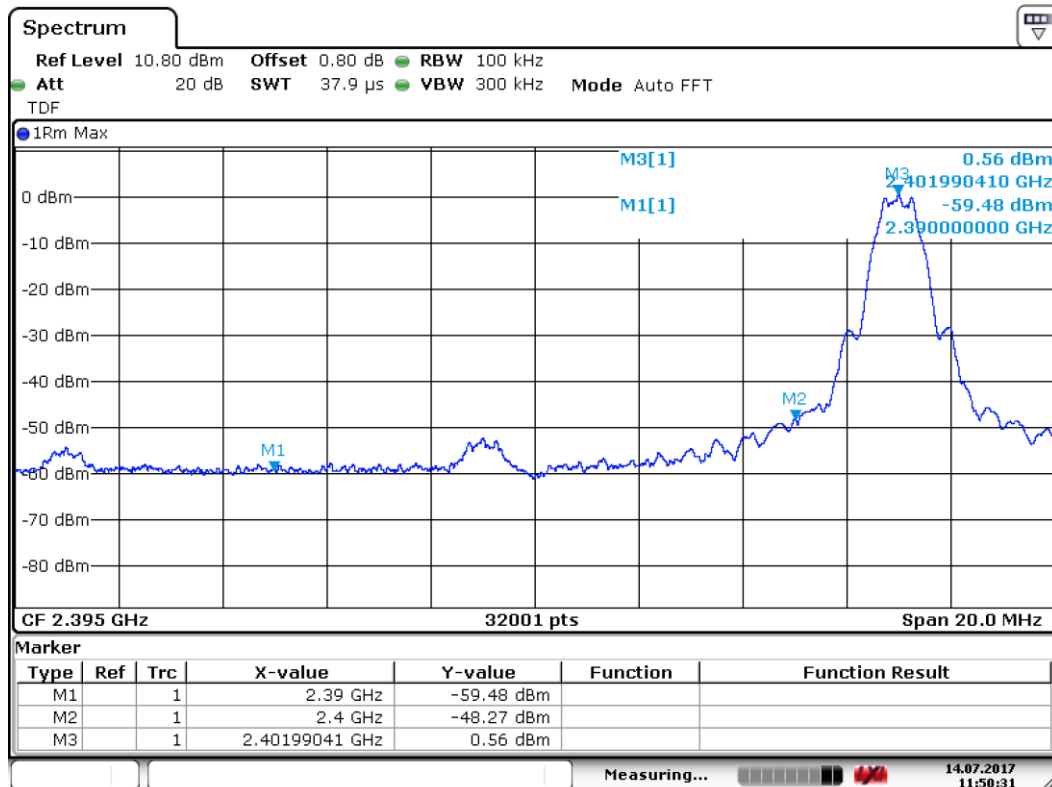


Figure 6: Lower Band Edge

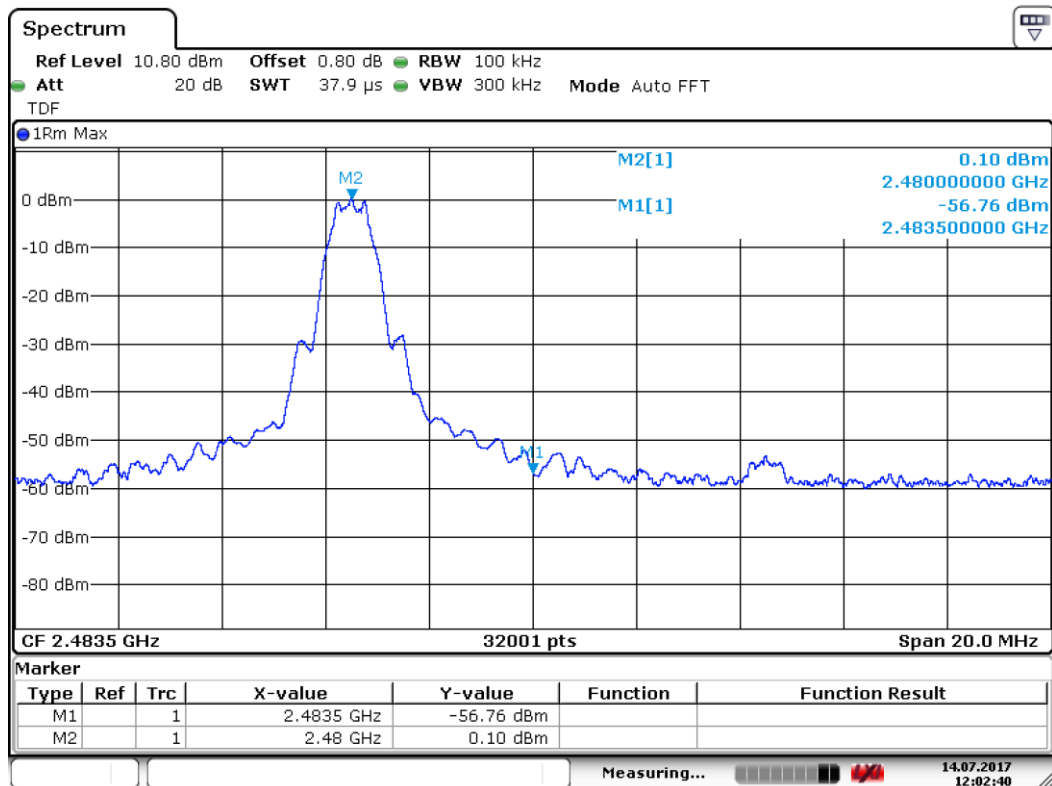


Figure 7: Upper Band Edge

Transmitter Band Edge Measurement and Conducted Spurious Emissions

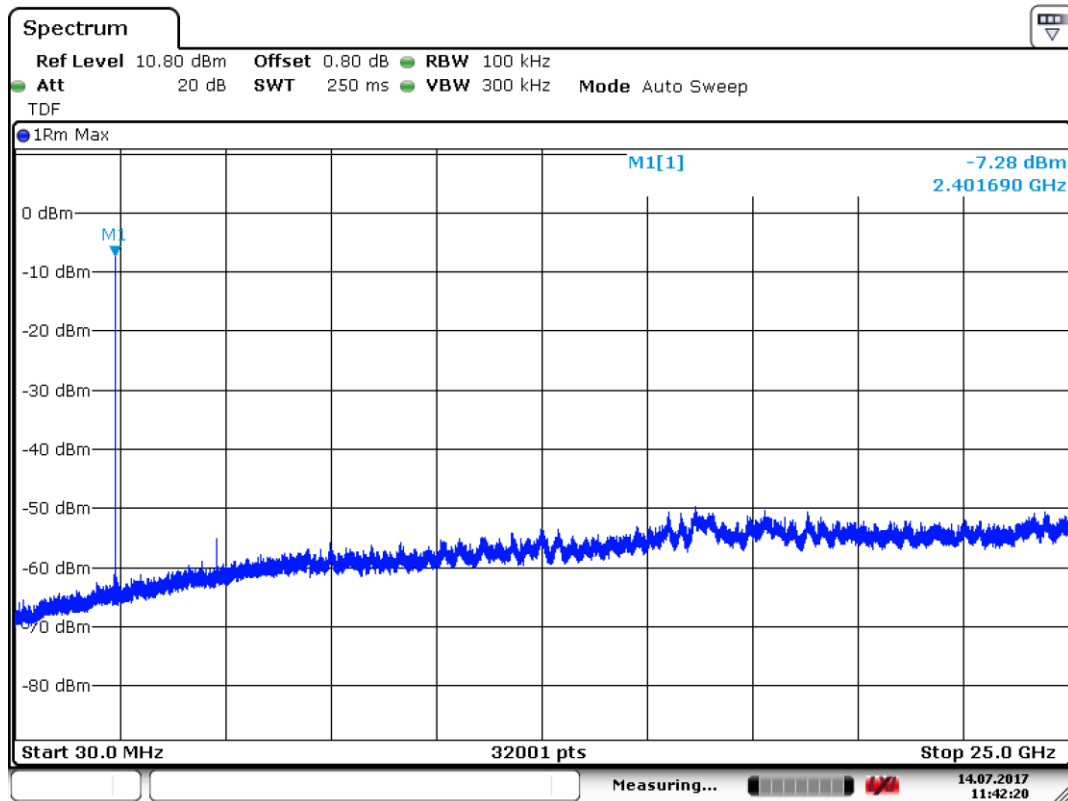


Figure 8: Conducted spurious emissions 30 - 25000 MHz channel low

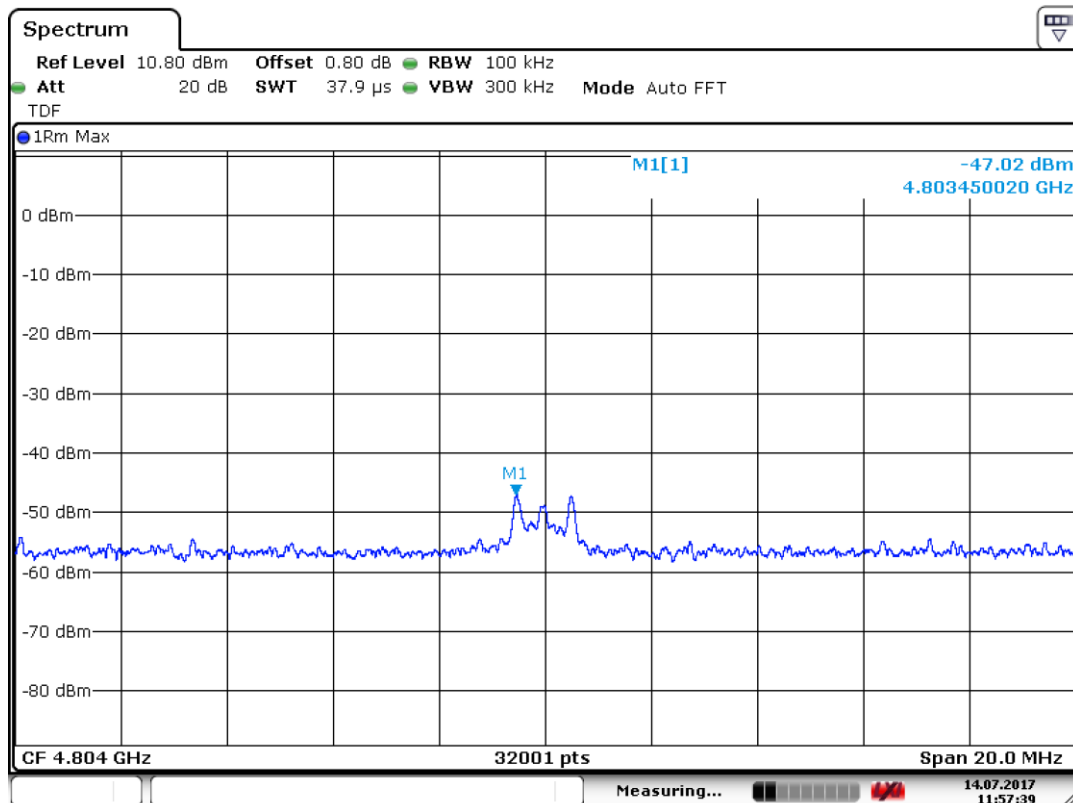


