



RADIO REPORT FCC 47 CFR Part 15C ISED Canada RSS-247 Digital transmission systems operating within the 2400.0 MHz - 2483.5 MHz band	
Report Reference No	G0M-2210-1706-TFC247BL-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	 <p>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</p>
Applicant	Haltian Oy
Address	Yrttipellontie 1 D 90230 Oulu Finland
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	Asset tracking tag
Model(s)	TTG
Additional Model(s)	None
Brand Name(s)	Thingsee Nano Tag
Hardware Version(s)	TTG_04S
Software Version(s)	thingsee_tag_silabs_01b_wp51_2022.02.01.1
FCC ID	2AEU3TSNANO
IC	20236-TSNANO
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	2022-10-07	
Report:		
Compiled by	Odai Qawasmeh	
Tested by (+ signature) (Responsible for Test)	Odai Qawasmeh	
Approved by (+ signature) (Test Lab Engineer)	Wilfried Treffke	
Date of Issue	2022-11-29	
Total number of pages	76	
General Remarks:		
<p>The test results presented in this report relate only to the object tested.</p> <p>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.</p> <p>This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.</p>		
Additional Comments:		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2022-11-29	Initial Release	

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
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

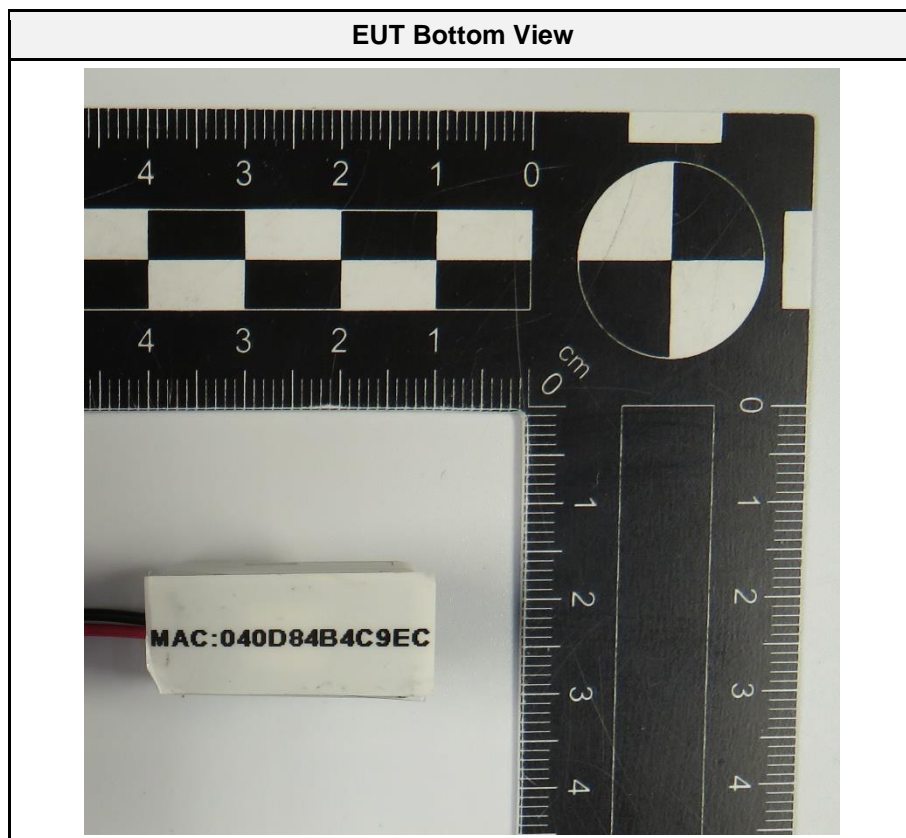
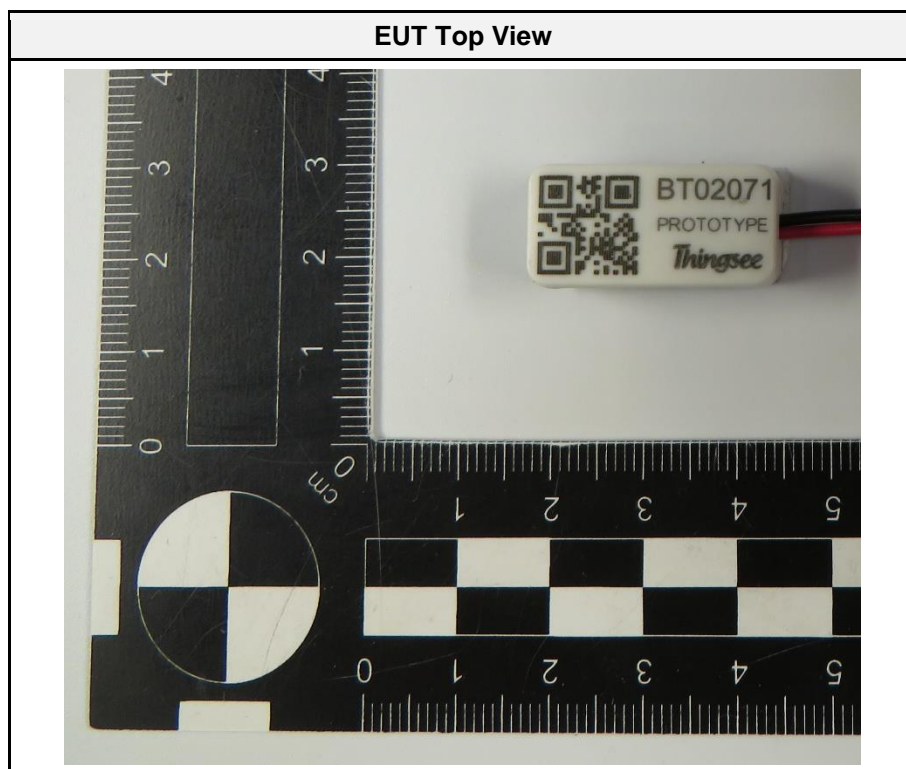
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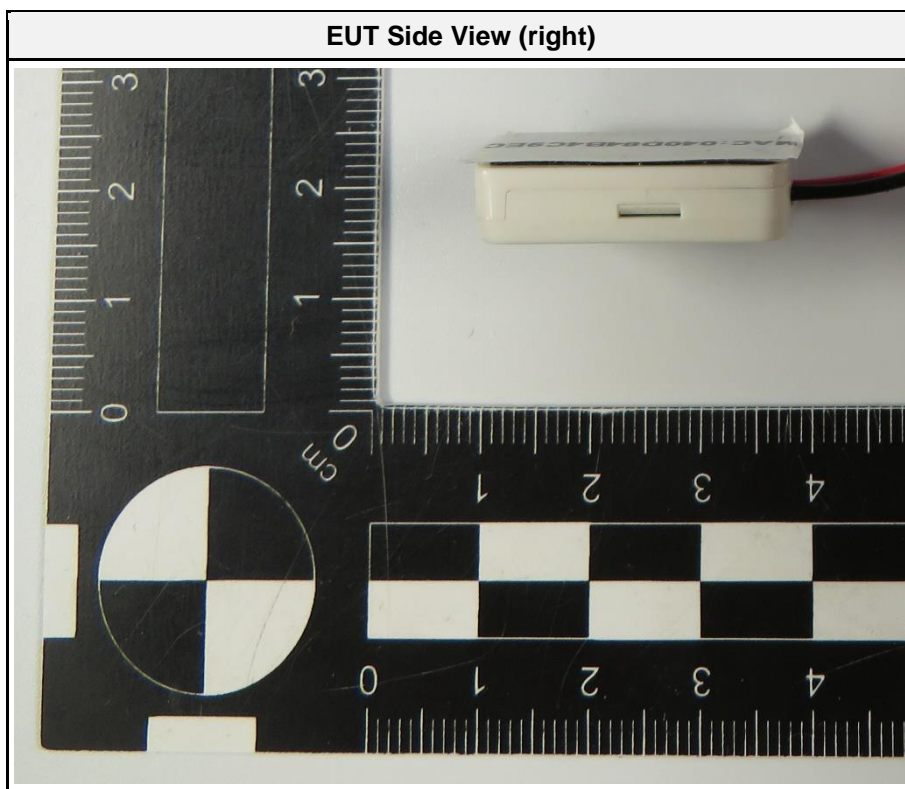
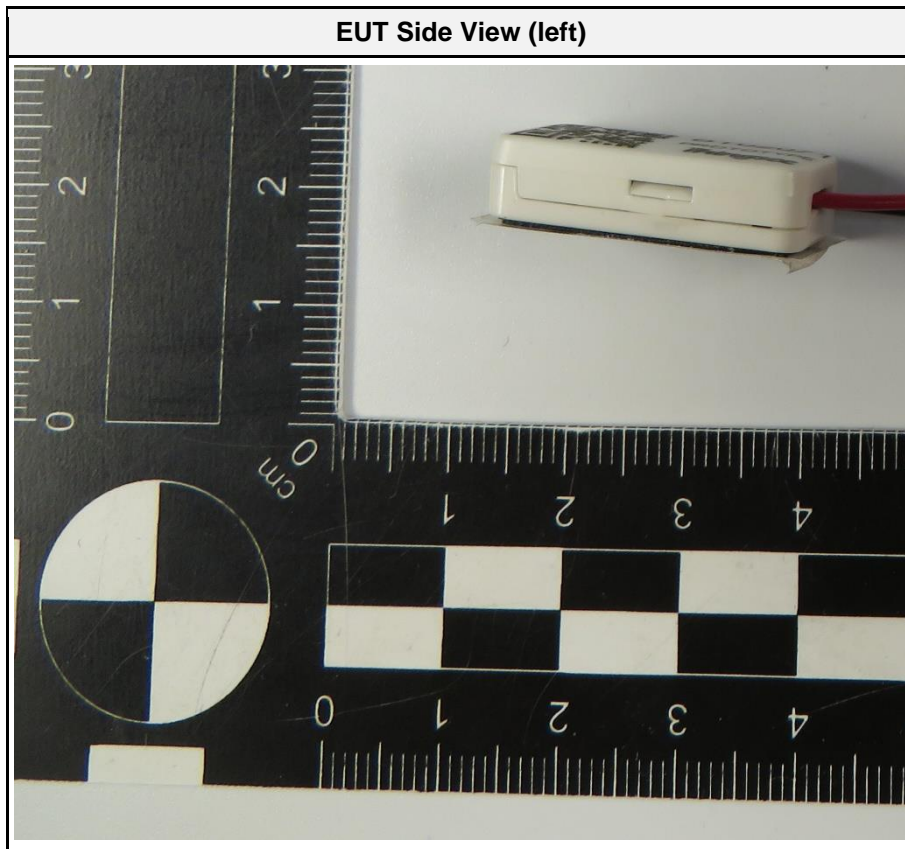
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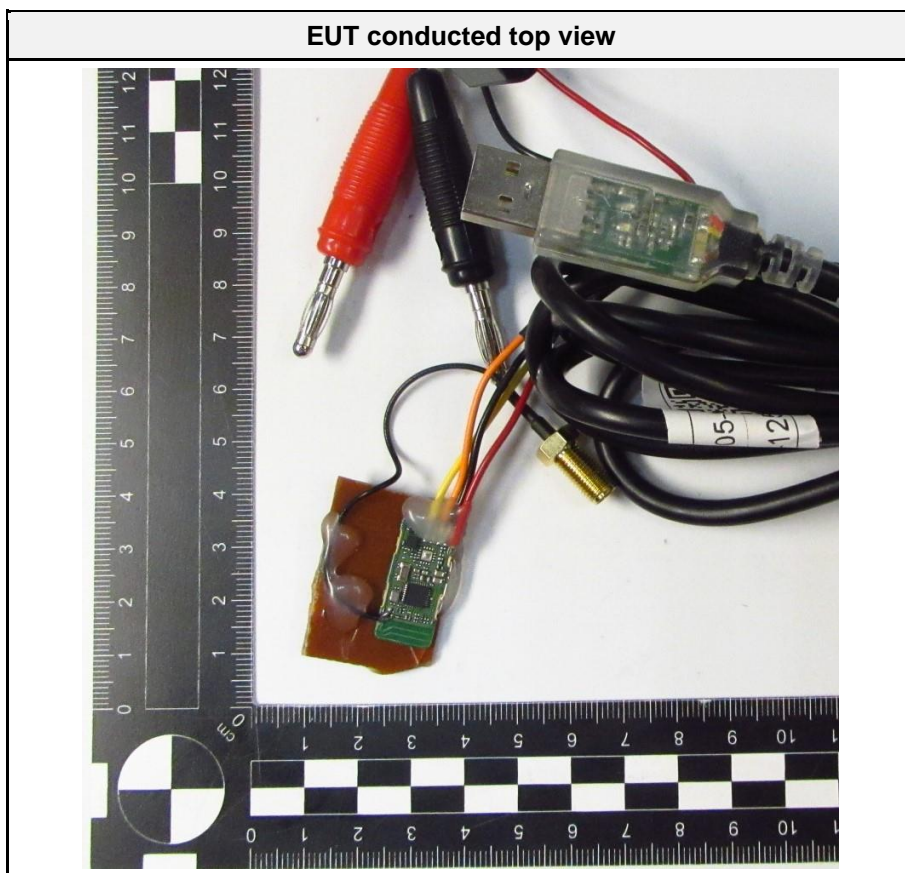
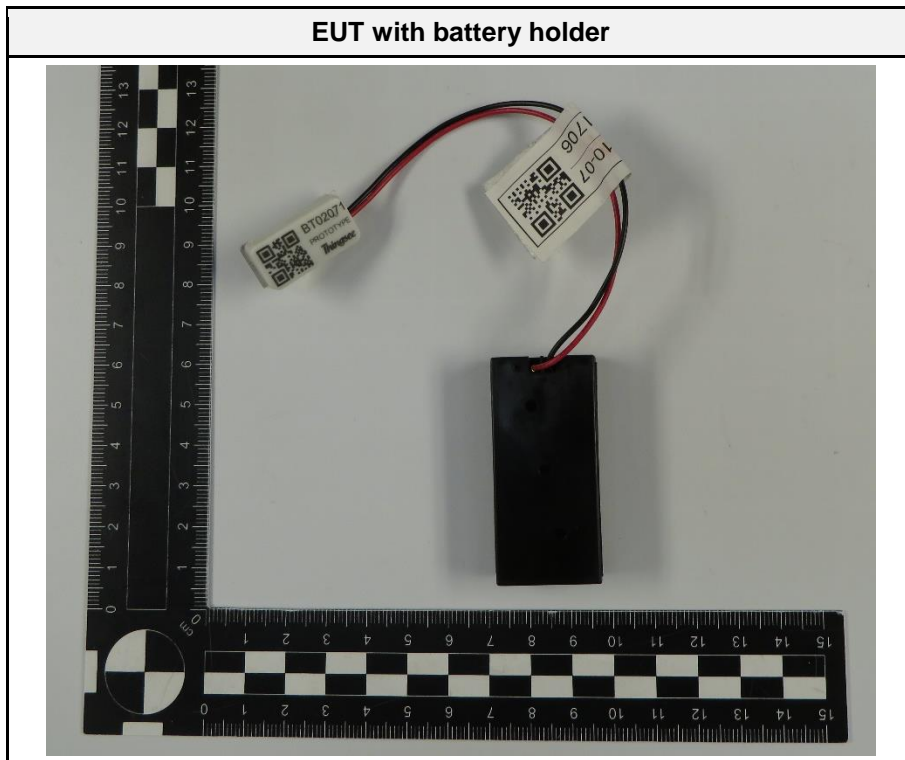
1 Equipment (Test Item) Under Test

Description	Asset tracking tag	
Model	TTG	
Additional Model(s)	None	
Brand Name(s)	Thingsee Nano Tag	
Serial Number(s)	Prototype	
Test Sample Id(s)	Radiated sample: 41732 Conducted sample: 39791	
Hardware Version(s)	TTG_04S	
Software Version(s)	thingsee_tag_silabs_01b_wp51_2022.02.01.1	
PMN	Thingsee Nano Tag	
HVIN	TTG	
FVIN	thingsee_tag_silabs_01b_wp51_2022.02.01.1	
HMN	N/A	
FCC ID	2AEU3TSNANO	
IC	20236-TSNANO	
Equipment type	End Product	
Radio type	Transceiver	
Assigned frequency bands	2400.0 MHz - 2483.5 MHz	
Radio technology	Bluetooth LE Hardware	
Supported datarate(s)	1MBit/s	
Modulation	GFSK	
Number of antenna ports	1	
Antenna	Type	Integrated
	Model	PCB antenna
	Manufacturer	Hattian Oy
	Gain	0.4 dBi (declared by manufacturer)
Supply Voltage	V _{NOM}	3 VDC (Battery)
Operating Temperature	T _{NOM}	25 °C
AC/DC-Adaptor	None	
Manufacturer	Hattian Oy Yrttipellontie 1 D 90230 Oulu Finland	

