Wireless Transceiver Test Report

FCC ID: A94412555 IC: 3232A-412555

Certificate # 1514.1

Report number: EMC.412555.13.329.1

Prepared for: Bose Corporation
DCE - EMC
1 New York Ave, Framingham MA 01701

Product Tested: Bose® wireless remote control

Standards: FCC part 15, RSS-210, RSS-Gen and ICES-003

Report prepared by: Bryan Cerqua

Signature: Bryan H Cerqua

November 25, 2013

Report reviewed by: Mike Royer

Signature: Michael A. Royer

November 25, 2013

Report issue date: November 25, 2013

Changes from previous revision: Original version

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Bose Corporation, 1 New York Ave, Framingham, MA01701, USA
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1. Report Summary

1.1 Product	Bose® wireless remote control
1.2 Client	Bose Corporation The Mountain, Framingham MA 01701
1.3 Applicable Standards	**FCC part 15.B and C** **RSS - 210 issue 8** **RSS - Gen issue 3** **ICES - 003 issue 4**
Test Results:	Pass ☒ Fail ☐
1.4 Test Laboratory	Bose DCE laboratories 1 New York Ave Framingham, MA01701. IC registration : 3232A FCC site registration under A2LA cert. #1514

This report relates only to the items tested.

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2. Product description

Bluetooth low energy wireless remote control with display.
Battery powered using four non rechargeable AA cells in series (6VDC).

While developers use a cable to interact with the product, users have no access. Users can not interact with this product using cable for control, changing or any other purpose.

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3. Applicable standards, requirements and tests

FCC part 15	RSS-210	RSS-Gen	Test references.	Result / Data section
15.15(b)		5.4	There are no user-accessible controls for the adjustment of any transmitter parameters in the device under test.	Complies
15.27			There are no special devices such as shielded cables or special connectors required for compliance to the applicable standards.	Complies
15.203			An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The antenna is not accessible by the user.	Complies
15.205	2.2		The device does not operate in either the US or Canadian restricted bands.	Complies
15.107 15.207		7.2.4	Conducted emissions, 150kHz–30 MHz	Not Applicable
15.247 (a) (2)	A8.2 (a)		Minimum 6 dB Bandwidth	Complies Section 6.2
		4.6.1	99% Occupied bandwidth	Section 6.3
15.247 (b) (3)	A8.4 (4)		Output power:	Complies Section 6.4
15.247 (e)	A8.2 (b)		Power spectral density	Complies Section 6.5
15.247(d)	A8.5	4.9 (a)	Out of band emissions	Complies Section 6.6
		6.2	Receiver spurious emissions	Complies Section 6.7
15.205 15.209		7.2.5	Radiated emissions below 1 GHz	Complies Section 7
15.205 15.209		7.2.5	Radiated emissions above 1 GHz	Complies Section 8
OET65	Canada Health and Safety code 6		SAR exemption calculation	Complies Section 9

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4. Environmental conditions

All testing is performed under the following conditions, unless otherwise defined in the detail test report section.

Temperature:	22 ± 4 °C
Humidity:	30 – 60 % RH

5. EUT configuration

The Bose® wireless remote operates on 4 non-rechargeable AA cells. New batteries are installed prior to testing. When performing conducted RFtransmitter measurements a serial data cable is connected between the EUT and computer to allow for programming the EUT. No cables are connected to the EUT when making radiated measurements.

When performing radiated measurements the EUT is using it's built in PCB etch antenna with a measured gain of -2.9 dBi.

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6. Conducted RF antenna port test results

6.1. Test setup

EUT's antenna port is connected to the input of the spectrum analyzer using a 6.5" SMK to SMA-F cable. When the test cable is connected to the antenna test port the internal PCB etch antenna is disconnected. The cable loss at 2.45 GHz was measured at 0.7 dB. This loss was accounted for by using the reference level offset feature of the ESIB40 spectrum analyzer. The automatic n dB down measurement feature was used on the spectrum analyzer.

6.2. Minimum 6 dB Bandwidth

LIMIT:

FCC 15.247 (a) (2)

IC RSS-210 A8.2 (a)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

Channel	Center Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (kHz)	Result
0	2402	739	500	Pass
20	2442	725	500	Pass
39	2480	723	500	Pass

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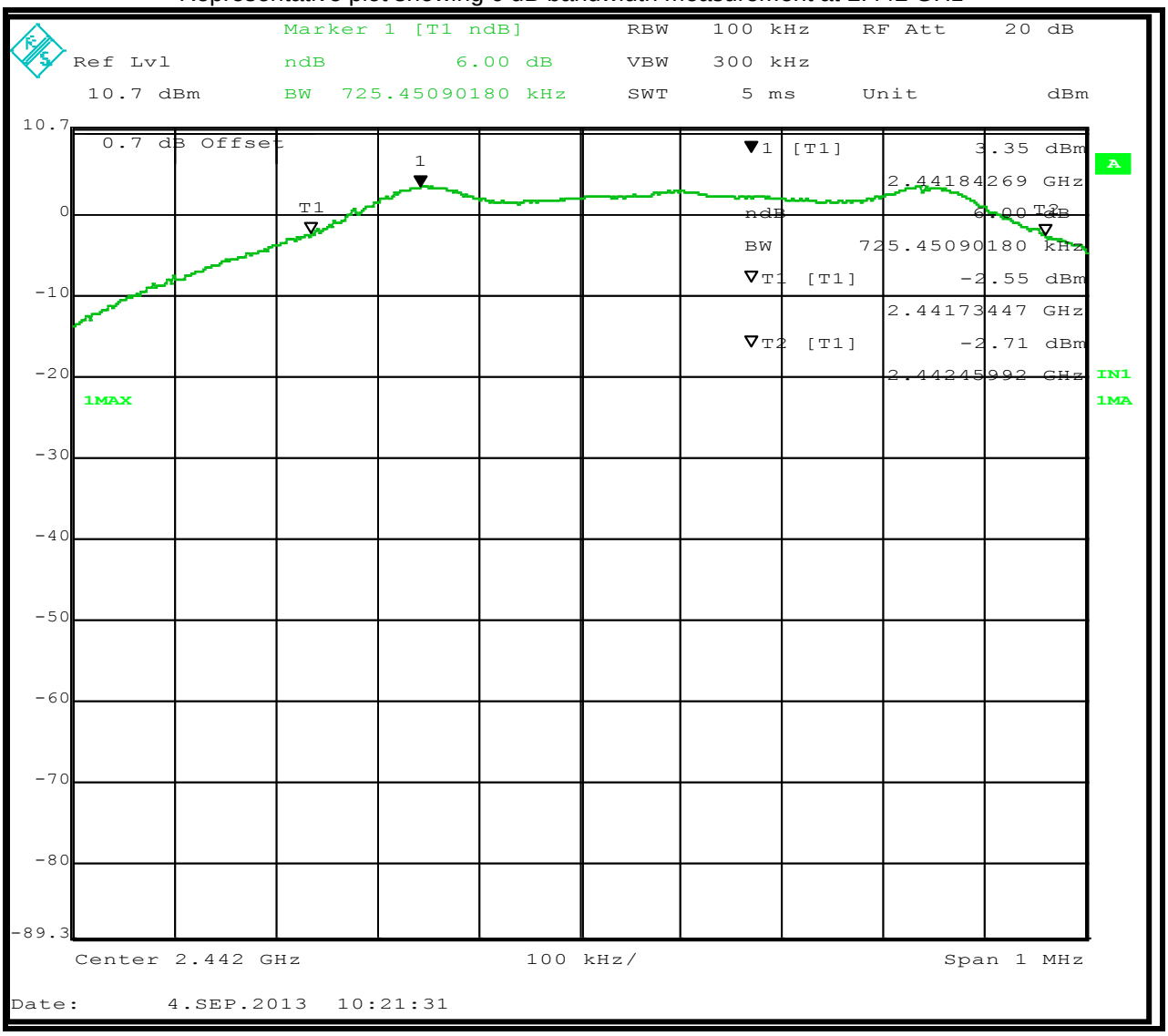
Representative plot showing 6 dB bandwidth measurement at 2.442 GHz



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6.3. 99% Bandwidth

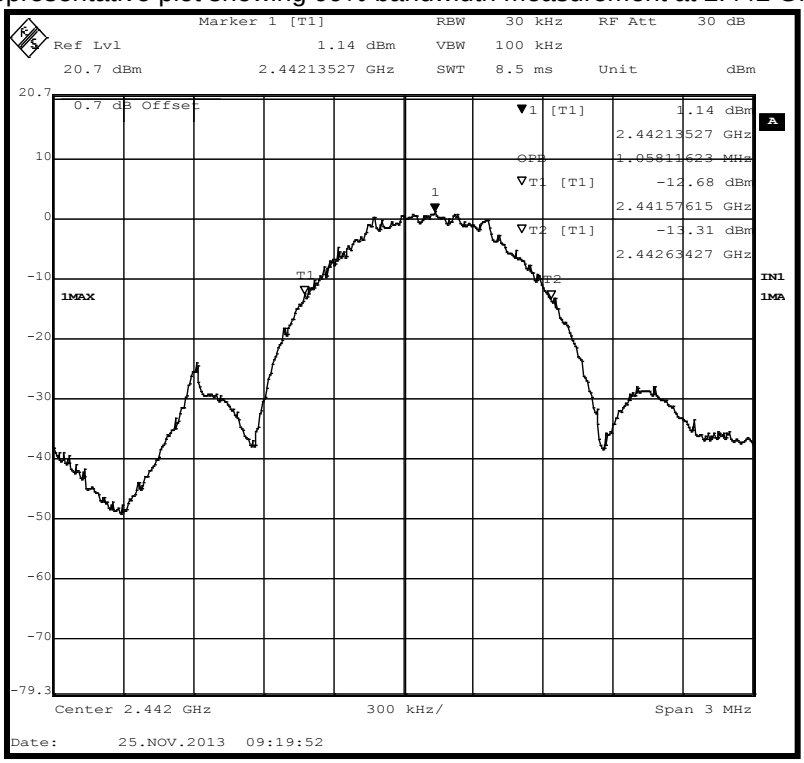
LIMIT:

RSS-Gen 4.6.1

RESULTS:

Channel	Center Frequency (MHz)	99% Bandwidth (MHz)
0	2402	1.064
20	2442	1.058
39	2480	1.064

Representative plot showing 99% bandwidth measurement at 2.442 GHz



Used built in measurement feature of ESIB for 99% bandwidth
RBW = 1 % of Span = 0.01*3 MHz = 30 kHz
VBW >= 3 * RBW = 100 kHz.

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6.4. Output power

LIMIT:

FCC 15.247 (b) (3)
IC RSS-210 A8.4 (4)

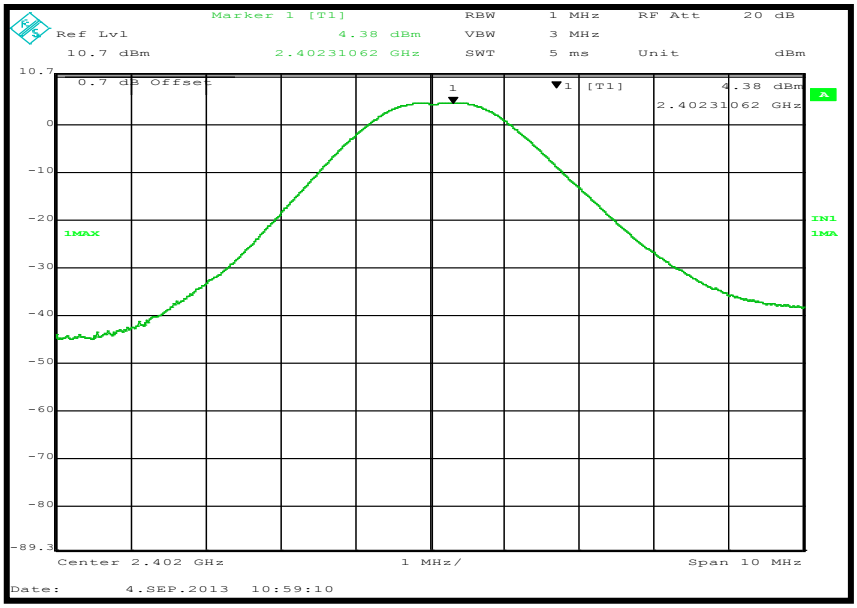
The maximum peak conducted output power shall not exceed 1 Watt. The e.i.r.p. shall not exceed 4 W.

