



<b>EMC TEST REPORT</b> <b>FCC 47 CFR Part 15B</b> <b>Industry Canada ICES-003</b> <b>Electromagnetic compatibility - Unintentional radiators</b>	
<b>Report Reference No.</b> .....	G0M-1707-6725-EF0115B-V01
<b>Testing Laboratory</b> .....	Eurofins Product Service GmbH
Address .....	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation .....	<div style="text-align: center;">   </div> <p>A2LA Accredited Testing Laboratory, Certificate No.: 1983.01            FCC Test Firm Designation Number: DE0008            IC Testing Laboratory site: 3470A-2</p>
<b>Applicant's name</b> .....	Leica Geosystems AG
Address .....	Heinrich Wild Strasse 9435 Heerbrugg SWITZERLAND
<b>Test specification:</b>	
Standard.....	47 CFR Part 15 Subpart B ICES-003, Issue 6:2016 ANSI C63.4:2014
<b>Equipment under test (EUT):</b>	
Product description	External GNSS Antenna
Model No.	GG04 plus
Additional Models	None
Hardware version	1.0.1
Firmware / Software version	1.0.12
	FCC-ID: RFD-SAGG04P                      IC: 3177A-SAGG04P
<b>Test result</b>	<b>Passed</b>

**Possible test case verdicts:**


- not applicable to test object ..... : N/A
- test object does meet the requirement..... : P (Pass)
- test object does not meet the requirement..... : F (Fail)


**Testing:**

Date of receipt of test item ..... : 2017-09-11

Date (s) of performance of tests ..... : 2017-11-21 – 2017-11-22

Compiled by ..... : Matthias Handrik

Tested by (+ signature)..... : Matthias Handrik 

Approved by (+ signature) ..... : Jens Marquardt 

Deputy Head of Lab

Date of issue ..... : 2017-11-22

Total number of pages ..... : 24

**General remarks:**

**The test results presented in this report relate only to the object tested.**

**The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.**

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

**Additional comments:**

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## Version History

Version	Issue Date	Remarks	Revised by
V01	2017-11-22	Initial Release	

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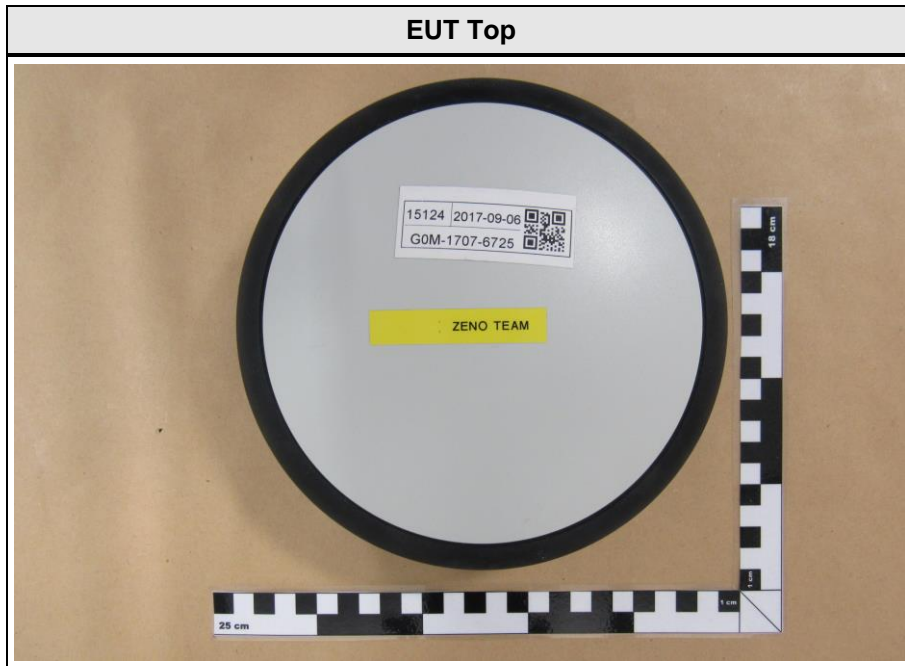
## REPORT INDEX

<b>1</b>	<b>EQUIPMENT (TEST ITEM) DESCRIPTION</b>	<b>5</b>
1.1	Photos – Equipment external	6
1.2	Photos – Equipment internal	7
1.3	Photos – Test setup	9
1.4	Supporting Equipment Used During Testing	10
1.5	Input / Output Ports	10
1.6	Operating Modes and Configurations	11
1.7	Test Equipment Used During Testing	12
1.8	Sample emission level calculation	13
<b>2</b>	<b>RESULT SUMMARY</b>	<b>14</b>
<b>3</b>	<b>TEST CONDITIONS AND RESULTS</b>	<b>15</b>
3.1	Test Conditions and Results – Radiated emissions	15

