

Test Report



INTENTIONAL RADIATOR TESTS ACCORDING TO FCC PART 15 C

Equipment Under Test: Handheld Material Analyzer

Model: LMDS2850

Manufacturer: Oxford Instruments Analytical Oy
Tarvonsalmenkatu 17
FI-02631 ESPOO
FINLAND

Customer: Oxford Instruments Analytical Oy
Tarvonsalmenkatu 17
FI-02631 ESPOO
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: 23 September 2016

Issued by:

A blue ink signature of Emil Haverinen.

Emil Haverinen
Testing Engineer

Date: 23 September 2016

Checked by:

A blue ink signature of Rauno Repo.

Rauno Repo
Testing Engineer

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Equipment Under Test (EUT)

Trade mark: Oxford Instruments
Model: LMDS2850
Type: Handheld material analyzer
Serial no: 100005 & 100008
FCC ID: Contains FCC ID: Z64-WL18SBMOD
IC: Contains IC ID: 451I-WL18SBMOD

Description of the EUT

The EUT is handheld material analyzer using 802.11b/g module made by Texas Instruments (FCC ID: Z64-WL18SBMOD).

The device has USB port for transferring data from the device. The EUT uses battery which can be charged when it is connected to the device or via separate charging dock.

The module's Bluetooth, 802.11n, HT40 and MIMO capabilities have been disabled.

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.

Ratings and declarations

Operating Frequency Range (OFR): 2412 - 2462 MHz
Channels: 11
Channel separation: 5 MHz
Channel bandwidth: 20 MHz (802.11b)
22 MHz (802.11g)
Conducted power: 14.71 dBm
Transmission technique: DSSS
Modulation: CCK, OFDM
Antenna gain: 4.0 dBi

Power Supply

Operating voltage range: 12 VDC

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 with special software embedded to the EUT operating system. Normal test modulation and maximum transmit power was used in all 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	N/T
§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	N/T
§15.247(e) / RSS-247 5.2(2)	Power Spectral Density	N/T
RSS-GEN 6.6	99% Occupied Bandwidth	N/T
§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

Some tests were not performed; test report will be used to apply for C2PC. Unperformed tests marked as N/T (not tested).

EUT Test Conditions During Testing

The EUT was set to transmit at its maximum duty cycle and power (setting 15). The EUT was powered from its batteries.

The EUT was set to following channels during the tests:

Channel Low (Ch 1) = 2412 MHz

Channel Mid (Ch 6) = 2437 MHz

Channel High (Ch 11) = 2462 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

Average Conducted Output Power

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 16.8.2016
Temperature: 23 °C
Humidity: 49 %
Measurement uncertainty $\pm 2.87\text{dB}$ 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. Average conducted output power was measured with average power meter.

The EUT was connected to the power meter via 10 dB attenuator.

Results:

Table 1: Average conducted power 802.11b

Data rate [Mbps]	Conducted power [dBm]			Limit [dBm]	Result
	Low channel	Mid channel	High channel		
1	14.71	14.16	14.18	30	PASS
2	14.62	14.16	13.93	30	PASS
5.5	13.91	13.31	13.02	30	PASS
11	12.85	12.49	12.20	30	PASS

Table 2: Average conducted power 802.11g

Data rate [Mbps]	Conducted power [dBm]			Limit [dBm]	Result
	Low channel	Mid channel	High channel		
6	11.68	12.39	10.87	30	PASS
9	10.82	11.66	10.01	30	PASS
12	10.20	11.10	9.45	30	PASS
18	9.16	10.18	8.52	30	PASS
24	8.16	9.19	7.47	30	PASS
36	7.24	7.85	6.58	30	PASS
48	6.46	6.26	5.77	30	PASS
54	5.51	4.99	4.86	30	PASS

Original grant test report of the module has had following output powers:

802.11b 17.96 dBm
802.11g 20.59 dBm

Transmitter Radiated Spurious Emissions

Transmitter Radiated Spurious Emissions 30 – 26500 MHz

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 25.8 - 2.9.2016
Humidity: 50 - 56 %
Temperature: 20 - 22 °C
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). The Quasi-peak value is the measured value corrected with the correction factor.

Radiated spurious emissions measurements were tested with 1Mbps data rate since it has the highest power. Measurements less than 1 GHz were performed only on middle channel.

