FCC/IC Test Report

FOR:

Model Name: A1427
Apple TV
FCC ID: BCGA1427
IC ID: 579C-A1427

47 CFR Part 15.247 for DSSS Systems

IC RSS-210 Issue 8

TEST REPORT #: EMC_APPLE_089_11001_BT_DSSS_Rev1
DATE: 2012-02-10

ACCREDITED
TESTING LABORATORY
Certificate #2135.01

Bluetooth Qualification Test Facility (BQTF)

CTIA Authorized Test Lab
LAB CODE 20020328-00

FCC listed
A2LA Accredited

IC recognized # 3462B

***CETECOM* Inc.**
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CETECOM Inc. is a Delaware Corporation with Corporation number: 2113686

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1 Assessment

The following device was tested against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS 210 Issue 8 and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Apple Inc.	The device is a digital media receiver designed to play internet content onto a TV through an HDMI port. It incorporates WiFi and Bluetooth radios.	A1427

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2012-02-10	Compliance	Sajay Jose (Test Lab Manager)	Sajay Jose 2012.02.10 09:44:49 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2012-02-10	Compliance	Calvin Lee (EMC Engineer)	Calvin Lee Digitally signed by Calvin Lee DN: cn=Calvin Lee, c=US, o=CETECOM Inc, ou=Compliance, email=calvin.lee@cetecomusa.com Date: 2012.02.10 09:20:23 -08'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Test Lab Director:	Heiko Strehlow
Responsible Project Leader:	Calvin Lee

2.2 Identification of the Client

Applicant's Name:	Apple Inc.
Street Address:	1 Infinite Loop Mail Stop26A
City/Zip Code	Cupertino, California 95014
Country	USA
Contact Person:	Marc Douat
Phone No.	1-408-862-2927
e-mail:	mdouat@apple.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as above.
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	Apple TV/A1427
HW / SW Revision :	EVT/9B123
FCC-ID / IC-ID:	BCGA1427 / 579C-A1427
Product Description:	The device is a digital media receiver designed to play internet content onto a TV through an HDMI port. It incorporates WiFi and Bluetooth radios.
Frequency Bands supported:	BT 4.0: ISM Band 2400-2483.5 MHz
Type(s) of Modulation:	GFSK
Power Supply:	100-240V/50-60Hz 6 Watts
Prototype / Production unit:	Prototype
EUT Specifications for mode of test: BT 4.0 Mode	
Frequency Range / number of channels:	BT 4.0: 2402MHz – 2480MHz / 40
Modes of Operation:	BT - development firmware used to force transmitter and achieve 63% duty cycle

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	PT662763	EVT	9B123	Conducted sample
2	PT677761	EVT	9B123	Radiated Sample

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number
1	Mac Book Pro	Apple	A1150	YD6124XQVJ1
2	AC Power Cord	Apple	N/A	N/A

4 Subject Of Investigation

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Industry Canada rules RSS-210 Issue 8.

This test report is to support a request for new equipment authorization under the FCC ID **BCGA1427** and IC ID **579C-A1427**.
All testing was performed on the product referred to in Section 3 as EUT.
This test report contains full radiated and conducted testing results as per

- 47 CFR Part 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter A- General, Part 15- Radio Frequency Devices.
- RSS-210 Issue 7: Spectrum Management and Telecommunications- Radio Standards Specification. Low-power Licence-exempt radio communication devices (All frequency bands): Category 1 equipment.

During the testing process the EUT was tested on low, mid and high channels for all the supported modes of operation. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(b)(4) RSS210 A8.4(2)	Antenna Gain	Nominal	-	☐	☐	☐	■	Complies
§15.247(e) RSS210 A8.2(b)	Power Spectral Density	Nominal	802.11b 802.11g 802.11n 802.11a	■	☐	☐	☐	Complies
§15.247(a)(1) RSS210 A8.1(b)	Carrier Frequency Separation	Nominal	-	☐	☐	■	☐	-
§15.247(a)(1) RSS210 A8.1(d)	Number of Hopping Channels	Nominal	-	☐	☐	■	☐	-
§15.247(a)(1)(iii) RSS210 A8.3(1)	Time of occupancy	Nominal	-	☐	☐	■	☐	-
§15.247(a)(1) RSS210 A8.2(a)	Spectrum Bandwidth	Nominal	802.11b 802.11g 802.11n 802.11a	■	☐	☐	☐	Complies
§15.247(b)(1) RSS210 A8.4(2)	Maximum Output Power	Nominal	802.11b 802.11g 802.11n 802.11a	■	☐	☐	☐	Complies
§15.247(d) RSS210 A8.5	Band edge compliance-Conducted	Nominal	802.11b 802.11g 802.11n	☐	☐	☐	■	Note 1
§15.247(d) RSS210 A8.5	Band edge compliance-Radiated	Nominal	802.11b 802.11g 802.11n	■	☐	☐	☐	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Conducted	Nominal	802.11b 802.11g 802.11n 802.11a	■	☐	☐	☐	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Radiated	Nominal	802.11b 802.11g 802.11n 802.11a	■	☐	☐	☐	Complies
§15.209(a) RSS Gen	TX Spurious Emissions Radiated<30MHz	Nominal	802.11b 802.11n 802.11a	■	☐	☐	☐	Complies
§15.207(a)	Conducted Emissions <30MHz	Nominal	802.11b 802.11n	■	☐	☐	☐	Complies

Note: NA= Not Applicable; NP= Not Performed.

1. Band Edge compliance-conducted is NOT PERFORMED as the device passes radiated measurement.

6 Measurements

6.1 Radiated Measurement Procedure

ANSI C63.4:2003 Section 8.3.1.1: Exploratory radiated emission measurements

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

Broadband antennas and a spectrum analyzer or a radio-noise meter with a panoramic display are often useful in this type of testing. It is recommended that either a headset or loudspeaker be connected as an aid in detecting ambient signals and finding frequencies of significant emission from the EUT when the exploratory and final testing is performed in an OATS with strong ambient signals. Caution should be taken if either antenna height between 1 and 4 meters or EUT azimuth is not fully explored. Not fully exploring these parameters during exploratory testing may require complete testing at the OATS or semi-anechoic chamber when the final full spectrum testing is conducted.

The EUT should be set up in its typical configuration and arrangement, and operated in its various modes. For tabletop systems, cables or wires should be manipulated within the range of likely arrangements. For floor-standing equipment, the cables or wires should be located in the same manner as the user would install them and no further manipulation is made. For combination EUTs, the tabletop and floor-standing portions of the EUT shall follow the procedures for their respective setups and cable manipulation. If the manner of cable installation is not known, or if it changes with each installation, cables or wires for floor-standing equipment shall be manipulated to the extent possible to produce the maximum level of emissions.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. Variations in antenna height between 1 and 4 m, antenna polarization, EUT azimuth, and cable or wire placement (each variable within bounds specified elsewhere) shall be explored to produce the emission that has the highest amplitude relative to the limit. A step-by-step technique for determining this emission can be found in Annex C.

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beamwidth, the measurement antenna shall be aligned with the EUT.

ANSI C63.4:2003 Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be remaximized at the final test location before final radiated emissions measurements are performed. However, antenna height and polarity and EUT azimuth are to be varied. In addition, the full frequency spectrum (for the range to be checked for meeting compliance) shall be investigated.

This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement (associated with achieving the least margin with respect to the limit). This full spectrum test constitutes the compliance measurement.

For measurements above 1 GHz, use the cable, EUT arrangement, and mode of operation determined in the exploratory testing to produce the emission that has the highest amplitude relative to the limit. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the "cone of radiation" from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. The antenna may have to be higher or lower than the EUT, depending on the EUT's size and mounting height, but the antenna should be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. If the transmission line for the measurement antenna restricts its range of height and polarization, the steps needed to ensure the correct measurement of the maximum emissions, shall be described in detail in the report of measurements. Data collected shall satisfy the report requirements of Clause 10.

NOTES

1— Where limits are specified by agencies for both average and peak (or quasi-peak) detection, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
2—Use of waveguide and flexible waveguide may be necessary at frequencies above 10 GHz to achieve usable signal-to noise ratios at required measurement distances. If so, it may be necessary to restrict the height search of the antenna, and special care should be taken to ensure that maximum emissions are correctly measured.
3—All presently known devices causing emissions above 10 GHz are physically small compared with the beam-widths of typical horn antennas used for EMC measurements. For such EUTs and frequencies, it may be preferable to vary the height and polarization of the EUT instead of the receiving antenna to maximize the measured emissions.

Note: Measurement uncertainty for all radiated measurements= +/- 3dB

6.2 Sample Calculations for Radiated Measurements

6.2.1 Field Strength Measurements:

Field Strength measurements are directly taken from the Spectrum Analyzer/ Receiver, taking into account the cable loss between the Receiving Antenna and the Spectrum Analyzer/ Receiver. Antenna Factor is accounted for by the test SW.

FS (dBµV/m)= Measured Value on SA (dBµV)+ Cable Loss (dB)
Eg:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Field Strength Result (dBµV/m)
1000	95.5	3.5	99.0

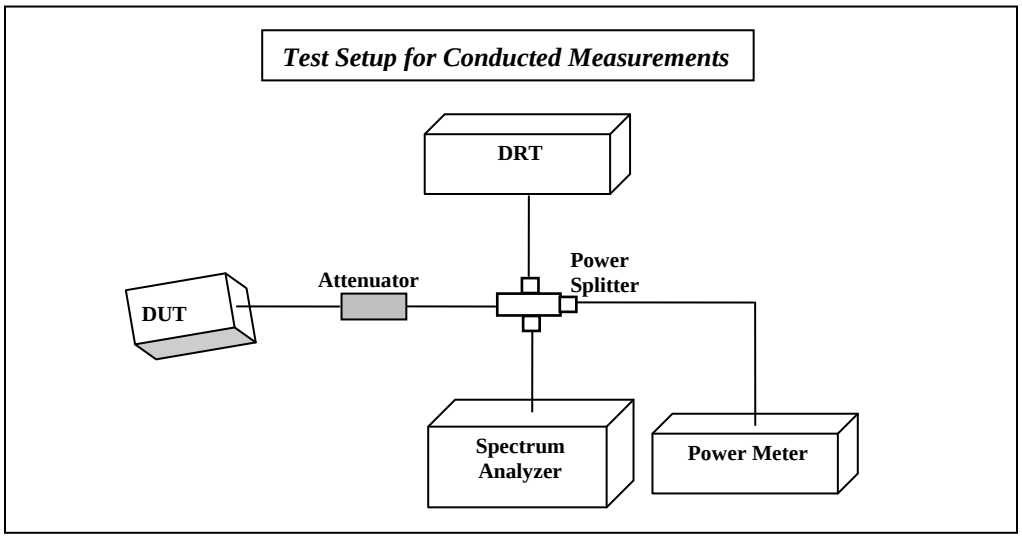
6.2.2 Power Measurements using Substitution Procedure:

The measurement on the Spectrum Analyzer is used as a basis for the Substitution procedure.
The EUT is replaced with a Signal Generator and an antenna. The setting on the Signal Generator is varied until the Spectrum Analyzer displays the original reading. EIRP is calculated as-

EIRP (dBm)= Signal Generator setting (dBm)- Cable Loss (dB)+ Antenna Gain (dBi)
Eg:

Frequency (MHz)	Measured SA (dBµV)	Signal Generator setting (dBm)	Antenna Gain (dBi)	Dipole Gain (dBd)	Cable Loss (dB)	EIRP (dBm)
1000	95.5	24.5	6.5	0	3.5	27.5

6.3 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the Digital Radio Communication Tester (DRT) to connect the EUT at the required channel (OR) alternatively use the EUT to set to transmit at a specific mode.
3. Measurements are to be performed with the EUT set to the low, middle and high channels.

