FCC/IC Test Report

FOR:

Manufacturer: CSR Technology Inc.

Model Name: CNS12015

Product Description: Bluetooth Low Energy Retail Tag

FCC ID: PIW-CNS12015
IC ID: 5255A-CNS12015

47 CFR Part 15.247 for DTS
IC RSS-210 Issue 8 & RSS-GEN Issue 4

TEST REPORT #: EMC_CSRTE-002-14001_FCC15_247
DATE: 12-10-14

FCC: Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and IC standard RSS-210 issue 8, Annex 8 and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
CSR Technology Inc.	Bluetooth Low Energy Retail	CNS12015

Responsible for Testing Laboratory:

Date	Section	Name	Signature
12-10-14	Compliance	Franz Engert (Compliance Manager)	Franz Engert Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com Date: 2014.12.10 14:47:24 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
12-10-14	Compliance	Yu-Chien Ho (EMC Engineer)	Yu-Chien Ho Digitally signed by Yu-Chien Ho DN: cn=Yu-Chien Ho, c=US, o=Cetecom Inc., ou=Compliance, email=yu-chien.ho@cetecom.com Date: 2014.12.10 10:55:36 -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
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Compliance Manager:	Franz Engert
Responsible Project Leader:	Yu-Chien Ho

2.2 Identification of the Client

Applicant's Name:	CSR Technology
Street Address:	2201 10th Street
City/Zip Code	Plano, TX 75074
Country	USA
Contact Person:	Miguel Bravo-Escos
Phone No.	+1 469 359 3736
Fax:	+1 972 231 1440
e-mail:	Mig.bravo-escos@cer.com

2.3 Identification of the Manufacturer

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

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	Kingfisher / CNS12015
HW / SW Revision :	Rev 5d / phase5-tag-stable02014-01-28-xIDE-2.3.0.31
FCC-ID / IC-ID:	PIW-CNS12015 / 5255A-CNS12015
Product Description:	Bluetooth Low Energy Retail
Technology / Type(s) of Modulation:	Bluetooth v4.0, LE, using FHSS with GFSK
Operating Frequency Range (MHz) / Channels	Nominal band: 2400 – 2483.5; Center to center: 2402 (Ch. 0) – 2480 (Ch. 39), 40 Channels
Declared antenna Information	Printed dipole, peak gain 4 dBi
Declared output powers:	Declared maximum output from production. According to exhibits from Customer the power key value is set to 0 in production without further verifying the actual output power of the final product.
power supply:	Battery, 3.0 V DC
operating temperature range	-10ºC to 55ºC
Prototype / Production unit	Production

3.2 Identification of the Equipment under Test (EUT):

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	1312068	Rev 5d	phase5-tag-stable02014-01-28-xIDE-2.3.0.31	Radiated RF Sample

3.3 Test modes of operation:

Mode	Data rate (Mbps)	Modulation scheme
BT LE	1.0	GFSK

3.4 Date of Testing:

6/16/14 – 7/1/14

4 Subject Of Investigation

The objective of the evaluation documented in this report was to assess if the performance of the EUT meets the relevant requirements specified in in FCC rules 95 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS 210 Issue 8.

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(e) RSS210 A8.2(b)	Power Spectral Density	Nominal	BT LE	■	☐	☐	☐	Complies
§15.247(a)(1) RSS210 A8.2(a)	Occupied Bandwidth	Nominal	BT LE	■	☐	☐	☐	Complies
§15.247(b)(1) RSS210 A8.4(4)	Maximum Peak Conducted Output Power and EIRP	Nominal	BT LE	■	☐	☐	☐	Complies
§15.247(d) RSS210 A8.5	Band edge compliance-Conducted	Nominal	N/A	☐	☐	☐	■	1
§15.247(d) RSS210 A8.5	Band edge compliance-Radiated	Nominal	BT LE	■	☐	☐	☐	Complies
§15.247(d) RSS210 A8.5	TX Spurious emissions-Conducted	Nominal	N/A	☐	☐	☐	■	2
§15.247(d) RSS210 A8.5	TX Spurious emissions-Radiated	Nominal	BT LE	■	☐	☐	☐	Complies
§15.209(a) RSS Gen	TX Spurious Emissions Radiated<30MHz	Nominal	BT LE	■	☐	☐	☐	Complies

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

1. Band edge compliance-Conducted is NOT PERFORMED since conducted sample was not provided my customer.
2. Conducted spurious emissions test against non-restricted band limits is NOT PERFORMED since radiated spurious emissions against more stringent restricted band limits over the complete measurement range (9kHz to 26GHz) is passed.

6 Measurements

6.1 Measurement Uncertainty

	Uncertainty in dB radiated <30MHz	Uncertainty in in dB radiated 30MHz - 1GHz	Uncertainty in dB radiated > 1GHz	Uncertainty in dB Conducted measurement
standard deviation k=1	2.48	1.93	2.16	0.63
95% confidence interval in dB	4.86	3.79	4.23	1.24
95% confidence interval in dB in delta to Result	+-2.5 dB	+-2.0 dB	+- 2.3dB	+-0.7dB

6.2 Test Conditions

Temperature: 19°C to 25°C;
Operating Voltage: 3.0V for radio measurements;
Relative Humidity 20% to 50%

6.3 Radiated Emissions Measurement Procedure

The radiated measurement is performed according to:
ANSI C63.4 (2009)
ANSI C63.10 (2009)

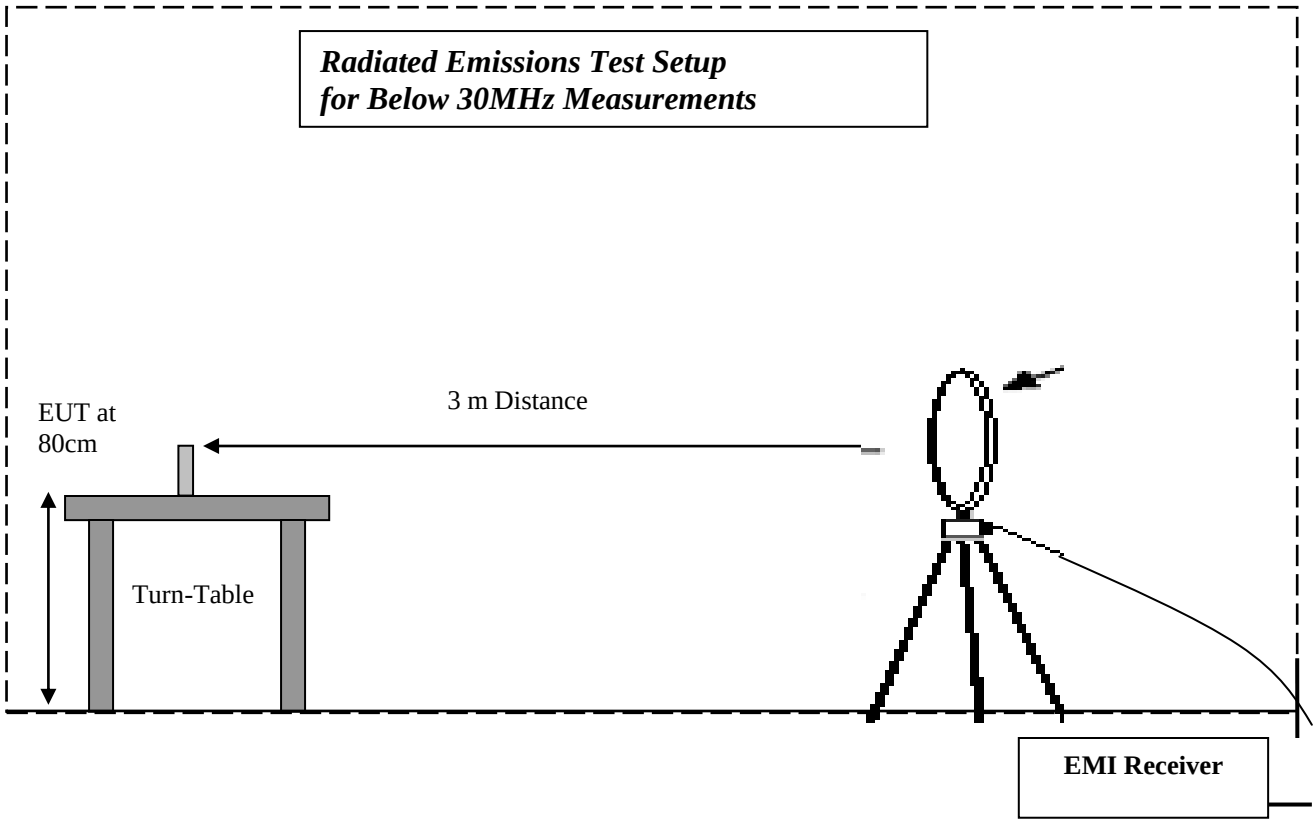
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 16 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9kHz to 30MHz, a Biconlog antenna is used from 30MHz to 1GHz, two different horn antennas are used to cover frequencies up to 40GHz.

6.4 Procedure for measurements other than emission

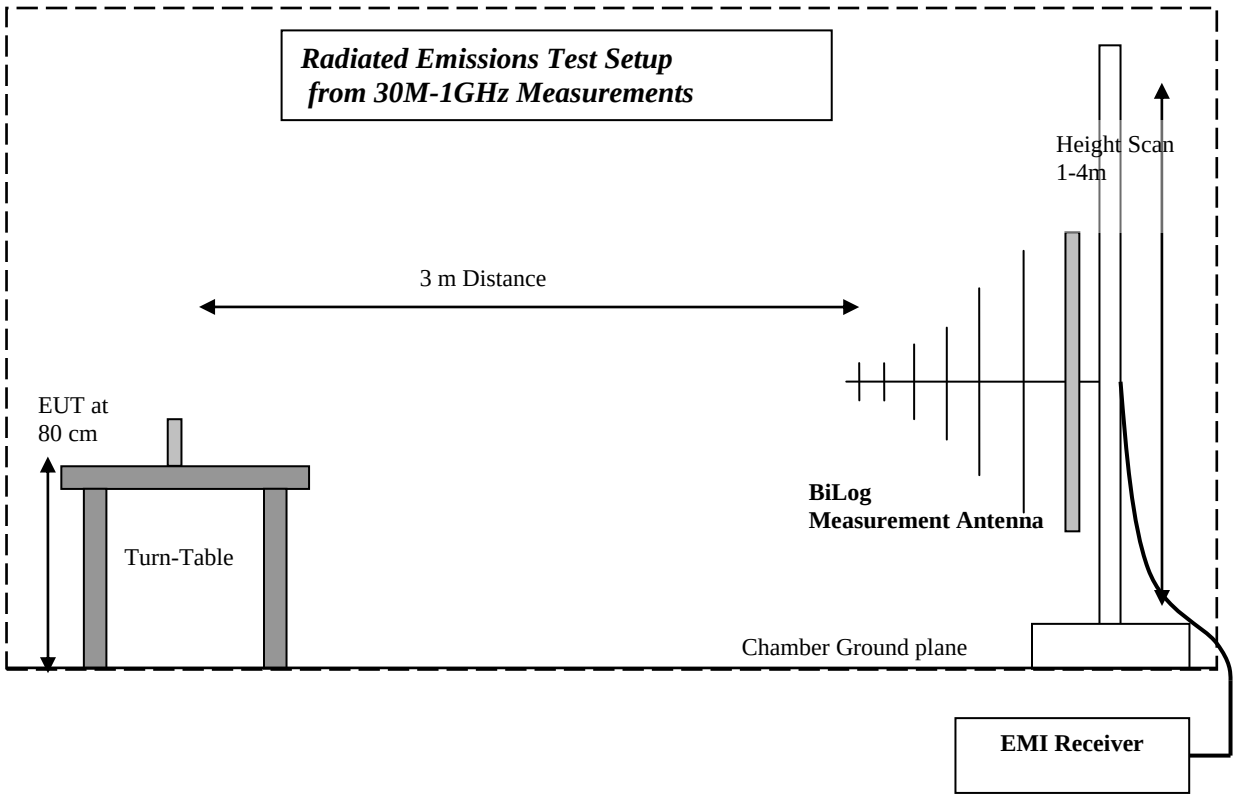
All measurements procedures were taken from the latest DTS KDB
558074 D01 DTS Meas Guidance v03r02.
Detailed spectrum analyzer settings are described in the individual chapter with the results.

6.5 RF Measurement Setup – Radiated

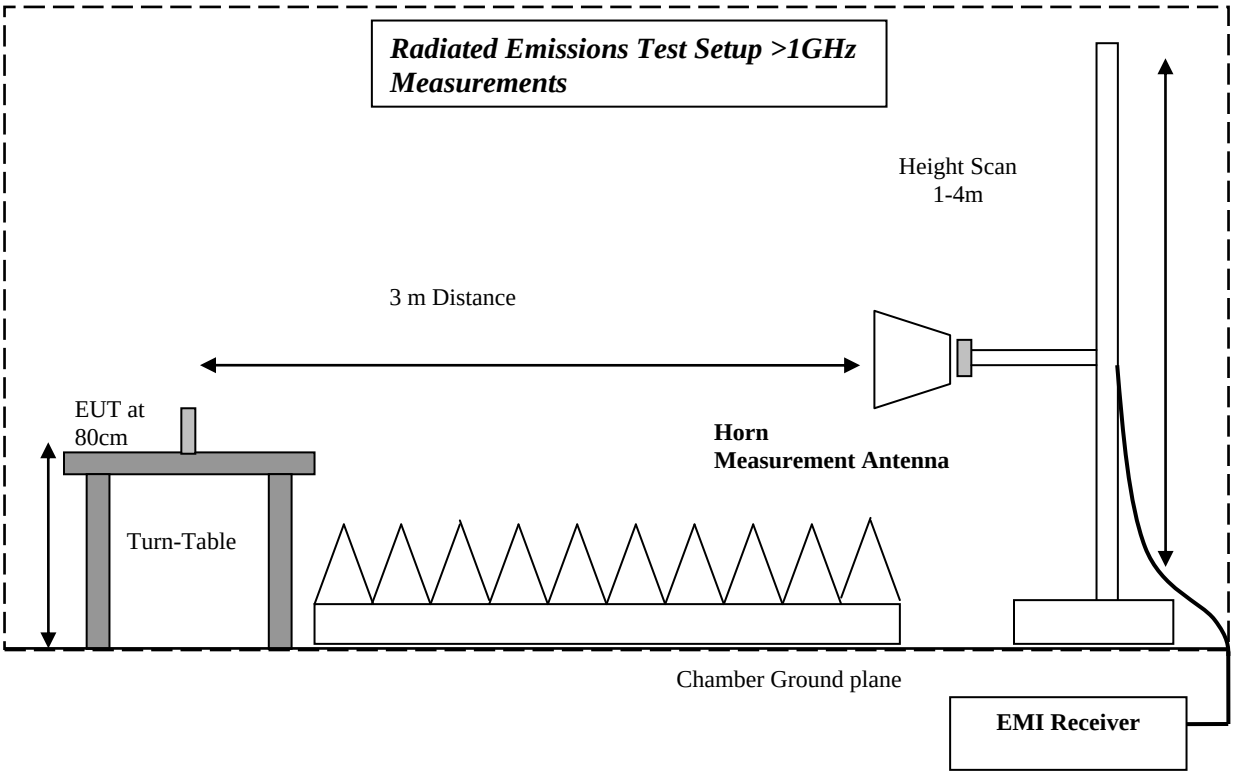
6.5.1 Radiated emissions below 30MHz



6.5.2 Radiated emissions between 30MHz and 1GHz



6.5.3 All other measurements



Note: As there was only a radiated sample available from customer all testing has been done in an anechoic chamber environment. For all field strength, power and power density measurements the above state uncertainty for radiated above 1GHz applies.

