FCC / IC Test Report

FOR:

Model:
Rufus Cuff

Product Description:
Ruggedized wearable with a 3.2” screen, WiFi/BT connectivity, voice and video calling

FCC ID: 2AKCH-RC0001
IC ID: 22124-RC0001

Applied Rules and Standards:
47 CFR Part 15.247 (DSS)
RSS-247 Issue 1 (FHSs)
RSS-Gen Issue 4

REPORT #: EMC_RUFUS-001-16001_15.247_DSS

DATE: 2016-11-10

A2LA Accredited

IC recognized # 3462B-1

***CETECOM* Inc.**
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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant IC standard RSS-247 Issue 1, and RSS-Gen Issue 4.

No deviations were ascertained.

Company	Description	Model #
Rufus Labs, Inc.	Ruggedized wearable with a 3.2" screen, WiFi/BT connectivity, voice and video calling	RC0001

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2016-11-10	Compliance	Franz Engert (Compliance Manager)	Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Complience, email=franz.engert@cetecom.com

Responsible for the Report:

Date	Section	Name	Signature
2016-11-10	Compliance	Kris Lazarov (EMC Engineer)	Kris Lazarov Digitally signed by Kris Lazarov DN: cn=Kris Lazarov, o, ou, email=kris.lazarov@cetecom.com, c=US

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Compliance Manager:	Franz Engert
Responsible Project Leader:	Kris Lazarov

2.2 Identification of the Client

Applicant's Name:	Rufus Labs, Inc.
Street Address:	8033 Sunset Blvd.
City/Zip Code	Los Angeles, CA 90046
Country	USA
Contact Person:	Trent Oshiro
Phone No.	415-758-0976
e-mail:	toshiro@rufuslabs.com

2.3 Identification of the Manufacturer

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

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No	RC0001
HW Version	Model 12 Rev 4
SW Version	1.0
FCC-ID	2AKCH-RC0001
IC-ID	22124-RC0001
HVIN	RC0001
PMN	Rufus Cuff
Product Description	Ruggedized wearable with a 3.2" screen, WiFi/BT connectivity, voice and video calling
Integrated Module	Model: WL1831MOD / FCC ID: Z64-WL18SBMOD / IC ID: 451I-WL18SBMOD
Frequency Range / number of channels	Nominal band: 2400 MHz to 2483.5 MHz; 79 Channels
Type(s) of Modulation	GFSK; DQPSK; 8DPSK
Modes of Operation	FHSS Bluetooth 3.0 + EDR
Antenna Information as declared	TDK Chip antenna ANT016008, max gain = 2.4dBi
Max. Output Powers	Peak Conducted Power 7dBm
Power Supply/ Rated Operating Voltage Range	3.2 V (min) / 3.7 V (nom) / 4.2 V (max)
Operating Temperature Range	Tmin: 0 ºC / Tmax 85 ºC
Other Radios included in the device	Wi-Fi 802.11b/g/n / Bluetooth 4.0
Sample Revision	☐Prototype Unit ■Production Unit ☐Pre-Production
EUT Dimensions	97.6mm x 64.0mm x 12.5mm
EUT Diameter	■ < 60 cm ☐ Other _____

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	Cuff 1	Model 12 Rev 4	1.0	Radiated Sample

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	AC/DC Adapter	S24A22	Salcomp	16120000425B

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1	

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. and this test report is to support a request for new equipment authorization under the FCC ID: 2AKCH-RC0001 and IC ID: 22124-RC0001

According to the guidelines from FCC KDB 996369 for the product under evaluation, and the pre-certified module to be integrated (WL1831MOD) as described in Section 3, the output power has been verified to be within the specified production tolerances and measurement uncertainties, and where relevant test procedures did not change the conducted test results from module certification are re-used. Full Radiated Spurious Emissions test was conducted according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 Issue 1 of Industry Canada.

The module test data can be obtained under the FCC Filing ID: Z64-WL18SBMOD and IC Filling: 451I-WL18SBMOD.

Testing procedures are based on Public Notice "DA 00-705: March 30, 2000" and ANSI C63.10:2013 for FHSS systems.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(b)(1) RSS-247 5.4(2)	Maximum Peak Conducted Output Power	Nominal	GFSK	■	☐	☐	☐	Complies Note 2; 3
§15.247(d) RSS-247 5.5	Band Edge Compliance	Nominal	GFSK	☐	☐	☐	■	Complies Note 3
§15.247(a)(1) RSS-247 5.1(1)	Spectrum Bandwidth	Nominal	GFSK DQPSK 8DPSK	☐	☐	☐	■	Complies Note 3
§15.247(a)(1) RSS-247 5.1(1)	Carrier Frequency Separation	Nominal	GFSK	☐	☐	☐	■	Complies Note 3
§15.247(a)(1) RSS-247 5.1(4)	Number of Hopping Channels	Nominal	GFSK	☐	☐	☐	■	Complies Note 3
§15.247(a)(1)(iii) RSS-247 5.1(4)	Time of occupancy	Nominal	GFSK	☐	☐	☐	■	Complies Note 3
§15.247(d) §15.209 (a) RSS-Gen 6.13	TX Spurious emissions-Radiated	Nominal	GFSK	■	☐	☐	☐	Complies
§15.207(a) RSS-Gen 8.8	AC Conducted Emissions <30MHz	Nominal	GFSK	■	☐	☐	☐	Complies

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Radiated RF Output Power test intended for power verification on mid channel of applicable frequency band – see section 7.1.
Note 3: Leveraged from module certification.

6 Measurements

6.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)

