

RADIO REPORT FCC 47 CFR Part 15C ISED Canada RSS-247 Frequency hopping systems operating within the 2400.0 MHz - 2483.5 MHz band	
Report Reference No	G0M-2108-9956-TFC247BT-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	    DAkkS - Registration number : D-PL-12092-01-03 (ISED) ISED Testing Laboratory site: 3470A DAkkS - Registration number : D-PL-12092-01-04 (FCC) FCC Filed Test Laboratory, Reg.-No.: 96970
Applicant	Leica Geosystems AG
Address	Heinrich-Wild-Strasse 9435 Heerbrugg SWITZERLAND
Test Specification	47 CFR Part 15C RSS-247, Issue 2, 2017-02 RSS-Gen, Issue 5, Amendment 2, 2021-02
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Bluetooth, WLAN and BLE Module
Model(s)	TiWi-BLE
Additional Model(s)	None
Brand Name(s)	None
Hardware Version(s)	1.0
Software Version(s)	4.0
FCC ID	RFD-BTWCO
IC	3177A-BTWCO
Test Result	PASSED

Possible test case verdicts:		
Required by standard but not tested	N/T	
Not required by standard	N/R	
Not applicable to EUT	N/A	
Test object does meet the requirement	P(PASS)	
Test object does not meet the requirement	F(FAIL)	
Testing:		
Test Lab Temperature	20 °C - 30 °C	
Test Lab Humidity	25 % - 55 %	
Date of receipt of test item	2021-10-14	
Report:		
Compiled by	Jens Degenhardt	
Tested by	Jens Degenhardt	
Tested and supervised by (Responsible for Test)	Florian Voigt	
Approved by (Deputy Head of Lab)	Toralf Jahn	
Date of Issue	2022-03-24	
Total number of pages	46	
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:		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2022-03-24	Initial Release	

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
BR	Basic Rate (Bluetooth)
EDR	Enhanced Data Rate (Bluetooth)
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
RBW	Resolution bandwidth
RMS	Root mean square
VBW	Video bandwidth
V _{NOM}	Nominal supply voltage

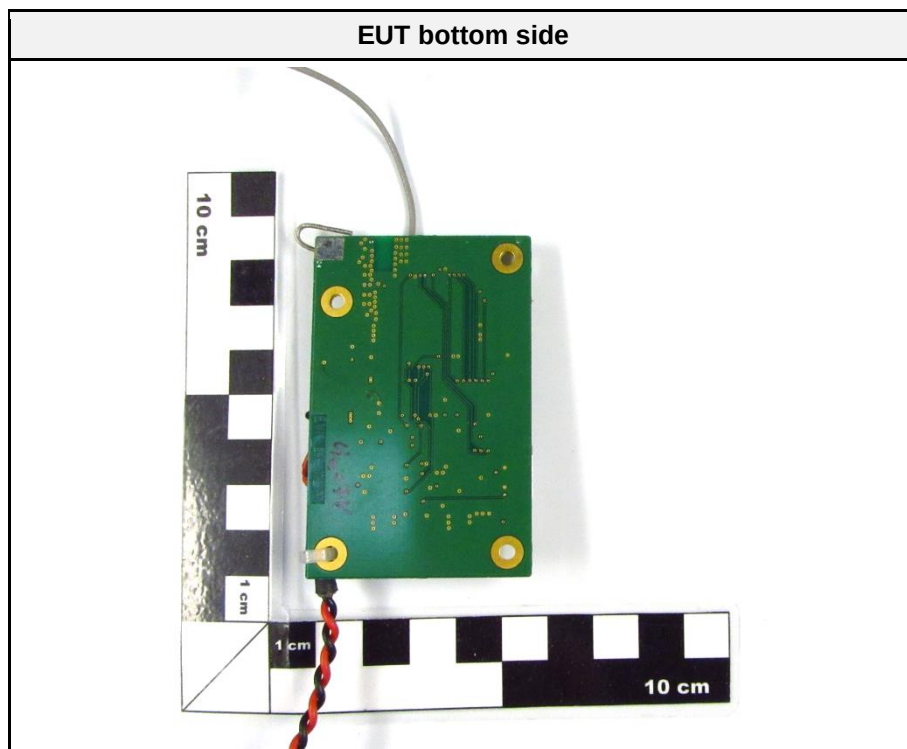
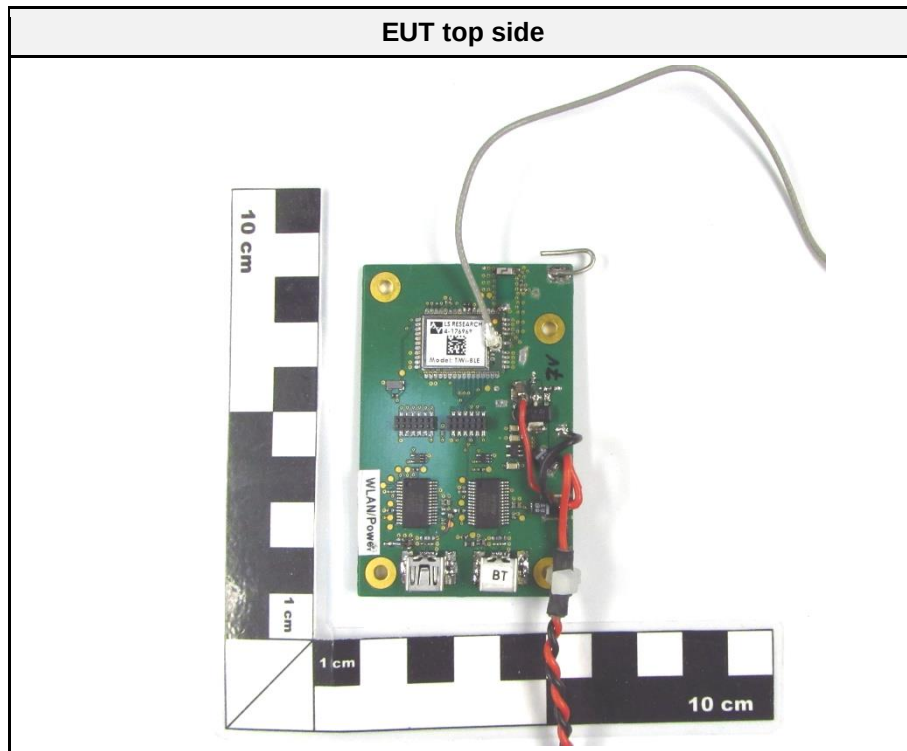
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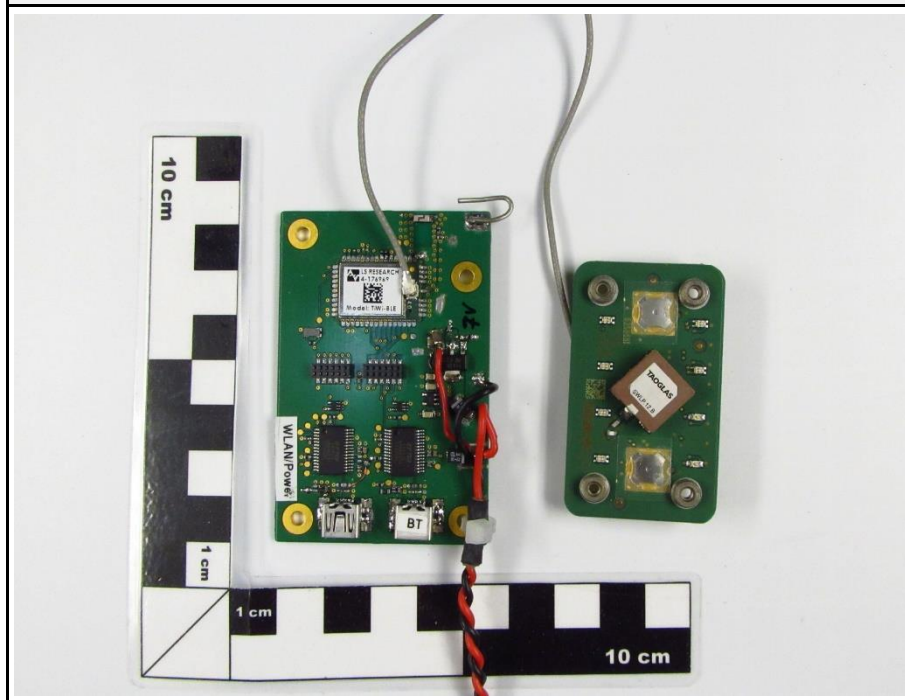
1 Equipment (Test Item) Under Test

Description	Bluetooth, WLAN and BLE Module	
Model	TiWi-BLE	
Additional Model(s)	None	
Brand Name(s)	None	
Serial Number(s)	None	
Test Sample Id(s)	36589	
Hardware Version(s)	1.0	
Software Version(s)	4.0	
PMN	Leica Geosystems AG	
HVIN	TIWI	
FVIN	N/A	
HMN	N/A	
FCC ID	RFD-BTWCO	
IC	3177A-BTWCO	
Equipment type	Radio Module	
Radio type	Transceiver	
Assigned frequency bands	2400.0 MHz - 2483.5 MHz	
Radio technology	Bluetooth	
Modulation	GFSK, PI/4-DQPSK, 8-DPSK	
Number of antenna ports	1	
Radio Module	Type	Bluetooth and WLAN module
	Model	TIWI-BLE
	Manufacturer	LS Research
	HW Version	1.0
	SW Version	4.0
	FCC ID	RFD-BTWCO
	IC	3177A-BTWCO
Antenna	Type	External antenna
	Model	SWLP.2450.12.4.B.02
	Manufacturer	Taoglas
	Gain	2 dBi
Supply Voltage	V _{NOM}	7 VDC
Operating Temperature	T _{NOM}	25 °C
AC/DC-Adaptor	None	
Manufacturer	Leica Geosystems AG Heinrich-Wild-Strasse 9435 Heerbrugg SWITZERLAND	

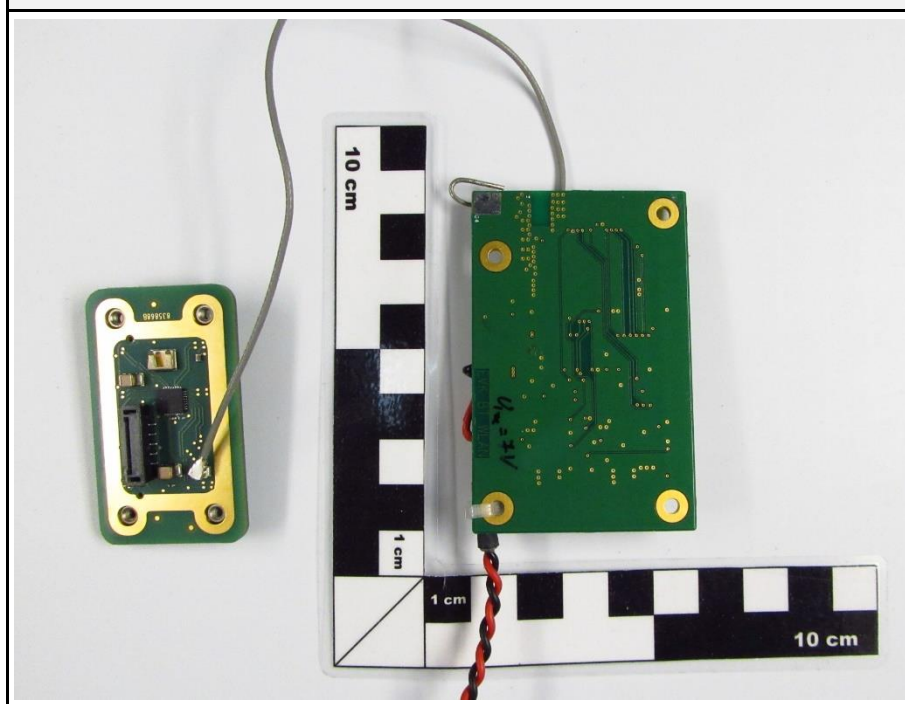
1.1 Photos – Equipment External



EUT + antenna, top side



EUT+antenna, bottom side

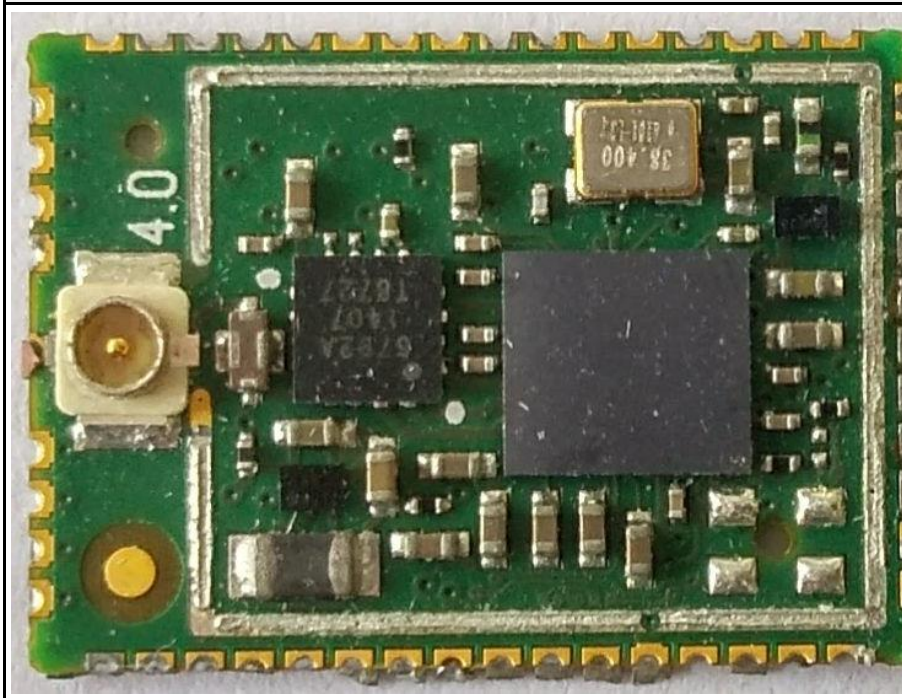


1.2 Photos – Equipment Internal

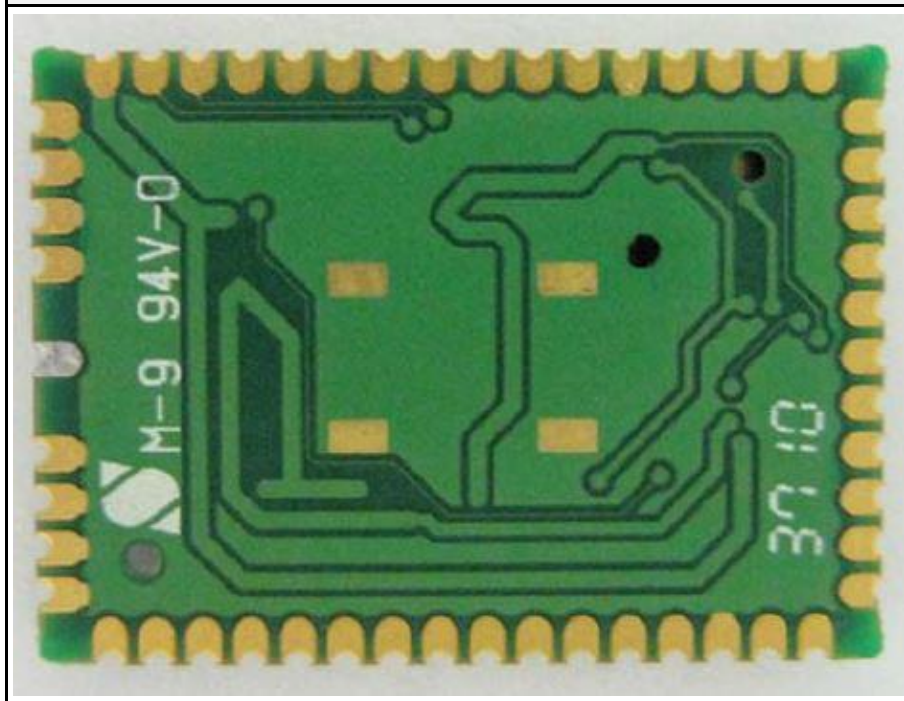
Radio module TIWI-BLE, FCC ID: RFD-BTWCO