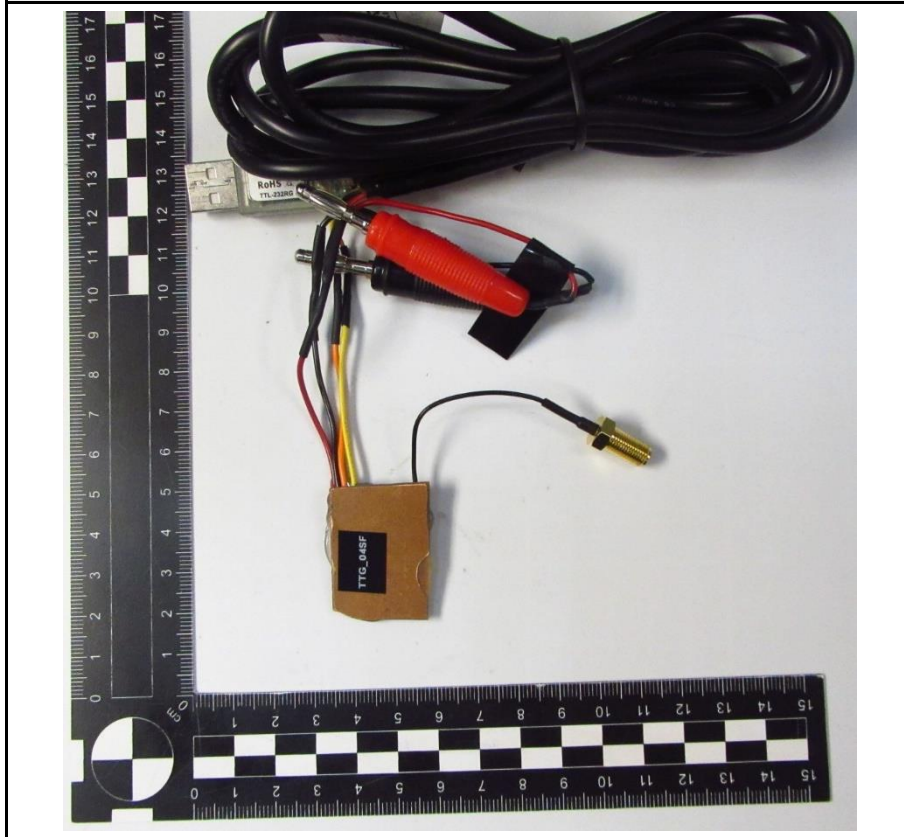
1.1 Photos – Equipment External



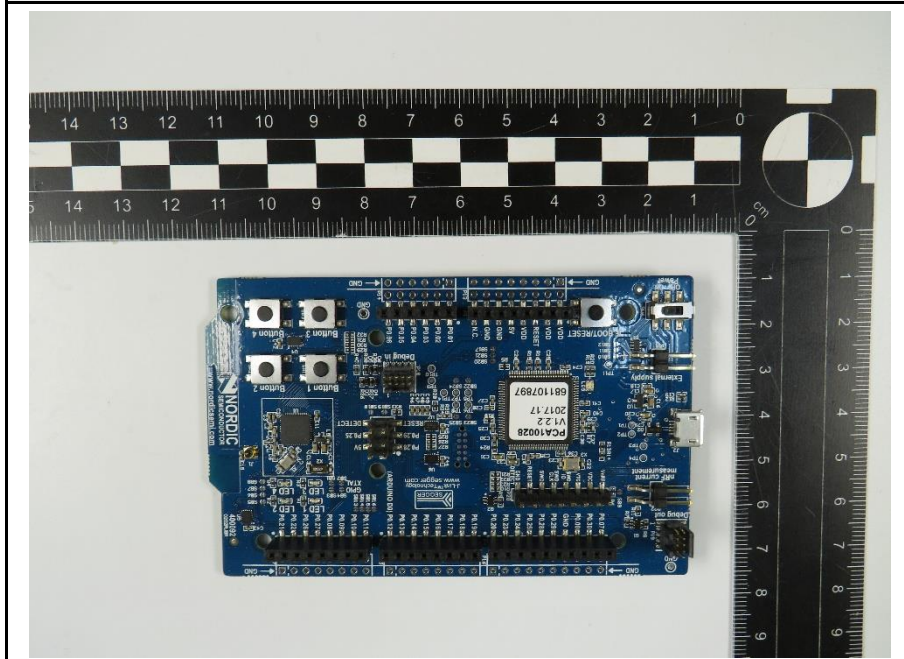




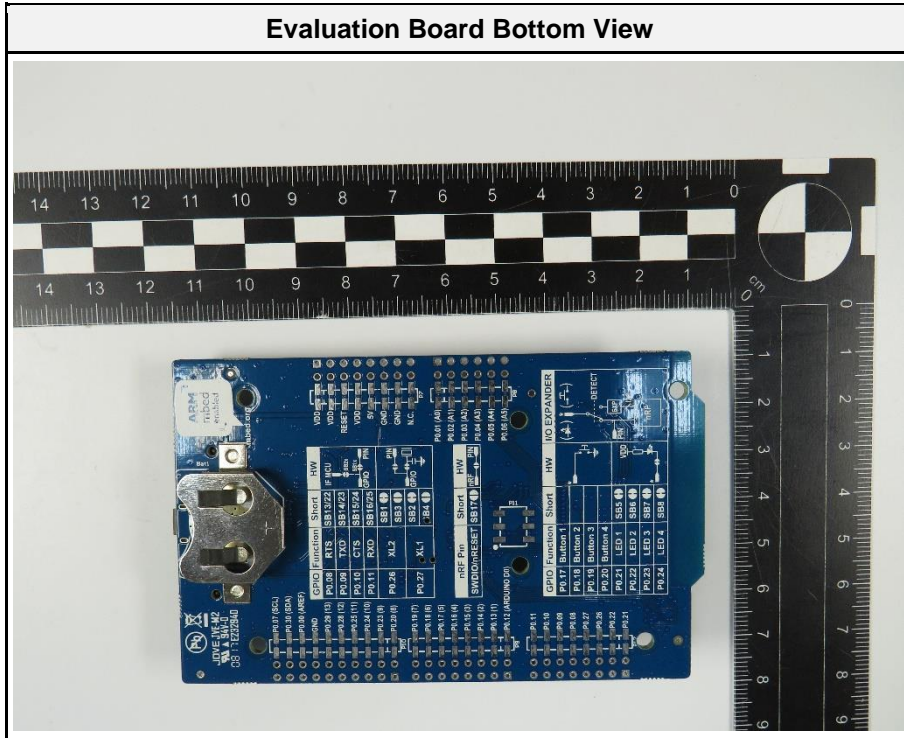
EUT conducted bottom view



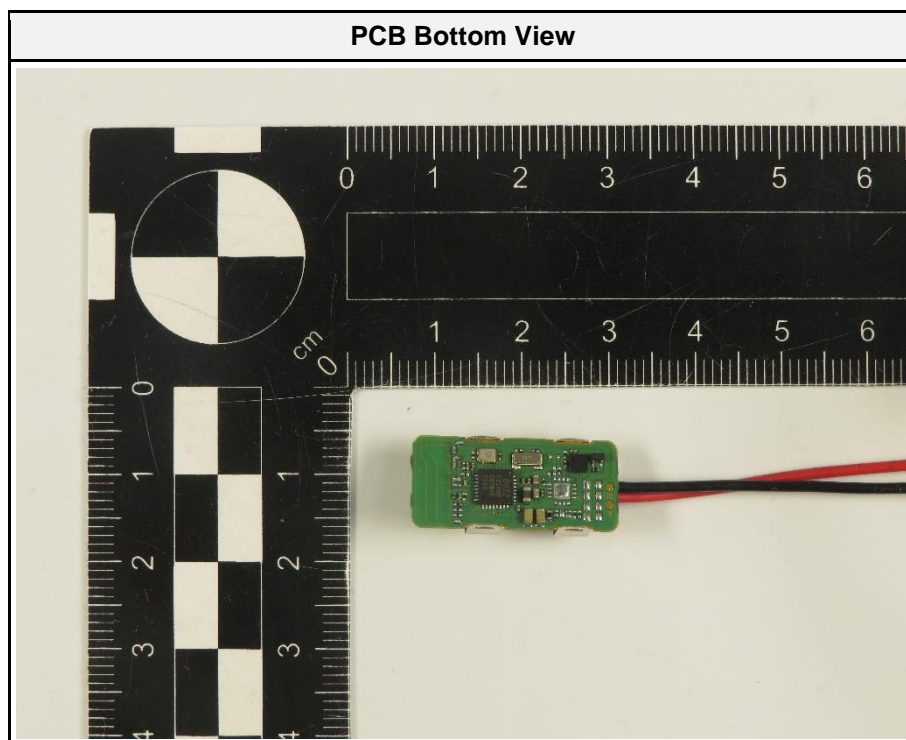
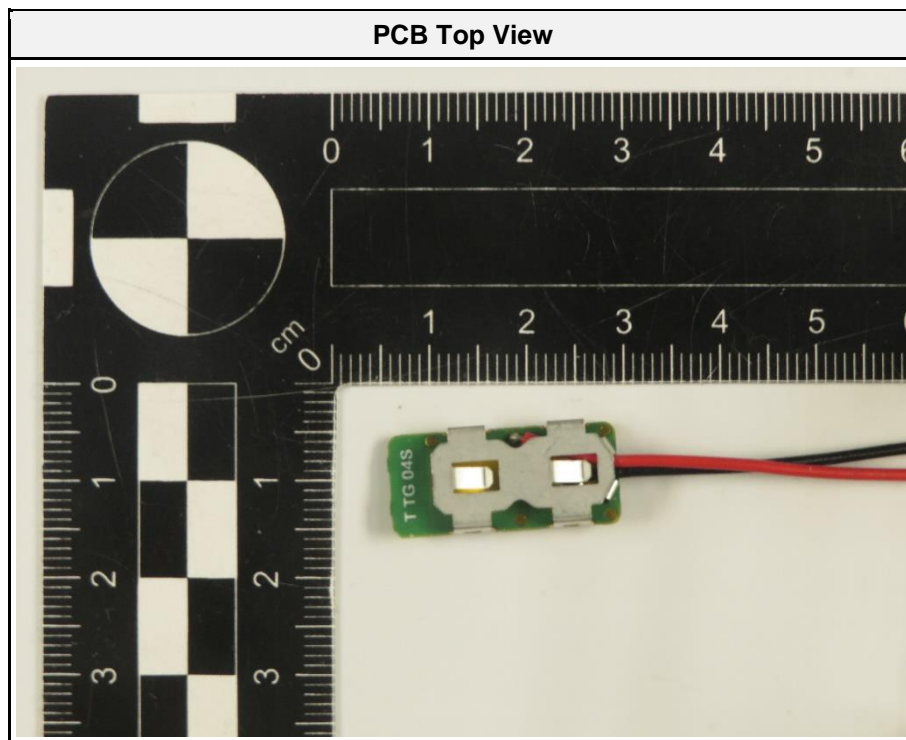
Evaluation Board Top View



Evaluation Board Bottom View



1.2 Photos – Equipment Internal



1.3 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Laptop	Lenovo	T450	
AE	Evaluation board	Nordic	nRF52	Wireless control of EUT test modes
SFT	Heat Software for PC	Haltian Oy	---	Connecting to the EUT and set test mode
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment:				

1.4 Test Modes

Mode	Description
GFSK	Mode = Transmit Modulation = GFSK Spreading = None Packet Type = PRBS9 Packet Length = 193 Bytes Data rate = 1 Mbit/s Duty cycle = 88% Power setting = 1dBm (software setting)
Receive	Mode = Receive
Comment: With above settings, the highest duty cycle is achieved.	

1.5 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	Tx	0	2402
F2	Tx / Rx	19	2440
F3	Tx	39	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	Informational only
FCC § 15.247(a)(2) ISED RSS-247, Issue 2 (section 5.2)	6 dB Bandwidth	ANSI C63.10-2013	PASS	
FCC § 15.247(b) ISED RSS-247, Issue 2 (section 5.4)	Maximum peak conducted power	ANSI C63.10-2013	PASS	
FCC § 15.247(e) ISED RSS-247, Issue 2 (section 5.2)	Power spectral density	ANSI C63.10-2013	PASS	
FCC § 15.207 ISED RSS-247, Issue 2 (section 3.1)	AC power line conducted emissions	ANSI C63.10-2013	N/R	Not directly or indirectly connectable to mains network
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Band edge compliance	ANSI C63.10-2013	PASS	
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Conducted spurious emissions	ANSI C63.10-2013	PASS	
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 - Occupied bandwidth

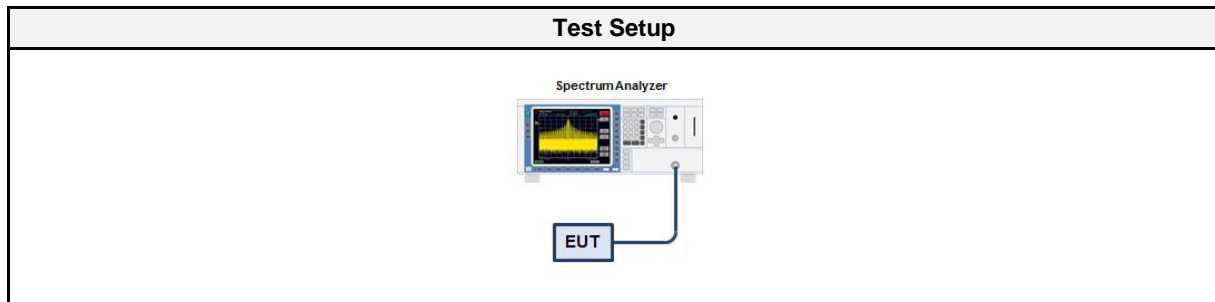
3.1.1 Information

Test Information	
Reference	ISED RSS-Gen, Issue 5 A2 (section 6.7)
Measurement Method	ANSI C63.10 6.9.3
Measurement Uncertainty	$\pm 1.26 \%$
Test Sample ID	39791
Operator	Florian Voigt
Date	2022-05-24

3.1.2 Limits

Limits
None (Informational only)

3.1.3 Setup



3.1.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSW 43	EF00896	2021-07	2022-07
Cable	Huber+Suhner	Sucoflex 102EA	EF00779 CAABR	2022-02	2023-02

3.1.5 Procedure

Test Procedure
<ol style="list-style-type: none"> 1. EUT transmitter is activated in test mode under normal conditions 2. The spectrum analyzer is set to peak detection and maximum hold with a span twice the emission spectrum 3. The resolution bandwidth is set to the range of 1 % to 5 % of the occupied bandwidth 4. The occupied bandwidth is measured with the build-in analyzer function

3.1.6 Results

Test Results		
Mode	Frequency [MHz]	Bandwidth [MHz]
GFSK	2402	1.014
GFSK	2440	1.015
GFSK	2480	1.016

Occupied Bandwidth

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Occupied Bandwidth [MHz]: 1.014



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Occupied Bandwidth

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Occupied Bandwidth [MHz]: 1.015



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Occupied Bandwidth

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 6.9.3
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Occupied Bandwidth [MHz]: 1.016



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3.2 Test Conditions and Results - 6 dB bandwidth

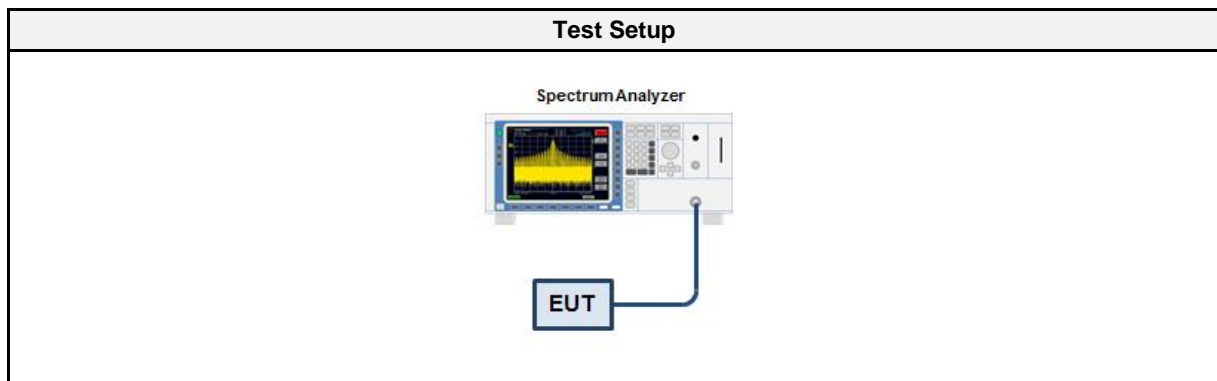
3.2.1 Information

Test Information	
Reference	FCC § 15.247(a)(2); ISED RSS-247, Issue 2 (section 5.2)
Measurement Method	ANSI C63.10 11.8
Measurement Uncertainty	± 1.26 %
Operator	Florian Voigt
Date	2022-05-24

3.2.2 Limits

Limits
≥ 500kHz

3.2.3 Setup



3.2.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSW 43	EF00896	2021-07	2022-07
Cable	Huber+Suhner	Sucoflex 102EA	EF00779 CAABR	2022-02	2023-02

3.2.5 Procedure

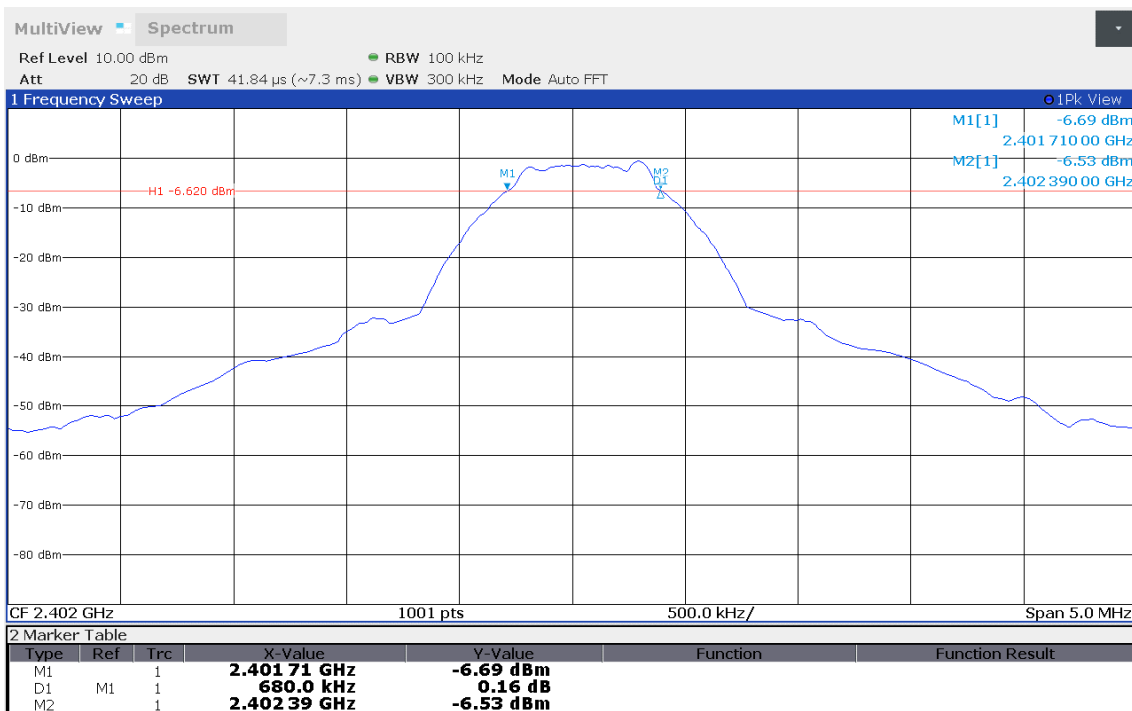
Test Procedure
<ol style="list-style-type: none"> 1. EUT set to test mode 2. Span set to at least twice the emission spectrum 3. Detector set to peak and max hold and RBW is set to 100 kHz 4. Envelope peak value of emission spectrum is selected 5. Marker on envelope of spectrum is set to level of -6 dB to the left of the peak 6. Marker on envelope of spectrum is set to level of -6 dB to the right of the peak 7. 6 dB Bandwidth is determined by marker frequency separation

