



# **FCC Test Report**

**FOR:**

## **iRhythm Technologies**

**Model Name/ Model No: ZIO SR / K102A5001**

**Product Description: ZIO SR ECG Gateway.**

**FCC ID: 2AFBP-SR15G**

**47 CFR Part 15.247 (DTS)**

**TEST REPORT #: EMC\_IRHYT-003-15001\_15.247\_BTLE-Rev1**  
**DATE: 2015-Oct-09**



**FCC Recognized**


**IC recognized #  
3462B**

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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 no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
iRhythm Technologies	ZIO SR ECG Gateway.	K102A5001

### Responsible for Testing Laboratory:

Franz Engert

Manager

2015-10-09      Compliance      Compliance Services

Date	Section	Name	Signature
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### Responsible for the Report:

James Donnellan


(Sr. EMC Engineer)

2015-10-09      Compliance

Date	Section	Name	Signature
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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.

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## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the Test Report


<b>Company Name:</b>	CETECOM Inc.
<b>Department:</b>	Compliance
<b>Address:</b>	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
<b>Telephone:</b>	+1 (408) 586 6200
<b>Fax:</b>	+1 (408) 586 6299
<b>Compliance Manager:</b>	Josie Sabado
<b>Responsible Project Leader:</b>	James Donnellan

### 2.2 Identification of the Client

<b>Applicant's Name:</b>	iRhythm Technologies
<b>Street Address:</b>	650 Townsend St., Ste 380
<b>City/Zip Code</b>	San Francisco, CA 94103
<b>Country</b>	USA
<b>Contact Person:</b>	Matt Ho
<b>Phone No.</b>	415-632-5714
<b>Fax:</b>	415-632-5701
<b>e-mail:</b>	mho@irhythmtech.com

### 2.3 Identification of the Manufacturer


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

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### 3 Equipment under Test (EUT)

#### 3.1 Specification of the Equipment under Test

<b>Marketing Name / Model No:</b>	ZIO SR / K102A5001
<b>HW / SW Revision :</b>	2 / CC2541_SmartRF_Host
<b>FCC-ID:</b>	2AFBP-SR15G
<b>Product Description:</b>	ZIO SR ECG Gateway
<b>Radio Technology / Type(s) of Modulation:</b>	Integrated LSR Bluetooth v4.0, LE Model: TiWi-uB1 Module FCC ID: TFB-BT2. / GFSK Modulation
<b>Operating Frequency Ranges (MHz) / Channels:</b>	Nominal band: 2400 – 2483.5; Center to center: 2402(ch 0) – 2480(ch 39), 40 channels
<b>Antenna info:</b>	PCB Trace antenna - 4.2 dBi Peak Gain
<b>Max. Output Power:</b>	RF Output Power Per Data Sheet: 0 dBm EIRP -4.2 dBm
<b>Rated Operating Voltage Range / Power Supply:</b>	Low: 3.7 Nom: 3.9 High: 4.2
<b>Rated Operating Temperature Range:</b>	0 °C to 45 °C
<b>Other Radios included in the device:</b>	Integrated CDMA Radio module: Telit module CE910-DUAL
<b>EUT status</b>	Prototype

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### **3.2 Identification of the Equipment under Test (EUT)**

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	J152001511	2	CC2541_SmartRF_Host	Radiated

### **3.3 Identification of Accessory equipment**

STE #	Type	Manufacturer	Model	Serial Number
1	3.6 V Battery Pack	House Of Batteries	NCA103450-PC-1 Rev. B	-

### **3.4 Identification of Ancillary equipment:**


STE #	Type	Manufacturer	Model	Serial Number
1	Gateway Programming Assembly	iRhythm	-	-
2	Laptop	Dell	Latitude E6430s	966X7W1

### **3.5 Test mode of operation:**

Mode	Data rate (Mbps)	Modulation scheme
Bluetooth LE	1.0	GFSK

The device was configured with a laptop and manufacturer provided test SW, capable of setting the unit in Bluetooth LE mode / GFSK modulation while mounted on the Gateway Programming Assembly

For radiated spurious emissions, the EUT was tested on low, mid and high channels (2.4GHz) in Bluetooth LE mode / GFSK.


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#### **4 Subject Of Investigation**

The objective of the evaluation documented in this report was to assess if the performance of the EUT meets the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations

This test report is to support a request for new equipment authorization under the FCC ID 2AFBP-SR15G. All testing was performed on the product referred to in Section 3 as EUT.

As the product is based on a FCC pre-certified module (TiWi-uB1 FCC ID: TFB-BT2) and the conditions of the modular grant are met this report covers radiated emissions only.


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#### 4.1 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§15.247(e)	Power Spectral Density	Nominal	Bluetooth LE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	■	Complies
§15.247(a)(1)	Spectrum Bandwidth	Nominal	Bluetooth LE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	■	Complies
§15.247(b)(1)	Maximum Conducted Output Power and EIRP	Nominal	Bluetooth LE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	■	Complies
§15.247/15.209/15.205	Band edge compliance- Restricted Band Edges	Nominal	Bluetooth LE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	■	Complies
§15.247(d)	Band edge compliance- Unrestricted Band Edges	Nominal	Bluetooth LE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Complies
§15.247(d) §15.209	TX Spurious emissions-Radiated	Nominal	Bluetooth LE	■	<input type="checkbox"/>	■	<input type="checkbox"/>	Complies
§15.207(a)	AC Conducted Emissions	Nominal	Bluetooth LE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	■	Note 1.

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

**Note 1:** There is no external AC charging mechanism for this device.

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## 5 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