RESULTS:

The measured EUT antenna gain is -2.9 dBi

Channel	Center Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Result
0	2402	4.38	30	Pass
20	2442	3.64	30	Pass
39	2480	3.26	30	Pass

Modulation active, transmitting on specified channel.
Representative plot showing output power measurement at 2.402 GHz



0.7 dB test cable loss is accounted for using the reference level offset feature of ESIB 40

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6.5. Power spectral density

LIMIT:

FCC 15.247 (e)

IC RSS-210 A8.2 (b)

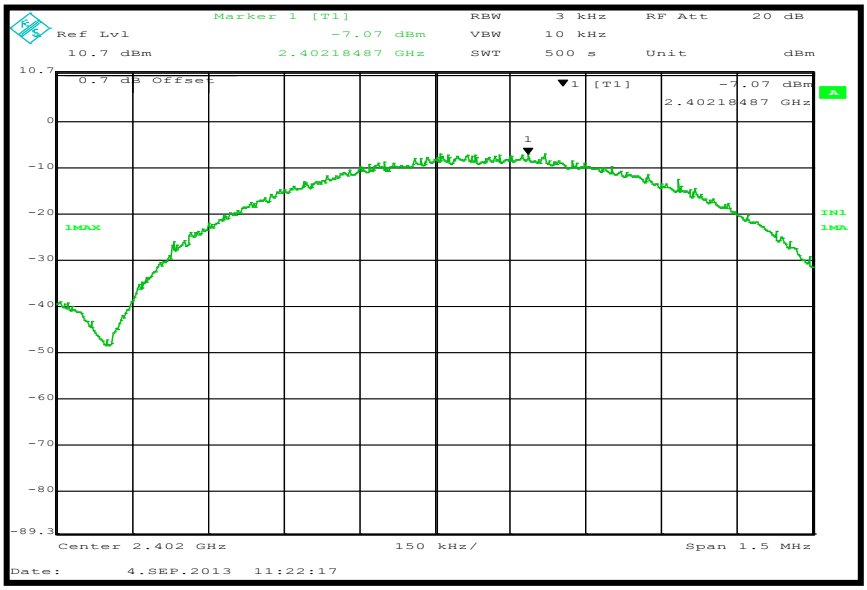
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS:

Channel	Center Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm)	Result
0	2402	-7.07	8	Pass
20	2442	-7.07	8	Pass
39	2480	-8.01	8	Pass

Output power was based on peak measurement therefore the power spectral density is also based on a peak measurement. Measured with modulation active on specified channel.

Representative plot showing power spectral density measurement at 2.402 GHz.



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6.6. Out of band emissions

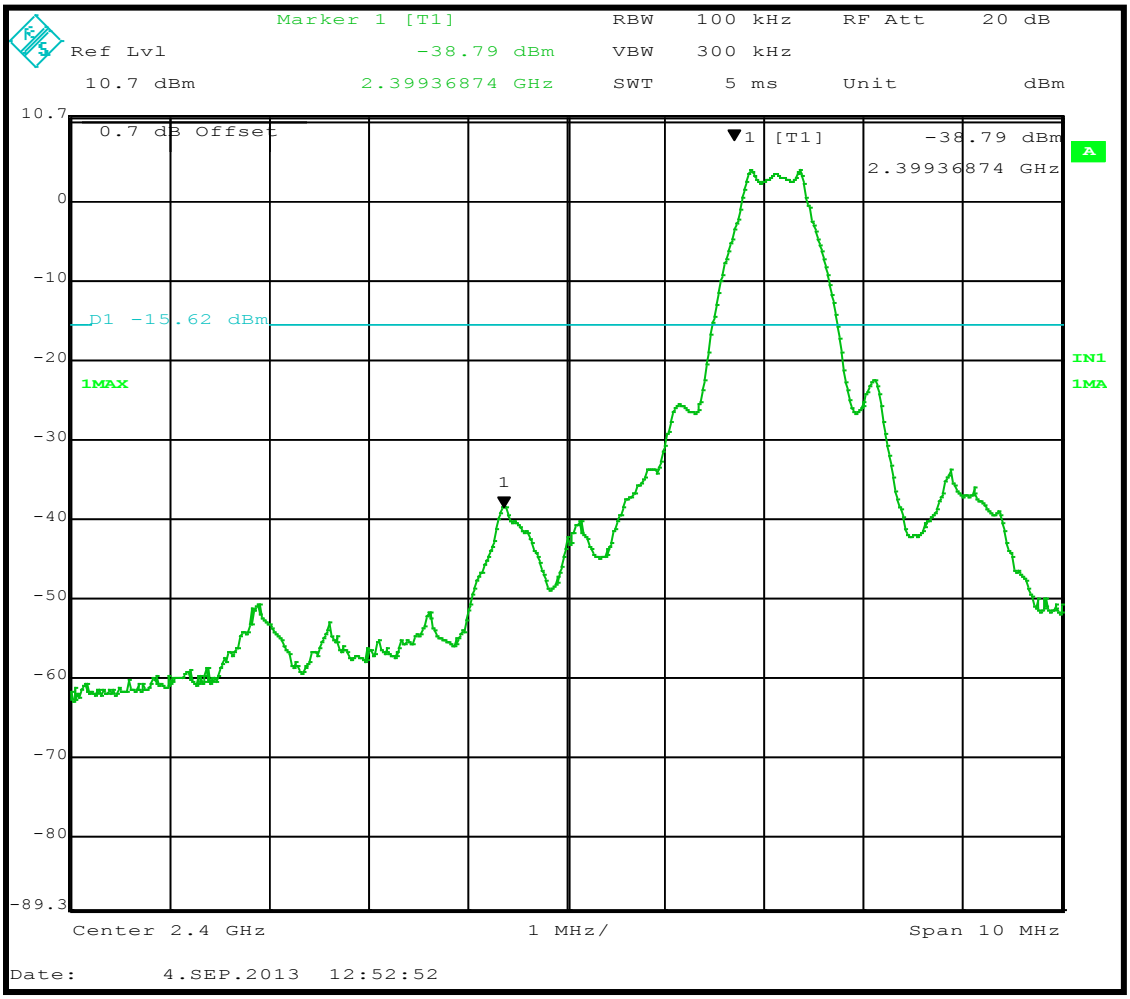
LIMIT:

FCC 15.247 (d)
IC RSS-210 A8.5, RSS-Gen 4.9 (a)

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB down from the maximum in band peak.

RESULTS:

Low channel band edge: (Display line set at 4.38 dBm – 20dB = -15.62 dB)
(4.38 dBm is the maximum value reported in section 6.4)



Maximum peak hold emissions are more than 20 dB down from in band peak.

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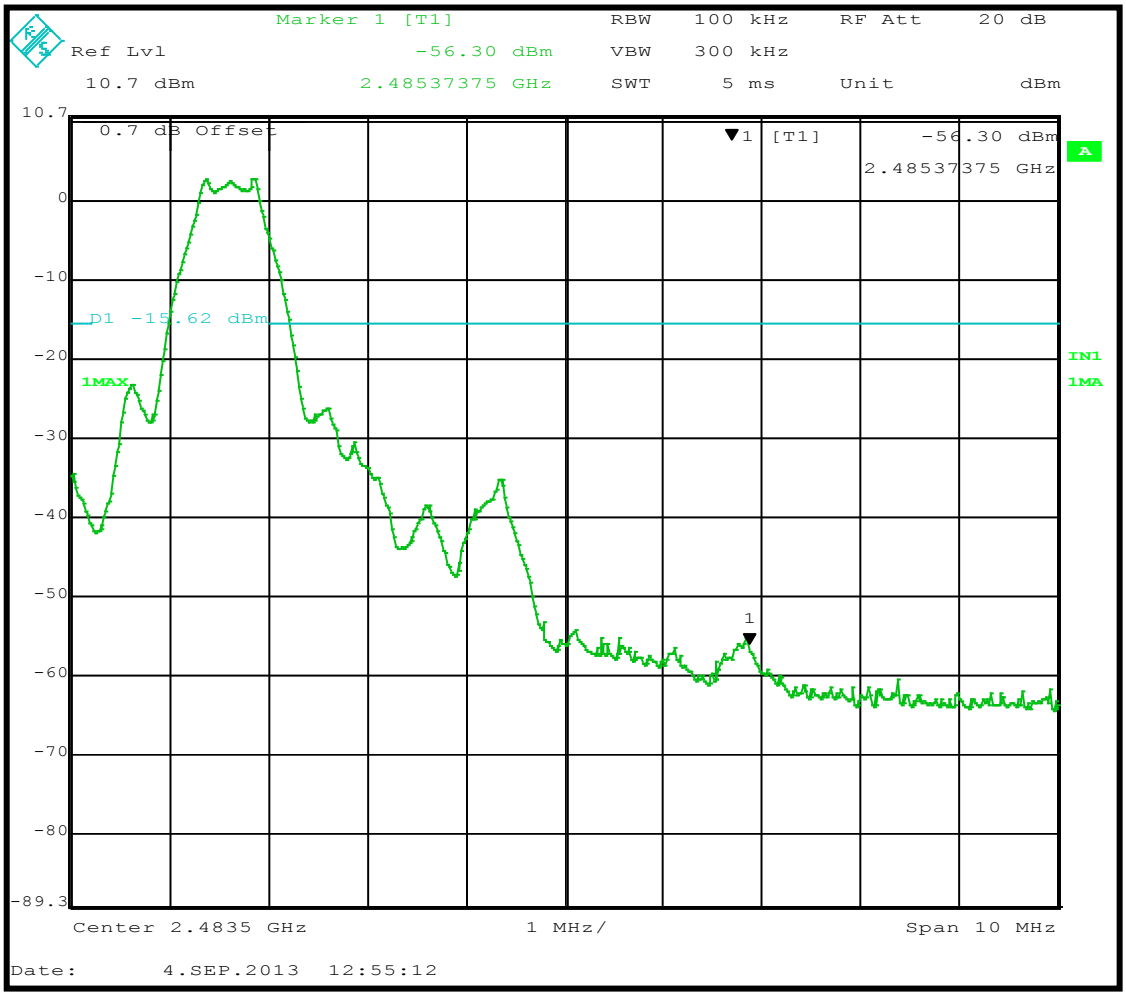
High channel band edge:



Maximum peak hold emissions are more than 20 dB down from in band peak.

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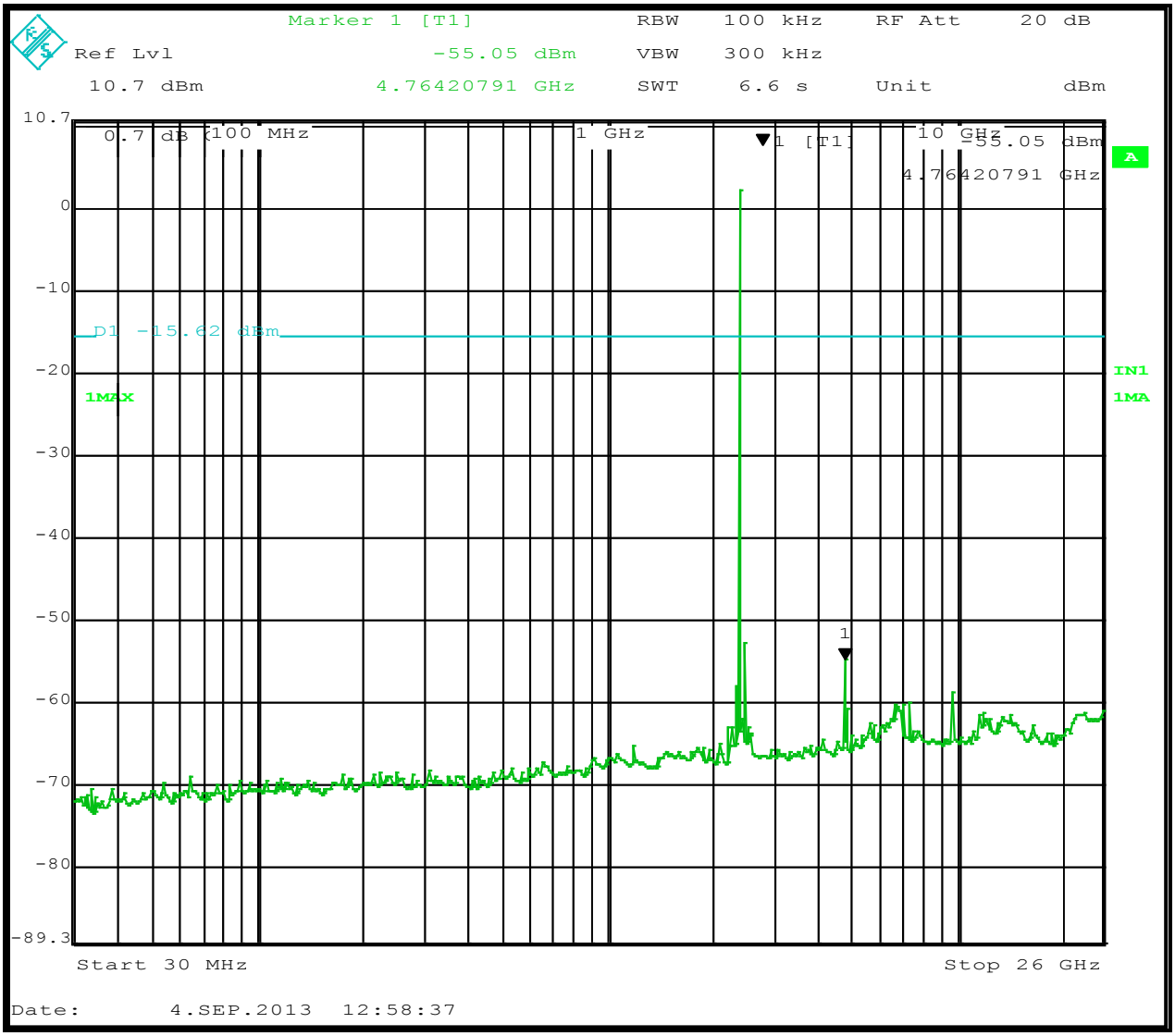
Low channel spurious:



Maximum peak hold emissions are more than 20 dB down from in band peak.
Large spike is the fundamental at 2.402 GHz