RF conducted measurement	±0.5 dB

6.2 Environmental Conditions during Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

6.3 Dates of Testing:

10/13/2016

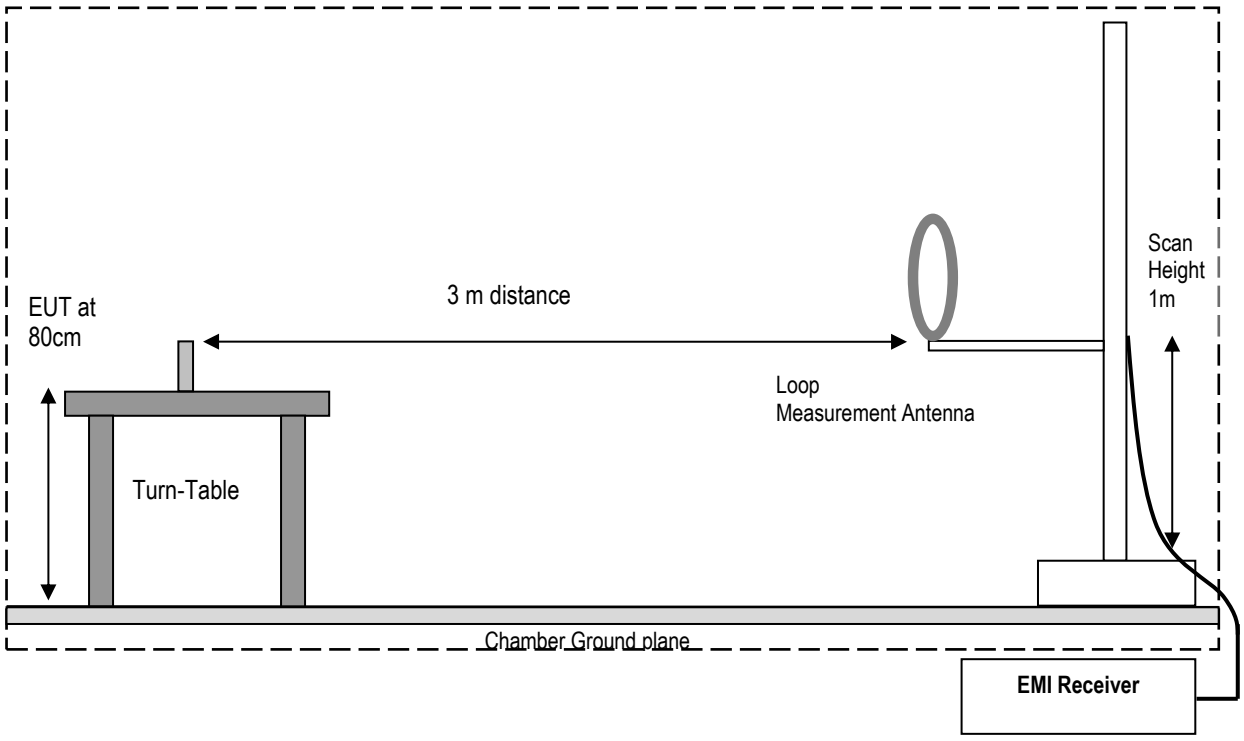
7 Measurement Procedures

7.1 Radiated Measurement

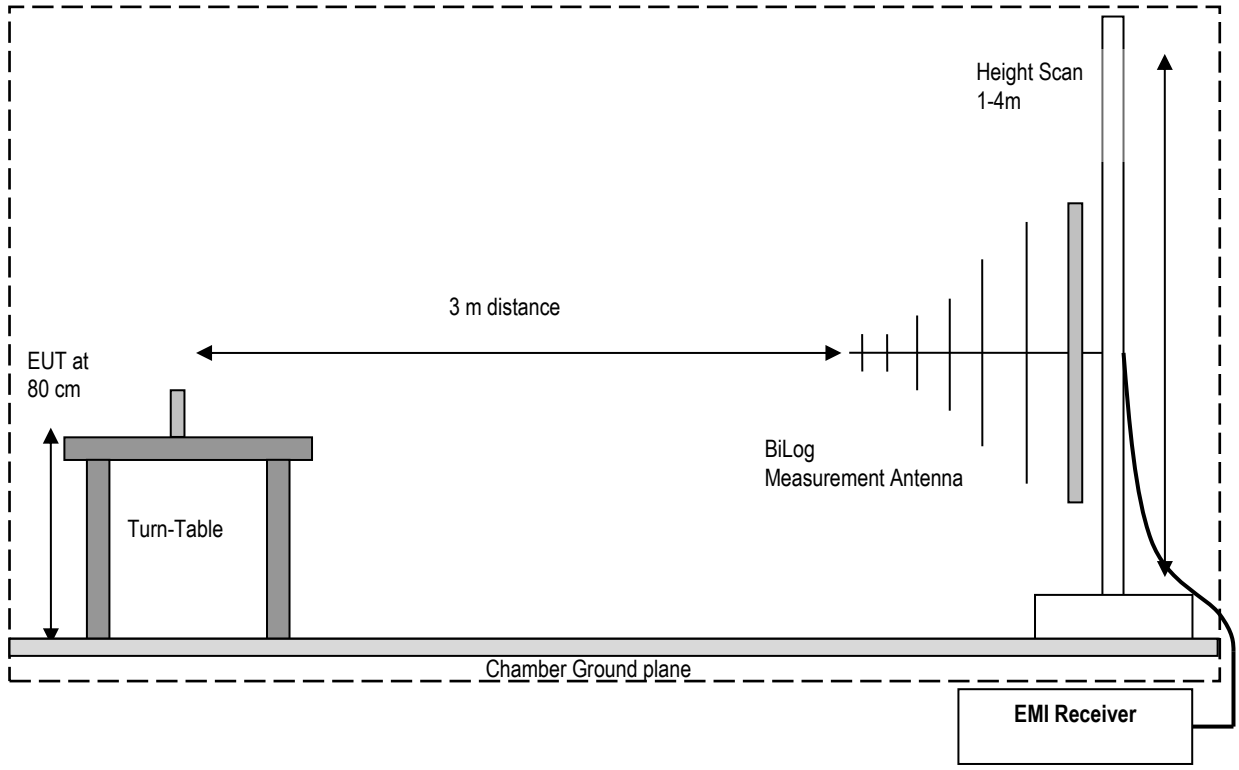
The radiated measurement is performed according to: ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

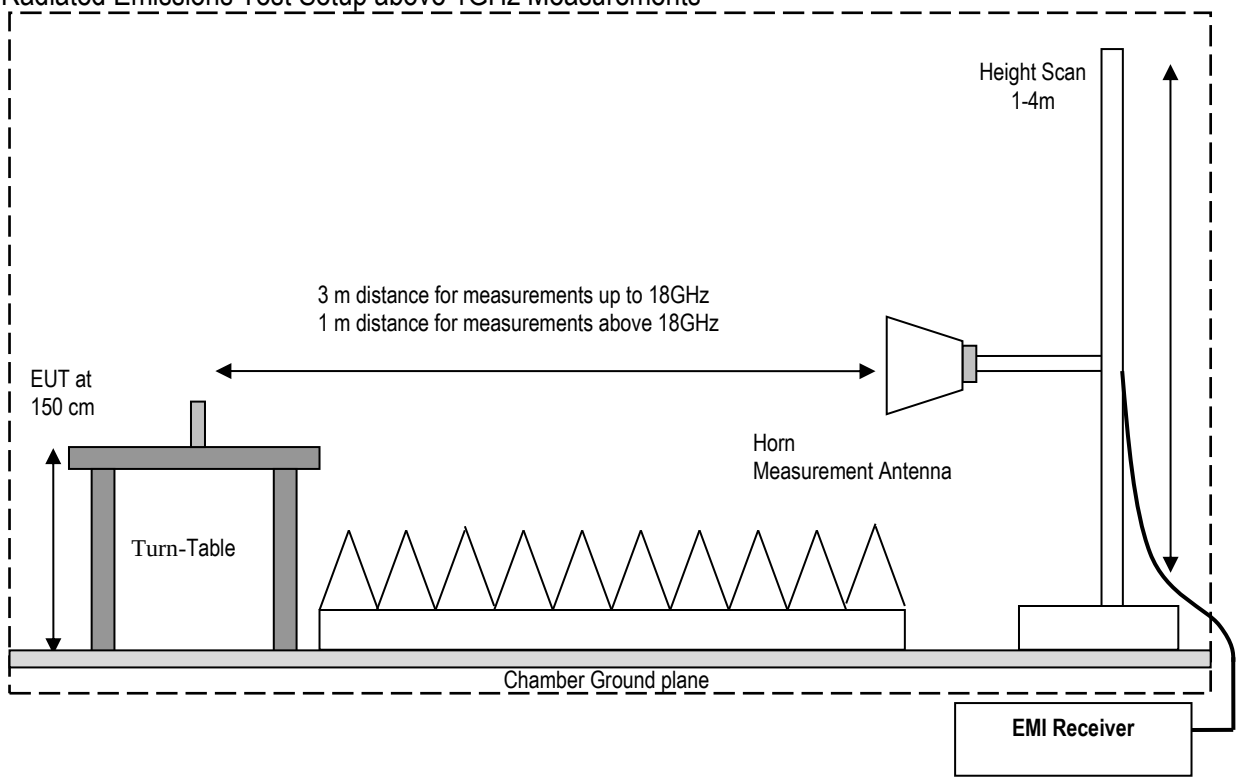
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, 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

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

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

Example:

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

7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.10 (2013)

8 Test Result Data

8.1 Output Power Verification

8.1.1 Mid Channel Radiated Measurement According to ANSI C63.10 (2013) for Power Verification

Spectrum Analyzer settings:

- RBW ≥ OBW
- VBW ≥ 3 × RBW
- Span ≥ 2 × RBW
- Detector = peak
- Trace mode = max hold
- Number of counts = 10000
- Sweep time = auto couple
- Allow trace to fully stabilize. Use the peak marker function to determine the peak amplitude level

8.1.2 Limits:

FCC §15.247 (b)(1)

- For frequency hopping systems employing less than 75 non-overlapping hopping channels in the 2400-2483.5 MHz band: 0.125 W (20.99dBm)

RSS-247 5.4(2)

- For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 0.125 W (20.99dBm) and the e.i.r.p. shall not exceed 0.5 W (26.99dBm) if the hopset uses less than 75 hopping channels

8.1.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain (dBi)
22° C	1	GFSK	120V AC	2.4

