Bluetooth 4.0 (Low Energy)

FCC / IC Test Report

FOR:

Intel Corporation

Model Name: EP110

Product Description: Intel 4.7-inch Smartphone with GSM, GPRS, EDGE, UMTS, HSPA+, LTE, Wi-Fi, BT and GPS radios

FCC ID: O2Z-EP110
IC ID: 1000W – EP110

47 CFR Part 15.247 (DTS)

RSS-210 Issue 8 Annex 8

TEST REPORT #: EMC_INTEL_054_14001_15.247_BTLE_rev3
DATE: 2014-12-15

Bluetooth Qualification Test Facility (BQTF)

FCC listed
A2LA Accredited

IC recognized # 3462E-1

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1 Assessment

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

Company	Description	Model #
Intel Corporation	Intel 4.7-inch Smartphone with GSM,GPRS,EDGE,UMTS,HSPA+,LTE, Wi-Fi, BT and GPS radios	EP110

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2014-12-15	Compliance	Milton Deleon (Lab Manager)	Milton Ponce de Leon Digitally signed by Milton Ponce de Leon DN: cn=Milton Ponce de Leon, c=US, o=Cetecom Inc., ou=OTA, email=milton.deleon@cetecom.com Date: 2014.12.15 15:50:33 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2014-12-15	Compliance	Muhammad Umair Anees (EMC Engineer)	Muhammad Umair Anees Digitally signed by Muhammad Umair Anees DN: cn=Muhammad Umair Anees, c=US, o=EMC, ou=Compliance, email=Muhammad.Anees@cetecom.com Date: 2014.12.15 15:45:13 -08'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

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Compliance Manager:	Franz Engert
Responsible Project Leader:	Muhammad Umair Anees

2.2 Identification of the Client

Applicant's Name:	Intel Corporation
Street Address:	2200 Mission College MS:SC1-20
City/Zip Code	Santa Clara / 95054
Country	USA
Contact Person:	Christine Ryan
Phone No.	408 300 2167
Fax:	408-765-2336
e-mail:	Christine.m.ryan@intel.com

2.3 Identification of the Manufacturer

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

2.1 Testing Period:

07/18/2014 -08/20/2014

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	Intel 4.7-inch Smartphone / EP110
HW / SW Revision :	PR2 / 4.4.4 KTU84P main engineering 53181-dev-keys
FCC-ID / IC-ID:	O2Z-EP110 / 1000W- EP110
Product Description:	Intel 4.7-inch Smartphone with GSM,GPRS,EDGE,UMTS,HSPA+,LTE, Wi-Fi, BT and GPS radios
Technology / Type(s) of Modulation:	Bluetooth v4.0, LE, using FHSS with GFSK
Operating Frequency Ranges (MHz) / Channels:	Nominal band: 2400 – 2483.5; Center to center: 2402(ch 0) – 2480(ch 39), 40 channels
Antenna info:	Internal Monopole Documented max antenna gain(2.4GHz) = -3.7dBi
Max. Output Power:	Peak Conducted: 6.55dBm (4.5 mW)
Rated Operating Voltage Range / Power Supply:	Rechargeable lithium-ion battery Vmin: 3.6V/ Vnom: 3.8V/ Vmax: 4.2V
Rated Operating Temperature Range:	-10ºC to +55ºC
Other Radios included in the device:	Intel XMM 7260 Radio Module • GSM 850/900/1800/1900MHz GPRS / EDGE Multi-slot class 33 operation • WCDMA / HSPA+ 850/900/1700/1900/2100 MHz • LTE 700/800/850/900/1700/1800/1900/2100/2600 Wi-Fi (2.4 GHz and 5GHz), BT Basic/EDR (2.4 GHz), BTLE(BCM4339) GPS 1575.42 MHz
EUT status	Prototype

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	INV141400717	PR2	4.4.4 KTU84P main engineering 53181-dev-keys	Radiated and Conducted RF Sample
2	INV141401015	PR2	4.4.4 KTU84P main engineering 53181-dev-keys	AC Conducted Sample

3.3 Identification of Accessory equipment

STE #	Type	Manufacturer	Model	Serial Number
1	AC/DC Adapter	Salcomp	SC1402	1309500144736

3.4 Test mode of operation:

Mode	Data rate (Mbps)	Modulation scheme
802.15 BTLE	1.0	GFSK

4 Subject Of Investigation

The objective of the measurements applied by CETECOM Inc. was to establish compliance of the EUT as described under Ch. 3 of this Test Report, with the applicable criteria specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-210 Issue 8, Annex 8 of Industry Canada.

This test report is to support a request for new equipment authorization under the FCC ID **O2Z-EP110** and IC ID **1000-EP110.**

During the testing process the EUT was tested on low, mid and high channels for all the supported modes of operation.

A Bluetooth test tool provided by the manufacturer was used to set different channels and test modes. This test tool allows for constant transmit and receive modes for Bluetooth EDR and Bluetooth LE radio testing. The test tool was downloaded on local PC and test commands were run locally. All test commands and scripts were provided by the manufacturer.

For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e) RSS-210 A8.2(b)	Power Spectral Density	Nominal	802.15 (LE)	■	☐	☐	☐	Complies
§15.247(a)(1) RSS-210 A8.2(a)	Emission Bandwidth	Nominal	802.15 (LE)	■	☐	☐	☐	Complies
§15.247(b)(1) RSS-210 A8.4(4)	Maximum Peak Conducted Output Power and EIRP	Nominal	802.15 (LE)	■	☐	☐	☐	Complies
§15.247(d) RSS-210 A8.5	Band edge compliance	Nominal	802.15 (LE)	■	☐	☐	☐	Complies
§15.247(d) §15.209 RSS-210 A8.5	TX Spurious emissions-Conducted	Nominal	802.15 (LE)	☐	☐	☐	■	1
§15.247(d) §15.209 RSS-210 A8.5 RSS-Gen 8.9	TX Spurious emissions-Radiated	Nominal	802.15 (LE)	■	☐	☐	☐	Complies
§15.207(a) RSS-Gen 8.8	AC Conducted Emissions	Nominal	802.15 (LE)	■	☐	☐	☐	Complies

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

1. Conducted spurious emissions test against non-restricted band limits is NOT PERFORMED since radiated spurious emissions against more stringent restricted band limits over the complete measurement range (9kHz to 26GHz) is passed.

6 Measurements

6.1 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.

Radiated Measurement Uncertainty: ±3dB

6.1.1 Sample Calculations for Radiated Measurements

Measurements from the Spectrum Analyzer/ Receiver are 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.

6.2 Conducted Emissions Procedure

ANSI C63.10 (2009) Section 6.2.5: Final AC Power-Line Conducted Emission Measurements

Based on the exploratory tests of the EUT performed in 6.2.4, the one EUT cable configuration and arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is selected for the final measurement, while applying the appropriate modulating signal to the EUT. If the EUT is relocated from an exploratory test site to a final test site, the highest emissions shall be remaximized at the final test location before final ac power-line conducted emission measurements are performed. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) is then performed for the full frequency range for which the EUT is being tested for compliance without further variation of the EUT arrangement, cable positions, or EUT mode of operation. If the EUT is comprised of equipment units that have their own separate ac power connections, e.g., floor-standing equipment with independent power cords for each shelf that are able to connect directly to the ac power network, each current-carrying conductor of one unit is measured while the other units are connected to a second (or more) LISN(s). All units shall be separately measured. If a power strip is provided by the manufacturer, to supply all of the units making up the EUT, only the conductors in the power cord of the power strip shall be measured.

If the EUT uses a detachable antenna, these measurements shall be made with a suitable dummy load connected to the antenna output terminals; otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended. When measuring the ac conducted emissions from a device that operates between 150 kHz and 30 MHz a non-detachable antenna may be replaced with a dummy load for the measurements within the fundamental emission band of the transmitter, but only for those measurements.

Record the six highest EUT emissions relative to the limit of each of the current-carrying conductors of the power cords of the equipment that comprises the EUT over the frequency range specified by the procuring or regulatory agency. Diagram or photograph the test setup that was used. See Clause 8 for full reporting requirements.

Section 6.2.5: Measurement requirements

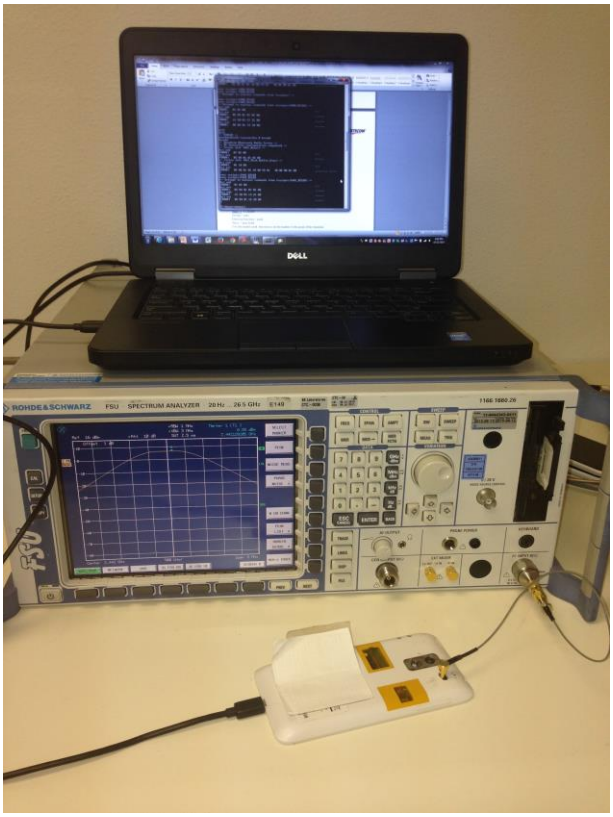
The LISN housing, measuring instrument case, reference ground plane, vertical conducting plane, if used, shall be bonded together.

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument, or where permitted or required, the emission currents on the power line sensed by a current probe. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer, and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements, using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having a 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Measurement Uncertainty: ±3.0dB

6.3 RF Conducted Measurement Procedure

Measurement is according to FCC KDB 558074 D01 DTS Measurement Guidance v03r02. Test setup is shown below.



1. Connect the EUT to a PC equipped with Bluetooth test tool through USB cable.
2. Connect the EUT conducted port for Bluetooth/WIFI to the input of the spectrum analyzer as shown in the test setup above.
3. Enter test commands to set a specific Bluetooth test channel and verify on the spectrum analyzer.
4. Measurements are to be performed with the EUT set to the low, middle and high channels.

Measurement Uncertainty: ±0.5dB

6.4 Maximum Peak Conducted Output Power and EIRP

6.4.1 Limits:

Maximum Peak Conducted Output Power:
FCC §15.247 (b)(1): 1W
IC RSS-210 issue 8, annex 8.4(2): 1W
EIRP:
IC RSS-210 issue 8, annex 8.4(2): 4W

6.4.2 Test Conditions:

Tnom: 21°C; Vnom: 3.8V

6.4.3 Test Procedure

Measurement according to 558074 D01 DTS Measurement Guidance v03r02 sections 9.1.1

Peak Conducted Output Power
RBW ≥ DTS bandwidth of the emission being measured
VBW ≥ 3x RBW
Span ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold
Use the marker-peak function to set the marker to the peak of the emission.

6.4.4 Test Data

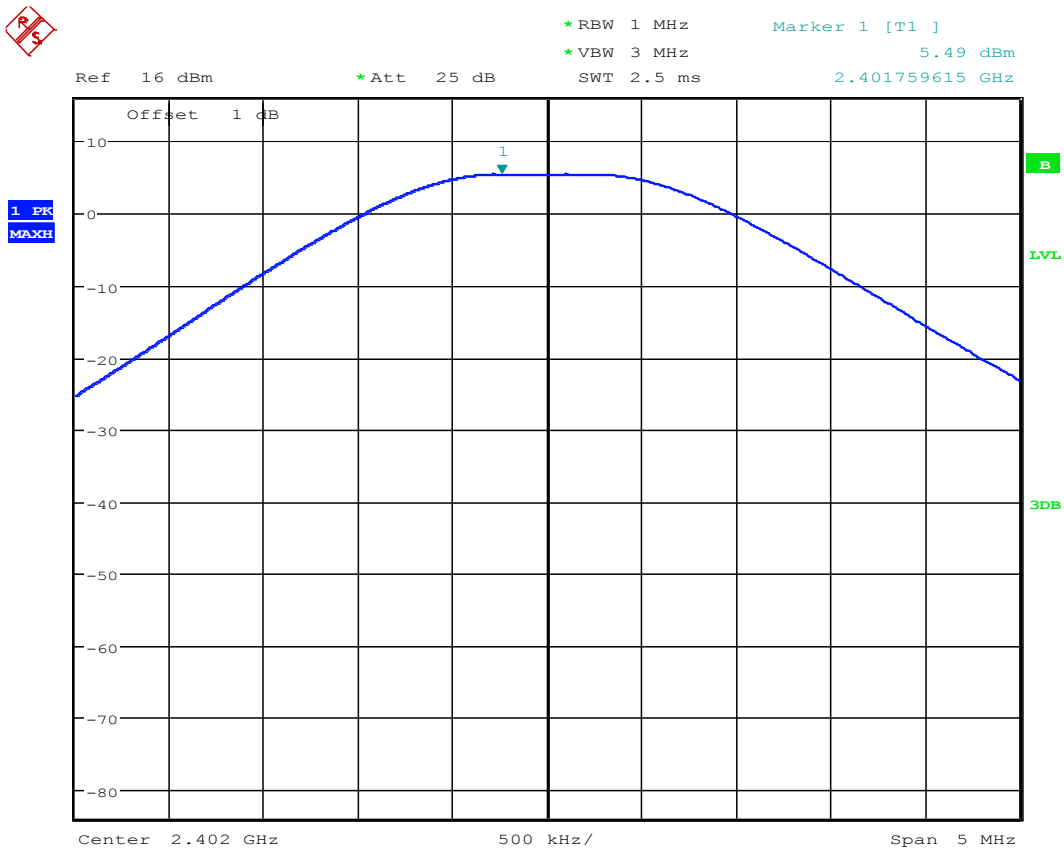
Maximum Peak Conducted Output Power (dBm) in 802.15 (BTLE)		
2402 Channel 0	**2442 Channel 18**	**2480 Channel 39**
5.49	6.55	5.65

Declared Antenna Gain in the 2.4GHz band: -3.7 dBi.