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 3: Peak results (1 Mbps / ch low)

Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1250.025000	53.5	1000.0	1000.000	166.0	V	338.0	7.8	20.4	73.9
2385.400000	52.7	1000.0	1000.000	150.0	V	221.0	14.0	21.2	73.9
2397.325000	60.2	1000.0	1000.000	177.0	V	13.0	14.1	13.7	73.9
2412.800000	100.2	1000.0	1000.000	150.0	V	220.0	14.1	-	-
4823.900000	48.1	1000.0	1000.000	150.0	H	118.0	-3.1	25.8	73.9
17186.90000	52.8	1000.0	1000.000	400.0	V	324.0	14.2	21.1	73.9

Transmitter Radiated Spurious Emissions

Table 4: Average results (1 Mbps / ch low)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1250.025000	45.6	1000.0	1000.000	166.0	V	338.0	7.8	8.3	53.9
2385.400000	39.6	1000.0	1000.000	150.0	V	221.0	14.0	14.3	53.9
2397.325000	47.0	1000.0	1000.000	177.0	V	13.0	14.1	6.9	53.9
2412.800000	96.7	1000.0	1000.000	150.0	V	220.0	14.1	-	-
4150.000000	34.0	1000.0	1000.000	206.0	H	357.0	-4.6	19.9	53.9
4249.900000	34.8	1000.0	1000.000	192.0	H	352.0	-4.2	19.1	53.9
4350.000000	35.3	1000.0	1000.000	205.0	H	353.0	-4.0	18.6	53.9
4823.900000	42.3	1000.0	1000.000	150.0	H	114.0	-3.1	11.6	53.9
7235.100000	32.1	1000.0	1000.000	150.0	V	207.0	0.4	21.8	53.9
17187.000000	39.0	1000.0	1000.000	400.0	H	353.0	14.2	14.9	53.9

Middle channel

Table 5: Quasi-peak results (1 Mbps / ch mid)

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
399.998000	31.0	1000.0	120.000	100.0	V	0.0	17.7	15.0	46.0
416.659000	30.8	1000.0	120.000	100.0	V	0.0	18.3	15.2	46.0
533.333000	32.2	1000.0	120.000	100.0	V	0.0	20.9	13.8	46.0
566.661000	32.8	1000.0	120.000	100.0	V	0.0	21.6	13.2	46.0
750.028000	35.4	1000.0	120.000	100.0	H	0.0	25.2	10.6	46.0
966.669000	35.8	1000.0	120.000	100.0	V	0.0	27.9	18.1	53.9

Table 6: Peak results (1 Mbps / ch mid)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
399.998000	32.9	1000.0	120.000	100.0	V	0.0	17.7	-	-
416.659000	32.7	1000.0	120.000	100.0	V	0.0	18.3	-	-
533.333000	34.5	1000.0	120.000	100.0	V	0.0	20.9	-	-
566.661000	35.2	1000.0	120.000	100.0	V	0.0	21.6	-	-
750.028000	37.8	1000.0	120.000	100.0	H	0.0	25.2	-	-
966.669000	38.9	1000.0	120.000	100.0	V	0.0	27.9	-	-
1250.025000	53.0	1000.0	1000.000	190.0	V	352.0	7.8	20.9	73.9
1350.025000	52.2	1000.0	1000.000	242.0	H	42.0	7.7	21.7	73.9

Table 7: Average results (1 Mbps / ch mid)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1250.025000	46.3	1000.0	1000.000	190.0	V	352.0	7.8	7.6	53.9
1350.025000	44.7	1000.0	1000.000	242.0	H	42.0	7.7	9.2	53.9
4550.100000	34.3	1000.0	1000.000	205.0	H	344.0	-3.6	19.6	53.9
4874.000000	37.7	1000.0	1000.000	150.0	H	192.0	-3.0	16.2	53.9

Transmitter Radiated Spurious Emissions

High channel

Table 8: Peak results (1 Mbps / ch high)

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1249.825000	53.2	1000.0	1000.000	191.0	V	0.0	7.8	20.7	73.9
2488.500000	53.4	1000.0	1000.000	204.0	V	212.0	14.4	20.5	73.9
4250.100000	43.8	1000.0	1000.000	150.0	H	347.0	-4.2	30.1	73.9
4924.000000	44.8	1000.0	1000.000	150.0	H	192.0	-3.0	29.1	73.9
17176.80000	51.9	1000.0	1000.000	400.0	H	40.0	14.2	22.0	73.9

Table 9: Average results (1 Mbps / ch high)

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1249.825000	45.5	1000.0	1000.000	191.0	V	0.0	7.8	8.4	53.9
2488.500000	40.8	1000.0	1000.000	204.0	V	212.0	14.4	13.1	53.9
4249.900000	34.6	1000.0	1000.000	192.0	H	353.0	-4.2	19.3	53.9
4924.000000	35.7	1000.0	1000.000	150.0	H	136.0	-3.0	18.2	53.9
17185.20000	38.7	1000.0	1000.000	400.0	V	359.0	14.2	15.2	53.9

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Standard: ANSI C63.10 (2013)
Tested by: EHA
Date: 16.8 - 17.8.2016
Humidity: 51 %
Temperature: 23 °C
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)).

