SGS

Test Report

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

INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test:	Sports vehicles OBD diagnostic dongle
Model:	OBD-micro
Manufacturer:	Compo USA Inc. Suite 106 1301 Wake Forest Rd RALEIGH, NC 27604 USA
Customer:	Componentality Oy Äyritie 12 A FI-01510 VANTAA FINLAND
FCC Rule Part:	15.247: 2015
IC Rule Part:	RSS-247, Issue 1, 2015 RSS-GEN Issue 4, 2014
KDB:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 (June 9, 2015)

Date: 31 August 2017
Issued by:
Emil Haverinen
Testing Engineer

Date: 31 August 2017
Checked by:
Rauno Repo
Testing Engineer

Table of Contents

Equipment Under Test (EUT)

Model:	OBD-micro
Type:	Sports vehicles OBD diagnostic dongle
Serial no:	-
FCC ID:	2AJ3M-MSSDK
IC:	22034-MSSDK

Description of the EUT

The EUT is a diagnostics tool to be used for vehicle diagnostics. Vehicle information, fault codes and other parameters are sent via Bluetooth Low Energy connection when asked from the EUT to the smart device which has the OBD software installed. The EUT is powered from vehicle's battery.

Classification of the device

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

Modifications Incorporated in the EUT

The EUT was tested without its plastic enclosure. Debug/programming pins and cables of the device were still attached for controlling the radio.

Ratings and declarations

Operating Frequency Range (OFR):	2402 - 2480 MHz
Channels:	40
Channel separation:	2 MHz
99% Channel bandwidth:	1.531827130 MHz (ch mid)
Effective conducted power:	-10.64 dBm
Transmission technique:	DSSS
Modulation:	GFSK
Integral Antenna gain:	1 dBi

Power Supply

Operating voltage range:	12 VDC (tested with 3.3 V provided by programming device , 12 V is regulated before it enters the RF chip)

Mechanical Size of the EUT

Height: 18.5 mm Width: 18.7 mm Length: 35.4 mm

Samples

Two samples were used in the testing. Normal commercial sample with integral antenna for radiated emissions and a sample with integral antenna removed and replaced with 50Ω coaxial cable and SMA-connector for conducted RF tests. During the tests the EUT was set into continuous transmit and was set to the channel under test. Normal test modulation and maximum transmit power was used in all tests. No modifications were done during the tests.

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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(4)	Maximum Peak Conducted Output Power	**PASS**
§15.247(a)(2) / RSS-247 5.2(1)	6 dB Bandwidth	**PASS**
§15.247(e) / RSS-247 5.2(2)	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 is powered from the vehicle battery.

EUT Test Conditions During Testing

The EUT was in continuous transmit mode during all the tests. The EUT was configured into wanted channel under the test using special software.

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

☐ 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

TEST RESULTS

Maximum Peak Conducted Output Power

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	2 September 2016	
Temperature:	22 °C	
Humidity:	53 %	
Measurement uncertainty:	± 2.87dB	Level of confidence 95 % (k = 2)

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

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.

Measurements were made using averaging power meter.

Results:

Table 1: Maximum average conducted output power

Channel	Conducted Power [dBm]	Limit [dBm]	Margin [dBm]	Result
Low	-10.64	30	40.64	PASS
Mid	-11.63	30	41.63	PASS
High	-12.69	30	42.69	PASS

Transmitter Radiated Spurious Emissions 9 kHz – 26500 MHz

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	2 September 2016 23 August 2017	
Temperature:	21 - 22 °C	
Humidity:	43 - 53 %	
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).

Peak values of emissions below 1000 MHz measured for reference as well as transmitter fundamental.

Frequency range [MHz]	Limit [µV/m]	Limit [dBµV/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)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
35.848000	**9.8**	**1000.0**	**120.000**	**246.0**	**V**	**200.0**	**13.5**	**30.2**	**40.0**

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)
35.848000	**16.1**	**1000.0**	**120.000**	**246.0**	**V**	**200.0**	**13.5**	**-**	**-**
2390.000000	**50.3**	**1000.0**	**1000.000**	**166.0**	**H**	**223.0**	**3.0**	**23.6**	**73.9**
2400.000000	**54.2**	**1000.0**	**1000.000**	**166.0**	**H**	**223.0**	**3.0**	**19.7**	**73.9**
2402.250000	**81.8**	**1000.0**	**1000.000**	**166.0**	**H**	**220.0**	**3.0**	**-**	**-**
4803.950000	**66.9**	**1000.0**	**1000.000**	**150.0**	**H**	**230.0**	**6.2**	**7.0**	**73.9**
17112.25000	**60.6**	**1000.0**	**1000.000**	**382.0**	**V**	**246.0**	**24.0**	**13.3**	**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)
2390.000000	35.8	1000.0	1000.000	166.0	H	223.0	3.0	18.1	53.9
2400.000000	36.4	1000.0	1000.000	166.0	H	223.0	3.0	17.5	53.9
2402.050000	77.4	1000.0	1000.000	166.0	H	223.0	3.0	-	-
4803.950000	50.1	1000.0	1000.000	150.0	H	230.0	6.2	3.8	53.9
17096.75000	47.2	1000.0	1000.000	311.0	H	26.0	24.0	6.7	53.9
21423.95000	36.7	1000.0	1000.000	400.0	V	268.0	21.1	17.2	53.9
23517.20000	38.2	1000.0	1000.000	400.0	V	253.0	24.2	15.7	53.9
26495.55000	37.5	1000.0	1000.000	340.0	V	333.0	26.2	16.4	53.9

Middle channel

Table 5: Quasi-peak results (ch mid)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
938.271000	26.6	1000.0	120.000	190.0	H	15.0	27.6	19.4	46.0