Figure 9: Conducted spurious emissions, low, 2nd harmonic

Transmitter Band Edge Measurement and Conducted Spurious Emissions

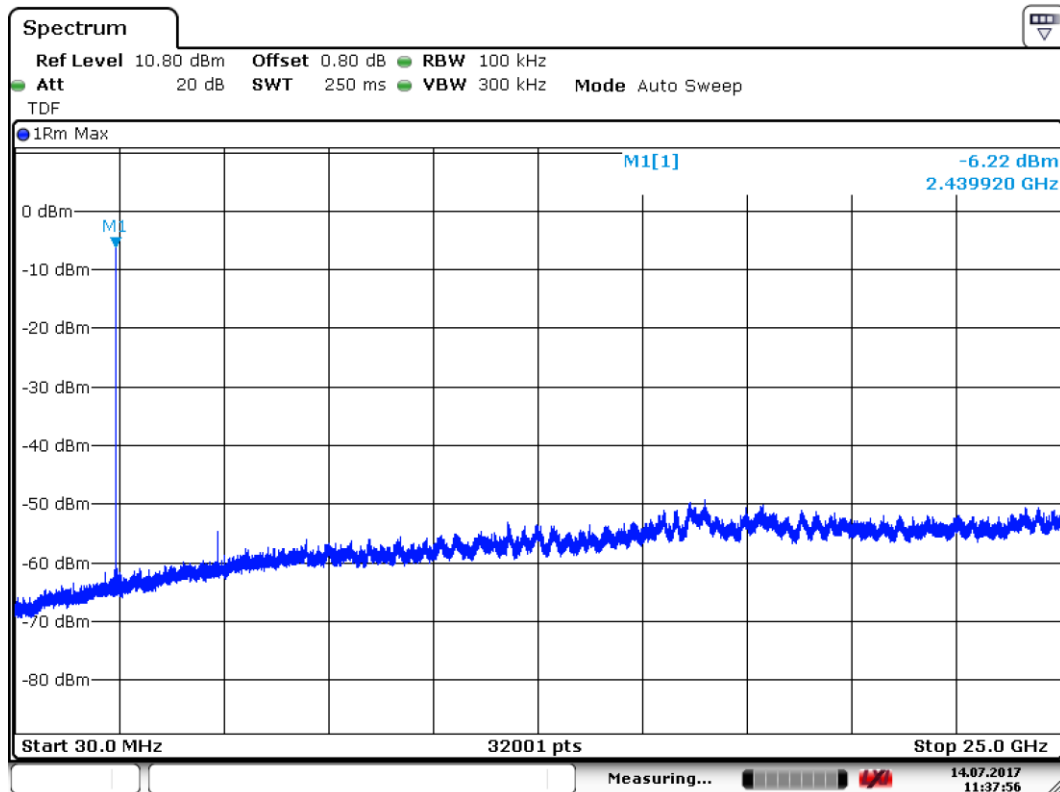


Figure 10: Conducted spurious emissions 30 - 25000 MHz channel mid

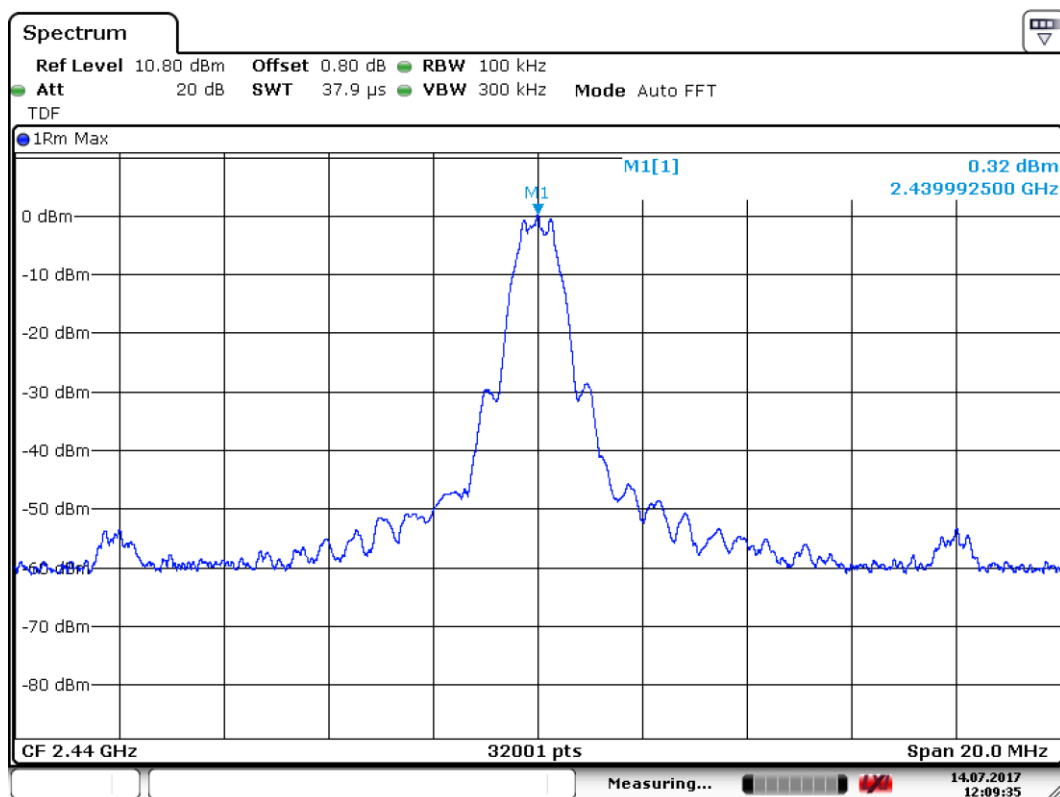


Figure 11: Conducted spurious emissions, mid channel