Measurements were performed with both modulation schemes with speed rate where highest power was achieved.

Table 10: Band edge attenuation 1 Mbps data rate

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-43.4 dBc	-53.7 dBc
Limit: -20dBc	

Table 11: Band edge attenuation 54 Mbps data rate

Band Edge Attenuation	
Lower Band Edge	Upper Band Edge
-30.6 dBc	-40.3 dBc
Limit: -20dBc	

802.11b

Table 12: Conducted spurious emissions channel low 1 Mbps

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
970.98	-60.03	-14.41	45.62	PASS
2412.53	5.59	-	-	Carrier
6997.89	-51.80	-14.41	37.39	PASS
9792.21	-51.66	-14.41	37.25	PASS
12483.22	-49.00	-14.41	34.59	PASS
15532.72	-47.27	-14.41	32.86	PASS
16460.53	-44.93	-14.41	30.52	PASS
19153.23	-46.34	-14.41	31.93	PASS
24453.13	-46.53	-14.41	32.12	PASS
25016.43	-46.05	-14.41	31.64	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 13: Conducted spurious emissions channel mid 1 Mbps

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
991.41	-60.52	-14.55	45.97	PASS
2438.03	5.45	-	-	Carrier
6384.13	-51.97	-14.55	37.42	PASS
8485.19	-51.82	-14.55	37.27	PASS
12500.56	-49.15	-14.55	34.59	PASS
15506.28	-46.97	-14.55	32.41	PASS
16168.23	-45.82	-14.55	31.27	PASS
19488.75	-47.57	-14.55	33.02	PASS
24484.25	-46.33	-14.55	31.78	PASS
26297.25	-45.37	-14.55	30.82	PASS

Table 14: Conducted spurious emissions channel high 1 Mbps

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
869.25	-60.46	-15.26	45.20	PASS
2463.06	4.74	-	-	Carrier
6988.14	-52.02	-15.26	36.77	PASS
8472.06	-51.70	-15.26	36.45	PASS
12534.87	-49.65	-15.26	34.39	PASS
15786.30	-47.27	-15.26	32.02	PASS
16199.26	-46.13	-15.26	30.87	PASS
19497.28	-47.00	-15.26	31.75	PASS
24139.73	-46.47	-15.26	31.22	PASS
26315.58	-46.16	-15.26	30.90	PASS

802.11g

Table 15: Conducted spurious emissions channel low 6 Mbps

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
813.81	-59.56	-18.86	40.70	PASS
2465.78	1.14	-	-	Carrier
6983.92	-51.36	-18.86	32.50	PASS
8457.35	-51.13	-18.86	32.26	PASS
11804.21	-49.31	-18.86	30.44	PASS
15834.96	-47.16	-18.86	28.29	PASS
16496.25	-45.74	-18.86	26.88	PASS
19508.06	-47.48	-18.86	28.62	PASS
24443.19	-46.32	-18.86	27.45	PASS
26220.33	-46.23	-18.86	27.36	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

Table 16: Conducted spurious emissions channel mid 6 Mbps

Frequency [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]	Result
847.73	-59.91	-16.47	43.44	PASS
2435.78	3.53	-	-	Carrier
6996.02	-52.04	-16.47	35.57	PASS
8473.66	-51.75	-16.47	35.29	PASS
12502.81	-49.50	-16.47	33.03	PASS
15522.22	-46.75	-16.47	30.28	PASS
16479.00	-45.80	-16.47	29.33	PASS
19162.60	-47.06	-16.47	30.59	PASS
24434.10	-46.42	-16.47	29.95	PASS
26261.25	-45.51	-16.47	29.04	PASS