6.4.5 Measurement Result

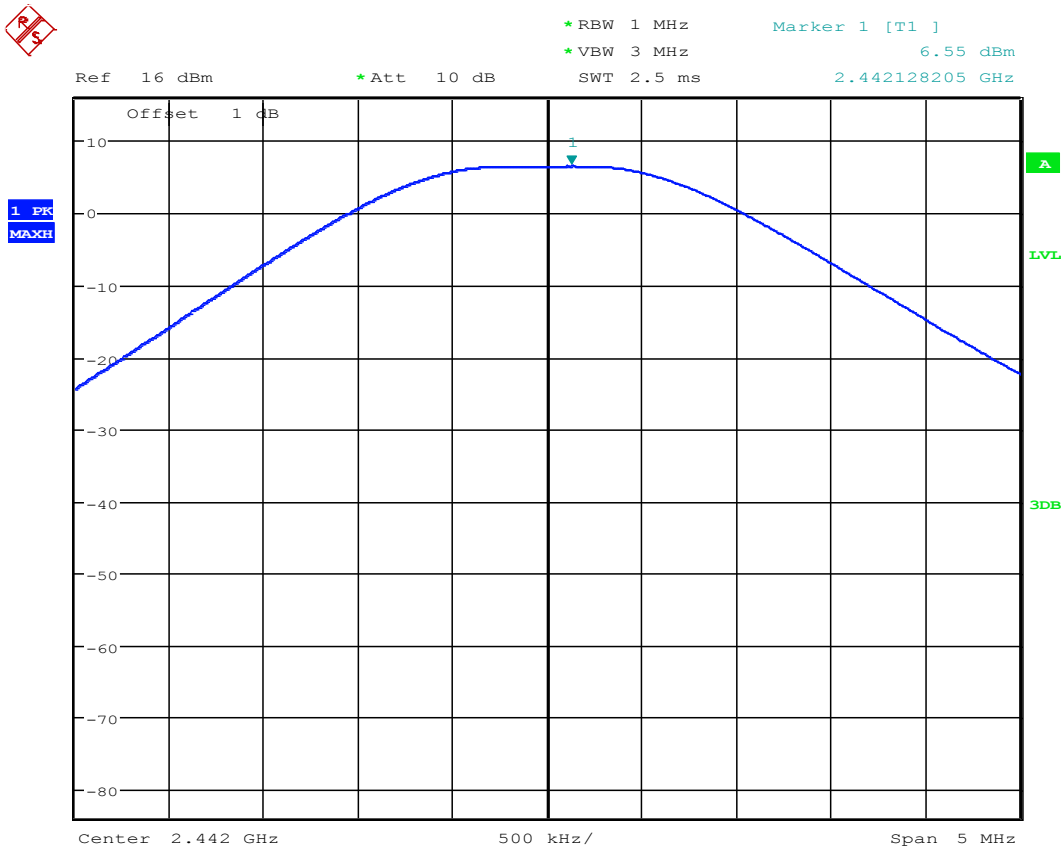
Pass.

6.4.6 Conducted Peak Power -Ch Low (2402 MHz)- GFSK (BTLE)



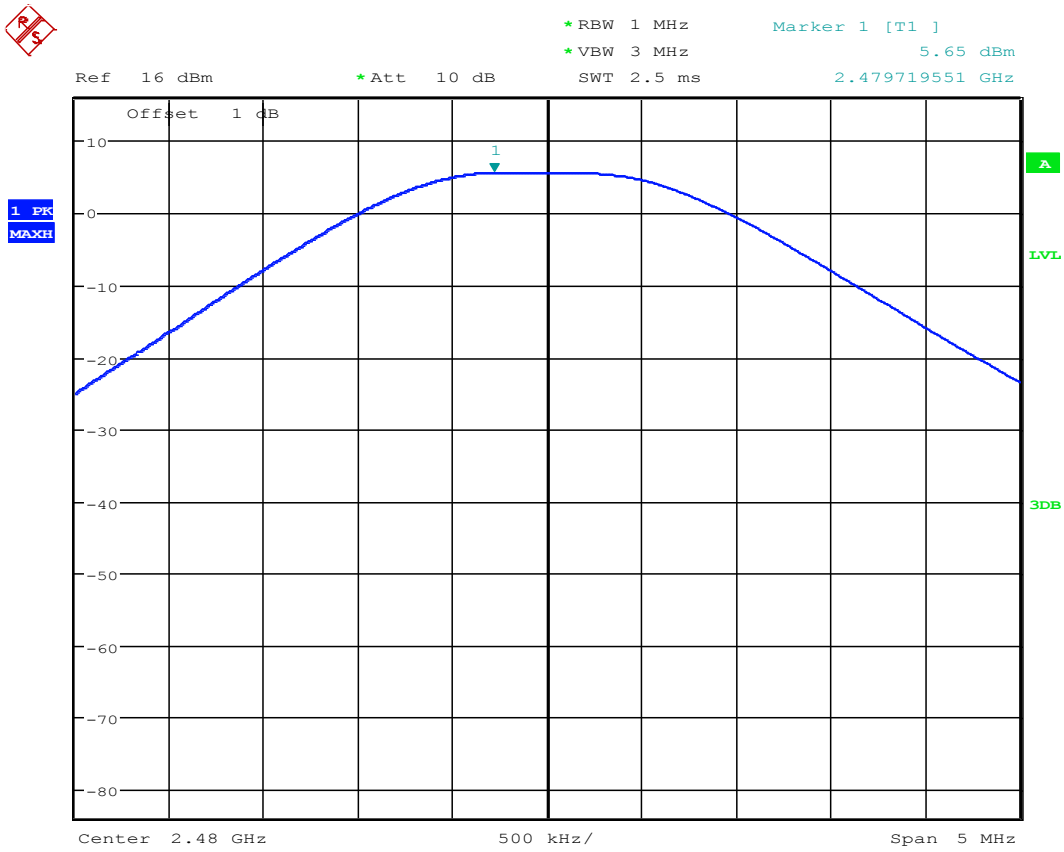
Date: 15.OCT.2014 14:15:03

6.4.7 Conducted Peak Power –Ch Mid (2442 MHz)- GFSK (BTLE)



Date: 21.OCT.2014 14:26:31

6.4.8 Conducted Peak Power –Ch High (2480 MHz)- GFSK (BTLE)



Date: 21.OCT.2014 14:10:52

6.5 Band Edge Compliance – at restricted and non-restricted band edges

6.5.1 Limits:

§15.209/15.205/15.247 (d) & RSS-Gen 7.2.2/ 7.2.5, RSS-210 8.5

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. 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).

6.5.2 Test Conditions:

Tnom: 21°C; Vnom: 3.8V

6.5.3 Measurement Procedure:

These measurements are performed according to FCC KDB 558074 D01 DTS Measurement Guidance v03r02.

Band edge measurements have been carried out as conducted setup. Section 11.2 and 11.3 allow both radiated and conducted tests. First a reference level is established by measuring the peak in band power in 100kHz bandwidth. Then the emissions close to the band edge are measured and verified that the levels are 20dBc or 20dB below the reference carrier level. The limit line shown in the plots is calculated as 20dB below the reference level.

Low band edge (2400MHz) is measured as normal emission test as specified in section 11 of the referenced KDB. Since high band edge (2483.5MHz) falls next to the restricted band (2483.5-2500MHz), it is measured as restricted band. As mentioned in the referenced KDB section 11.1.c, attenuations to level below the 15.209 general radiated emission limits is not required.

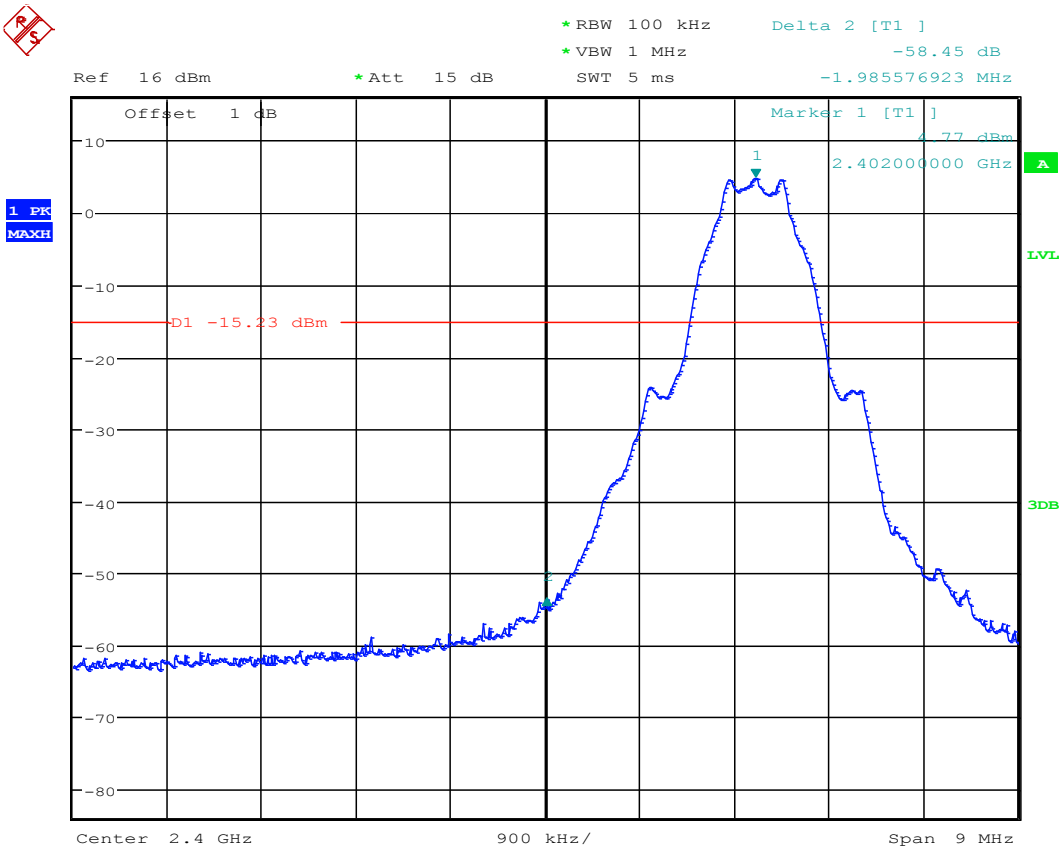
Section 12.2.2 is followed for the measurement of the upper restricted band.

6.5.4 Measurement Result

Pass.

6.5.5 Test Data/plots: 2.4 GHz Band

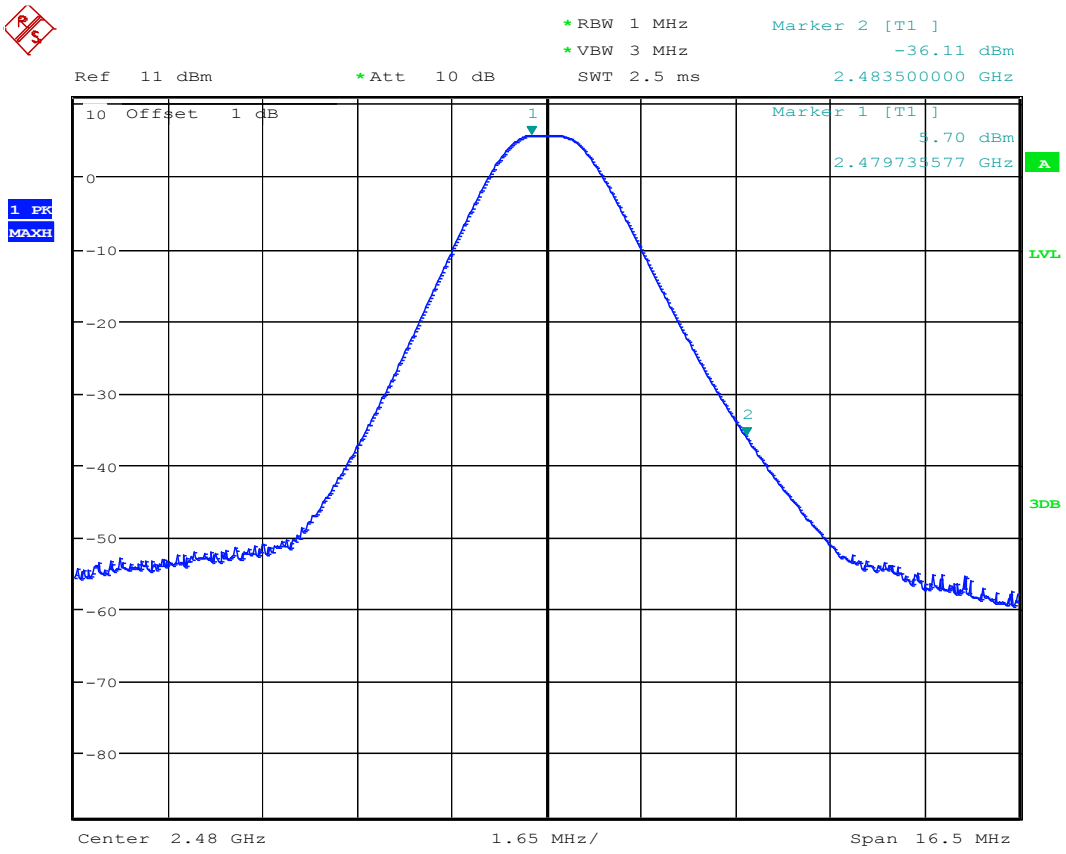
Lower band edge –Ch Low- BTLE (Peak) Conducted



