Wireless Transceiver Module Test Report

FCC ID: A94412568 IC: 3232A-412568

Certificate # 1514.1

Report number: EMC. 412568.13.185.1

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

Product Tested: Bose® model 412568 Wireless Module

Standards: FCC part 15, RSS210 , RSS-gen and ICES-003

Report prepared by: Brent DeWitt

Signature:

October 10, 2013

Report reviewed by: Chad Bell

Signature:

October 10, 2013

Report issue date: October 10, 2013

Changes from previous revision: Radiated emissions on bare module re-measured.

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1. Report Summary

1.1 Product	Bose® model 412568 Wireless Module
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, MA 01701. 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

Bose® model 412568 wireless module operating under the IEEE 802.11b/g standard as well as Bluetooth Low Energy. The system contains a second radio utilizing Bluetooth® LE (Low Energy) protocol for remote control. The module is designed for use in multiple Bose products and meets the requirements for modular approval.

The module is powered from a 5 volt supply and has on-module power regulation. Only power, data and audio signals leave or enter on the module connectors.

The 802.11 radio integrated circuit used on the RF module has one IEEE 802.11 RF output that is multiplexed between two etched PIF antennas that are not accessible by the end user.
Only one antenna is actively transmitting at a given time. The Bluetooth LE radio circuit has only one etched PIF antenna. The antennas for each protocol are located at opposite ends of the module.

IEEE 802.11 Operating channels and frequencies

Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412	5	2432	9	2452
2	2417	6	2437	10	2457
3	2422	7	2442	11	2462
4	2427	8	2447		

Rates and Modulation

DSSS	Modulation	OFMD	Modulation
1 Mbps	DBPSK	6, 9 Mbps	BPSK
2 Mbps	DQPSK	12, 18 Mbps	QPSK
5.5 Mbps	DQPSK	24, 36 Mbps	QAM16
11 Mbps	DQPSK	48, 54 Mbps	QAM64

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3. Applicable standards, requirements and tests

FCC part 15	RSS210	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 antennas are 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	Complies Section 6.1
15.109 15.209			Radiated emissions < 1GHz	Complies Section 6.2
15.247(d)		4.9	Radiated emissions > 1 GHz, Transmitter harmonics.	Complies Section 6.3
15.247 (b)(3)	A8.4 (2)	4.8	Maximum peak conducted output power	Complies Section 6.4
15.247 (a)(2)		4.6.2	6 dB Bandwidth, 99% occupied bandwidth	Complies Section 6.5
15.247(e)			Power spectral density	Complies Section 6.6
15.247(d)	A8.5	4.9 7.2.5	Conducted spurious emissions	Complies Section 6.7
		4.10, 6.2	Receiver Spurious emissions	Complies Section 6.8
OET65	Canada Health and Safety code 6		MPE calculation	Complies Section 6.9

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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:

For all radiated emissions tests, the module was tested with no enclosure. For conducted mode tests, the module was tested in a plastic, unshielded housing and powered by a suitable "wall-wart" power adapter. In both cases, a small printed circuit board in the enclosure stepped down the adapter voltage to 5 volts and provided means to connect a serial terminal for command and control and audio output.

The plastic housing was cut away on the bottom to allow easy connection to the 802.11 and Bluetooth LE test connectors. The connectors disconnect the etch antennas when the 50 ohm adapter cable is attached for conducted RF measurements. These connectors are unavailable to the end user in Bose products.

For intentional radiator testing, the channel frequency, modulation mode and data rate are programmed using a proprietary interface and test commands. The RF power settings are set in firmware and are not adjustable by the end user.

Worst case emissions are with the following settings.

DSSS 802.11b with data rate of 1 MBPS
OFDM 802.11g with data rate of 6 MBPS

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6. Detailed Test Results, Unintentional Emissions

6.1. AC power line conducted emissions

6.1.1. Requirements

FCC rules part 15.207, RSS 210 section 7.2.4

Frequency	Limits dB(µV)	
MHz	Quasi-peak	Average
0.15 -0.5	66-56	56-46
0.5 – 1.6	56	46
1.6 – 30	60	50

6.1.2. Test setup details

The EUT was tested in accordance with ANSI C63.4 test setup conditions. A linear wall supply provided power to the module through a simple “breakout board”, which adapts the supplies coaxial power connector to the BoseLink DIN connector. Bose test macro “exercise_all.ttl” was used to generate maximum activity on the board and both radios were set to rated output power. Noise in the 150 kHz to 1 MHz is highly impulsive in nature.

6.1.3. Test data

Worst case summary: 14.1 dB QP margin at 437.4 kHz

Neutral side of LISN showed worst case emissions

Frequency	MEASURED		LIMIT		MARGIN		Notes
MHz	dBµV QP	dBµV AVG	dBµV QP	dBµV AVG	dB QP	dB AVG	
0.4374	43.00	14.80	57.1	47.1	14.1	32.3	Line
0.3653	43.00	14.80	58.6	48.6	15.6	33.8	Line
0.1615	46.00	32.20	65.4	55.4	19.4	23.2	Line
0.7430	35.20	10.50	56.0	46.0	20.8	35.5	Line
24.0624	27.60	25.20	60.0	50.0	32.4	24.8	Neu.
24.0000	19.90	16.50	60.0	50.0	40.1	33.5	Line

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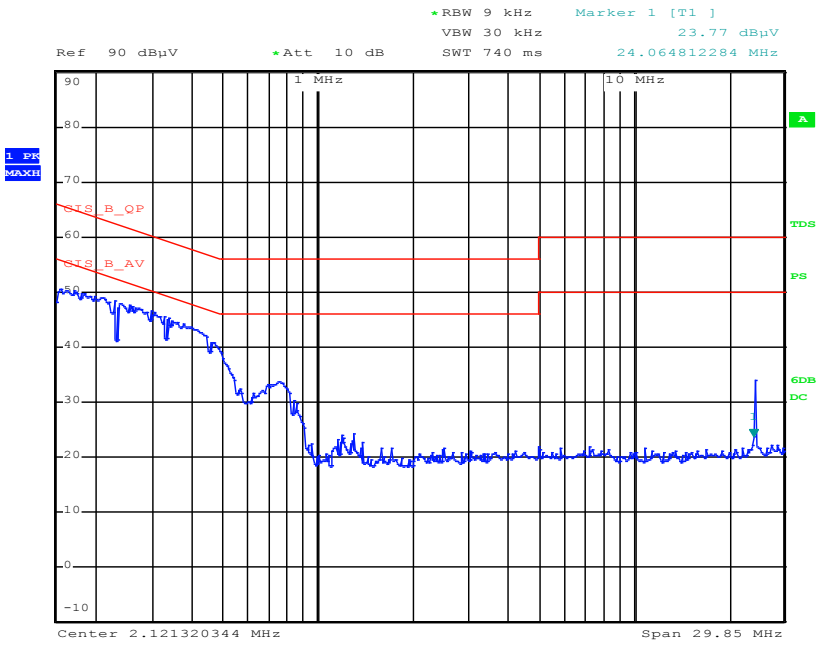
LISN L+N, Max Hold 1 Minute, Peak Detection:



Date: 18.JUL.2013 14:39:30

6.1.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				Last	Due date
LISN	EMCO	3810/2	TN600	3/6/2012	3/6/2014
EMI Test Receiver	Rohde & Schwarz	ESCI	TN1420	4/3/2013	4/3/2014
Transient Limiter	HP	11947A	TN57	12/6/2011	12/6/2013

6.1.5. Test information

Date of test:	18 July 2013	**Test location :**	DCE lab – Henry room
EUT serial:	05	**Tested by:**	B. DeWitt
Test Conclusion:	Pass		

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6.2. Radiated emissions below 1 GHz

6.2.1. Requirements

FCC rules part 15.109, 15.209, ICES-003 issue 4 (2004) and CAN/CSA-CEI/IEC CISPR 22:02

Frequency	Limit in dBµV/m @3m
MHz	Quasi-peak
30 – 230	40
230 - 1000	47
Above 1000	54

6.2.2. Test setup details

The EUT was placed on an 80 cm high table and configured for worst case emissions based on previous testing. EUT was tested using an Apple iPod Touch nearby in Airplay mode and also with audio sourced from iPod into AUX input on the rear of the EUT. There is no volume adjustment associated with the module. Audio output is at fixed line level. In use, there are not direct connections from the module to external cables. For the purpose of this test, a small, 5 volt wall adapter supplied power.

The EUT was tested in both BTLE and 802.11 transmit and receive modes.

The EUT was positioned in three axes:

X-axis: board flat on the table

Y-axis: board with long edge on the table, short edge up

Z-axis: board short edge on the table, long edge up

Description of cables:

Unshielded DC power cable from 5VDC power supply.

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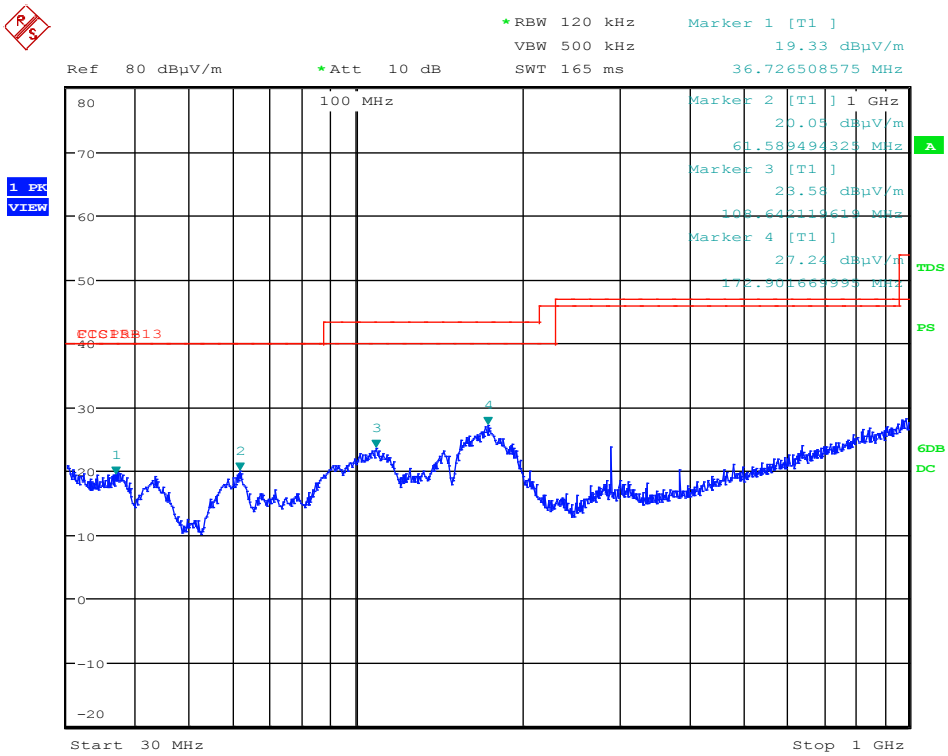
6.2.3. Test data



Max-Hold Peak Pre-scan, 30MHz – 1GHz, X-Axis

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B				Table Azimuth (0° closest to ant)	Receiving Antenna	
			Limit (dBµV/m) QP/AVG*	Limit (dBµV/m) Peak	Margin (dB) QP/AVG*	Margin (dB) Peak		Pol (H/V)	Height (Meters)
37.848	16.20	22.30	40.0	N/A	23.8	N/A	0	V	1.0
58.415	15.10	20.30	40.0	N/A	24.9	N/A	119	V	1.0
109.042	20.50	25.30	43.5	N/A	23.0	N/A	0	V	1.0
142.699	18.50	23.90	43.5	N/A	25.0	N/A	0	V	1.0
172.708	23.20	28.10	43.5	N/A	20.3	N/A	71	H	1.0
288.003	23.90	27.20	46.0	N/A	22.1	N/A	330	H	1.0

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP	Measured Amplitude (dBµV/m) Peak	CISPR 13 "Other"				Table Azimuth (0° closest to ant)	Receiving Antenna	
			Limit (dBµV/m) QP	Margin (dB) QP				Pol (H/V)	Height (Meters)
37.848	16.20	22.30	40.0	23.8			0	V	1.0
58.415	15.10	20.30	40.0	24.9			119	V	1.0
109.042	20.50	25.30	40.0	19.5			0	V	1.0
142.699	18.50	23.90	40.0	21.5			0	V	1.0
172.708	23.20	28.10	40.0	16.8			71	H	1.0
288.003	23.90	27.20	47.0	23.1			330	H	1.0

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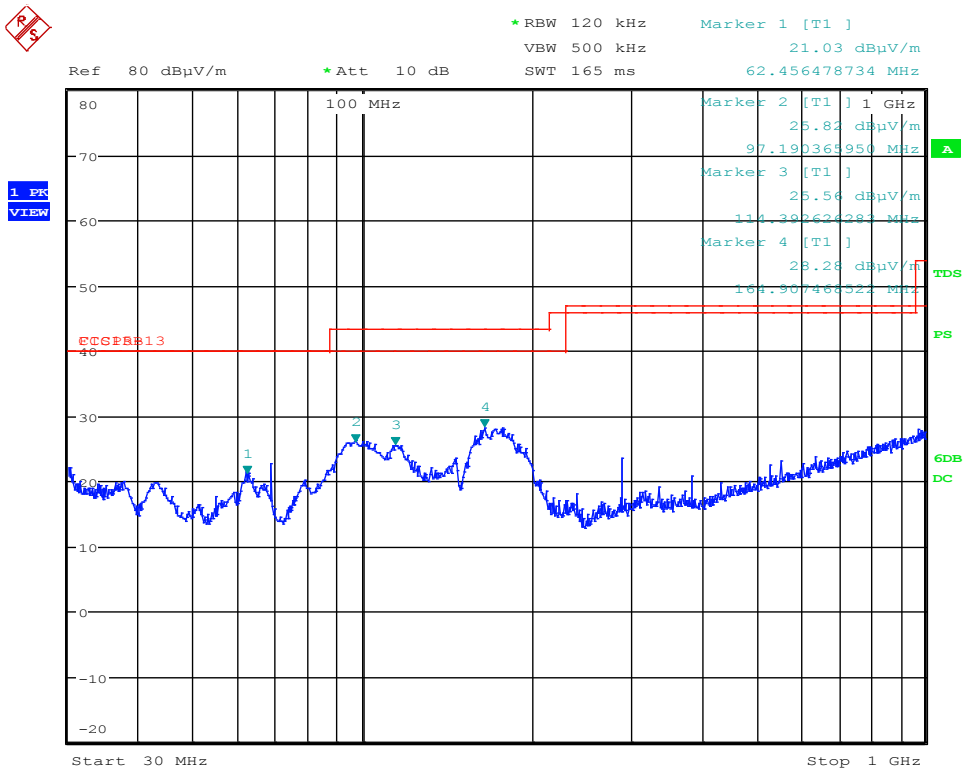

Max-Hold Peak Pre-scan, 30MHz – 1GHz, Y-Axis

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) QP/AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) QP/AVG*	FCC 15B Margin (dB) Peak	Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)
62.457	16.50	22.70	40.0	N/A	23.5	N/A	0	V	1.0
97.235	23.30	27.20	43.5	N/A	20.2	N/A	0	V	1.0
114.134	21.30	27.20	43.5	N/A	22.2	N/A	0	V	1.0
145.981	18.30	24.00	43.5	N/A	25.2	N/A	282	V	1.0
170.233	21.50	26.90	43.5	N/A	22.0	N/A	53	H	1.0
288.003	23.70	25.90	46.0	N/A	22.3	N/A	337	H	1.0

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP	Measured Amplitude (dBµV/m) Peak	CISPR 13 "Other" Limit (dBµV/m) QP	CISPR 13 "Other" Margin (dB) QP			Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)
62.457	16.50	22.70	40.0	23.5			0	V	1.0
97.235	23.30	27.20	40.0	16.7			0	V	1.0
114.134	21.30	27.20	40.0	18.7			0	V	1.0
145.981	18.30	24.00	40.0	21.7			282	V	1.0
170.233	21.50	26.90	40.0	18.5			53	H	1.0
288.003	23.70	25.90	47.0	23.3			337	H	1.0

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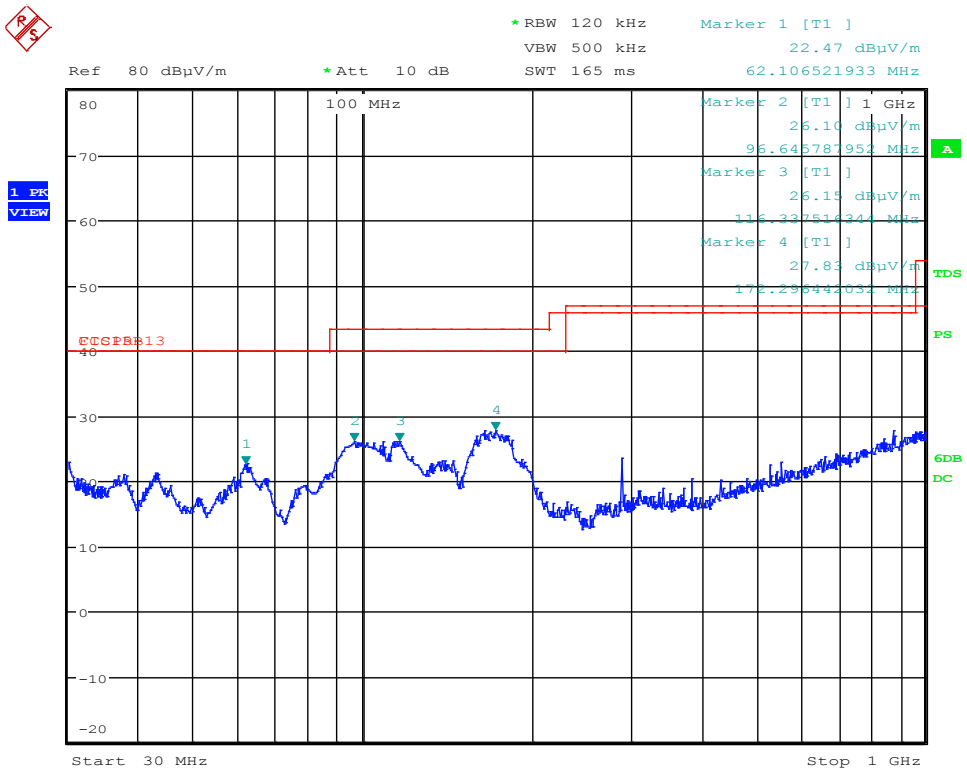

Max-Hold Peak Pre-scan, 30MHz – 1GHz, Z-Axis

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) QP/AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) QP/AVG*	FCC 15B Margin (dB) Peak	Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)
62.617	17.40	24.20	40.0	N/A	22.6	N/A	239	V	1.0
96.466	22.80	27.20	43.5	N/A	20.7	N/A	0	V	1.0
114.668	21.60	27.50	43.5	N/A	21.9	N/A	0	V	1.0
139.217	19.00	24.90	43.5	N/A	24.5	N/A	0	V	1.0
171.716	20.80	26.70	43.5	N/A	22.7	N/A	94	H	1.0
288.004	22.90	25.70	46.0	N/A	23.1	N/A	332	H	1.0

Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP	Measured Amplitude (dBµV/m) Peak	CISPR 13 "Other" Limit (dBµV/m) QP	CISPR 13 "Other" Margin (dB) QP			Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)
62.617	17.40	24.20	40.0	22.6			239	V	1.0
96.466	22.80	27.20	40.0	17.2			0	V	1.0
114.668	21.60	27.50	40.0	18.4			0	V	1.0
139.217	19.00	24.90	40.0	21.0			0	V	1.0
171.716	20.80	26.70	40.0	19.2			94	H	1.0
288.004	22.90	25.70	47.0	24.1			332	H	1.0

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6.2.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				last	due
Antenna	Sunol Sciences	JB6	TN1541	7/30/2013	7/30/2015
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Preamplifier	Minicircuits	ZX60-3018G	TN2077	4/8/2013	4/8/2014
Emissions Cable Set	Bose Corporation	N/A	TN1445	3/5/2013	3/5/2014

6.2.5. Test information

Date of test:	10/7/2013	**Test location :**	DCE - Maxwell House
EUT serial:	SN06	**Tested by:**	N. Sanford
Test Conclusion:	Pass		

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6.3. Radiated emissions above 1 GHz

6.3.1. Requirements

FCC part 15.205(a), 15.209, 15.247(d), RSS210 A8.5

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)

In any 100 kHz BW, the radiated spurious emissions shall be attenuated at least 20dB below the level of the wanted signal.

6.3.2. Test Setup

The EUT was placed on an 80 cm high turn table and configured to transmit with modulation active on a given channel and antenna. The EUT is placed in the normal upright position while adjusting the turn table position and measurement antenna height through a range of 1 to 4 meters to capture the highest emissions.

Above 1 GHz:

Horns with suitable pre-amps mounted directly on them are used for the measurement of the harmonics. The EUT is operated on channels 1, 6 and 11 for the low, middle and high end of the frequency range at the defined limit distance of 3 meters. Above 18GHz the measurement distance is reduced to make sure the instrumentation noise floor is well below the limit.

The EUT is rotated around the vertical axis, the antenna polarization changed from H to V and the antenna height is varied from 1 to 4 meters in order to find the maximum value of the harmonic emission.

Above 18 GHz account is taken of the beam width of the horn antennas to make sure the EUT remains in the main lobe of the antenna.

X-axis position is flat on foam table.

Y-axis position is long edge on table, short edge up.

Z-axis position is short edge on table, long edge up.

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6.3.3. Test Data

Radiated emissions between 1 and 4 GHz were measured for channels 1, 6 and 11 for both DSSS and OFDM modulation while operating on each antenna. Excluding the fundamental, all emissions were below the 15.209 limits by more than 10 dB (peak).

