



FCC/IC Test Report

FOR:

Model Name: 01102436

Connected Personal Navigation Device

FCC ID: IPH-01102436

IC ID: 1792A-01102436

47 CFR Part 15.247 for FHSS Systems

IC RSS-210 Issue 7

TEST REPORT #: EMC_GARMI_023_10001_15.247BT_rev1

DATE: 2010-07-02



**FCC listed
A2LA Accredited**

**IC recognized #
3462B**

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TABLE OF CONTENTS

1	Assessment	4
2	Administrative Data	5
2.1	Identification of the Testing Laboratory Issuing the EMC Test Report	5
2.2	Identification of the Client	5
2.3	Identification of the Manufacturer	5
3	Equipment under Test (EUT)	6
3.1	Specification of the Equipment under Test	6
3.2	Identification of the Equipment Under Test (EUT)	7
3.3	Identification of Accessory equipment	7
4	Subject Of Investigation	8
5	Measurements	9
5.1	Radiated Measurement Procedure	9
5.2	Conducted Measurement Procedure	12
5.3	Maximum Peak Output Power	13
5.3.1	Limits:	13
5.3.2	Test Conditions:	13
5.3.3	Test Result:	13
5.3.4	Test Data/plots:	14
5.4	Restricted Band Edge Compliance	23
5.4.1	Limits: §15.247/15.205	23
5.4.2	Test Data/plots:	24
5.5	Spectrum Bandwidth/ 20dB Bandwidth	36
5.5.1	Limits:	36
5.5.2	Test Result:	36
5.5.3	Test Data/plots:	37
5.6	Carrier Frequency Separation	46
5.6.1	Limits:	46
5.6.2	Test Result:	46
5.6.3	Test Data/plot:	46
5.7	Number of hopping channels	47
5.7.1	Limits:	47
5.7.2	Test Result:	47
5.7.3	Test Data/plot:	47
5.8	Time of occupancy (Dwell time)	52
5.8.1	Limits:	52
5.8.2	Test Result:	52
5.9	Power Spectral Density (Hybrid system in Inquiry mode/ Page scan)	52
5.9.1	Limits: § 15.247 (e)	52
5.9.2	Test Result:	52



5.10	Transmitter Spurious Emissions- Conducted	53
5.10.1	Limits:	53
5.10.2	Test Conditions:	53
5.10.3	Test data/ plots:	53
5.10.4	Test data/ plots:	54
5.11	Transmitter Spurious Emissions- Radiated	57
5.11.1	Limits:	57
5.11.2	Limits: §15.209	57
5.11.3	Limits: §15.209	58
5.11.4	Test Result:	58
5.11.5	Test data/ plots:	59
5.12	Receiver Spurious Emissions- Radiated	68
5.12.1	Limits: §15.109	68
5.12.2	Test Conditions:	68
5.12.3	Test Result:	68
5.12.4	Test data/ plots:	69
5.13	AC POWER LINE CONDUCTED EMISSIONS § 15.107/207	71
5.13.1	LIMITS	71
6	<i>Test Equipment and Ancillaries used for tests</i>	73
7	<i>BLOCK DIAGRAMS</i>	74
8	<i>Revision History</i>	76



1 Assessment

The following is in compliance with 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 7.

Company	Description	Model #
Garmin International	Connected Personal Navigation Device	01102436

Responsible for Testing Laboratory:

2010-07-02 Compliance Marc Douat
 (Test Lab Manager)

Date	Section	Name	Signature
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Responsible for the Report:

2010-07-02 Compliance Satya Radhakrishna
 (EMC Project Engineer)

Date	Section	Name	Signature
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The test results of this test report relate exclusively to the test item specified in Section 3. 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 the CETECOM Inc USA.



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
Responsible Test Lab Director:	Heiko Strehlow
Responsible Project Leader:	Satya Radhakrishna

2.2 Identification of the Client

Applicant's Name:	Garmin International
Street Address:	1500 E 151 st Street
City/Zip Code	Olathe, KS, 66062
Country	USA
Contact Person:	Van Ruggles
Phone No.	913.440.2278
Fax:	913.397.8282
e-mail:	van.ruggles @garmin.com

2.3 Identification of the Manufacturer

Same as above

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name:	nüvi 1695
Model No:	01102436
Product Type:	Connected Personal Navigation Device
Hardware Revision :	3
Software Revision :	2.00
FCC-ID:	IPH-01102436
IC-ID :	1792A-01102436
Frequency:	ISM Band 2400-2483.5 MHz
Type(s) of Modulation:	GFSK, $\pi/4$ DQPSK, 8- DPSK (FHSS)
Number of channels:	79
Antenna Type:	2.2 dBi peak gain
Equipment Classification:	<input type="checkbox"/> Fixed <input type="checkbox"/> Vehicular <input checked="" type="checkbox"/> Portable <input type="checkbox"/> Module
Power Supply:	Car Charger: Output 4.75-5.25 V/2A/ internal 3.7V Li-ion battery
Temperature Range:	-20°C to 55°C



3.2 Identification of the Equipment Under Test (EUT)

EUT #	Model Number	HW Version	SW Version	Serial Number
1	01102436	3	2.00	IYK000064
2	01102436	3	2.00	IYK000057

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number
1	Car charger	Garmin	320-00239-50	Unknown
2	AC adapter	Garmin	PSA/05R-050Q	Z10150553A1



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 7. The device was tested according to measurement guideline stated in FCC public notice DA 00-705 which lists the Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

This test report is to support a request for new equipment authorization under the FCC ID **IPH-01102436** and IC ID **1792A-01102436**.

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 FCC15.247. Radiated tests were performed on EUT#1 with AE#1 with the exception of test in section 5.13, AC power line conducted emissions which was performed on EUT#1 and AE#2. Conducted tests were performed on EUT#2 with AE#1.

During the testing process the EUT was tested on a single channel using PRBS payload using DH5, 2DH5 or 3DH5 packets, all data in this report shows the worst case between horizontal and vertical polarization measurements.

5 Measurements

5.1 Radiated Measurement Procedure

The device was tested according to measurement guideline stated in FCC public notice DA 00-705 which lists the Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems as well as the procedures stated below.

ANSI C63.4 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 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.

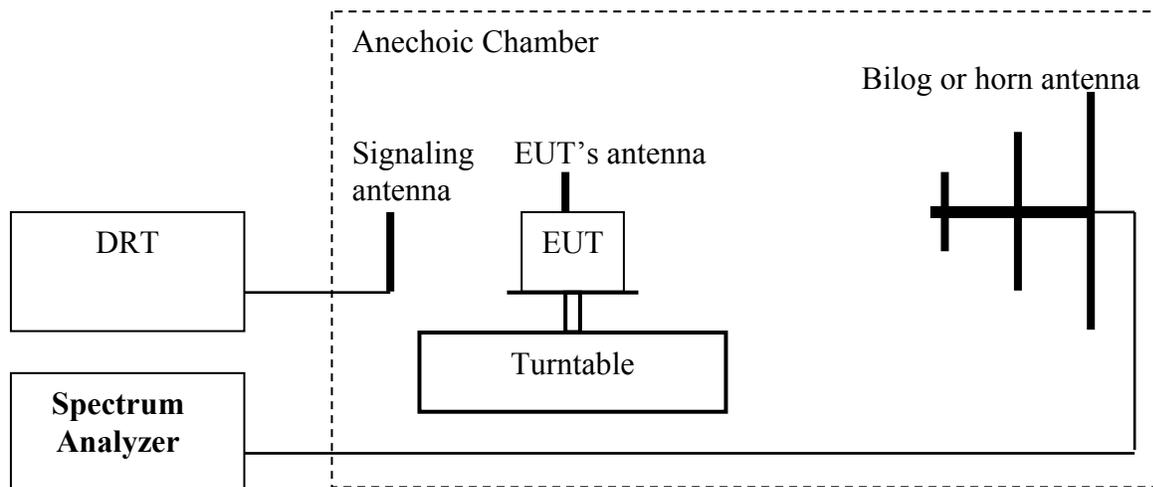
This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on 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.

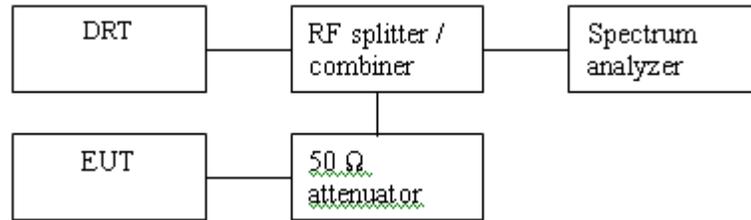
Ref: TIA-603C 2004 -2.2.17.2 Effective Radiated Power (ERP) or Effective Isotropic Radiated Power (EIRP)



1. Connect the equipment as shown in the above diagram with the EUT's antenna in a vertical orientation.
2. Adjust the settings of the Digital RadioCommunication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Set the spectrum analyzer to the channel frequency. Set the analyzer to measure peak hold with the required settings.
4. Rotate the EUT 360°. Record the peak level in dBm (**LVL**).
5. Replace the EUT with a vertically polarized half wave dipole or known gain antenna. The center of the antenna should be at the same location as the center of the EUT's antenna.
6. Connect the antenna to a signal generator with known output power and record the path loss in dB (**LOSS**). **LOSS** = Generator Output Power (dBm) – Analyzer reading (dBm).
7. Determine the ERP using the following equation:
ERP (dBm) = LVL (dBm) + LOSS (dB)
8. Determine the EIRP using the following equation:
EIRP (dBm) = ERP (dBm) + 2.14 (dB)
9. Measurements are to be performed with the EUT set to the low, middle and high channels.

Spectrum analyzer settings: RBW=VBW=3MHz

5.2 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the Digital RadioCommunication Tester (DRT) to set the EUT to its maximum power at the required channel.
3. Measurements are to be performed with the EUT set to the low, middle and high channels.



5.3 Maximum Peak Output Power

5.3.1 Limits:

§15.247 (b)(1)

RSS 210- A8.4(2)

Nominal Peak Output Power < 30 dBm (1W)

5.3.2 Test Conditions:

Tnom: 23°C; Vnom: 5 V

RBW=VBW=3MHz

5.3.3 Test Result:

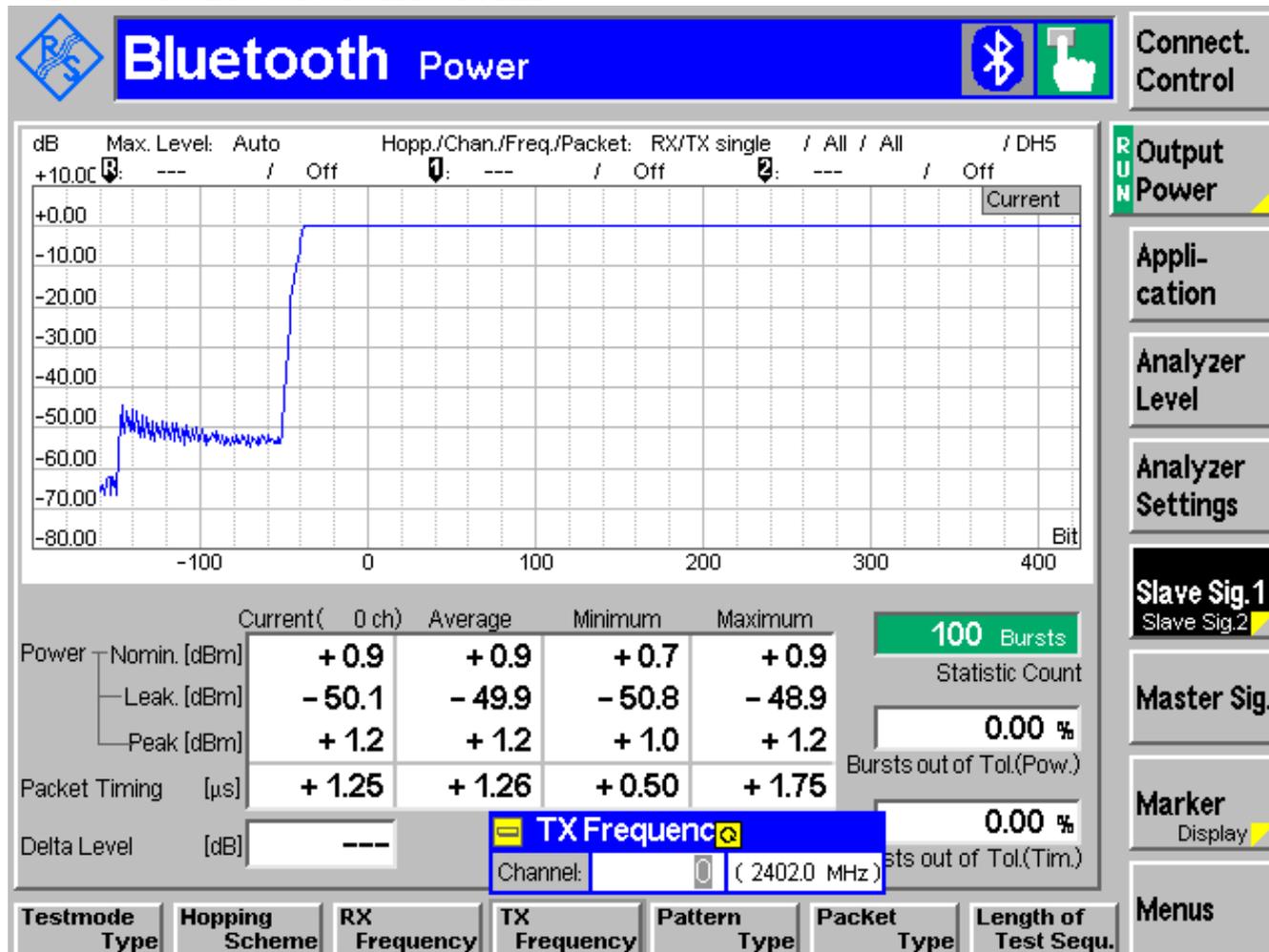
Max Peak Output Power- Conducted (dBm)			
Modulation	Frequency (MHz)		
	2402	2441	2480
GFSK	1.2	1.3	0.9
$\pi/4$ DQPSK	0.5	0.7	0.1
8-DPSK	0.5	0.8	0.2
Measurement Uncertainty: ± 0.5 dB			

EIRP values are calculated by adding antenna gain to the Peak Conducted Power values.
 EIRP =Antenna Gain (dBi) + Conducted Peak Power (dBm) / Antenna Gain=2.2 dBi

Max Peak Output Power- Radiated (dBm)			
Modulation	Frequency (MHz)		
	2402	2441	2480
GFSK	3.4	3.5	3.1
$\pi/4$ DQPSK	2.7	2.9	2.3
8-DPSK	2.7	3.0	2.4
Measurement Uncertainty: ± 3 dB			

5.3.4 Test Data/plots:

Conducted Peak Power GFSK 2402 MHz





Conducted Peak Power GFSK 2441 MHz

Bluetooth Power
📶
👆

dB Max. Level: Auto Hopp./Chan./Freq./Packet: RX/TX single / All / All / DH5

+10.00 --- / Off 0: --- / Off 2: --- / Off

Current

	Current(39 ch)	Average	Minimum	Maximum	
Power Nomin. [dBm]	+ 1.1	+ 1.1	+ 0.9	+ 1.1	<div style="background-color: #008000; color: white; padding: 2px; display: inline-block; font-weight: bold;">100</div> Bursts Statistic Count
Leak. [dBm]	- 54.7	- 55.0	- 56.0	- 54.1	
Peak [dBm]	+ 1.3	+ 1.3	+ 1.1	+ 1.3	
Packet Timing [μs]	+ 1.25	+ 1.33	+ 0.75	+ 1.75	0.00 % Bursts out of Tol.(Pow.)
Delta Level [dB]	---				0.00 % Bursts out of Tol.(Tim.)

TX Frequency
🔍

Channel: (2441.0 MHz)

Testmode Type
Hopping Scheme
RX Frequency
TX Frequency
Pattern Type
Packet Type
Length of Test Sequ.

RUN

Output Power

Appli-
cation

Analyzer
Level

Analyzer
Settings

Slave Sig.1

Slave Sig.2

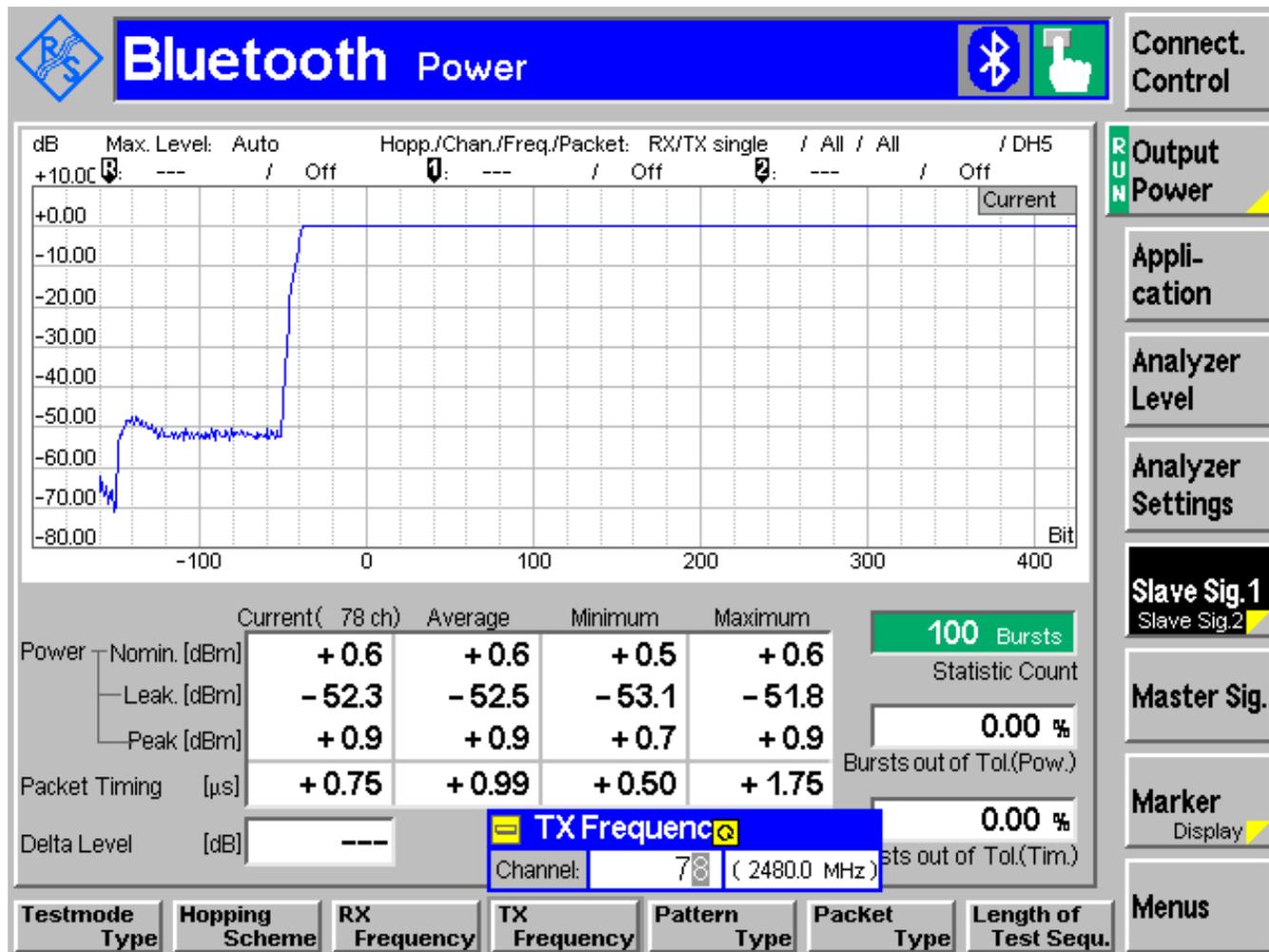
Master Sig.

Marker
Display

Menus



Conducted Peak Power GFSK 2480 MHz



Conducted Peak Power $\pi / 4$ DQPSK 2402 MHz

Bluetooth Power

dB Max. Level: Auto Hopp./Chan./Freq./Packet: RX/TX single / All / All / 2-DH5
 +10.00 --- / Off 0: --- / Off 2: --- / Off

Current

	Current (0 ch)	Average	Minimum	Maximum
Power Nomin. [dBm]	-2.1	-2.1	-2.1	-2.0
Leak. [dBm]	-45.9	-45.8	-46.3	-45.3
Peak [dBm]	+0.4	+0.3	+0.1	+0.5
Packet Timing [μs]	+0.75	+0.86	+0.25	+1.25
Delta Level [dB]	---			

100 Bursts
Statistic Count
0.00 %
Bursts out of Tol.(Pow.)
0.00 %
Bursts out of Tol.(Tim.)

TX Frequency

 Channel: 0 (2402.0 MHz)

Testmode Type

Hopping Scheme

RX Frequency

TX Frequency

Pattern Type

Packet Type

Length of Test Sequ.

Connect. Control

Output Power

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

Master Sig.

Marker Display

Menus

Conducted Peak Power $\pi / 4$ DQPSK 2441 MHz

Bluetooth Power

dB Max. Level: Auto Hopp./Chan./Freq./Packet: RX/TX single / All / All / 2-DH5

 On / Off
 On / Off
 On / Off

	Current (39 ch)	Average	Minimum	Maximum
Power Nomin. [dBm]	-1.9	-1.9	-1.9	-1.9
Leak. [dBm]	-44.1	-44.2	-44.6	-43.9
Peak [dBm]	+0.7	+0.5	+0.3	+0.7
Packet Timing [μs]	+0.50	+0.59	+0.00	+1.00
Delta Level [dB]	---			

100 Bursts

Statistic Count

0.00 %

Bursts out of Tol.(Pow.)

0.00 %

Bursts out of Tol.(Tim.)

TX Frequency

Channel: 39 (2441.0 MHz)

Testmode Type
Hopping Scheme
RX Frequency
TX Frequency
Pattern Type
Packet Type
Length of Test Sequ.

Connect. Control

Output Power

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1

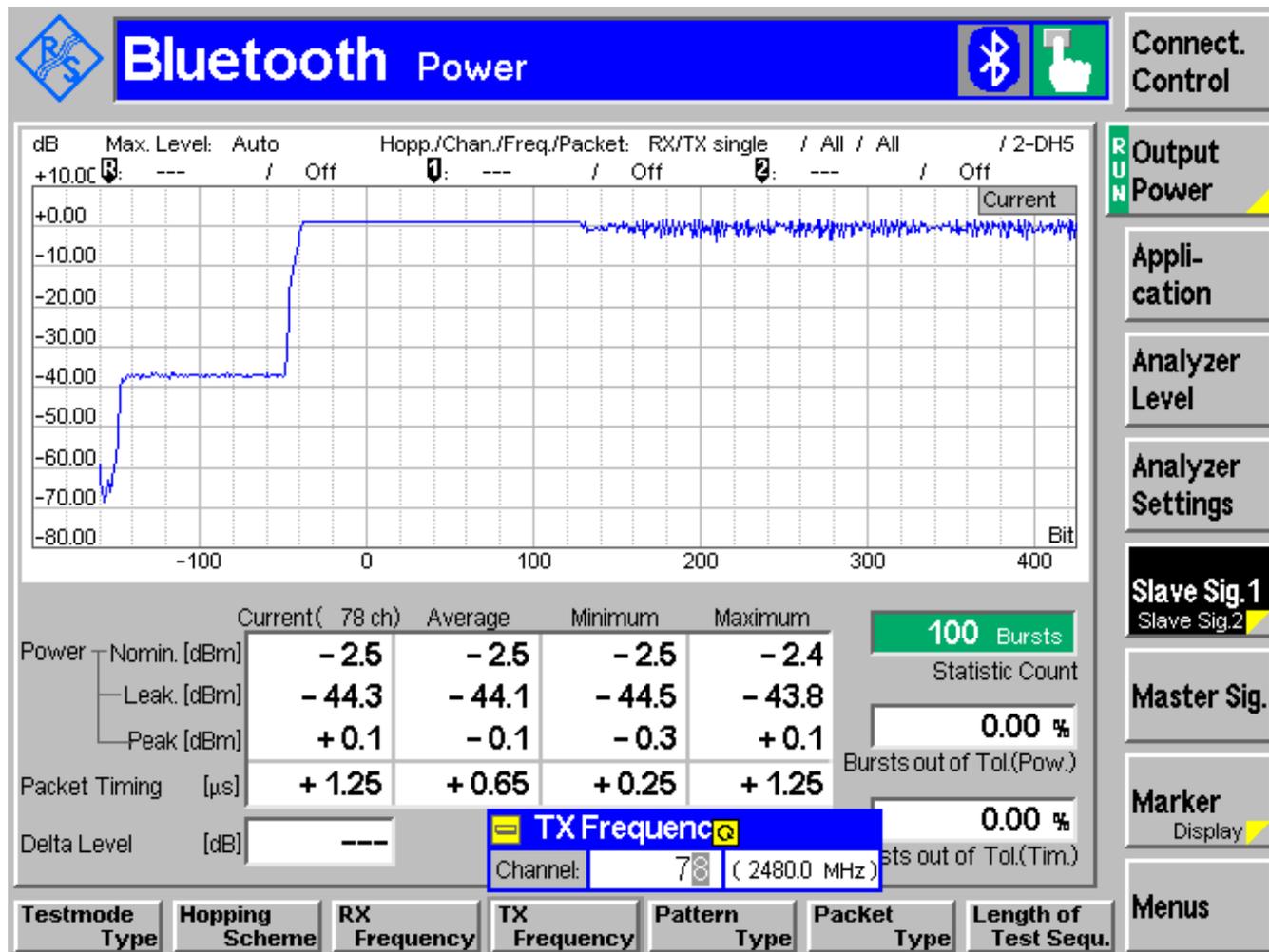
Slave Sig. 2

Master Sig.

Marker Display

Menus

Conducted Peak Power $\pi / 4$ DQPSK 2480 MHz





Conducted Peak Power 8DPSK 2402 MHz

Bluetooth Power

dB Max. Level: Auto
 +10.00 --- / Off

Hopp./Chan./Freq./Packet: RX/TX single / All / All / 3-DH5
 0: --- / Off 2: --- / Off

Current

	Current(0 ch)	Average	Minimum	Maximum
Power Nomin. [dBm]	-2.0	-2.0	-2.1	-2.0
Leak. [dBm]	-46.0	-45.9	-46.3	-45.4
Peak [dBm]	+0.3	+0.4	+0.3	+0.5
Packet Timing [µs]	+0.25	+0.49	+0.00	+1.25
Delta Level [dB]	---			

TX Frequency

Channel: (2402.0 MHz)

100 Bursts
 Statistic Count

0.00 %
 Bursts out of Tol.(Pow.)

0.00 %
 Bursts out of Tol.(Tim.)

Testmode Type

Hopping Scheme

RX Frequency

TX Frequency

Pattern Type

Packet Type

Length of Test Sequ.

Connect. Control

Output Power

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

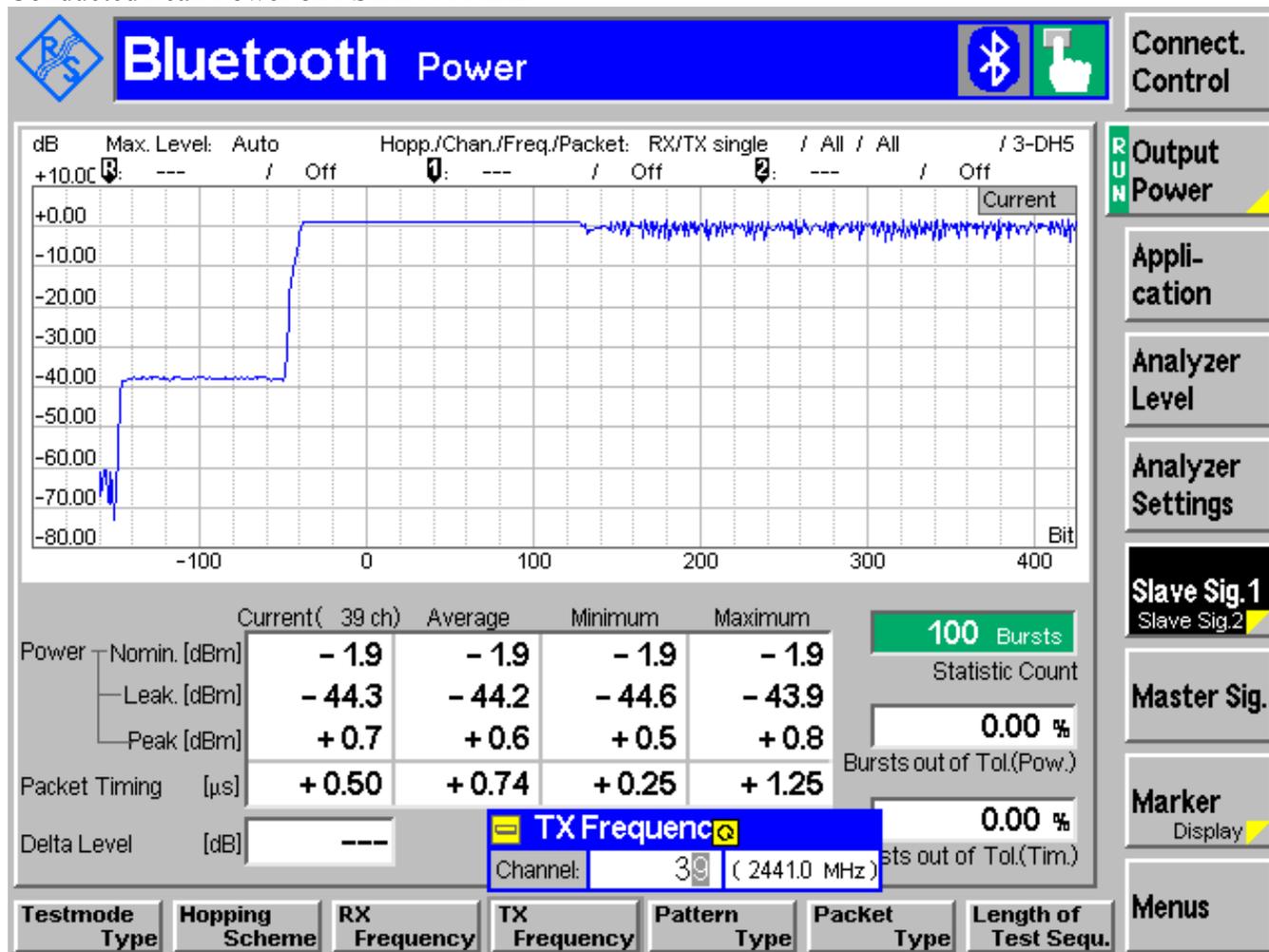
Master Sig.

Marker Display

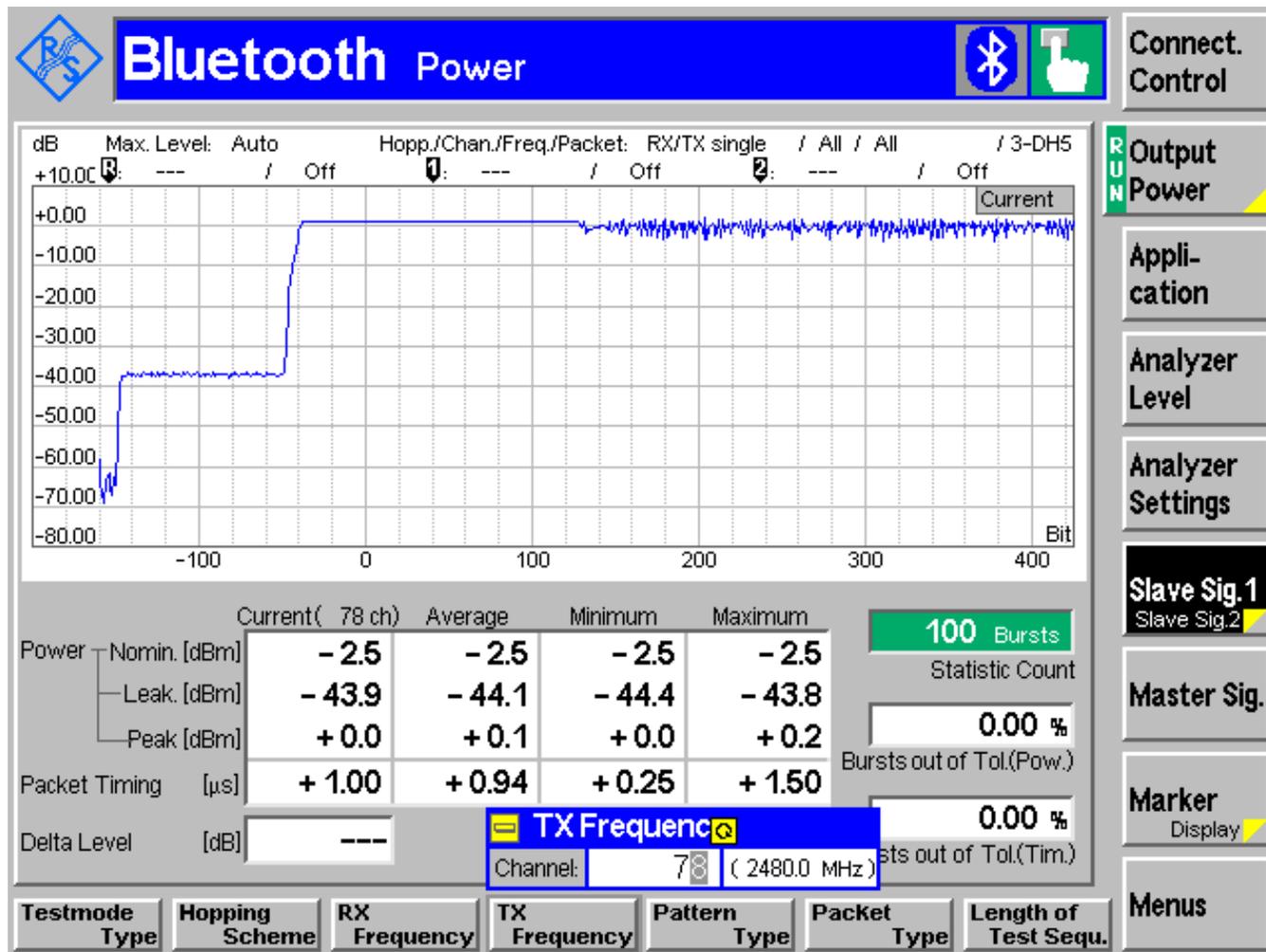
Menus



Conducted Peak Power 8DPSK 2441 MHz



Conducted Peak Power 8DPSK 2480 MHz





5.4 Restricted Band Edge Compliance

5.4.1 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
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. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)).

*PEAK LIMIT= 74dBµV/m

*AVG. LIMIT= 54dBµV/m

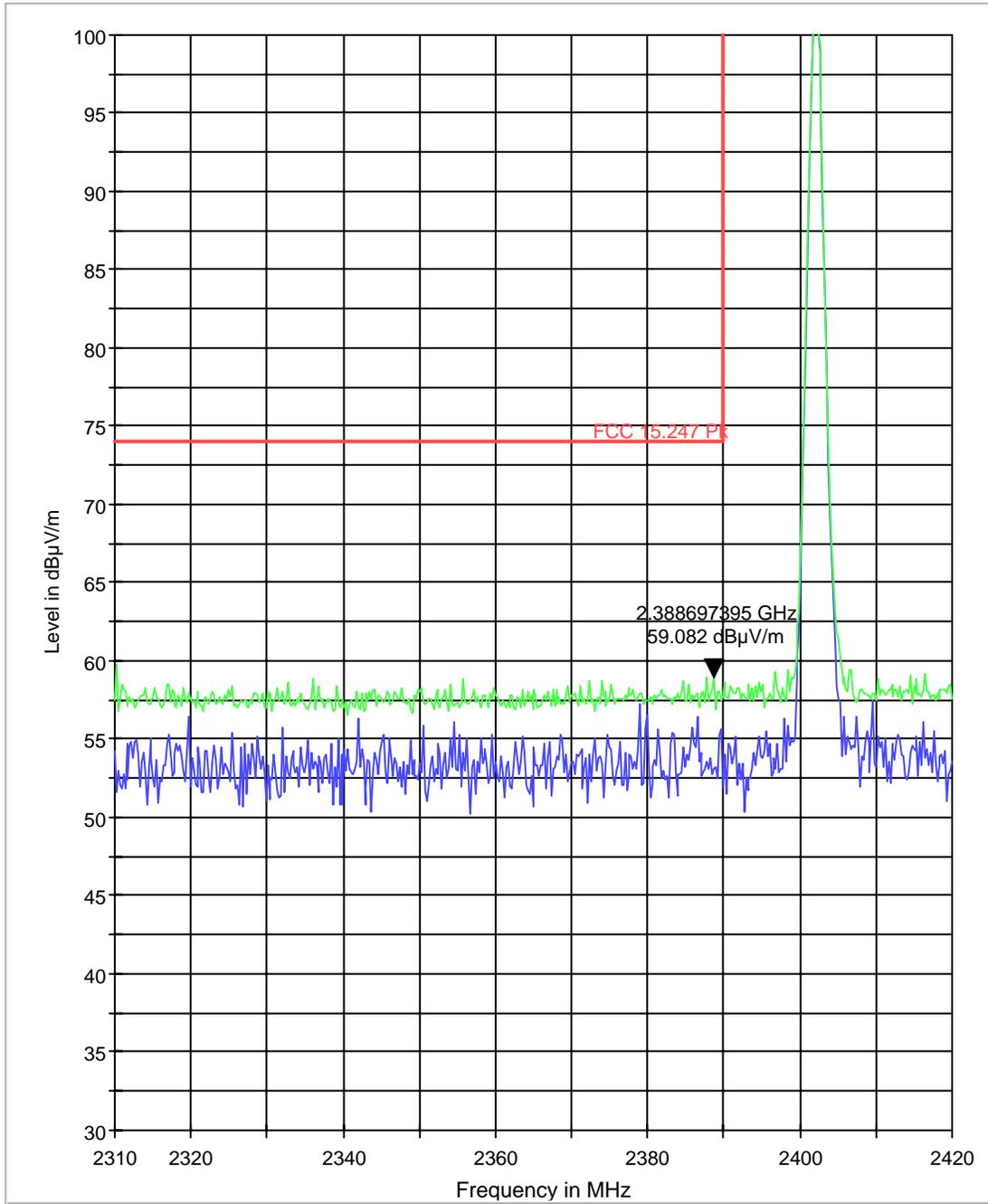
Note: Average measurements were performed using video averaging by setting RBW=1MHz and VBW=10Hz



5.4.2 Test Data/plots:

Lower band edge peak -GFSK modulation

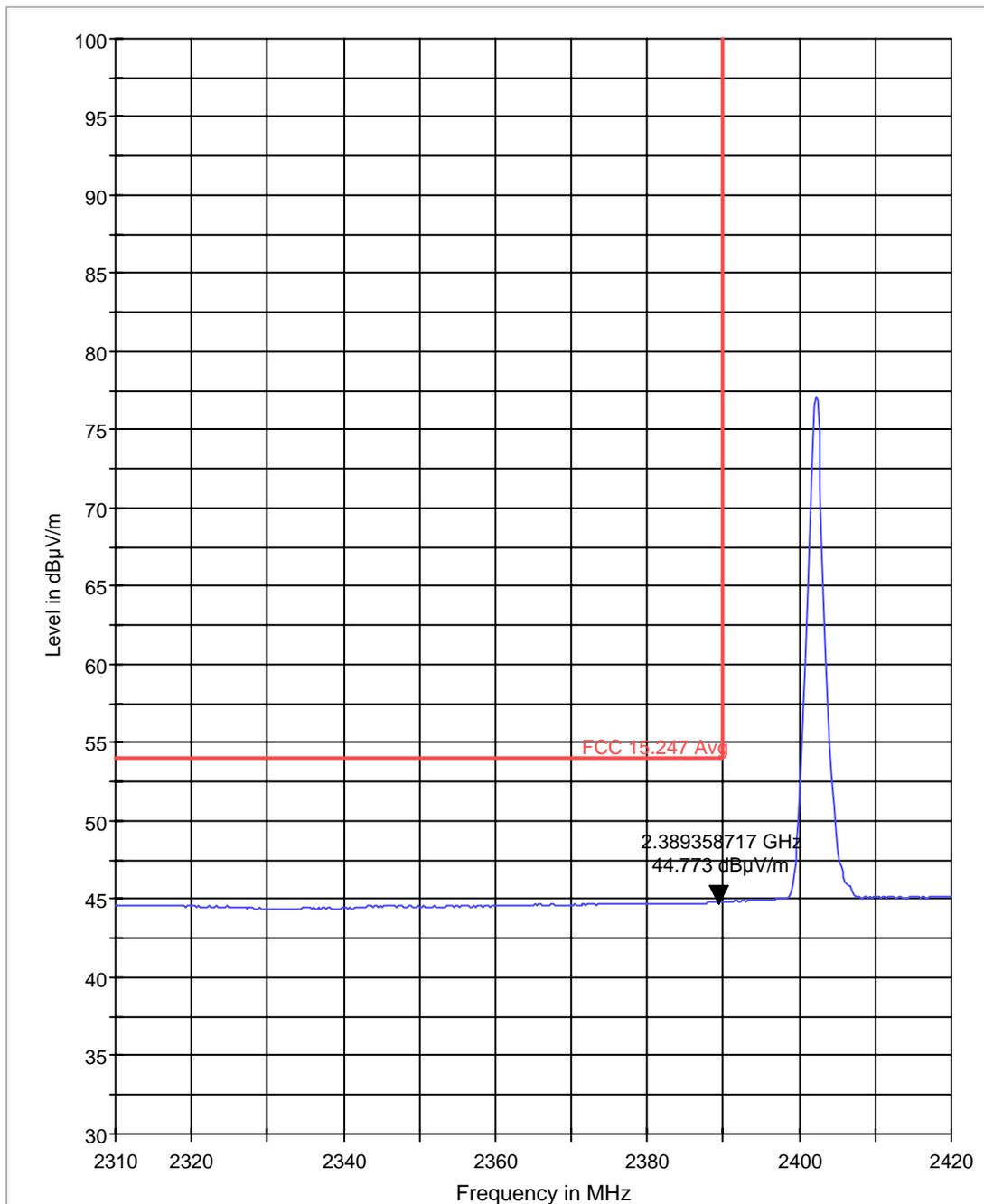
FCC 15.247 LBE Pk 3m





Lower band edge average -GFSK modulation

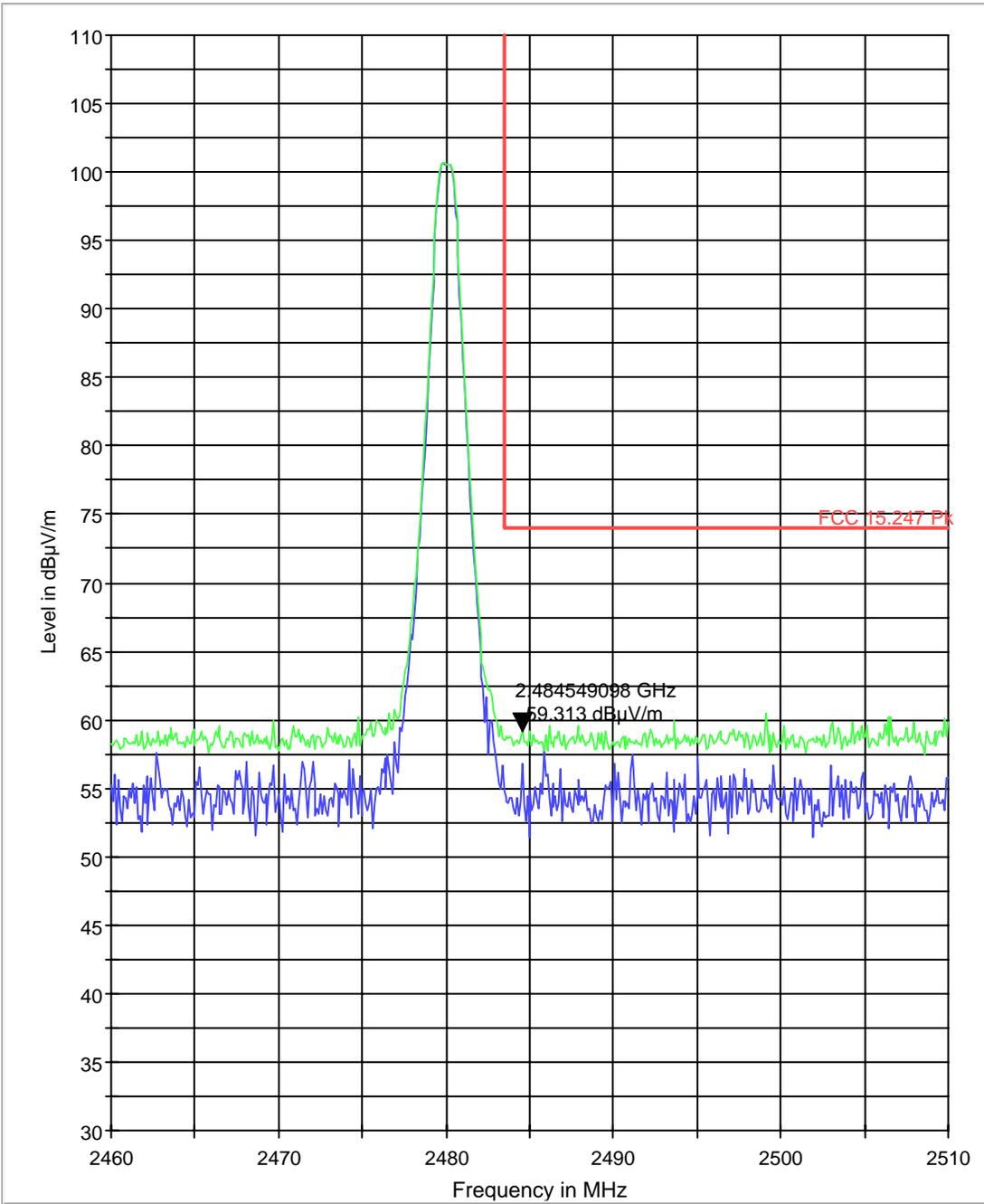
FCC 15.247 LBE Avg 3m





Higher band edge peak -GFSK modulation

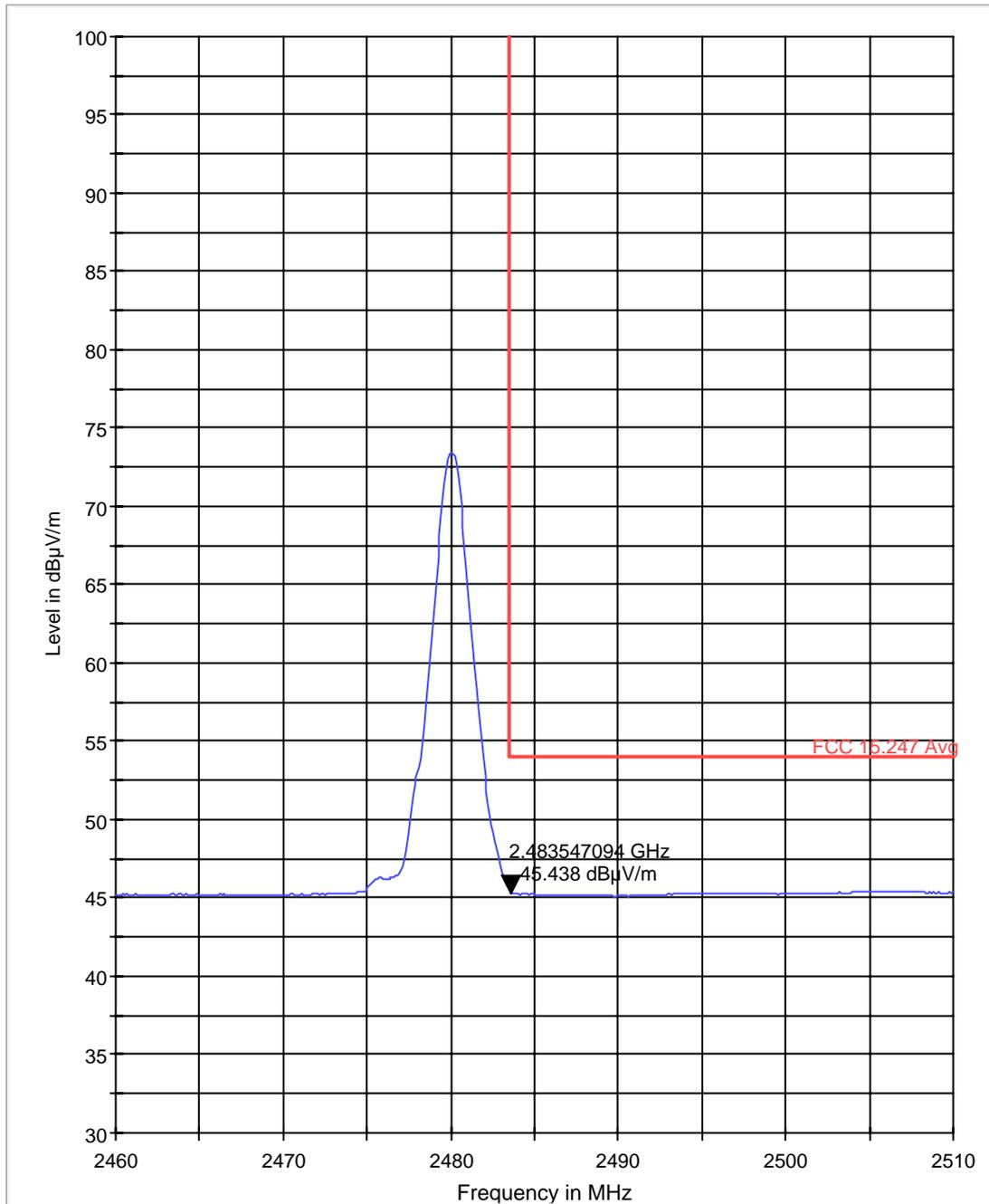
FCC 15.247 HBE Pk 3m





Higher band edge average-GFSK modulation

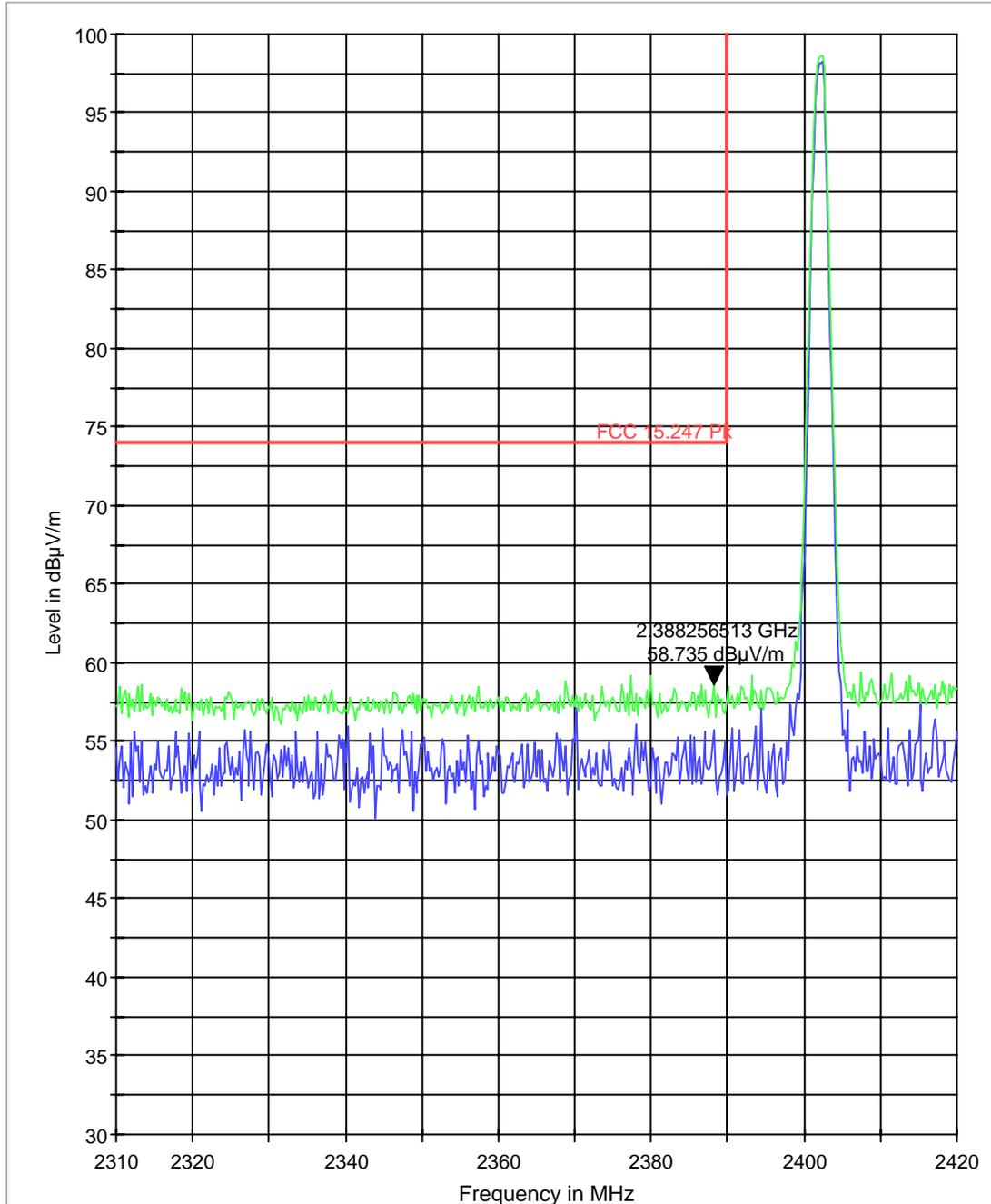
FCC 15.247 HBE Avg 3m





Lower band edge peak - $\pi/4$ DQPSK modulation

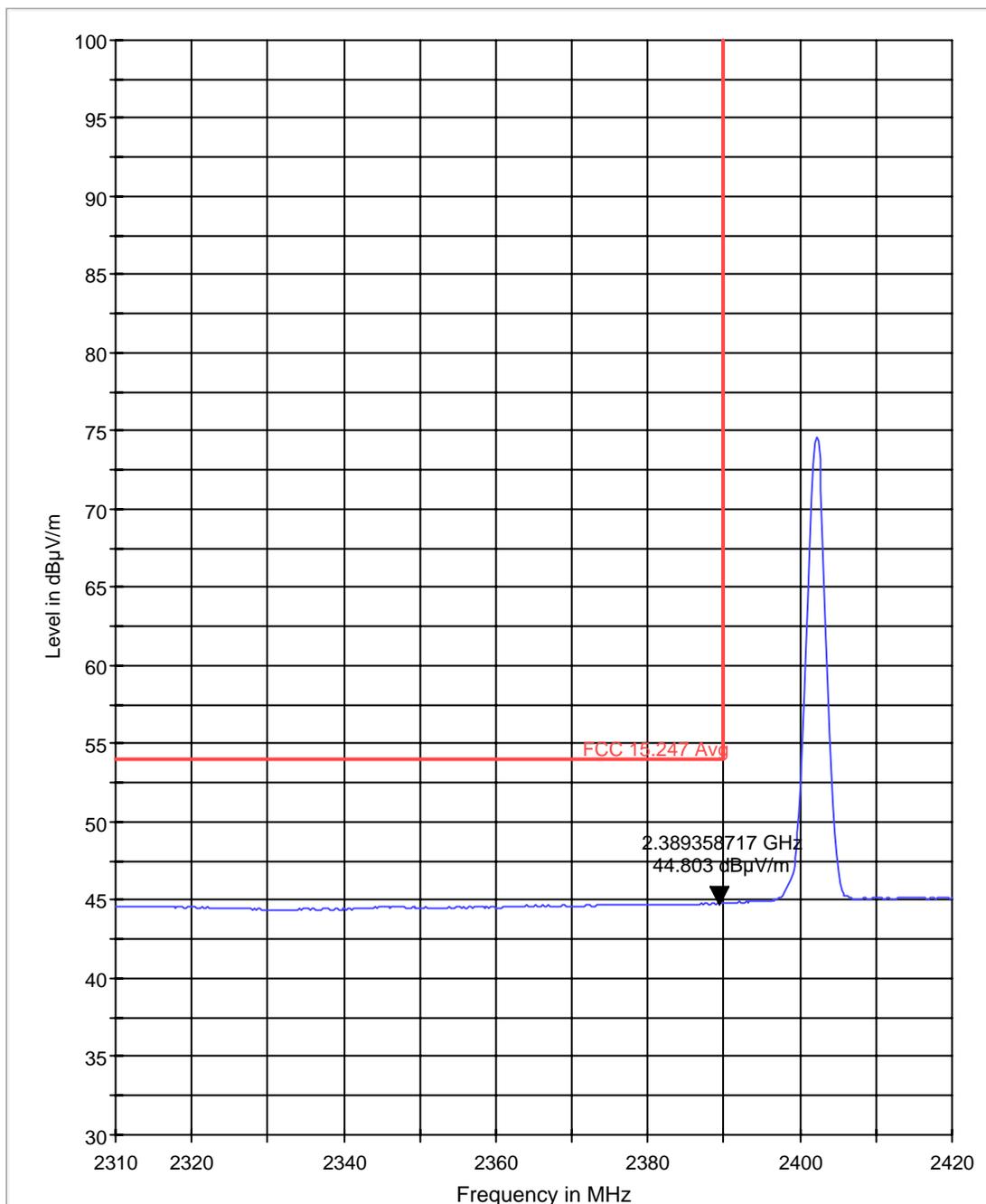
FCC 15.247 LBE Pk 3m





Lower band edge average $-\pi/4$ DQPSK modulation

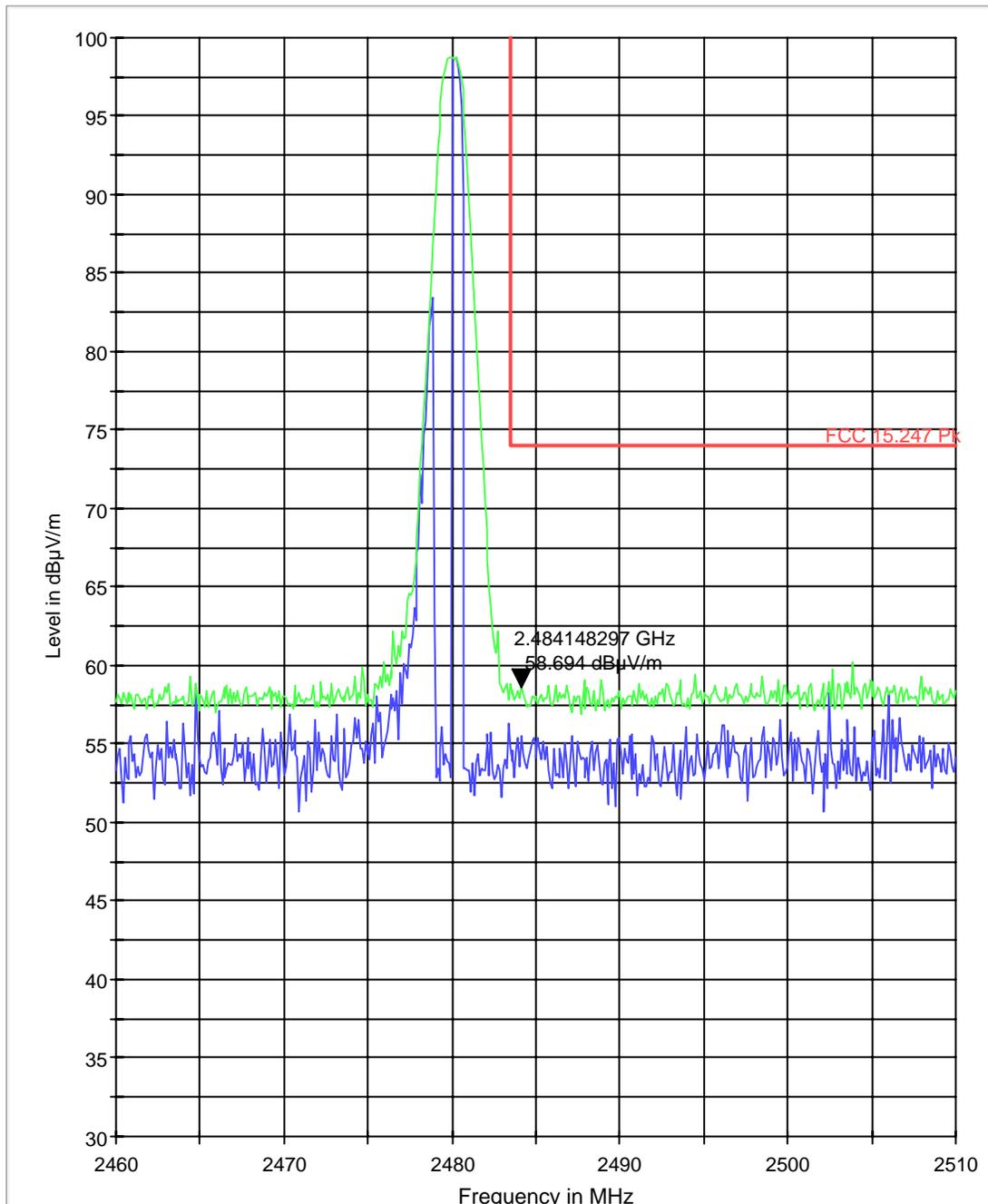
FCC 15.247 LBE Avg 3m





Higher band edge peak $-\pi/4$ DQPSK modulation

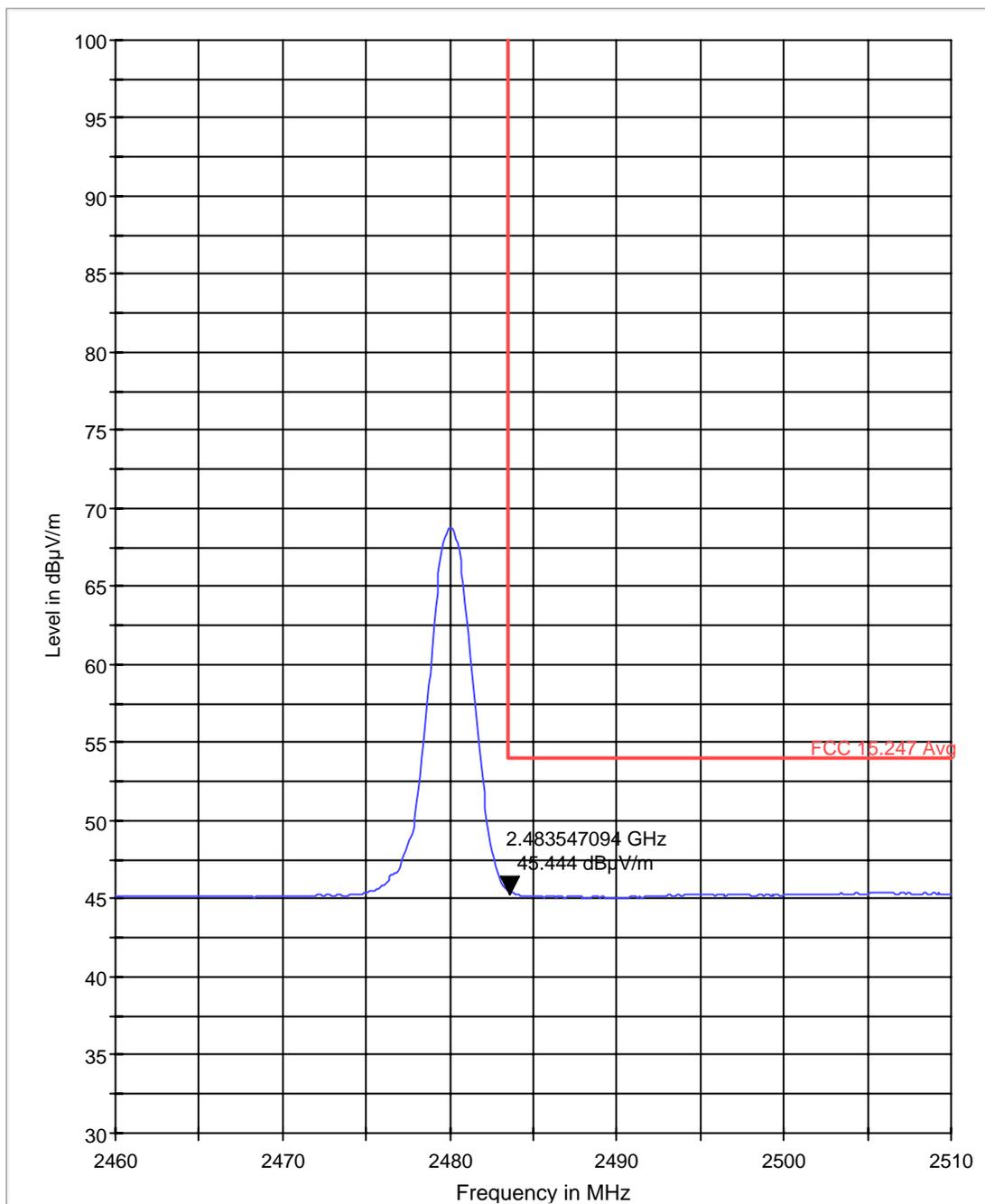
FCC 15.247 HBE Pk 3m





Higher band edge average- $\pi/4$ DQPSK modulation

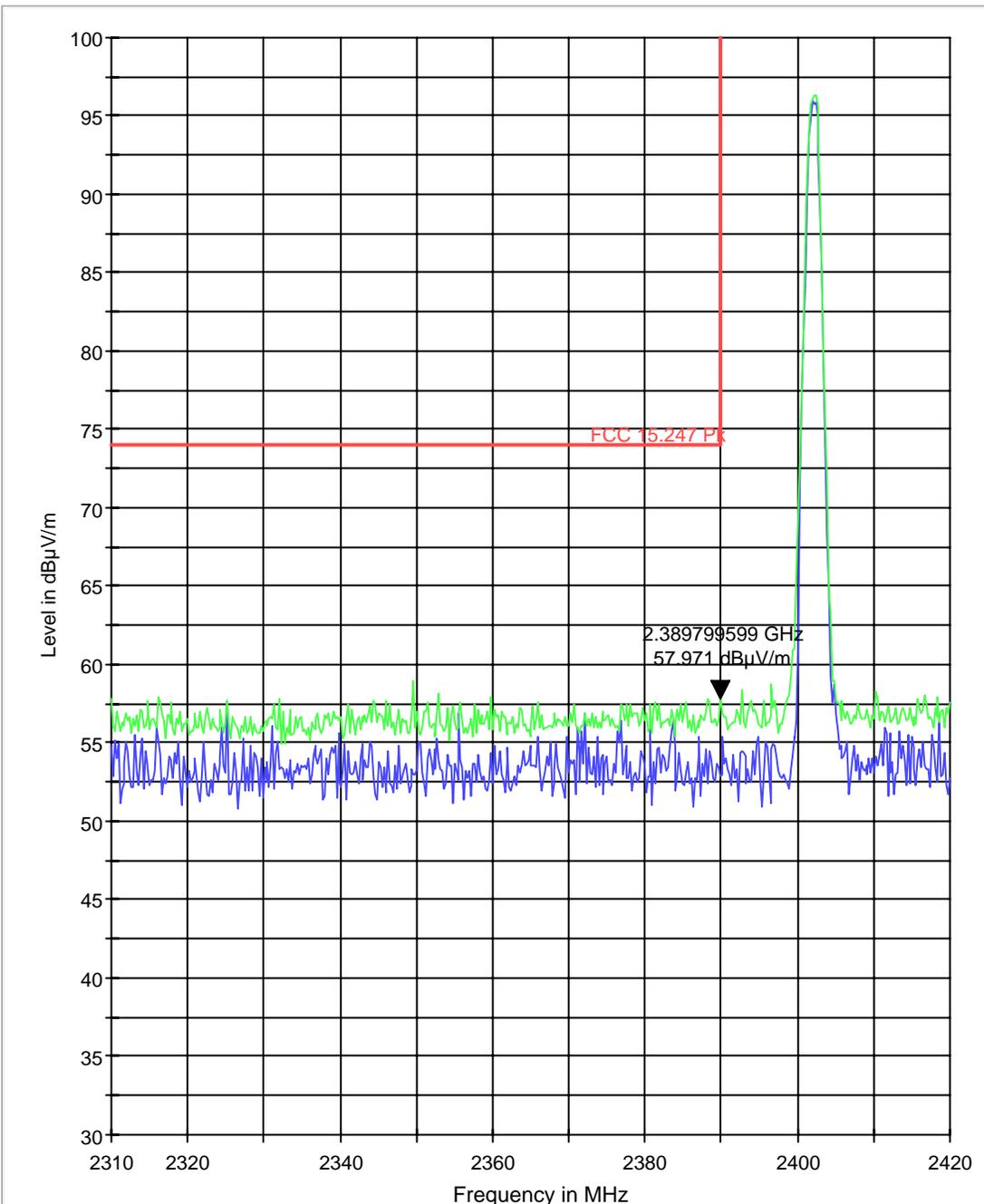
FCC 15.247 HBE Avg 3m





Lower band edge peak - 8DPSK modulation

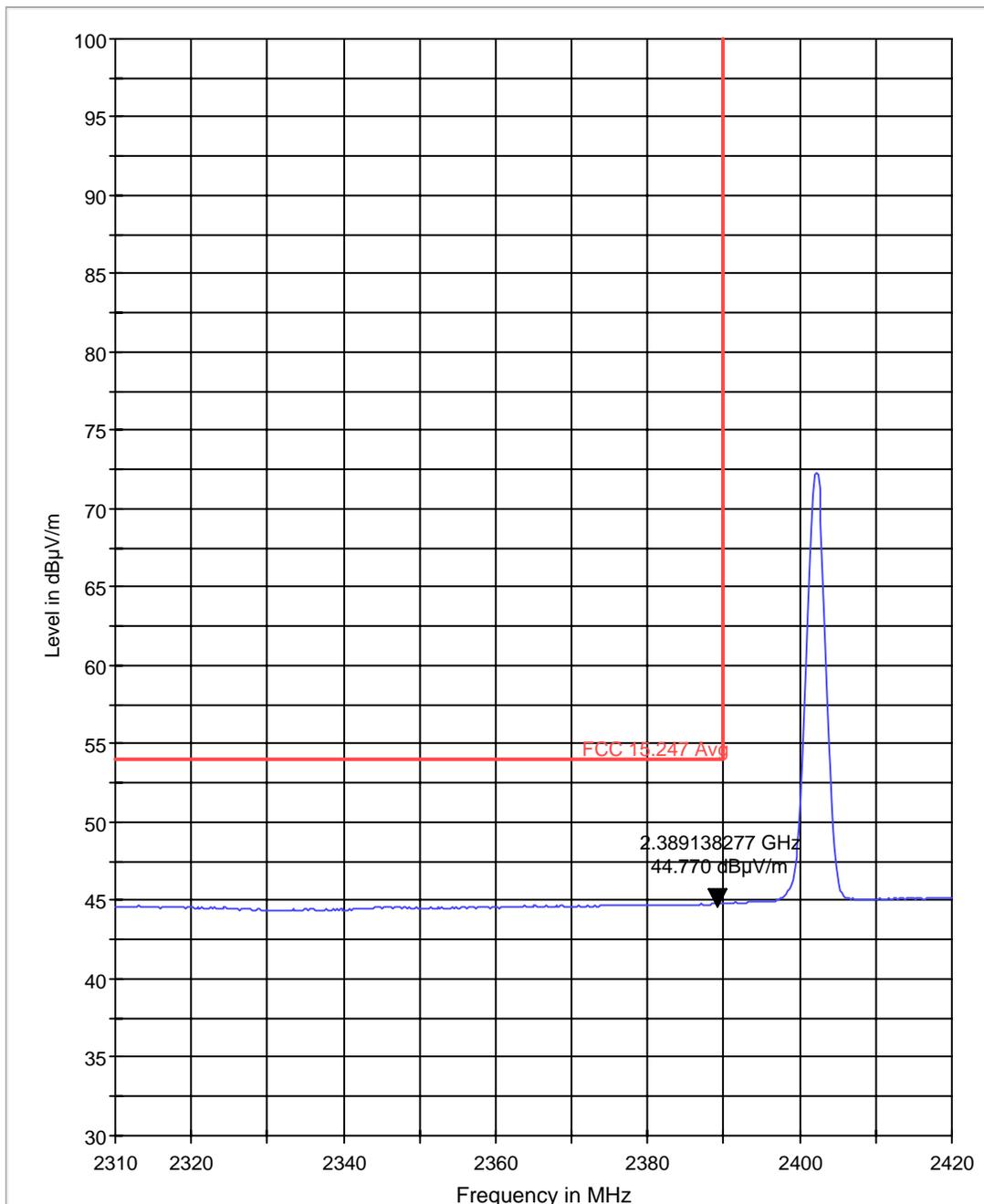
FCC 15.247 LBE Pk 3m





Lower band edge average -8DPSK modulation

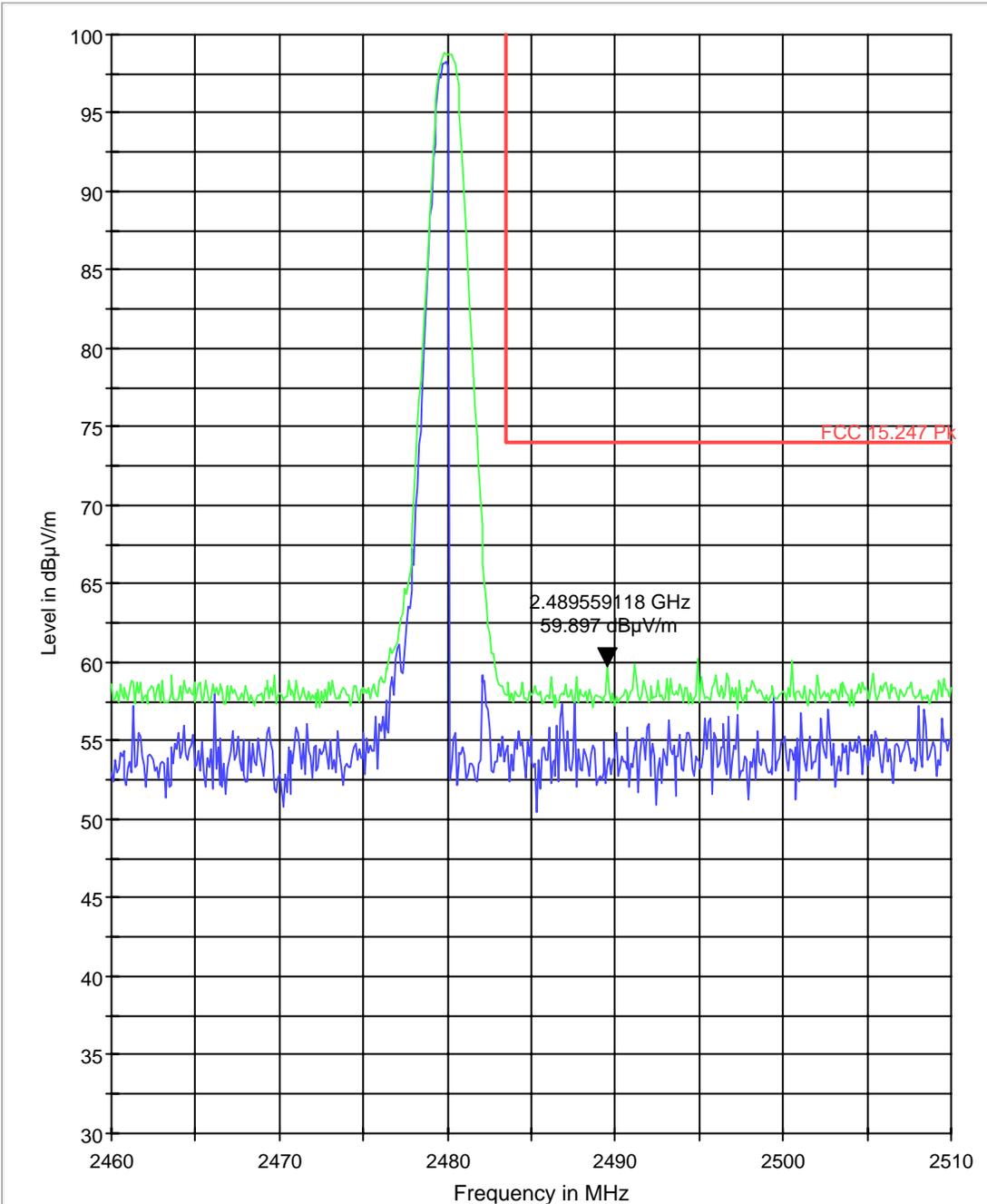
FCC 15.247 LBE Avg 3m





Higher band edge peak - 8DPSK modulation

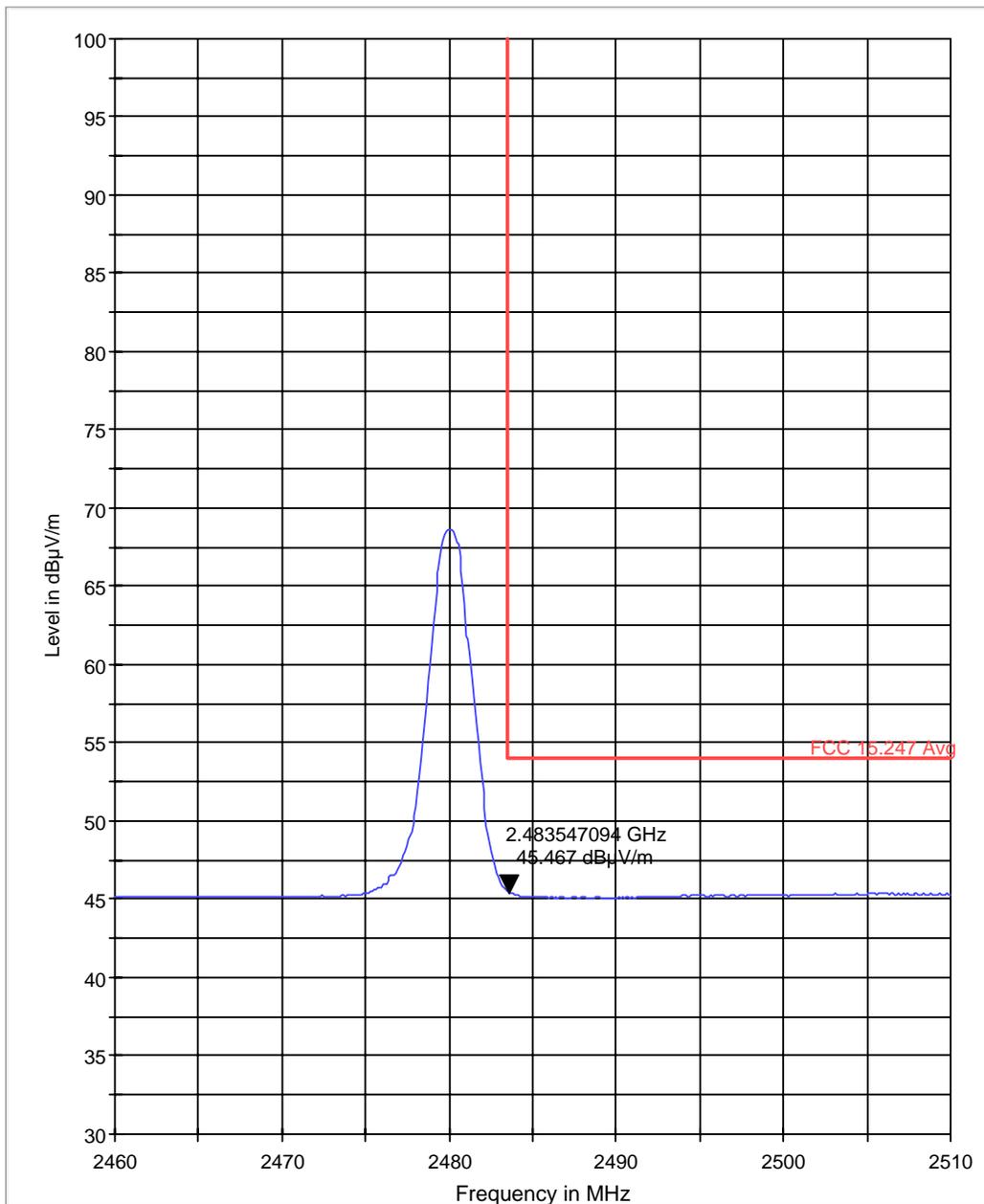
FCC 15.247 HBE Pk 3m





Higher band edge average-8DPSK modulation

FCC 15.247 HBE Avg 3m





5.5 Spectrum Bandwidth/ 20dB Bandwidth

5.5.1 Limits:

§ 15.247 (a)(1)

RSS 210- A8.1(b)

Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

GFSK < 1000 kHz

$\pi / 4$ DQPSK < 1500 kHz

8 dPSK < 1500kHz

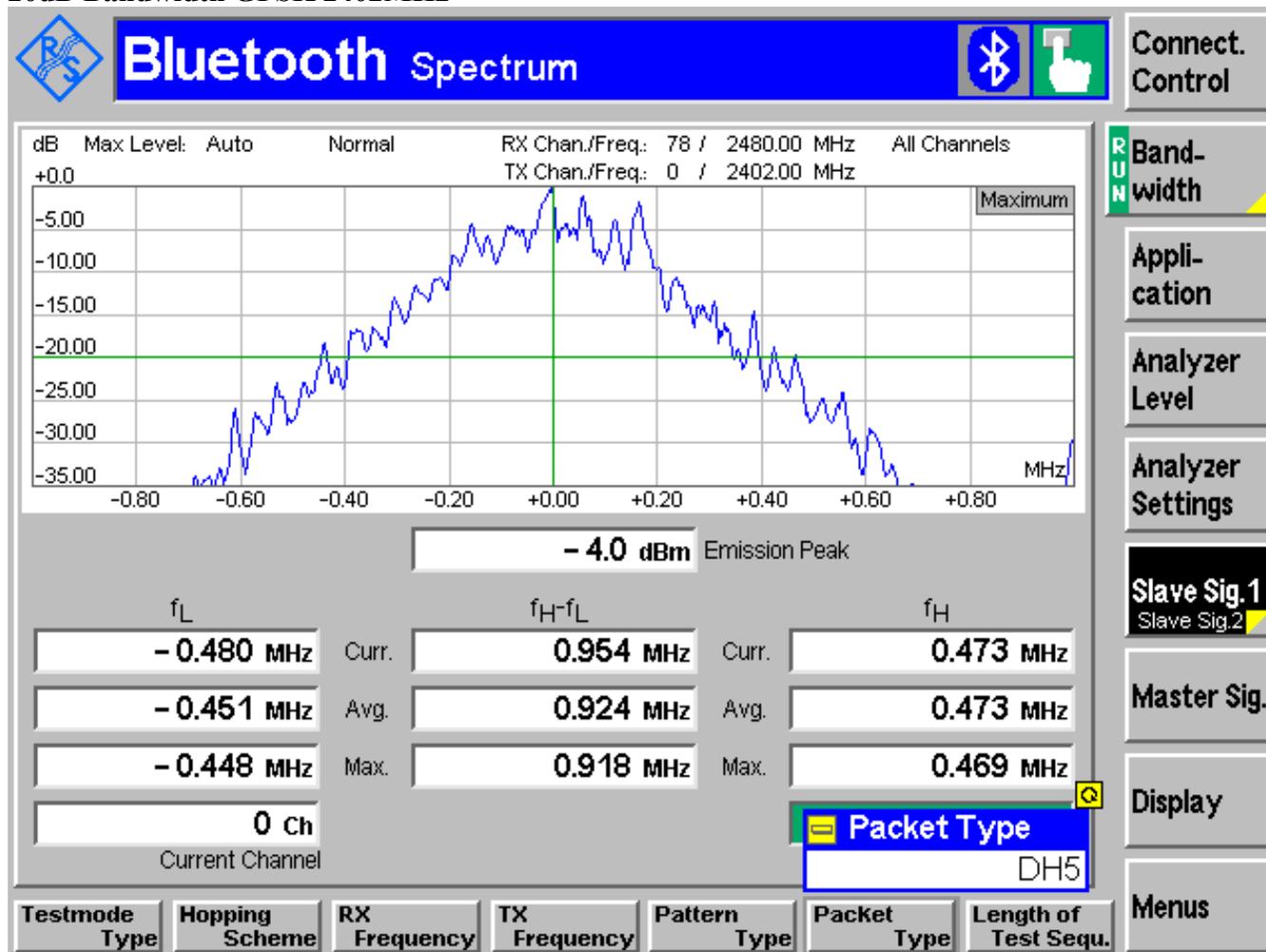
5.5.2 Test Result:

20dB Bandwidth (kHz)			
Modulation	Frequency (MHz)		
	2402	2441	2480
GFSK	0.918	0.917	0.877
$\pi/4$ DQPSK	1.199	1.185	1.183
8-DPSK	1.253	1.250	1.238
Measurement Uncertainty: ± 1 kHz			

RBW=VBW=10 kHz

5.5.3 Test Data/plots:

20dB Bandwidth GFSK 2402MHz



20dB Bandwidth GFSK 2441MHz

Bluetooth Spectrum

dB Max Level: Auto Normal
RX Chan./Freq.: 78 / 2480.00 MHz All Channels

+0.0
TX Chan./Freq.: 39 / 2441.00 MHz

-3.7 dBm Emission Peak

f _L		f _H -f _L		f _H
-0.482 MHz	Curr.	0.956 MHz	Curr.	0.475 MHz
-0.480 MHz	Avg.	0.953 MHz	Avg.	0.473 MHz
-0.448 MHz	Max.	0.917 MHz	Max.	0.469 MHz

39 ch
Current Channel

Packet Type
DH5

Testmode Type
Hopping Scheme
RX Frequency
TX Frequency
Pattern Type
Packet Type
Length of Test Sequ.

Connect. Control

Bandwidth

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1

Slave Sig. 2

Master Sig.

Display

Menus

20dB Bandwidth GFSK 2480MHz

Bluetooth Spectrum

dB Max Level: Auto Normal RX Chan./Freq.: 78 / 2480.00 MHz All Channels
 TX Chan./Freq.: 78 / 2480.00 MHz

- 4.1 dBm Emission Peak

f_L		$f_H - f_L$		f_H
-0.478 MHz	Curr.	0.950 MHz	Curr.	0.472 MHz
-0.481 MHz	Avg.	0.953 MHz	Avg.	0.473 MHz
-0.448 MHz	Max.	0.877 MHz	Max.	0.429 MHz

78 Ch
Current Channel

Packet Type
DH5

Testmode Type

Hopping Scheme

RX Frequency

TX Frequency

Pattern Type

Packet Type

Length of Test Sequ.

Connect. Control

RUN Bandwidth

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

Master Sig.

Display

Menus

20dB Bandwidth $\pi / 4$ DQPSK 2402MHz

Bluetooth Spectrum

dB Max Level: Auto Normal
RX Chan./Freq.: 78 / 2480.00 MHz All Channels

+0.0
TX Chan./Freq.: 0 / 2402.00 MHz
Maximum

-5.7 dBm Emission Peak

f_L		$f_H - f_L$		f_H
-0.695 MHz	Curr.	1.379 MHz	Curr.	0.684 MHz
-0.696 MHz	Avg.	1.371 MHz	Avg.	0.675 MHz
-0.599 MHz	Max.	1.199 MHz	Max.	0.600 MHz

0 Ch
Current Channel

Packet Type
2-DH5

Slave Sig. 1
Slave Sig. 2

Testmode Type

Hopping Scheme

RX Frequency

TX Frequency

Pattern Type

Packet Type

Length of Test Sequ.

Connect. Control

RUN Bandwidth

Application

Analyzer Level

Analyzer Settings

Master Sig.

Display

Menus

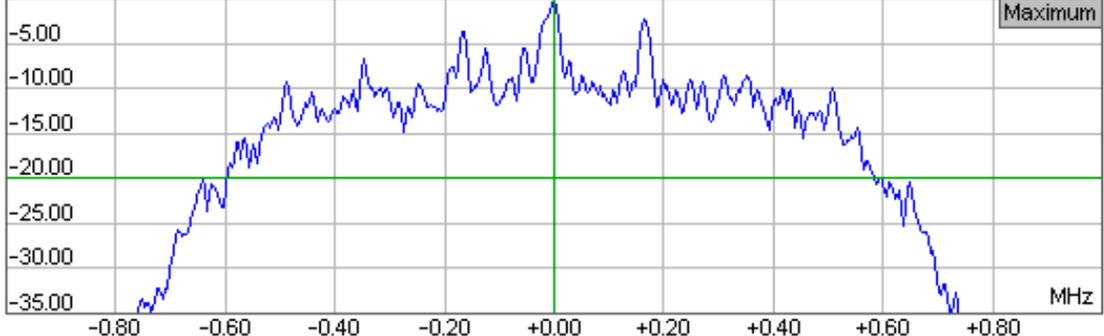
20dB Bandwidth $\pi / 4$ DQPSK 2441MHz

Bluetooth Spectrum

dB Max Level: Auto Normal
RX Chan./Freq.: 78 / 2480.00 MHz All Channels

+0.0
TX Chan./Freq.: 39 / 2441.00 MHz

Maximum



- 5.6 dBm Emission Peak

f _L		f _H -f _L		f _H
- 0.693 MHz	Curr.	1.365 MHz	Curr.	0.672 MHz
- 0.696 MHz	Avg.	1.370 MHz	Avg.	0.674 MHz
- 0.600 MHz	Max.	1.185 MHz	Max.	0.586 MHz

39 ch
Current Channel

Packet Type
 2-DH5

Testmode Type
Hopping Scheme
RX Frequency
TX Frequency
Pattern Type
Packet Type
Length of Test Sequ.

Connect. Control

Bandwidth

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

Master Sig.

Display

Menus

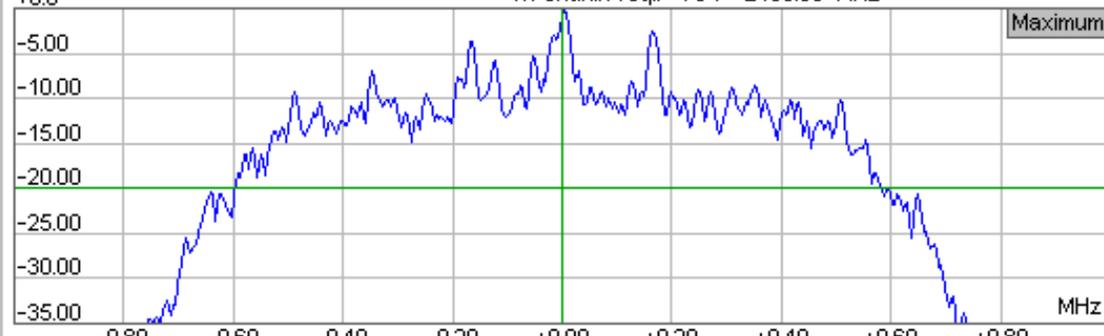
20dB Bandwidth $\pi / 4$ DQPSK 2480MHz

Bluetooth Spectrum

dB Max Level: Auto Normal
RX Chan./Freq.: 78 / 2480.00 MHz All Channels

+0.0
TX Chan./Freq.: 78 / 2480.00 MHz

Maximum



- 6.0 dBm Emission Peak

f_L		$f_H - f_L$		f_H
-0.696 MHz	Curr.	1.368 MHz	Curr.	0.672 MHz
-0.696 MHz	Avg.	1.368 MHz	Avg.	0.672 MHz
-0.599 MHz	Max.	1.183 MHz	Max.	0.584 MHz

78 ch

Current Channel

Packet Type

2-DH5

Testmode Type
Hopping Scheme
RX Frequency
TX Frequency
Pattern Type
Packet Type
Length of Test Sequ.

Connect. Control

Bandwidth

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1

Slave Sig. 2

Master Sig.

Display

Menus

20dB Bandwidth 8-DPSK 2402MHz

Bluetooth Spectrum

dB Max Level: Auto Normal
RX Chan./Freq.: 78 / 2480.00 MHz All Channels

+0.0
TX Chan./Freq.: 0 / 2402.00 MHz

Maximum

- 5.8 dBm Emission Peak

f_L		$f_H - f_L$		f_H
-0.688 MHz	Curr.	1.375 MHz	Curr.	0.686 MHz
-0.685 MHz	Avg.	1.374 MHz	Avg.	0.690 MHz
-0.637 MHz	Max.	1.253 MHz	Max.	0.616 MHz

0 Ch
Current Channel

= Packet Type
3-DH5

Testmode Type
Hopping Scheme
RX Frequency
TX Frequency
Pattern Type
Packet Type
Length of Test Sequ.

Connect. Control

Bandwidth

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

Master Sig.

Display

Menus

20dB Bandwidth 8-DPSK 2441MHz

Bluetooth Spectrum

dB Max Level: Auto Normal
 RX Chan./Freq.: 78 / 2480.00 MHz All Channels
 TX Chan./Freq.: 39 / 2441.00 MHz

Maximum

- 5.6 dBm Emission Peak

f_L	$f_H - f_L$	f_H
- 0.678 MHz	1.367 MHz	0.689 MHz
- 0.685 MHz	1.374 MHz	0.688 MHz
- 0.637 MHz	1.250 MHz	0.614 MHz

39 Ch
Current Channel

☰ Packet Type

3-DH5

Testmode Type

Hopping Scheme

RX Frequency

TX Frequency

Pattern Type

Packet Type

Length of Test Sequ.

Connect. Control

Band-width

Appli-cation

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

Master Sig.

Display

Menus

20dB Bandwidth 8-DPSK 2480MHz

Bluetooth Spectrum
📶
👆

dB Max Level: Auto Normal RX Chan./Freq.: 78 / 2480.00 MHz All Channels
 TX Chan./Freq.: 78 2480.00 MHz

- 6.1 dBm Emission Peak

f_L		$f_H - f_L$		f_H
-0.687 MHz	Curr.	1.359 MHz	Curr.	0.672 MHz
-0.685 MHz	Avg.	1.373 MHz	Avg.	0.688 MHz
-0.637 MHz	Max.	1.238 MHz	Max.	0.601 MHz

78 Ch
Current Channel

☰ Packet Type
🔍

3-DH5

Testmode Type

Hopping Scheme

RX Frequency

TX Frequency

Pattern Type

Packet Type

Length of Test Sequ.

Connect. Control

RUN Bandwidth

Application

Analyzer Level

Analyzer Settings

Slave Sig. 1
Slave Sig. 2

Master Sig.

Display

Menus

5.6 Carrier Frequency Separation

5.6.1 Limits:

§ 15.247 (a) (1)

RSS 210- A8.1(b)

Minimum 25kHz or 2/3 of the 20dB bandwidth of the hopping system

5.6.2 Test Result:

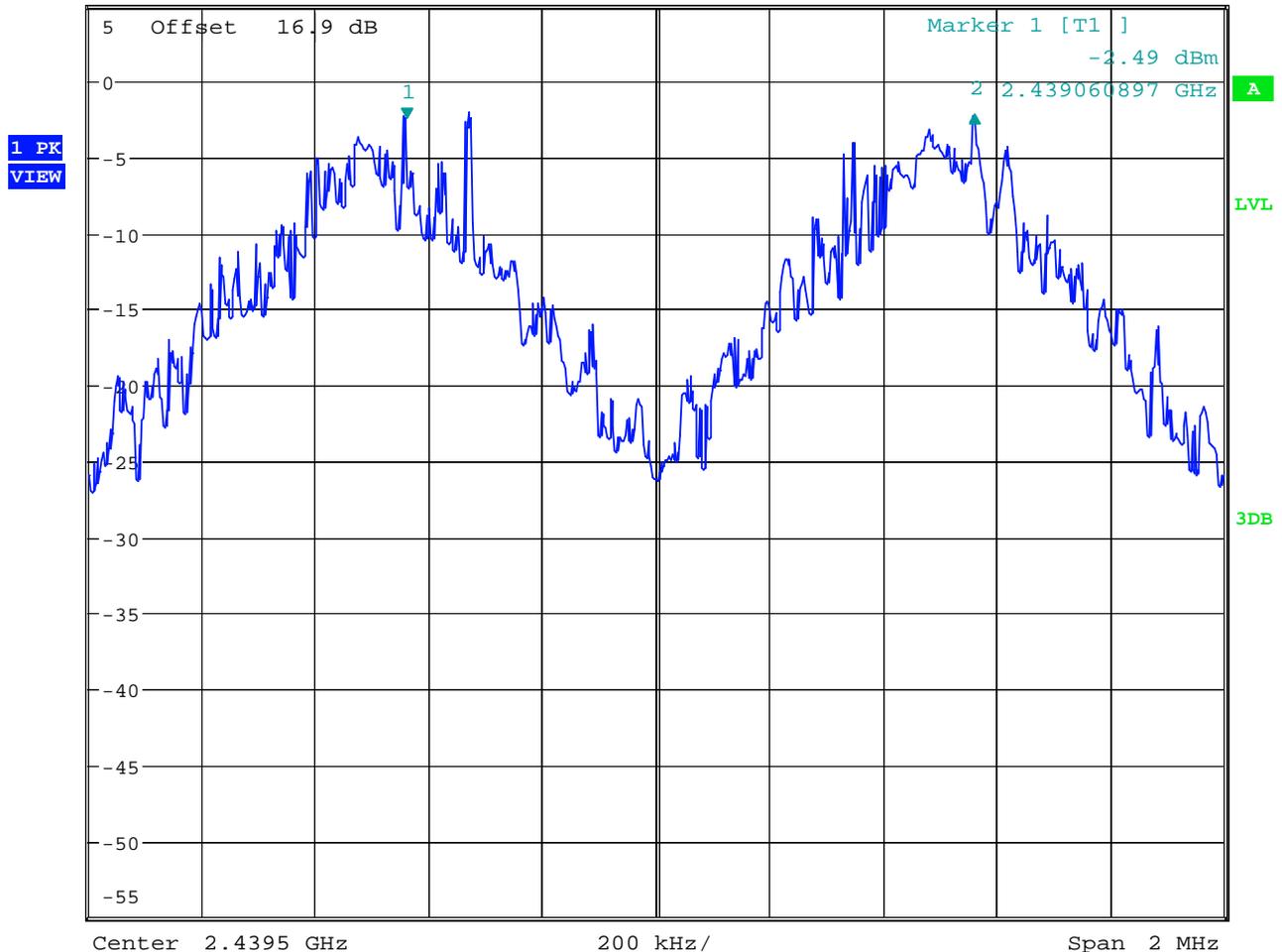
Modulation: 8-DPSK

Channel Separation: 1 MHz

5.6.3 Test Data/plot:



* RBW 20 kHz Delta 2 [T1]
* VBW 50 kHz 0.24 dB
Ref 5 dBm Att 15 dB SWT 20 ms 1000.00000000 kHz



5.7 Number of hopping channels

5.7.1 Limits:

§ 15.247 (a) (1)

RSS 210- A8.1(d)

Atleast 15 non-overlapping channels

5.7.2 Test Result:

Modulation: 8-DPSK

Number of hopping channels: 79

5.7.3 Test Data/plot:

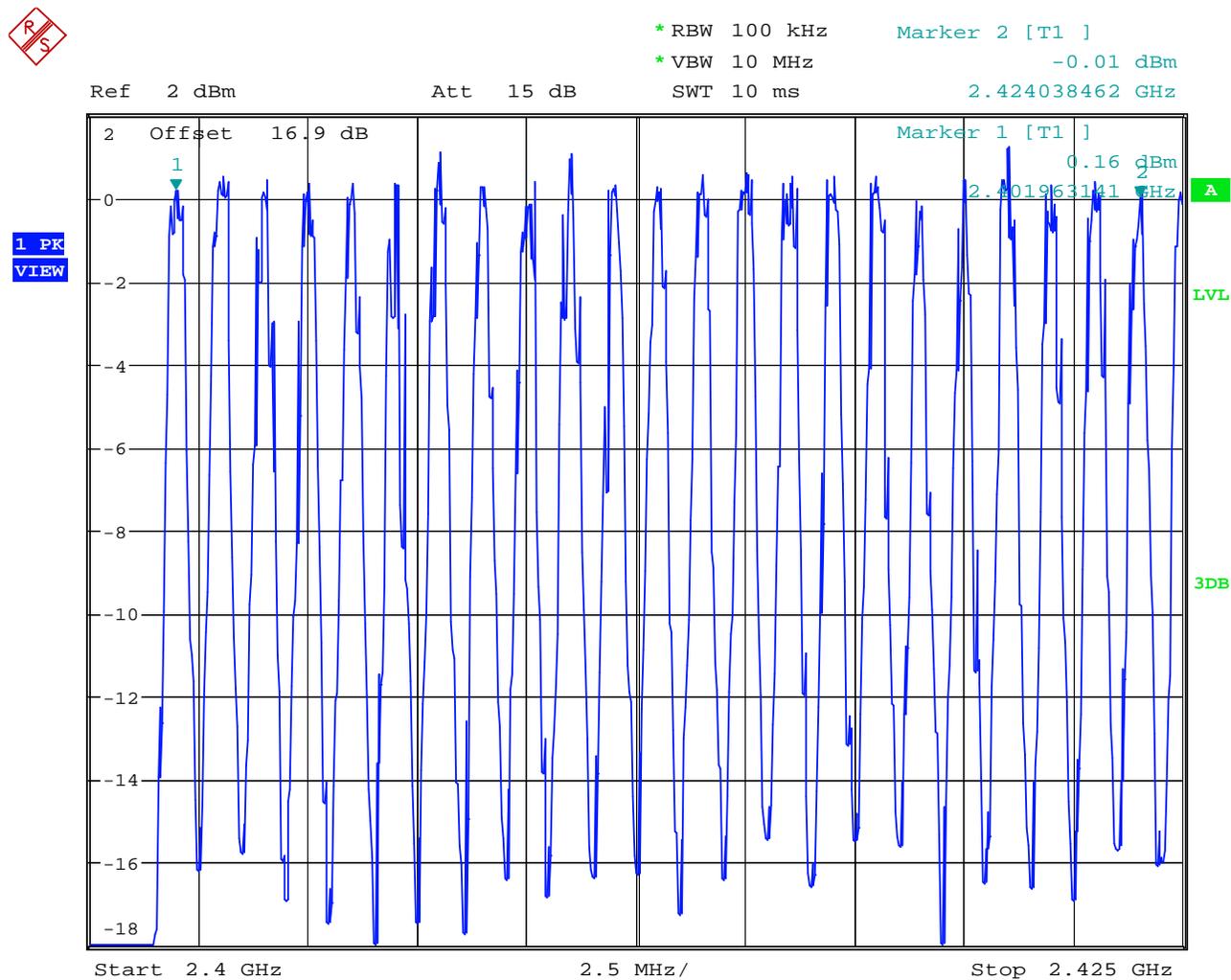
See Plots 1-4 below



PLOT-1

Channel 0-Channel 22

Number of channels 23

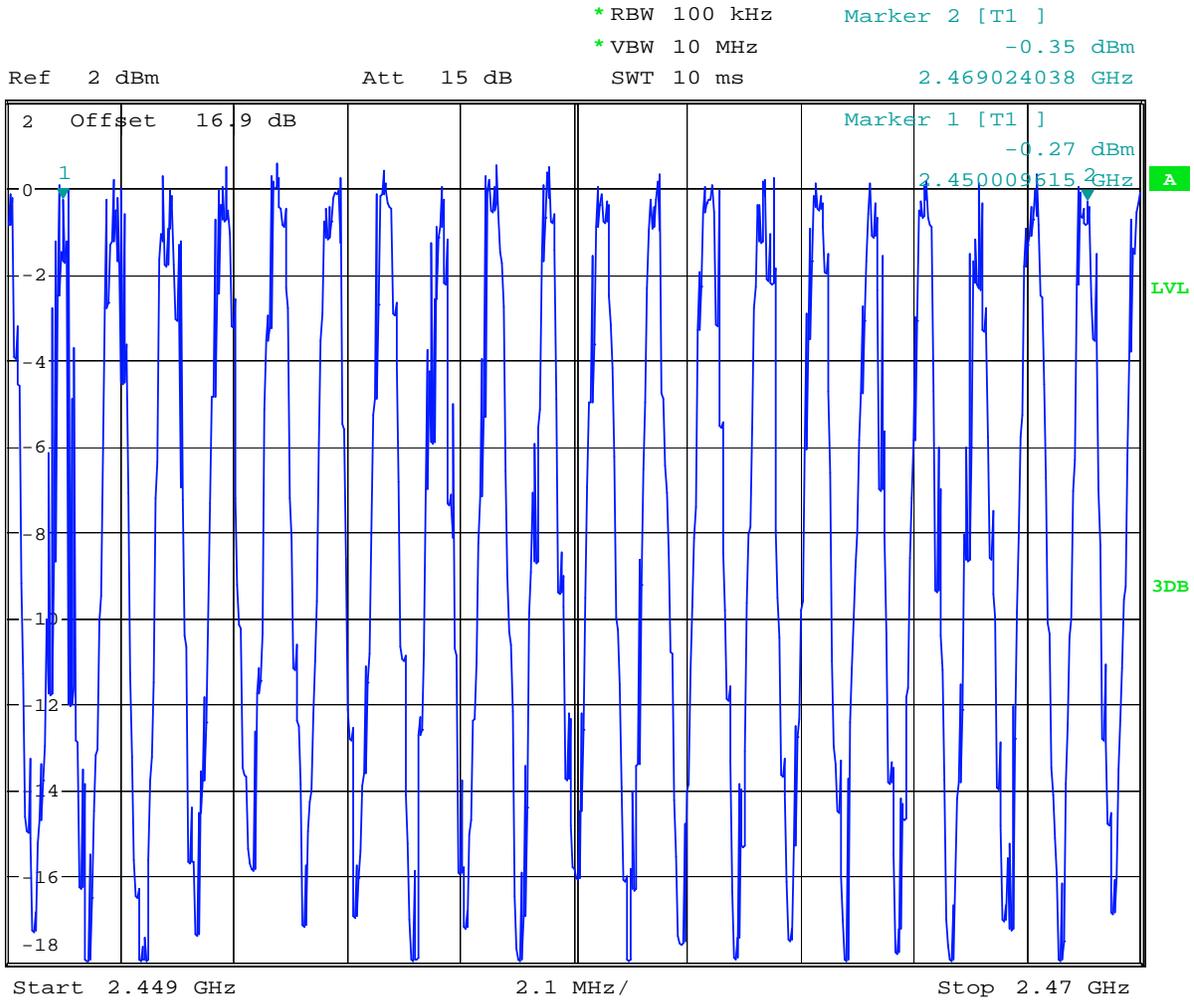


Date: 21.MAY.2010 16:17:05

PLOT-3

Channel 48-Channel 67

Number of channels 20



5.8 Time of occupancy (Dwell time)

5.8.1 Limits:

§ 15.247 (a) (1) (iii)

RSS 210- A8.1(d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.8.2 Test Result:

For Bluetooth devices:

The dwell time of 0.4 s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is as follows:

Dwell time = time slot length * hop rate / number of hopping channels * 31.6 s

Example for a DH1 packet (with a maximum length of one time slot)

Dwell time = $625 \mu\text{s} * 1600 \text{ 1/s} / 79 * 31.6 \text{ s} = 0.4 \text{ s}$ (in a 31.6 s period)

For multi-slot packet the hopping is reduced according to the length of the packet.

Example for a DH5 packet (with a maximum length of five time slots)

Dwell time = $5 * 625 \mu\text{s} * 1600 * 1/5 * 1/s / 79 * 31.6 \text{ s} = 0.4 \text{ s}$ (in a 31.6 s period)

This is according to Bluetooth Core Specification for all Bluetooth devices. Therefore all BT devices satisfy FCC requirement on time of occupancy (dwell time) in the data mode.

5.9 Power Spectral Density (Hybrid system in Inquiry mode/ Page scan)

5.9.1 Limits: § 15.247 (e)

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.

5.9.2 Test Result:

Not Applicable.



5.10 Transmitter Spurious Emissions- Conducted

5.10.1 Limits:

§ 15.247 (d)

RSS 210-A8.5

30dBm for the transmitter.

-20dBc in the frequency range 30MHz- 25GHz.

5.10.2 Test Conditions:

Modulation: ABC

Analyzer settings: F<1G: RBW=VBW=100 kHz

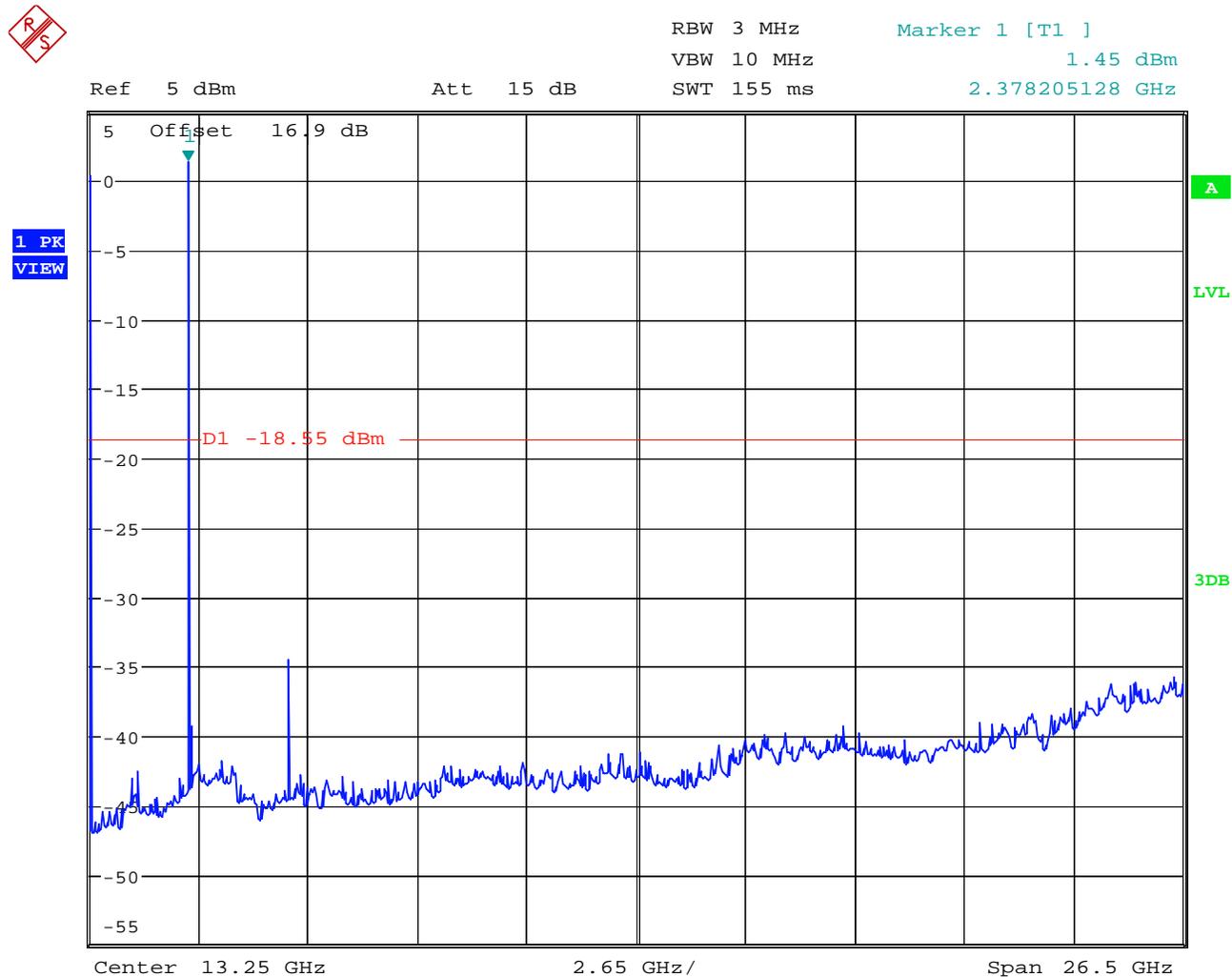
F>1G: RBW=VBW=1 MHz.

5.10.3 Test data/ plots:

Conducted Spurious Emissions			
Channel	Frequency (MHz)	Amplitude (dBm)	Limits
Low	2402	1.45	30dBm
	No critical peaks		-20dBc
Mid	2441	1.65	30 dBm
	No critical peaks		-20dBc
High	2480	0.96	30 dBm
	No critical peaks		-20dBc
Measurement Uncertainty: ±1 dB			

5.10.4 Test data/ plots:

Conducted Spurious Emission 2402MHz

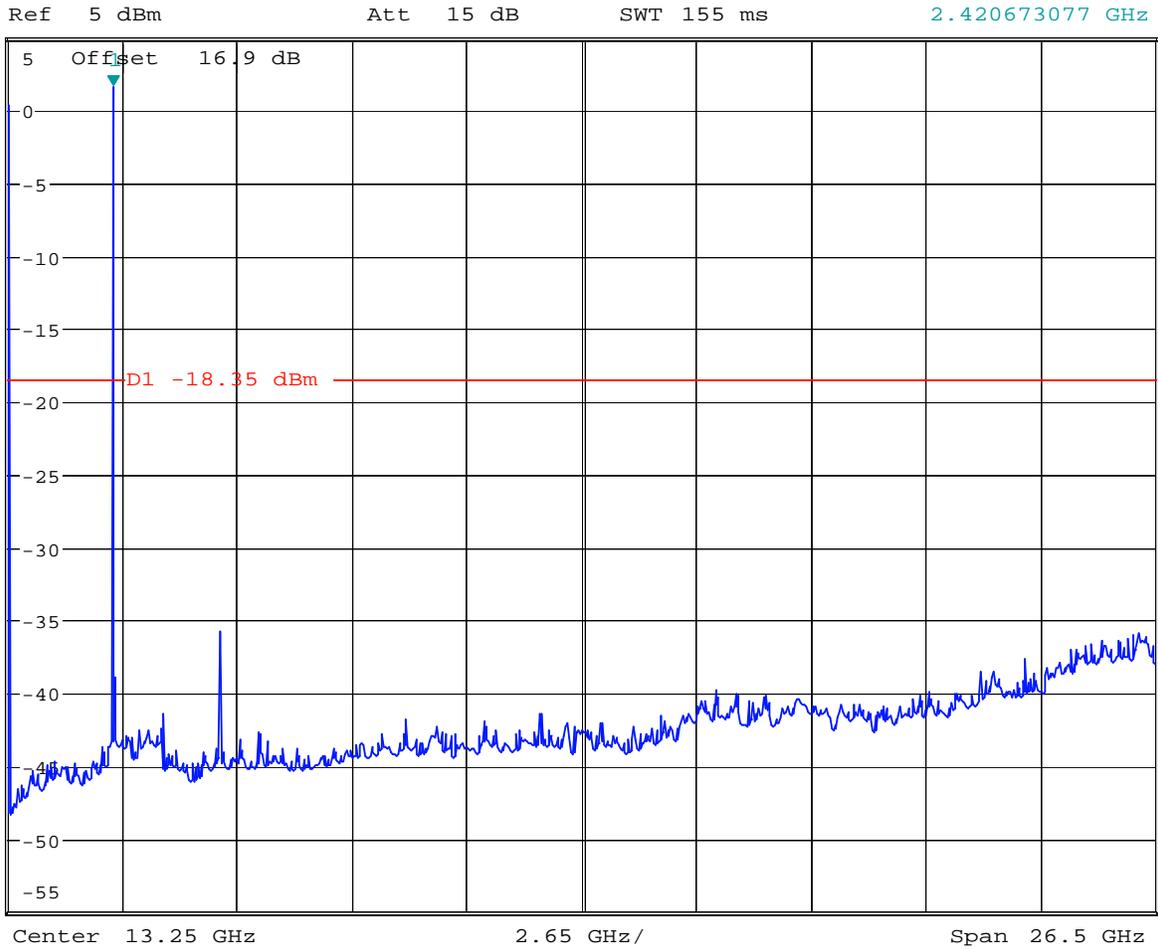




Conducted Spurious Emission 2441 MHz



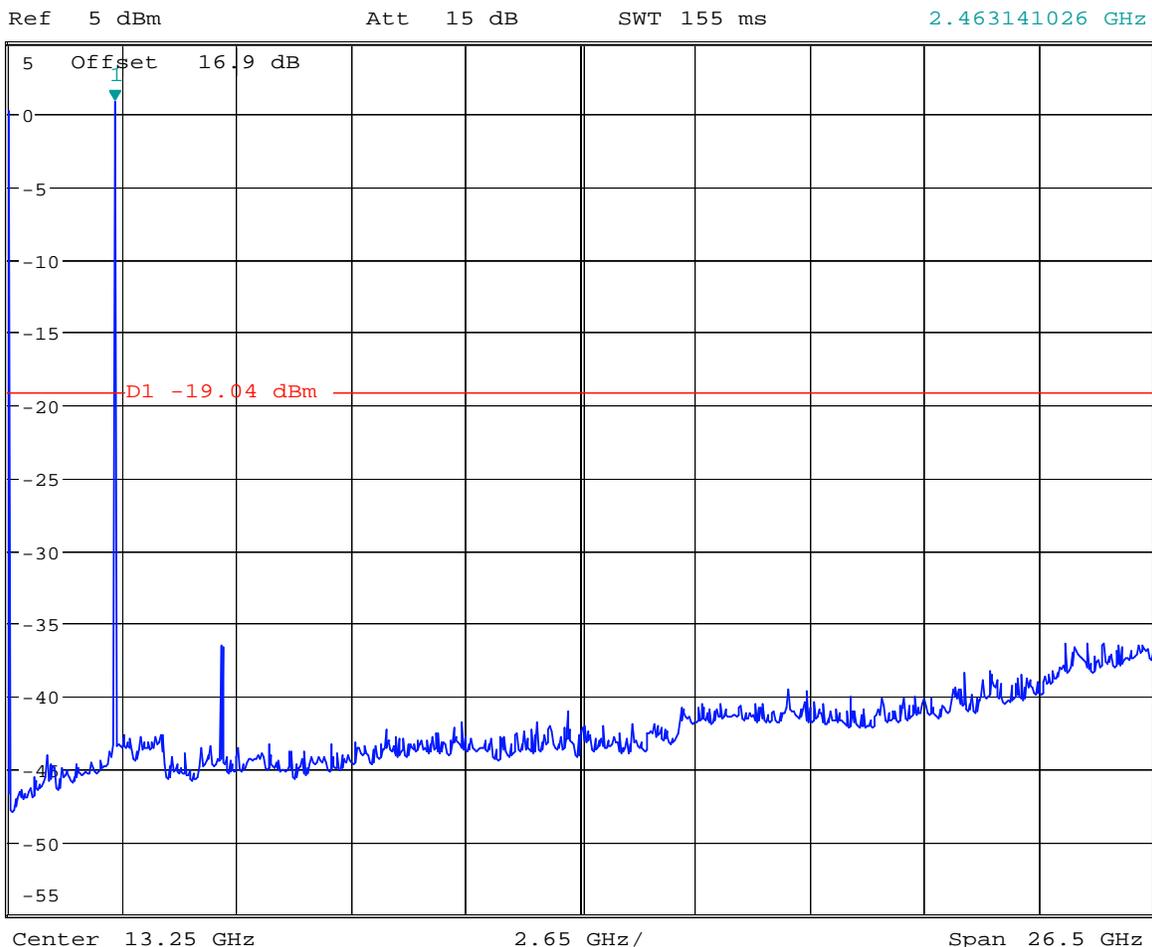
RBW 3 MHz Marker 1 [T1]
VBW 10 MHz 1.65 dBm
SWT 155 ms 2.420673077 GHz



Conducted Spurious Emission 2480MHz



RBW 3 MHz Marker 1 [T1]
VBW 10 MHz 0.96 dBm
SWT 155 ms 2.463141026 GHz





5.11 Transmitter Spurious Emissions- Radiated

**5.11.1 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. In addition, 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) (see §15.205(c)).

*PEAK LIMIT= 74dBµV/m

*AVG. LIMIT= 54dBµV/m

5.11.2 Limits: §15.209

(For measurement distance of 3m)

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)



NOTE:

1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3 and 25 GHz very short cable connections to the antenna was used to minimize the noise level.

2. All measurements are done in Peak mode using an Average limit, unless specified within the plots.

5.11.3 Limits: §15.209

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)	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

5.11.4 Test Result:

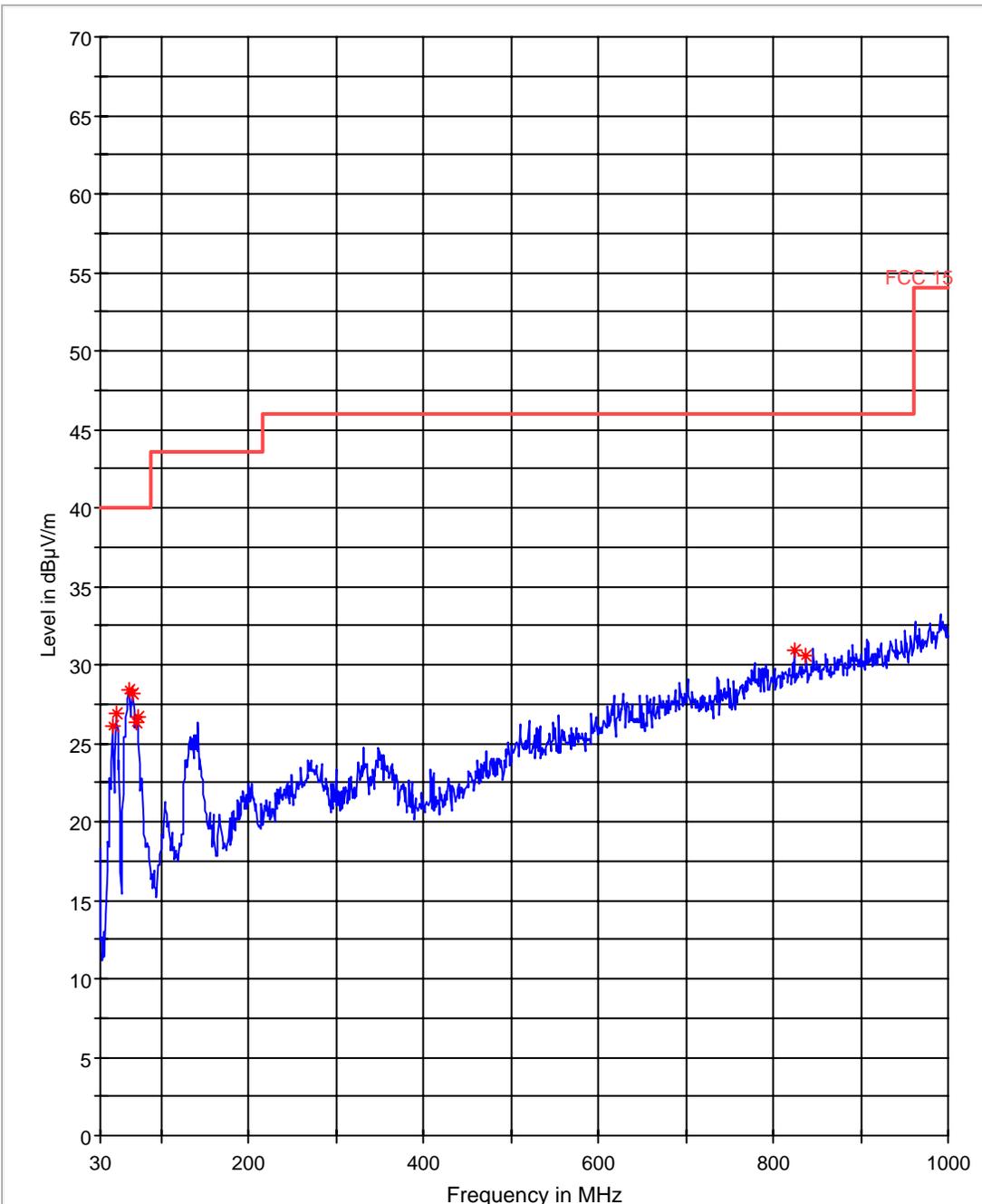
No significant emissions measurable. Plots reported here represent the worse case emissions.



5.11.5 Test data/ plots:

Low Channel 2402 MHz: 30MHz-1GHz

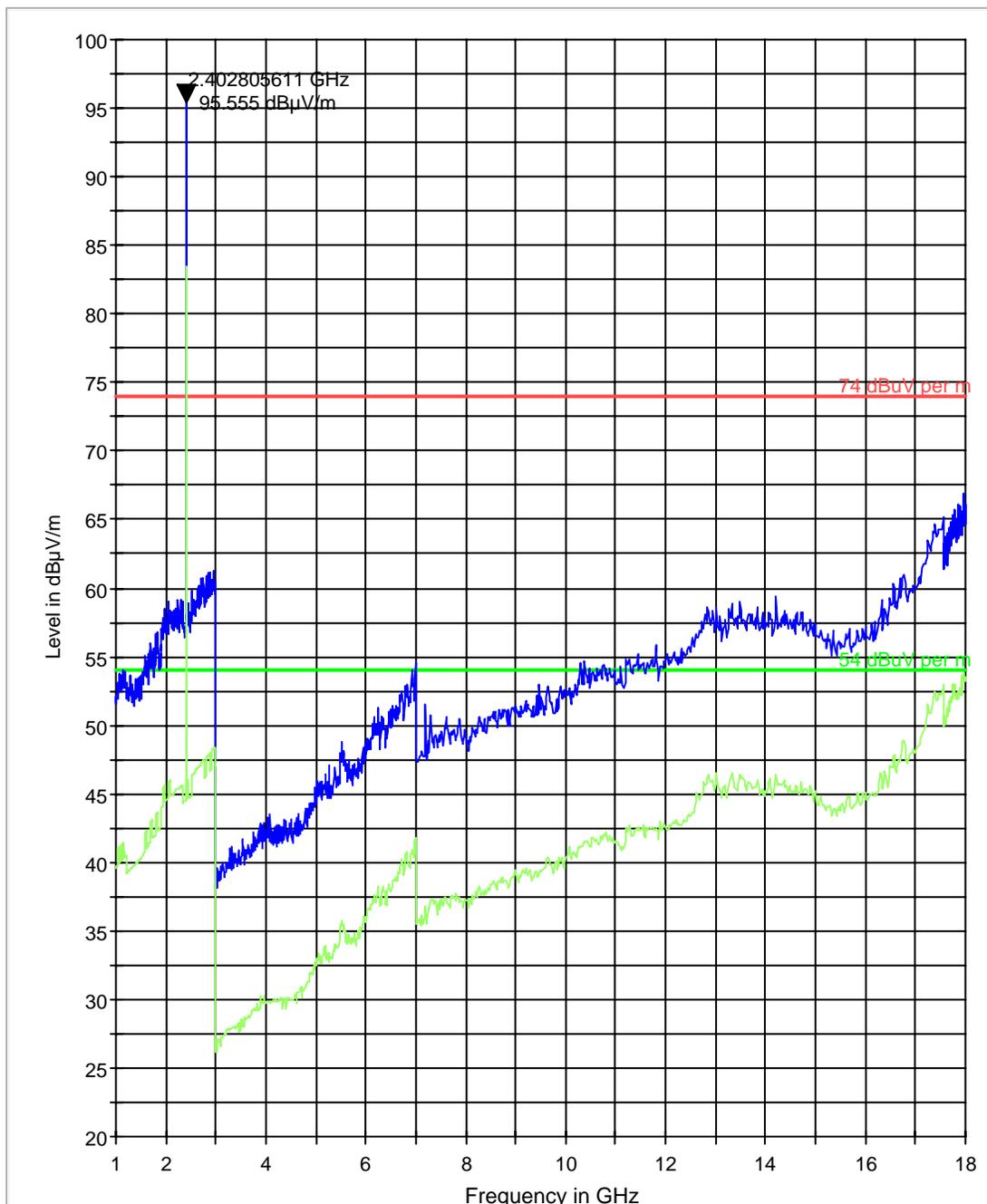
FCC 15 30-1000MHz





Low Channel 2402 MHz: 1GHz-18GHz

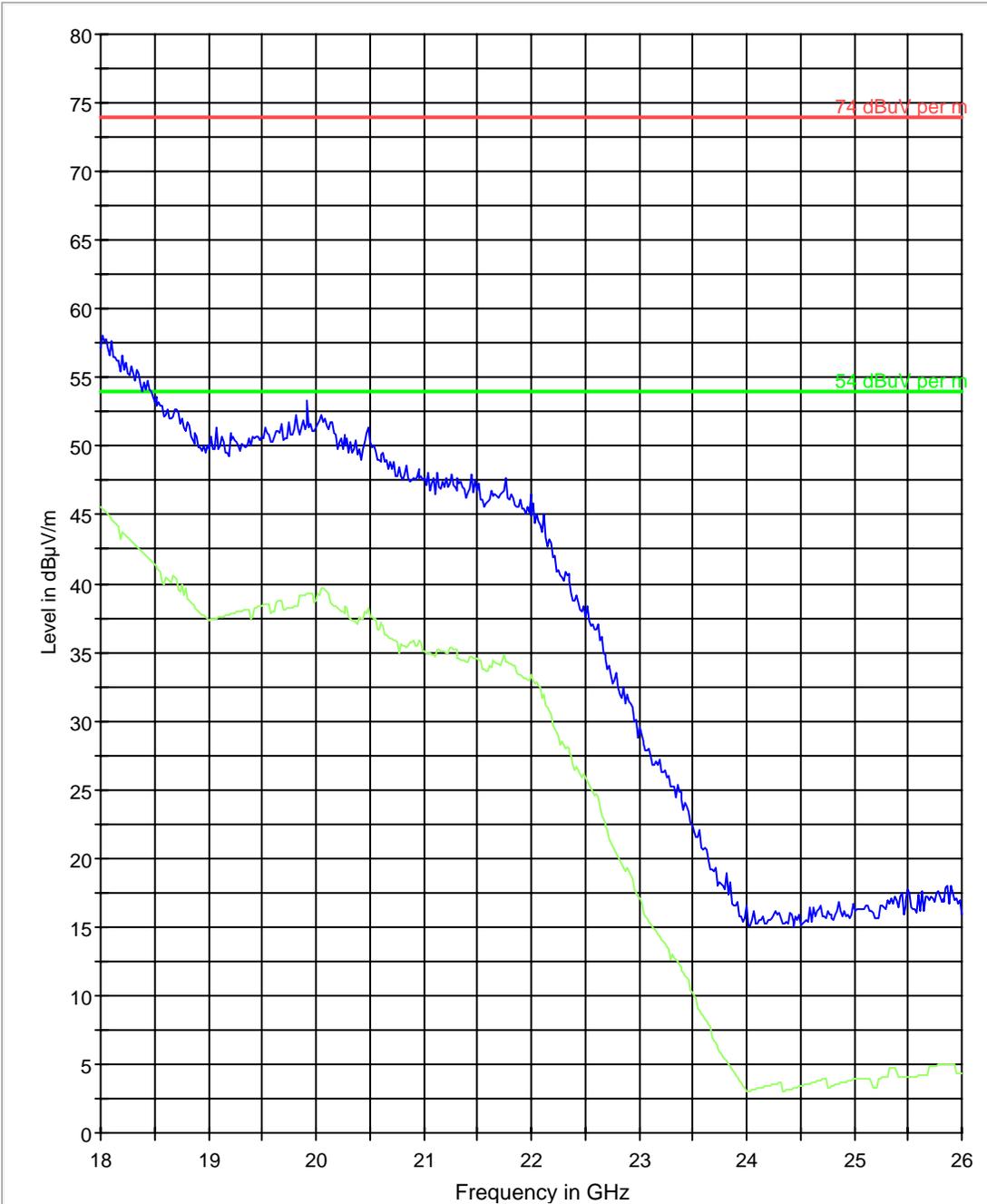
FCC 15 1-18GHz





Low Channel 2402 MHz: 18GHz-25GHz

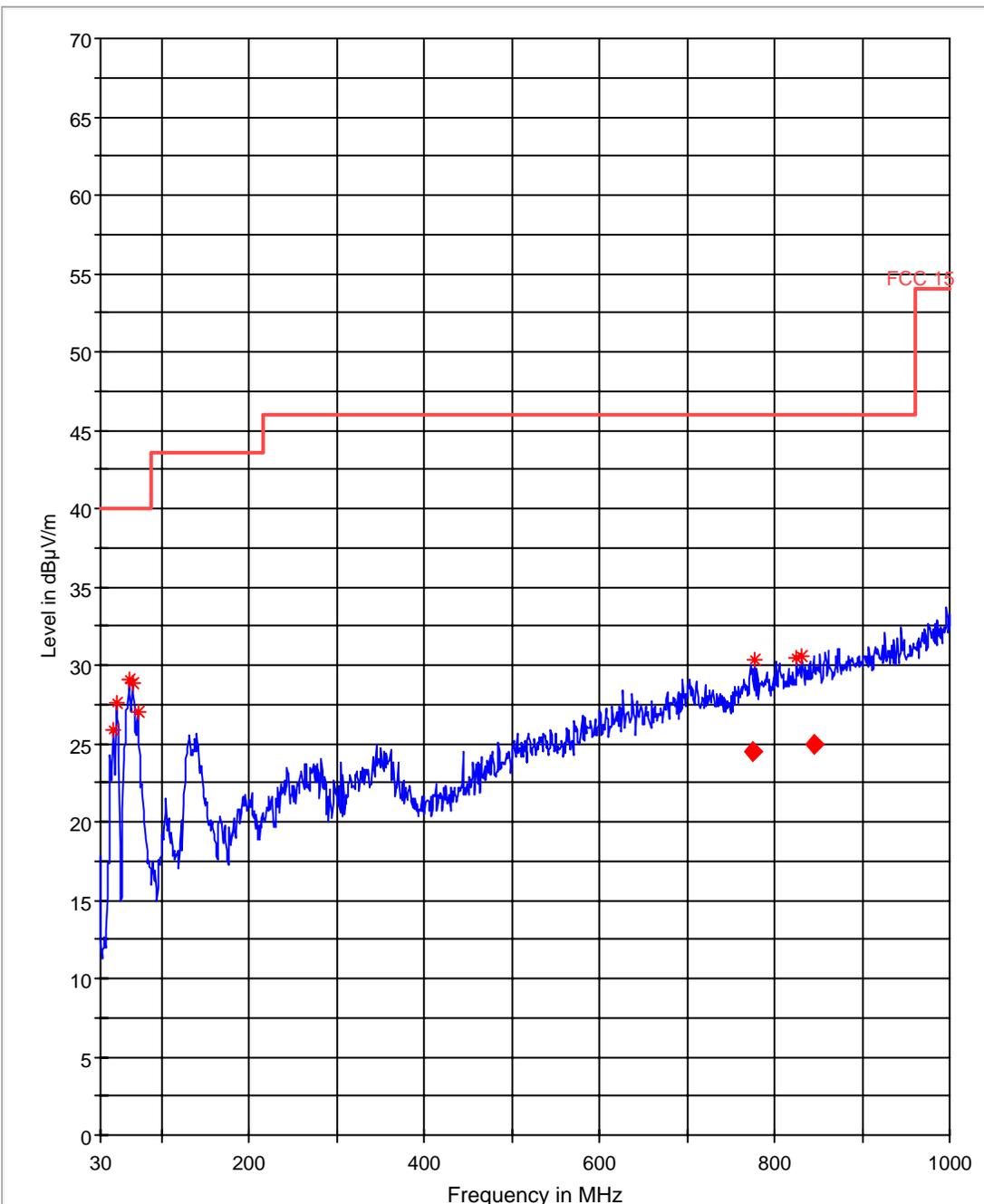
FCC 15 18-26GHz





Mid Channel 2441 MHz: 30MHz-1GHz

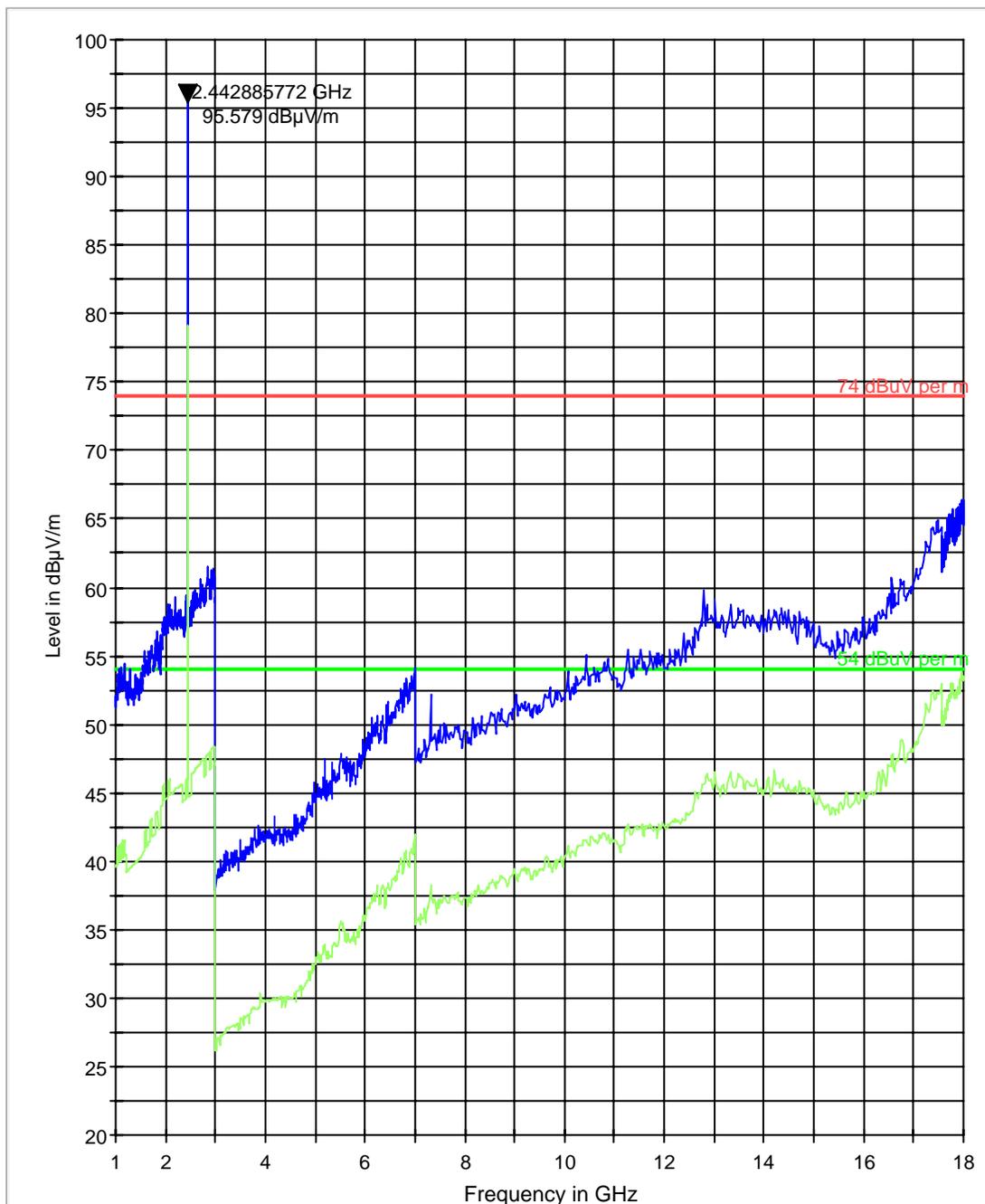
FCC 15 30-1000MHz





Mid Channel 2441 MHz: 1GHz-18GHz

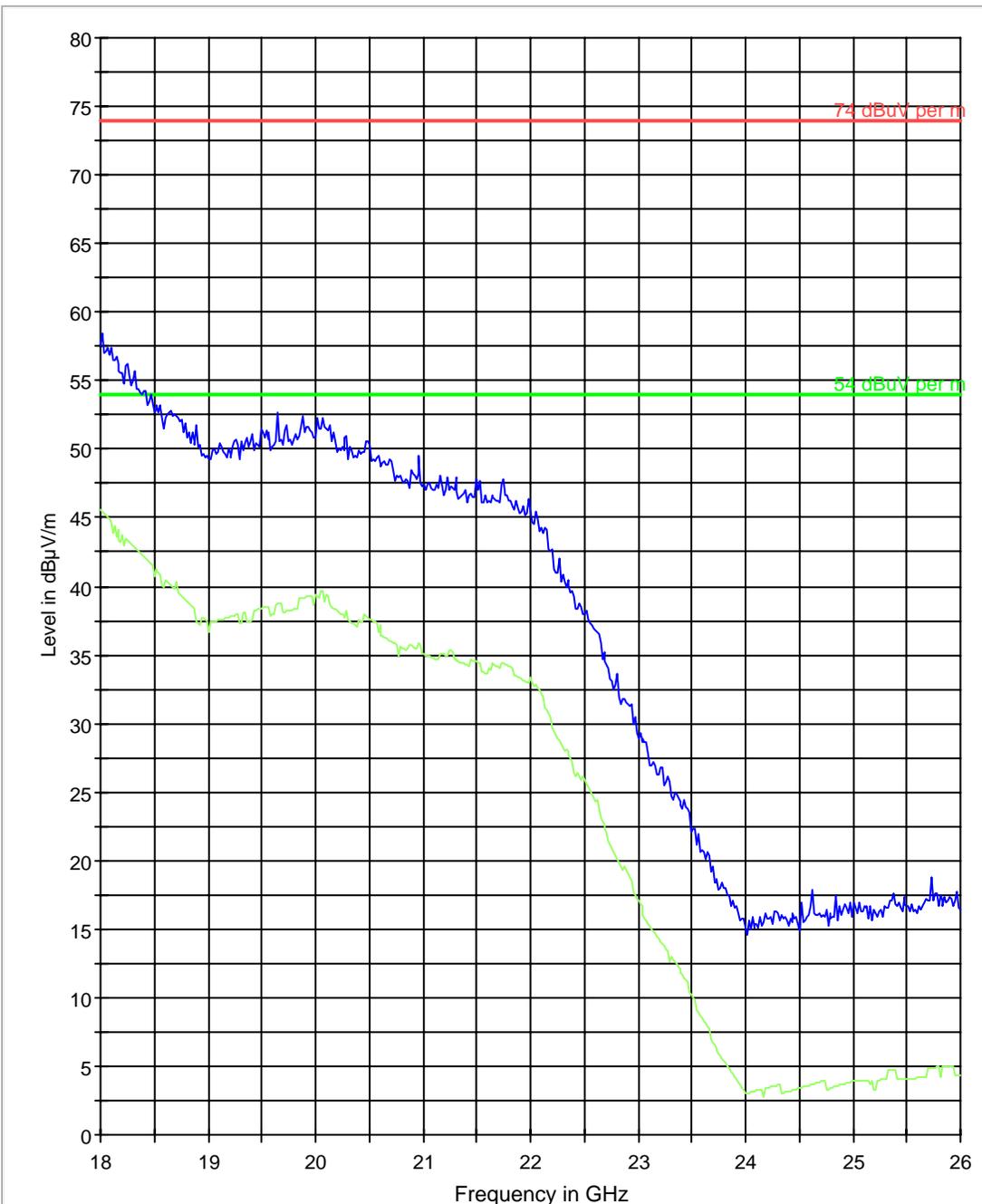
FCC 15 1-18GHz





Mid Channel 2441 MHz: 18GHz-25GHz

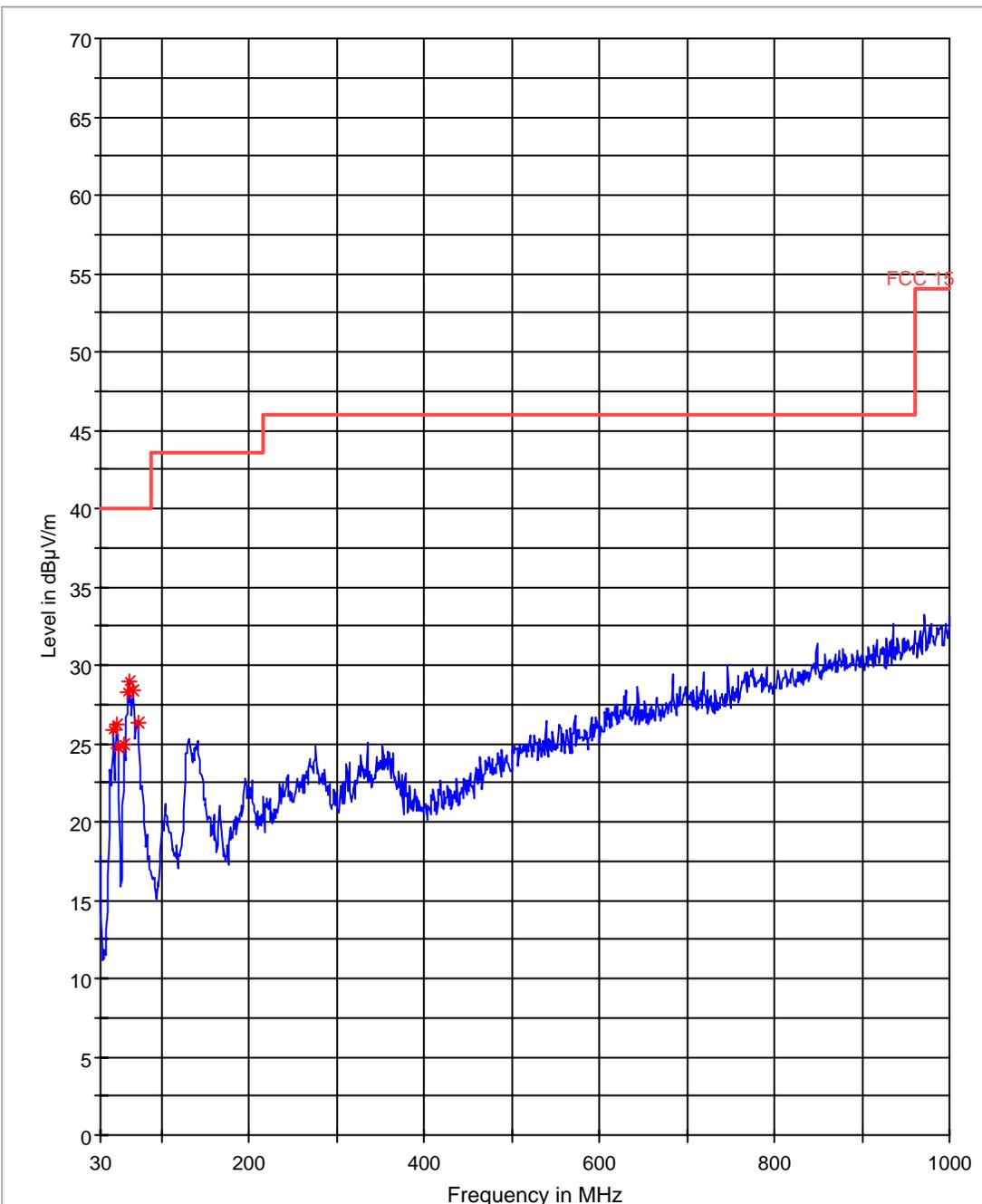
FCC 15 18-26GHz





High Channel 2480MHz: 30MHz-1GHz

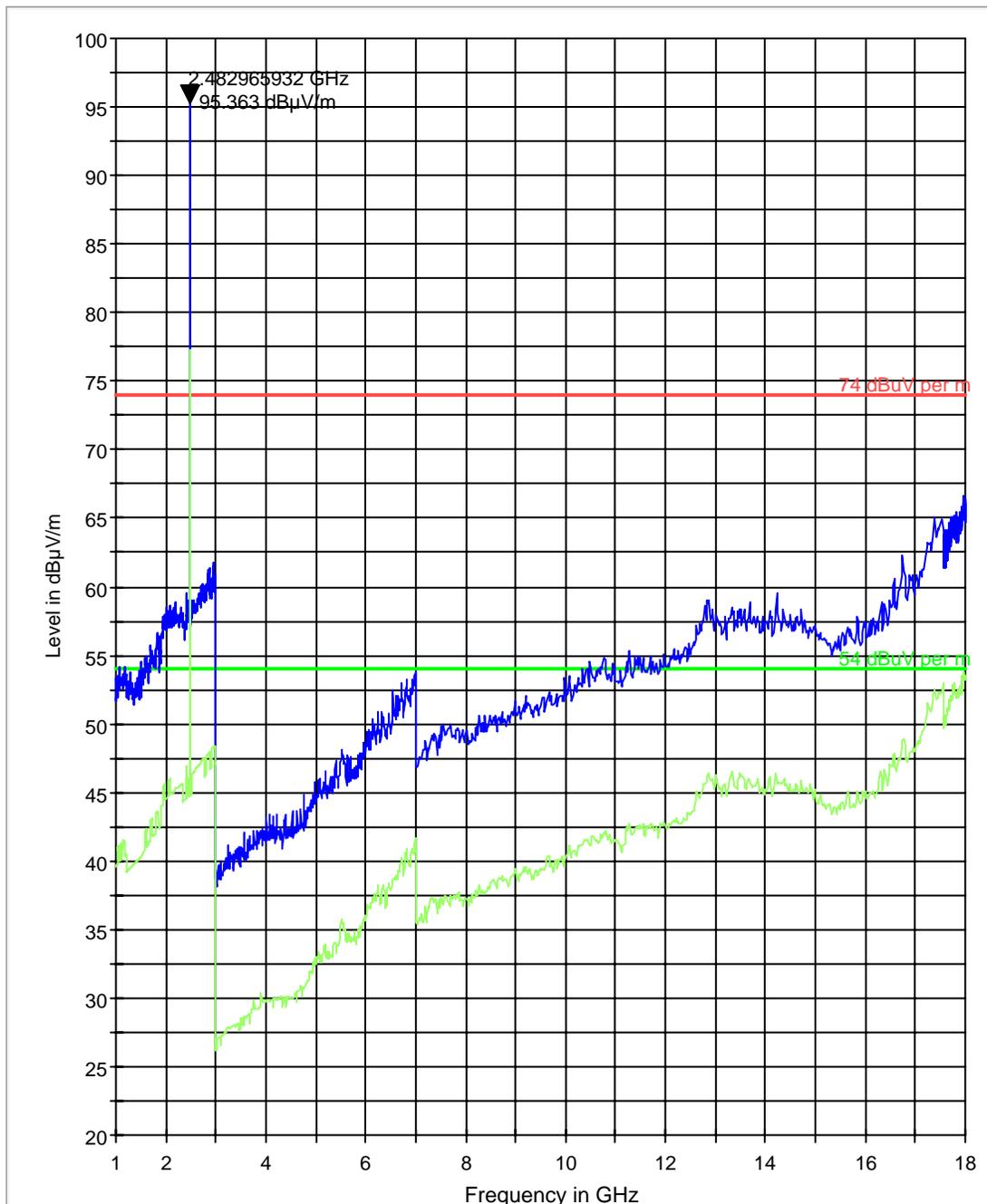
FCC 15 30-1000MHz





High Channel 2480MHz: 1GHz-18GHz

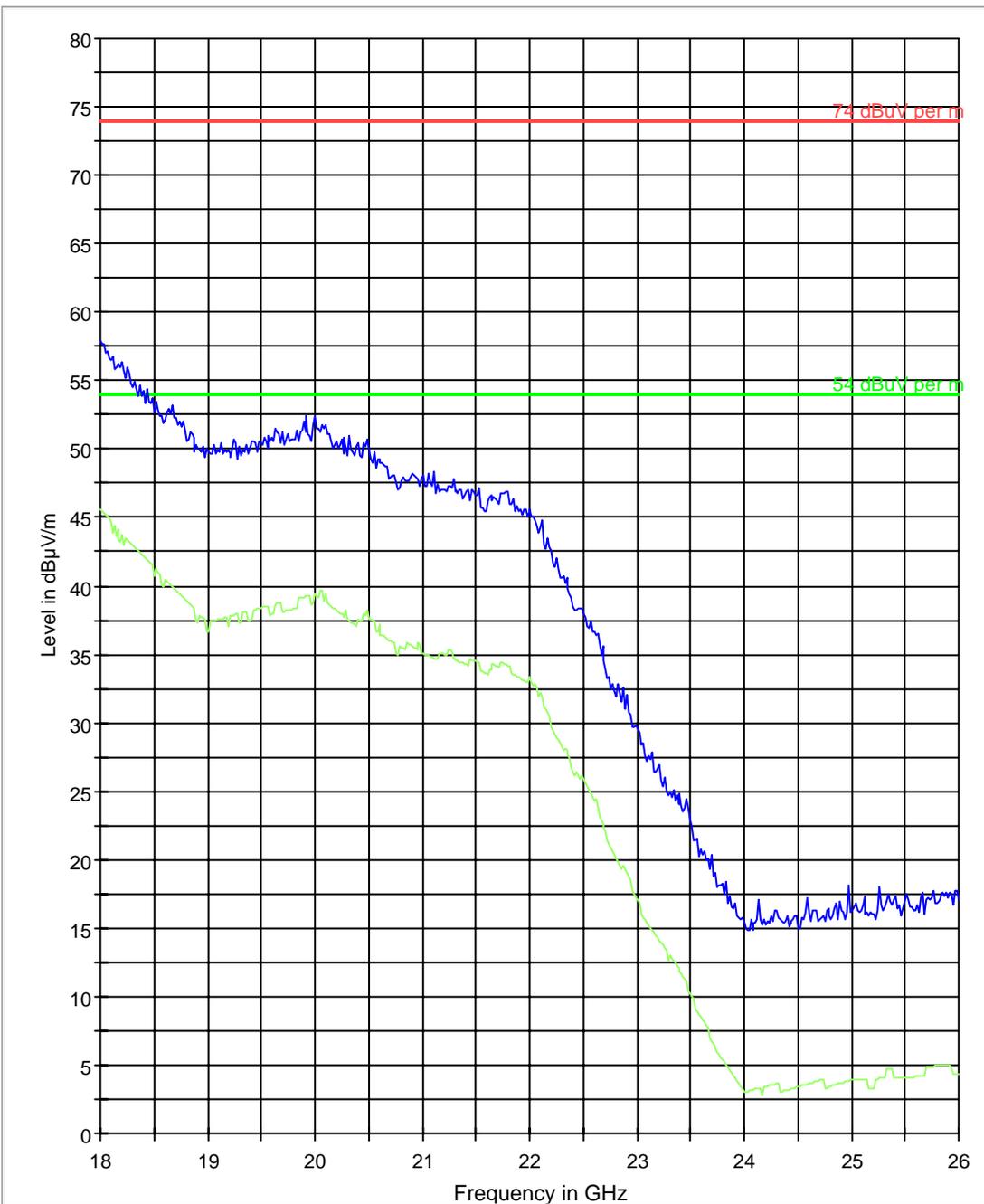
FCC 15 1-18GHz





High Channel 2480MHz: 18GHz-25GHz

FCC 15 18-26GHz





5.12 Receiver Spurious Emissions- Radiated

5.12.1 Limits: §15.109

Frequency of emission (MHz)	Field strength ($\mu\text{V/m}$)	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
30–88	100 (40dB $\mu\text{V/m}$)	3
88–216	150 (43.5 dB $\mu\text{V/m}$)	3
216–960	200 (46 dB $\mu\text{V/m}$)	3
Above 960	500 (54 dB $\mu\text{V/m}$)	3

5.12.2 Test Conditions:

Modulation: 8-DPSK

5.12.3 Test Result:

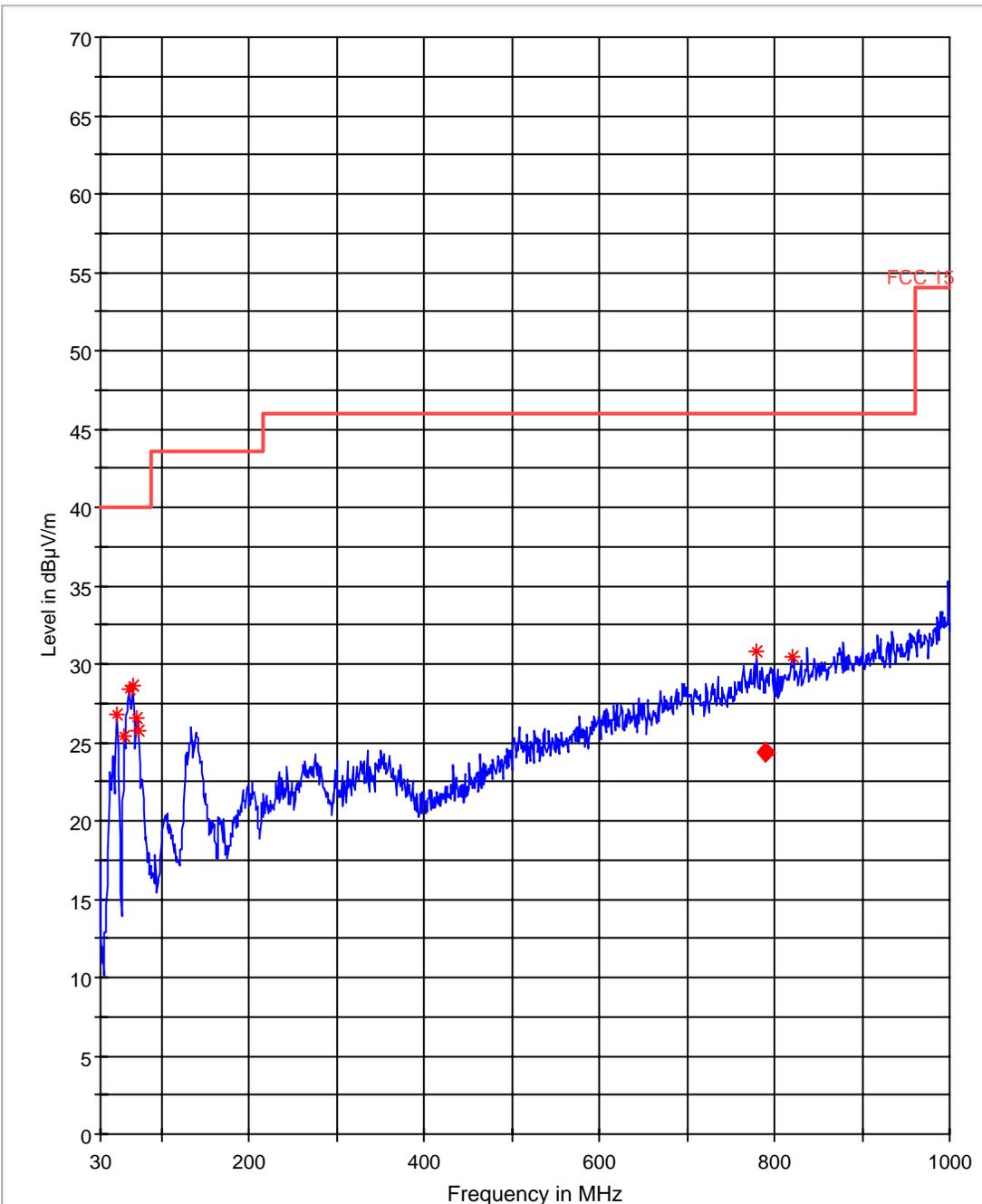
No significant emissions measurable. Plots reported here represent the worse case emissions.



5.12.4 Test data/ plots:

30MHz-1GHz

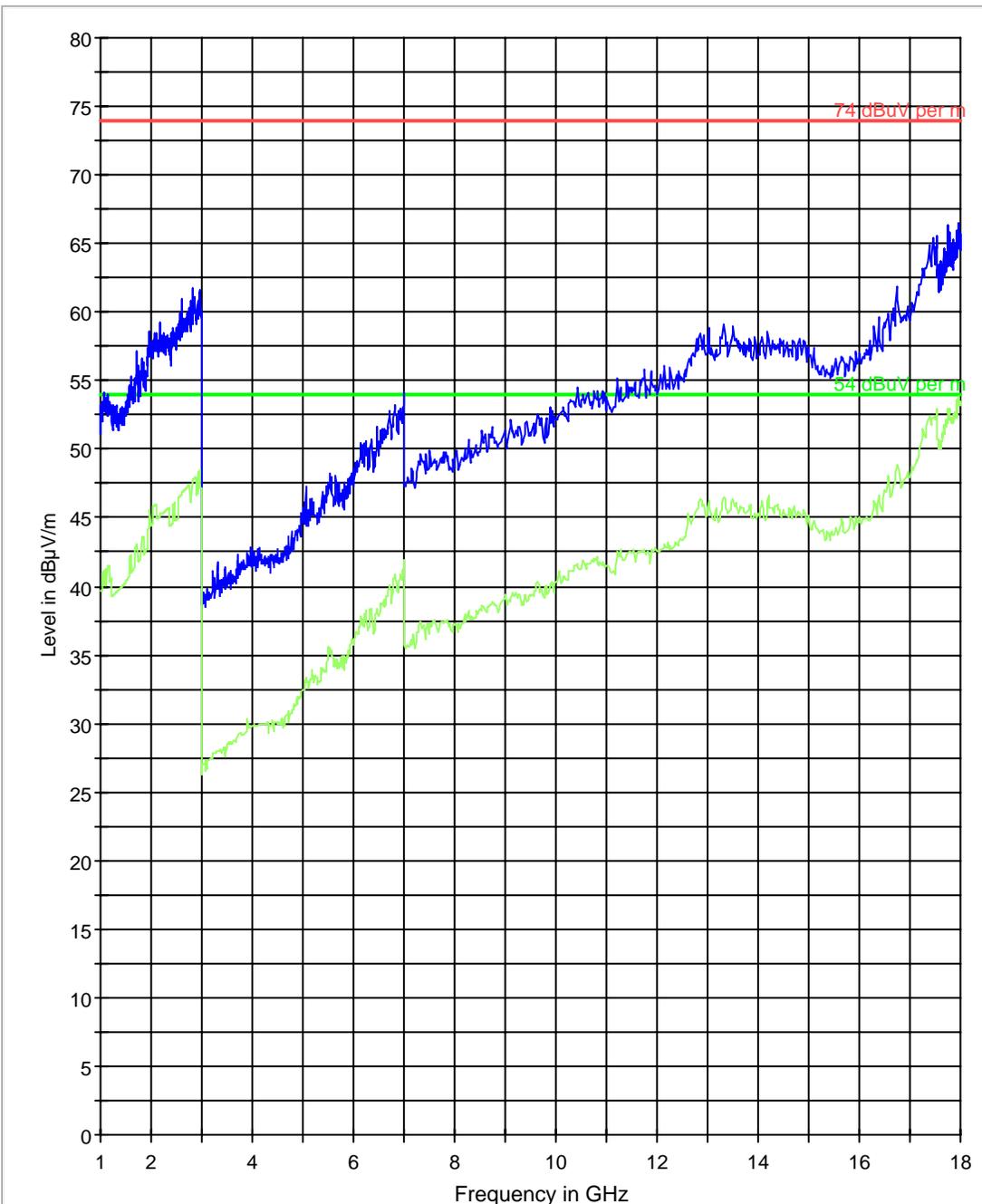
FCC 15 30-1000MHz





1GHz-18GHz

FCC 15 1-18GHz





5.13 AC POWER LINE CONDUCTED EMISSIONS § 15.107/207

5.13.1 LIMITS

Technical specification: 15.107 / 15.207 (Revised as of August 20, 2002)

Limit

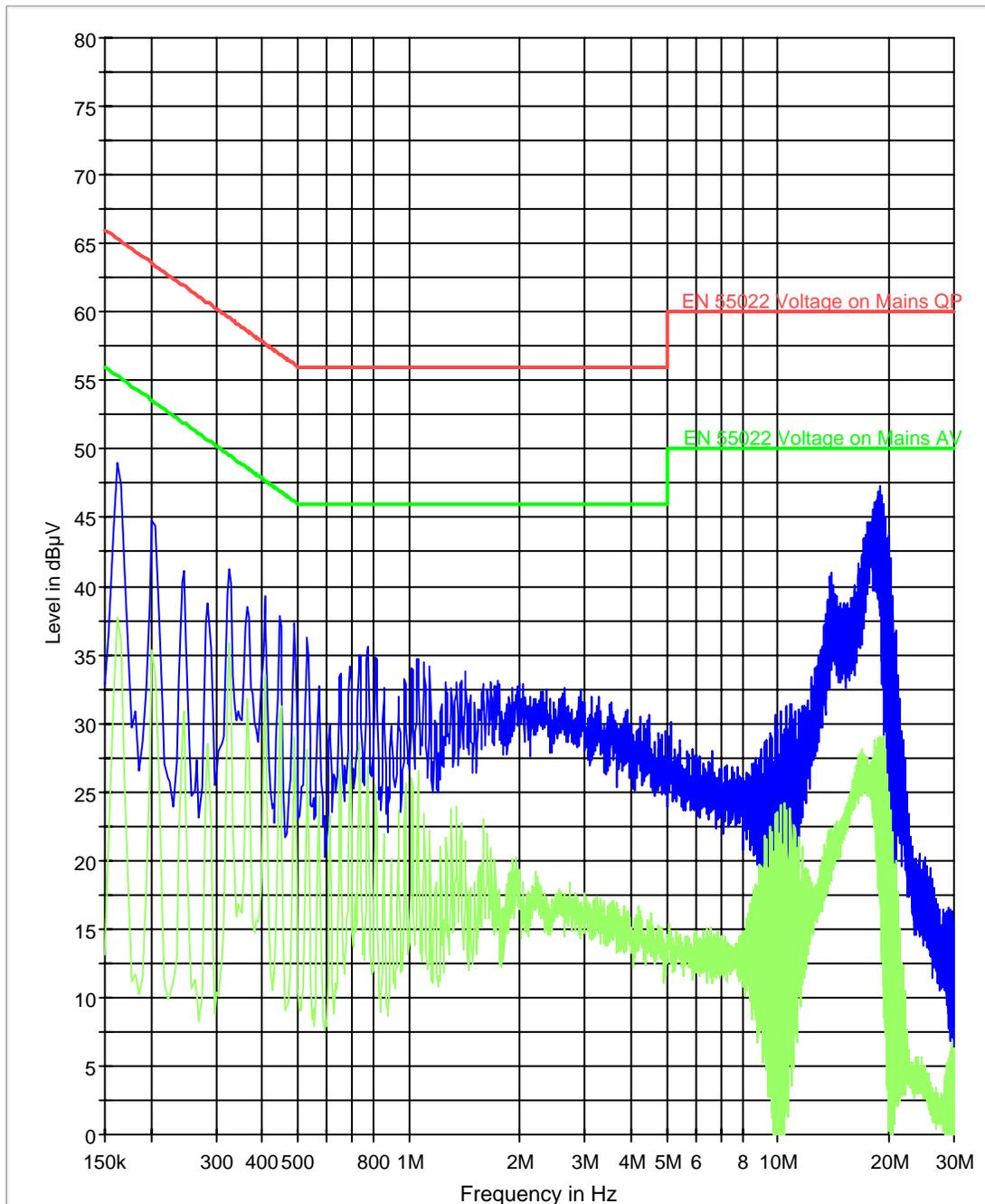
Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

* Decreases with logarithm of the frequency

ANALYZER SETTINGS: RBW = 10KHz VBW = 10KHz

BT CH 39 GFSK Modulation

CISPR 22 Mains Conducted ESH3-Z5





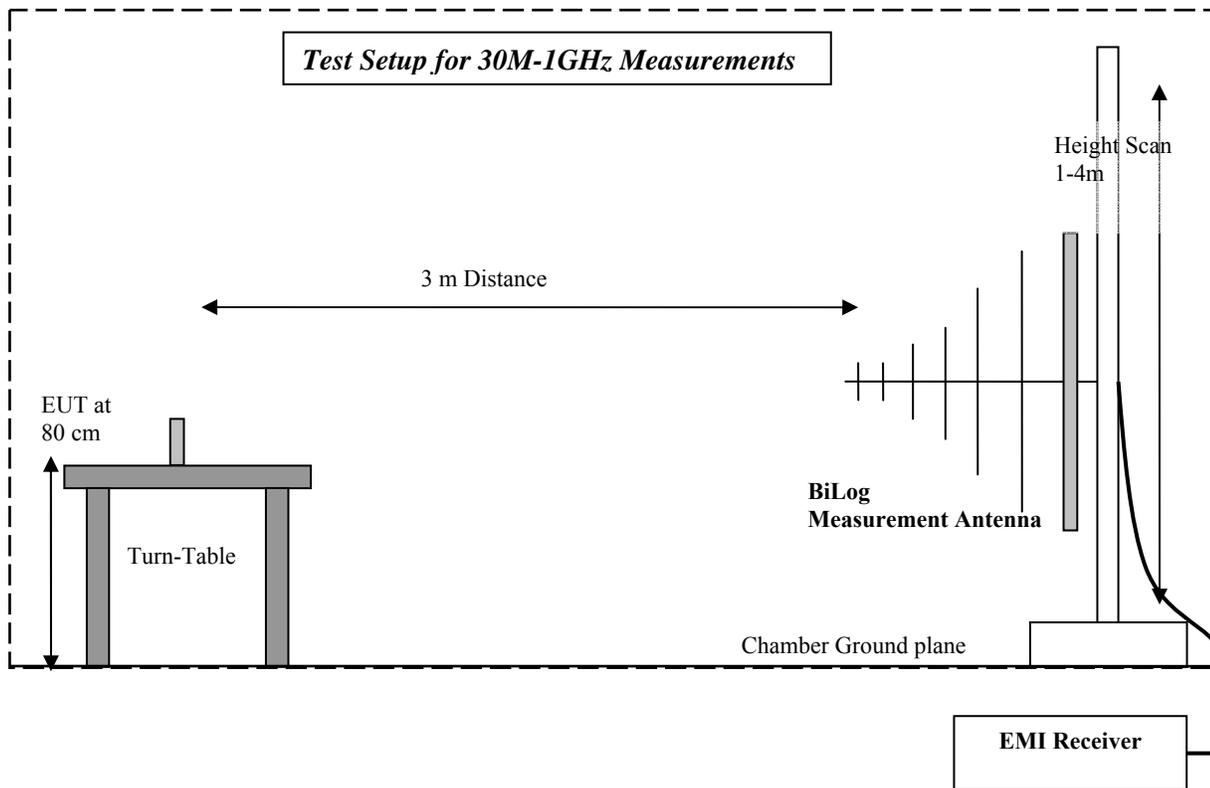
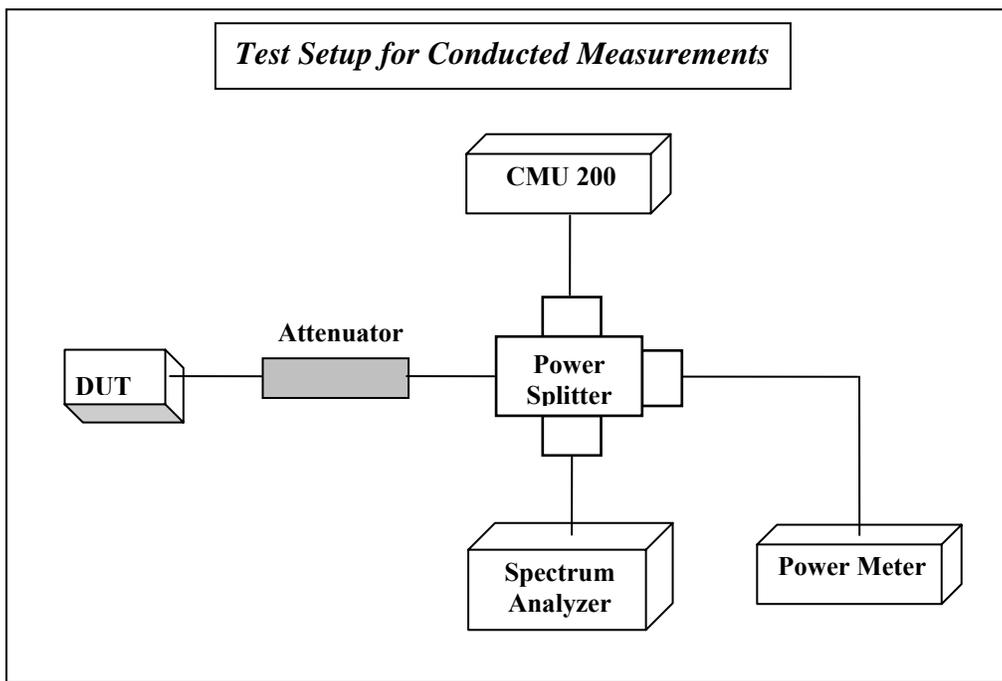
6 Test Equipment and Ancillaries used for tests

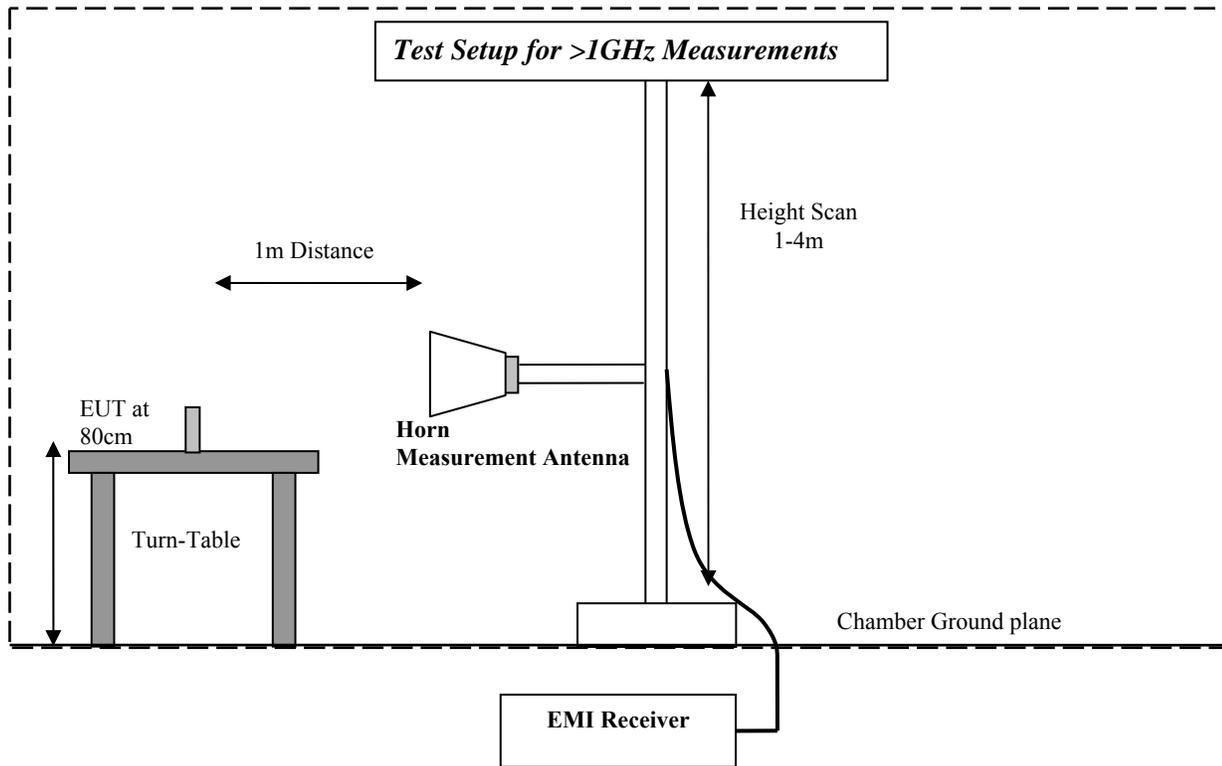
Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
Radio Communication Tester	CMU 200	Rohde & Schwarz	101821	May 2009	1 year
Radio Communication Tester	CMU 200	Rohde & Schwarz	109879	May 2009	1 year
Radio Communication Tester	CMU 200	Rohde & Schwarz	110759	May 2009	1 year
Bluetooth Tester	CBT	Rohde & Schwarz	100212	May 2009	1 year
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2009	1 year
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	Dec 2009	1 year
Loop Antenna	6512	EMCO	00049838	July 2008	2 years
Biconilog Antenna	3141	EMCO	0005-1186	June 2009	2 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Jan 2009	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Jan 2009	3 years
Communication Antenna	IBP5-900/1940	Kathrein	n/a	n/a	n/a
High Pass Filter	5HC2700	Trilithic Inc.	9926013	n/a	n/a
High Pass Filter	4HC1600	Trilithic Inc.	9922307	n/a	n/a
6GHz High Pass Filter	HPM50106	Microtronics	001	n/a	n/a
Pre-Amplifier	JS4-00102600	Miteq	00616	May 2009	1 year
LISN	50-25-2-08	FCC	08014	Apr 2009	1 year
Power Smart Sensor	R&S	NRP-Z81	100161	May 2009	1 Year
Power Smart Sensor	R&S	NRP-Z22	100223	May 2009	1 Year
Upconverter	PXI-5610	NI	E93740	Aug 2008	2 years
Waveform Generator	PXI-5421	NI	E965F1	Aug 2008	2 years
10dB attenuator	ATT-0298-10	MidwestMicrowav	n/a	n/a	n/a
Power Splitter	11667B	Hewlett Packard	645348	n/a	n/a
DC Power Supply	E3610A	Hewlett Packard	KR83021224	n/a	n/a
DC Power Supply	E3610A	Hewlett Packard	KR83023316	n/a	n/a
DC Power Supply	6632A	Hewlett Packard	3524A-12822	n/a	n/a
DC Power Supply	6655A	Hewlett Packard	3403A-00487	n/a	n/a
Multimeter	179	Fluke	N/A	Feb 2010	1 Year
Temp Hum Logger	TM320	Dickson	03280063	Feb 2010	1 Year
Temp Hum Logger	TM325	Dickson	5285354	Feb 2010	1 Year
Climatic Chamber	VT4004	Votsch	G1115	May 2009	1 year

Note:

Equipment calibration is performed by an accredited calibration lab according to ISO 17025 requirements. Calibration intervals are determined from manufacturer recommendation and/or lab discretion. Cetecom Inc takes all measures to calibrate equipment before the due date; for instances when the equipment has to be used beyond the calibration due date, necessary steps are taken for calibration verification and documented to meet the Quality System requirements.

7 **BLOCK DIAGRAMS**







8 Revision History

Date	Report Name	Changes to report	Report prepared by
2010-06-14	EMC_GARMI_023_10001_15.247BT	Original report	Satya Radhakrishna
2010-07-02	EMC_GARMI_023_10001_15.247BT_rev1	<ol style="list-style-type: none"> 1. included ac adapter information in section 3.3 2. included description of ac adapter in test setups in section 4. 3. Added section 5.13 for ac power line conducted emissions and included result plot. 4. Included reference to measurement guideline DA-705 in section 4 and section 5. 	Satya Radhakrishna