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)
938.271000	32.8	1000.0	120.000	190.0	H	15.0	27.6	-	-
2440.050000	80.0	1000.0	1000.000	166.0	H	223.0	2.9	-	-
4879.600000	63.2	1000.0	1000.000	150.0	H	230.0	6.3	10.7	73.9
17105.45000	60.2	1000.0	1000.000	150.0	V	64.0	24.1	13.7	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)
2439.900000	75.6	1000.0	1000.000	166.0	H	223.0	2.9	-	-
4880.050000	50.6	1000.0	1000.000	150.0	H	231.0	6.3	3.3	53.9
17185.55000	47.5	1000.0	1000.000	150.0	V	131.0	23.9	6.4	53.9
22423.40000	36.5	1000.0	1000.000	392.0	V	357.0	22.6	17.4	53.9
24429.55000	38.1	1000.0	1000.000	400.0	H	50.0	23.6	15.8	53.9
26495.65000	37.4	1000.0	1000.000	340.0	V	169.0	26.2	16.5	53.9

High channel

Table 8: Quasi-peak results (ch high)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
32.399000	11.9	1000.0	120.000	100.0	V	198.0	13.1	28.1	40.0
47.321000	17.1	1000.0	120.000	100.0	V	180.0	14.6	22.9	40.0
82.278000	7.2	1000.0	120.000	100.0	V	180.0	9.4	32.8	40.0
944.973000	26.7	1000.0	120.000	275.0	H	148.0	27.7	19.3	46.0

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)
32.399000	35.6	1000.0	120.000	100.0	V	198.0	13.1	-	-
47.321000	38.5	1000.0	120.000	100.0	V	350.0	14.6	-	-
82.278000	28.8	1000.0	120.000	100.0	V	180.0	9.4	-	-
944.973000	32.8	1000.0	120.000	275.0	H	148.0	27.7	-	-
2480.250000	77.6	1000.0	1000.000	150.0	H	219.0	3.1	-	-
2490.300000	49.6	1000.0	1000.000	150.0	H	6.0	3.2	24.3	73.9
4960.350000	58.5	1000.0	1000.000	150.0	H	123.0	6.3	15.4	73.9

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)
2480.050000	73.0	1000.0	1000.000	150.0	H	218.0	3.1	-	-
2492.700000	35.8	1000.0	1000.000	150.0	H	35.0	3.3	18.1	53.9
4959.950000	49.1	1000.0	1000.000	150.0	H	122.0	6.3	4.8	53.9
20438.85000	36.1	1000.0	1000.000	400.0	V	168.0	19.7	17.8	53.9
24856.20000	36.9	1000.0	1000.000	366.0	H	214.0	23.3	17.0	53.9

Radiated Band Edge results

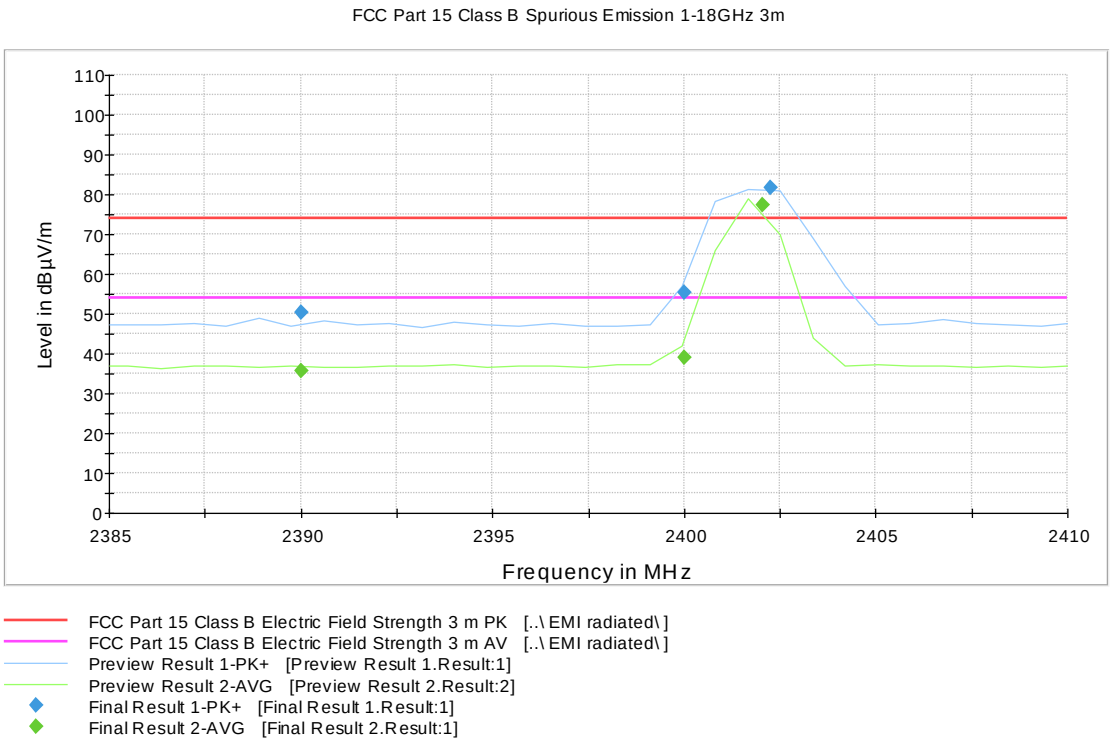

Figure 1: Radiated Band Edge measurement graph (ch low)