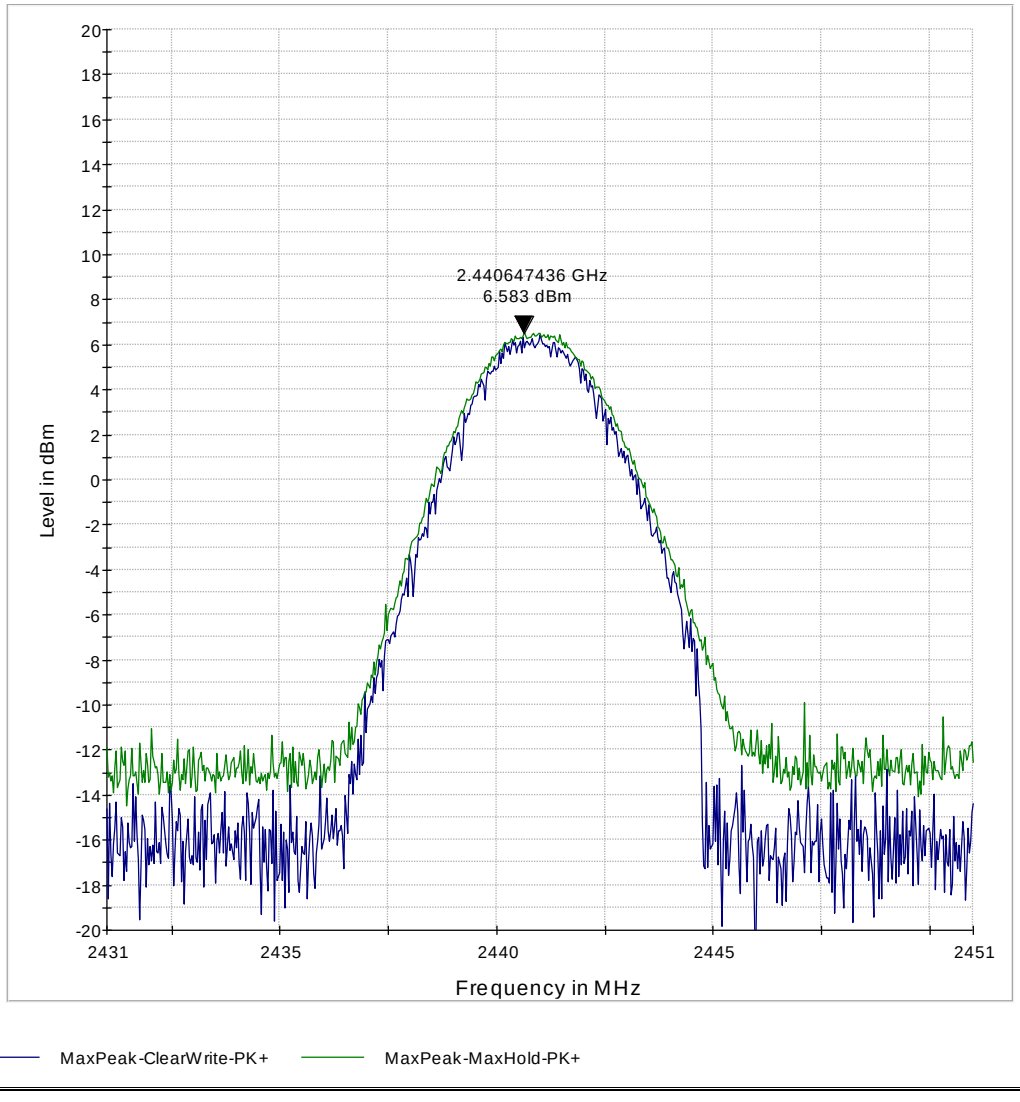
8.1.4 Measurement result:

Plot #	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Result
1	2440	6.58	20.99(Pk) / 26.99(EIRP)	Pass

8.1.5 Measurement Plots:

Plot #1

2440 MHz | **Modulation/Packet Type:** Bluetooth LE



8.2 Radiated Transmitter Spurious Emissions

8.2.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW=120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW= 1MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.2.2 Limits:

FCC §15.247

- 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)).

FCC §15.209 & RSS-Gen 8.9

- 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 of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

- 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	Above 38.6
13.36-13.41			

- 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

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input	Antenna Gain (dBi)
23° C	1	GFSK	120V AC	2.4

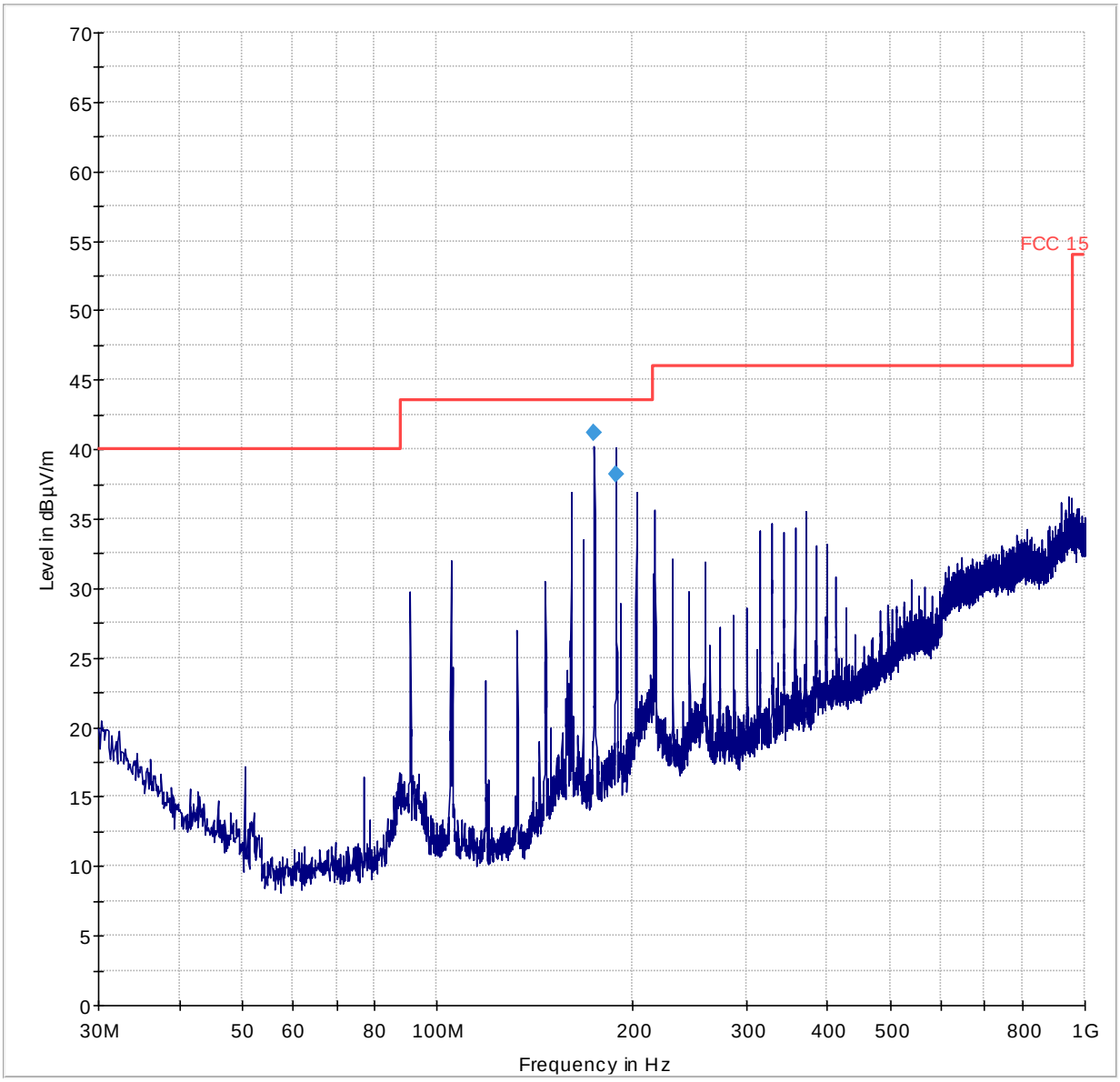
8.2.4 Measurement result:

Plot #	Channel #	Scan Frequency	Limit	Result
1-3	Low	30 MHz – 18 GHz	See section 8.2.2	Pass
4-8	Mid	9 kHz – 26 GHz	See section 8.2.2	Pass
9-11	High	30 MHz – 18 GHz	See section 8.2.2	Pass