6.3.3.1. 1 to 8 GHz

X-axis data

FCC 15B Class B Product (Residential) @ 3 Meters										
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) QP/AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) QP/AVG*	FCC 15B Margin (dB) Peak	Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes / Mode
WiFi Measurements										
Fundamental Measurements										
2412.000	101.30	112.60					298	H	1.5	Antenna 1 Channel 1 B mode 11MBPS Fundamental
2437.000	99.60	111.20					306	H	1.4	Antenna 1 Channel 6 B mode 11MBPS Fundamental
2462.000	99.10	110.90					314	H	1.3	Antenna 1 Channel 11 B mode 11MBPS Fundamental
2412.000	87.70	103.30					300	H	1.4	Antenna 1 Channel 1 G mode 54MBPS Fundamental
2437.000	89.50	106.10					306	H	1.1	Antenna 1 Channel 6 G mode 54MBPS Fundamental
2462.000	89.80	105.60					309	H	1.4	Antenna 1 Channel 11 G mode 54MBPS Fundamental
2412.000	105.50	116.90					117	H	1.5	Antenna 2 Channel 1 B mode 11MBPS Fundamental
2437.000	104.90	116.10					117	H	1.5	Antenna 2 Channel 6 B mode 11MBPS Fundamental
2462.000	104.10	115.80					121	H	1.4	Antenna 2 Channel 11 B mode 11MBPS Fundamental
2412.000	94.90	111.50					112	H	1.5	Antenna 2 Channel 1 G mode 54MBPS Fundamental
2437.000	95.90	111.70					113	H	1.2	Antenna 2 Channel 6 G mode 54MBPS Fundamental
2462.000	96.10	112.00					118	H	1.4	Antenna 2 Channel 11 G mode 54MBPS Fundamental
2.3 - 2.5GHz Restricted Band										
2311.991	50.70	62.30	54.0	74.0	3.3	11.7	113	H	1.2	Antenna 1 Channel 1 B mode 11MBPS
2311.990	48.70	59.20	54.0	74.0	5.3	14.8	107	H	1.3	Antenna 1 Channel 1 G mode 54MBPS
2324.991	43.50	56.60	54.0	74.0	10.5	17.4	109	H	1.3	Antenna 1 Channel 1 G mode 54MBPS
2311.990	50.40	62.40	54.0	74.0	3.6	11.6	110	H	1.3	Antenna 2 Channel 1 B mode 11MBPS
2311.990	49.40	60.50	54.0	74.0	4.6	13.5	109	H	1.3	Antenna 2 Channel 1 G mode 54MBPS
2336.991	51.70	61.60	54.0	74.0	2.3	12.4	107	H	1.2	Antenna 1 Channel 6 B mode 11MBPS
2486.991	51.50	65.50	54.0	74.0	2.5	8.5	114	H	1.2	Antenna 1 Channel 6 B mode 11MBPS
2336.991	50.50	61.30	54.0	74.0	3.5	12.7	108	H	1.3	Antenna 1 Channel 6 G mode 54MBPS
2486.991	48.50	60.50	54.0	74.0	5.5	13.5	116	H	1.2	Antenna 1 Channel 6 G mode 54MBPS
2336.991	51.40	60.30	54.0	74.0	2.6	13.7	113	H	1.3	Antenna 2 Channel 6 B mode 11MBPS
2486.991	51.80	68.00	54.0	74.0	2.2	6.0	121	H	1.1	Antenna 2 Channel 6 B mode 11MBPS
2336.991	49.40	59.70	54.0	74.0	4.6	14.3	109	H	1.6	Antenna 2 Channel 6 G mode 54MBPS
2486.991	50.90	64.60	54.0	74.0	3.1	9.4	116	H	1.5	Antenna 2 Channel 6 G mode 54MBPS
2361.989	52.60	62.00	54.0	74.0	1.4	12.0	109	H	1.6	Antenna 1 Channel 11 B mode 11MBPS
2311.990	47.10	57.80	54.0	74.0	6.9	16.2	109	H	1.3	Antenna 1 Channel 11 G mode 54MBPS
2339.995	48.60	63.50	54.0	74.0	5.4	10.5	111	H	1.3	Antenna 1 Channel 11 G mode 54MBPS
2361.989	48.80	60.40	54.0	74.0	5.2	13.6	109	H	1.2	Antenna 1 Channel 11 G mode 54MBPS
2361.989	48.90	61.10	54.0	74.0	5.1	12.9	109	H	1.3	Antenna 2 Channel 11 G mode 54MBPS
Harmonics										
2nd Harmonic										
4824.000	35.70	48.80	54.0	74.0	18.3	25.2	102	H	1.1	Antenna 1 Channel 1 B mode 11MBPS
4824.000	42.80	55.10	54.0	74.0	11.2	18.9	125	H	1.1	Antenna 2 Channel 1 B mode 11MBPS
4874.000	33.00	46.50	54.0	74.0	21.0	27.5	272	H	1.1	Antenna 1 Channel 6 B mode 11MBPS
4874.000	31.00	44.80	54.0	74.0	23.0	29.2	266	H	1.0	Antenna 2 Channel 6 B mode 11MBPS
4924.000	30.80	43.80	54.0	74.0	23.2	30.2	271	H	1.0	Antenna 1 Channel 11 B mode 11MBPS
4924.000	31.50	43.10	54.0	74.0	22.5	30.9	245	H	1.0	Antenna 2 Channel 11 B mode 11MBPS
BTLE Measurements										
2338.000	42.90	51.10	54.0	74.0	11.1	22.9	86	H	1.0	Restricted Band Edge Low Channel (Tx @ 2402MHz)
2370.000	37.70	49.30	54.0	74.0	16.3	24.7	87	H	1.0	Restricted Band Edge Low Channel (Tx @ 2402MHz)
2483.500	44.40	56.00	54.0	74.0	9.6	18.0	85	H	1.0	Restricted Band Edge High Channel (Tx @ 2480MHz)
2402.000	101.40	103.10	54.0				85	H	1.0	Fundamental at Low Channel (Ch 0)
2442.000	101.00	102.80	54.0				86	H	1.0	Fundamental at Mid Channel (Ch 20)
2480.000	100.50	101.40	54.0				89	H	1.0	Fundamental at High Channel (Ch 39)

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Y-axis data

FCC 15B Class B Product (Residential) @ 3 Meters										
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) QP/AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) QP/AVG*	FCC 15B Margin (dB) Peak	Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes / Mode
WiFi Measurements										
Fundamental Measurements										
2412.000	100.90	112.20					0	V	1.0	Antenna 1 Channel 1 B mode 11MBPS Fundamental
2437.000	100.80	112.40					15	V	1.0	Antenna 1 Channel 6 B mode 11MBPS Fundamental
2462.000	100.50	111.70					255	V	1.0	Antenna 1 Channel 11 B mode 11MBPS Fundamental
2412.000	86.40	102.40					255	V	1.0	Antenna 1 Channel 1 G mode 54MBPS Fundamental
2437.000	90.70	106.50					152	V	1.0	Antenna 1 Channel 6 G mode 54MBPS Fundamental
2462.000	90.40	106.40					256	V	1.0	Antenna 1 Channel 11 G mode 54MBPS Fundamental
2412.000	97.80	109.40					272	V	1.0	Antenna 2 Channel 1 B mode 11MBPS Fundamental
2437.000	100.60	112.10					109	V	1.3	Antenna 2 Channel 6 B mode 11MBPS Fundamental
2462.000	98.60	109.90					279	V	1.2	Antenna 2 Channel 11 B mode 11MBPS Fundamental
2412.000	89.10	104.70					256	V	1.2	Antenna 2 Channel 1 G mode 54MBPS Fundamental
2437.000	89.90	106.20					111	V	1.1	Antenna 2 Channel 6 G mode 54MBPS Fundamental
2462.000	90.10	106.50					124	V	1.4	Antenna 2 Channel 11 G mode 54MBPS Fundamental
2.3 - 2.5GHz Restricted Band										
2311.991	49.50	58.20	54.0	74.0	4.5	15.8	47	V	1.1	Antenna 1 Channel 1 B mode 11MBPS
2311.991	45.00	55.50	54.0	74.0	9.0	18.5	47	V	1.0	Antenna 1 Channel 1 G mode 54MBPS
2324.992	38.80	52.70	54.0	74.0	15.2	21.3	50	V	1.0	Antenna 1 Channel 1 G mode 54MBPS
2311.990	49.80	58.70	54.0	74.0	4.2	15.3	258	V	1.0	Antenna 2 Channel 1 B mode 11MBPS
2311.990	46.30	57.50	54.0	74.0	7.7	16.5	256	V	1.0	Antenna 2 Channel 1 G mode 54MBPS
2336.991	49.10	57.00	54.0	74.0	4.9	17.0	58	V	1.0	Antenna 1 Channel 6 B mode 11MBPS
2486.991	50.40	65.40	54.0	74.0	3.6	8.6	348	V	1.0	Antenna 1 Channel 6 B mode 11MBPS
2336.991	45.90	56.30	54.0	74.0	8.1	17.7	57	V	1.0	Antenna 1 Channel 6 G mode 54MBPS
2486.991	46.80	58.80	54.0	74.0	7.2	15.2	347	V	1.0	Antenna 1 Channel 6 G mode 54MBPS
2336.991	51.30	60.60	54.0	74.0	2.7	13.4	257	V	1.0	Antenna 2 Channel 6 B mode 11MBPS
2486.991	51.40	64.10	54.0	74.0	2.6	9.9	333	V	1.0	Antenna 2 Channel 6 B mode 11MBPS
2336.991	47.60	58.30	54.0	74.0	6.4	15.7	258	V	1.0	Antenna 2 Channel 6 G mode 54MBPS
2486.991	46.50	58.10	54.0	74.0	7.5	15.9	334	V	1.0	Antenna 2 Channel 6 G mode 54MBPS
2361.989	46.10	55.70	54.0	74.0	7.9	18.3	323	V	1.0	Antenna 1 Channel 11 B mode 11MBPS
2311.990	42.60	53.10	54.0	74.0	11.4	20.9	337	V	1.0	Antenna 1 Channel 11 G mode 54MBPS
2339.995	43.10	58.30	54.0	74.0	10.9	15.7	57	V	1.0	Antenna 1 Channel 11 G mode 54MBPS
2361.989	45.40	56.70	54.0	74.0	8.6	17.3	353	V	1.0	Antenna 1 Channel 11 G mode 54MBPS
2361.989	44.80	56.10	54.0	74.0	9.2	17.9	323	V	1.0	Antenna 2 Channel 11 G mode 54MBPS
Harmonics										
2nd Harmonic										
4824.000	38.20	51.00	54.0	74.0	15.8	23.0	81	V	1.0	Antenna 1 Channel 1 B mode 11MBPS
4824.000	37.40	50.50	54.0	74.0	16.6	23.5	64	H	1.3	Antenna 2 Channel 1 B mode 11MBPS
4874.000	36.10	49.30	54.0	74.0	17.9	24.7	351	V	1.0	Antenna 1 Channel 6 B mode 11MBPS
4874.000	34.60	47.80	54.0	74.0	19.4	26.2	131	H	1.3	Antenna 2 Channel 6 B mode 11MBPS
4924.000	32.10	44.20	54.0	74.0	21.9	29.8	149	H	1.0	Antenna 1 Channel 11 B mode 11MBPS
4924.000	31.90	44.40	54.0	74.0	22.1	29.6	275	V	1.0	Antenna 2 Channel 11 B mode 11MBPS
BTLE Measurements										
2338.000	41.80	51.00	54.0	74.0	12.2	23.0	86	V	1.0	Restricted Band Edge Low Channel (Tx @ 2402MHz)
2370.000	37.40	49.10	54.0	74.0	16.6	24.9	86	V	1.0	Restricted Band Edge Low Channel (Tx @ 2402MHz)
2483.500	44.10	55.60	54.0	74.0	9.9	18.4	87	V	1.0	Restricted Band Edge High Channel (Tx @ 2480MHz)
2402.000	101.00	102.40	54.0				87	V	1.0	Fundamental at Low Channel (Ch 0)
2442.000	100.70	102.10	54.0				86	V	1.0	Fundamental at Mid Channel (Ch 20)
2480.000	100.10	101.10	54.0				89	V	1.0	Fundamental at High Channel (Ch 39)

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Z-axis data

FCC 15B Class B Product (Residential) @ 3 Meters										
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) QP/AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) QP/AVG*	FCC 15B Margin (dB) Peak	Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes / Mode
WiFi Measurements										
Fundamental Measurements										
2412.000	99.60	110.90					209	H	1.5	Antenna 1 Channel 1 B mode 11MBPS Fundamental
2437.000	99.50	110.90					201	H	1.5	Antenna 1 Channel 6 B mode 11MBPS Fundamental
2462.000	100.10	111.60					0	H	1.4	Antenna 1 Channel 11 B mode 11MBPS Fundamental
2412.000	87.50	103.50					15	H	1.1	Antenna 1 Channel 1 G mode 54MBPS Fundamental
2437.000	91.30	107.50					0	H	1.4	Antenna 1 Channel 6 G mode 54MBPS Fundamental
2462.000	90.10	106.20					0	H	1.4	Antenna 1 Channel 11 G mode 54MBPS Fundamental
2412.000	94.90	106.10					317	H	1.0	Antenna 2 Channel 1 B mode 11MBPS Fundamental
2437.000	95.90	107.30					304	H	1.0	Antenna 2 Channel 6 B mode 11MBPS Fundamental
2462.000	95.40	106.80					336	H	1.0	Antenna 2 Channel 11 B mode 11MBPS Fundamental
2412.000	84.80	101.30					316	H	1.0	Antenna 2 Channel 1 G mode 54MBPS Fundamental
2437.000	86.10	102.20					303	H	1.0	Antenna 2 Channel 6 G mode 54MBPS Fundamental
2462.000	85.50	101.80					304	H	1.0	Antenna 2 Channel 11 G mode 54MBPS Fundamental
2.3 - 2.5GHz Restricted Band										
2311.991	48.30	57.10	54.0	74.0	5.7	16.9	180	H	1.2	Antenna 1 Channel 1 B mode 11MBPS
2311.992	43.90	54.10	54.0	74.0	10.1	19.9	177	H	1.2	Antenna 1 Channel 1 G mode 54MBPS
2324.991	37.70	50.60	54.0	74.0	16.3	23.4	182	H	1.3	Antenna 1 Channel 1 G mode 54MBPS
2311.990	44.70	53.50	54.0	74.0	9.3	20.5	347	H	1.2	Antenna 2 Channel 1 B mode 11MBPS
2311.990	38.80	49.90	54.0	74.0	15.2	24.1	338	H	1.2	Antenna 2 Channel 1 G mode 54MBPS
2336.991	45.60	53.90	54.0	74.0	8.4	20.1	13	H	1.0	Antenna 1 Channel 6 B mode 11MBPS
2486.991	49.70	62.70	54.0	74.0	4.3	11.3	145	H	1.1	Antenna 1 Channel 6 B mode 11MBPS
2336.991	45.00	55.70	54.0	74.0	9.0	18.3	13	H	1.2	Antenna 1 Channel 6 G mode 54MBPS
2486.991	45.80	57.80	54.0	74.0	8.2	16.2	146	H	1.1	Antenna 1 Channel 6 G mode 54MBPS
2336.991	44.10	53.10	54.0	74.0	9.9	20.9	344	H	1.2	Antenna 2 Channel 6 B mode 11MBPS
2486.991	47.40	60.90	54.0	74.0	6.6	13.1	303	H	1.0	Antenna 2 Channel 6 B mode 11MBPS
2336.991	40.00	50.90	54.0	74.0	14.0	23.1	345	H	1.2	Antenna 2 Channel 6 G mode 54MBPS
2486.991	42.90	55.00	54.0	74.0	11.1	19.0	304	H	1.0	Antenna 2 Channel 6 G mode 54MBPS
2361.989	47.30	56.70	54.0	74.0	6.7	17.3	177	H	1.2	Antenna 1 Channel 11 B mode 11MBPS
2311.990	41.90	52.90	54.0	74.0	12.1	21.1	180	H	1.2	Antenna 1 Channel 11 G mode 54MBPS
2339.995	42.50	57.70	54.0	74.0	11.5	16.3	18	H	1.2	Antenna 1 Channel 11 G mode 54MBPS
2361.989	43.40	55.00	54.0	74.0	10.6	19.0	166	H	1.2	Antenna 1 Channel 11 G mode 54MBPS
2361.989	43.80	56.80	54.0	74.0	10.2	17.2	325	H	1.1	Antenna 2 Channel 11 G mode 54MBPS
Harmonics										
2nd Harmonic										
4824.000	37.50	49.80	54.0	74.0	16.5	24.2	121	V	1.0	Antenna 1 Channel 1 B mode 11MBPS
4824.000	40.60	53.20	54.0	74.0	13.4	20.8	278	V	1.0	Antenna 2 Channel 1 B mode 11MBPS
4874.000	35.30	48.80	54.0	74.0	18.7	25.2	111	V	1.2	Antenna 1 Channel 6 B mode 11MBPS
4874.000	35.00	48.30	54.0	74.0	19.0	25.7	260	V	1.5	Antenna 2 Channel 6 B mode 11MBPS
4924.000	33.40	44.70	54.0	74.0	20.6	29.3	134	V	1.0	Antenna 1 Channel 11 B mode 11MBPS
4924.000	32.90	44.10	54.0	74.0	21.1	29.9	268	V	1.0	Antenna 2 Channel 11 B mode 11MBPS
BTLE Measurements										
2338.000	42.10	50.80	54.0	74.0	11.9	23.2	86	H	1.0	Restricted Band Edge Low Channel (Tx @ 2402MHz)
2370.000	37.20	49.00	54.0	74.0	16.8	25.0	87	H	1.0	Restricted Band Edge Low Channel (Tx @ 2402MHz)
2483.500	44.10	55.50	54.0	74.0	9.9	18.5	87	H	1.0	Restricted Band Edge High Channel (Tx @ 2480MHz)
2402.000	100.90	102.70	54.0				87	H	1.0	Fundamental at Low Channel (Ch 0)
2442.000	100.40	102.40	54.0				86	H	1.0	Fundamental at Mid Channel (Ch 20)
2480.000	100.20	101.10	54.0				89	H	1.0	Fundamental at High Channel (Ch 39)

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802.11 Band Edge Data

X-axis

Antenna	Channel	Frequency (MHz)	Modulation	Marker Delta RBW = 100kHz (dB)	Detector	Max (dB)	Max - Delta (dB)	Limit dBµV/m @ 3m	Margin (dB)
1	1	2412	B 11MBPS	53.91	Peak	112.6	58.69	74	15.31
1	1	2412	B 11MBPS	53.91	Average	101.3	47.39	54	6.61
1	1	2412	G 54MBPS	49.96	Peak	103.3	53.34	74	20.66
1	1	2412	G 54MBPS	49.96	Average	87.7	37.74	54	16.26
1	11	2462	B 11MBPS	53.17	Peak	110.9	57.73	74	16.27
1	11	2462	B 11MBPS	53.17	Average	99.1	45.93	54	8.07
1	11	2462	G 54MBPS	45.97	Peak	105.6	59.63	74	14.37
1	11	2462	G 54MBPS	45.97	Average	89.8	43.83	54	10.17
2	1	2412	B 11MBPS	54.12	Peak	116.9	62.78	74	11.22
2	1	2412	B 11MBPS	54.12	Average	105.5	51.38	54	2.62
2	1	2412	G 54MBPS	47.68	Peak	111.5	63.82	74	10.18
2	1	2412	G 54MBPS	47.68	Average	94.9	47.22	54	6.78
2	11	2462	B 11MBPS	55.38	Peak	115.8	60.42	74	13.58
2	11	2462	B 11MBPS	55.38	Average	104.1	48.72	54	5.28
2	11	2462	G 54MBPS	48.98	Peak	112	63.02	74	10.98
2	11	2462	G 54MBPS	48.98	Average	96.1	47.12	54	6.88

Y-axis

Antenna	Channel	Frequency (MHz)	Modulation	Marker Delta RBW = 100kHz (dB)	Detector	Max (dB)	Max - Delta (dB)	Limit dBµV/m @ 3m	Margin (dB)
1	1	2412	B 11MBPS	55.17	Peak	112.2	57.03	74	16.97
1	1	2412	B 11MBPS	55.17	Average	100.9	45.73	54	8.27
1	1	2412	G 54MBPS	46.56	Peak	102.4	55.84	74	18.16
1	1	2412	G 54MBPS	46.56	Average	86.4	39.84	54	14.16
1	11	2462	B 11MBPS	57.44	Peak	111.7	54.26	74	19.74
1	11	2462	B 11MBPS	57.44	Average	100.5	43.06	54	10.94
1	11	2462	G 54MBPS	47.54	Peak	106.4	58.86	74	15.14
1	11	2462	G 54MBPS	47.54	Average	90.4	42.86	54	11.14
2	1	2412	B 11MBPS	53.87	Peak	109.4	55.53	74	18.47
2	1	2412	B 11MBPS	53.87	Average	97.8	43.93	54	10.07
2	1	2412	G 54MBPS	48.85	Peak	104.7	55.85	74	18.15
2	1	2412	G 54MBPS	48.85	Average	89.1	40.25	54	13.75
2	11	2462	B 11MBPS	55.46	Peak	109.9	54.44	74	19.56
2	11	2462	B 11MBPS	55.46	Average	98.6	43.14	54	10.86
2	11	2462	G 54MBPS	44.55	Peak	106.5	61.95	74	12.05
2	11	2462	G 54MBPS	44.55	Average	90.1	45.55	54	8.45

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Z-axis									
Antenna	Channel	Frequency (MHz)	Modulation	Marker Delta RBW = 100kHz (dB)	Detector	Max (dB)	Max - Delta (dB)	Limit dBµV/m @ 3m	Margin (dB)
1	1	2412	B 11MBPS	52.15	Peak	110.9	58.75	74	15.25
1	1	2412	B 11MBPS	52.15	Average	99.6	47.45	54	6.55
1	1	2412	G 54MBPS	48.53	Peak	103.5	54.97	74	19.03
1	1	2412	G 54MBPS	48.53	Average	87.5	38.97	54	15.03
1	11	2462	B 11MBPS	52.79	Peak	111.6	58.81	74	15.19
1	11	2462	B 11MBPS	52.79	Average	100.1	47.31	54	6.69
1	11	2462	G 54MBPS	44.45	Peak	106.2	61.75	74	12.25
1	11	2462	G 54MBPS	44.45	Average	90.1	45.65	54	8.35
2	1	2412	B 11MBPS	51.57	Peak	106.1	54.53	74	19.47
2	1	2412	B 11MBPS	51.57	Average	94.9	43.33	54	10.67
2	1	2412	G 54MBPS	45.49	Peak	101.3	55.81	74	18.19
2	1	2412	G 54MBPS	45.49	Average	84.8	39.31	54	14.69
2	11	2462	B 11MBPS	51.23	Peak	106.8	55.57	74	18.43
2	11	2462	B 11MBPS	51.23	Average	95.4	44.17	54	9.83
2	11	2462	G 54MBPS	46.18	Peak	101.8	55.62	74	18.38
2	11	2462	G 54MBPS	46.18	Average	85.5	39.32	54	14.68