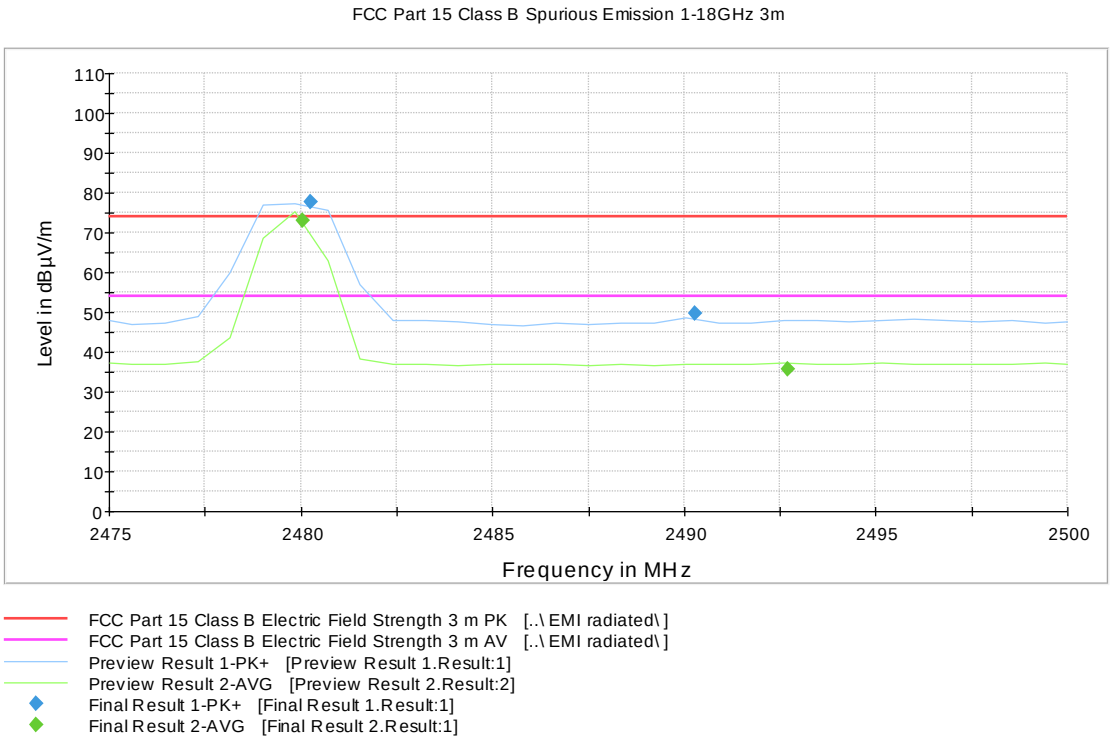

Figure 2: Radiated Band Edge measurement graph (ch high)

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	2 September 2016	
Temperature:	22 °C	
Humidity:	53 %	
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**
-40.56 dBc	-45.89 dBc
Limit: -20dBc	

Table 12: Conducted spurious emissions channel low

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
91.88	-57.24	-30.72	-26.52	PASS
2399.89	-50.88	-30.72	-20.16	PASS
2402.00	-10.72	-	-	Carrier
3802.03	-65.77	-30.72	-35.05	PASS
4803.74	-42.60	-30.72	-11.88	PASS
7206.76	-60.78	-30.72	-30.07	PASS
12518.09	-59.17	-30.72	-28.46	PASS
15836.27	-56.87	-30.72	-26.15	PASS
16225.51	-54.76	-30.72	-24.04	PASS
19169.82	-57.09	-30.72	-26.38	PASS
24839.36	-56.82	-30.72	-26.10	PASS
25575.58	-55.96	-30.72	-25.24	PASS

Table 13: Conducted spurious emissions channel mid

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
91.85	-56.71	-31.06	-25.65	PASS
2128.69	-66.07	-31.06	-35.01	PASS
2439.98	-11.06	-	-	Carrier
3982.40	-65.76	-31.06	-34.70	PASS
4879.39	-47.21	-31.06	-16.15	PASS
7320.01	-54.95	-31.06	-23.89	PASS
12497.38	-58.93	-31.06	-27.87	PASS
15833.74	-57.03	-31.06	-25.97	PASS
16105.14	-55.68	-31.06	-24.61	PASS
21208.35	-56.62	-31.06	-25.56	PASS
24428.94	-56.59	-31.06	-25.53	PASS
25009.87	-56.41	-31.06	-25.35	PASS

Table 14: Conducted spurious emissions channel high

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
91.91	-57.10	-31.05	-26.05	PASS
1978.37	-67.99	-31.05	-36.93	PASS
2479.99	-11.05	-	-	Carrier
2499.26	-51.85	-31.05	-20.79	PASS
4960.02	-49.17	-31.05	-18.12	PASS
7440.00	-54.01	-31.05	-22.95	PASS
12444.31	-59.13	-31.05	-28.08	PASS
15848.83	-56.37	-31.05	-25.31	PASS
16158.67	-55.71	-31.05	-24.65	PASS
19147.70	-57.29	-31.05	-26.23	PASS
24405.97	-56.43	-31.05	-25.38	PASS
25579.29	-55.96	-31.05	-24.90	PASS