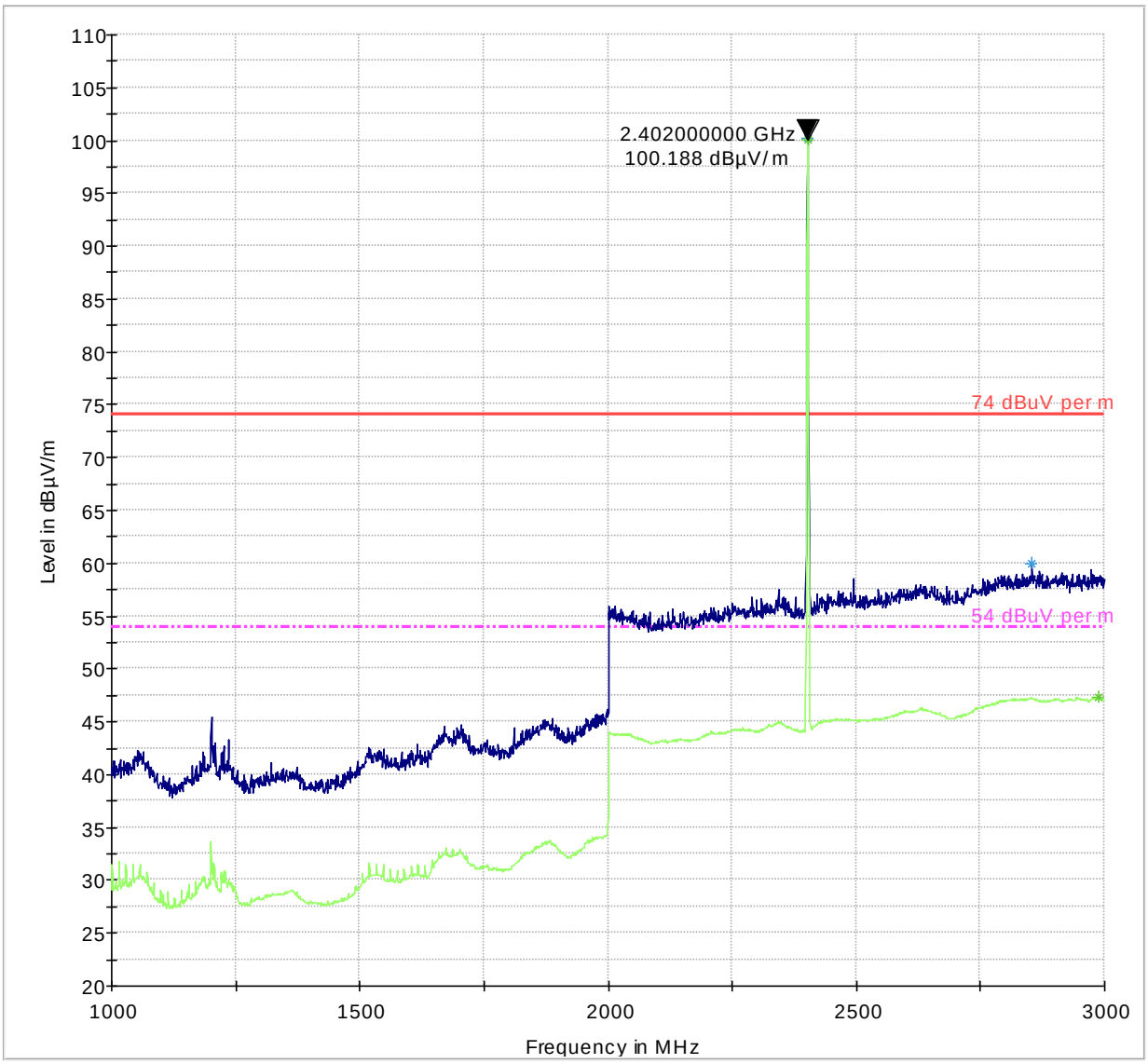
8.2.5 Measurement Plots:

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

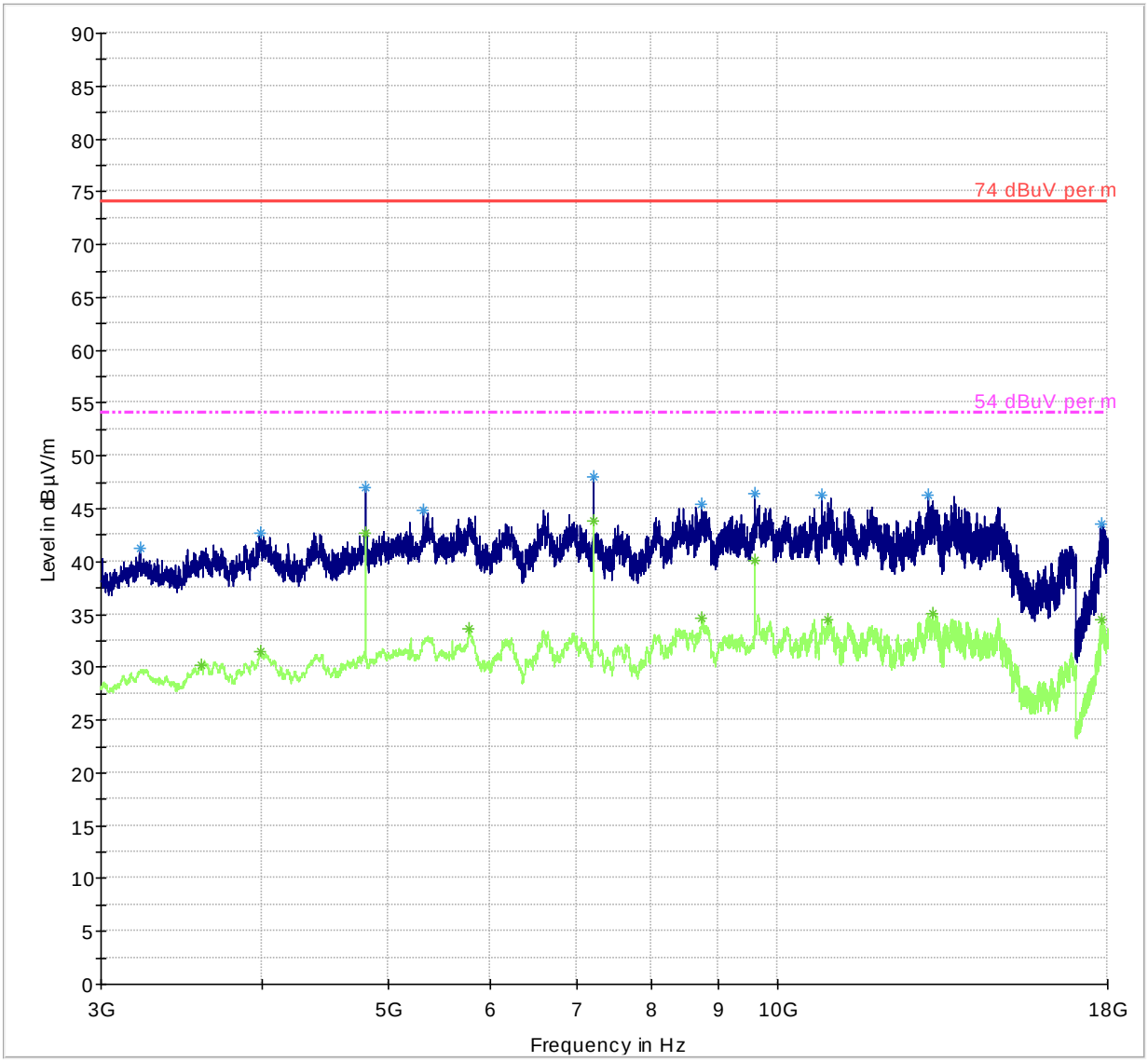
Plot #1 Radiated Emissions: 30 MHz – 1GHz	
Modulation: GFSK	**Channel: Low**



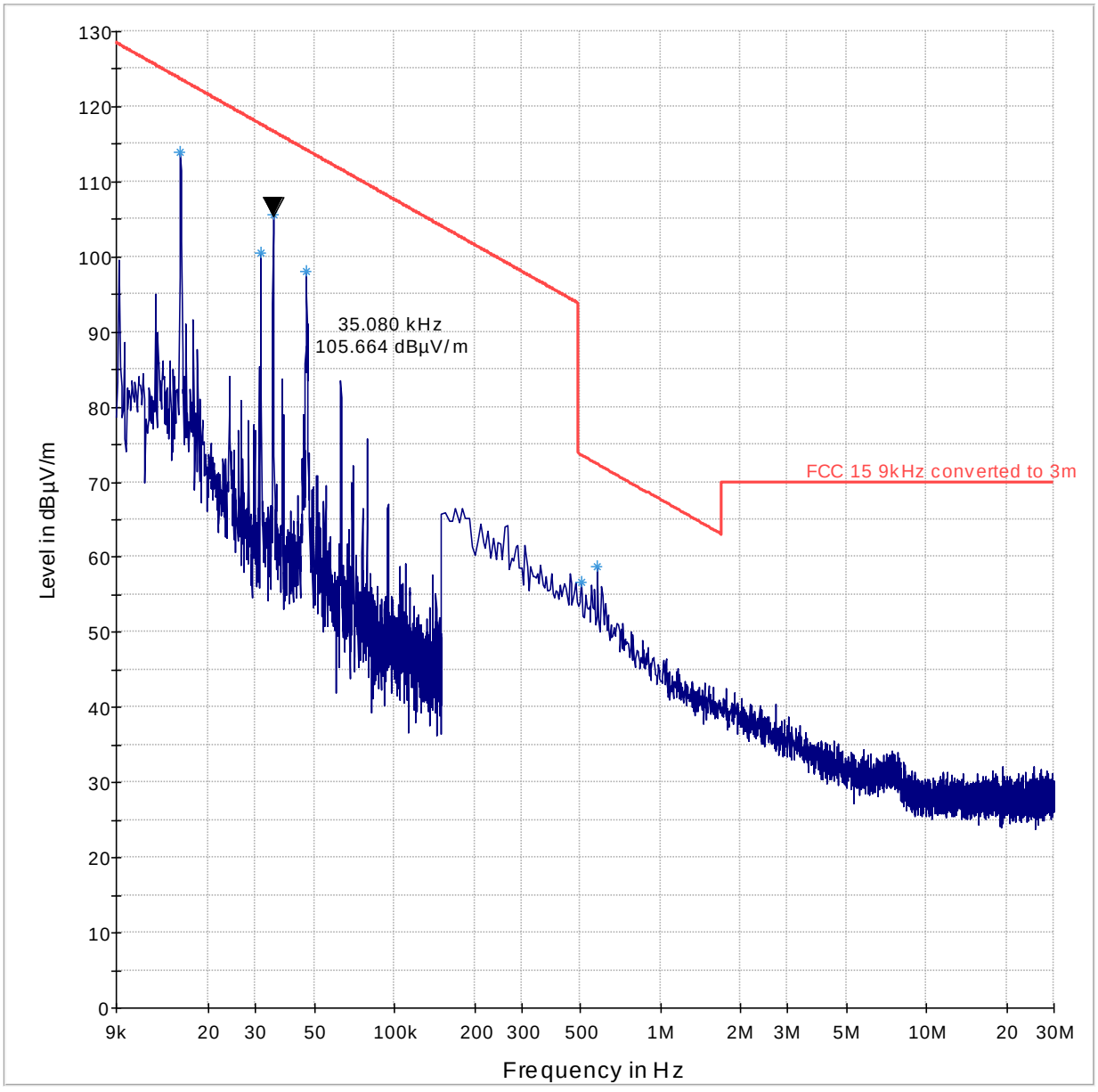
Plot # 2 Radiated Emissions: 1-3 GHz	
Modulation: GFSK	**Channel: Low**