3.2.6 Results

Test Results				
Mode	Frequency [MHz]	Bandwidth [kHz]	Limit [kHz]	Verdict
GFSK	2402	680	500	PASS
GFSK	2440	700	500	PASS
GFSK	2480	685	500	PASS

DTS (6 dB) Bandwidth

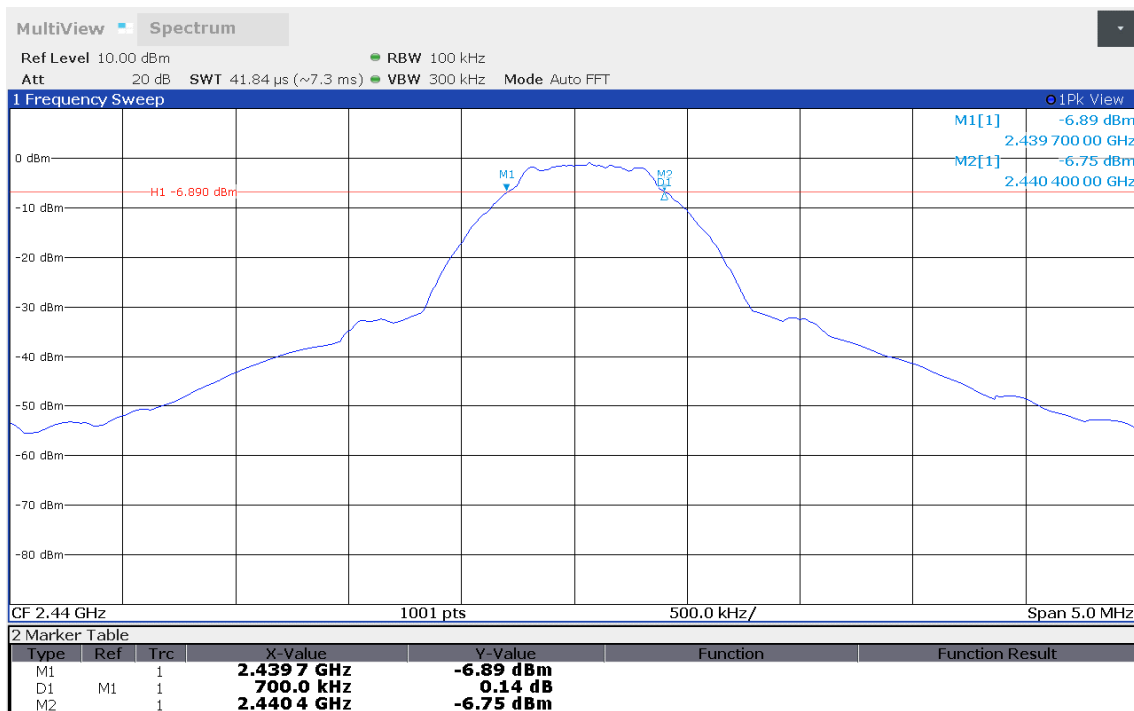
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Lower Frequency [MHz]: 2401.710
 Upper Frequency [MHz]: 2402.390
 6 dB Bandwidth [kHz]: 680



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DTS (6 dB) Bandwidth

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Lower Frequency [MHz]: 2439.700
 Upper Frequency [MHz]: 2440.400
 6 dB Bandwidth [kHz]: 700



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DTS (6 dB) Bandwidth

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.8.1 Option 1
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Lower Frequency [MHz]: 2479.710
 Upper Frequency [MHz]: 2480.395
 6 dB Bandwidth [kHz]: 685



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3.3 Test Conditions and Results - Maximum peak conducted output power

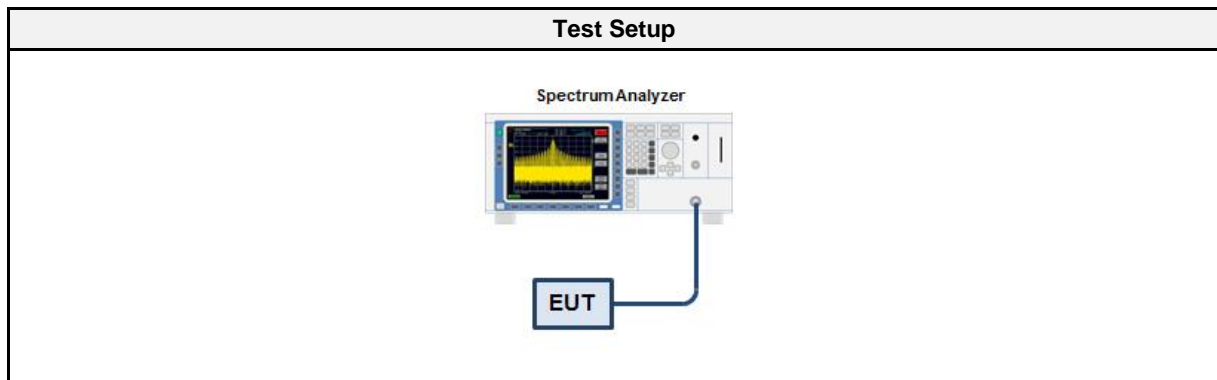
3.3.1 Information

Test Information	
Reference	FCC § 15.247(b); ISED RSS-247, Issue 2 (section 5.4)
Measurement Method	ANSI C63.10 11.9.1
Measurement Uncertainty	± 2.86 dB
Operator	Florian Voigt
Date	2022-05-24

3.3.2 Limits

Limits
1 W (30 dBm)
The conducted output power limit specified above is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in the table, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.3 Setup



3.3.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSW 43	EF00896	2021-07	2022-07
Cable	Huber+Suhner	Sucoflex 102EA	EF00779 CAABR	2022-02	2023-02

3.3.5 Procedure

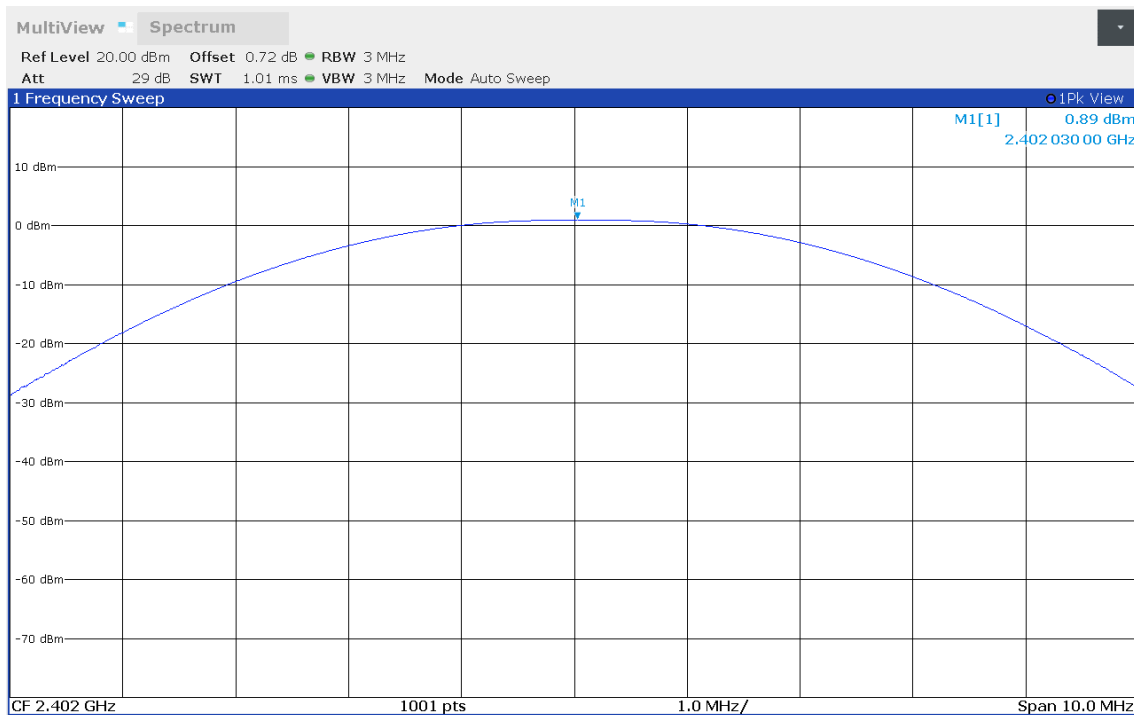
Test Procedure
<ol style="list-style-type: none"> 1. EUT set to test mode (Communication tester is used if needed) 2. Analyzer resolution bandwidth is set ≥ DTS bandwidth 3. Detector set to peak and max hold 4. Sweep time is set to auto 5. After the trace has stabilized a marker is set to peak of envelope

3.3.6 Results

Test Results				
Channel [MHz]	Power [dBm]	Power [W]	Limit [W]	Verdict
2402	0.89	0.0012	1.0	PASS
2440	0.99	0.0013	1.0	PASS
2480	0.95	0.0012	1.0	PASS

Peak Conducted Output Power

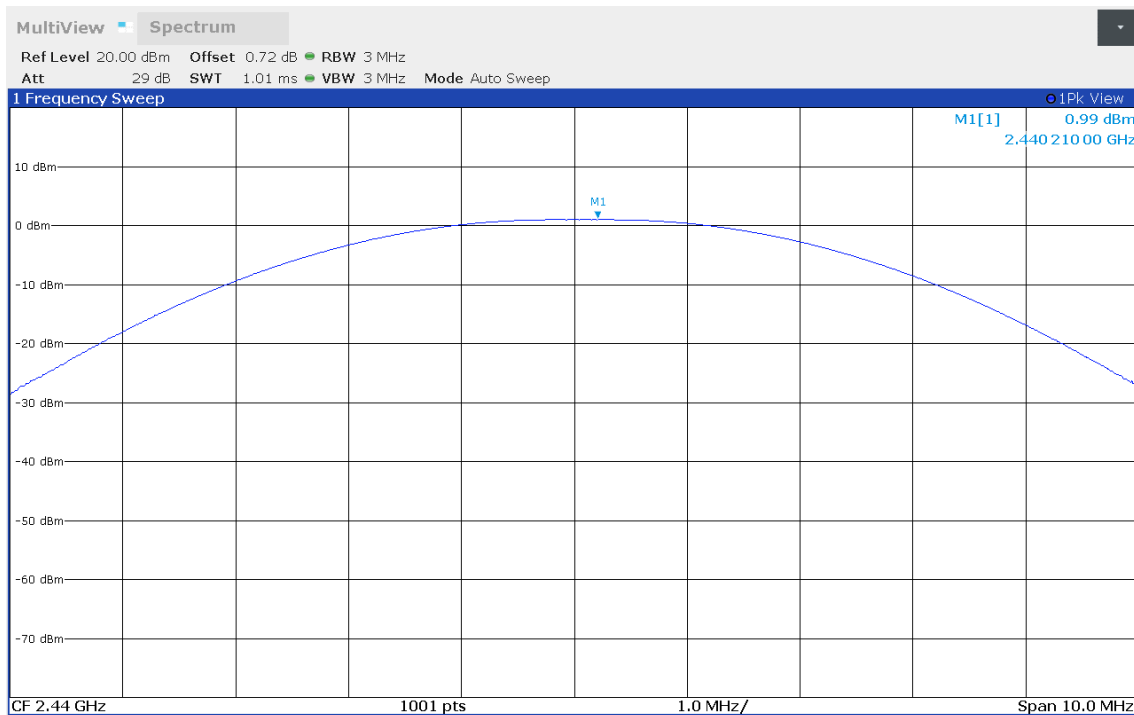
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Peak Power [dBm]: 0.886
 Peak Power [W]: 0.0012



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Peak Conducted Output Power

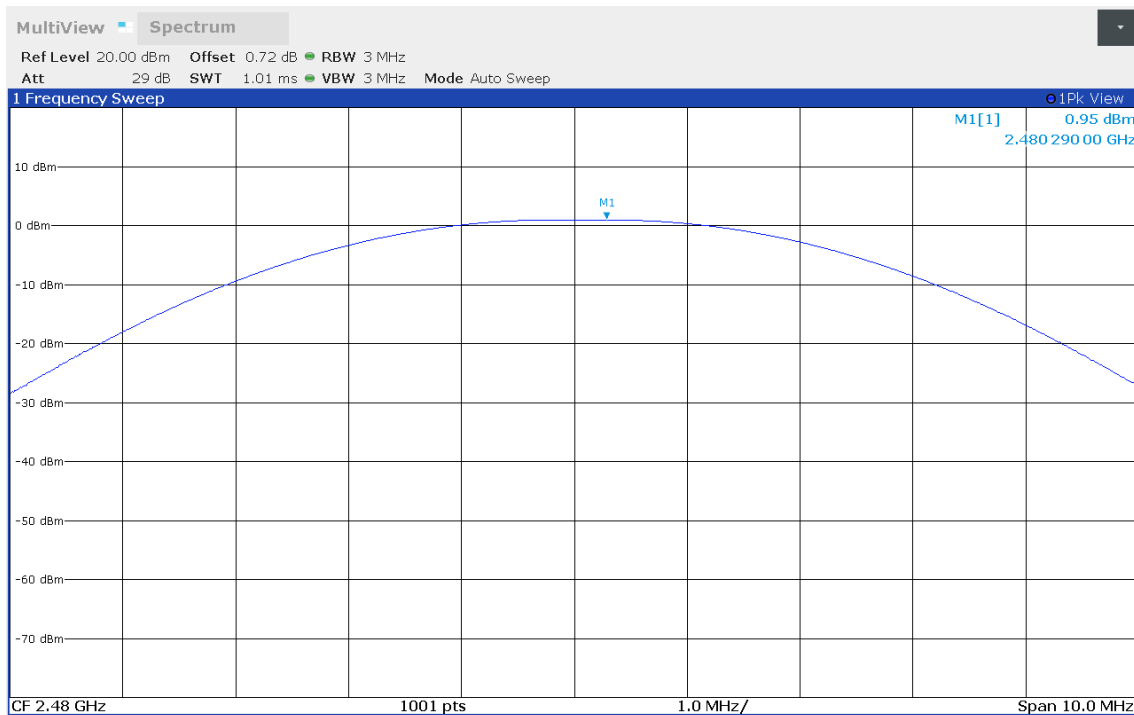
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Peak Power [dBm]: 0.990
 Peak Power [W]: 0.0013



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Peak Conducted Output Power

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.9.1.1
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Peak Power [dBm]: 0.954
 Peak Power [W]: 0.0012



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3.4 Test Conditions and Results - Power spectral density

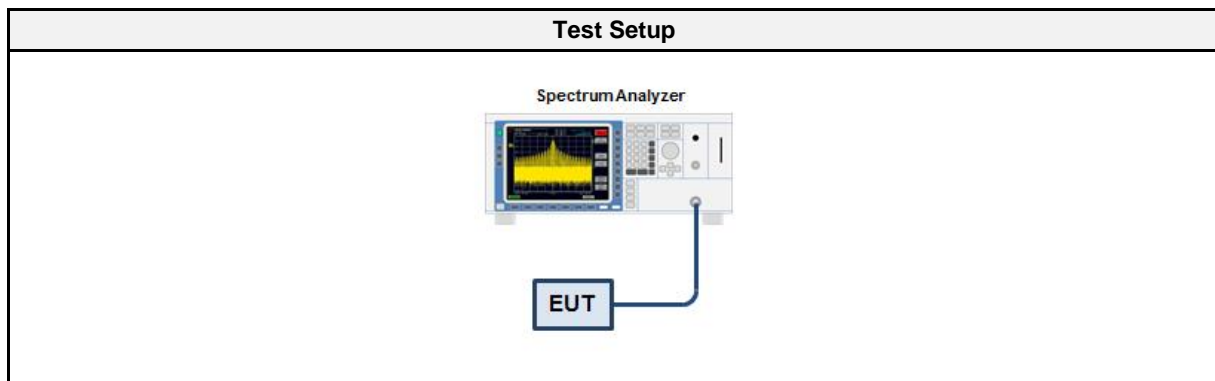
3.4.1 Information

Test Information	
Reference	FCC § 15.247(e); ISED RSS-247, Issue 2 (section 5.2)
Measurement Method	ANSI C63.10 11.10.2, 14.3.2
Measurement Uncertainty	± 2.86 dB
Operator	Florian Voigt
Date	2022-05-24

3.4.2 Limits

Limits
8 dBm / 3 kHz

3.4.3 Setup



3.4.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSW 43	EF00896	2021-07	2022-07
Cable	Huber+Suhner	Sucoflex 102EA	EF00779 CAABR	2022-02	2023-02