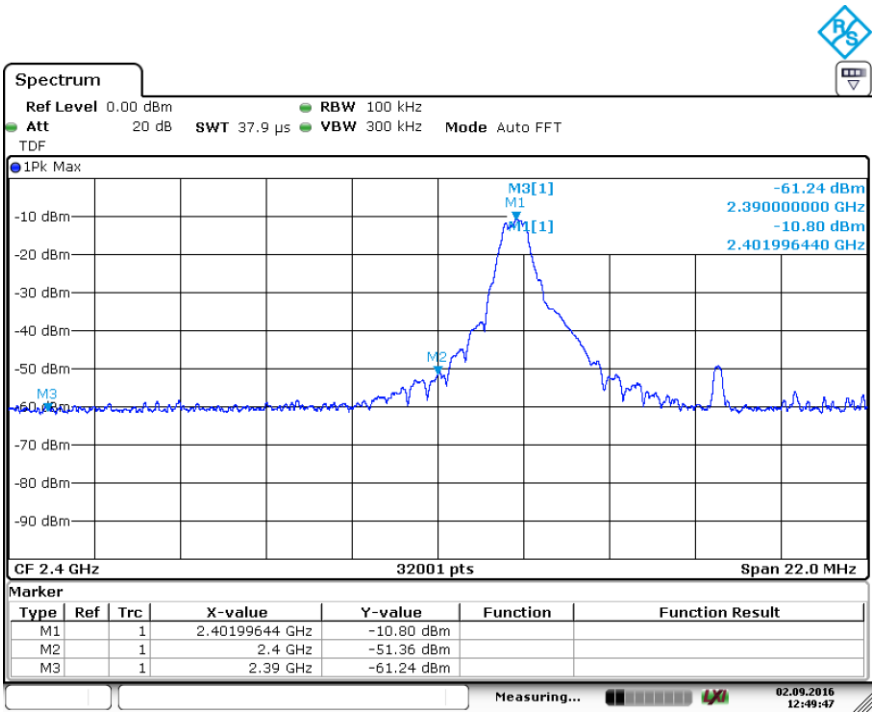

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Figure 3: Lower Band Edge

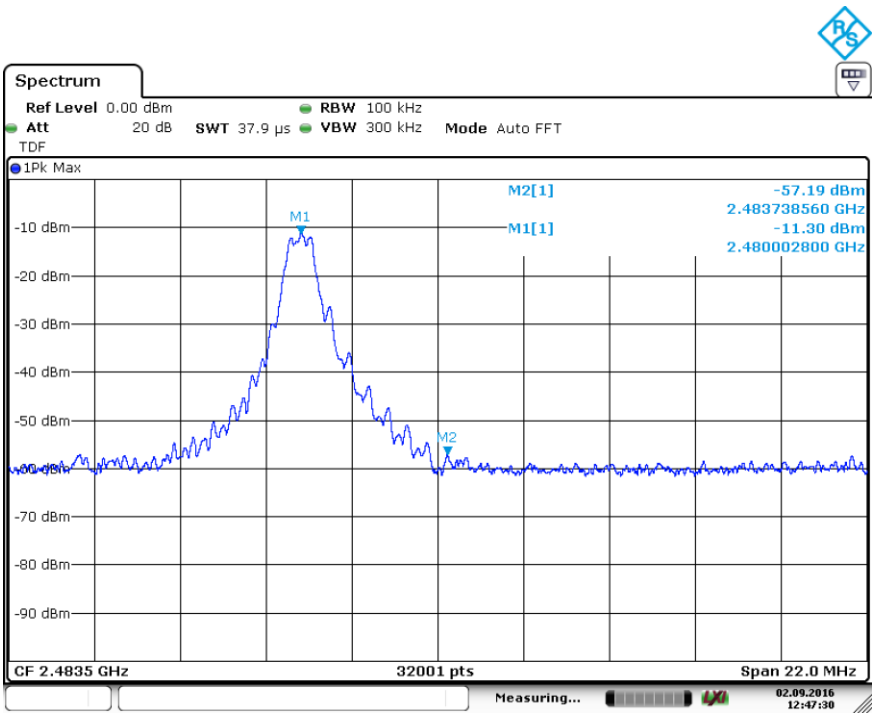

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Figure 4: Upper Band Edge.