### 5.1 Environmental conditions during Test:

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

### 5.2 Dates of Testing:

05-26-2015 – 06-03-2015

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## 6 Measurements

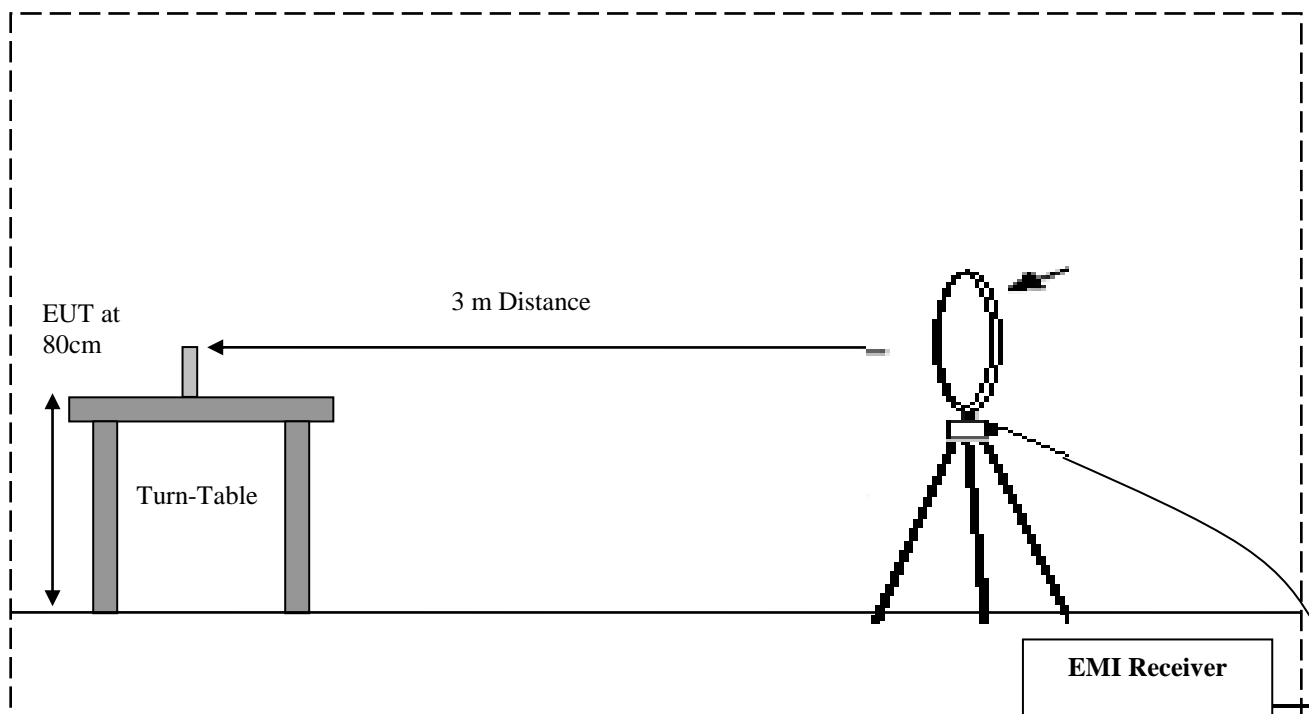
### 6.1 Radiated Measurement

The radiated measurement is performed according to:

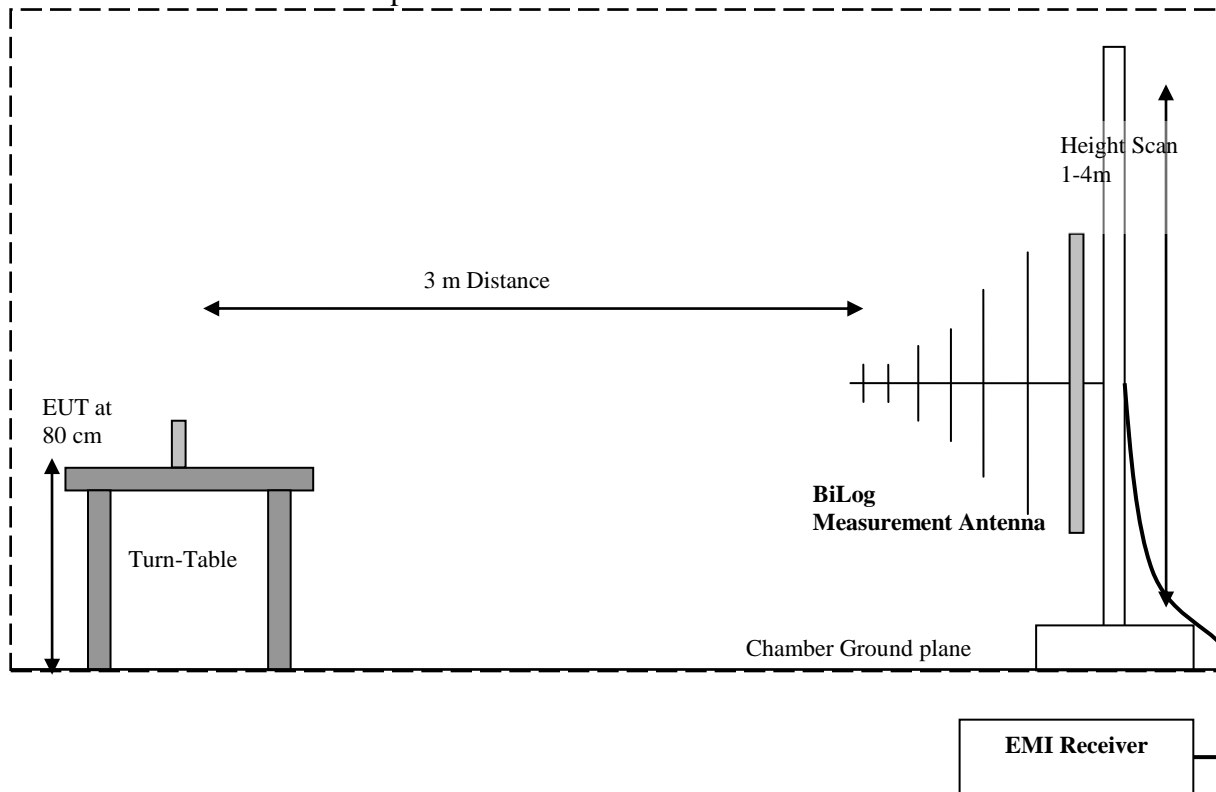
ANSI C63.10 (2013)

- 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

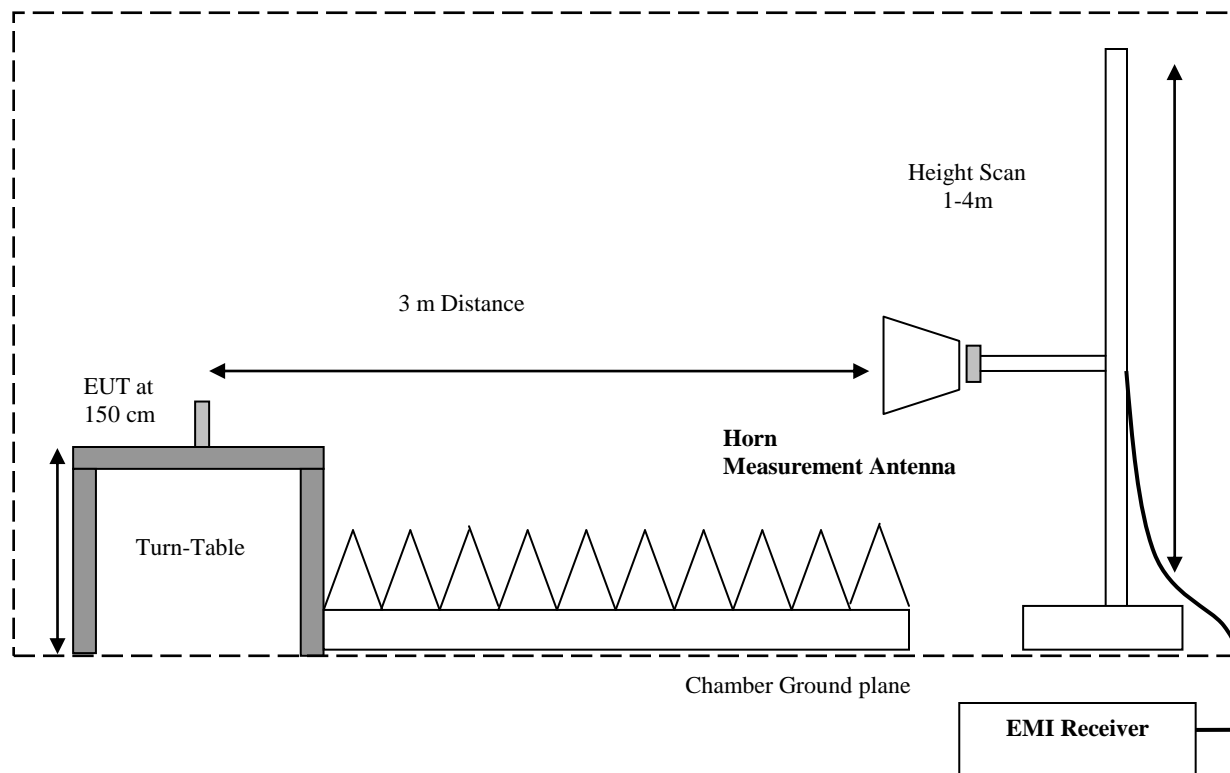


Radiated Emissions Test Setup 30MHz-1GHz Measurements



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## Radiated Emissions Test Setup Above 1GHz Measurements