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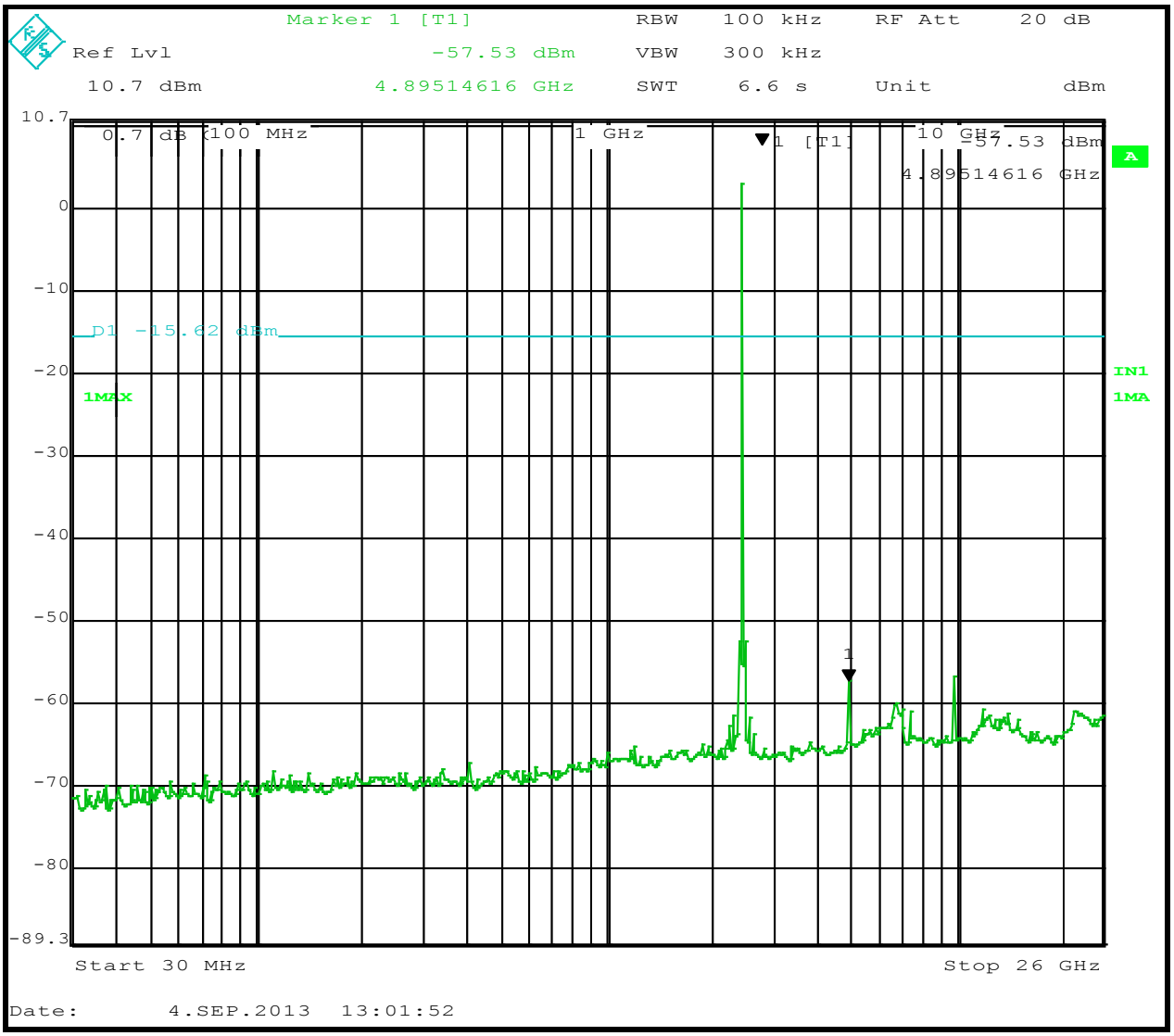
Middle channel spurious:



Maximum peak hold emissions are more than 20 dB down from in band peak.
Large spike is the fundamental at 2.442 GHz

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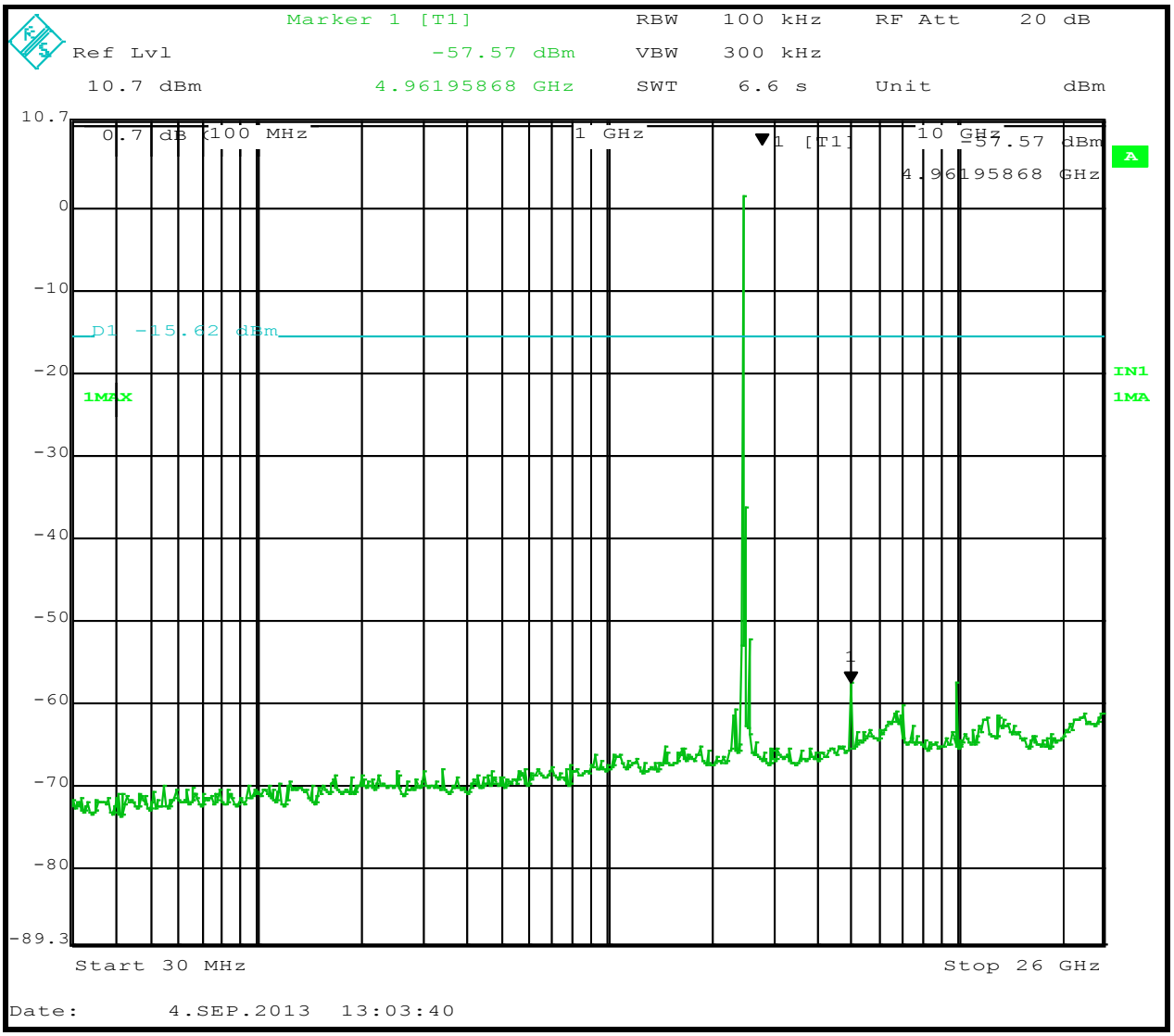
High channel spurious:



Maximum peak hold emissions are more than 20 dB down from in band peak.
Large spike is the fundamental at 2.480 GHz

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6.7. Receiver spurious emissions

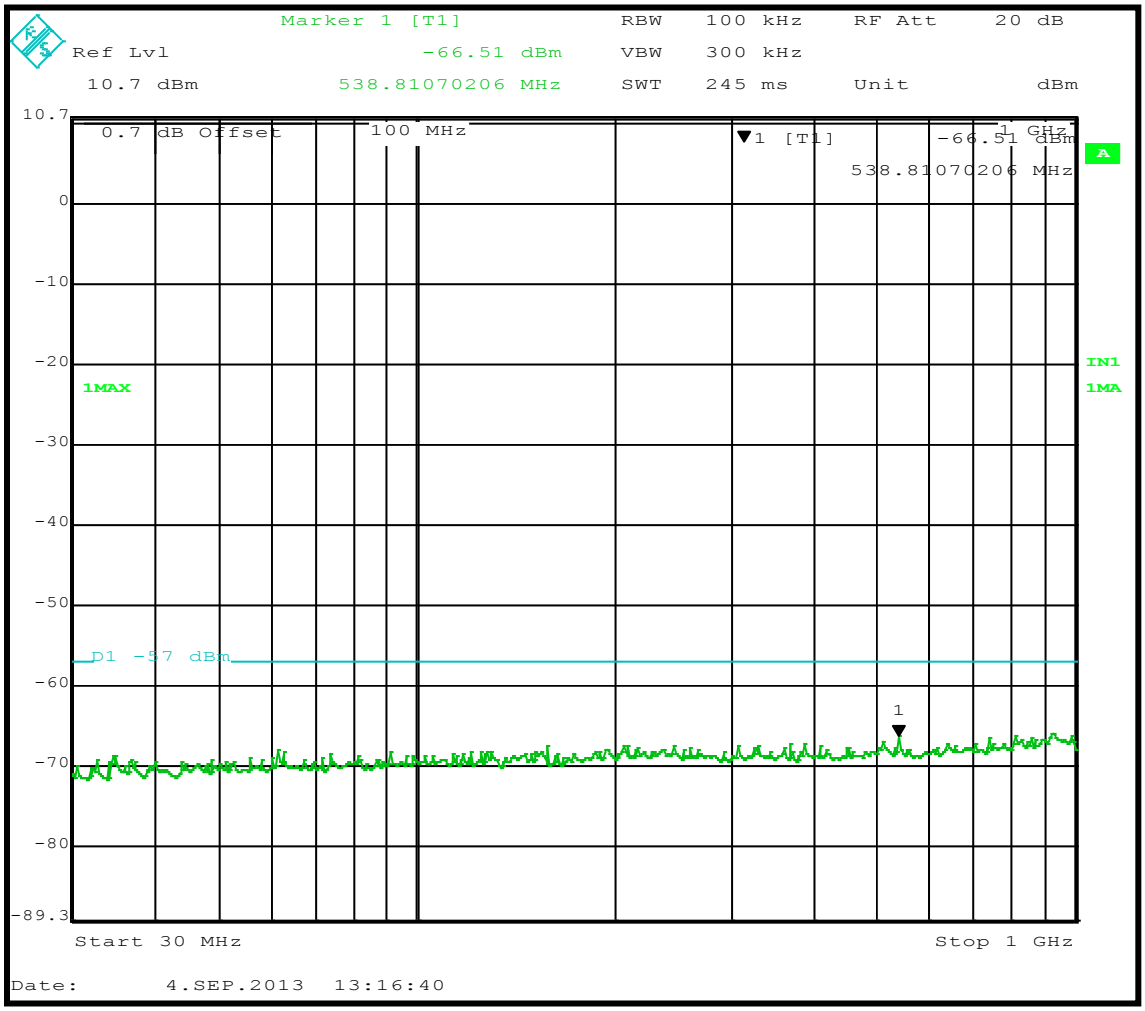
LIMIT:

RSS-Gen 6.2

Receiver mode spurious emissions at any discrete frequency shall not exceed 2 nanowatts (-57 dBm) in the band 30 -1000 MHz, and 5 nanowatts (-53 dBm) above 1000 MHz.

RESULTS:

Receiving on 2442 MHz, conducted spurious below 1 GHz



No emissions above –57 dBm observed.