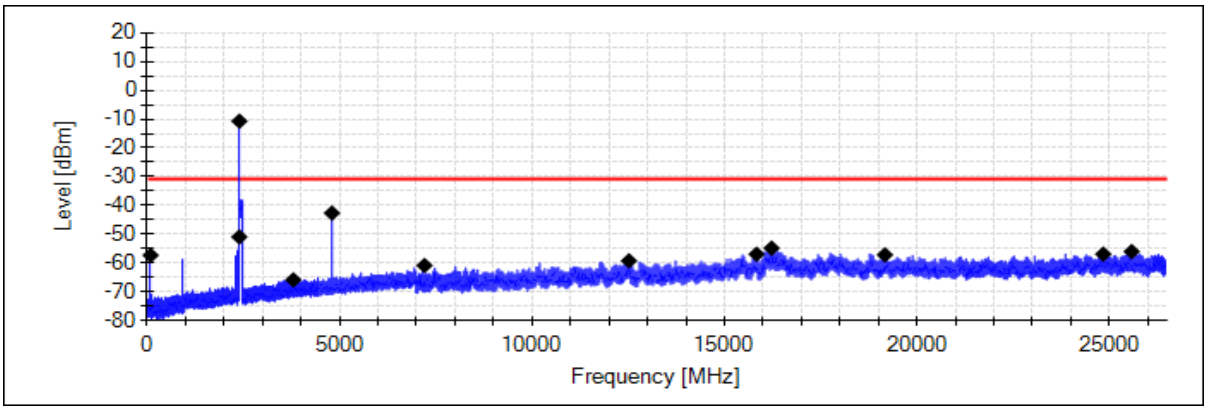

Figure 5: Conducted Spurious Emissions 30 - 26500 MHz channel low

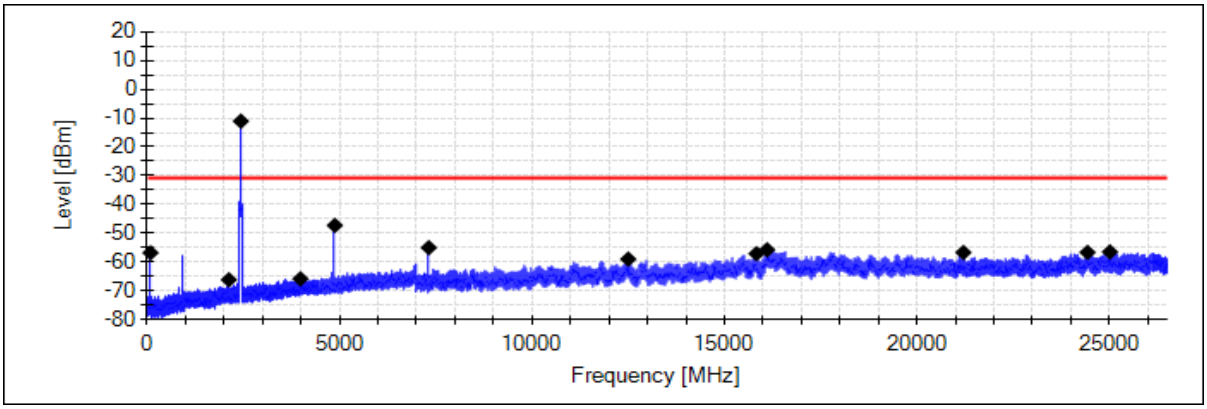

Figure 6: Conducted Spurious Emissions 30 - 26500 MHz channel mid

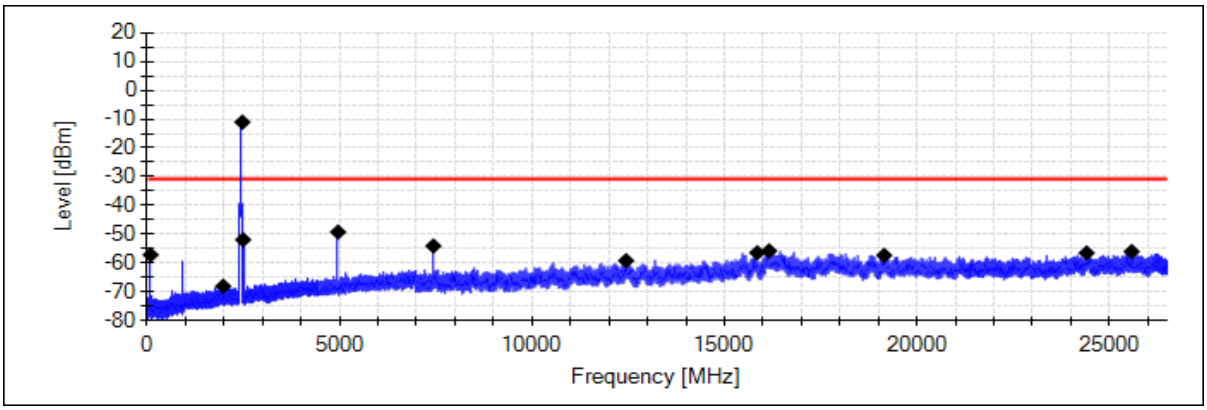

Figure 7: Conducted Spurious Emissions 30 - 26500 MHz channel high

6 dB Bandwidth of the Channel

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	2 September 2016	
Temperature:	22 °C	
Humidity:	53 %	

FCC Rule: 15.247(a)(2)
RSS-247 5.2(1)

Results:

Table 15: 6 dB bandwidth test results

Channel	6 dB BW [kHz]	Minimum limit [kHz]
Low	699.15	500
Mid	702.32	
High	706.85	

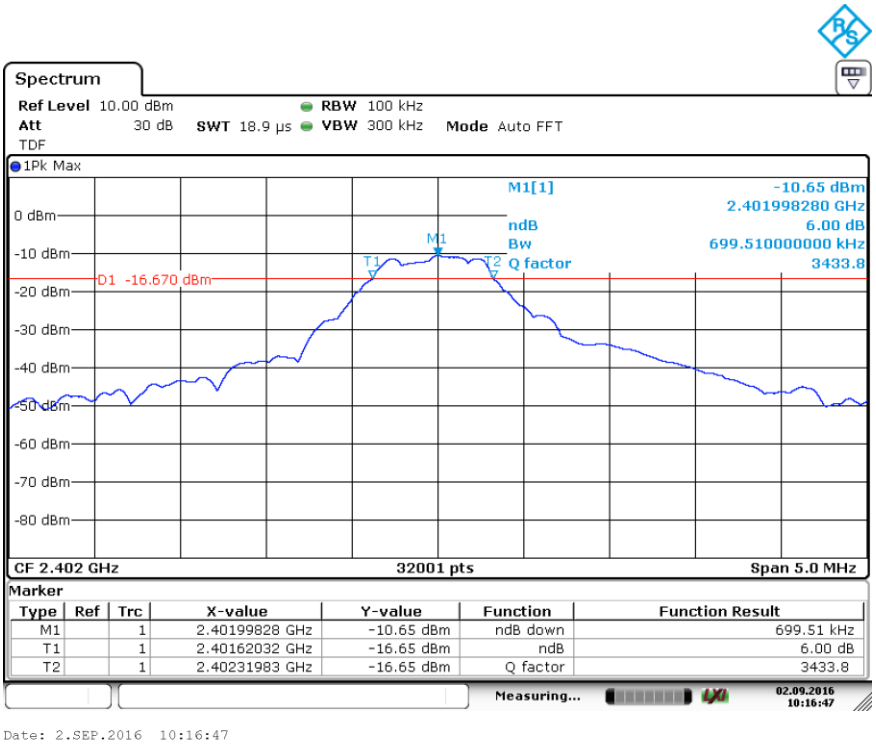

Figure 8: 6 dB bandwidth channel low

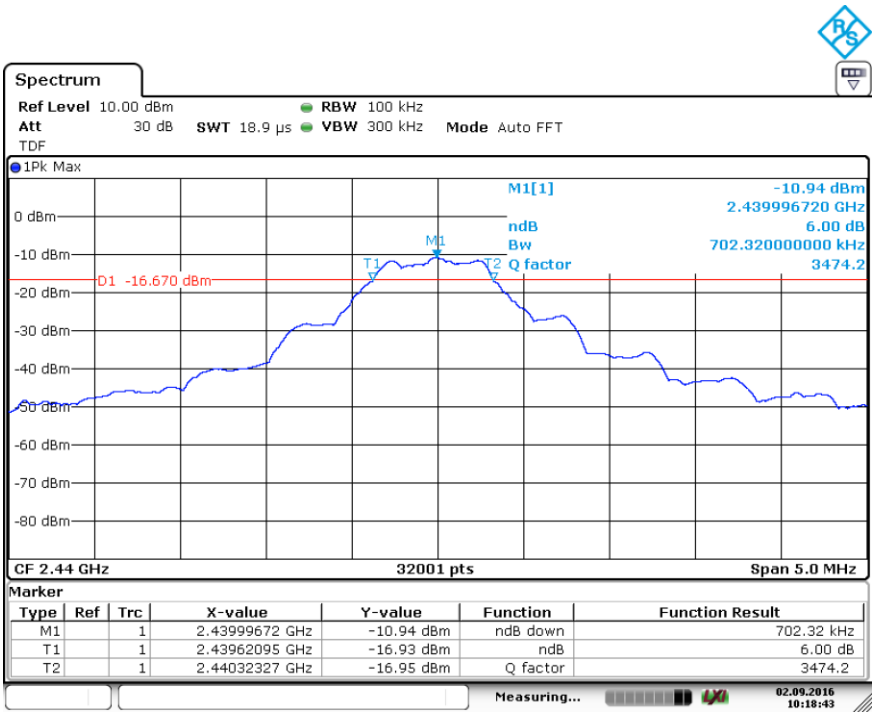

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Figure 9: 6 dB bandwidth channel mid