Note: Measurement uncertainty for all conducted measurements= +/- 0.5dB

6.4 Maximum Peak Output Power

6.4.1 Limits:

6.4.1.1 §15.247 (b)(3)

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 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. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

6.4.1.2 RSS 210- A8.4(2)

Nominal Peak Output Power < 30 dBm (1W)
EIRP < 36dBm

6.4.2 Test Conditions:

Tnom: 20.5°C; Vnom: 120V

Spectrum Analyzer settings:

RBW=3MHz, VBW=3MHz, Detector: Peak- Max Hold.
Sweep Time: Auto
Span=10MHz

Max. Antenna Gain (dBi):

2.4 GHz Band: 3.7 dBi

6.4.3 Test Result: 2.4 GHz Band

Conducted Peak Power was measured with a spectrum analyzer with 63% duty cycle.
Duty Cycle = 10 log (1/x); x=0.63; Duty Cycle = 2.0 dB

Measured Peak Output Power- Conducted (dBm)			
Modulation	**Frequency (MHz)**		
	2402 Channel 0	**2440 Channel 19**	**2480 Channel 39**
GFSK	7.89	7.76	8.17
Measurement Uncertainty: ±0.5dB			

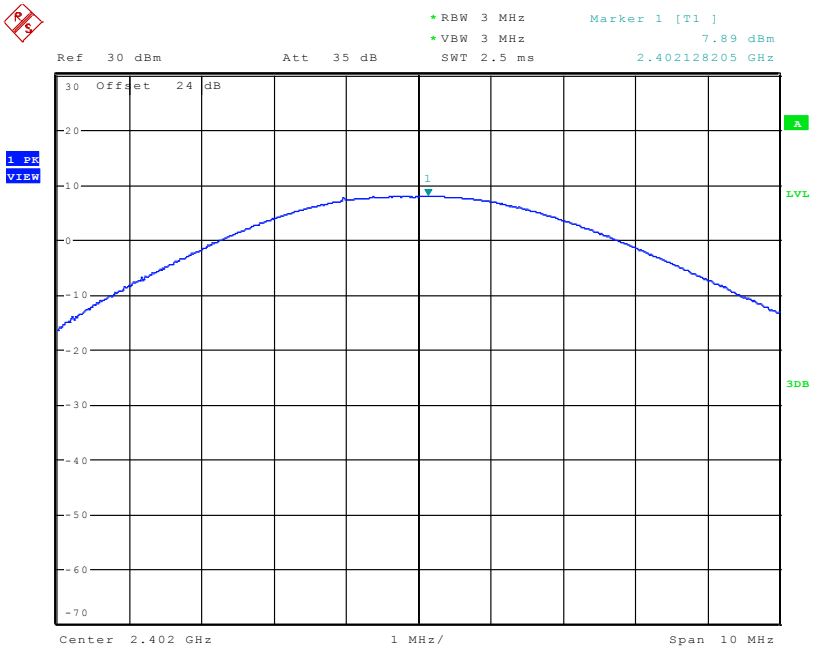
Calculated Peak Output Power- Radiated (dBm)			
Modulation	**Frequency (MHz)**		
	2412 Channel 1	**2437 Channel 6**	**2462 Channel 11**
GFSK	13.59	13.46	13.87
Measurement Uncertainty: ±3.0dB			

Note: Radiated EIRP is calculated as
Conducted Measurement + max. Antenna Gain (3.7dBi) + Duty Cycle (2.0 dB)

6.4.3.1 Measurement result:
Pass.

6.4.4 Test Data/plots: 2.4GHz Band

Conducted Peak Power BT 4.0 2402 MHz



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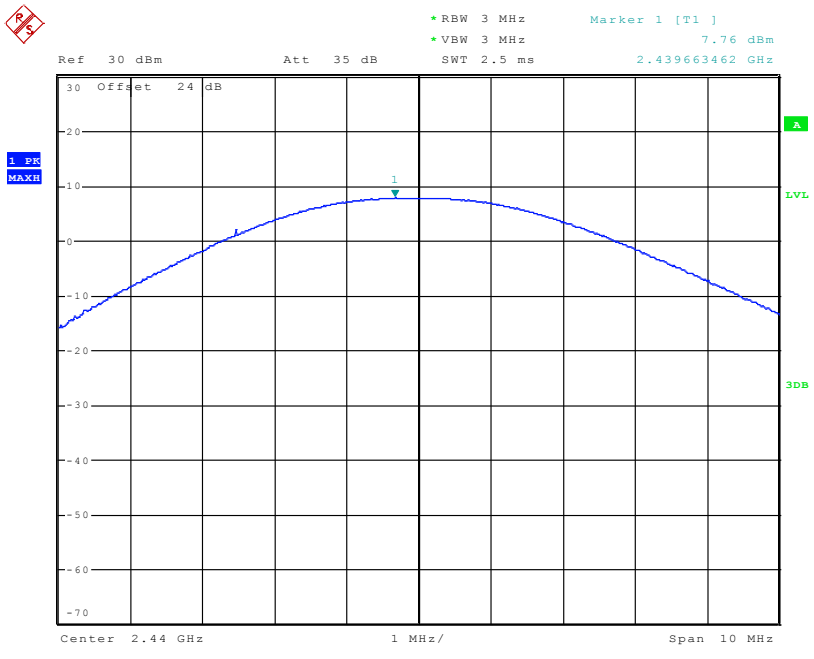
Conducted Peak Power BT 4.0 2440 MHz



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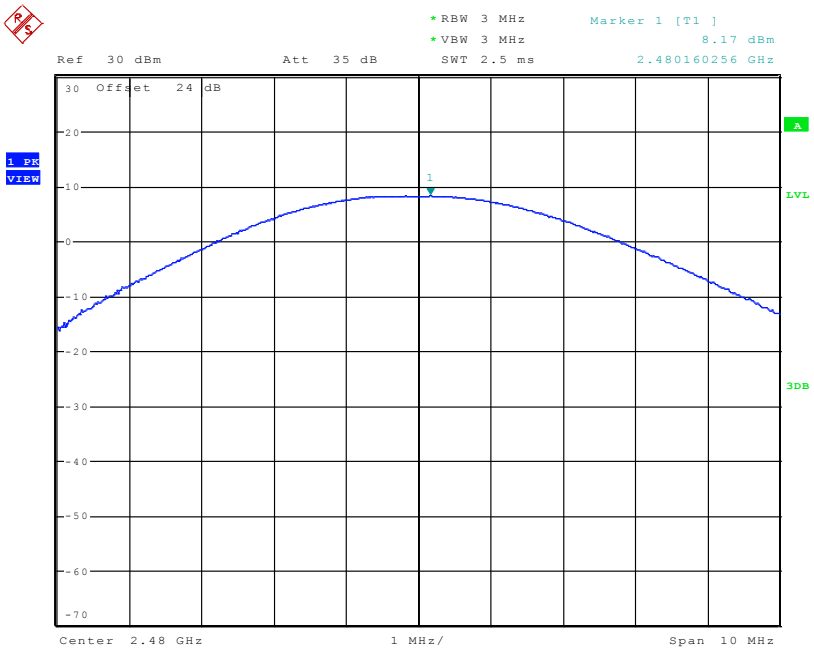
Conducted Peak Power BT 4.0 2480 MHz



6.5 Restricted Band Edge Compliance

6.5.1 Limits: §15.247/15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

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.

6.5.2 Measurement Procedure:

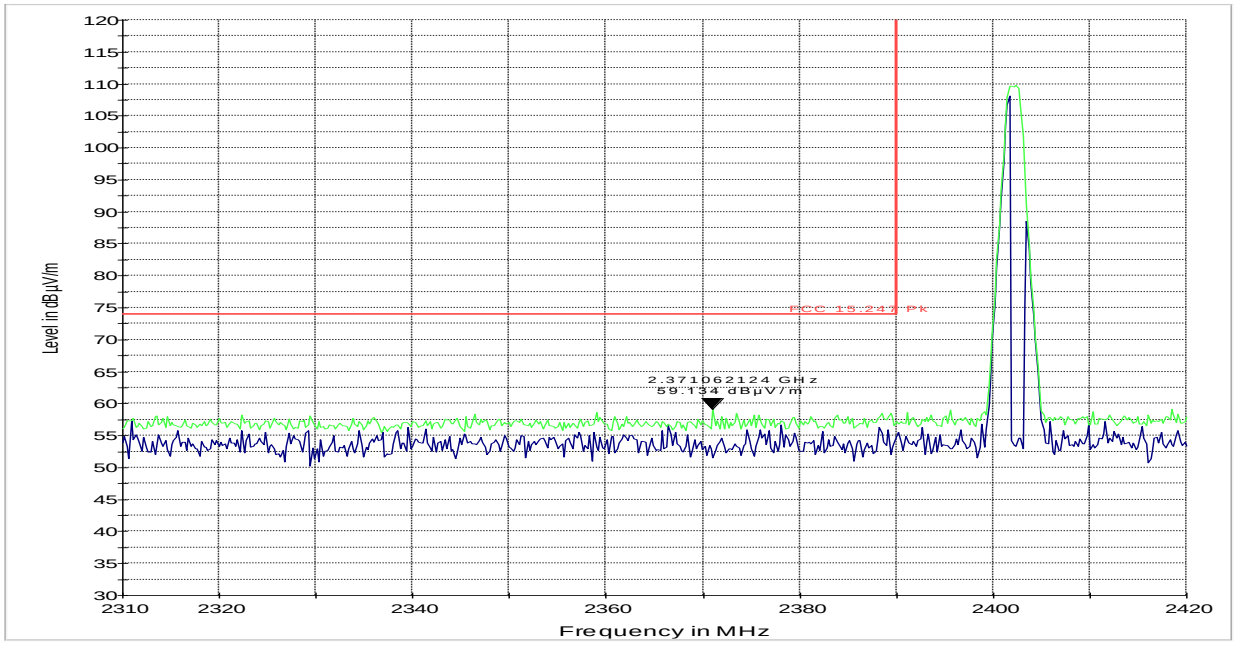
Peak measurements are made using a peak detector and RBW=1MHz.
Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.
*PEAK LIMIT= 74dBµV/m
*AVG. LIMIT= 54dBµV/m
Measurement Uncertainty: ±3.0dB

6.5.2.1 Measurement Result

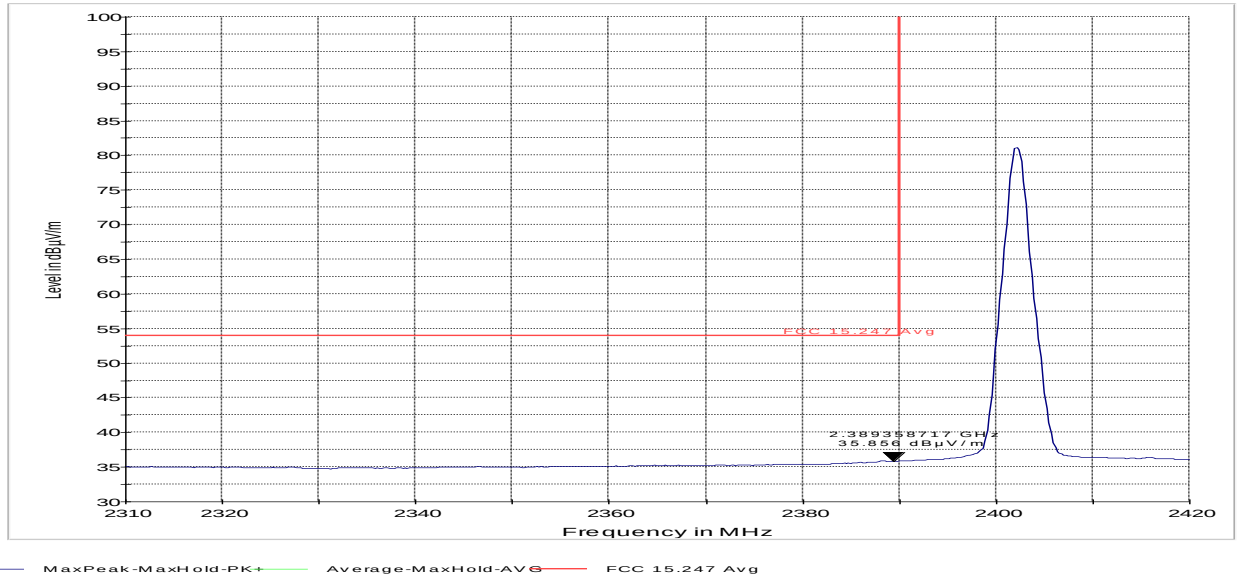
Pass.