Transmitter Band Edge Measurement and Conducted Spurious Emissions

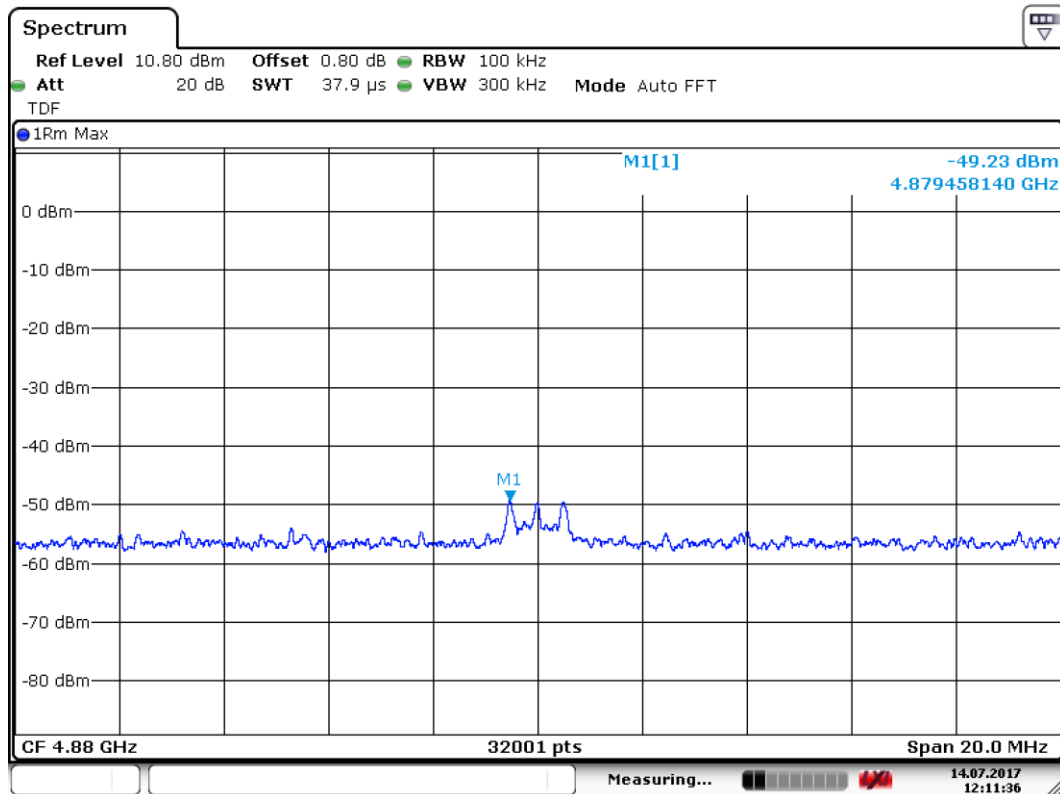


Figure 12: Conducted spurious emissions, mid 2nd harmonic

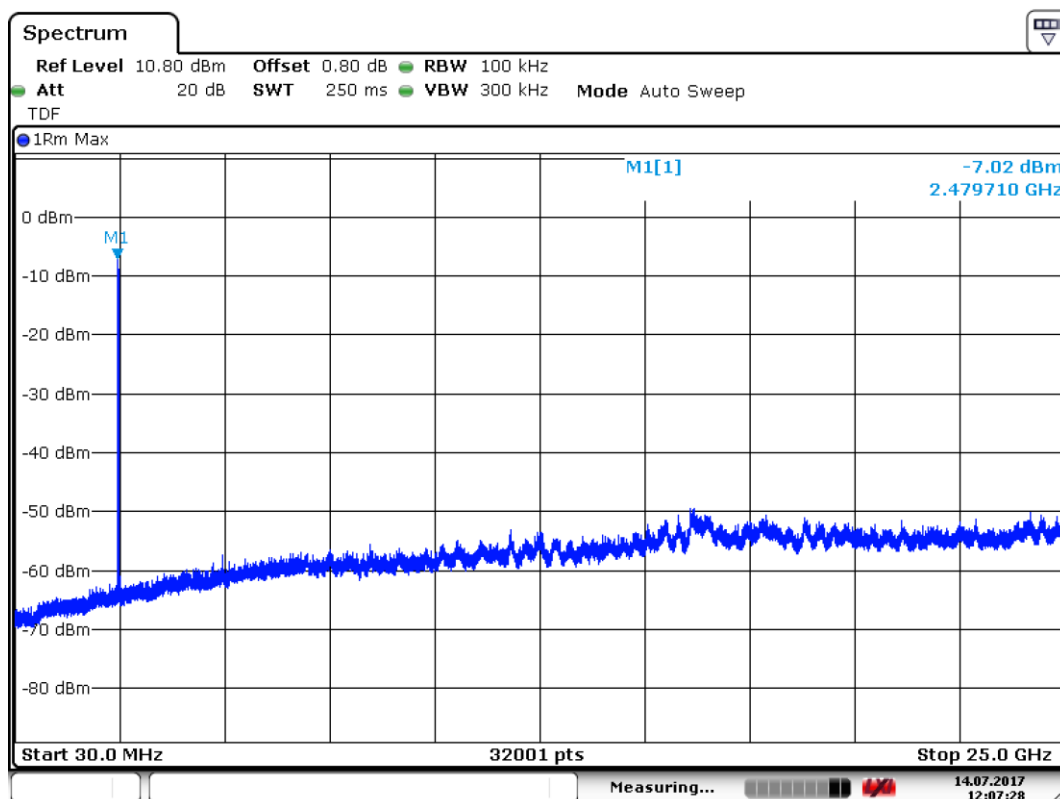


Figure 13: Conducted spurious emissions 30 - 26500 MHz channel high

Transmitter Band Edge Measurement and Conducted Spurious Emissions

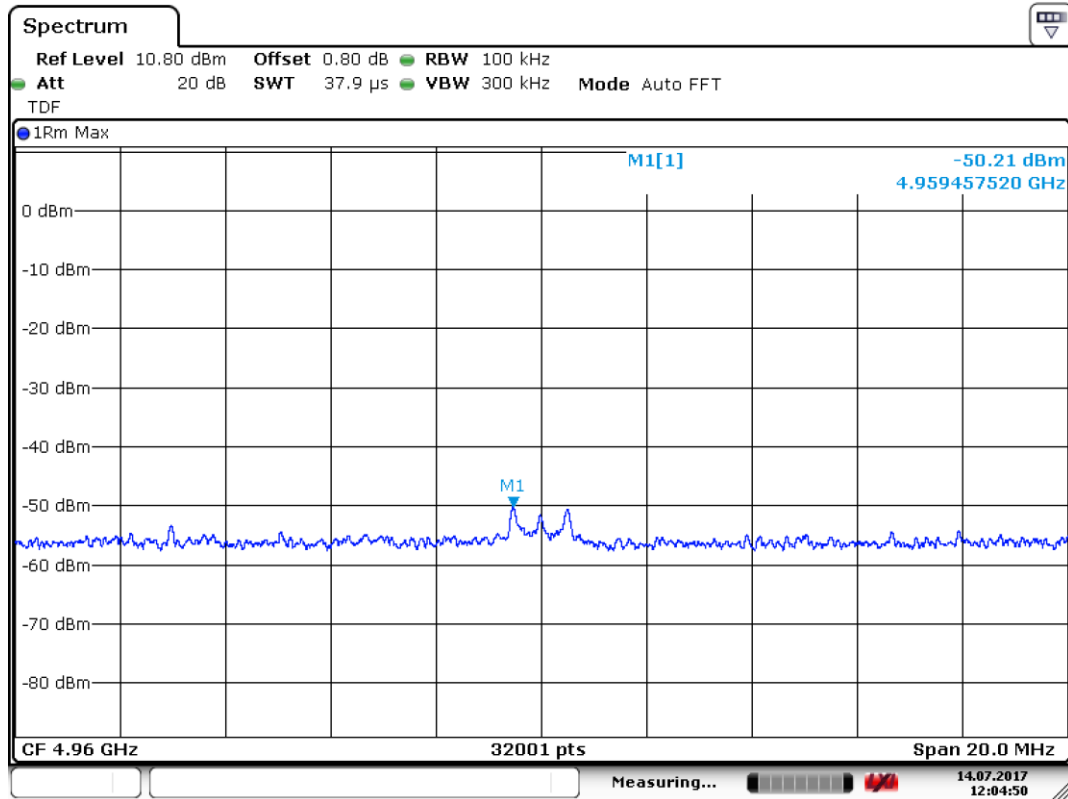


Figure 14: Conducted spurious emissions, high 2nd harmonic

6 dB Bandwidth of the Channel

Standard: ANSI C63.10
Tested by: PKA
Date: 14 July 2017
Temperature: 23 °C
Humidity: 35 % RH

FCC Rule: 15.247(a)(2)
RSS-247 5.2(a)

Results:

Table 15: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	720.700	500
Mid	729.400	
High	732.300	