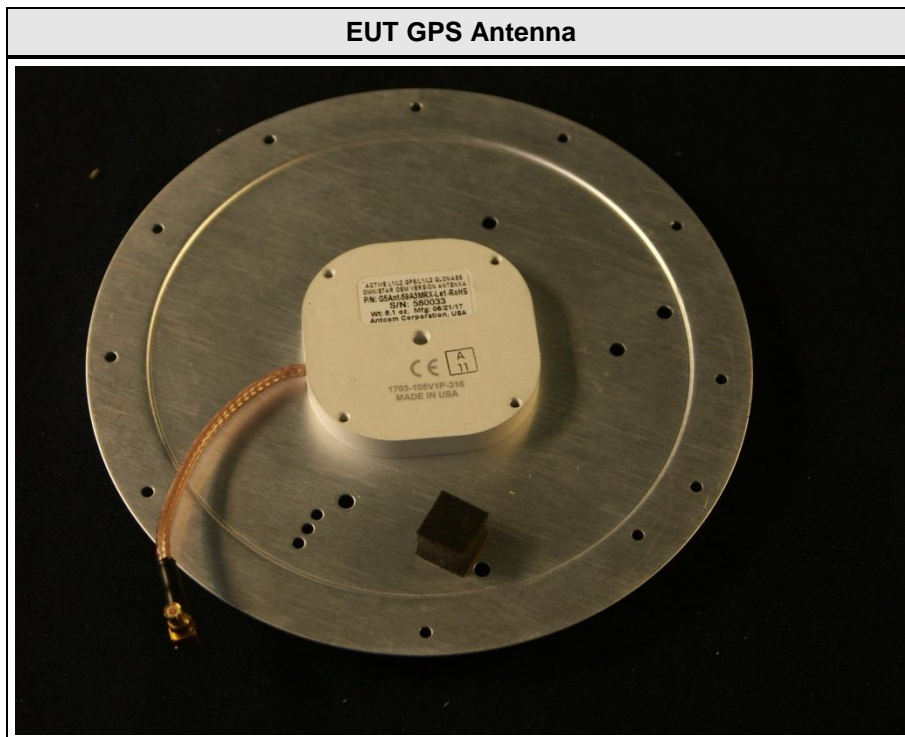
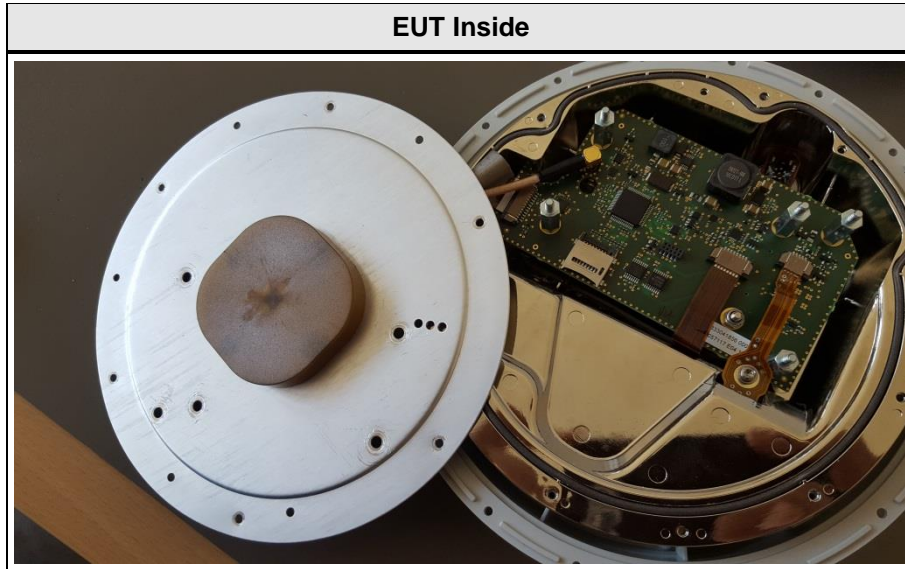
## 1 Equipment (Test item) Description

<b>Description</b>	External GNSS Antenna	
<b>Model</b>	GG04 plus	
<b>Additional Models</b>	None	
<b>Serial number</b>	None	
<b>Hardware version</b>	1.0.1	
<b>Software / Firmware version</b>	1.0.12	
<b>FCC-ID</b>	RFD-SAGG04P	
<b>Contains IC</b>	3177A-SAGG04P	
<b>Power supply</b>	7.2 VDC	
<b>AC/DC-Adaptor</b>	None	
<b>Radio module</b>	Type	Bluetooth module
	Model	unspecified
	Manufacturer	TI
	HW Version	unspecified
	SW Version	unspecified
	FCC-ID	Z64-2564N
	IC	451I-2564N
<b>Manufacturer</b>	Leica Geosystems AG Heinrich Wild Strasse 9435 Heerbrugg SWITZERLAND	
<b>Highest emission frequency</b>	Fmax [MHz] = 2400	
<b>Device classification</b>	Class B	
<b>Equipment type</b>	Tabletop	
<b>Number of tested samples</b>	1	