6.5.3 Test Data/plots: 2.4 GHz Band

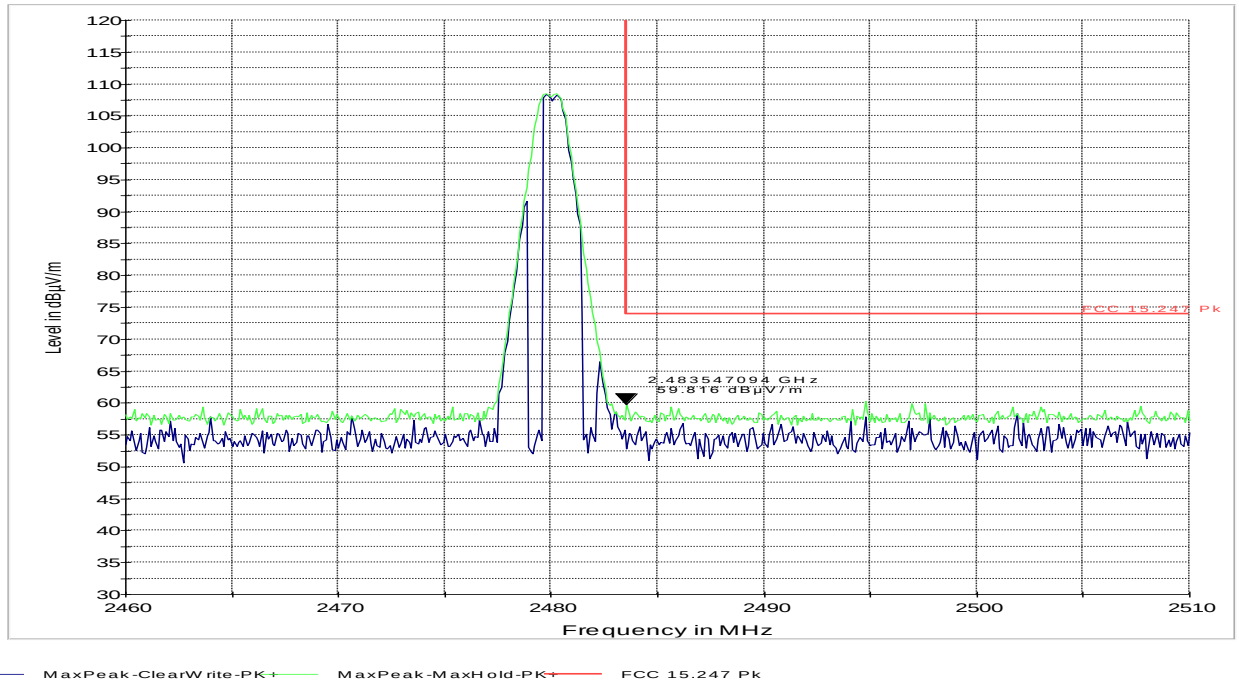
Lower band edge peak BT 4.0 Ch. 0



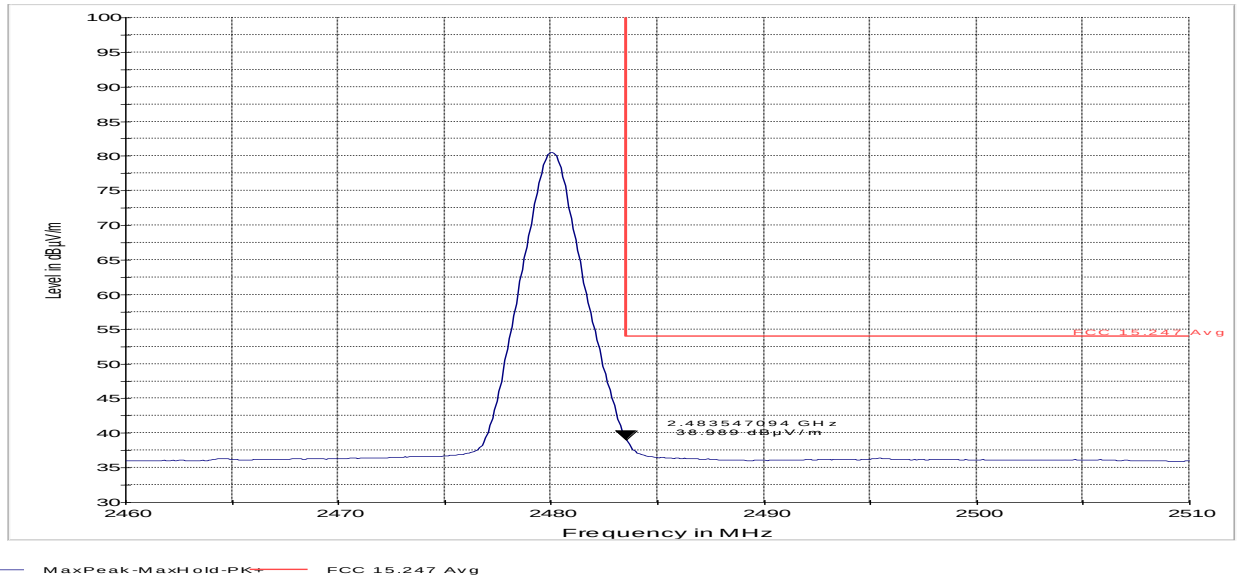
Lower band edge average BT 4.0 Ch. 0



Higher band edge peak BT 4.0 Mode Ch. 39



Higher band edge average BT 4.0 Mode Ch. 39



6.6 Occupied Bandwidth/ 20dB Bandwidth

6.6.1 Limits:

6.6.1.1 §15.247 (a)(2)
6.6.1.2 RSS 210- A8.2(a)
Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.6.2 Test Conditions:

Tnom: 25°C; Vnom: 120 V
Spectrum Analyzer settings:
RBW=20kHz, VBW=50kHz, Detector: Peak- Max hold;
Sweep Time: Auto
Span=5MHz

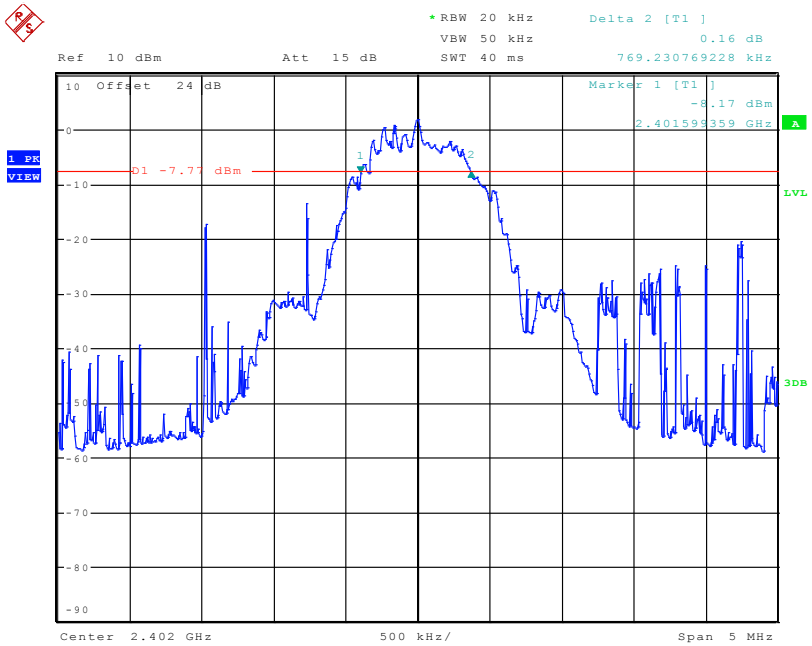
6.6.3 Test Result: 2.4 GHz Band

Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2402 Channel 1		2440 Channel 6		2480 Channel 11	
	6dB	20dB/ 99%	6dB	20dB/ 99%	6dB	20dB/ 99%
BT 4.0	0.769	1.0577	0.657	1.0417	0.5929	1.0417
Measurement Uncertainty: ±100 kHz						

6.6.3.1 Measurement Result
Pass.

6.6.4 Test Data/plots: 2.4 GHz Band

6dB Bandwidth BT 4.0 Mode 2402 MHz



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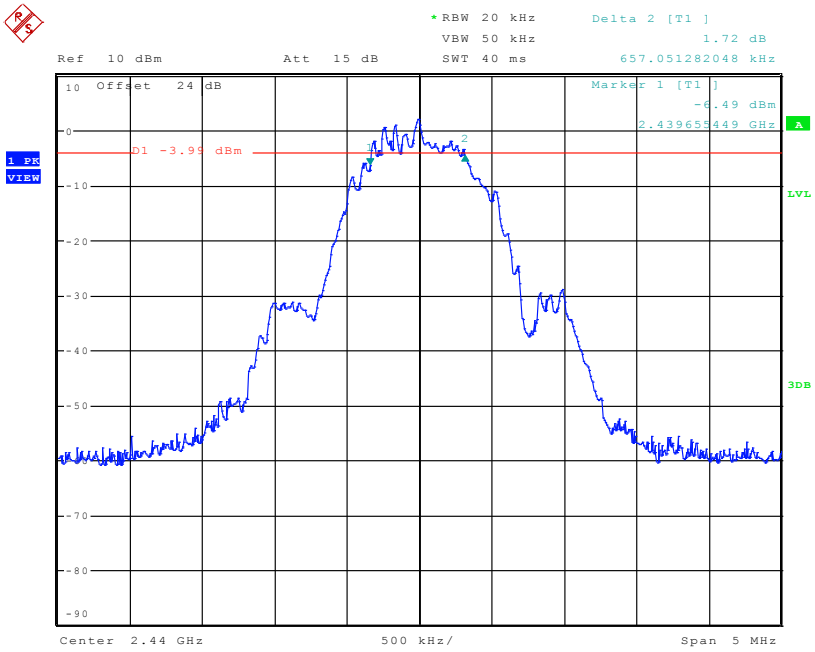
6dB Bandwidth BT 4.0 Mode 2440 MHz



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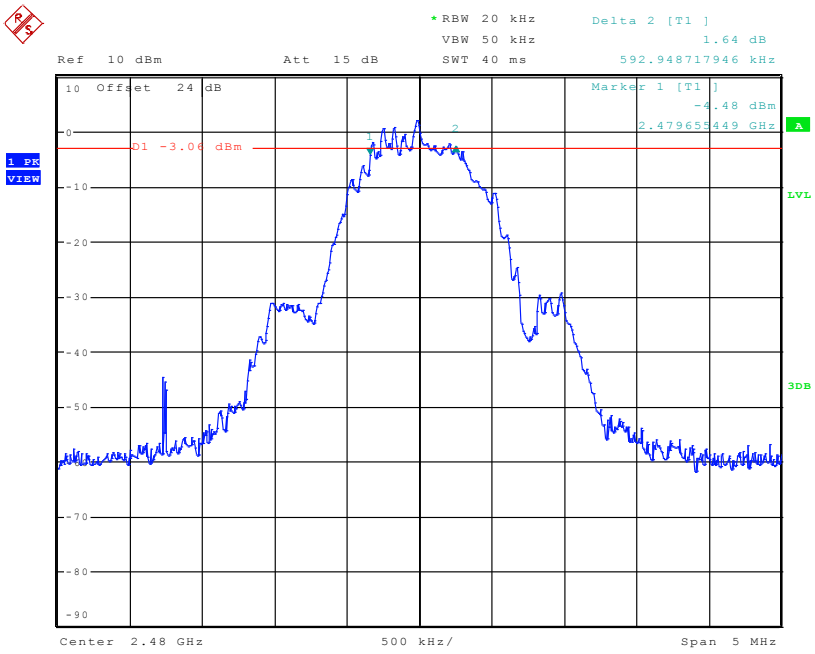
6dB Bandwidth BT 4.0 Mode 2480 MHz



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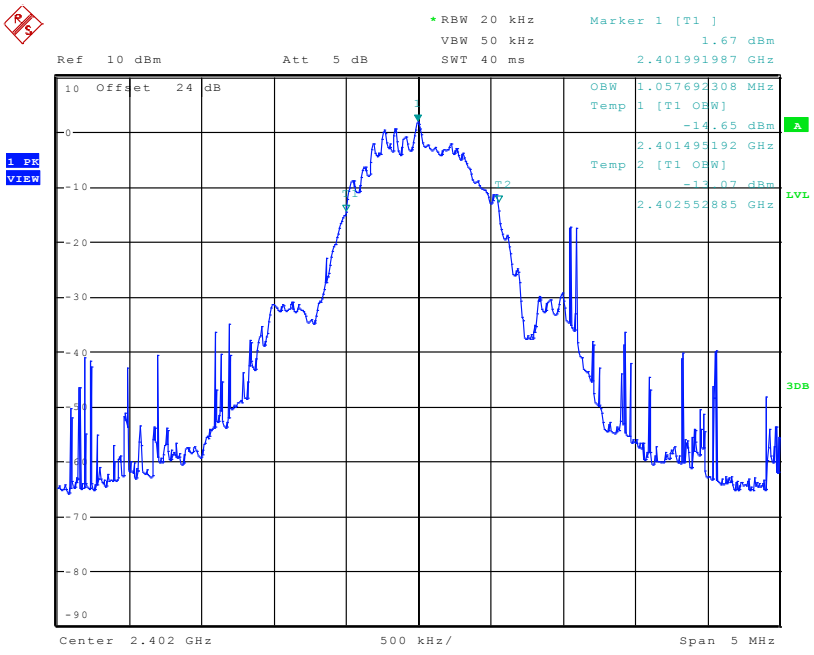
20dB Bandwidth BT 4.0 Mode 2402 MHz



