FCC/IC Test Report

FOR

Multitech Systems, Inc.

MultiConnect Embedded PCIe Cellular Modem

FCC ID: AU792U12616836
IC: 125A-0048, Model Number: MTPCIE-H5-V-BW

47 CFR Part 15.247 (DSS)

IC RSS-210 Issue 8, Annex 8

TEST REPORT #: EMC_MULTI_055_13001_MTPCIE-H5-V-BW_DSS
DATE: 2014-01-21

FCC:
A2LA Accredited

IC recognized #
3462B-1

***CETECOM* Inc.**
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1 Assessment

The following equipment (and as identified in Ch.3 of this test report) was evaluated against the applicable criteria specified in FCC CFR47 Part 15.247, 15.207, 15.205, 15.209 and Industry Canada Standards RSS-210 Issue 8, Annex 8 and RSS-GEN issue 3.
No deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Multitech Systems, Inc.	MultiConnect Embedded PCIe Cellular Modem	MTPCIE-H5-V-BW

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2014-01-21	Compliance	Franz Engert (Test Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2014-01-21	Compliance	Danh Le (EMC Engineer)	

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
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Telephone:	+1 (408) 586 6200
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Test Lab Manager:	Franz Engert
Responsible Project Leader:	Danh Le

2.2 Identification of the Client

Applicant's Name:	Multi-Tech Systems, Inc.
Street Address:	2205 Woodale Drive
City/Zip Code	Mounds View, MN 55112
Country	USA
Contact Person:	Jody Lanes
Phone No.	763 717 5500
Fax:	763-785-9874
e-mail:	jlanes@multitech.com

2.3 Identification of the Manufacturer

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

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Description:	**MultiConnect Embedded PCIe Cellular Modem**
FCC-ID :	**AU792U12616836**
IC ID:	**125A-0048**
Model Number (IC model no.):	**MTPCIE-H5-V-BW**
Product Description:	PCIe card module (limited modular) incorporating a pre-certified 3G cellular and a 2.4GHz WLAN / Bluetooth combo radio module (details see under "Other Radios" below)
Technology / Type(s) of Modulation:	Bluetooth version 4.0, using Frequency Hopping Spread Spectrum with GFSK or π/4 DQPSK or 8DPSK modulation
Operating Frequency Ranges (MHz) / Channels:	Nominal band: 2400 – 2483.5; Center to center: 2402(ch 1) – 2480(ch 79), 79 channels;
Antenna info (antenna as presented for testing with the development board):	external screw mount dipole antenna with RP-SMA(M) connector (Taoglas GW.11.A153); 2.3dBi peak gain; The antenna is connected to the related UFL connector on board of the PCIe card by an additional cable (loss ca. 0.6dB);
Max. Output Powers:	Conducted (Measured): GFSK: 9.66 dBm (.0092W); π/4DQPSK: 9.49 dBm(.0089W); 8DPSK: 9.45 dBm(.0088W) EIRP (conducted + documented antenna gain): GFSK: 11.96 dBm(.0157W); π/4DQPSK: 11.79 dBm(.0151W); 8DPSK: 11.75 dBm(.0149W)
Rated Operating Voltage Range:	Vmin: 2.7V / Vnom: 3.3V / Vmax: 4.2V, over PCIe card interface;
Rated Operating Temperature Range:	–35°C ~ +85°C
Other Radios included:	1.Telit HE910-D 3G module, FCC ID: RI7HE910; IC ID: 5131A-HE910 • GSM 850 / 900 / 1800 / 1900 • UMTS FDD: BandI/BandII/Band/IV/BandV/BandVIII 2.Murata LBEE5ZSTNC, 802.11bgn 2.4 GHz / Bluetooth 4.0 combo module, FCC-ID: VPYLBTN, IC: 772C-LBTN; 3.GPS 1575.42 MHz
Test Sample Status:	Prototype

3.2 Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	Sample	HW/SW Version
1	16446920	Radiated/Conducted	A/12.00.003

3.3 Accessories of the EUT

AC #	Type	Manufacturer	Model Number	Part Number
1	BT/WLAN Antenna	Taoglas	GW.11.A153	MAF94300
2	Antenna cable Coax R-SMA to UFL 6 inch	--	--	45009628L

3.4 Ancillary Equipment

AE #	Type	Manufacturer	Model	Part Number
1	Development Board	Multitech	MTPCIE-DK	--
2	AC Switching Power Supply	GlobTek, Inc.	GT-41052-1509	WR9QD1700L9P-N-MT

3.5 Environmental conditions during Test:

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

3.6 Dates of Testing:

04/22/2013 – 05/13/2013

3.7 Other Testing Notes:

1. The EUT was set in BT Test mode using a development software supplied by the manufacturer. The software was used to control different modulation schemes, channels etc., as required for testing.
2. The EUT was tested on low, mid and high channels in GFSK, π/4DQPSK and 8DPSK modes.
3. Test Configuration - Test Set-up:
   The EUT (the PCIe card MTPCIE-H5-V-BW) has been tested while mounted on and connected to a developer board.
   The developer board provides standard PCIe data and power interfaces as well as the connection from the UFL antenna connectors for the radios on board of the PCIe card to the related SMA connectors external to the developer kit.
   The conducted RF measurements have been made at the SMA connectors, taking into account the loss of the cable from the UFL on board of the PCIe card to the SMA connector.
4. The PCIe card has been declared and documented to have its own RF shielding, power regulation, data buffering and internal frequency supply.
   The developer kit is described in detail in the Developer Guide which is provided with this filing.
5. Taking into account guidance from FCC KDB 996369 (modular approval) and where relevant test procedures did not change most conducted test results are leveraged from the related test report #31KE0354-HO-01-B-R1 issued on July 26, 2011 by UL Japan, Inc. of the certification of the integrated Bluetooth/WLAN combo module (see section 3.1).

4 Subject of Investigation

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

- FCC CFR47 Parts 15.247, 15.207, 15.205/15.209
- Industry Canada Radio Standard Specifications RSS-210 Issue 8, RSS-Gen Issue 3

This test report is to support a request for new equipment authorization as single modular approval under the FCC ID: **AU792U12616836** and IC ID **125A-0048.**

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS-210 A8.2(b)	Power Spectral Density	Nominal	-	☐	☐	■	☐	Note 1
§15.247(a)(1) RSS-210 A8.1(b)	Carrier Frequency Separation	Nominal	Hopping	☐	☐	☐	■	Note 2
§15.247(a)(1) RSS-210 A8.1(d)	Number of Hopping Channels	Nominal	Hopping	☐	☐	☐	■	Note 2
§15.247(a)(1)(iii) RSS-210 A8.3(1)	Time of occupancy	Nominal	Hopping	☐	☐	☐	■	Note 2
§15.247(a)(1) RSS-210 A8.2(a)	Spectrum Bandwidth	Nominal	GFSK π/4DQPSK 8DPSK	☐	☐	☐	■	Note 2
§15.247(b)(1) RSS-210 A8.4(2)	Maximum Peak Conducted Output Power	Nominal	GFSK π/4DQPSK 8DPSK	■	☐	☐	☐	Complies
§15.247(d) RSS-210 A8.5	Band edge compliance-Conducted	Nominal	GFSK π/4DQPSK 8DPSK	☐	☐	☐	■	Note 3
§15.209(a) RSS-GEN 7.2	Band edge compliance-Radiated	Nominal	GFSK π/4DQPSK 8DPSK	■	☐	☐	☐	Complies
§15.247(d) RSS-210 A8.5	TX Spurious emissions-Conducted	Nominal	GFSK π/4DQPSK 8DPSK	☐	☐	☐	■	Note 2
§15.209(a) RSS-GEN 7.2	TX Spurious emissions-Radiated	Nominal	GFSK	■	☐	☐	☐	Complies
§15.207(a) RSS-GEN 7.2	Conducted Emissions <30MHz	Nominal	GFSK	■	☐	☐	☐	Complies

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

1. Power Spectral Density is NOT APPLICABLE for devices with hopping functionality.
2. Testing leveraged from FCC test report #: 31KE0354-HO-01-B-R1
3. Band Edge compliance-conducted is NOT PERFORMED as the device passes radiated measurement against the more stringent restricted band limits

6 Measurements

6.1 Measurement Method:

Testing is performed according to FCC Public Notice DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems and according to relevant parts of ANSI C63.4 (2009) as detailed below.

6.2 Radiated Measurement Procedure

ANSI C63.4 (2009) Section 8.3.1.1: Exploratory radiated emission measurements
Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. A shielded room may be used for exploratory testing, but may have anomalies that can lead to significant errors in amplitude measurements.

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

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

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

When measuring emissions above 1 GHz, the frequencies of maximum emission shall be determined by manually positioning the antenna close to the EUT and by moving the antenna over all sides of the EUT while observing a spectral display. It will be advantageous to have prior knowledge of the frequencies of

emissions above 1 GHz. If the EUT is a device with dimensions approximately equal to that of the measurement antenna beamwidth, the measurement antenna shall be aligned with the EUT.