7 Maximum Peak Output Power (EIRP)

7.1 Limits:

FCC §15.247 (b)(1): 1W peak conducted output power.
IC RSS-210 issue 8, annex 8.4(2): 1W peak conducted output poweer
EIRP: IC RSS-210 issue 8, Annex 8.4(2): 4W

The measurements deliver EIRP results and thus the antenna Gain of 4dBi was subtracted from EIRP to prove compliance with the peak conducted output power limit.

7.2 Test Conditions:

Tnom: 21°C; Vnom: 3V

7.3 Test Procedure

Measurement according to FCC KDB 558074 D01 v03 R02 section 9.1.1

Center Frequency: The center frequency to DTS channel under test.
Span: 3x RBW
RBW: Greater or equal to OCB
VBW: ≥ 3 x RBW
Sweep Time: Auto couple
Detector = Peak
Trace: Max hold

Antenna Gain (dBi):
Max. Antenna Gain in 2.4 GHz – 2.4835 GHz band = 4 dBi

7.4 Test Results:

Measured EIRP (dBm)			
Mode	Frequency (MHz)		
	2402 Ch. Low	2440 Ch. Mid	2480 Ch. High
BT LE	8.1 dBm	9.3 dBm	10.4 dBm

Declared Antenna Gain in the 2.4GHz band: is 4 dBi

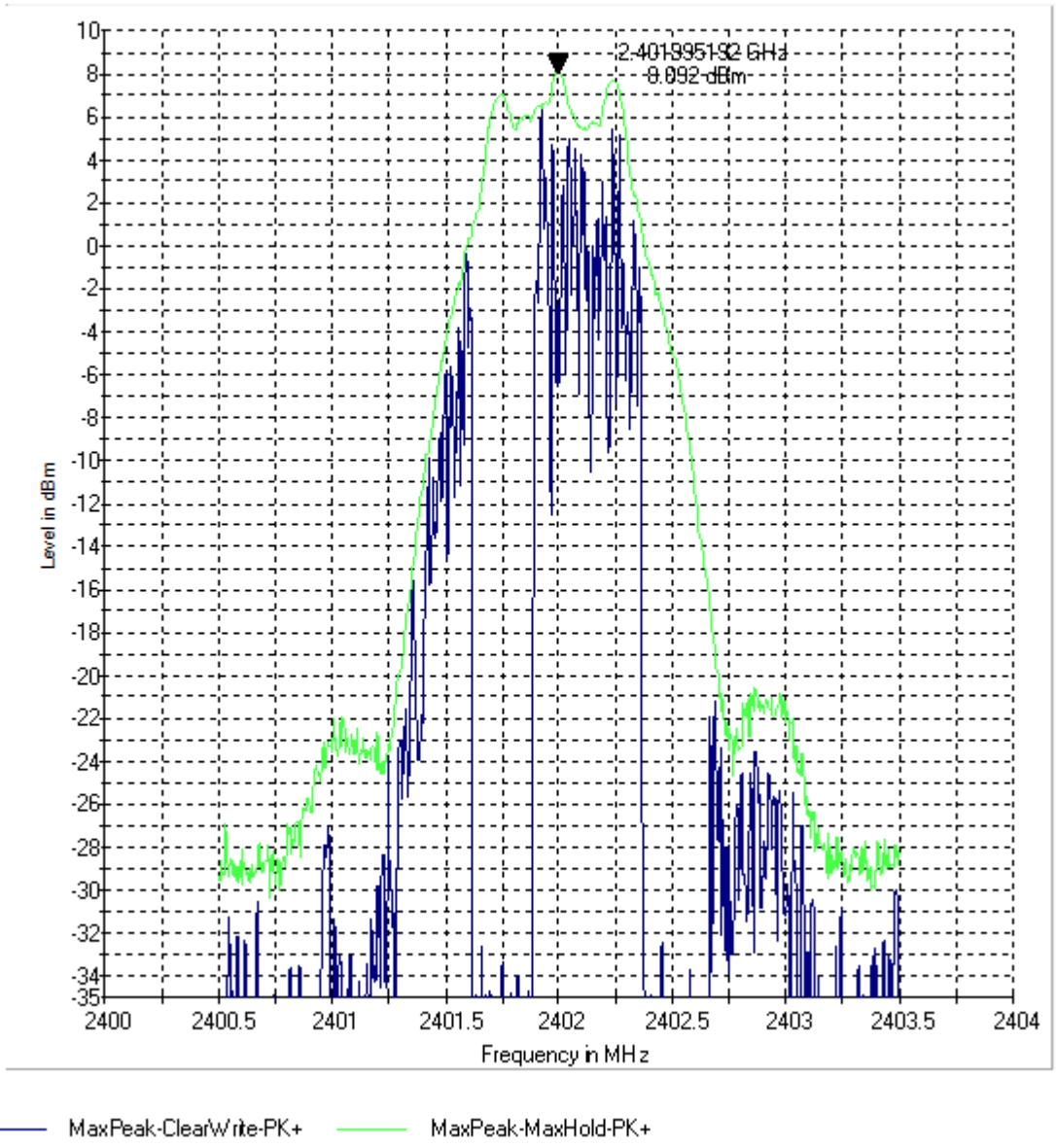
Calculated Maximum Peak Output Power = measured EIRP - Antenna Gain			
Mode	Frequency (MHz)		
	2402 Ch. Low	2440 Ch. Mid	2480 Ch. High
BT LE	4.1 dBm	5.3 dBm	6.4 dBm

7.5 Measurement Verdict:

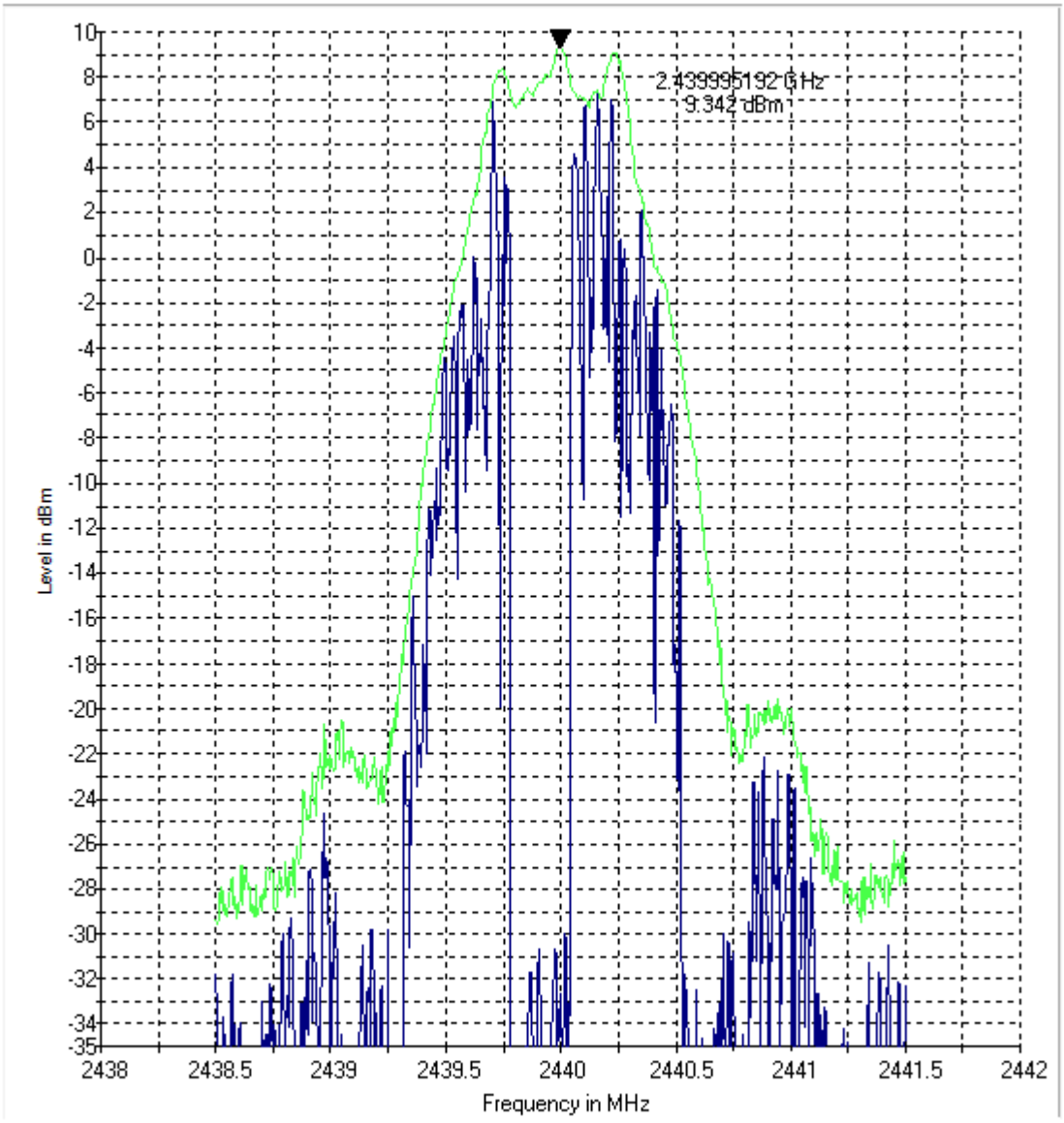
Pass.

7.6 Measurement Plots:

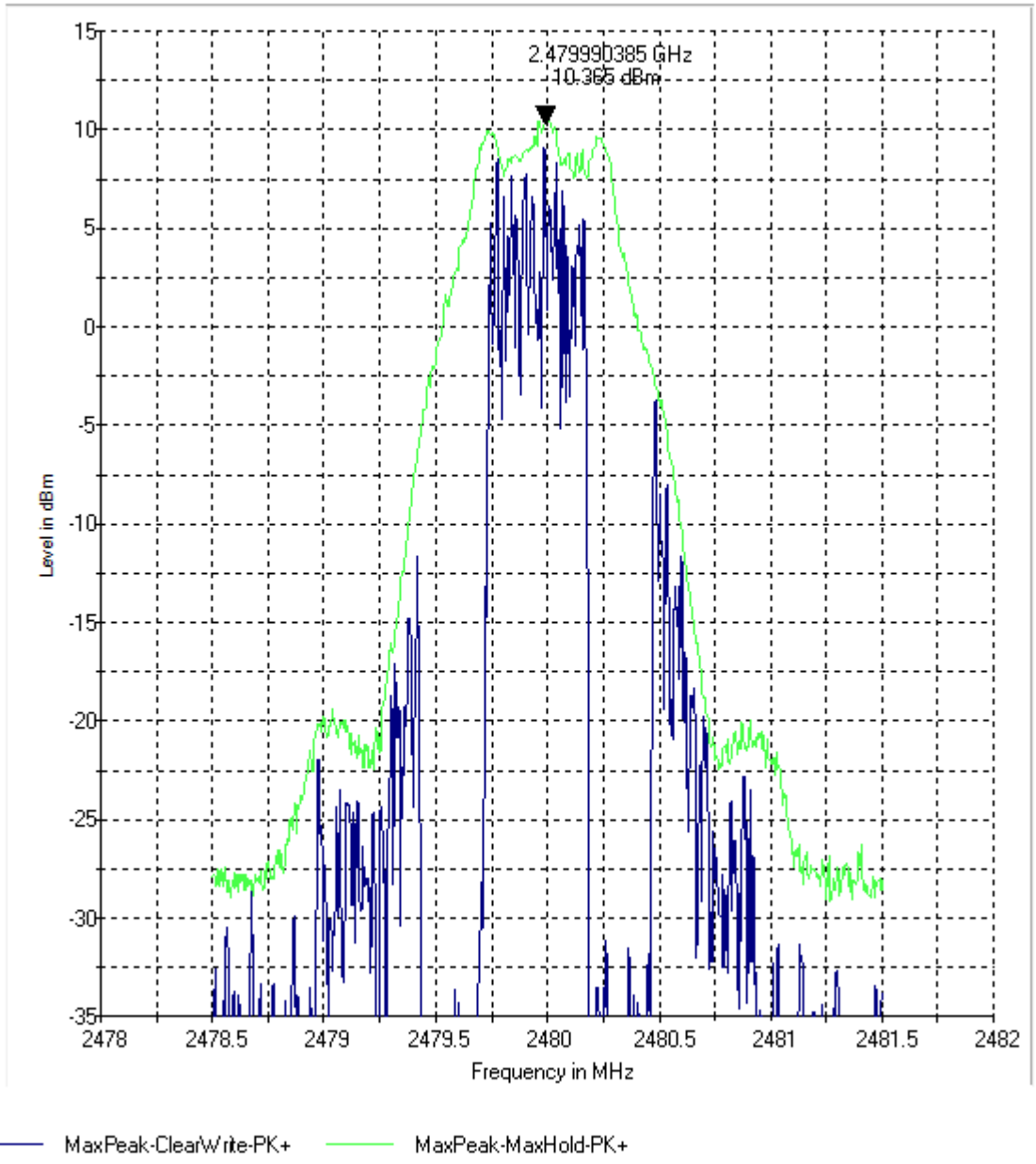
EIRP, BT LE: Ch. Low, 2402 MHz



EIRP, BT LE: Ch. Mid, 2440MHz



EIRP, BT LE: Ch. High, 2480 MHz



8 Power Spectral Density

8.1 Limits:

§ 15.247 (e) & 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.