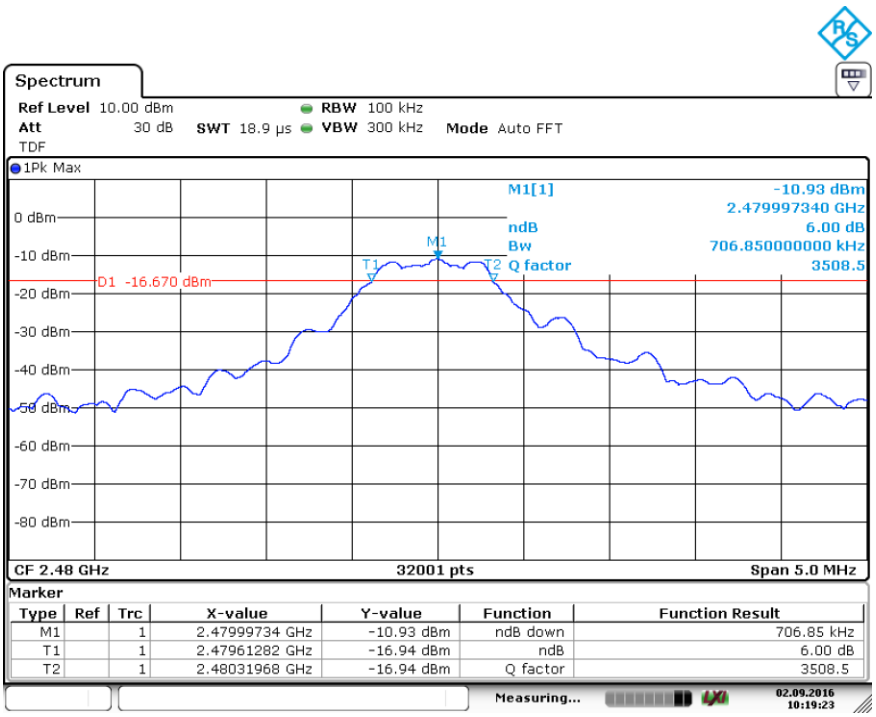

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Figure 10: 6 dB bandwidth channel high

Power Spectral Density

Standard:	ANSI C63.10	(2013)
Tested by:	EHA	
Date:	2 September 2016	
Temperature:	22 °C	
Humidity:	53 %	

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

Results:

Table 16: Power spectral density test results

Channel	PSD dBm/10 kHz	Maximum limit [dBm/3kHz]
Low	-17.61	+8.00
Mid	-18.04	
High	-16.91	