### 6.1.1 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:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

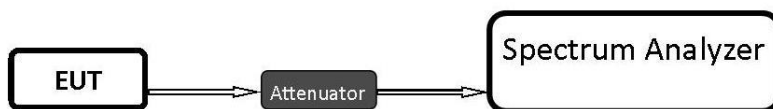
Example:

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

### 6.2 Power Line Conducted Measurement Procedure

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

Reference: FCC Public Notice DA 00-705:2000 (Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems).



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

## 7 Radiated Transmitter Spurious Emissions - Restricted Bands

### 7.1 Limits:

#### §15.247/15.205/15.209 (restricted bands)

(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
<sup>1</sup> 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	( <sup>2</sup> )
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= 74dB $\mu$ V/m

\*AVG. LIMIT= 54dB $\mu$ V/m

**Table 1: Field strength limits table above 30 MHz**

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

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**Table 2: Field strength limits table below 30 MHz**

Frequency of emission (MHz)	Field strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30

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 described in 5.4.

**The highest (or worst-case) data rate shall be recorded for each measurement.**

## **7.2 Test Conditions:**

Tnom: 23.6 °C; Vnom: 3.7V

**Test mode:** *Modulation:* GFSK

## **7.3 Measurement procedure:**

Measurement according to ANSI C63.10:2013 (also refer to section 6.1 in this test report)