1.1 Photos – Equipment external

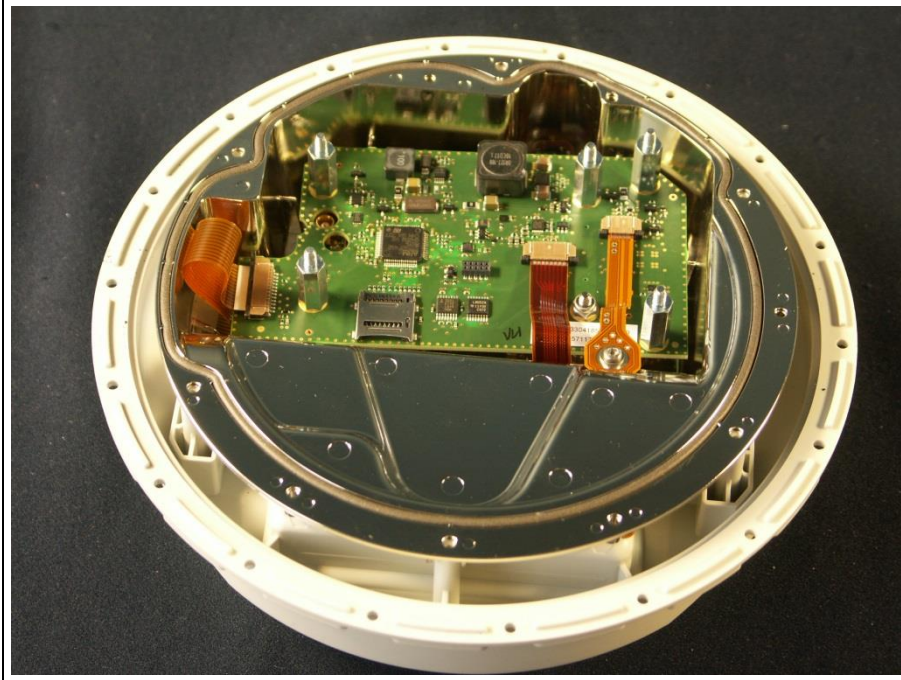


1.2 Photos – Equipment internal

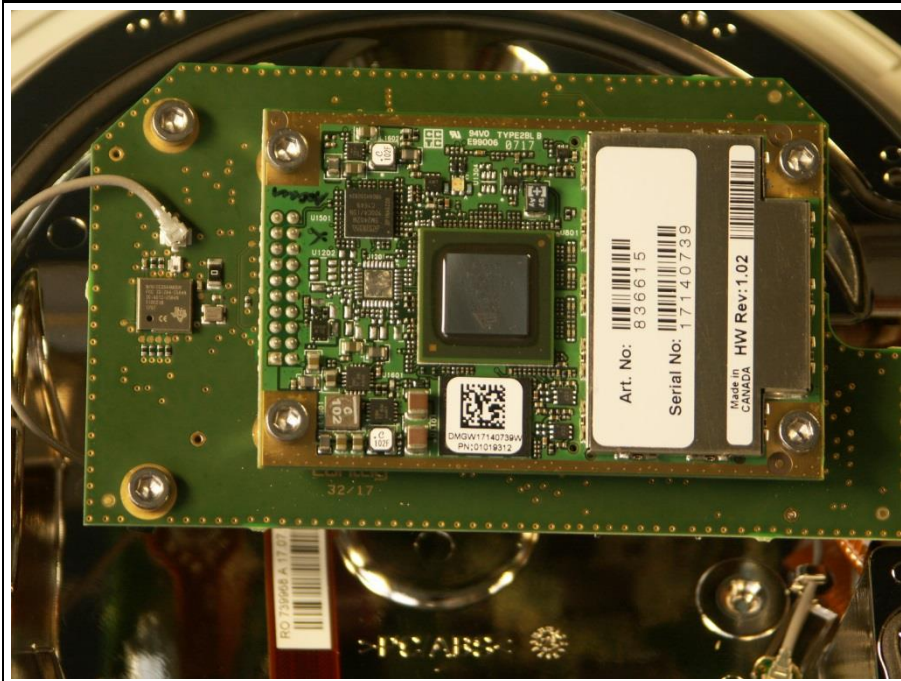




EUT PCB I

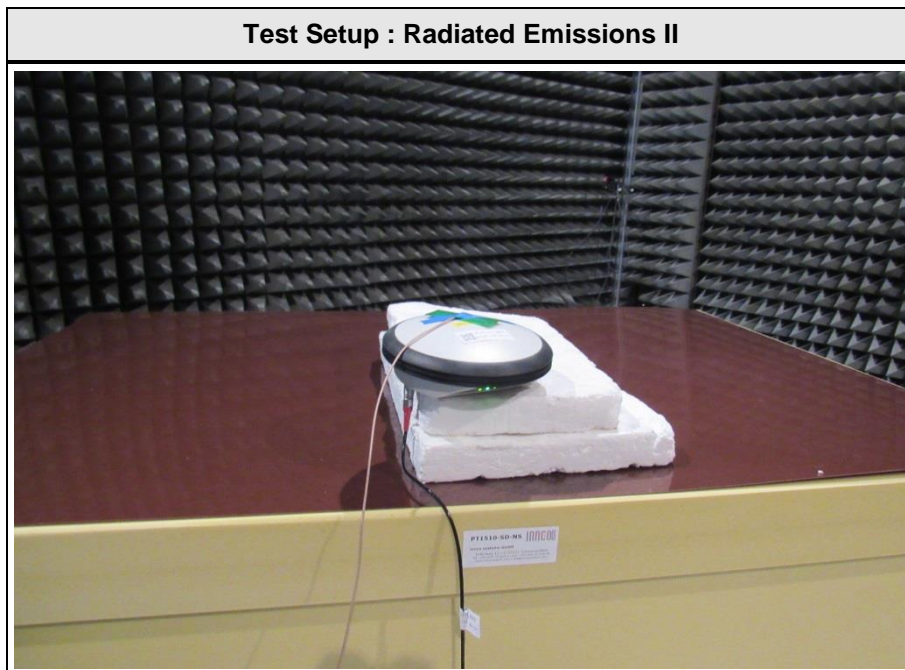
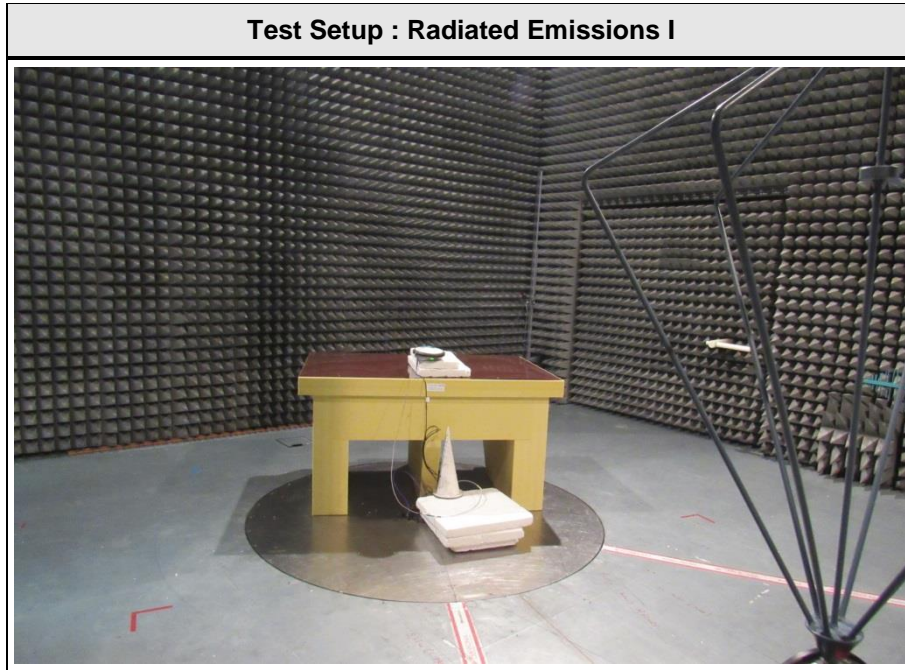


EUT PCB II





1.3 Photos – Test setup



#### 1.4 Supporting Equipment Used During Testing

Product Type*	Device	Manufacturer	Model No.	Comments
AE	Laptop	Dell	Latitude E6420	S/N CXJ43R1
AE	Software	Leica	Slog 2.00V609	

**\*Note:** Use the following abbreviations:

AE : Auxiliary/Associated Equipment, or

SIM : Simulator (Not Subjected to Test)

CABL : Connecting cables

#### 1.5 Input / Output Ports

Port #	Name	Type*	Max. Cable Length	Cable Shielded	Comments
1	USB	I/O	2.8m	Yes	spare link to remote controller
2	RS232	I/O	2.8m	Yes	data link to accessory devices

**\*Note:** Use the following abbreviations:

AC : AC power port

DC : DC power port

N/E : Non electrical

I/O : Signal input or output port

TP : Telecommunication port

## 1.6 Operating Modes and Configurations

Mode #	Description
1	EUT powered up. Bluetooth connection to laptop. GPS/GNSS receive local position.