8.2 Measurement procedure:

FCC KDB 558074 D01 V03R02 section 10.2
Center Frequency: The center frequency to DTS channel under test.
Span: 1.5 x the DTS BW
RBW: 3 kHz ≤ RBW ≤ 100 kHz
VBW: ≥ 3 x RBW
Sweep Time: Auto couple
Detector = Peak
Trace: Max hold
Allow trace to fully stabilize and use peak marker function to determine the highest level as the PSD.
Measurements were taken in the anechoic chamber and the spectrum analyzer was offset for the total attenuation of the measurement.

8.3 Test Results:

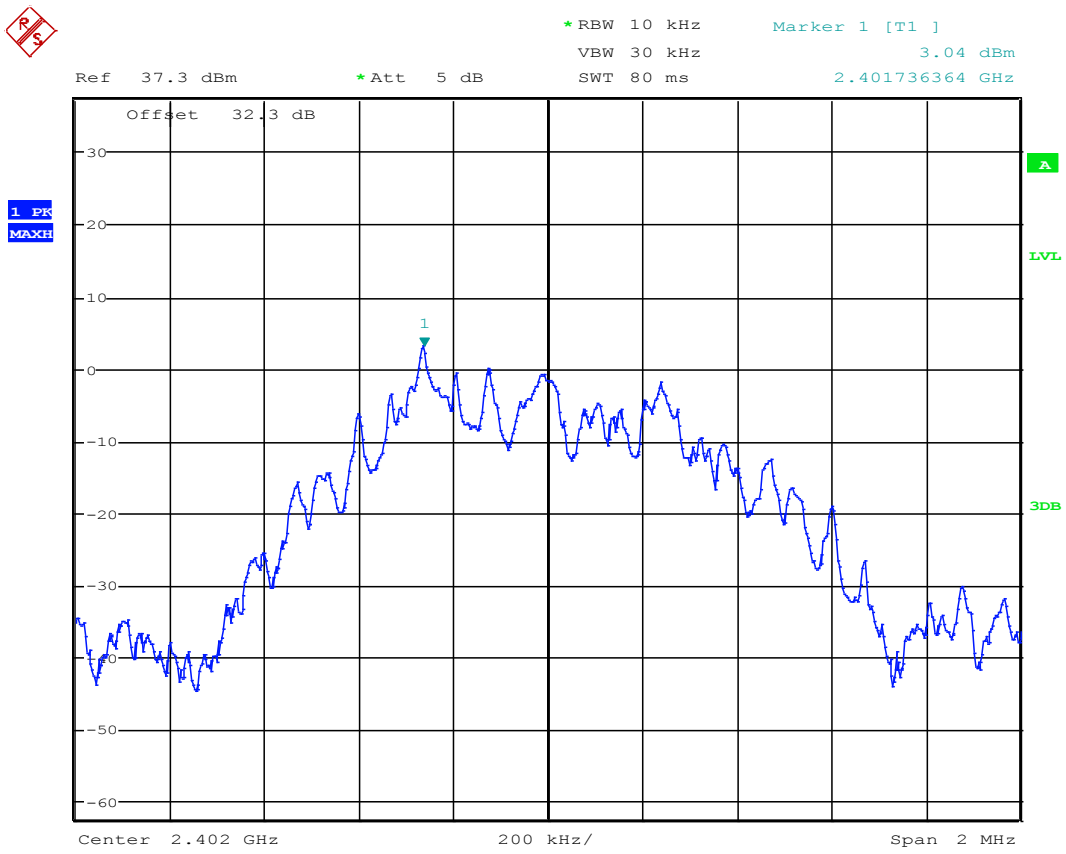
Peak power spectral density = Measured EIRP Power Spectral Density (dBm/MHz) – 4di Gain			
Mode	**Frequency (MHz)**		
	2402 Ch. Low	**2440 Ch. Mid**	**2480 Ch. High**
BT LE	3.0	4.1	5.4

8.4 Measurement Verdict:

Pass.

8.5 Measurement Plots:

Peak Output Power, BT LE: Ch. Low, 2402 MHz



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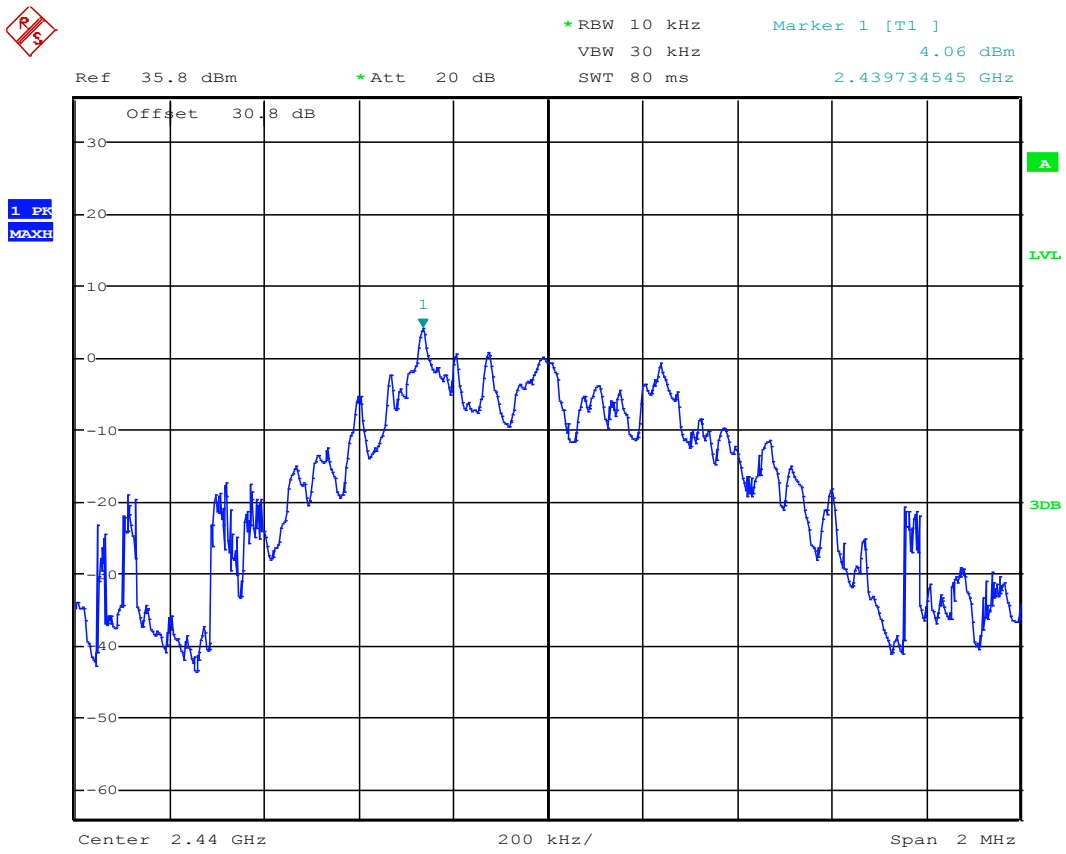
Peak Output Power, Bt LE: Ch. Mid, 2440 MHz



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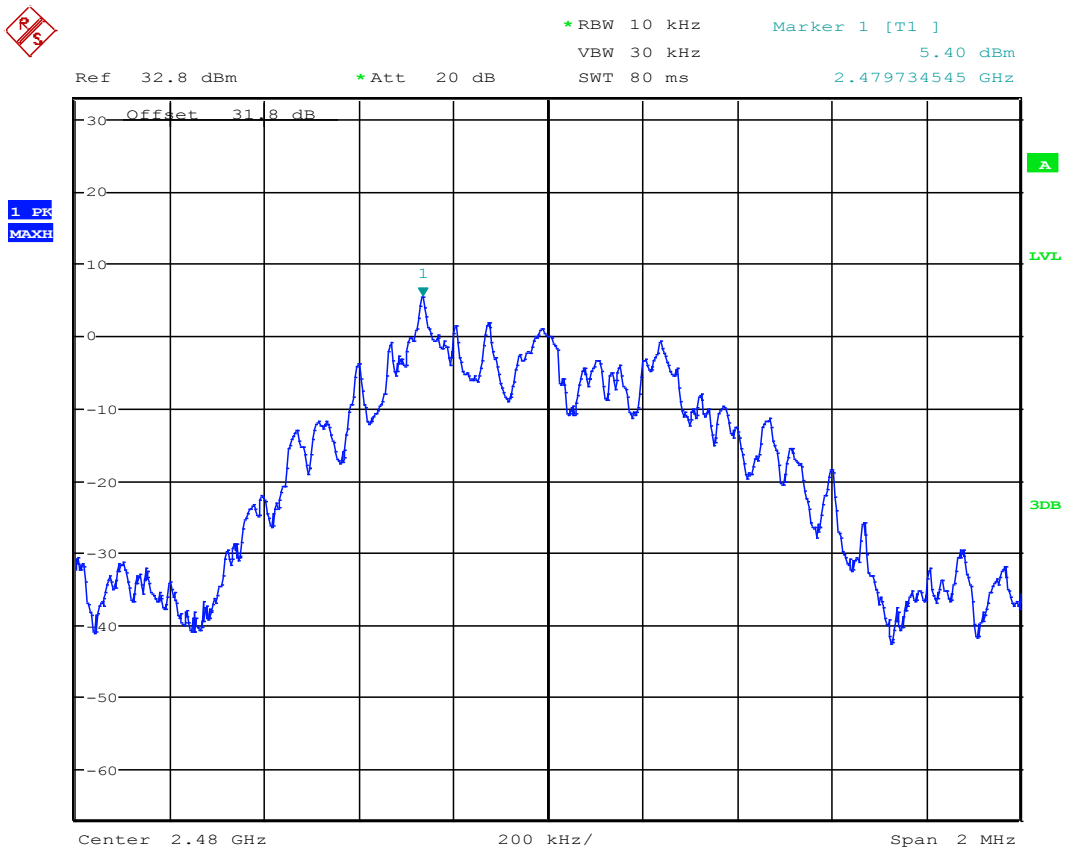
Peak Output Power, BT LE: Ch. High, 2480 MHz



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9 Band Edge Compliance – Applying Restricted Band Limits - Radiated

9.1 Limits:

§15.209/15.205/15.247 (d) & RSS-GEN Issue 4, sections 8.9 and 8.10, RSS-210 8.5
(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 paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

9.2 Measurement Procedure:

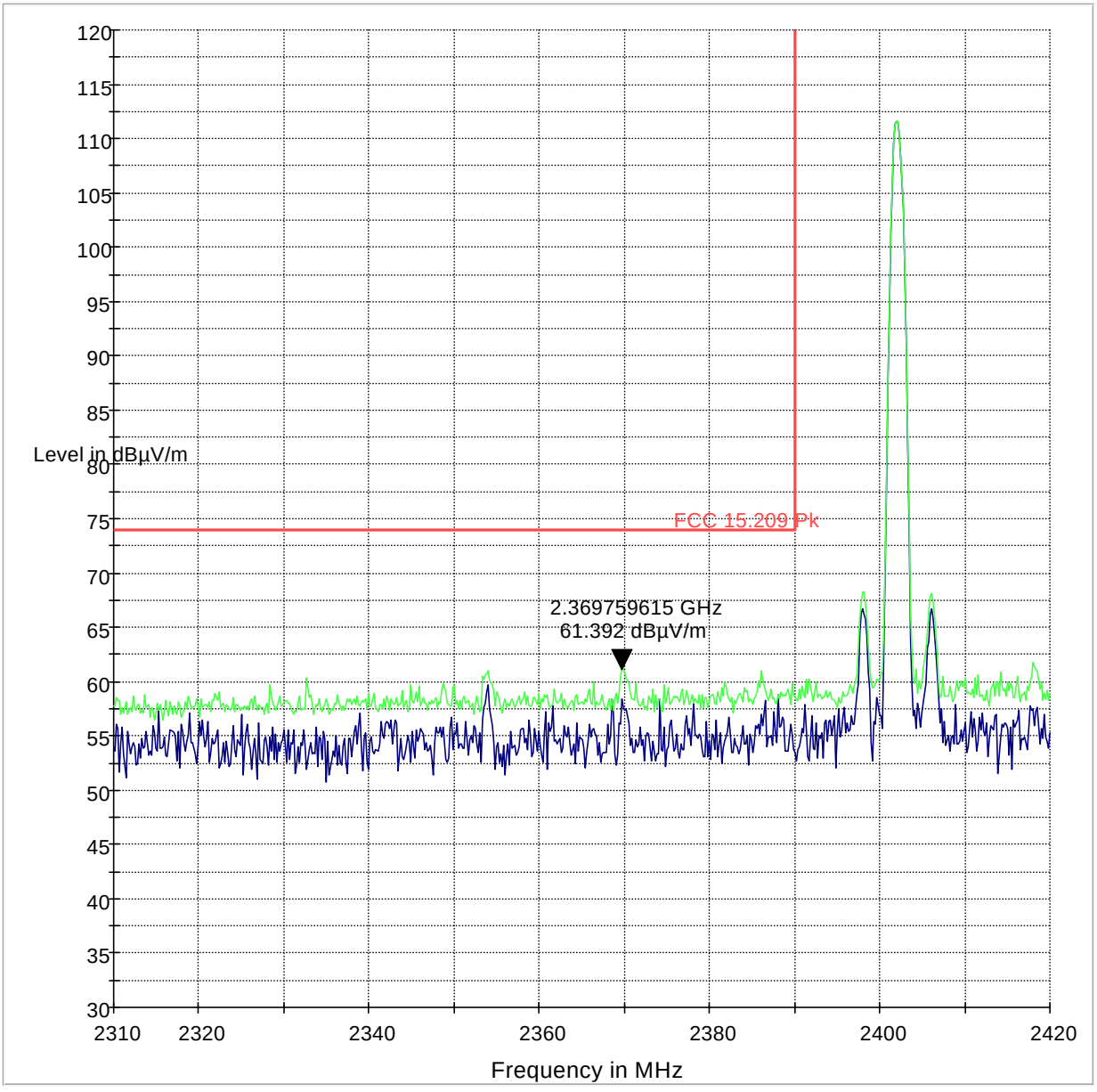
Peak measurements are made using a peak detector and RBW=1MHz.
Average measurements performed using a peak detector and according to video averaging procedure with RBW=1MHz and VBW=10Hz.
*PEAK LIMIT= 74dBµV/m
*AVG. LIMIT= 54dBµV/m
Measurement Uncertainty: ±3.0dB