3.4.5 Procedure

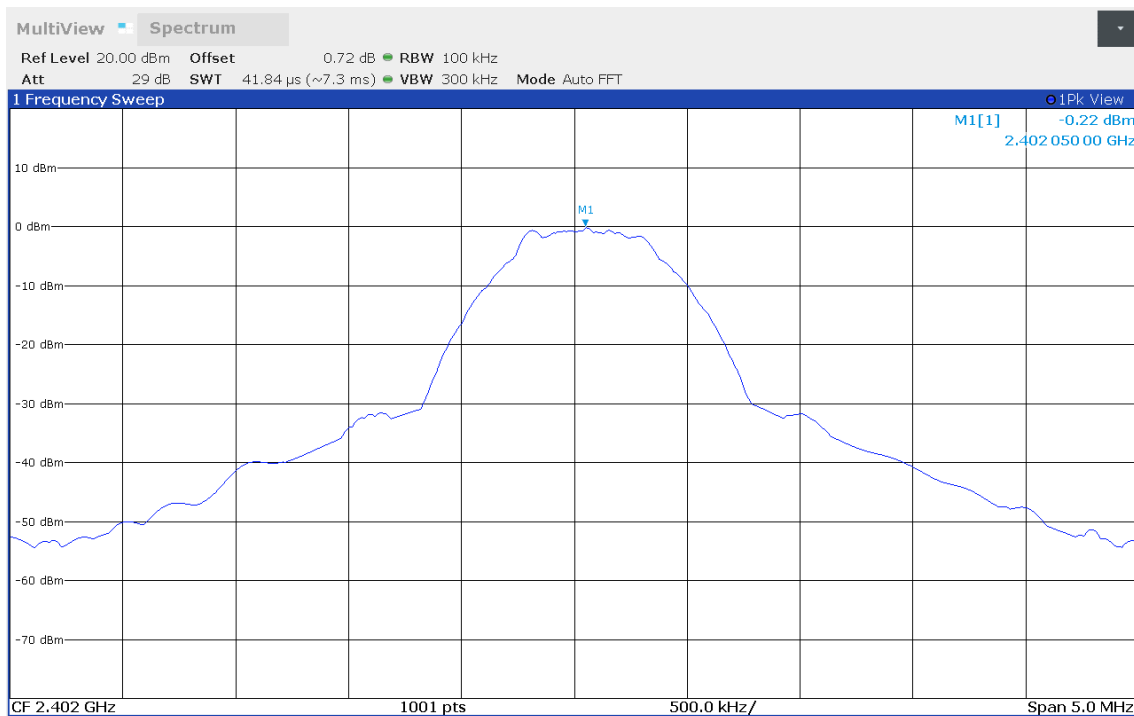
Test Procedure
<ol style="list-style-type: none"> 1. EUT set to test mode 2. The analyzer is set to DTS channel center frequency with a span of 1.5 times the DTS bandwidth 3. The RBW is set to 100 kHz with VBW ≥ RBW and the detector is set to peak with max hold 4. After the trace has stabilized a marker is set to the envelope maximum 5. If the power spectral density is above the limit the RBW is reduced (not lower than 3 kHz) and the measurement is repeated 6. If the EUT has more than one transmit chain the procedure is repeated for each transmit chain

3.4.6 Results

Test Results			
Channel [MHz]	PSD [dBm/RBW]	Limit [dBm/3kHz]	Verdict
2402	-0.22	8.0	PASS
2440	-0.67	8.0	PASS
2480	-0.23	8.0	PASS
RBW = 100 kHz			

Peak Power Spectral Density

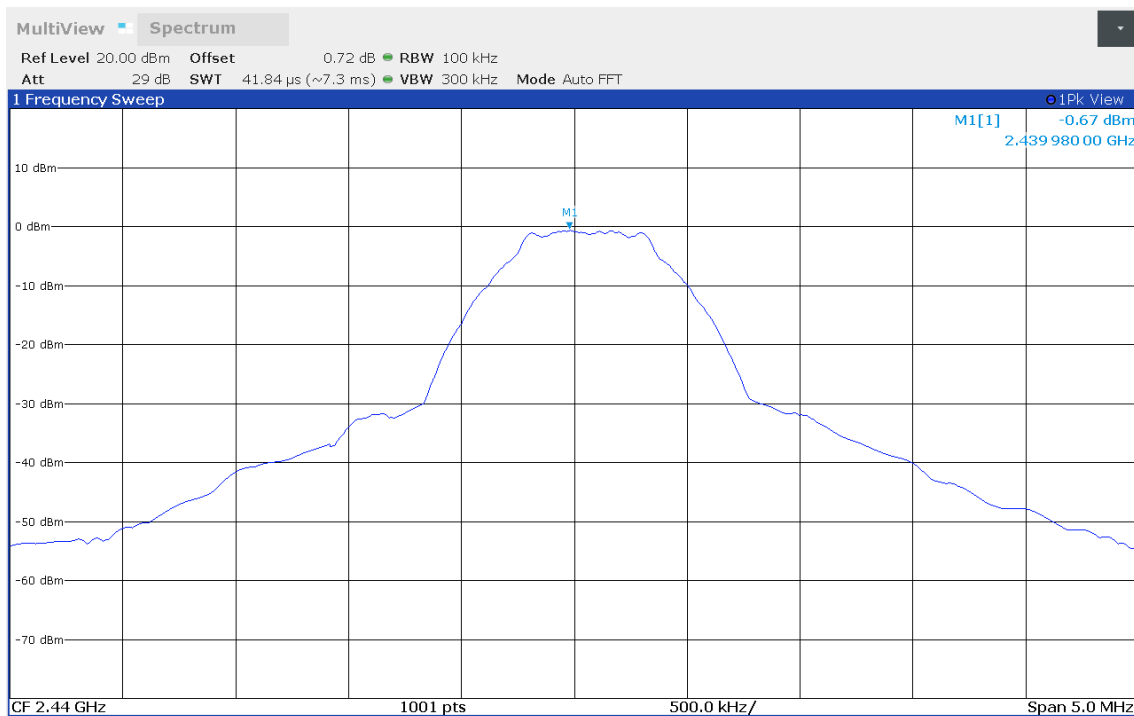
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Peak Frequency [MHz]: 2402.050
 Spectral Density [dBm/RBW]: -0.216
 Resolution Bandwidth [kHz]: 100 kHz



15:20:37 24.05.2022

Peak Power Spectral Density

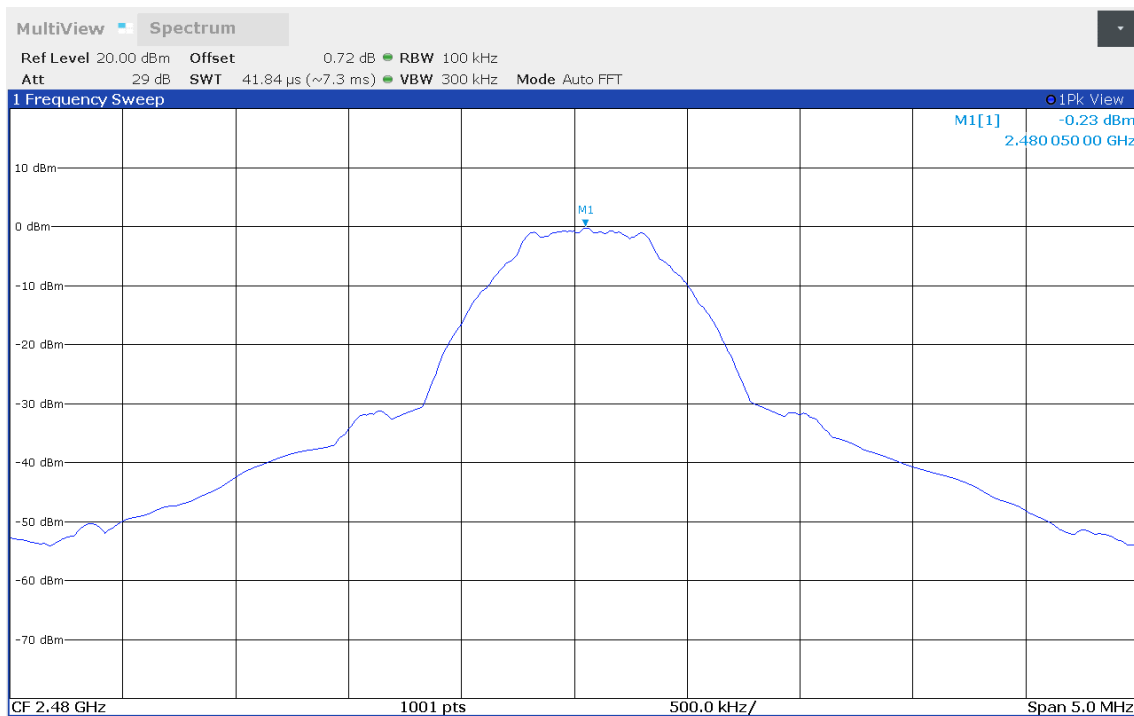
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Peak Frequency [MHz]: 2439.980
 Spectral Density [dBm/RBW]: -0.671
 Resolution Bandwidth [kHz]: 100 kHz



15:21:34 24.05.2022

Peak Power Spectral Density

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.10.2
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Peak Frequency [MHz]: 2480.050
 Spectral Density [dBm/RBW]: -0.225
 Resolution Bandwidth [kHz]: 100 kHz



15:22:39 24.05.2022

3.5 Test Conditions and Results - Band-edge compliance

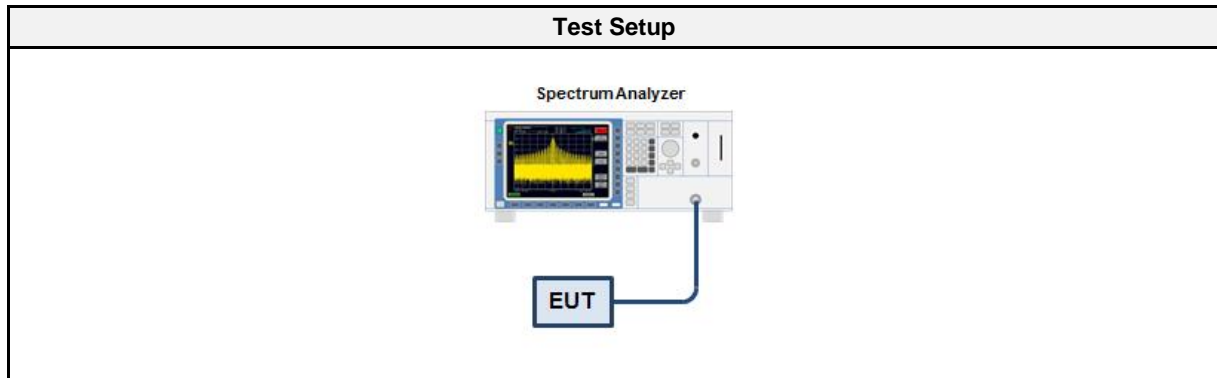
3.5.1 Information

Test Information	
Reference	FCC § 15.247(d); ISED RSS-247, Issue 2 (section 5.5)
Measurement Uncertainty	± 3.64 dB
Measurement Method	ANSI C63.10 11.13
Operator	Florian Voigt
Date	2022-05-24

3.5.2 Limits

Limits	
Power Measurement	Out-of-band attenuation [dB]
Peak	20
RMS	30

3.5.3 Setup



3.5.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSW 43	EF00896	2021-07	2022-07
Cable	Huber+Suhner	Sucoflex 102EA	EF00779 CAABR	2022-02	2023-02

3.5.5 Procedure

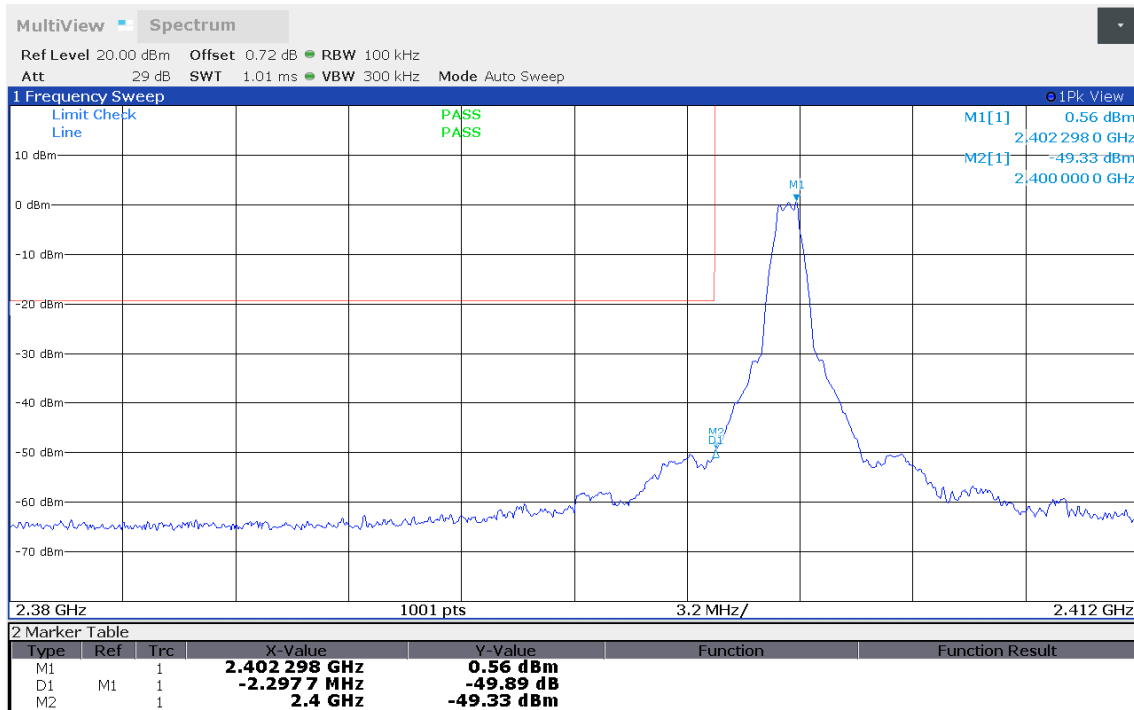
Test Procedure
<ol style="list-style-type: none"> 1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels within frequency band and outside frequency band 5. Band edge attenuation is determined from level difference

3.5.6 Results

Test Results				
Mode	Channel [MHz]	Out-of-band Attenuation [dB]	Limit [dB]	Verdict
GFSK	2402	-49.89	-20	PASS
GFSK	2480	-52.51	-20	PASS

Emissions in nonrestricted frequency bands at the Band-edge

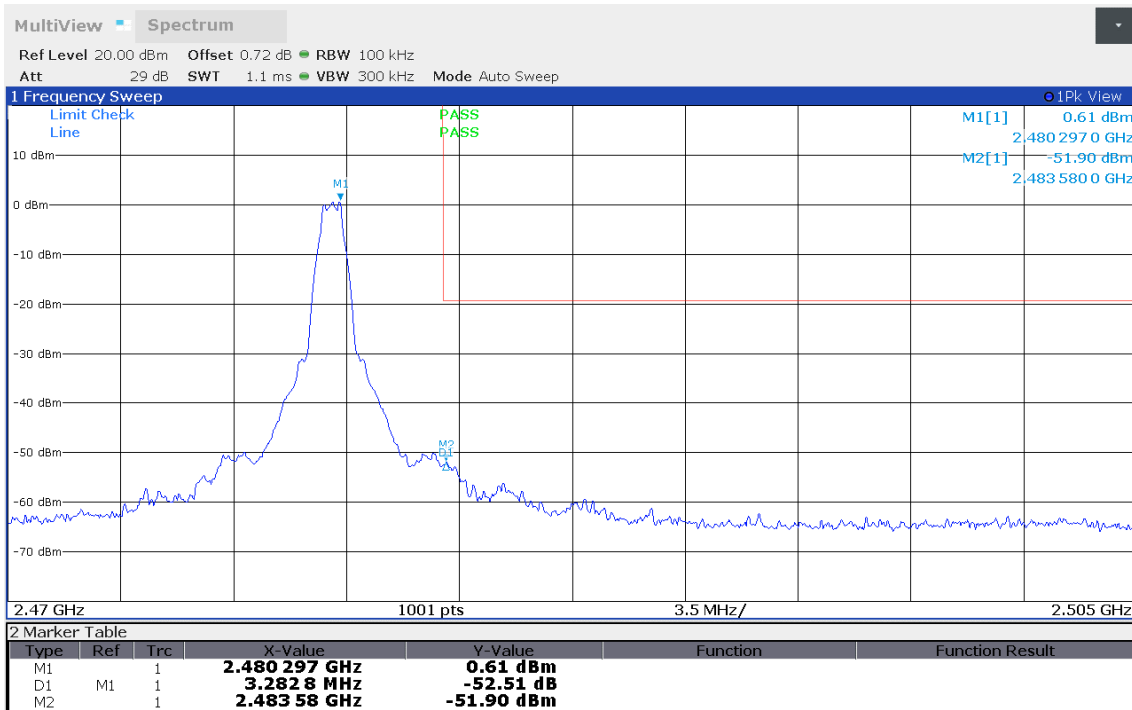
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 7.8.6, 6.10.4
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Band-edge: Lower
 In-band Frequency [MHz]: 2402.298
 Max. in-band Level [dBm/100 kHz]: 0.556
 Out-of-band Frequency [MHz]: 2400.0
 Max. out-of-band Level [dBm/100 kHz]: -49.331
 Attenuation [dB]: -49.89



15:29:00 24.05.2022

Emissions in nonrestricted frequency bands at the Band-edge

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 7.8.6, 6.10.4
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Band-edge: Upper
 In-band Frequency [MHz]: 2480.297
 Max. in-band Level [dBm/100 kHz]: 0.611
 Out-of-band Frequency [MHz]: 2483.58
 Max. out-of-band Level [dBm/100 kHz]: -51.896
 Attenuation [dB]: -52.51



15:30:27 24.05.2022

3.6 Test Conditions and Results - Conducted spurious emissions

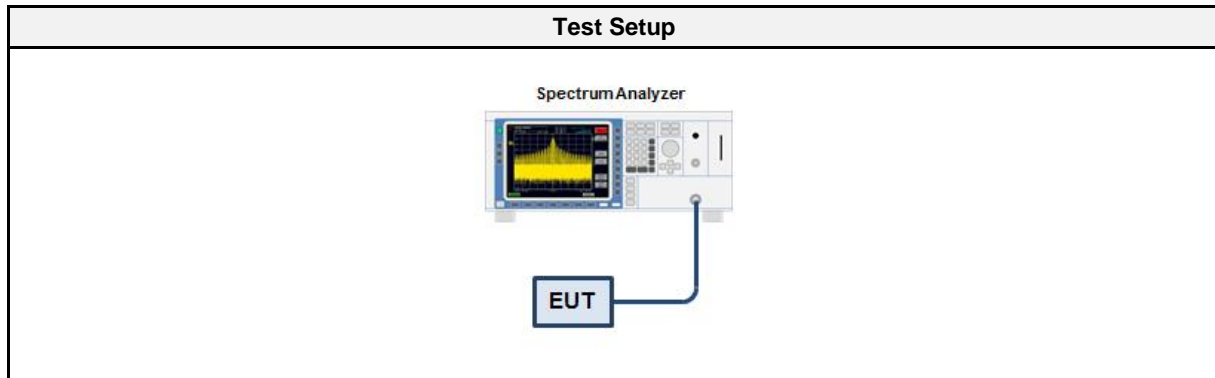
3.6.1 Information

Test Information	
Reference	FCC § 15.247(d); ISED RSS-247, Issue 2 (section 5.5)
Measurement Uncertainty	± 4.25 dB
Measurement Method	ANSI C63.10 11.11
Operator	Florian Voigt
Date	2022-05-24