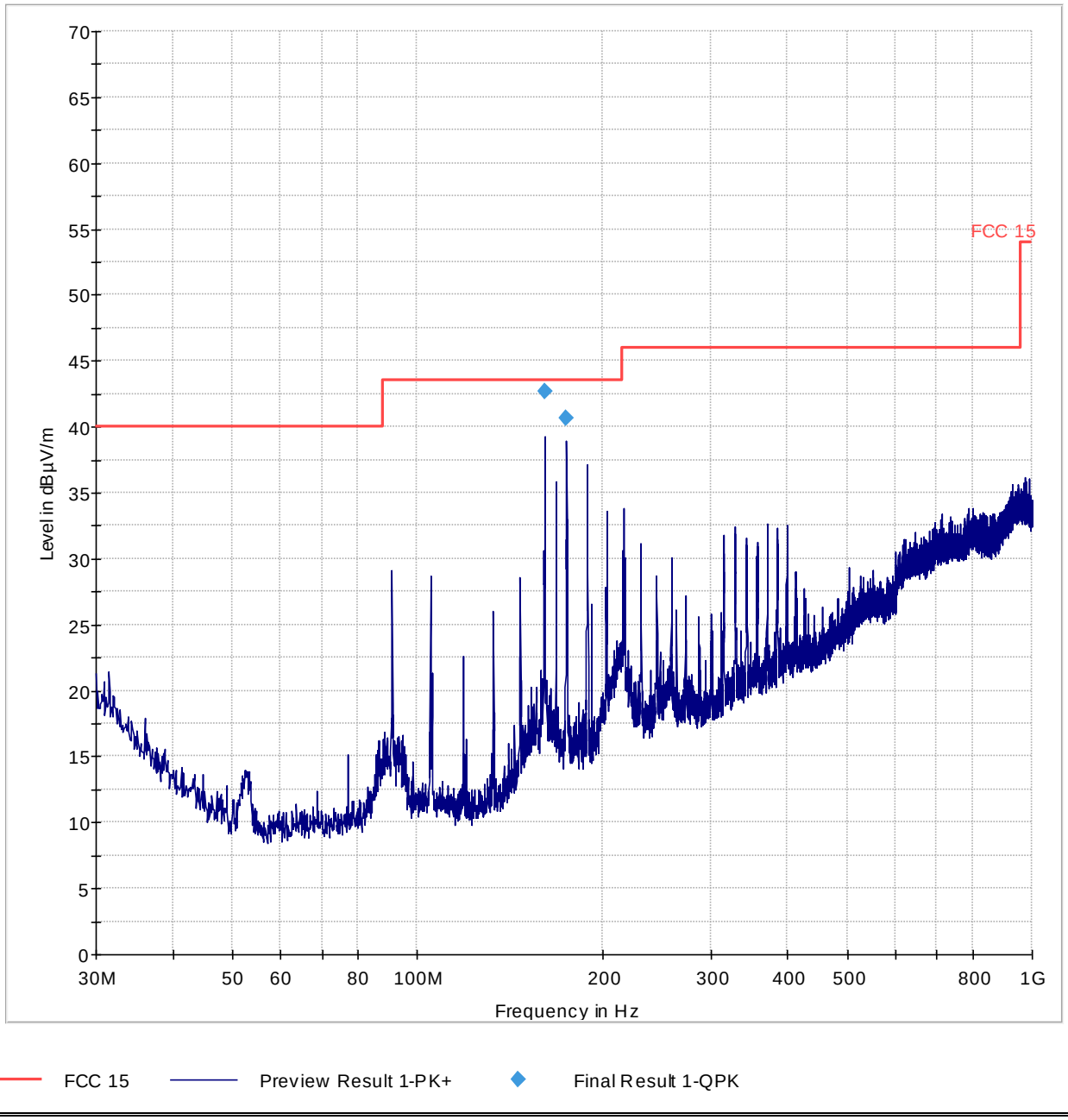
Plot # 3 Radiated Emissions: 3-18 GHz	
Modulation: GFSK	**Channel: Low**



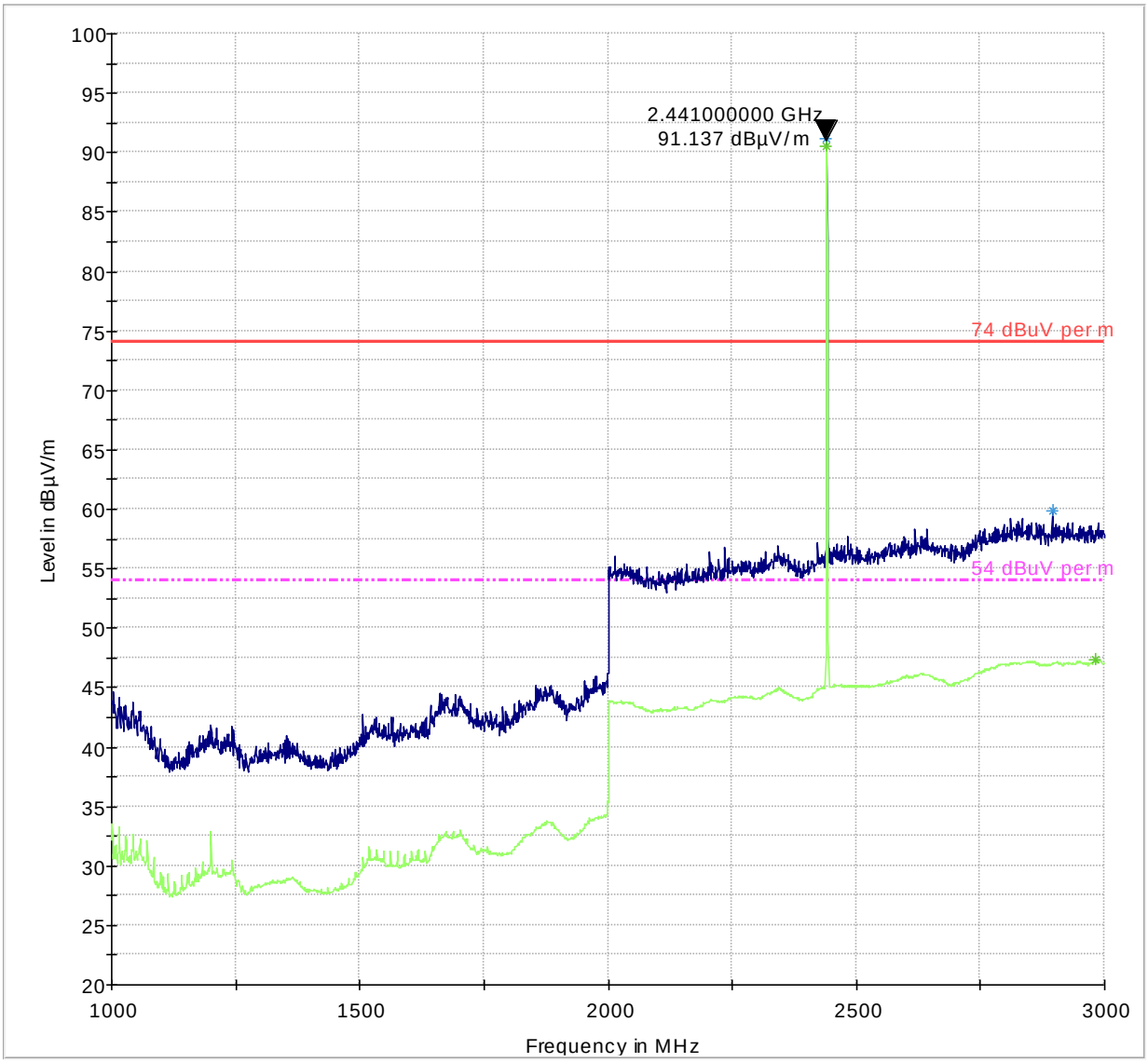
Plot # 4 Radiated Emissions: 9 KHz - 30 MHz	
Modulation: GFSK	**Channel: Mid**