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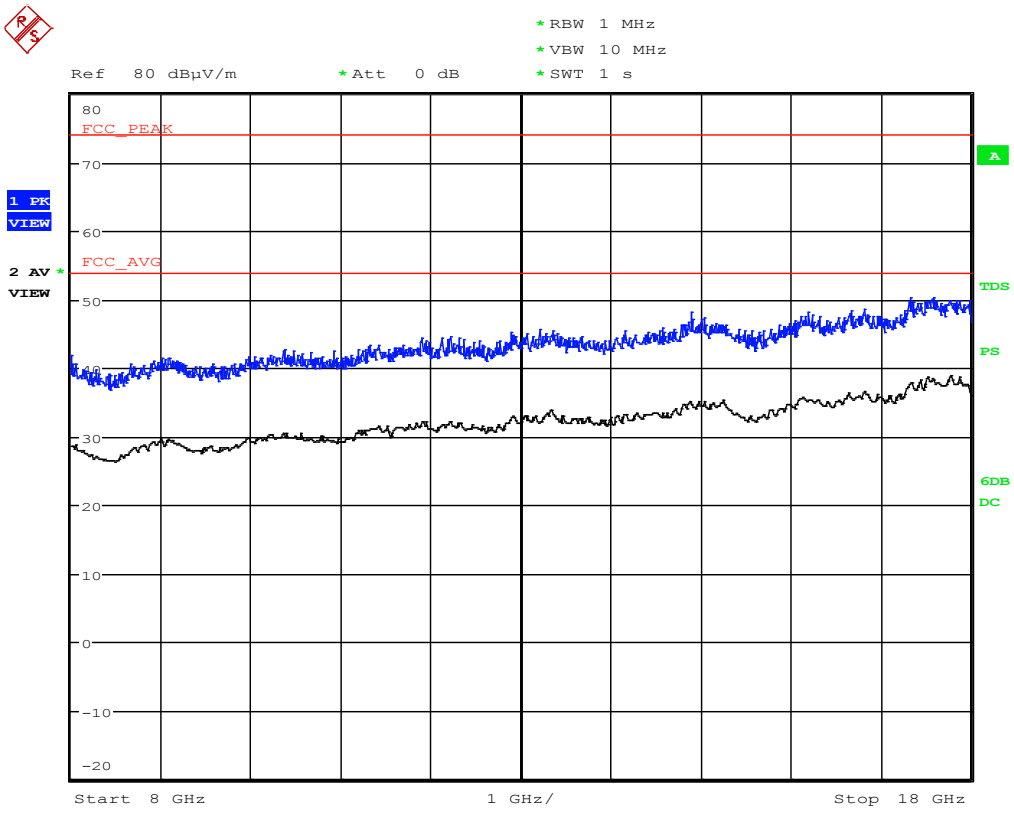
6.3.3.4 8 to 18 GHz

Measurements on channels 1, 6 and 11 for both antenna ports using a standard gain horn with a preamp mounted on the horn antenna. No emissions were observed above the instrumentation noise floor. The noise floor measured more than 10 dB below the FCC peak limit (74 dBuV/m) at a 3 meter distance.

No average detector measurements were made since the noise floor of the test equipment was above the limit of 54 dBuV/m.

802.11b/g



Date: 14.MAY.2013 00:01:32

Ambient

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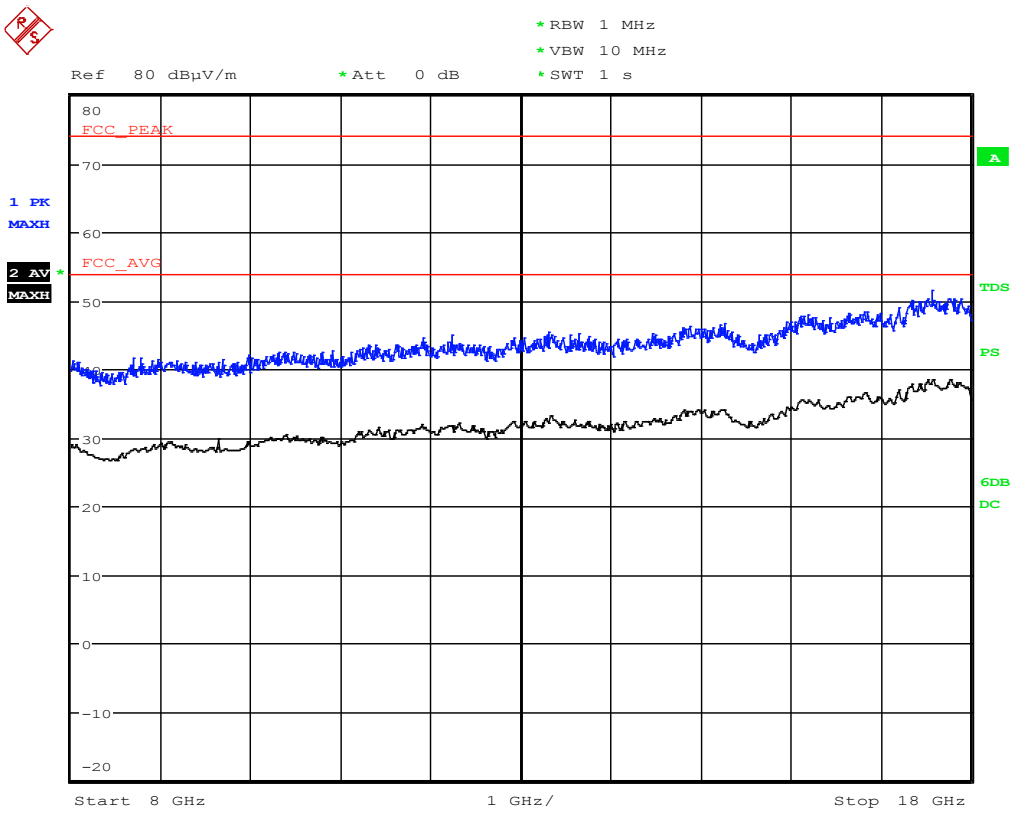

Date: 21.MAY.2013 23:24:56

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 1 from Antenna 1 in B mode at 11MBPS

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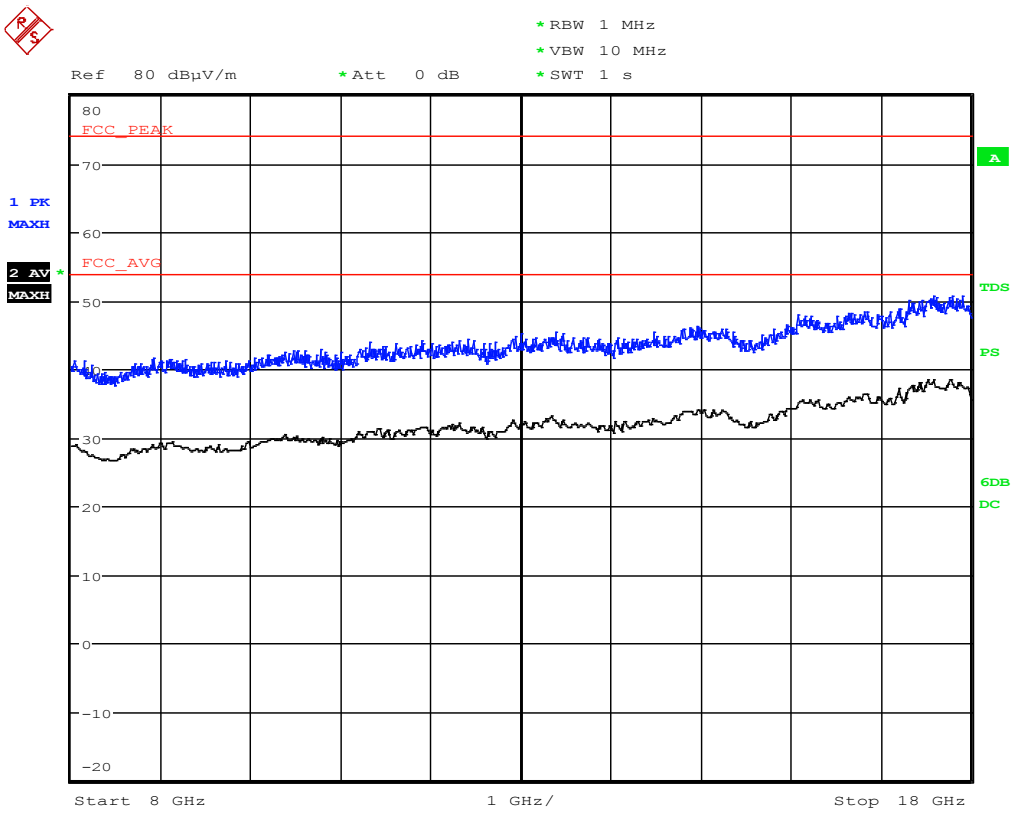

Date: 21.MAY.2013 23:34:06

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 1 from Antenna 1 in G mode at 54MBPS

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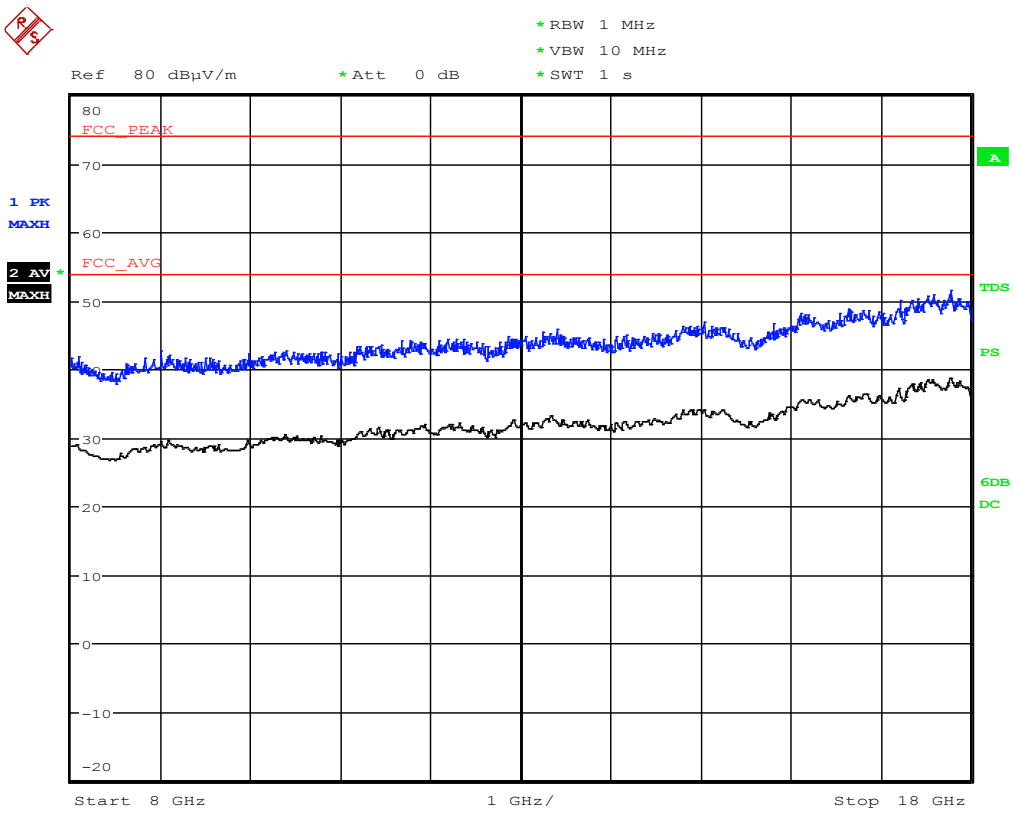

Date: 21.MAY.2013 23:39:53

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 1 from Antenna 2 in B mode at 11MBPS

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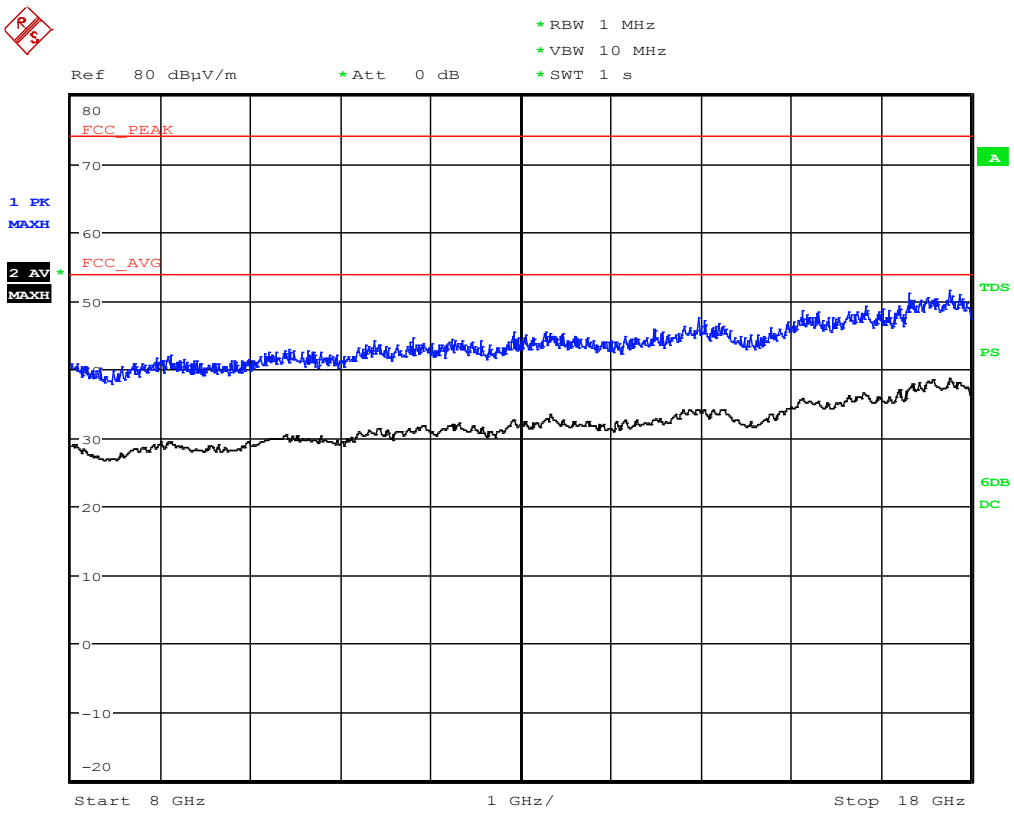

Date: 21.MAY.2013 23:44:02

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 1 from Antenna 2 in G mode at 54MBPS

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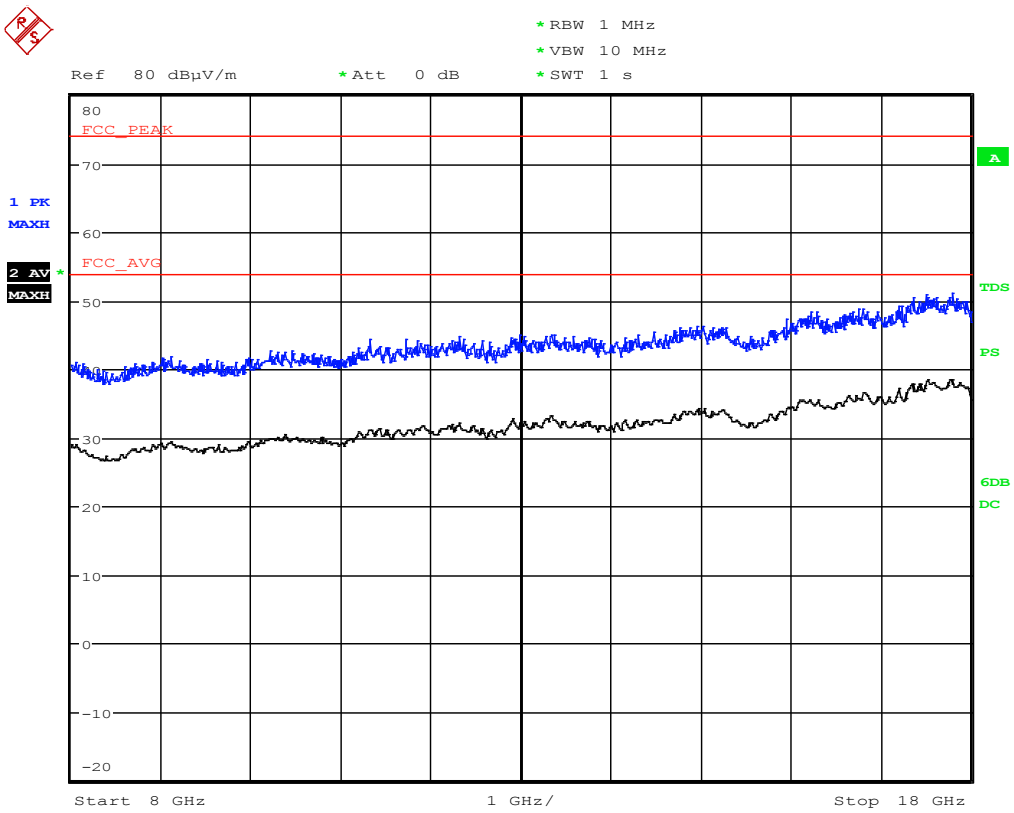

Date: 21.MAY.2013 23:48:32

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 6 from Antenna 1 in B mode at 11MBPS

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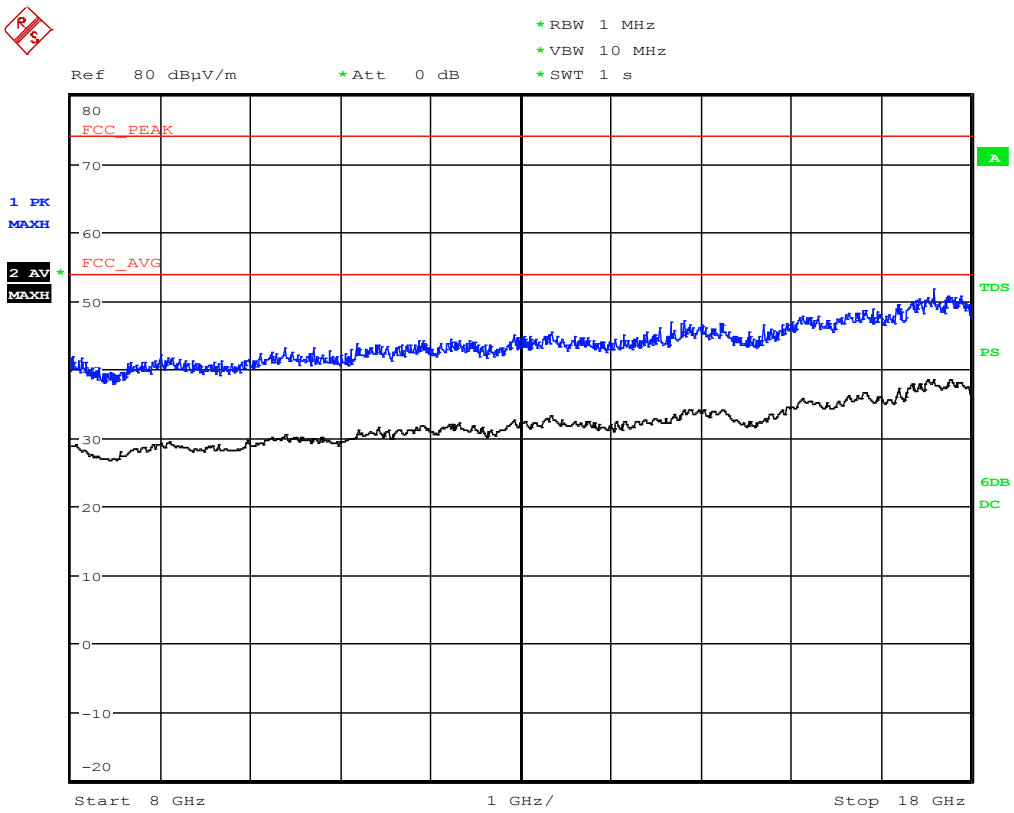

Date: 21.MAY.2013 23:54:08

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 6 from Antenna 1 in G mode at 54MBPS