ANSI C63.4 (2009) Section 8.3.1.2: Final radiated emission measurements

Based on the measurement results in 8.3.1.1, the one EUT, cable and wire arrangement, and mode of operation that produces the emission that has the highest amplitude relative to the limit is selected for the final measurement. The final measurement is then performed on a site meeting the requirements of 5.3, 5.4, or 5.5 as appropriate without variation of the EUT arrangement or EUT mode of operation. If the EUT is relocated from an exploratory test site to a final test site, the highest emission shall be 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.
Measurement Uncertainty: ±3dB

6.3 Sample Calculations for Radiated Measurements

6.3.1.1 Field Strength Measurements:

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

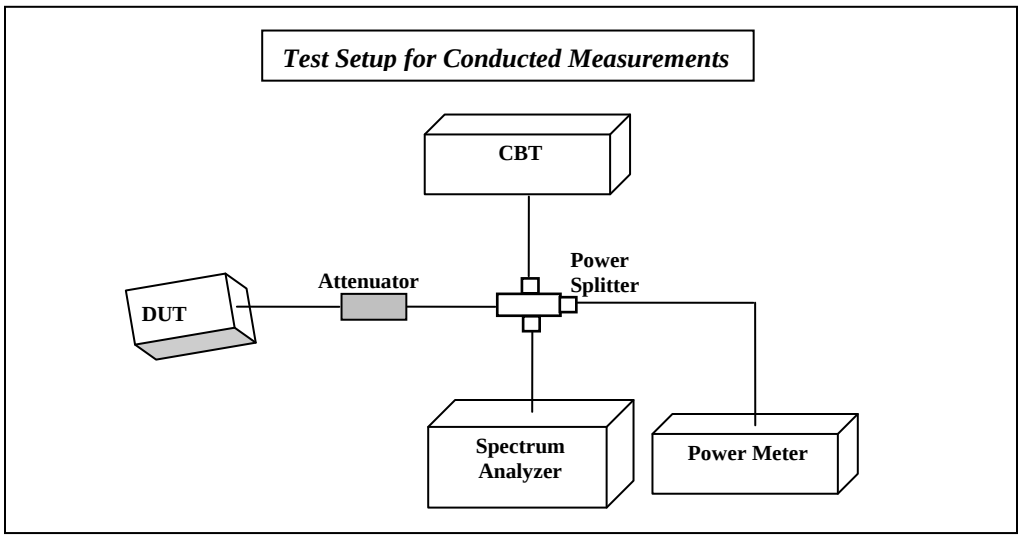
1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

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

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

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

6.4 Conducted Measurement Procedure



1. Connect the equipment as shown in the above diagram.
2. Adjust the settings of the CBT (Rohde-Schwarz Bluetooth Tester) to connect the EUT at the required mode of test.
3. Measurements are to be performed with the EUT set to the low, middle and high channels and for GFSK, π/4DQPSK and 8DPSK modulation schemes.

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

6.5 Maximum Peak Output Power

6.5.1 Limits:

6.5.1.1 §15.247 (b)(1)
Maximum peak conducted output power, for FHS with number of hopping channels ≥ 75 and antenna gain ≤ 6 dBi: 1 W;

6.5.1.2 RSS-210- A8.4(2)
Maximum peak conducted output power, with number of hopping channels ≥ 75: 1 W, E.I.R.P ≤ 4 W;

6.5.1.3 RSS 210- A8.4(2)
Nominal Peak Output Power < 30 dBm (1W)

6.5.2 Test Conditions:

Tnom: 20°C; Vnom: 3.3 V
Hopping OFF

6.5.3 Test Procedure:

Measurement according to DA 00-705 utilizing a Spectrum Analyzer.
The EIRP is calculated by adding the rated maximum antenna gain of +2.3 dBi to the measured conducted peak power;

6.5.4 Test Result:

Measured Max Peak Output Power- Conducted (dBm)			
Modulation	**Frequency (MHz)**		
	2402	**2441**	**2480**
GFSK	9.66	9.56	9.37
π/4 DQPSK	9.49	9.13	9.29
8-DPSK	9.45	9.29	9.14

Calculated Max Peak Output Power- Radiated EIRP (dBm)			
Modulation	**Frequency (MHz)**		
	2402	**2441**	**2480**
GFSK	11.96	11.86	11.67
π/4 DQPSK	11.79	11.43	11.59
8-DPSK	11.75	11.59	11.44

Note: Radiated EIRP = *Conducted Measurement + Antenna Gain*

6.5.4.1 Measurement Verdict:
Pass.

6.6 Restricted Band Edge Compliance

6.6.1 Reference and Limits:

§15.247/15.205/15.209; RSS-GEN 7.2;

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

§15.205 Restricted bands of operation.

(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			

§15.209 Radiated emission limits; general requirements.
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	100 (40dBµV/m)	30
30–88	150 (43.5 dBµV/m)	3
88–216	200 (46 dBµV/m)	3
216–960	500 (54 dBµV/m)	3
Above 960	100 (40dBµV/m)	3

RSS-GEN, issue 3, section 7.2.2 Emissions falling within restricted frequency bands
Restricted bands, identified in Table 3, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

(a) fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 3;
(b) unwanted emissions falling into restricted bands of Table 3 shall comply with the limits specified in RSS-Gen;
(c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.

Table 3: Restricted Frequency Bands

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Note: Certain frequency bands listed in Table 1 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200– and 300– series RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

RSS-GEN, issue 3, section 7.2.2 Transmitter Spurious Emission Limits

Spurious emissions from licence-exempt transmitters shall comply with the field strength limits shown below. Additionally, the level of any transmitter spurious emission shall not exceed the level of the transmitter's fundamental emission.

Table 5: General Field Strength Limits for Transmitters at Frequencies Above 30 MHz

Frequency (MHz)	Field Strength (microvolt/m)	Distance (m)
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

Note: Transmitting devices are not permitted in Table 1 bands or, unless stated otherwise, in TV bands (54-72 MHz, 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-806 MHz).

Table 6: General Field Strength Limits for Transmitters at Frequencies Below 30 MHz (Transmit)

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement distance
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1.705-30 MHz	30 (29.5 dBµV/m)	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing an average detector

6.6.2 Test Conditions:

Tnom: 20°C; Vnom: 3.3V
Hopping OFF

6.6.3 Measurement Procedure:

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

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

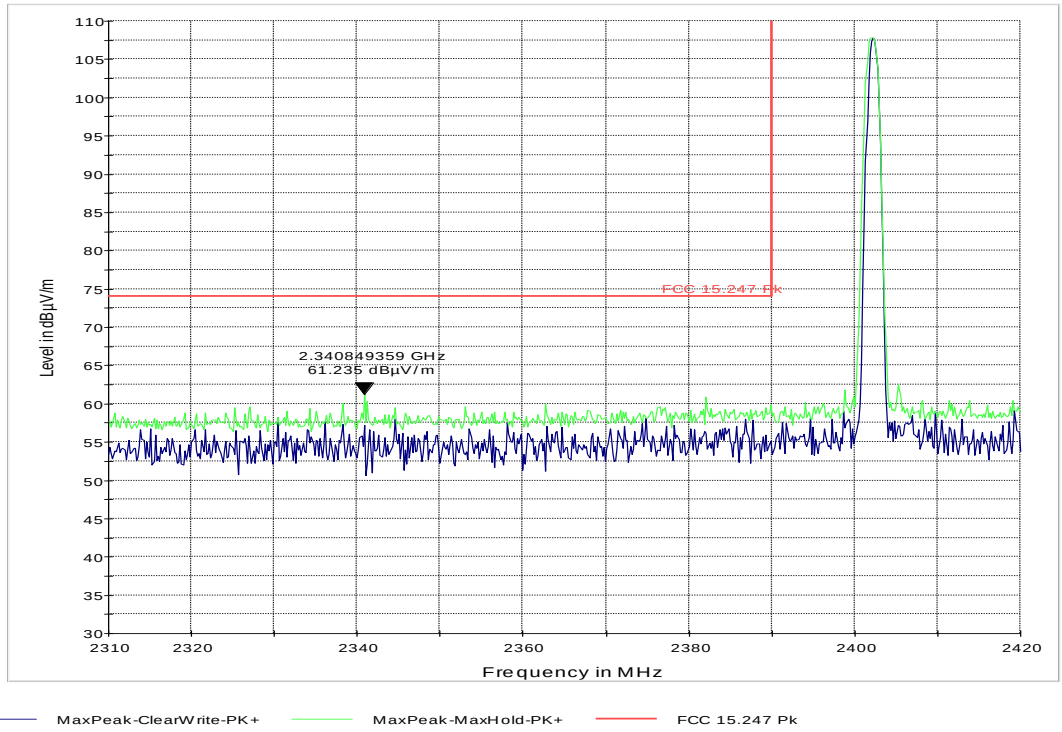
The device was set to operate in GFSK test mode (highest conducted output power) and measurement results as reported here, representing the worst case.