9.3 Measurement Result

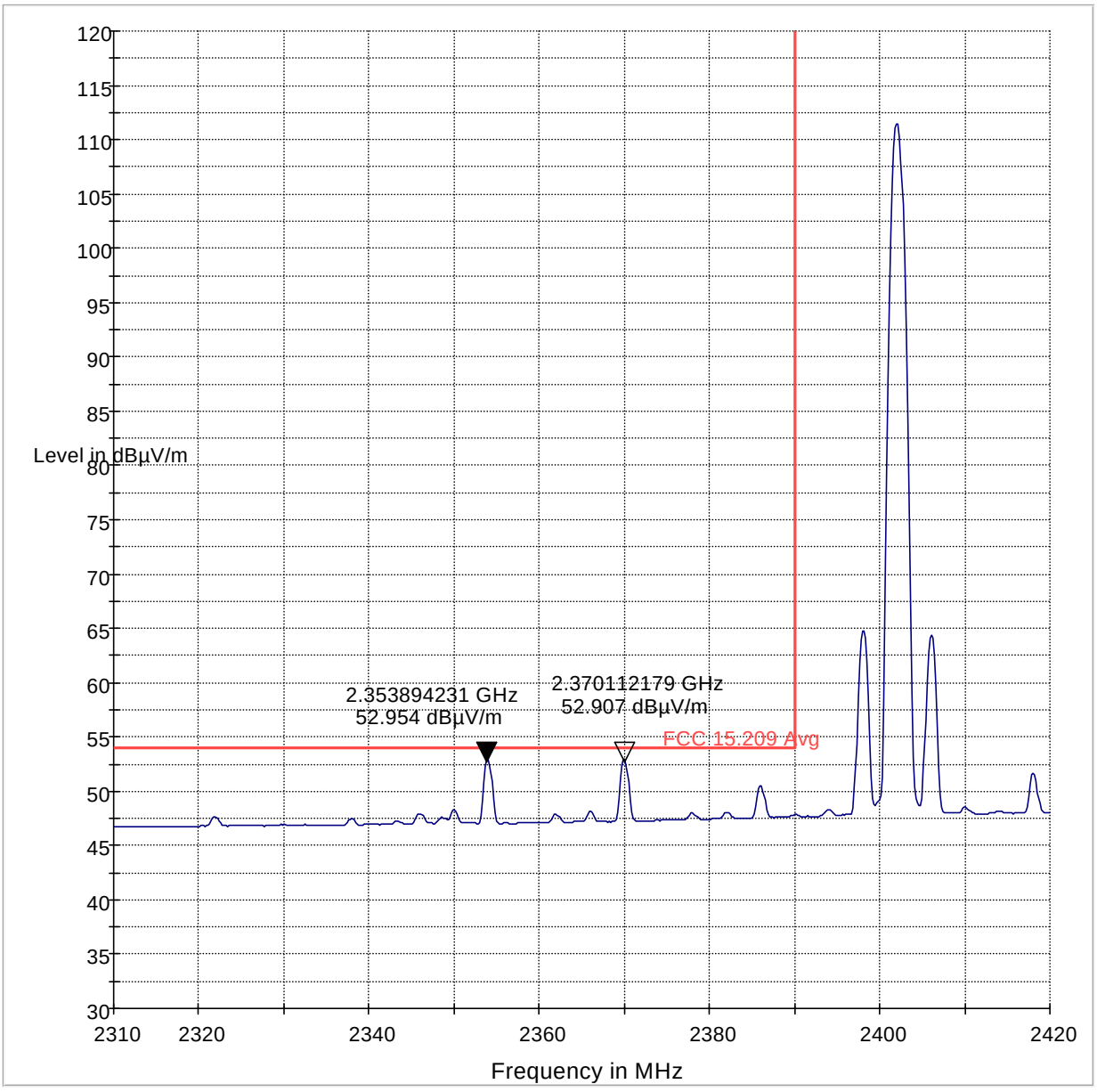
Pass.

9.4 Test Plots

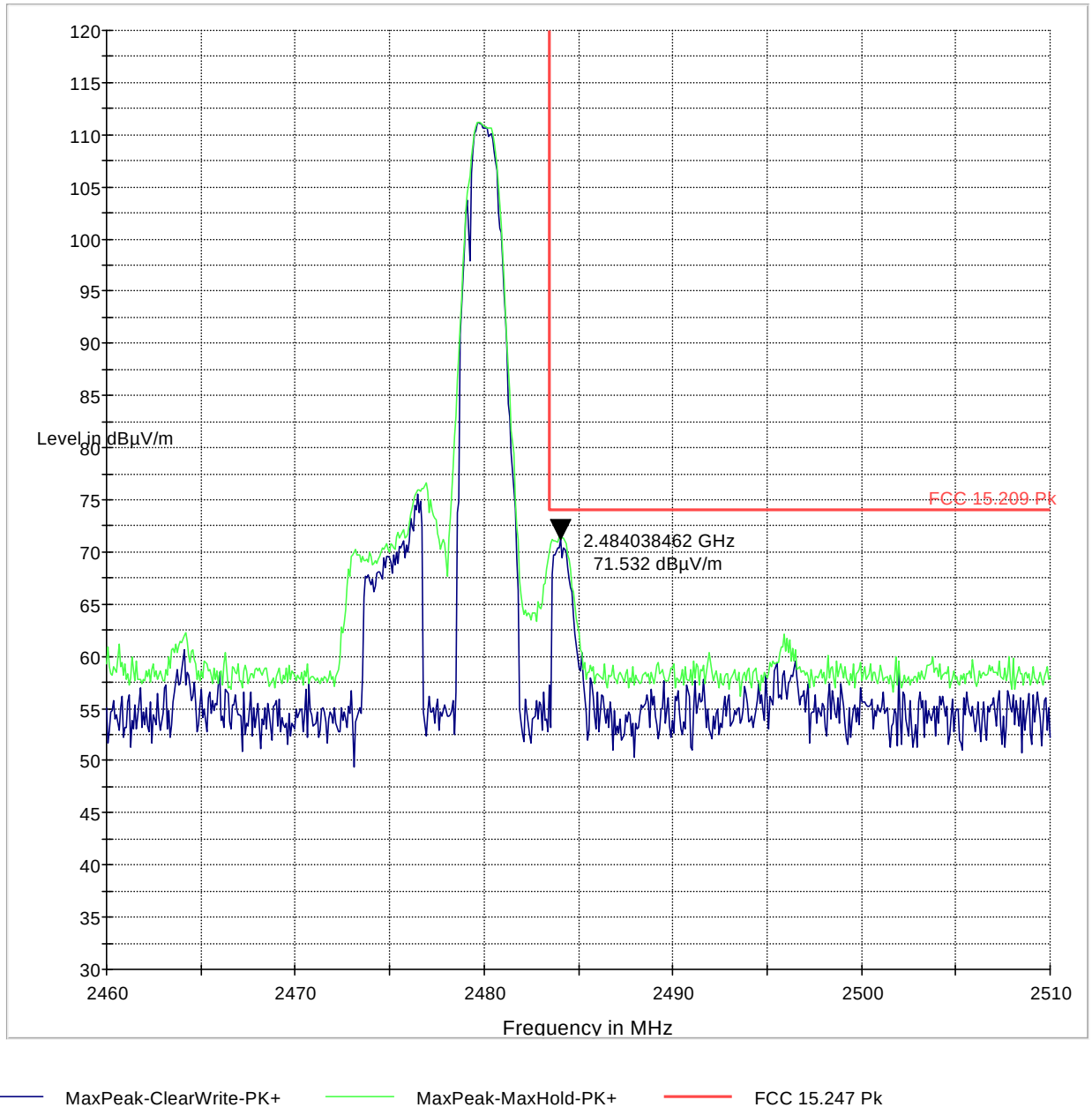
Lower Band Edge Peak EIRP, BTLE



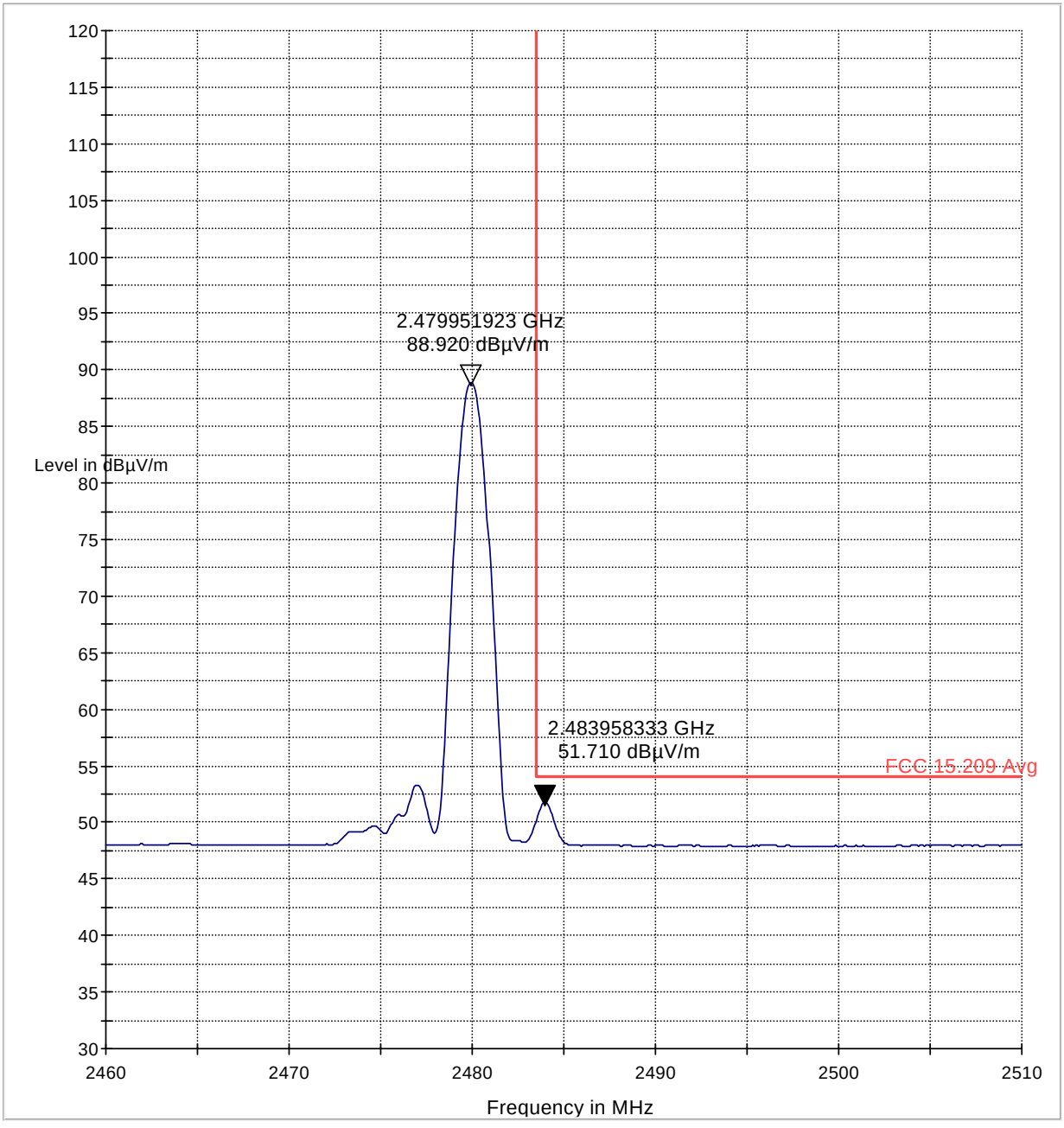
Lower Band Edge Average EIRP, BTLE



Upper Band Edge Peak EIRP, BTLE



Upper Band Edge Average EIRP, BTLE



10 Occupied Bandwidth (6dB and 99% Bandwidth)

10.1 Limits:

§15.247 (a)(2)
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.

10.2 Test Conditions:

Tnom: 22°C; Vnom: 3.0V

10.3 Measurement procedure:

Center Frequency: The center frequency to DTS channel under test.
Span: 3 x RBW
RBW: ≥ OCB
VBW: ≥ 3 x RBW
Sweep Time: Auto couple
Detector = Peak
Trace: Max hold
Allow the trace to stabilize

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the peak level measured in the fundamental emission.

10.4 Test Results:

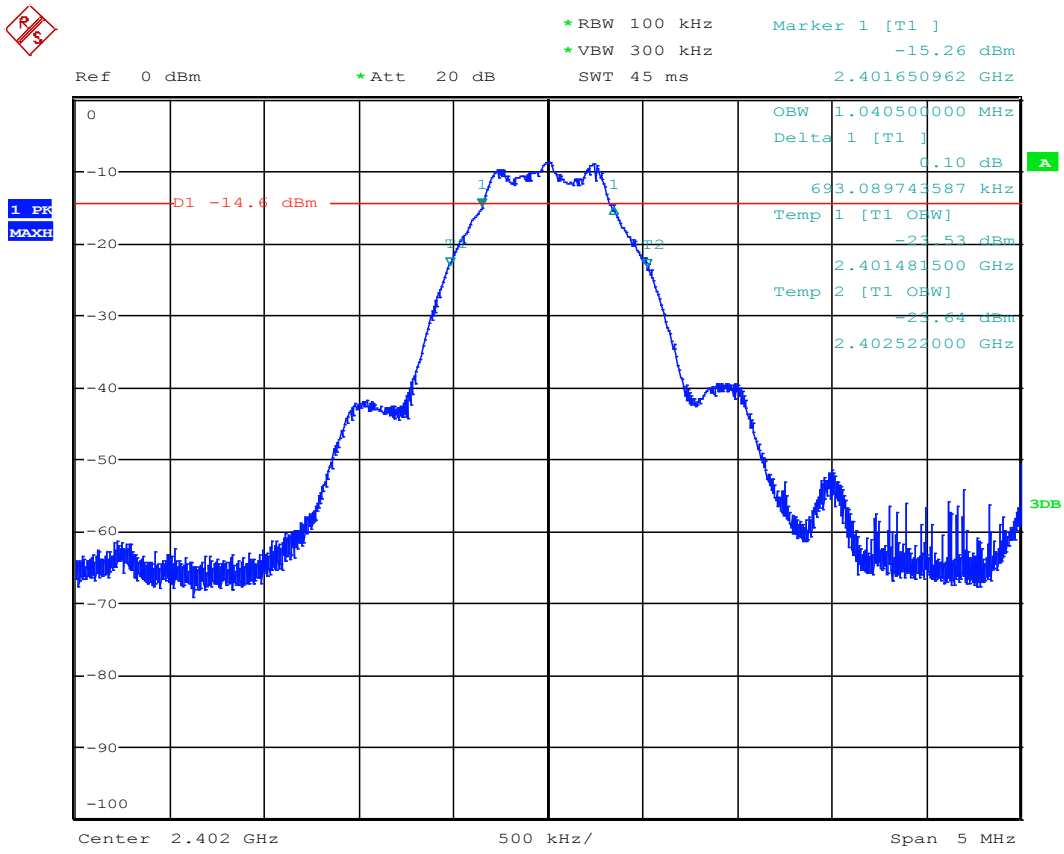
Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2402 Ch. Low		2440 Ch. Mid		2480 Ch. High	
	6dB (KHz)	99% (MHz)	6dB (KHz)	99% (MHz)	6dB (KHz)	99% (MHz)
BT LE	693.09	1.04	737.17	1.04	691.08	1.038
Measurement Uncertainty: ±100 kHz						

10.5 Measurement Verdict:

Pass.