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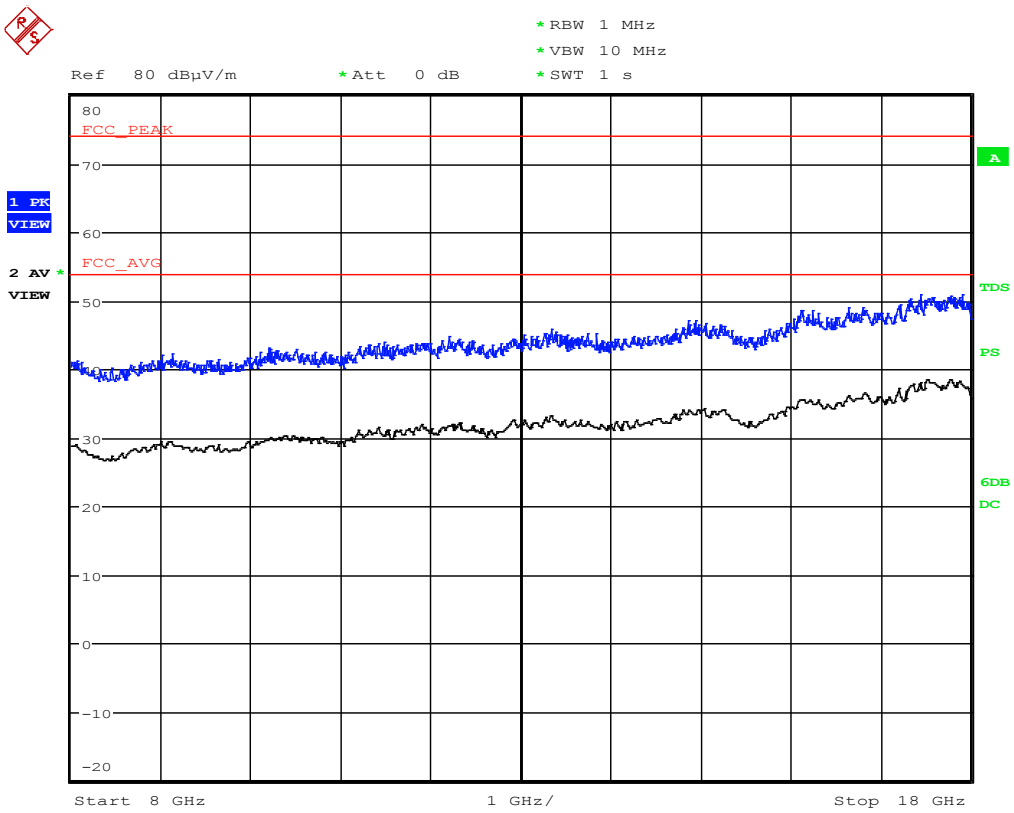
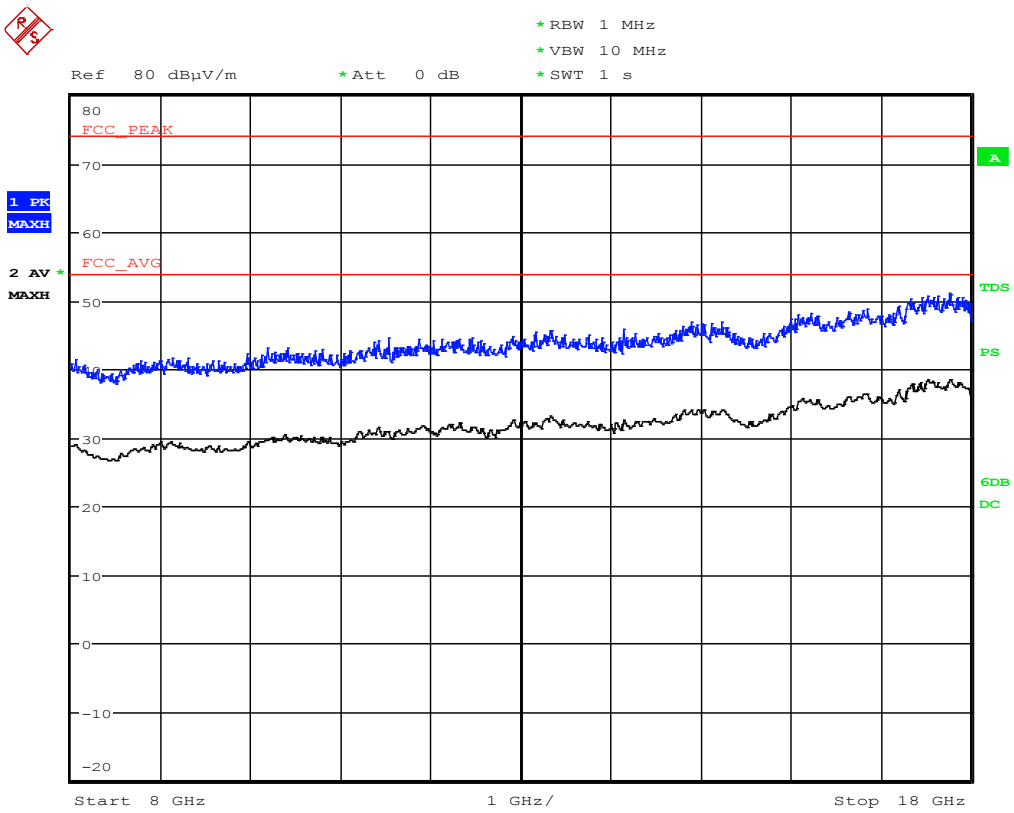
Tel: (508) 766-6000 Fax: (508) 766-1145



Date: 22.MAY.2013 00:00:35

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 6 from Antenna 2 in B mode at 11MBPS

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
Tel: (508) 766-6000 Fax: (508) 766-1145



Date: 22.MAY.2013 00:05:15

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 6 from Antenna 2 in G mode at 54MBPS

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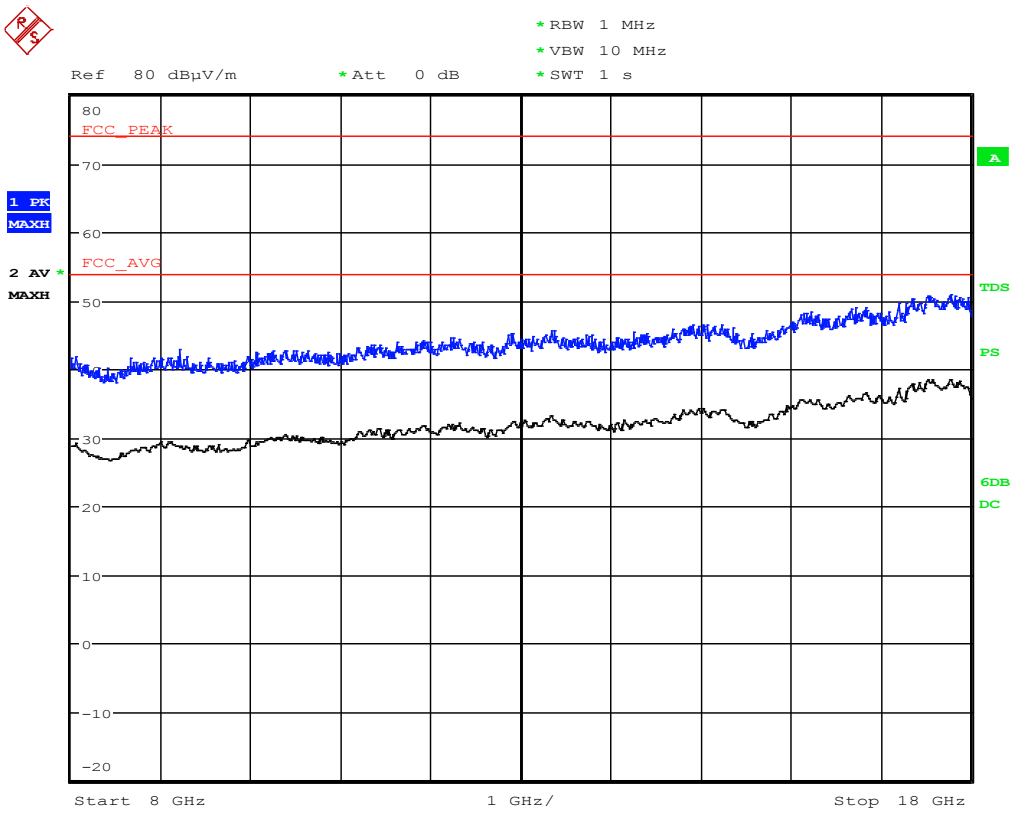
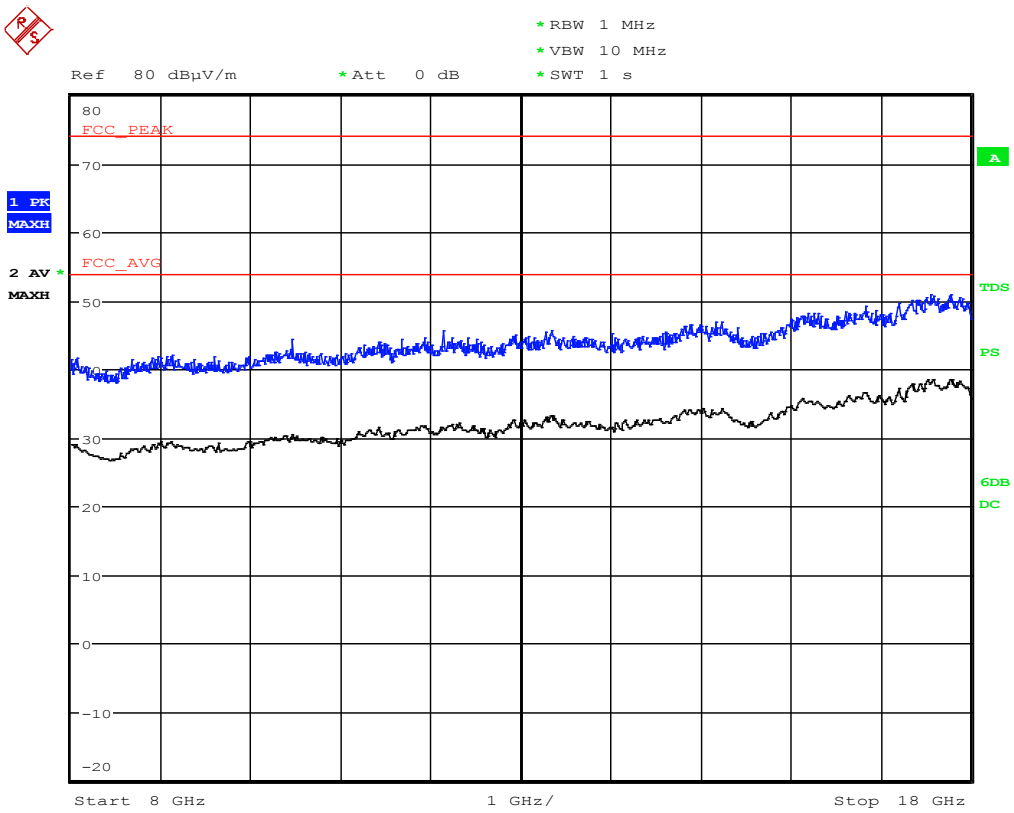


Date: 22.MAY.2013 00:11:47

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 11 from Antenna 1 in B mode at 11MBPS

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
Tel: (508) 766-6000 Fax: (508) 766-1145



Date: 22.MAY.2013 00:17:53

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 11 from Antenna 1 in G mode at 54MBPS

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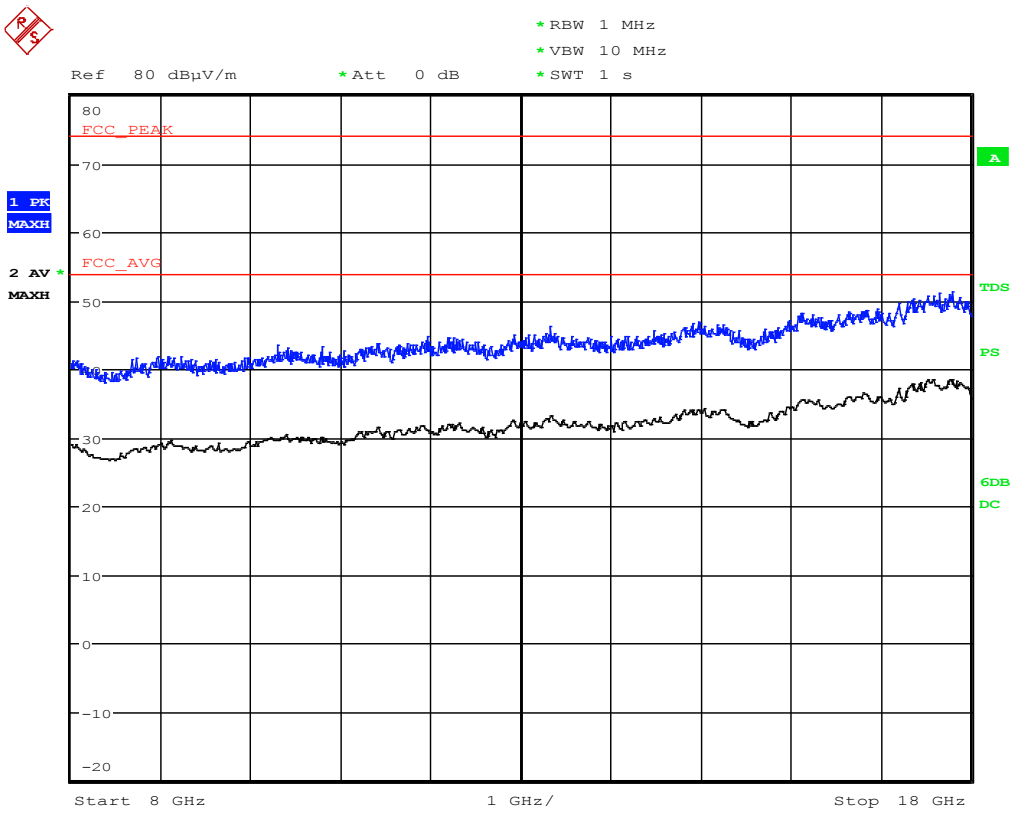

Date: 22.MAY.2013 00:23:09

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 11 from Antenna 2 in B mode at 11MBPS

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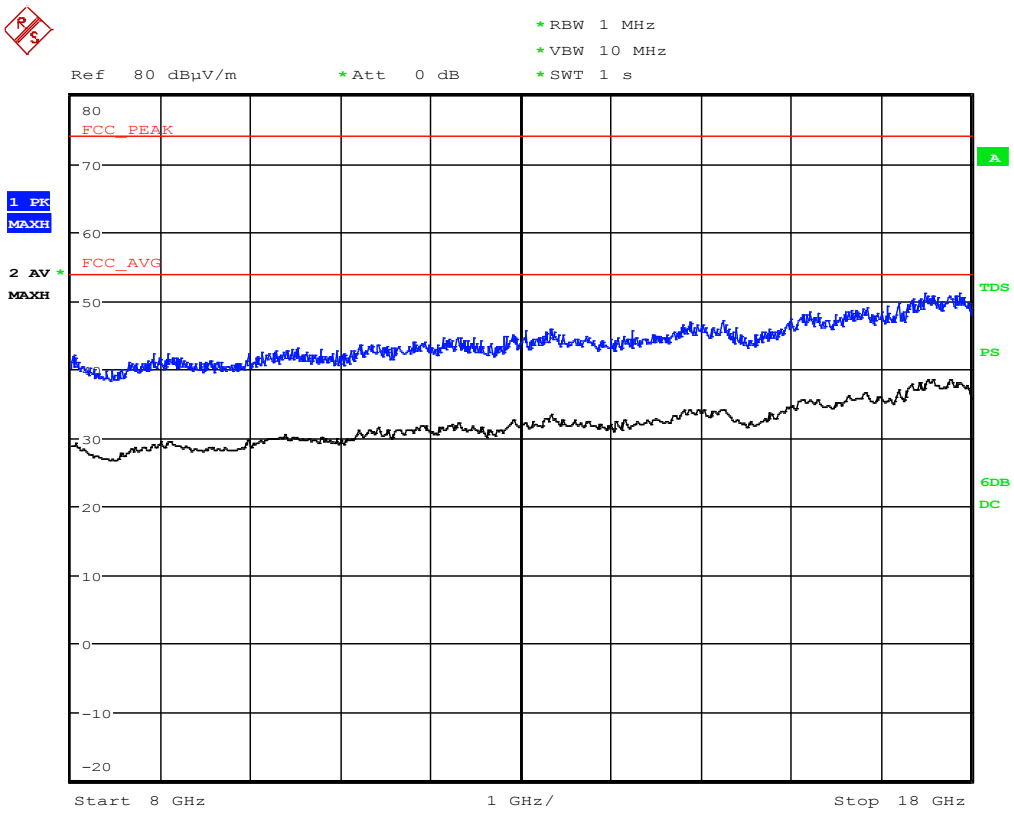

Date: 22.MAY.2013 00:33:07

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in transmitting on Channel 11 from Antenna 2 in G mode at 54MBPS

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8 – 18GHz Harmonics

FCC 15B Class B Product (Residential) @ 3 Meters										
Emission Frequency (MHz)	Measured Amplitude (dBµV/m) QP/AVG*	Measured Amplitude (dBµV/m) Peak	FCC 15B Limit (dBµV/m) QP/AVG*	FCC 15B Limit (dBµV/m) Peak	FCC 15B Margin (dB) QP/AVG*	FCC 15B Margin (dB) Peak	Table Azimuth (0° closest to ant)	Receiving Antenna Pol (H/V)	Receiving Antenna Height (Meters)	*Average detector used for frequencies above 1 GHz. Notes / Mode
3rd Harmonic										
7236.000	32.30	45.90	54.0	74.0	21.7	28.1				Noise Floor
7311.000	31.70	45.20	54.0	74.0	22.3	28.8				Noise Floor
7386.000	32.50	45.80	54.0	74.0	21.5	28.2				Noise Floor
4th Harmonic										
9648.000	32.40	44.60	54.0	74.0	21.6	29.4				Noise Floor
9748.000	29.90	43.30	54.0	74.0	24.1	30.7				Noise Floor
9848.000	30.10	43.90	54.0	74.0	23.9	30.1				Noise Floor
5th Harmonic										
12060.000	32.50	45.80	54.0	74.0	21.5	28.2				Noise Floor
12185.000	33.40	46.90	54.0	74.0	20.6	27.1				Noise Floor
12310.000	33.50	47.10	54.0	74.0	20.5	26.9				Noise Floor
6th Harmonic										
14472.000	34.70	48.00	54.0	74.0	19.3	26.0				Noise Floor
14622.000	34.40	47.90	54.0	74.0	19.6	26.1				Noise Floor
14772.000	35.30	49.00	54.0	74.0	18.7	25.0				Noise Floor
7th Harmonic										
16884.000	36.90	50.30	54.0	74.0	17.1	23.7				Noise Floor
17059.000	37.10	50.80	54.0	74.0	16.9	23.2				Noise Floor
17234.000	37.00	51.00	54.0	74.0	17.0	23.0				Noise Floor

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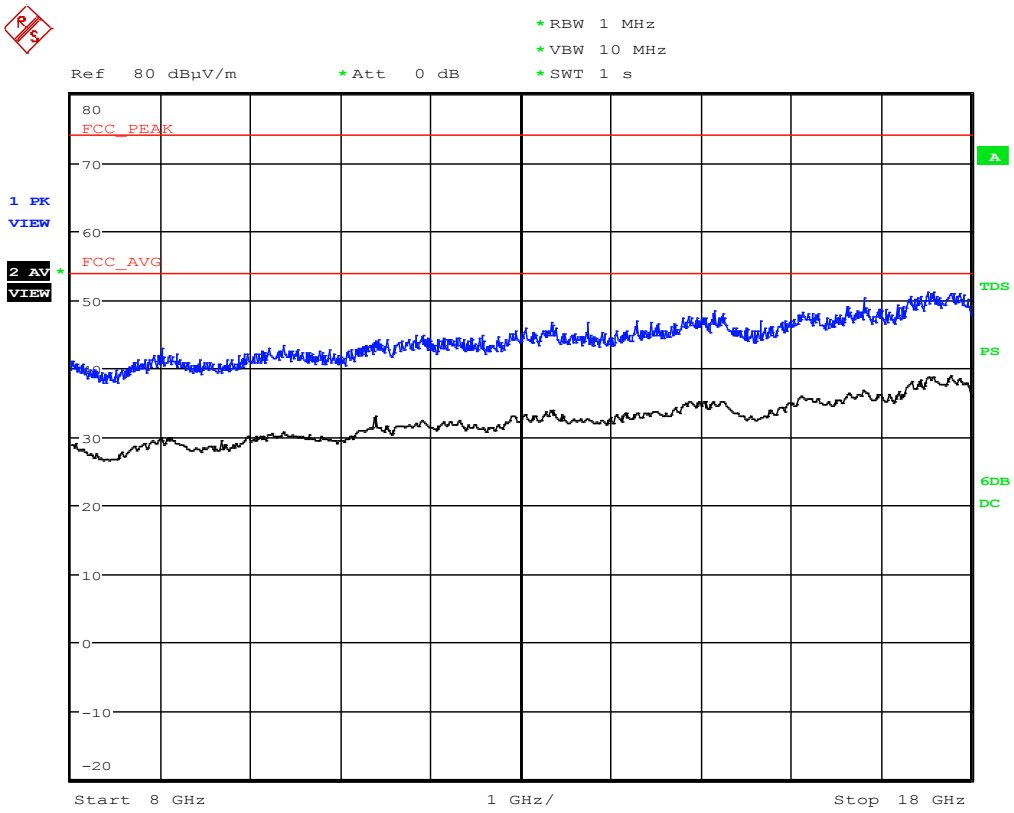
Bluetooth LE



Date: 14.MAY.2013 00:08:40

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in Tx mode hopping on all channels

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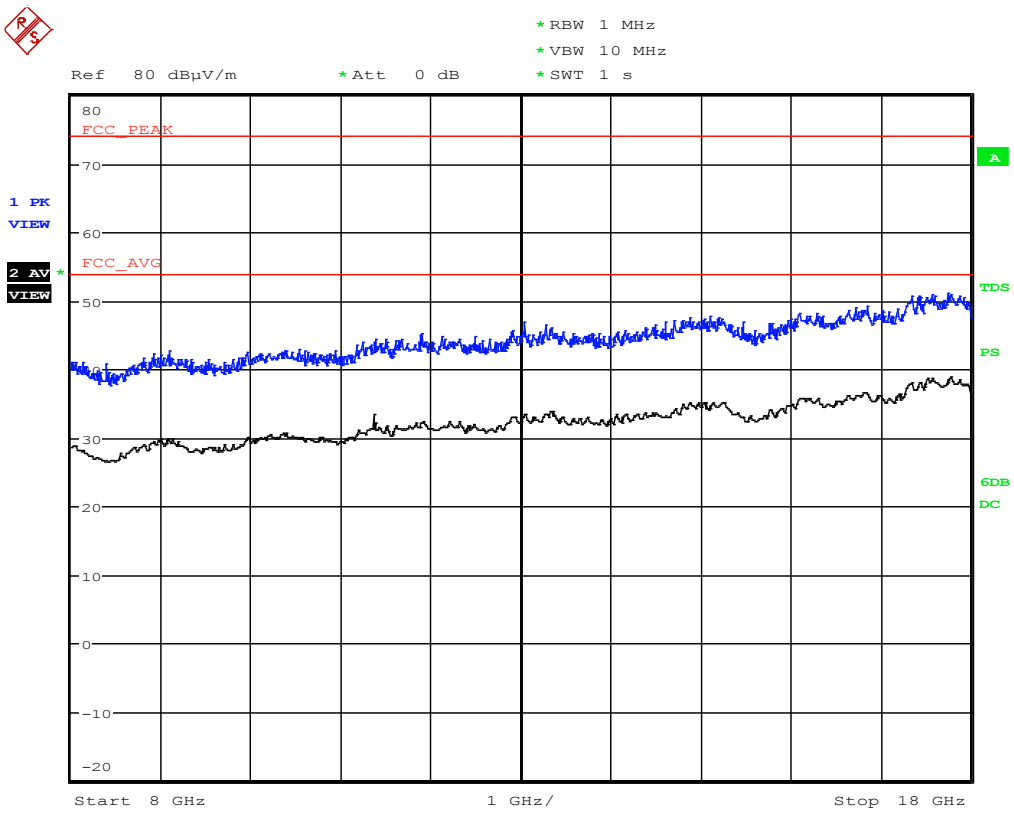
Tel: (508) 766-6000 Fax: (508) 766-1145