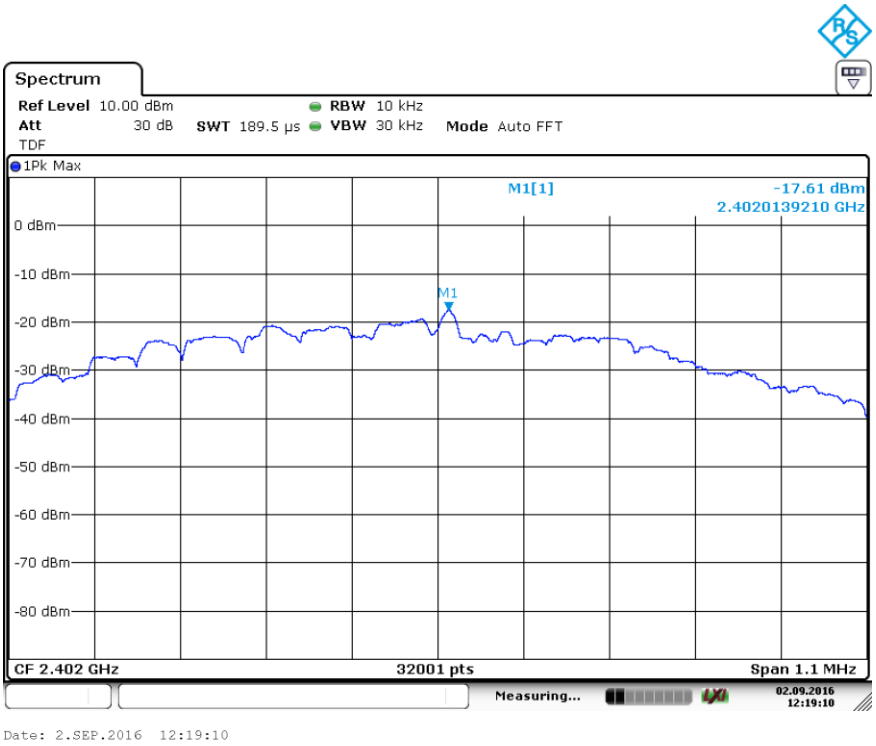


Figure 11: Power spectral density channel low

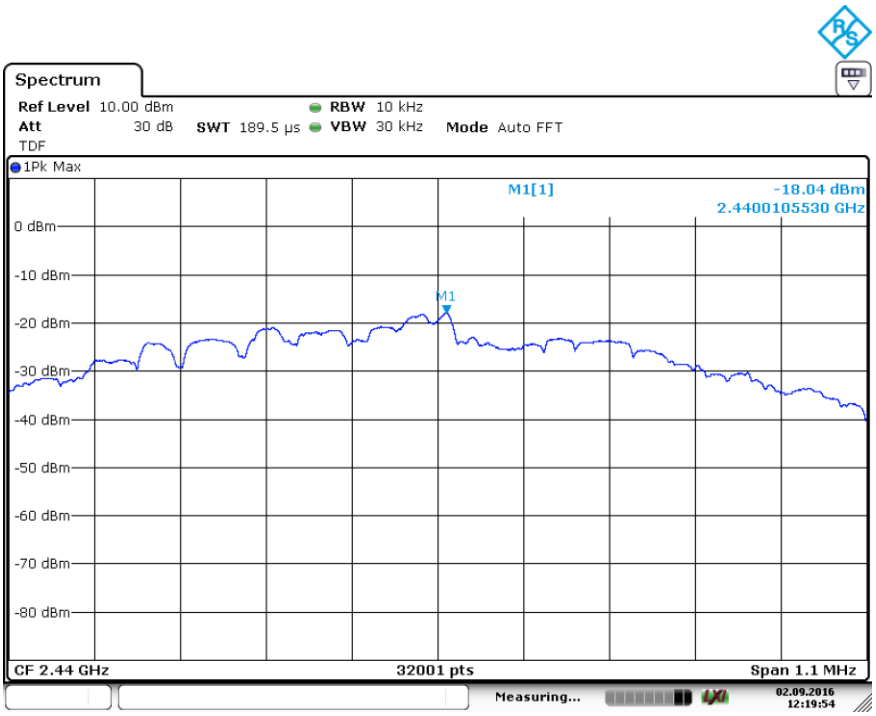


Figure 12: Power spectral density channel mid

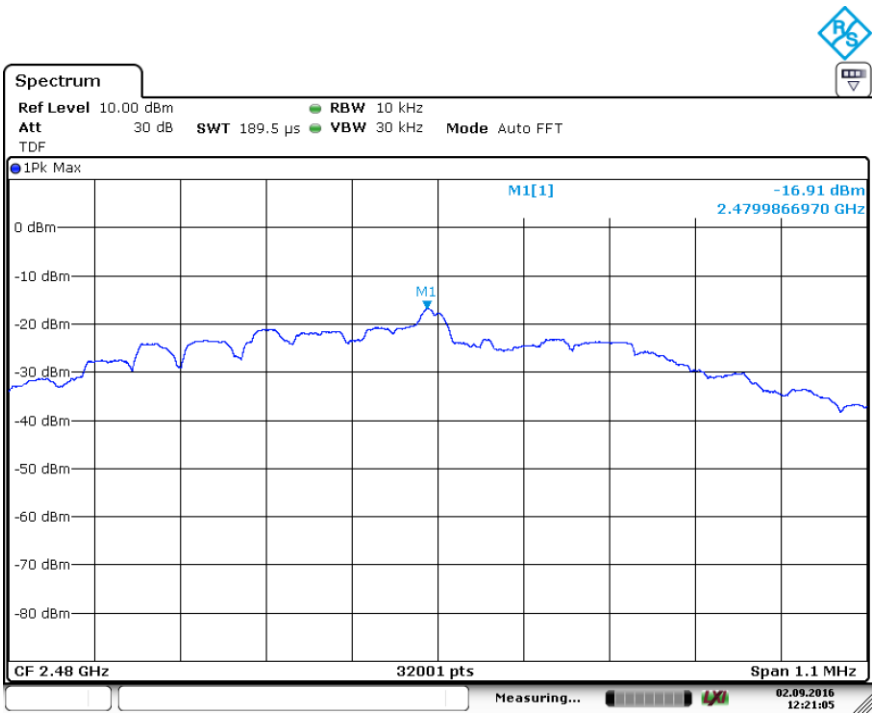


Figure 13: Power spectral density channel high

99% Occupied Bandwidth

Standard:	RSS-GEN	(2014)
Tested by:	EHA	
Date:	2 September 2016	
Temperature:	22 °C	
Humidity:	53 %	

RSS-GEN 6.6

Table 17: 99% occupied bandwidth test results

Channel	Limit	99 % BW [MHz]	Result
Low	-	1.330427174	PASS
Mid	-	1.531827130	PASS
High	-	1.440267492	PASS