6.6.3.1 Measurement Verdict

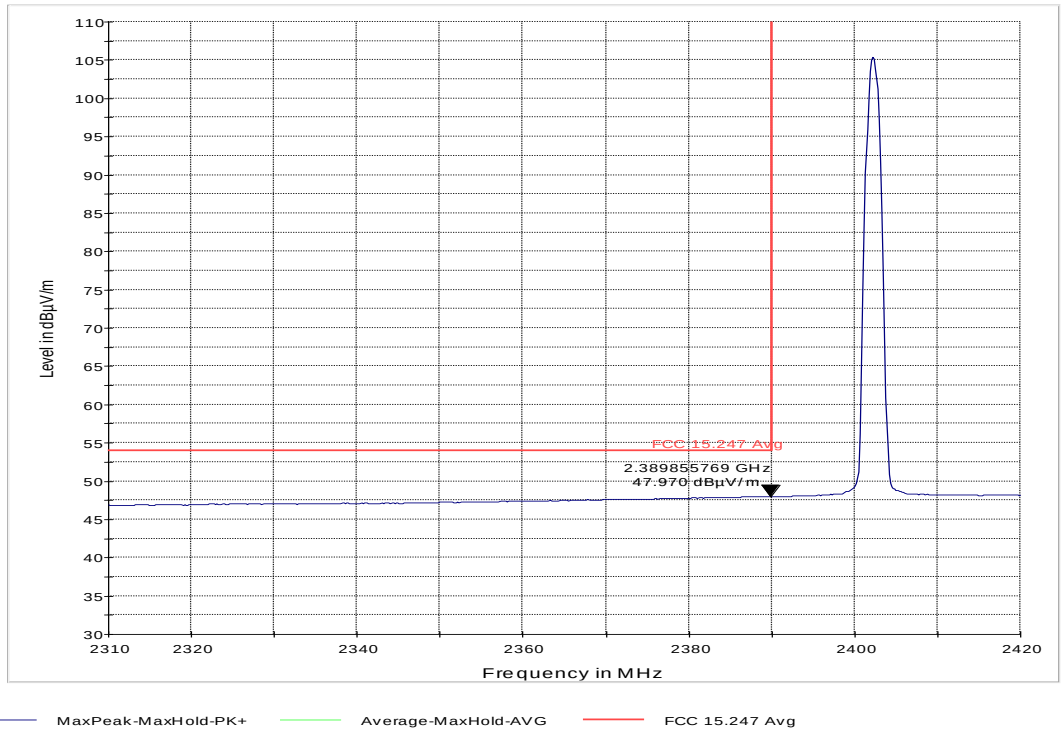
Pass.

6.6.4 Test Data/plots:

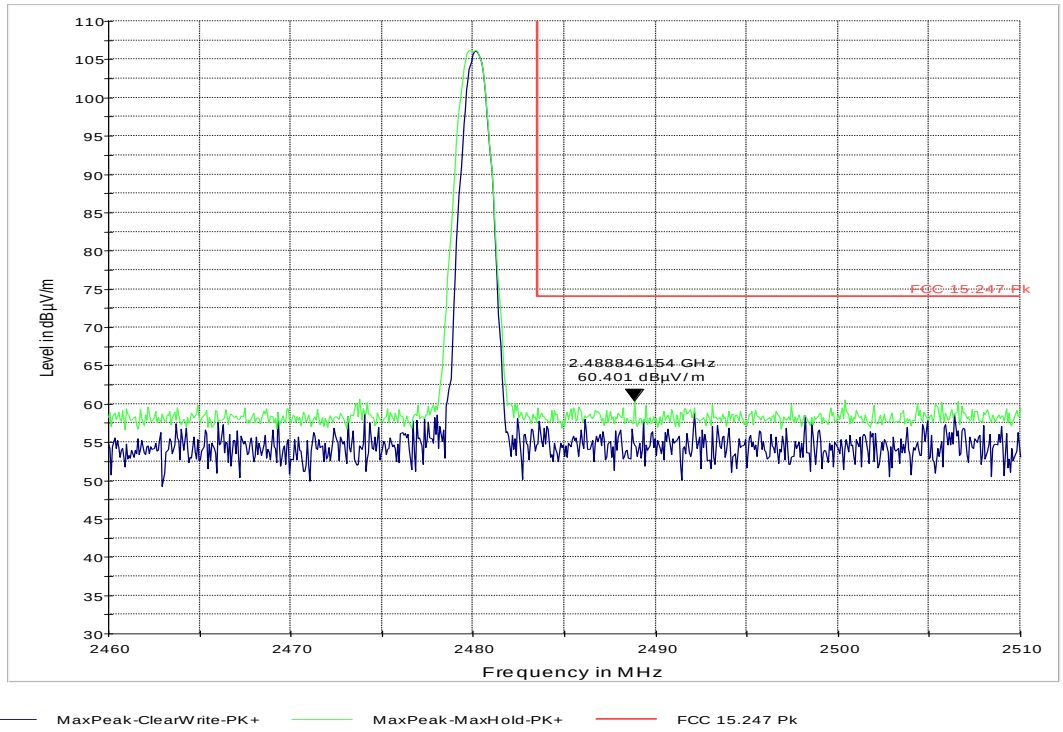
Lower band edge peak -GFSK modulation (2402MHz)



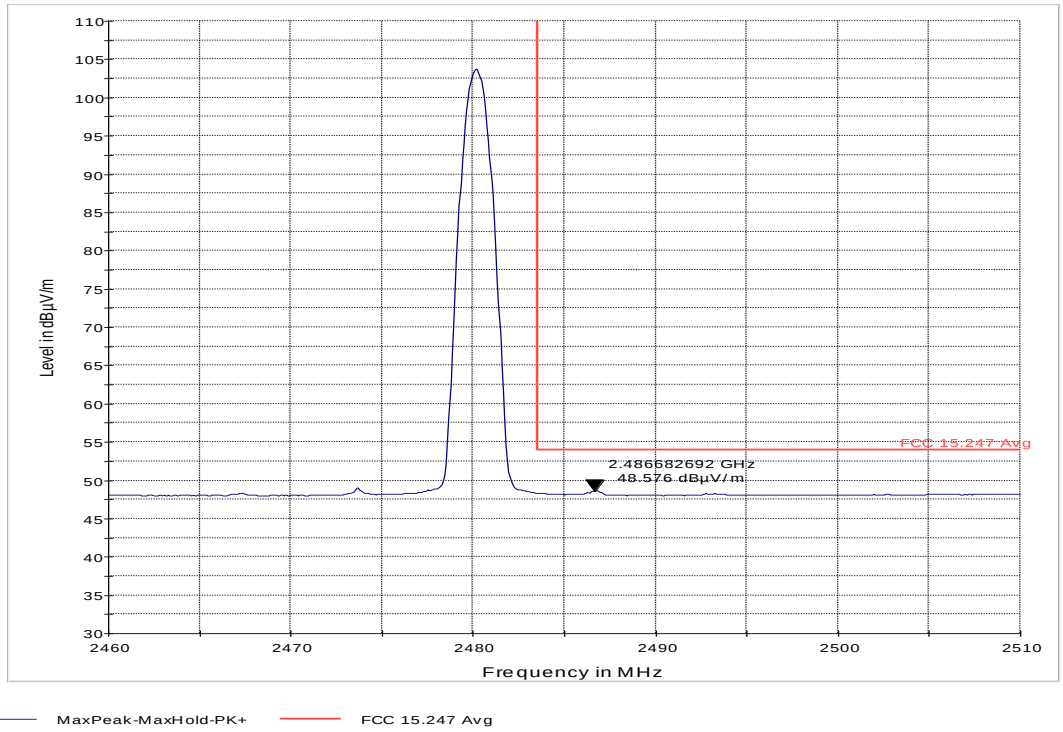
Lower band edge average -GFSK modulation (2402MHz)



Higher band edge peak -GFSK modulation (2480MHz)



Higher band edge average-GFSK modulation (2480MHz)



6.7 Transmitter Spurious Emissions into Restricted Bands – Radiated

6.7.1 Reference and Limits:

§15.247/15.205/15.209; RSS-GEN 7.2;
Details see section 6.6

6.7.2 Test Result:

The device was set to operate in GFSK test mode (highest conducted output power) and measurement results as reported here, represents the worst case radiated spurious emissions.
Unless mentioned otherwise, the emissions outside the limit lines in the plots are from the transmit signal.
For radiated measurements, all data in this report shows the worst case emissions data between H/V antenna polarizations and for all 3 orthogonal orientations of the EUT.

6.7.3 Test Conditions:

Tnom: 20°C; Vnom: 3.6 V
Hopping OFF

6.7.4 Measurement Procedure:

Peak measurements are made using a peak detector and RBW=120kHz (<1GHz) and RBW= 1MHz (>1GHz)

6.7.5 Testing Notes:

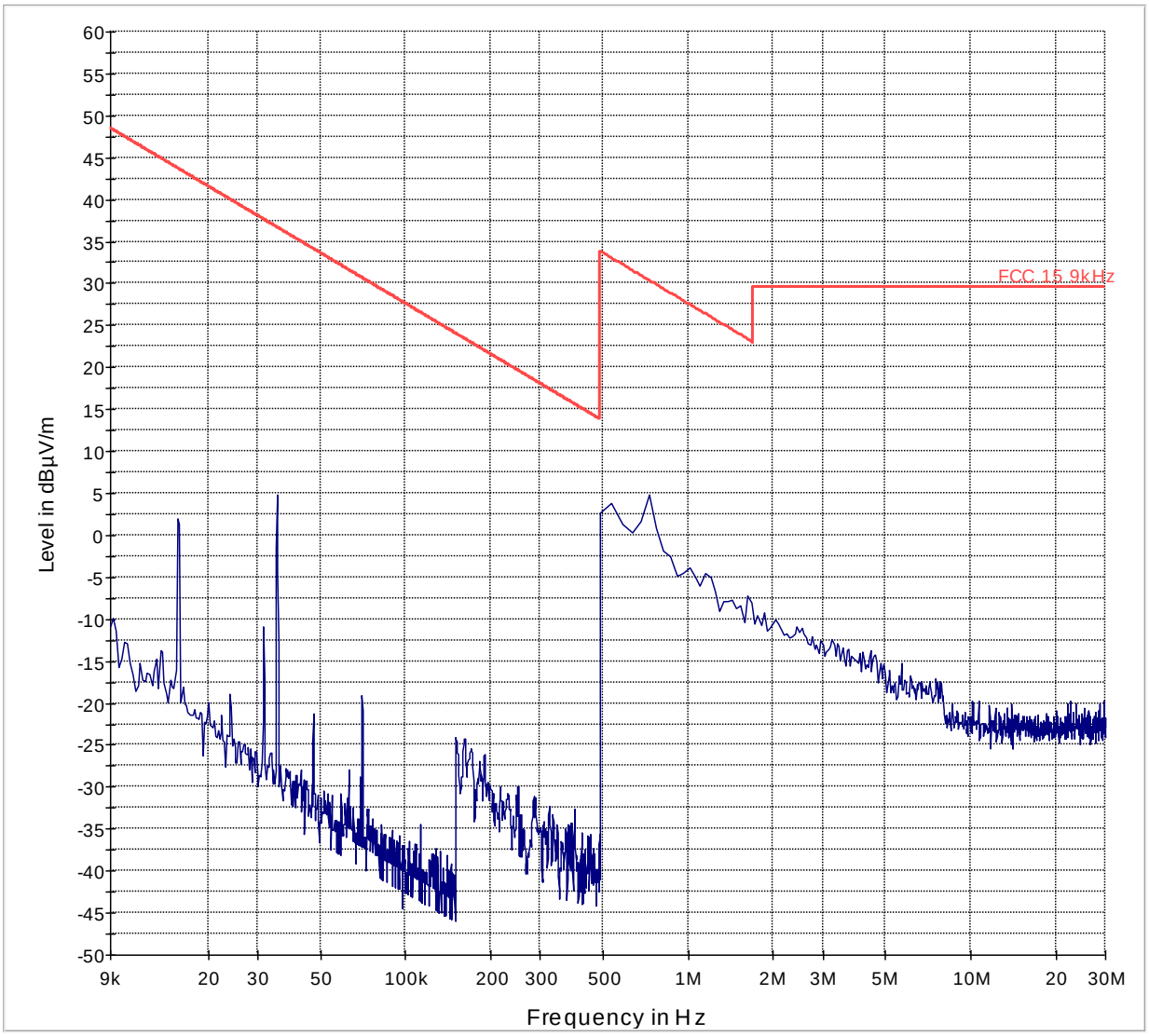
The following plots show the worst case per frequency range out of all tested modes of operation.
For the measurement range up to 30 MHz in the following plots the field strength results from 3m distance measurement are extrapolated to 300m and 30m distance respectively, by 40dB/decade, according to part 15.31(f)(2), per antenna factor scaling.
The red limit line shows the 300 m limit up to 490 kHz, the 30m limit up to 30 MHz and 3m limit above 30MHz.

6.7.6 Measurements Verdict

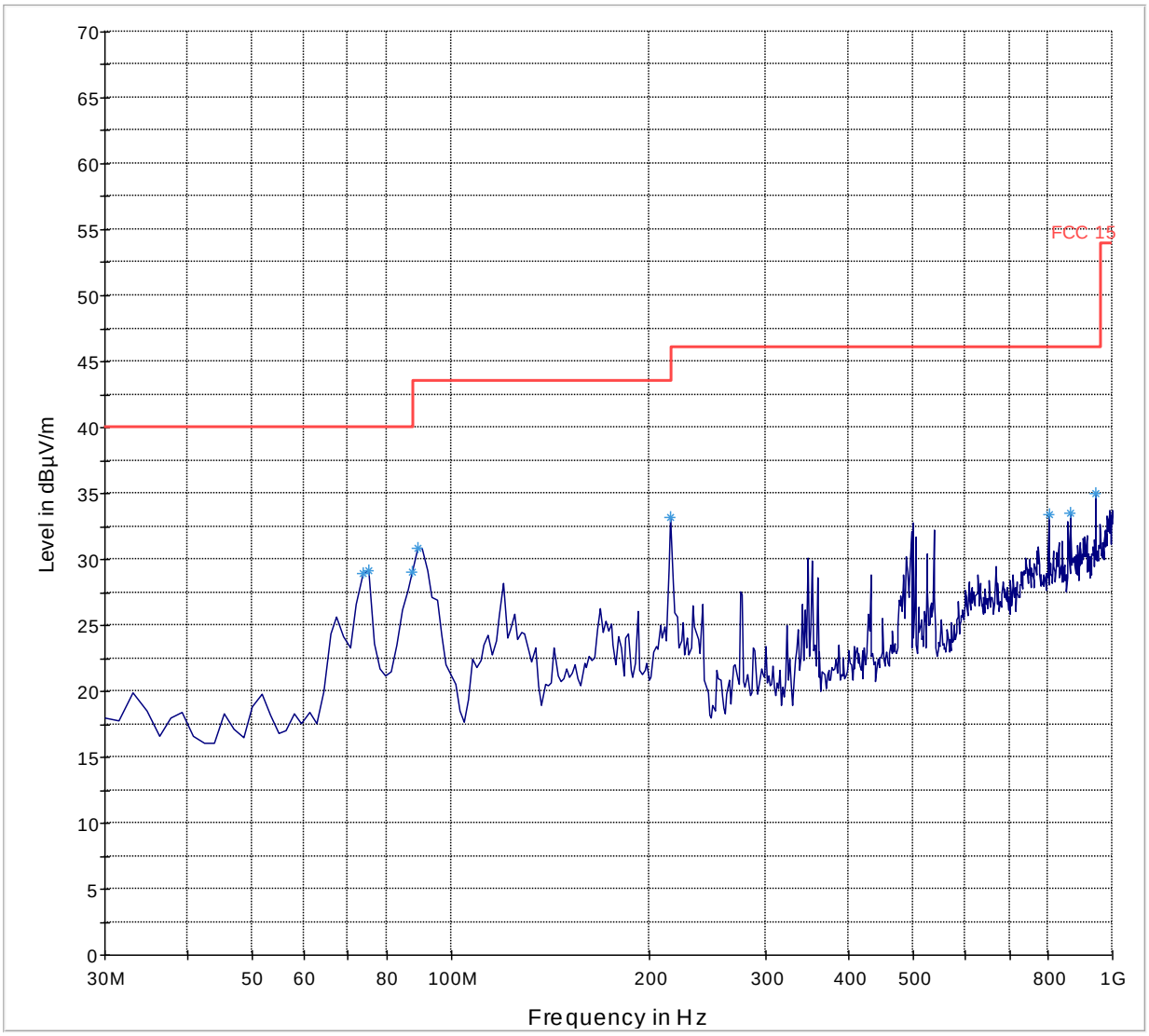
Pass.

6.7.7 Test data/ plots:

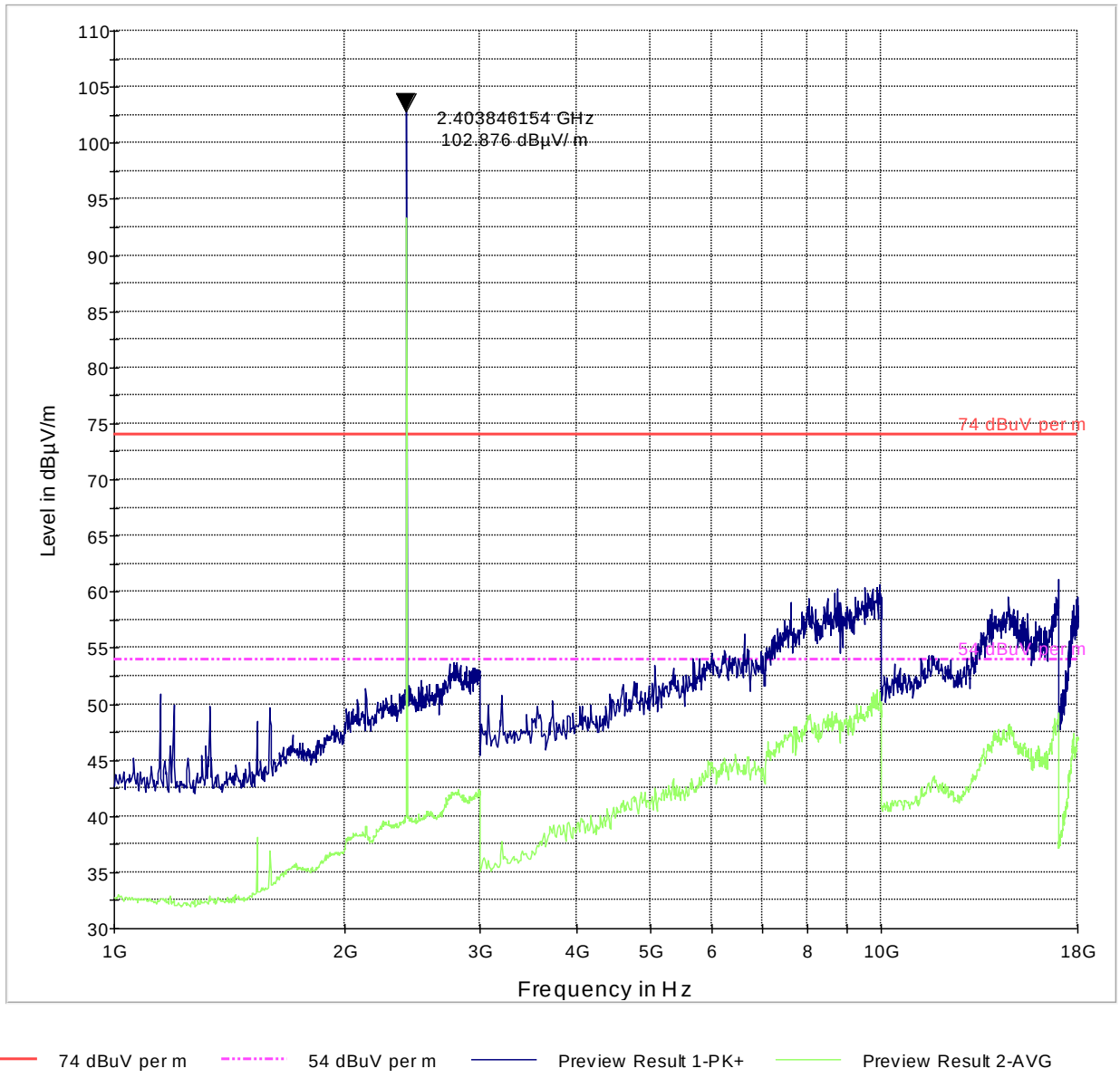
Transmitter Radiated Spurious Emission: Ch39- 9k-30MHz



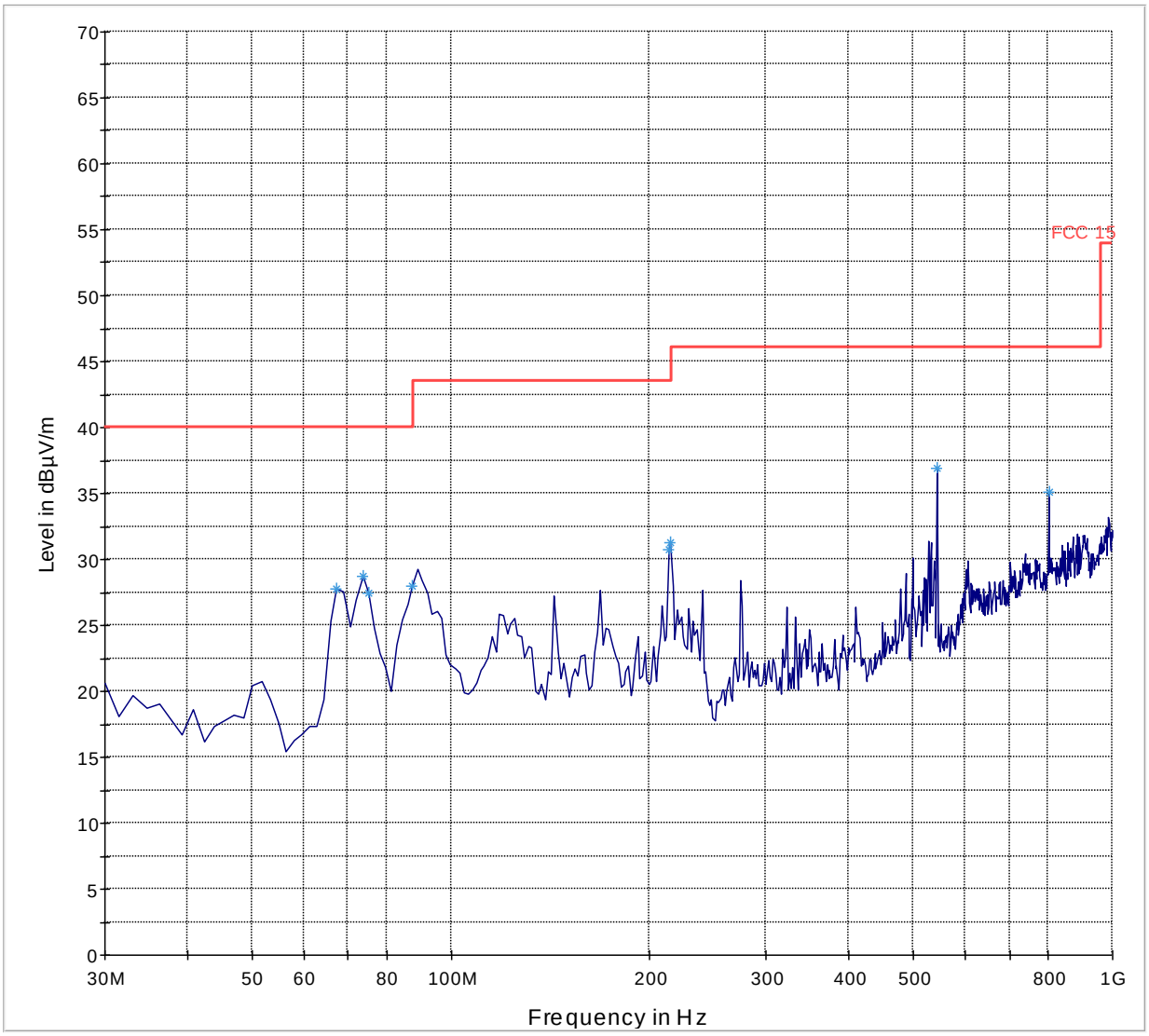
Transmitter Radiated Spurious Emission- Ch0- 30MHz-1GHz



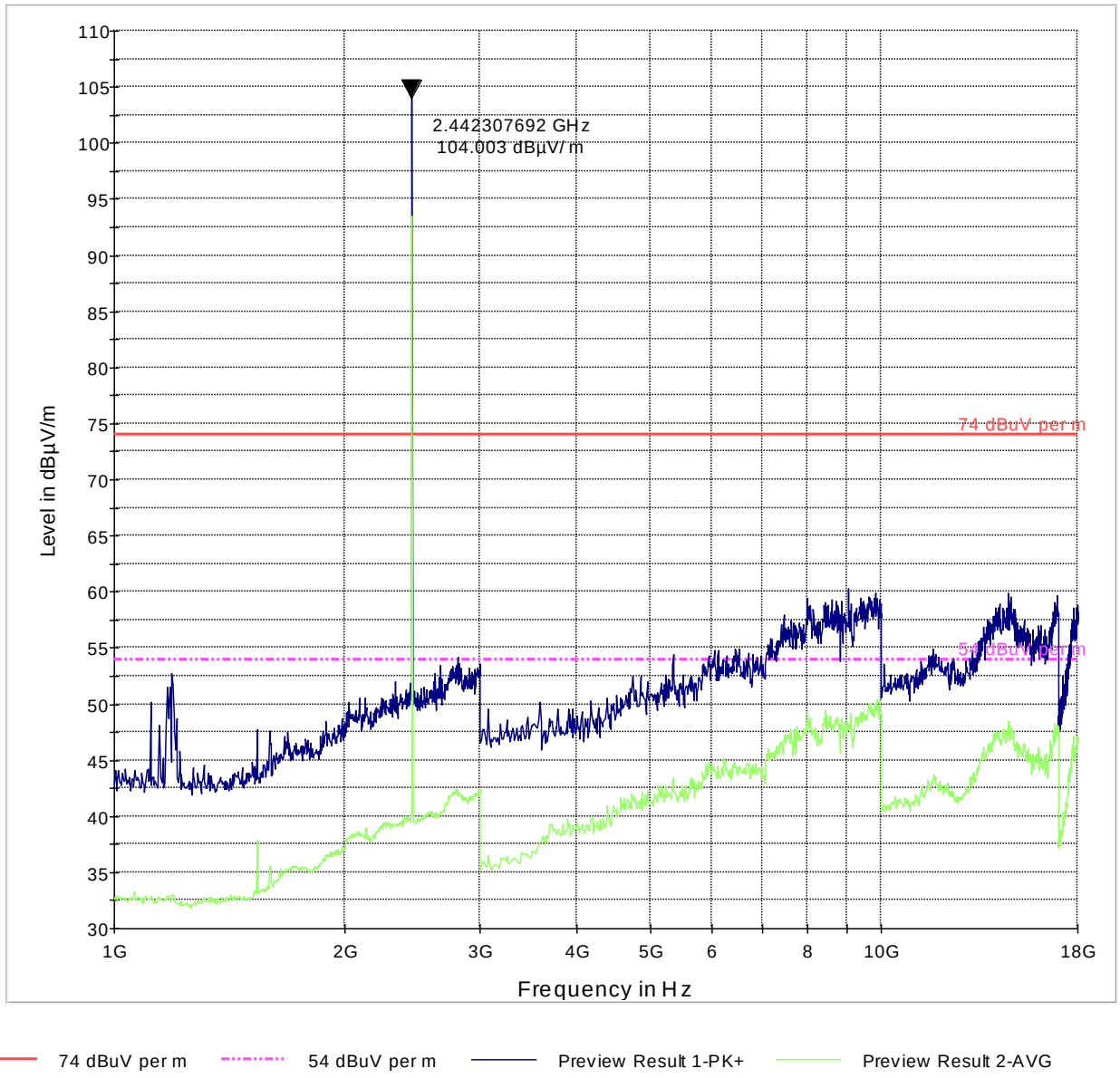
Transmitter Radiated Spurious Emission- Ch0- 1GHz-18GHz



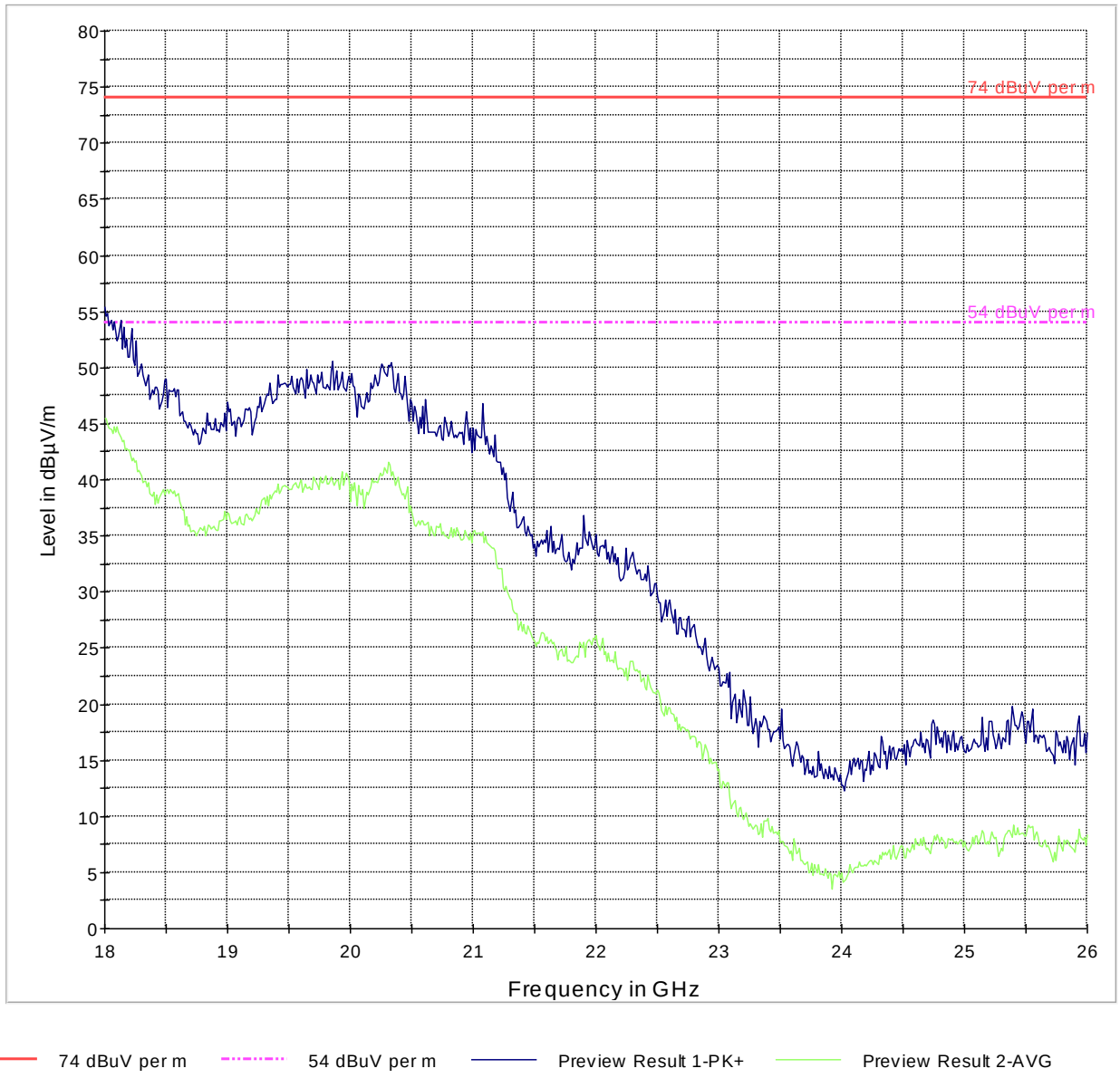
Transmitter Radiated Spurious Emission- Ch39- 30MHz-1GHz



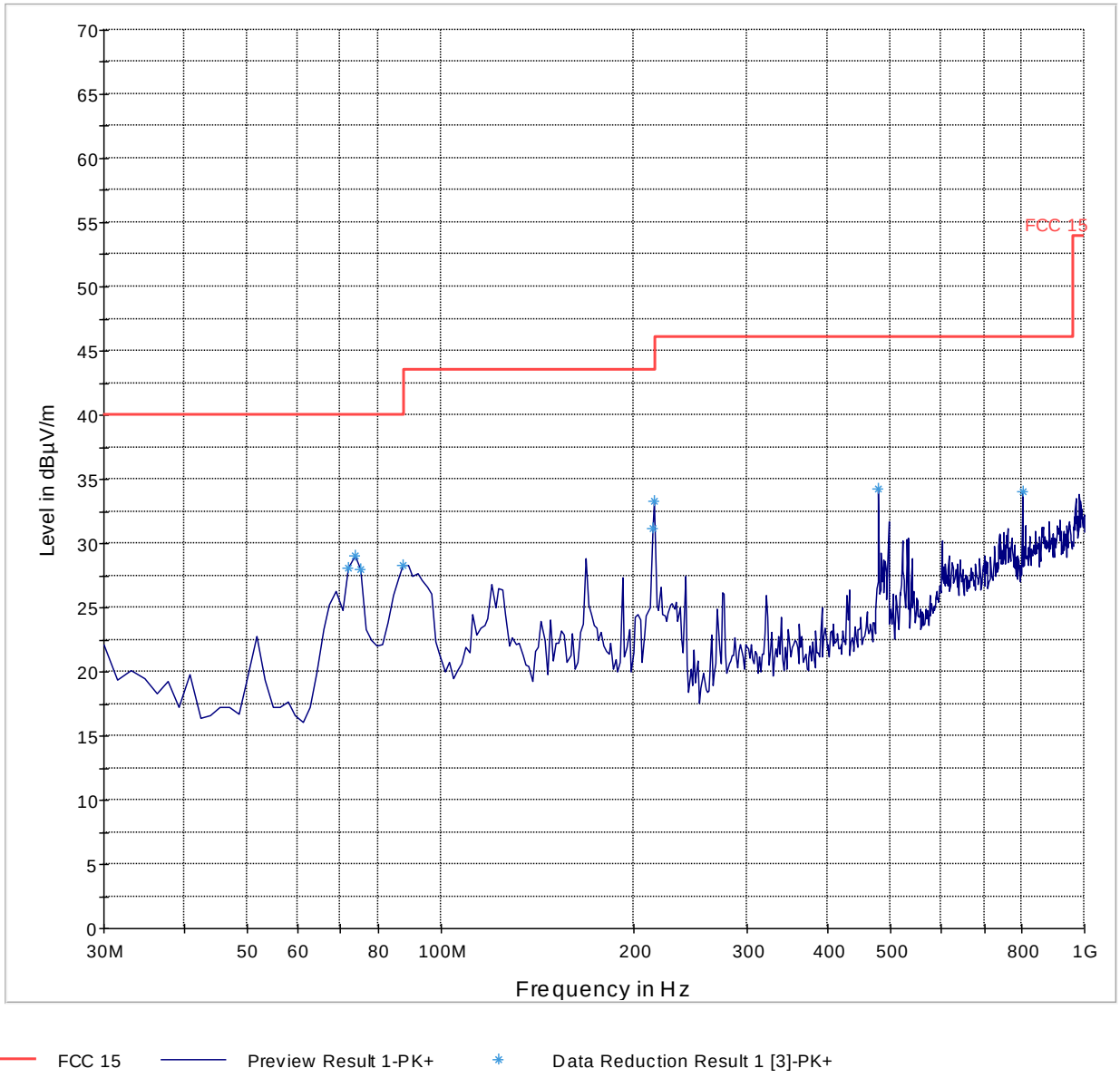
Transmitter Radiated Spurious Emission- Ch39- 1GHz-18GHz