Date: 21.OCT.2014 12:41:13

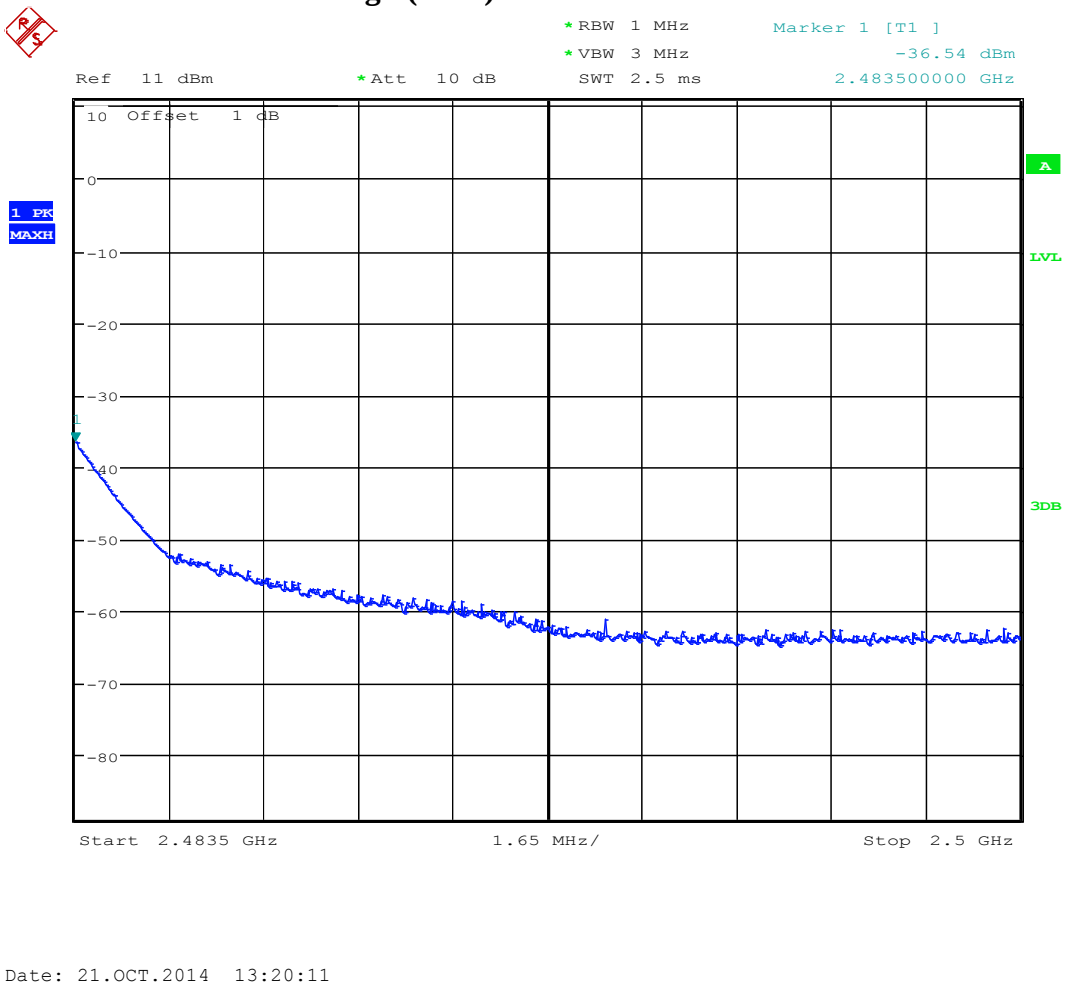
Restricted Band (Conducted)

Channel 39 (2480MHz) which is closest to the restricted band (2483.5MHz-2500MHz) and is at the upper band edge is set to determine compliance.



Date: 21.OCT.2014 13:24:51

Upper restricted band – Ch High (Peak)



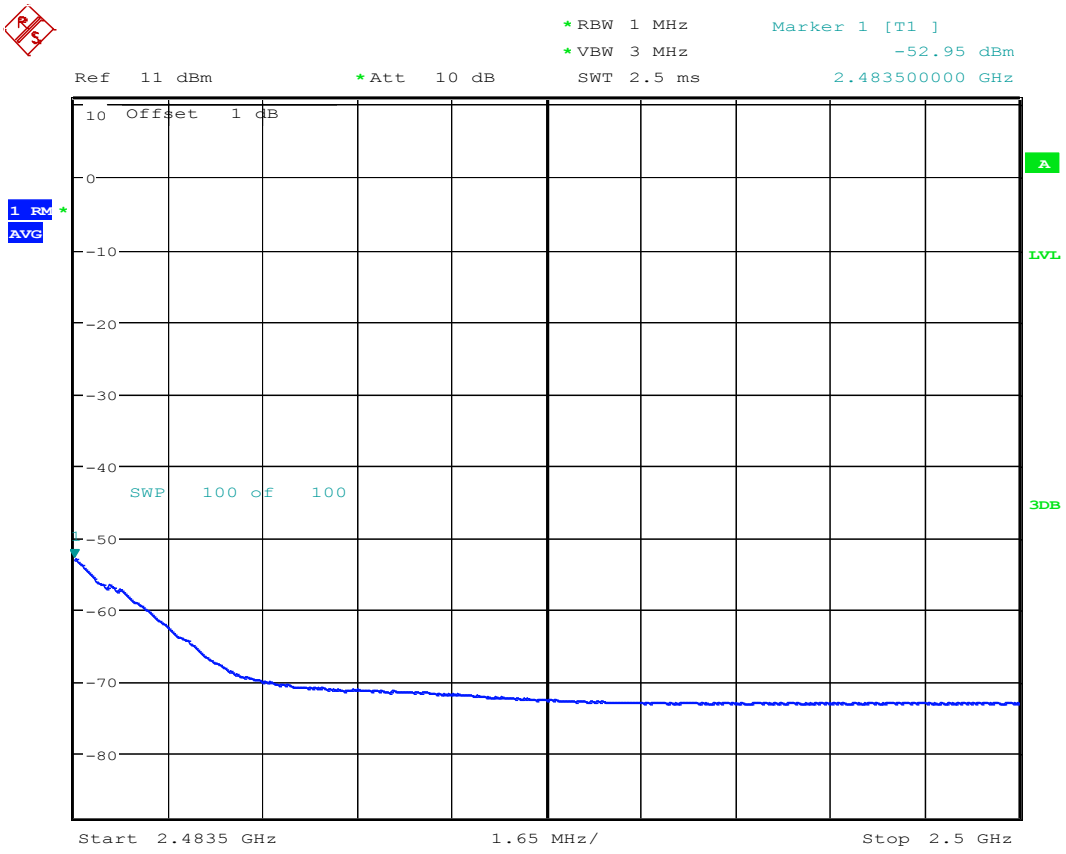
Maximum EIRP level =-36.54 +2dBi = -34.54dBm

Convert the EIRP level to an equivalent electric field strength using the following relationship:

E= EIRP -20logD +104.8
E= -34.54-9.54+104.58
E= 60.5dBuV/m

This value pass the FCC limit of 74dBuV/m for peak measurement.

Upper restricted band – Ch High (Average)



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Maximum EIRP level =-52.95 + 2dBi = -50.95dBm

Convert the EIRP level to an equivalent electric field strength using the following relationship:

E= EIRP -20logD +104.8
E= -50.95-9.54+104.58
E= 44.09 dBuV/m

This value pass the FCC limit of 54dBuV/m for average measurement.

6.6 Occupied Bandwidth (6dB and 99% Bandwidth)

6.6.1 Limits:

6.6.1.1 § FCC 15.247 (a) (2) and IC reference RSS-210 i8, A8.2.(a)

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.

6.6.2 Test Conditions:

Tnom: 22 ºC; Vnom: 3.8V

6.6.3 Test Procedure

Measurement according to FCC KDB 558074 D01 v03r02 section 8.1

For 6 dB bandwidth:

Spectrum Analyzer settings:

Span= Wide enough to capture the entire emission bandwidth
RBW= 100 KHz
VBW≥ 3xRBW
Detector: Peak-
Sweep Time: Auto
Trace = Max Hold
Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the peak level measured in the fundamental emission.

For 99% bandwidth:

Use the occupied bandwidth in the measurement function of the spectrum analyzer with power bandwidth setting at 99%

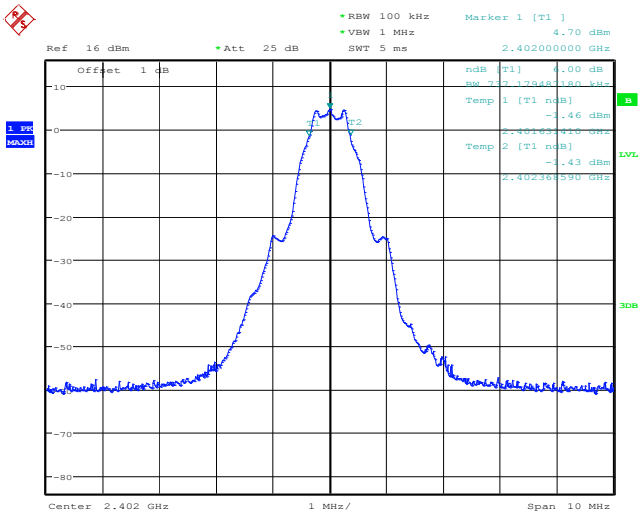
6.6.4 Test Data Results:

2.4 GHz Band

Occupied Bandwidth (MHz)						
Mode	Frequency (MHz)					
	2402 Channel 0		2442 Channel 18		2480 Channel 39	
	6dB (KHz)	99% (MHz)	6dB (KHz)	99% (MHz)	6dB (KHz)	99% (MHz)
802.15 LE	727.1	1.08	712.1	1.08	712.1	1.08

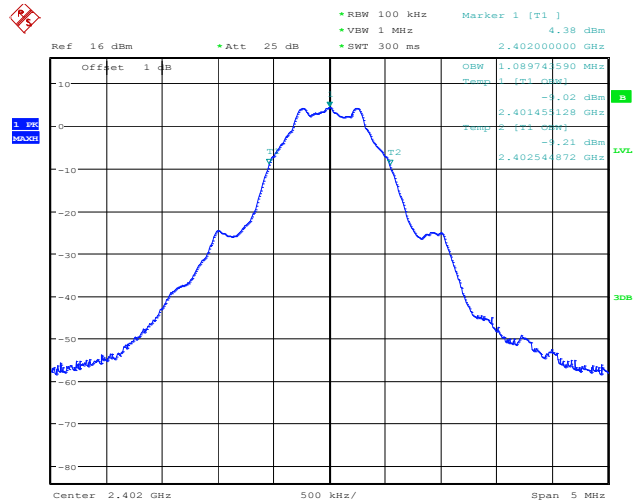
6.6.5 6dB & 99% Bandwidth 802.15 -Ch Low -2404 MHz

6dB BW



Date: 15.OCT.2014 10:35:32

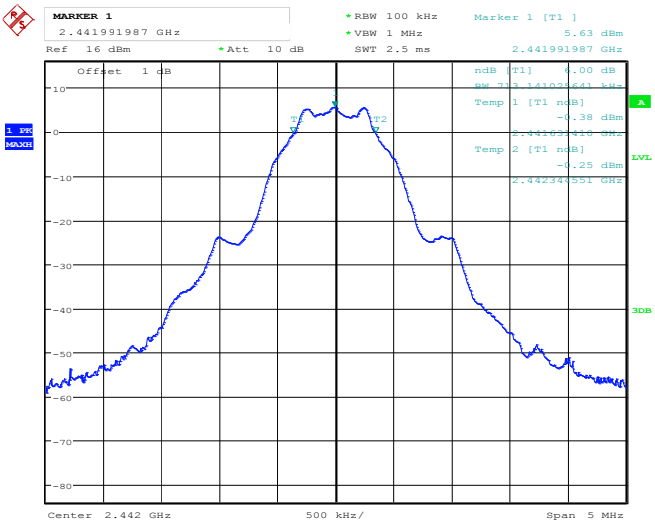
99% BW



Date: 15.OCT.2014 11:22:58

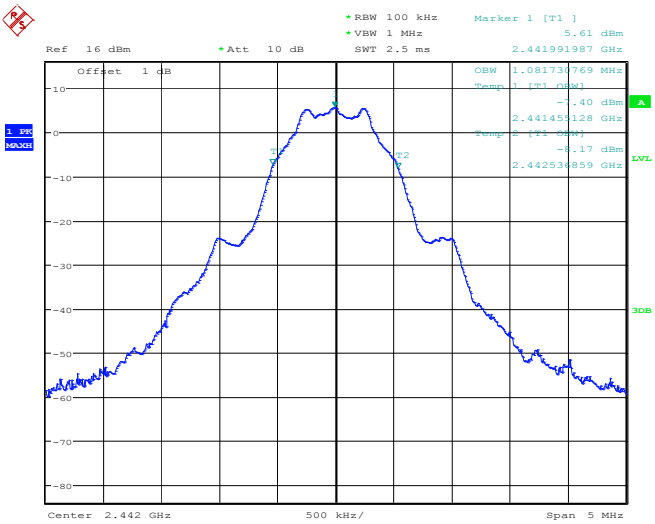
6.6.6 6dB & 99% Bandwidth 802.15 -Ch Mid -2442 MHz

6dB BW



Date: 21.OCT.2014 14:24:47

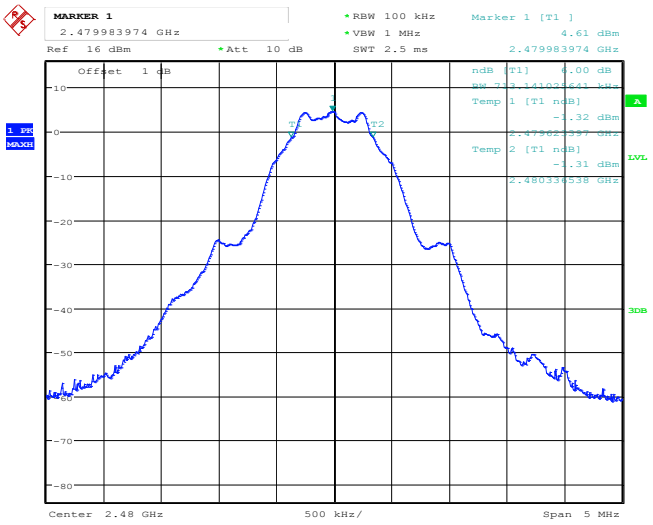
99% BW



Date: 21.OCT.2014 14:25:25

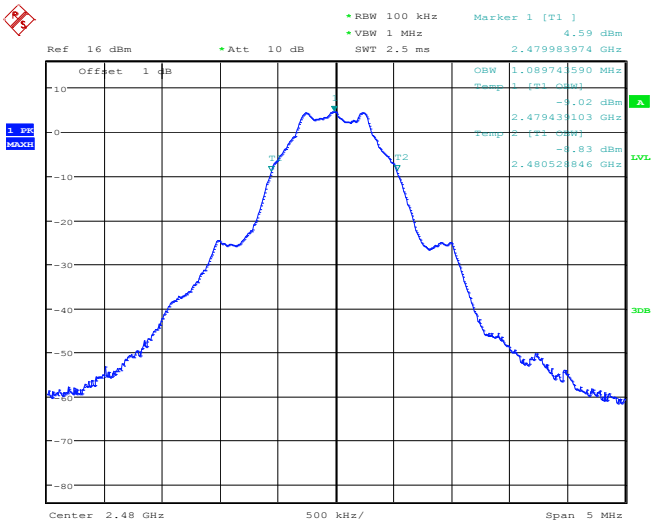
6.6.7 6dB & 99% Bandwidth 802.15 -Ch High -2478 MHz

6dB BW



Date: 21.OCT.2014 14:14:42

99% BW



Date: 21.OCT.2014 14:16:06

6.6.8 Measurement Result

Pass.