### **Analyzer Settings:**

From 9 KHz – 30 MHz

**RBW** = 9 KHz

**Detector:** Peak

From 30 MHz – 1 GHz

**Detector** = Peak / Quasi-Peak

**RBW**=120 KHz (<1GHz)

Above 1 GHz

**Detector** = Peak / Average

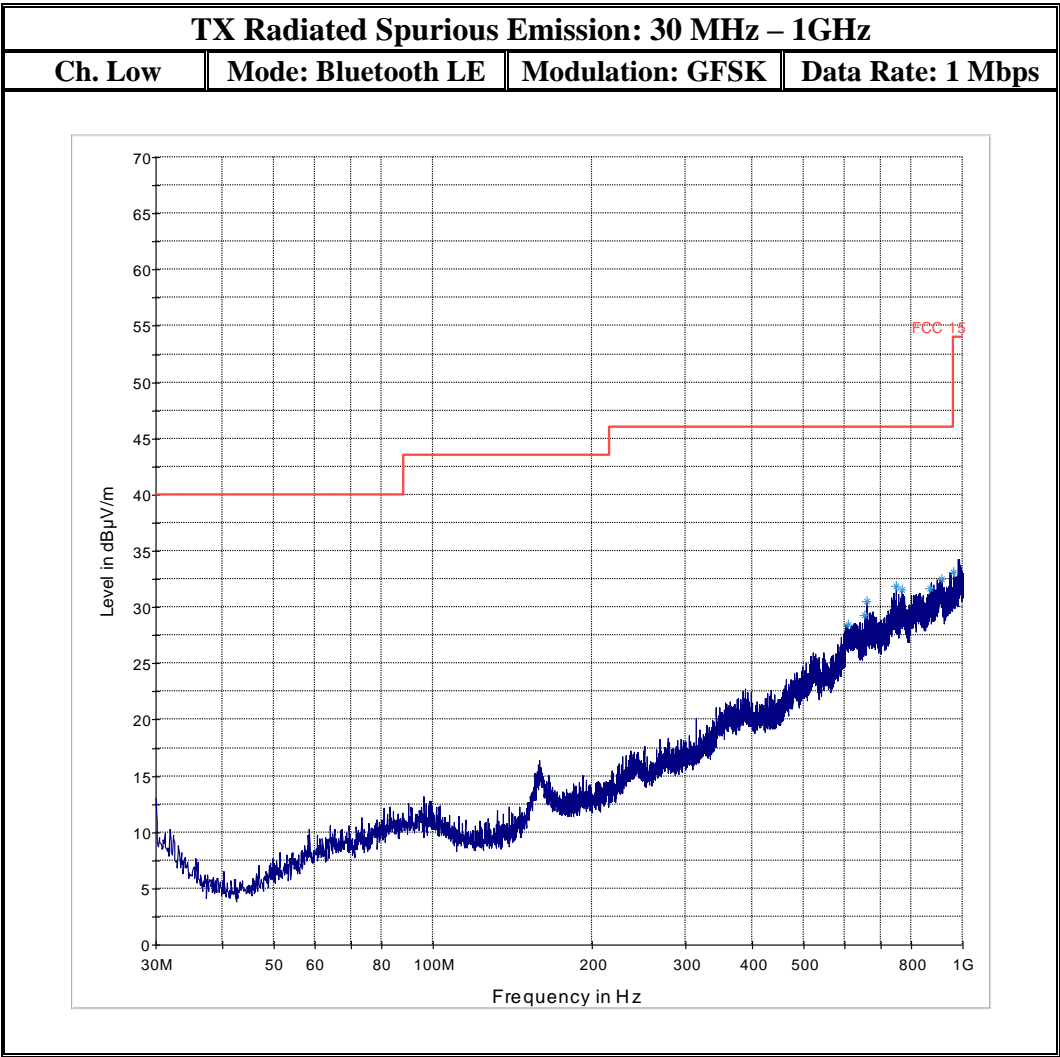
**RBW**= 1MHz

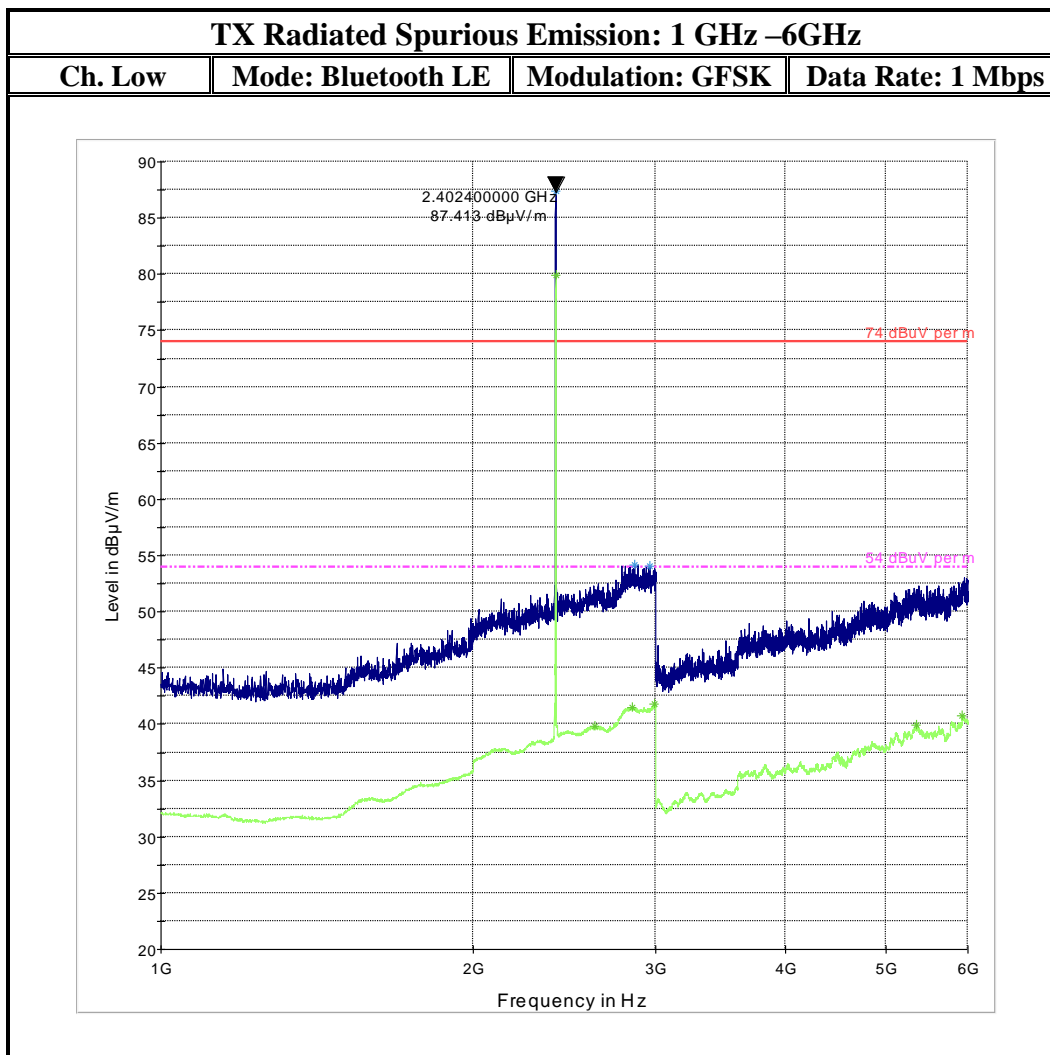
**Test mode:** *Modulation:* GFSK- at max output power.

## **7.4 Verdict:**

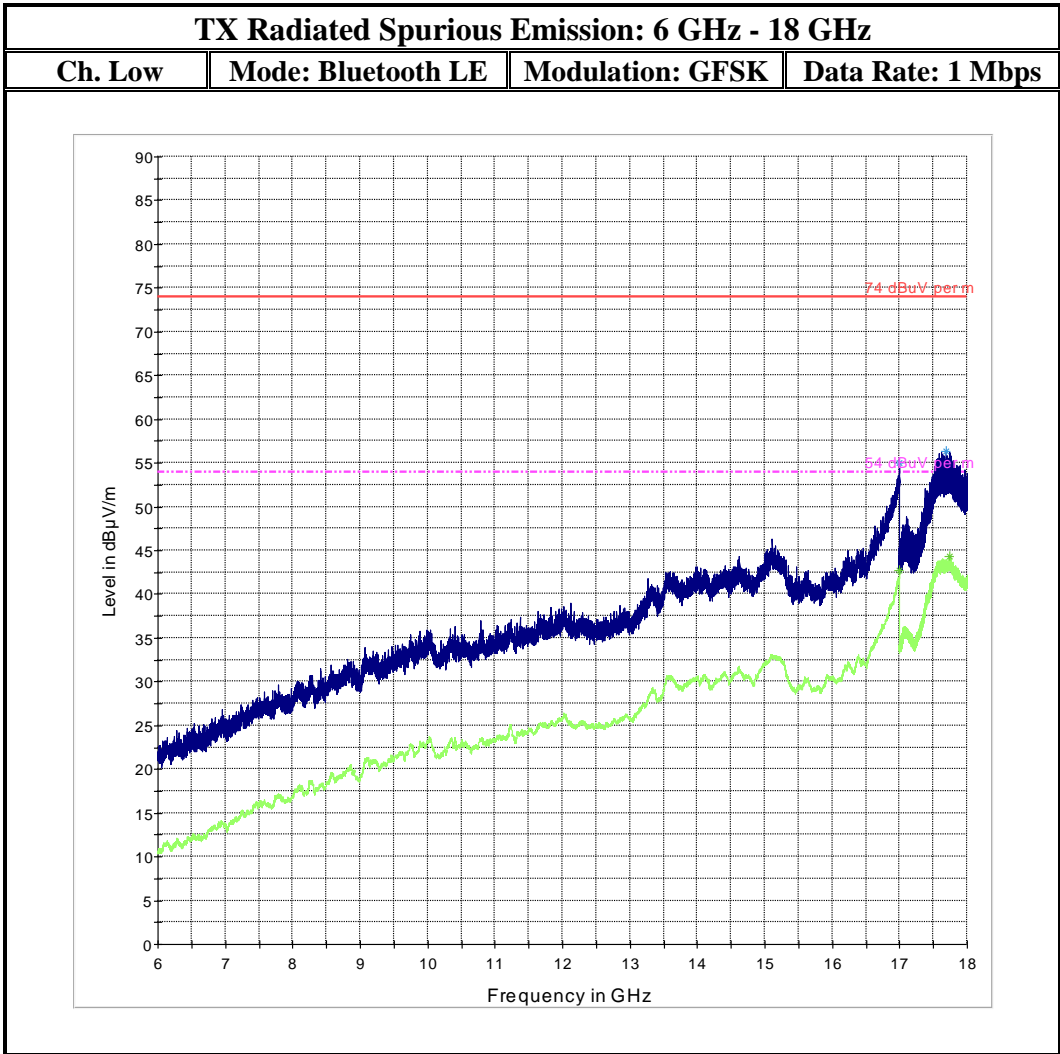
Plots reported here represent the worst case emissions for horizontal and vertical antenna polarizations and for three orientations of the EUT. PASS