Table 17: Conducted spurious emissions channel high 6 Mbps

Frequency [MHz]	Level [dBm]	Limit [dBc]	Margin [dB]	Result
852.16	-59.97	-17.54	42.43	PASS
2414.50	2.46	-	-	Carrier
6896.74	-51.95	-17.54	34.41	PASS
8629.56	-52.19	-17.54	34.65	PASS
12495.31	-49.40	-17.54	31.86	PASS
15525.12	-47.36	-17.54	29.82	PASS
16461.47	-45.06	-17.54	27.52	PASS
19847.90	-47.47	-17.54	29.93	PASS
24417.97	-46.95	-17.54	29.41	PASS
25508.41	-45.68	-17.54	28.14	PASS

Transmitter Band Edge Measurement and Conducted Spurious Emissions

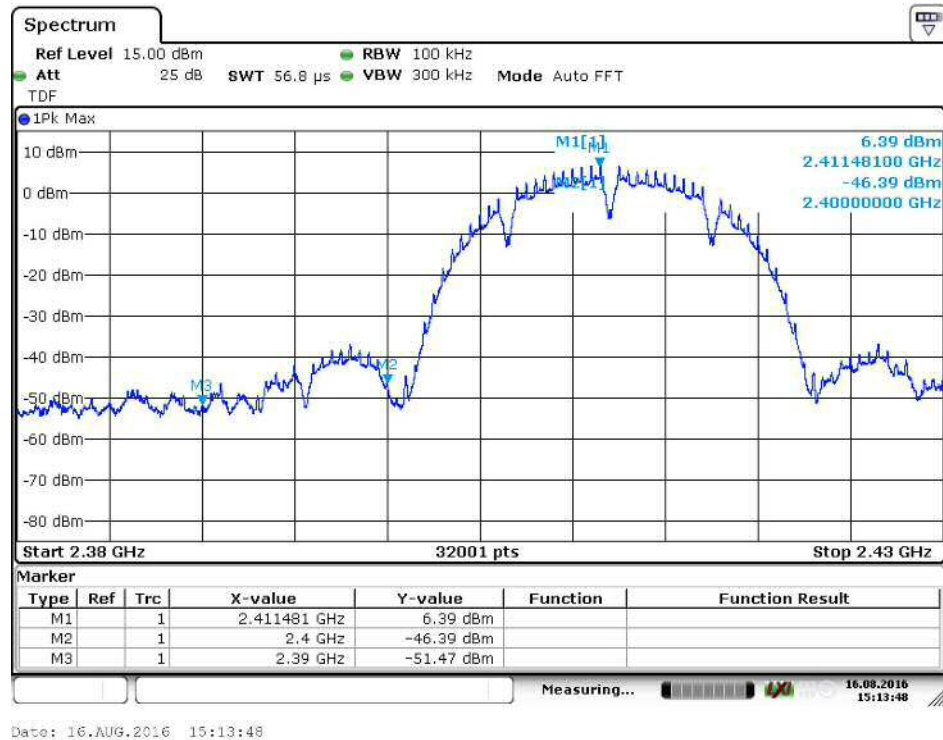


Figure 1. Lower Band Edge 1Mbps.