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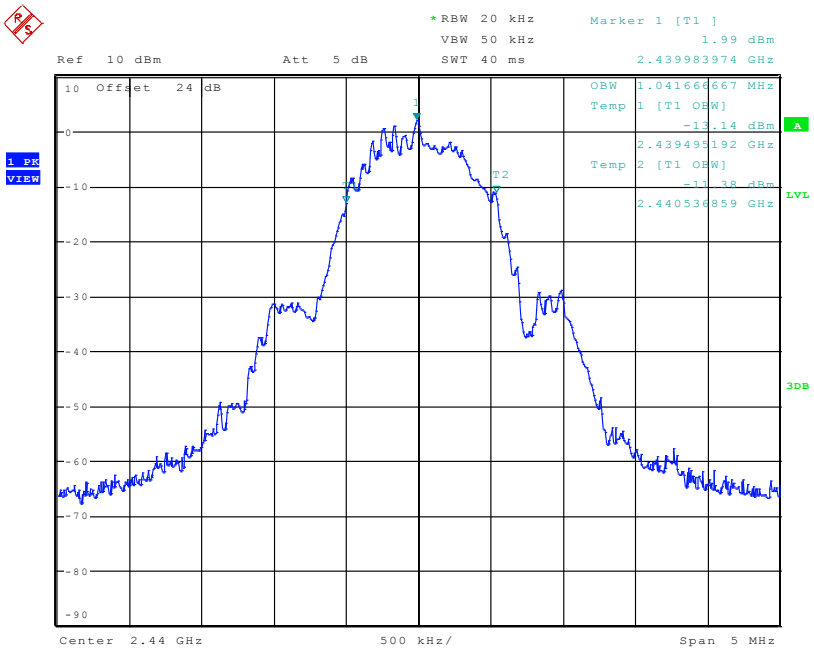

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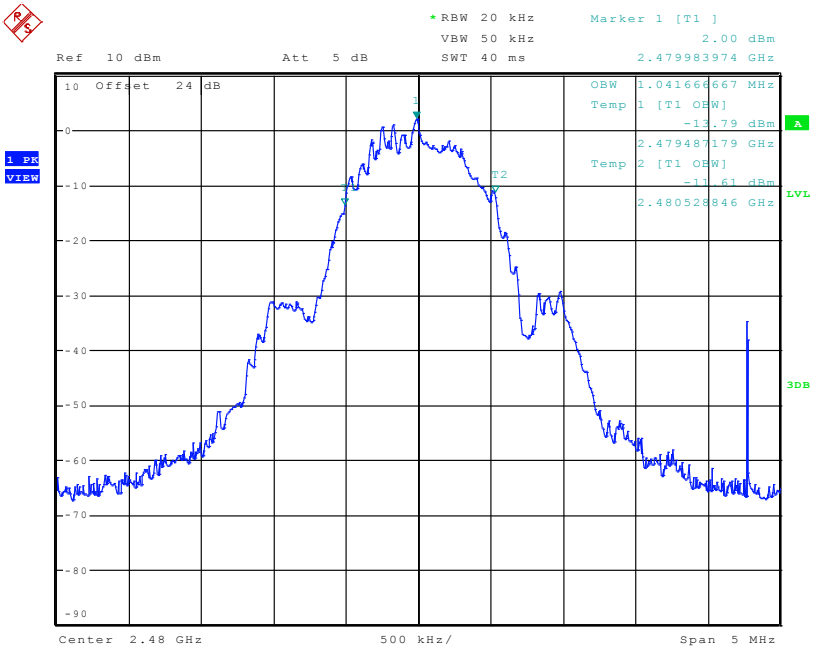
20dB Bandwidth BT 4.0 Mode 2480 MHz



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6.7 Power Spectral Density

6.7.1 Limits:

6.7.1.1 § 15.247 (e)

6.7.1.2 RSS 210- A8.2(b)

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

6.7.2 Measurement procedure:

1. Determine the highest peak level for a sweep with RBW=VBW=100kHz and span =10MHz.
2. Set the peak level at the center of the screen and sweep again for a span of 5MHz.
3. Repeat step 2 with a span of 1MHz.
4. Set the peak level at the center of the screen and sweep with RBW=3kHz, VBW=10kHz, Span=300kHz and sweep time of 100sec.
5. Allow two sweeps to complete to determine the highest level as the PSD.

6.7.3 Test results: 2.4 GHz

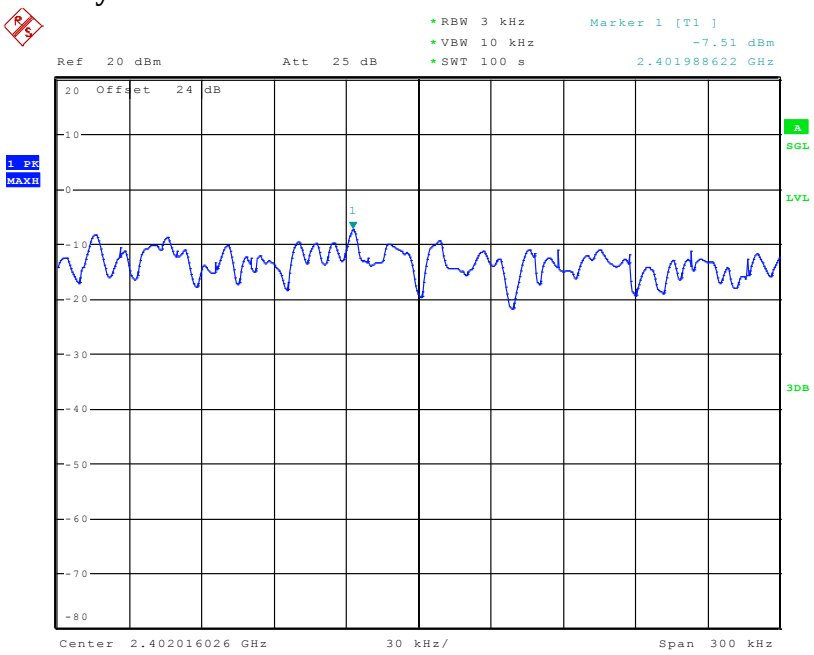
Conducted Power Spectral Density (dBm)			
Mode	**Frequency (MHz)**		
	2402 Channel 1	**2440 Channel 6**	**2480 Channel 11**
BT 4.0	-7.51	-7.11	-7.31

6.7.3.1 Measurement Result

Pass.

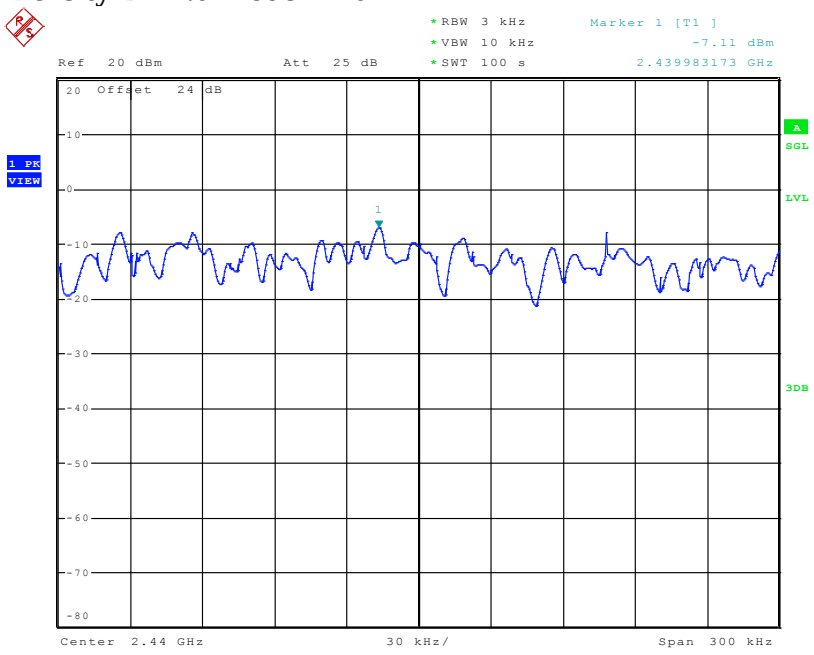
6.7.4 Test Data/plots: 2.4 GHz Band

Power Spectral Density BT 4.0 Mode 2402 MHz



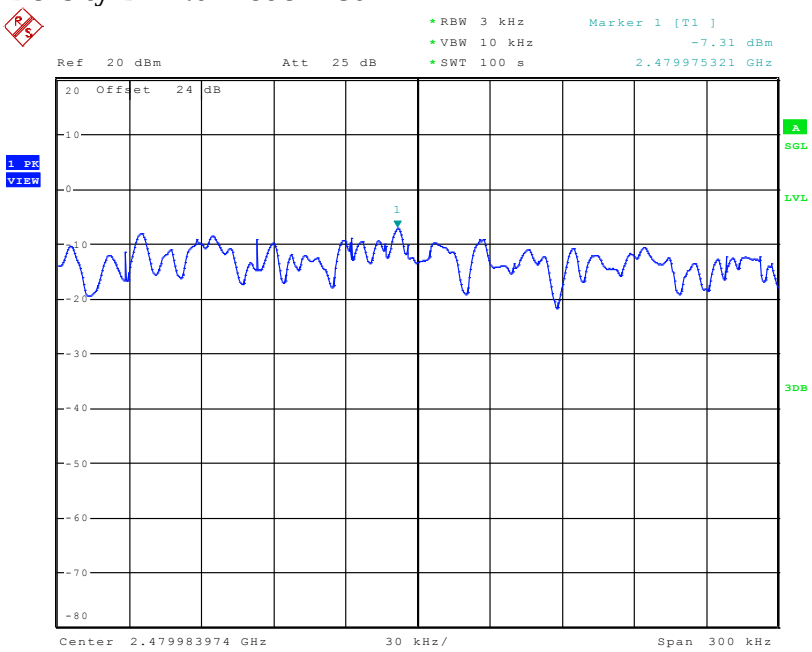
Date: 24.JAN.2012 10:17:09

Power Spectral Density BT 4.0 Mode 2440 MHz



Date: 24.JAN.2012 10:25:48

Power Spectral Density BT 4.0 Mode 2480 MHz



Date: 24.JAN.2012 10:28:40

6.8 Transmitter Spurious Emissions- Conducted § 15.247 (c)

6.8.1 Reference and Limits:

6.8.1.1 § 15.247 (d)
6.8.1.2 RSS 210-A8.5
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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.
30dBm for the transmitter.
-20dBc in the frequency range 30MHz- 25GHz.

6.8.2 Test Conditions:

Spectrum Analyzer settings:
RBW=100kHz, VBW=300kHz, Detector: Peak- Max hold;
Sweep Time: Auto
Span=Full range

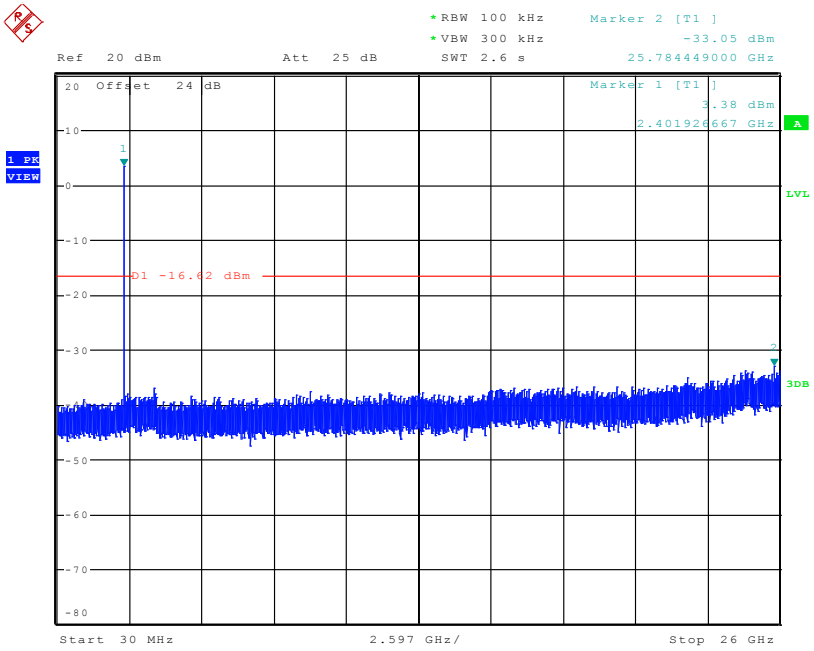
6.8.3 Test data/ plots: 2.4 GHz Band

Conducted Spurious Emissions			
Channel	**Frequency (MHz)**	**Amplitude (dBm)**	**Limits**
		BT 4.0 Mode	
Low	**2402**	3.38	30dBm
	Spurious	All other peaks >20dB below limit	-20dBc
Mid	**2440**	4.51	30 dBm
	Spurious	All other peaks >20dB below limit	-20dBc
High	**2480**	3.97	30 dBm
	Spurious	All other peaks >20dB below limit	-20dBc

6.8.3.1 Measurement Result
Pass.

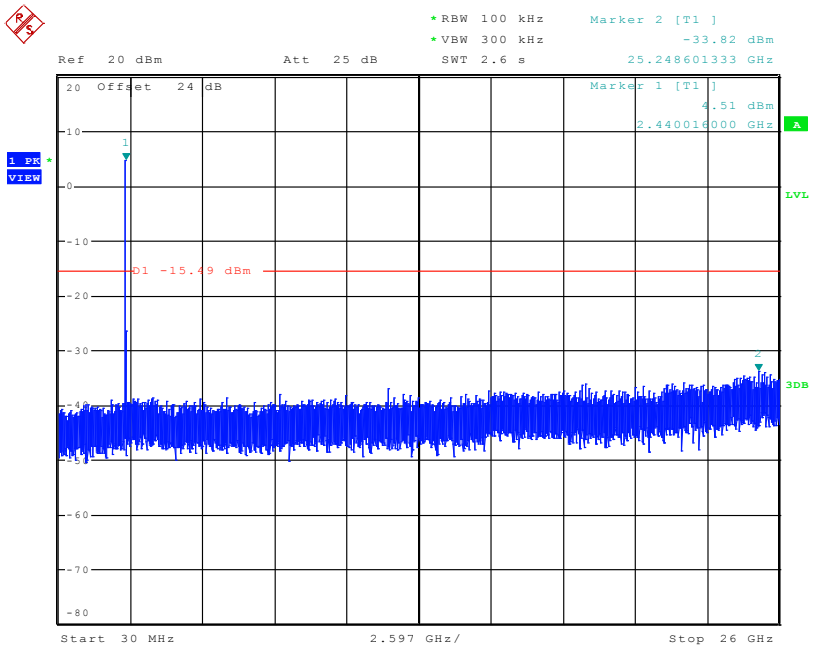
6.8.4 Test data/ plots: 2.4 GHz Band

Conducted Spurious Emission BT 4.0 Mode 2402 MHz



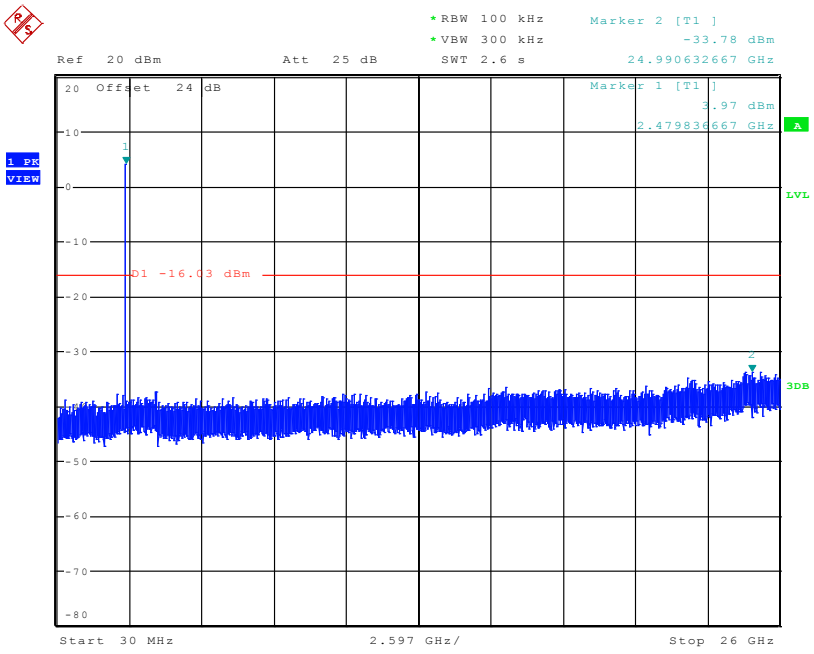
Date: 24.JAN.2012 10:42:44

Conducted Spurious Emission BT 4.0 Mode 2440 MHz



Date: 24.JAN.2012 10:43:42

Conducted Spurious Emission BT 4.0 Mode 2480 MHz



Date: 24.JAN.2012 10:41:44

6.9 Transmitter Spurious Emissions- Radiated

6.9.1 Limits:

§15.247/15.205
RSS 210-A8.5

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

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 Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB.

*PEAK LIMIT= 74dBµV/m
*AVG. LIMIT= 54dBµV/m

Table 1:

Frequency of emission (MHz)	Field strength (µV/m)
30–88	100 (40dBµV/m)
88–216	150 (43.5 dBµV/m)
216–960	200 (46 dBµV/m)
Above 960	500 (54 dBµV/m)

Table 2:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30

6.9.2 Test Result:

Test mode: *Modulation:* 802.11n- since highest conducted power and additionally 802.11b.
Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.
Plots reported here represent the worse case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.
Measurement Uncertainty: ±3.0dB

6.9.2.1 Measurement Result

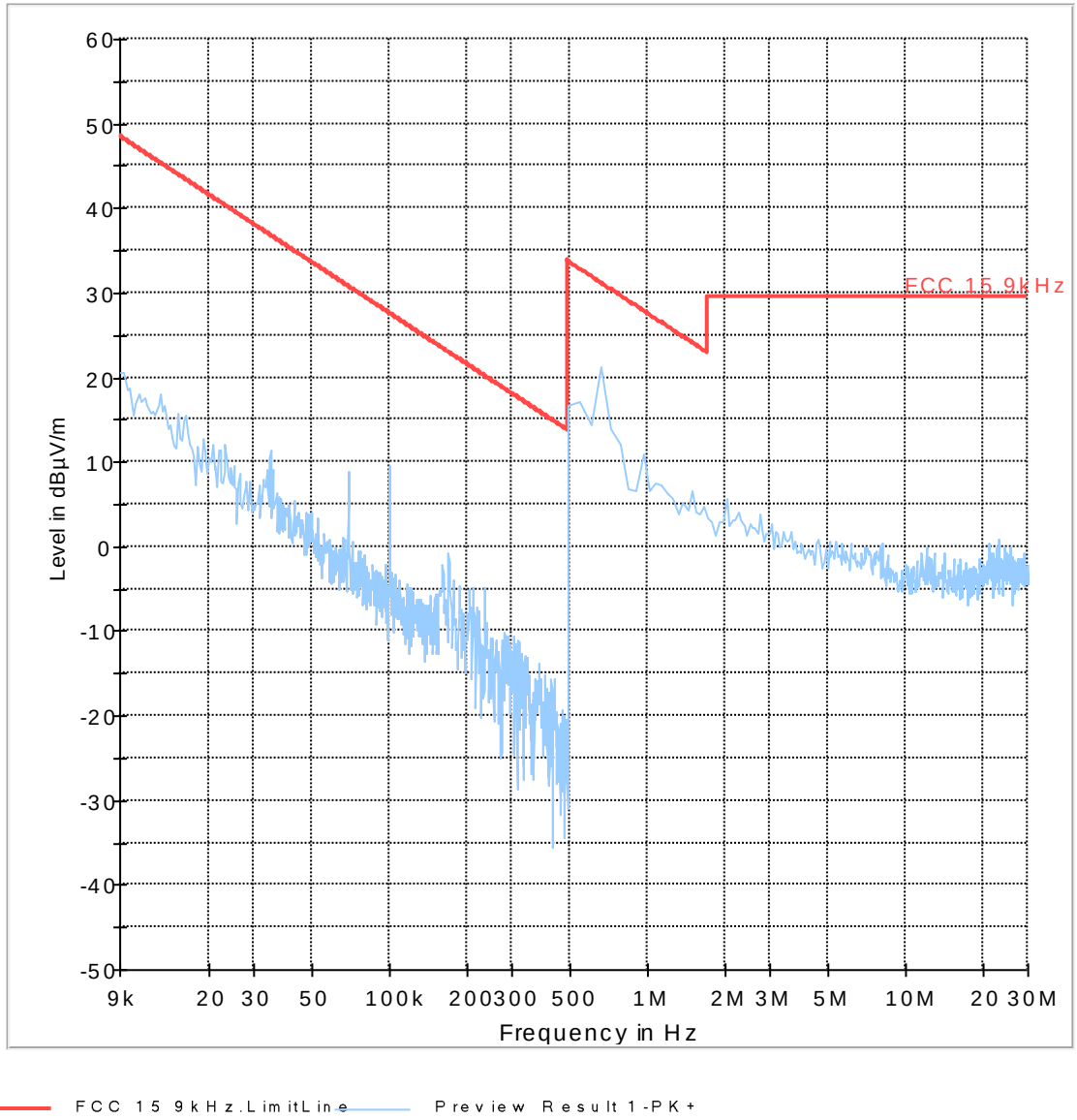
Pass.

6.9.3 Test data/ plots: 2.4 GHz Band

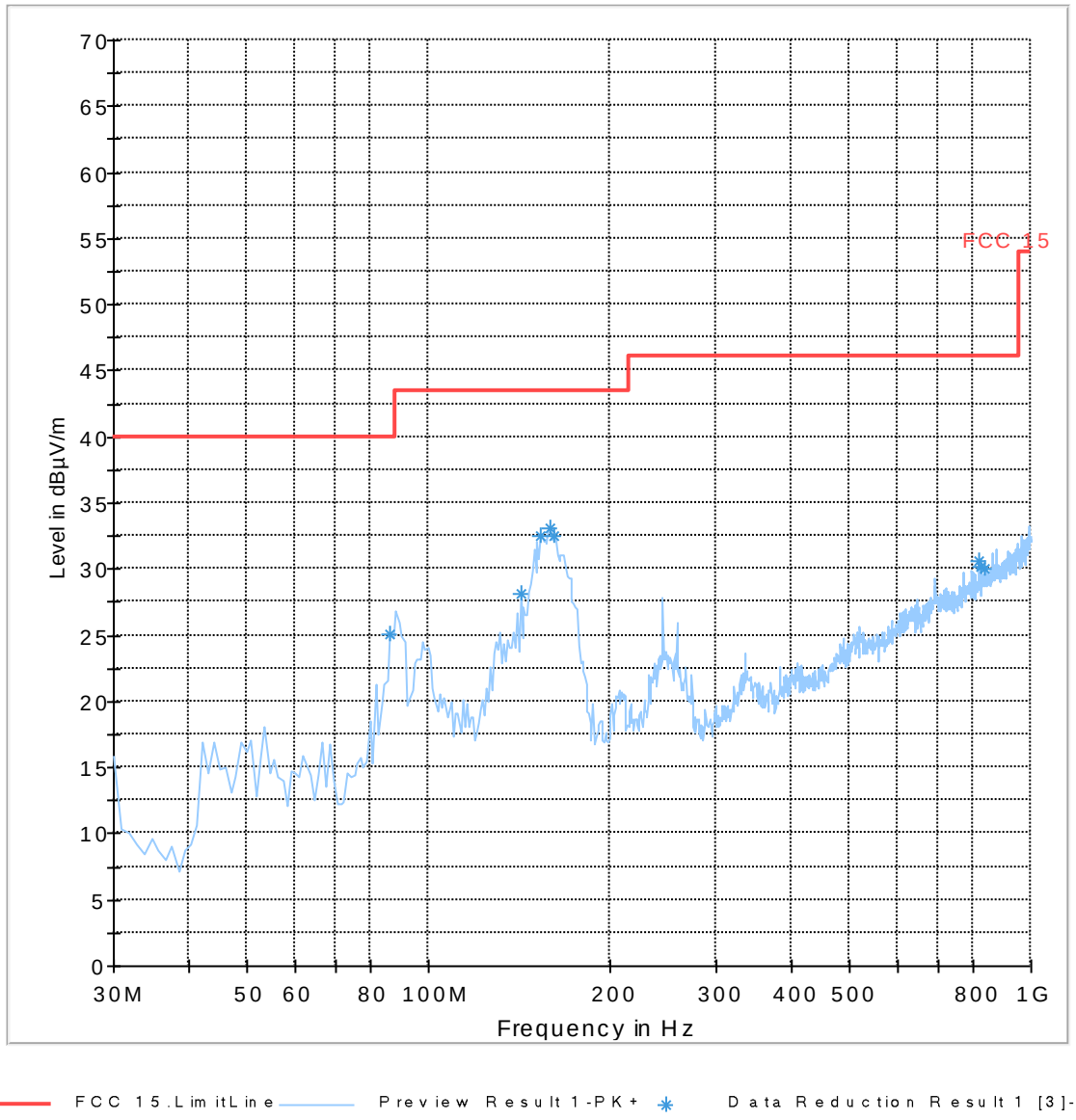
Transmitter Radiated Spurious Emission:<30MHz

Note: Worst case representation for all modes of operation in this frequency range-Limits adjusted for 3m measurement.