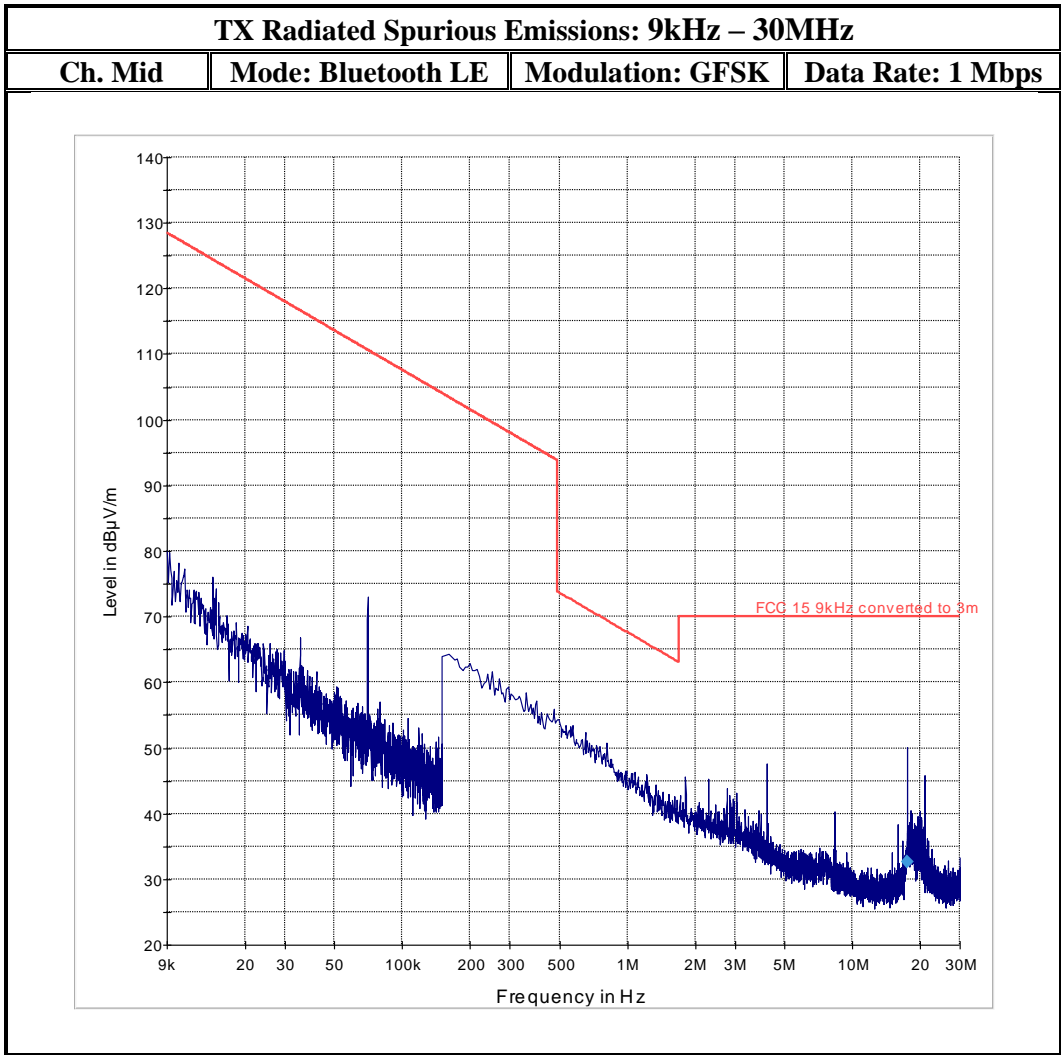
### 7.5 Measurement Plots:

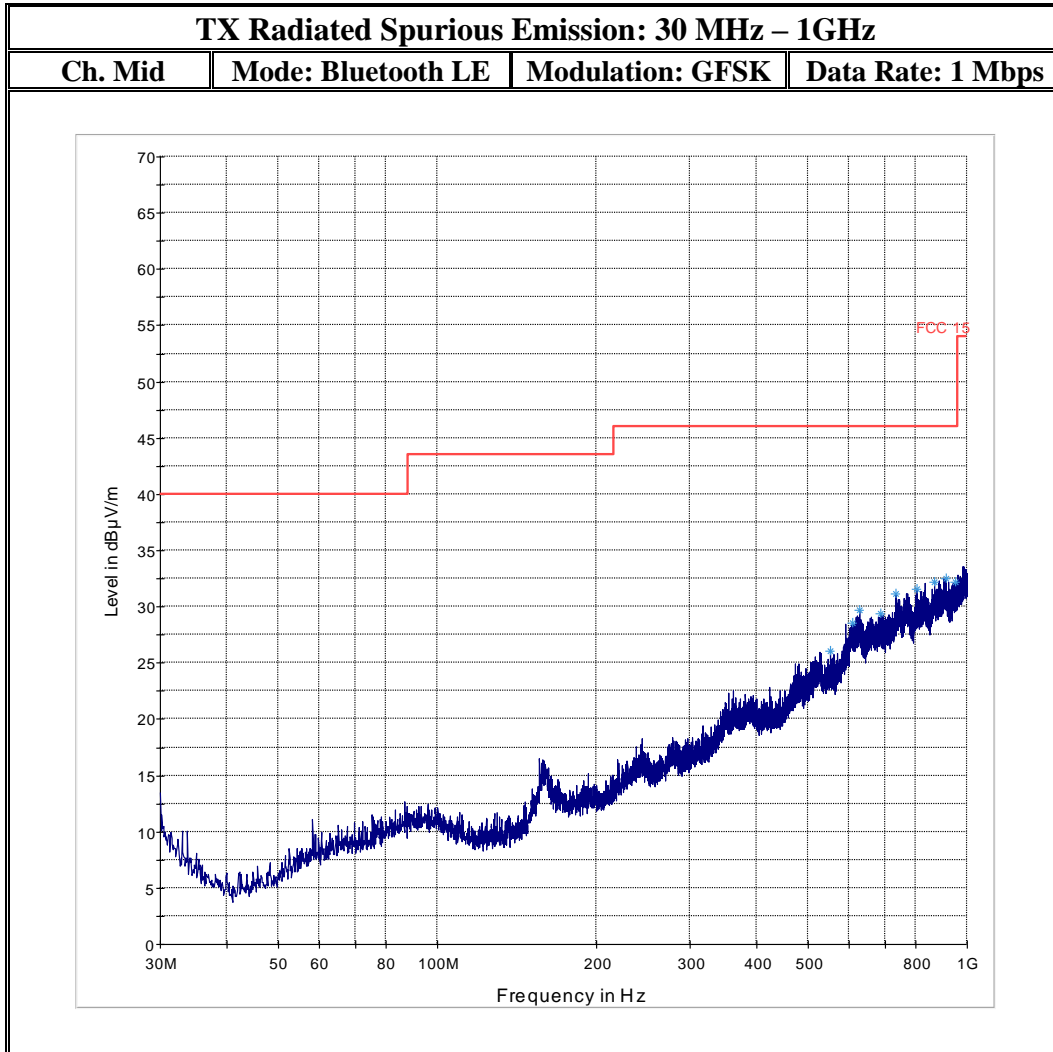


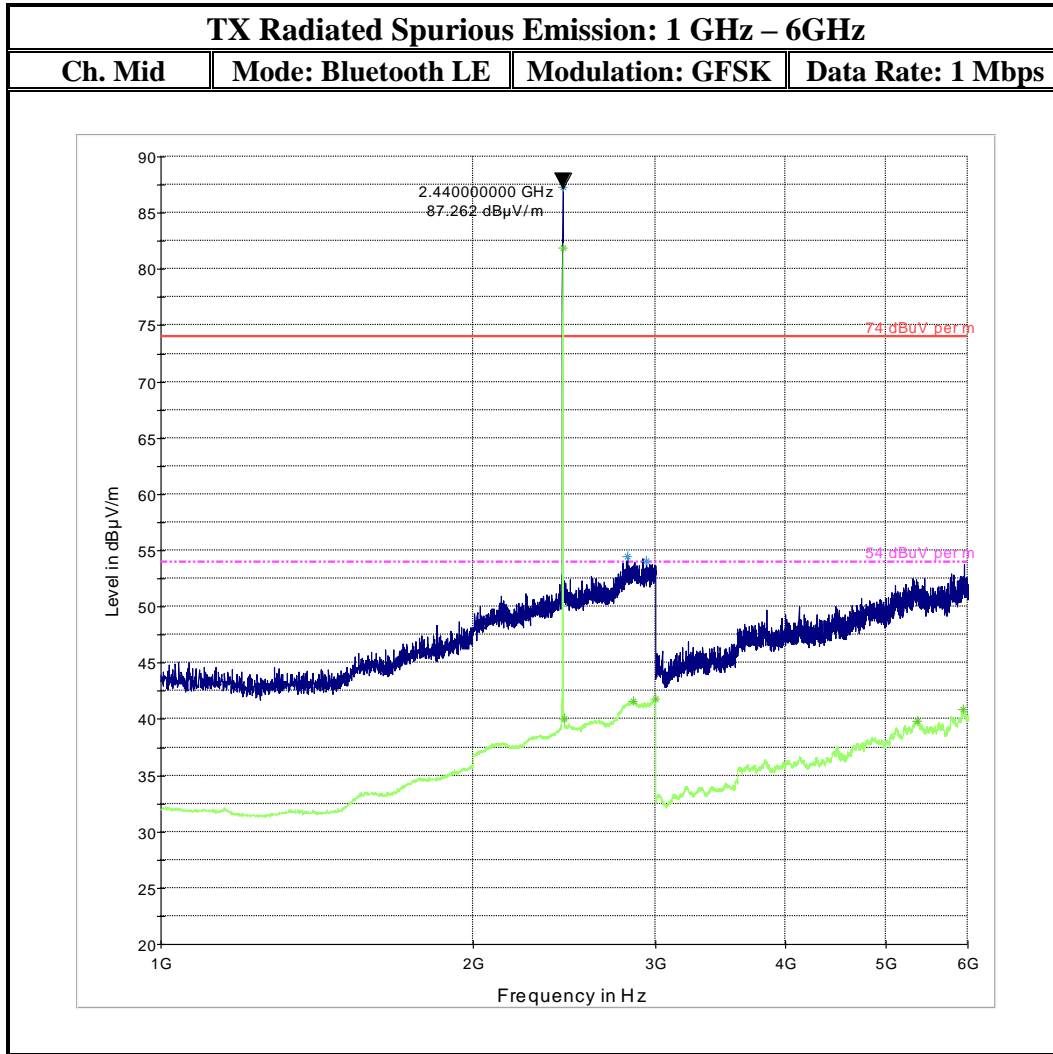


Note: the peak above the limit is the uplink signal

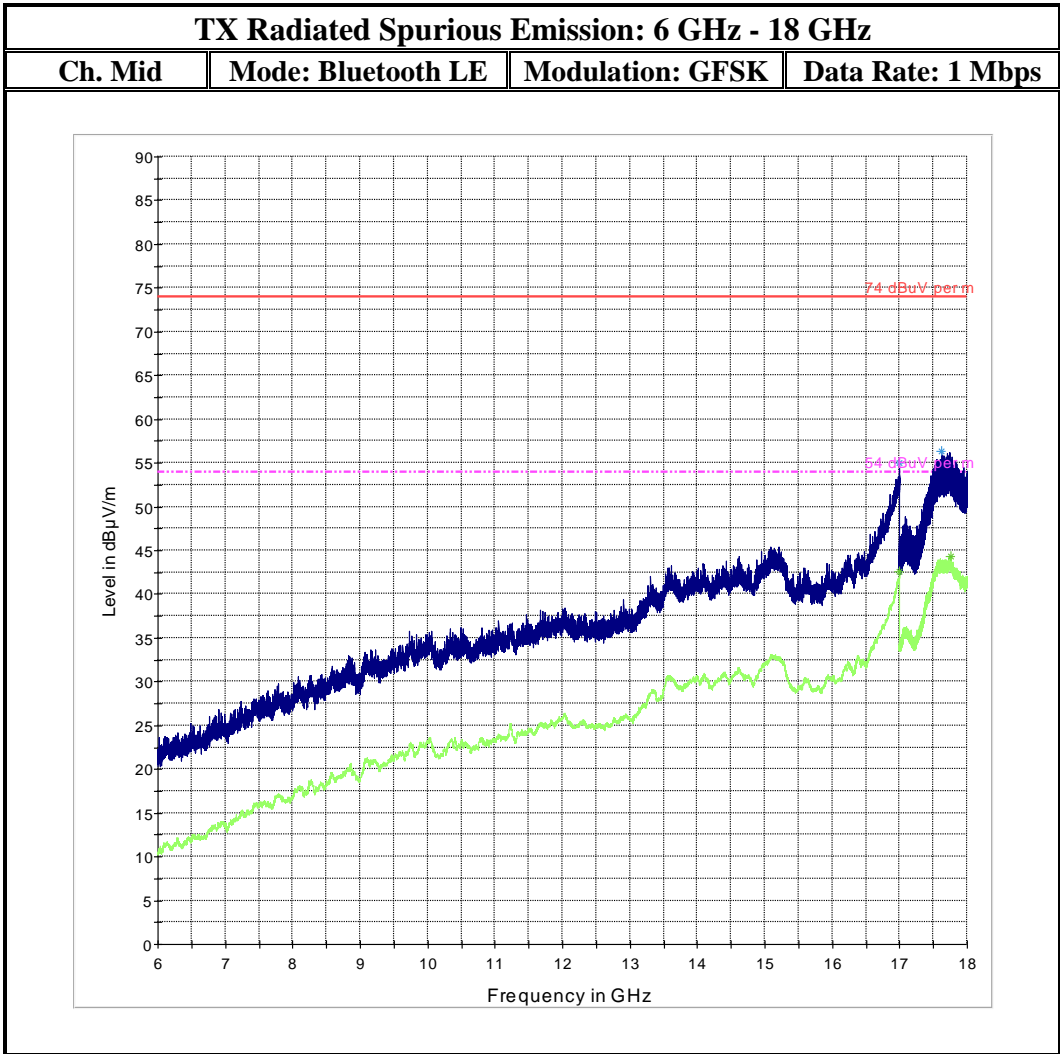




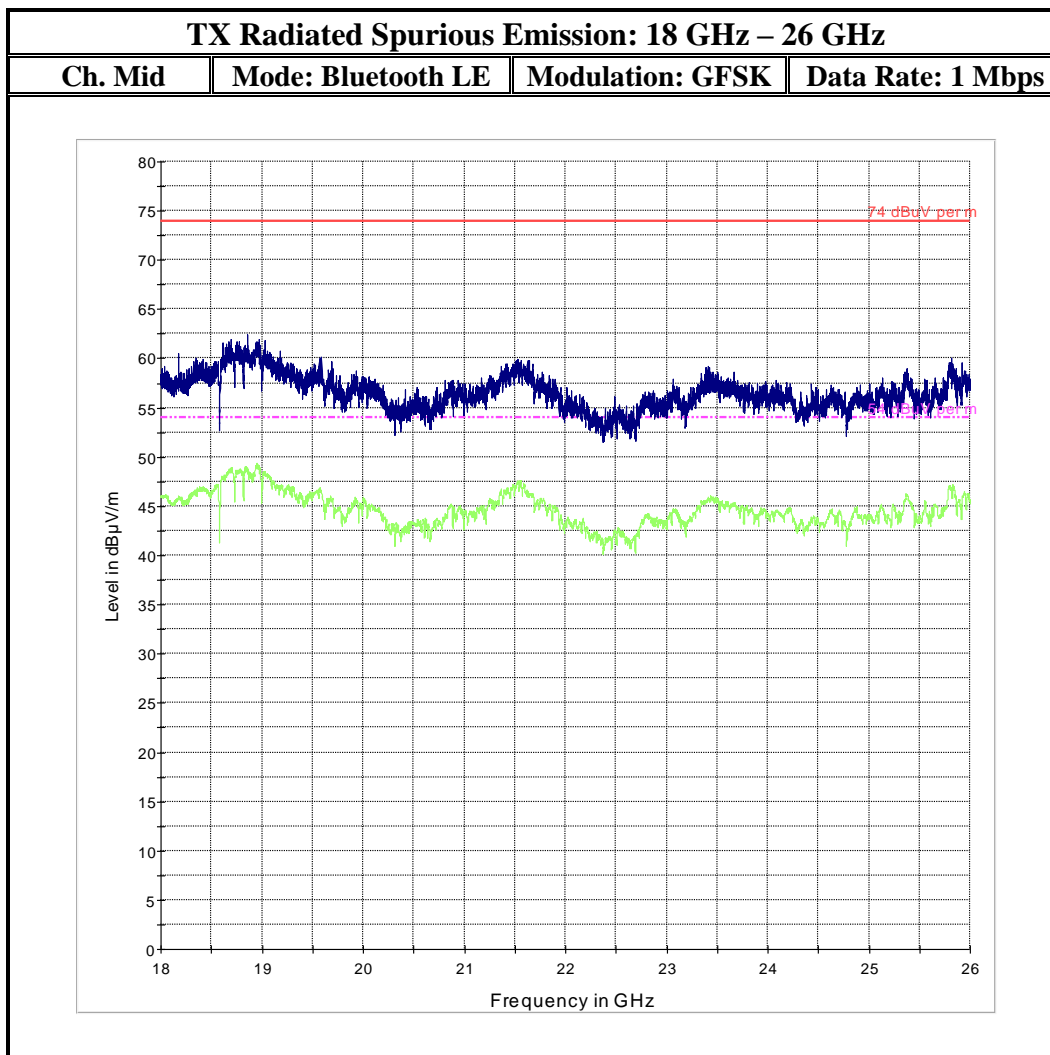


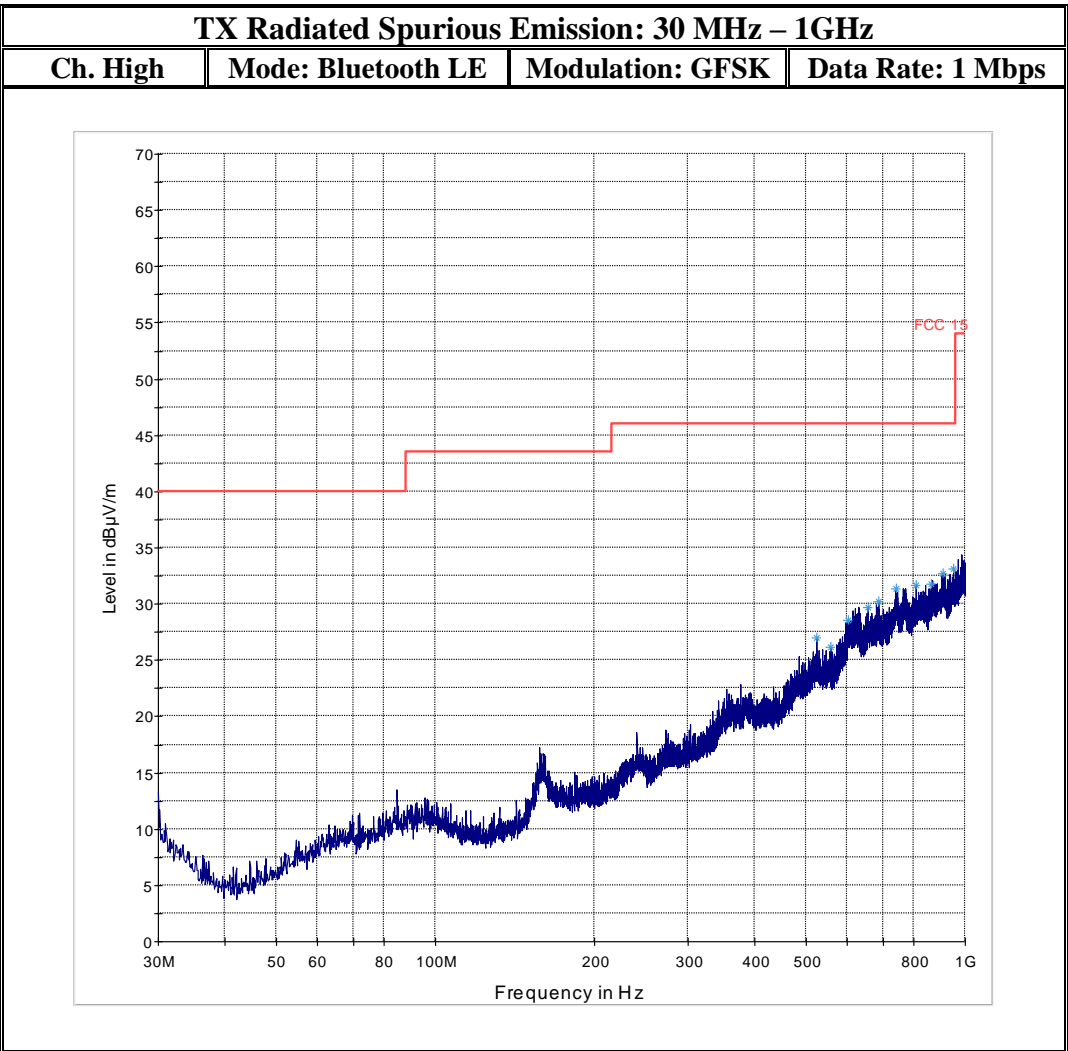


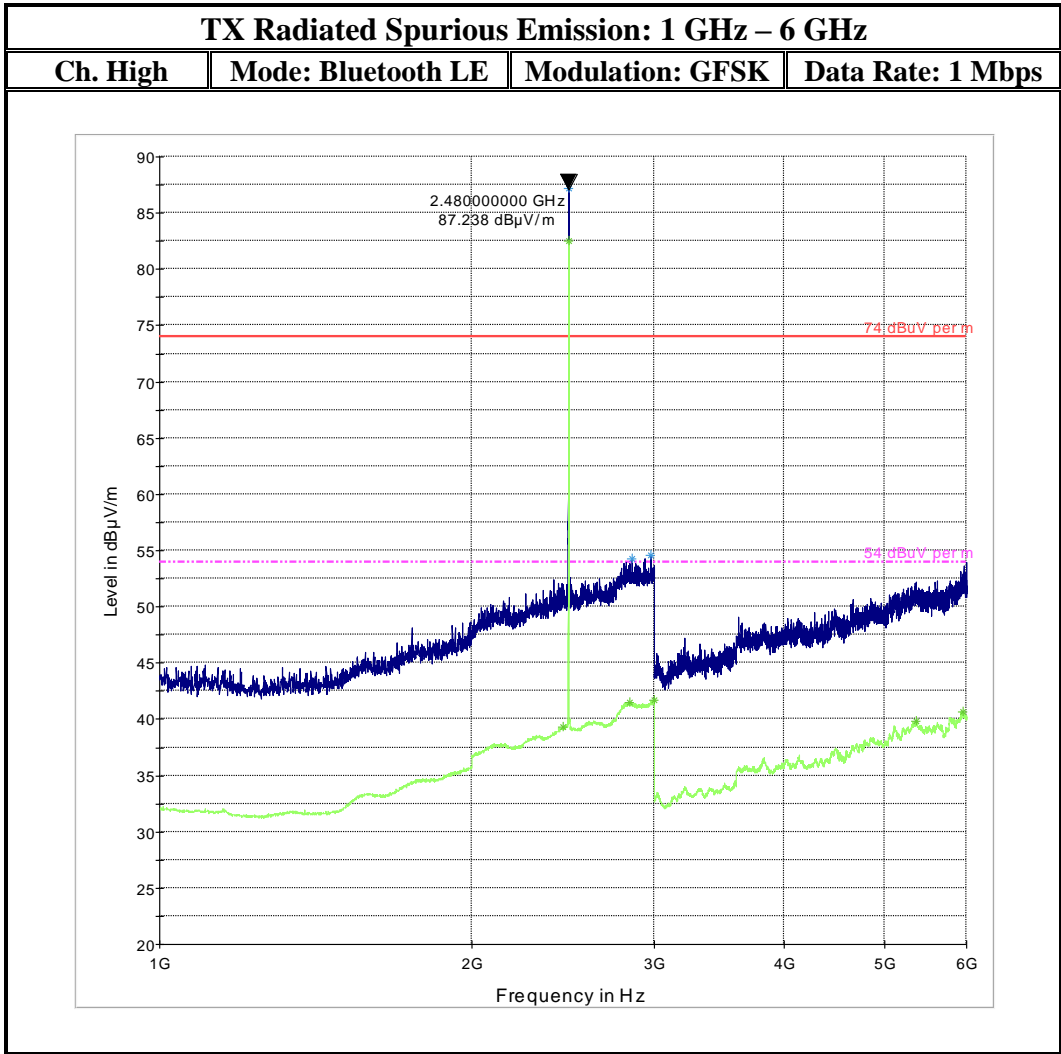
Note: the peak above the limit is the uplink signal

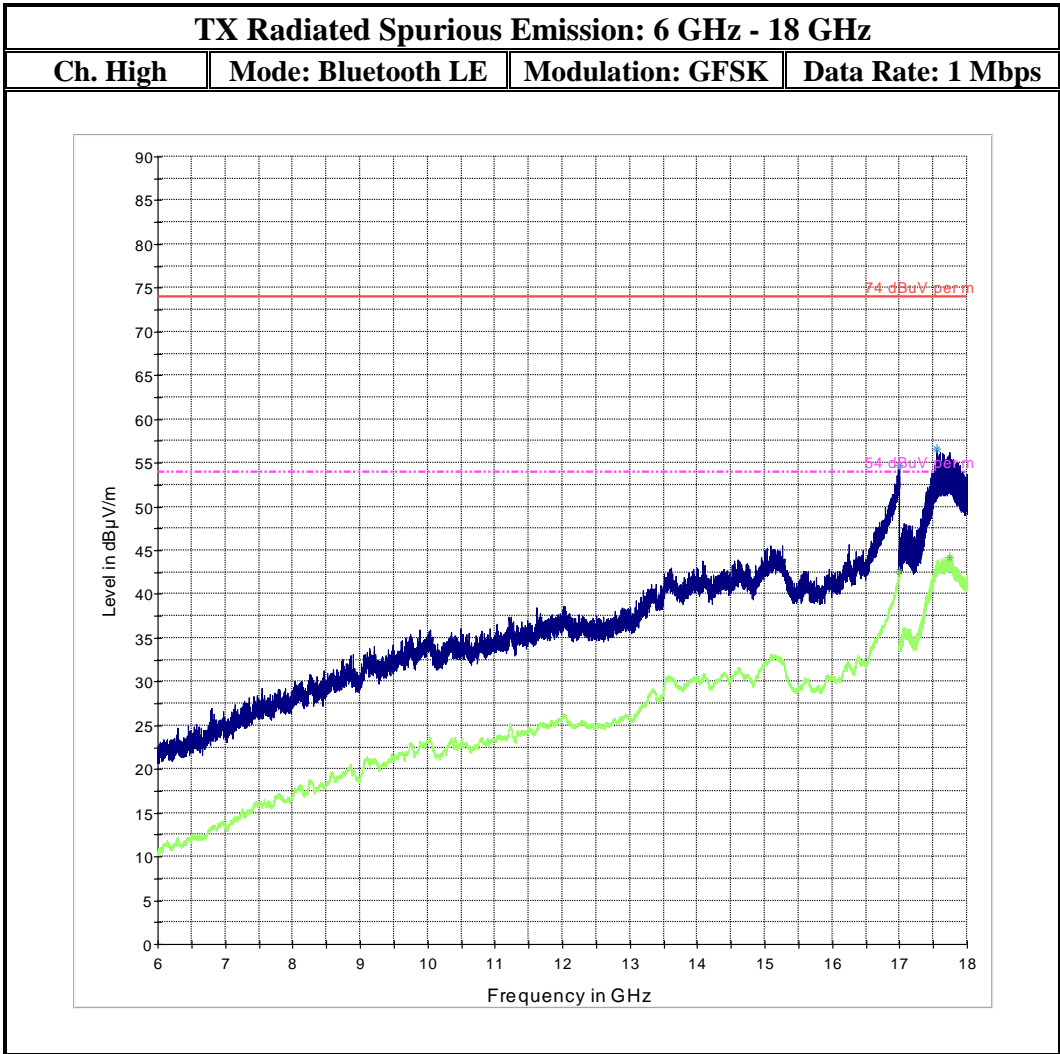



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## 8 Test Equipment and Ancillaries used for tests

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
	Turn table	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
	High Pass Filter	5HC2700	Trilithic Inc.	9926013	Part of system calibration	
	High Pass Filter	4HC1600	Trilithic Inc.	9922307	Part of system calibration	
	6GHz High Pass Filter	HPM50106	Microtronics	001	Part of system calibration	
	Pre-Amplifier	JS4-00102600	Miteq	00616	Part of system calibration	
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Jun 2015	2 Year
	Spectrum Analyzer	Rohde&Schwarz	FSU	200065	Jul 2015	3 Years
	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	ETS	3149	J000123908	Feb 2014	3 years
	Horn Antenna	EMCO	3115	35114	Jul 2015	3 Years
	Loop Antenna	ETS	6507	161344	Feb 2015	3 years

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## 9 Revision History

Date	Report Name	Report Changes	Report prepared by
2015-07-15	EMC_IRHYT-003-15001_15.247_BTLE	Initial Release	James Donnellan
2015-10-09	EMC_IRHYT-003-15001_15.247_BTLE-Rev1	Updated based on Review	James Donnellan