3.6.2 Limits

Limits	
Power Measurement	Out-of-band attenuation [dB]
Peak	20
RMS	30

3.6.3 Setup



3.6.4 Equipment

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Spectrum Analyser	R&S	FSW 43	EF00896	2021-07	2022-07
Cable	Huber+Suhner	Sucoflex 102EA	EF00779 CAABR	2022-02	2023-02

3.6.5 Procedure

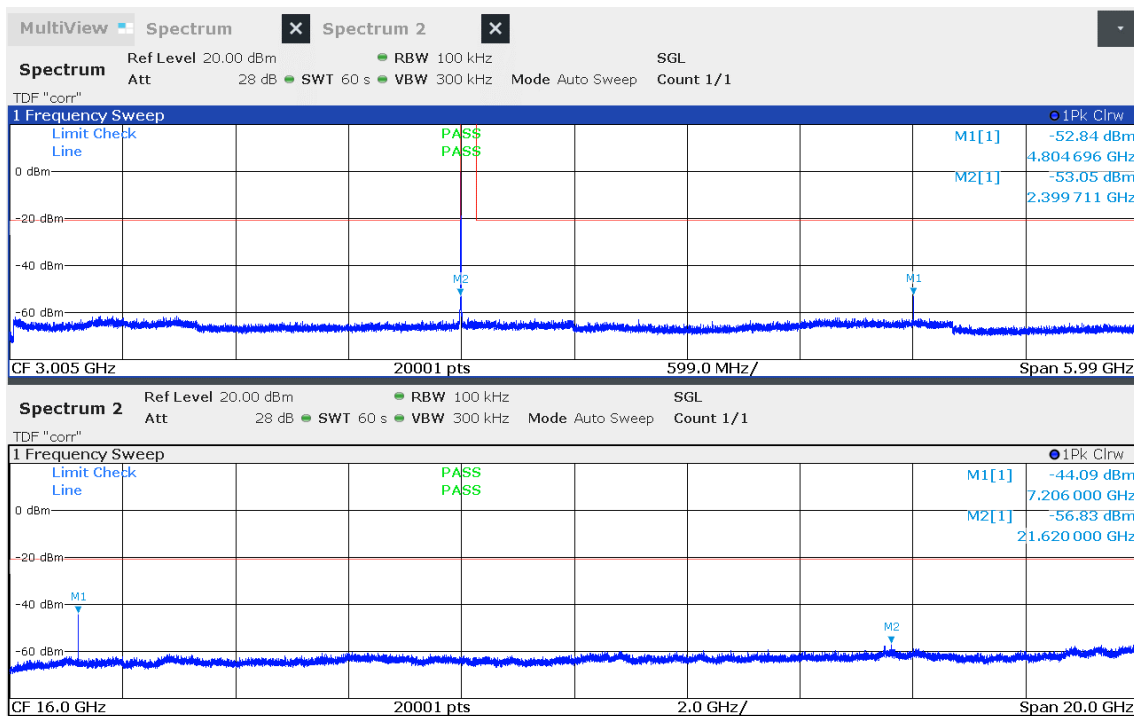
Test Procedure
<ol style="list-style-type: none"> 1. EUT set to test mode (Communication tester is used if needed) 2. Span set around lower band edge and detector is set to peak and max hold 3. Resolution bandwidth is set to 100 kHz 4. Markers are set to peak emission levels outside frequency band

3.6.6 Results

Test Results		
Mode	Channel [MHz]	Verdict
GFSK	2402	PASS
GFSK	2440	PASS
GFSK	2480	PASS

Conducted Spurious Emissions

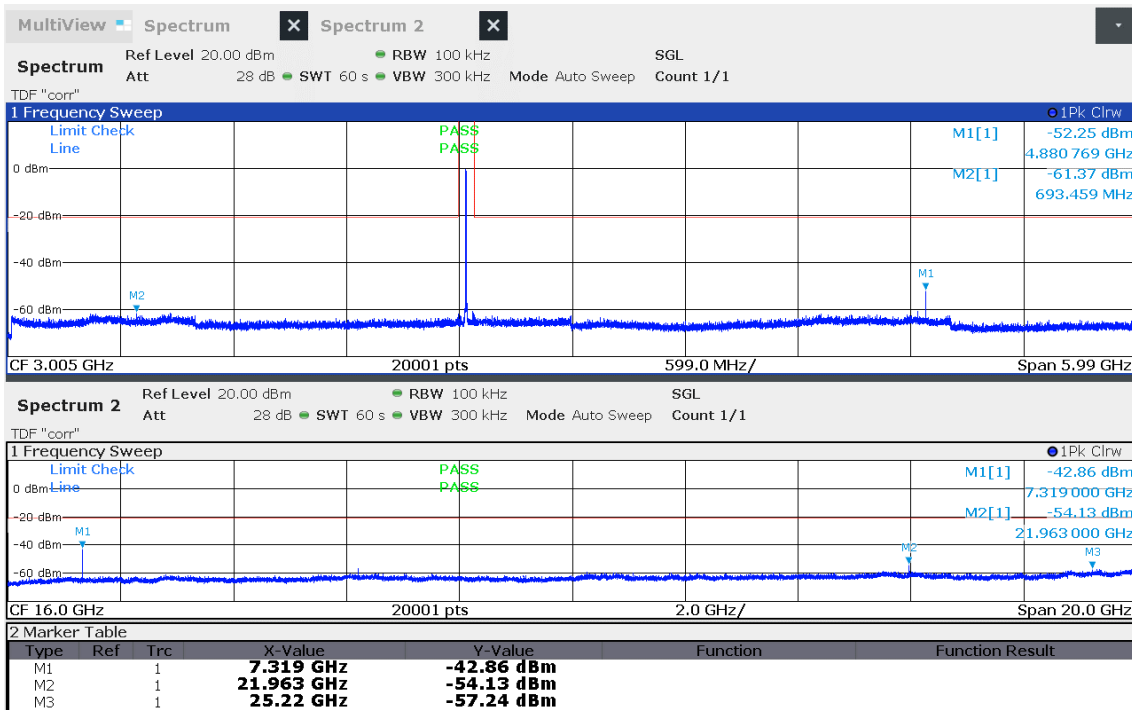
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: GFSK, Channel: 0, 2402 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Max. in-band Frequency [MHz]: 2402.3
 Max. in-band Level [dBm/100 kHz]: -0.6
 Out-of-band Limit [dBm/100 kHz]: -20.6



15:38:59 24.05.2022

Conducted Spurious Emissions

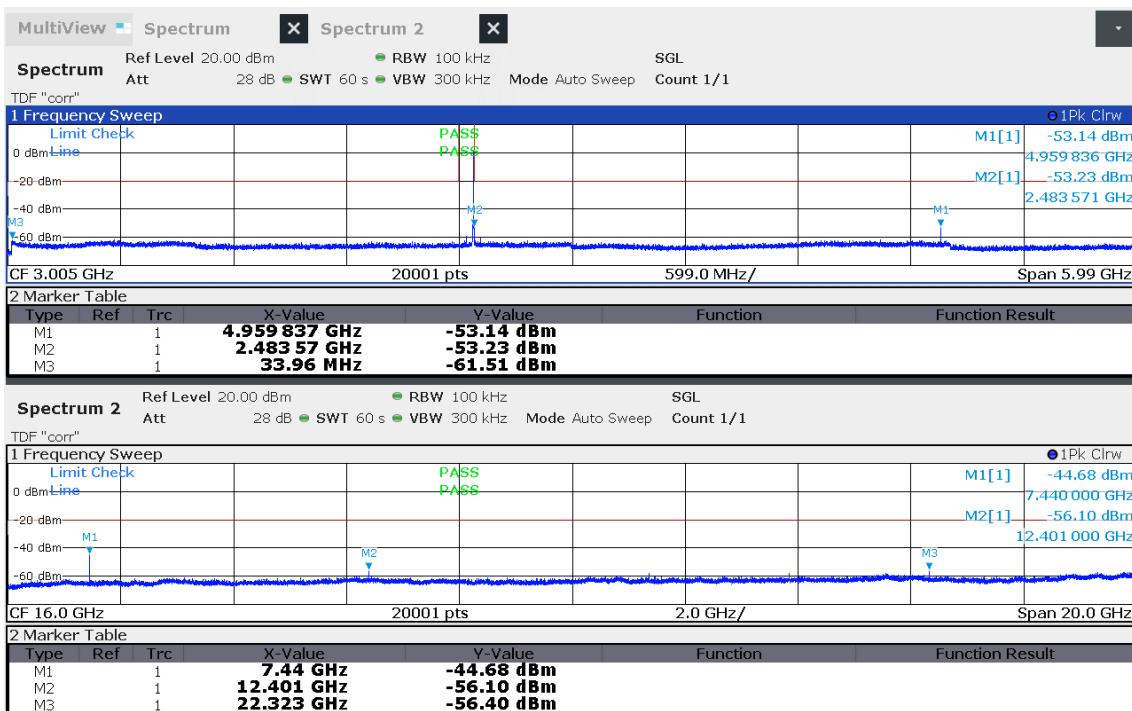
Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: GFSK, Channel: 19, 2440 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Max. in-band Frequency [MHz]: 2440.1
 Max. in-band Level [dBm/100 kHz]: -0.7
 Out-of-band Limit [dBm/100 kHz]: -20.7



15:45:40 24.05.2022

Conducted Spurious Emissions

Project Number: G0M-2201-1258
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 39791
 Reference Standards: FCC 15.247, RSS-247
 Reference Method: ANSI C63.10:2013, Section 11.11
 Operational Mode: GFSK, Channel: 39, 2480 MHz
 Operating Conditions: Tnom/Vnom
 Operator: Florian Voigt
 Test Site: Eurofins Product Service GmbH
 Test Date: 2022-05-24
 Max. in-band Frequency [MHz]: 2480.3
 Max. in-band Level [dBm/100 kHz]: -0.5
 Out-of-band Limit [dBm/100 kHz]: -20.5



15:48:24 24.05.2022

3.7 Test Conditions and Results - Transmitter radiated emissions

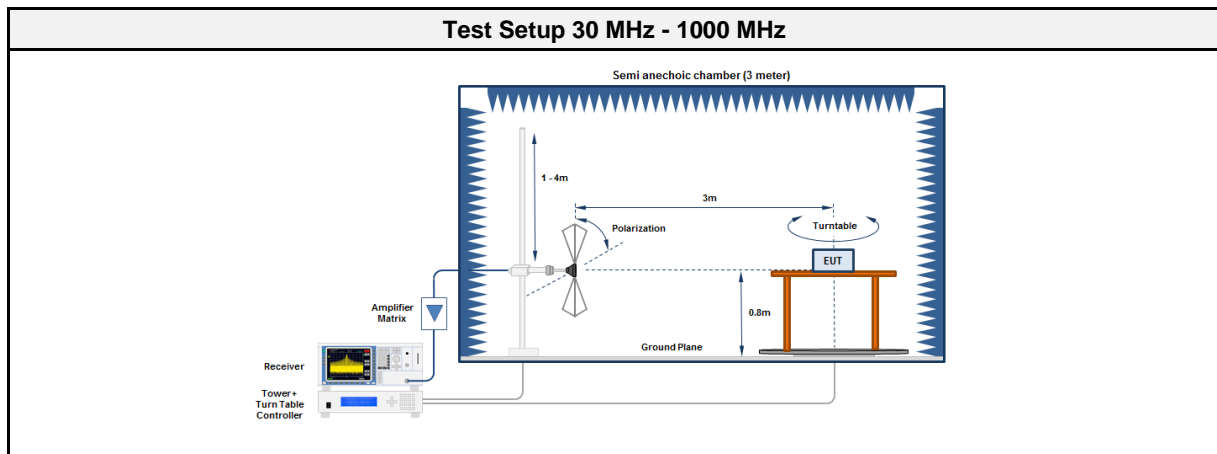
3.7.1 Information

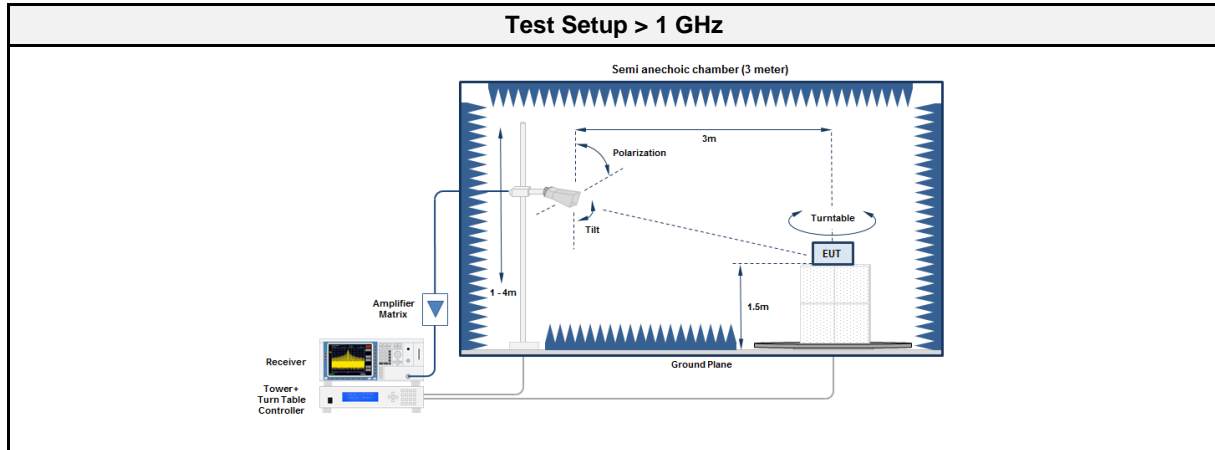
Test Information	
Reference	FCC § 15.247(d); FCC § 15.209; ISSED RSS-Gen, Issue 5 A2 (section 6.13)
Measurement Uncertainty	± 5.95 dB
Measurement Method	ANSI C63.10 6.4, 6.5, 6.6, 11.12
Operator	Odai Qawasmeh
Date	2022-11-01

3.7.2 Limits

Limits			
Frequency range [MHz]	Detector	Field strength [$\mu\text{V}/\text{m}$]	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

3.7.3 Setup





3.7.4 Equipment

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

Test Equipment 30 MHz - 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	2023-01
Antenna	R&S	HK 116	EF00030	2021-05	2024-05
Antenna	R&S	HL 223	EF00187	2022-06	2025-06

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF01011	2022-11	2023-11
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2021-07	2023-01
Antenna	Schwarzbeck	BBHA 9120B	EF01678	2021-03	2024-03
Antenna	Schwarzbeck	HWRD 650	EF01679	2021-03	2024-03
Antenna	Amplifier Research	AT4560	EF00302	2021-06	2023-06

3.7.5 Procedure

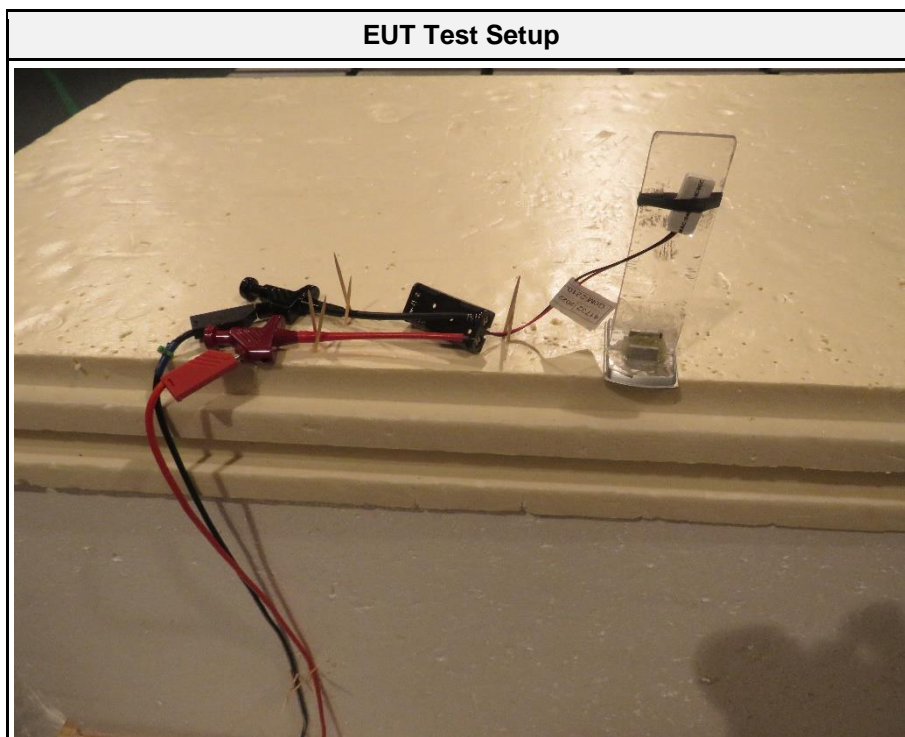
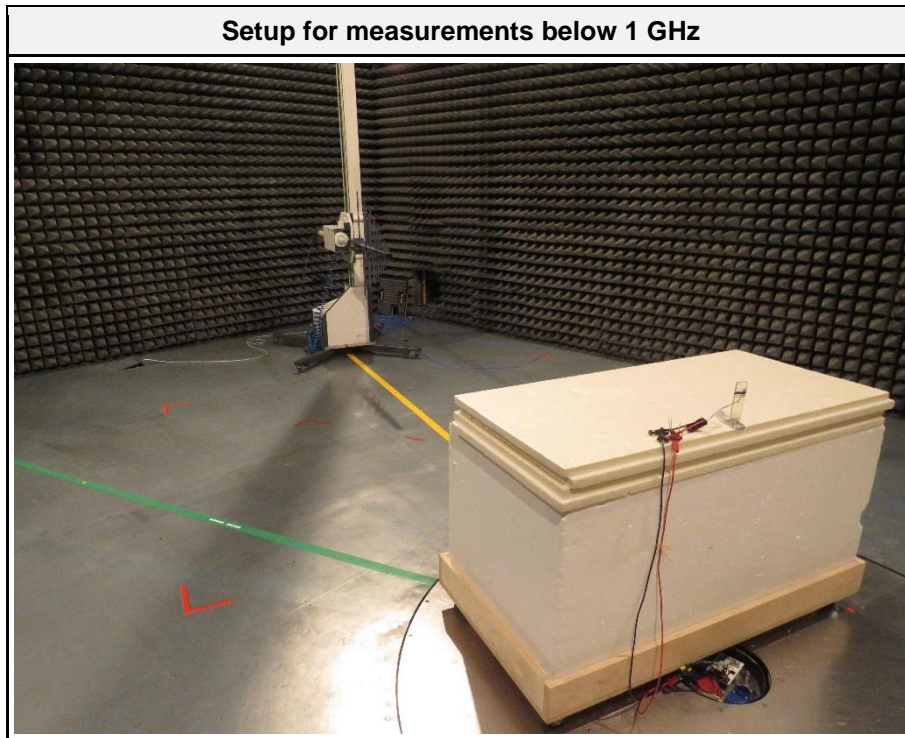
Test Procedure 30 MHz - 1000 MHz
<ol style="list-style-type: none"> EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground EUT set to test mode The receiver is set to peak detection with max hold The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m All significant emissions are measured again using the corresponding final detector