6.7 Power Spectral Density

6.7.1 Limits:

§ 15.247 (e) & RSS-210 A8.2 (b)

For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

6.7.2 Test Conditions:

Tnom: 21°C; Vnom: 3.8V

6.7.3 Measurement procedure

Measurement according to FCC 558074 D01 DTS Measurement Guidance v03r02 section 10.2

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 x the DTS BW
3. Set the RBW=3 kHz, VBW ≥ 3 x RBW and sweep time = auto.
4. Trace mode = max hold
5. Detector = Peak
6. Allow trace to fully stabilize and use peak marker function to determine the highest level as the PSD.

6.7.4 Test Data Results: 2.4 GHz

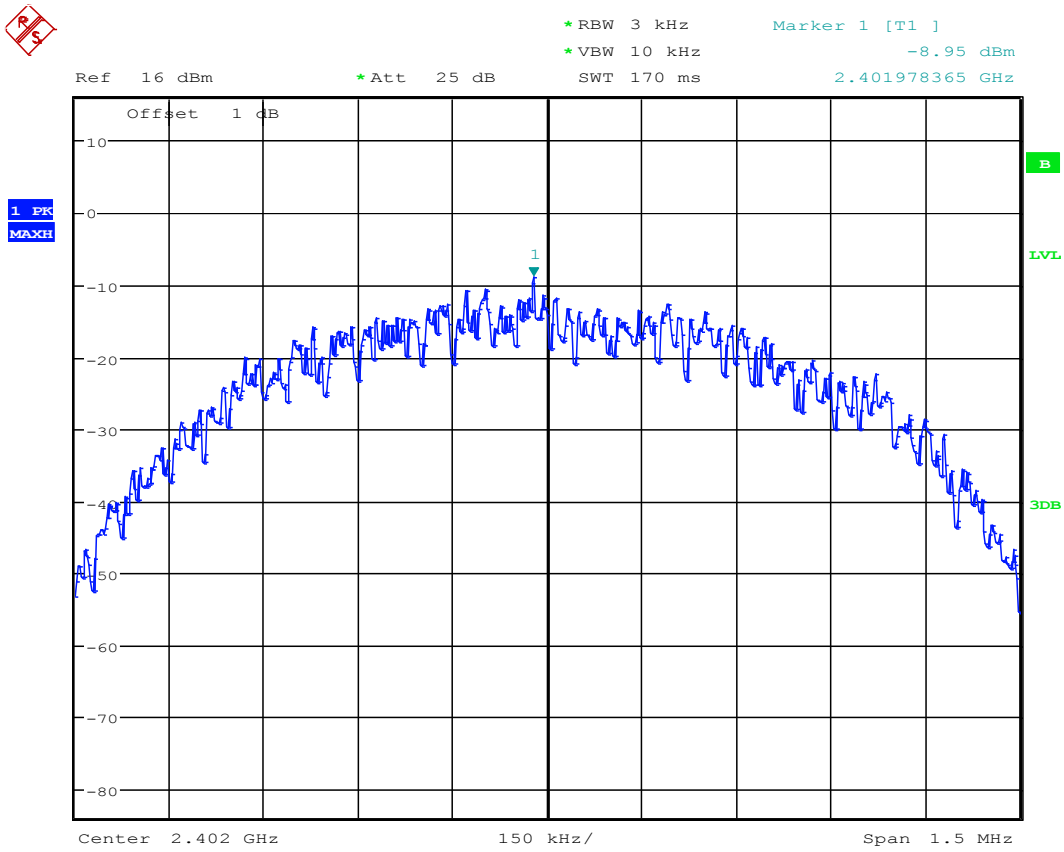
Power Spectral Density (dBm)			
Mode	**Frequency (MHz)**		
	2402 Channel 0	**2442 Channel 18**	**2480 Channel 39**
802.15 (BTLE)	-8.95	-7.82	-8.93

6.7.5 Measurement Result

Pass.

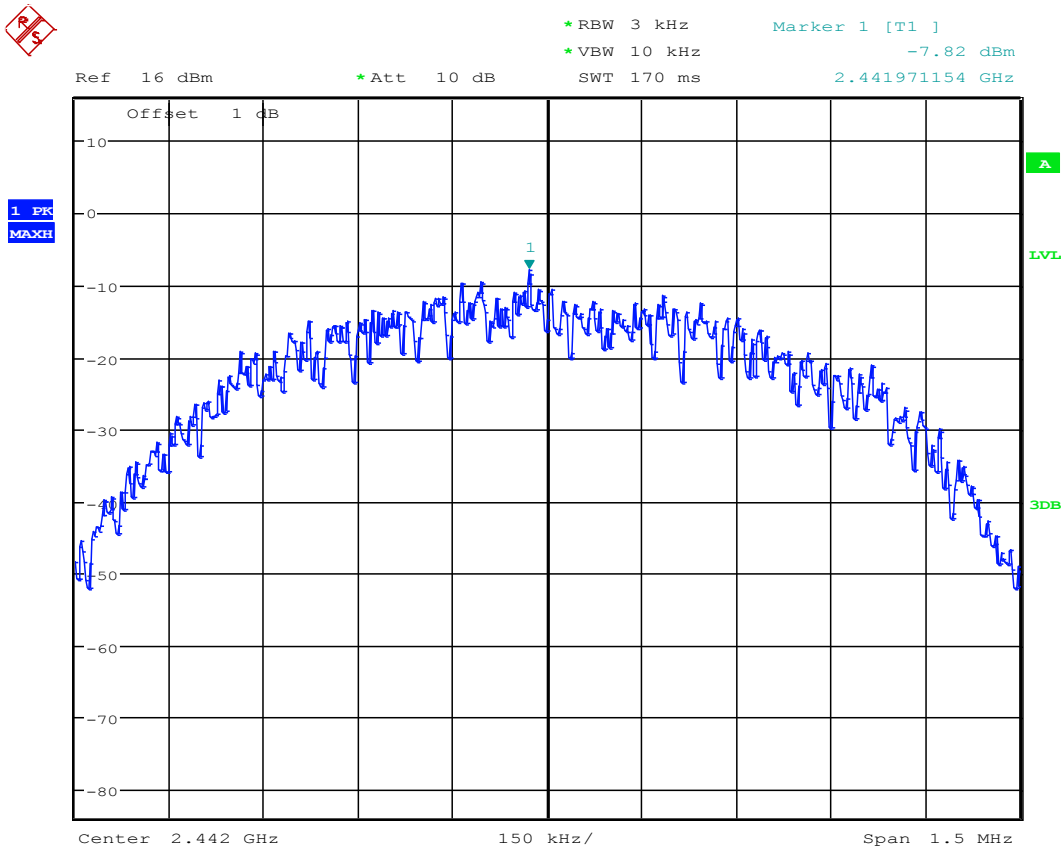
6.8 Measurement Plots:

Power Spectral Density GFSK -Ch Low -2402MHz



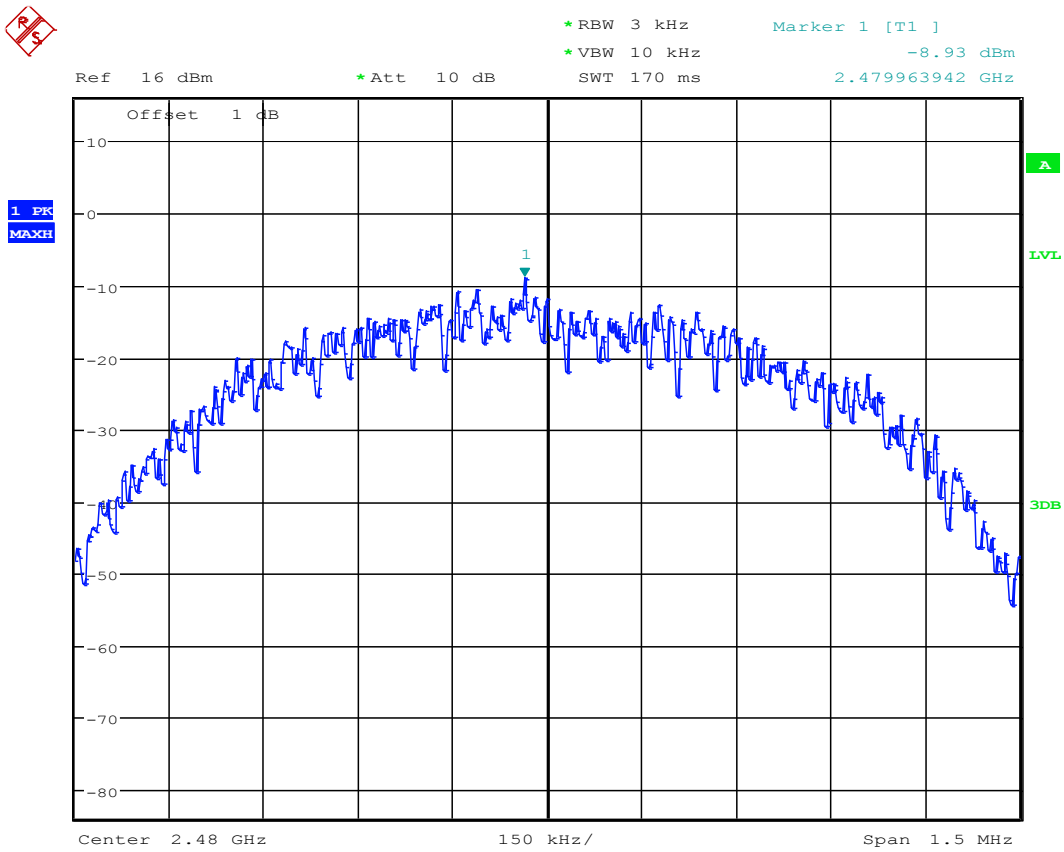
Date: 15.OCT.2014 14:19:48

Power Spectral Density GFSK –Ch Mid -2442 MHz



Date: 21.OCT.2014 14:22:37

Power Spectral Density GFSK –Ch High -2480 MHz



6.9 Radiated Transmitter Spurious Emissions - Restricted Band Limits

6.9.1 Limits:

§15.209/15.205/15.247 & RSS-Gen i3 section 8.9/8.10, RSS-210 A8.5

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			

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

6.9.2 Test Conditions:

Tnom: 23 °C; Vnom: 3.8V
Test mode: *Modulation:* GFSK

6.9.3 Measurement procedure:

Measurement according to ANSI C63.4 (2009) (also refer to section 6.1 in this test report)

6.9.4 Test Result:

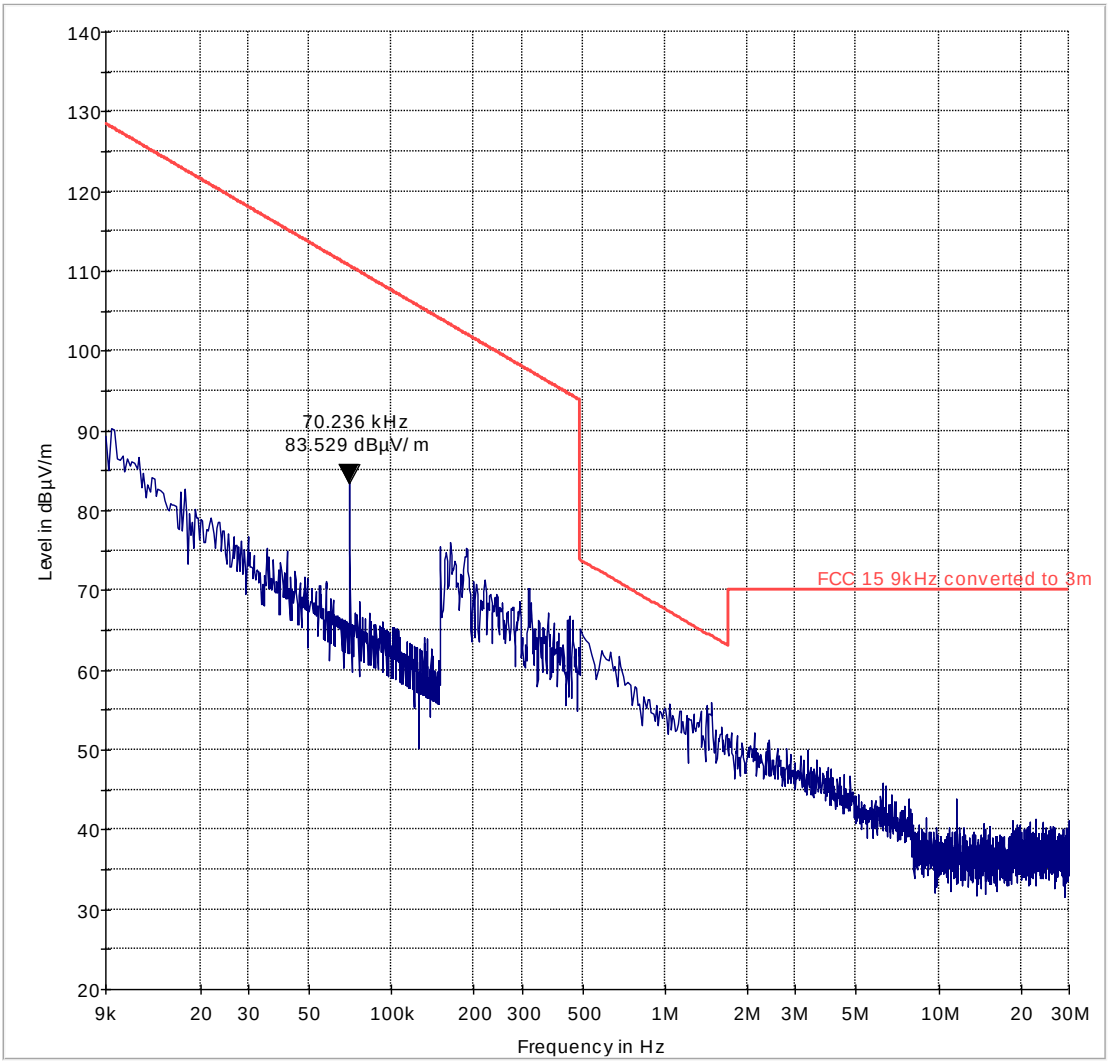
Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT.