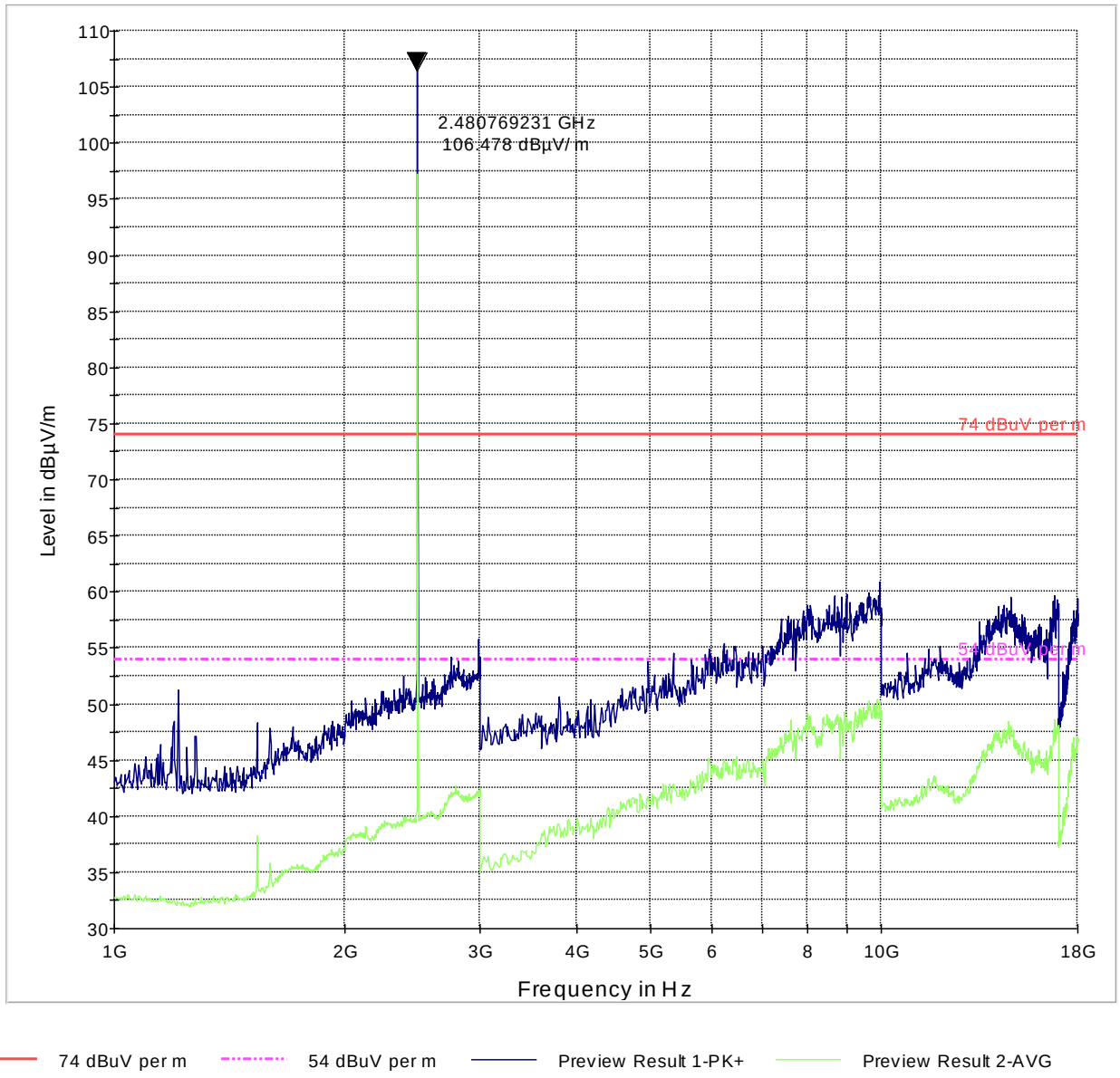
Transmitter Radiated Spurious Emission- Ch39- 18GHz-26GHz



Transmitter Radiated Spurious Emission: Ch78- 30-1GHz



Transmitter Radiated Spurious Emission- Ch78- 1GHz-18GHz



6.8 AC Power Line Conducted Emissions

6.8.1 References:

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

6.8.2 Limits:

6.8.2.1 §15.207 Conducted limits- Intentional Radiators:

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

6.8.2.2 RSS-Gen 7.2.2

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

Table 1:

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

*Decreases with the logarithm of the frequency.

Analyzer Settings: CISPR Bandwidth- 9KHz.

6.8.3 Test Conditions:

Modulation: GFSK- Transmit modes of operation
Measurement Uncertainty: ±3.0dB

6.8.4 Results

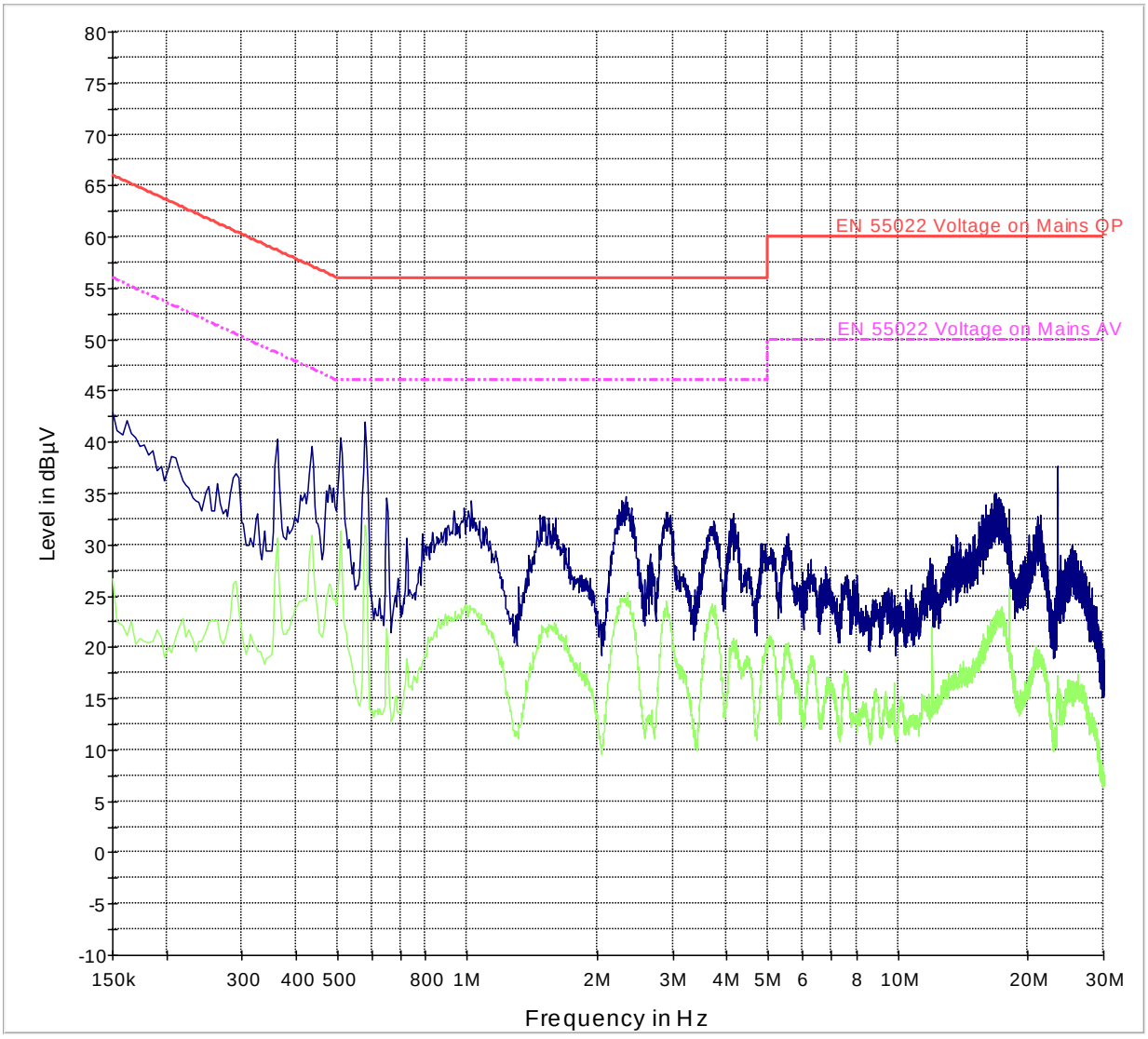
Plots shown here represent the combined worse case emissions for power lines, phases and neutral line.