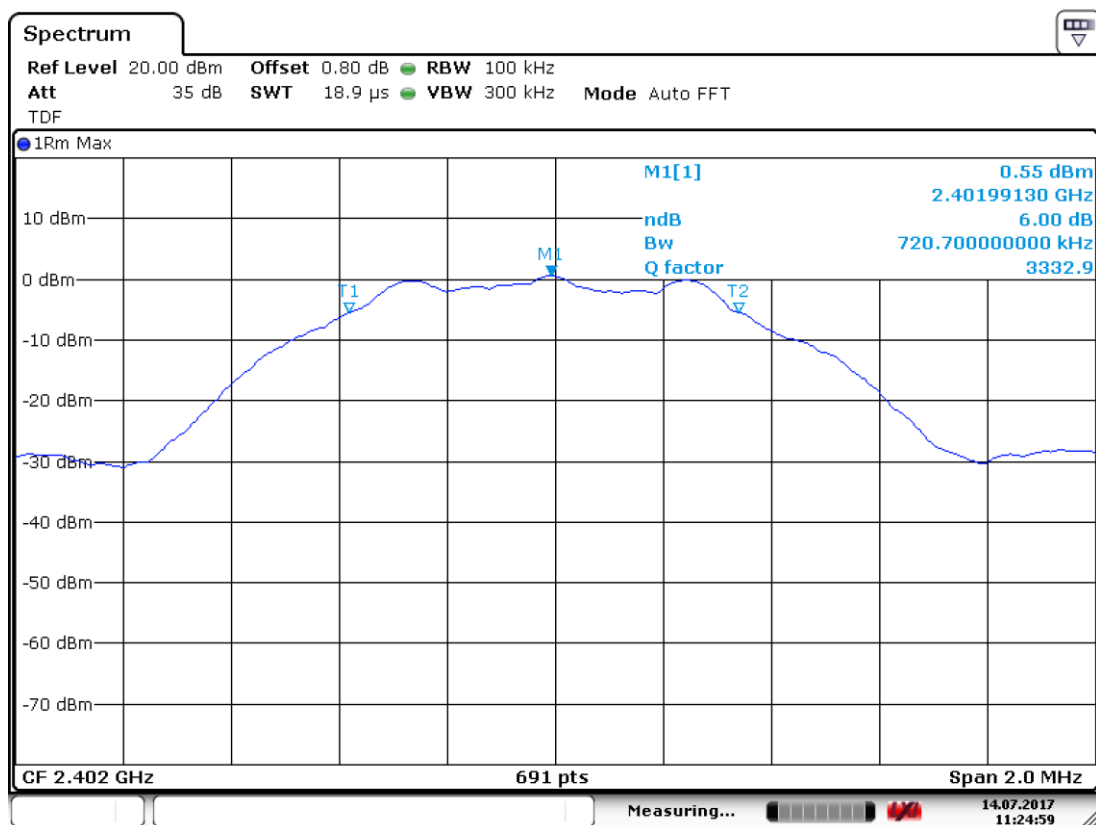


Figure 15: 6 dB bandwidth channel low

6 dB Bandwidth of the Channel

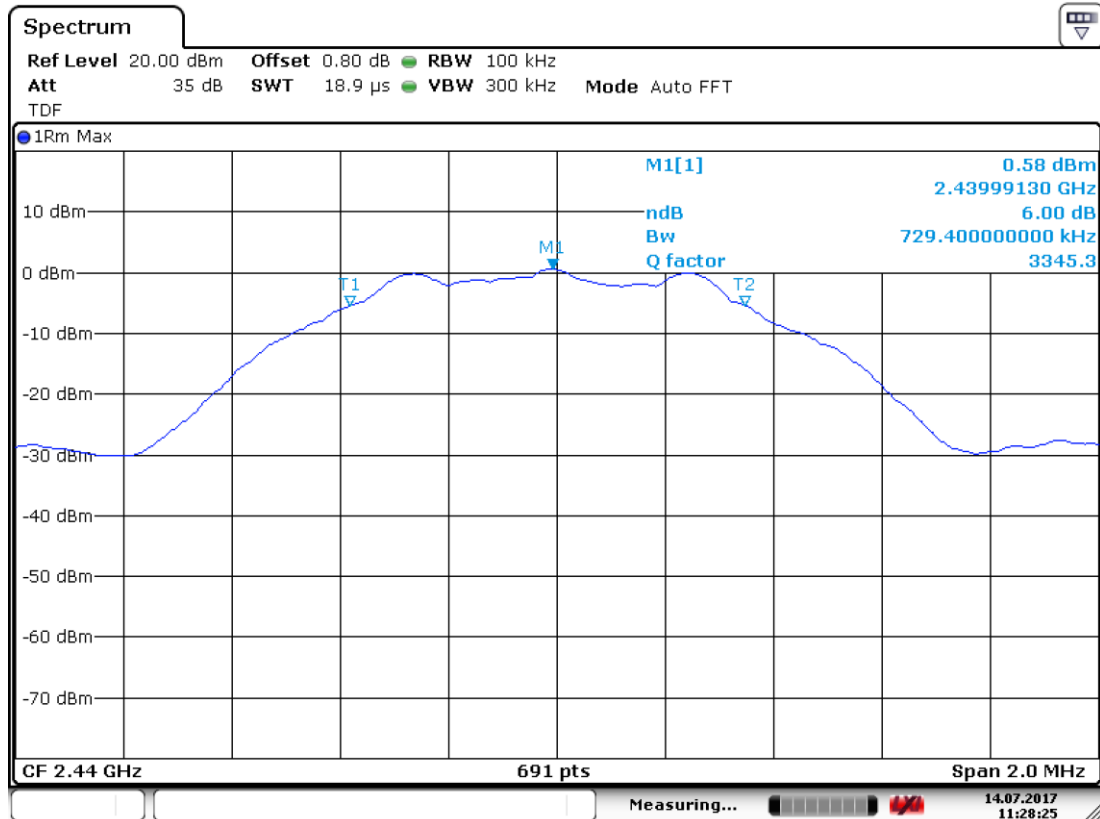


Figure 16: 6 dB bandwidth channel mid

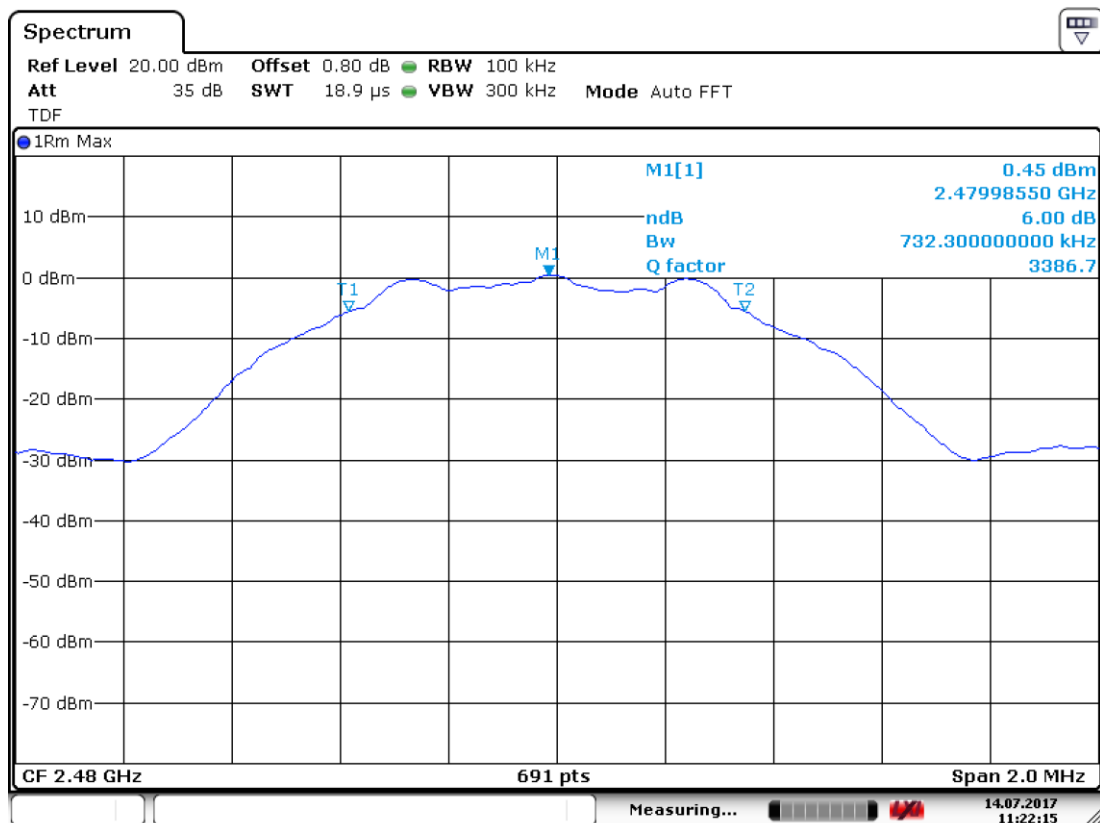


Figure 17: 6 dB bandwidth channel high

Power Spectral Density

Standard: ANSI C63.10
Tested by: PKA
Date: 14 July 2017
Temperature: 23 °C
Humidity: 35 % RH