10.6 Measurement Plots: 2.4 GHz Band

6dB & 99% Bandwidth: Ch. Low, 2402 MHz



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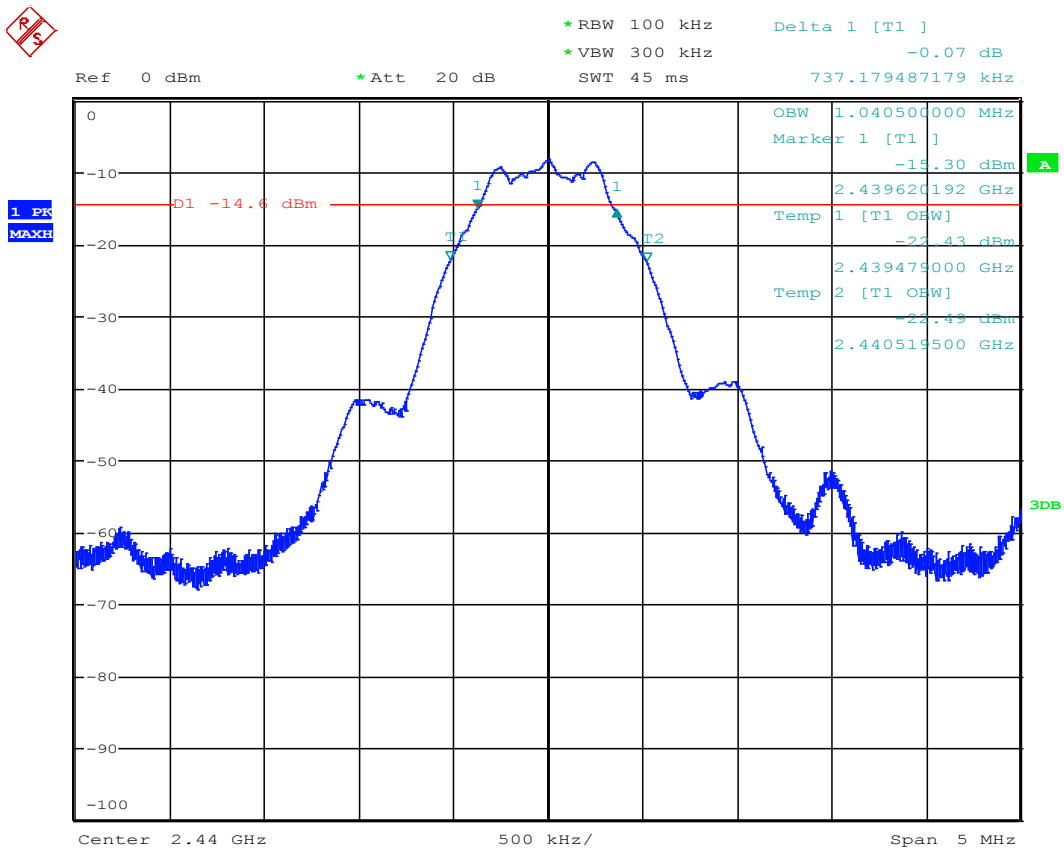
6dB & 99% Bandwidth: Ch. Mid, 2440 MHz



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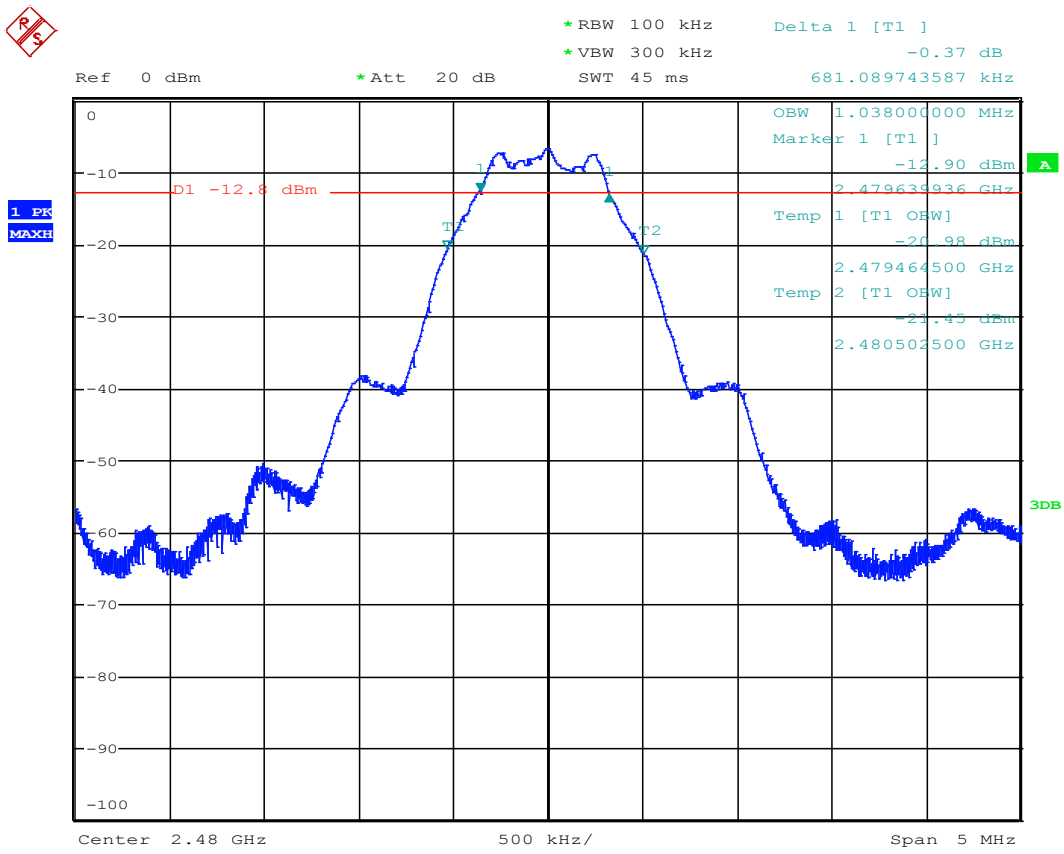
6dB & 99% Bandwidth: Ch. High, 2480 MHz



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11 Transmitter Spurious Emissions- Radiated

11.1 Limits:

§15.209/15.205 & RSS-GEN Issue 4. Sections 8.9 and 8.10

(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

11.2 Test Result:

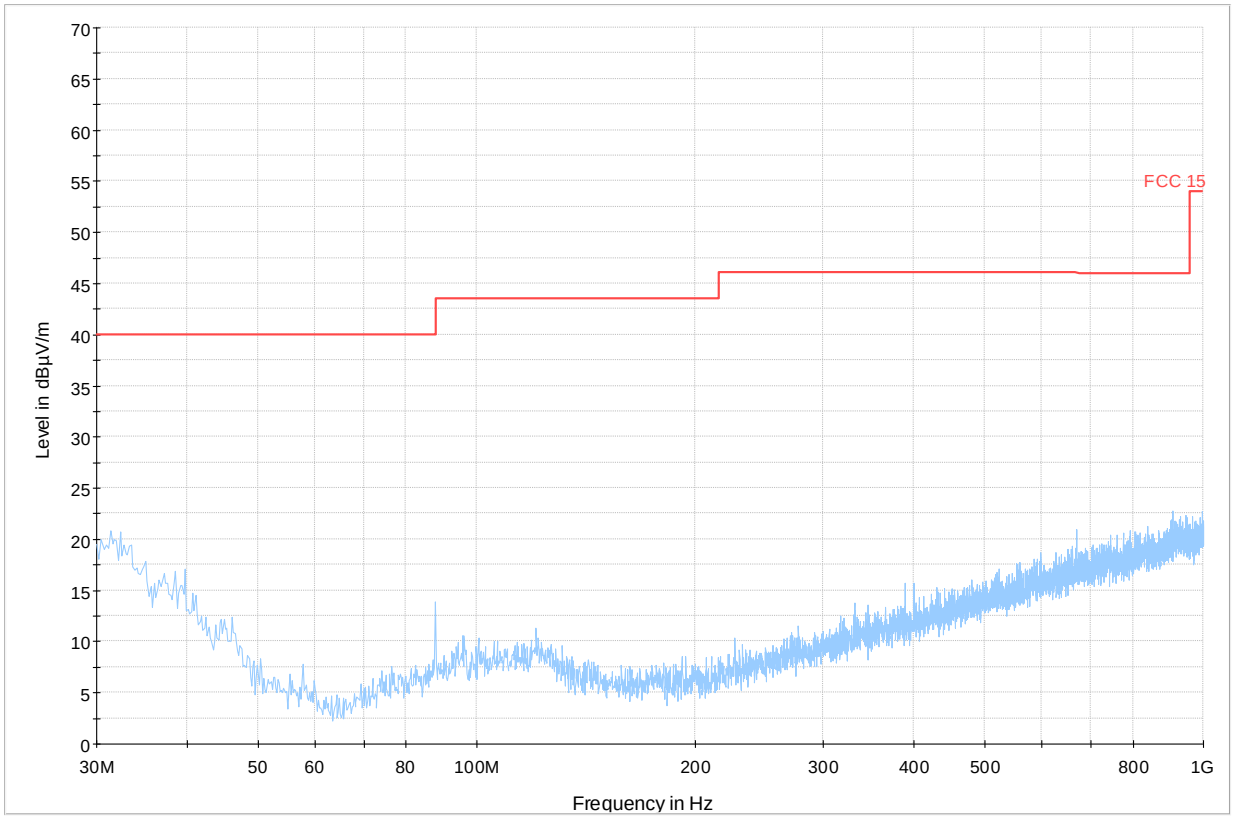
Modulation: GFSK.
Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.
Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.
Measurement Uncertainty: ±3.0dB

11.3 Measurement Verdict:

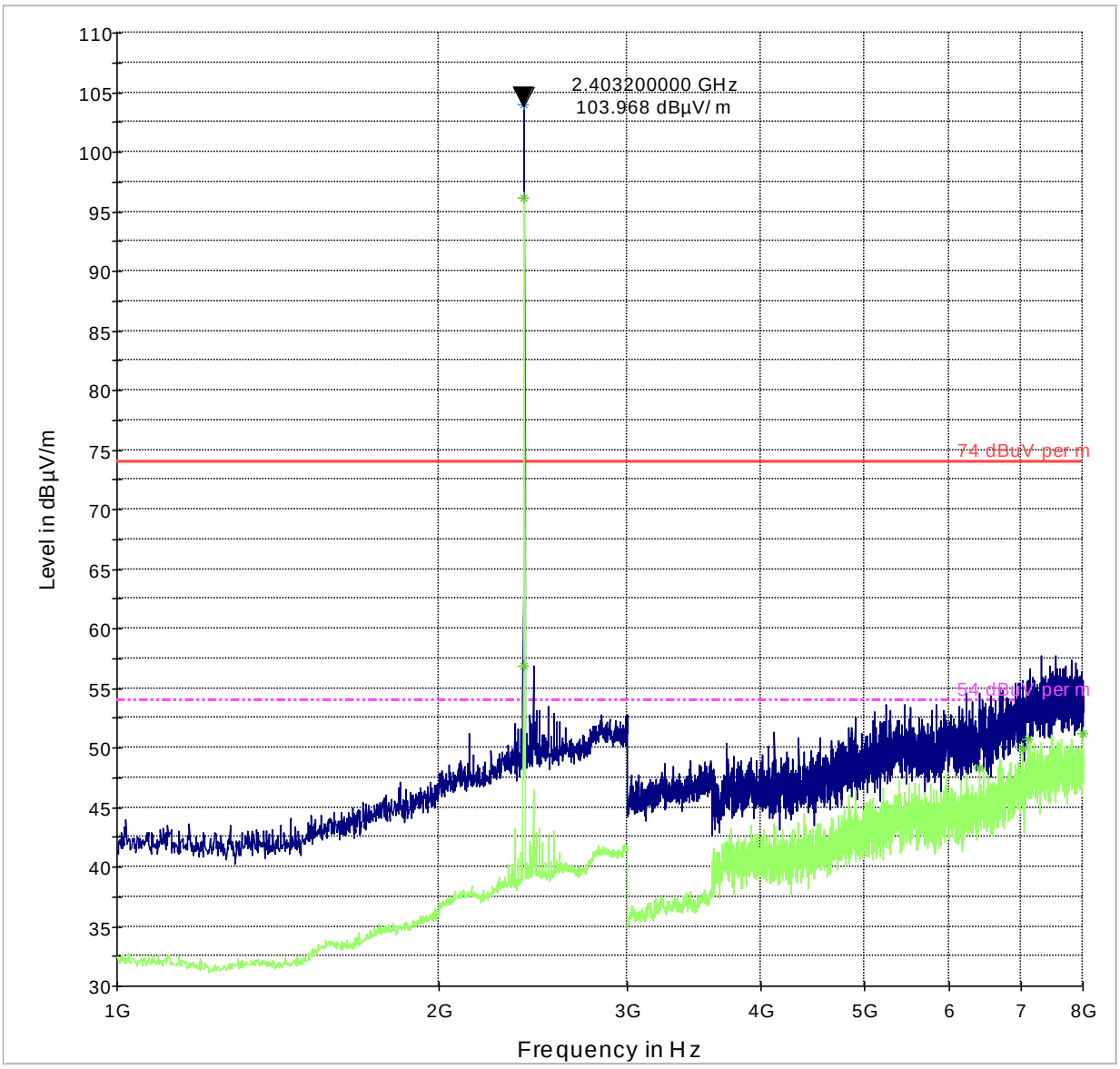
Pass.