6.8.4.1 Measurement Result

Pass.

6.8.5 Test Results:

BT TX Mode:



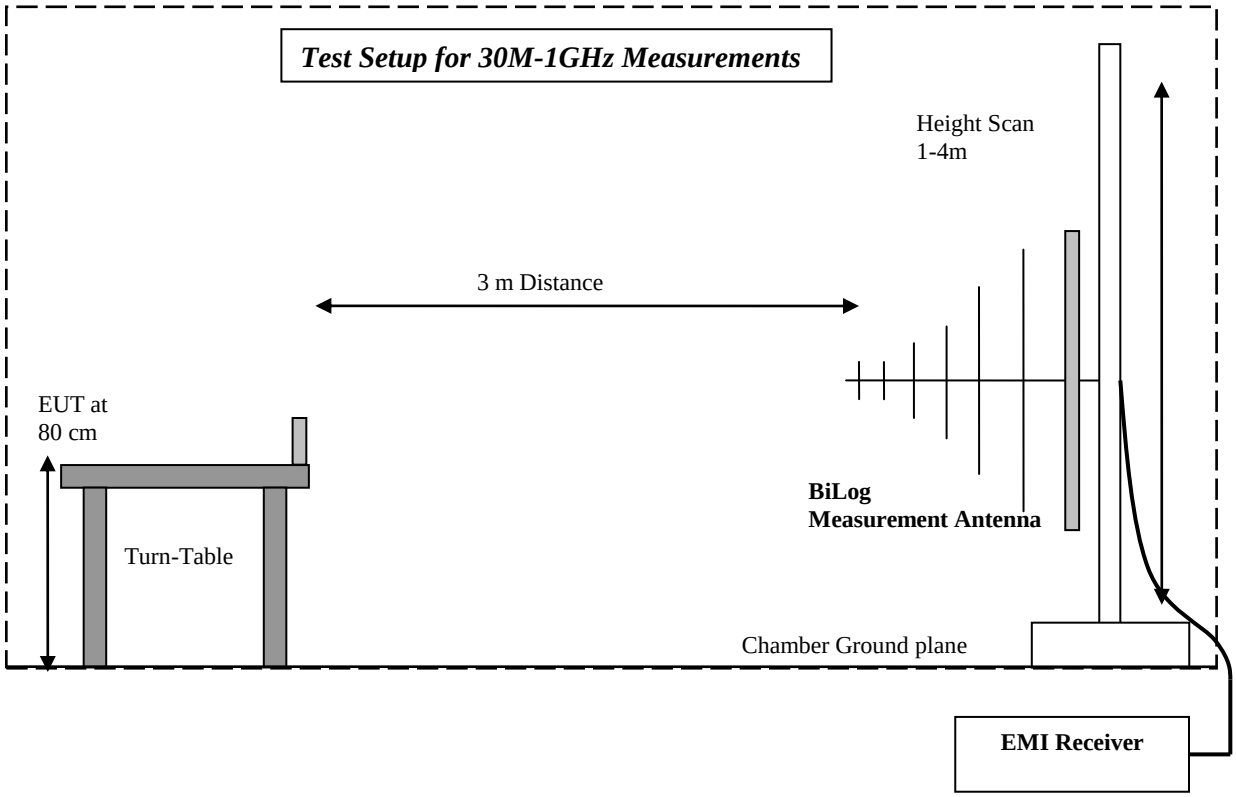
EN 55022 Voltage on Mains QP
Preview Result 1-PK+
EN 55022 Voltage on Mains AV
Preview Result 2-AVG

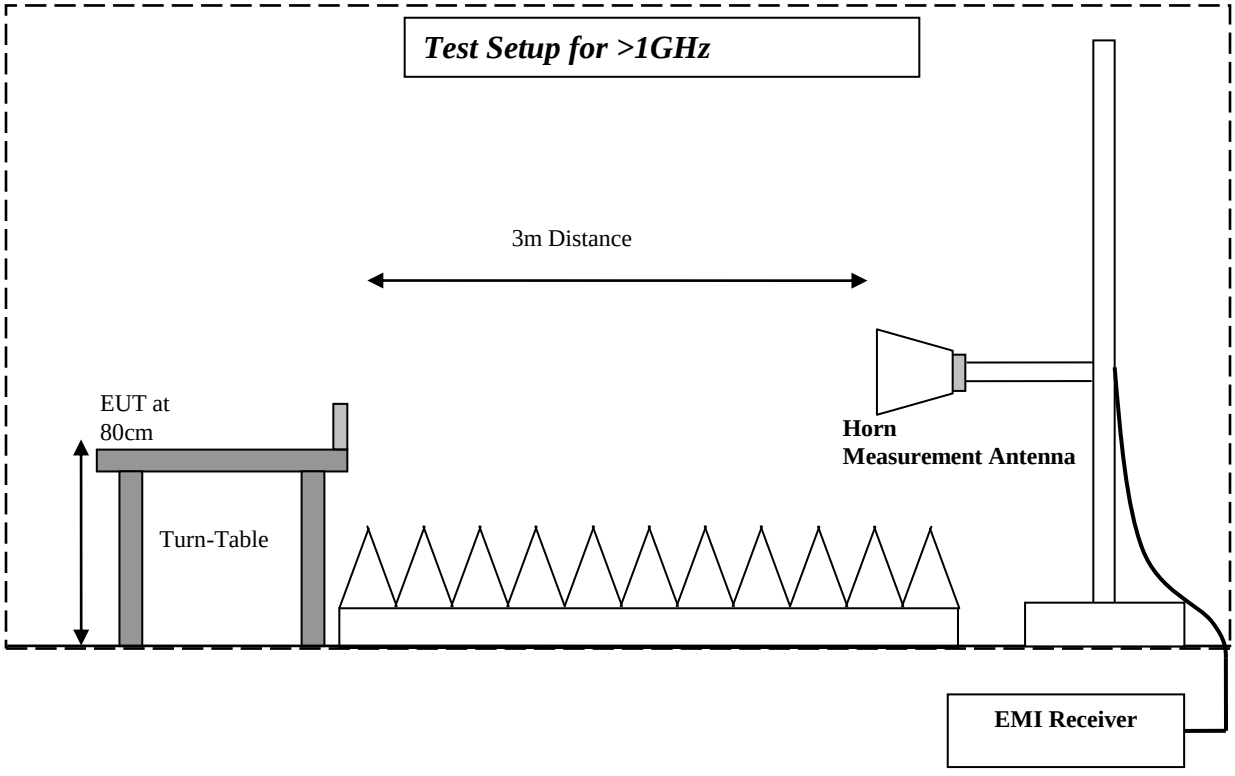
7 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turntable	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Aug 2012	1 Year
	Spectrum Analyzer	Agilent	E4440A	MY46186445	Dec 2012	1 Year
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHZ HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
Ancillary equipment						
	Humidity Temperature Logger	Dickson	TM320	03280063	Apr 2013	1 Year
	Digital Barometer	VWR	35519-055	91119547	Dec 2012	1 Years
	Climatic Chamber	Votsch	VT4004	G1115	N/A	N/A
	DC Power Supply	HP	E3610A	KR83023316	N/A	N/A
	DC Power Supply	Protek	3003B	H012771	N/A	N/A
	Communication Antenna	IBP5-900/1940	Kathrein	N/A	N/A	N/A

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

8 Test Setup Info:





9 Revision History

Date	Change Description	Revision
2014-01-15	n.a.	initial
2014-01-21	marketing name / description changed	Rev. 1