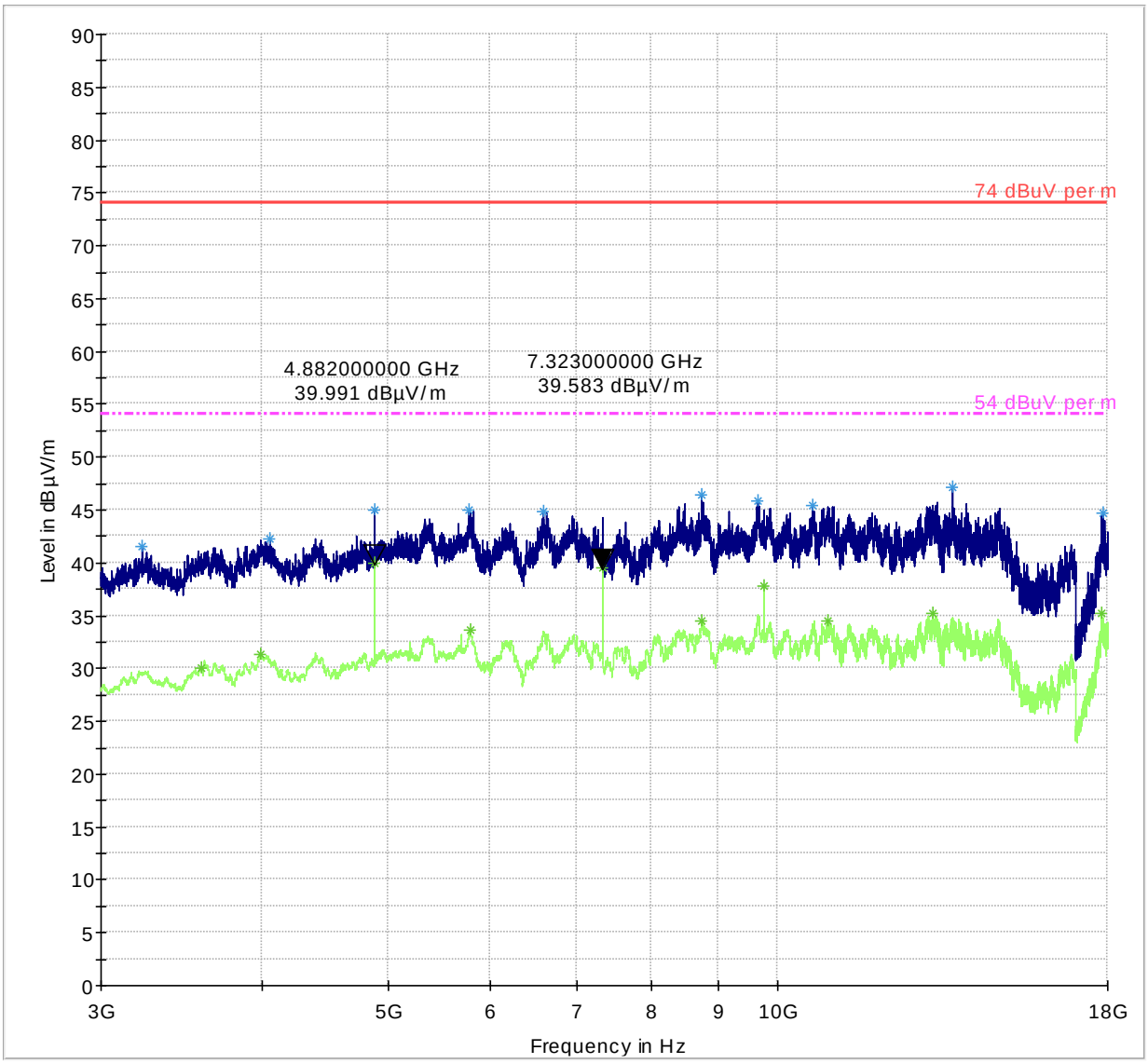
Plot #5 Radiated Emissions: 30 MHz – 1GHz	
Modulation: GFSK	**Channel: Mid**



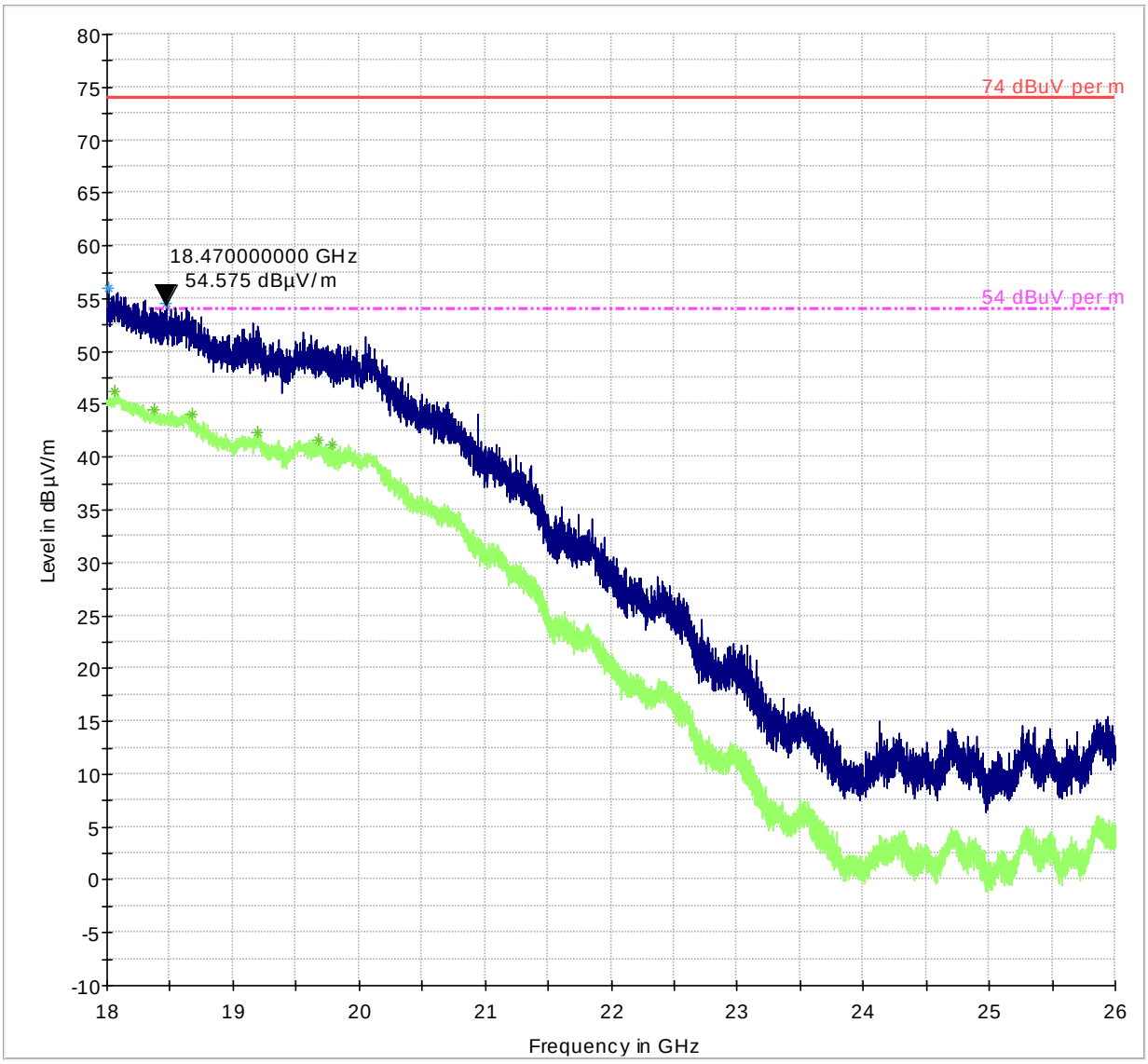
Plot #6 Radiated Emissions: 1-3 GHz	
Modulation: GFSK	**Channel: Mid**