6.9.5 Measurement Result

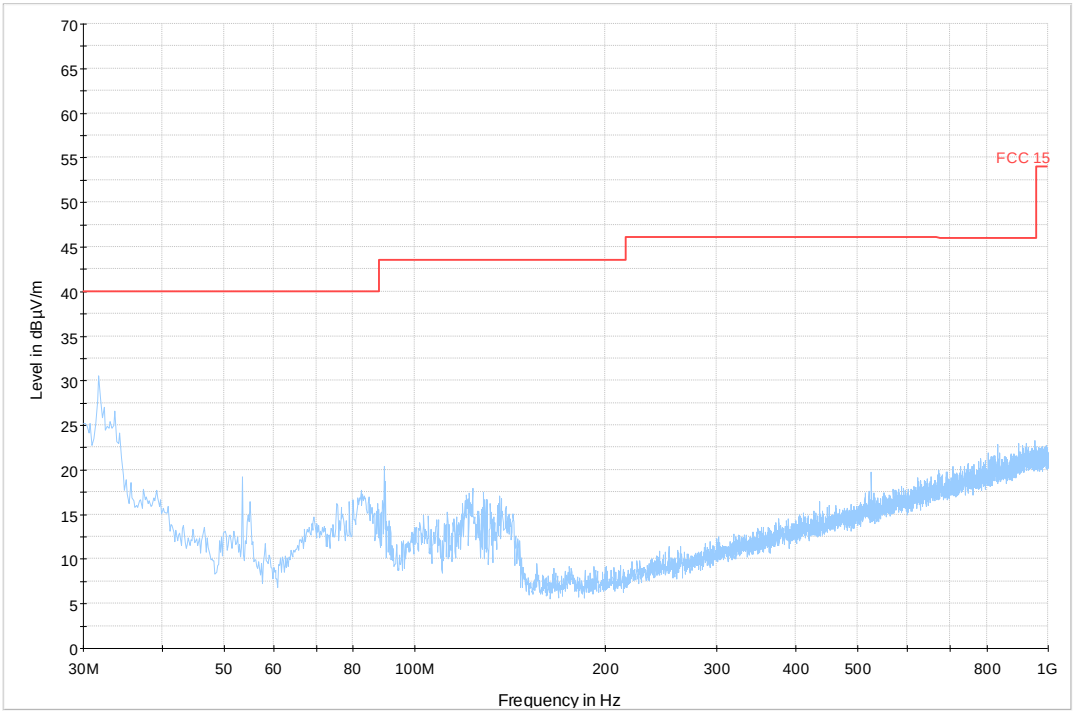
Pass.

6.9.6 Measurement Plots:

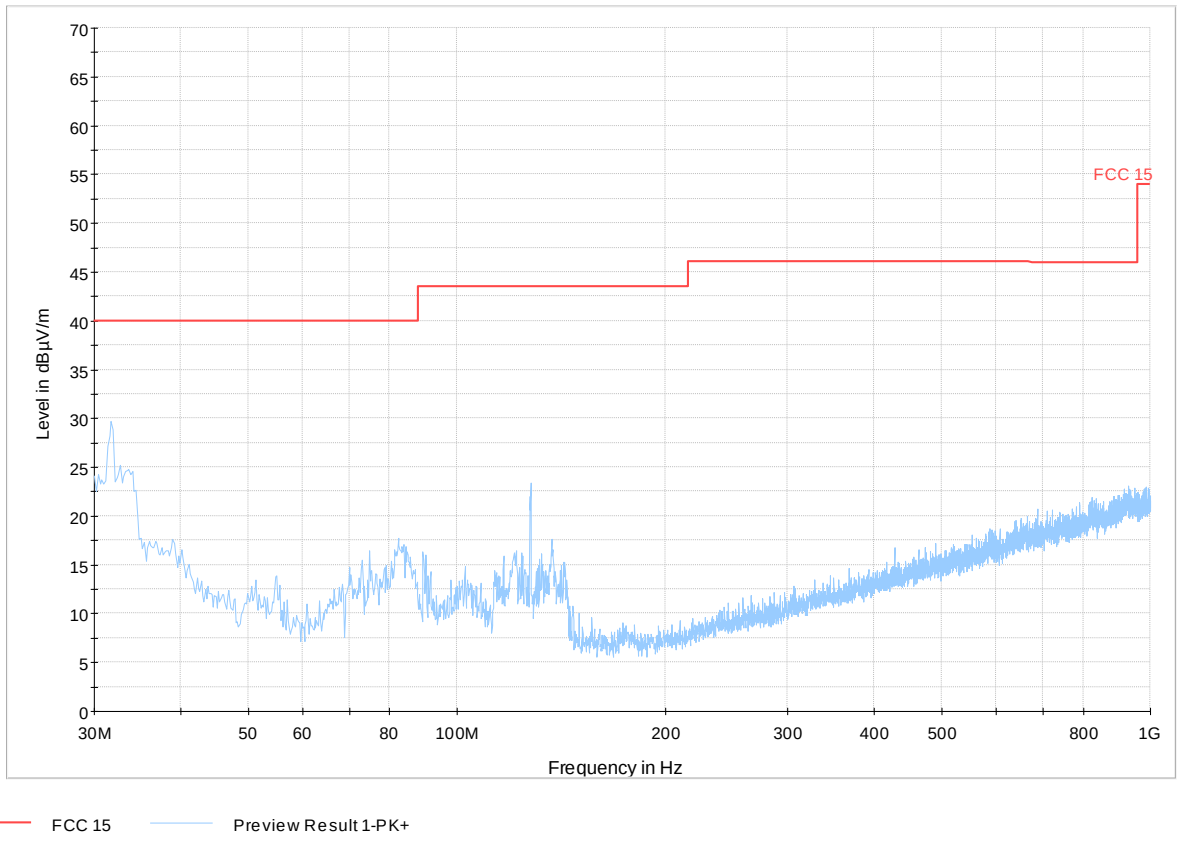
Transmitter Radiated Spurious Emission: Ch Mid- 9kHz – 30MHz- GFSK



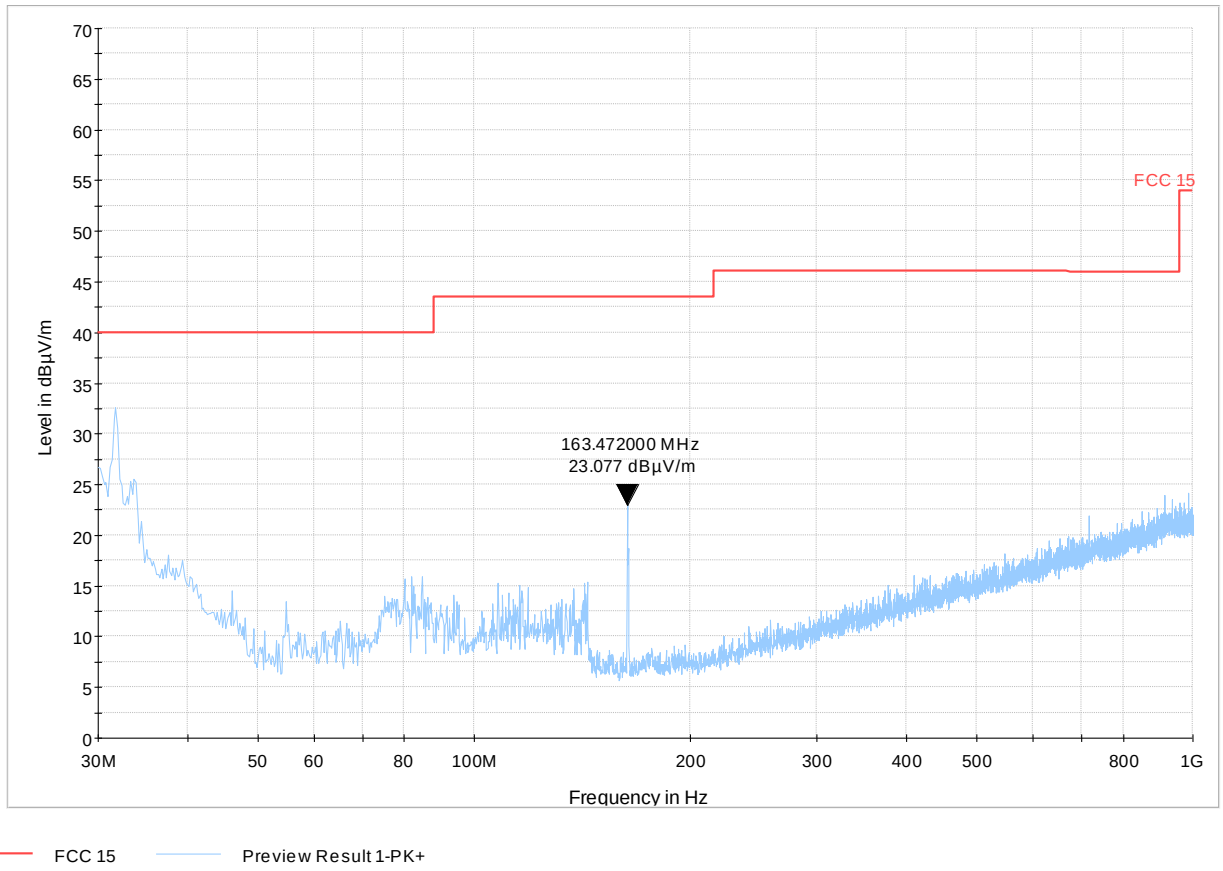
Transmitter Radiated Spurious Emission: Ch Low- 30 MHz – 1GHz- GFSK



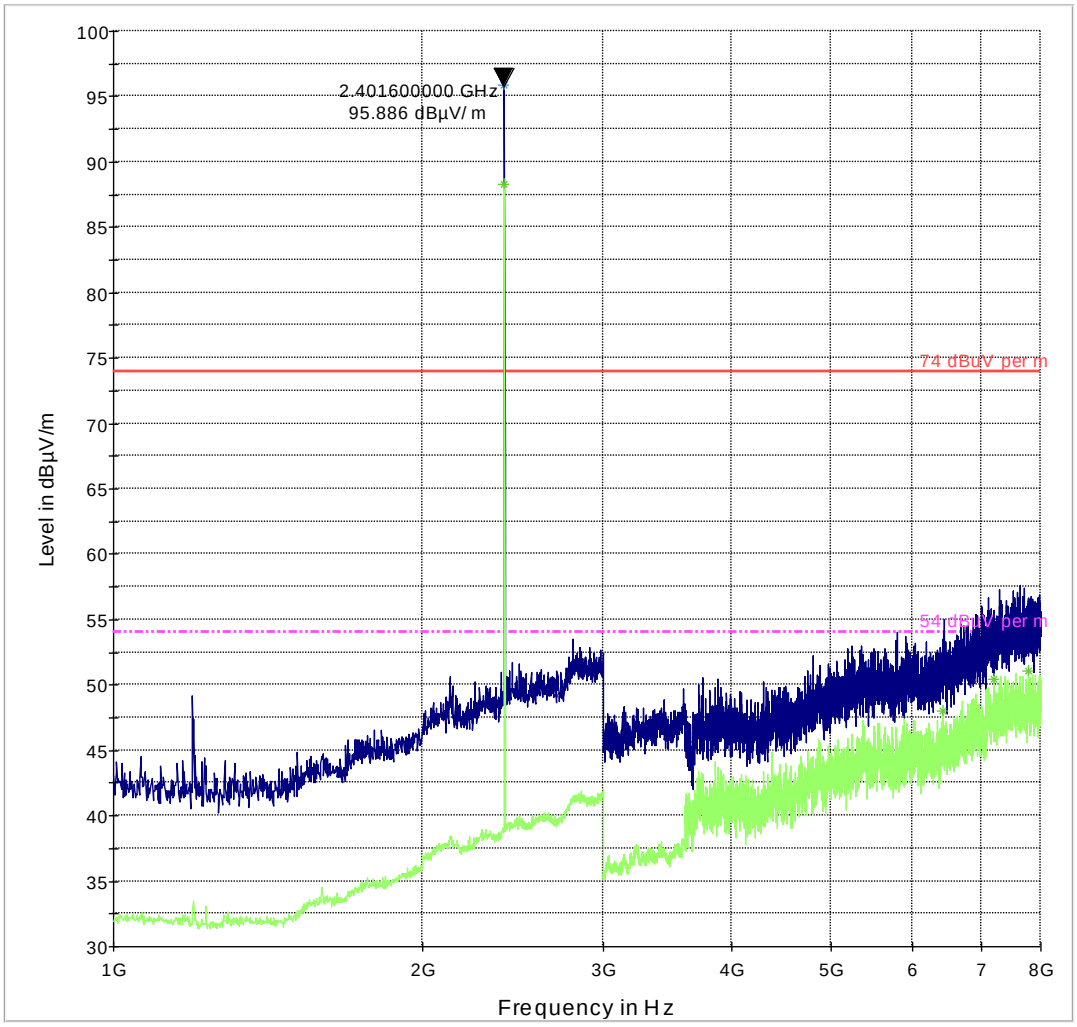
Transmitter Radiated Spurious Emission: Ch Mid- 30 MHz – 1GHz- GFSK



