FCC/IC Test Report

FOR:

Manufacturer: Harman International

Model Number: CMC VP4
Product Description: Automotive Infotainment Unit

FCC ID: QNG-BE2804
IC ID: 6434C-BE2804

47 CFR Part 15.247 for DTS Systems

IC RSS-210 Issue 8

TEST REPORT #: EMC_HARMA-027-12001_DTS
DATE: 2013-02-08

FCC: Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.
Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecomusa.com ◆ http://www.cetecom.com
CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

1 Assessment

The following equipment (and as identified in Ch.3 of this test report) was evaluated against the applicable criteria specified in FCC CFR47 Part 15.247, 15.207, 15.209 and Industry Canada Standards RSS 210 Issue 8
No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Harman International	Automotive Infotainment Unit	CMC VP4

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2013-02-08	Compliance	Sajay Jose (EMC Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2013-02-08	Compliance	Calvin Lee (EMC Project Engineer)	Digitally signed by Calvin Lee Date: 2013.02.09 10:07:38 -08'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the 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 Manager:	Sajay Jose
Test Engineer:	Calvin Lee

2.2 Identification of the Client

Client:	Harman International
Street Address:	26500 Haggerty Road
City/Zip Code	Farmington Hills, MI 48331
Country	USA
Contact Person:	Shain E. Chmura
Phone No.	+1 (248) 592-3157
e-mail:	schmura@harman.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

Model Number:	CMC VP4
FCC-ID / IC-ID:	QNG-BE2804 / 6434C-BE2804
HW Version:	PV
Product Description:	Automotive Infotainment Unit
Frequency Band of Operation:	ISM: 2400 – 2483.5 MHz
Frequency Range of Test:	2412 MHz- 2462 MHz
No. of Channels:	11
Type(s) of Modulation:	802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g: OFDM (64QMA, 16QAM, QPSK, BPSK)
Antenna info:	Fakra style external antenna Manufacturer stated Max. Antenna Gain: 2 dBi
Max Output Powers:	Conducted (Measured): 802.11b: 18.6 dBm(0.0724 W): 802.11g: 19.6 dBm(0.0912 W); EIRP (Calculated): 802.11b:20.6 dBm(0.1148 W) 802.11g: 21.6 dBm(0.1445 W)
Other Radios in the device:	Bluetooth: 2402 – 2480 MHz
Rated Operating Voltage Range:	9-16 VDC
Rated Operating Temperature Range:	-40°C to 85°C
Test Sample Status:	Pre-production

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	Notes
1	BE6150J0023040011	PV	Radiated Sample
2	BE6150J0023040037	PV	Conducted Sample for verifying output power.

3.3 Identification of Accessory equipment (not used during test)

STE #	Type	Manufacturer	Model	Serial Number
1	Ethernet-USB Adapter	Cisco	USB200M	CU906M729067
2	Laptop #1	Dell	Latitude D510	DT7570

3.4 Environmental conditions during Test:

The following environmental conditions were maintained during the course of testing:
Ambient Temperature: 20-25^{o}C
Relative humidity: 40-60%

3.5 Dates of Testing:

Nov. 28 & Dec. 6, 2012.

3.6 Test modes of operation:

The test modes of operation, as described below, are based on the max output power for different data rates and modulations, as described in the module certification report.

Mode	Data rate (Mbps)	Modulation scheme
802.11b	1.0	BPSK
802.11g	6.0	BPSK

The device was configured with a manufacturer provided test SW, capable of setting the unit in different supported modulation schemes, data rates and channels of operation.
The EUT was tested on low, mid and high channels in 802.11b, and 802.11g modes.

4 Subject of Investigation

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in

- FCC CFR47 Parts 15.247, 15.207, 15.209
- IC RSS-210 Issue 8

This test report is to support a request for new equipment authorization under the FCC ID **QNG-BE2804** and IC ID **6434C-BE2804**.

CMC VP4 integrates the pre-certified Bluetooth/WLAN module, model: CWN-01/ UWM-WBT from Wistron NeWeb Corporation.

Based on verification that the module's conducted output power is within limits and following guidance from FCC KDB 996369, this test report covers the radiated test portion of the above listed FCC rule parts.

For conducted test results, reference is made to the results from the module's pre-certification and as documented in test report # FR1D0821AA issued by SPORTON International Inc., on Dec. 22, 2011, with FCC ID: NKRUWMWBT-CWM01

5 Summary of Measurement Results

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

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

1. Test only applicable to frequency hopping systems.
2. Band Edge compliance-conducted is not performed as the device passes radiated measurement.
3. Tests labeled "NP" re-used from module test report.

6 Measurements

6.1 Measurement Method:

All radiated and conducted testing is performed according to guidelines in FCC publication KDB558074 D01Meas Guidance v02: Measurement Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247, Oct 2012.

6.2 Radiated Measurement Procedure

ANSI C63.4 (2009) 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 beam width, the measurement antenna shall be aligned with the EUT.

ANSI C63.4 (2009) 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 re-maximized 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.

Measurement Uncertainty: ±3dB

6.3 Sample Calculations for Radiated Measurements

6.3.1.1 Field Strength Measurements:

Measurements from the Spectrum Analyzer/ Receiver is used to calculate the Field Strength, taking into account the following parameters:

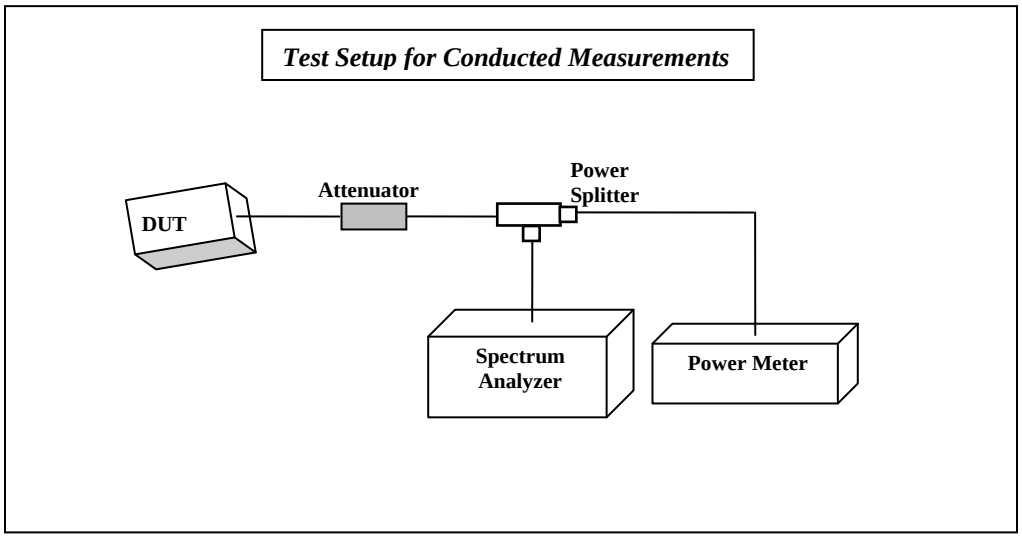
1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

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

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the above equation.

6.4 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. A test SW provided by the manufacturer is used to control the different modulations, data rates and max output power configurations.
3. Measurements are to be performed with the EUT set to the low, middle and high channels for 802.11b and 802.11g modes.
4. Measurement Uncertainty: ±0.5dB

6.5 Maximum Peak Conducted Output Power

6.5.1 Limits:

6.5.1.1 §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.