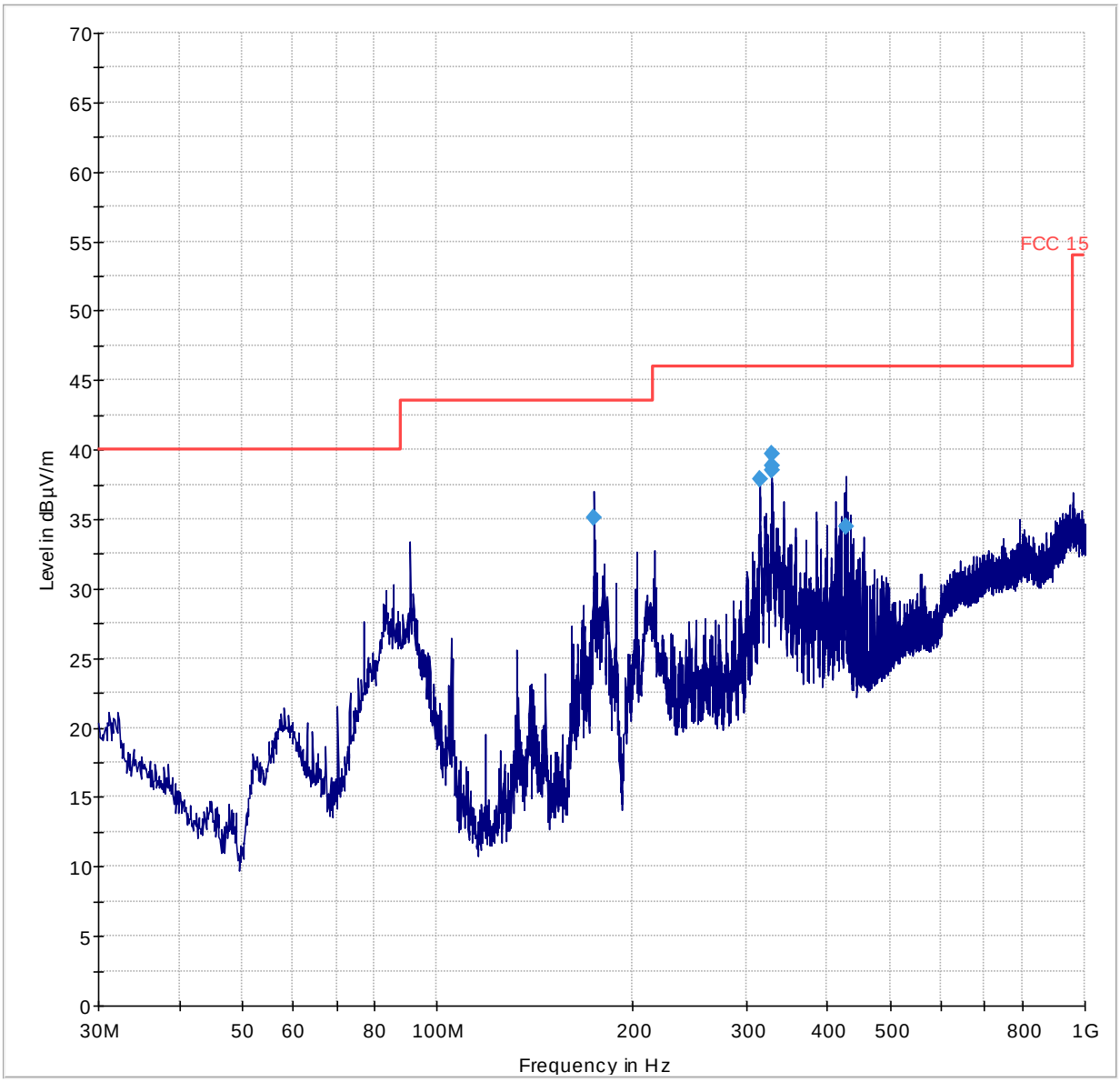
Plot #7 Radiated Emissions: 3-18 GHz	
Modulation: GFSK	**Channel: Mid**



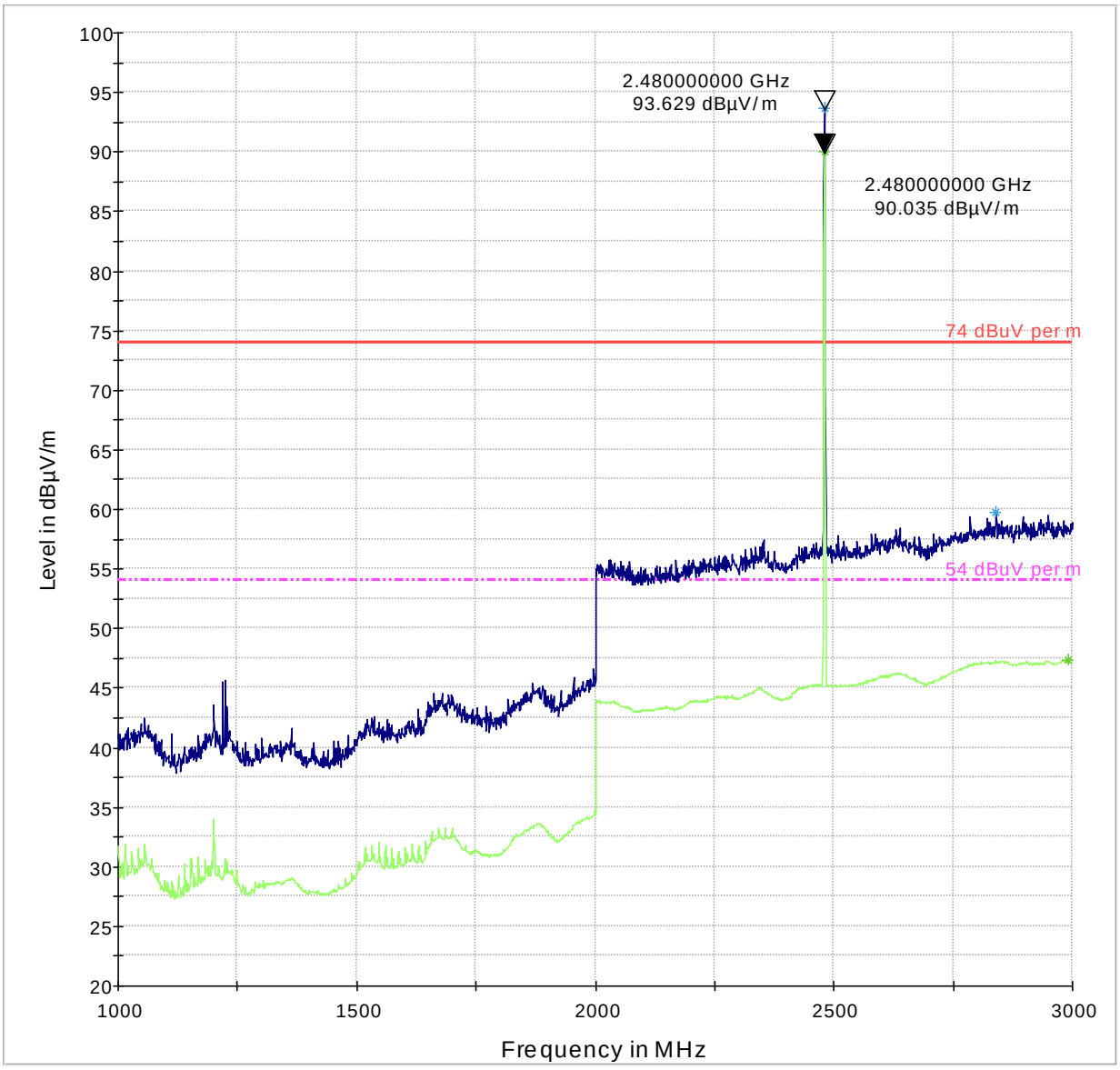
Plot #8 Radiated Emissions: 18-26 GHz	
Modulation: GFSK	**Channel: Mid**