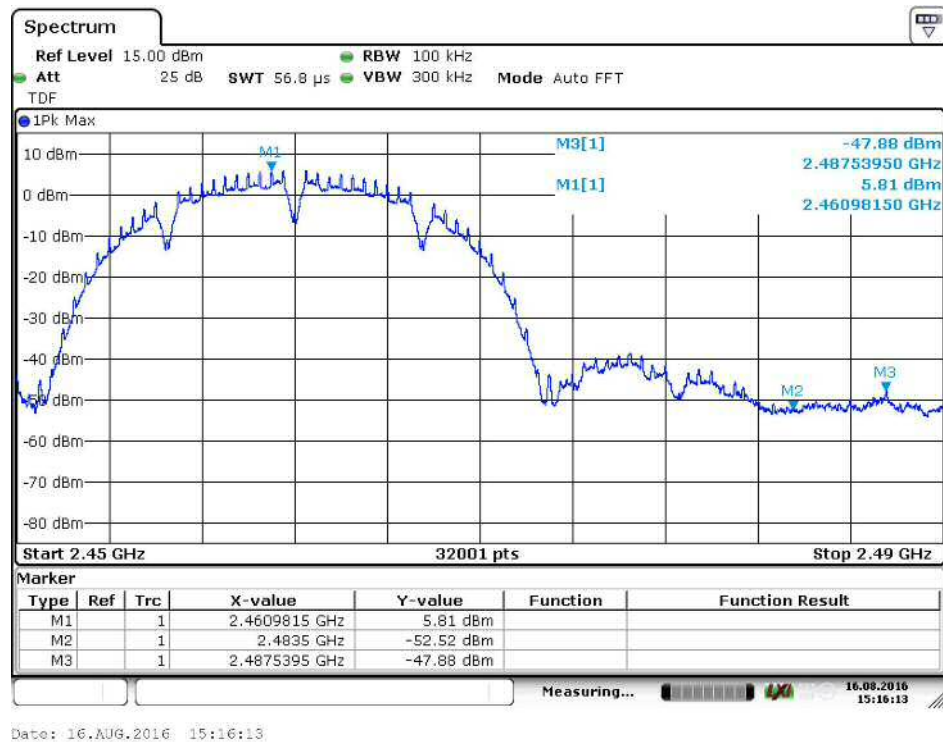


Figure 2. Upper Band Edge 1Mbps

Transmitter Band Edge Measurement and Conducted Spurious Emissions

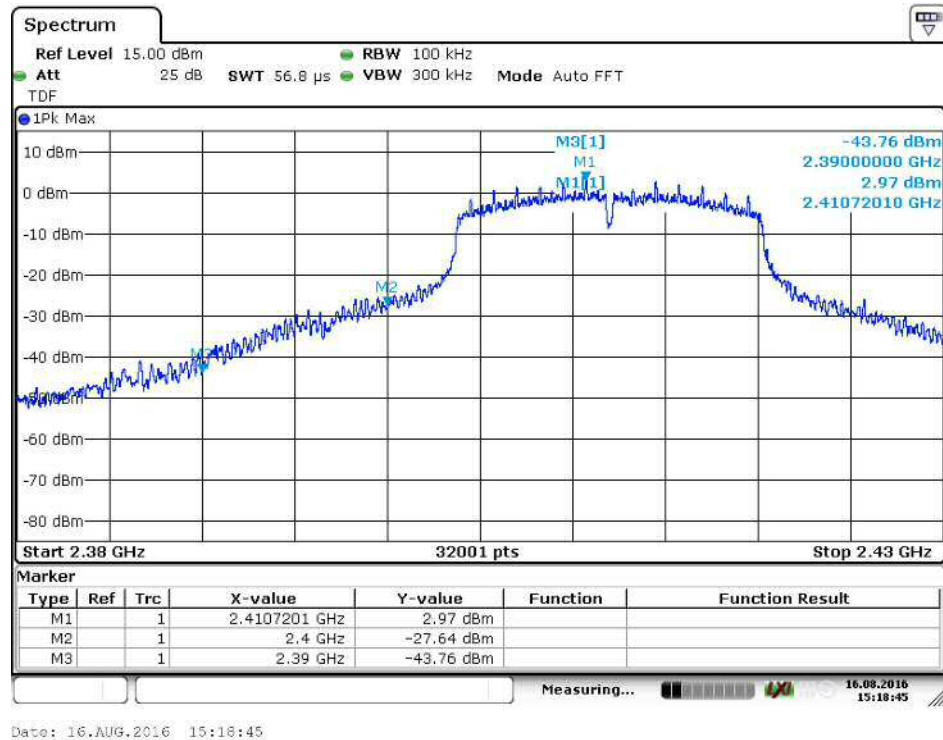


Figure 3. Lower Band Edge 6Mbps.