6.5.1.2 RSS 210- A8.4(2)

Nominal Peak Output Power < 30 dBm (1W)

6.5.2 Test Conditions:

Tnom: 25°C; Vnom: 12 V

6.5.3 Test Procedure:

Measurement according to FCC KDB 558074 D01 DTS Meas Guidance v02, section 8.1.1- Option 2

Spectrum Analyzer settings:

RBW=1MHz, VBW=3MHz, Detector: Peak- Max Hold.
Sweep Time: Auto
Span= 20 MHz (to fully encompass DTS Bandwidth)

6.5.4 Test Result:

Measured Maximum Peak Conducted Output Power (dBm)			
Mode	**Frequency (MHz)**		
	2412 Channel 1	**2437 Channel 6**	**2462 Channel 11**
	Peak	Peak	Peak
802.11b	17.	18.0	18.6
802.11g	18.6	18.9	19.6

Calculated Maximum Peak Radiated Output Power (dBm)			
Mode	**Frequency (MHz)**		
	2412 Channel 1	**2437 Channel 6**	**2462 Channel 11**
802.11b	19.4	20.0	20.6
802.11g	20.6	20.9	21.6

Note: Radiated EIRP= Conducted Peak Power+ Antenna Gain
Max. Antenna gain = 2dBi

6.5.4.1 Measurement Verdict:
Pass.

6.6 Unwanted Emissions into Restricted Frequency Bands- Radiated

6.6.1 Limits:

6.6.1.1 §15.247/15.205
6.6.1.2 RSS 210-A8.5

15.247 (d) Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

15.205 (a) 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			

15.209 (a) Emission Limits:

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	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
30–88	100**	3
88–216	150**	3
216–960	200**	3
Above 960	500	3

6.6.2 Test Conditions:

Tnom: 20°C; Vnom: 12VDC

6.6.3 Test Procedure:

Peak measurements are made using a peak detector and RBW=1MHz.
*PEAK LIMIT= 74dBµV/m

Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.
*AVG. LIMIT= 54dBµV/m

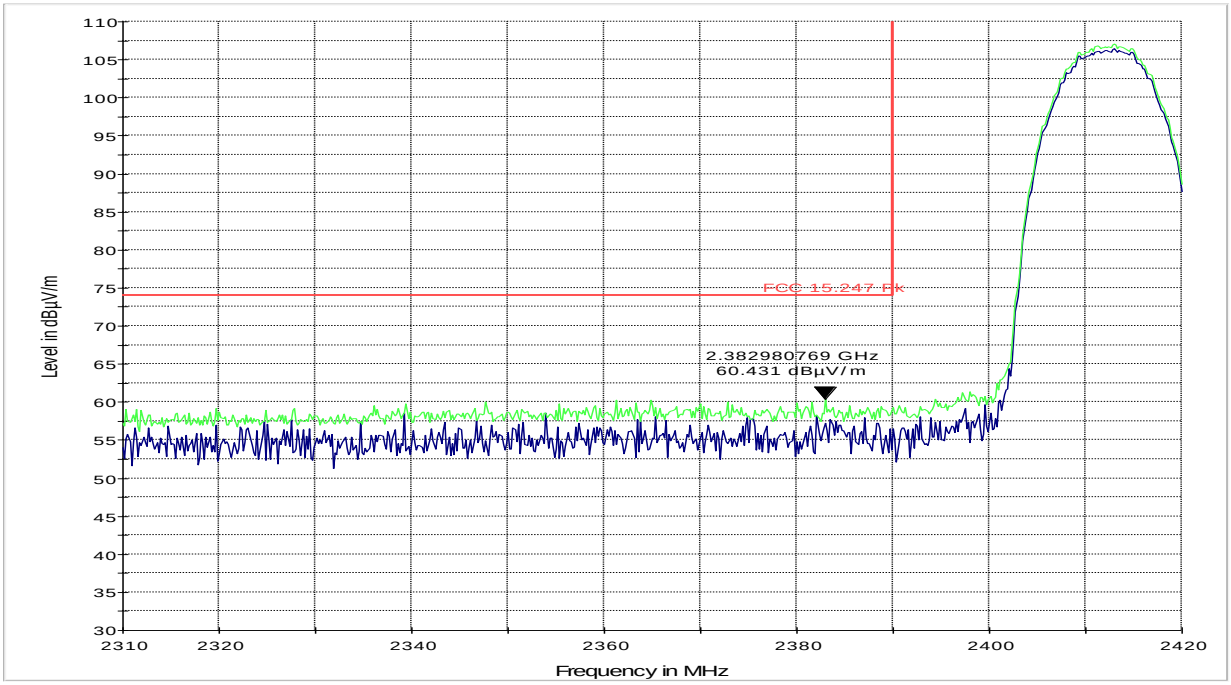
Measurement Uncertainty: ±3.0dB

6.6.3.1 Measurement Verdict:

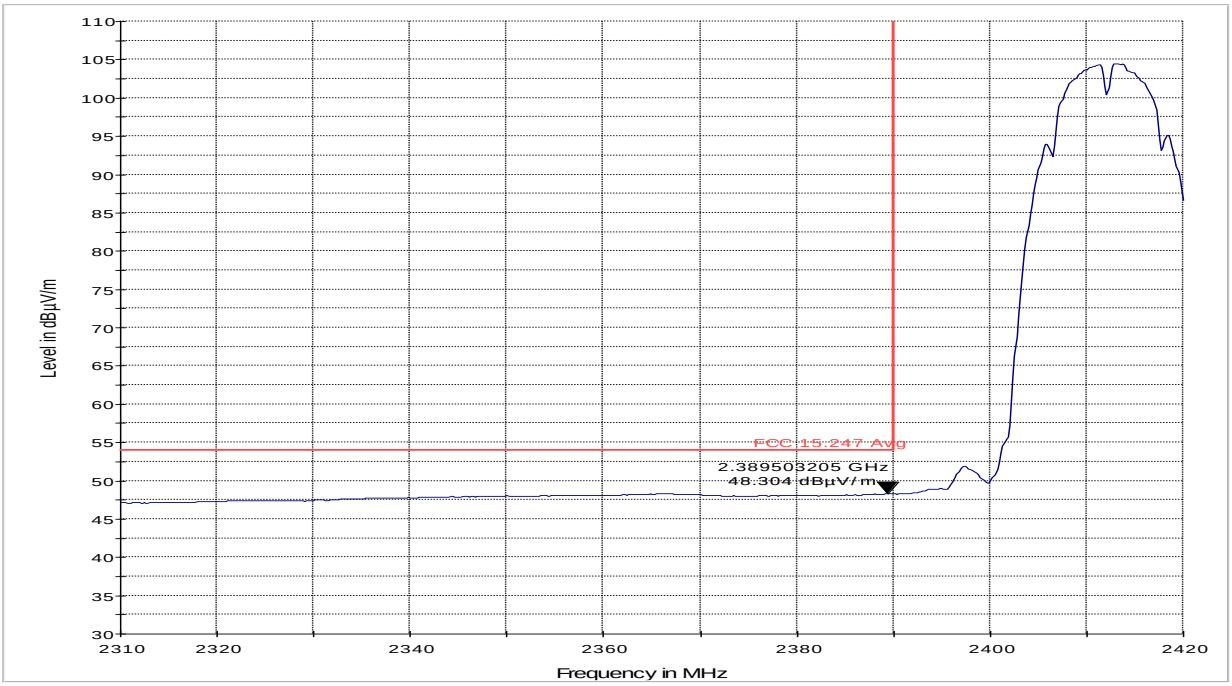
Pass.