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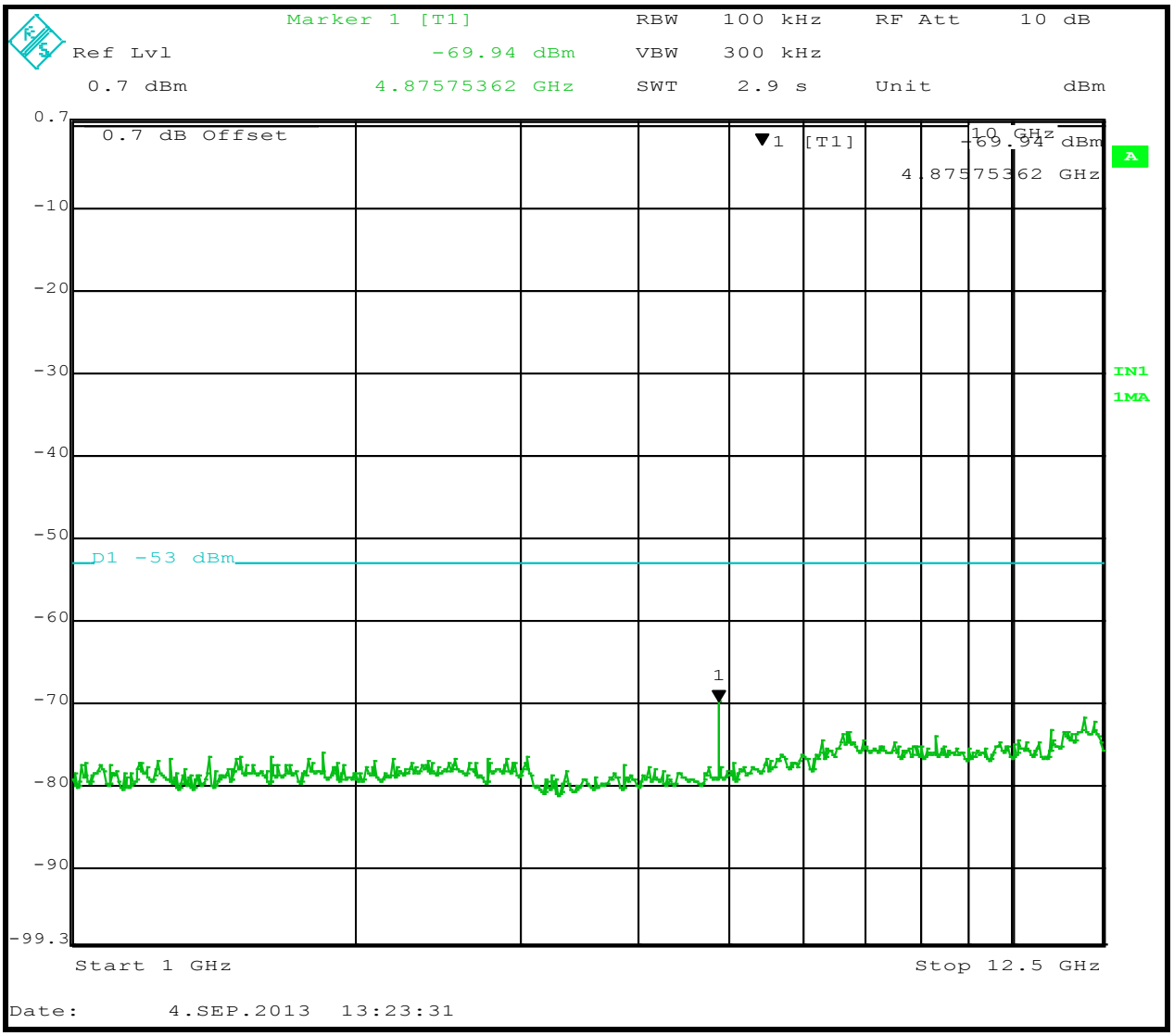
Receiving on 2442 MHz, conducted spurious above 1 GHz



No emissions above –53 dBm observed.

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6.8. Test and measurement equipment.

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				Last	Due
Spectrum Analyzer	Rhode & Schwarz	ESIB40	TN1560	4/4/2013	4/4/2014
SMK to SMA-F test cable (6.5")	SMK Electronics	CRC9001-3901F	NA	Verify	

6.9. Test information

Date of test:	9/4/2013 & 11/25/2013	**Test location :**	Transmitter test bench
EUT serial:	5DA	**Tested by:**	B. Cerqua
Test Conclusion:	Pass		

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7. Radiated emissions below 1 GHz

7.1. Limits

FCC 15.205 & FCC15.209, RSS-Gen 7.2.5

Frequency	Limit in dBµV/m @3m
MHz	Quasi-peak
30 – 88	40.0
88 - 216	43.5
216 - 960	46.0
> 960	54.0

7.2. Test setup

The EUT is placed in a standard ANSI C63.10 test setup. The EUT is rotated around the vertical axis, the antenna polarization changed from H to V and the antenna height above the ground plane is varied from 1 to 4 meters in order to maximize the emissions.

EUT was tested in 3 different orientations. See test setup photos file for description on the different EUT orientations

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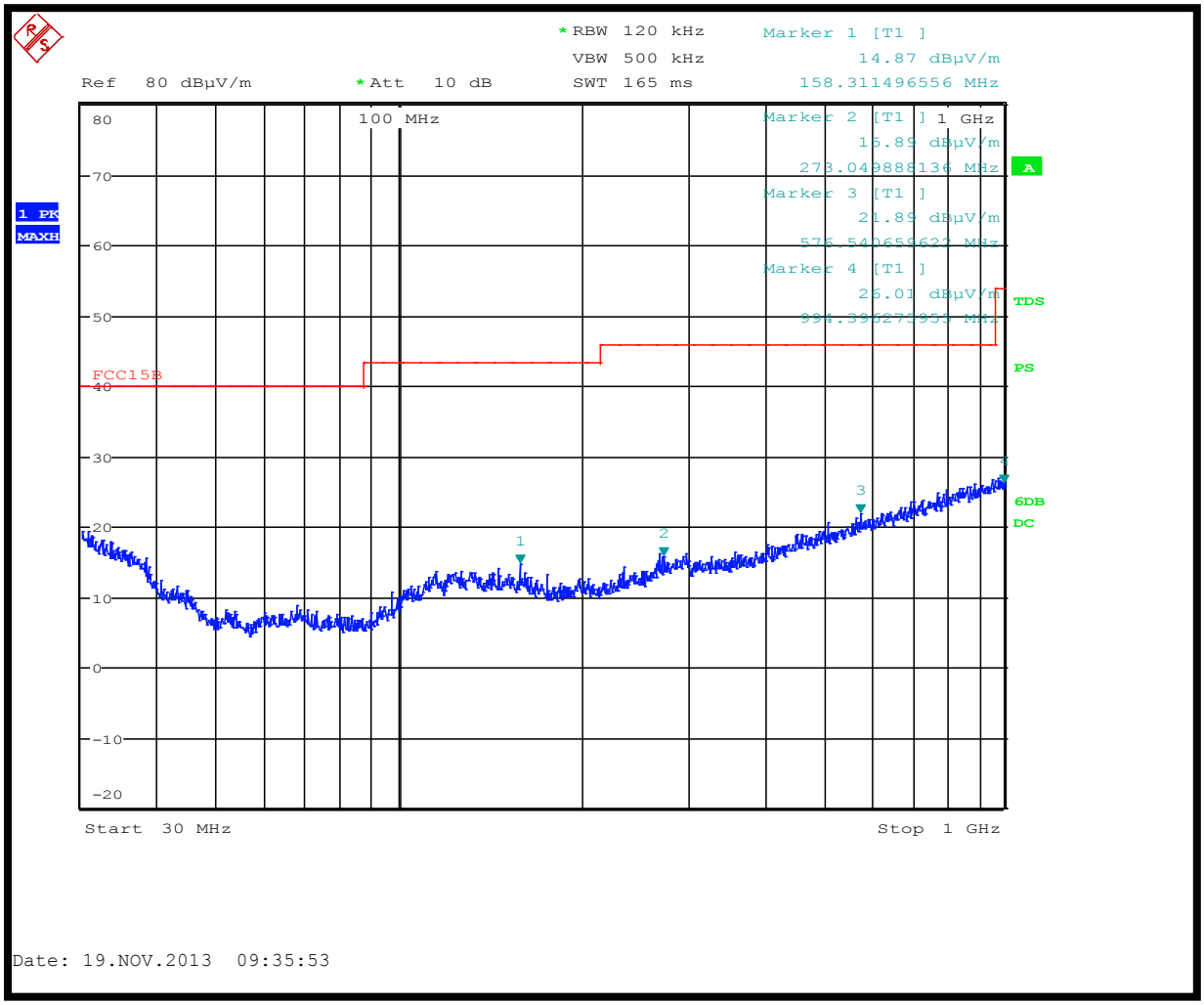
7.3. Measurement results

7.3.1 Out of band emissions while transmitting

EUT is in the X position orientation.

Vertical and horizontal antenna polarizations combined.



Maximum peak hold emissions are more than 10 dB below the QP limit therefore no quasi-peak measurements were made.

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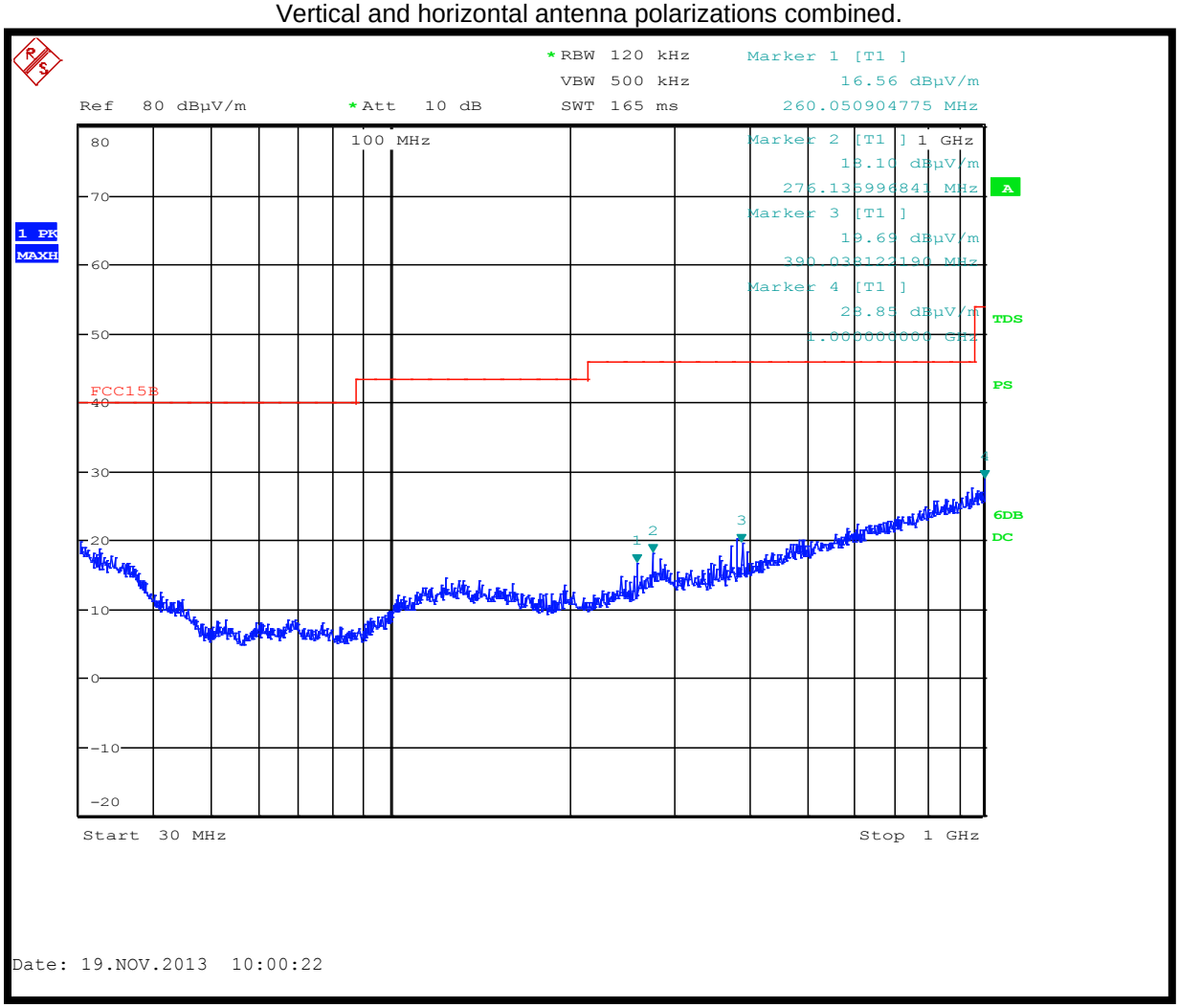
EUT is in the Y position orientation.

Vertical and horizontal antenna polarizations combined.



Maximum peak hold emissions are more than 10 dB below the QP limit therefore no quasi-peak measurements were made.