Date: 14.MAY.2013 00:00:24

Max-Hold Peak Pre-scan, 8GHz – 18GHz, EUT in Rx mode at 2442MHz (Ch 20)

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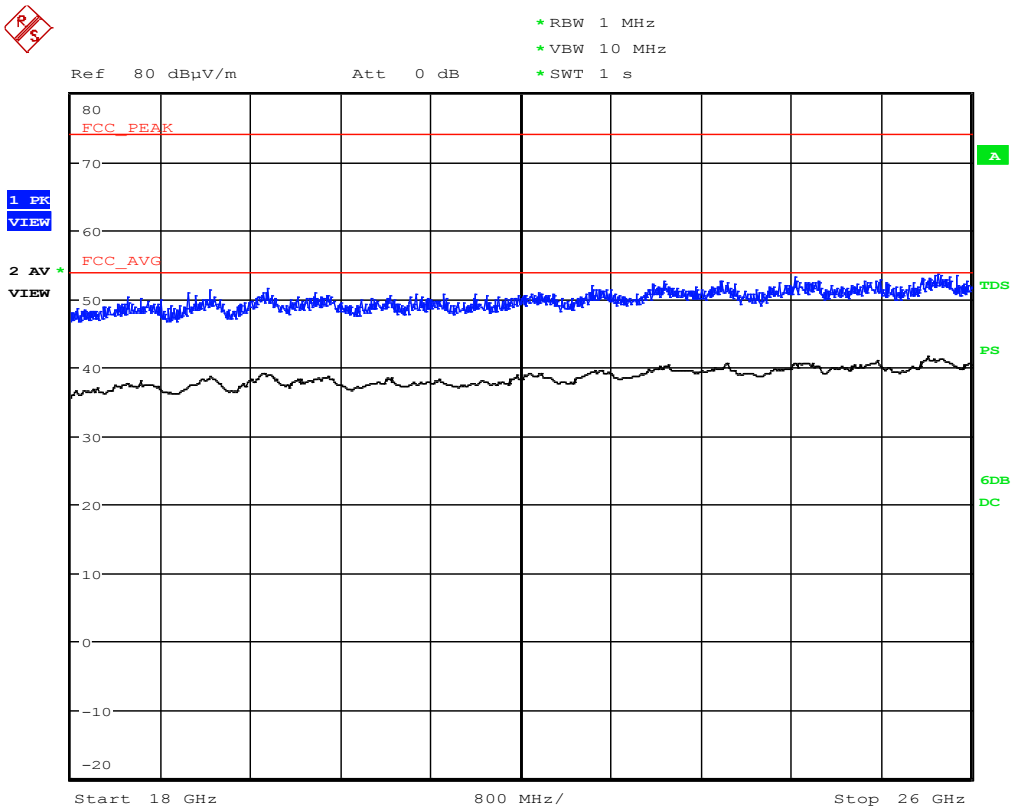
Tel: (508) 766-6000 Fax: (508) 766-1145

6.3.3.5 18 to 26 GHz

The measurements distance was reduced to 1 meter using a standard gain horn antenna with a preamp mounted directly on the horn antenna. No emissions were measured above the instrumentation noise floor which was more than 10 dB below the FCC peak limit of 74 dBuV/m. The results were the same for both vertical and horizontal antenna polarizations.

802.11b/g



Max-Hold Peak Pre-scan, 18GHz – 26GHz, EUT in transmitting on Channel 1 from Antenna 1 in B mode at 11MBPS

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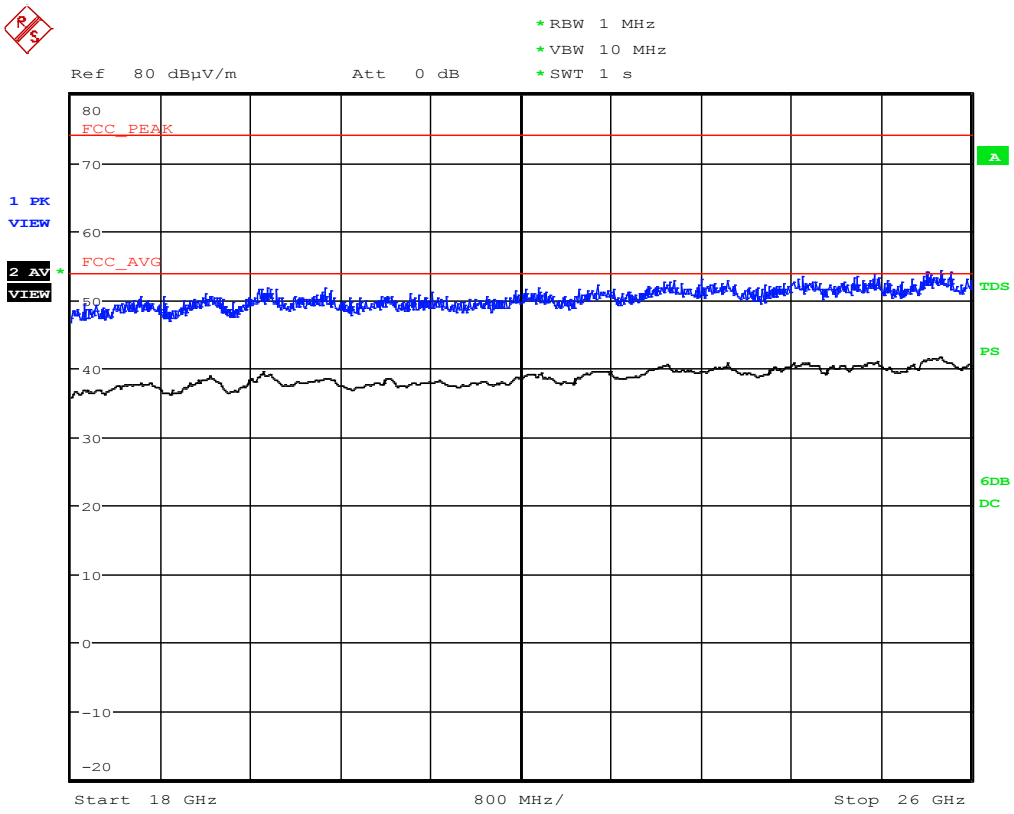
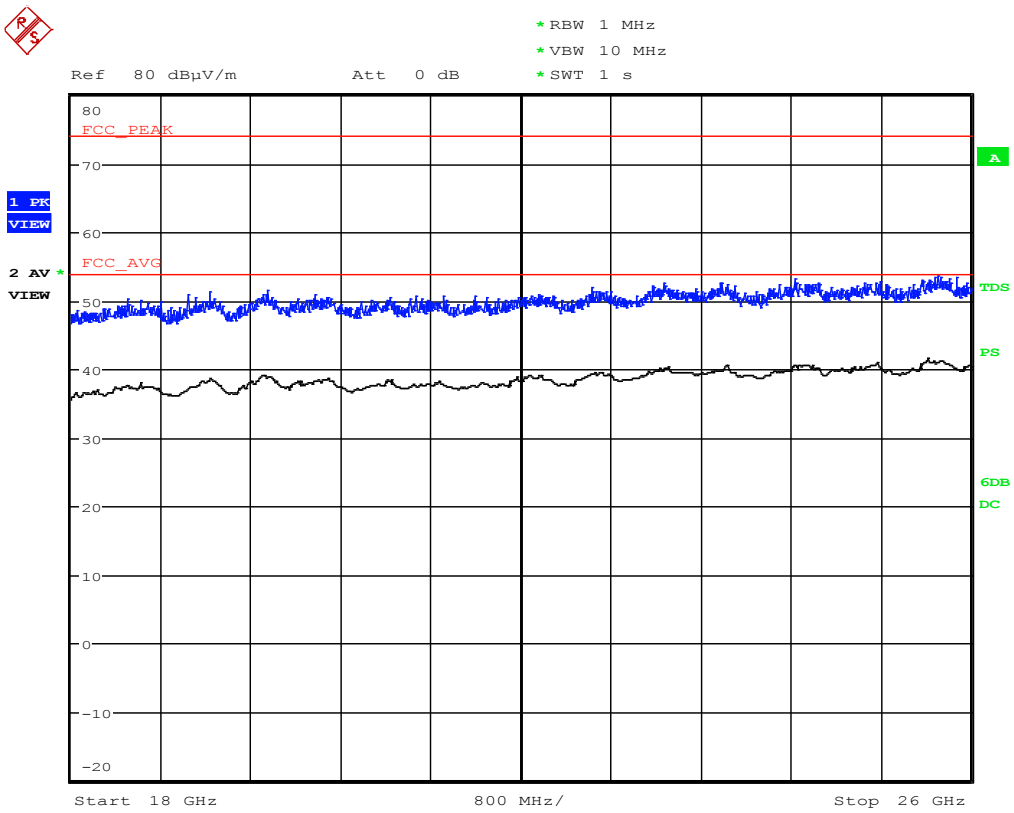
Bluetooth LE



Date: 15.MAY.2013 23:37:37

Max-Hold Peak Pre-scan, 18GHz – 26GHz, EUT in Tx mode hopping on all channels

Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
Tel: (508) 766-6000 Fax: (508) 766-1145



Date: 15.MAY.2013 23:38:45

Max-Hold Peak Pre-scan, 18GHz – 26GHz, EUT in Rx mode at 2442MHz (Ch 20)

6.3.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESU40	TN1663	4/5/2013	4/5/2014
Antenna cable	Florida RF Labs		TN2165	3/5/2013	3/5/2014
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

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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	9/20/2012	9/20/2013
40 GHz preamp	Miteq	JS4018004000-30-8P-A1	TN1757	6/14/2012	6/14/2013

6.3.5. Test information

Date of test:	5/15/2013 to 5/21/2013 10/9/2013 (1-8 GHz)	**Test location:**	DCE Maxwell House
EUT serial:	SN06	**Tested by:**	N. Sanford
Test Conclusion:	Pass		

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6.4. Maximum conducted output power

6.4.1 Requirements:

FCC 15.247(b)(3) , RSS 210 A8.4 (2)

The maximum peak conducted output power is 30 dBm (1 Watt)

6.4.2 Test setup details:

Peak output power is measured using R&S NRVS power meter with a NRV-Z4 diode detector power sensor head. A mini-circuits SMA type 10 dB pad was used on the input to the diode detector power sensor. The EUT is connected to the 10 dB pad using a 15cm SMK TS-7 to SMA female RG174 coax cable. Measured loss of TS-7 to SMA cable with SMA-M to SMA-M adapter is 0.7 dB at 2.45 GHz. The SMA male to SMA male adapter is placed between 10 dB pad and adapter cable.

Custom test commands are used to keep the EUT transmitting continuously.

802.11b/g
Power was measured with modulation active for 802.11b (DSSS) and 802.11g (OFDM) at low (CH1), middle (CH6) and high (CH11) operating frequencies.

Bluetooth LE

Power was measure with modulation active (GFSK) at connector/switch J900 at low (CH1), middle (CH19) and high (CH39) operating frequencies.

6.4.3 Test data:

802.11b/g

Channel	Frequency (MHz)	Conn.	Mode	Modulation	NRVS Reading (dBm)	Pad Correction (dB)	Adapter Loss (dB)	Peak power	Status
1	2412	4	B	DSSS	1.3	10	0.7	12.0	Pass
6	2437	4	B	DSSS	2.5	10	0.7	13.2	Pass
11	2462	4	B	DSSS	2.5	10	0.7	13.2	Pass
1	2412	4	G	OFDM	2.7	10	0.7	13.4	Pass
6	2437	4	G	OFDM	2.4	10	0.7	13.1	Pass
11	2462	4	G	OFDM	2.3	10	0.7	13.0	Pass
1	2412	3	B	DSSS	1.2	10	0.7	11.9	Pass
6	2437	3	B	DSSS	2.1	10	0.7	12.8	Pass
11	2462	3	B	DSSS	2.2	10	0.7	12.9	Pass
1	2412	3	G	OFDM	3.1	10	0.7	13.8	Pass
6	2437	3	G	OFDM	2.9	10	0.7	13.6	Pass
11	2462	3	G	OFDM	3.1	10	0.7	13.8	Pass

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Bluetooth LE

Channel	Frequency (MHz)	NRVS Reading (dBm)	Pad Correction (dB)	Adapter Loss (dB)	Peak power (dBm)	Status
1	2406	-6.8	10	0.7	3.9	Pass
19	2444	-7.3	10	0.7	3.4	Pass
39	2480	-8.2	10	0.7	2.5	Pass

All measured peak conducted output power is below the 30 dBm limit.

6.4.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
Power meter	Rohde & Schwarz	NRVS	TN1293	4/5/2012	4/5/2013
Power sensor	Rohde & Schwarz	NRV-Z4	TN1296	4/5/2012	4/5/2013

6.4.5 Test information

Date of test:	2/28/2013	**Test location:**	Transmitter Test Bench
EUT serial:	SN03	**Tested by:**	B. DeWitt
Test Conclusion:	Pass		

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6.5. 6 dB & 99% occupied bandwidth

6.5.1. Requirements

FCC 15.247 (a)(2)

6 dB bandwidth shall be at least 500 kHz.

99% occupied bandwidth for reporting purposes only.

6.5.2. Test setup details

The EUT is connected to input of a spectrum analyzer using SMK TS-7 to SMA cable with a SMA-Male to SMA-Male adapter.

For the 99% bandwidth measurements the built in measurement within the ESIB40 was used.
RBW = 300 kHz, VBW = 1 MHz

Custom test commands are used to keep the EUT transmitting continuously.

802.11b/g

The 6 dB bandwidth is measured for each RF output for low (CH1), middle (CH6) and high (CH11) operating channels using 802.11b (DSSS) and 802.11g (OFDM) modulation.
RBW=100 kHz, VBW = 300 kHz

Bluetooth LE

The 6 dB bandwidth is measured for low (CH1), middle (CH19) and high (CH39) operating channels using GFSK modulation.
RBW=30 kHz, VBW = 100 kHz

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6.5.3. Test data

(6 dB Bandwidth measurement results)

802.11b/g

Output	Channel	Frequency (MHz)	Modulation	6 dB Bandwidth (MHz)	Limit (kHz)	Status
CON3	1	2412	DSSS	12.02	500	Pass
CON3	6	2437	DSSS	11.74	500	Pass
CON3	11	2462	DSSS	11.94	500	Pass
CON3	1	2412	OFDM	16.71	500	Pass
CON3	6	2437	OFDM	16.71	500	Pass
CON3	11	2462	OFDM	16.79	500	Pass

Bluetooth LE

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Limit (kHz)	Status
1	2406	721	500	Pass
19	2444	721	500	Pass
39	2480	741	500	Pass

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(99% occupied bandwidth measurement results)

802.11b/g

Output	Channel	Frequency (MHz)	Modulation	99% Bandwidth (MHz)
CON3	1	2412	DSSS	15.99
CON3	6	2437	DSSS	15.95
CON3	11	2462	DSSS	16.03
CON3	1	2412	OFDM	17.00
CON3	6	2437	OFDM	17.00
CON3	11	2462	OFDM	16.80

Bluetooth LE

Channel	Frequency (MHz)	99% Bandwidth (MHz)
1	2406	1.095
19	2444	1.102
39	2480	1.062

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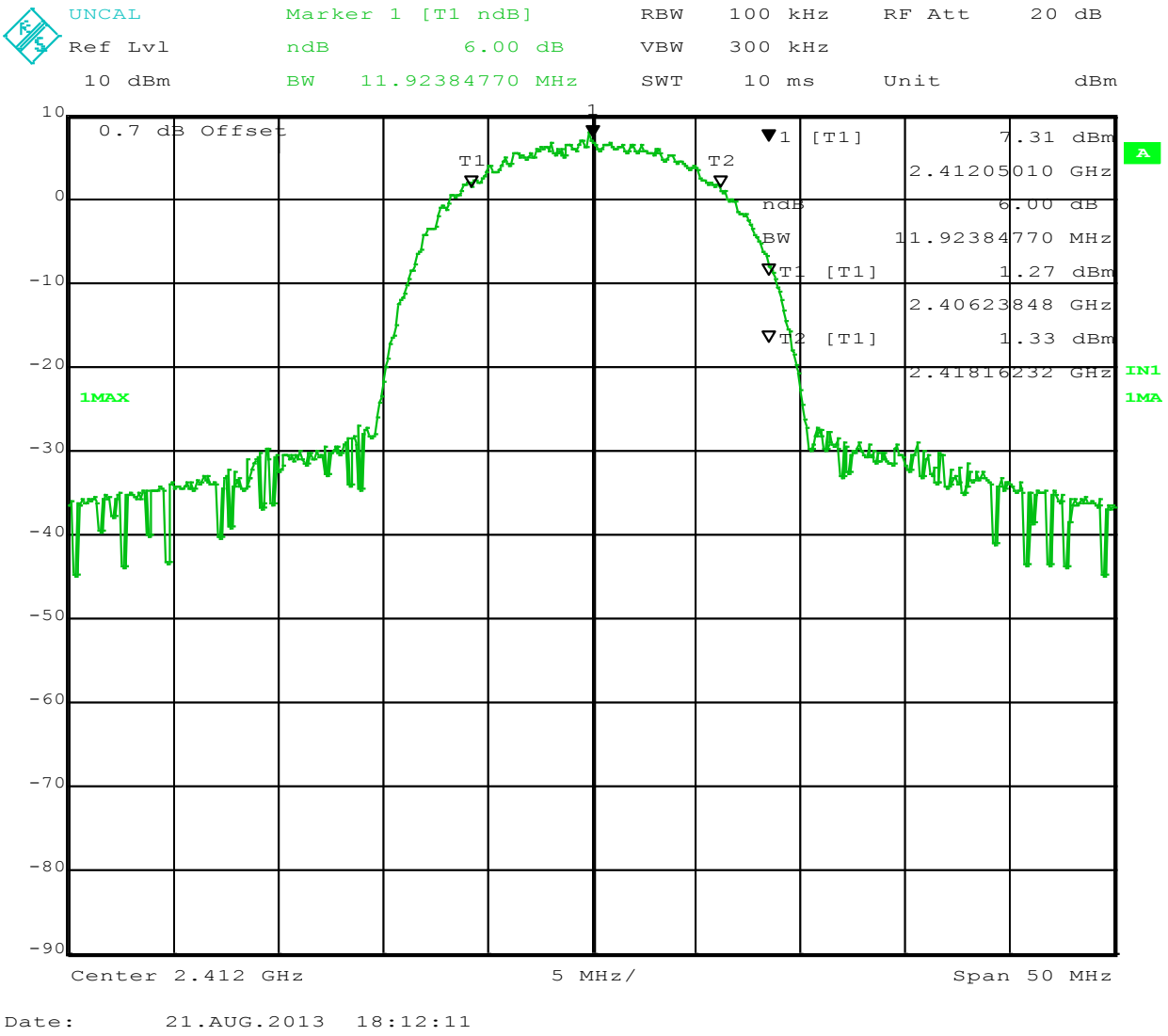
Representative spectrum analyzer plot showing a 6 dB bandwidth measurement with 802.11b DSSS modulation.

Marker 1 is at peak. T1 and T2 are 6 dB down from peak.