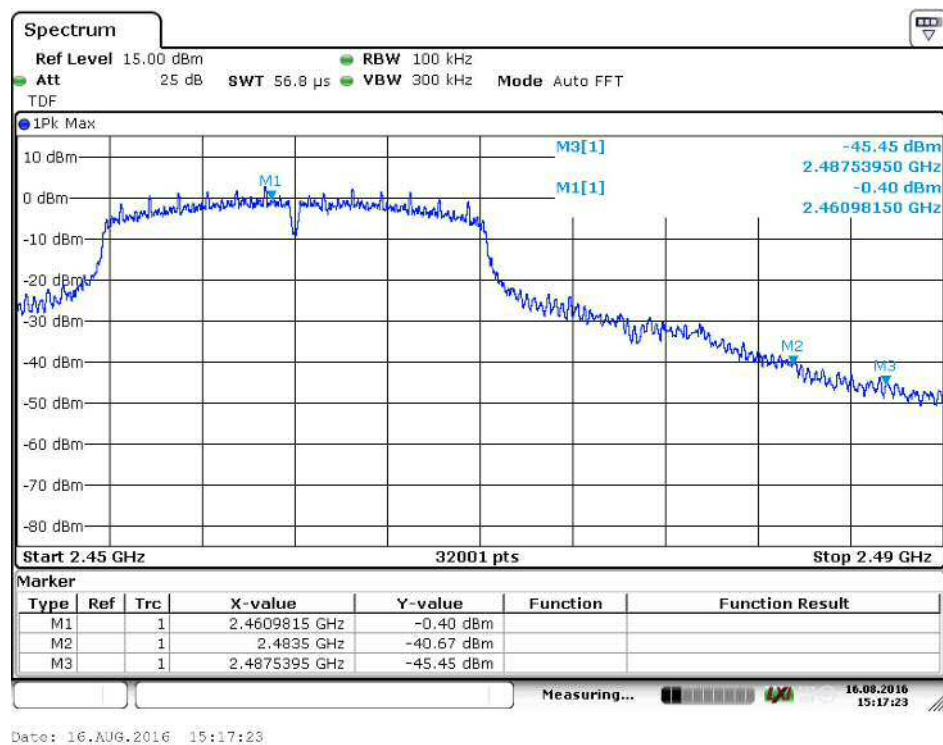


Figure 4. Upper Band Edge 6Mbps.