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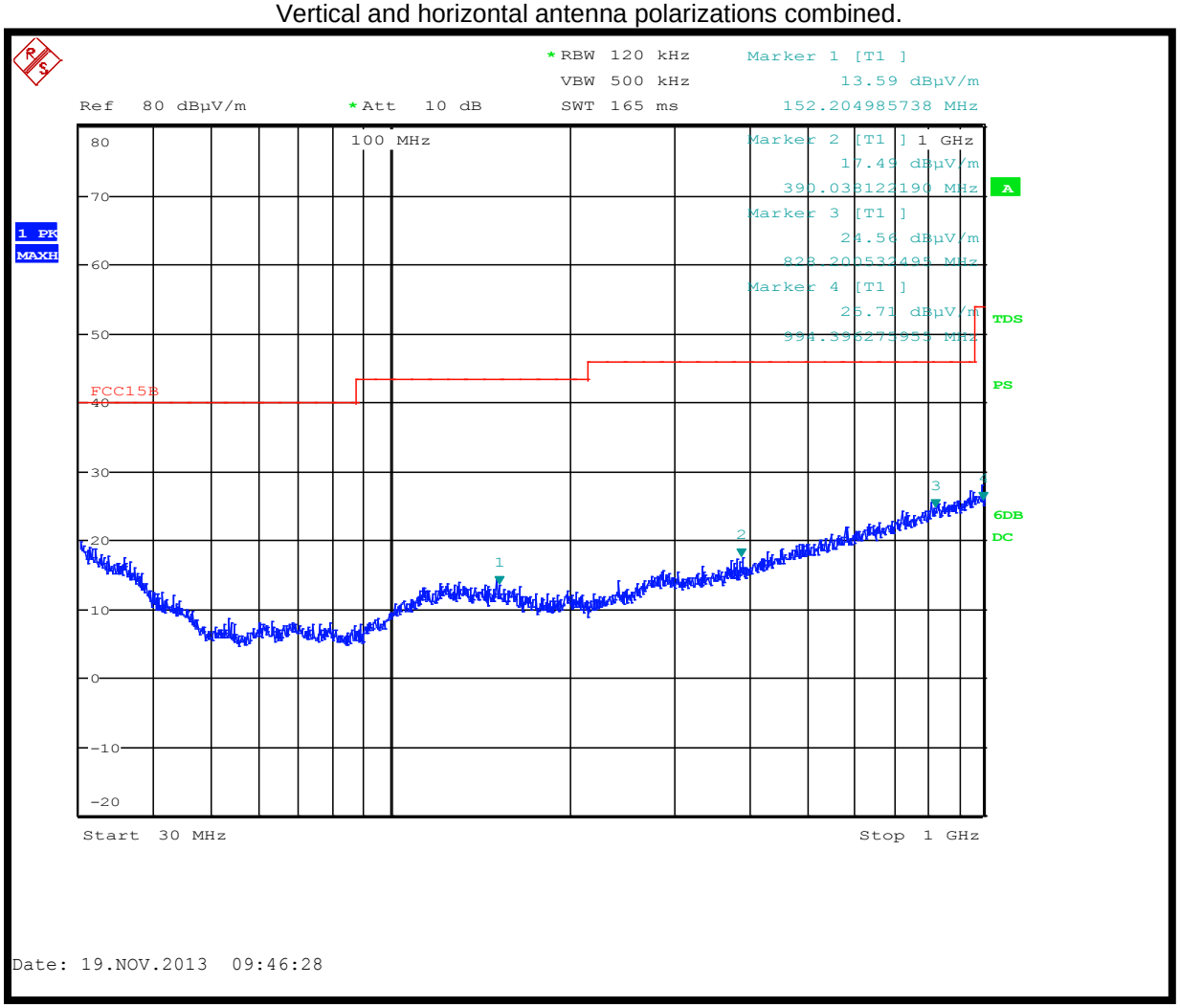
EUT is in the Z position orientation.

Vertical and horizontal antenna polarizations combined.



Maximum peak hold emissions are more than 10 dB below the QP limit therefore no quasi-peak measurements were made.

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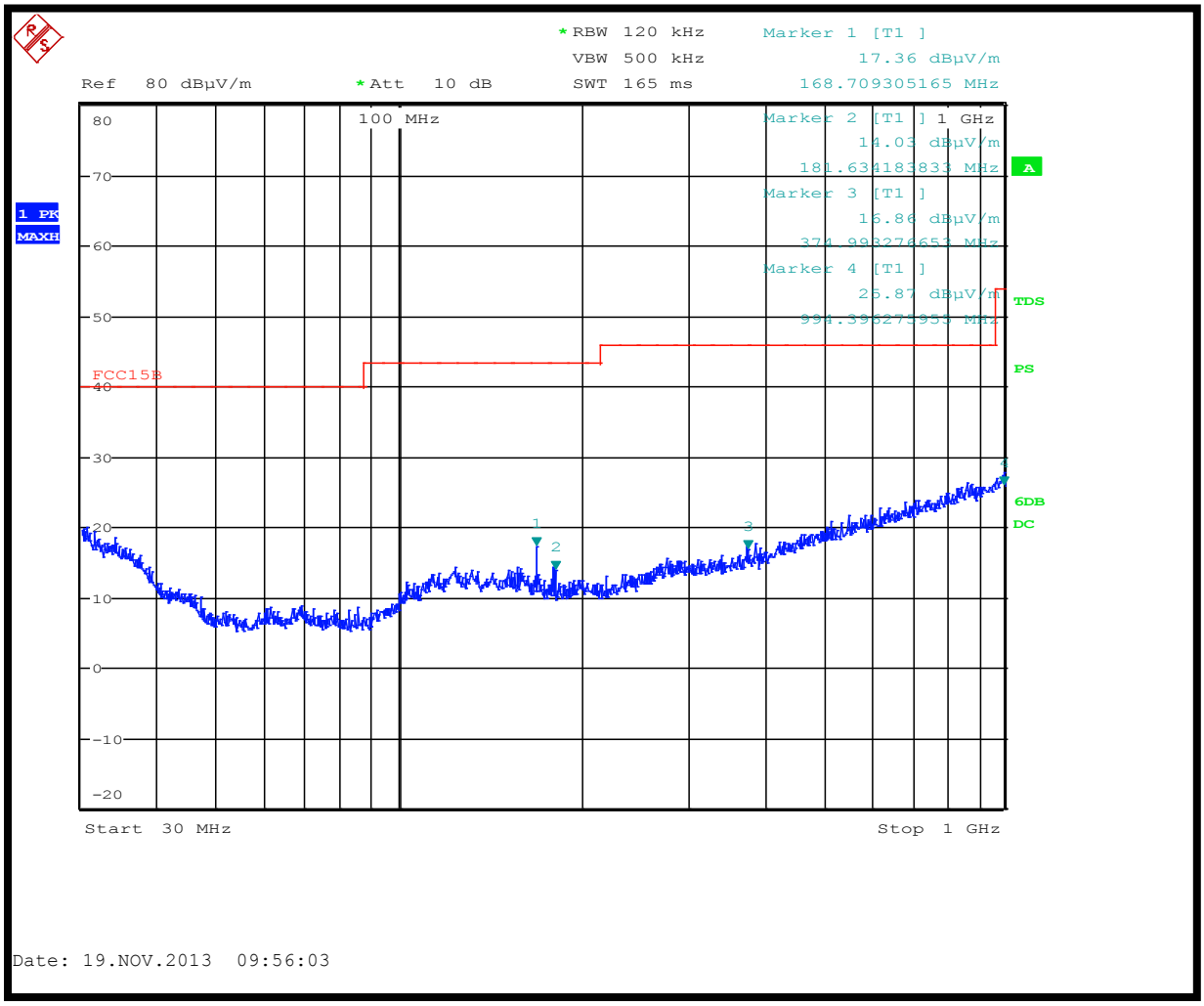
7.3.2 Receiver spurious emissions < 1 GHz

RSS - Gen (6)

Receiving on 2442 MHz

EUT is in the X position orientation.

Vertical and horizontal antenna polarizations combined.



Maximum peak hold emissions are more than 10 dB below the QP limit therefore no quasi-peak measurements were made.

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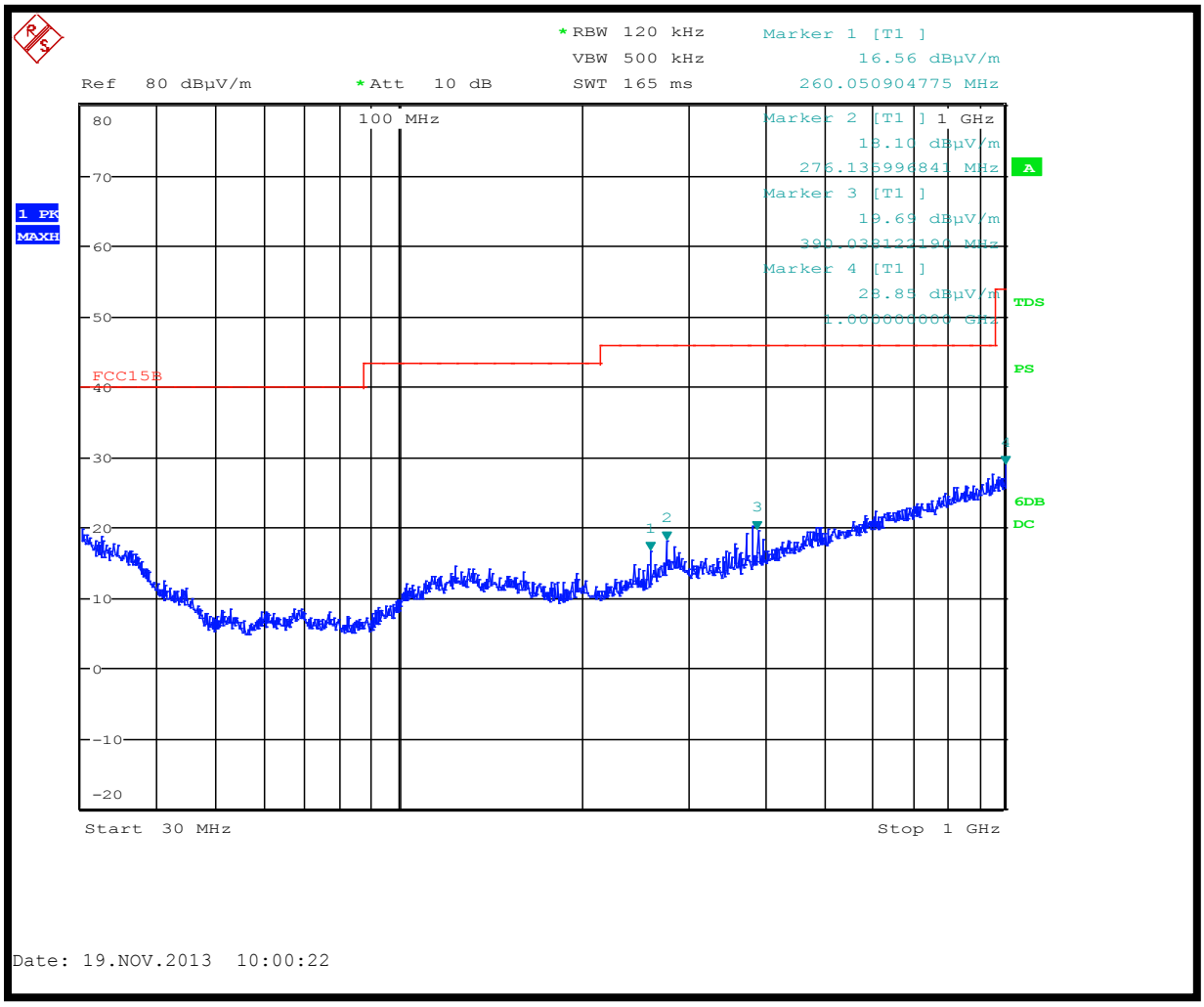
Receiving on 2442 MHz

EUT is in the Y position orientation.

Vertical and horizontal antenna polarizations combined.



Maximum peak hold emissions are more than 10 dB below the QP limit therefore no quasi-peak measurements were made.

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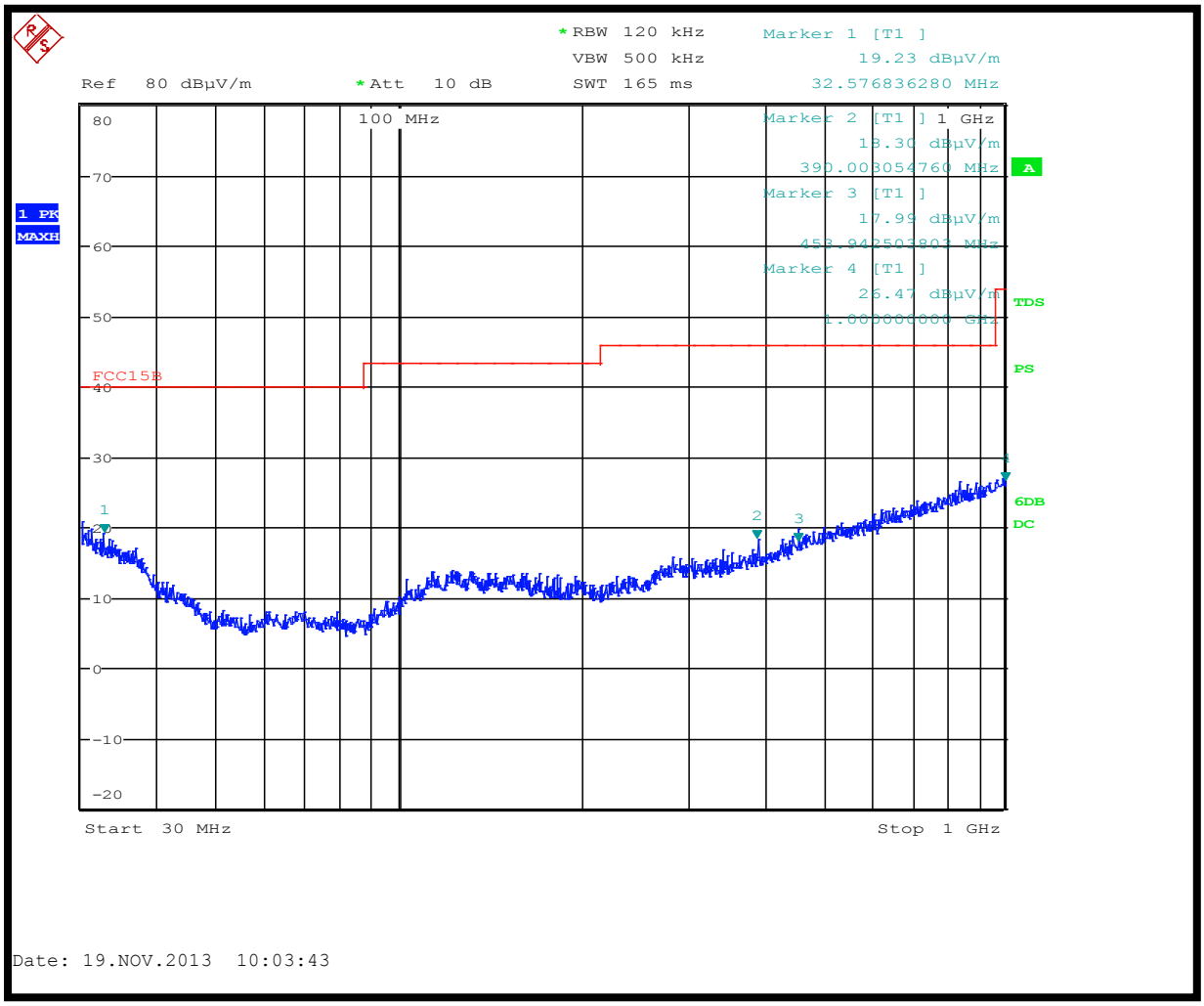
Receiving on 2442 MHz

EUT is in the Z position orientation.