Channel 1 (2412 MHz) 802.11b DSSS 11 MBPS



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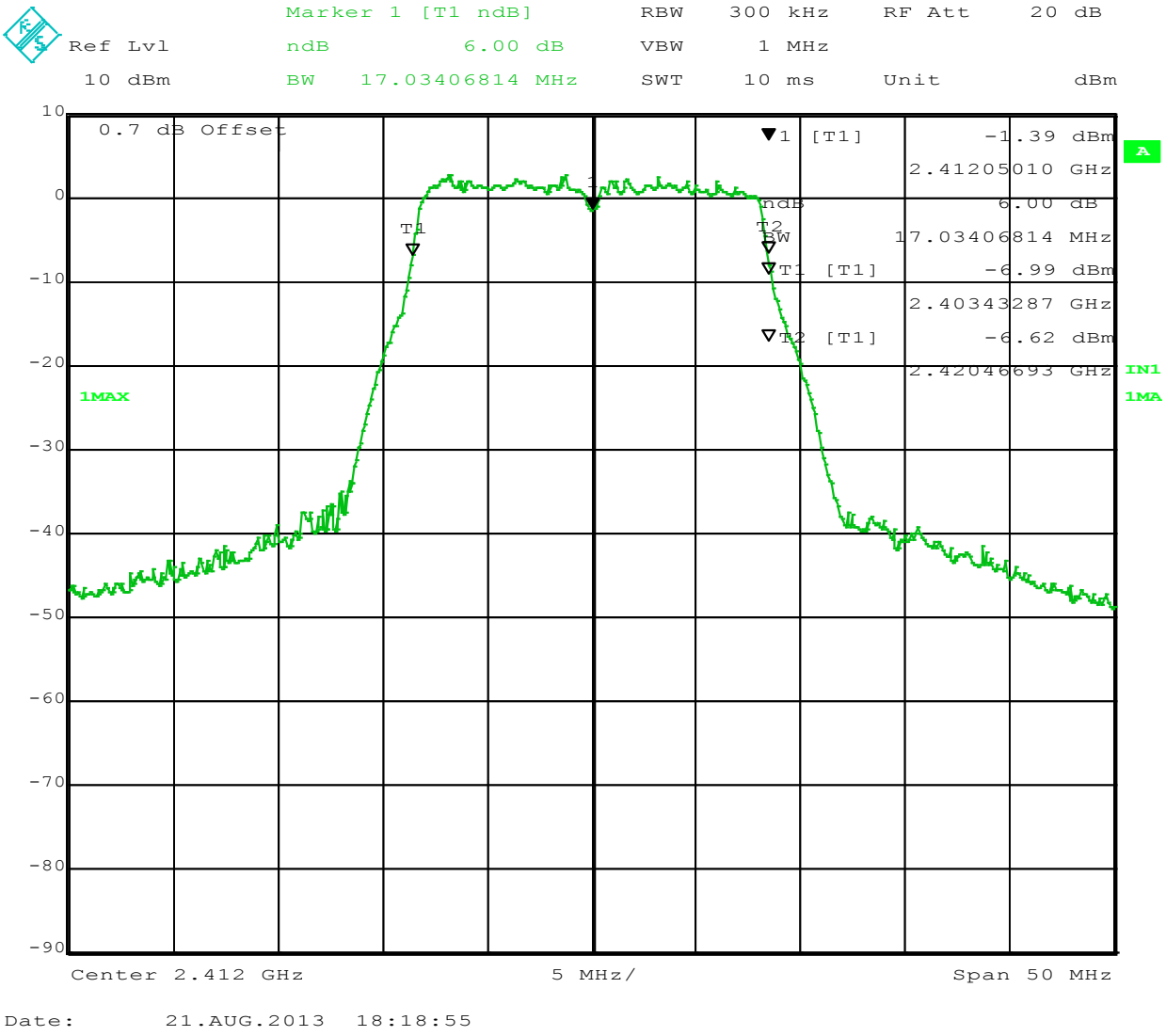
Tel: (508) 766-6000 Fax: (508) 766-1145

Representative spectrum analyzer plot showing a 6 dB bandwidth measurement with 802.11g OFDM modulation.

Marker 1 is at peak. T1 and T2 are 6dB down.

Channel 1 (2412 MHz) 802.11g OFDM 54 MBPS



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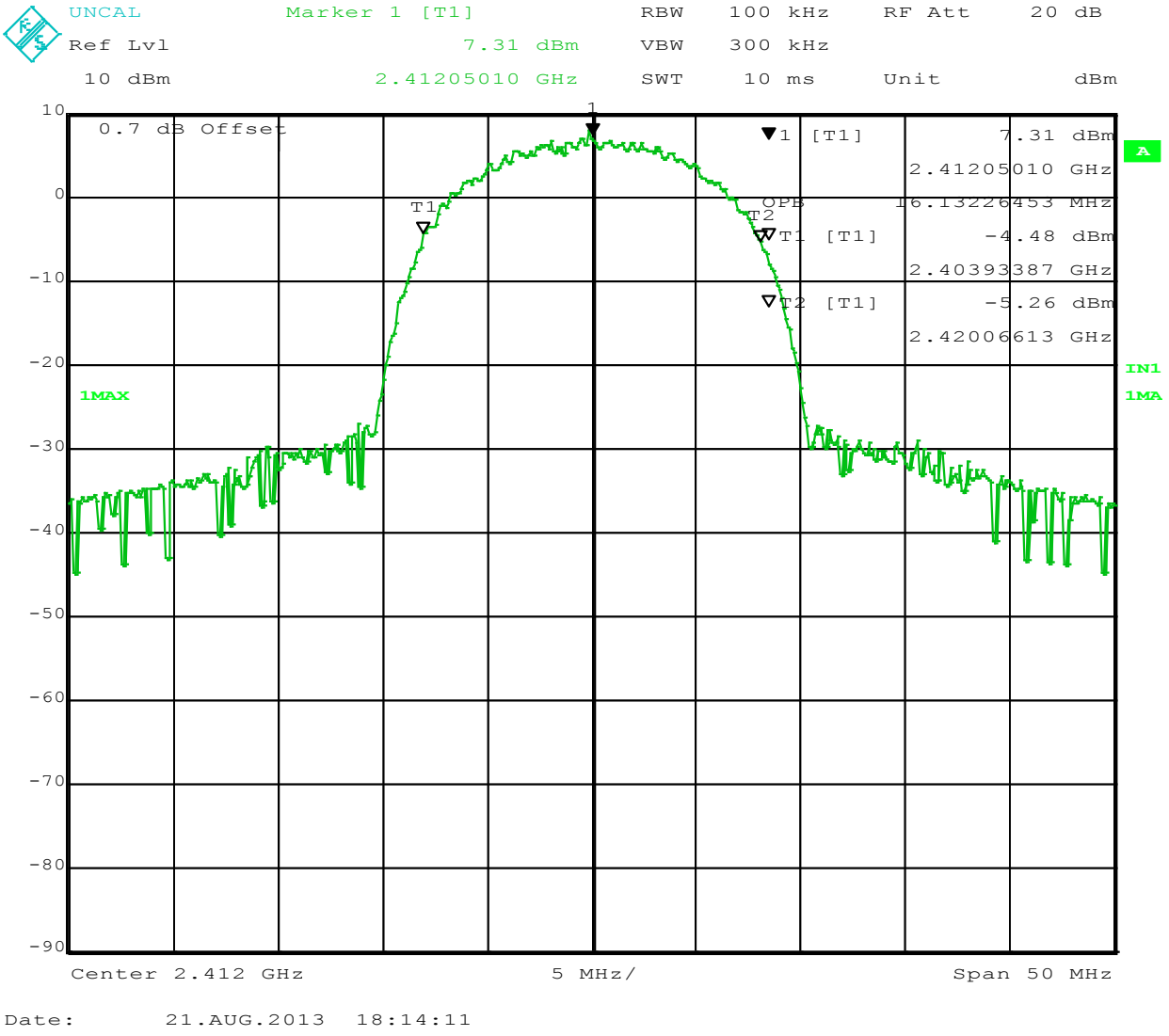
Tel: (508) 766-6000 Fax: (508) 766-1145

Representative spectrum analyzer plot showing 99% occupied dB bandwidth measurement with 802.11b DSSS modulation

Channel 1, 802.11b DSSS 11 MBPS



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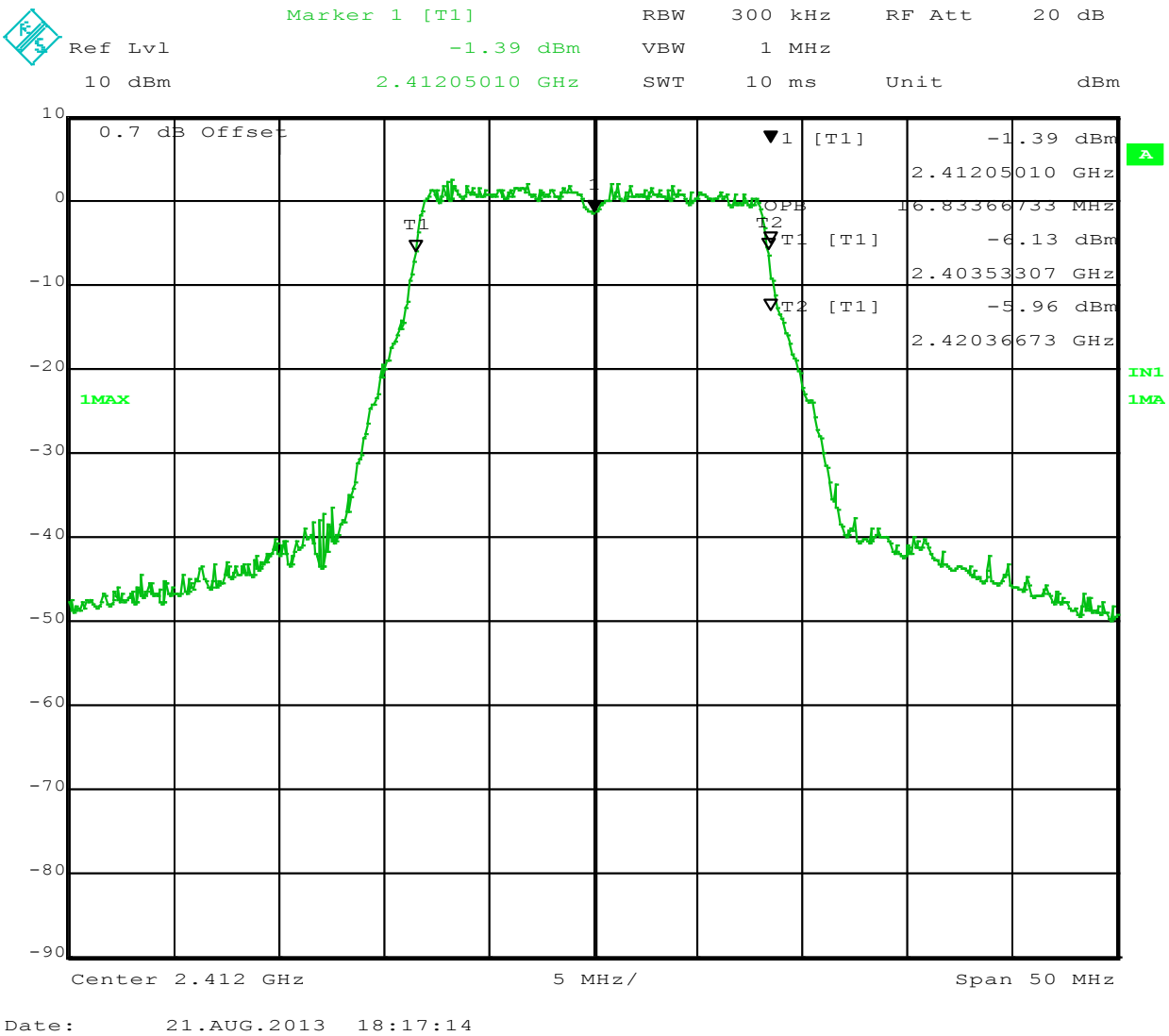
Representative spectrum analyzer plot showing 99% occupied dB bandwidth measurement with 802.11g OFDM modulation

Channel 1, 802.11g OFDM 54 MBPS



Bose Corporation, 1 New York Ave, Framingham, MA 01701, USA
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6.5.4. Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESIB 40	TN1560	4/4/2013	4/4/2014

5.5.5. Test information

Date of test:	8/21/2013, 5/21/2013	**Test location:**	Transmitter Test Bench
EUT serial:	SN007	**Test by:**	B. DeWitt
Test Conclusion:	Pass		

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Tel: (508) 766-6000 Fax: (508) 766-1145

6.6. Power spectral density

6.6.1. Requirements

FCC 15.247 (3) (1) iii, RSS210 A8.1 (d)

The power spectral density measured in a 3 kHz resolution bandwidth must be less than 8 dBm.

6.6.2. Test setup details

The EUT RF module output is connected to the spectrum analyzer using a SMK TS-7 to SMA adapter cable and a SMA male to male adapter.

The procedure outline in the OET KDB 558074 D01 DTS measurement guideline document was used.

The resolution bandwidth is set to 100 kHz and the video bandwidth is set to 500 kHz. Sweep time is set to auto. The maximum peak value is scaled by applying a bandwidth correction factor (BWCF) equal to 10*LOG(3kHz / 100kHz) = -15.2 dB

6.6.3. Test data

802.11b/g

Output	Channel	Frequency (MHz)	Modulation	100 kHz Max Peak (dBm)	BW CF (dB)	Corrected PSD in 3 kHz BW (dBm)	Limit (dBm)	Status
CON4	1	2412	DSSS	4.42	-15.2	-10.78	8	Pass
CON4	6	2437	DSSS	5.21	-15.2	-9.99	8	Pass
CON4	11	2462	DSSS	4.69	-15.2	-10.51	8	Pass
CON3	1	2412	OFDM	0.52	-15.2	-14.68	8	Pass
CON3	6	2437	OFDM	0.4	-15.2	-14.8	8	Pass
CON3	11	2462	OFDM	0.43	-15.2	-14.77	8	Pass
CON4	1	2412	DSSS	5.1	-15.2	-10.1	8	Pass
CON4	6	2437	DSSS	4.62	-15.2	-10.58	8	Pass
CON4	11	2462	DSSS	4.71	-15.2	-10.49	8	Pass
CON3	1	2412	OFDM	0.67	-15.2	-14.53	8	Pass
CON3	6	2437	OFDM	0.64	-15.2	-14.56	8	Pass
CON3	11	2462	OFDM	0.62	-15.2	-14.58	8	Pass

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Bluetooth LE

Output	Channel	Frequency (MHz)	Modulation	100 kHz Max Peak (dBm)	BW CF (dB)	Corrected PSD in 3 kHz BW (dBm)	Limit (dBm)	Status
J900	1	2406	GFSK	1.16	-15.2	-14.04	8	Pass
J900	19	2444	GFSK	1.17	-15.2	-14.03	8	Pass
J900	39	2480	GFSK	1.14	-15.2	-14.06	8	Pass

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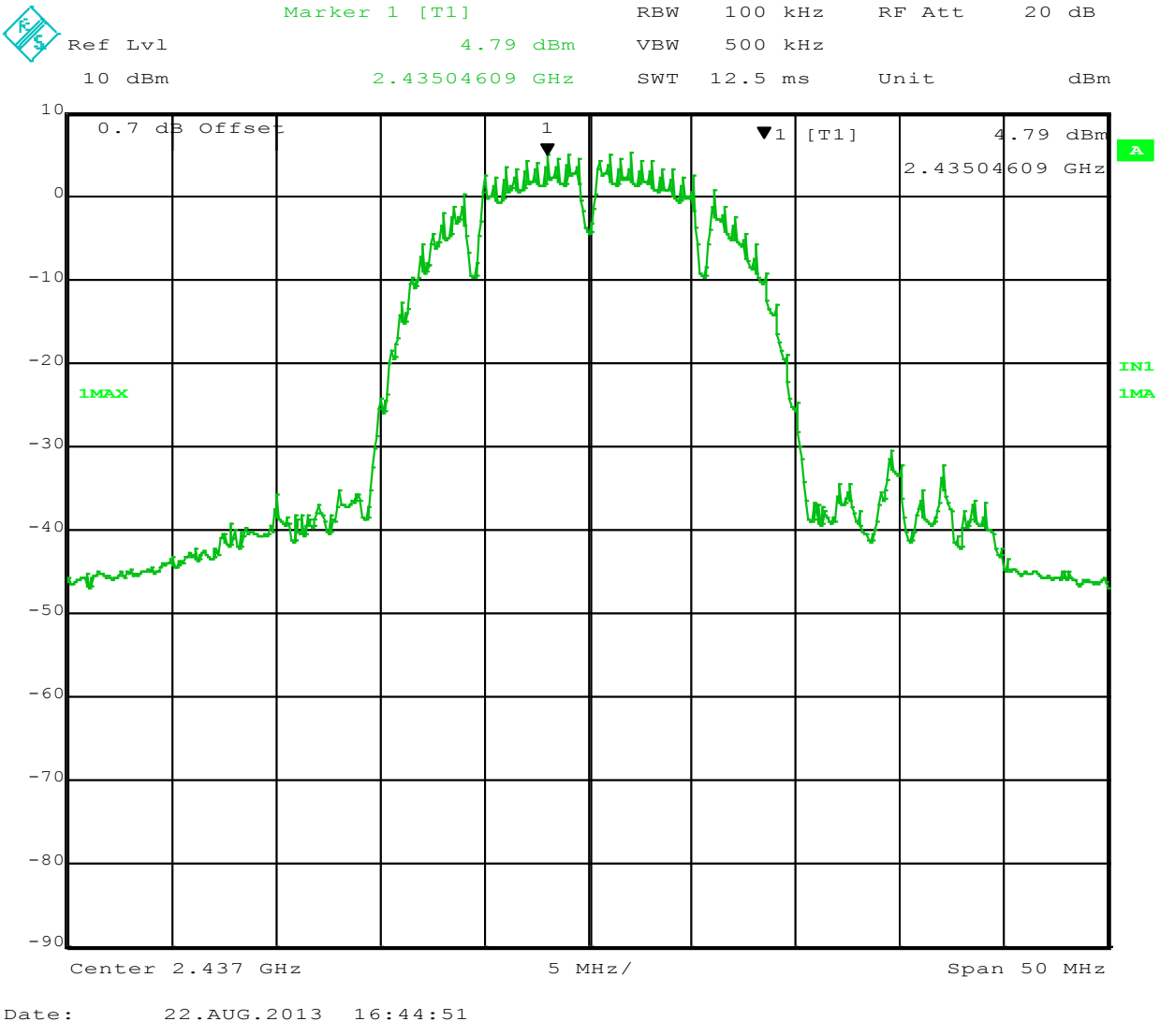
Representative spectrum analyzer plot showing a power spectral density measurement with 802.11b DSSS modulation.

Channel 6 (2437 MHz) 802.11b DSSS 1 MBPS

4.79 – 15.2 = -10.41 dBm



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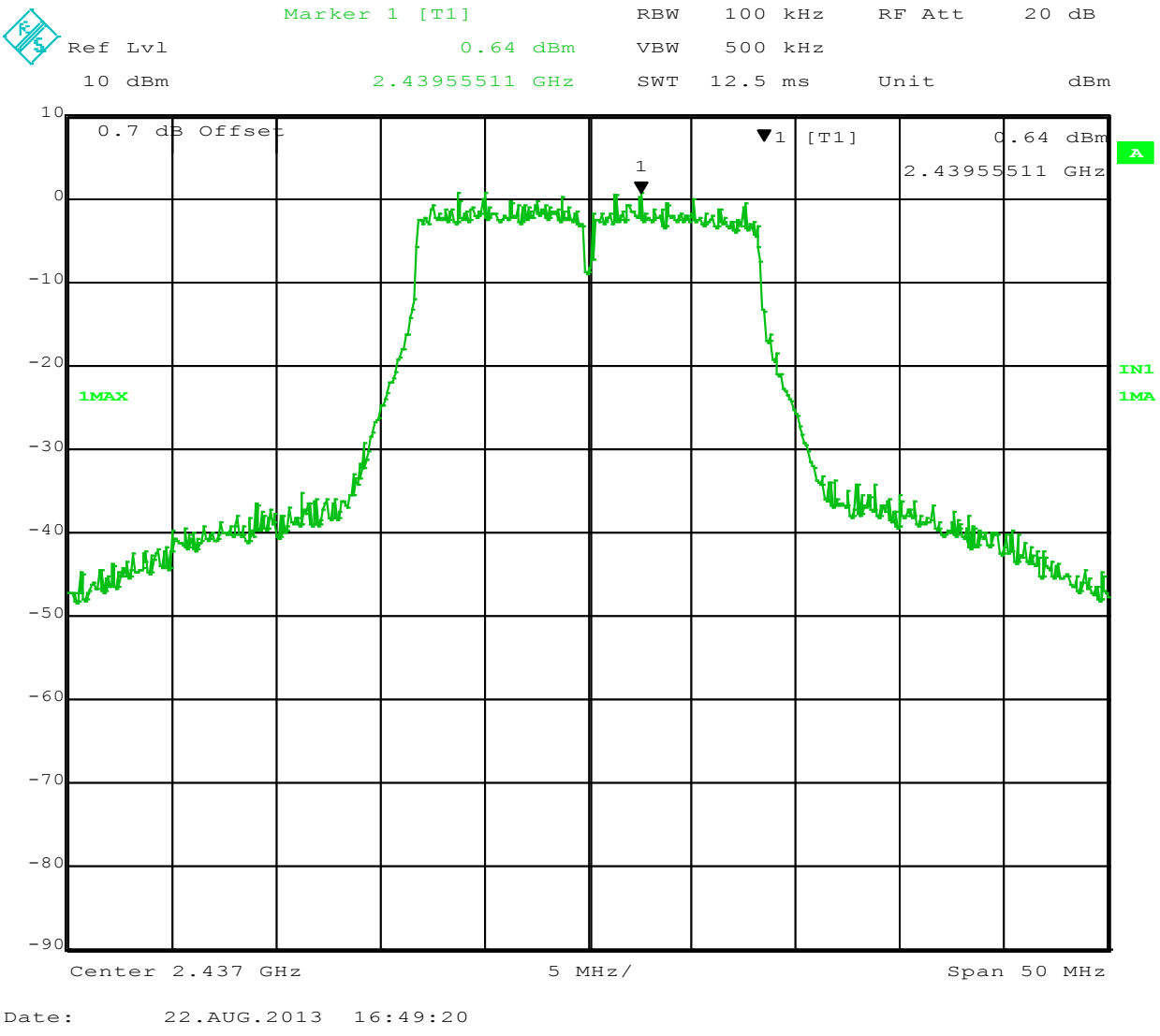
Representative spectrum analyzer plot showing a power spectral density measurement with 802.11g OFDM modulation.