11.4 Measurement Plots: 2.4 GHz Band

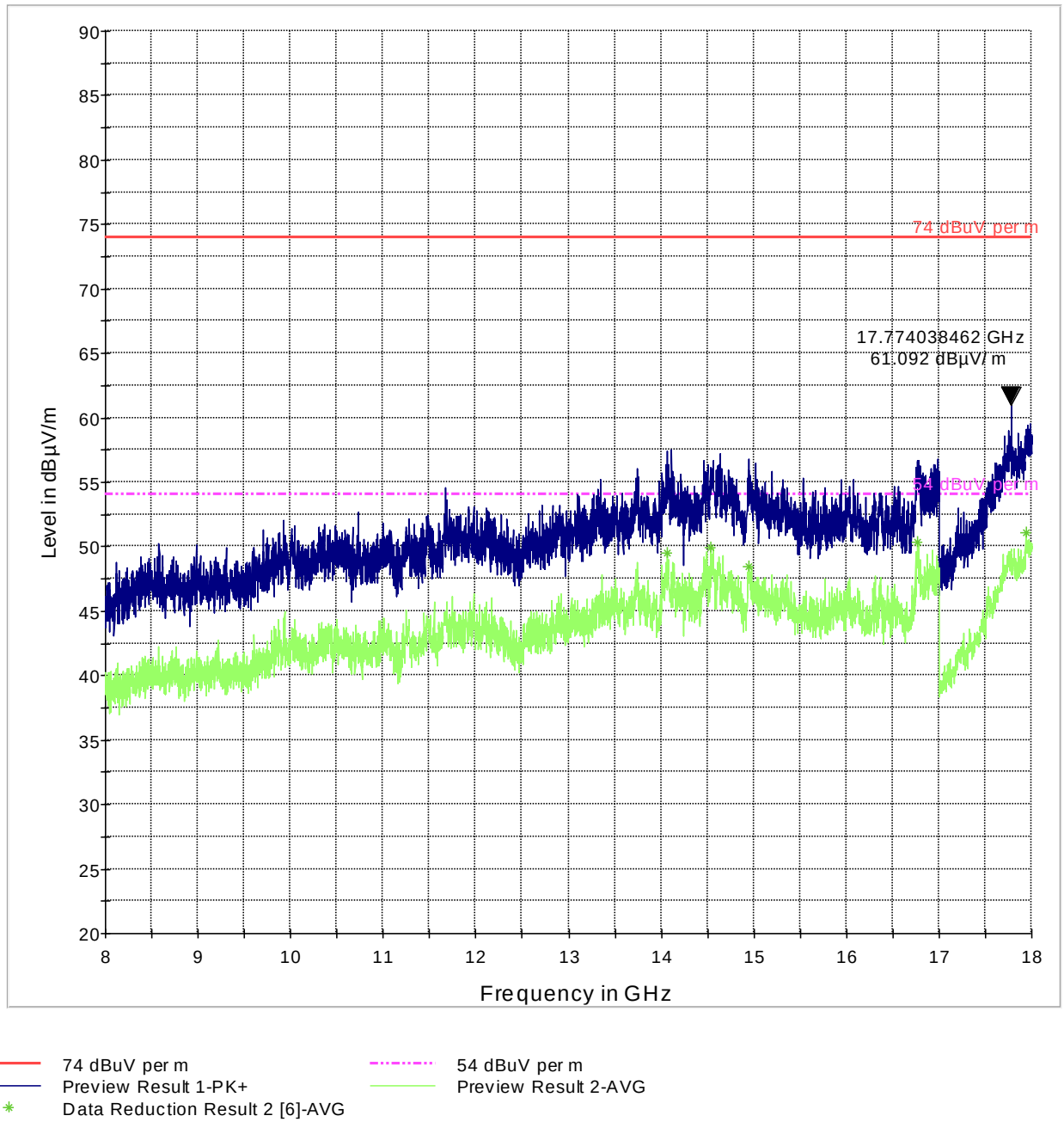
Transmitter Radiated Spurious Emission, 30 MHz – 1 GHz: Ch. Low



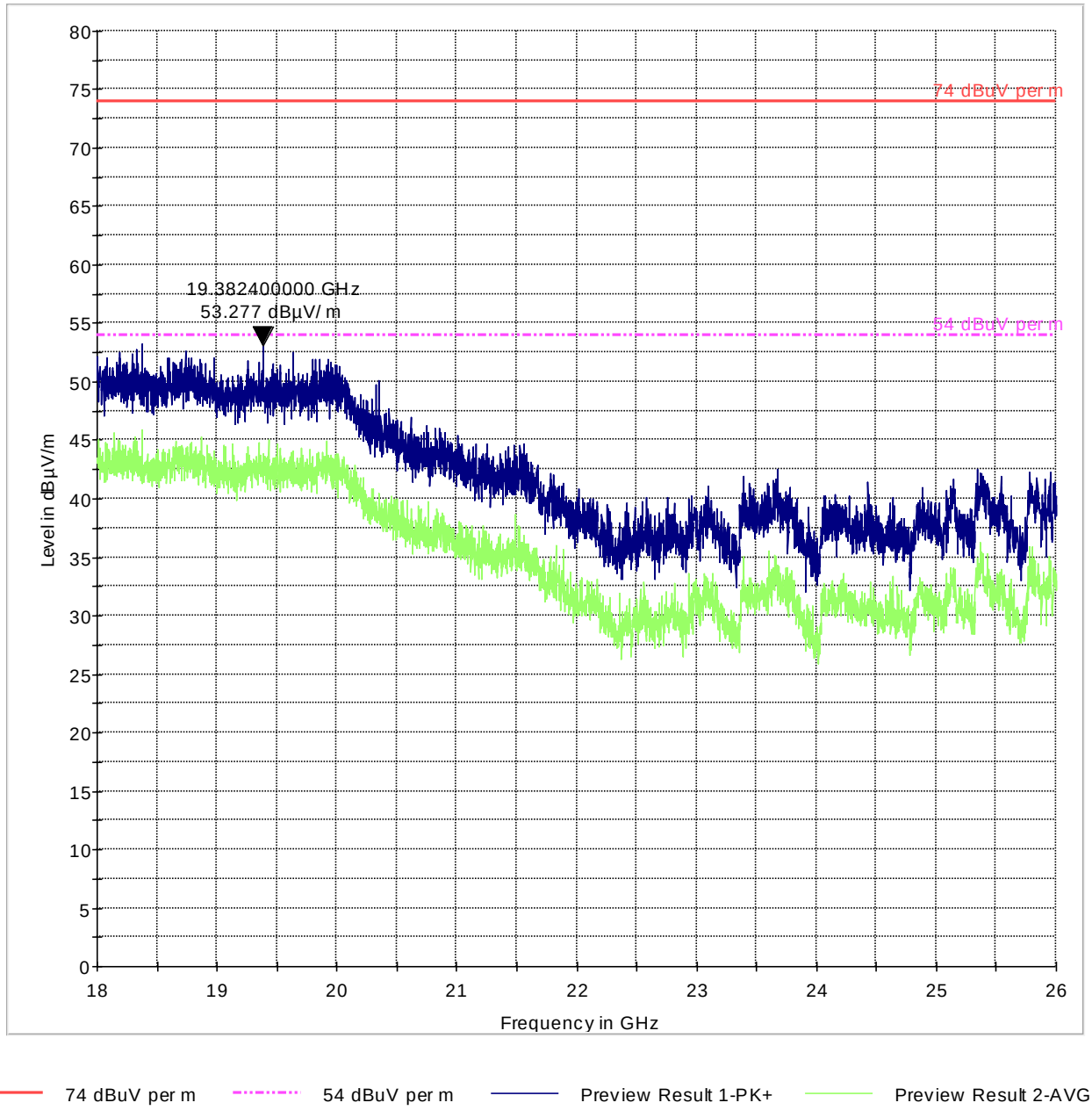
Transmitter Radiated Spurious Emission, 1 GHz – 8 GHz: Ch. Low



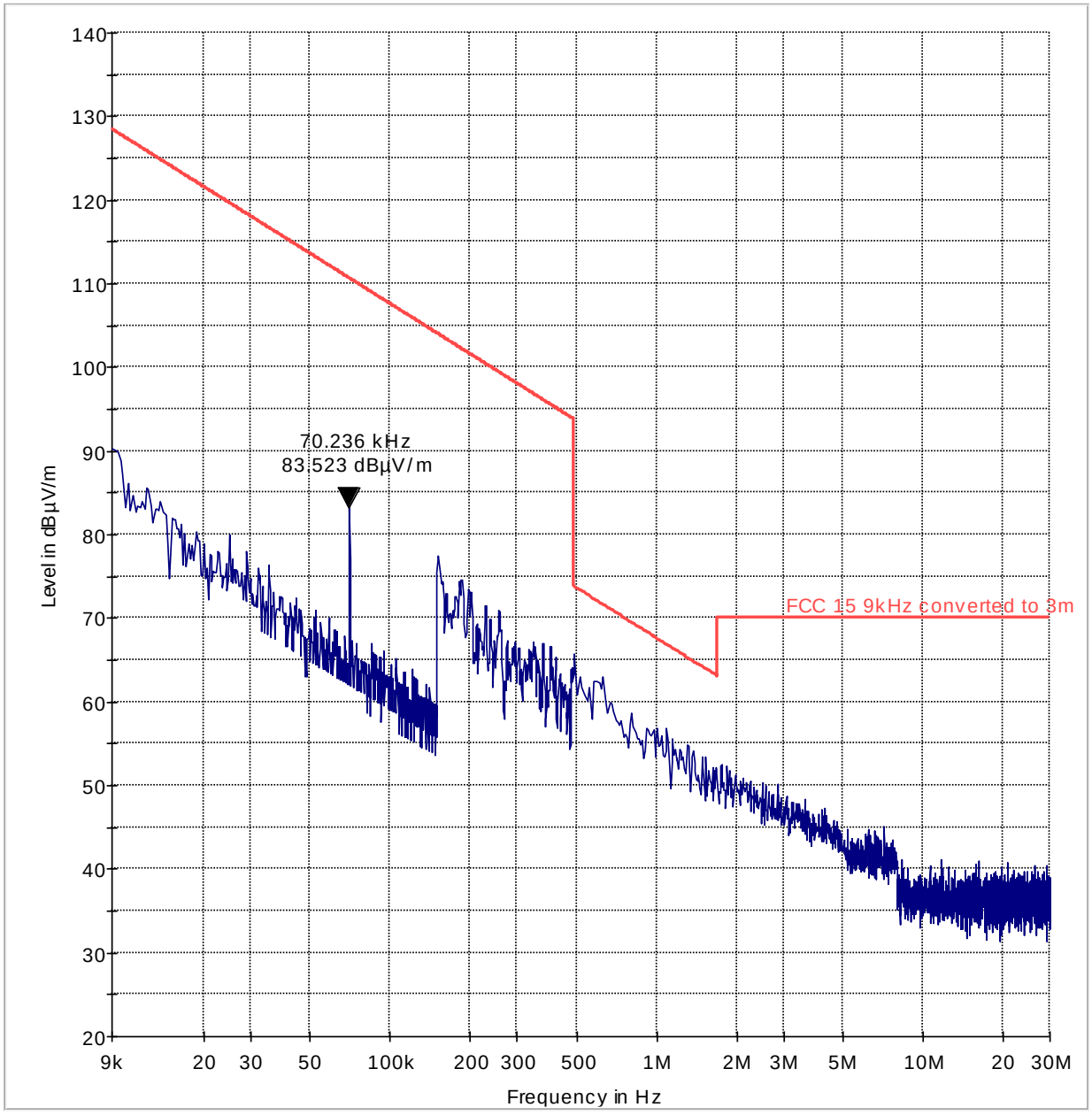
Transmitter Radiated Spurious Emission: 8 GHz – 18 GHz: Ch. Low



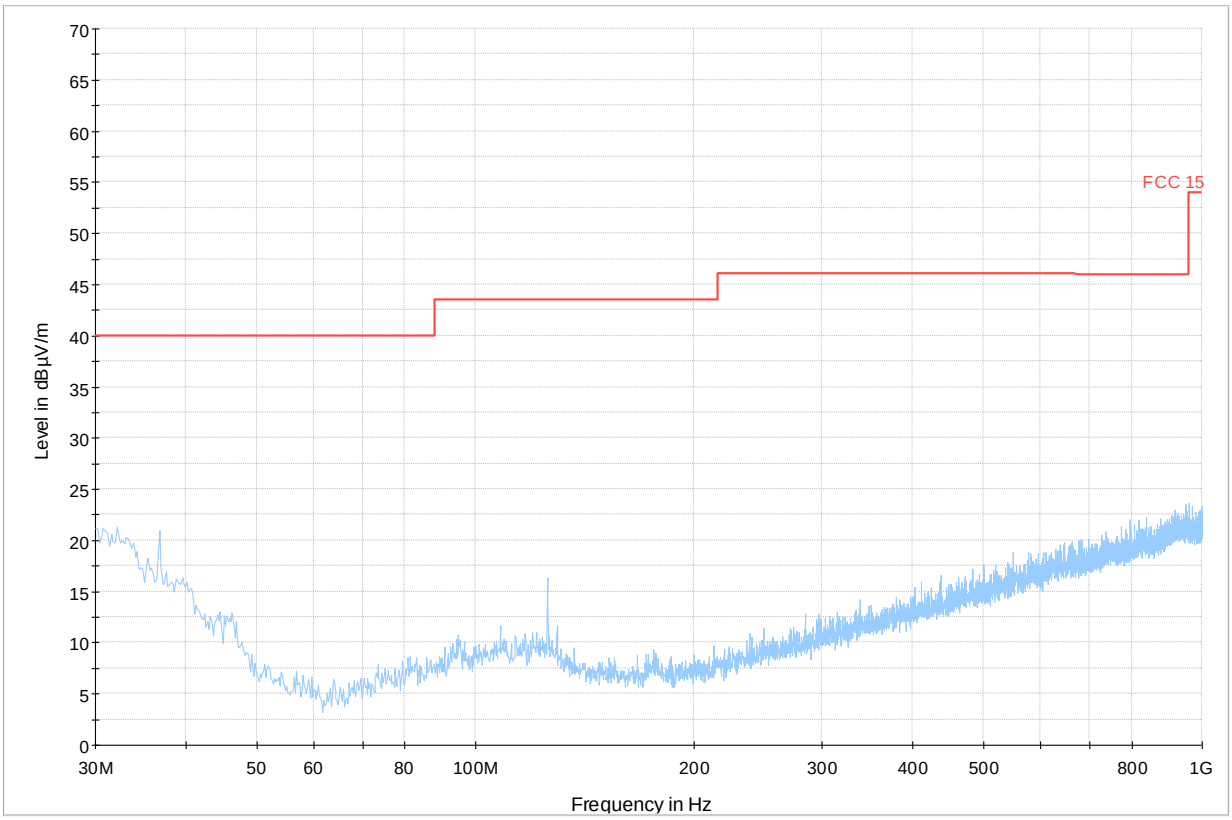
Transmitter Radiated Spurious Emission, 18 GHz – 26 GHz: Ch. Low