Transmitter Band Edge Measurement and Conducted Spurious Emissions

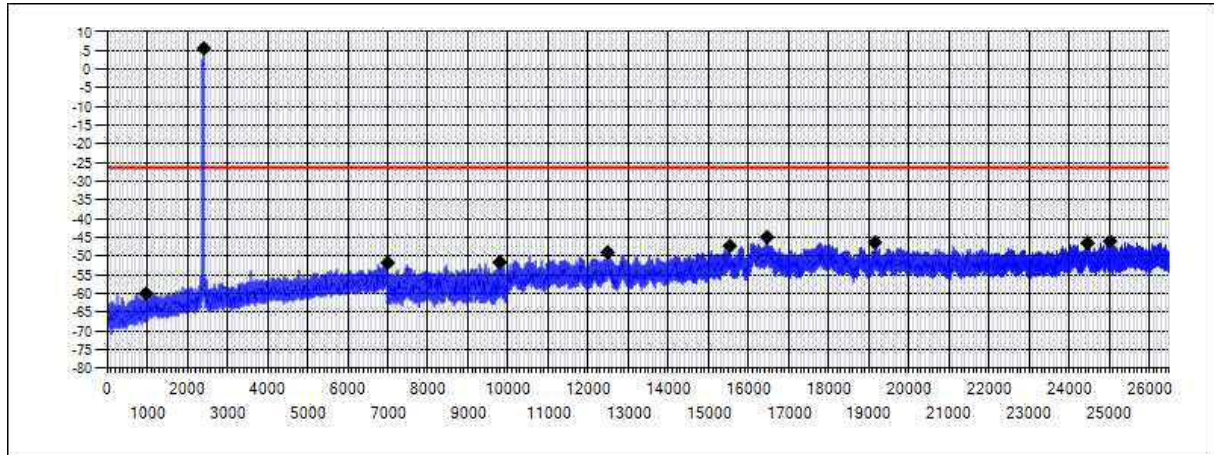


Figure 1: Conducted Spurious Emissions 30 - 26500 MHz channel low 1 Mbps

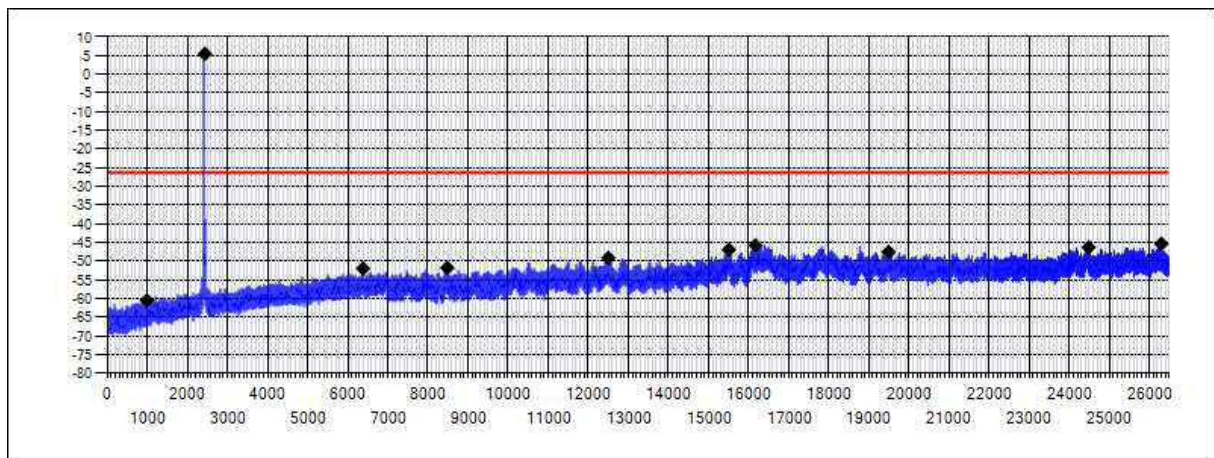


Figure 2: Conducted Spurious Emissions 30 - 26500 MHz channel mid 1 Mbps

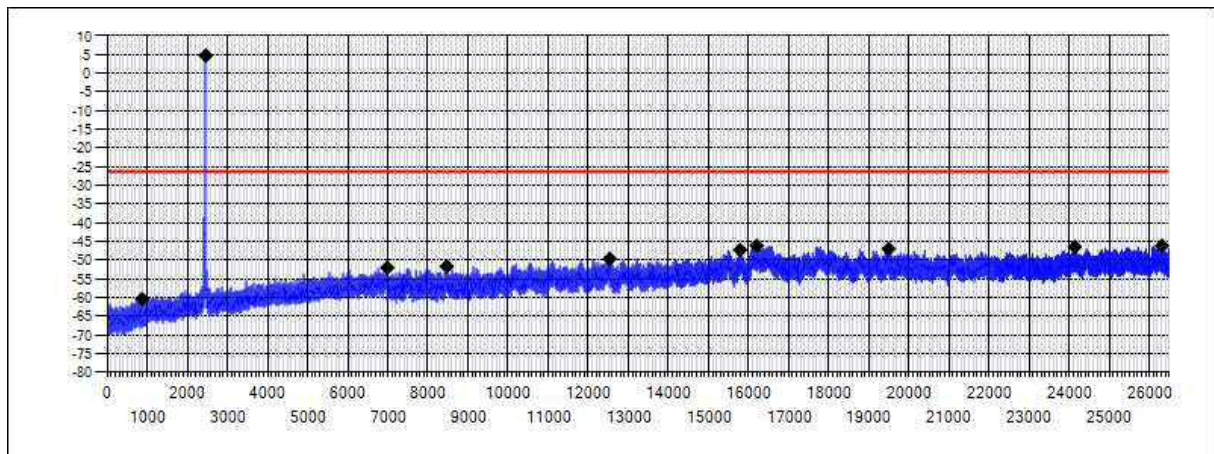


Figure 3: Conducted Spurious Emissions 30 - 26500 MHz channel high 1 Mbps

Transmitter Band Edge Measurement and Conducted Spurious Emissions

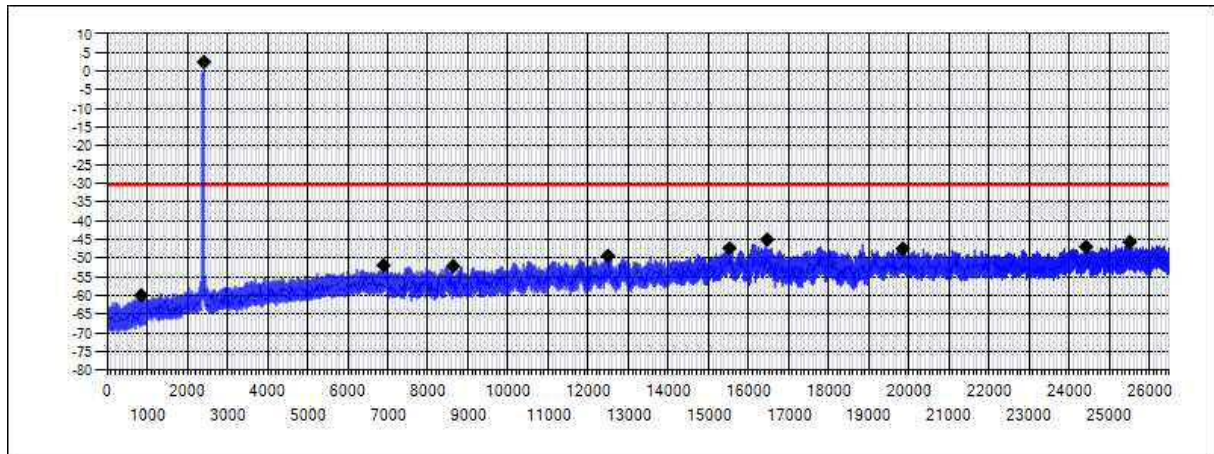


Figure 1: Conducted Spurious Emissions 30 - 26500 MHz channel low 6 Mbps

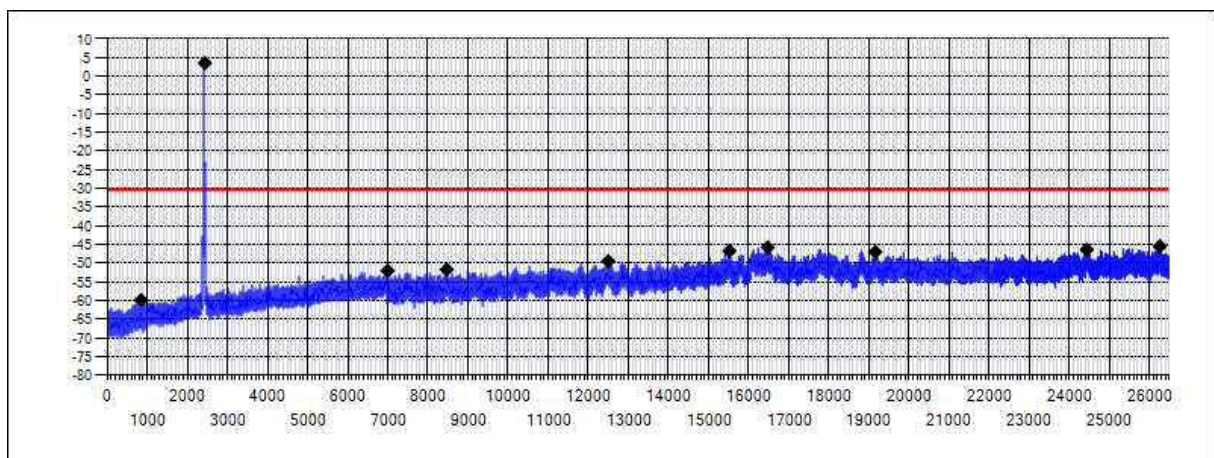


Figure 2: Conducted Spurious Emissions 30 - 26500 MHz channel mid 6 Mbps

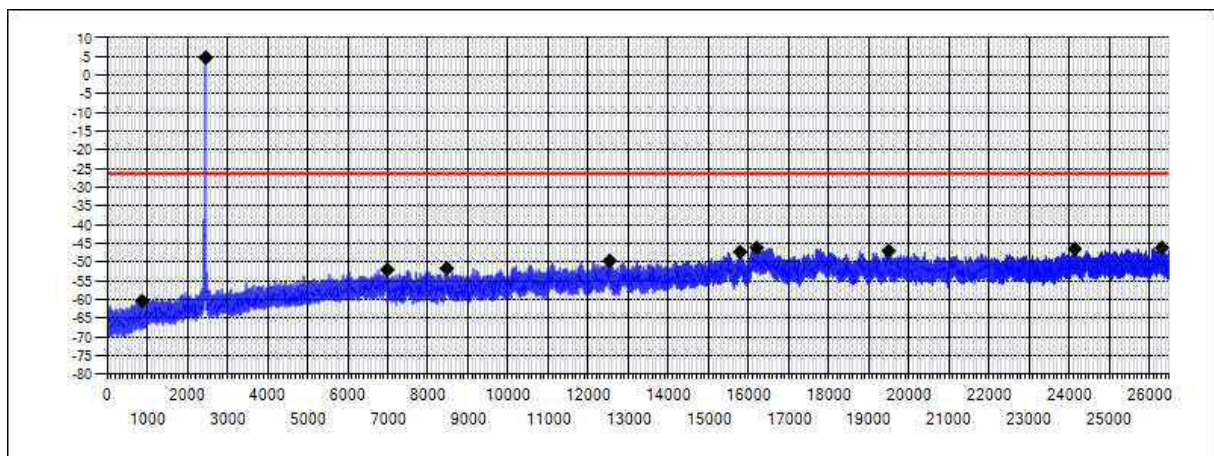


Figure 3: Conducted Spurious Emissions 30 - 26500MHz channel high 6 Mbps

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 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	inv:8453	2016-06-10	2017-06-10
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
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).