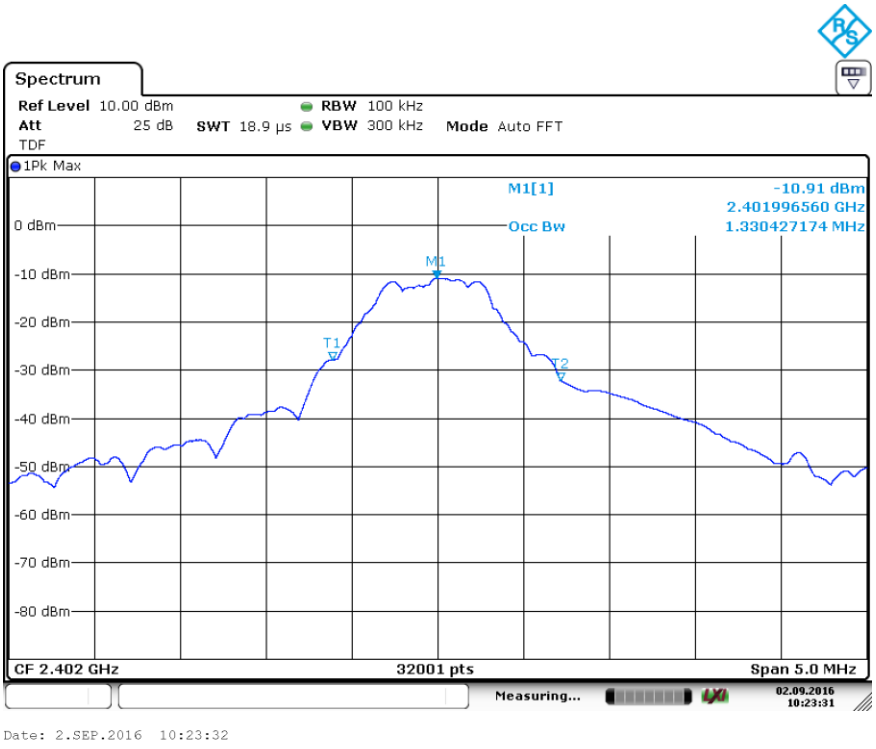
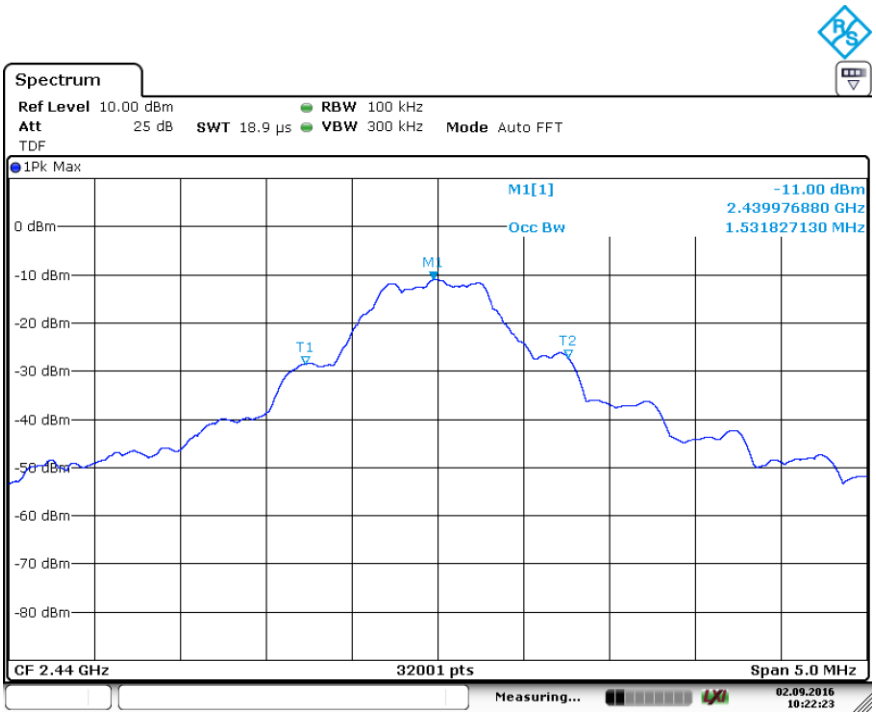
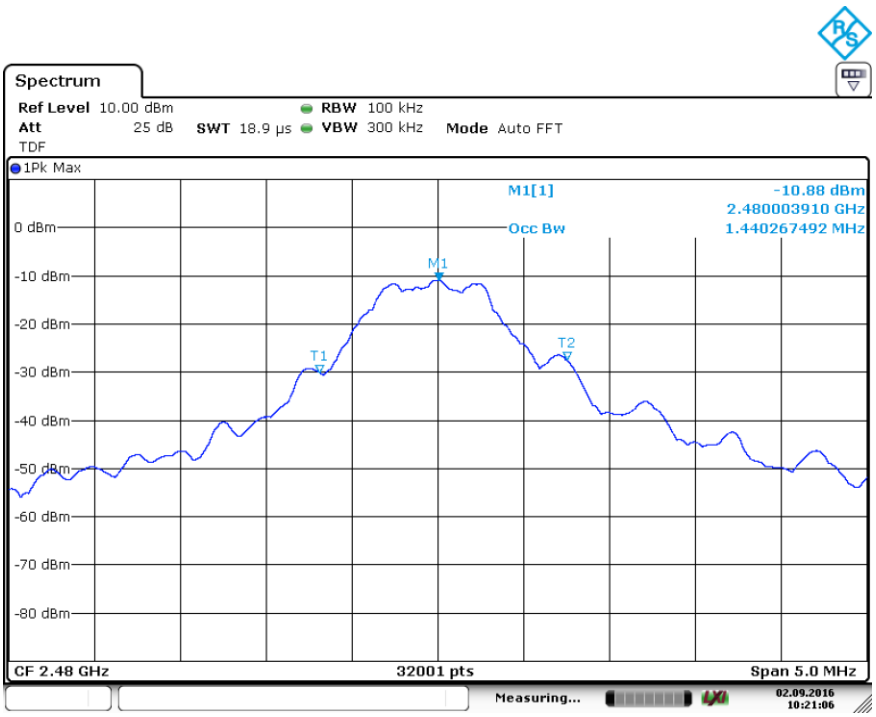


Figure 14: 99% OBW channel low



Date: 2.SEP.2016 10:22:23

Figure 15: 99% OBW channel mid



Date: 2.SEP.2016 10:21:07

Figure 16: 99% OBW channel high

TEST EQUIPMENT

Equipment	Manufacturer	Type	Inv or serial	Prev Calib	Next Calib
MONITORING ANTENNA	A.H. SYSTEMS	SAS-200/518	inv:7873	-	-
MONITORING SPECTRUM ANALYZER	AGILENT	E7405A	inv:9746	2016-01-07	2018-01-07
ANTENNA MAST	MATURO	TAM 4.0E	inv:10181	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv:10182	-	-
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv:10183	-	-
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	inv:8453	2016-06-10 2017-07-10	2017-06-10 2018-07-10
SIGNAL ANALYZER	ROHDE & SCHWARZ	FSV40	inv:9093	2016-06-10	2017-06-10
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
ANTENNA	ROHDE & SCHWARZ	HFH2-Z2 , 335.4711.52	inv:8013	2016-08-29	2018-08-29
HIGH PASS FILTER	WAINWRIGHT	WHKX4.0/18G-10SS	sn:10	2016-01-22	2017-01-22
ATTENUATOR 10 dB	HUBER & SUHNER	6610.19.AA	sn:7	2016-02-02	2017-02-02
AC POWER SOURCE	CALIFORNIA INSTRUMENTS	5001 iX Series II	inv:7826	-	-

All used measurement equipment was calibrated (if required).