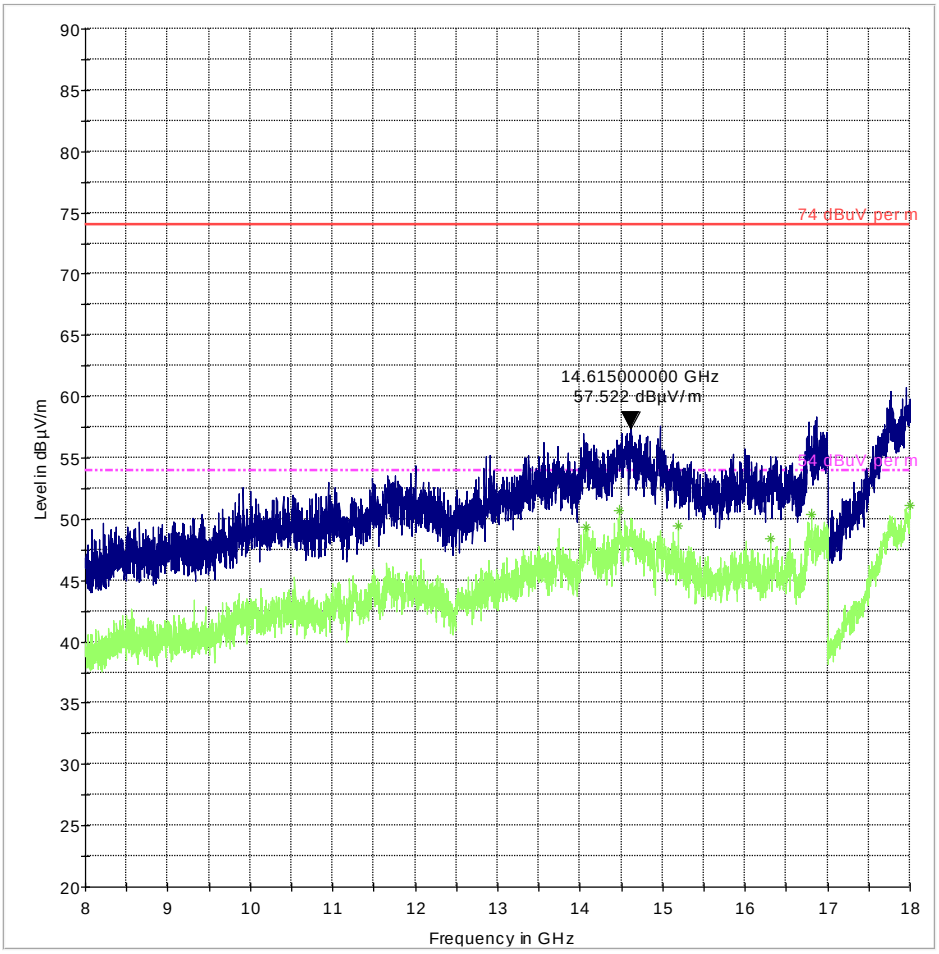
Transmitter Radiated Spurious Emission: Ch High- 30 MHz – 1GHz- GFSK



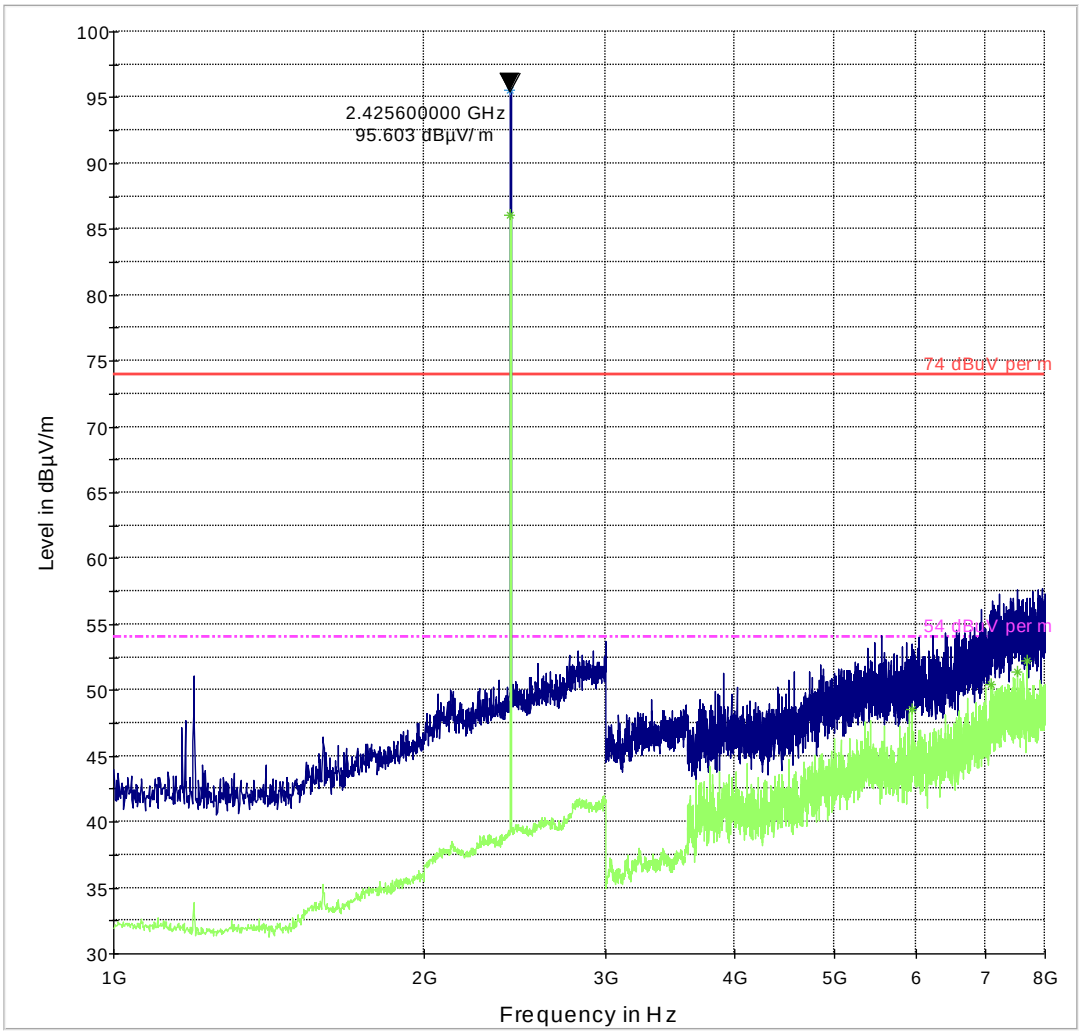
Transmitter Radiated Spurious Emission: Ch Low- 1 GHz –8GHz- GFSK



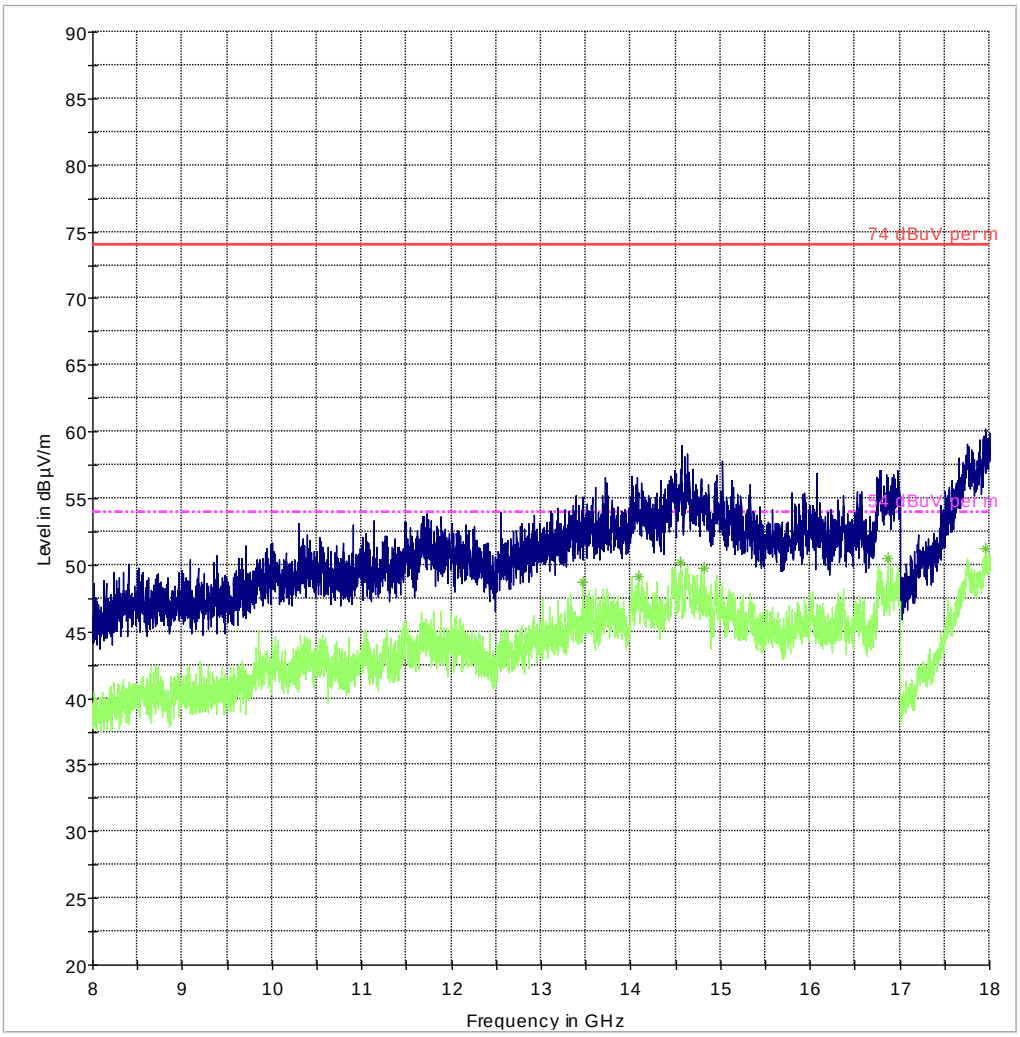
Transmitter Radiated Spurious Emission: Ch Low- 8 GHz – 18GHz- GFSK



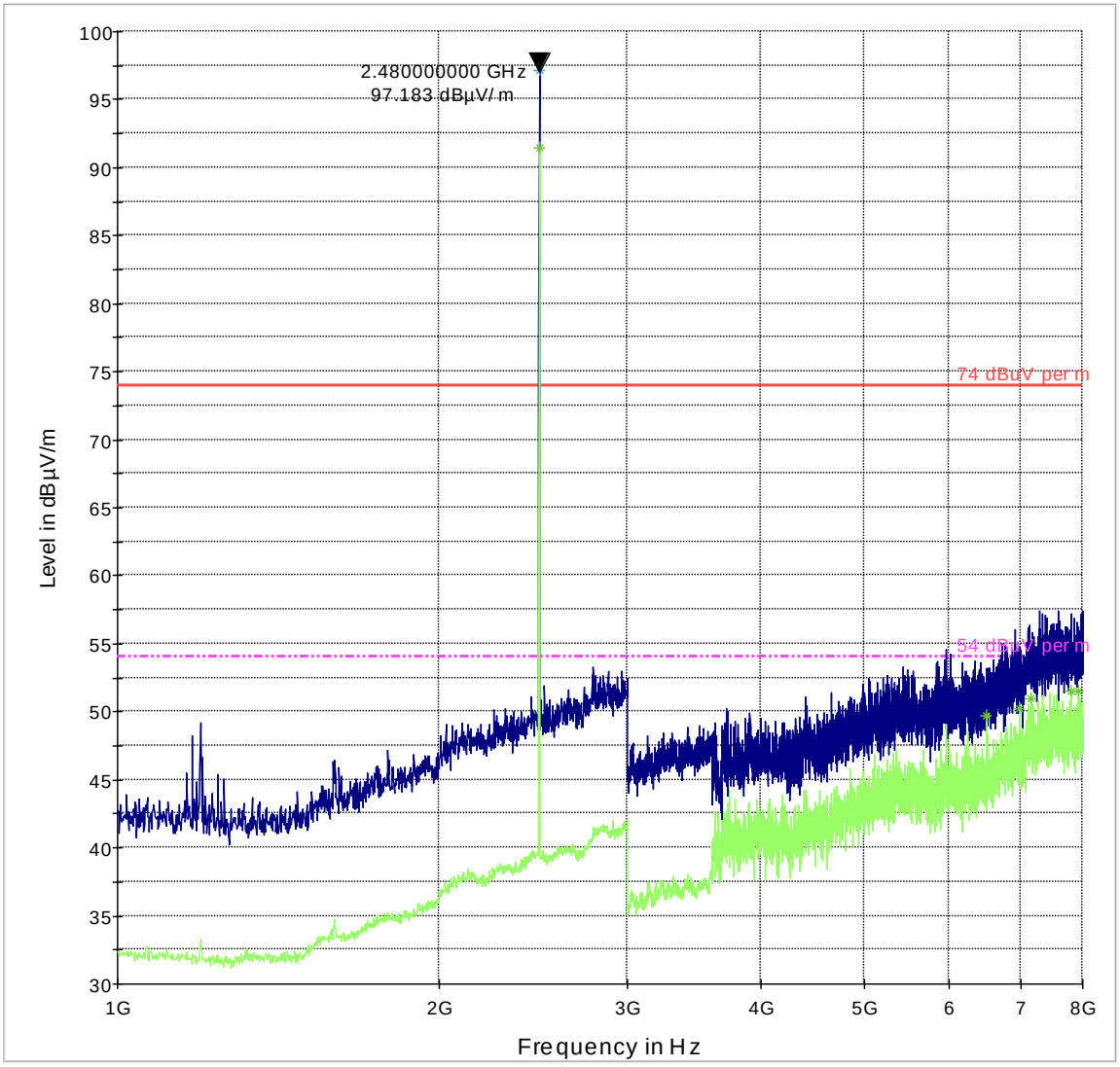
Transmitter Radiated Spurious Emission: Ch Mid- 1 GHz – 8GHz- GFSK