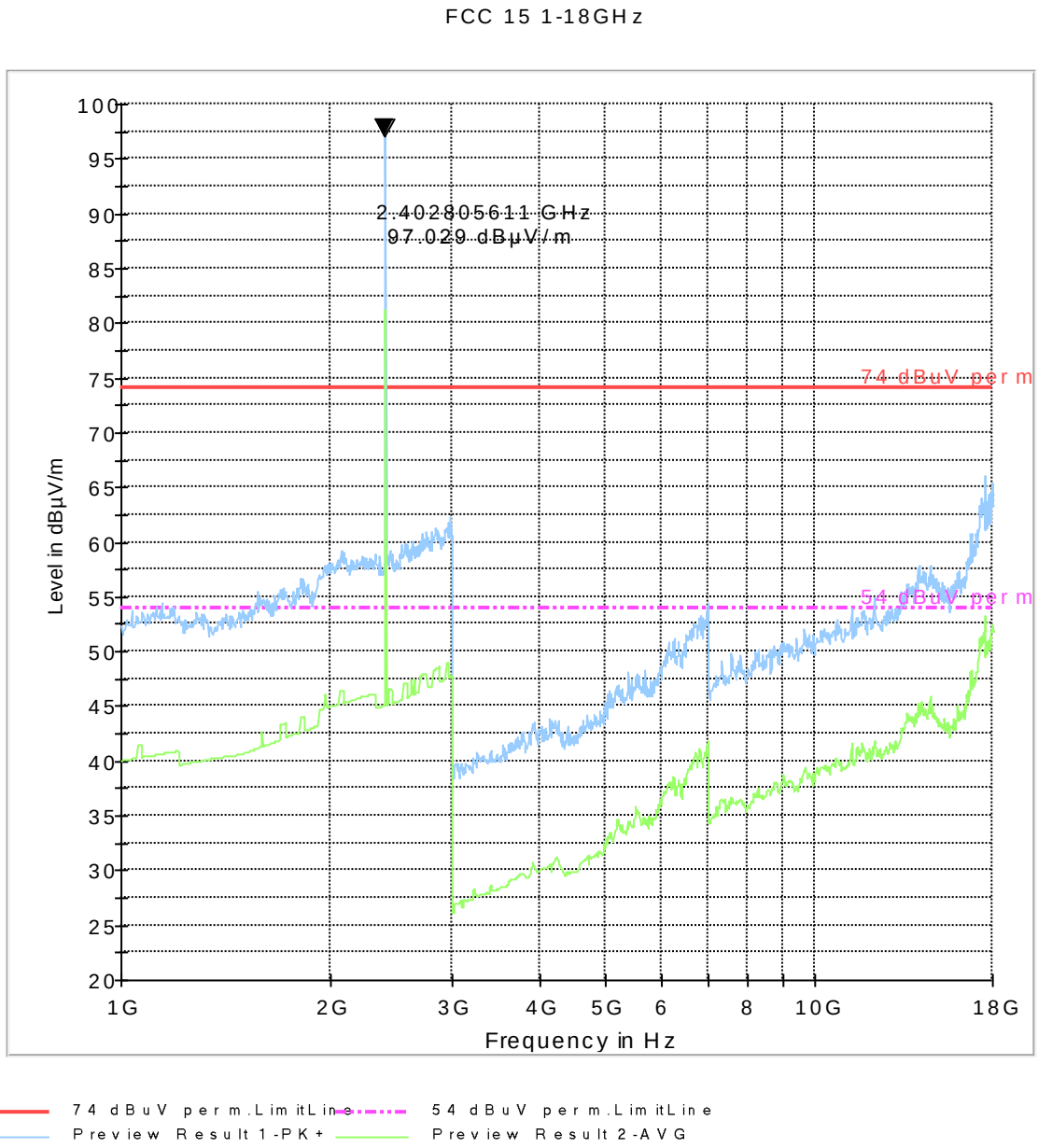
Transmitter Spurious Emission – 9k-30MHz - 802.11b - 2440MHz



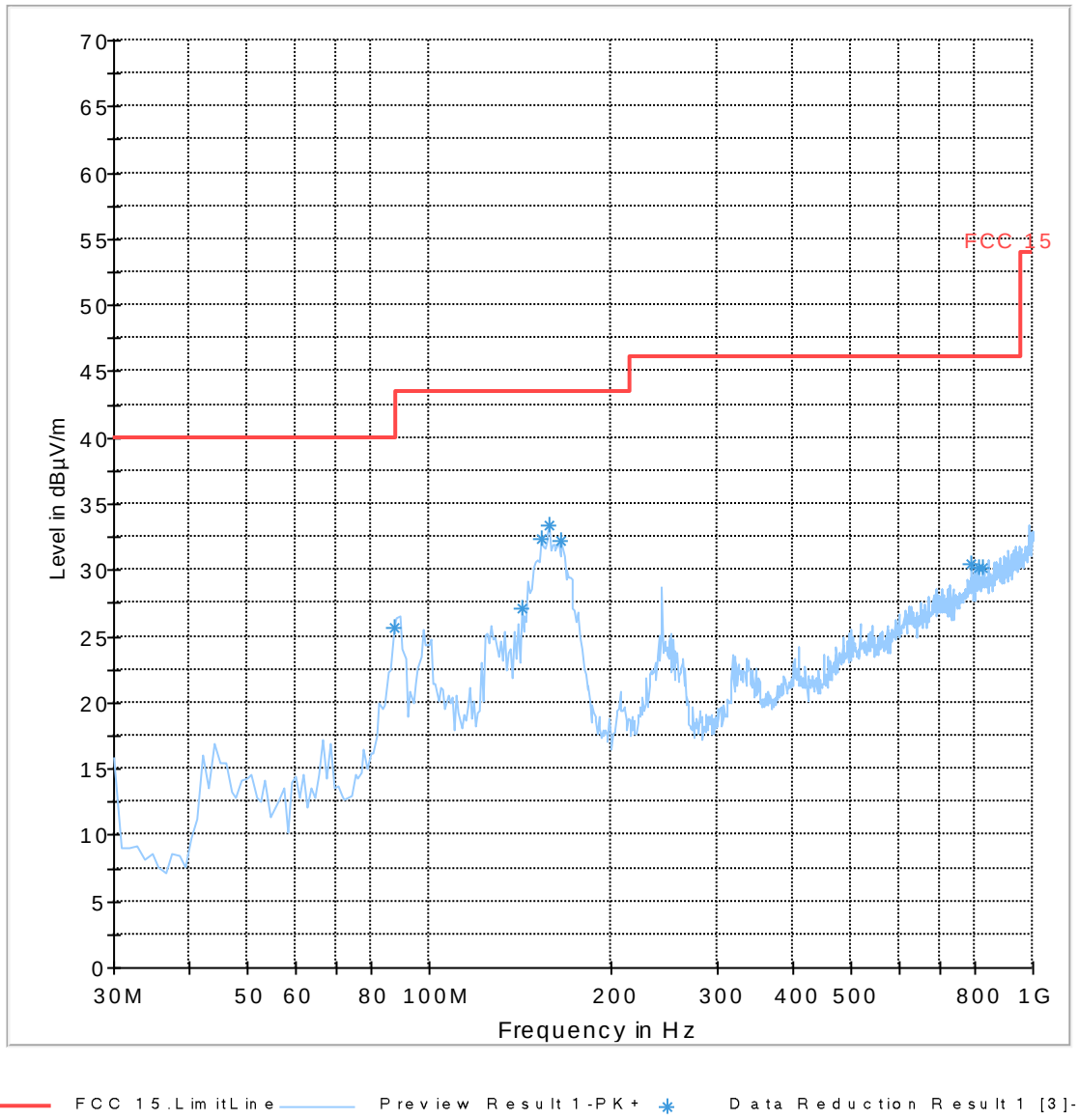
Transmitter Radiated Spurious Emission - 30M-1GHz – BT 4.0 Mode – 2402MHz



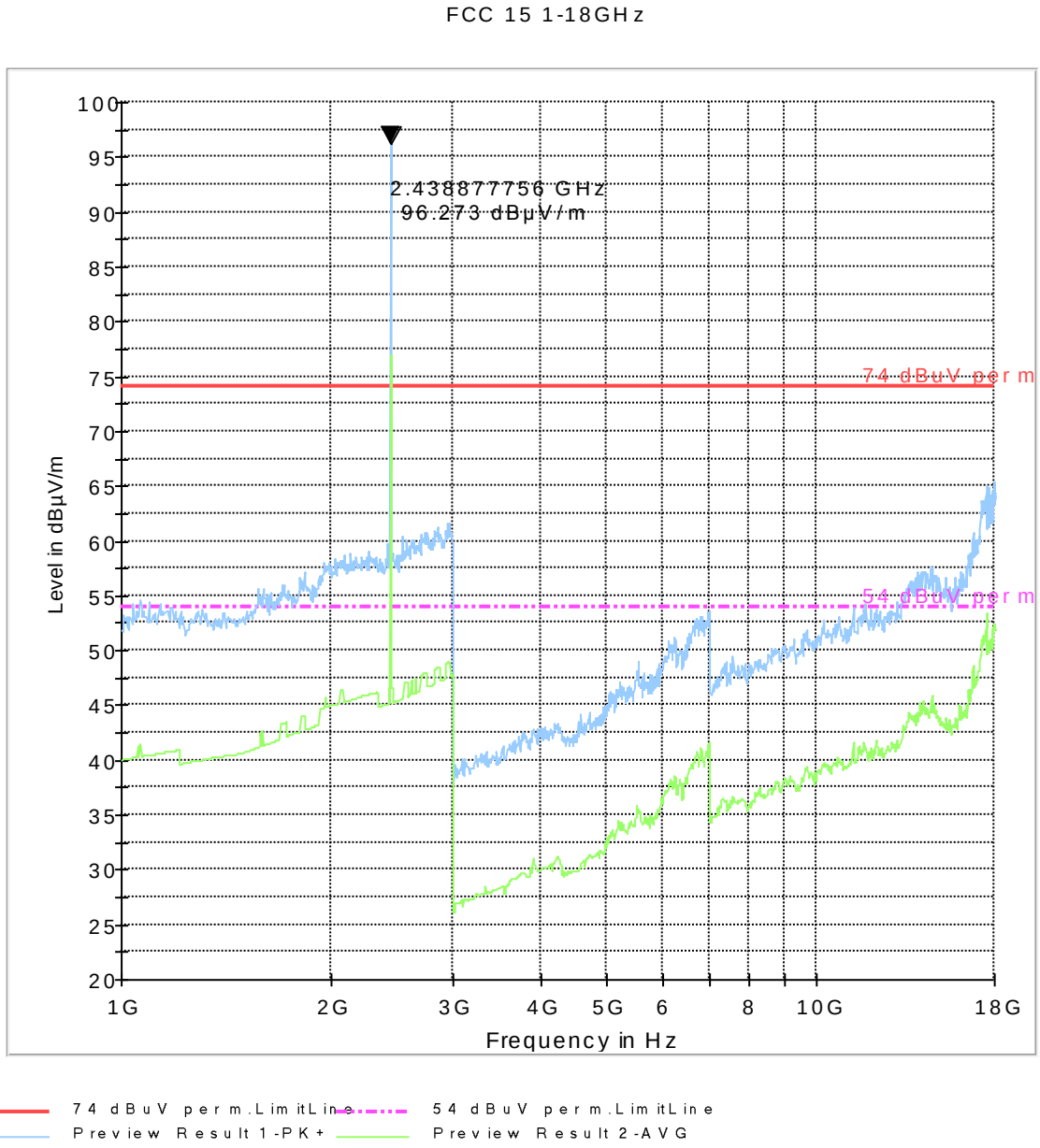
Transmitter Radiated Spurious Emission - 1G-18GHz – BT 4.0 Mode - 2402MHz