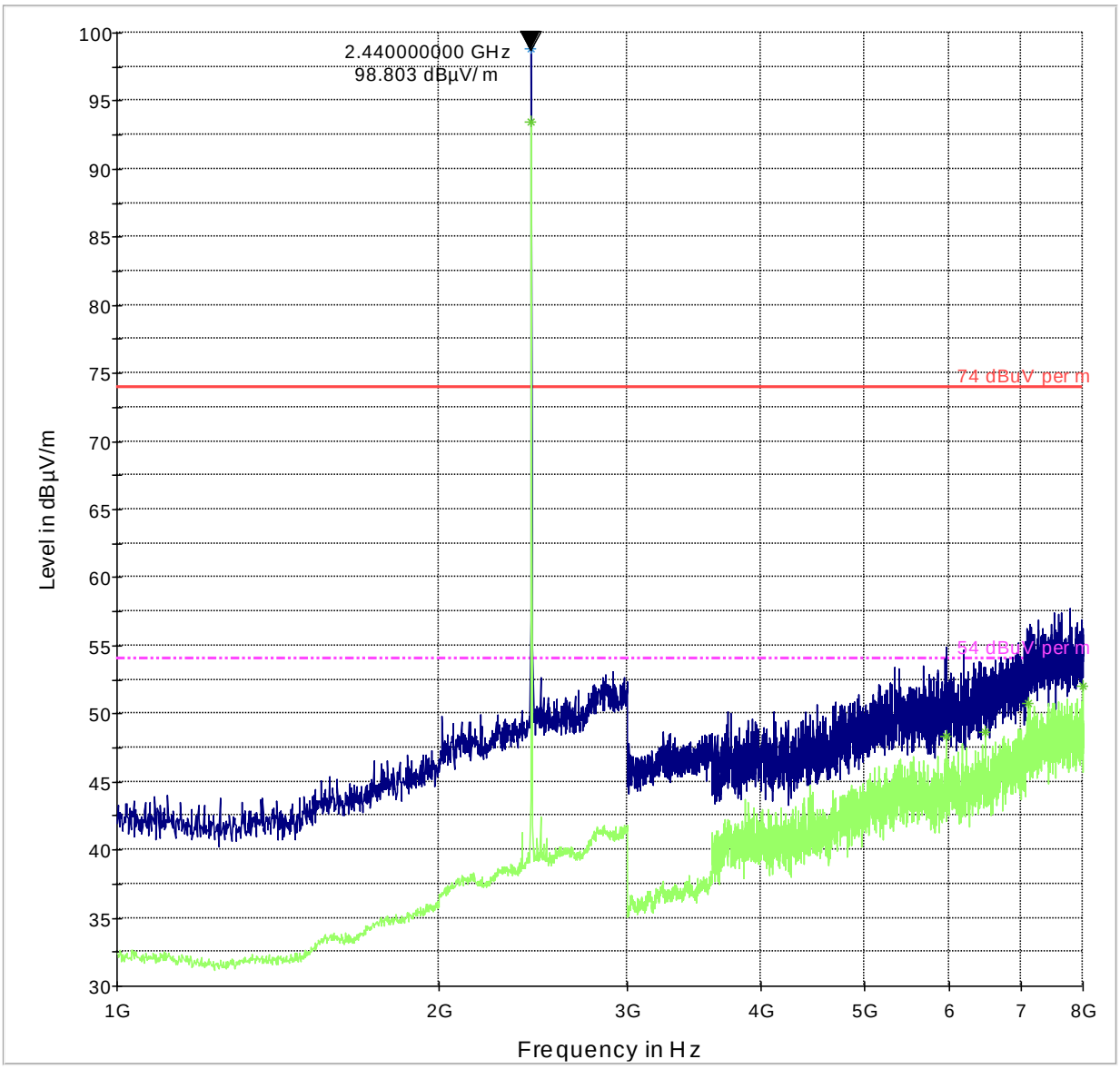
Transmitter Radiated Spurious Emission, 9 kHz – 30 MHz: Ch. Mid



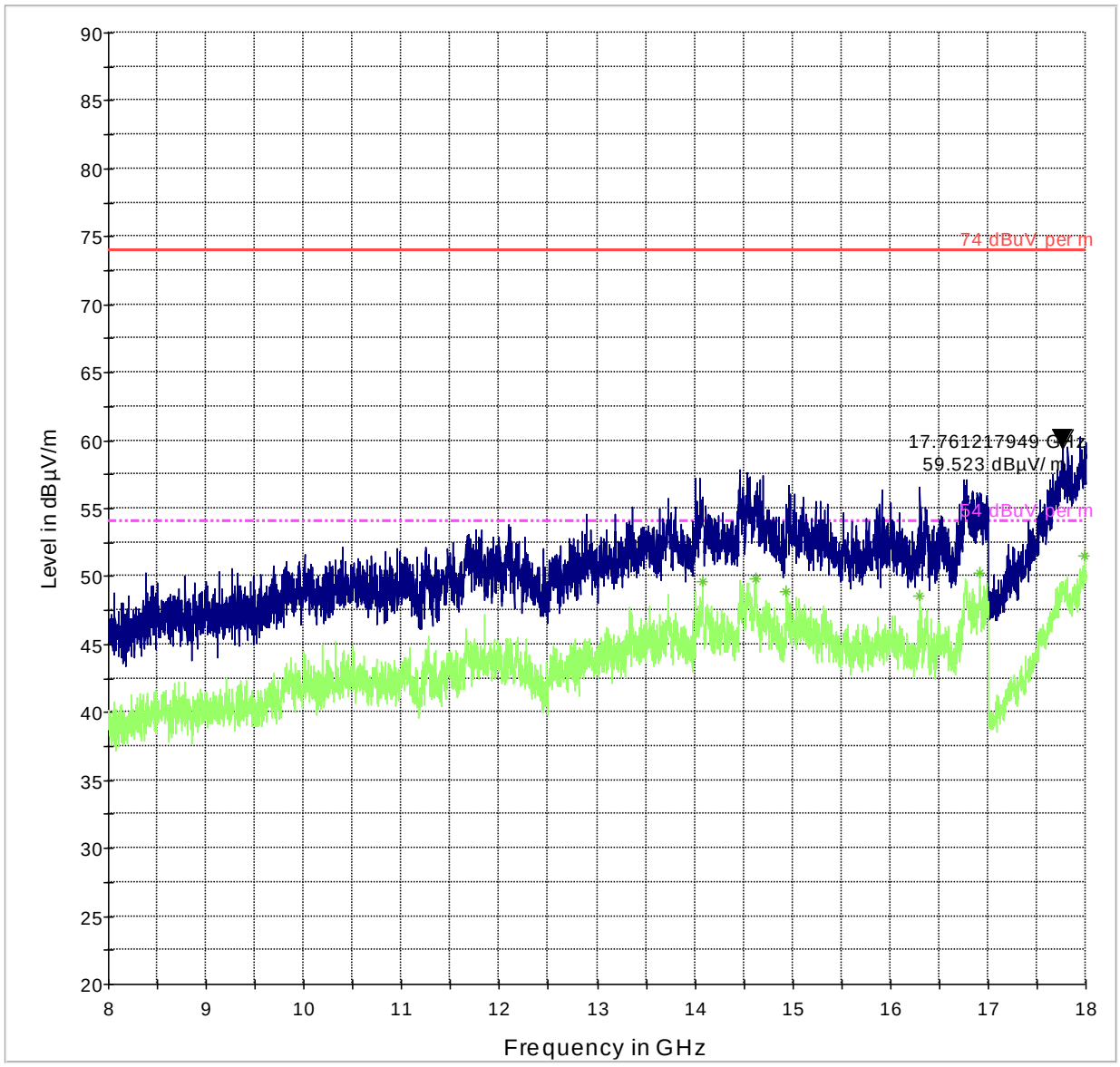
Transmitter Radiated Spurious Emission, 30 MHz – 1GHz: Ch. Mid



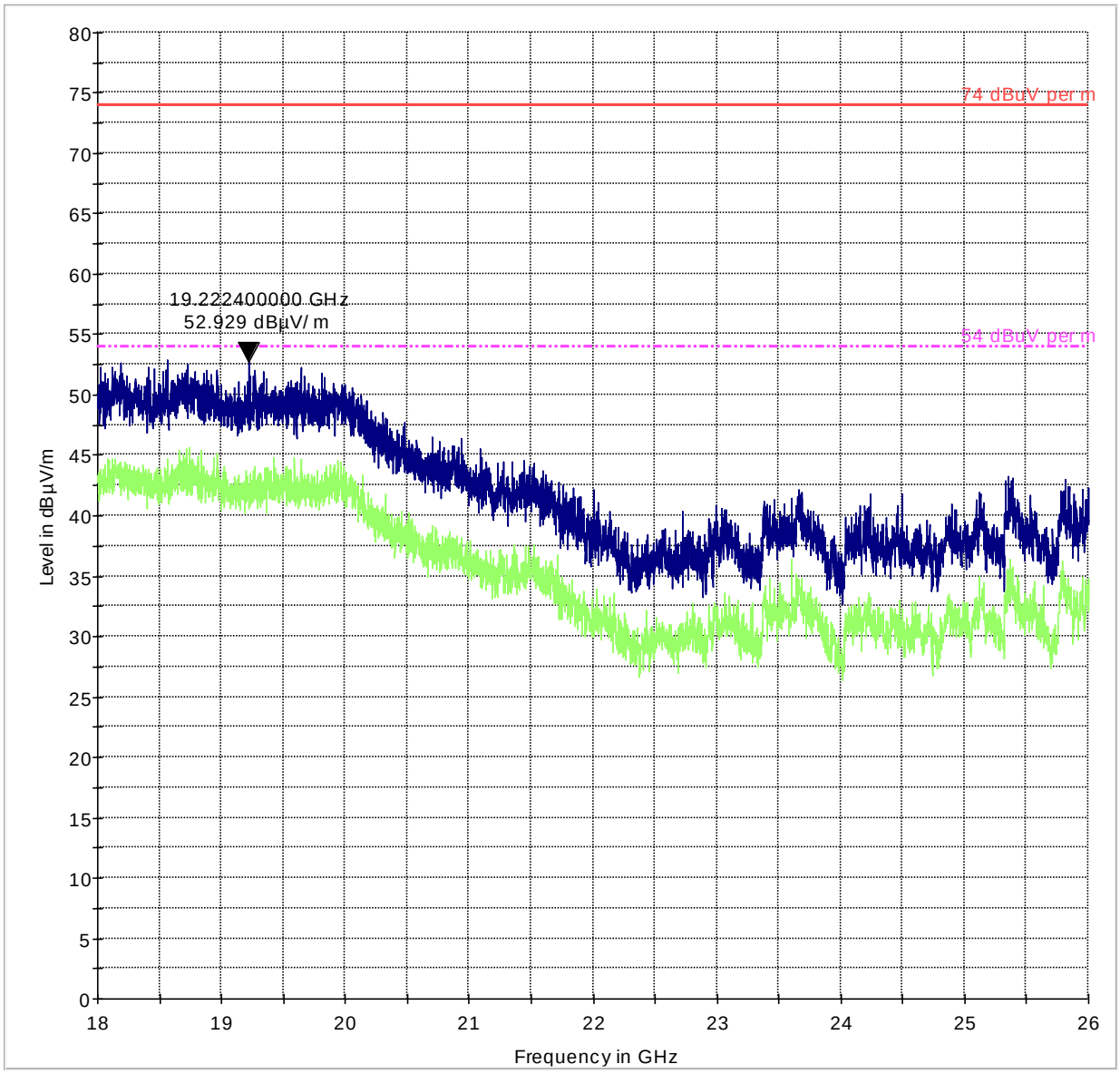
Transmitter Radiated Spurious Emission, 1 GHz – 8 GHz: Ch. Mid