Radio module TIWI-BLE, FCC ID: RFD-BTWCO



Radio module TIWI-BLE bottom side



1.3 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
SFT	Tiwi BT Eval Tool	LS research	Tiwi BT Eval Tool V4.0.0.0	Test mode tool
AE	Laptop	Lenovo	T440	SN:PC01B76F
AE	USB over fiber	mk messtechnik	optoUSB-2.0	Transceiver
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment:				

1.4 Test Modes

Mode	Description
3-DH5 Single	Mode = Transmit Modulation = 8-DPSK Spreading = None Packet type = 3-DH5
Receive	Mode = Receive
Comment: Test mode has been selected as the worst case by evaluation of conducted peak output power listed in the original test report G0M-1410-4214-TFC247BT-V01 issued on 2015-05-12 by Eurofins Product Service GmbH	

1.5 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx	0	2402
F2	Tx / Rx	39	2441
F3	Tx	78	2480

1.6 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 dBμV. 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:

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

Net:

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

Limit:

This is the FCC Class B radiated emission limit (in units of dBμV/m). The FCC limits are given in units of μV/m. The following formula is used to convert the units of μV/m to dBμV/m:

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

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:

Reading + AF	= Net Reading	:	Net reading - FCC limit	= Margin
+21.5 dBμV + 26 dB/m	= 47.5 dBμV/m	:	47.5 dBμV/m - 57.0 dBμV/m	= -9.5 dB

2 Result Summary

FCC 47 CFR Part 15C, ISED RSS-247				
Product Standard Reference	Requirement	Reference Method	Result	Remarks
ISED RSS-Gen, Issue 5 A2 (section 6.7)	Occupied Bandwidth	ANSI C63.10-2013	N/R	
FCC § 15.247(a)(1) ISED RSS-247 § 5.1 Issue 2	20 dB Bandwidth	ANSI C63.10-2013	N/T	
FCC § 15.247(a)(1)(iii) ISED RSS-247, Issue 2 (section 5.1)	Number of hopping frequencies	ANSI C63.10-2013	N/T	
FCC § 15.247(a)(1) ISED RSS-247, Issue 2 (section 5.1)	Frequency hopping channel separation	ANSI C63.10-2013	N/T	
FCC § 15.247(a)(1)(iii) ISED RSS-247, Issue 2 (section 5.1)	Time of occupancy (Dwell time)	ANSI C63.10-2013	N/T	
FCC § 15.247(b) ISED RSS-247, Issue 2 (section 5.4)	Maximum peak conducted power	ANSI C63.10-2013	N/T	
FCC § 15.207 ISED RSS-247, Issue 2 (section 3.1)	AC power line conducted emissions	ANSI C63.10-2013	N/T	
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Band edge compliance	ANSI C63.10-2013	N/T	
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Conducted spurious emissions	ANSI C63.10-2013	N/T	
FCC § 15.247(d) FCC § 15.209 ISED RSS-Gen, Issue 5 A2 (section 6.13)	Transmitter radiated spurious emissions	ANSI C63.10-2013	PASS	
ISED RSS-247, Issue 2 (section 3.1)	Receiver radiated spurious emissions	ANSI C63.4-2014	PASS	
Comment:				

Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

3 Test Conditions and Results

3.1 Test Conditions and Results - Transmitter radiated emissions

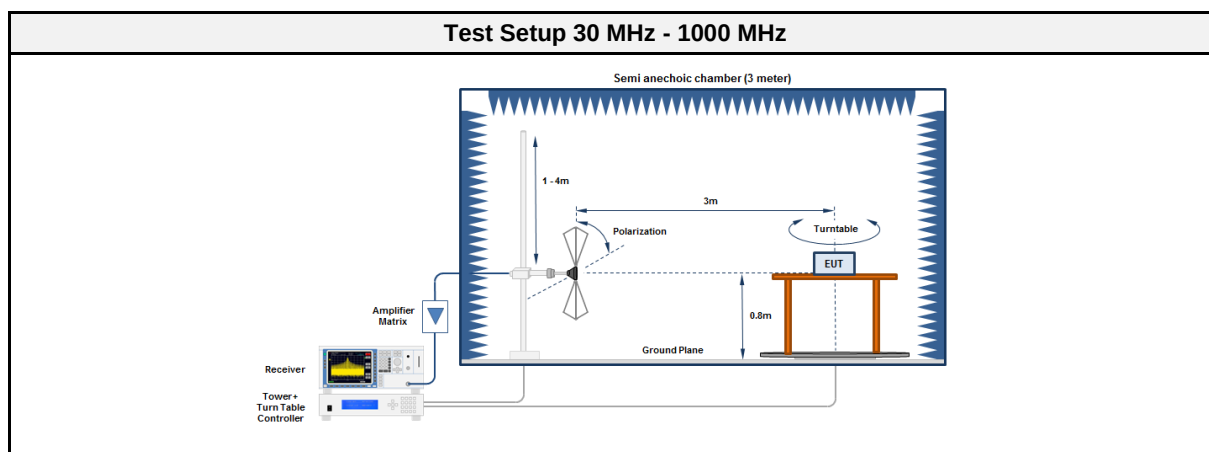
3.1.1 Information

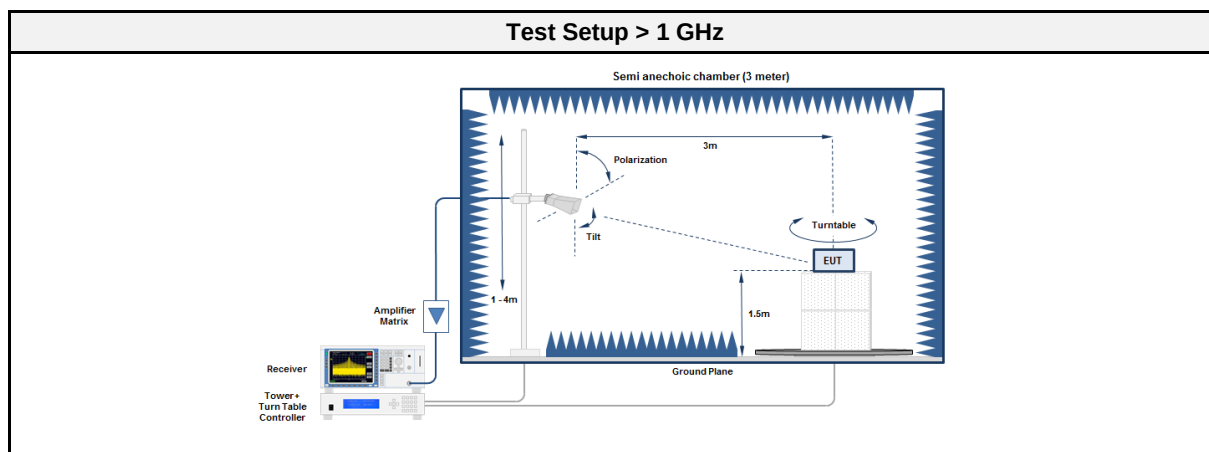
Test Information	
Reference	FCC § 15.247(d); FCC § 15.209; ISSED RSS-Gen, Issue 5 A2 (section 6.13)
Measurement Uncertainty	± 5.95 dB
Measurement Method	ANSI C63.10 6.4, 6.5, 6.6
Operator	Jens Degenhardt, Florian Voigt
Date	2021-12-07 + 2021-11-29

3.1.2 Limits

Limits			
Frequency range [MHz]	Detector	Field strength [µV/m]	Measurement distance [m]
0.009 - 0.09	Average	2400/F[kHz]	300
0.09 - 0.110	Quasi-Peak	2400/F[kHz]	300
0.110 - 0.490	Average	2400/F[kHz]	300
0.490 - 1.705	Quasi-Peak	24000/F[kHz]	30
1.705 - 30.0	Quasi-Peak	30	30
30 - 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
>1000	Average	500	3

3.1.3 Setup





3.1.4 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2020.1.8

Test Equipment 30 - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2021-02	2024-02
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2021-07	2022-07
Antenna	R&S	HK 116	EF00030	2021-05	2024-05
Antenna	R&S	HL 223	EF00187	2019-05	2022-05

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber	Frankonia	AC 2	EF01616	2021-09	2022-09
Spectrum analyzer	R&S	FSU43	EF01631	2021-07	2022-07
Horn antenna	Schwarzbeck	BBHA 9120B	EF01678	2021-03	2022-03
Horn Antenna	Schwarzbeck	HWRD 650	EF01679	2021-03	2022-03
Antenna	Amplifier Research	AT4560	EF00302	2021-06	2023-06

3.1.5 Procedure

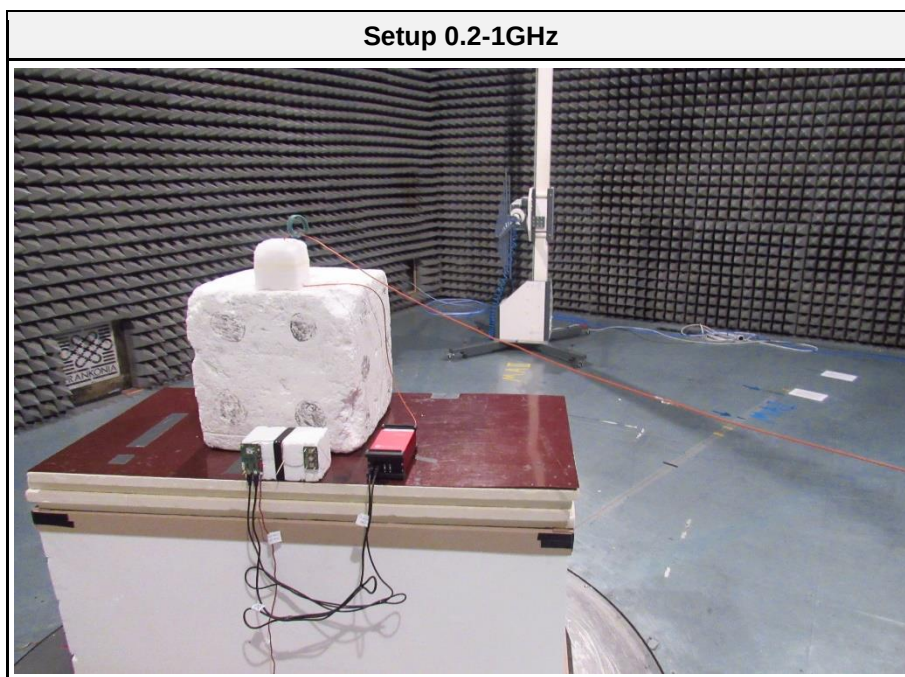
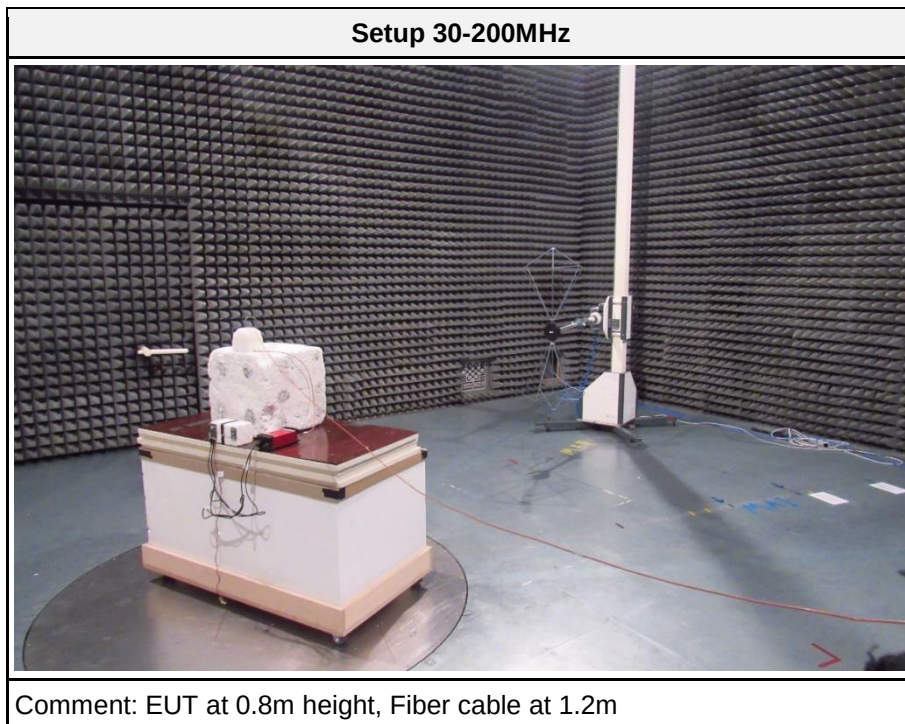
Test Procedure 30 MHz - 1000 MHz
1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector

Test Procedure > 1 GHz
1. EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector

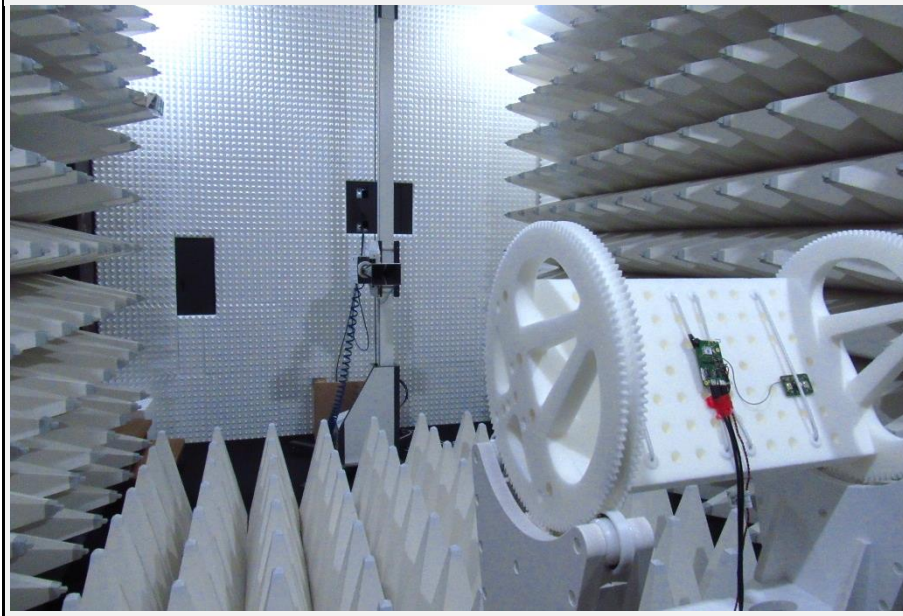
3.1.6 Results

Test Results - 3-DH5						
Channel [MHz]	Emission [MHz]	Level [dBμV/m]	Det.	Pol.	Limit [dBμV/m]	Margin [dB]
2402	37.8285	25.50	qpk	ver	40.00	-14.53
2402	124.9917	30.50	qpk	ver	43.50	-13.02
2402	612.1	29.50	pk	hor	46.00	-16.50
2402	2388.8	61.87	pk	hor	74.00	-12.13
2402	2388.8	46.96	avg	hor	54.00	-07.04
2402	4804	42.55	pk	ver	74.00	-31.45
2402	4804	33.38	avg	ver	54.00	-20.62
2441	2388.1	50.86	pk	hor	74.00	-23.14
2441	2388.1	35.81	avg	hor	54.00	-18.19
2441	2487.7	49.47	pk	ver	74.00	-24.53
2441	2487.7	28.97	avg	ver	54.00	-25.03
2441	37.905	24.90	qpk	ver	40.00	-15.13
2441	125.0045	30.70	qpk	ver	43.50	-12.81
2441	264.7	27.00	pk	hor	46.00	-19.04
2441	327.48	26.70	pk	hor	46.00	-19.30
2441	611.92	30.50	pk	hor	46.00	-15.54
2480	37.7902	24.90	qpk	ver	40.00	-15.05
2480	124.996	30.60	qpk	ver	43.50	-12.92
2480	612.5	30.80	pk	hor	46.00	-15.21
2480	2389	53.48	pk	hor	74.00	-20.52
2480	2389	39.47	avg	hor	54.00	-14.53
2480	2483.7	61.56	pk	ver	74.00	-12.44
2480	2483.7	48.35	avg	ver	54.00	-05.65
2480	4960	47.90	pk	hor	74.00	-26.10
2480	4960	42.41	avg	hor	54.00	-11.59

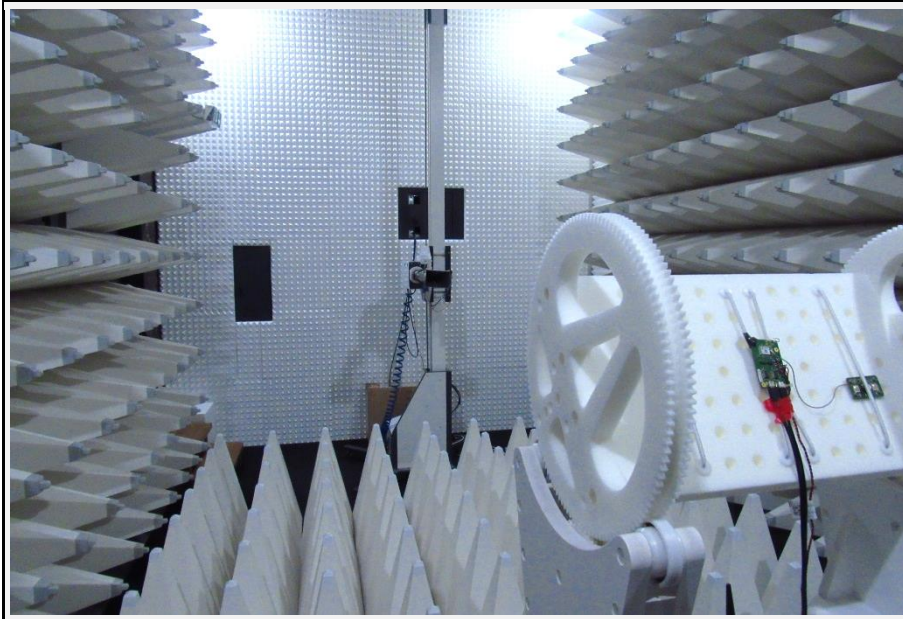
3.1.7 Setup Photos



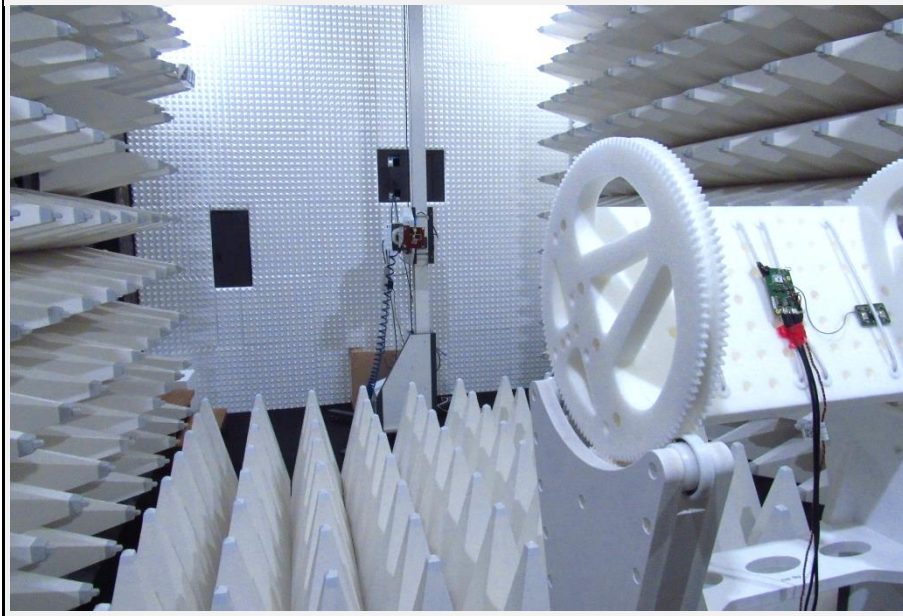
Setup 1-8GHz



Setup 8-18GHz



Setup 18-26.5GHz



3.2 Test Conditions and Results - Receiver radiated emissions

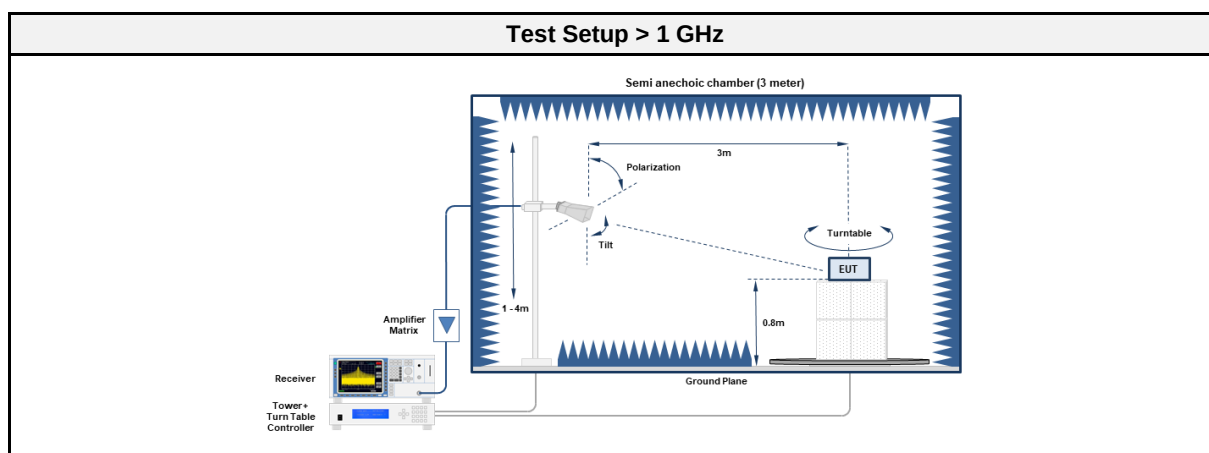
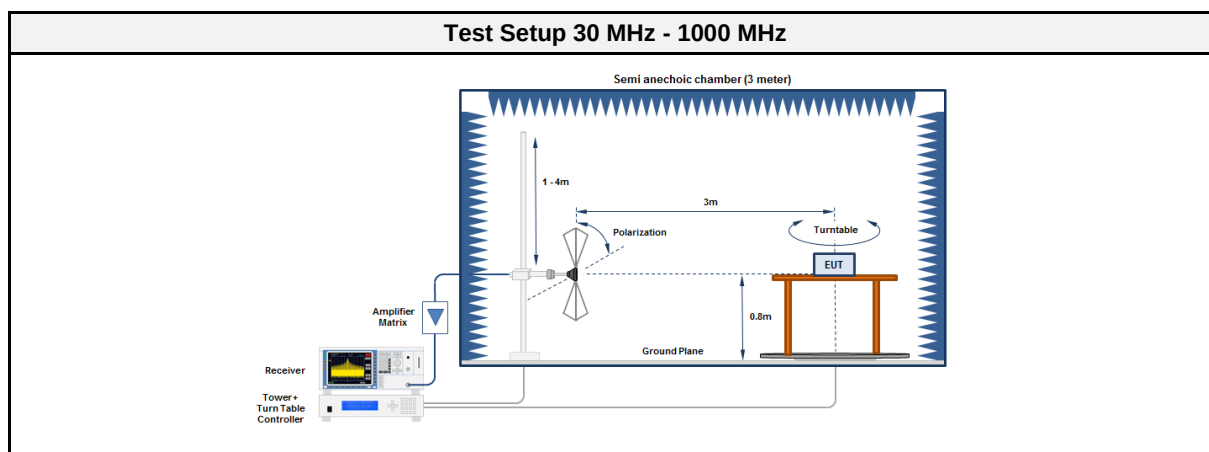
3.2.1 Information

Test Information	
Reference	ISED RSS-247, Issue 2 (section 3.1)
Measurement Uncertainty	± 5.95 dB
Measurement Method	ANSI C63.4-2014 8.1-8.3
Operator	Florian Voigt, Jens Degenhardt
Date	2021-12-07 - 2021-12-13

3.2.2 Limits

Limits			
Frequency range [MHz]	Detector	Field strength [$\mu\text{V/m}$]	Measurement distance [m]
30 - 88	Quasi-Peak	100	3
88 - 216	Quasi-Peak	150	3
216 - 960	Quasi-Peak	200	3
960 - 1000	Quasi-Peak	500	3
>1000	Average	500	3

3.2.3 Setup



3.2.4 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	RadiMation	2020.1.8

Test Equipment 30 - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2021-02	2024-02
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2021-07	2022-07
Antenna	R&S	HK 116	EF00030	2021-05	2024-05
Antenna	R&S	HL 223	EF00187	2019-05	2022-05

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2021-02	2024-02
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2021-07	2022-07
Horn Antenna	Schwarzbeck	BBHA 9120B	EF00018	2019-10	2022-10
Horn Antenna	Schwarzbeck	HWRD 650	EF01679	2021-03	2022-03

3.2.5 Procedure

Test Procedure 30 - 1000 MHz	
1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector	

Test Procedure > 1 GHz	
1. EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground 2. EUT set to test mode 3. The receiver is set to peak detection with max hold 4. The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m 5. All significant emissions are measured again using the corresponding final detector	

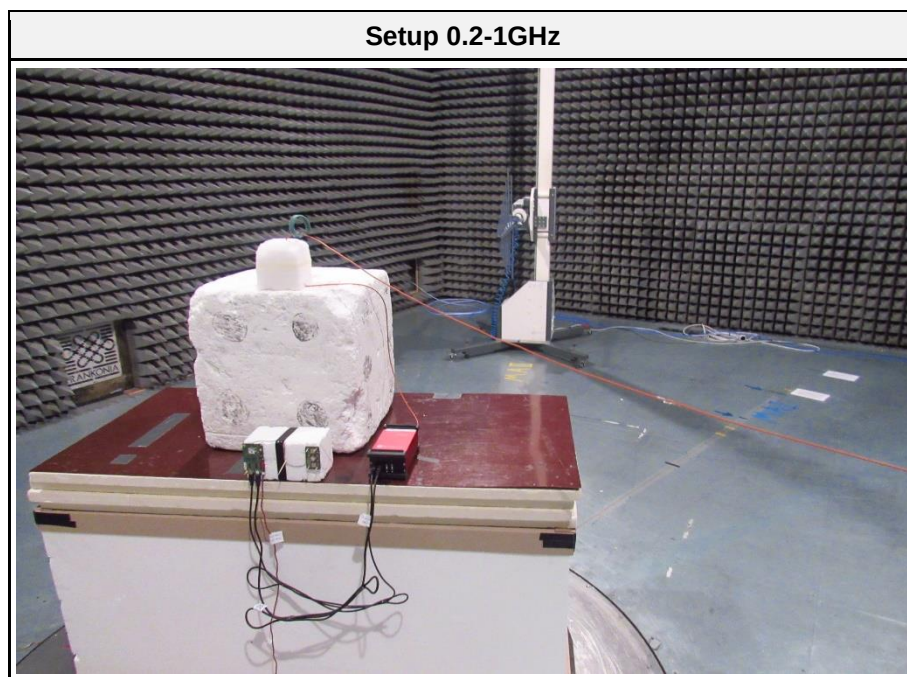
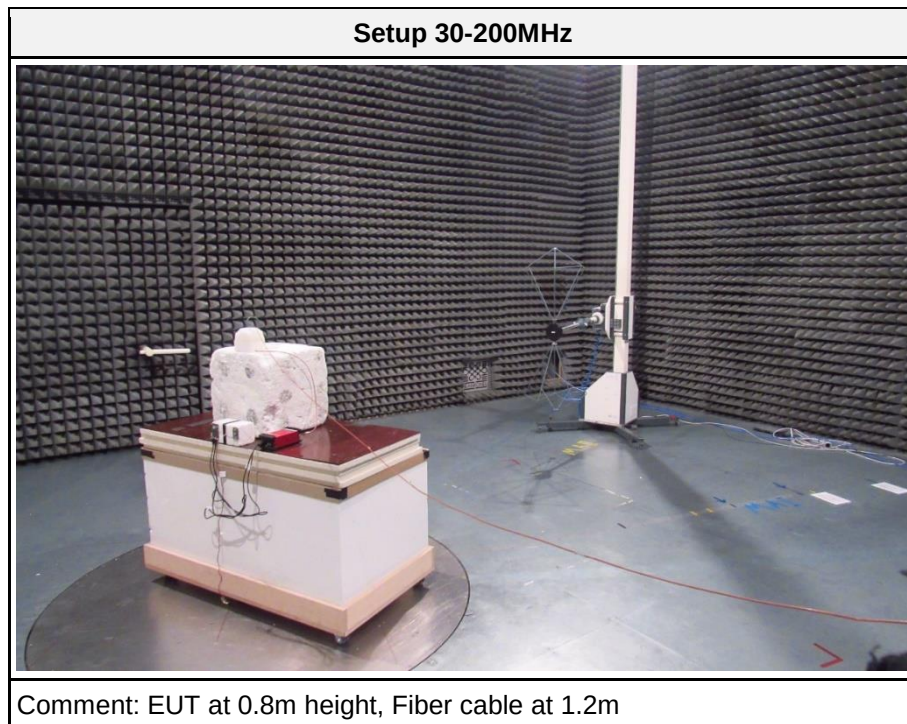
3.2.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dBμV/m]	Det.	Pol.	Limit [dBμV/m]	Margin [dB]
2441	34.624	28.10	qpk	ver	40.00	-11.93
2441	108.0076	27.90	qpk	ver	43.50	-15.58
2441	125.0002	31.20	qpk	ver	43.50	-12.28
2441	562.5	32.10	qpk	hor	46.00	-13.93
2441	624.984	35.10	qpk	hor	46.00	-10.88
2441	1997	50.06	pk	ver	74.00	-23.94
2441	1997	26.13	avg	ver	53.98	-27.85
2441	9648	40.98	pk	hor	74.00	-33.02
2441	9648	35.35	avg	hor	53.98	-18.63