FCC Rule: 15.247(e)
RSS-247 5.2(b)

Results:

Table 16: Power spectral density test results

Channel	PSD dBm/10 kHz	Maximum limit [dBm/3kHz]
Low	-14.86	+8.00
Mid	-14.79	
High	-14.99	

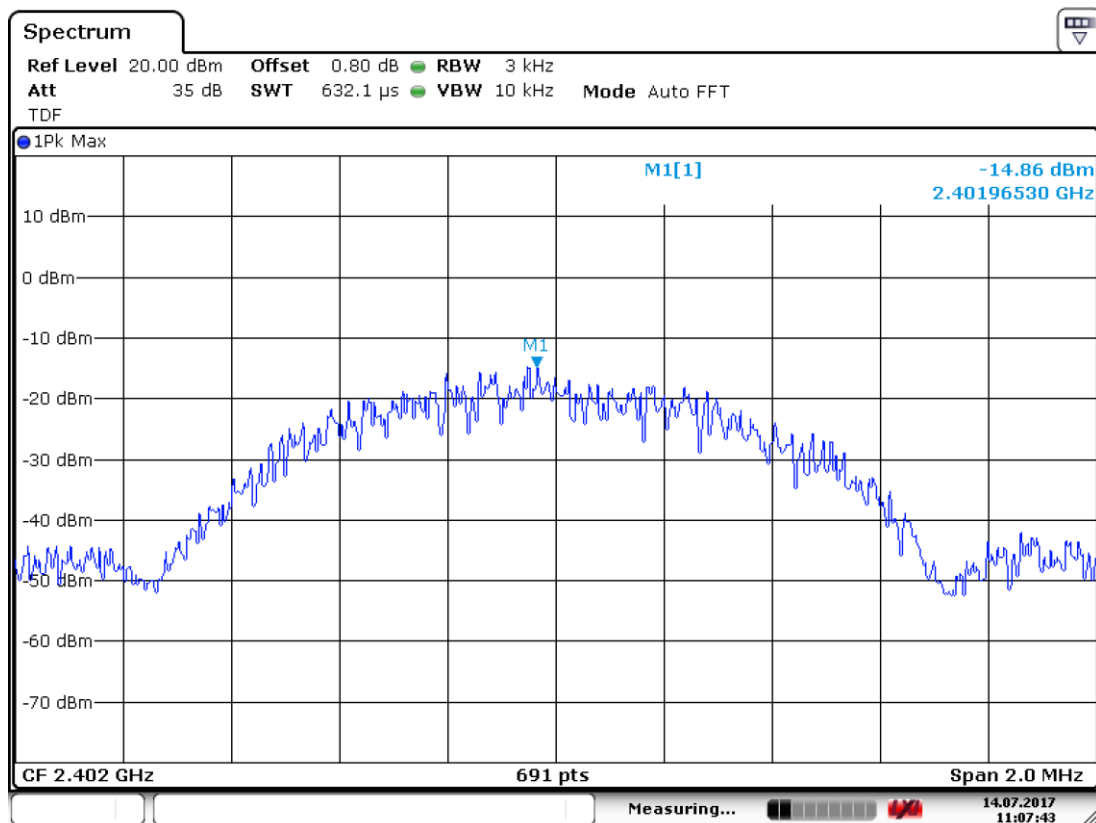


Figure 18: Power spectral density channel low

Power Spectral Density

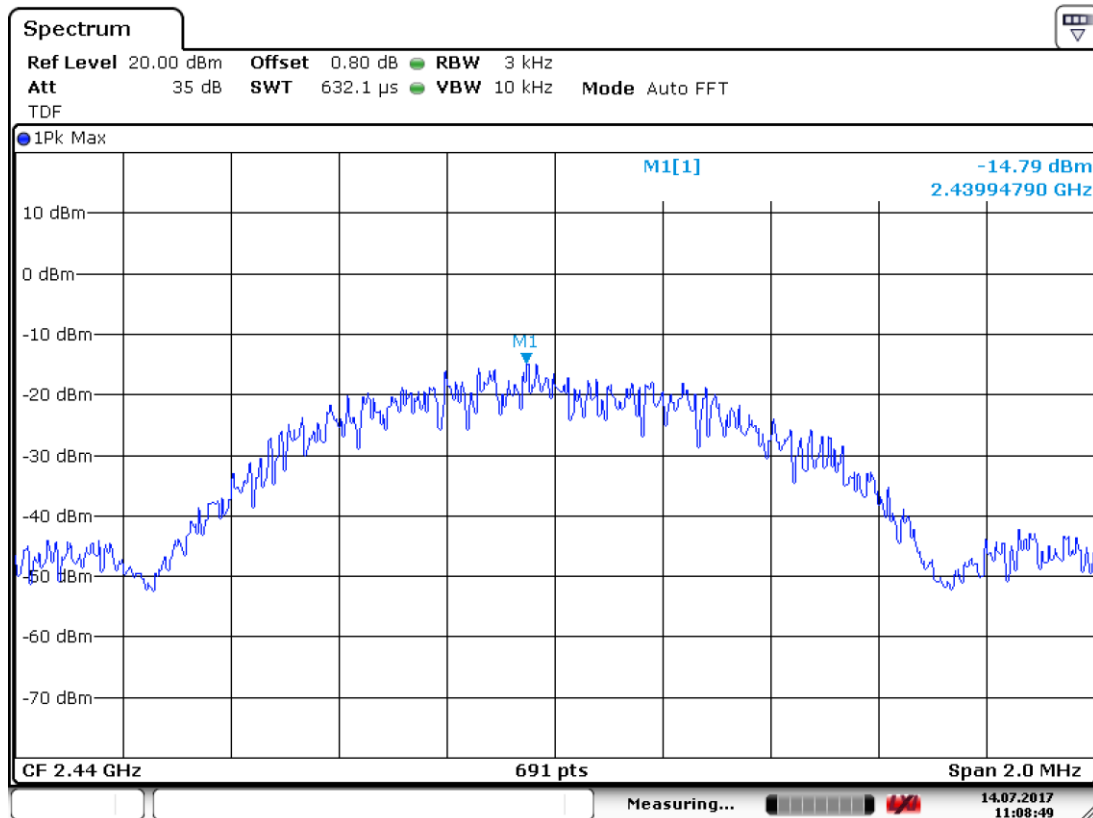


Figure 19: Power spectral density channel mid

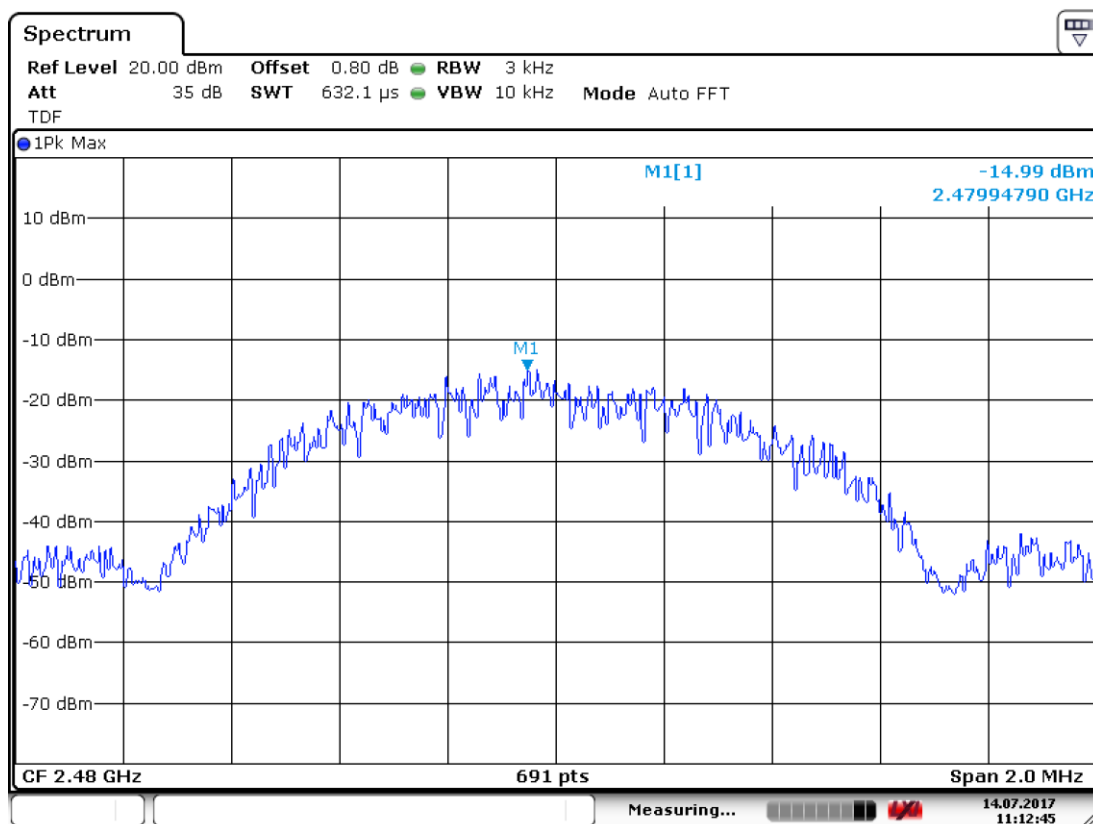


Figure 20: Power spectral density channel high

99% Occupied Bandwidth

Standard: RSS-GEN
Tested by: PKA
Date: 14 July 2017
Temperature: 23 °C
Humidity: 35 % RH

RSS-GEN 6.6

Table 17: 99% occupied bandwidth test results

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.070911722	PASS
Mid	-	1.073806078	PASS
High	-	1.079594790	PASS