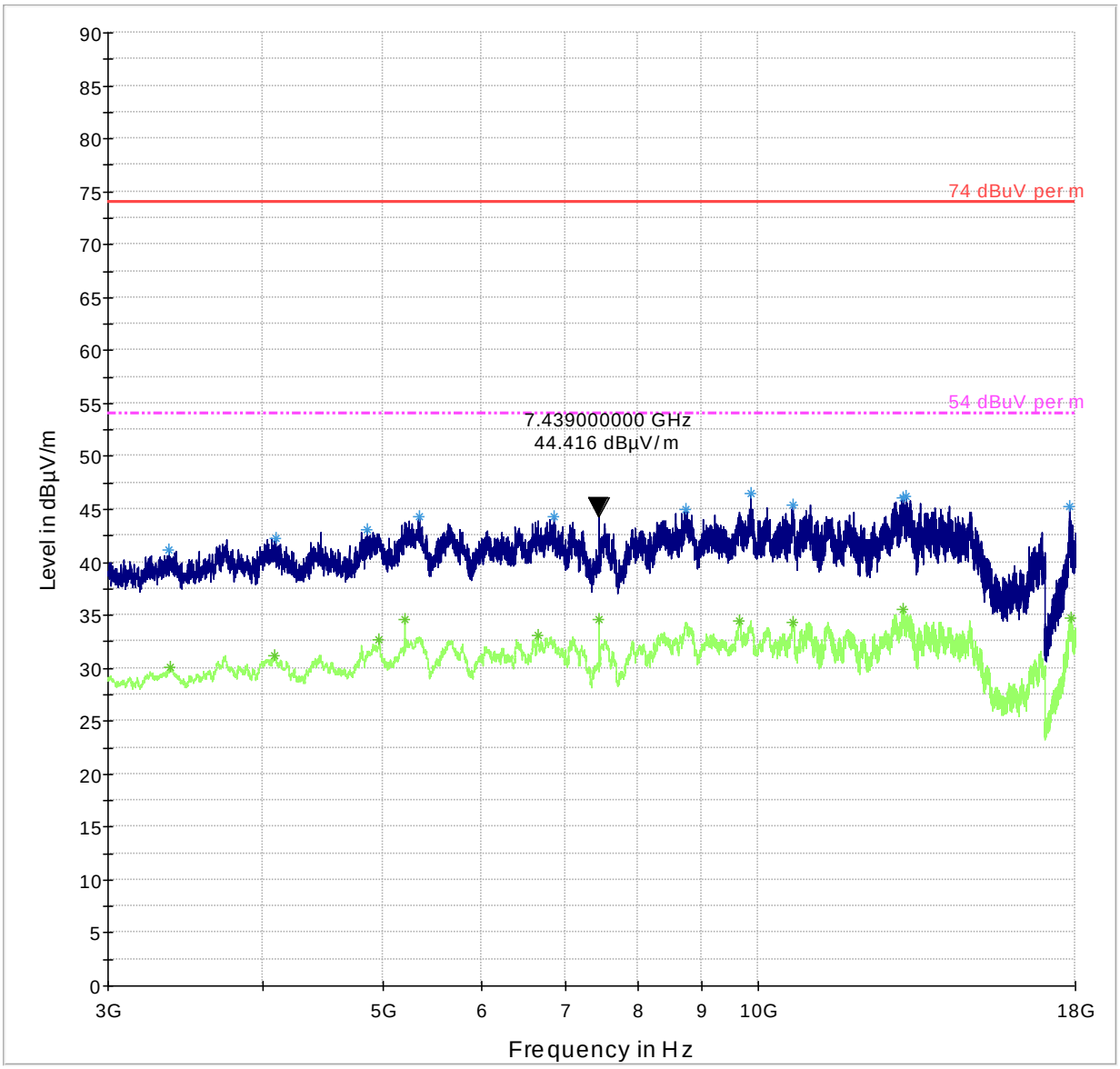
Plot #9 Radiated Emissions: 30 MHz – 1GHz	
Modulation: GFSK	**Channel: High**



Plot # 10 Radiated Emissions: 1-3 GHz and Restricted Bands	
Modulation: GFSK	**Channel: High**



Plot #11 Radiated Emissions: 3-18 GHz	
Modulation: GFSK	**Channel: High**



8.3 AC Power Line Conducted Emissions

8.3.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Detector: Peak / Average for Pre-scan
- Quasi-Peak/Average for Final Measurements

8.3.2 Limits:

FCC §15.207(a) & RSS-Gen 8.8

- 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 frequency ranges.

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.

8.3.3 Test conditions and setup:

Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power line (L1, L2, L3, N)	Power Input
22	1	GFSK	Line & Neutral	110V / 60Hz

8.3.4 Measurement Result:

Plot #	Port	EUT Set-Up #	EUT operating mode	Scan Frequency	Limit	Result
1	AC Mains	1	GFSK	150 kHz – 30 MHz	See section 8.3.2	Pass

8.3.5 Measurement Plots:

Plot # 1

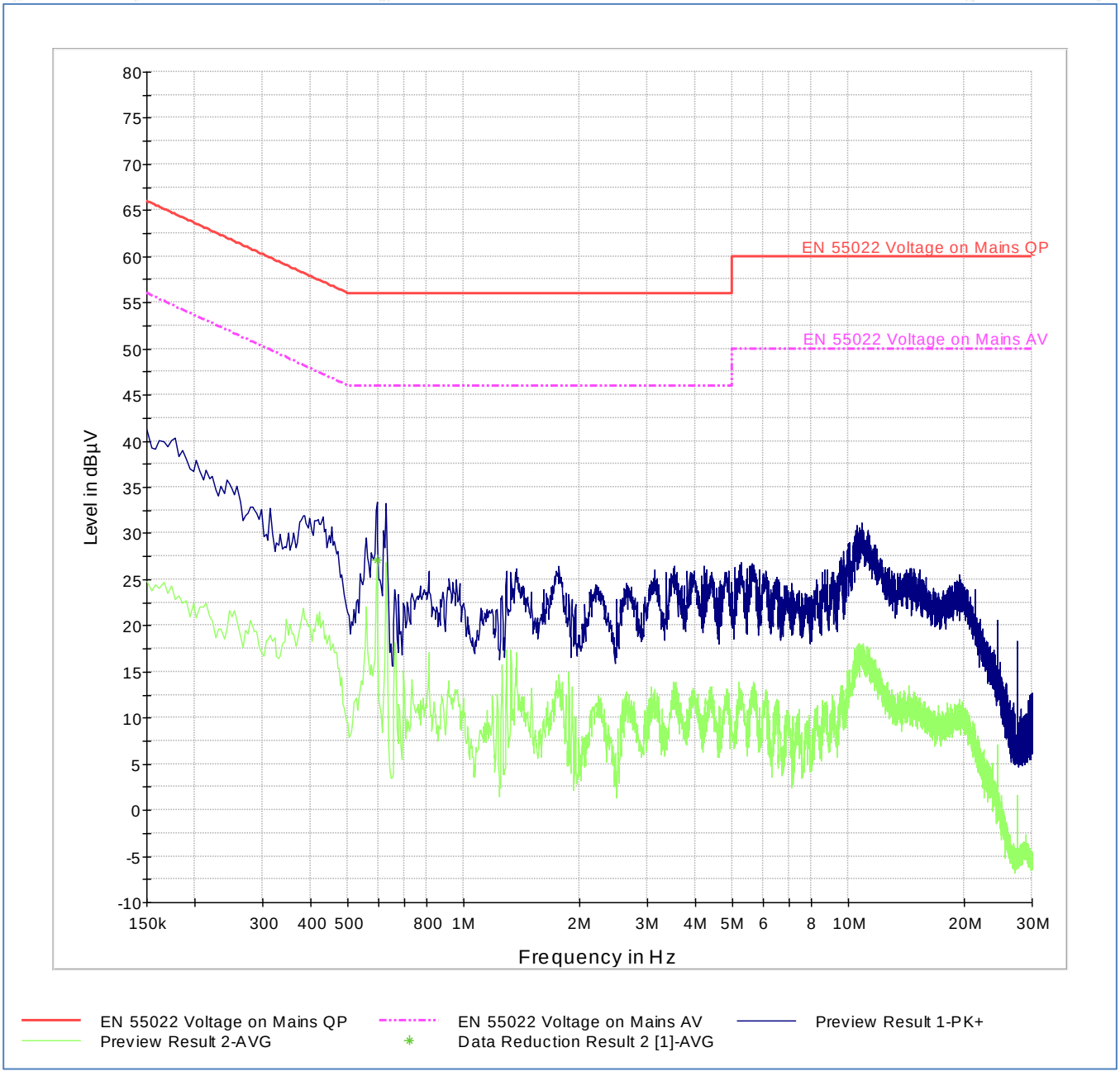
Quasipeak Measurement Final Result

No emissions above the -20dB margin were evaluated

Average Measurement Final Result

No emissions above the -20dB margin were evaluated

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



Test Date:11/10/2016 6:35:27 Test Engineer:SMoon

9 Test setup photos

Setup photos are included in supporting file name: "EMC_RUFUS-001-16001_15.247 _Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Biconilog 3142E	Biconlog Antenna	EMCO	3142E	166067	3 years	6/14/2014
Antenna Loop 6512	Loop Antenna	ETS Lindgren	6512	49838	3 years	3/13/2014
Antenna Horn 3115 SN 35111	Horn Antenna	EMCO	3115	35111	3 years	7/24/2015
Antenna Horn 3116	Horn Antenna	ETS Lindgren	3116	70497	3 years	7/22/2015
Digital Barometer	Compact Digital Barometer	Control Company	35519-055	91119547	2 Years	4/7/2015
FSU26	Spectrum Analyzer	R&S	FSU26	200302	3 years	7/4/2015
Thermometer Humidity TM320	Thermometer Humidity	Dickson	AY1072	0528	1 Year	11/04/2016

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.

11 Revision History

Date	Report Name	Changes to report	Report prepared by
2016-11-10	EMC_RUFUS-001-16001_15.247_DSS	Initial Version	Kris Lazarov