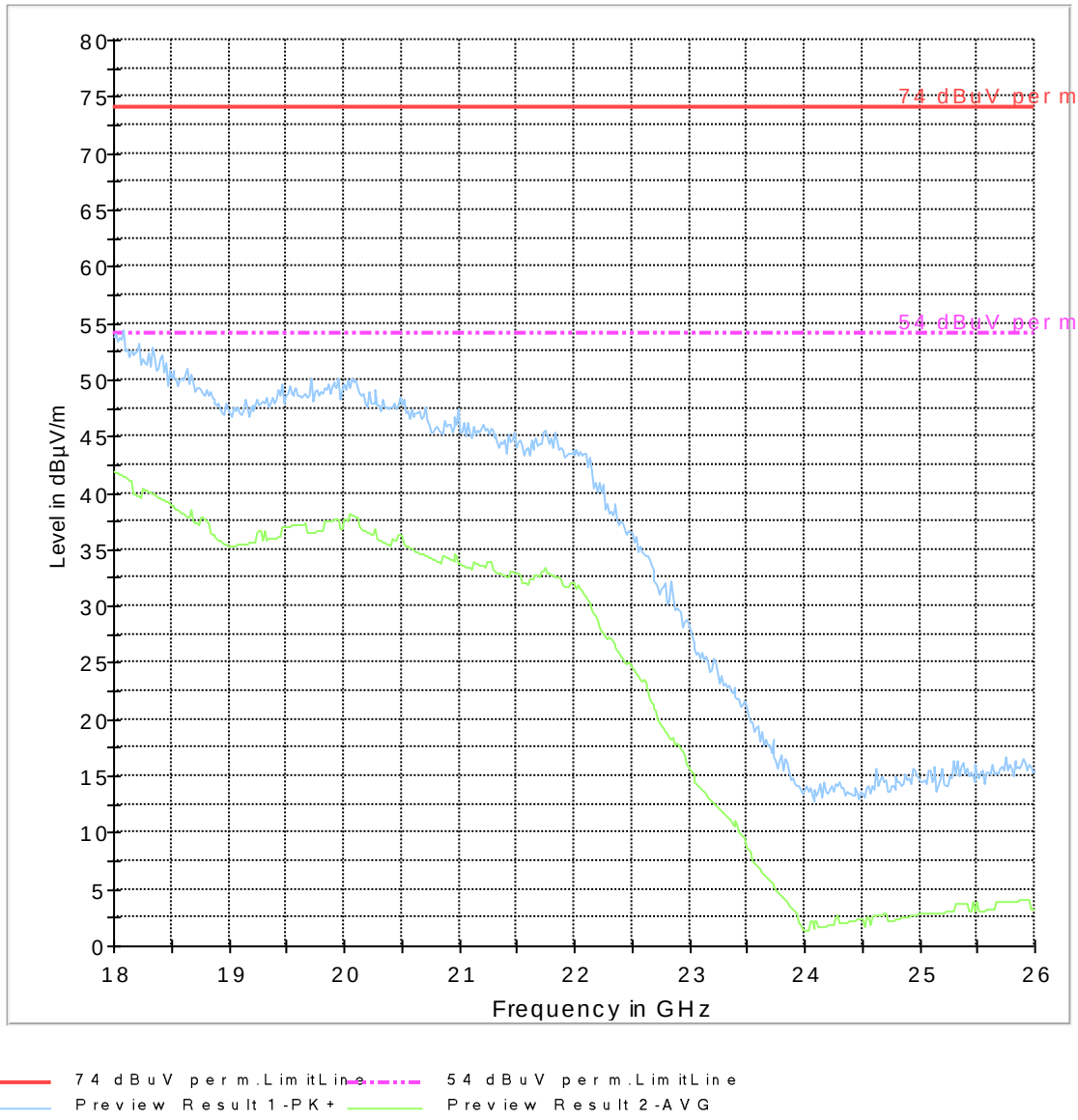
Transmitter Radiated Spurious Emission - 30M-1GHz – BT 4.0 Mode - 2440MHz



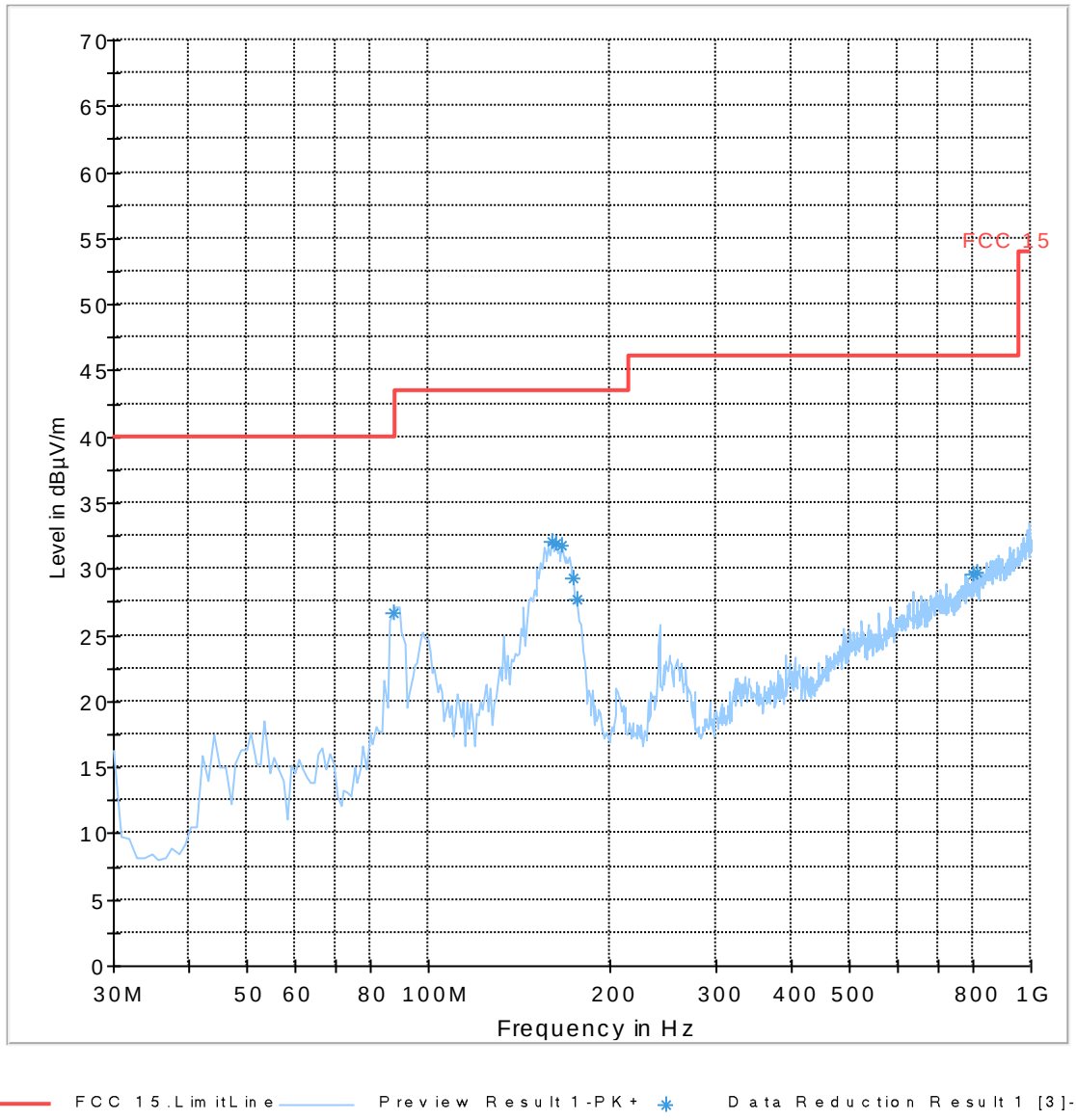
Transmitter Radiated Spurious Emission - 1G-18GHz – BT 4.0 Mode - 2440MHz
The Peak in the plot is the BT TCH signal



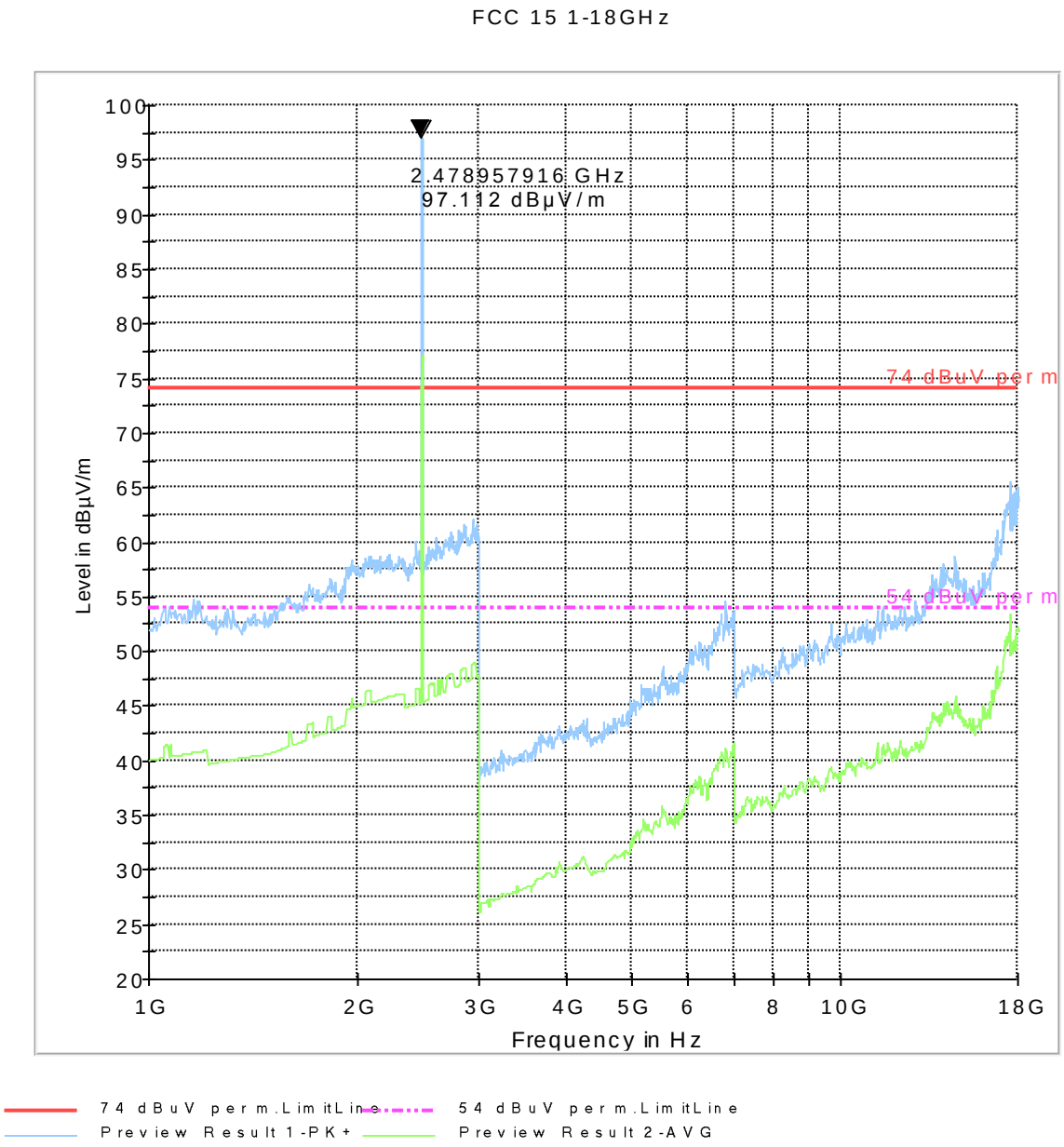
Transmitter Radiated Spurious Emission - 18G-26GHz – BT 4.0 Mode - 2440MHz
Worst case representation in this frequency range for all modes.