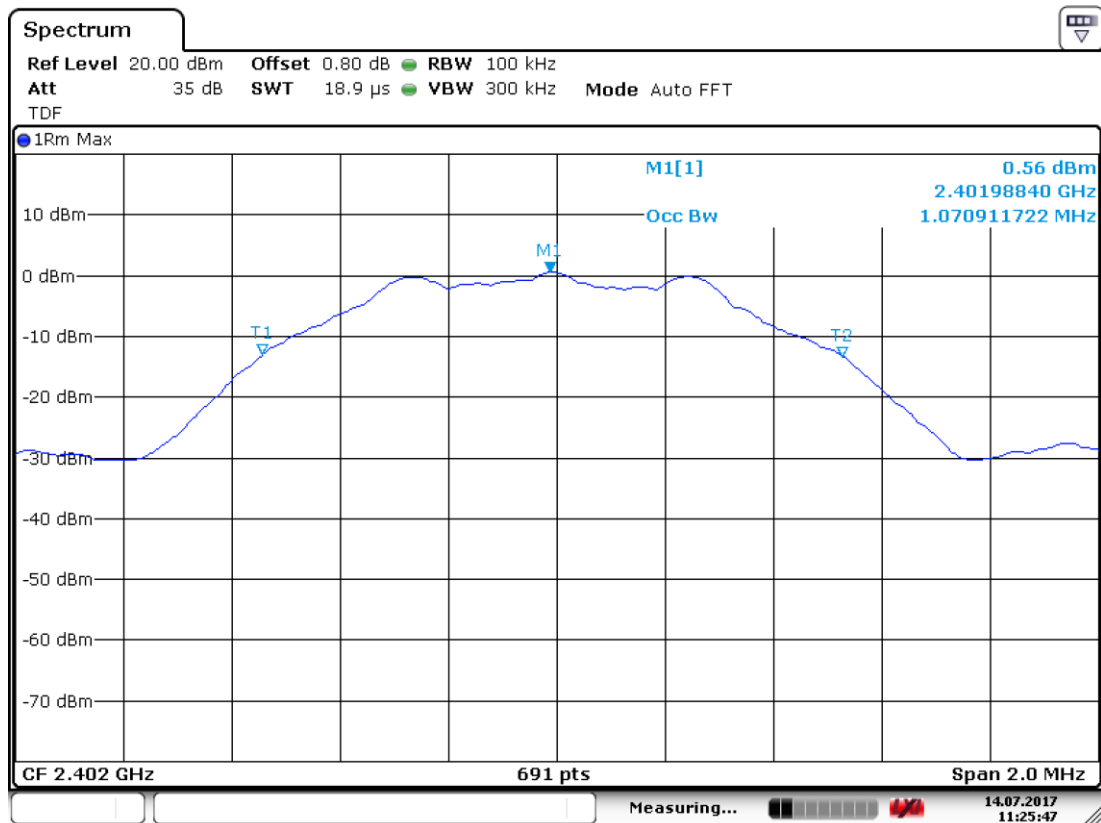


Figure 21: 99% OBW channel low

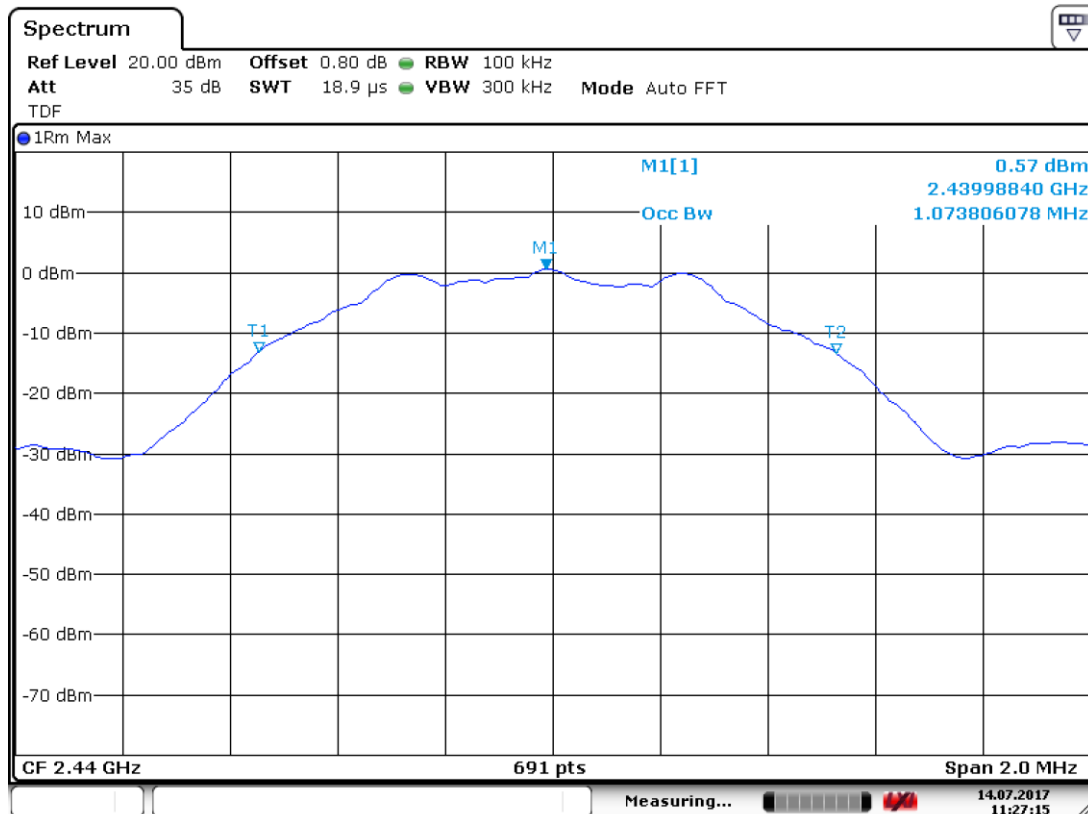


Figure 22: 99% OBW channel mid

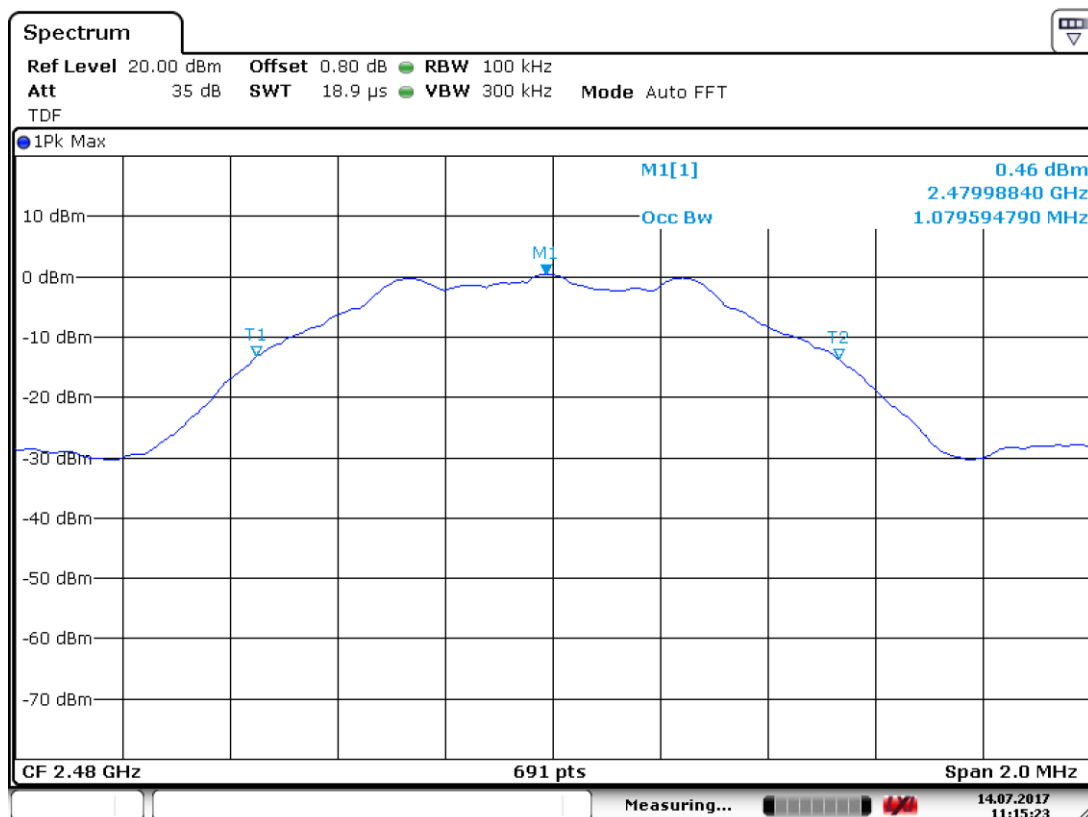


Figure 23: 99% OBW channel high

TEST EQUIPMENT

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	-	-
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2	inv:8013	2016-08-29	2018-08-29
SPECTRUM ANALYZER	AGILENT	E7405A	inv:9746	2016-01-07	2018-01-07
PREAMPLIFIER	CIAO	CA118-3123	inv:10278	2016-11-28	2017-11-28
PREAMPLIFIER	ALC MICROWAVE	AWB-2018-40-08	inv:9749	2016-08-30	2017-08-30
DC-POWER SUPPLY	DELTA ELEKTRONIKA	SM 130-25D	sn:03494	-	-
ANTENNA	EMCO	3117	inv:7293	2016-03-16	2018-03-16
ANTENNA	EMCO	3160-09	inv:7294	2017-03-16	2018-03-16
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU 26	inv:8453	2017-07-10	2018-07-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2017-07-07	2018-07-07
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv:8013	2016-08-29	2017-08-29
ANTENNA	SCHWARZBECK	VULB 9168	inv:8911	2016-10-25	2018-10-25