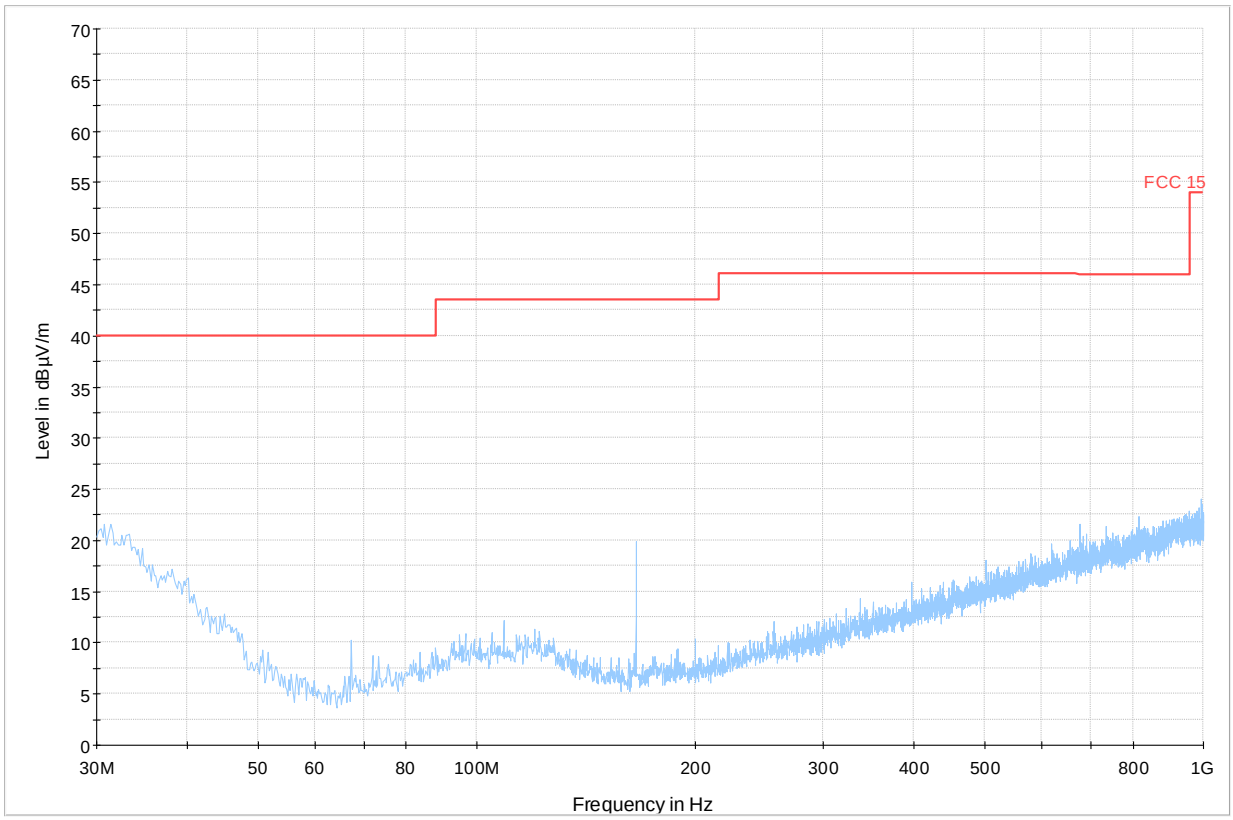
Transmitter Radiated Spurious Emission, 8 GHz – 18 GHz: Ch. Mid



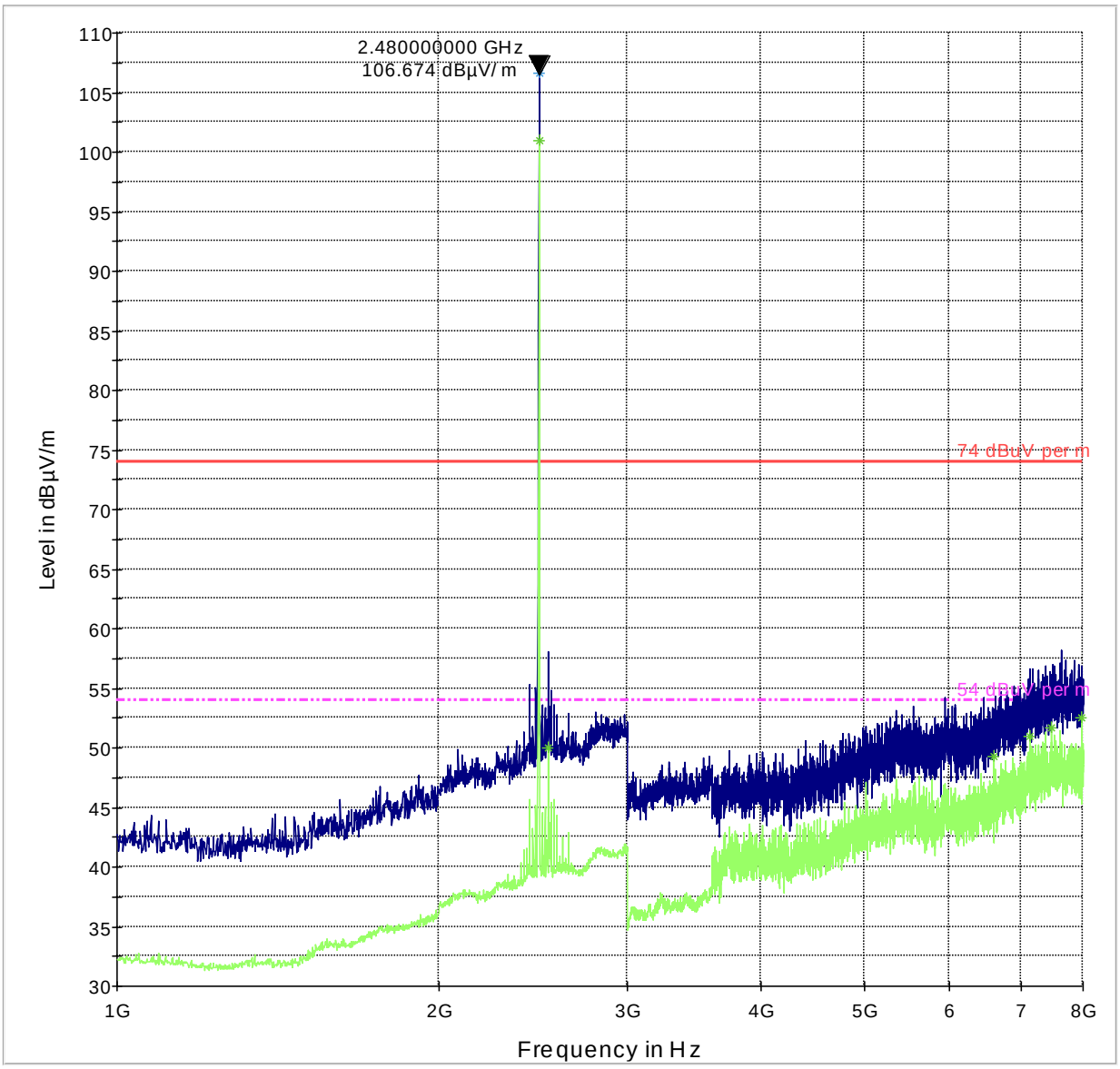
Transmitter Radiated Spurious Emission, 18 GHz – 26 GHz Ch. Mid



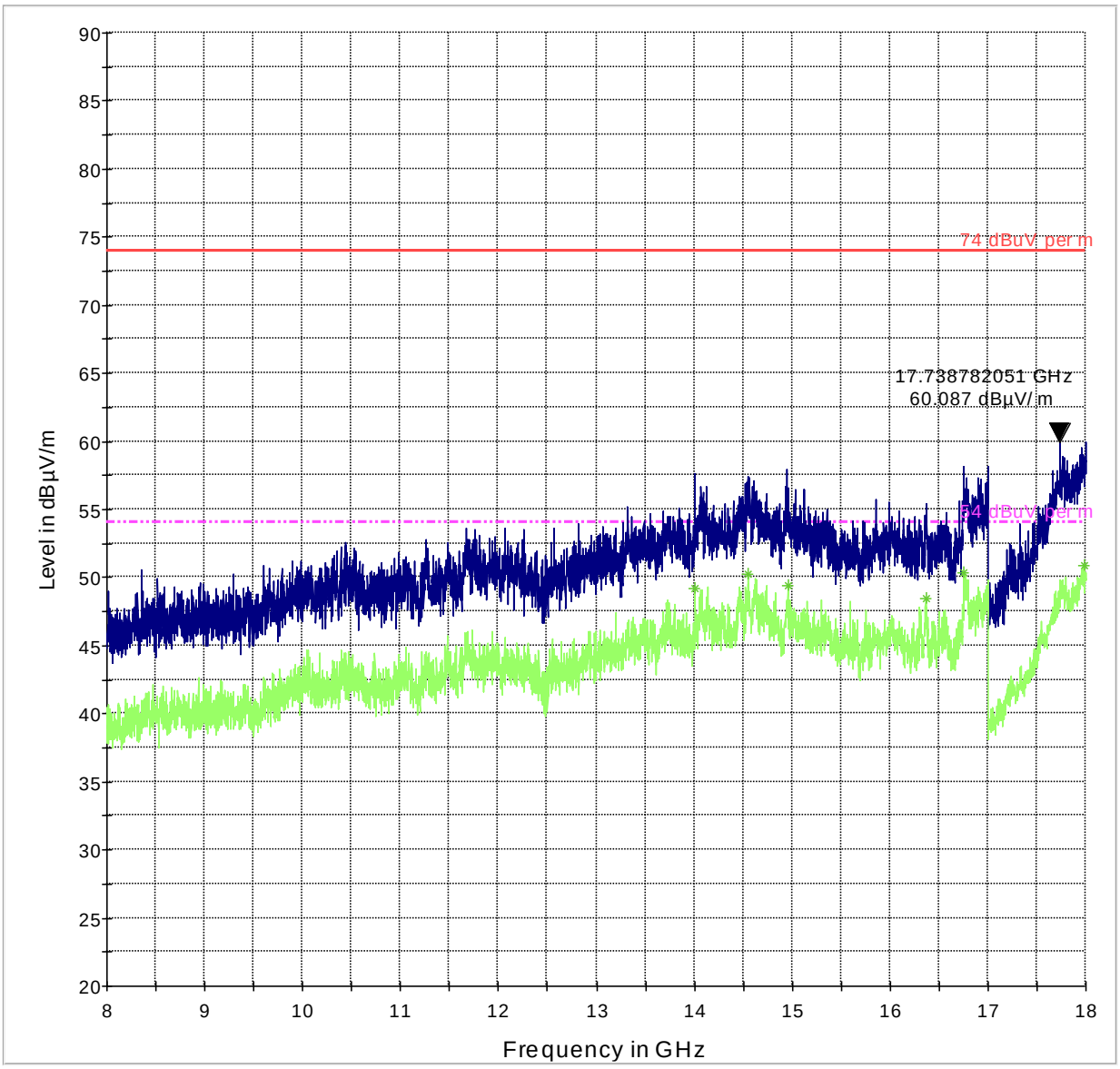
Transmitter Radiated Spurious Emission, 30 MHz – 1GHz: Ch. High



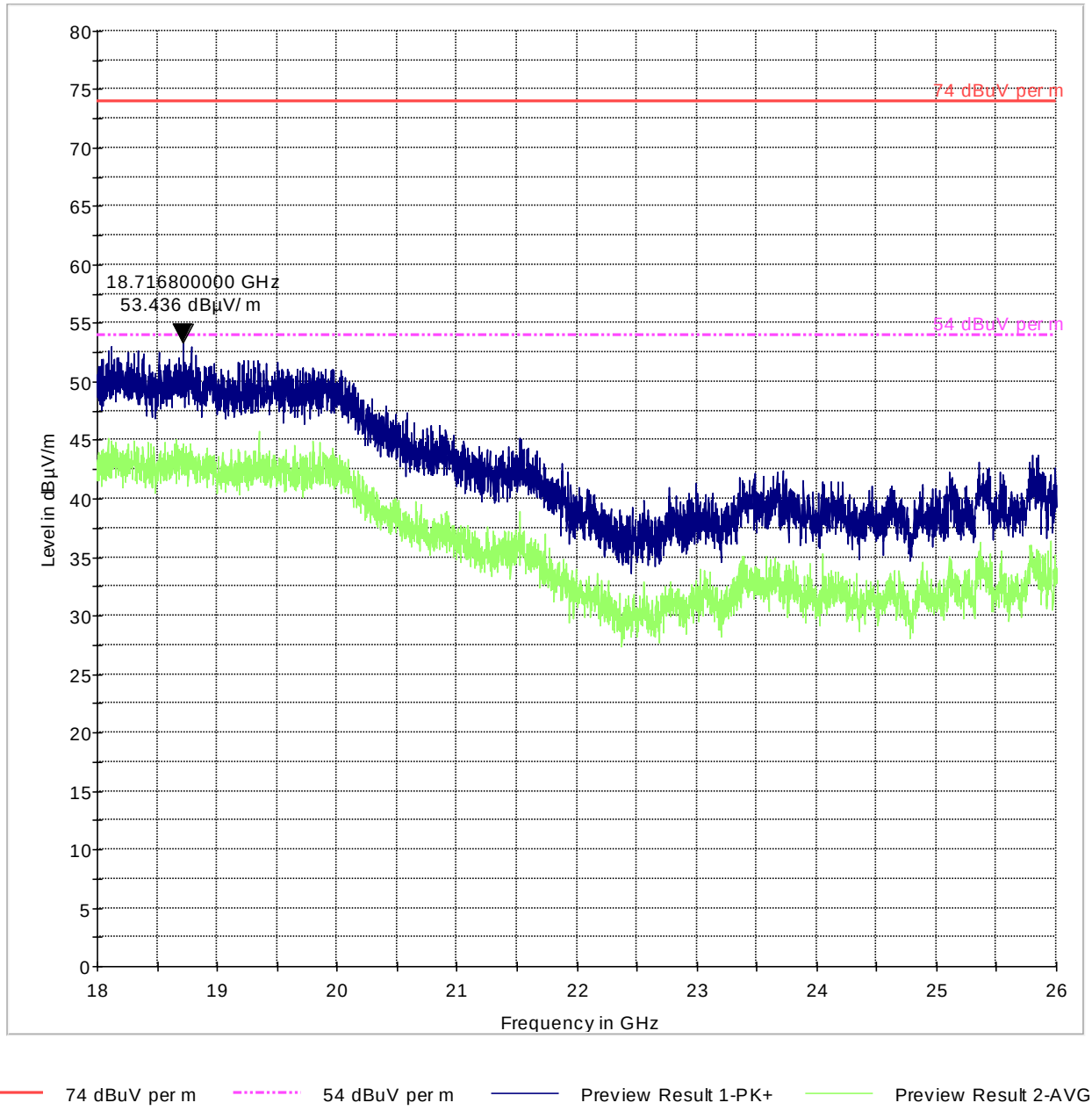
Transmitter Radiated Spurious Emission, 1 GHz – 8 GHz: Ch. High



Transmitter Radiated Spurious Emission, 8 GHz – 18 GHz: Ch. High



Transmitter Radiated Spurious Emission, 18 GHz – 26 GHz: Ch. High



12 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turn table	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	Sept 2013	2 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	Jun 2013	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
	LISN	Rohde and Schwarz	ESV 216	101129	Mar 2013	2 years
Ancillary equipment						
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A
	Signal Generator	Agilent	83712B	US37101255	N/A	N/A
	Power Splitter	Agilent	11667B	52565	N/A	N/A
	Temp Hum Logger	TM325	Dickson	5285354	Apr 2014	1 Year
	Climatic Chamber	Votsch	VT4004	G1115	N/A	N/A

13 Revision History

Date	Report Name	Changes to report	Report prepared by
12/10/14	**EMC_CSRT-002-14001_FCC15_247**	**Final**	**YHO**