6.6.4 Test Data/plots:

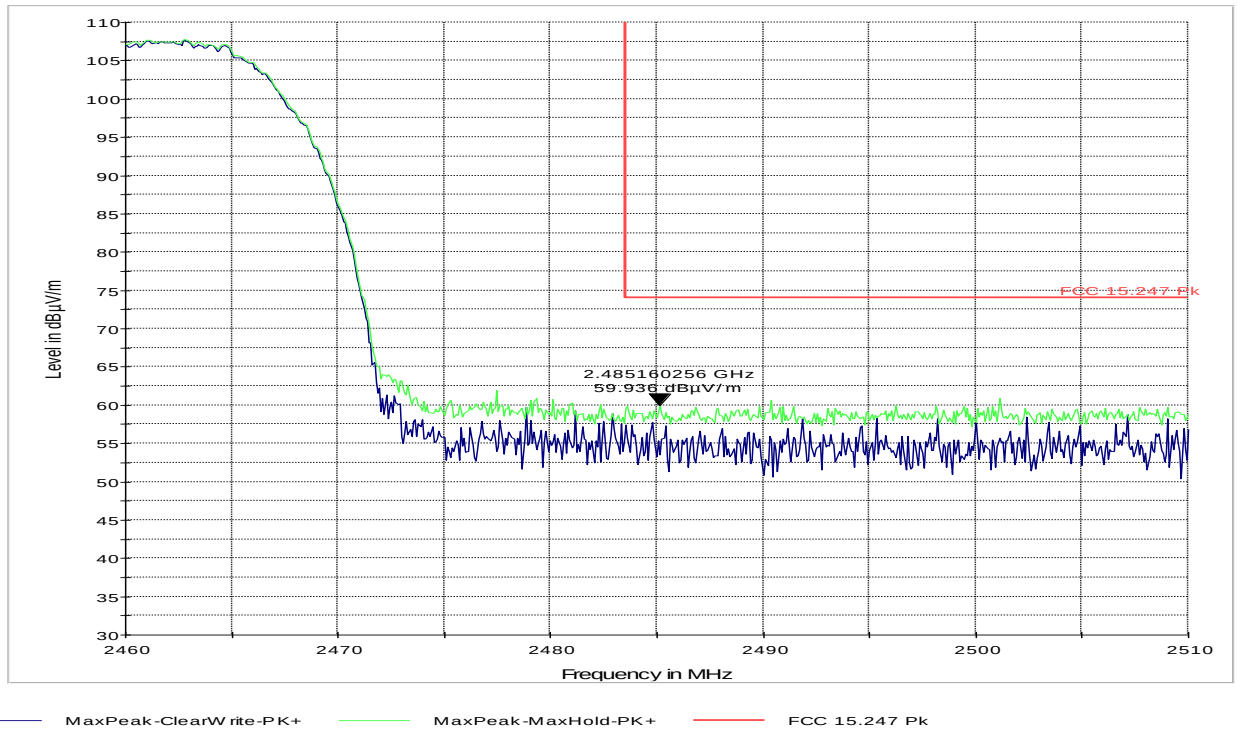
Lower band edge peak -802.11b mode



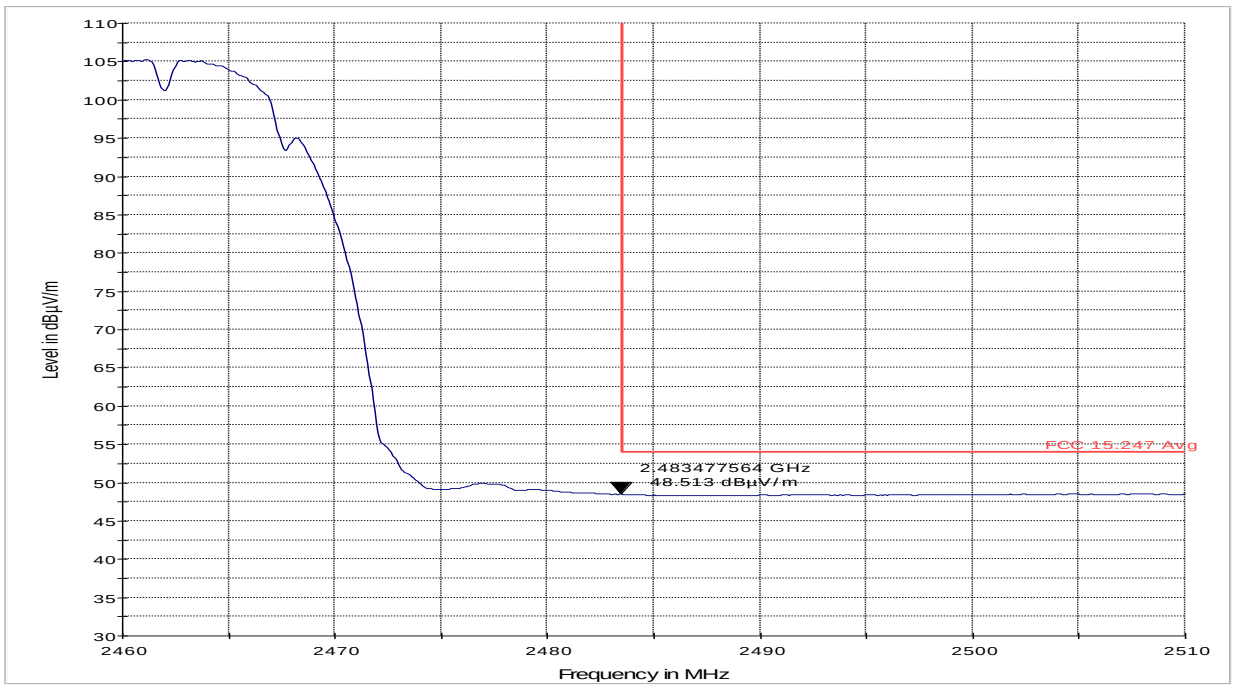
Lower band edge average -802.11b mode



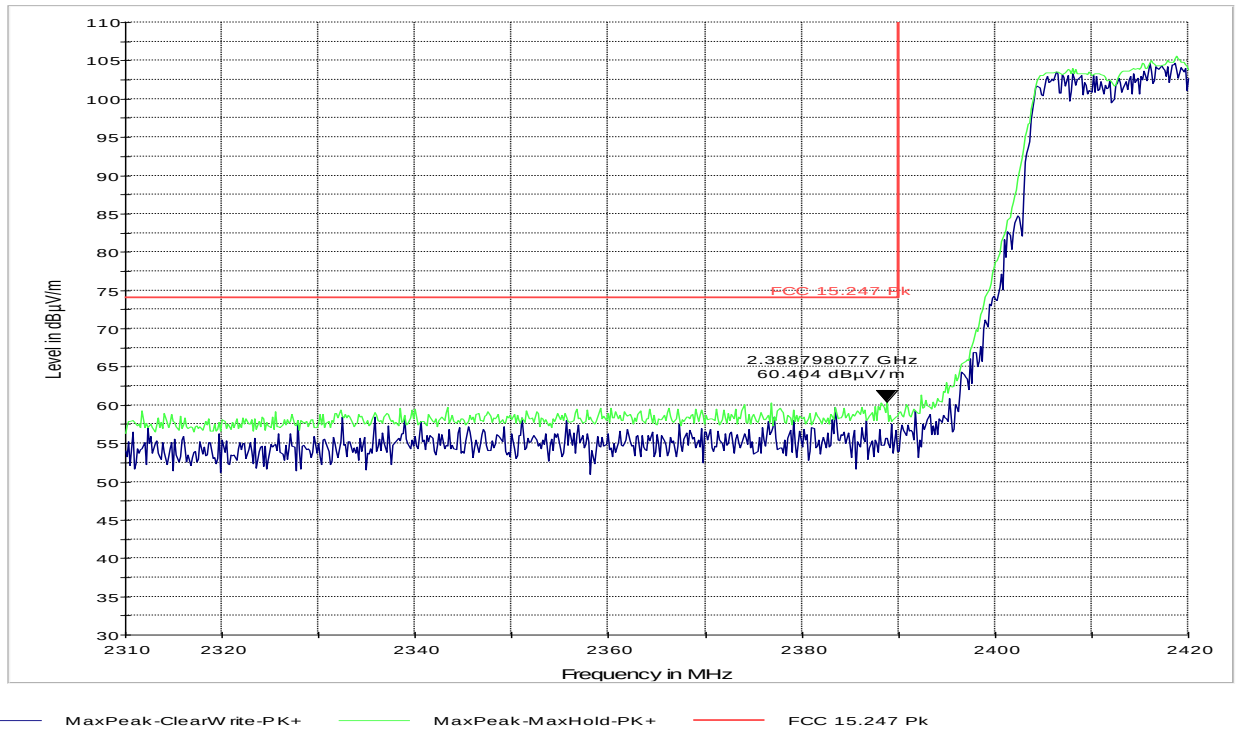
Higher band edge peak -802.11b mode



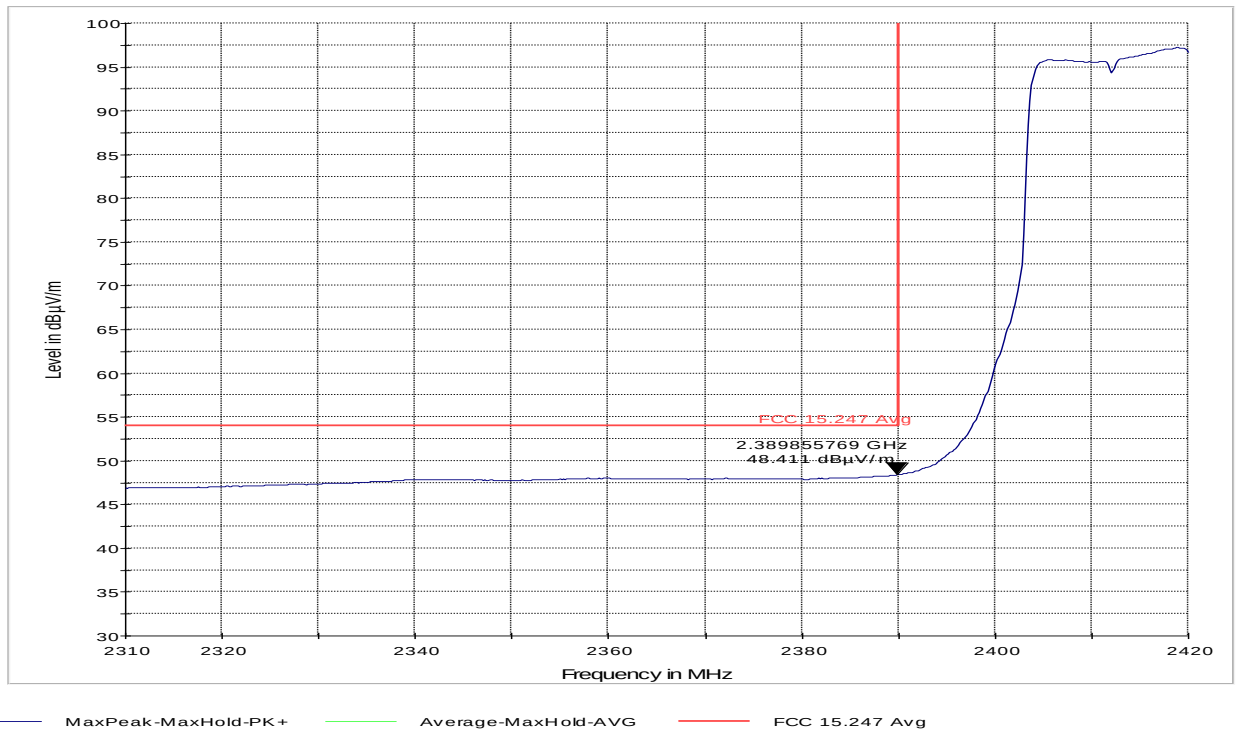
Higher band edge average-802.11b mode



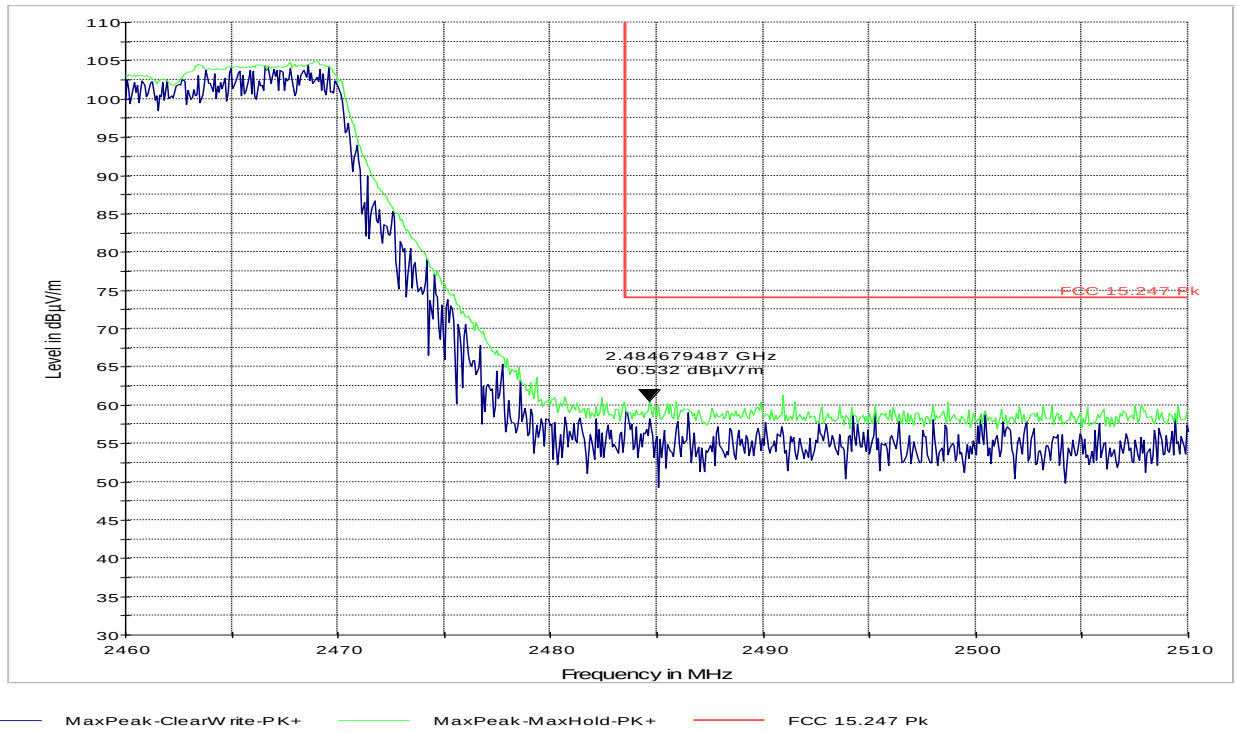
Lower band edge peak – 802.11g mode



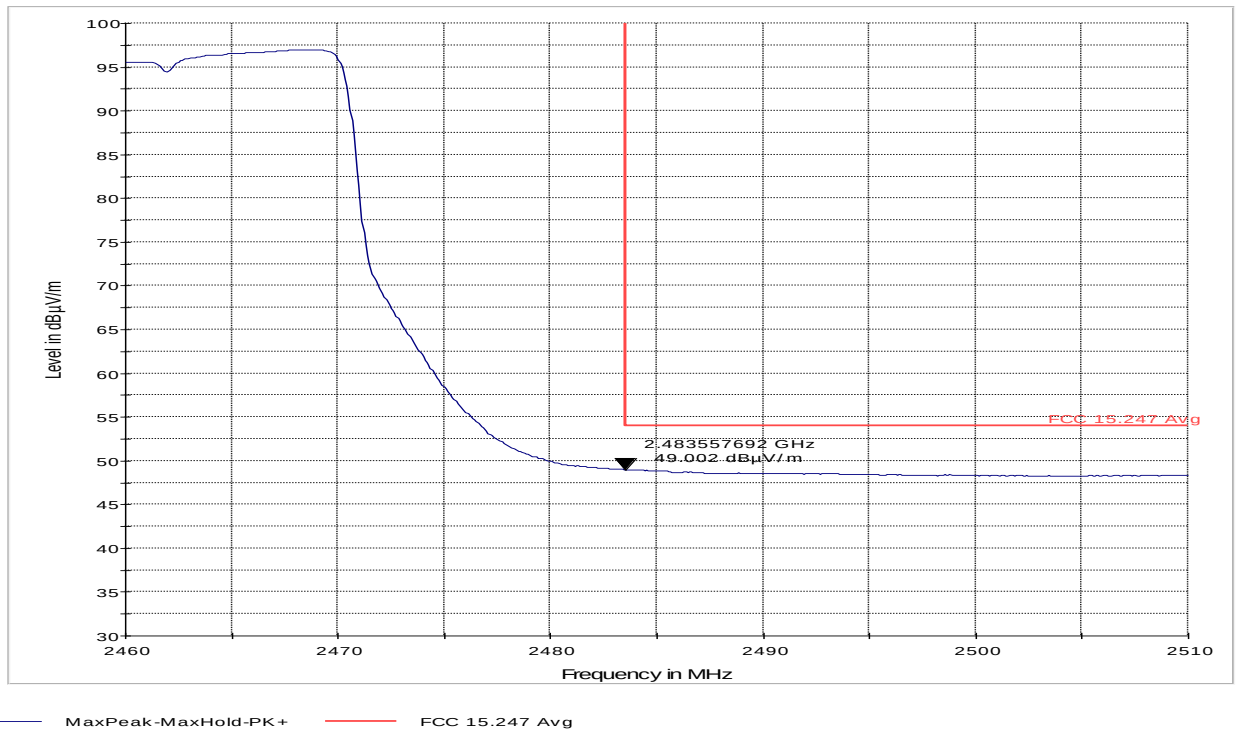
Lower band edge average -802.11g mode



Higher band edge peak -802.11g mode



Higher band edge average- 802.11g mode



6.7 Transmitter Spurious Emissions- Radiated

6.7.1 Limits:

§15.247/15.205
RSS 210-A8.5

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

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)

6.7.2 Test Conditions:

Tnom: 20°C; Vnom: 12 VDC

6.7.3 Test Result:

Test mode: 802.11b mode was used during the measurements since this mode operates with the highest output power and represents the worst case scenario for radiated measurements.

Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.

Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

Measurement Uncertainty: ±3.0dB

6.7.3.1 Measurement Verdict:

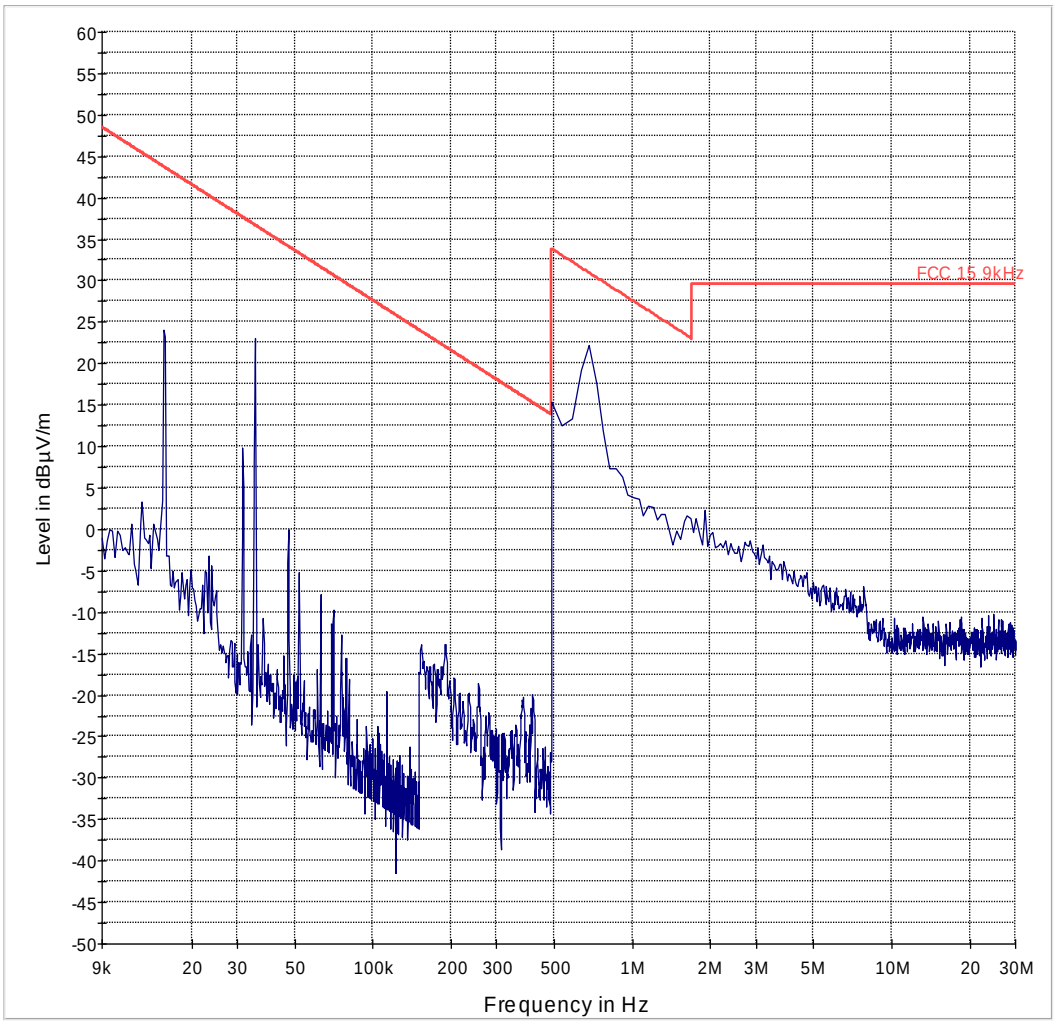
Pass.

6.7.4 Test data/ plots:

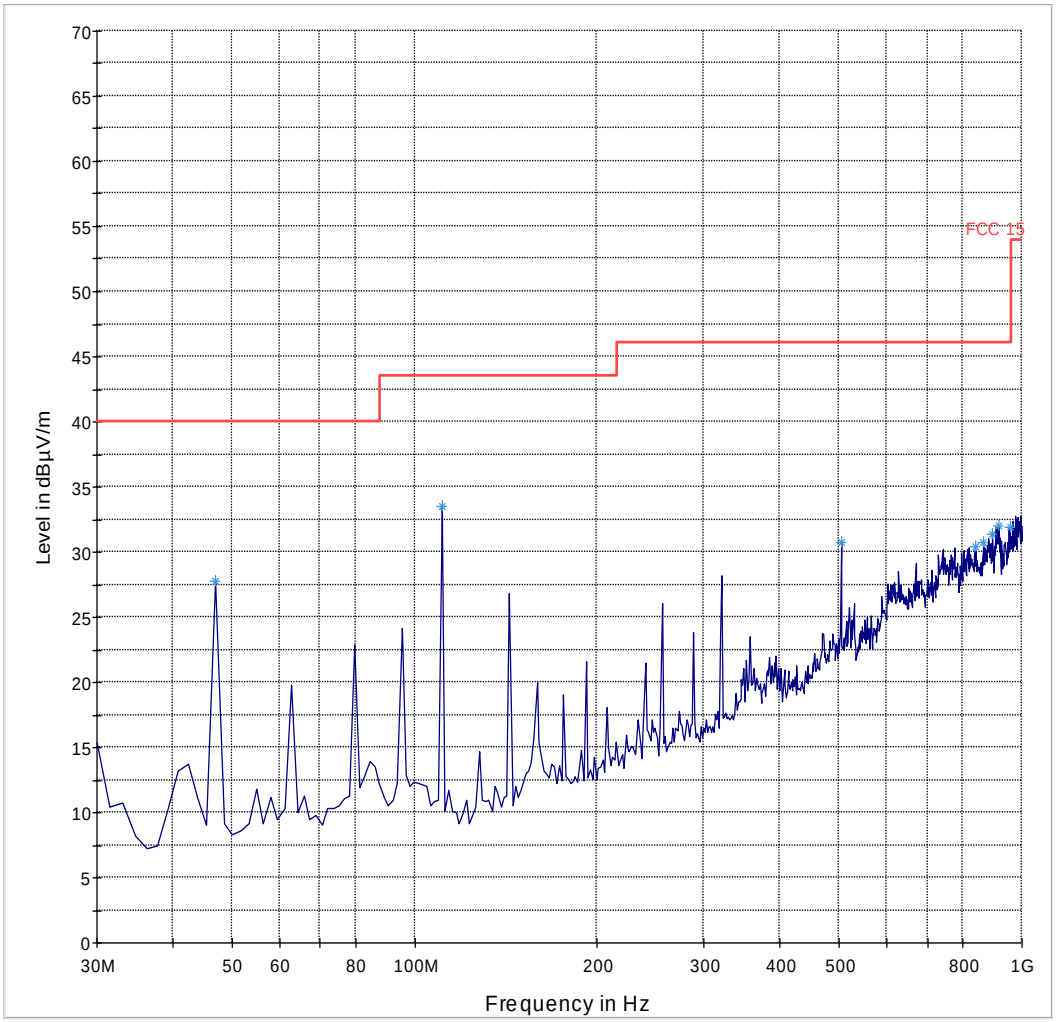
Transmitter Radiated Spurious Emission :< 30MHz