Channel 6 (2437 MHz) 802.11g OFDM 6 MBPS

0.64 – 15.2 = -14.56 dBm



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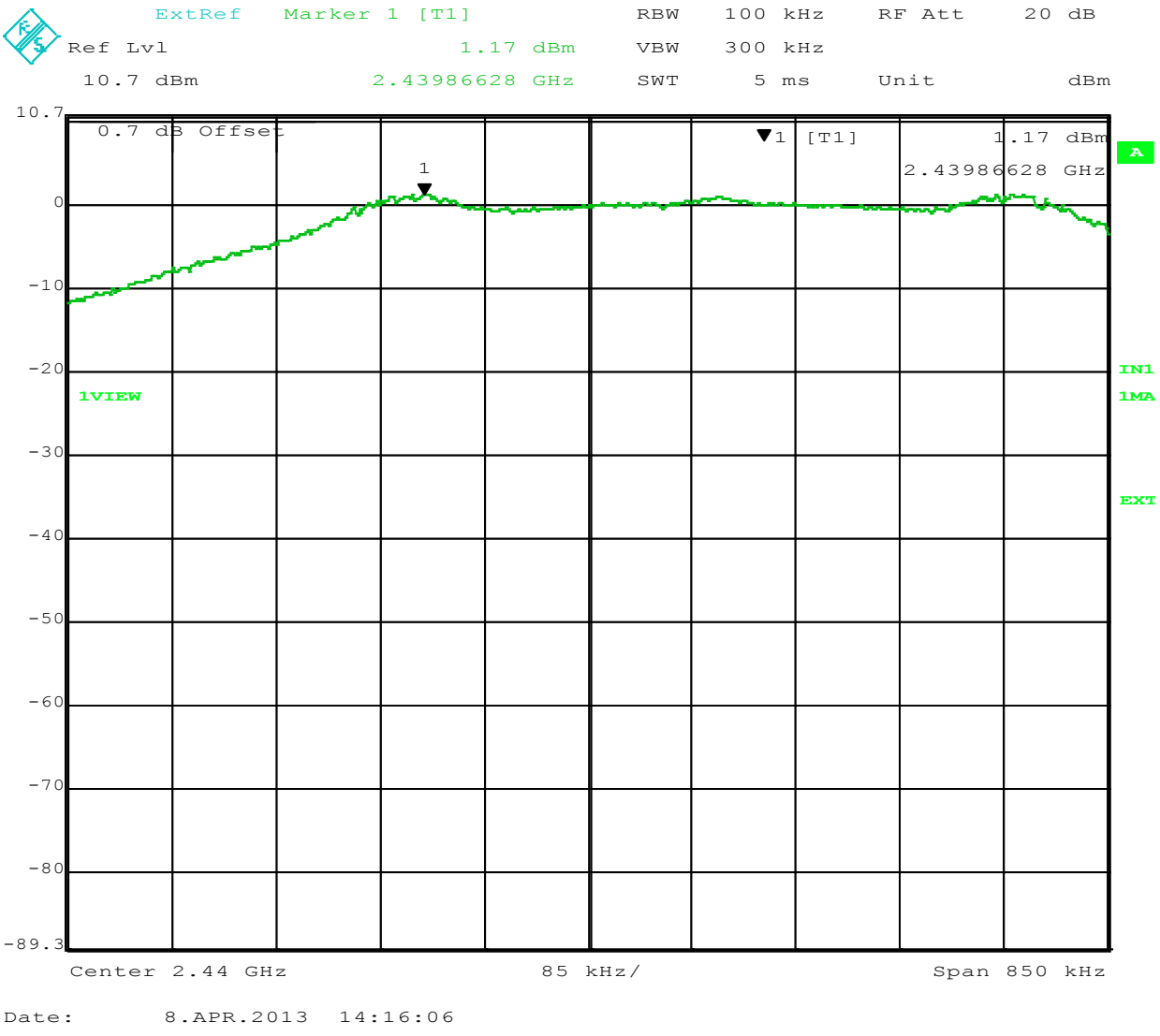
Representative spectrum analyzer plot showing a power spectral density measurement with Bluetooth LE GFSK modulation.

Channel 19 (2444 MHz) Bluetooth LE GFSK

1.17 – 15.2 = -14.03 dBm



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6.6.4. Test information

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				last	due
EMI Test Receiver	Rohde & Schwarz	ESIB40	TN1560	4/4/2013	4/4/2014

6.6.5. Test information

Date of test:	4/8/2013,8/22/2013	**Test Location:**	DCE – Transmitter Test Bench
EUT serial:	SN07	**Tested by:**	B. DeWitt
Test Conclusion:	Pass		

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6.7. Conducted spurious emissions.

6.7.1 Requirements

FCC part 15.247(d), RSS-Gen 7.2.5

6.7.2 Test Setup

The EUT was connected to the spectrum analyzer using a SMK TS-7 to SMA adapter cable. Conducted spurious emissions were measured for channels 1 and 11 for both 802.11b & 802.11g modulation modes.

Marker one represents the maximum peak reading. The display line is placed 20 dB below the peak. The emissions were measured for the lower and upper band edges as well as from 30 MHz to 26 GHz.

RBW = 100 kHz, VBW = 300 kHz

6.7.3 Test Data

802.11b/g

Output	Channel	Frequency (MHz)	Modulation	Peak (dBm)	DLINE1 (20 dB down)	Frequency (GHz)	Measurement (dBm)	Margin	Status
CON4	1	2412	DSSS	4.62	-15.38	6.69	-51	-35.62	Pass
CON4	11	2462	DSSS	4.88	-15.12	6.69	-51	-35.88	Pass
CON4	1	2412	OFDM	2.09	-17.91	6.69	-51	-33.09	Pass
CON4	11	2462	OFDM	0.55	-19.45	6.69	-51	-31.55	Pass

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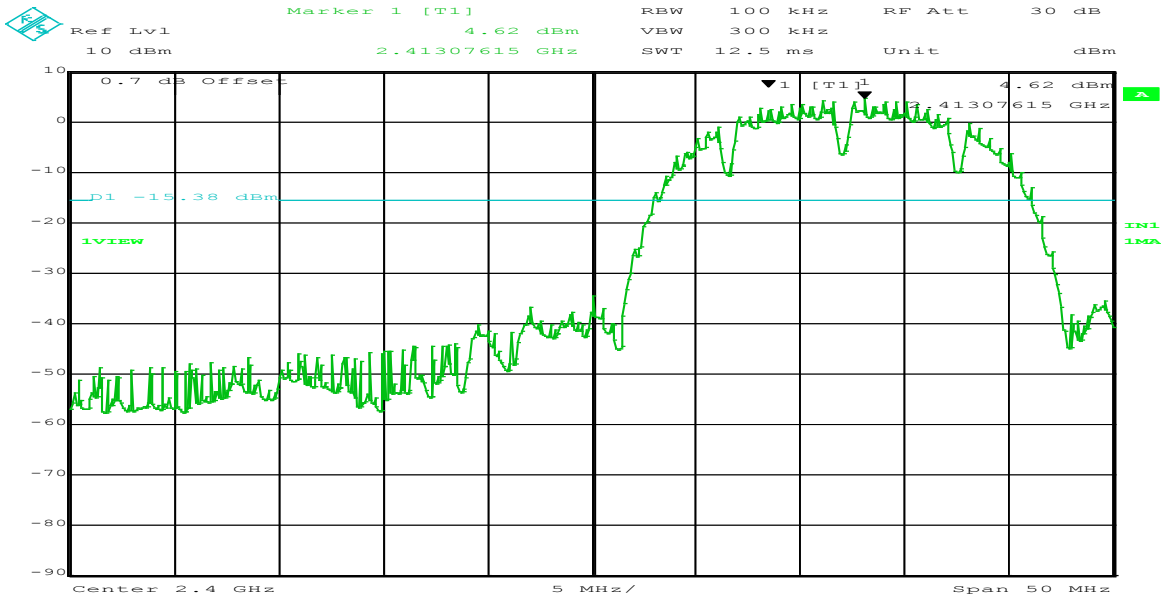
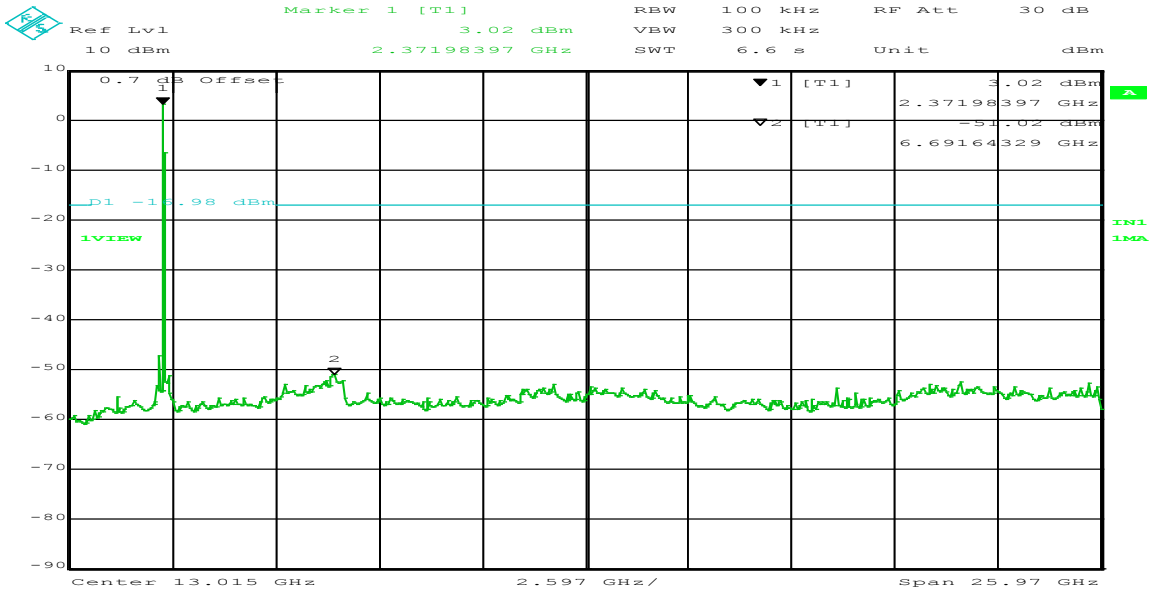
Representative spectrum analyzer plot showing conducted spurious emission measurement.
Channel 1, 802.11b DSSS modulation.





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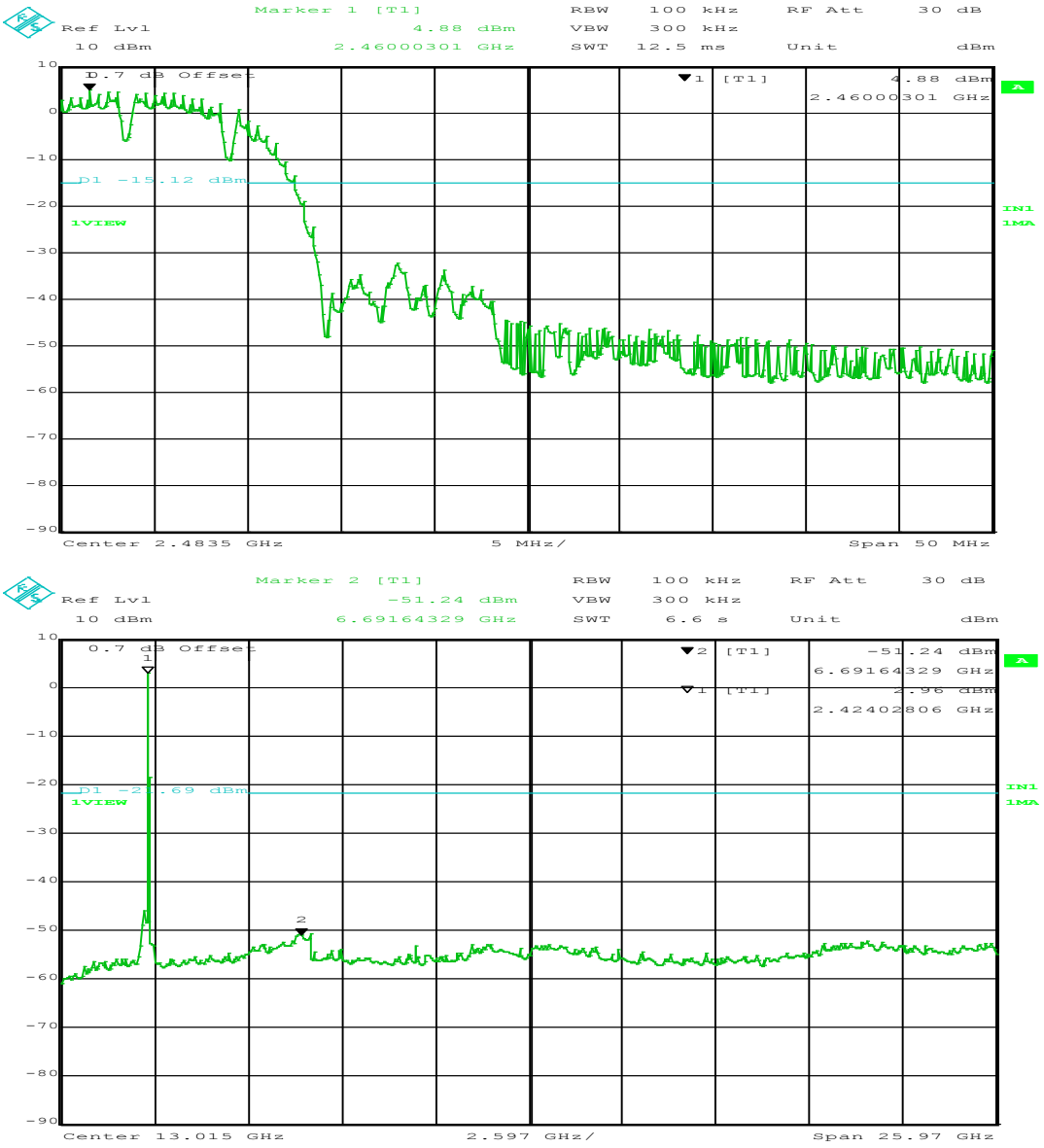
Representative spectrum analyzer plot showing conducted spurious emission measurement.
Channel 11, 802.11b DSSS modulation.



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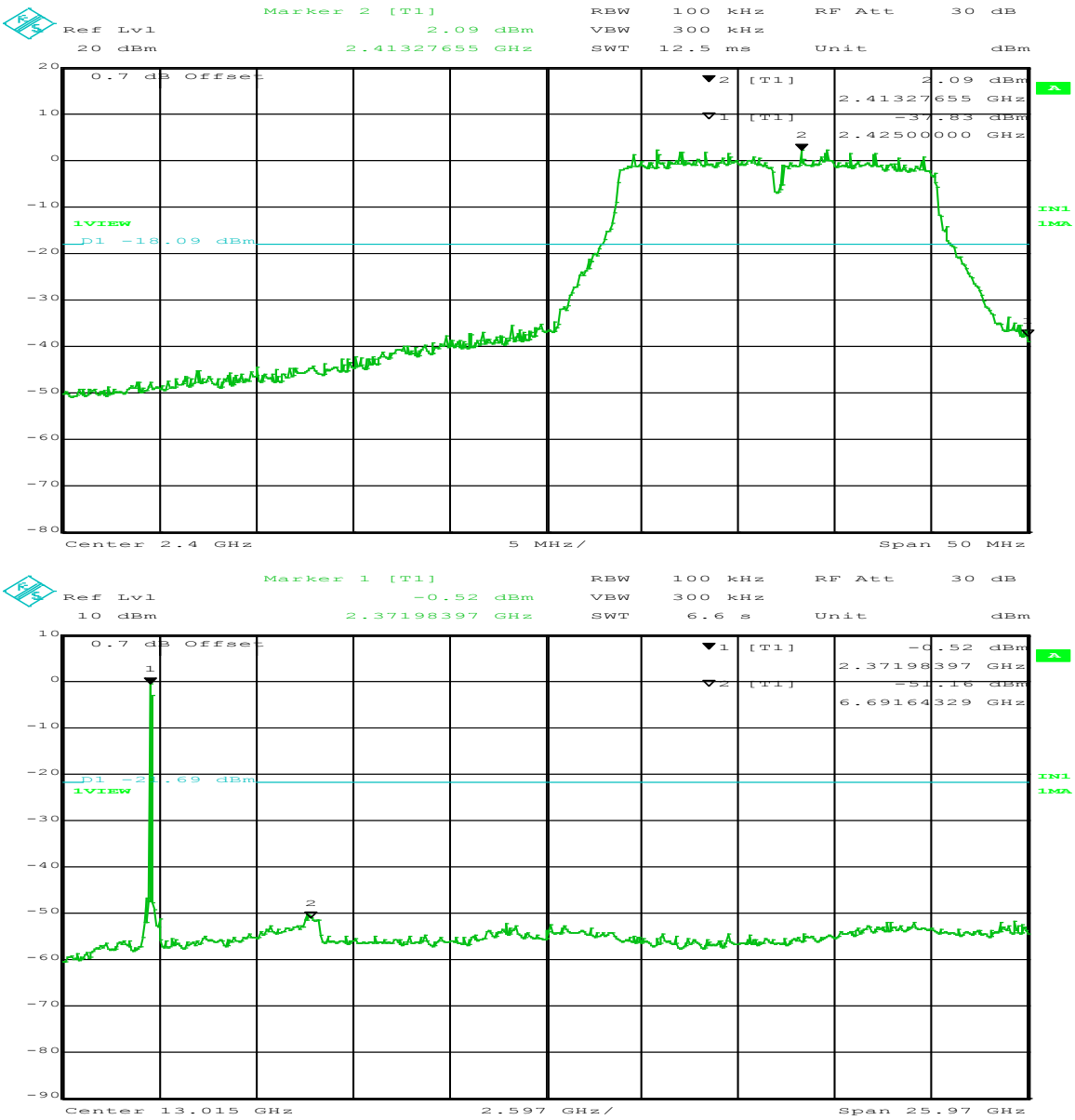
Representative spectrum analyzer plot showing conducted spurious emission measurement.
Channel 1, 802.11g OFDM modulation.



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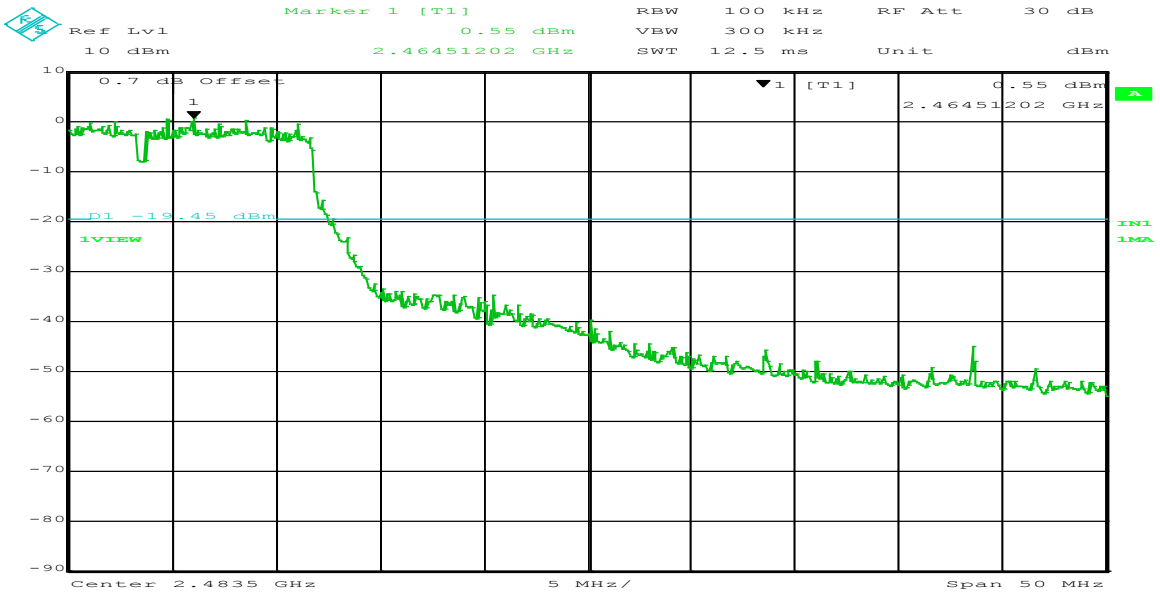
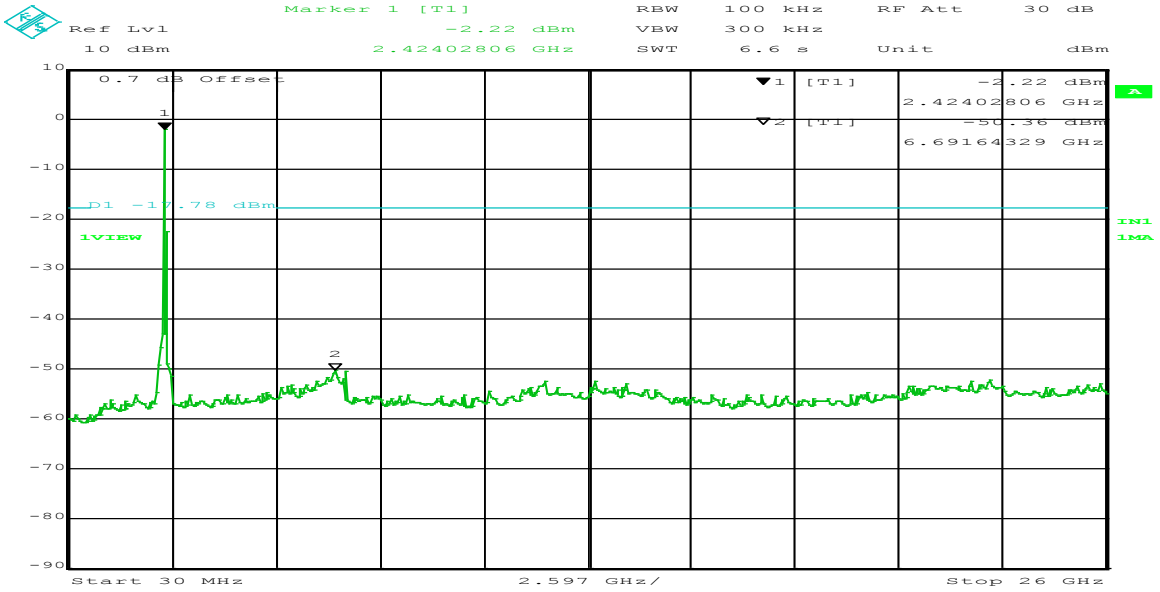
Representative spectrum analyzer plot showing conducted spurious emission measurement.
Channel 11, 802.11g OFDM modulation





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Bluetooth LE

Output	Channel	Frequency (MHz)	Modulation	Peak (dBm)	DLINE1 (20 dB down)	Frequency (GHz)	Measurement (dBm)	Margin	Status
J900	1	2406	GFSK	2.02	-17.98	2.4	-37.6	-19.62	Pass
J900	39	2480	GFSK	1.27	-18.73	2483.5	-53	-34.27	Pass