Transmitter Radiated Spurious Emission - 30M-1GHz – BT 4.0 Mode - 2480MHz



Transmitter Radiated Spurious Emission - 1G-18GHz – BT 4.0 Mode - 2480MHz
The Peak in the plot is the BT TCH signal



Receiver

6.10 AC Power Line Conducted Emissions

6.10.1 References:

FCC: CFR Part 15.207
IC: RSS-Gen Section 7.2.2
The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

6.10.2 Limits:

6.10.2.1 §15.207 Conducted limits- Intentional Radiators:

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

6.10.2.2 RSS-Gen 7.2.2

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown below. The tighter limit applies at the frequency range boundaries.

Table 1:

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

Analyzer Settings: CISPR Bandwidth- 9KHz.

6.10.3 Test Conditions:

Modulation: 802.11b- Transmit and Receive modes of operation
Measurement Uncertainty: ±3.0dB

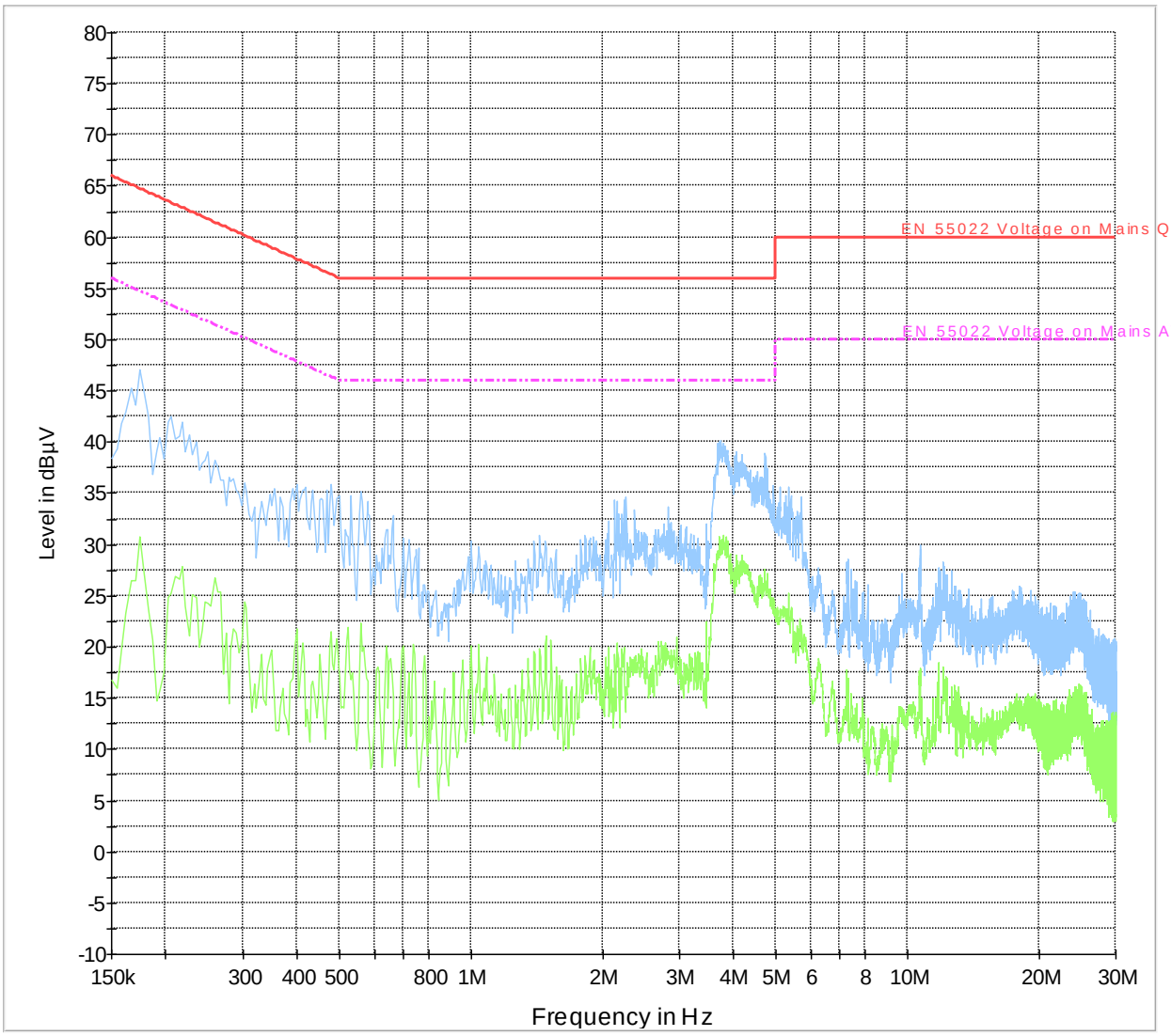
6.10.4 Results

Plots shown here represent the combined worse case emissions for power lines, phases and neutral line.

6.10.4.1 Measurement Result

Pass.

6.10.5 Test Results:
BT 4.0 TX Mode – 2.4GHz Band – 2440MHz

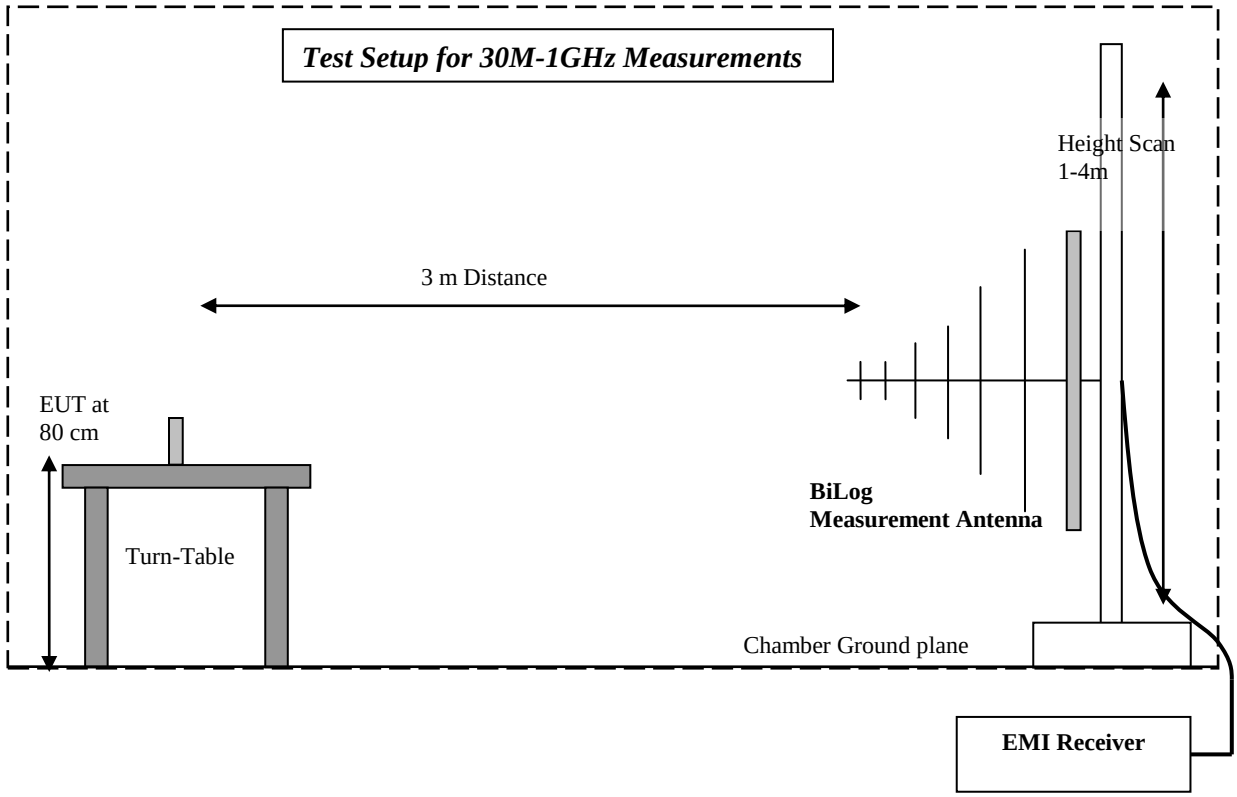


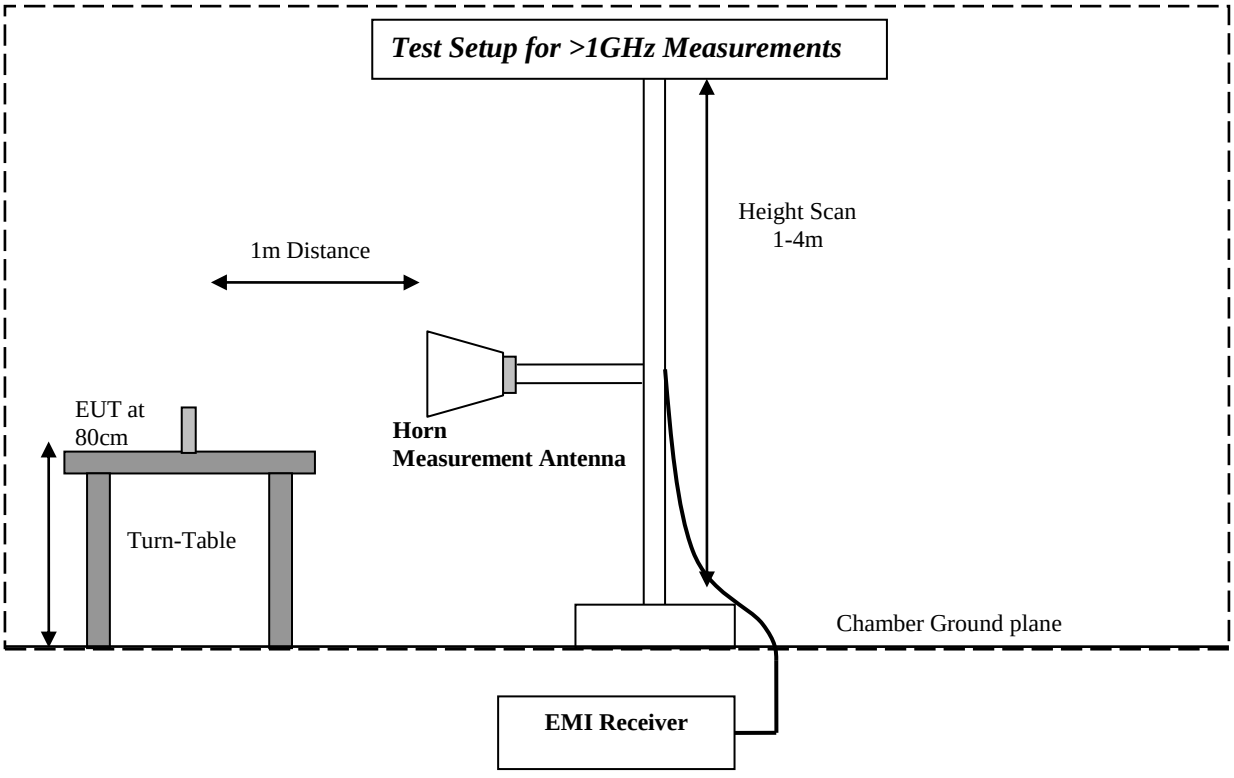
7 Test Equipment and Ancillaries used for tests

Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2011	1 year
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	May 2011	1 year
Loop Antenna	6512	EMCO	00049838	Oct 2011	3 years
Biconilog Antenna	3141	EMCO	0005-1186	June 2009	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Jan 2009	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Oct 2011	3 years
High Pass Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
High Pass Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
6GHz High Pass Filter	HPM50106	Microtronics	001	Part of system calibration	
Pre-Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
LISN	50-25-2-08	FCC	08014	June 2011	1 year
Power Smart Sensor	R&S	NRP-Z81	100161	May 2011	1 Year
DC Power Supply	E3610A	Hewlett Packard	KR83021224	n/a	n/a
Multimeter	MM200	Klein	N/A	Apr 2011	1 Year
Temp Hum Logger	TM320	Dickson	03280063	Feb 2011	1 Year

Note: Testing on this EUT performed while the equipment calibration status was still valid.

8 Block Diagrams





9 Revision History

Date	Report Name	Changes to report	Report prepared by
1/31/2012	EMC_APPLE_089_11001_15.247BT_DTS	First Version	Calvin Lee
2/10/2012	EMC_APPLE_089_11001_15.247BT_DTS_Rev1	Removed Receiver test data from pages 40-43, 46.	Calvin Lee