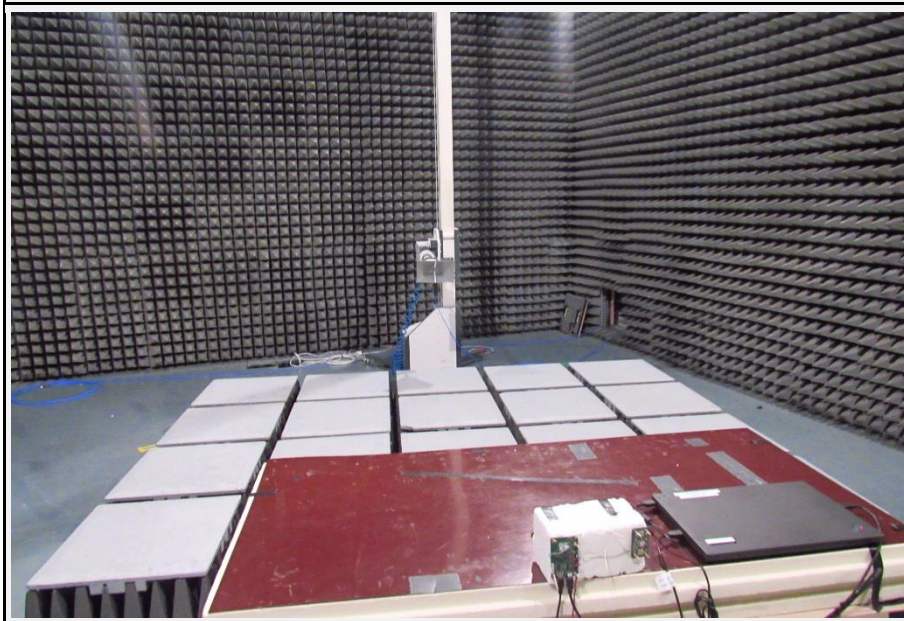
Test Report No.: G0M-2108-9956-TFC247BT-V01

Eurofins Product Service GmbH
Storkower Str. 38c, D-15526 Reichenwalde, Germany

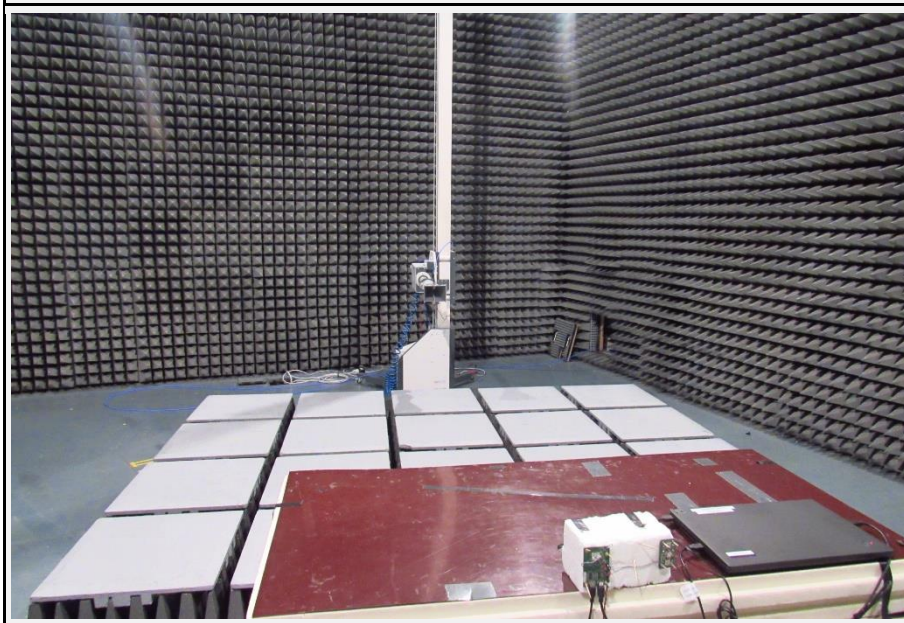
3.2.7 Setup Photos



Setup 1-6.5GHz



Setup 6.5-18GHz



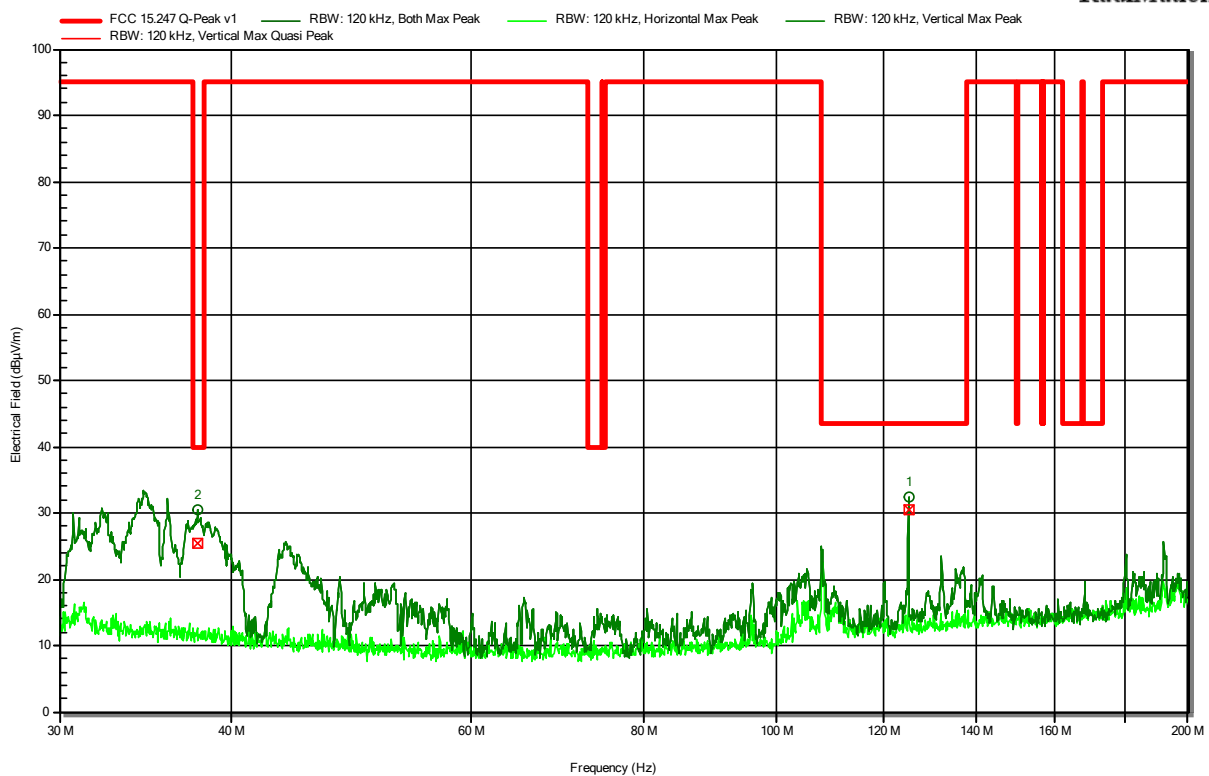
ANNEX A Transmitter spurious emissions

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; 2402MHz, 3-DH5 Single
 Test Date: 2021-12-07
 Note:

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RadiMation



Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
37.8285 MHz	25.5 dBµV/m	40 dBµV/m	-14.53 dB	Pass	Vertical
124.9917 MHz	30.5 dBµV/m	43.5 dBµV/m	-13.02 dB	Pass	Vertical

Test Report No.: G0M-2108-9956-TFC247BT-V01

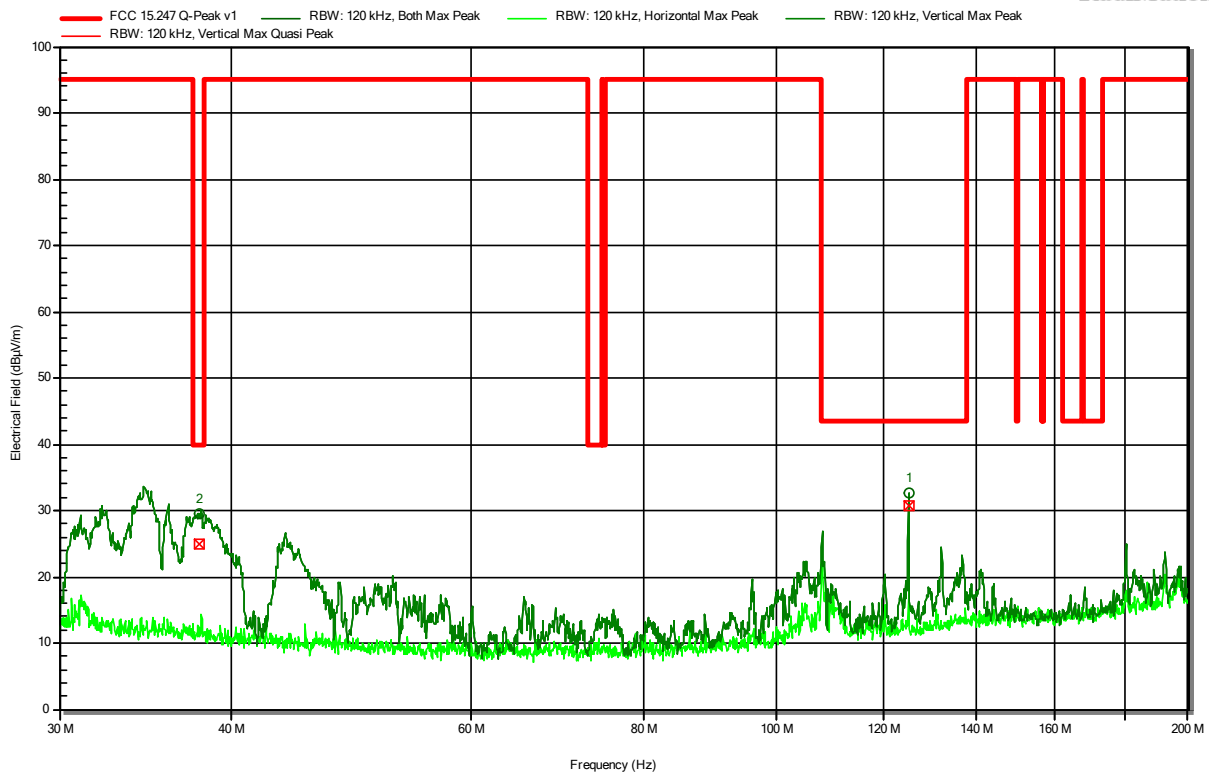
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; 2441MHz, 3-DH5 Single
 Test Date: 2021-12-07
 Note:

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RadiMation



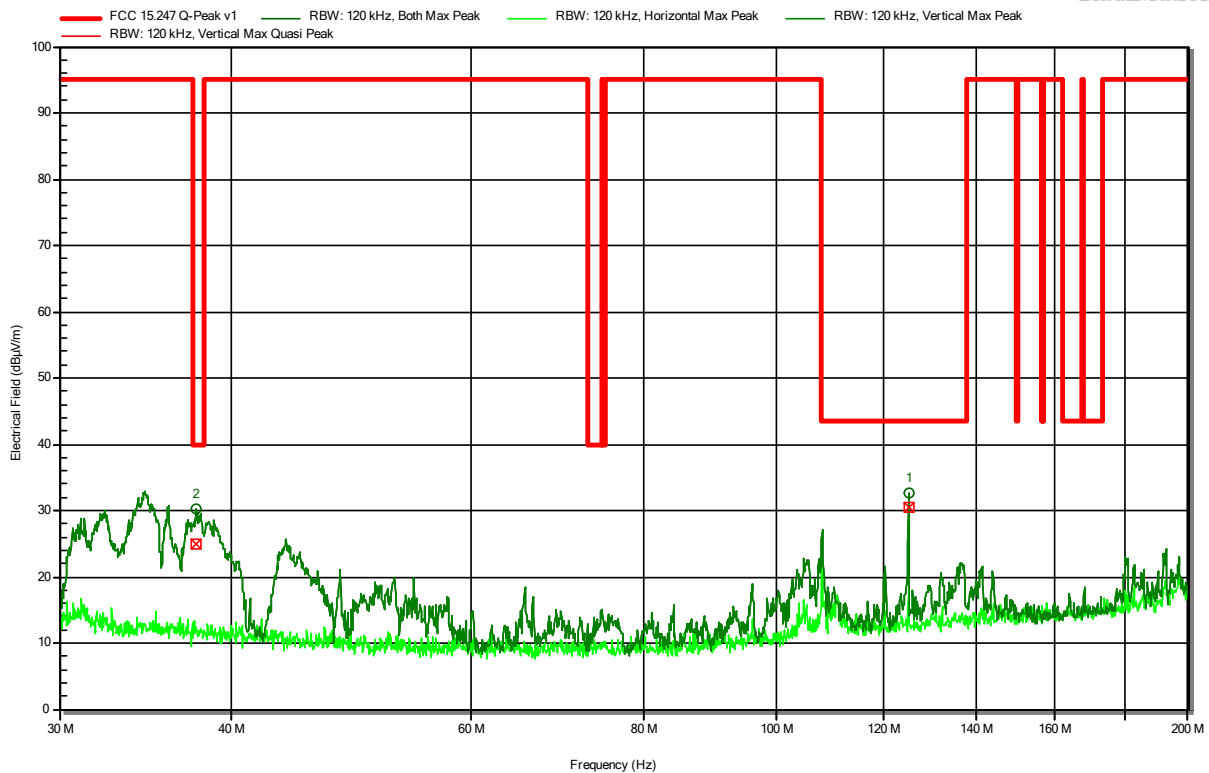
Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
37.905 MHz	24.9 dBμV/m	40 dBμV/m	-15.13 dB	Pass	Vertical
125.0045 MHz	30.7 dBμV/m	43.5 dBμV/m	-12.81 dB	Pass	Vertical

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; 2480MHz, 3-DH5 Single
 Test Date: 2021-12-07
 Note:

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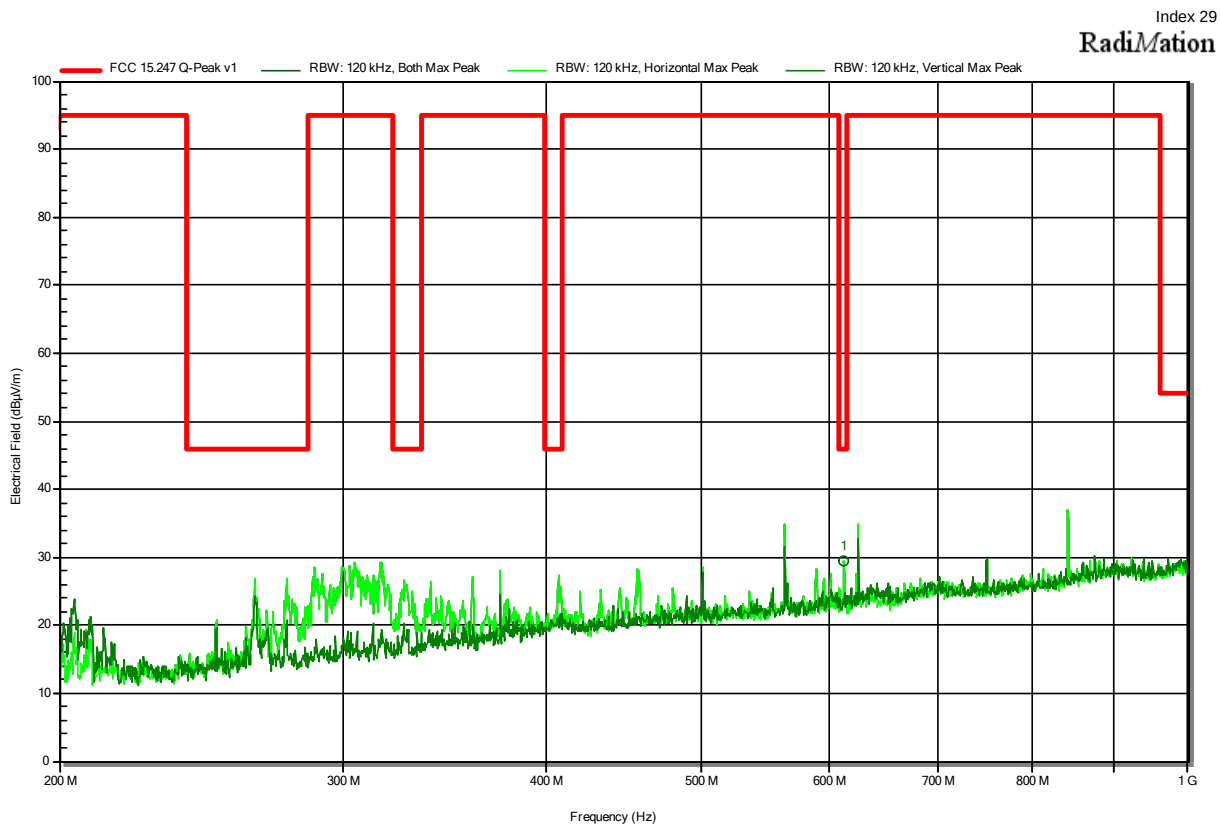
RadiMation



Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
37.7902 MHz	24.9 dBμV/m	40 dBμV/m	-15.05 dB	Pass	Vertical
124.996 MHz	30.6 dBμV/m	43.5 dBμV/m	-12.92 dB	Pass	Vertical

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

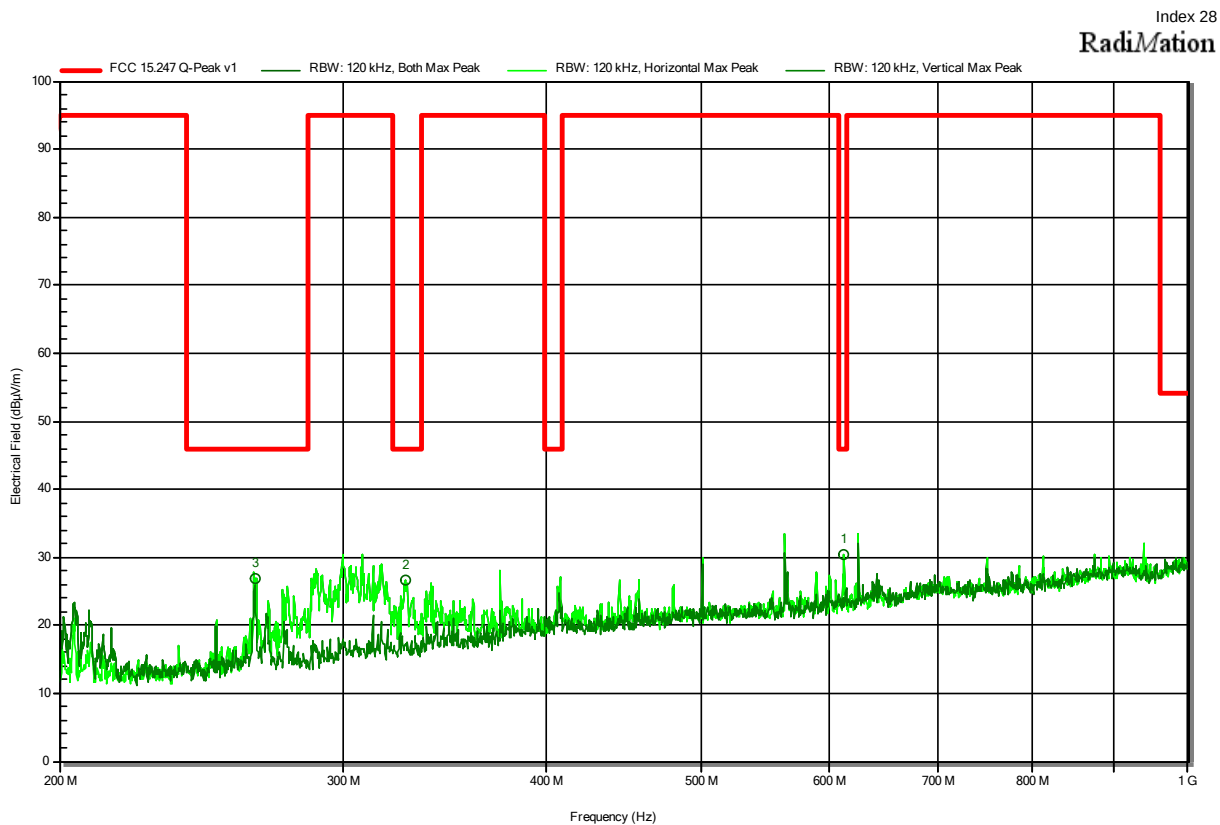
Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; 2402MHz, 3-DH5 Single
 Test Date: 2021-12-07
 Note:



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
612.1 MHz	29.5 dBµV/m	46 dBµV/m	-16.5 dB	Pass	Horizontal

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

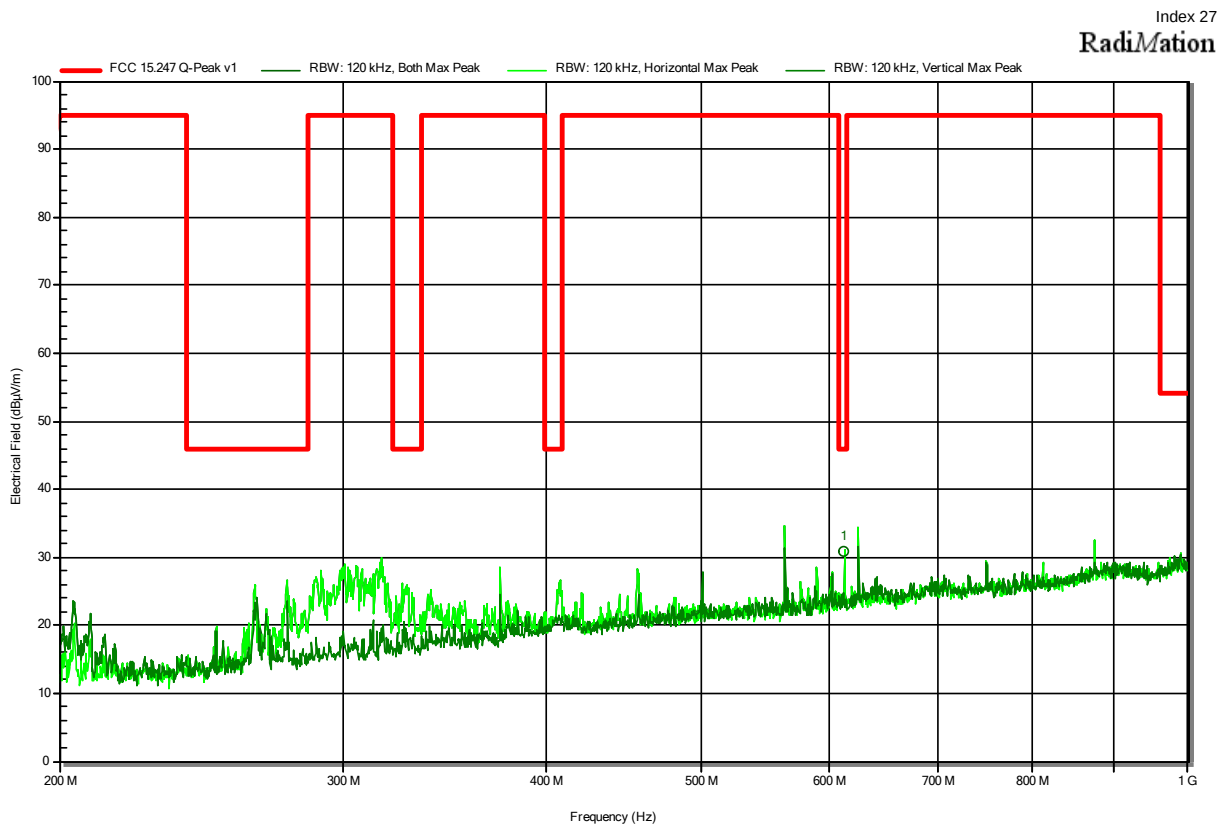
Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; 2441MHz, 3-DH5 Single
 Test Date: 2021-12-07
 Note:



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
264.7 MHz	27 dBµV/m	46 dBµV/m	-19.04 dB	Pass	Horizontal
327.48 MHz	26.7 dBµV/m	46 dBµV/m	-19.3 dB	Pass	Horizontal
611.92 MHz	30.5 dBµV/m	46 dBµV/m	-15.54 dB	Pass	Horizontal

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

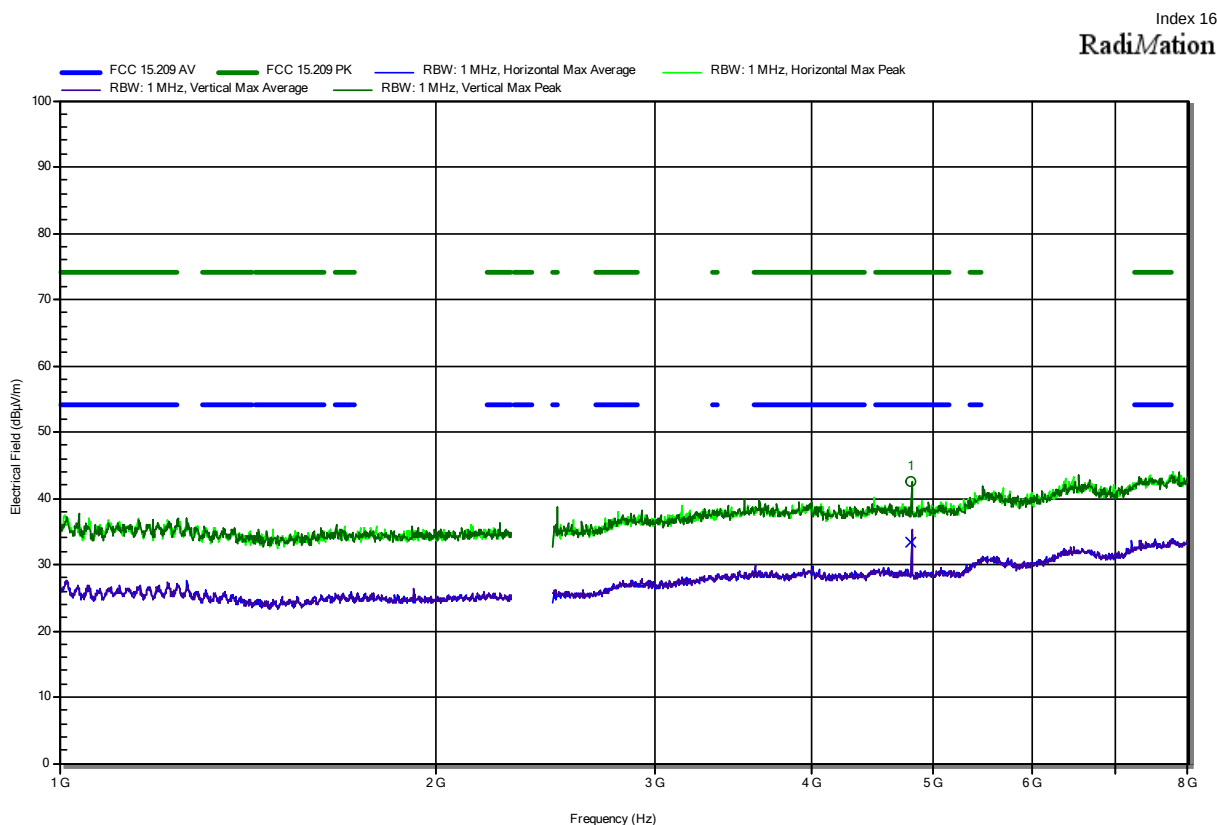
Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; 2480MHz, 3-DH5 Single
 Test Date: 2021-12-07
 Note:



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
612.5 MHz	30.8 dBµV/m	46 dBµV/m	-15.21 dB	Pass	Horizontal

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

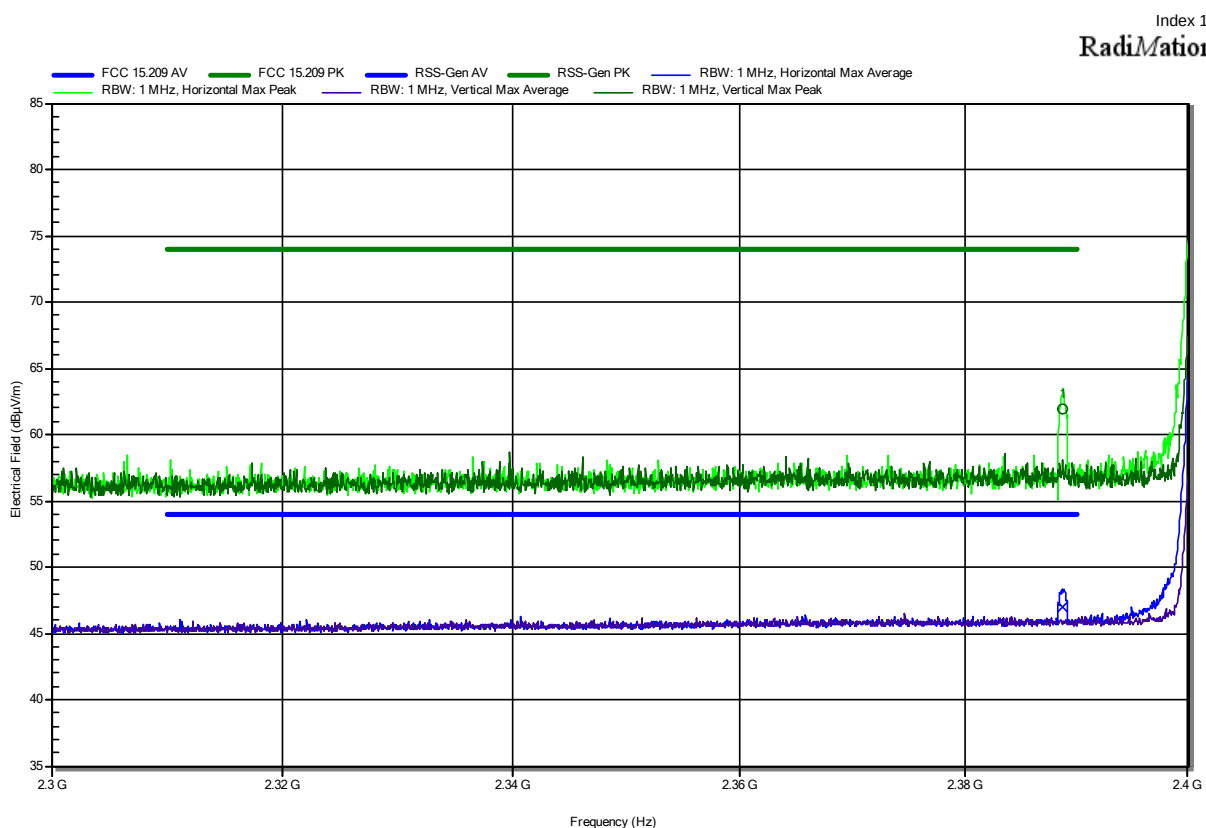
Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2402MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:



Frequency 4.804 GHz	Peak 42.55 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -31.45 dB	Peak Status Pass	Polarization Vertical
Frequency 4.804 GHz	Average 33.38 dBµV/m	Average Limit 54 dBµV/m	Average Difference -20.62 dB	Average Status Pass	Polarization Vertical

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2402MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note: lower bandedge



Frequency 2.3888 GHz	Peak 61.87 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -12.13 dB	Peak Status Pass	Polarization Horizontal
Frequency 2.3888 GHz	Average 46.96 dBµV/m	Average Limit 54 dBµV/m	Average Difference -7.04 dB	Average Status Pass	Polarization Horizontal

Test Report No.: G0M-2108-9956-TFC247BT-V01

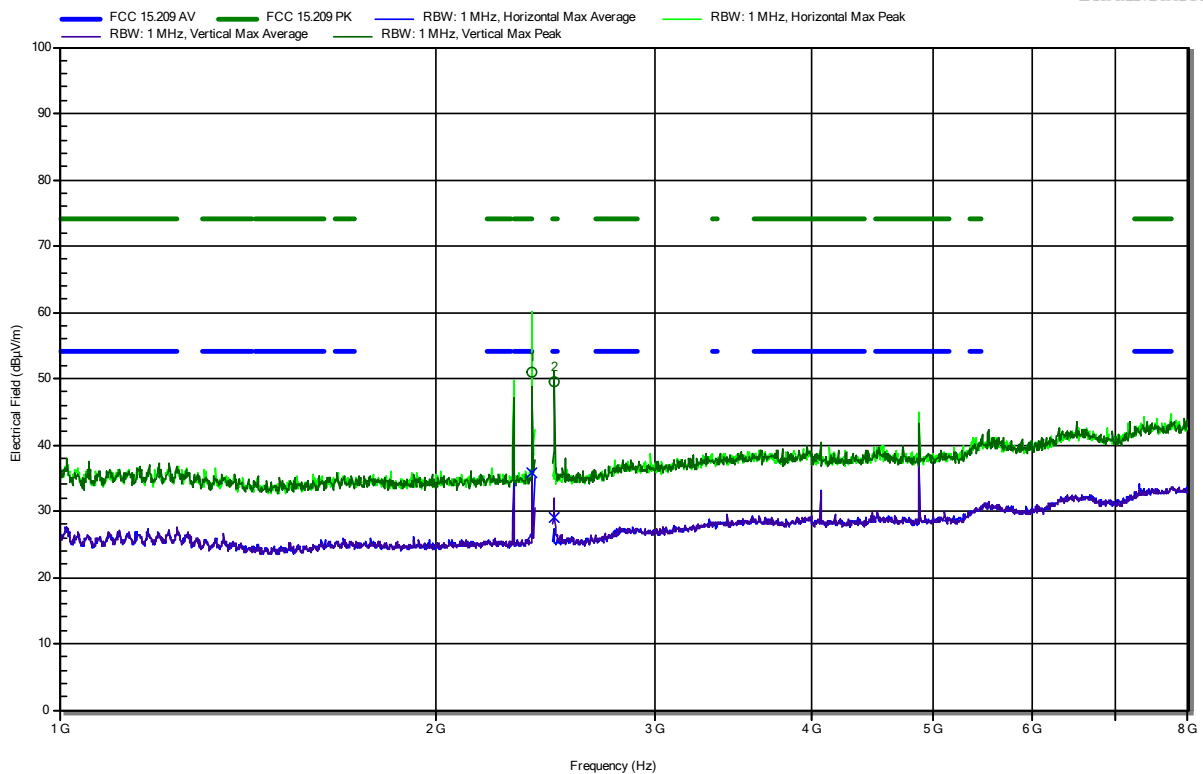
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2440MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

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RadiMation



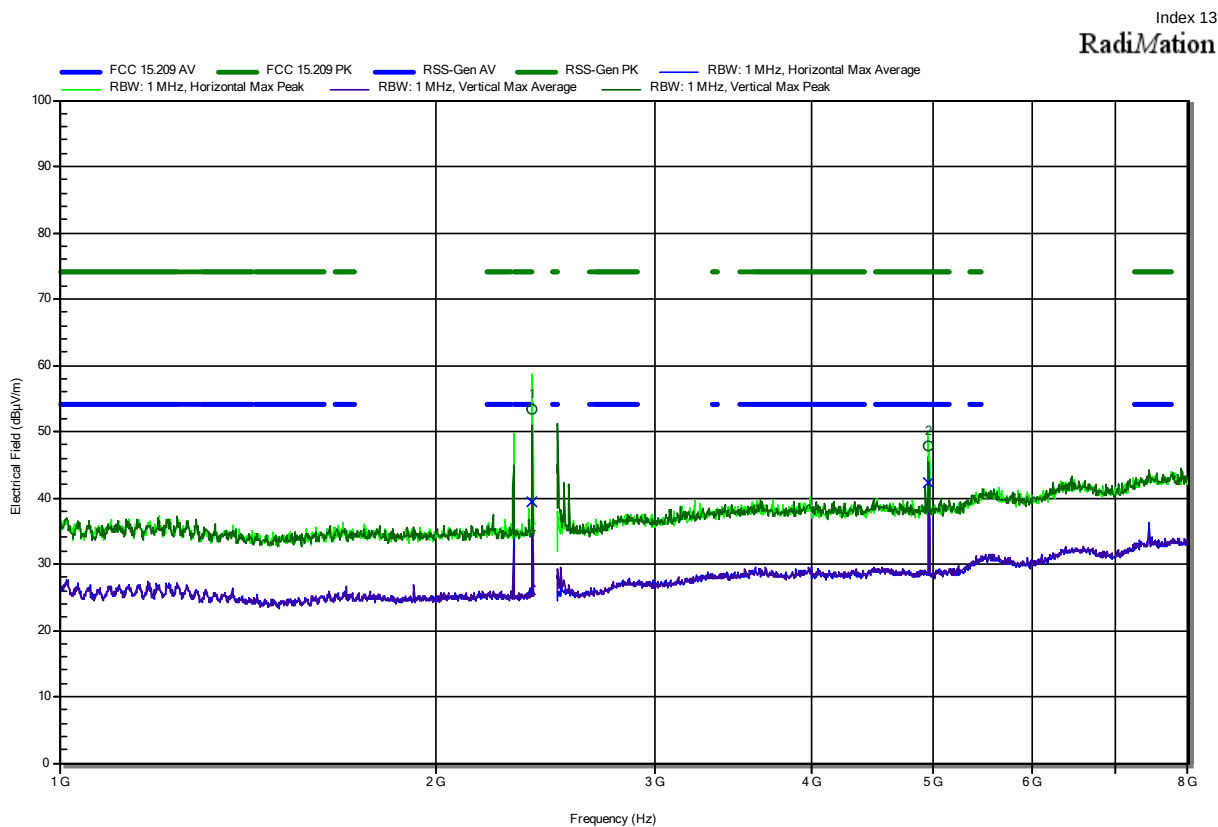
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
2.3881 GHz	50.86 dBµV/m	74 dBµV/m	-23.14 dB	Pass	Horizontal
2.4877 GHz	49.47 dBµV/m	74 dBµV/m	-24.53 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
2.3881 GHz	35.81 dBµV/m	54 dBµV/m	-18.19 dB	Pass	Horizontal
2.4877 GHz	28.97 dBµV/m	54 dBµV/m	-25.03 dB	Pass	Vertical

Test Report No.: G0M-2108-9956-TFC247BT-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2480MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
2.389 GHz	53.48 dBµV/m	74 dBµV/m	-20.52 dB	Pass	Horizontal
4.96 GHz	47.9 dBµV/m	74 dBµV/m	-26.1 dB	Pass	Horizontal

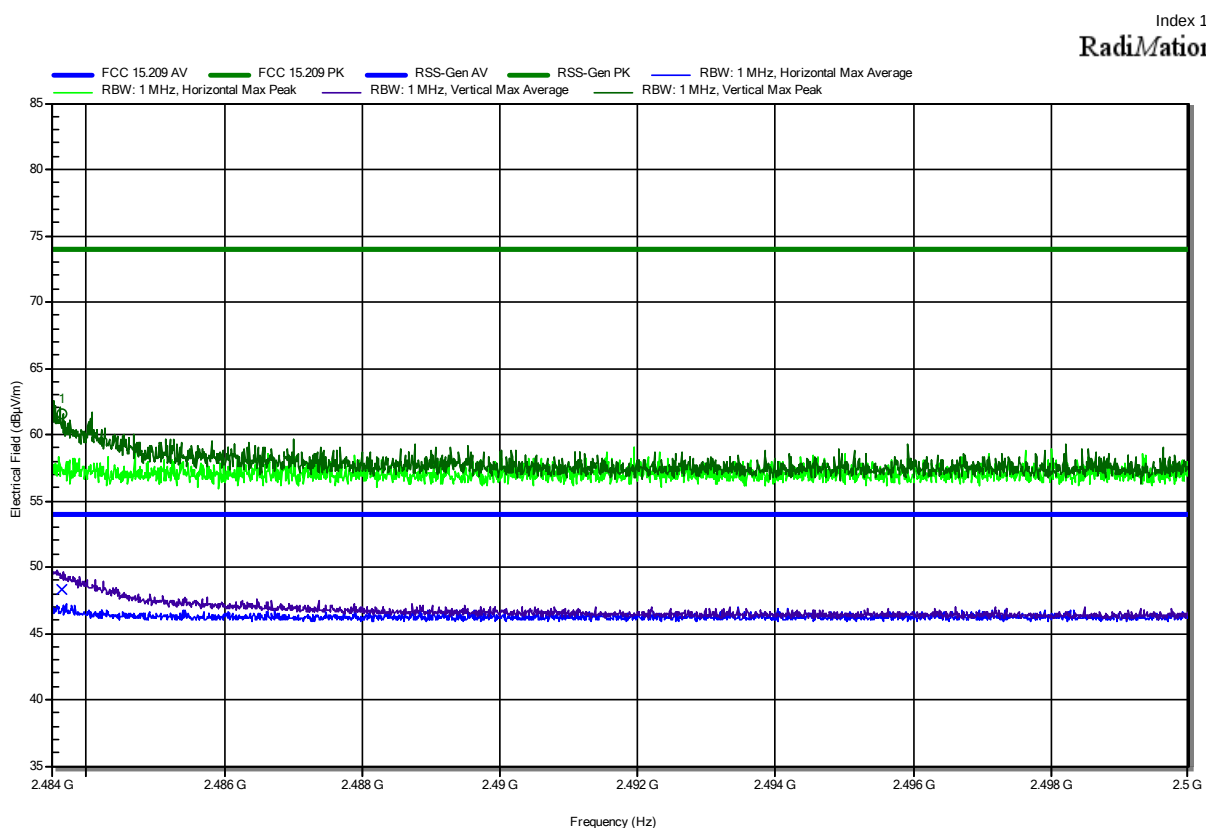
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
2.389 GHz	39.47 dBµV/m	54 dBµV/m	-14.53 dB	Pass	Horizontal
4.96 GHz	42.41 dBµV/m	54 dBµV/m	-11.59 dB	Pass	Horizontal

Test Report No.: G0M-2108-9956-TFC247BT-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; 2480MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note: upper bandedge



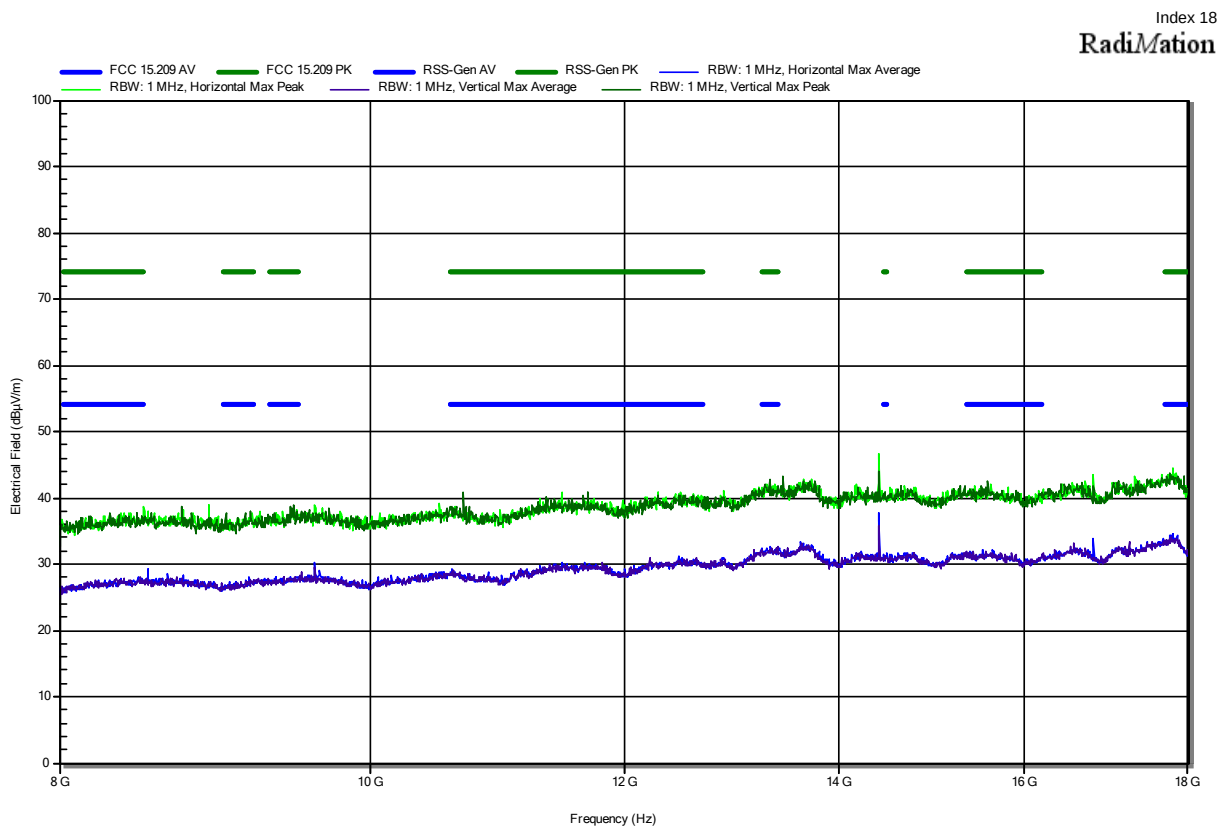
Frequency 2.4837 GHz	Peak 61.56 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -12.44 dB	Peak Status Pass	Polarization Vertical
Frequency 2.4837 GHz	Average 48.35 dBµV/m	Average Limit 54 dBµV/m	Average Difference -5.65 dB	Average Status Pass	Polarization Vertical

