FCC Test Report

FOR:

Model Name: ZB24TM-Z2750
2.4GHz Zigbee wireless transceiver module

FCC ID: V24275

47 CFR Part 15.247 for DSSS Systems

TEST REPORT #: EMC_CET10_086_11001_15.247_Rev2
DATE: 2011-08-22

ACCREDITED TESTING LABORATORY Certificate #2135.01

Bluetooth Qualification Test Facility (BQTF)

CTIA Authorized Test Lab LAB CODE 20020328-00

FCC listed
A2LA Accredited

IC recognized # 3462B

***CETECOM* Inc.**
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: 2113686
Board of Directors: Dr. Harald Ansorge, Hans Peter May.

TABLE OF CONTENTS

1 Assessment

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

Company	Description	Model #
NEC Engineering, Ltd.	2.4 GHz Zigbee wireless transceiver module	ZB24TM-Z2750

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2011-08-22	Compliance	Sajay Jose (Test Lab Manager)	Sajay Jose 2011.08.22 18:13:18 -07'00'

Responsible for the Report:

Date	Section	Name	Signature
2011-08-22	Compliance	Christopher Torio (EMC Engineer)	Christopher Torio Digitally signed by Christopher Torio DN: cn=Christopher Torio, c=US - UNITED STATES, o=Cetecom, Inc, ou=Compliance, email=christopher.torio@cetecomusa.com Date: 2011.08.22 17:53:27 -07'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

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

2.2 Identification of the Client

Applicant's Name:	NEC Engineering, Ltd.
Street Address:	1753 Shimonumabe, Nakahara-ku, Kawasaki-shi
City/Zip Code	Kanagawa, 211-8666
Country	Japan
Contact Person:	Mr. Hiroyuki Fujimi
Phone No.	+81 (044) 435-9626
Fax:	+81 (044) 435-9672
e-mail:	h-fujimi@pb.jp.nec.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	NAITO DENSEI MACHIDA MFG CO., LTD.
Manufacturers Address:	1220-1, Shimoichinose, Minami-Alps-shi
City/Zip Code	Yamanashi, 400-0314
Country	Japan

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	ZB24TM-Z2750
HW / SW Revision :	2.1 / 90
FCC-ID:	V24275
Product Description:	2.4 GHz Zigbee Wireless transceiver module
Frequency Range / number of channels:	2400-2483.5MHz / 16;
Type(s) of Modulation:	DSSS
Data Rate:	250 kbps
Antenna Type / gain / position / min. distance to other antenna (if appl):	Low: -1.1 dBi Mid: 0.1 dBi High: -0.2 dBi
Output Powers:	Low Channel Conducted: 4.51 dBm; Low Channel Radiated: 3.41 dBm; Mid Channel Conducted: 4.23 dBm; Mid Channel Radiated: 4.34 dBm; High Channel Conducted: 3.91 dBm; High Channel Radiated: 3.69 dBm
Power supply	3.6V DC
Operating temperature range	-10ºC to 75ºC
Prototype / Production Unit	Prototype

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes/Comments	Cetecom ID
1	Z05	2.1	90		C012301
2	Z01	2.1	90	Conducted Sample	C012302

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number	Cetecom ID
1	Development Board	NEC	N/A	N/A	C012303
2	EMC Laptop #2	Dell	PP11L	H5914A03	N/A

4 Subject Of Investigation

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations.

This test report is to support a request for new equipment authorization under the FCC ID **V24275.**

All testing was performed on the product referred to in Section 3 as EUT.
This test report contains full radiated and conducted testing results as per

- 47 CFR Part 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communications Commission subchapter A- General, Part 15- Radio Frequency Devices.

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

5 Summary of Measurement Results

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

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

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

6 Measurements

6.1 Radiated Measurement Procedure

ANSI C63.4 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.

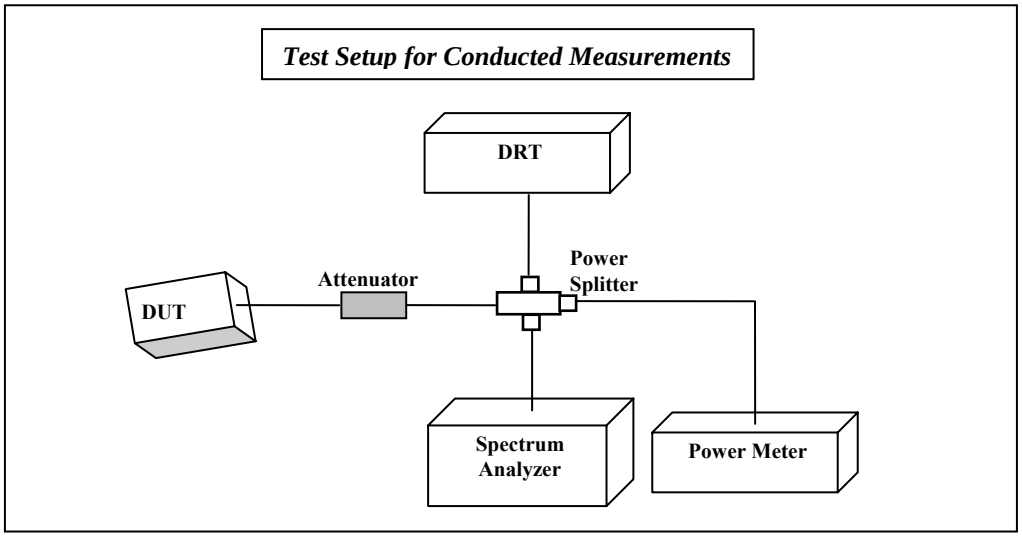
This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. During the full frequency spectrum investigation, particular focus should be made on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

6.2 Conducted Measurement Procedure



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

6.3 Maximum Peak Output Power

6.3.1 References:
FCC CFR §2.1046

6.3.2 Measurement requirements:

6.3.2.1 FCC 2.1046: RF power output.

Power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on circuit elements as specified. The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

6.3.3 Limits:

6.3.3.1 §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.

6.3.4 Test Conditions:

Tnom: 25°C; Vnom: 3.6V

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

6.3.5 Test Result:

Output Power- Conducted (dBm)			
Mode	**Frequency (MHz)**		
	2405 Channel 11	**2440 Channel 18**	**2480 Channel 26**
	Peak	Peak	Peak
Zigbee	4.51	4.23	3.90
Measurement Uncertainty: ±0.5dB			

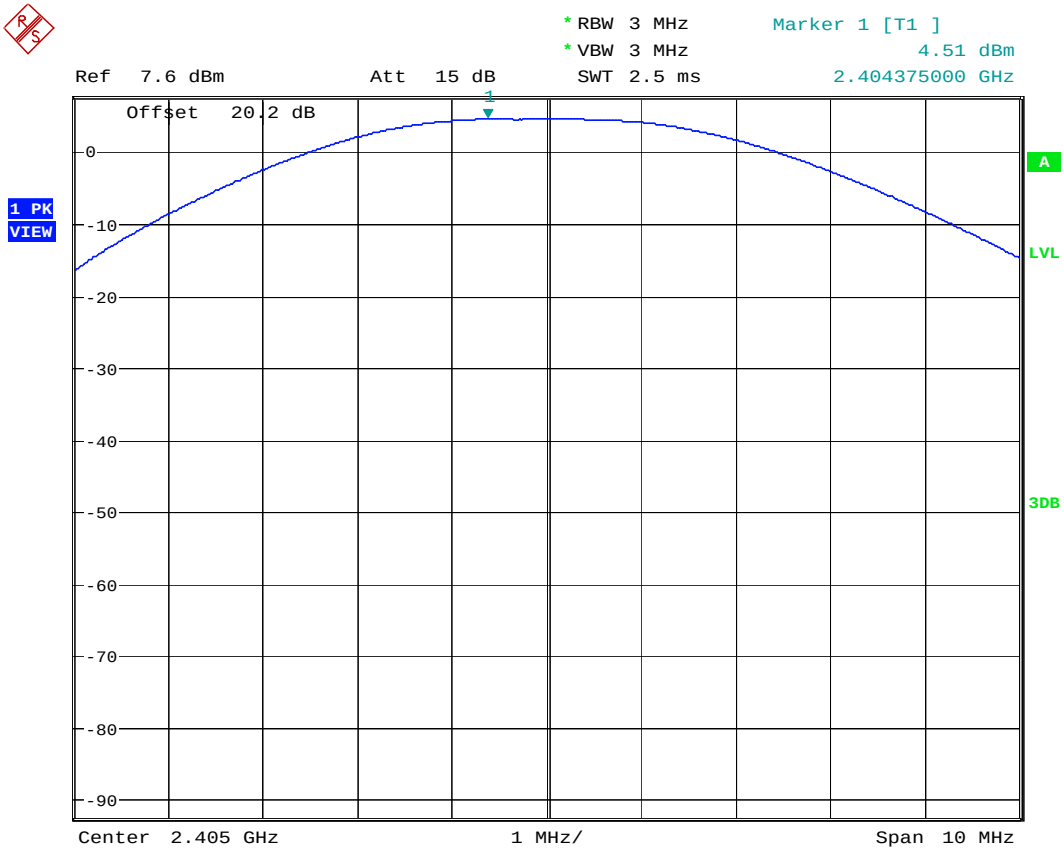
Max Peak Output Power- Radiated (dBm)			
Mode	**Frequency (MHz)**		
	2405 Channel 11	**2440 Channel 18**	**2480 Channel 26**
Zigbee	3.41	4.34	3.69
Measurement Uncertainty: ±3dB			

6.3.5.1 Measurement Result

Pass.

6.3.6 Test Data/plots:

Conducted Peak Power 2405 MHz



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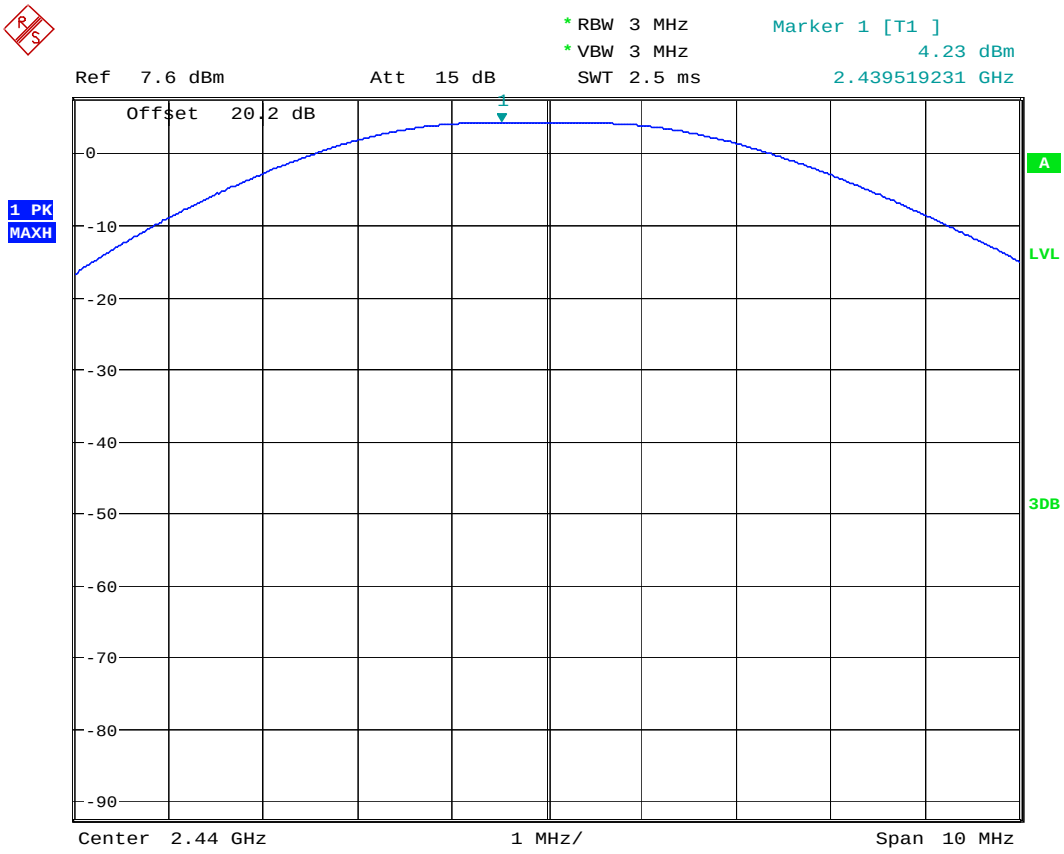
Conducted Peak Power 2440 MHz



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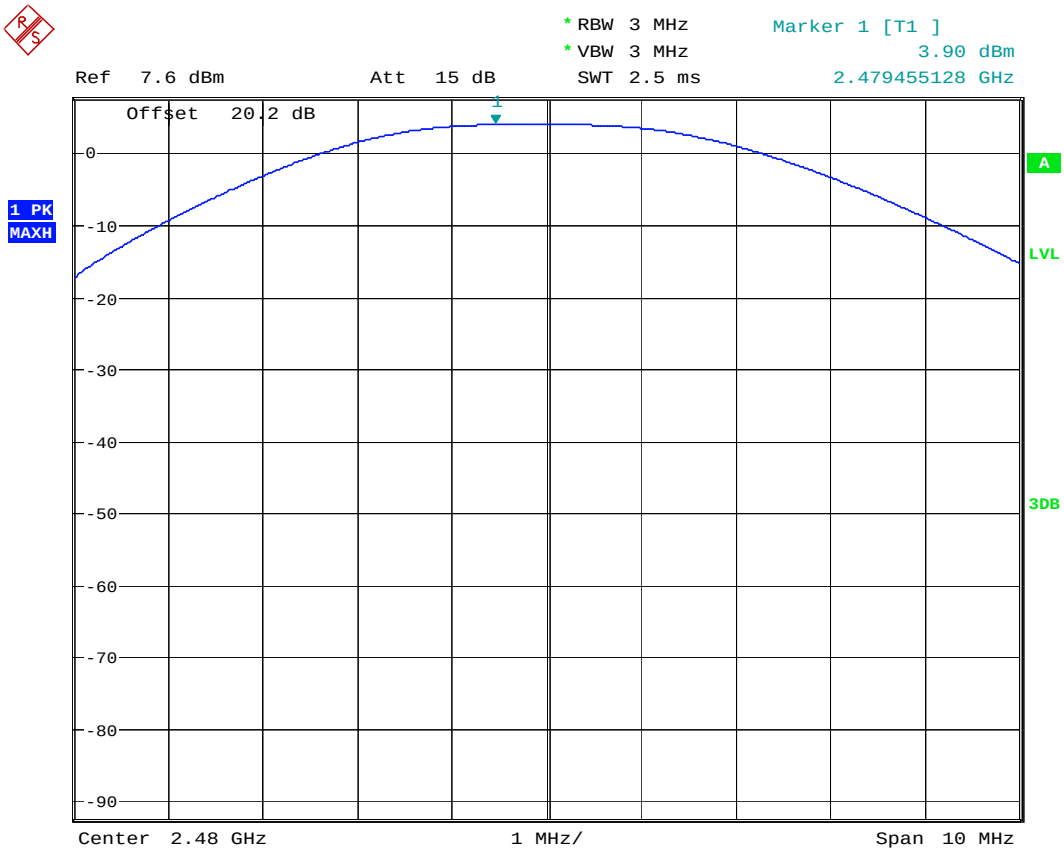
Conducted Peak Power 2480 MHz



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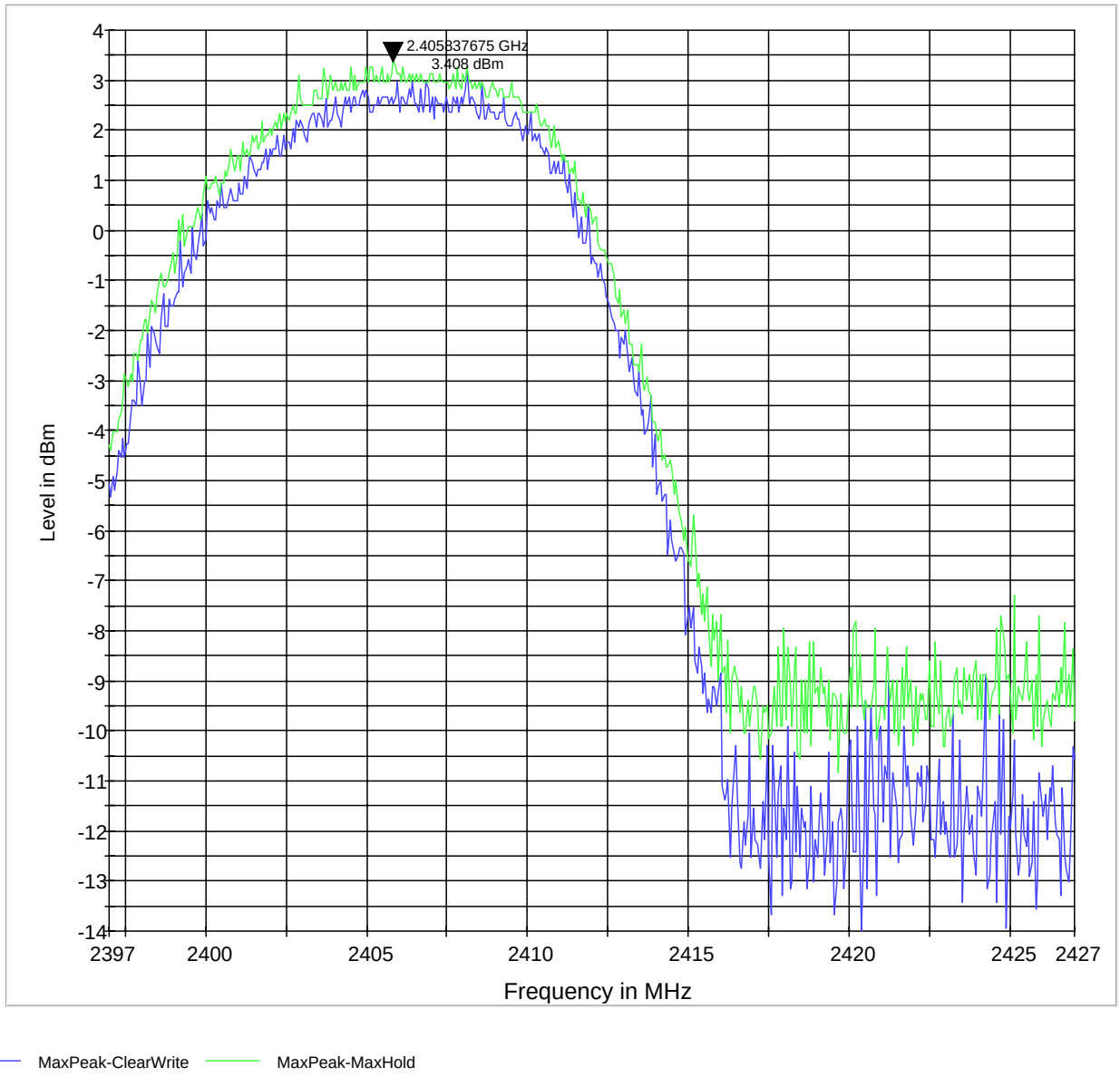
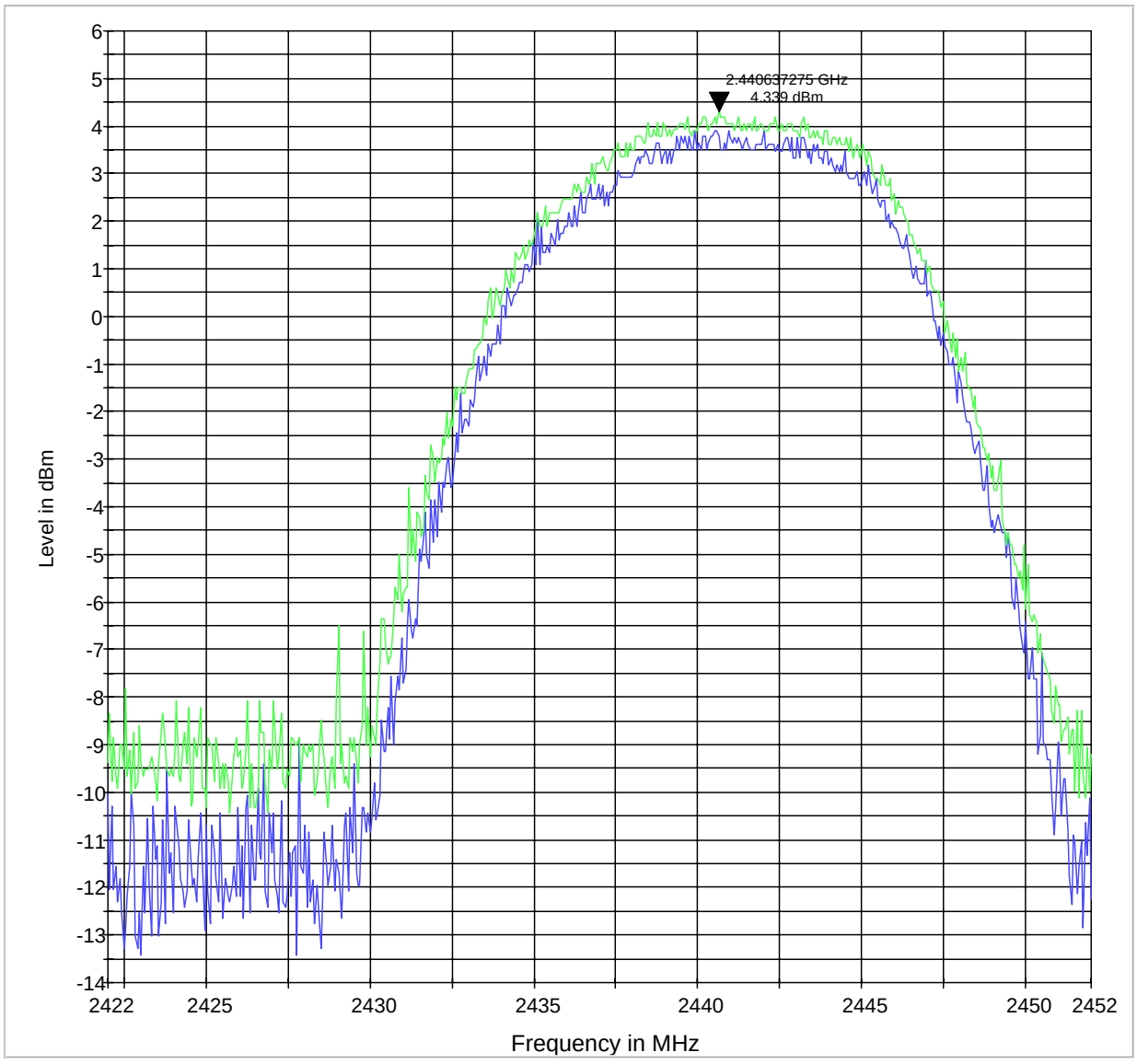
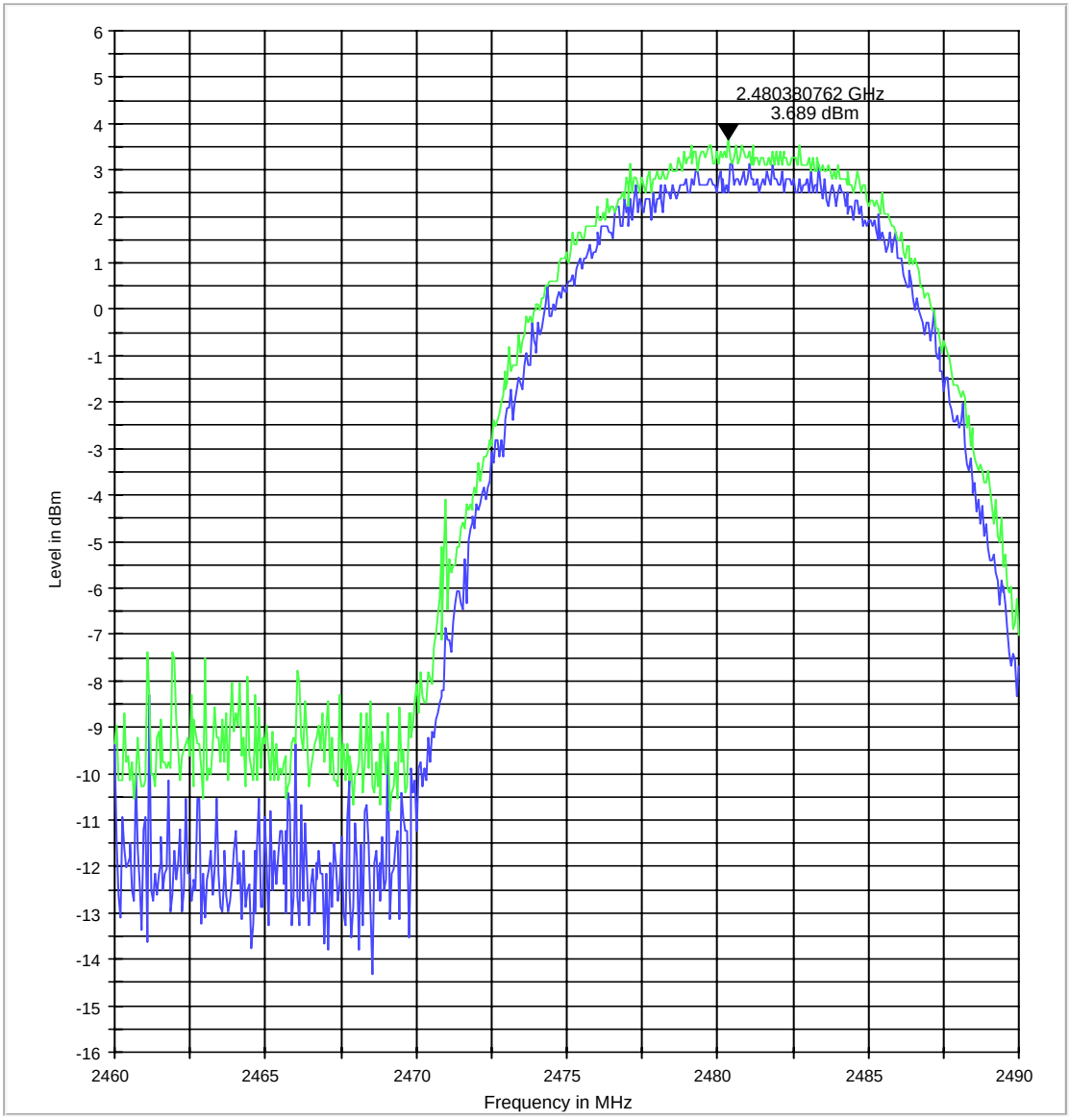
Radiated Peak Power 2405 MHz



Radiated Peak Power 2440 MHz



Radiated Peak Power 2480 MHz



6.4 Restricted Band Edge Compliance

6.4.1 References:
FCC CFR §2.1053

6.4.2 Limits: §15.247/15.205
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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

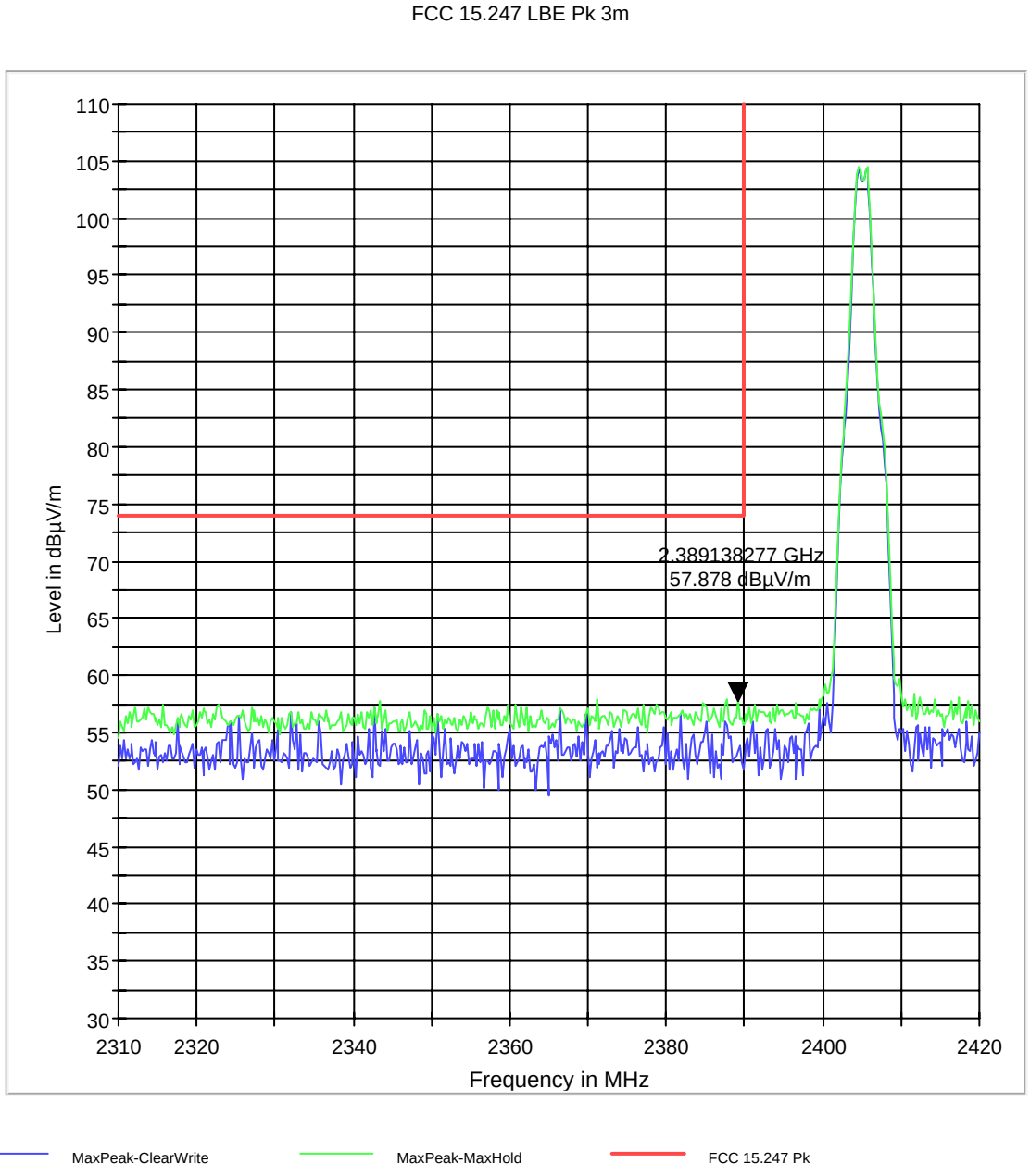
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

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

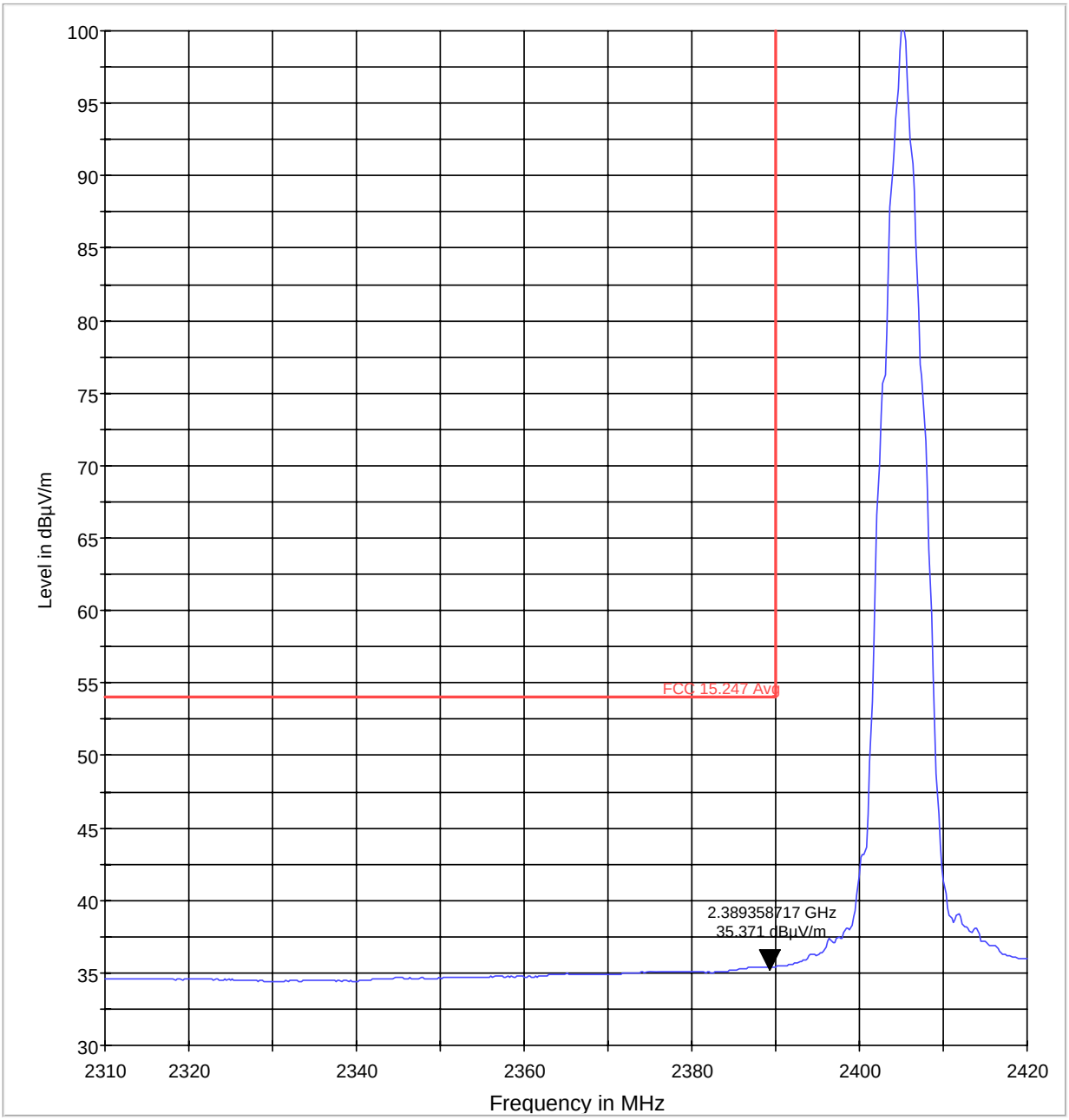
6.4.3.1 Measurement Result
Pass.

6.4.4 Test Data/plots:

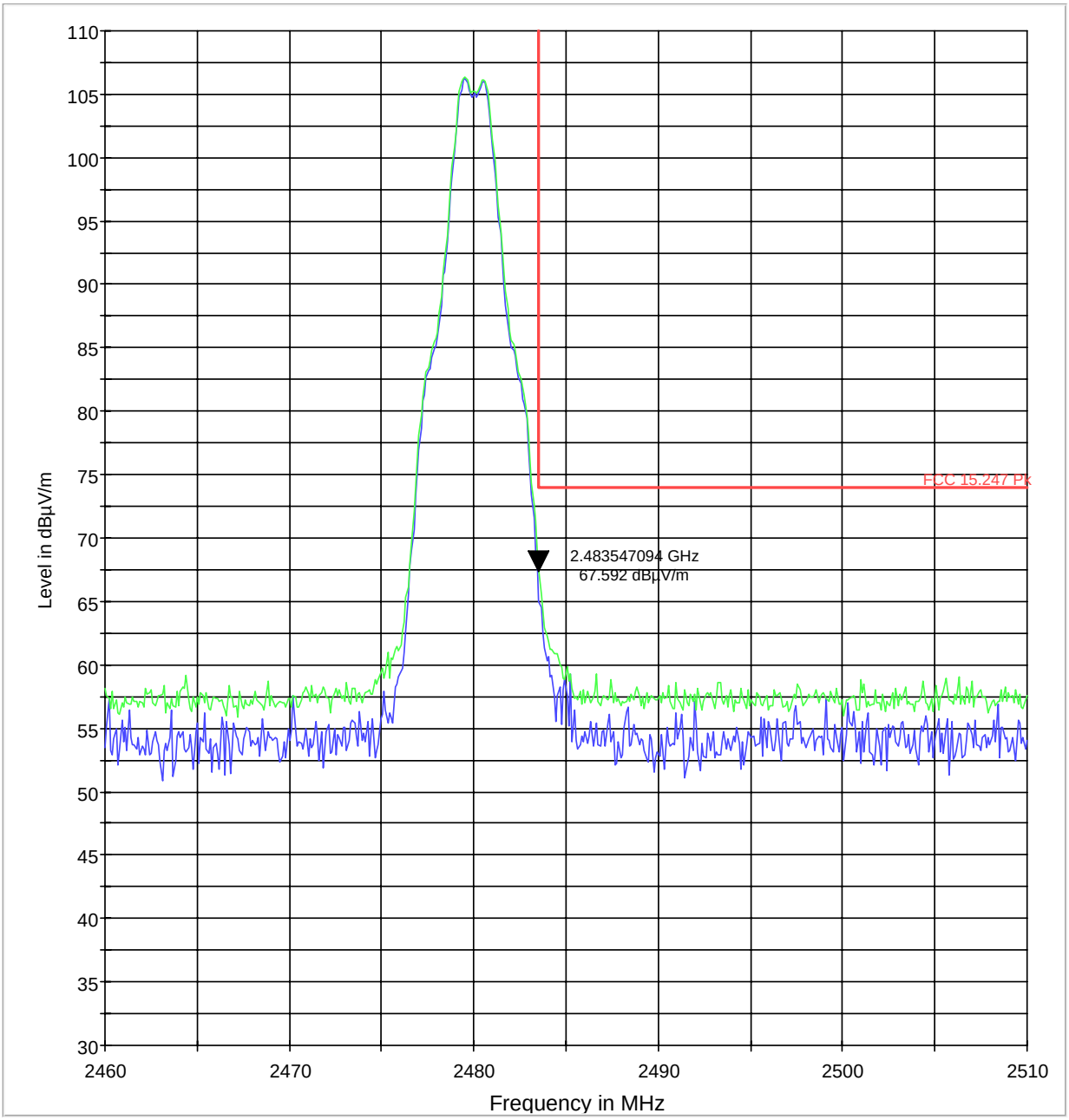
Lower band edge peak



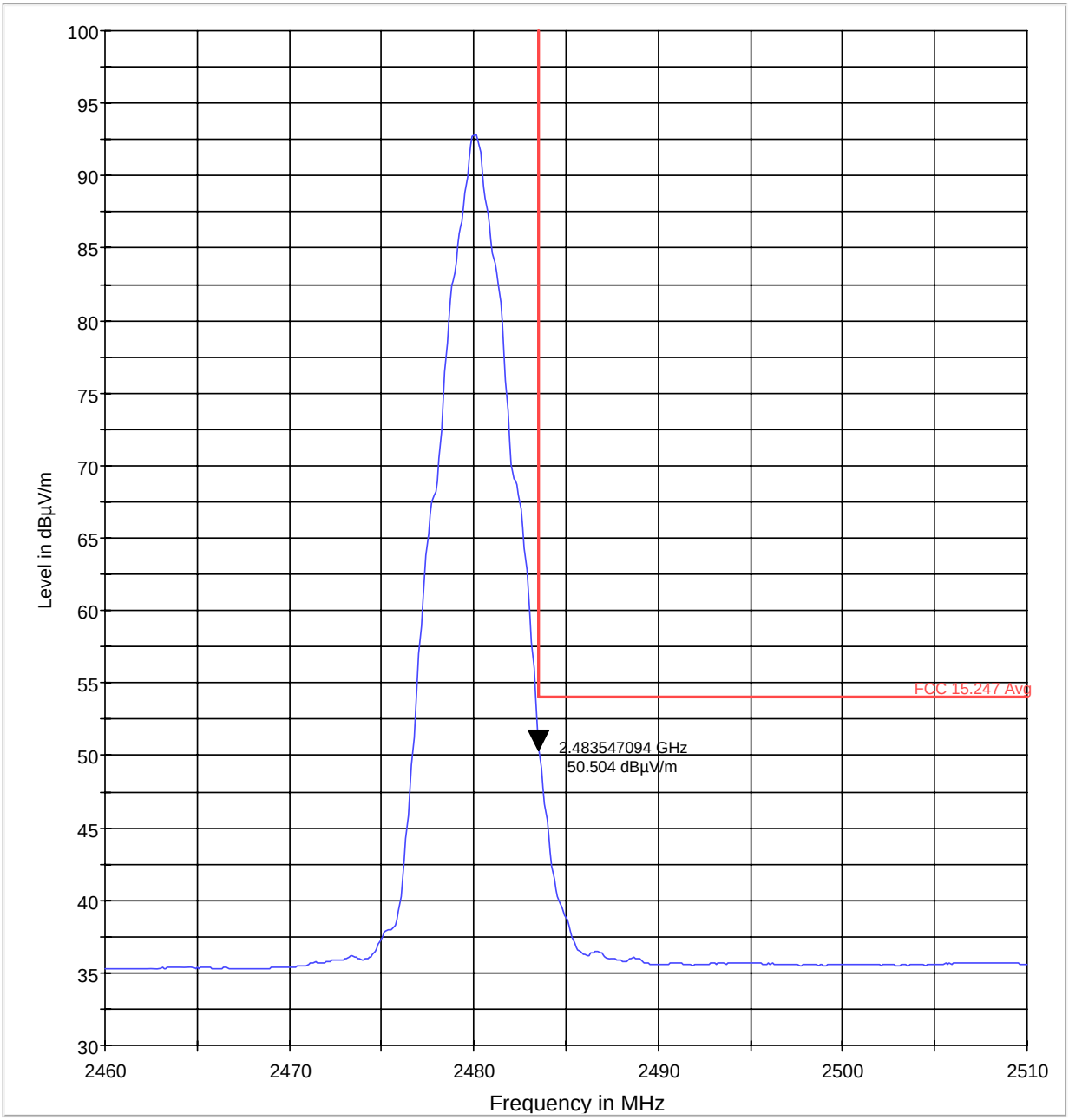
Lower band edge average



Higher band edge peak



Higher band edge average



6.5 Occupied Bandwidth/ 20dB Bandwidth

6.5.1 References:
FCC CFR §2.1049

6.5.2 Measurement requirements:

6.5.2.1 FCC 2.1049: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable.
(h) Transmitters employing digital modulation techniques-when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated.

6.5.3 Limits:
6.5.3.1 §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.

6.5.4 Test Conditions:
Tnom: 25°C; Vnom: 3.6V
Spectrum Analyzer settings:
RBW=200kHz, VBW=500kHz, Detector: Peak- Max hold;
Sweep Time: Auto
Span=10MHz

6.5.5 Test Result:

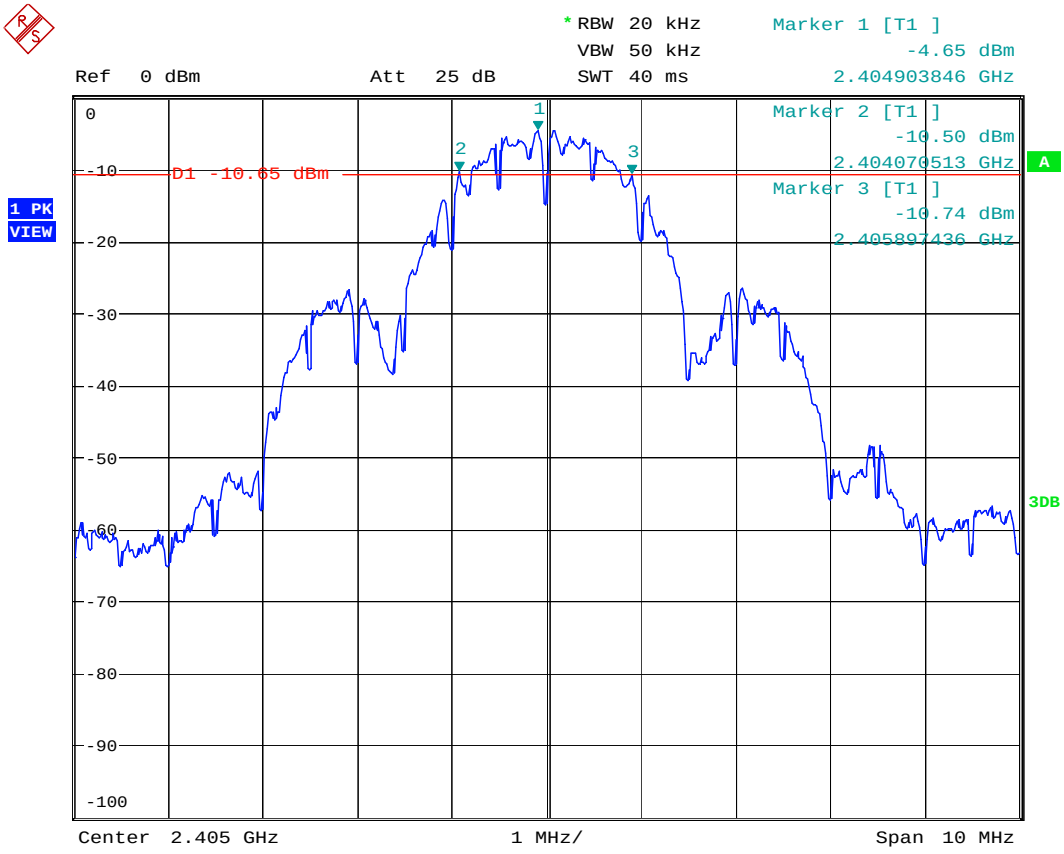
Occupied Bandwidth (MHz)						
Mode	**Frequency (MHz)**					
	2405 Channel 11		**2440 Channel 18**		**2480 Channel 26**	
	6dB	**20dB/ 99%**	**6dB**	**20dB/ 99%**	**6dB**	**20dB/ 99%**
DSSS	1.83	2.61	1.83	2.63	1.67	2.63
Measurement Uncertainty: ±100 kHz						

6.5.5.1 Measurement Result

Pass.

6.5.6 Test Data/plots:

6dB Bandwidth 2405 MHz



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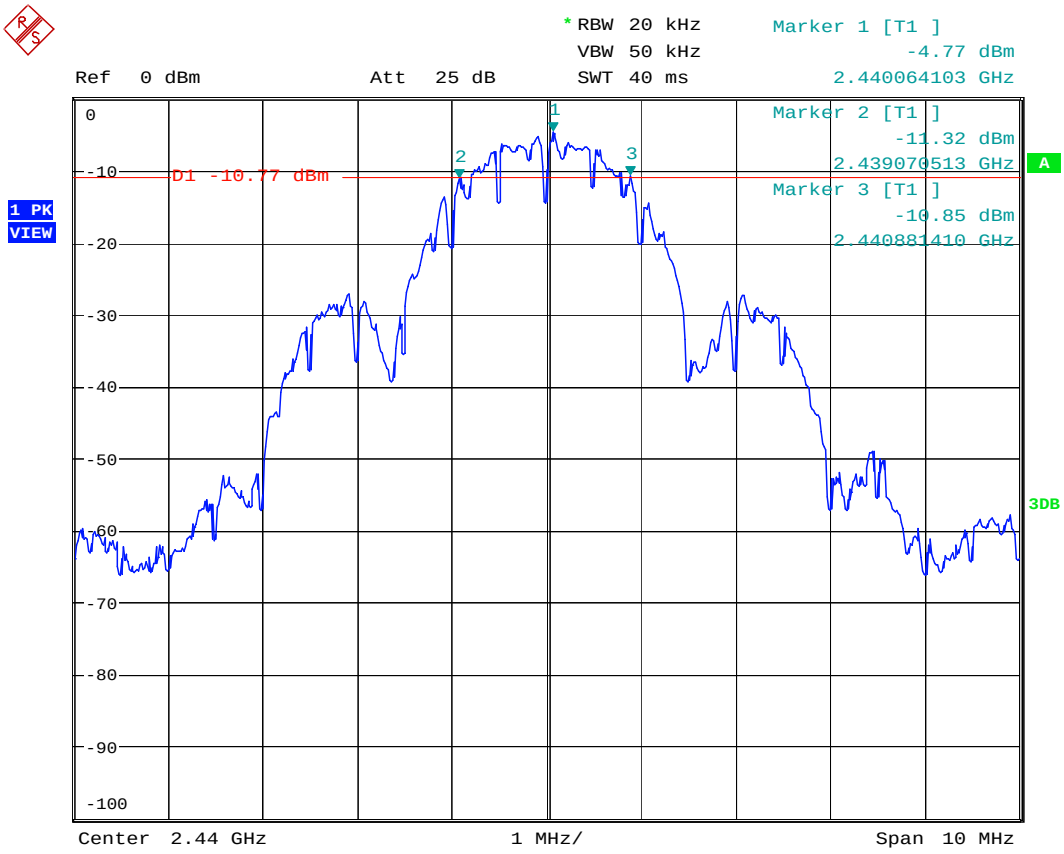
6dB Bandwidth 2440 MHz



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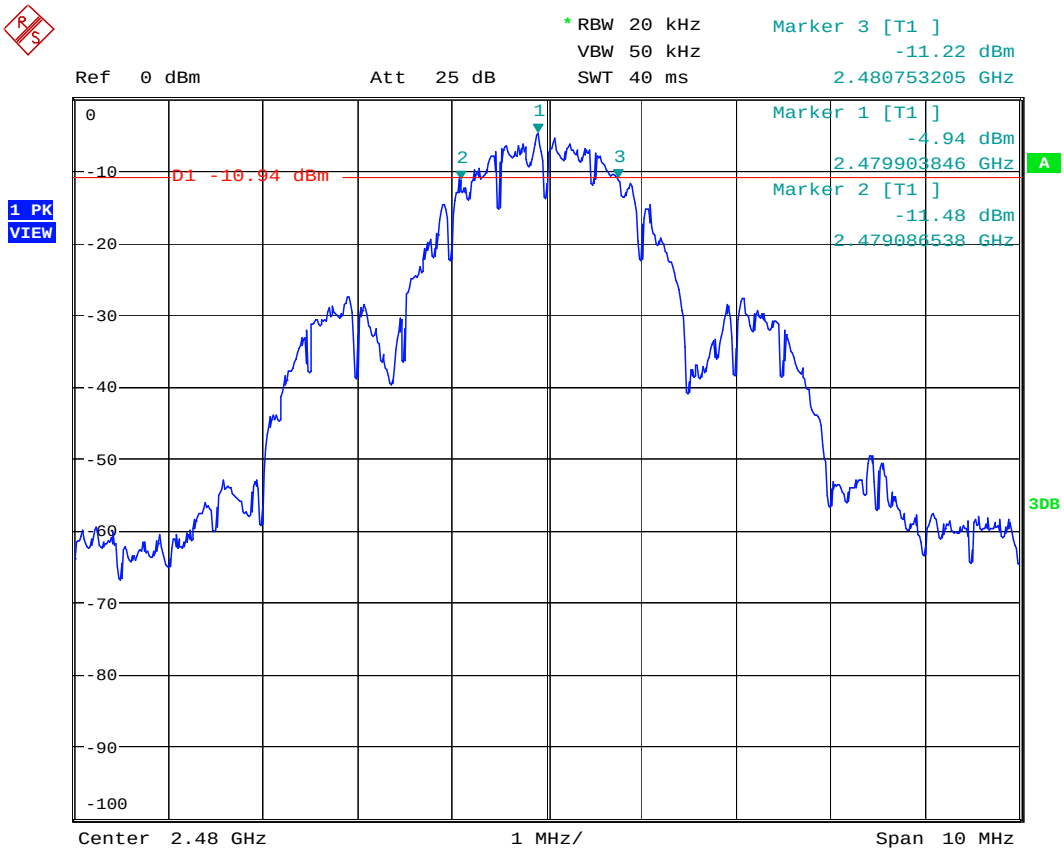
6dB Bandwidth 2480 MHz



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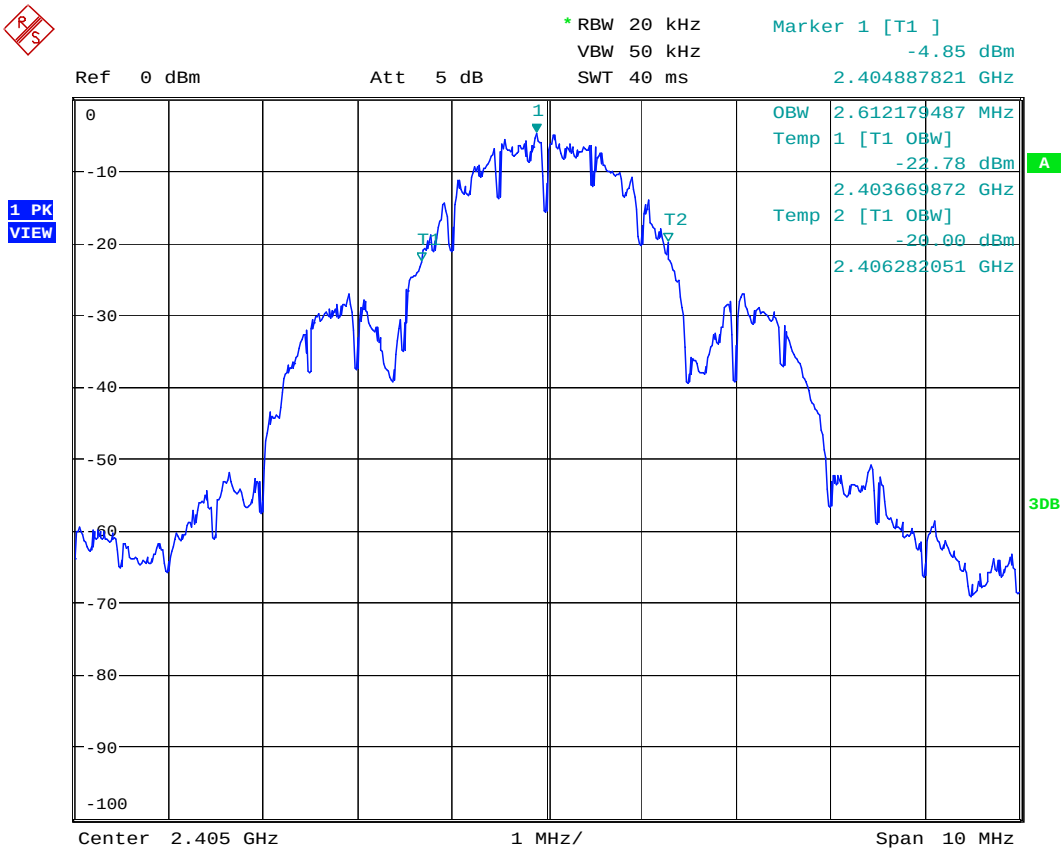
20dB Bandwidth 2405 MHz



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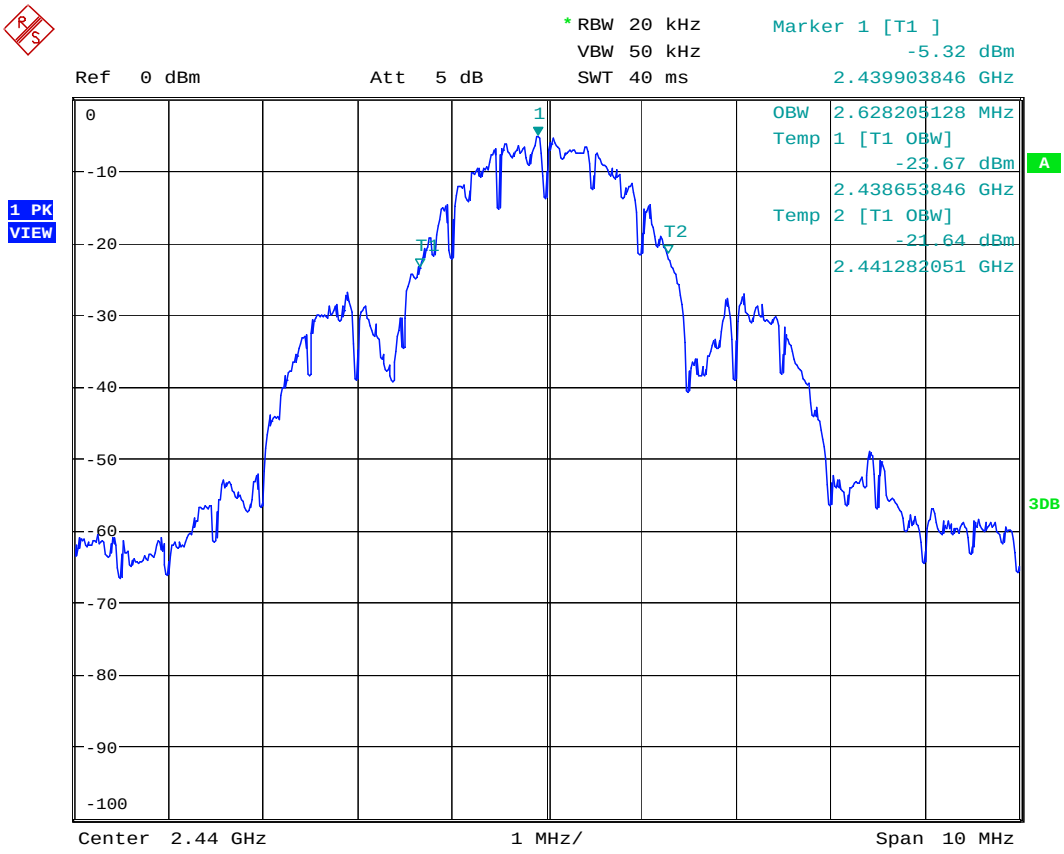
20dB Bandwidth 2440 MHz



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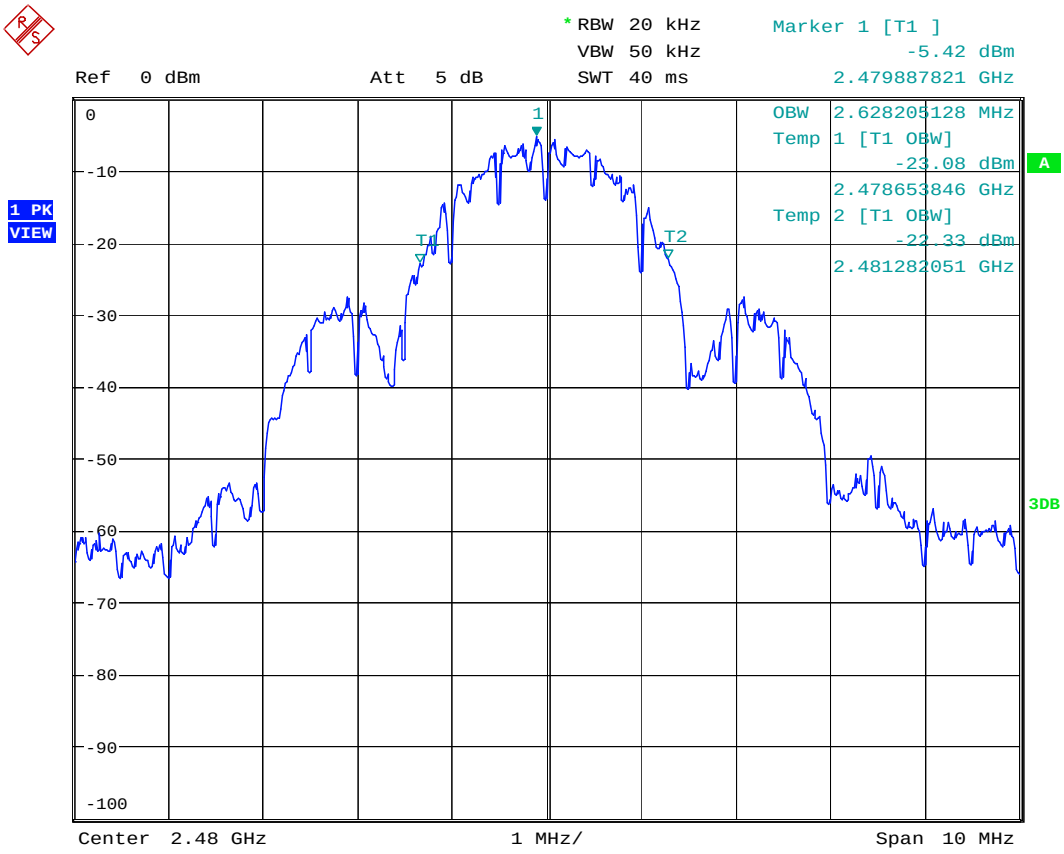
20dB Bandwidth 2480 MHz



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6.6 Power Spectral Density

6.6.1 Limits:

6.6.1.1 § 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.

6.6.2 Measurement procedure:

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

6.6.3 Test results:

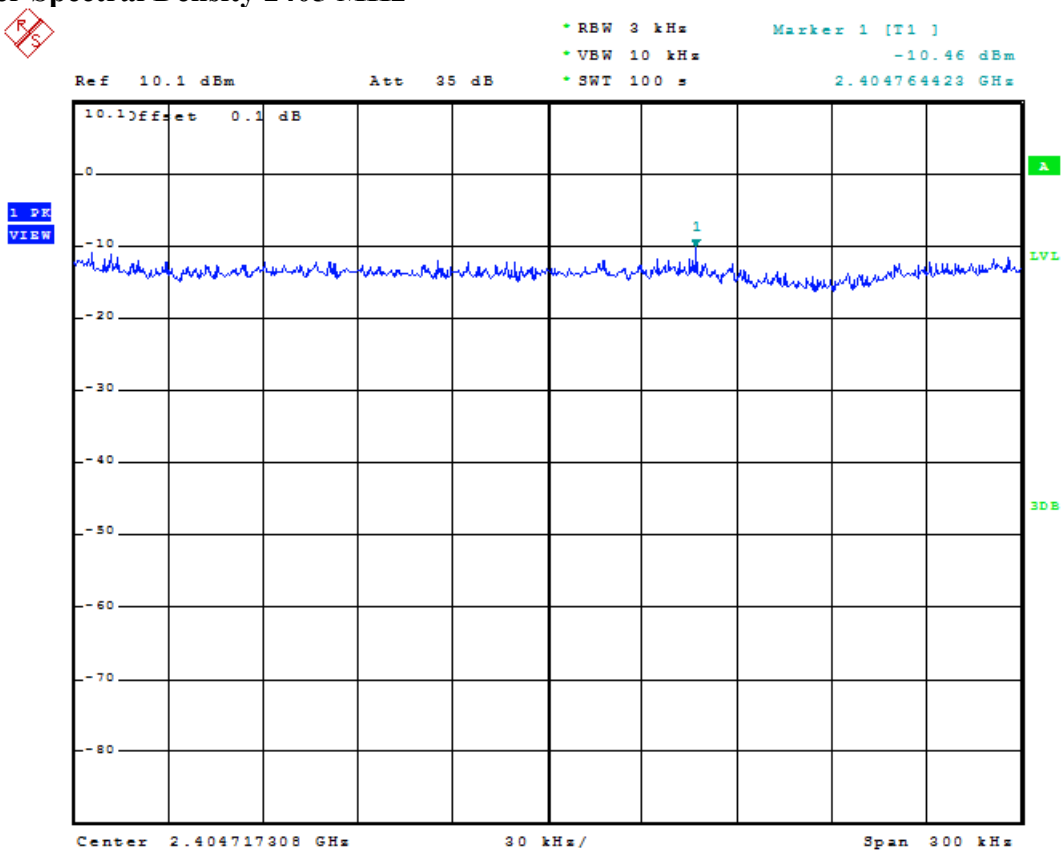
Power Spectral Density (dBm)			
Mode	**Frequency (MHz)**		
	2405 Channel 11	**2440 Channel 18**	**2480 Channel 26**
DSSS	-10.46	-10.72	-10.88
Measurement Uncertainty: ±0.5dB			

6.6.3.1 Measurement Result

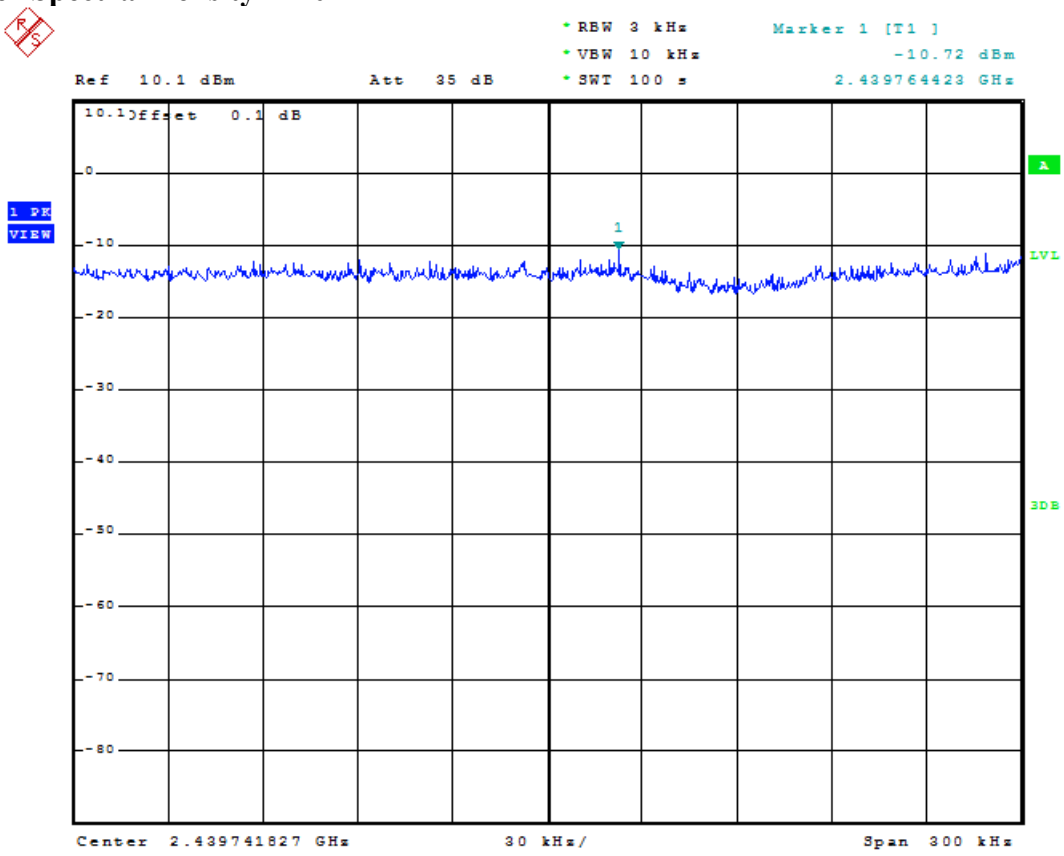
Pass.

6.6.4 Test Data/plots:

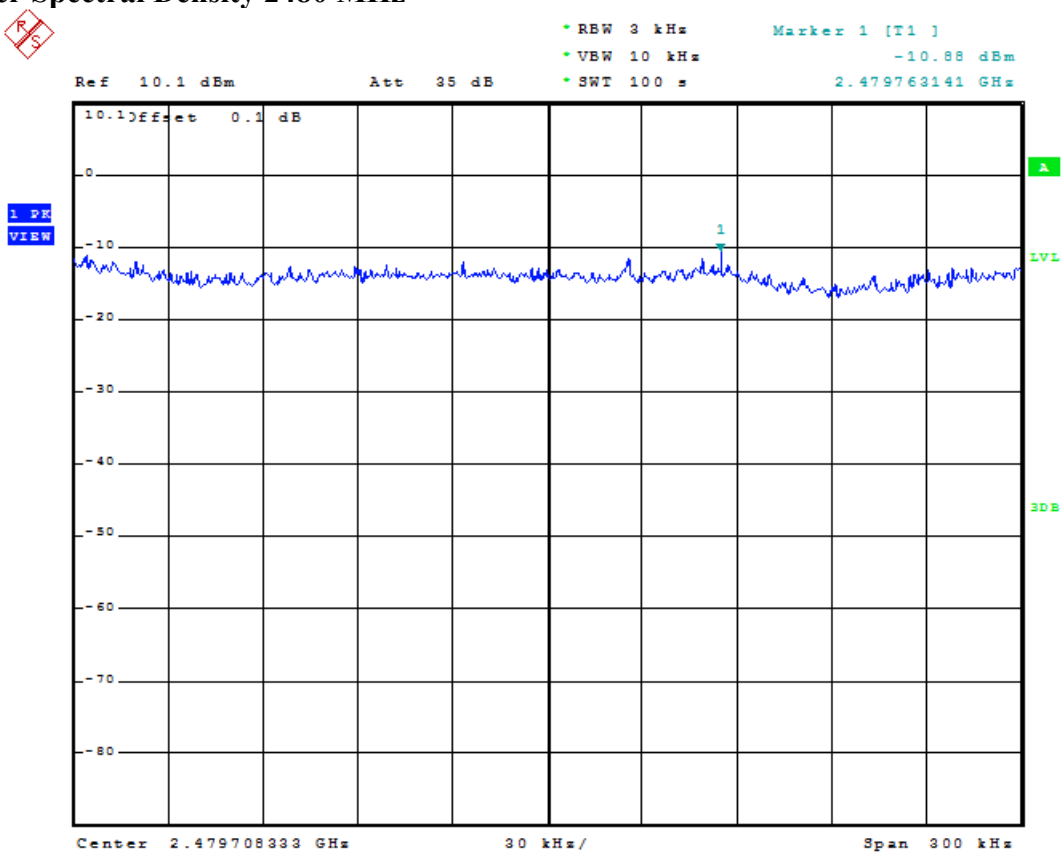
Power Spectral Density 2405 MHz



Power Spectral Density 2440 MHz



Power Spectral Density 2480 MHz



6.7 Transmitter Spurious Emissions- Conducted § 15.247 (c)

6.7.1 Reference and Limits:

6.7.1.1 § 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.
30dBm for the transmitter.
-20dBc in the frequency range 30MHz- 25GHz.

6.7.2 Test Conditions:

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

6.7.3 Test data/ plots:

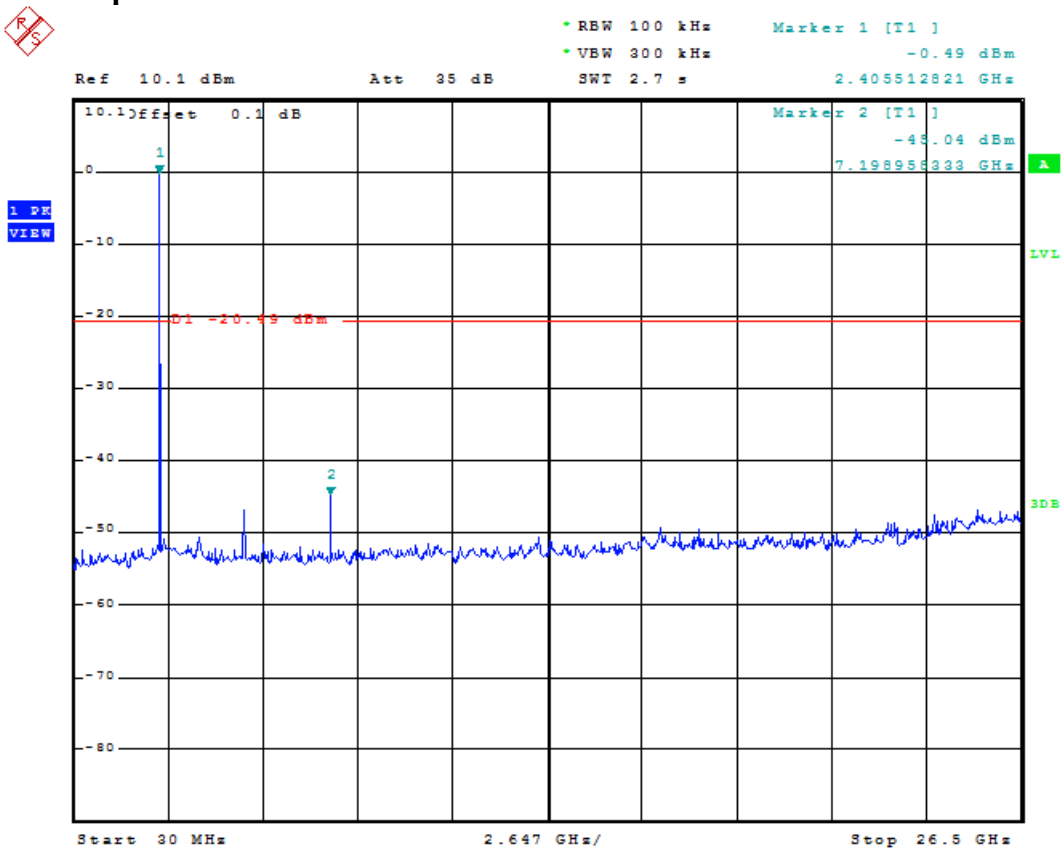
Conducted Spurious Emissions			
Channel	**Frequency (MHz)**	**Amplitude (dBm)**	**Limits**
		DSSS	
Low	**2405**	-0.49	30dBm
	Spurious	All other peaks >20dB below limit	-20dBc
Mid	**2440**	-0.61	30 dBm
	Spurious	All other peaks >20dB below limit	-20dBc
High	**2480**	-0.88	30 dBm
	Spurious	All other peaks >20dB below limit	-20dBc
Measurement Uncertainty: ±1.0 dB			

6.7.3.1 Measurement Result

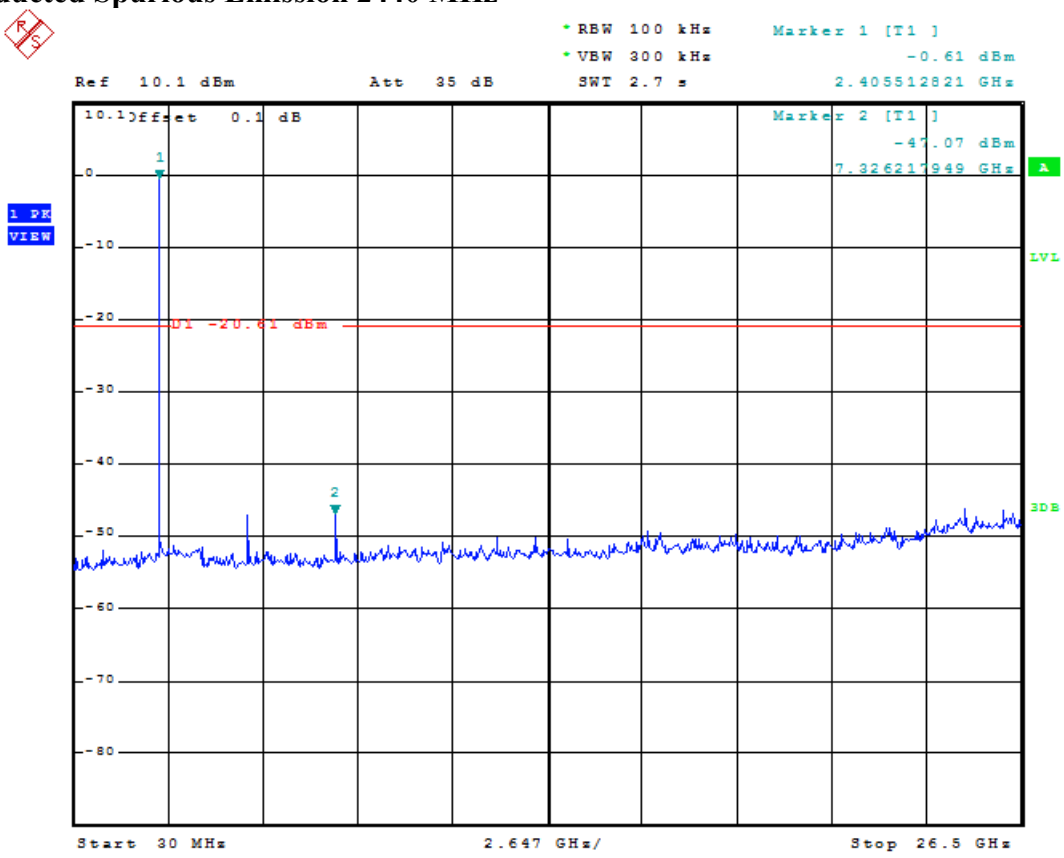
Pass.

6.7.4 Test data/ plots:

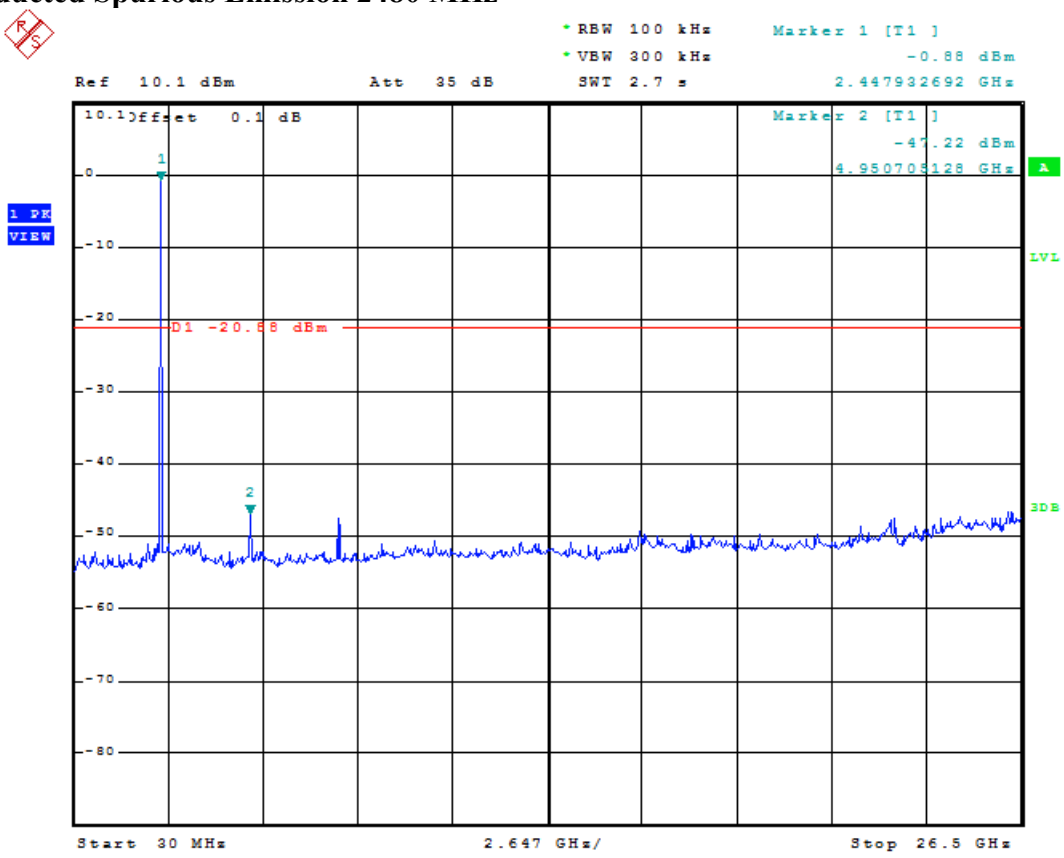
Conducted Spurious Emission 2405 MHz



Conducted Spurious Emission 2440 MHz



Conducted Spurious Emission 2480 MHz



6.8 Transmitter Spurious Emissions- Radiated

6.8.1 References:

FCC CFR 2.1053

6.8.2 Measurement requirements:

6.8.2.1 FCC 2.1053: Field strength of spurious radiation.

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission.

6.8.3 Limits:

§15.247/15.205

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

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

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB.

*PEAK LIMIT= 74dBµV/m

*AVG. LIMIT= 54dBµV/m

Table 1:

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

Table 2:

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

6.8.4 Test Result:

Test mode:

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

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

Measurement Uncertainty: ±3.0dB

6.8.4.1 Measurement Result

Pass.

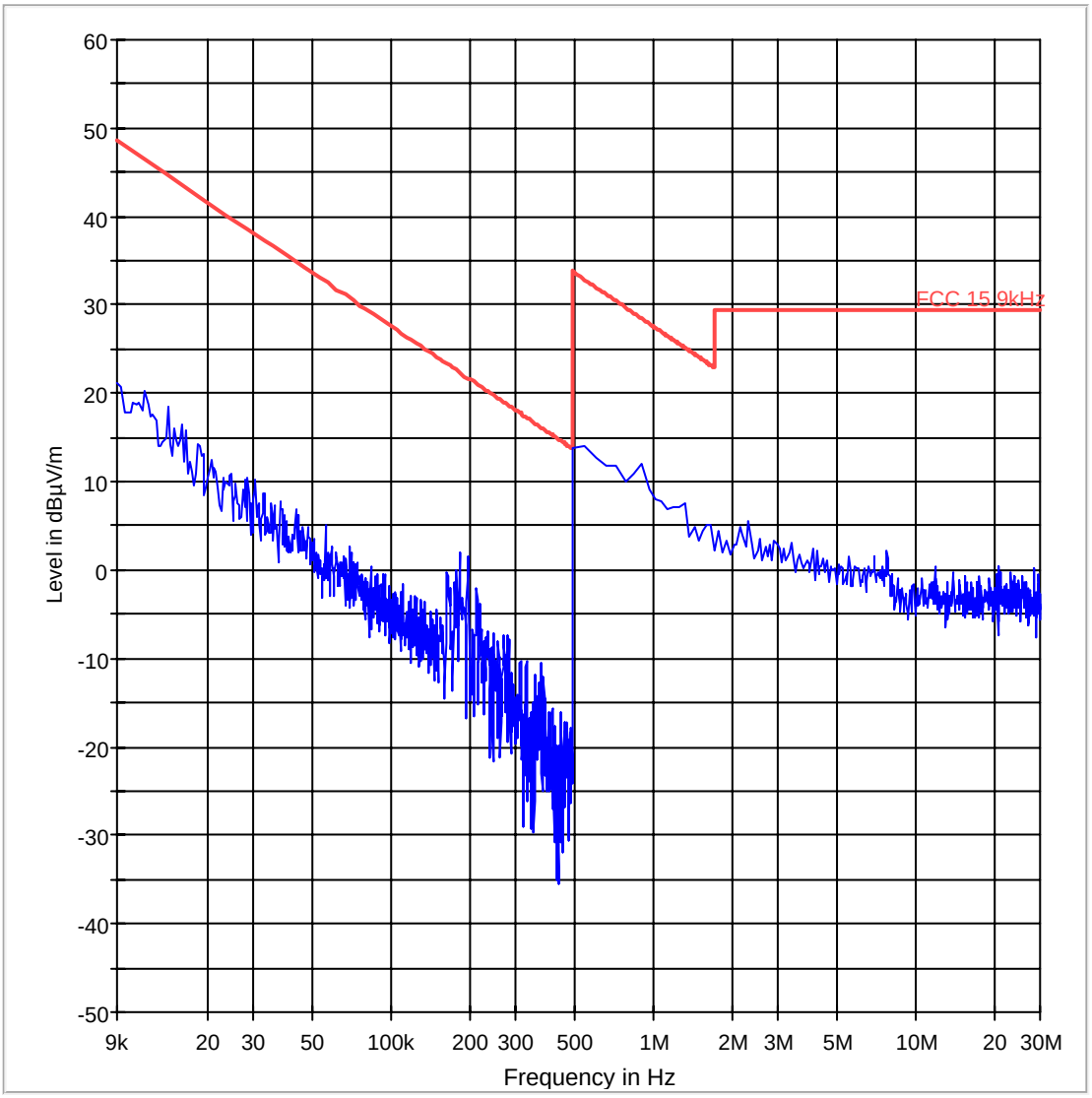
No spurious emissions reported below 30MHz.

6.8.5 Test data/ plots:

Transmitter Radiated Spurious Emission:<30MHz

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

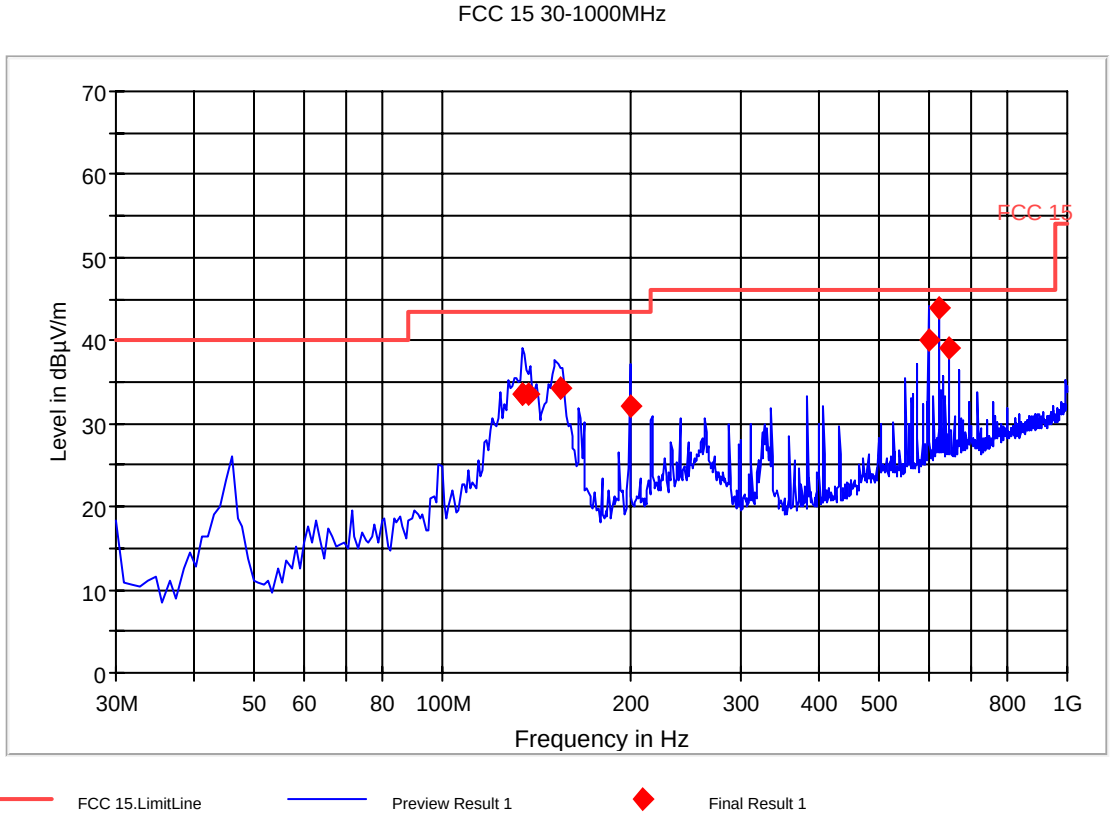
FCC 15 9kHz - 30 MHz



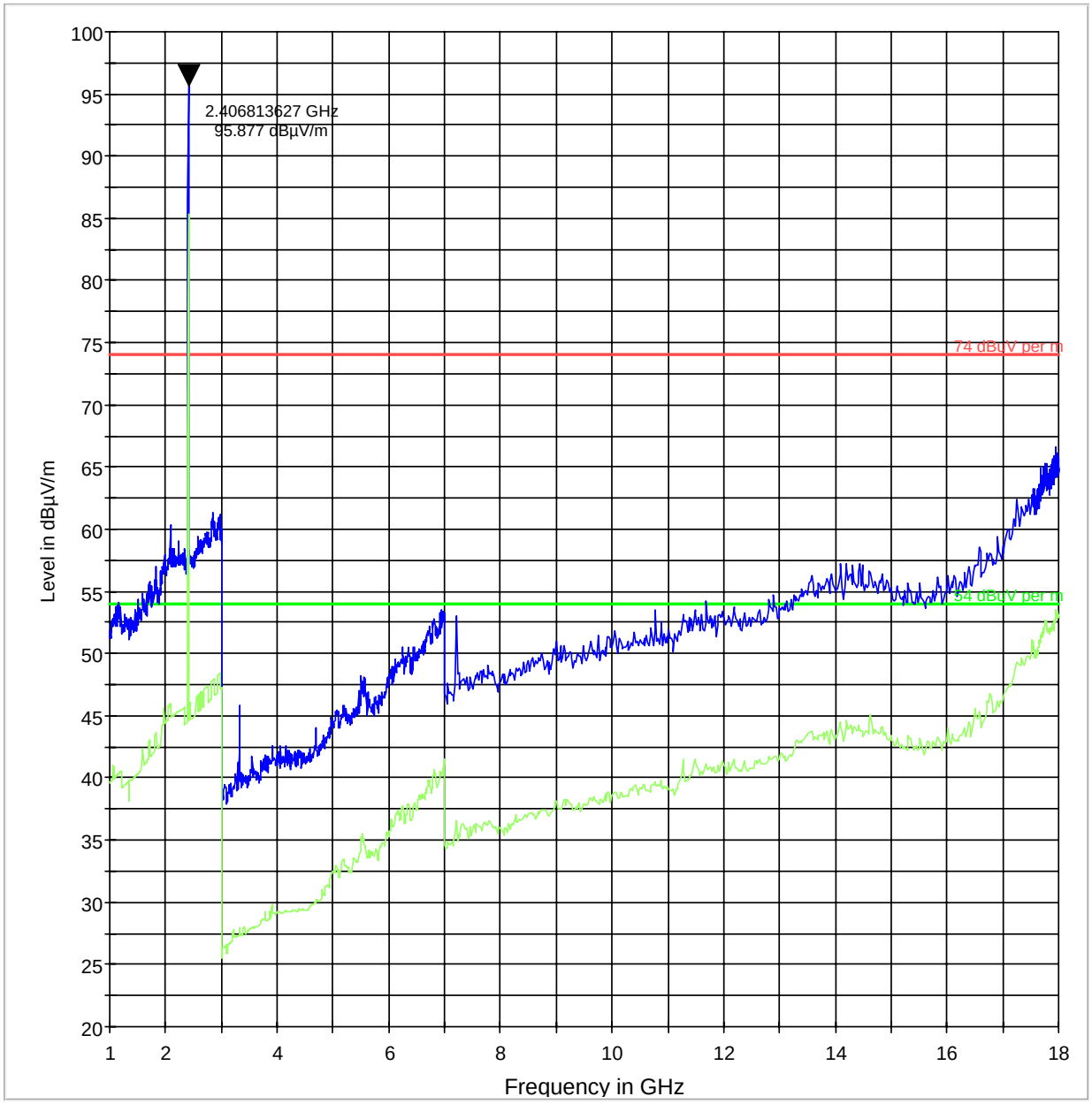
Transmitter Radiated Spurious Emission- Ch11- 30-1000MHz

Final Result

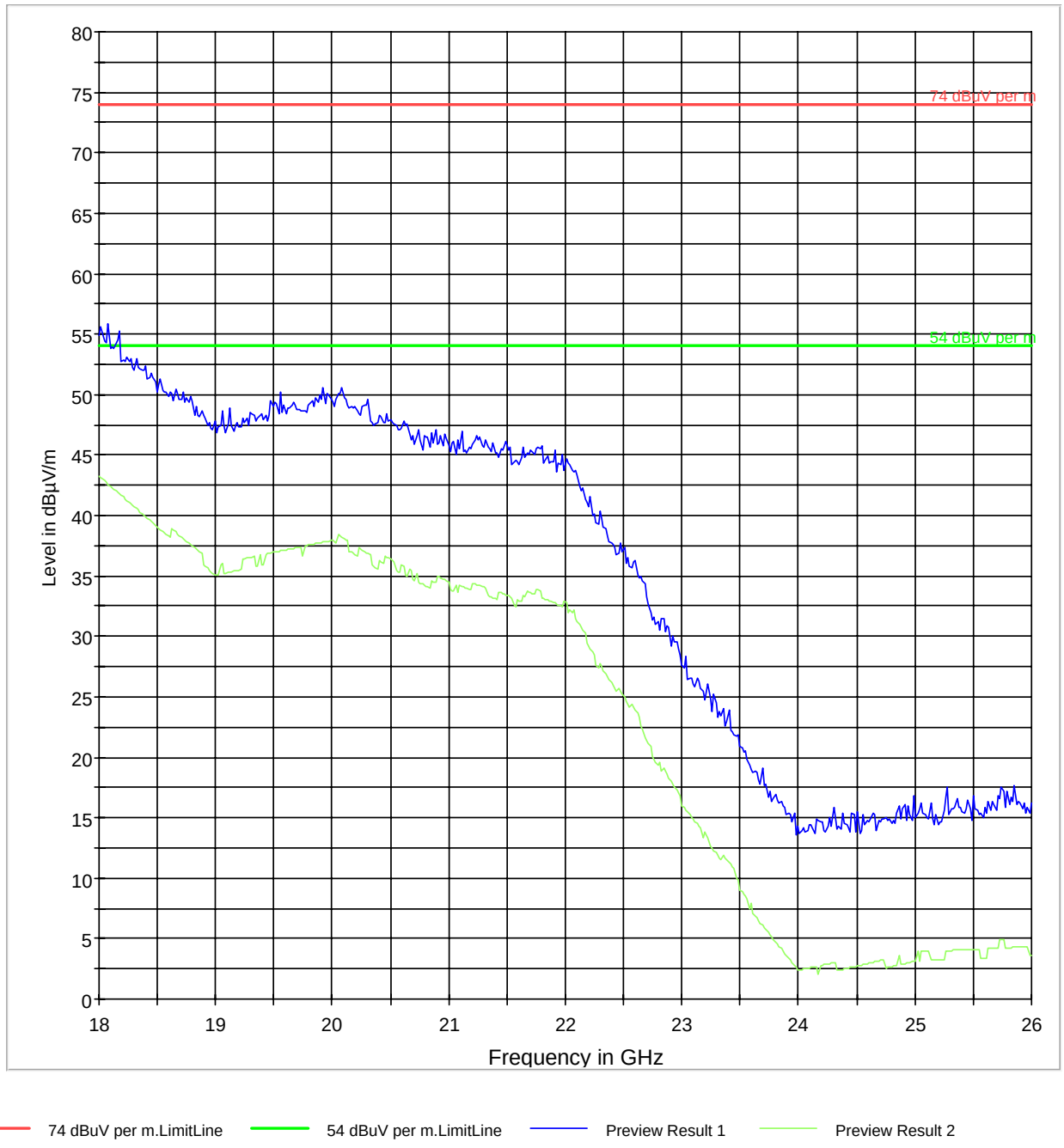
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
133.880708	33.5	20.0	120.000	120.0	H	268.0	9.4	10.0	43.5
134.582800	33.6	20.0	120.000	138.0	H	275.0	9.4	9.9	43.5
137.505839	33.5	20.0	120.000	252.0	H	75.0	9.6	10.0	43.5
154.910997	34.3	20.0	120.000	168.0	H	109.0	11.5	9.2	43.5
199.928961	32.2	20.0	120.000	138.0	H	45.0	11.4	11.3	43.5
599.768778	40.0	20.0	120.000	120.0	H	254.0	22.6	6.0	46.0
623.714860	44.0	20.0	120.000	120.0	H	261.0	23.5	2.0	46.0
647.716177	39.1	20.0	120.000	120.0	H	259.0	23.6	6.9	46.0



Transmitter Radiated Spurious Emission- Ch11- 1G-18GHz
Marker placed on Tx signal



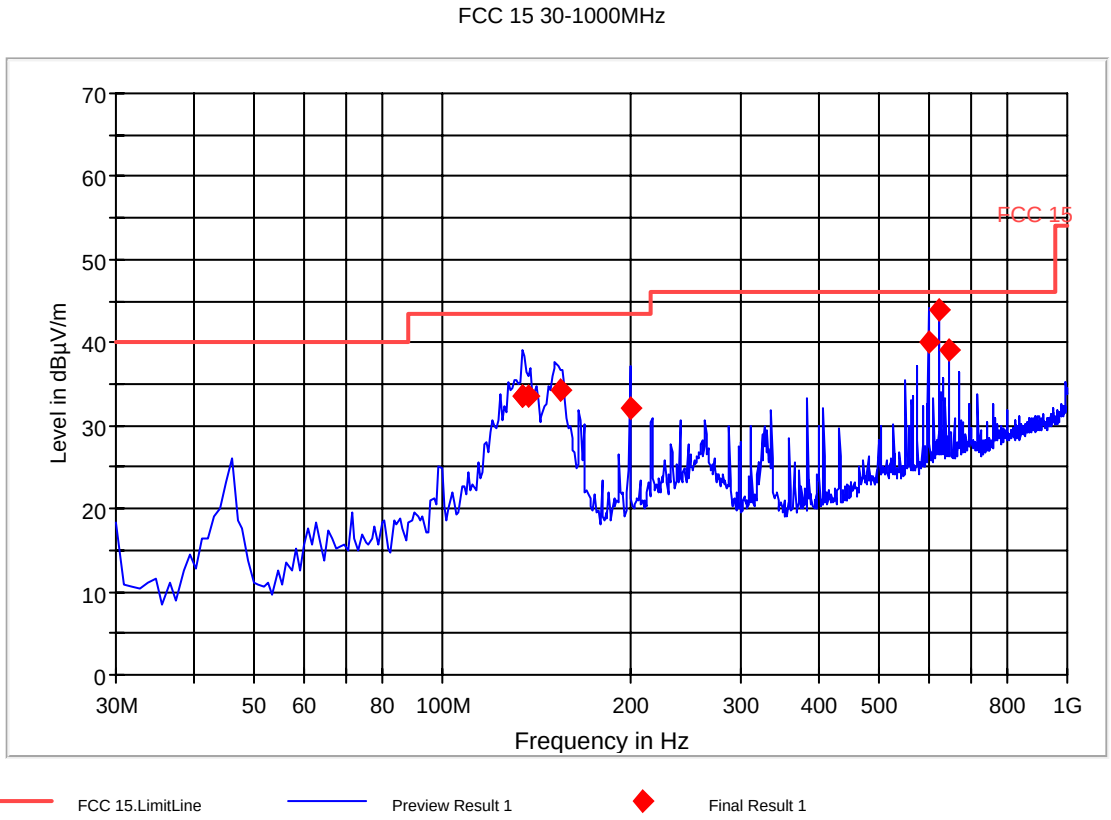
Transmitter Radiated Spurious Emission- Ch11- 18G-26GHz



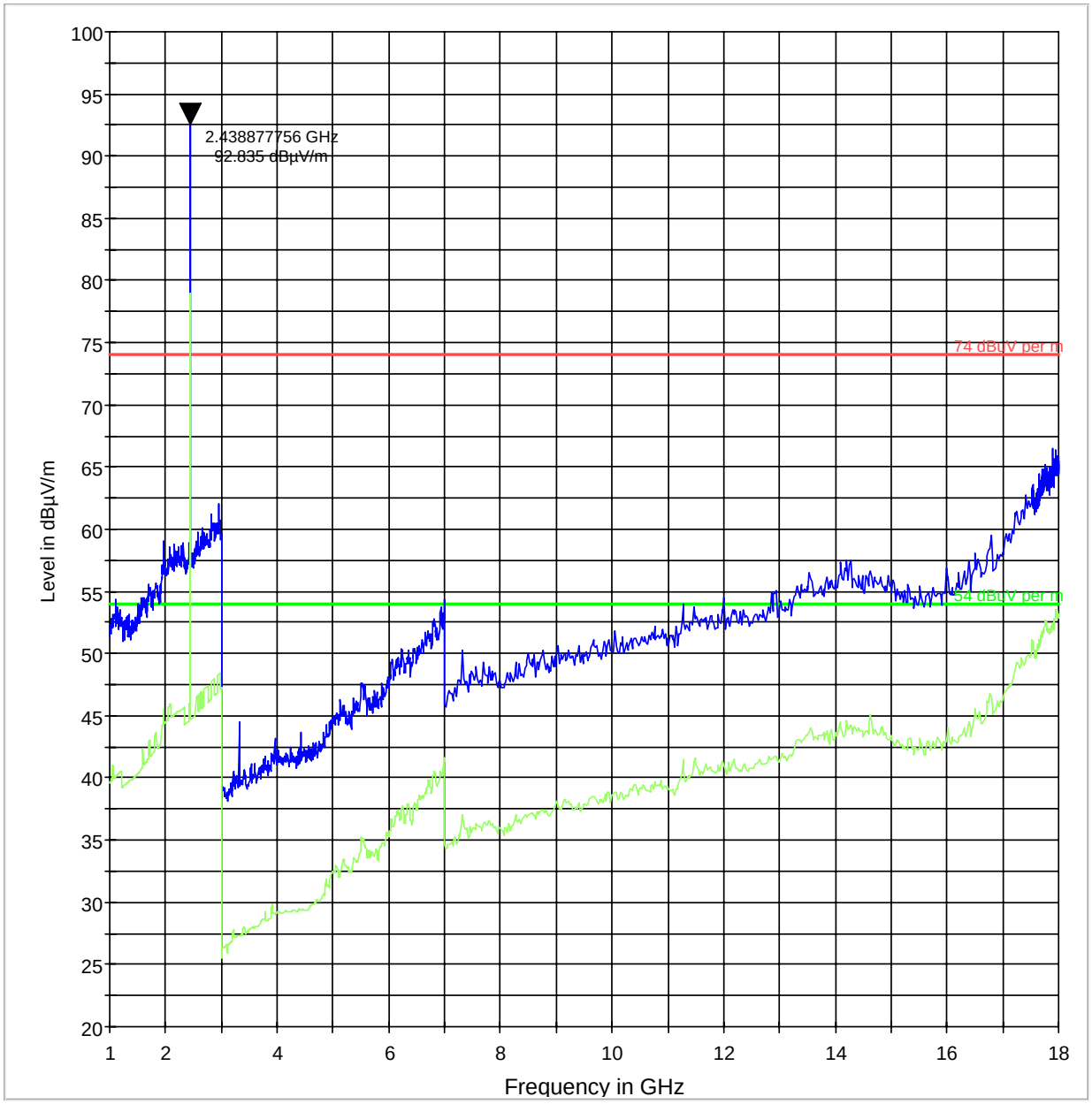
Transmitter Radiated Spurious Emission- Ch18- 30M-1GHz

Final Result

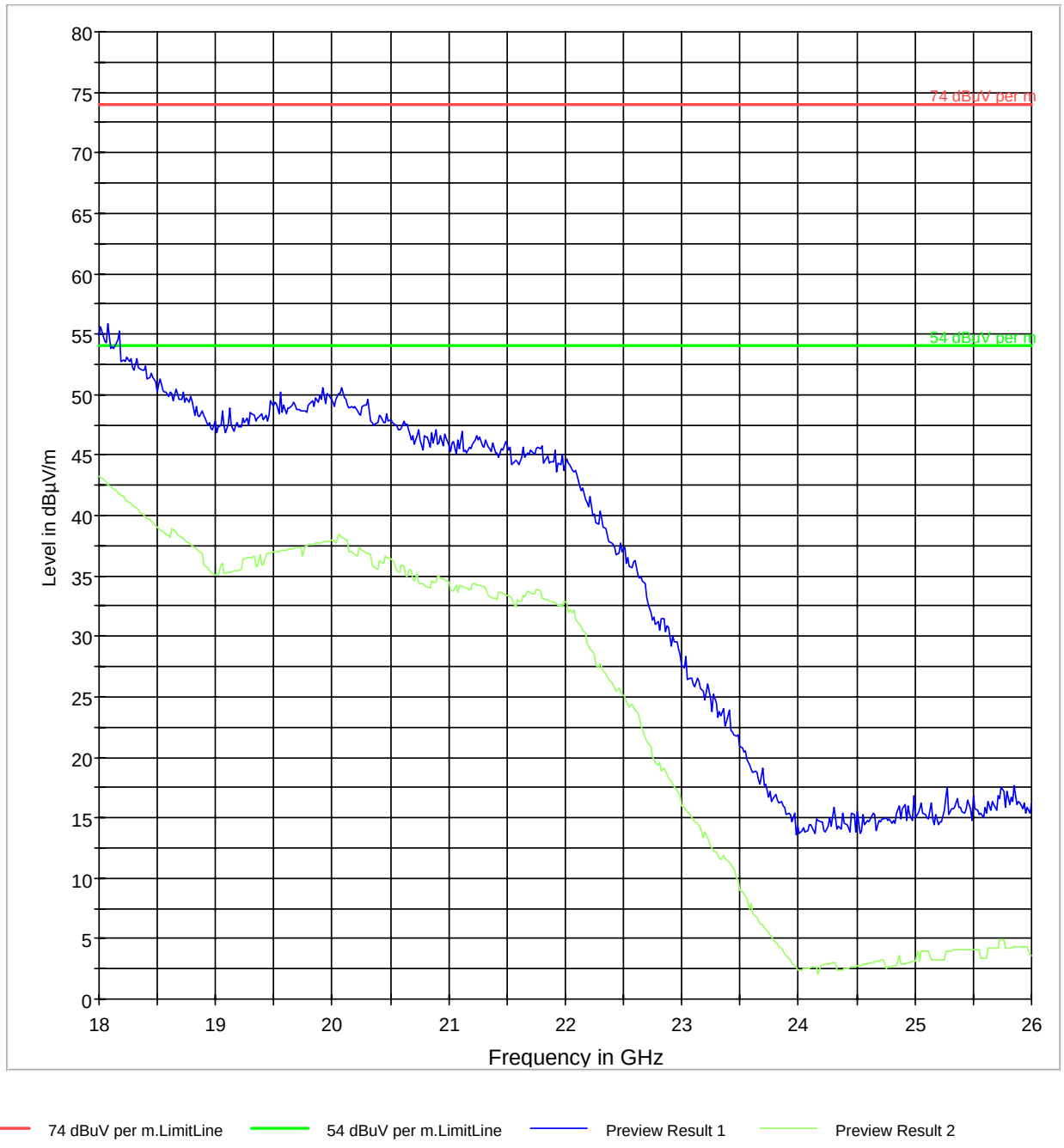
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
133.880708	33.5	20.0	120.000	120.0	H	268.0	9.4	10.0	43.5
134.582800	33.6	20.0	120.000	138.0	H	275.0	9.4	9.9	43.5
137.505839	33.5	20.0	120.000	252.0	H	75.0	9.6	10.0	43.5
154.910997	34.3	20.0	120.000	168.0	H	109.0	11.5	9.2	43.5
199.928961	32.2	20.0	120.000	138.0	H	45.0	11.4	11.3	43.5
599.768778	40.0	20.0	120.000	120.0	H	254.0	22.6	6.0	46.0
623.714860	44.0	20.0	120.000	120.0	H	261.0	23.5	2.0	46.0
647.716177	39.1	20.0	120.000	120.0	H	259.0	23.6	6.9	46.0



Transmitter Radiated Spurious Emission- Ch18- 1G-18GHz
Marker placed on Tx signal



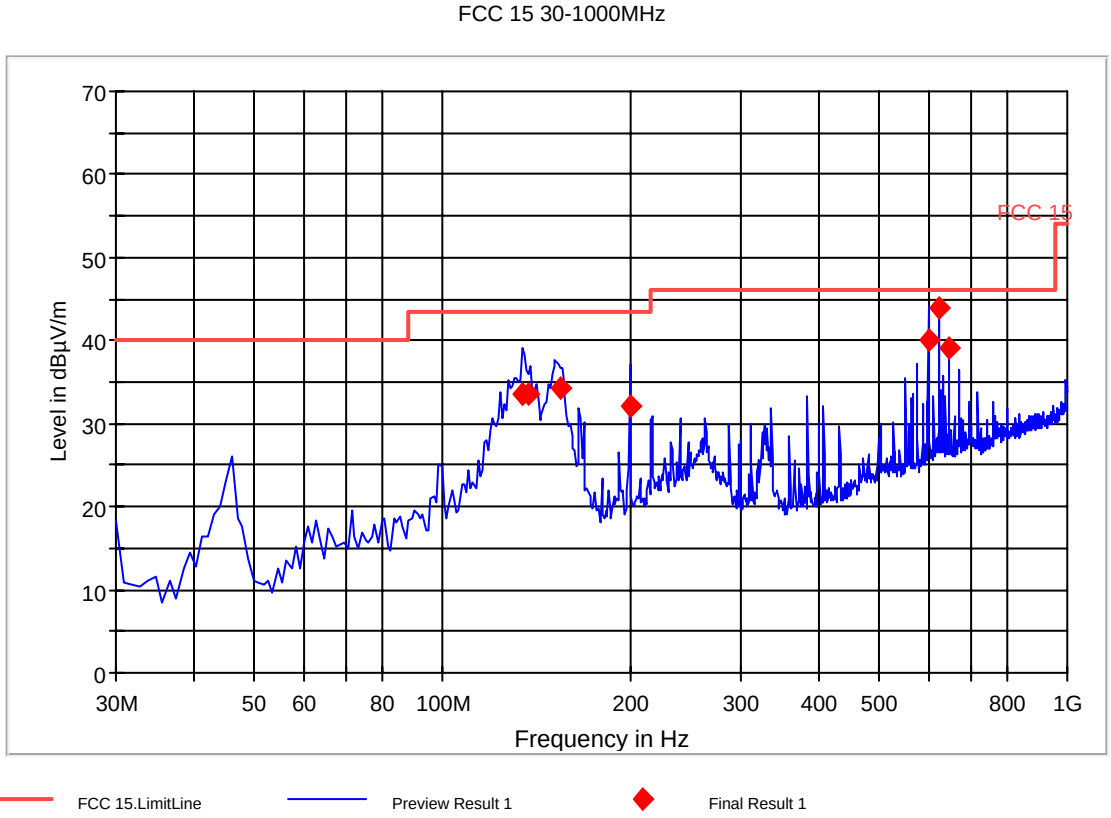
Transmitter Radiated Spurious Emission- Ch18- 18G-26GHz



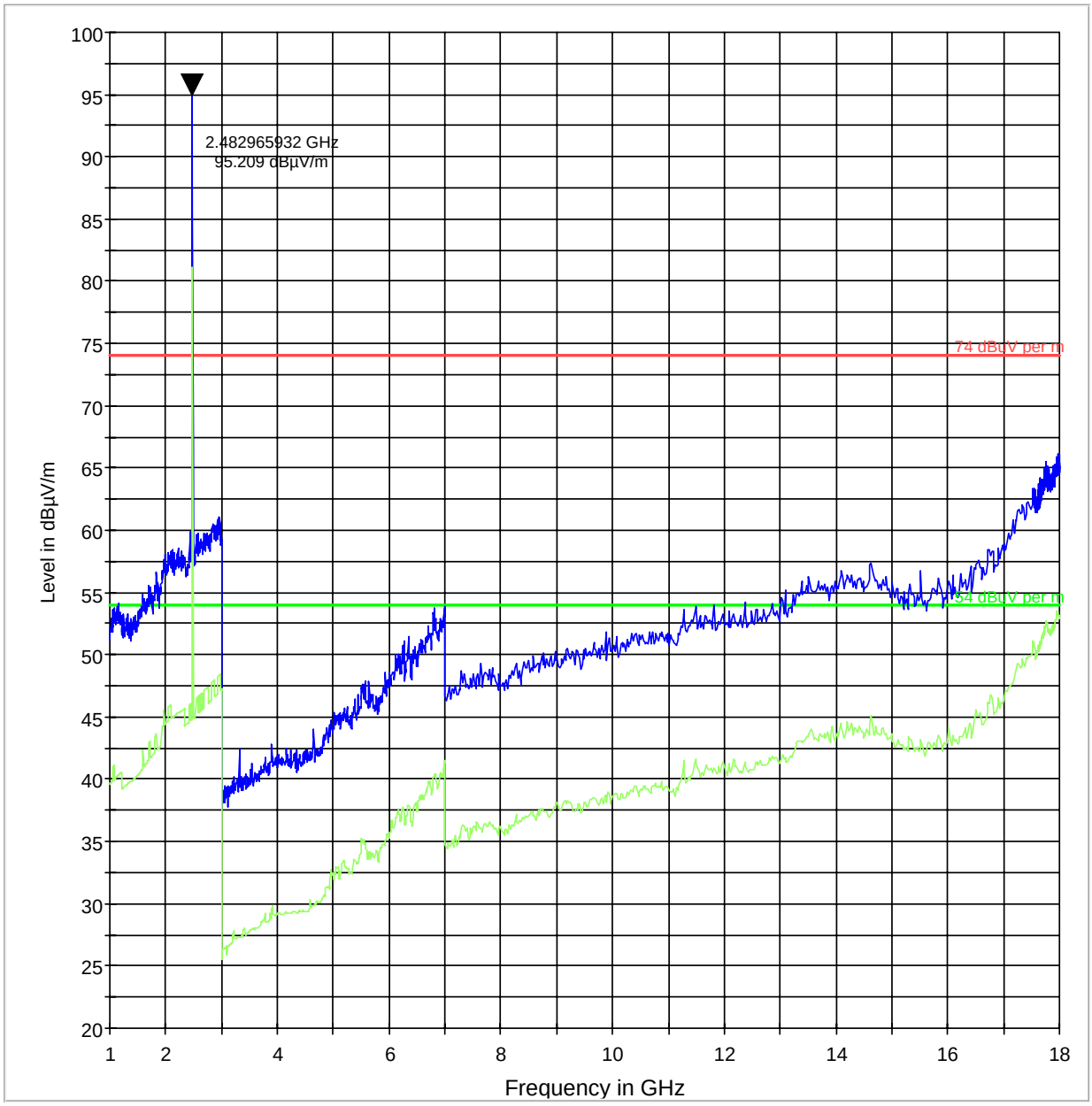
Transmitter Radiated Spurious Emission- Ch26- 30M-1GHz

Final Result

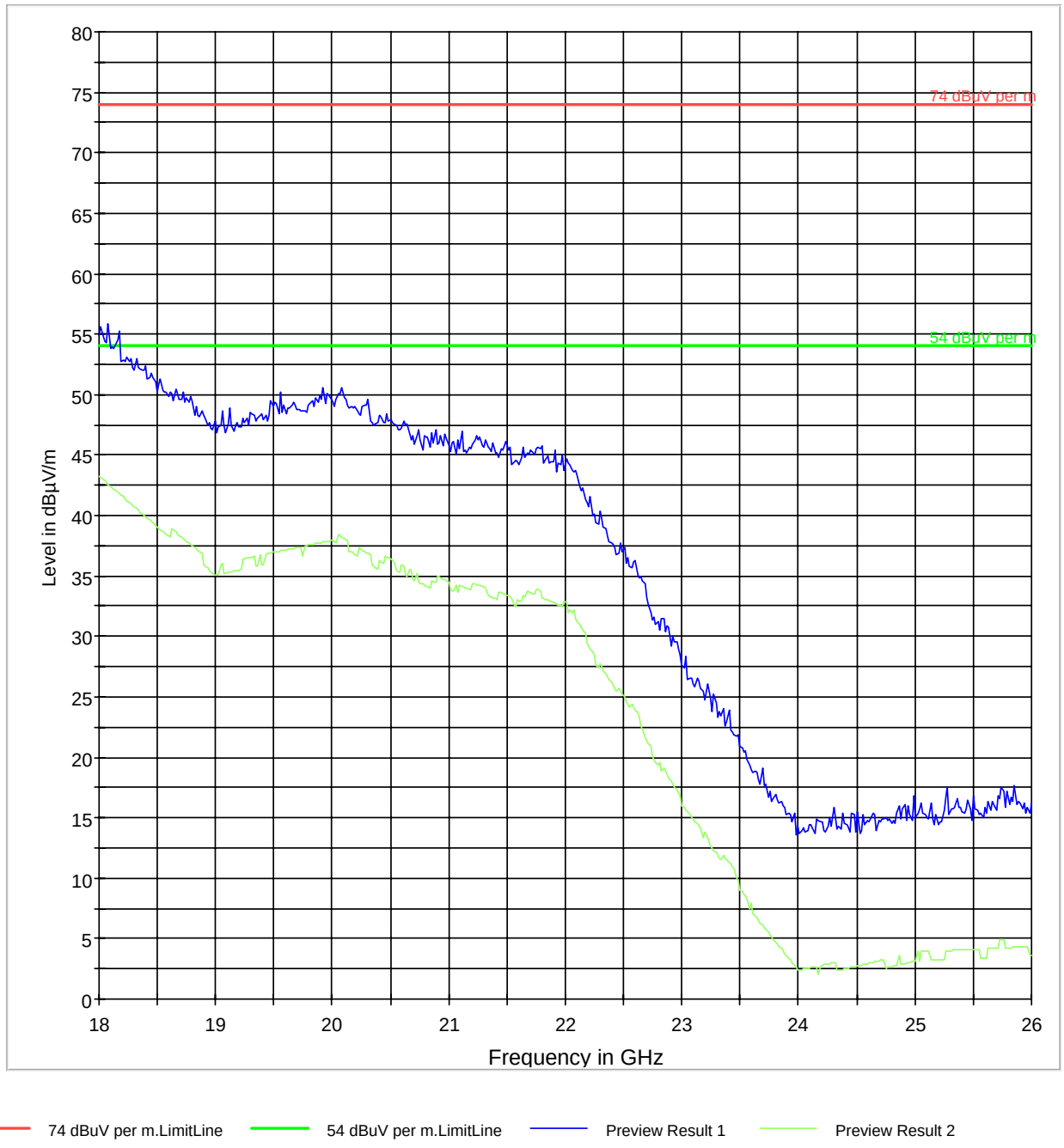
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
133.880708	33.5	20.0	120.000	120.0	H	268.0	9.4	10.0	43.5
134.582800	33.6	20.0	120.000	138.0	H	275.0	9.4	9.9	43.5
137.505839	33.5	20.0	120.000	252.0	H	75.0	9.6	10.0	43.5
154.910997	34.3	20.0	120.000	168.0	H	109.0	11.5	9.2	43.5
199.928961	32.2	20.0	120.000	138.0	H	45.0	11.4	11.3	43.5
599.768778	40.0	20.0	120.000	120.0	H	254.0	22.6	6.0	46.0
623.714860	44.0	20.0	120.000	120.0	H	261.0	23.5	2.0	46.0
647.716177	39.1	20.0	120.000	120.0	H	259.0	23.6	6.9	46.0



Transmitter Radiated Spurious Emission- Ch26- 1G-18GHz
Marker placed on Tx signal



Transmitter Radiated Spurious Emission- Ch26- 18G-26GHz



6.9 Receiver Spurious Emissions- Radiated

6.9.1 Limits:

6.9.1.1 FCC CFR §15.109

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
30–88	100 (40dBµV/m)	3
88–216	150 (43.5 dBµV/m)	3
216–960	200 (46 dBµV/m)	3
Above 960	500 (54 dBµV/m)	3

6.9.2 Test Conditions:

Mode: Receive mode
Measurement Uncertainty: ±3.0dB

6.9.3 Test Result:

No significant emissions measurable. Plots reported here represent the worse case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

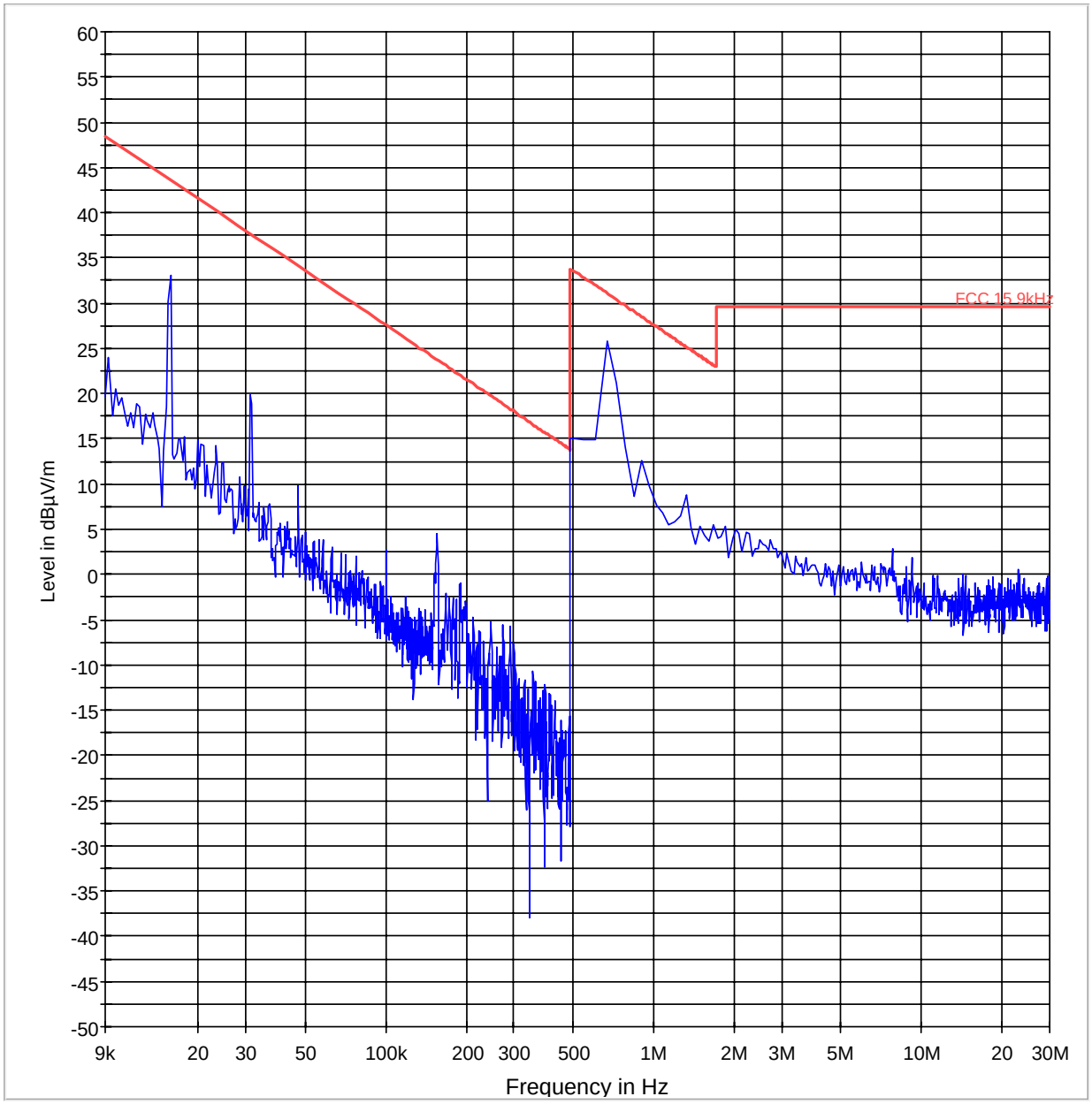
6.9.3.1 Measurement Result

Pass.

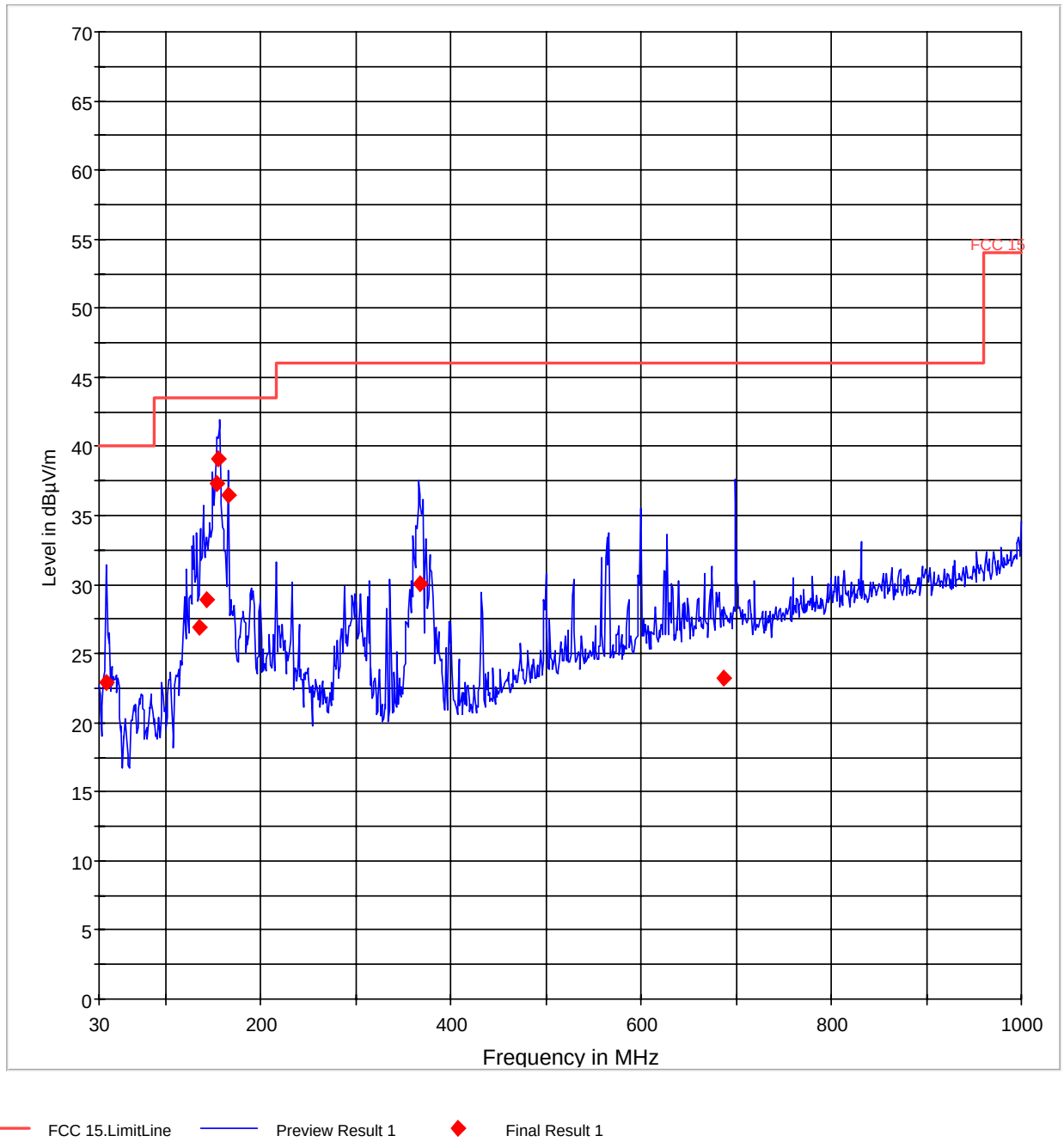
6.9.4 Test data/ plots:

Receive Mode: <30MHz

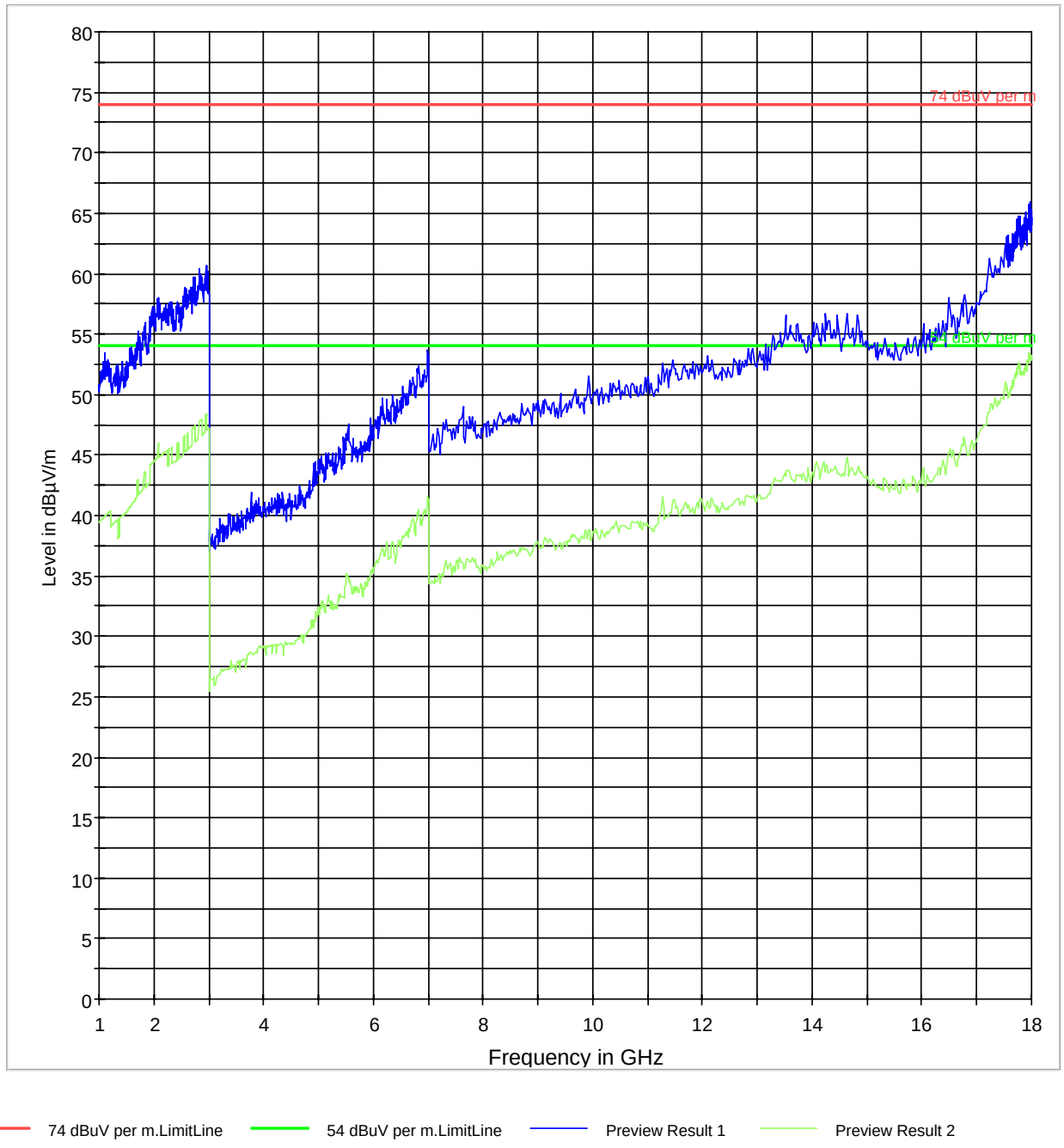
Note: Limits adjusted for 3m measurement.



Receive Mode: 30MHz-1GHz



Receive Mode: 1GHz-18GHz



6.10 AC Power Line Conducted Emissions

6.10.1 References:

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

6.10.2 Limits:

6.10.2.1 §15.207 Conducted limits- Intentional Radiators:

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

Table 1:

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

*Decreases with the logarithm of the frequency.

Analyzer Settings: CISPR Bandwidth- 9KHz.

6.10.3 Test Conditions:

Modulation:
Measurement Uncertainty: ±3.0dB

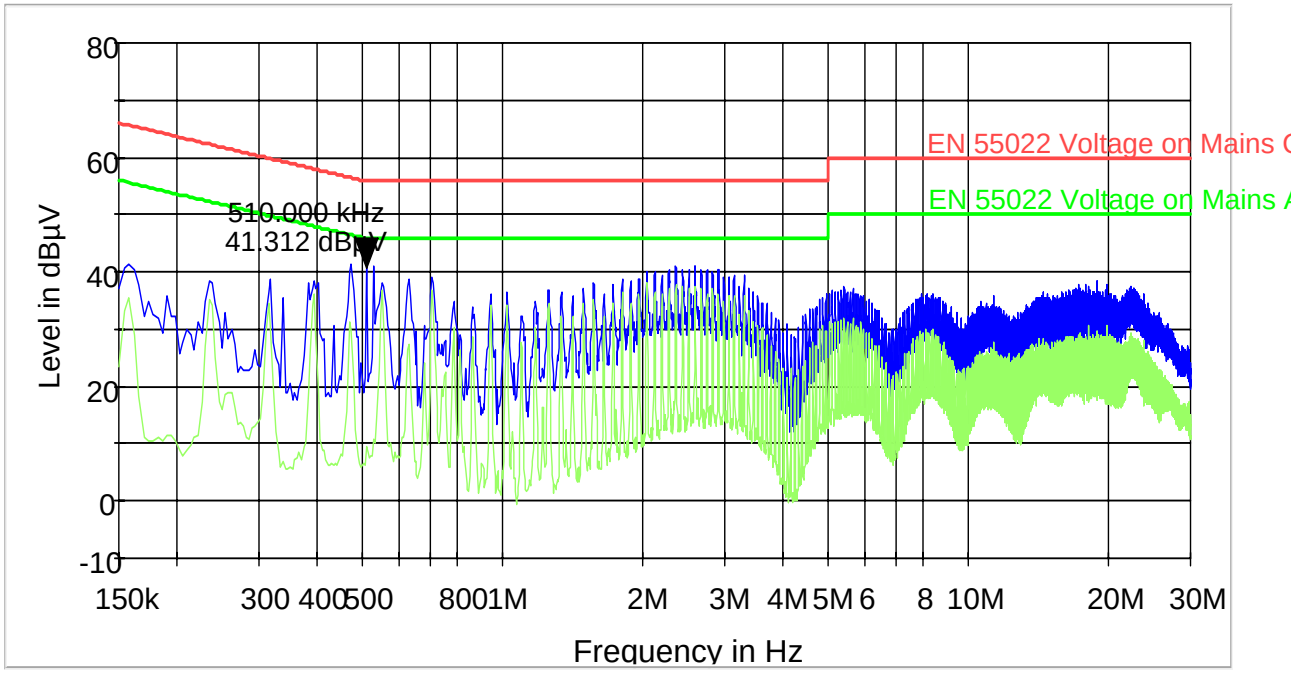
6.10.4 Test Summary:

Measurement performed with the module connected to a laptop using the USB Dev board. Line conducted emissions measured on the laptop power supply.

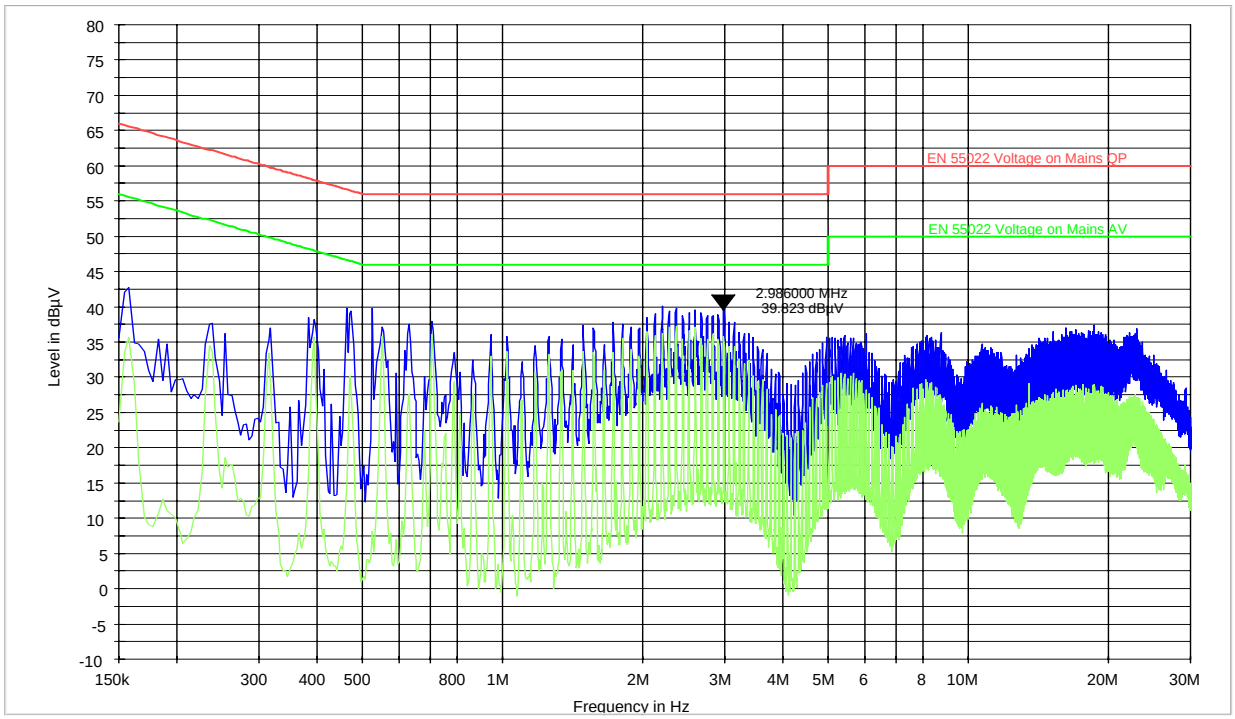
6.10.4.1 Test Result:
Pass

6.10.5 Test Data:

Transmit mode:



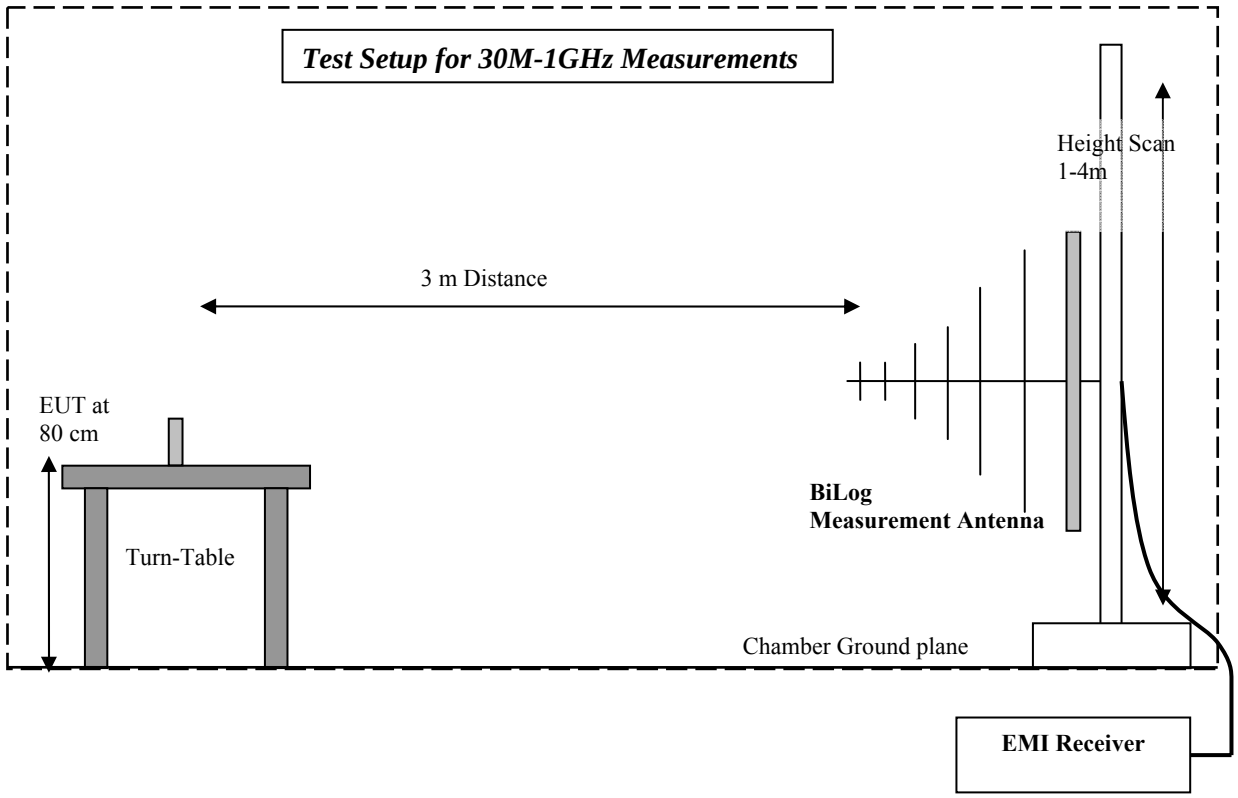
Idle mode:

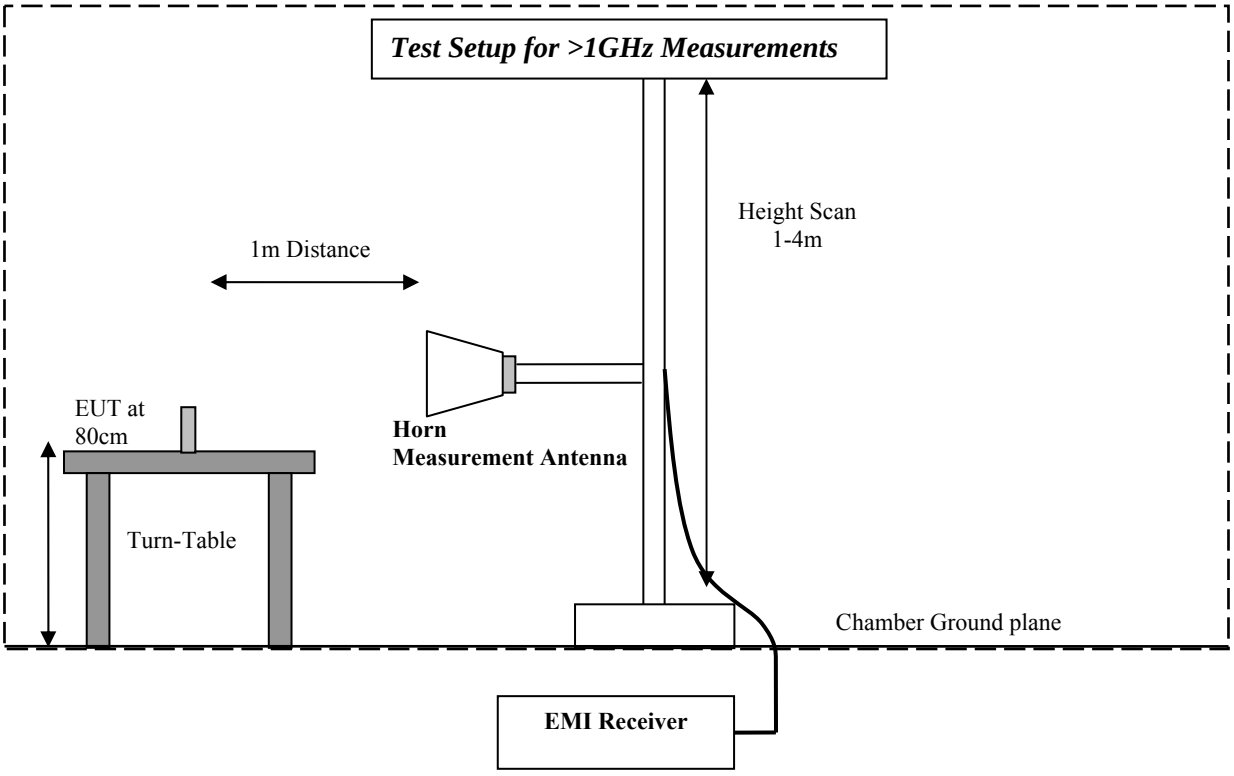


7 Test Equipment and Ancillaries used for tests

Instrument/Ancillary	Model	Manufacturer	Serial No.	Cal Date	Cal Interval
EMI Receiver/Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2011	1 year
Spectrum Analyzer	FSU	Rohde & Schwarz	200302	May 2011	1 year
Loop Antenna	6512	EMCO	00049838	April 2009	3 years
Biconilog Antenna	3141	EMCO	0005-1186	June 2009	3 years
Horn Antenna (1-18GHz)	3115	ETS	00035111	Jan 2009	3 years
Horn Antenna (18-40GHz)	3116	ETS	00070497	Jan 2009	3 years
Communication Antenna	IBP5-900/1940	Kathrein	n/a	n/a	n/a
High Pass Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
High Pass Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
6GHz High Pass Filter	HPM50106	Microtronics	001	Part of system calibration	
Pre-Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
Power Smart Sensor	R&S	NRP-Z81	100161	May 2011	1 Year
Multimeter	MM200	Klein	N/A	Apr 2011	1 Year
Temp Hum Logger	TM320	Dickson	03280063	Feb 2011	1 Year
Temp Hum Logger	TM325	Dickson	5285354	Feb 2011	1 Year

8 Block Diagrams





9 Revision History

Date	Report Name	Changes to report	Report prepared by
2011-08-17	**EMC_CET10_086_11001_15.247**	**First Version**	**Christopher Torio**
2011-08-19	**EMC_CET10_086_11001_15.247_Rev1**	**Corrected operating frequencies. Added AC Line conducted emissions data.**	**Satya**
2011-08-22	**EMC_CET10_086_11001_15.247_Rev2**	**Corrected bandwidth measurements**	**Christopher Torio**