Vertical and horizontal antenna polarizations combined.



Maximum peak hold emissions are more than 10 dB below the QP limit therefore no quasi-peak measurements were made.

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7.4. Test and measurement equipment.

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Antenna	Sunol	JB6	TN1541	7/24/2013	7/24/2014
Cable Set	Bose	NA	TN1445	3/5/2013	3/5/2014
Antenna Cable	Florida RF Labs	NMS-290-360.0-NMS	TN2165	2/13/2013	2/13/2014

7.5. Test information

Date of test:	11/19/2013	**Test location :**	Maxwell House
EUT serial:	38AE	**Tested by:**	B. Cerqua
Test Conclusion:	Pass		

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8. Radiated emissions above 1 GHz

Done in addition to conducted measurements to ensure emissions from enclosure are also within limits.

8.1. Limits

FCC part 15.205(a), 15.209(a), 15.247(d), RSS-Gen 6, 7.2.5

In any of the restricted bands defined in FCC part 15.205(a), the field strength at a distance of 3 meters shall not exceed 54dBµV/m (average) or 74dBµV/m (peak)

8.2. Test setup

The EUT is placed in a standard ANSI C63.10 test setup. The EUT is rotated around the vertical axis, the antenna polarization changed from H to V and the antenna height above the ground plane is varied from 1 to 4 meters in order to maximize the emissions. Worst case emissions were investigated and found to be with the EUT in the horizontal position which also showed the highest fundamental field strength.

When measuring the fundamental and harmonics the EUT is programmed on the low, middle and high frequency channels, for all other test cases the EUT is transmitting on all channels.

Various horn antennas with suitable pre-amps mounted directly on them were used to make emission measurements above 1 GHz. Above 18 GHz the measurement distance was originally set at 3 meters and no emissions were observed above the instrumentation noise floor. The measurements were repeated at measurement distance less than 0.3 meters and no emissions were observed.

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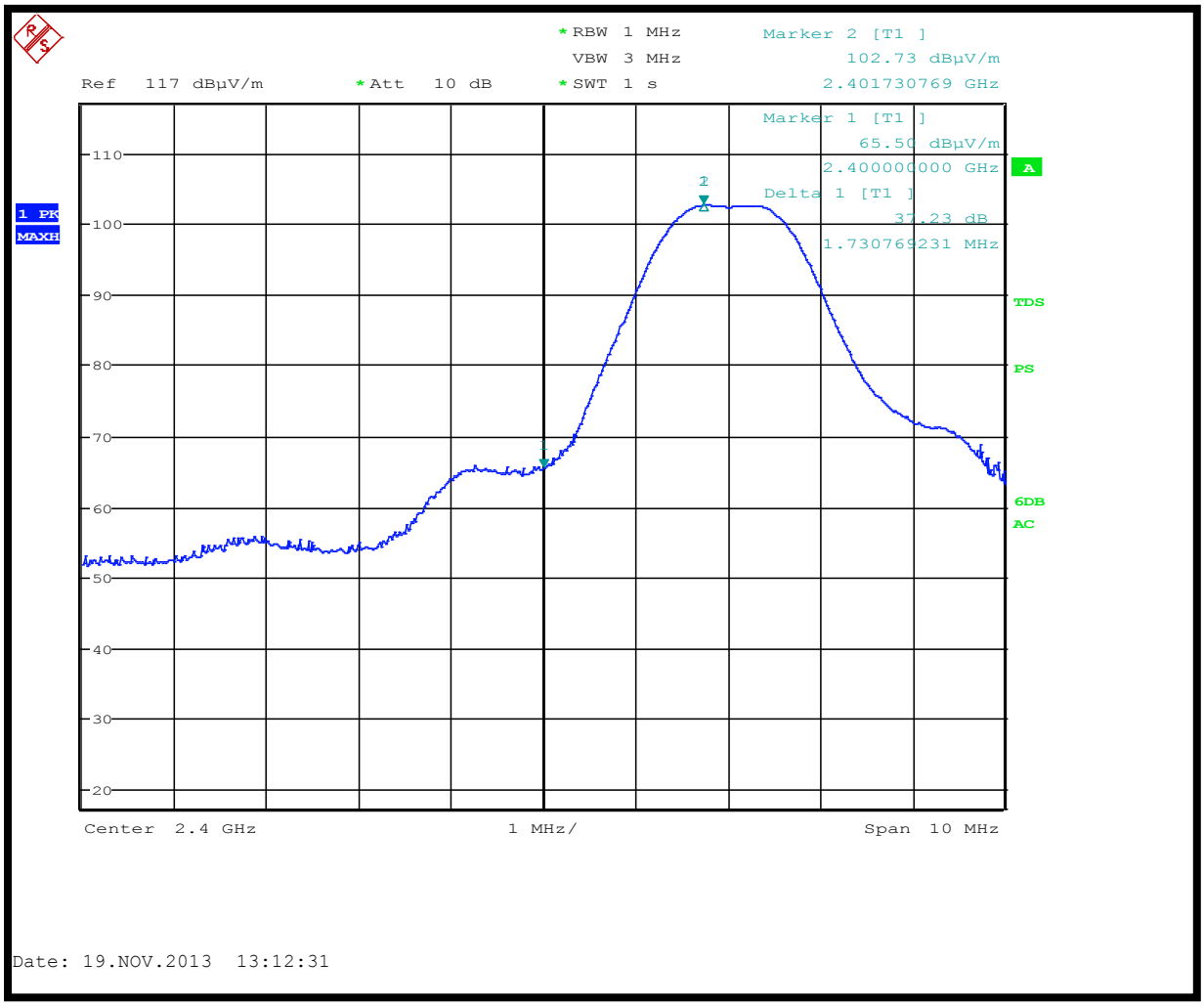
8.3. Measurement results

EUT transmitting on lowest channel (2402 MHz) with modulation active.

EUT in the X position.
Lower band edge radiated emissions
(3 meter distance, vertical & horizontal polarizations combined)



Maximum peak emissions are more than 20 dB down from in band peak.

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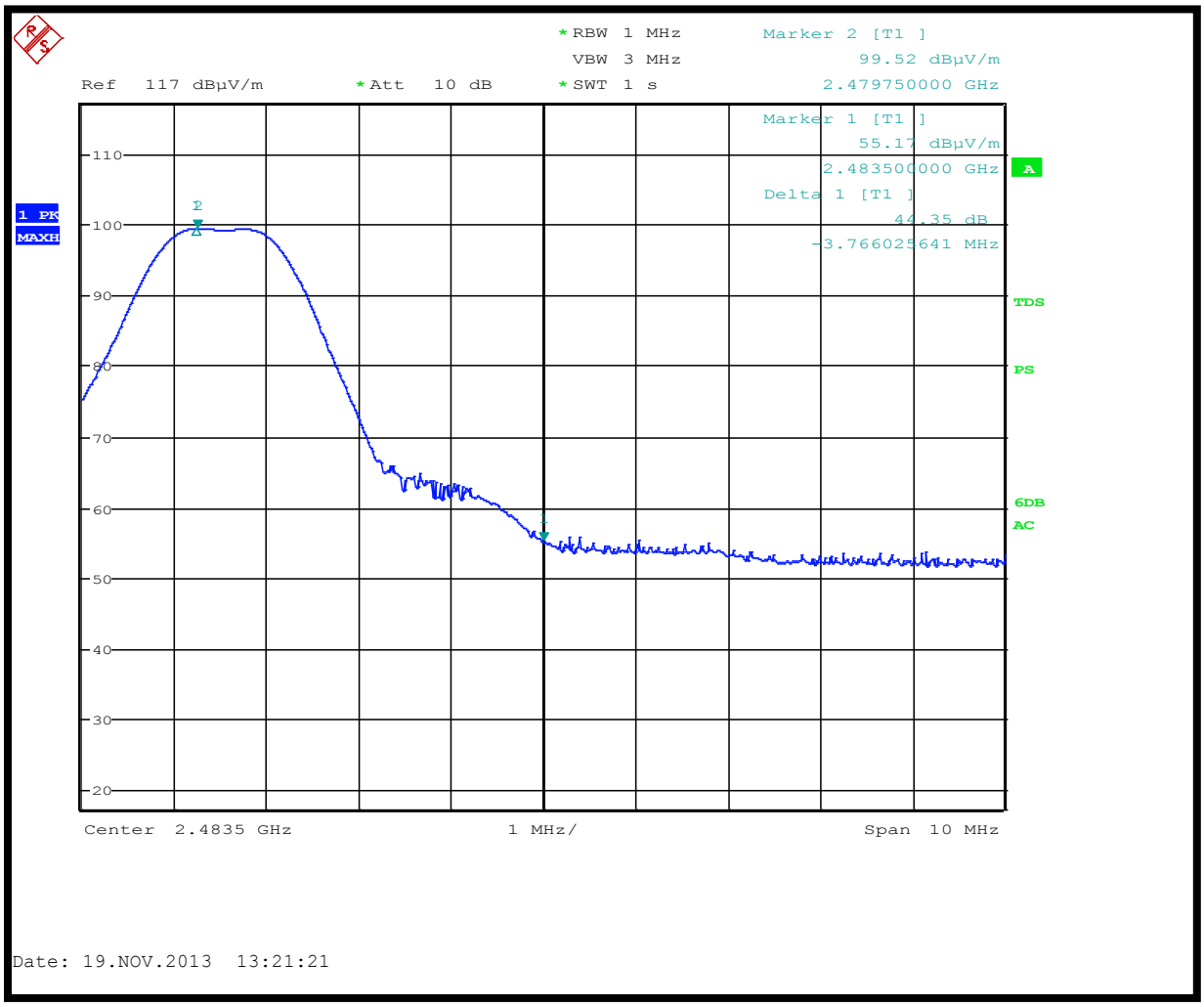
EUT transmitting on highest channel (2480 MHz) with modulation active.

EUT is in the X position
Upper band edge radiated emissions
(3 meter distance, vertical & horizontal antenna polarizations combined)



Maximum peak emissions are more than 20 dB down from in band peak.

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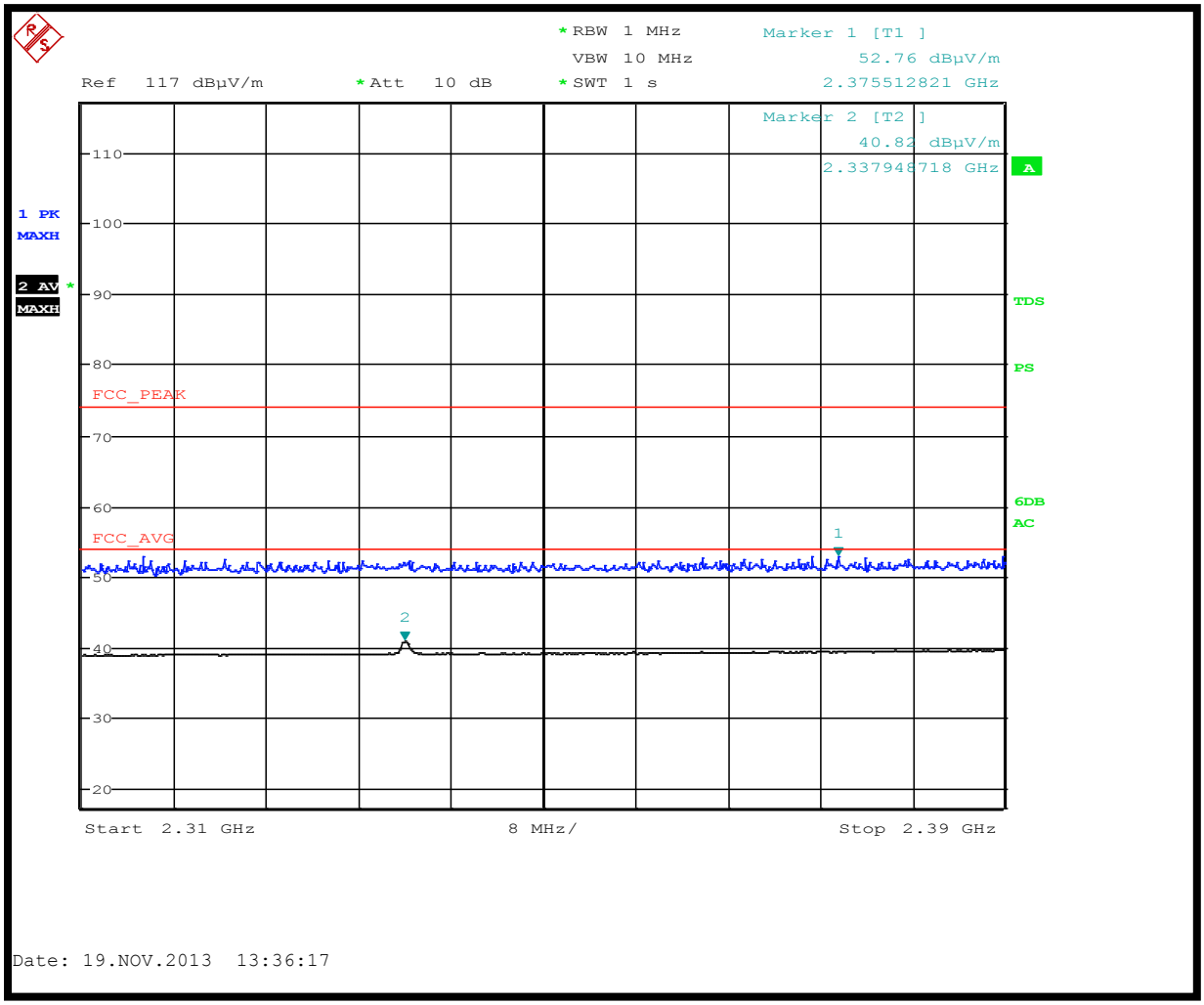
EUT is in the X position

Lower restricted band emissions

(3 meter distance, vertical & horizontal antenna polarizations combined)



Peak and average emissions are more than 10 dB below their respective 15.209 limits.