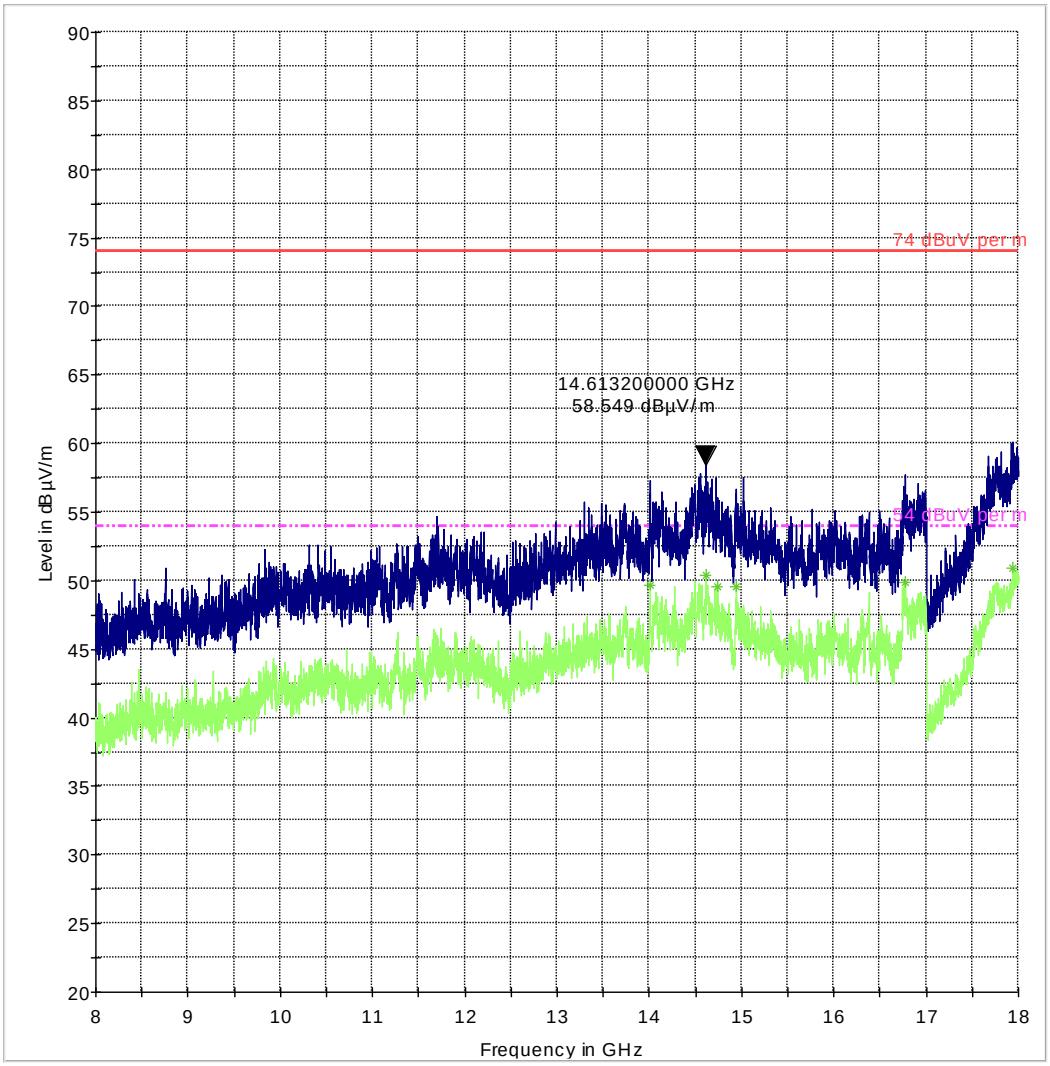
Transmitter Radiated Spurious Emission: Ch Mid- 8 GHz – 18GHz- GFSK



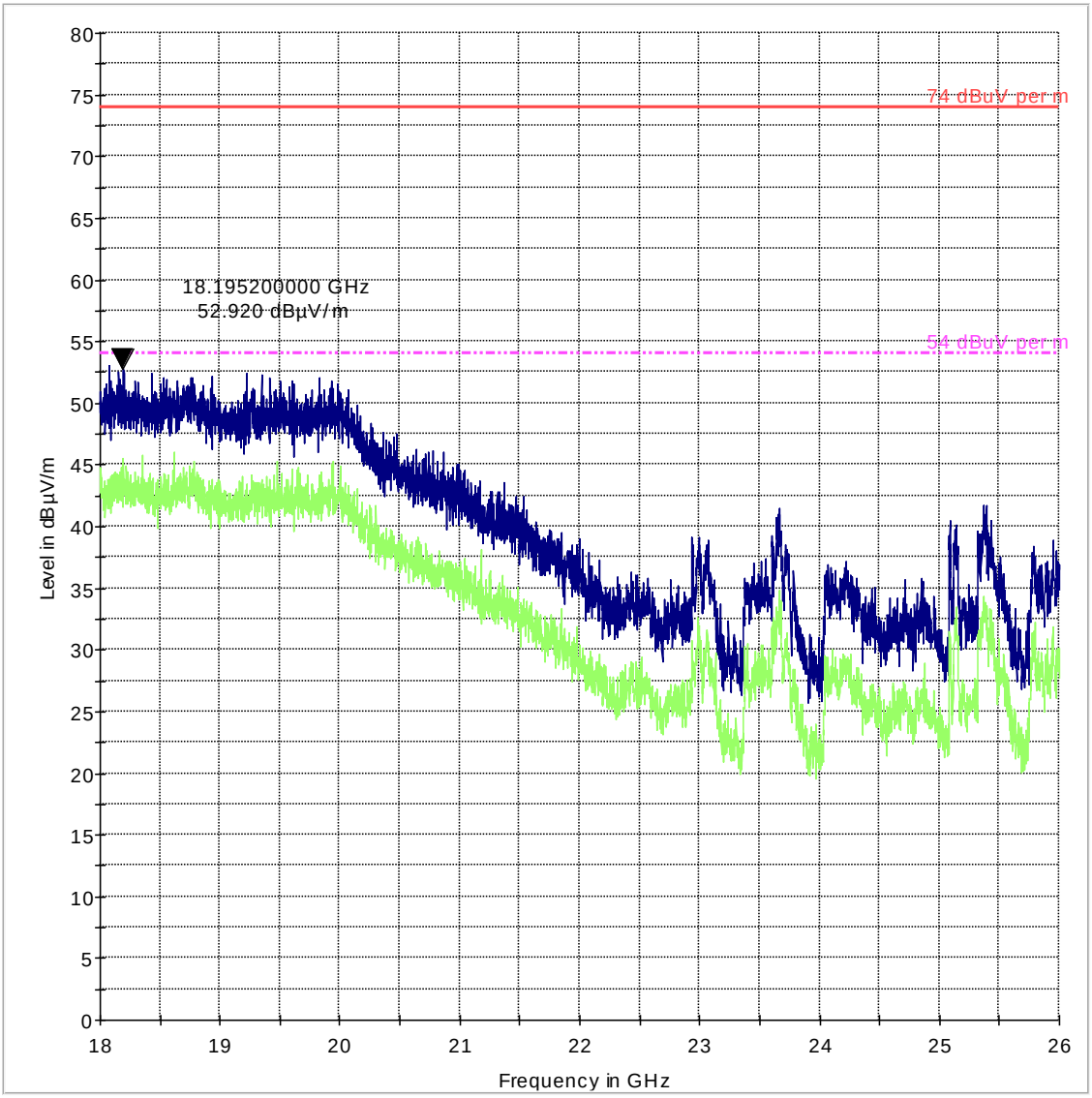
Transmitter Radiated Spurious Emission: Ch High- 1 GHz – 8GHz- GFSK



Transmitter Radiated Spurious Emission: Ch High- 8 GHz – 18GHz- GFSK



Transmitter Radiated Spurious Emission: Ch Mid- 18 GHz – 26 GHz- GFSK



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:

§15.207 & RSS-Gen issue 4 section 8.8

(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 frequencies 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.

6.10.3 Test Conditions:

Tnom: 23 °C; Vnom: 3.8V

Receive and transmit mode of operation of operation

6.10.4 Measurement procedure:

Measurement according to ANSI C63.10:2009 section 6.2 (also refer to section 6, 6.2 in this test report)
Analyzer Settings:
CISPR Bandwidth- 9KHz.
Detector = Qusi-peak / Average

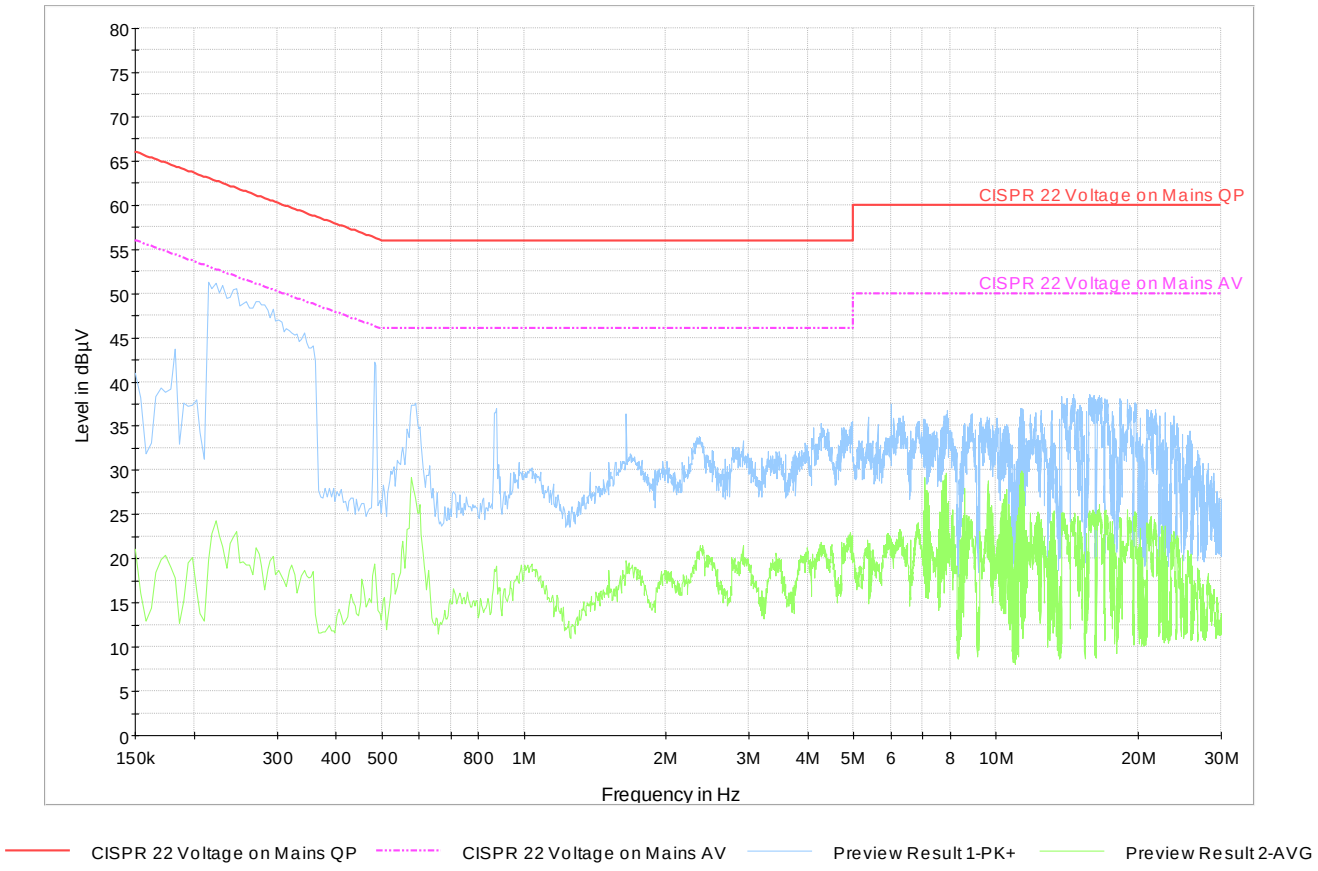
6.10.5 Results

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

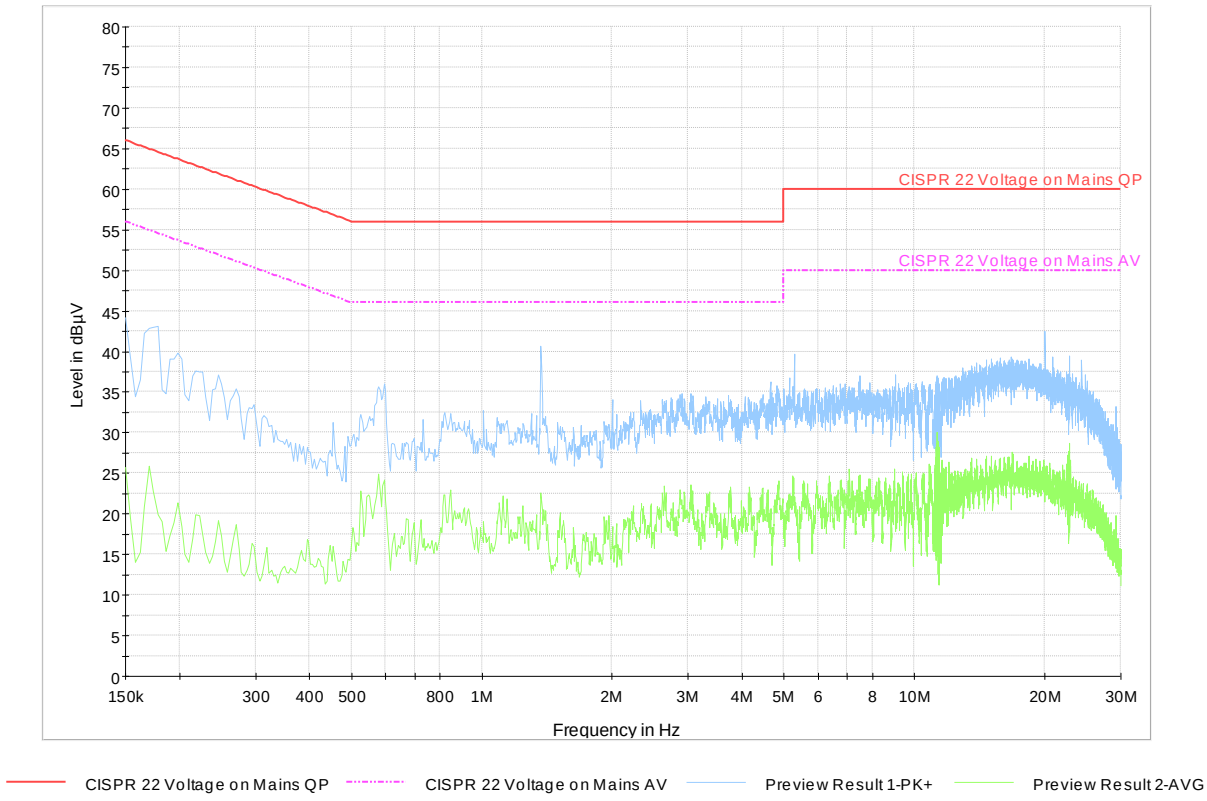
Pass.