Limits adjusted for 3m measurement

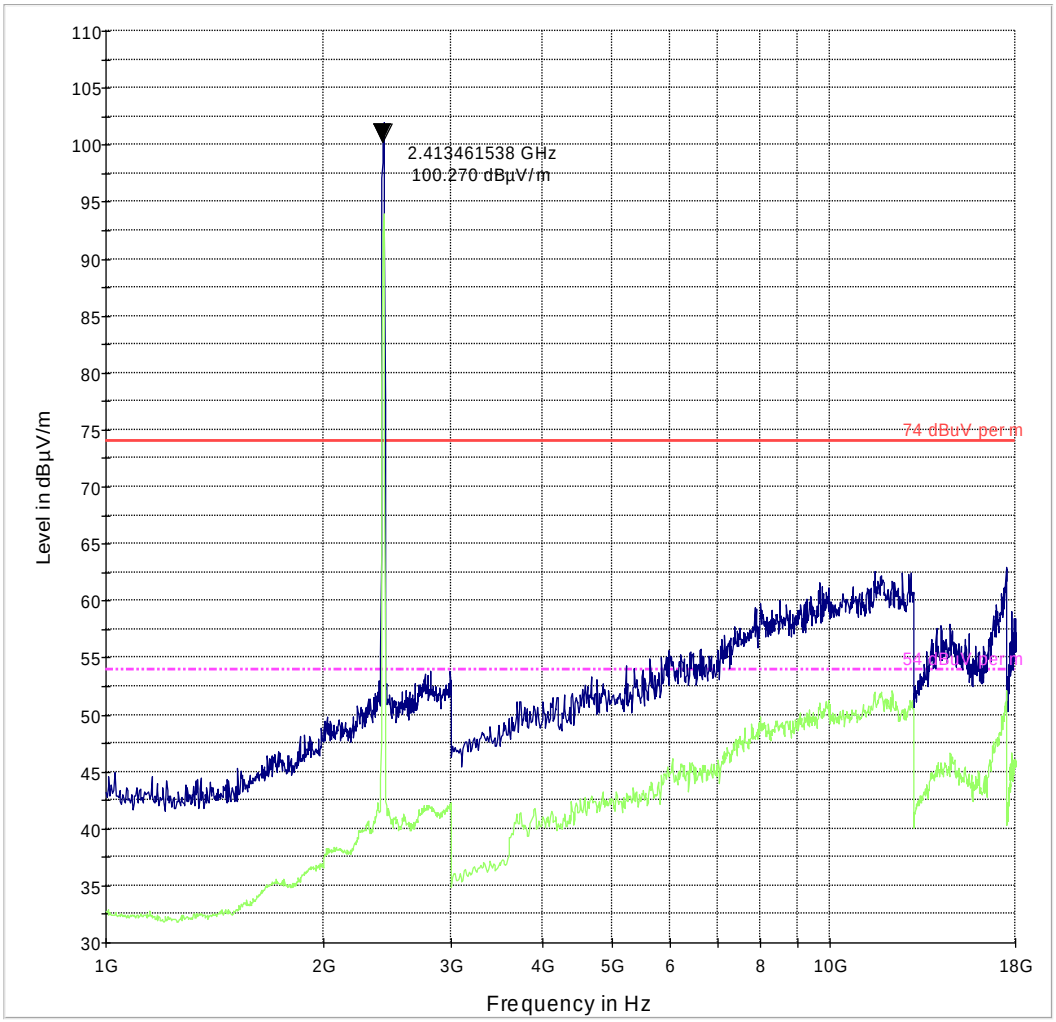
Note: Worst case representation for all modes of operation in this frequency range



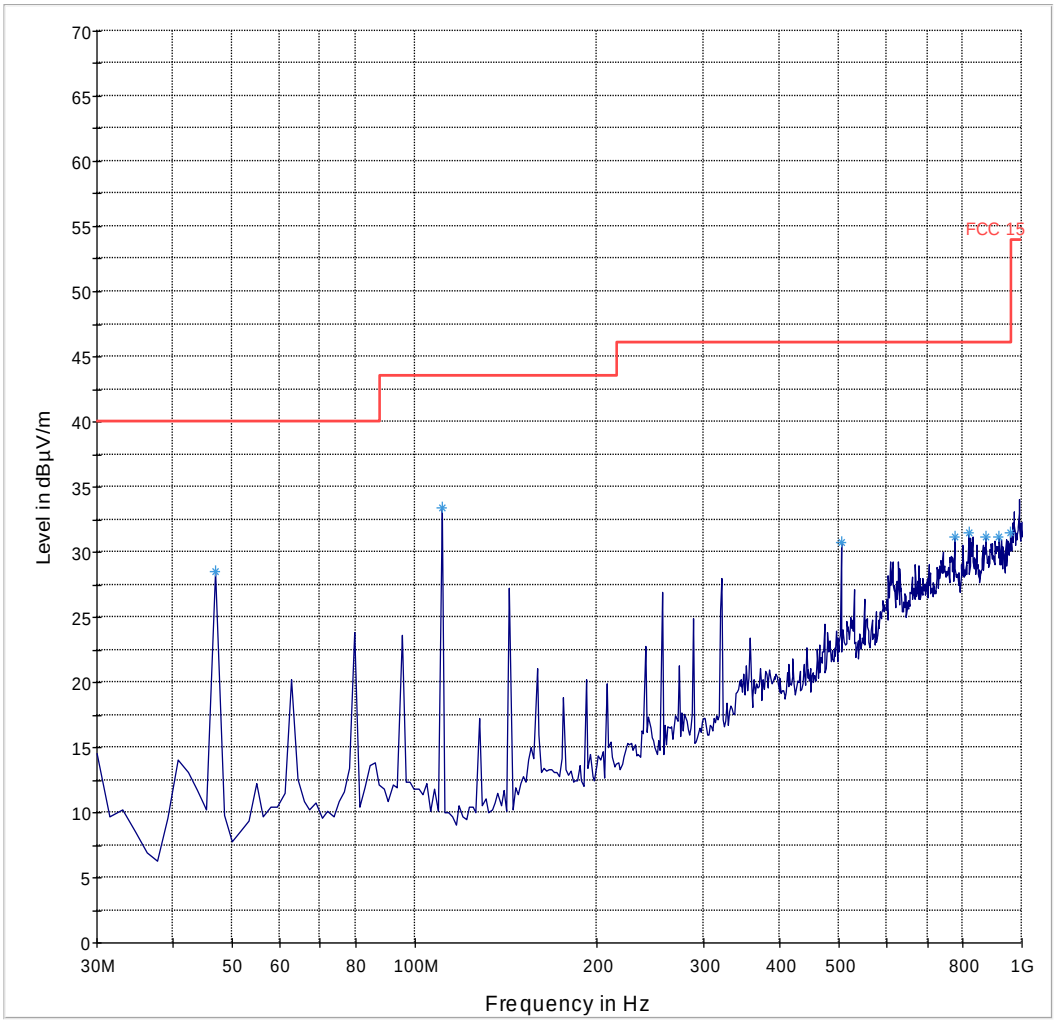
Transmitter Radiated Spurious Emission- Ch1- 30M-1GHz



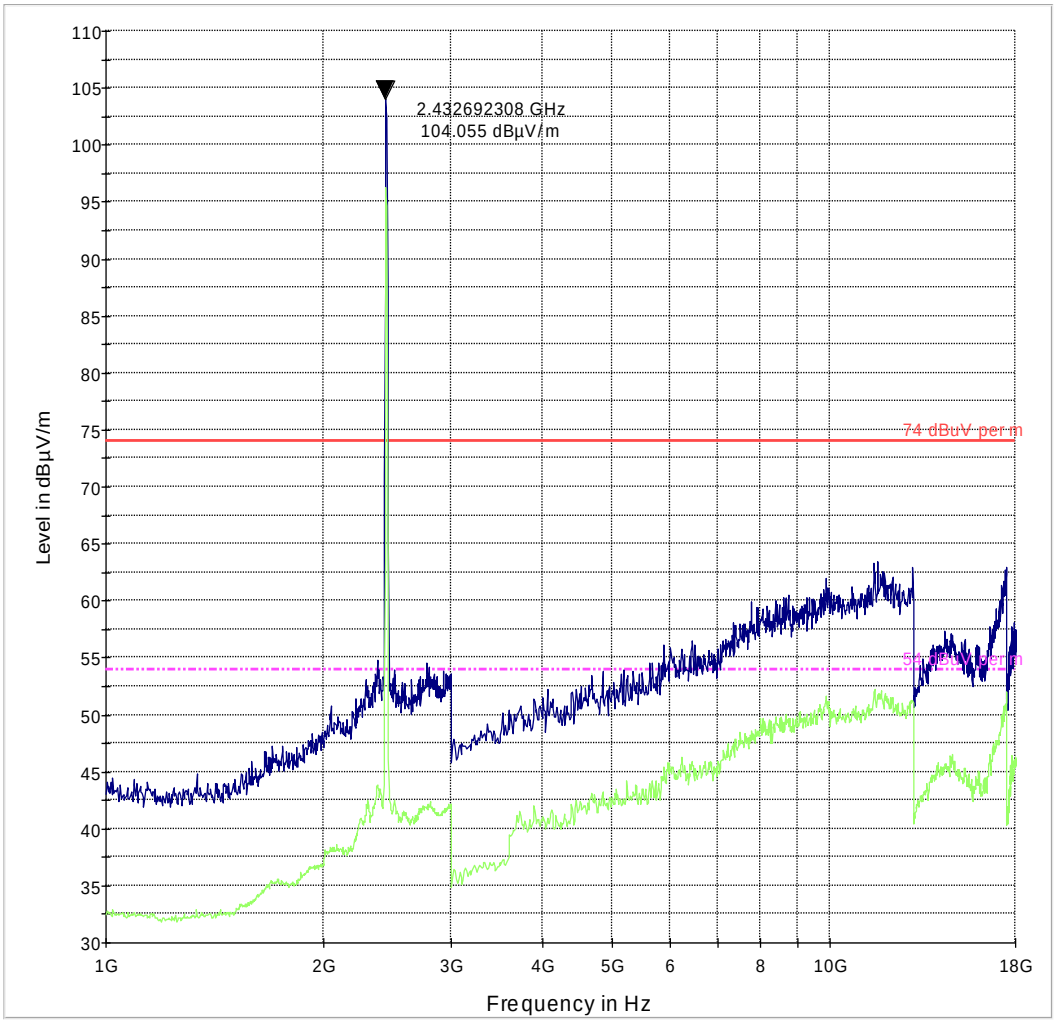
Transmitter Radiated Spurious Emission- Ch1- 1G-18GHz