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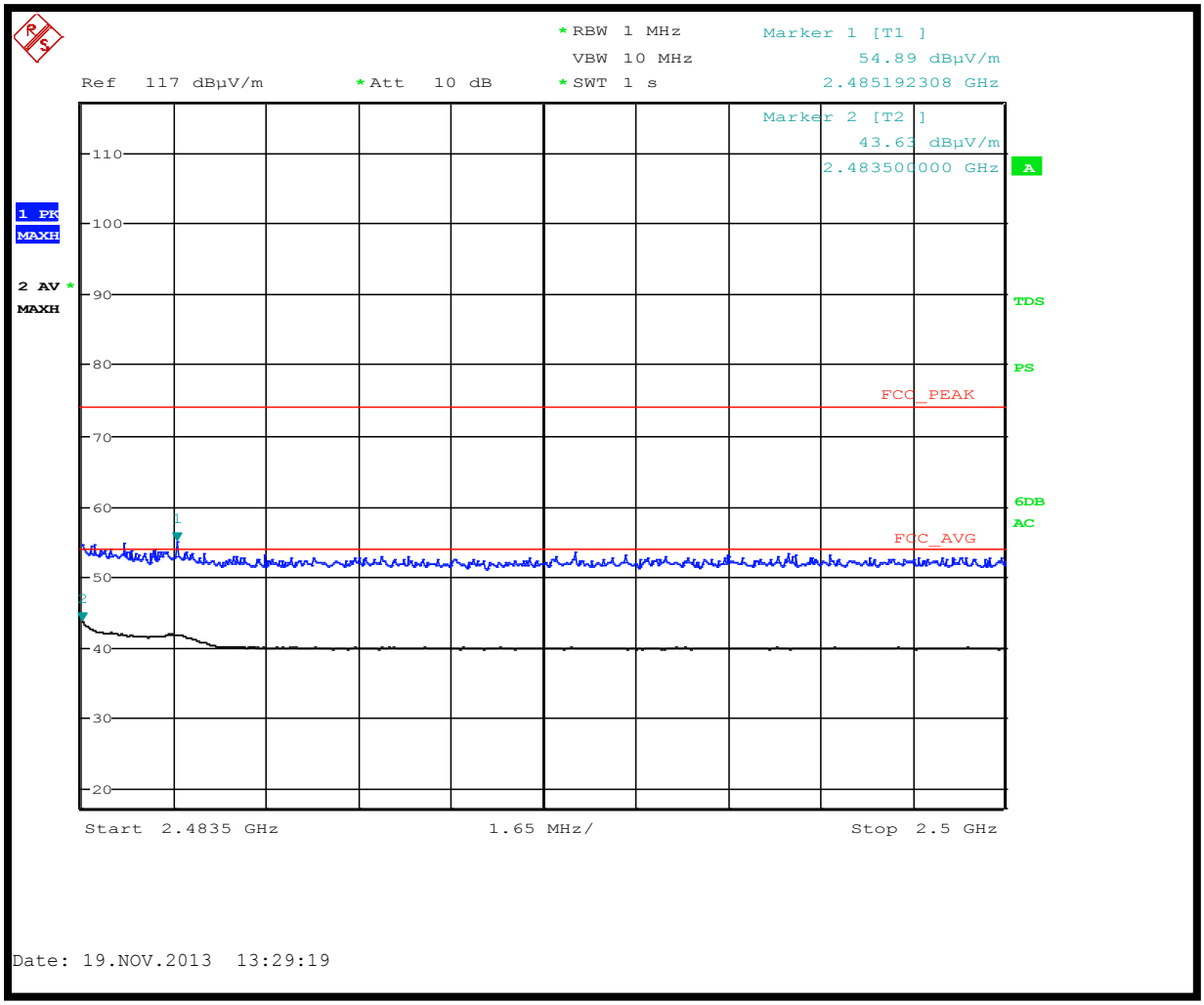
EUT is in the X position

Upper restricted band emissions

(3 meter distance, vertical & horizontal antenna polarizations combined)



Peak and average emissions are more than 10 dB below their respective 15.209 limits.

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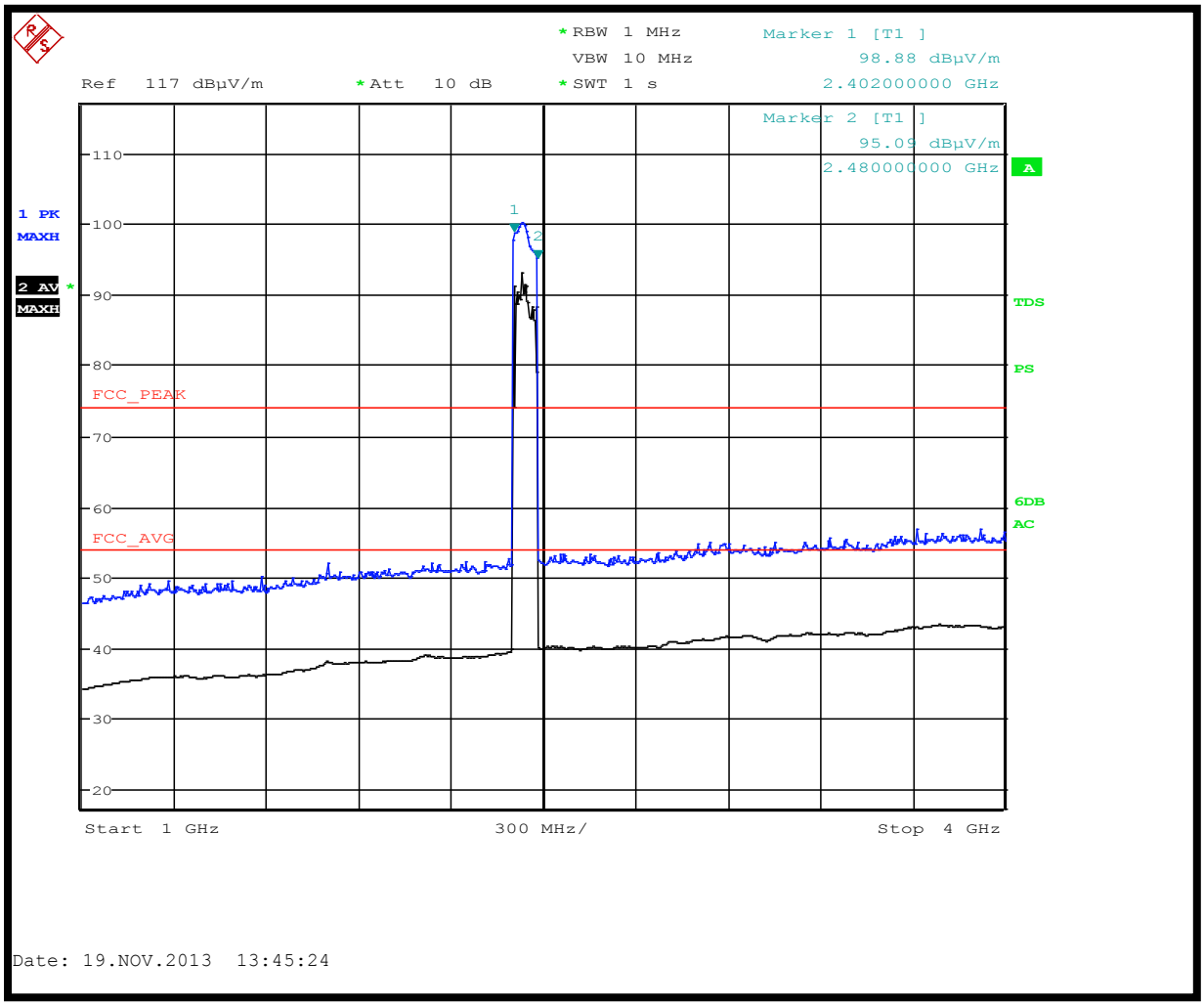
EUT is in the X position

Radiated emissions 1 GHz to 4 GHz

(3 meter distance, vertical & horizontal antenna polarizations combined)



Spurious peak and average emissions are more than 10 dB below the general limit.

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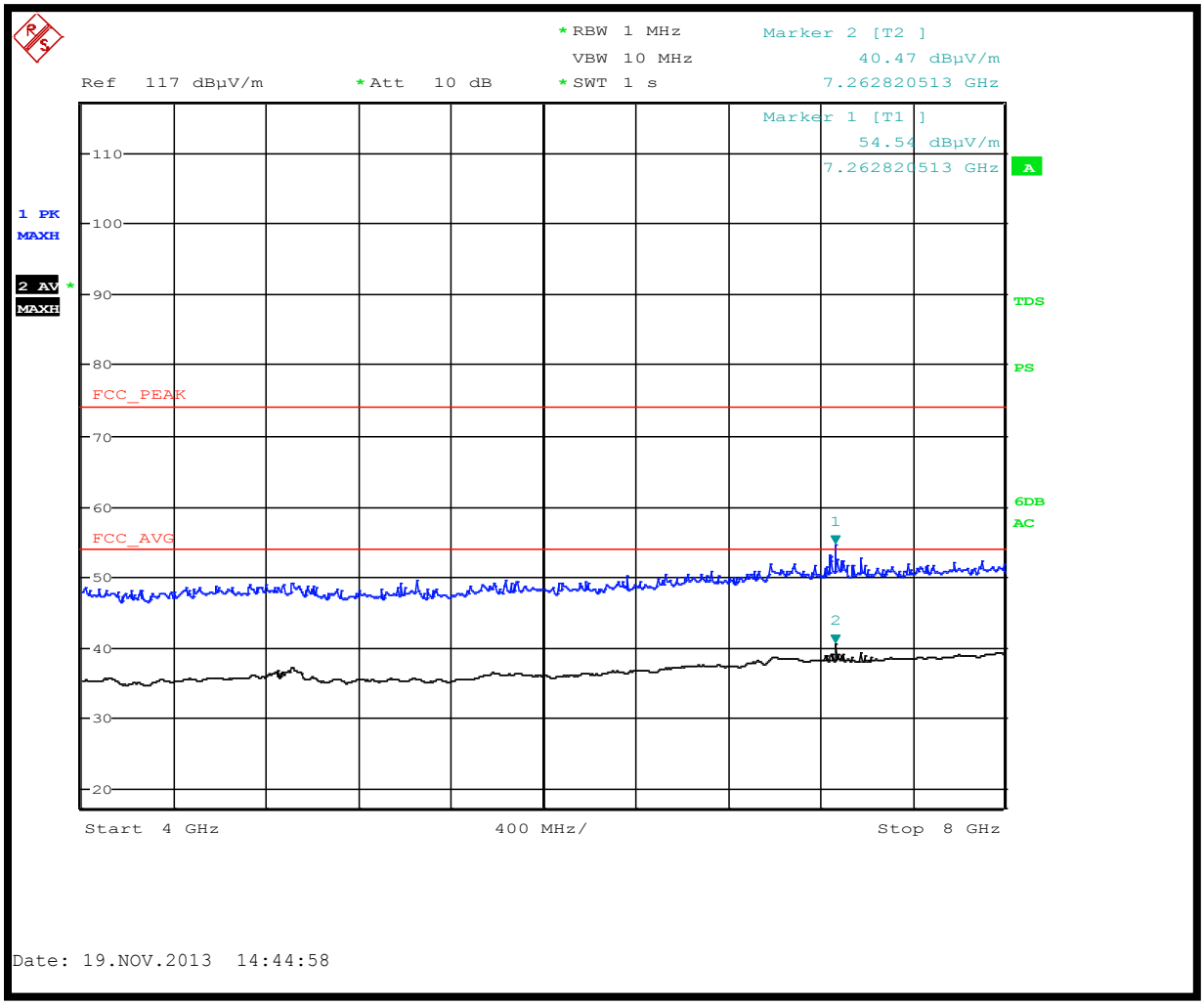
EUT is in the X position

Radiated emissions 4 GHz to 8 GHz

(3 meter distance, vertical & horizontal antenna polarizations combined)



Emissions near 7.2 GHz are the 3rd harmonic of the transmitter and covered in the table below:
All emissions are 10 dB below the general limit.