6.10.6 Test Data/ Plots

Conducted Emissions: 150 KHz – 30 MHz
TX Mode (GFSK):



RX/Idle mode:


CISPR 22 Voltage on Mains QP
CISPR 22 Voltage on Mains AV
Level in dBµV
Frequency in Hz
150k
300
400
500
800
1M
2M
3M
4M
5M
6
8
10M
20M
30M
CISPR 22 Voltage on Mains QP
CISPR 22 Voltage on Mains AV
Preview Result 1-PK+
Preview Result 2-AVG

7 Test Equipment and Ancillaries used for tests

7.1.1 Milpitas EMC Lab

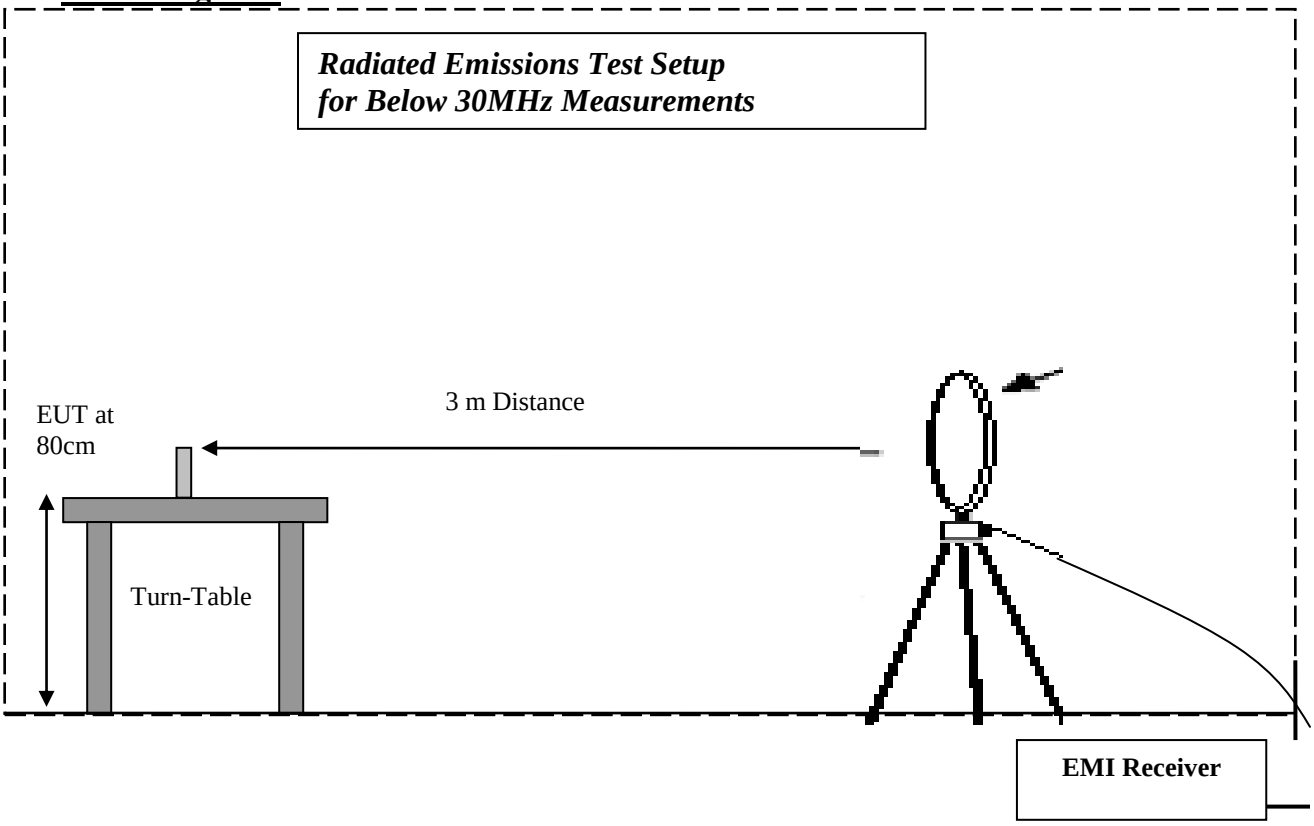
Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
3m Semi- Anechoic Chamber:						
Spectrum Analyzer	Rohde und Schwarz	FSU 26	200302	6/2013	2 years	6/2015
EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	9/2013	2 Year	9/2015
LISN	Rohde und Schwarz	ESV 216	101129	1/2013	2 years	1/2015
Radiocommunication Tester	Rohde and Schwarz	CMU 200	121672	2/2012	2 years	2/2014
Horn Antenna	EMCO	3115	35114	3/2012	3 Years	3/2015
Binconilog Antenna	EMCO	3141	0005-1186	4/2012	3 Years	4/2015
Ultralog Antenna	Rohde and Schwarz	HL 562	100495	2/2012	2 year	2/2014
Open Switch Control Unit	Rohde and Schwarz	OPS 130	10085	n/a		
Extention Unit Open Switch Control Unit	Rohde and Schwarz	OSP 150	10086	n/a		
Signal Generator	Rohde and Schwarz	SMF 100A	101833	2/2012	2 years	2/2014
Turn Table TT	Maturo	1.5 SI	TT 1.5SI/204/6070910	n/a		
Compact antenna Mast	Maturo	CAM 4.0-P	CAM4.0-P/067/6000910	n/a		
Multiple Control Unit	Maturo	MCU	2140910	n/a		
Pre-Amplifier	Rohde and Schwarz	TS-PR 18	100072	Part of the system calibration		
High Pass Filter	Mini-Circuits	SHP-1200+	RUU11201224	Part of the system calibration		
High Pass Filter	Wainwright Instr.	WHKX 3.0/18	109	Part of the system calibration		
Ancillary equipment:						
Multimeter	Fluke	115 True RMS	21752138	3/2013	2 years	3/2015
DC Power Supply	GW Instek	GPS-1850D	EM845907	n/a		
Temperature Chamber	Test Equity	107	0700533	n/a		
Temperatuer Chamber	Test Equity	115	150300	n/a		
Thermometer	Fluke	5411B	17560031	12/2012	2 years	12/2014
Antenna	TECT Electronics	FPA3-0.8-6.0R/1329	408213-0001	n/a		

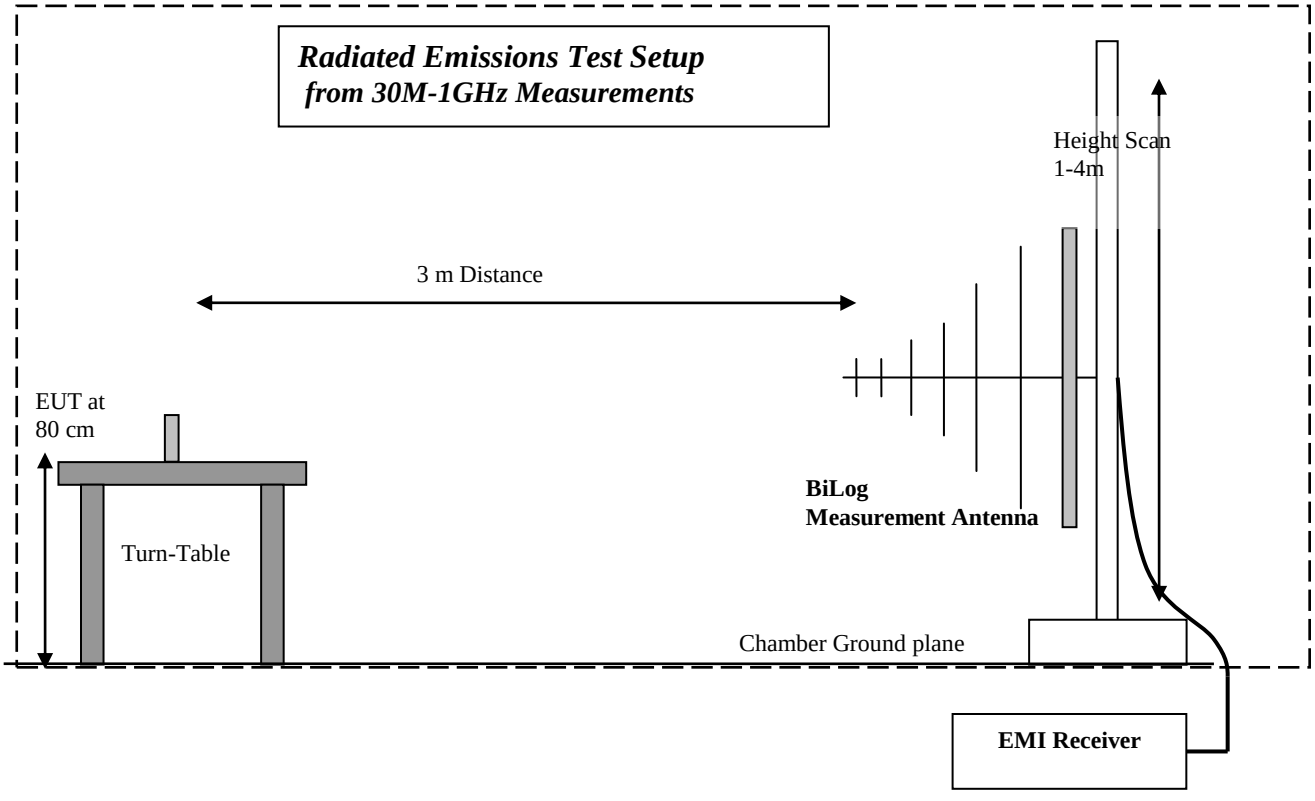
7.1.2 San Diego EMC Lab

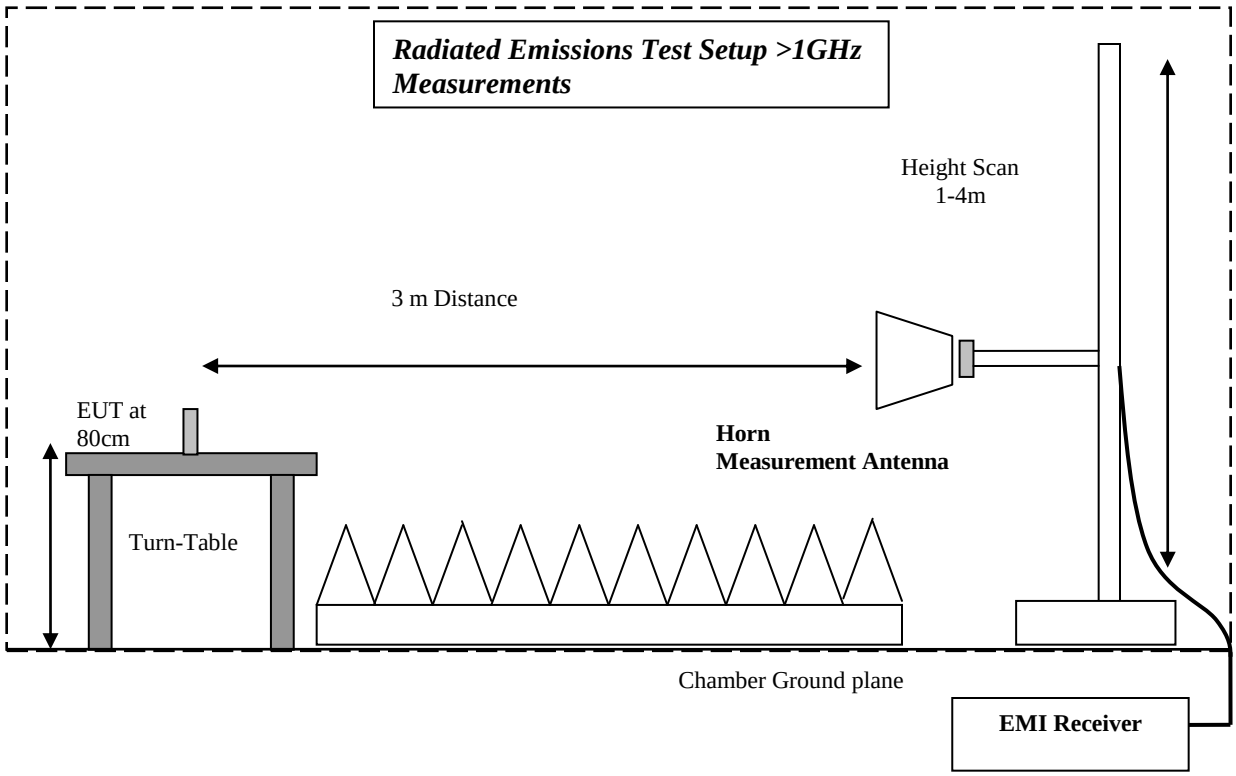
Equipment Name	Manufacturer	Type/Model	Serial No.	Cal Date	Cal Interval	Next cal date
3m Semi- Anechoic Chamber:						
Spectrum Analyzer	Rohde und Schwarz	FSU 26	200302	6/2013	2 years	6/2015
Receiver	Rohde und Schwarz	ESR3	101663	2/2013	2 years	2/2015
LISN	Rohde und Schwarz	ESV 216	101129	1/2013	2 years	1/2015
Radiocommunication Tester	Rohde and Schwarz	CMU 200	121672	7/2013	2 years	7/2015
Log Periodic Antenna	Rohde and Schwarz	HL 050	100515	4/2013	3 year	4/2016
Ultralog Antenna	Rohde and Schwarz	HL 562	100495	2/2012	3 year	2/2015
Open Switch Control Unit	Rohde and Schwarz	OPS 130	10085	n/a		
Extention Unit Open Switch Control Unit	Rohde and Schwarz	OSP 150	10086	n/a		
Turn Table TT	Maturo	1.5 SI	TT 1.5SI/204/6070910	n/a		
Compact antenna Mast	Maturo	CAM 4.0-P	CAM4.0-P/067/6000910	n/a		
Multiple Control Unit	Maturo	MCU	2140910	n/a		
Pre-Amplifier	Rohde and Schwarz	TS-PR 18	100072	Part of the system calibration		
High Pass Filter	Mini-Circuits	SHP-1200+	RUU11201224			
High Pass Filter	Wainwright Instr.	WHKX 3.0/18	109			

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 Block Diagrams






Radiated Emissions Test Setup >1GHz Measurements
Height Scan 1-4m
3 m Distance
EUT at 80cm
Horn Measurement Antenna
Turn-Table
Chamber Ground plane
EMI Receiver

9 Revision History

Date	Report Name	Changes to the report	Report prepared by
2014-09-30	EMC_INTEL_054_14001_15.247_BTLE	First Revision	Jennifer Huang
2014-10-21	EMC_INTEL_054_14001_15.247_BTLE_rev1	Low and High channels measured correctly. References to the KDB are made clear.	M. Umair Anees
2014-11-10	EMC_INTEL_054_14001_15.247_BTLE_rev2	Formatting	M. Umair Anees
2014-12-15	EMC_INTEL_054_14001_15.247_BTLE_rev3	Updated IC references RSS-Gen	M. Umair Anees