Transmitter Radiated Spurious Emission- Ch6- 30M-1GHz

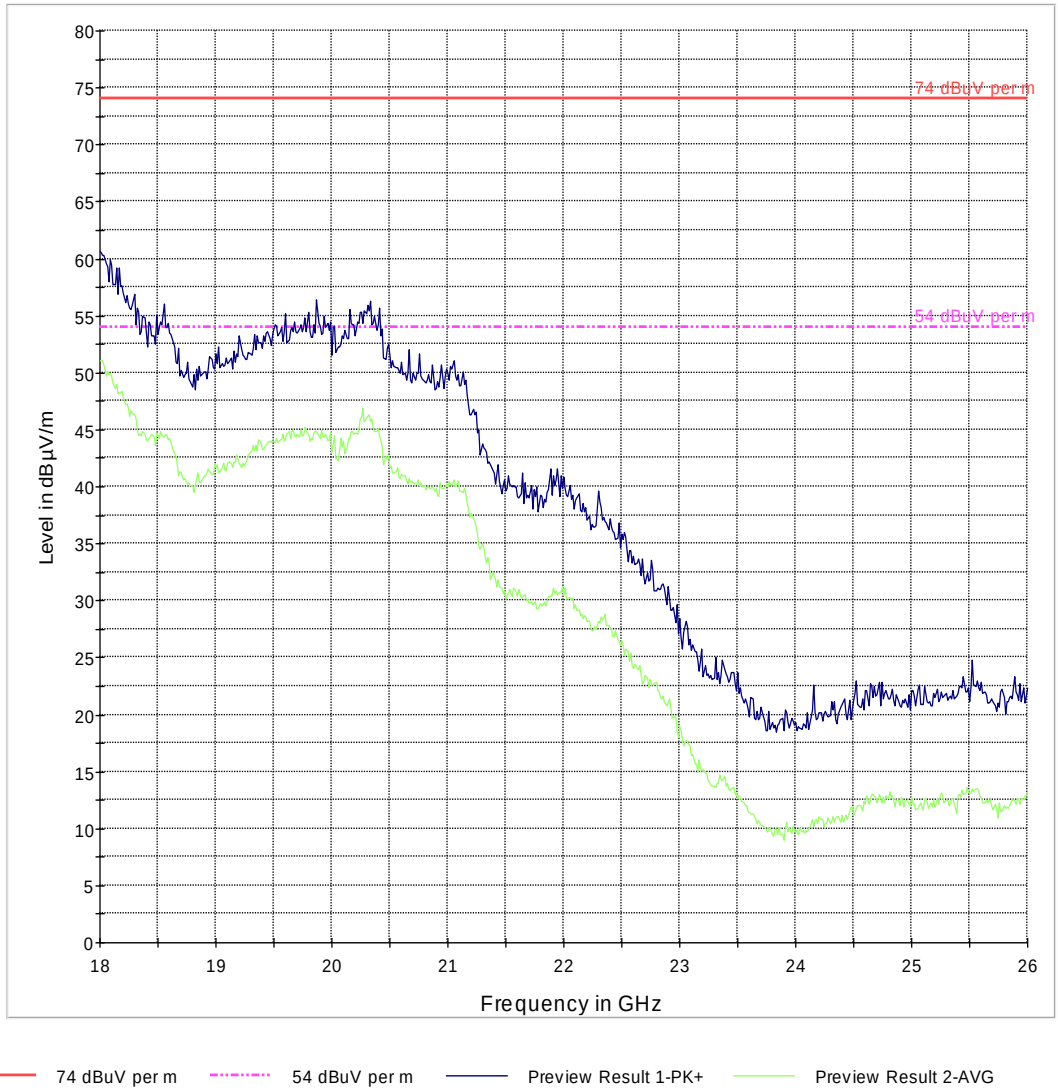


Transmitter Radiated Spurious Emission- Ch6- 1G-18GHz

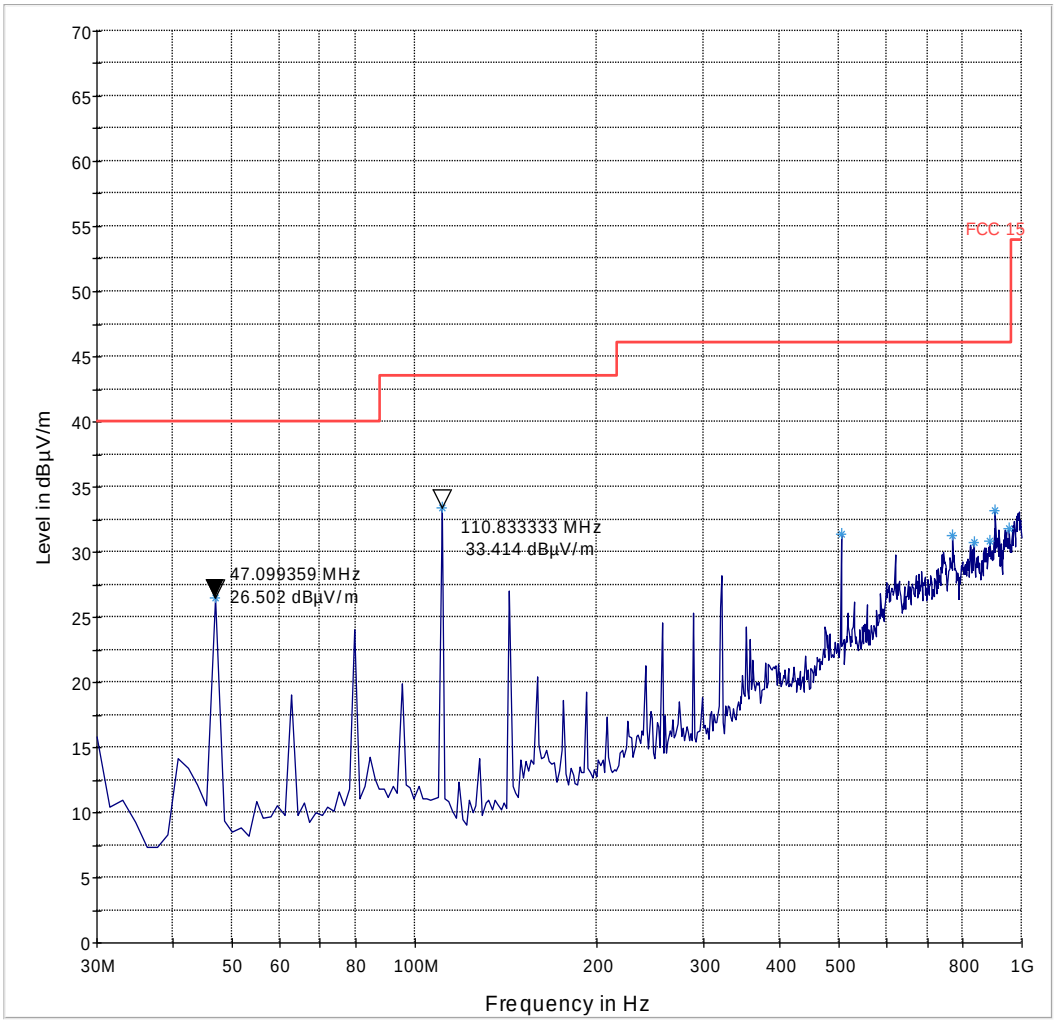


Transmitter Radiated Spurious Emission- Ch39- 18G-26GHz

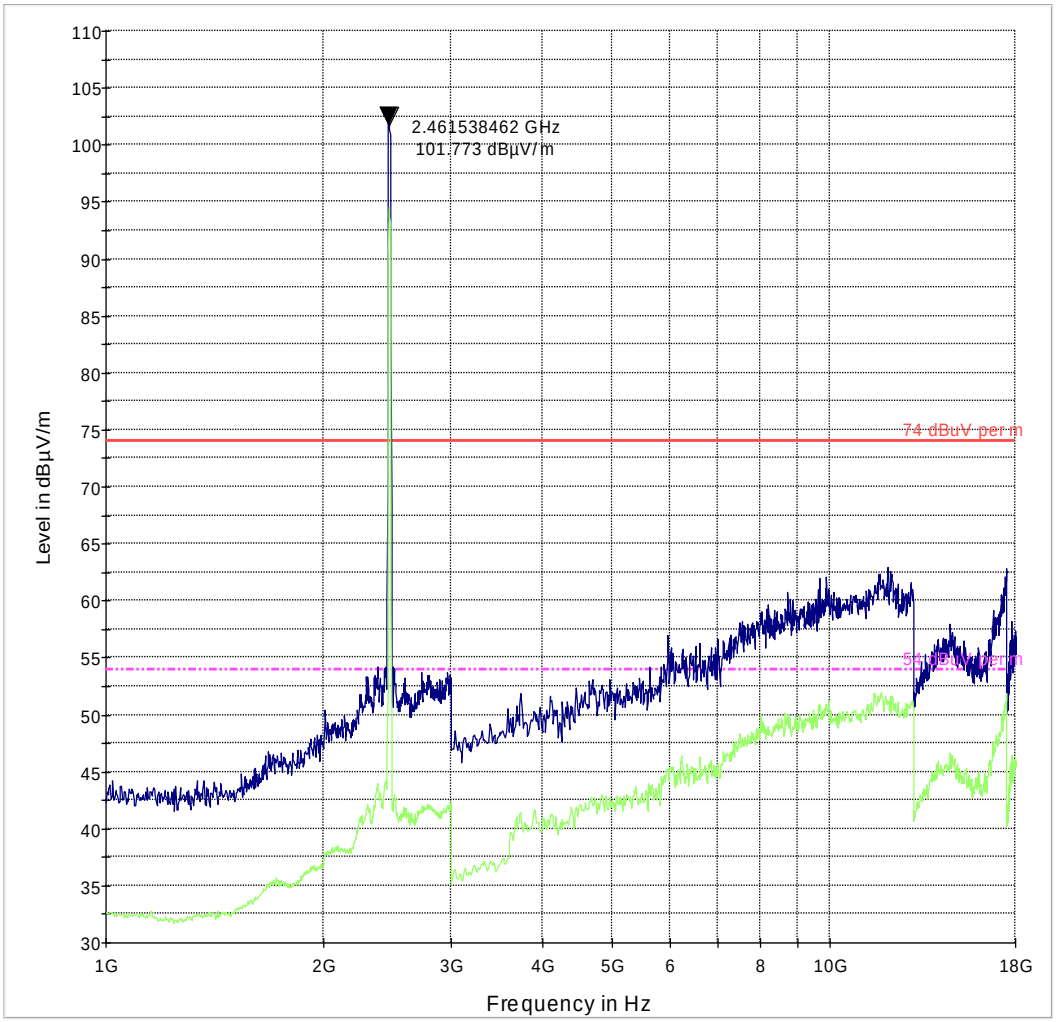
Note: Worst case representation for all channels and modes of operation in this frequency range-



Transmitter Radiated Spurious Emission- Ch11- 30M-1GHz



Transmitter Radiated Spurious Emission- Ch11- 1G-18GHz

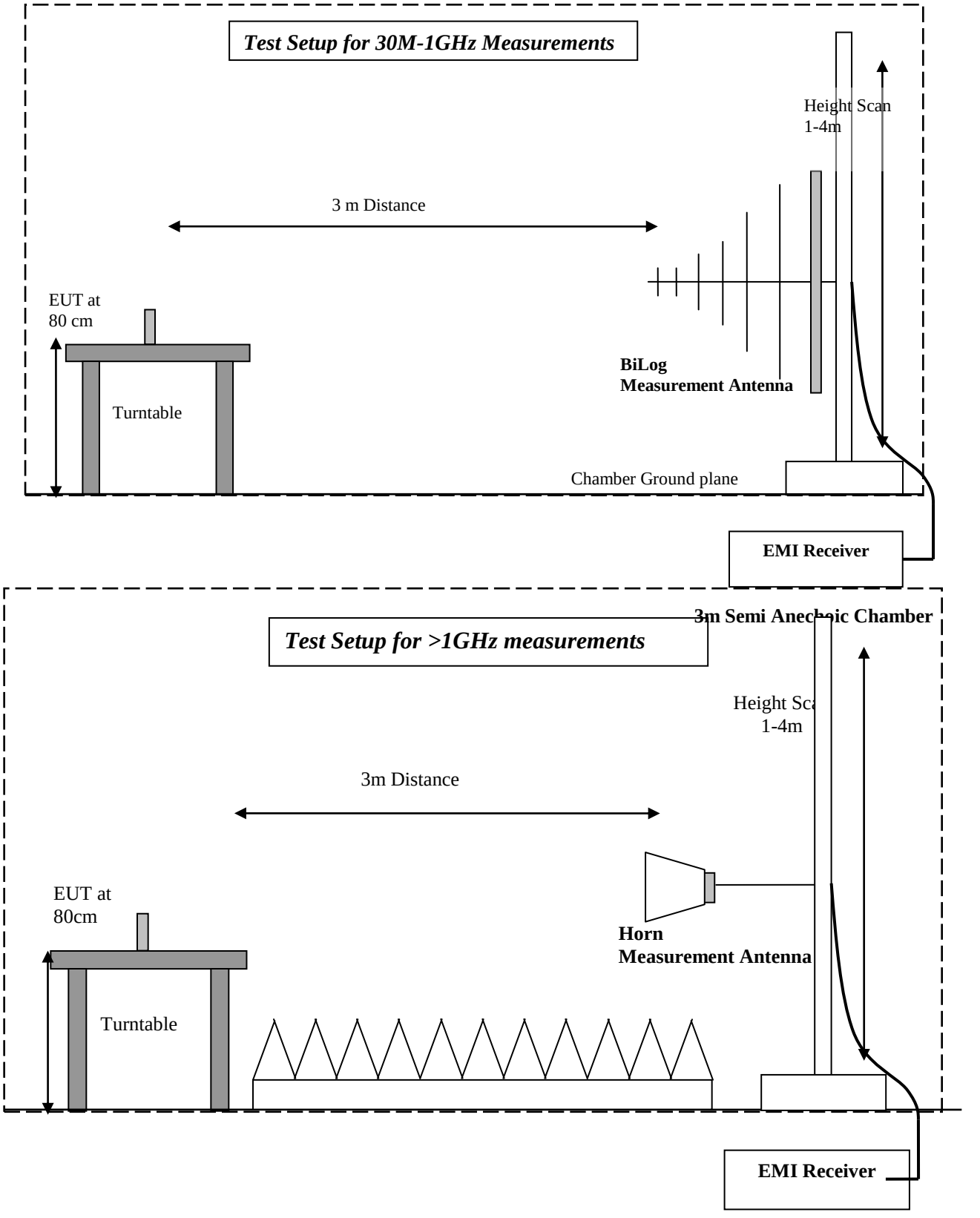


7 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turntable	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Jul 2012	1 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	May 2011	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHZ HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
Ancillary equipment						
	Multimeter	Klein Tools	MM200	001	Apr 2011	2 Years
	Humidity Temperature Logger	Dickson	TM320	03280063	Mar 2012	1 Year
	Digital Barometer	VWR	35519-055	91119547	Nov 2011	2 Years
	Climatic Chamber	Votsch	VT4004	G1115	N/A	N/A
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	DC Power Supply	Protek	3003B	H012771	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.
Calibration due dates, unless defined specifically, falls on the last day of the month.
Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

8 Test Setup Diagrams



9 Revision History

Date	Report Name	Changes to report	Report prepared by
2013-02-08	EMC_HARMA-027-12001_DTS	First Version	C Lee