Configuration #	EUT Configuration
1	EUT powered via internal battery. EUT receive via GPS the local position and transmit every second via Bluetooth the position to a laptop. On laptop runs a script for data logging.

**1.7 Test Equipment Used During Testing**

<b>Measurement Software</b>			
Description	Manufacturer	Name	Version
EMC Test Software	Dare Instruments	Radimation	2016.1.10

<b>Radiated emissions AC1</b>					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Biconical Antenna	R&S	HK 116	EF00030	2016-04	2019-04
LPD Antenna	R&S	HL 223	EF00187	2016-05	2019-05
Horn antenna	Schwarzbeck	BBHA 9120D	EF00018	2016-09	2019-09
MXE EMI Receiver	Keysight Technologies	N9038A-526/WXP	EF01070	2017-08	2018-08
RF Cable			-	System Cal.	System Cal
RF Cable			-	System Cal.	System Cal

## 1.8 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyzer in dB $\mu$ V. Any external preamplifiers used are taken into account through internal analyzer settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyzer. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyzer (dB}\mu\text{V)} + \text{A.F. (dB)} = \text{Net field strength (dB}\mu\text{V/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dB $\mu$ V/m). The FCC limits are given in units of  $\mu$ V/m. The following formula is used to convert the units of  $\mu$ V/m to dB $\mu$ V/m:

$$\text{Limit (dB}\mu\text{V/m)} = 20 * \log (\mu\text{V/m})$$

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

$$\begin{array}{rclcl} \text{Reading} & + & \text{AF} & = & \text{Net Reading} & : & \text{Net reading - FCC limit} & = & \text{Margin} \\ 21.5 \text{ dB}\mu\text{V} & + & 26 \text{ dB} & = & 47.5 \text{ dB}\mu\text{V/m} & : & 47.5 \text{ dB}\mu\text{V/m} - 57.0 \text{ dB}\mu\text{V/m} & = & -9.5 \text{ dB} \end{array}$$



## 2 Result Summary

FCC 47 CFR Part 15B, Industry Canada ICES-003				
Product Specific Standard	Requirement – Test	Reference Method	Result	Remarks
47 CFR 15.109 ICES-003 Item 6.2	Radiated emissions	ANSI C 63.4	PASS	
47 CFR 15.107 ICES-003 Item 6.1	AC power line conducted emissions	ANSI C63.4	N/A	
<b>Remarks:</b>				

### 3 Test Conditions and Results

#### 3.1 Test Conditions and Results – Radiated emissions

Radiated emissions acc. FCC 47 CFR 15.109 / ICES-003				Verdict: PASS		
Laboratory Parameters:		Required prior to the test		During the test		
Ambient Temperature		15 to 35 °C		{Temperature}		
Relative Humidity		30 to 60 %		{Humidity}		
Test according referenced standards		Reference Method				
		ANSI C63.4				
Sample is tested with respect to the requirements of the equipment class		Equipment class				
		Class B				
Test frequency range determined from highest emission frequency		Highest emission frequency				
		Fmax [MHz] = 2400				
Fully configured sample scanned over the following frequency range		Frequency range				
		30 MHz to 13 GHz				
Operating mode		1				
Configuration		1				
Limits and results Class B						
Frequency [MHz]	Quasi-Peak [dBµV/m]	Result	Average [dBµV/m]	Result	Peak [dBµV/m]	Result
30 – 88	40	PASS	-		-	-
88 – 216	43.5	PASS	-		-	-
216 – 960	46	PASS	-		-	-
960 – 1000	54	PASS	-		-	-
> 1000	-	-	54	PASS	74	PASS
Comments:						

**Test Procedure:**

The test site is in accordance with ANSI C63-4:2014 requirements and is listed by FCC.  
The measurement procedure is as follows:

## Exploratory measurement:

- The EUT was placed on a non-conductive table at a height of 0.8m.
- The EUT and support equipment, if needed, were set up to simulate typical usage.
- Cables, of type and length specified by the manufacturer, were connected to at least one port of each type and were terminated by a device or simulating load of actual usage.
- The antenna was placed at a distance of 3 or 10 m.
- The received signal was monitored at the measurement receiver.
  - Cables not bundled were manipulated within the range of likely arrangements to produce the highest emission amplitude
  - To maximize the suspected emissions the EUT is rotated 360 degrees. If the signal exceeds the previous amplitude, go back to the corresponding azimuth and manipulate the cables again for maximizing the emissions if possible.
  - Move the antenna from 1 to 4m to maximize the suspected highest amplitude signal.
- This procedure has to be performed in both antenna polarizations, horizontal and vertical.
- The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 1.3.

## Final measurement:

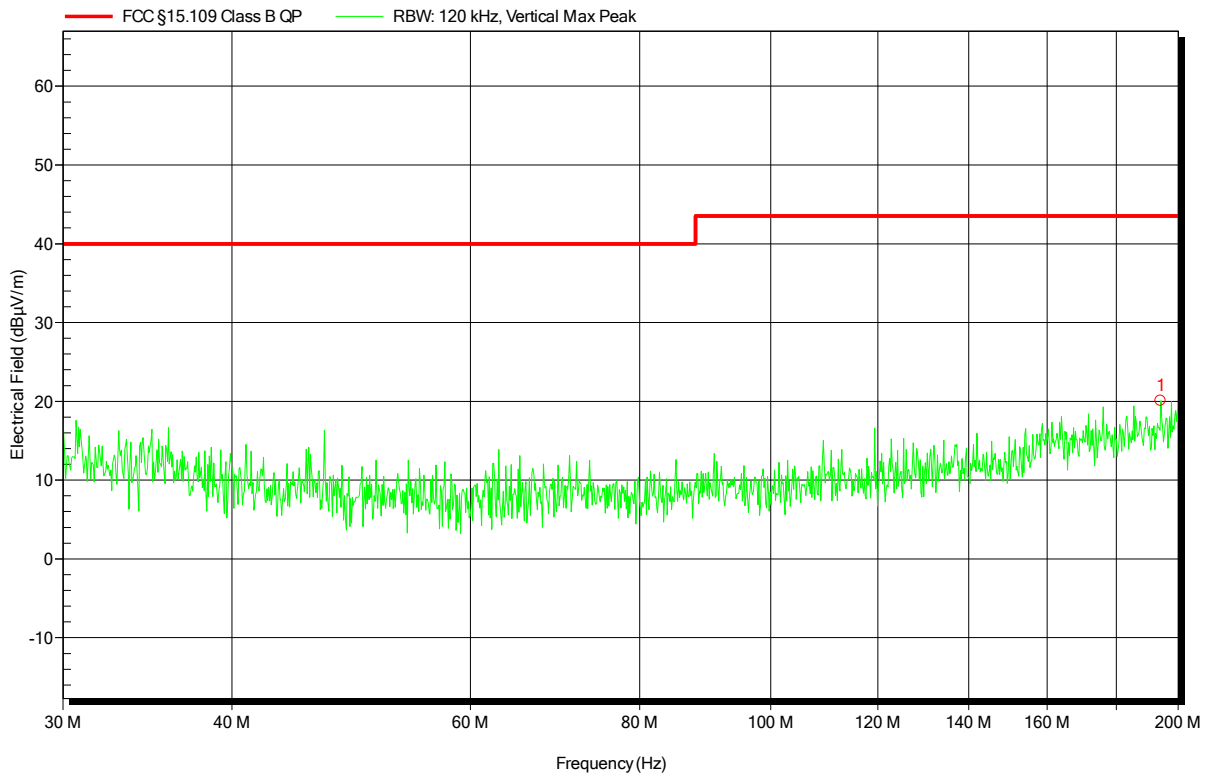
- The EUT was placed on a 0.8 m non-conductive table at a 3 m distance from the receive antenna. The antenna output was connected to the measurement receiver
- A biconical antenna was used for the frequency range 30 – 200 MHz, a logarithmic periodical antenna was used for the frequency range from 200 – 1000 MHz. Above one 1 GHz a Double Ridged Broadband Horn antenna was used. The antenna was placed on an adjustable height antenna mast
- The EUT and cable arrangement were based on the exploratory measurement results
- Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded.
- The test data of the worst-case conditions were recorded and shown on the next pages.

**Radiated emissions under normal conditions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant: Leica Geosystems AG  
 EUT Name: External GNSS Antenna  
 Model: GG04 plus  
 Test Site: Eurofins Product Service GmbH  
 Operator: Mr. Handrik  
 Test Conditions: Tnom: 22°C, Unom: 7.4 VDC  
 Antenna: Rohde & Schwarz HK 116, Vertical  
 Measurement distance: 3m  
 Mode: Mode#1  
 Test Date: 2017-11-21  
 Note:

Index 78



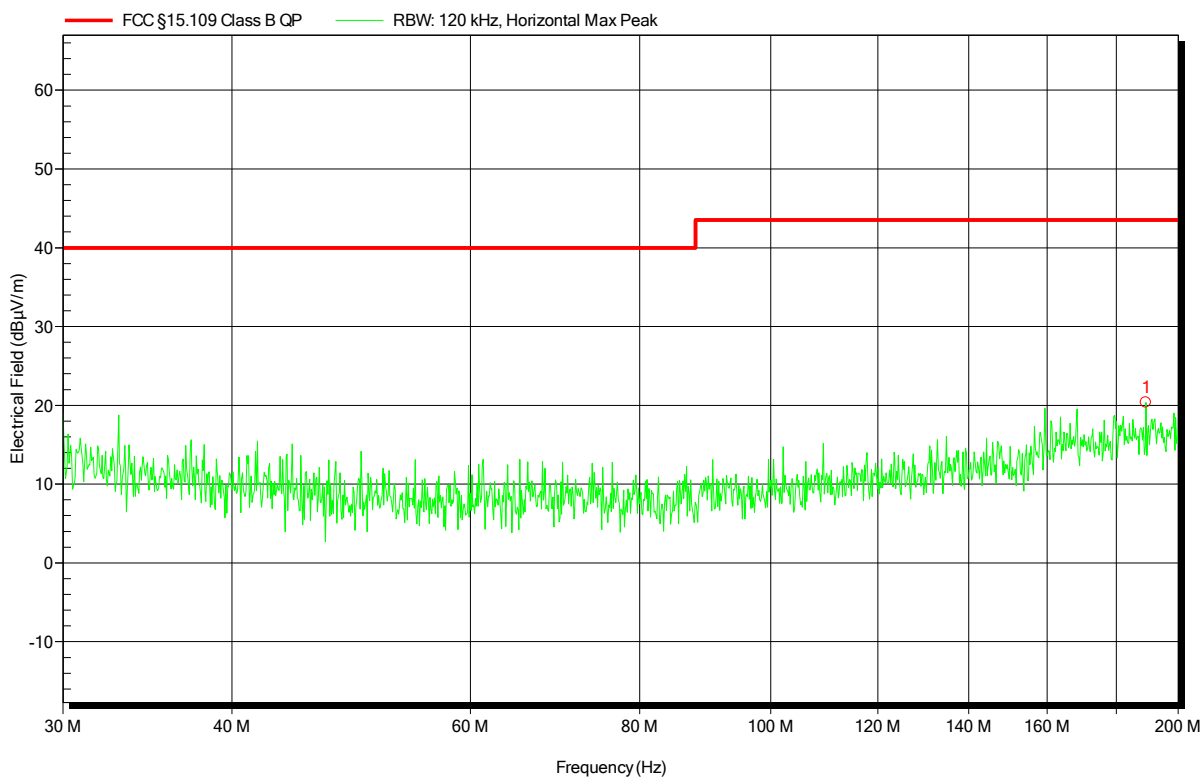
Peak Number	Frequency	Angle	Height
1	194.054 MHz	0 Degree	1 m

**Radiated emissions under normal conditions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant: Leica Geosystems AG  
 EUT Name: External GNSS Antenna  
 Model: GG04 plus  
 Test Site: Eurofins Product Service GmbH  
 Operator: Mr. Handrik  
 Test Conditions: Tnom: 22°C, Unom: 7.4 VDC  
 Antenna: Rohde & Schwarz HK 116, Horizontal  
 Measurement distance: 3m  
 Mode: Mode#1  
 Test Date: 2017-11-21  
 Note:

Index 79



Peak Number	Frequency	Angle	Height
1	189.25 MHz	0 Degree	1 m

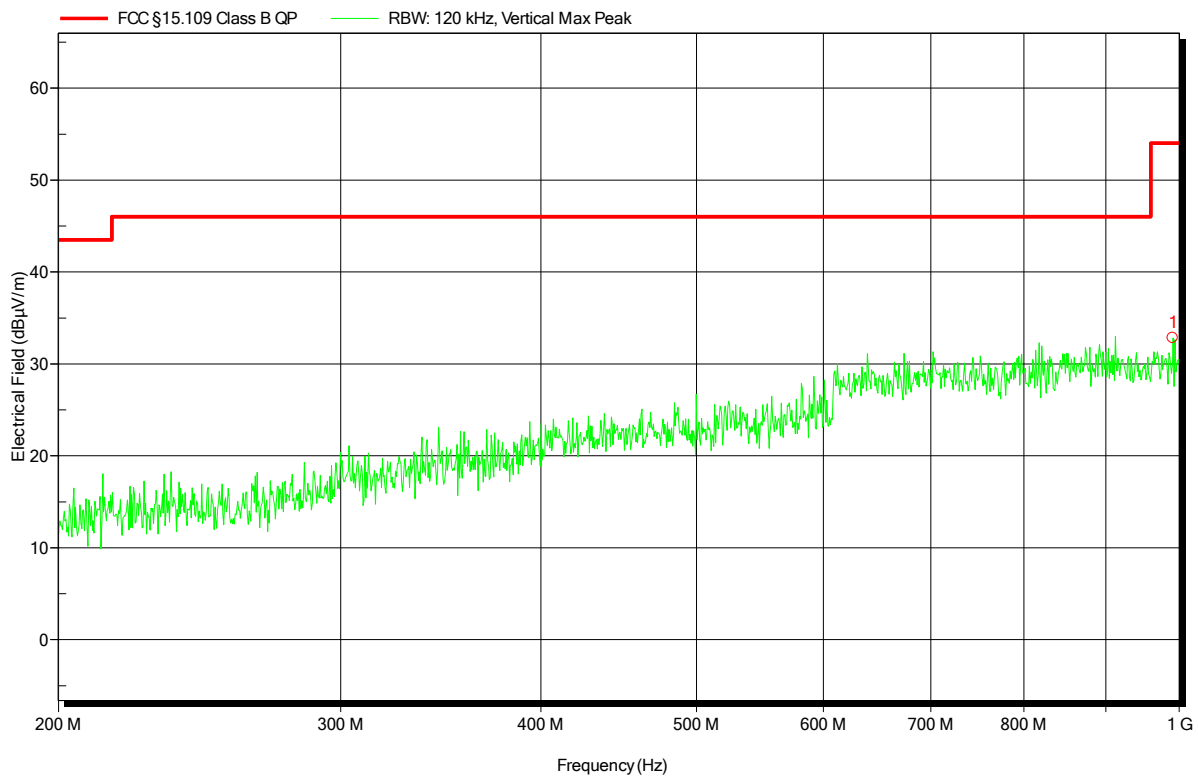


**Radiated emissions under normal conditions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant: Leica Geosystems AG  
 EUT Name: External GNSS Antenna  
 Model: GG04 plus  
 Test Site: Eurofins Product Service GmbH  
 Operator: Mr. Handrik  
 Test Conditions: Tnom: 22°C, Unom: 7.4 VDC  
 Antenna: Rohde & Schwarz HL 223, Vertical  
 Measurement distance: 3m  
 Mode: Mode#1  
 Test Date: 2017-11-21  
 Note:

Index 80



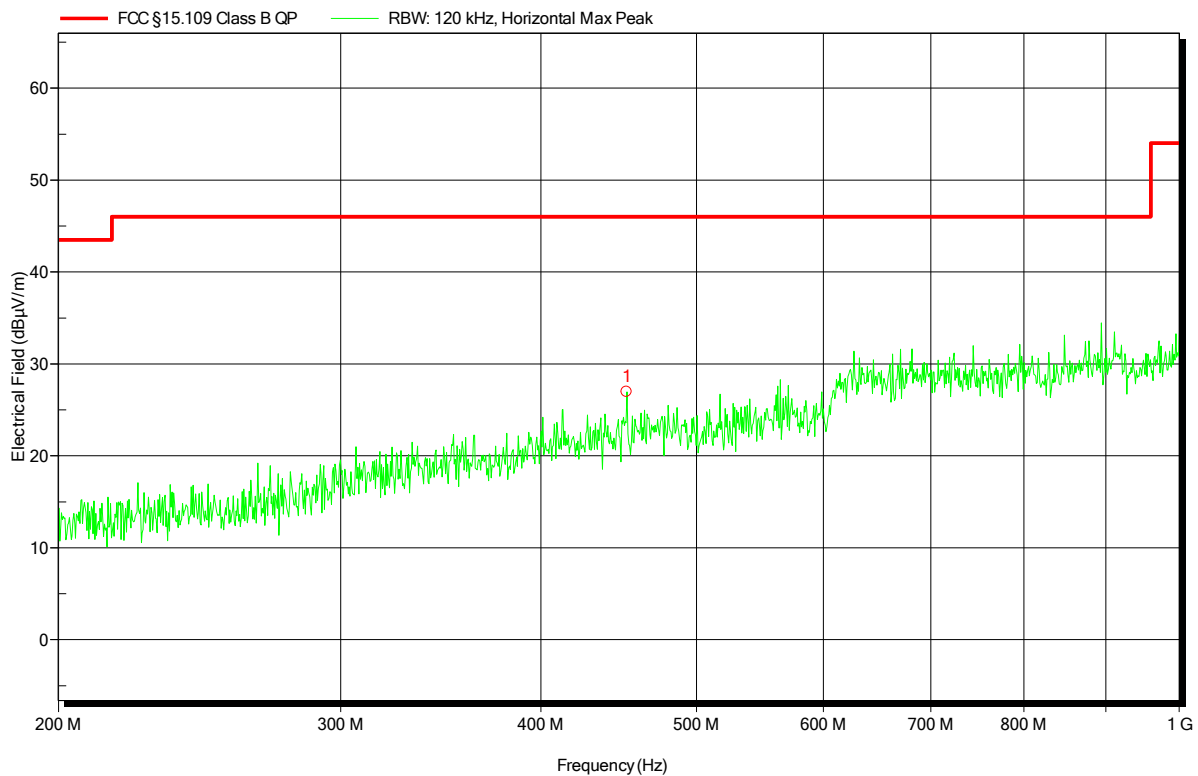
Peak Number	Frequency	Angle	Height
1	990.753 MHz	0 Degree	1 m

**Radiated emissions under normal conditions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant: Leica Geosystems AG  
 EUT Name: External GNSS Antenna  
 Model: GG04 plus  
 Test Site: Eurofins Product Service GmbH  
 Operator: Mr. Handrik  
 Test Conditions: Tnom: 22°C, Unom: 7.4 VDC  
 Antenna: Rohde & Schwarz HL 223, Horizontal  
 Measurement distance: 3m  
 Mode: Mode#1  
 Test Date: 2017-11-21  
 Note:

Index 81



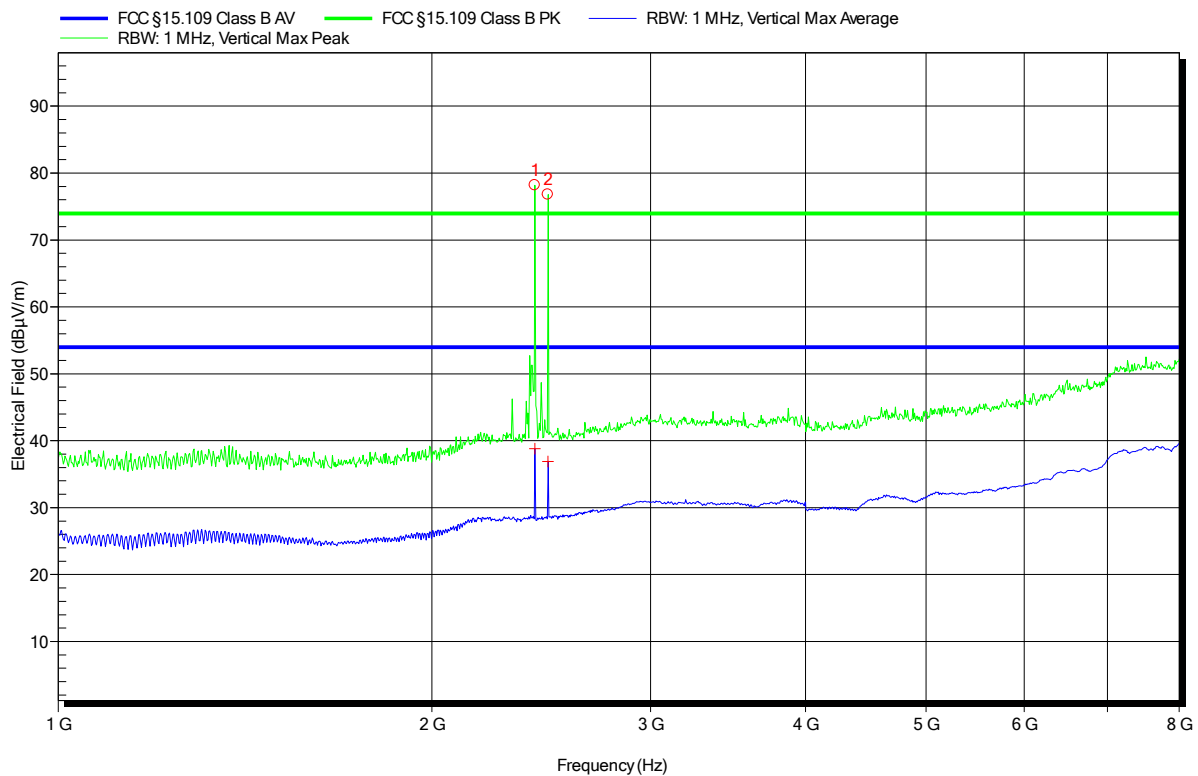
Peak Number	Frequency	Angle	Height
1	452.296 MHz	0 Degree	1 m

**Radiated emissions under normal conditions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant: Leica Geosystems AG  
 EUT Name: External GNSS Antenna  
 Model: GG04 plus  
 Test Site: Eurofins Product Service GmbH  
 Operator: Mr. Handrik  
 Test Conditions: Tnom: 22°C, Unom: 7.4 VDC  
 Antenna: Schwarzbeck BBHA 9120D, Vertical  
 Measurement distance: 3m  
 Mode: Mode#1  
 Test Date: 2017-11-21  
 Note:

Index 83



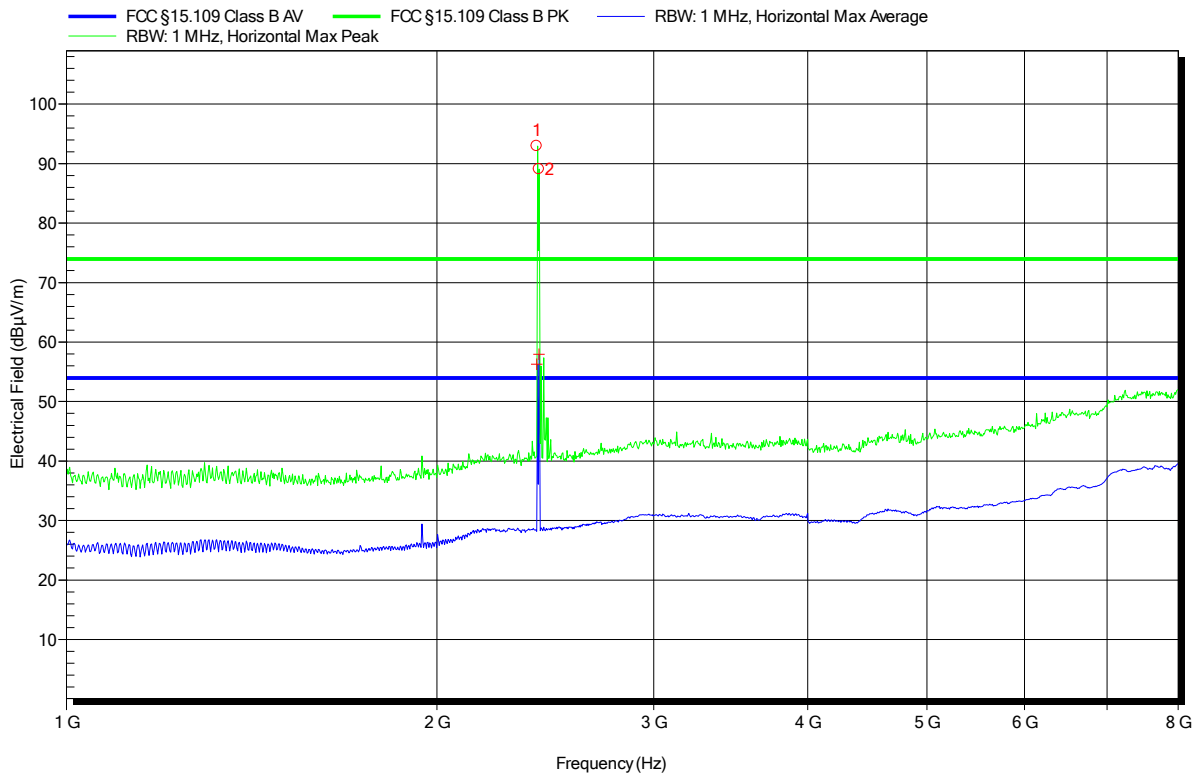
Peak Number	Frequency	
1	2.421 GHz	Bluetooth carrier
2	2.48 GHz	Bluetooth carrier

**Radiated emissions under normal conditions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant: Leica Geosystems AG  
 EUT Name: External GNSS Antenna  
 Model: GG04 plus  
 Test Site: Eurofins Product Service GmbH  
 Operator: Mr. Handrik  
 Test Conditions: Tnom: 22°C, Unom: 7.4 VDC  
 Antenna: Schwarzbeck BBHA 9120D, Horizontal  
 Measurement distance: 3m  
 Mode: Mode#1  
 Test Date: 2017-11-21  
 Note:

Index 82



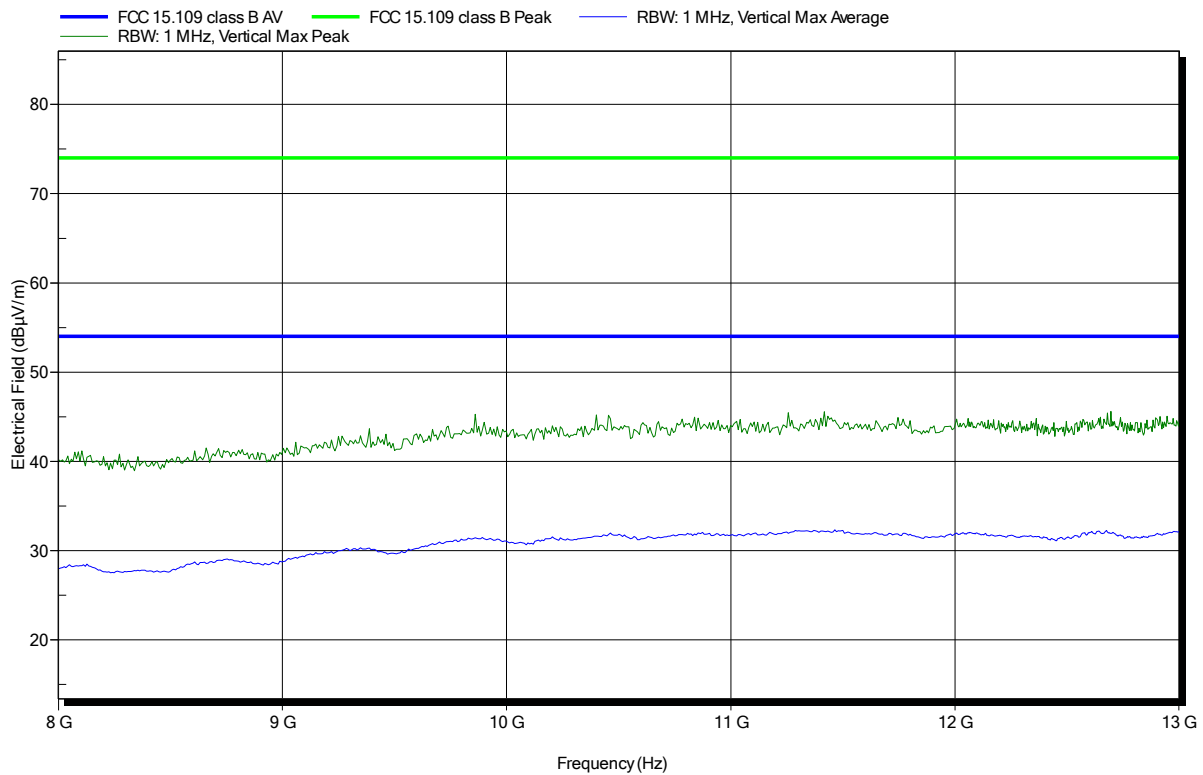
Peak Number	Frequency	
1	2.41 GHz	Bluetooth carrier
2	2.421 GHz	Bluetooth carrier

**Spurious emissions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant:	Leica Geosystems AG
EUT Name:	External GNSS Antenna
Model:	GG04 plus
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Pudell
Test Conditions:	Tnom: 22°C, Vnom: 7.4 VDC
Antenna:	Schwarzbeck BBHA 9120D, Vertical
Measurement distance:	1 m converted to 3m
Mode:	Mode#1
Test Date:	2017-11-22
Note:	

Index 90





**Spurious emissions according to FCC Part 15b**

Project number: G0M-1707-6725

Applicant:	Leica Geosystems AG
EUT Name:	External GNSS Antenna
Model:	GG04 plus
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Pudell
Test Conditions:	Tnom: 22°C, Vnom: 7.4 VDC
Antenna:	Schwarzbeck BBHA 9120D, Horizontal
Measurement distance:	1 m converted to 3m
Mode:	Mode#1
Test Date:	2017-11-22
Note:	

Index 91