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Fundamental, 2nd & 3rd harmonics (3 meter distance) (RBW = 1 MHz)

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) AVG	FCC 15B Margin (dB) Peak	EUT Position	Measurement Antenna Polarization
2402.000	101.30	104.50					X	H
2402.000	90.30	96.90					X	V
2402.000	95.60	100.50					Y	H
2402.000	97.80	101.80					Y	V
2402.000	99.80	102.80					Z	H
2402.000	94.30	100.30					Z	V
2442.000	101.40	102.50					X	H
2442.000	93.20	94.80					X	V
2442.000	94.70	96.10					Y	H
2442.000	98.40	99.50					Y	V
2442.000	99.40	100.40					Z	H
2442.000	95.20	96.50					Z	V
2480.000	98.70	99.80					X	H
2480.000	92.20	93.80					X	V
2480.000	92.30	93.90					Y	H
2480.000	95.20	96.60					Y	V
2480.000	97.00	98.20					Z	H
2480.000	94.70	96.10					Z	V
4804.000	33.40	41.00	54.0	74.0	20.6	33.0	X	V & H
4804.000	35.70	42.40	54.0	74.0	18.3	31.6	Y	V & H
4804.000	35.30	42.20	54.0	74.0	18.7	31.8	Z	V & H
7206.000	44.00	50.50	54.0	74.0	**10.0**	23.5	X	V & H
7206.000	42.60	49.30	54.0	74.0	11.4	24.7	Y	V & H
7206.000	40.70	47.80	54.0	74.0	13.3	26.2	Z	V & H
4884.000	34.30	42.00	54.0	74.0	19.7	32.0	X	V & H
4884.000	35.30	42.00	54.0	74.0	18.7	32.0	Y	V & H
4884.000	35.20	42.00	54.0	74.0	18.8	32.0	Z	V & H
7326.000	43.30	49.70	54.0	74.0	10.7	24.3	X	V & H
7326.000	39.40	46.50	54.0	74.0	14.6	27.5	Y	V & H
7326.000	39.10	46.60	54.0	74.0	14.9	27.4	Z	V & H
4960.000	32.10	40.00	54.0	74.0	21.9	34.0	X	V & H
4960.000	30.90	39.90	54.0	74.0	23.1	34.1	Y	V & H
4960.000	34.50	41.60	54.0	74.0	19.5	32.4	Z	V & H
7440.000	36.70	45.20	54.0	74.0	17.3	28.8	X	V & H
7440.000	33.70	42.80	54.0	74.0	20.3	31.2	Y	V & H
7440.000	34.40	43.50	54.0	74.0	19.6	30.5	Z	V & H

Worst case emission is for the 3rd harmonic of 2402 MHz with 10.0 dB AVG margin with the EUT in the X position.

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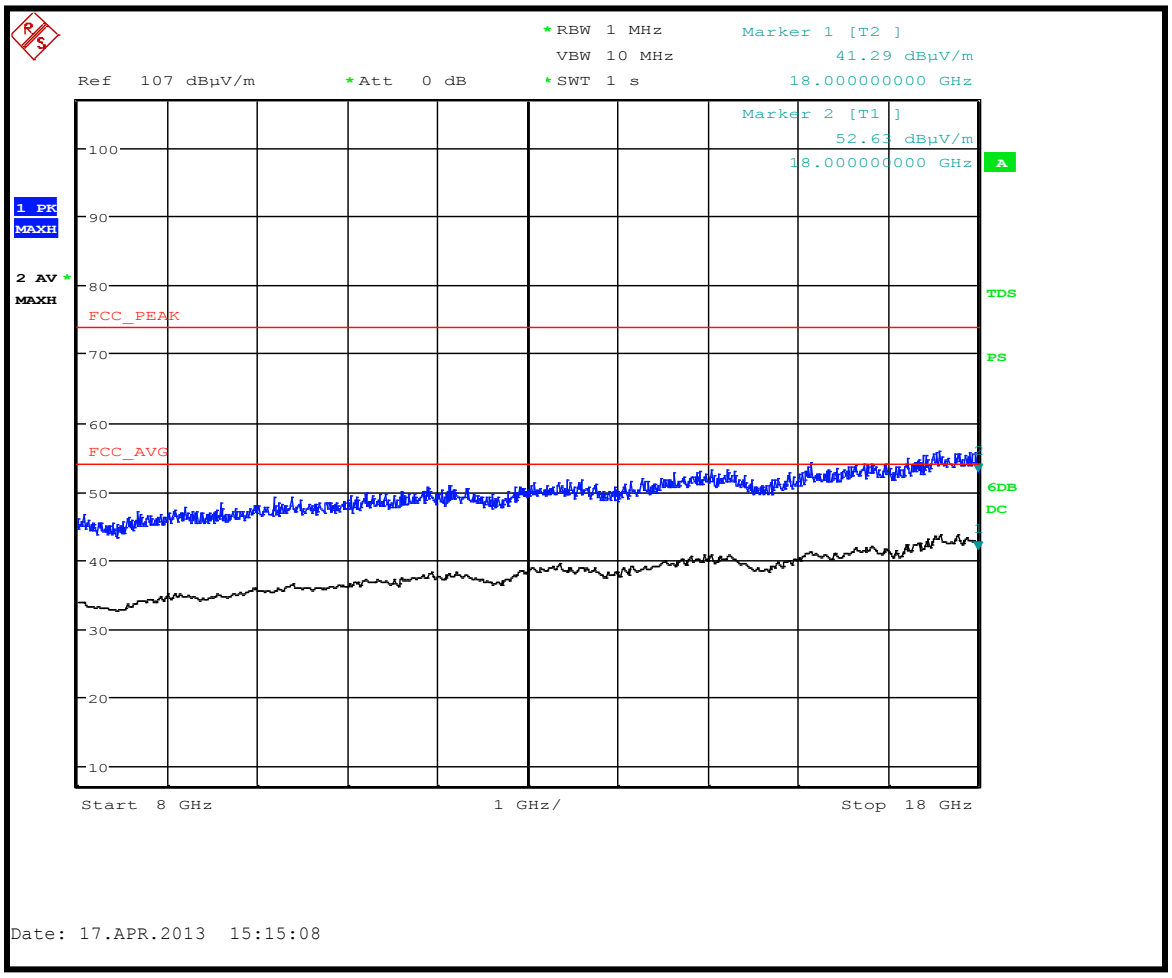
Radiated emissions 8 GHz to 18 GHz

EUT is in the worst case horizontal (X) position.
(3 meter distance, vertical & horizontal antenna polarizations combined)



Peak and average emissions are more than 10 dB below the general limit.

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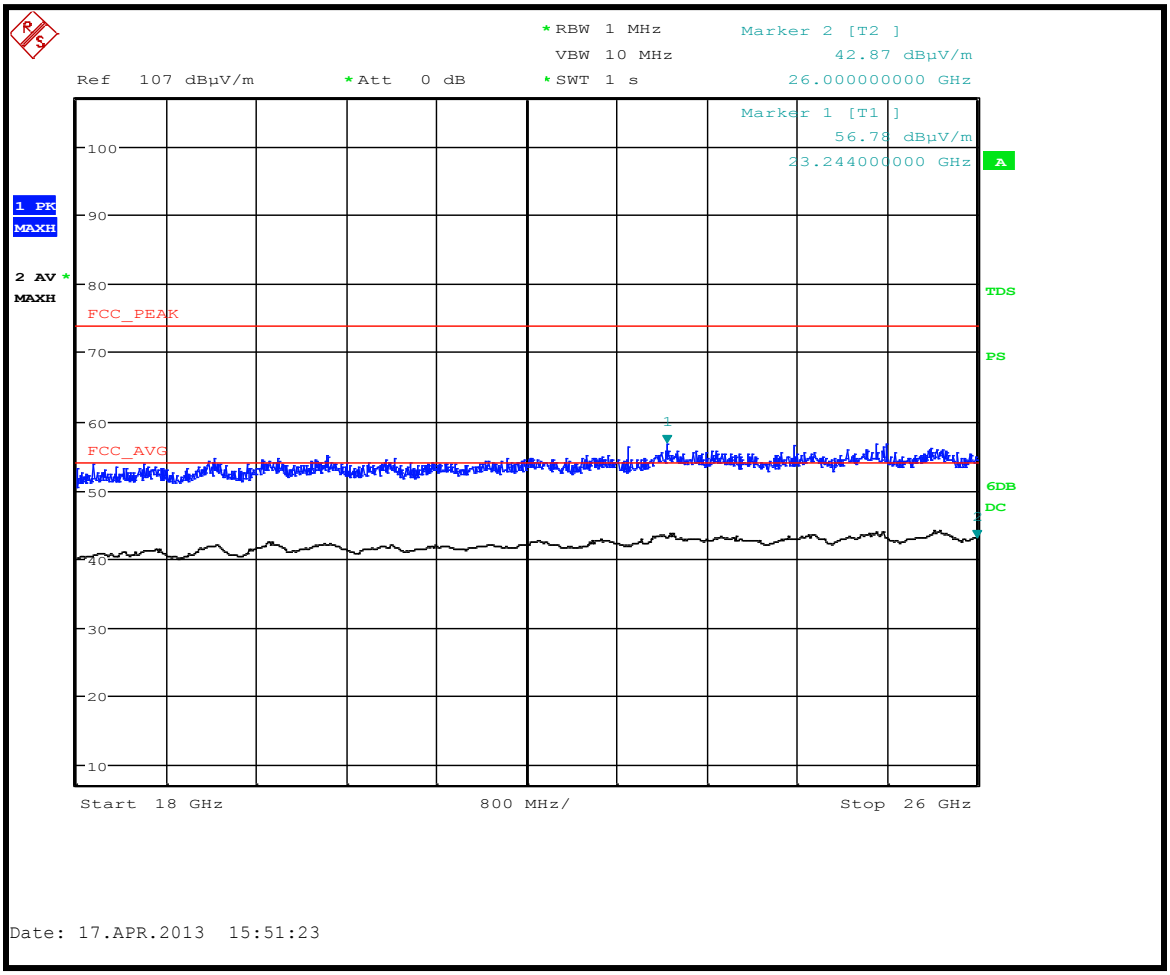
Radiated emissions 18 GHz to 26 GHz
(Distance reduced to less than 0.3 meters)

EUT is in the worst case horizontal (X) position.
(Vertical & horizontal antenna polarizations combined)



No emissions observed above the instrumentation noise floor, (distance < 3 meters).

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Receiver spurious emissions (radiated)

LIMIT:

RSS-Gen 6.1

54 dBuV/m (Average Detector, RBW = 1 MHz)

Spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is higher, without exceeding 40 GHz.

Highest frequency = 3 * 2.480 GHz = 7.44 GHz (Per RSS-Gen 4.10)

EUT receive operating all channels, measured on mid band channel (2442 MHz).

The only observed emission between 1 GHz and 7. 44 GHz was due to the 2nd harmonic of the local oscillator.

Local oscillator frequency = 2442 -1 MHz = 2441 MHz.
2nd harmonic of local oscillator = 2 * 2441 MHz = 4882 MHz.

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B					Measurement Antenna Polarization
			Limit (dBµV/m) AVG*	Limit (dBµV/m) Peak	Margin (dB) AVG	Margin (dB) Peak	EUT Position	
4882.000	42.90	45.70	54.0	74.0	11.1	28.3	X	V & H
4882.000	41.70	45.00	54.0	74.0	12.3	29.0	Y	V & H
4882.000	42.70	45.40	54.0	74.0	11.3	28.6	Z	V & H

Measured in spectrum analyzer receiver mode using RBW = 1 MHz, average detector.

Worst case margin of 11.1 dB AVG at 4882 MHz in the X position.

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8.4. Test and measurement equipment.

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Antenna Cable	Florida RF Labs	NMS-290-360.0-NMS	TN2165	2/13/2013	2/13/2014
Cable	RF Coax Inc.	K316MM-42	TN1277-18	NA	NA
1 to 18 GHz horn	EMCO	3115	TN478	7/12/2012	7/12/2015
4 to 8 GHz horn	AR	AT4003	TN727	12/6/2011	12/6/2014
8 to 18 GHz horn	AR	AT4004	TN728	12/1/2011	12/1/2014
18 to 26 GHz horn	Emco	3160-09	TN1307	2/23/2011	2/23/2014
20 GHz preamp	Miteq	AFS4-00102000-30-10P-4	TN1672	9/20/2011	9/20/2013
40 GHz preamp	Miteq	JS4018004000-30-8P-A1	TN1757	9/18/2013	9/13/2014

8.5. Test information

Date of test:	4/17/2013 & 11/19/2013	**Test location :**	Maxwell house
EUT serial:	68, 38AE	**Tested by:**	B. Cerqua
Test Conclusion:	Pass		

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9. SAR exemption calculation

Frequency Range: 2402-2480MHz

Based on FCC KDB 447498 D01 General RF Exposure Guidance v05r01 (Section 4.3)

Equation 1:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] * [√f(GHz)]

Distance between EUT antenna and body (hand) is 5mm

Maximum conducted output power measured (dBm) = 4.38 dBm (2.74 mW)
(see section 6.5 of this report)

Applying equation 1:

(2.74/5) * [√(2.480)] = 0.85 <= 3.0

Equation one is below the 3.0 1-g SAR exemption limit, device complies with FCC exposure limits for general population/uncontrolled exposure as a portable device without SAR evaluation.

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