Test Report No.: G0M-2108-9956-TFC247BT-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; 2402MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

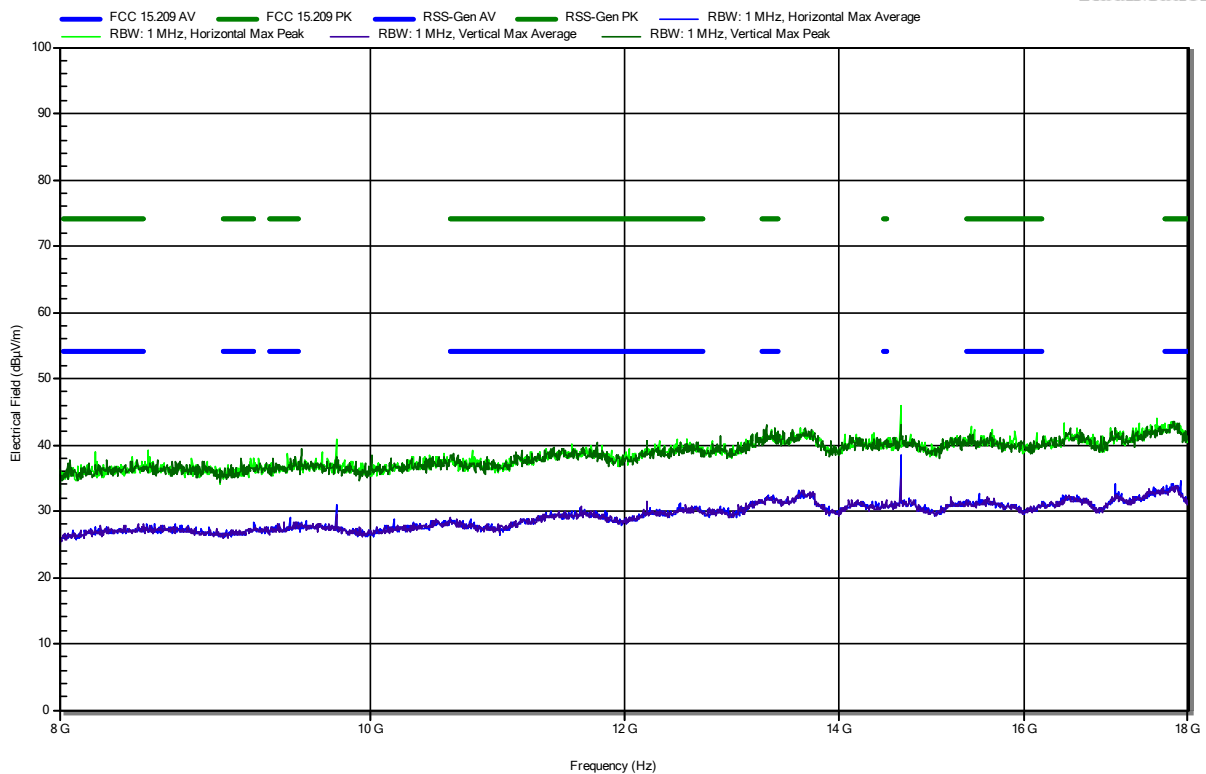


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; 2440MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

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RadiMation

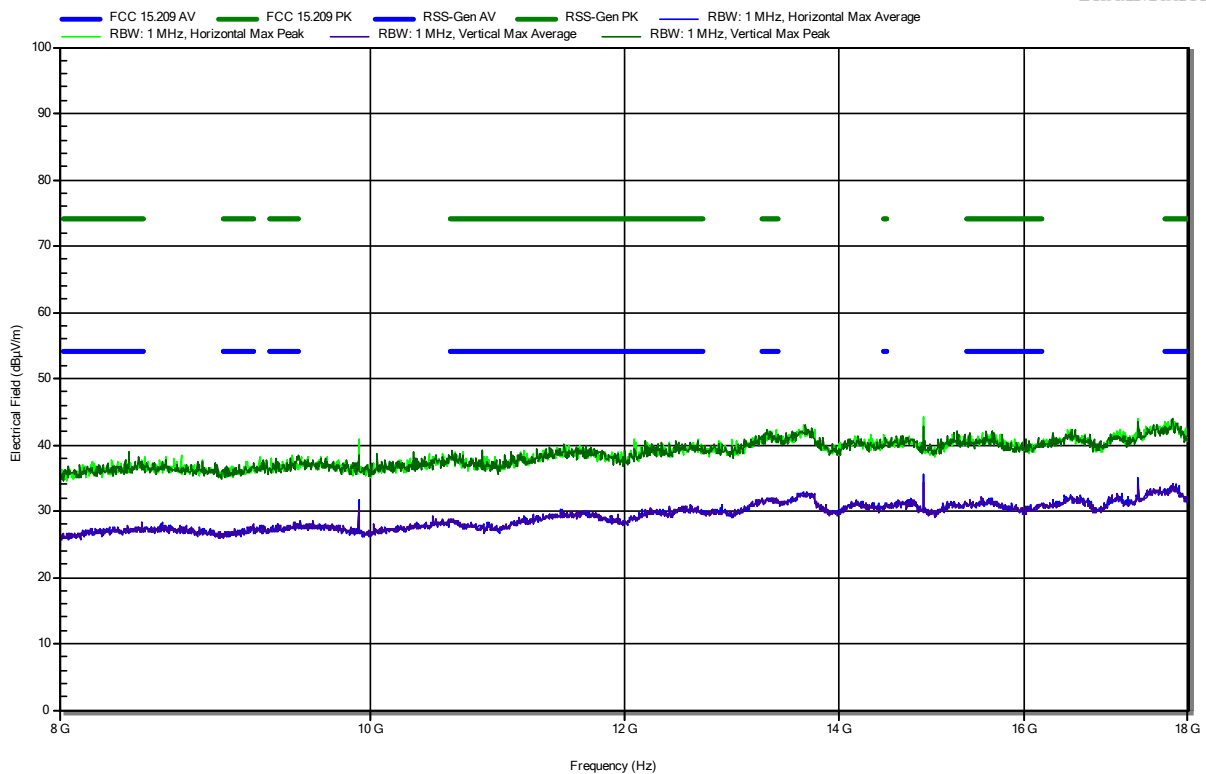


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; 2480MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

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RadiMation

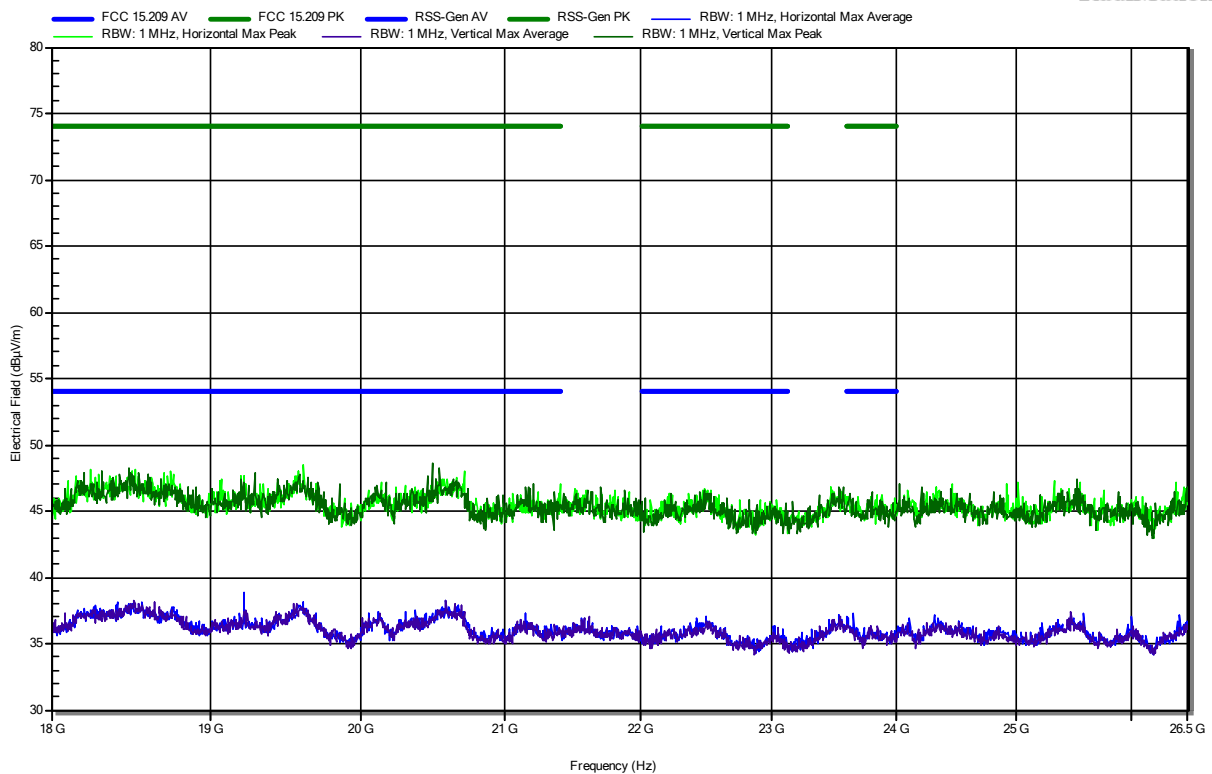


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; 2402MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

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RadiMation

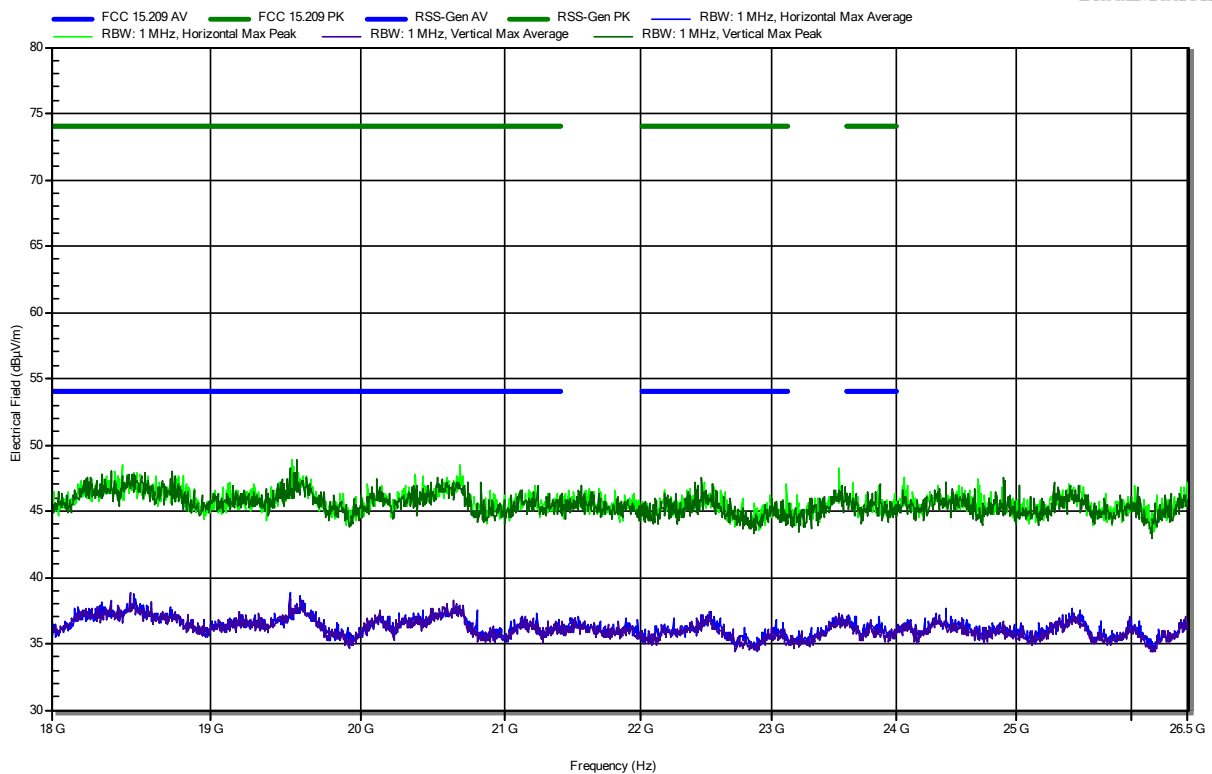


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; 2440MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

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RadiMation

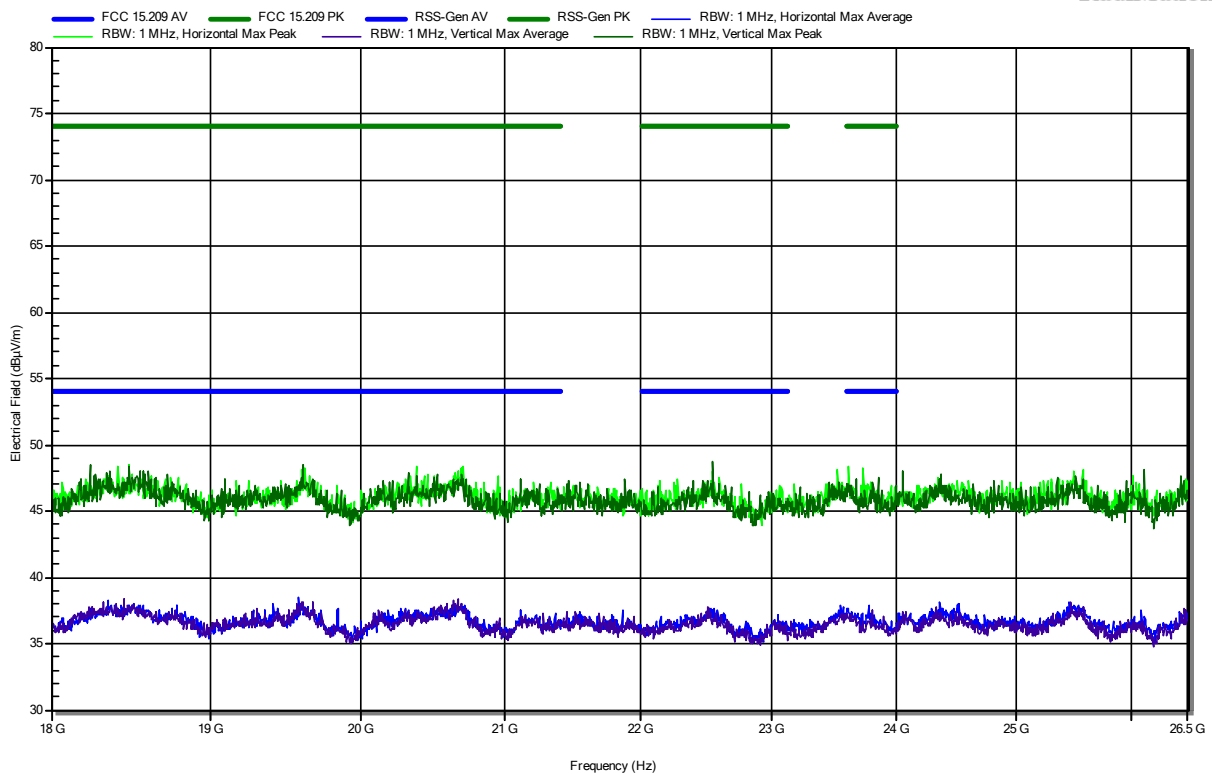


Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 7.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; 2480MHz, 3-DH5 Single
 Test Date: 2021-11-29
 Note:

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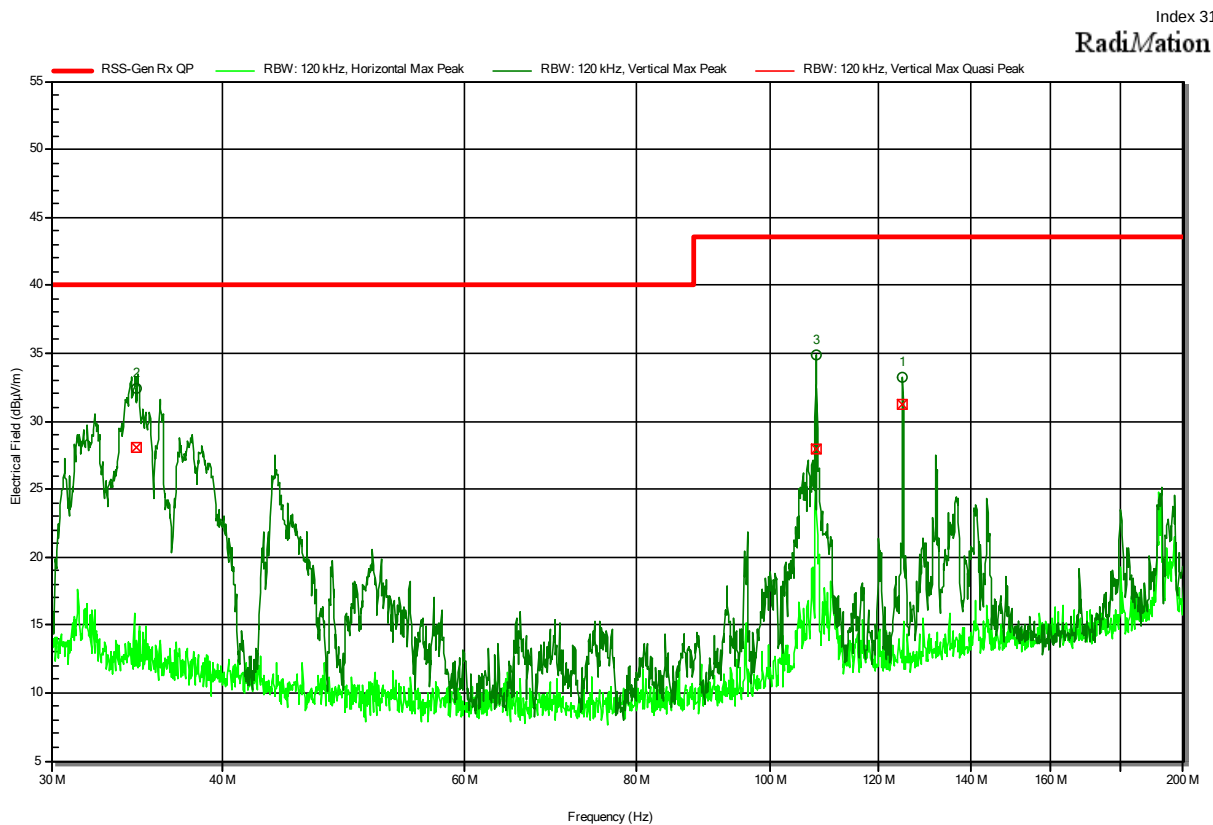
RadiMation



ANNEX B Receiver spurious emissions

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

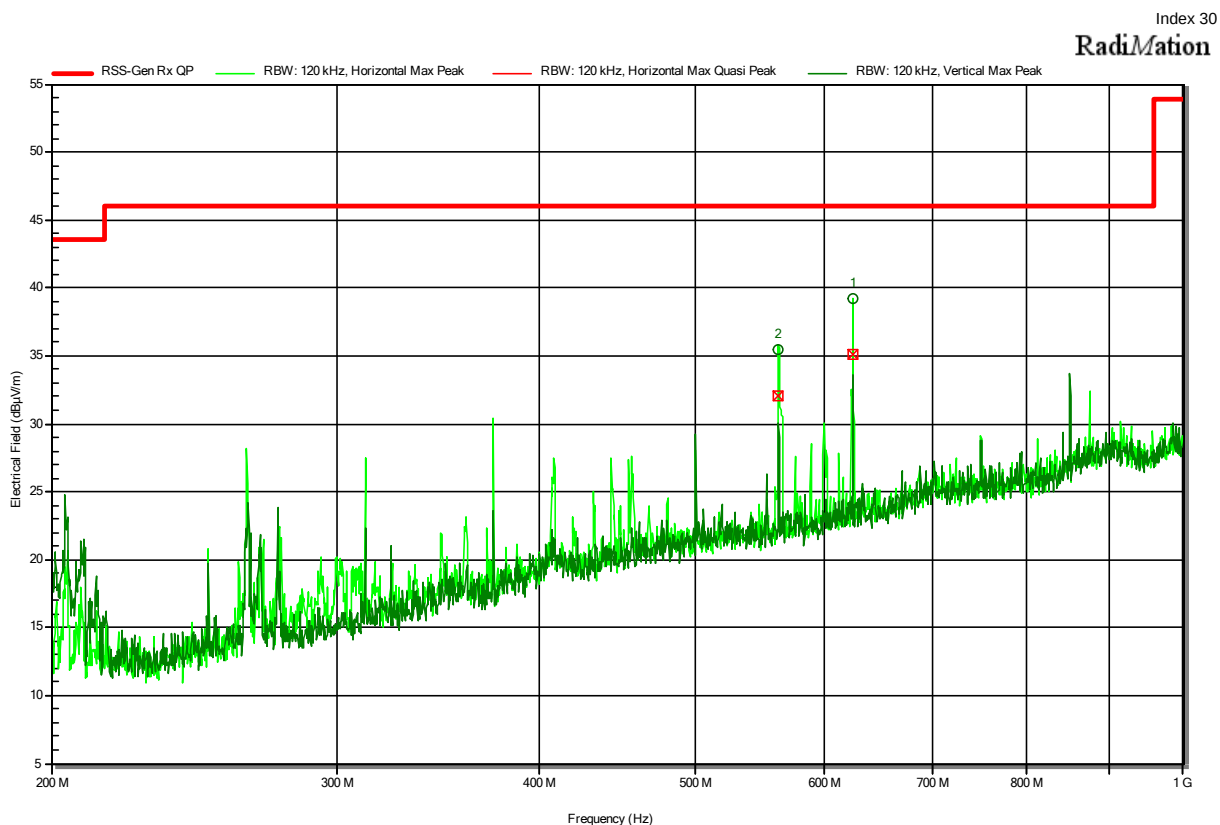
Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Rx; 2441MHz
 Test Date: 2021-12-07
 Note:



Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
34.624 MHz	28.1 dBµV/m	40 dBµV/m	-11.93 dB	Pass	Vertical
108.0076 MHz	27.9 dBµV/m	43.5 dBµV/m	-15.58 dB	Pass	Vertical
125.0002 MHz	31.2 dBµV/m	43.5 dBµV/m	-12.28 dB	Pass	Vertical

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Voigt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Rx; 2441MHz
 Test Date: 2021-12-07
 Note:



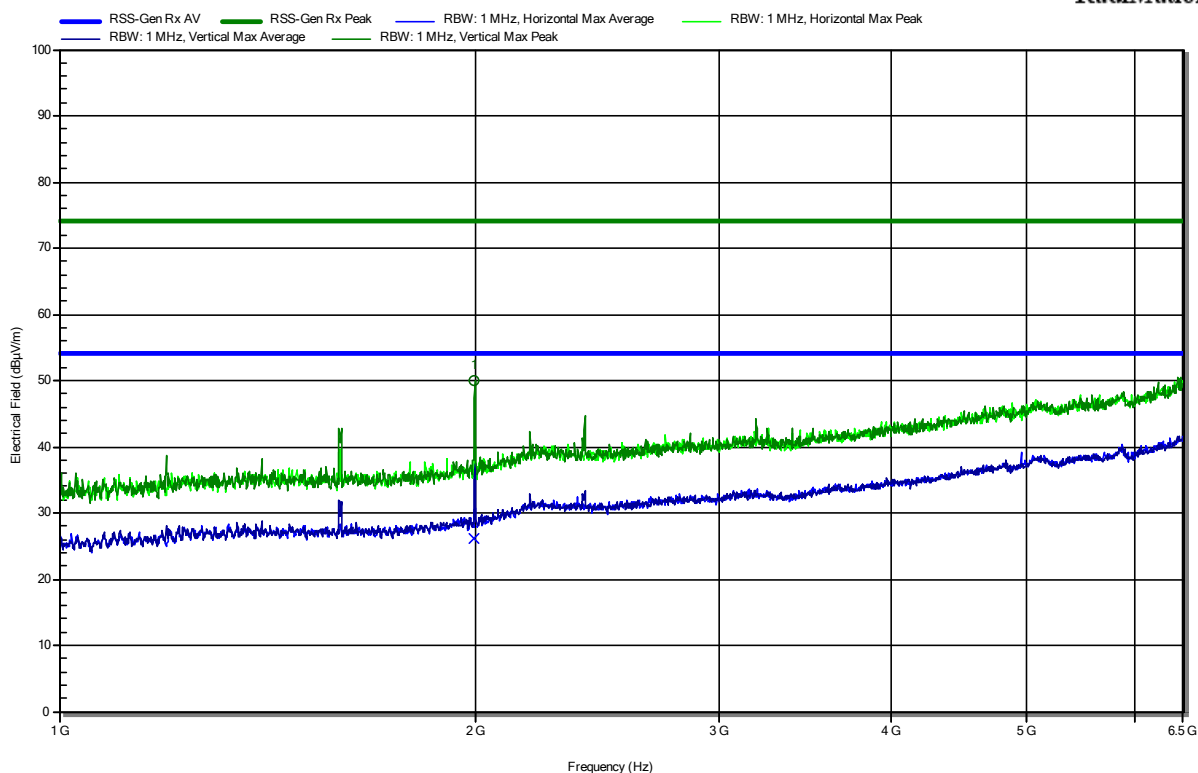
Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
562.5 MHz	32.1 dBµV/m	46 dBµV/m	-13.93 dB	Pass	Horizontal
624.984 MHz	35.1 dBµV/m	46 dBµV/m	-10.88 dB	Pass	Horizontal

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck BBHA 9120D
 Measurement distance: 3 m
 Mode: Rx; 2441MHz
 Test Date: 2021-12-13
 Note:

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RadiMation



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
1.997 GHz	50.06 dBµV/m	74 dBµV/m	-23.94 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
1.997 GHz	26.13 dBµV/m	53.98 dBµV/m	-27.85 dB	Pass	Vertical

Test Report No.: G0M-2108-9956-TFC247BT-V01

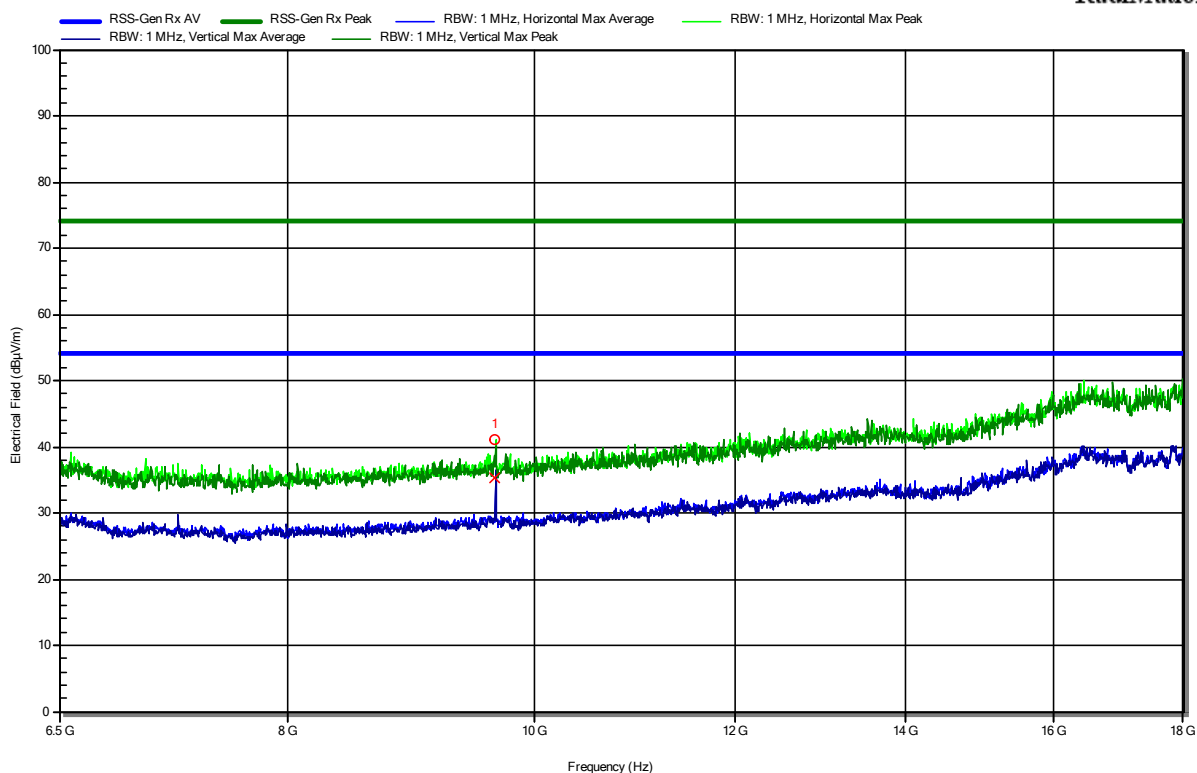
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to RSS-247, 47 CFR Part 15.247

Project Number: G0M-2108-9956
 Applicant: Leica Geosystems AG
 Model Description: Bluetooth, WLAN and BLE Module
 Model: TiWi-BLE
 Test Sample ID: 36589
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Degenhardt
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 22 °Celsius, Vnom: 7.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Rx; 2441MHz
 Test Date: 2021-12-10
 Note:

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RadiMation



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
9.648 GHz	40.98 dBµV/m	74 dBµV/m	-33.02 dB	Pass	Horizontal
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
9.648 GHz	35.35 dBµV/m	53.98 dBµV/m	-18.63 dB	Pass	Horizontal

=== END OF TEST REPORT ===

Test Report No.: G0M-2108-9956-TFC247BT-V01

Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany