

## FCC Test Report for Part 15.247

Product name : GPS Tracking System Guardian module  
Applicant : Findster Technologies S.A.  
FCC ID : 2AHM8-FND16GUS

Test report No.: 160201122 Ver 1.00

## Laboratory information

### Accreditation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001

### Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Telefication Netherlands.

### Testing Location

Test Site	Telefication BV
Test Site location	Edisonstraat 12a 6902 PK Zevenaar The Netherlands  Tel. +31316583180 Fax. +31316583189
Test Site FCC	NL0001

## Revision History

Version	Date	Remarks	By
1.00	26-05-2016	Initial release	ing. P.A. Suringa
0.50	11-05-2016	Draft for peer review	ing. P.A. Suringa

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## Summary of Test results

FCC	Description	Section in report	Verdict
923 MHz band operation			
15.247(b) (3) (4)	RF output power	3.1	Pass
15.247(d)	Conducted Spurious emissions	3.3	Pass
15.247(d)	Conducted Band edge	3.4	Pass
15.247(d)	Radiated Spurious emissions	3.5	Pass
15.247(f)	Hybrid operation	3.2	Pass
BLE mode			
15.247(a)	6dB Bandwidth	4.1	Pass
15.247(b)	RF output power	4.2	Pass
15.247(e)	Power spectral density	4.3	Pass
15.247(d)	Conducted Spurious emissions	4.4	Pass
15.247(d)	Conducted Band edge	4.5	Pass
15.247(d)	Radiated Spurious emissions	4.6	Pass

## 1 General Description

### 1.1 Applicant

Client name:	Findster Technologies S.A.
Address	Rua Pedro Nunes, Edifício C, Coimbra
Zip code:	3030-199
Country:	Portugal
Telephone:	+351 223 248 286
E-mail:	<a href="mailto:info@getfindster.com">info@getfindster.com</a>
Contact name:	David Barroso

### 1.2 Manufacturer

Manufacturer name:	Findster Technologies S.A.
Address:	Rua Pedro Nunes, Edifício C, Coimbra
Zip code:	3030-199
Country:	Portugal
Telephone:	+351 223 248 286
E-mail:	<a href="mailto:info@getfindster.com">info@getfindster.com</a>
Contact name:	David Barroso

### 1.3 Tested Equipment Under Test (EUT)

Product name:	GPS Tracking System Guardian module
Brand name:	Findster GUARDIAN
FCC ID:	2AHM8-FND16GUS
Serial number:	00000
Software version:	01
Hardware version:	01
Date of receipt	28 – 03 - 2016
Tests started:	28 – 03 - 2016
Testing ended:	07 – 04 - 2016

## 1.4 Product specifications of Equipment under test

923 MHz band	
Tx Frequency range	917 – 926.8 MHz
Rx frequency range	917 – 926.8 MHz
Maximum output power to antenna	0.025 W
Antenna gain	-0.4 dBi
Type of modulation	Proprietary
Emission designator	125KG1D

Bluetooth Low Energy (BLE)	
Tx Frequency range	2402 - 2480 MHz
Rx frequency range	2402 - 2480 MHz
Maximum output power to antenna	0.001 W
Antenna gain	< 2.6 dBi
Type of modulation	GFSK
Emission designator	1M00G1D

## 1.5 Modification of the Equipment Under Test (EUT)

None.

## 1.6 Environmental conditions

- Ambient temperature 21°C
- Humidity 41%

## 1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standard:

- FCC Part 15 Subpart C §15.247

## 1.8 Measurement guidance's

- FCC Public Notice No. DA 00-705
- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V03r05
- ANSI C63.10:2013
- ANSI C63.4: 2014
- FCC KDB Publication No. 453039



## 1.9 Observations and remarks

The product, model Guardian, is part of a location system of which the other part bears the model name Child. Communicating through Radio Frequency (RF) enables real-time monitoring of the Child's geo-location and activity. A high-precision GNSS tracking system is used, as well as a proprietary communication in the sub 1 GHz ISM band.

Bluetooth Low Energy (BLE) is used to send information directly from the Guardian to the Findster App.

Models Guardian as well as Child are both equipped with the same type of 923 MHz band RF module. For the test results of this 923 MHz band module, reference is made to Telefication Test Report no. 160201125 Ver 1.00 throughout this report.

## 1.10 Conclusions

The sample of the product showed NO NON-COMPLIANCES to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards"*.

All conducted tests are performed by:

Name : ing. P.A. Suringa

Review of test methods and report by:

Name : ing. R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 26 May 2016

Name : ing. M.P.T.M. Wouters v/d Oudenweijer

Function : Director Certification

Signature :



## 2 Test configuration of the Equipment Under Test

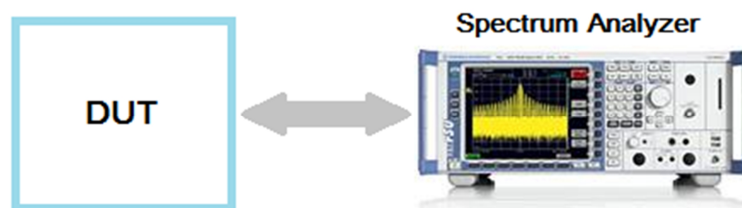
### 2.1 Test mode

The applicant provided test mode firmware of the EUT, in which it was possible to configure the EUT into different test channels.

### 2.2 Tested channels and Data rate

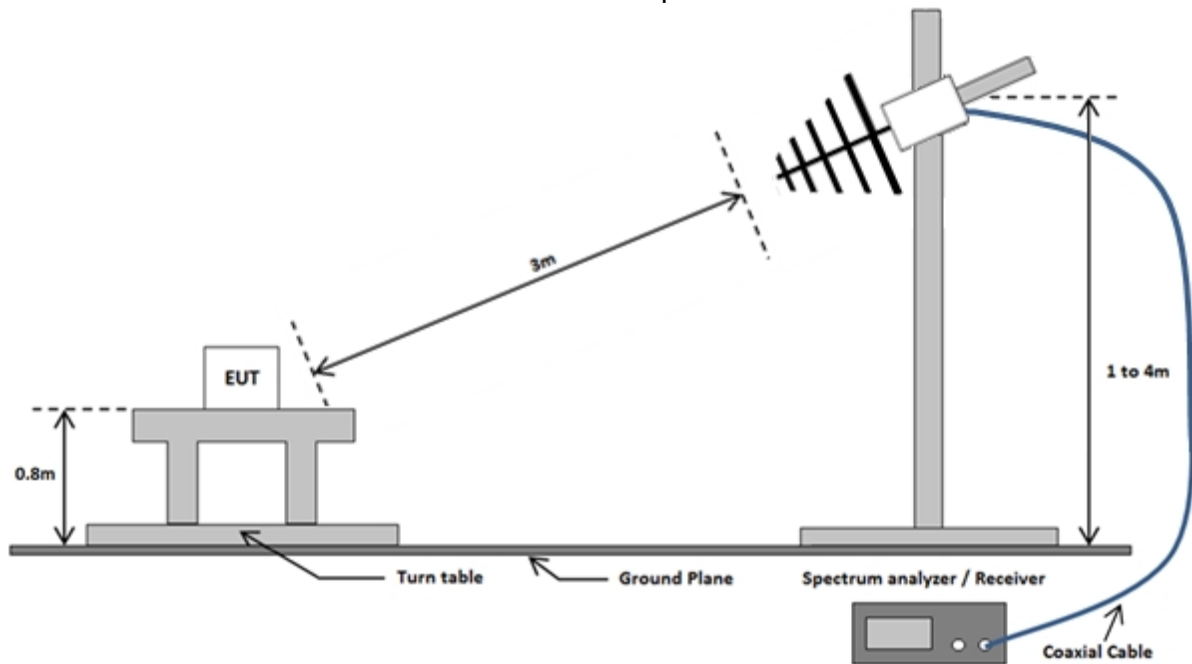
Technology Std.	Channel	Frequency (MHz)	Data rate
Bluetooth Low Energy	37	2402	1 Mbps
	17	2440	1 Mbps
	39	2480	1 Mbps

### 2.3 Conducted Test setup

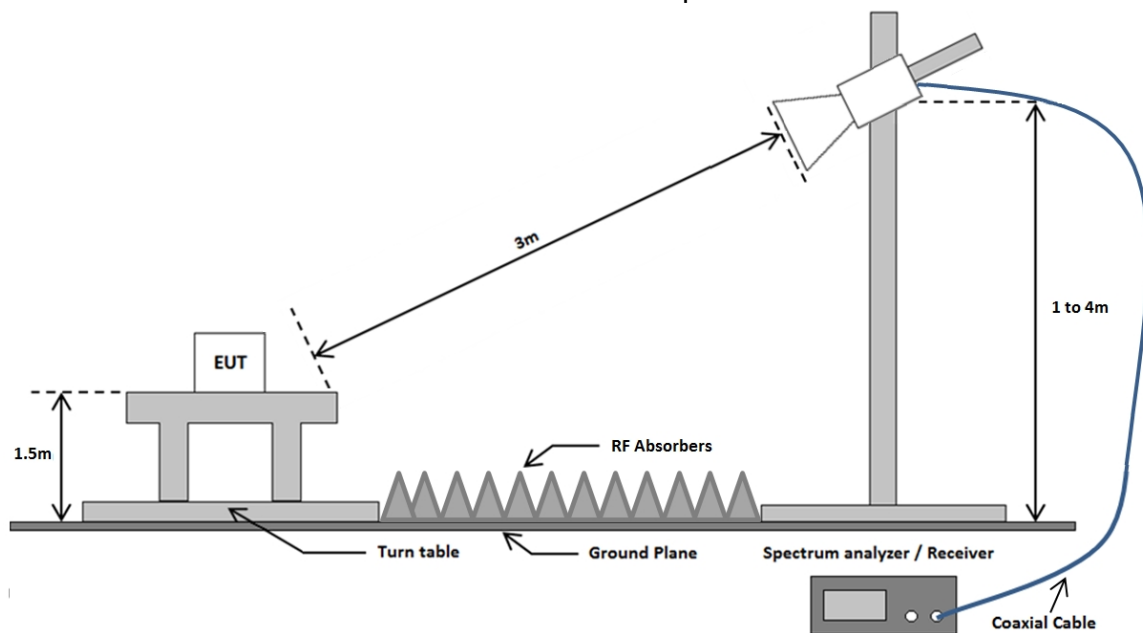


## 2.4 Radiated Test setup

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



## 2.5 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
EMI receiver	Rohde & Schwarz	ESR7	TE01220	4.6
Signal Analyzer	Rohde & Schwarz	FSP 40	TE11125	4.1, 4.2, 4.3, 4.4, 4.5, 4.6
Biconilog Antenna	Chase	CBL6112A	TE00967	--
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	4.6
Pre-amplifier	Miteq	JF4-18004000-30-8P-A1	TE11131	4.6
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE11132	4.6
Semi Anechoic Chamber (SAC)	Comtest Engineering BV	-	TE00861	4.6
High pass filter	Wainwright instruments	WHk3.0/18G-10EF	TE01140	4.6

## 2.6 Sample calculations

Field strength measurement example (ref. § 4.6.5 of this report)

Frequency	Polarization	Height	Peak
4,804 GHz	Vertical	4 m	40,1 dB $\mu$ V/m

The following relation applies:

$$E \text{ (dB}\mu\text{V/m)} = U \text{ (dB}\mu\text{V)} + AF \text{ (dB/m)} - G \text{ (dB)} + CL \text{ (dB)}$$

Where:

E = Electric field strength

U = Measuring receiver voltage

AF = Antenna Factor

G = Gain of the pre-amplifier

CL = Cable Loss

$$(40.1 = 28.9 + 33.0 - 28.8 + 7)$$

### **3 Test results 925 MHz band**

#### **3.1 Output Power Measurement**

Refer to section 3.1 of Telefication Test Report no. 160201125 Ver 1.0

#### **3.2 Hybrid operation**

##### **3.2.1 Power density**

Refer to section 3.2.1 of Telefication Test Report no. 160201125 Ver 1.00

##### **3.2.2 Average time of occupancy**

Refer to section 3.2.2 of Telefication Test Report no. 160201125 Ver 1.00

##### **3.2.3 Hopping function of a hybrid system: channel separation**

Refer to section 3.2.3 of Telefication Test Report no. 160201125 Ver 1.00

#### **3.3 Conducted Spurious Emissions Measurement**

Refer to section 3.3 of Telefication Test Report no. 160201125 Ver 1.00

#### **3.4 Conducted band edge measurements**

Refer to section 3.4 of Telefication Test Report no. 160201125 Ver 1.00

#### **3.5 Tx Radiated Emissions Measurement**

Refer to section 3.5 of Telefication Test Report no. 160201125 Ver 1.00

#### **3.6 Rx Radiated Emissions Measurement**

Refer to section 3.6 of Telefication Test Report no. 160201125 Ver 1.00

## 4 Test results BLE

### 4.1 6dB bandwidth Measurement

#### 4.1.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

#### 4.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

#### 4.1.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

#### 4.1.4 Test procedure

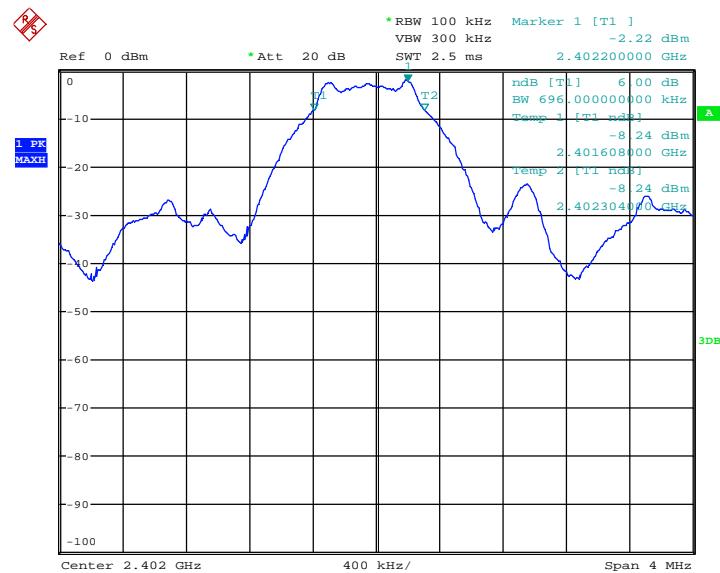
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.
4. Measurement is made with Spectrum analyser RBW =100 kHz. VBW = 3xRBW = 300 kHz.

#### 4.1.5 Test results of the 6 dB bandwidth Measurement

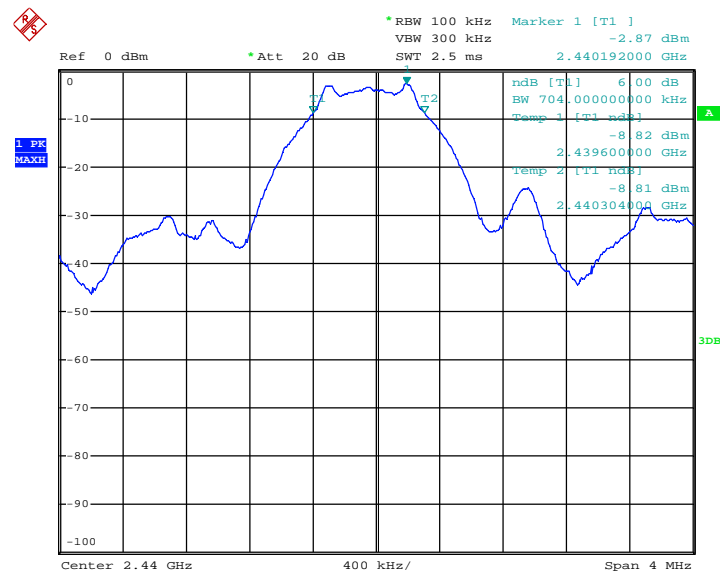
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low Energy	37	2402	1 Mbps	696
	17	2440	1 Mbps	704
	39	2480	1 Mbps	696
Uncertainty	±88.2 kHz			

## 4.1.6 Plots of the 6 dB bandwidth Measurement

### BLE 6 dB Bandwidth (Channel 37)



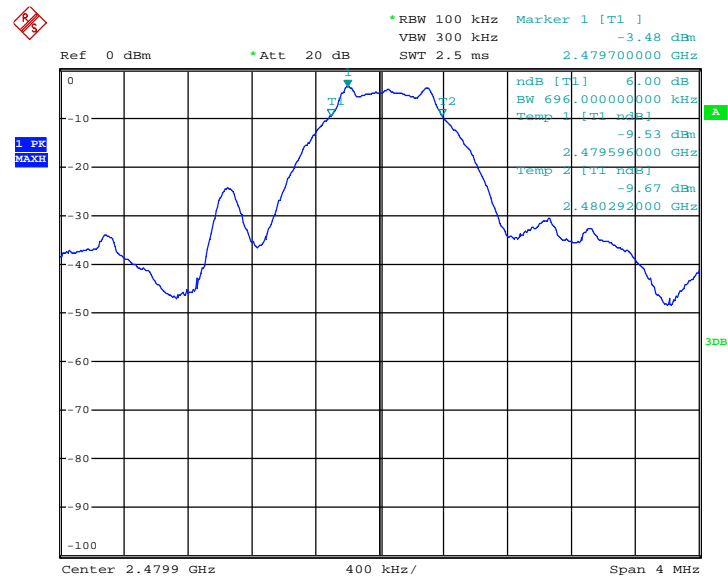
### BLE 6 dB Bandwidth (Channel 19)





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## BLE 6 dB Bandwidth (Channel 39)



## 4.2 Output Power Measurement

### 4.2.1 Limit

For systems using digital modulation in the 2400-2483.5 MHz, the limit for the peak output power is 30 dBm. If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

### 4.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

### 4.2.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

### 4.2.4 Test procedure

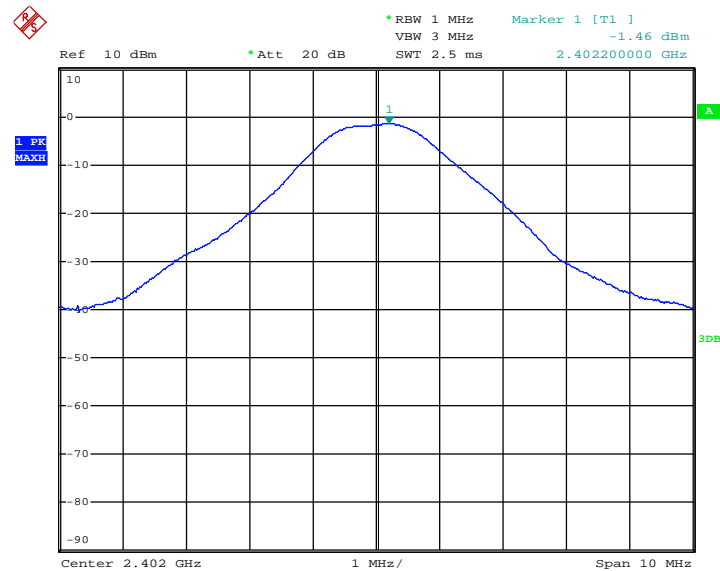
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.

### 4.2.5 Test results of Output Power Measurement

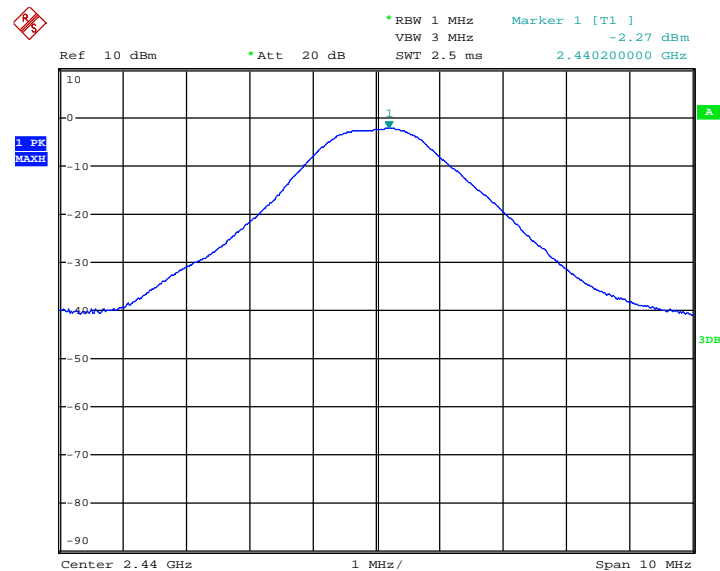
Technology Std.	Channels	Peak method		Peak output power (dBm)
		Frequency (MHz)	Data rate	
Bluetooth Low Energy	37	2402	1 Mbps	-1.46
	17	2440	1 Mbps	-2.27
	39	2480	1 Mbps	-2.97
Uncertainty	$\pm 1.78$ dB			

## 4.2.6 Plots of Peak Output Power Measurement

### BLE Peak Output Power (Channel 37)

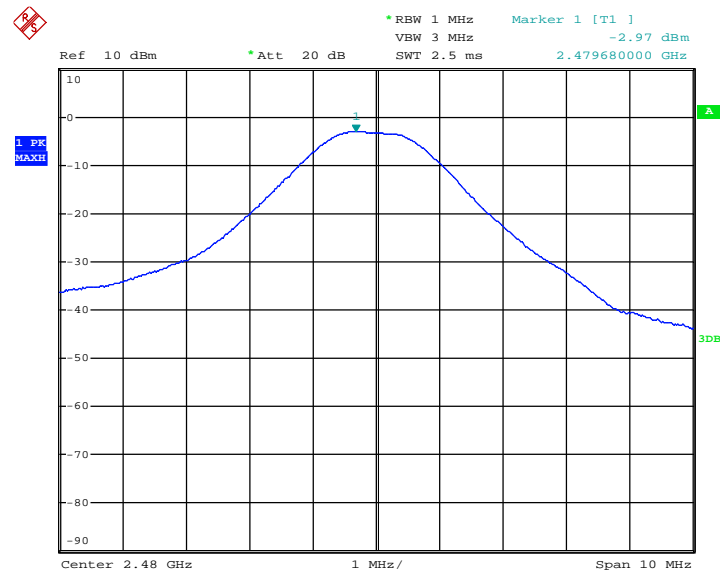


### BLE Peak Output Power (Channel 17)



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## BLE Peak Output Power (Channel 39)



### 4.3 Power Spectral Density

#### 4.3.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

#### 4.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

#### 4.3.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

#### 4.3.4 Test procedure

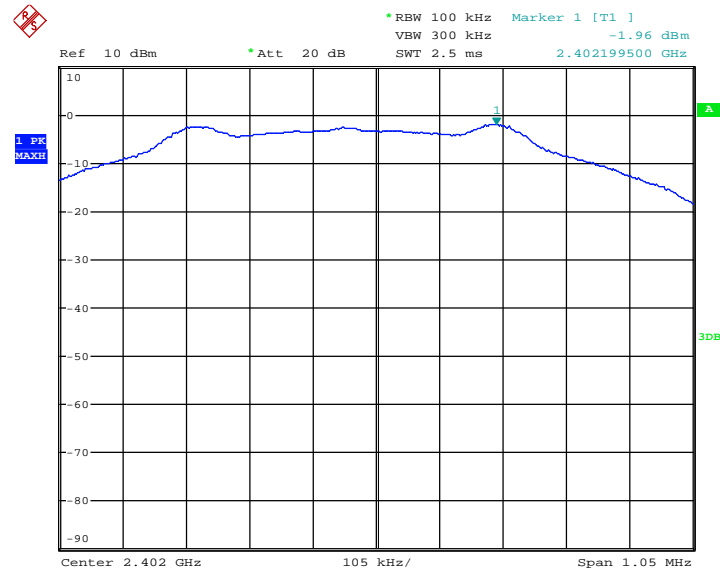
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.
4. The spectrum analyser is configured as following: RBW = 100kHz, VBW = 300 kHz which is equal or greater than 3xRBW, Detector = Peak, Sweep time = Auto couple, Trace mode = Max hold, Allow the trace to fully stabilize. Using the marker function of the spectrum analyzer to determine the maximum power level.

#### 4.3.5 Test results of Power Spectral Density Measurement

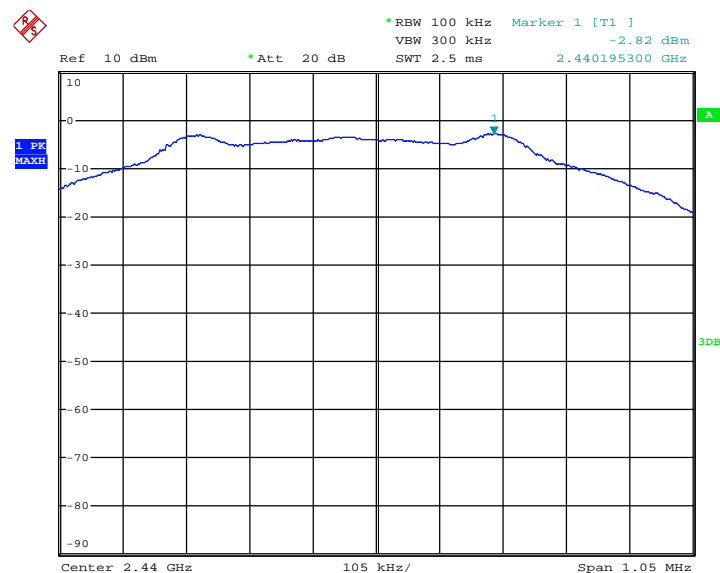
Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/100 kHz (dBm)
Bluetooth Low Energy	37	2402	1 Mbps	-1.96
	17	2440	1 Mbps	-2.82
	39	2480	1 Mbps	-3.52
Uncertainty	$\pm 0.63$ dB			

## 4.3.6 Plots of the Power Spectral Density Measurement

### Power Spectral Density 100 kHz (channel 37)

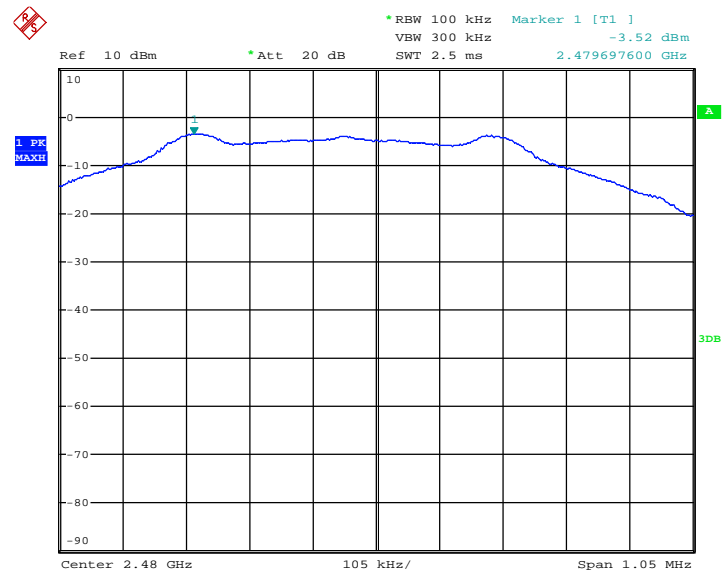


### Power Spectral Density 100 kHz (channel 17)



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## Power Spectral Density 100 kHz (channel 39)



## 4.4 Conducted Spurious Emissions Measurement

### 4.4.1 Limit

In any 100 kHz bandwidth outside the operating frequency band, the RF power 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 a RF conducted or a radiated measurement.

### 4.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

### 4.4.3 Test setup

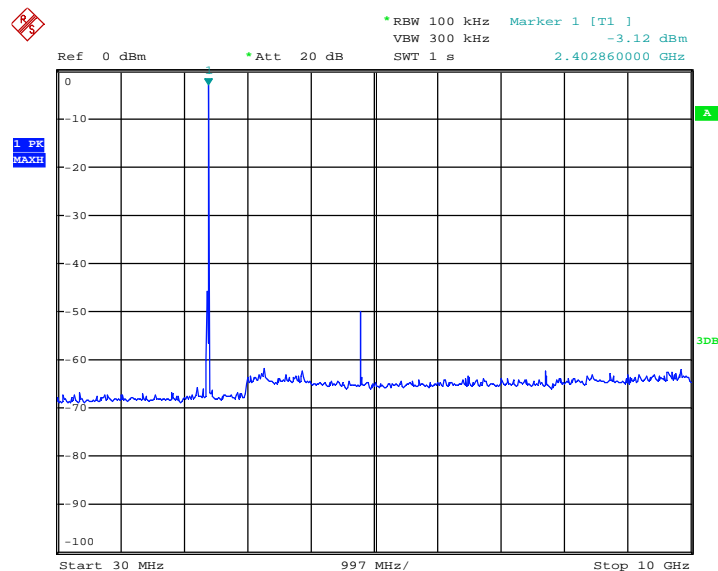
The test setup is as shown in chapter 2.3 of this report.

### 4.4.4 Test procedure

According to KDB Publication 558074 V03r05, sections 11.3 and 12.1

### 4.4.5 Plots of the Conducted Spurious Measurements

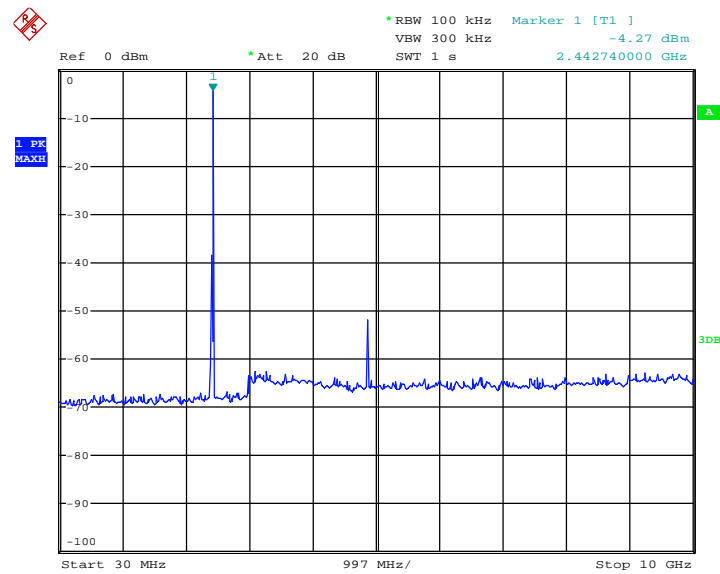
Conducted Spurious Emissions 30 -10000 MHz (Channel 37)



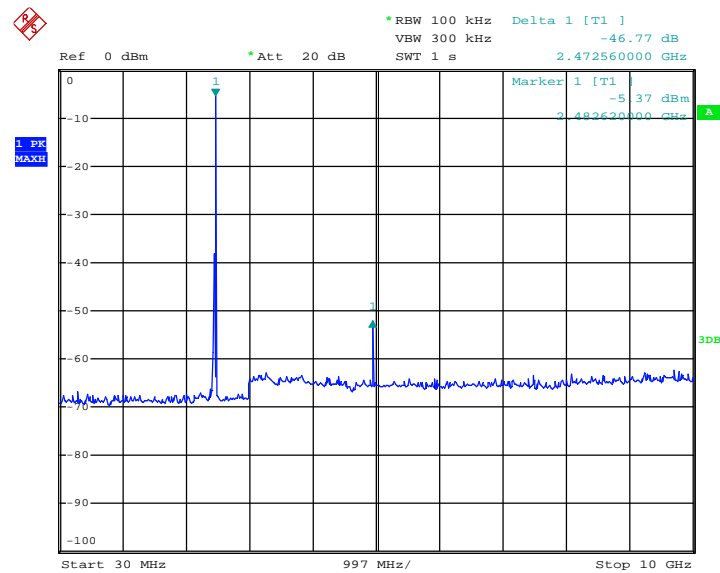


Report number: 160201122 Ver 1.00

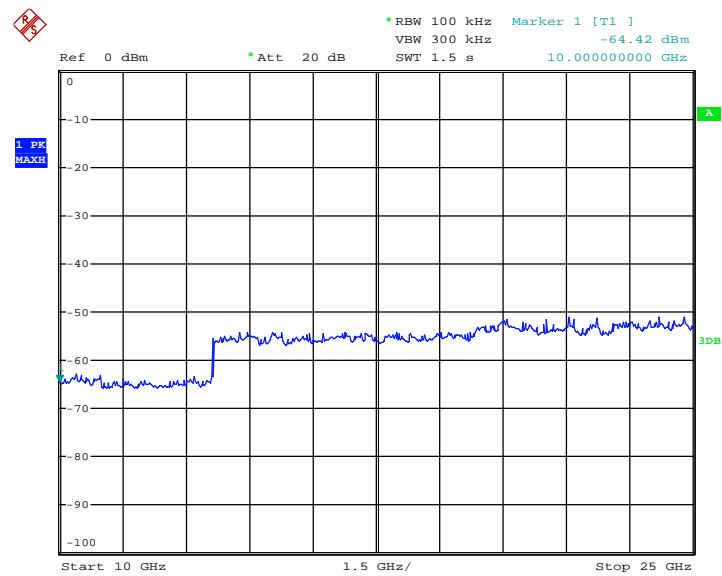
## Conducted Spurious Emissions 30 -10000 MHz (Channel 19)



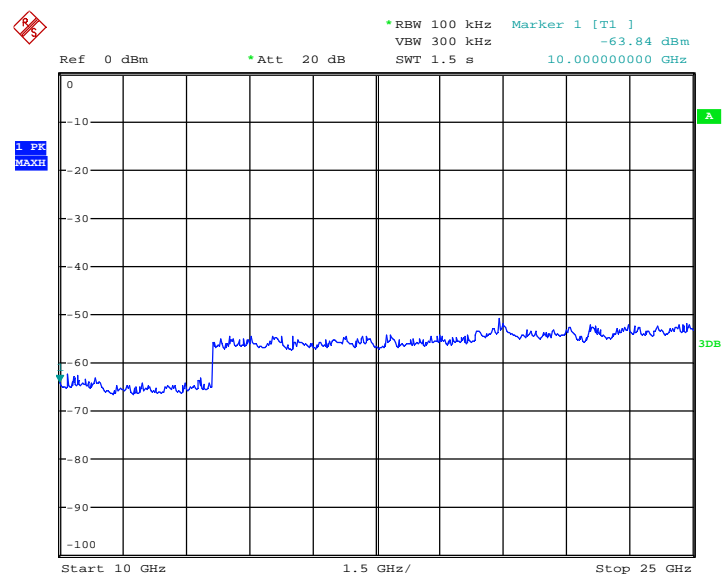
## Conducted Spurious Emissions 30 -10000 MHz (Channel 39)



### Conducted Spurious Emissions 10 – 25 GHz (Channel 0)

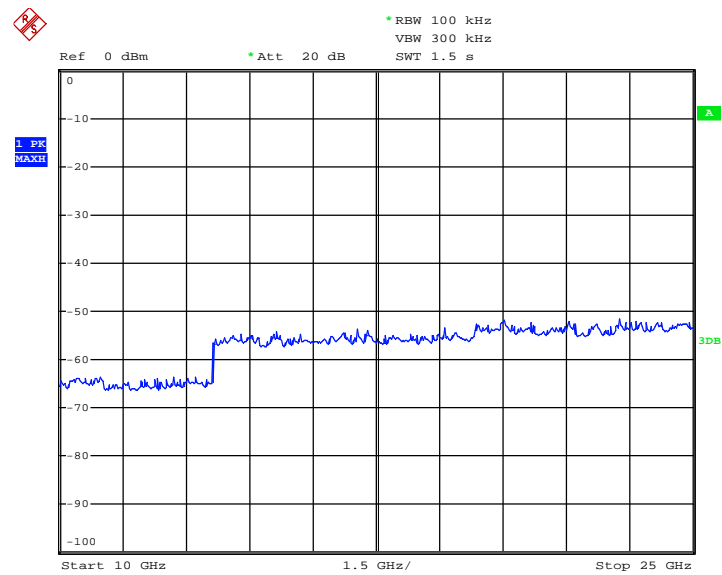


### Conducted Spurious Emissions 10 – 25 GHz (Channel 19)



Report number: 160201122 Ver 1.00

## Conducted Spurious Emissions 2 – 25 GHz (Channel 39)



## Measurement uncertainty

0.03 – 18 GHz	+0.6/-0.6 dB
---------------	--------------

## 4.5 Conducted Band edge Measurement

### 4.5.1 Limit

At the band edge of the authorized band, the level of the emission shall be at least 20 dB below the peak of the in-band emission, based on either a RF conducted or a radiated measurement.

### 4.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

### 4.5.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

### 4.5.4 Test procedure

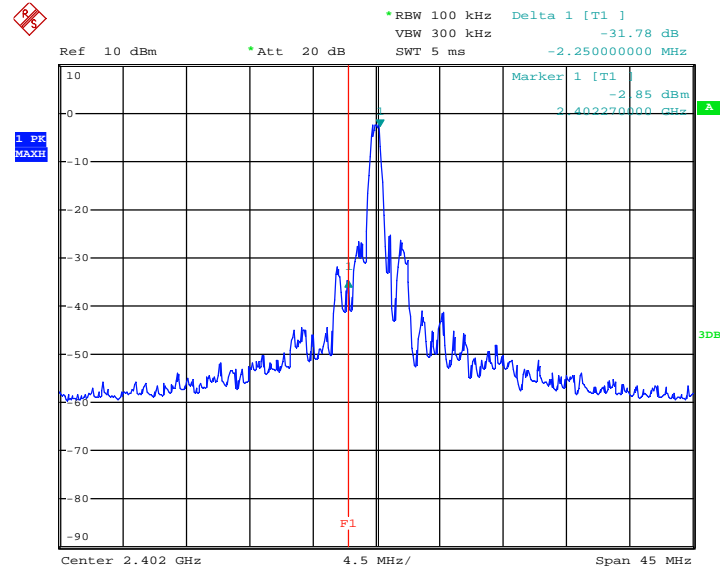
According to KDB Publication 558074 V03r05, sections 11.3 and 12.1

### 4.5.5 Test results of conducted Band Edges Measurements

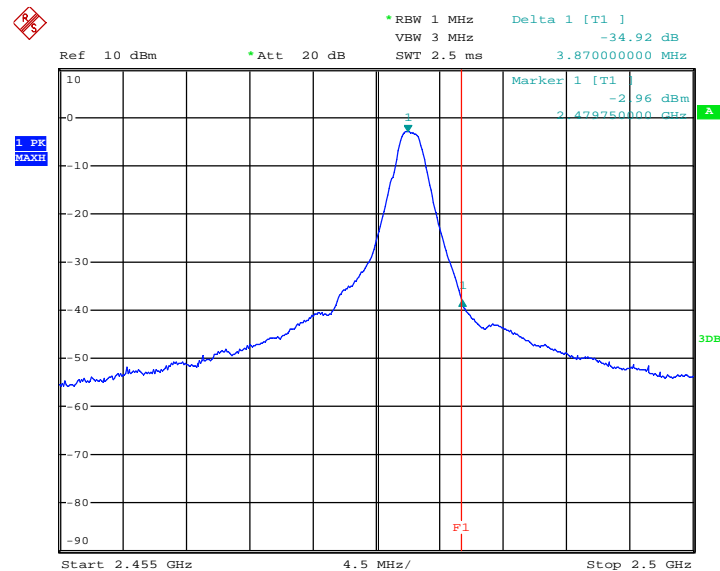
Technology Std.	Band edge				
	Channels	Frequency (MHz)	Data rate	N dB down (dB)	Limit (dB)
Bluetooth Low Energy	37	2402	1 Mbps	N = 31.8	≥ 20
	39	2480	1 Mbps	N = 34.9	≥ 20
Uncertainty	±0.63 dB				

## 4.5.6 Plots of the Conducted Band edge Measurements

### BLE Conducted Lower band edge(Channel 37)



### BLE Conducted Upper band edge(Channel 39)



## 4.6 Radiated Spurious Emissions Measurement

### 4.6.1 Limit

According to FCC part 15.209(a)

Frequency (MHz)	Field strength ( $\mu\text{V}/\text{m}$ )	Field strength ( $\text{dB}\mu\text{V}/\text{m}$ )	Measurement distance(m)
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

### 4.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

### 4.6.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

### 4.6.4 Test procedure

According to KDB Publication 558074 V03r05, sections 11.3 and 12.1

### 4.6.5 Test results of the Radiated Spurious Measurement

Frequency	Polarization	Height	Peak
4,804 GHz	Vertical	4 m	40,1 $\text{dB}\mu\text{V}/\text{m}$
4,879 GHz	Vertical	3,5 m	38,1 $\text{dB}\mu\text{V}/\text{m}$
4,959 GHz	Vertical	3,5 m	36,3 $\text{dB}\mu\text{V}/\text{m}$

Frequency	Polarization	Height	Peak
4,804 GHz	Horizontal	4 m	40,5 $\text{dB}\mu\text{V}/\text{m}$
4,879 GHz	Horizontal	3,5 m	38,4 $\text{dB}\mu\text{V}/\text{m}$
2,479 GHz	Horizontal	1 m	32,4 $\text{dB}\mu\text{V}/\text{m}$

Measurement uncertainty

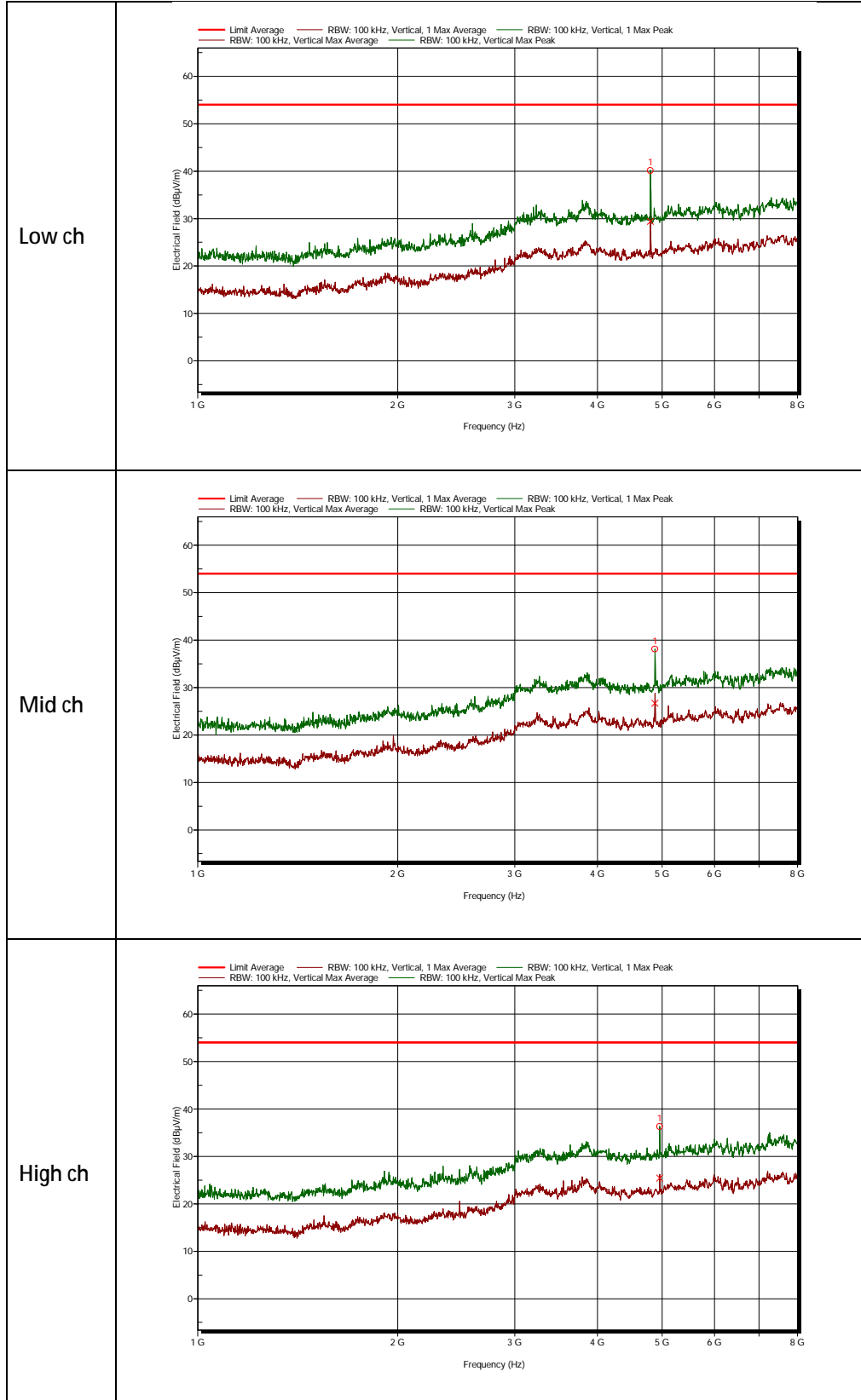
Frequency range (MHz)	Horizontal polarization	Vertical polarization
30 – 200	4.5 dB	5.4 dB
200 – 1000	3.6 dB	4.6 dB
1000 - 18000	5.7 dB	5.7 dB

Note:

Conducted measurements are performed in the range 0.03 - 25 GHz (ref. section 4.4) resulting in no observable harmonics other than the second (4.8 GHz), therefore radiated measurements were limited from 1 to 8 GHz

## 4.6.6 Plots of the Radiated Spurious Measurement

### Vertical polarization



### Horizontal polarization