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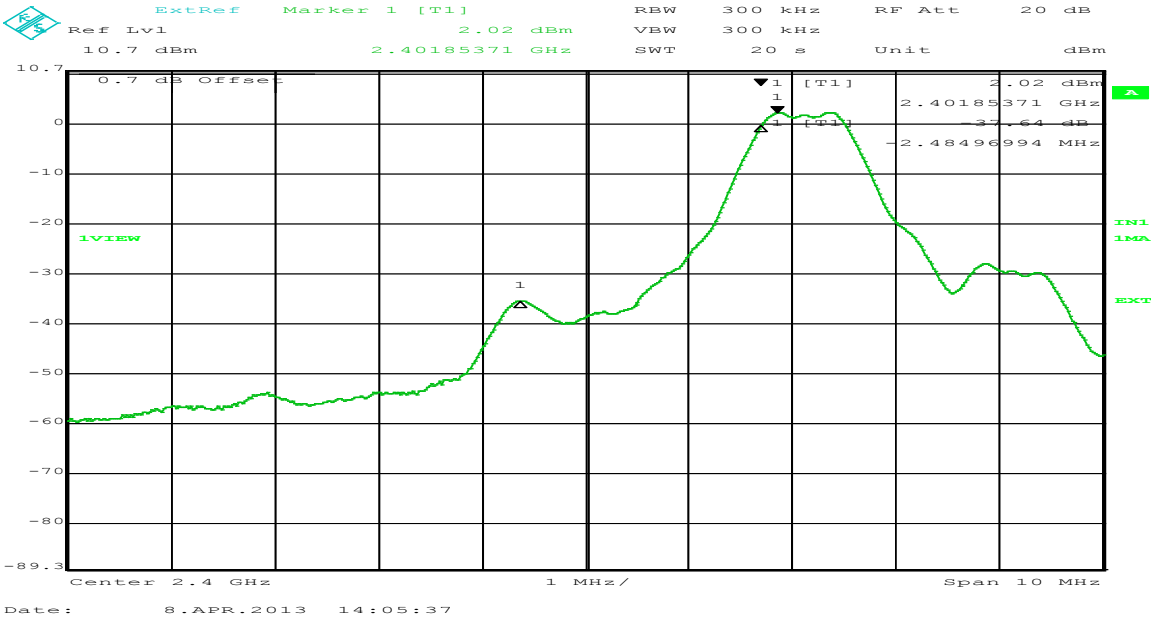

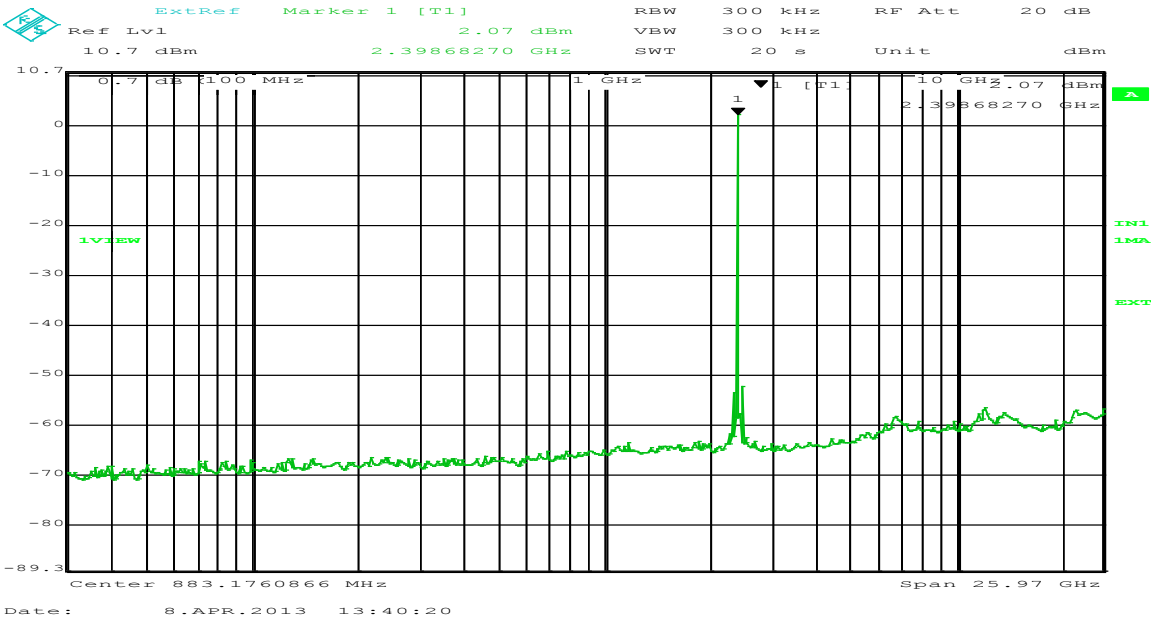

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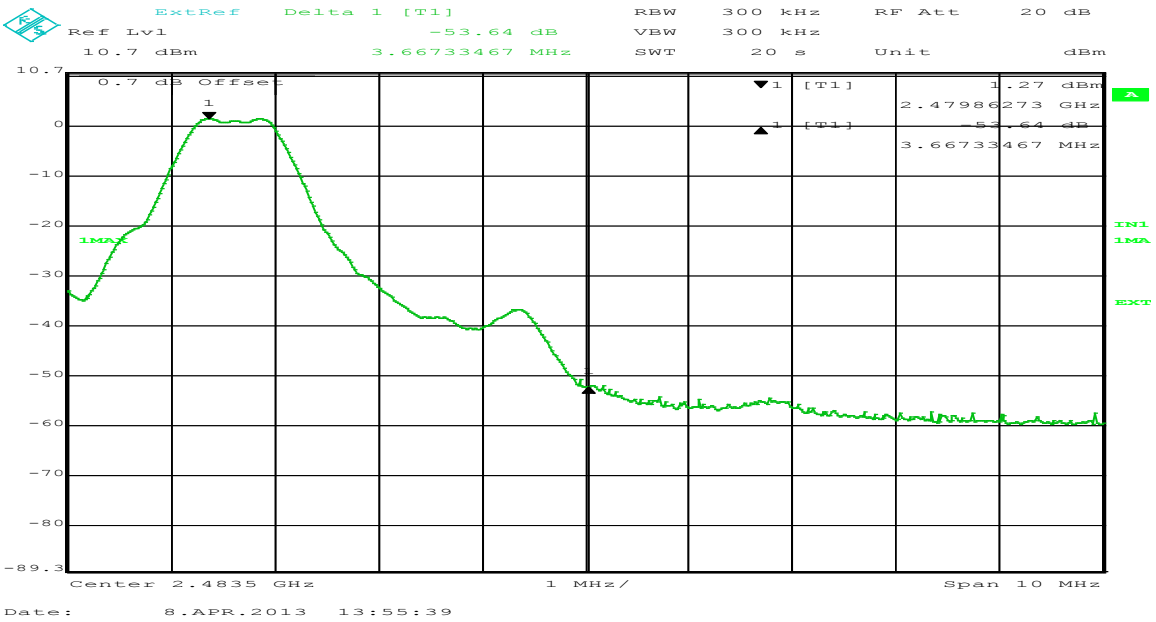

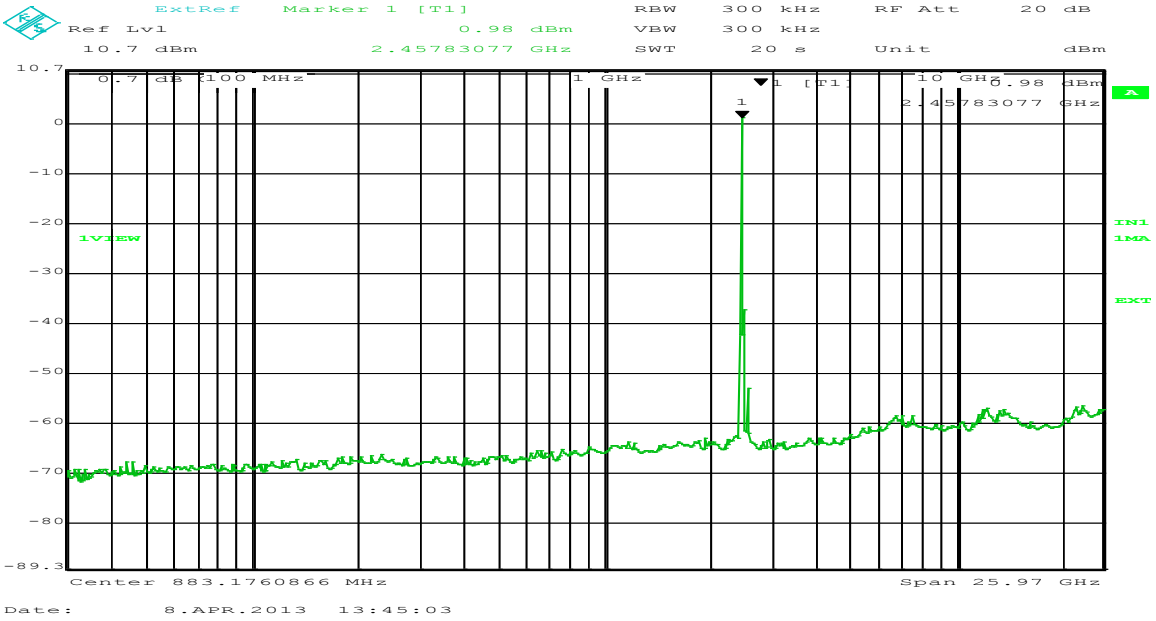

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6.7.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service	
				last	due
EMI Test Receiver	Rohde & Schwarz	ESIB40	TN1560	4/4/2013	4/4/2014

6.7.5 Test Equipment

Date of test:	4/8/2013,8/22/2013	**Test Location:**	DCE – Transmitter Test Bench
EUT serial:	SN05	**Tested by:**	B DeWitt
Test Conclusion:	Pass		

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6.8. Receiver spurious emissions

6.8.1 Requirements

RSS-Gen section 4.10
If the antenna is detachable, a conducted measurement may be performed.

RSS-GEN section 6.2
No spurious output signals appearing at the antenna terminals shall exceed 2 nW (-57dBm) in the band 30-1000 MHz, or 5 nW (-53dBm) above 1 GHz.

6.8.2 Test Setup

The EUT is tuned to the middle of the band and placed in receive mode.

Conducted:
The EUT antenna is automatically disconnected when the SMK TS-7 connector is attached to the test port. The 200mm adapter cable from TS-7 to SMA has approximately 0.7 dB of loss. For all conducted measurements the RG174 cable was connected directly to the spectrum analyzer. The EUT is placed in receive mode and tuned to the middle of the band (channel 6 = 2437 MHz for 802.11b/g and channel 19=2444 MHz for BTLE). A spectrum scan is made from 30 MHz to 12.5 GHz (covering the required 30MHz – 7.5 GHz range) with a 30 kHz RBW.

6.8.3 Test data

Worst case 802.11 RX spurious emissions on CON4 port: 9.726 GHz with 14.3 dB margin.

Worst case 802.11 RX spurious emissions on CON3 port: 2.424 GHz with 13.1 dB margin.

Worst case Bluetooth LE RX spurious emissions on J900 port: 2.382 GHz with 20.1 dB margin.

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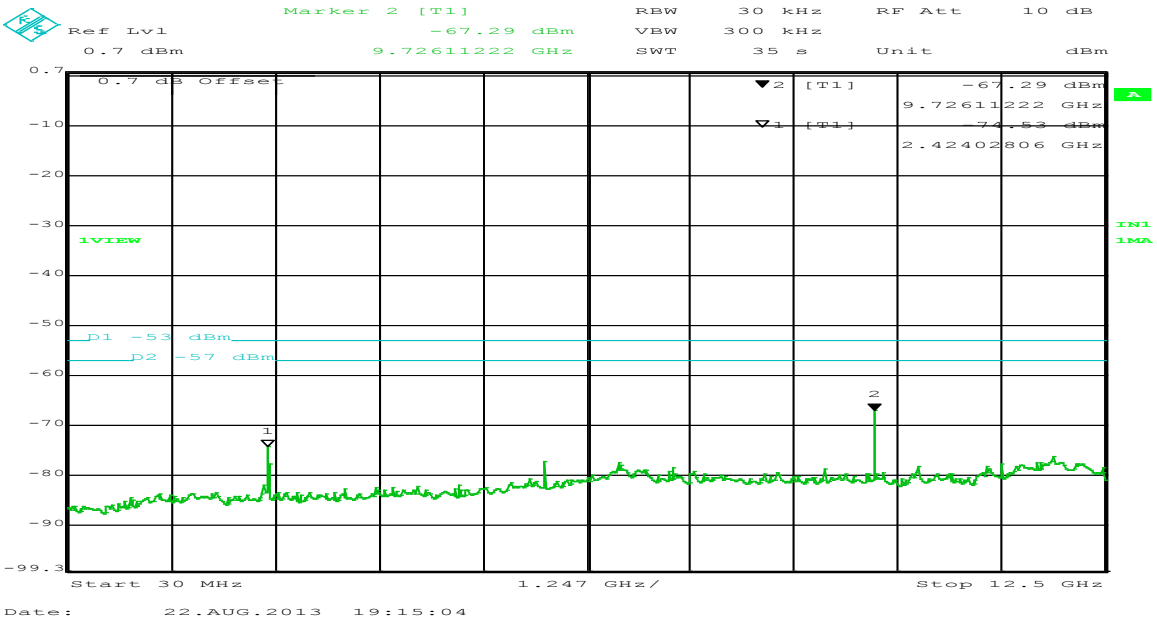
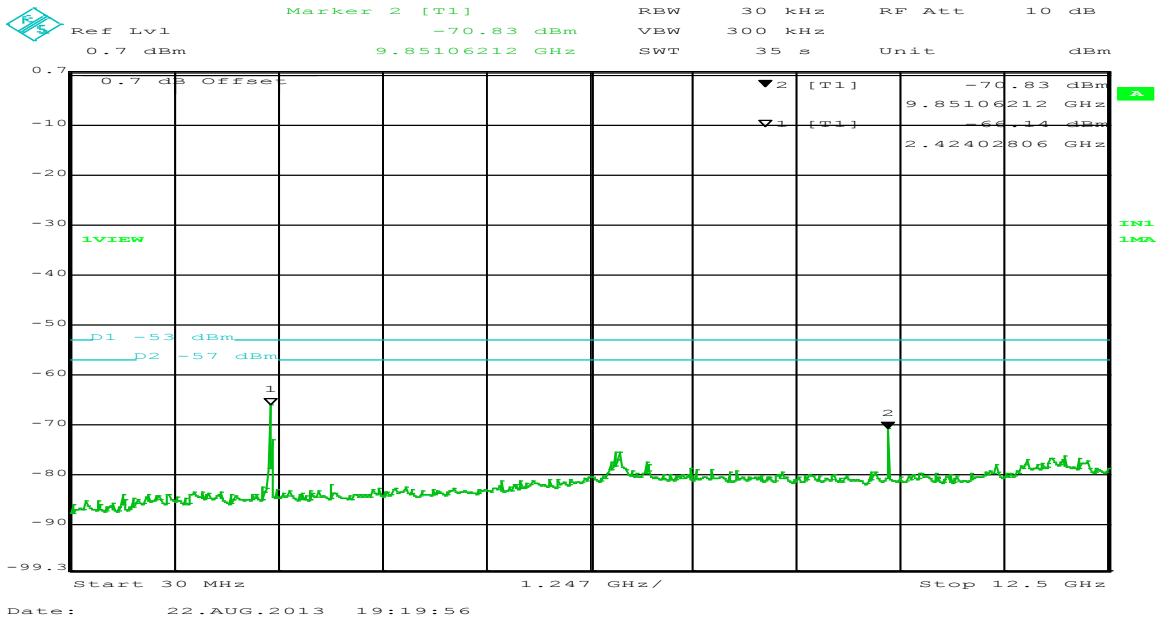
802.11 CON4 port:



802.11 CON3 port:



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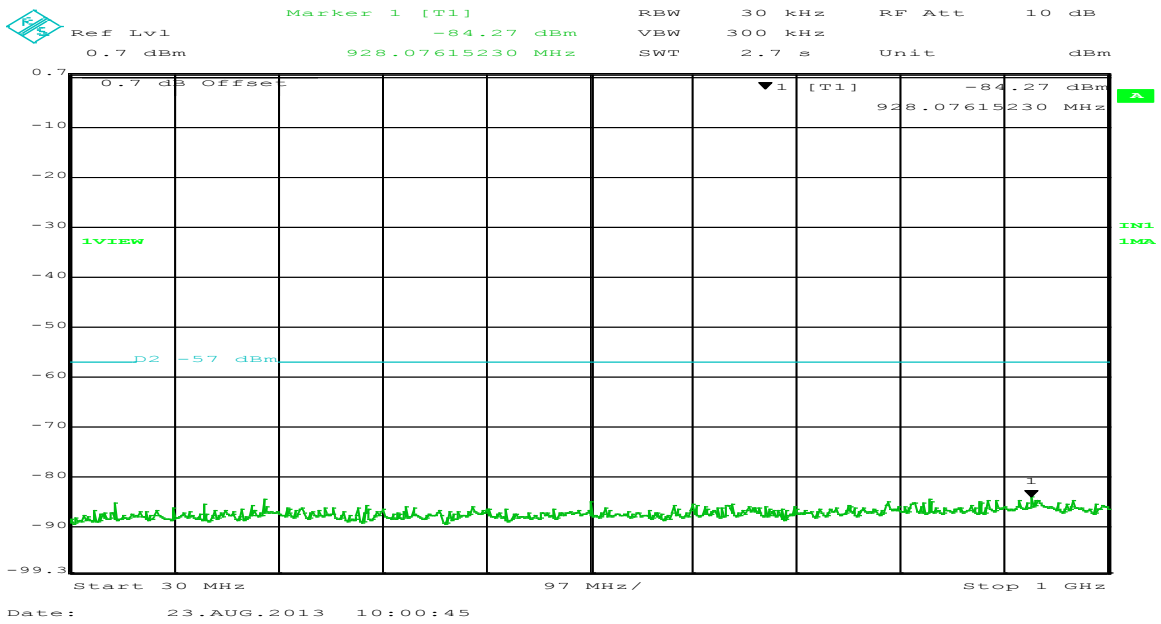
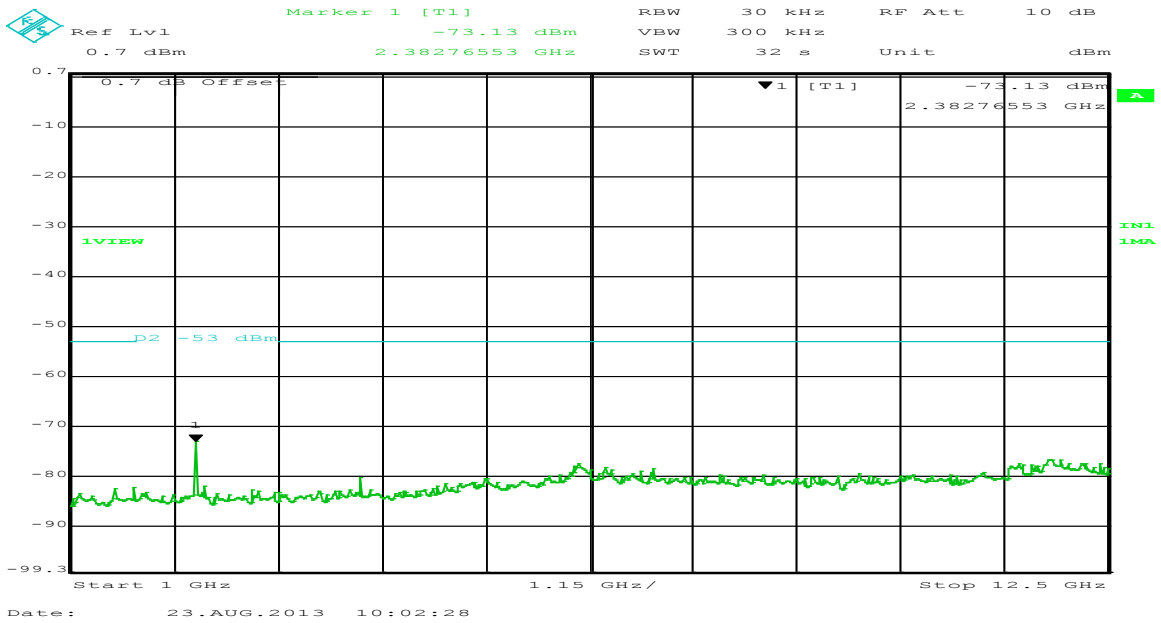
Bluetooth LE





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6.8.4 Test Equipment

Equipment Type	Manufacturer	Model	Serial or other ID	Service date	
				Last	Due
EMI Test Receiver	Rohde & Schwarz	ESIB40	TN1560	4/4/2013	4/4/2014

6.8.5 Test information

Date of test:	8/22-23/2013	Test location:	Transmitter Test Bench
EUT serial:	SN05	Tested by:	B. DeWitt
Test Conclusion:	Pass		

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6.9. Maximum permissible exposure

6.9.1 Limits

From FCC 1.310 Table 1 (B), the maximum value of S = 1.0mW/cm^2
From IC Safety Code 6, Section 2.2 Table 5 column 4, the maximum value of S = 10W/m^2

6.9.2 MPE calculation

S = EIRP/(4*Pi*D^2)

S = power density in W/m^2
D = separation distance in meters
EIRP = Equivalent Isotropic radiated power in W

The highest measured EIRP (measured using a vertically polarized horn antenna at 3 meters) is with antenna 11 on channel 6 at 13.6 dBm (0.0227 W).

The product (typically a table mounted device, categorized as “mobile” in FCC OET Guide65) is to be used with a greater than 20cm (0.2m) distance from the human body.
The owners guide has a statement that specifies the 20cm minimum separation distance.

S = EIRP/(4*Pi*D^2) = 0.0227/(4*Pi*0.2^2) = 0.0452 W/m^2 = 0.00452 mW/cm^2

FCC: 0.00452 mW/cm^2 < 1 mW/cm^2 Pass

IC: 0.0452 W/m^2 < 10W/m^2 Pass

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