Test Procedure > 1 GHz
<ol style="list-style-type: none"> EUT is placed on a non conducting support at the center of a turn table 1.5 m above the ground EUT set to test mode The receiver is set to peak detection with max hold The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m All significant emissions are measured again using the corresponding final detector

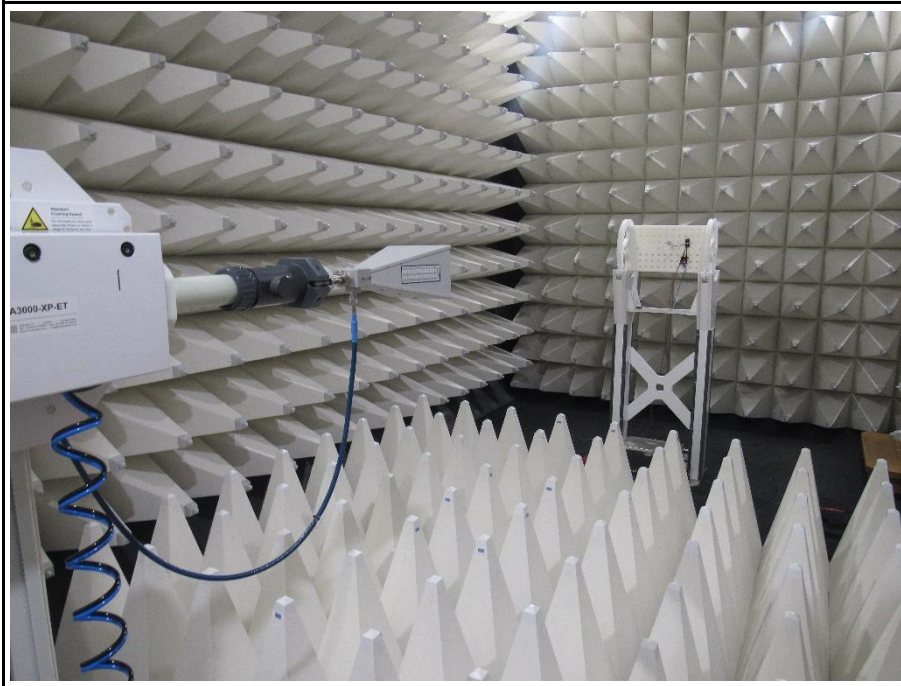
3.7.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dB μ V/m]	Det.	Pol.	Limit [dB μ V/m]	Margin [dB]
2402	150.0073	23.40	pk	ver	43.50	-20.13
2402	611.36	26.10	pk	ver	46.00	-19.92
2402	2355.5	52.82	pk	ver	74.00	-21.18
2402	2355.5	42.21	avg	ver	54.00	-11.79
2402	4803.9	52.84	pk	ver	74.00	-21.16
2402	4803.9	49.24	avg	ver	54.00	-04.76
2402	12009	46.50	pk	hor	74.00	-27.50
2402	12009	40.01	avg	hor	54.00	-13.99
2402	18082	48.22	pk	hor	74.00	-25.78
2402	18082	35.65	avg	hor	54.00	-18.35
2440	149.9988	23.20	pk	ver	43.50	-20.33
2440	612.54	25.40	pk	ver	46.00	-20.58
2440	4879.7	52.75	pk	ver	74.00	-21.25
2440	4879.7	49.73	avg	ver	54.00	-04.27
2440	7319.1	53.15	pk	hor	74.00	-20.85
2440	7319.1	48.43	avg	hor	54.00	-05.57
2440	12201	47.45	pk	hor	74.00	-26.55
2440	12201	39.87	avg	hor	54.00	-14.13
2440	18094	47.69	pk	ver	74.00	-26.31
2440	18094	35.99	avg	ver	54.00	-18.01
2480	149.9988	23.70	pk	ver	43.50	-19.79
2480	613.4	25.50	pk	ver	46.00	-20.49
2480	2486.6	54.90	pk	ver	74.00	-19.10
2480	2486.6	42.84	avg	ver	54.00	-11.16
2480	4960	56.41	pk	ver	74.00	-17.59
2480	4960	52.15	avg	ver	54.00	-01.85
2480	7439	53.05	pk	hor	74.00	-20.95
2480	7439	47.41	avg	hor	54.00	-06.59
2480	12399	47.13	pk	hor	74.00	-26.87
2480	12399	40.46	avg	hor	54.00	-13.54
2480	22321	49.57	pk	ver	74.00	-24.43
2480	22321	43.83	avg	ver	54.00	-10.17

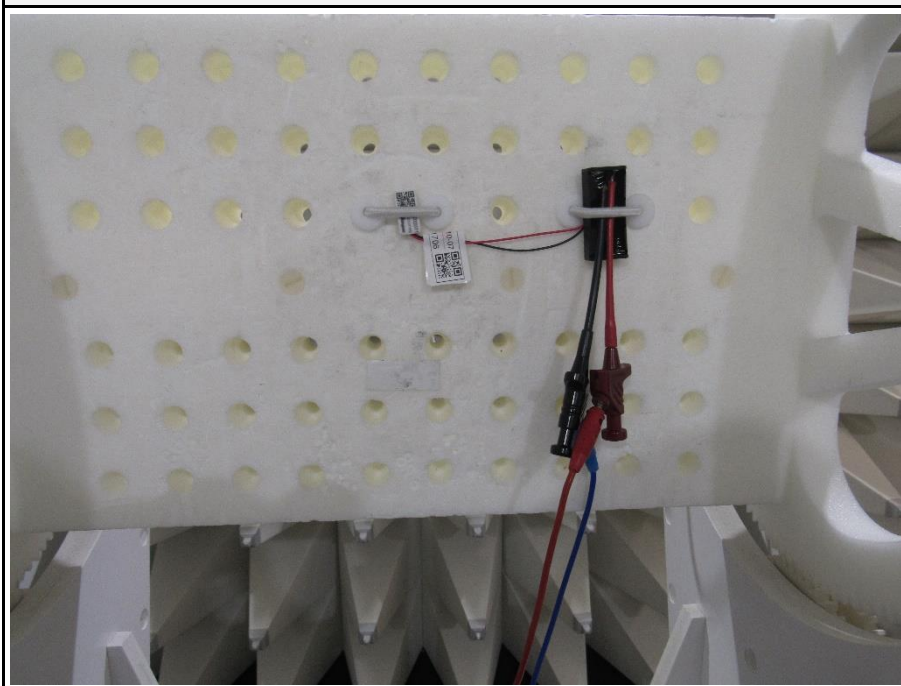
3.7.7 Setup Photos



Setup for measurements above 1 GHz



EUT Test Setup



3.8 Test Conditions and Results - Receiver radiated emissions

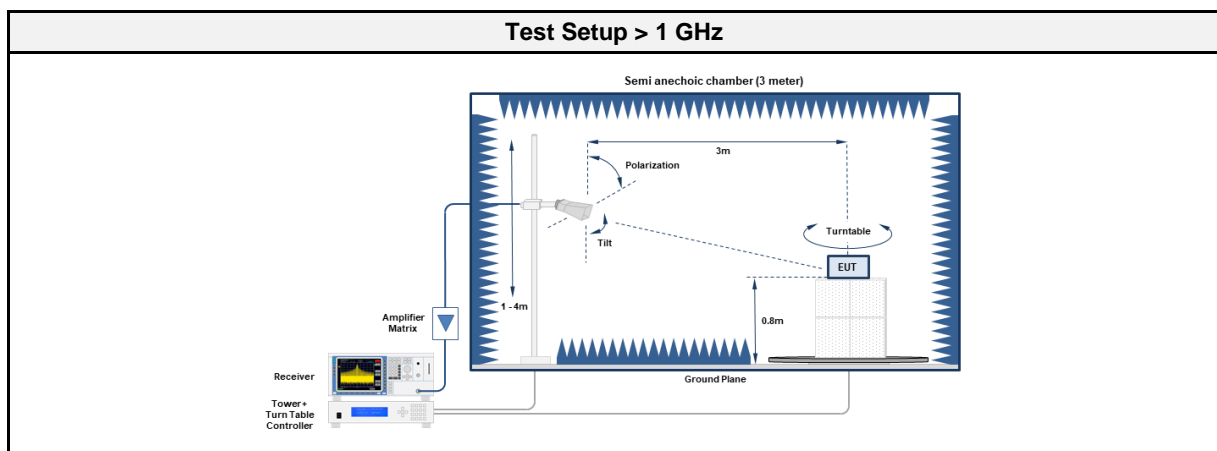
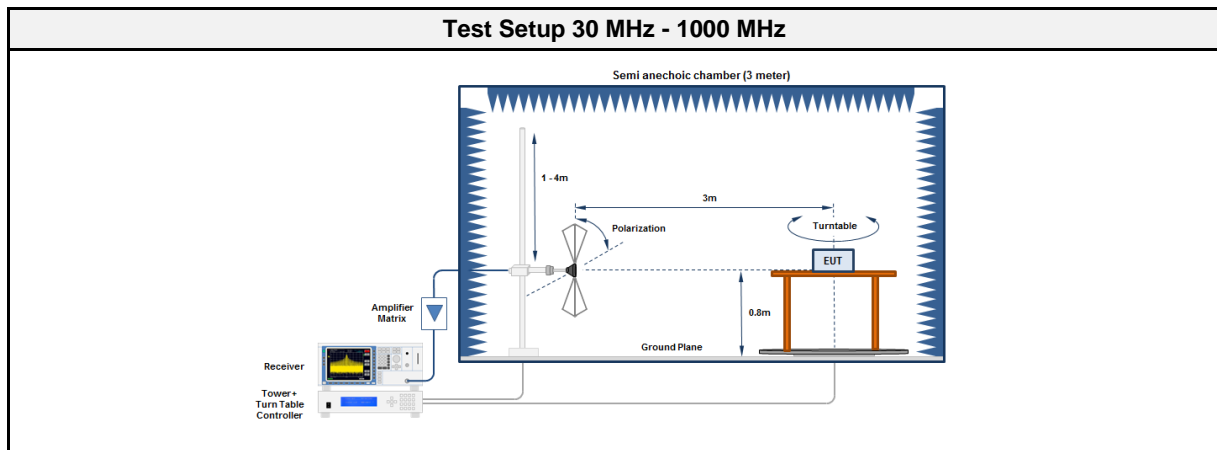
3.8.1 Information

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	Odai Qawasmeh
Date	2022-11-10

3.8.2 Limits

Limits			
Frequency range [MHz]	Detector	Field strength [$\mu\text{V}/\text{m}$]	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

3.8.3 Setup



3.8.4 Equipment

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

Test Equipment 30 MHz - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2022-11	2025-11
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2021-07	2023-01
Antenna	R&S	HK 116	EF00030	2021-05	2024-05
Antenna	R&S	HL 223	EF00187	2022-06	2025-06

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF01011	2022-11	2023-11
Measurement Receiver	Agilent	N9038A-526/WXP	EF01070	2021-07	2023-01
Antenna	Schwarzbeck	BBHA 9120B	EF01678	2021-03	2024-03
Antenna	Schwarzbeck	HWRD 650	EF01679	2021-03	2024-03

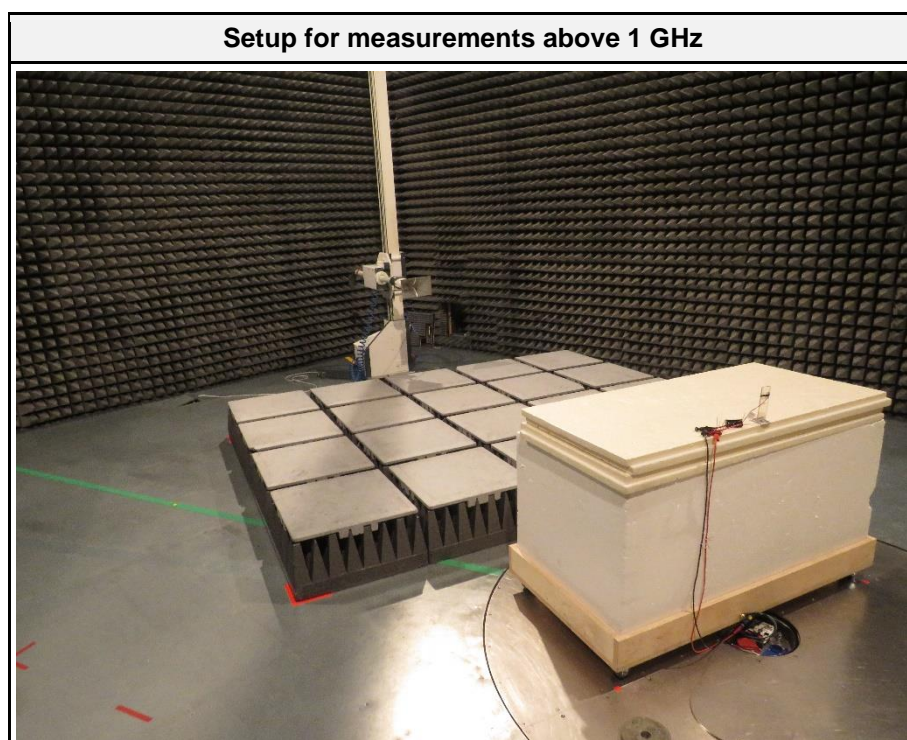
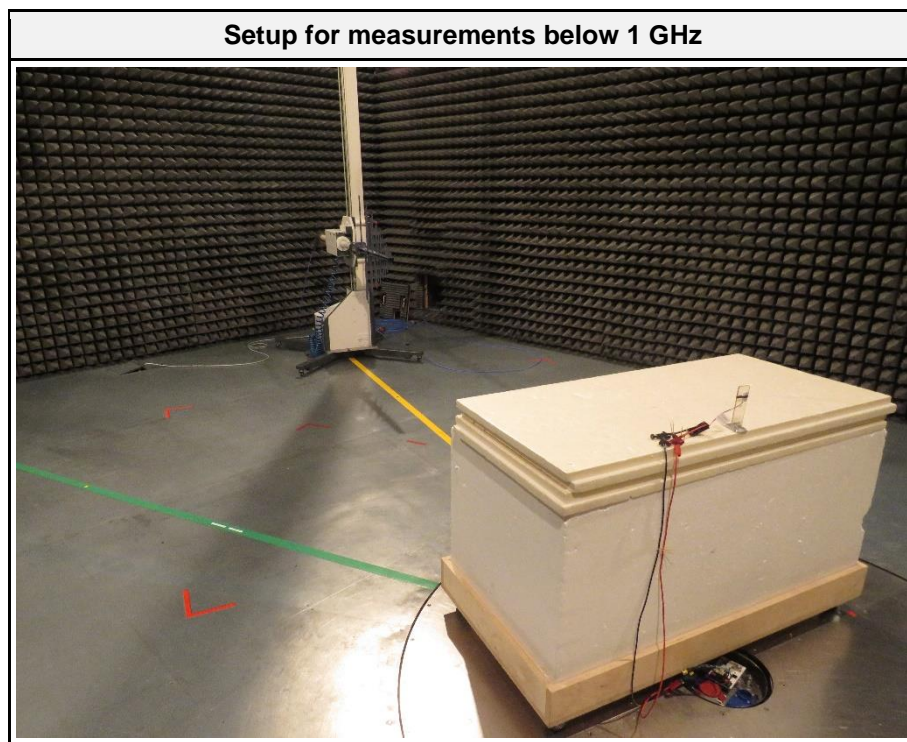
3.8.5 Procedure

Test Procedure
<ol style="list-style-type: none"> 1. EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground 2. EUT is 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

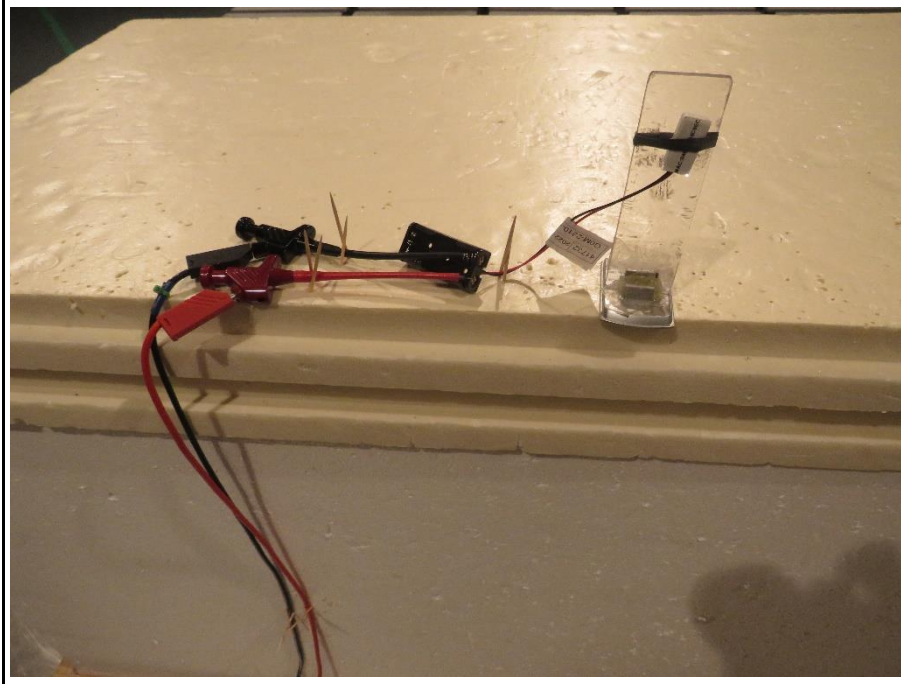
3.8.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dB μ V/m]	Det.	Pol.	Limit [dB μ V/m]	Margin [dB]
2440	150.0115	23.20	pk	ver	43.50	-20.28
2440	634.12	29.30	qpk	ver	46.00	-16.68
2440	732.06	28.50	qpk	ver	46.00	-17.50
2440	6353	50.11	pk	ver	74.00	-23.89
2440	6353	36.11	avg	ver	53.98	-17.87
2440	17995	49.90	pk	ver	74.00	-24.10
2440	17995	35.85	avg	ver	53.98	-18.13

3.8.7 Setup Photos



EUT Test Setup



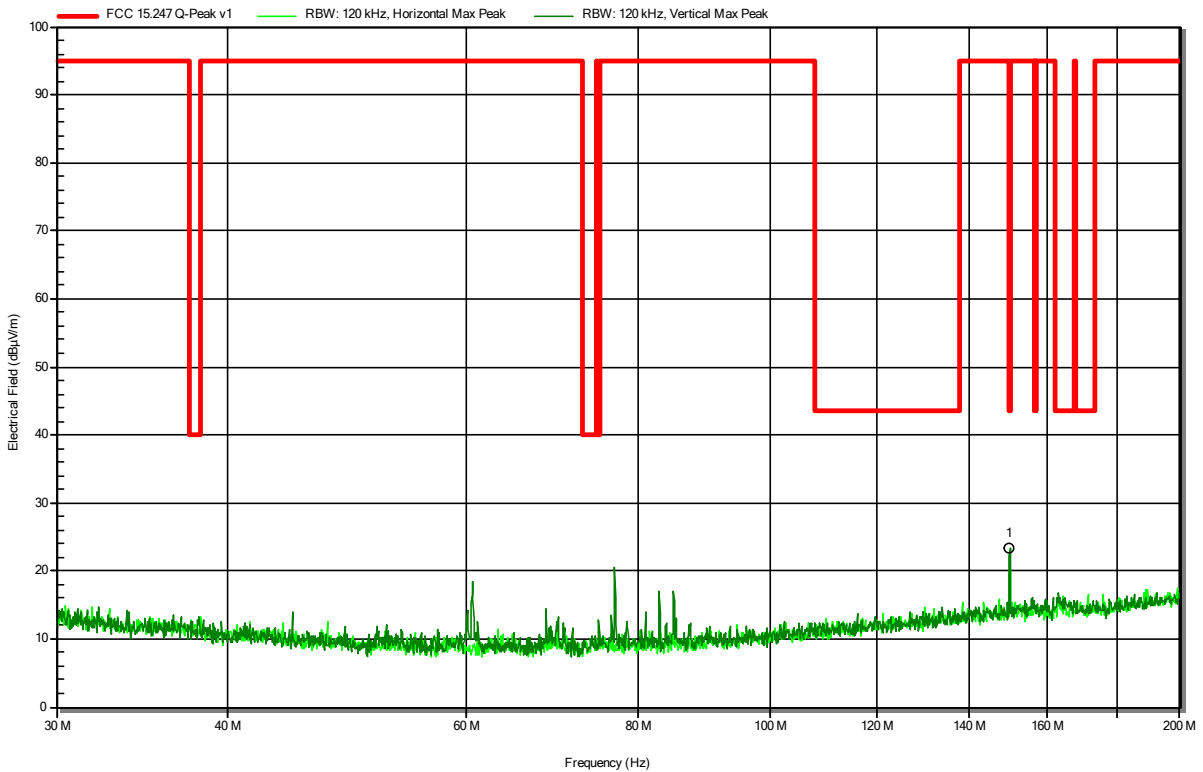
ANNEX A Transmitter spurious emissions

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2402 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-11
 Note:

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RadiMation



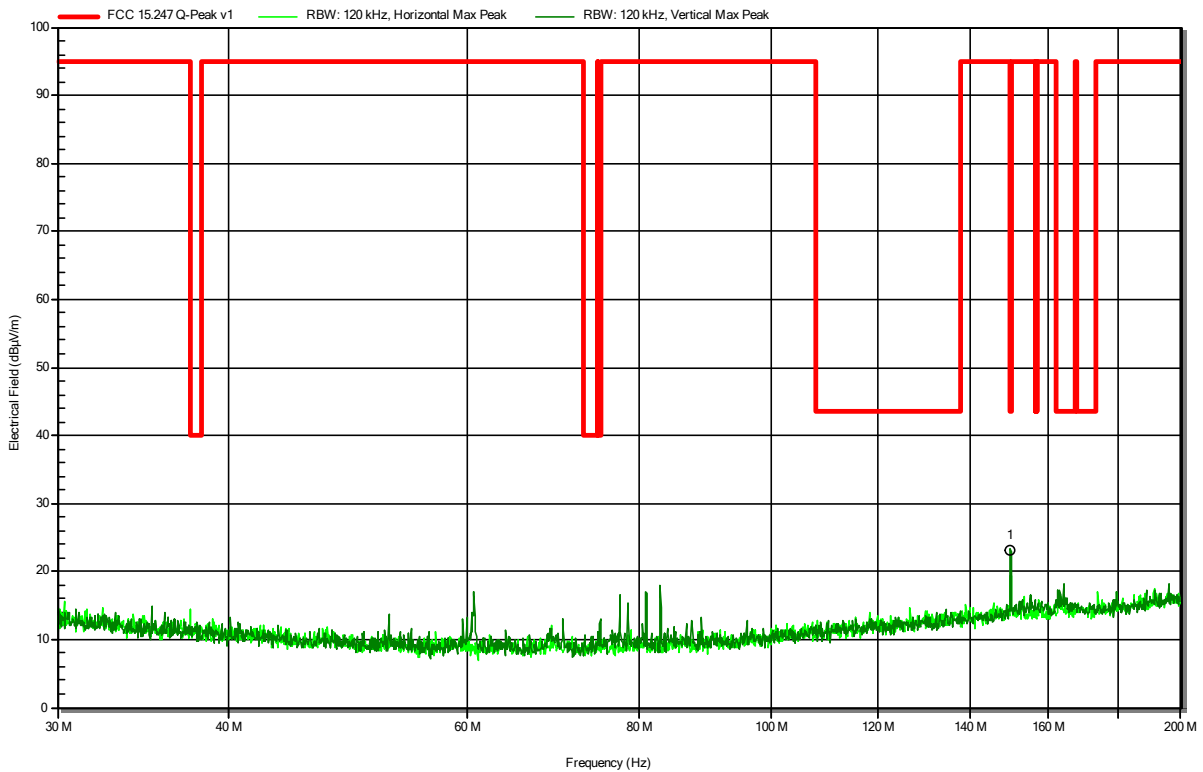
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
150.0073 MHz	23.4 dBµV/m	43.5 dBµV/m	-20.13 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2440 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-11
 Note:

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RadiMation



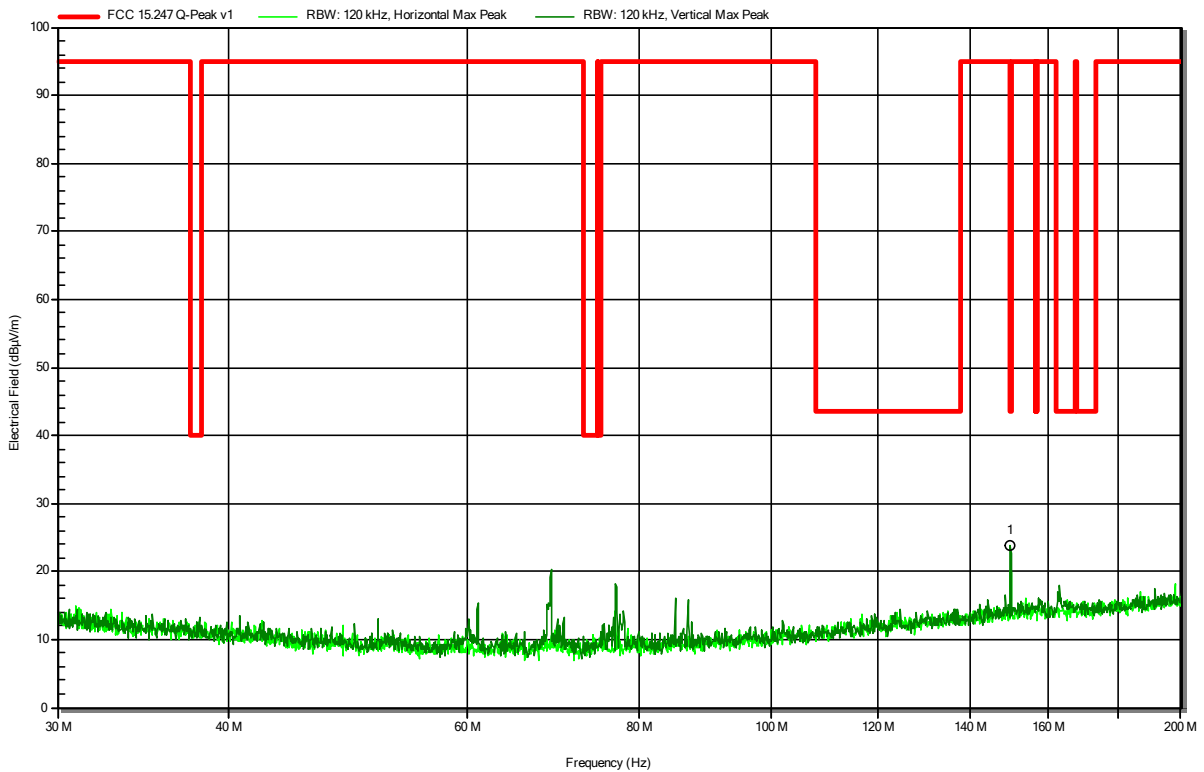
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
149.9988 MHz	23.2 dBµV/m	43.5 dBµV/m	-20.33 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-11
 Note:

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RadiMation



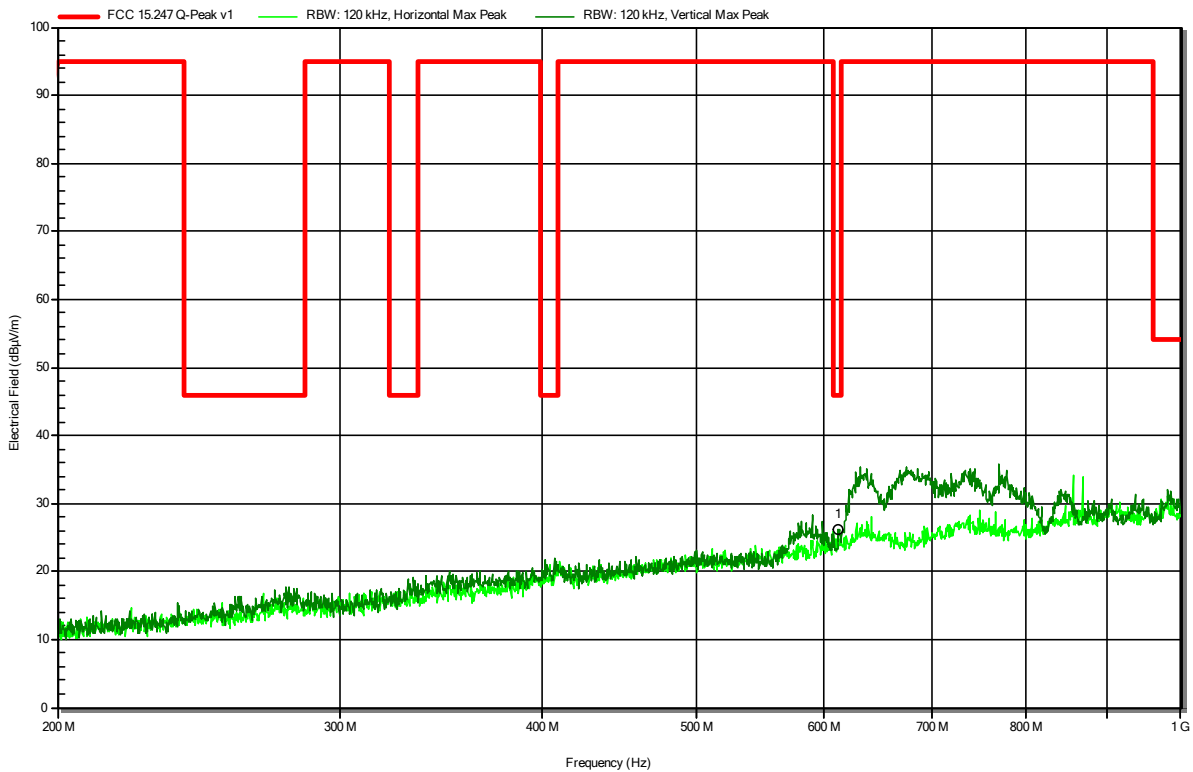
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
149.9988 MHz	23.7 dBµV/m	43.5 dBµV/m	-19.79 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2402 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-11
 Note:

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RadiMation



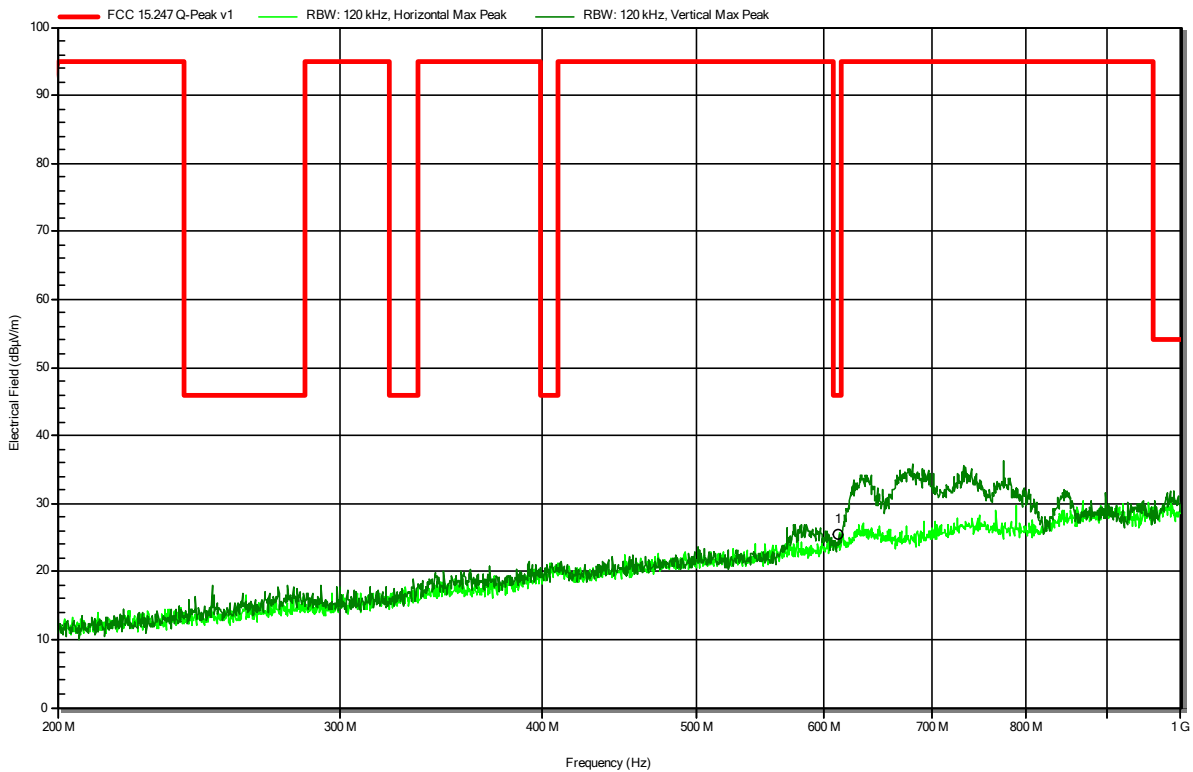
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
611.36 MHz	26.1 dBµV/m	46 dBµV/m	-19.92 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2440 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-11
 Note:

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RadiMation



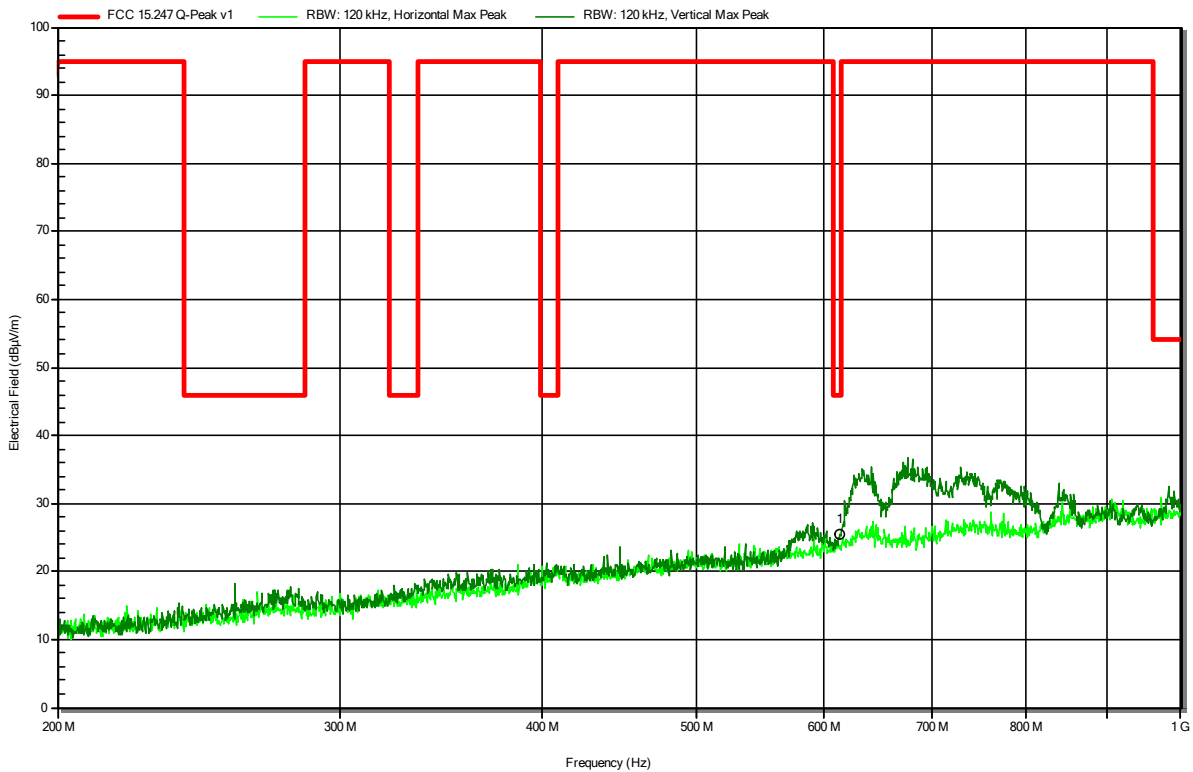
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
612.54 MHz	25.4 dBµV/m	46 dBµV/m	-20.58 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-11
 Note:

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RadiMation



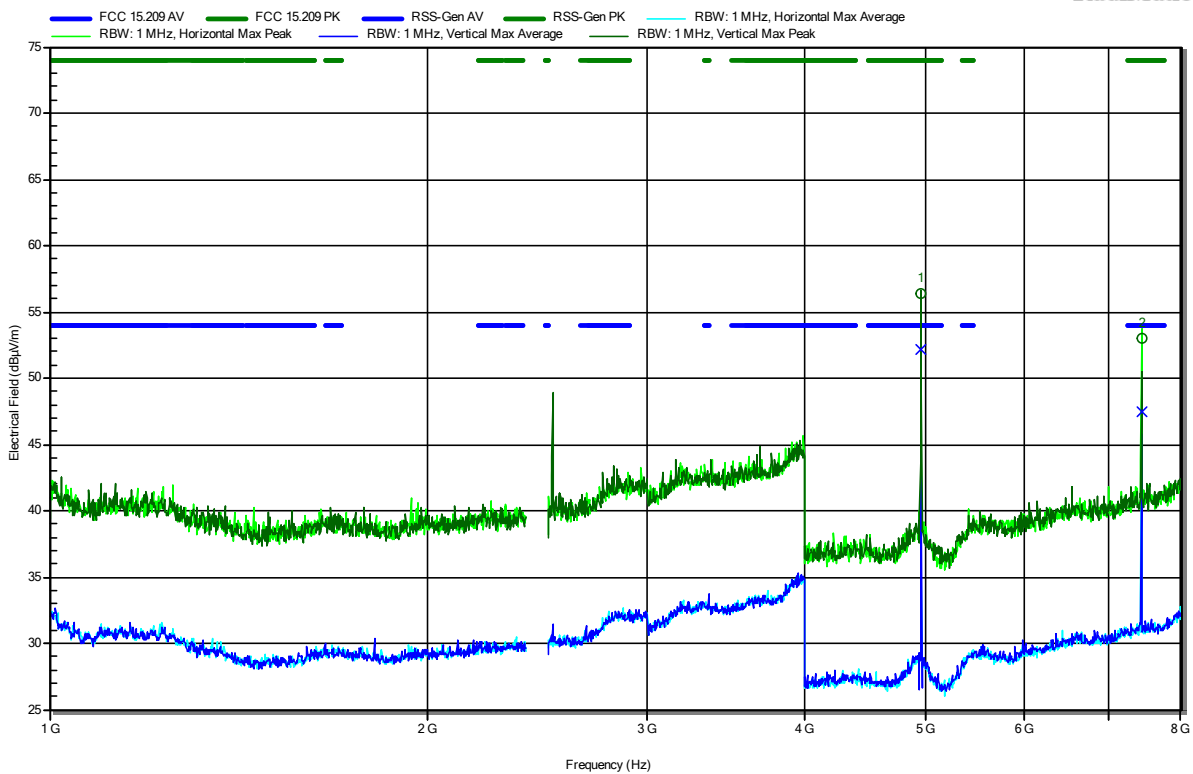
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
613.4 MHz	25.5 dBµV/m	46 dBµV/m	-20.49 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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RadiMation



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
4.96 GHz	56.41 dBµV/m	74 dBµV/m	-17.59 dB	Pass	Vertical
7.439 GHz	53.05 dBµV/m	74 dBµV/m	-20.95 dB	Pass	Horizontal

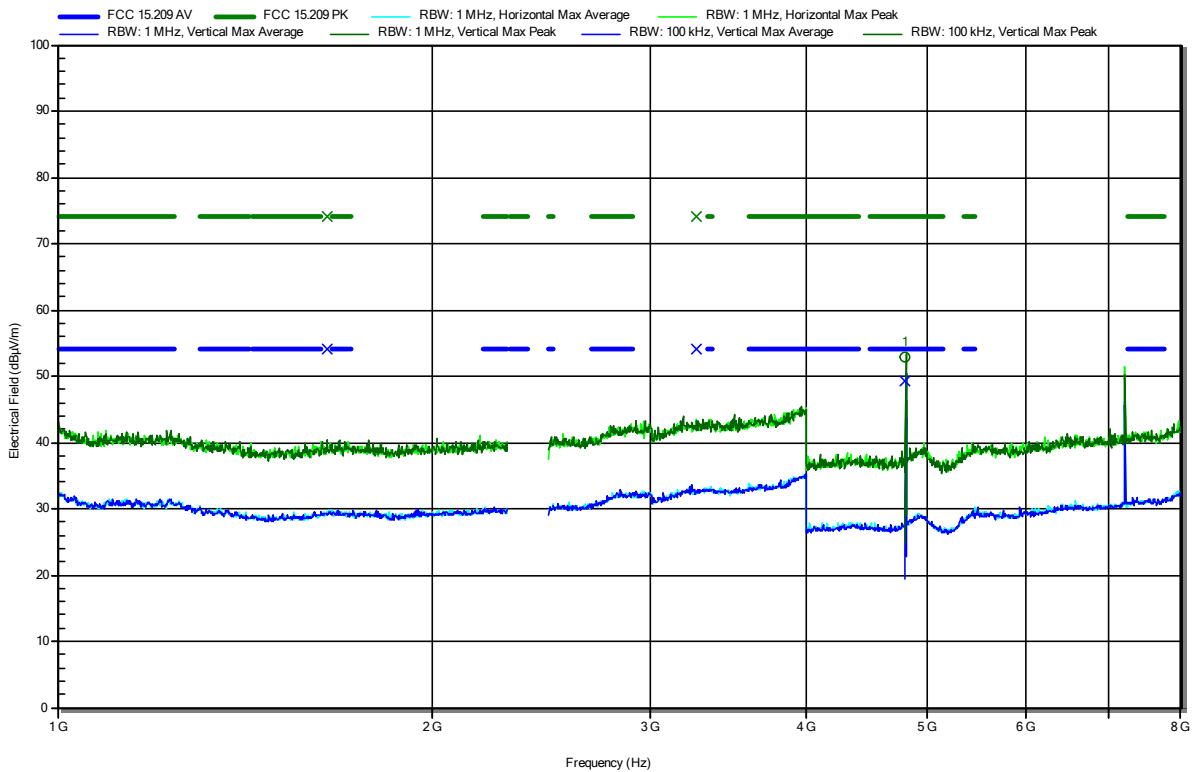
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
4.96 GHz	52.15 dBµV/m	54 dBµV/m	-1.85 dB	Pass	Vertical
7.439 GHz	47.41 dBµV/m	54 dBµV/m	-6.59 dB	Pass	Horizontal

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2402 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
4.8039 GHz	52.84 dBµV/m	74 dBµV/m	-21.16 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
4.8039 GHz	49.24 dBµV/m	54 dBµV/m	-4.76 dB	Pass	Vertical

Test Report No.: G0M-2210-1706-TFC247BL-V01

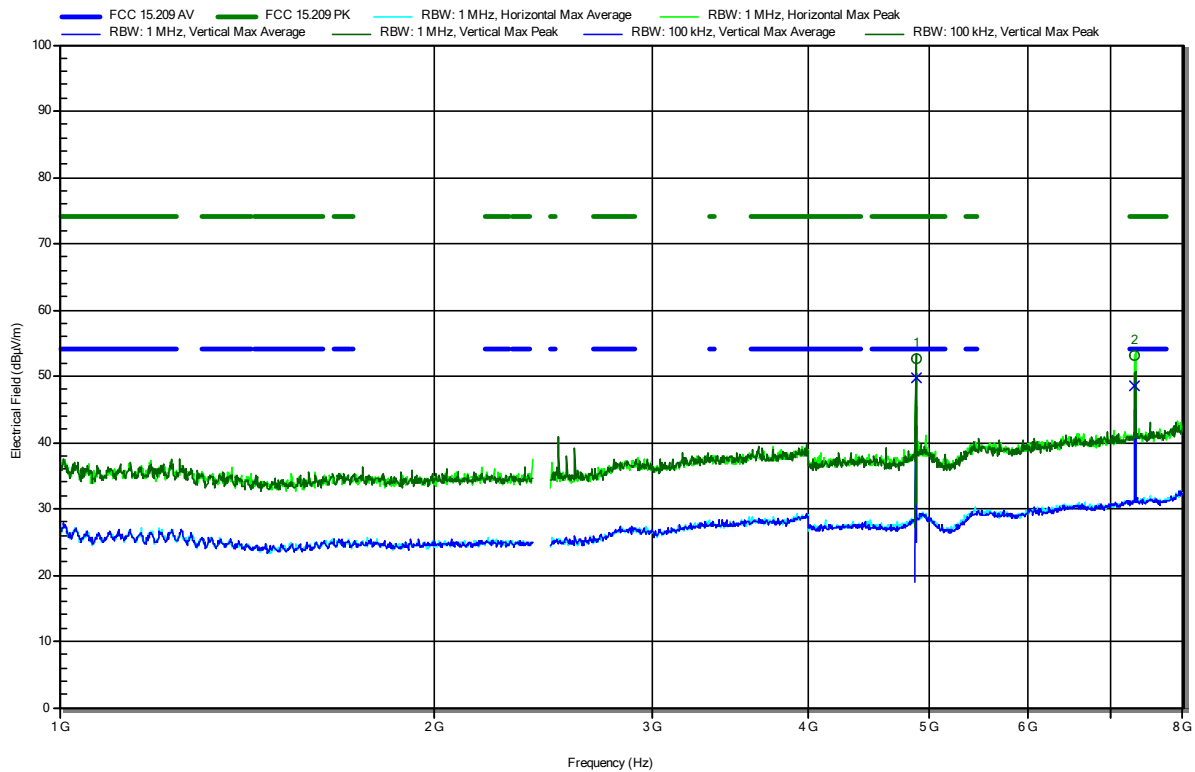
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2440 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
4.8797 GHz	52.75 dBµV/m	74 dBµV/m	-21.25 dB	Pass	Vertical
7.3191 GHz	53.15 dBµV/m	74 dBµV/m	-20.85 dB	Pass	Horizontal

Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
4.8797 GHz	49.73 dBµV/m	54 dBµV/m	-4.27 dB	Pass	Vertical
7.3191 GHz	48.43 dBµV/m	54 dBµV/m	-5.57 dB	Pass	Horizontal

Test Report No.: G0M-2210-1706-TFC247BL-V01

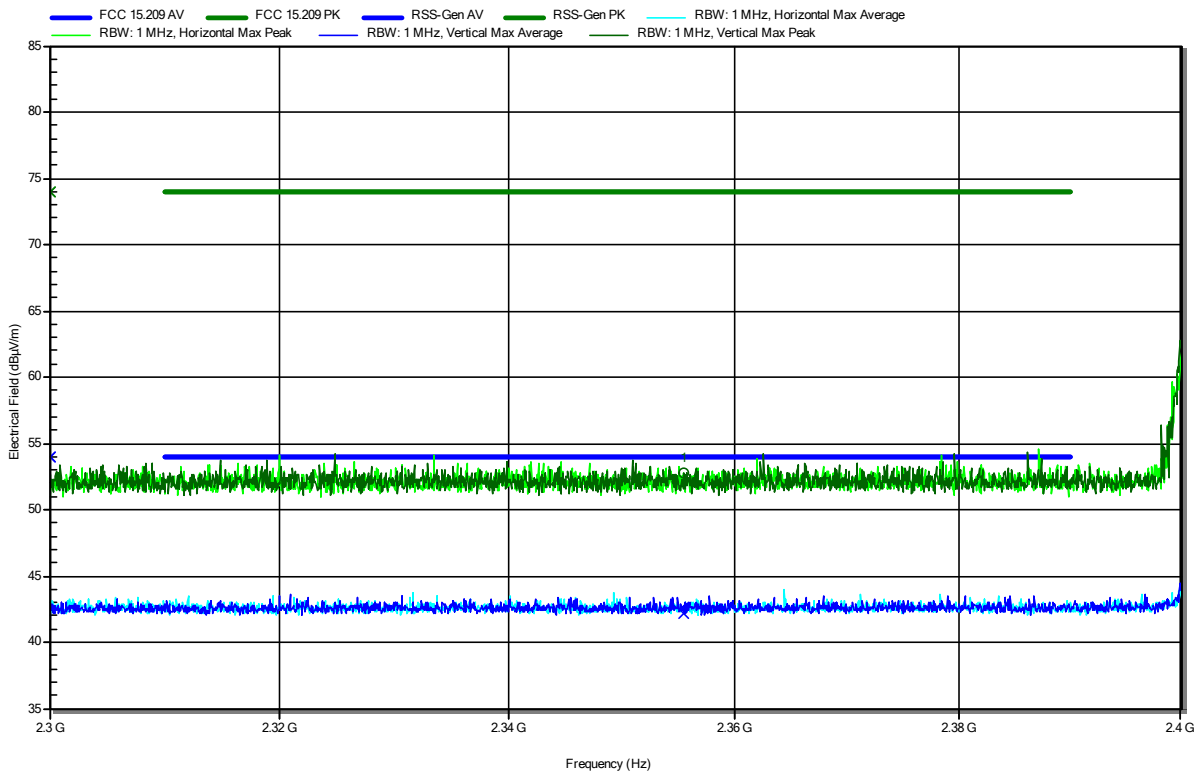
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2402 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note: lower bandedge

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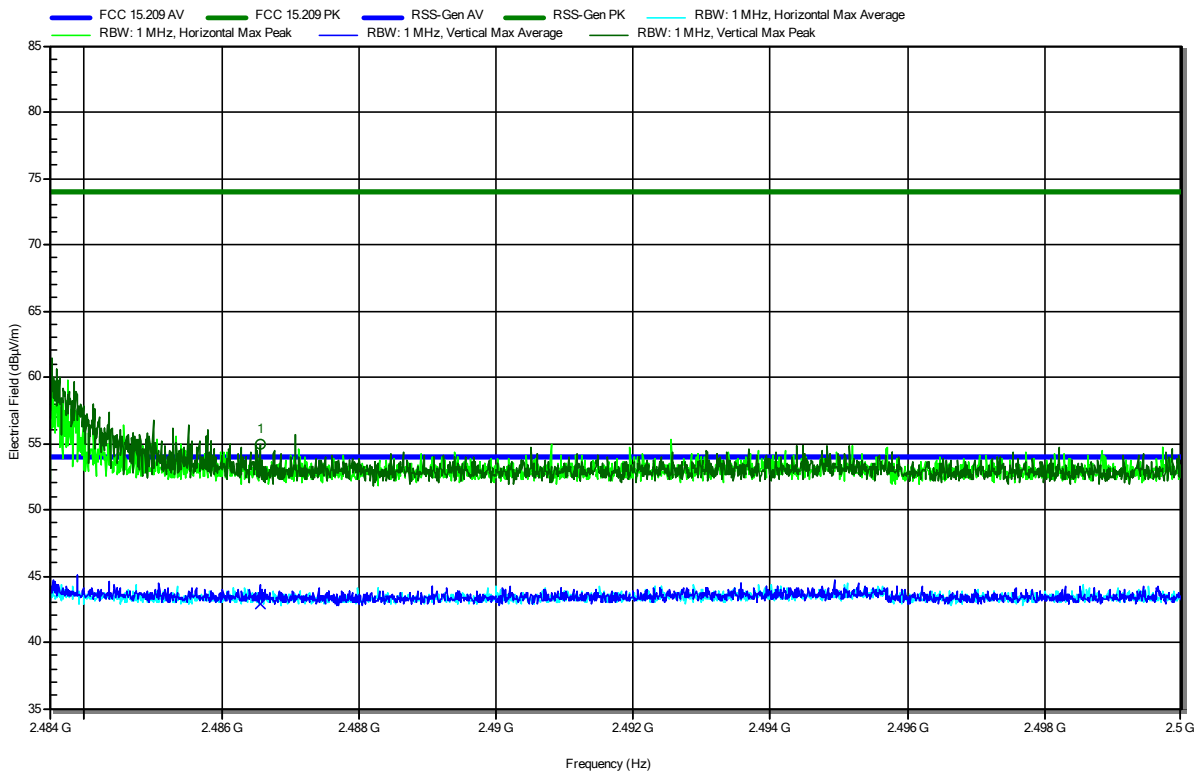
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
2.3555 GHz	52.82 dBµV/m	74 dBµV/m	-21.18 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
2.3555 GHz	42.21 dBµV/m	54 dBµV/m	-11.79 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note: upper bandedge

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RadiMation



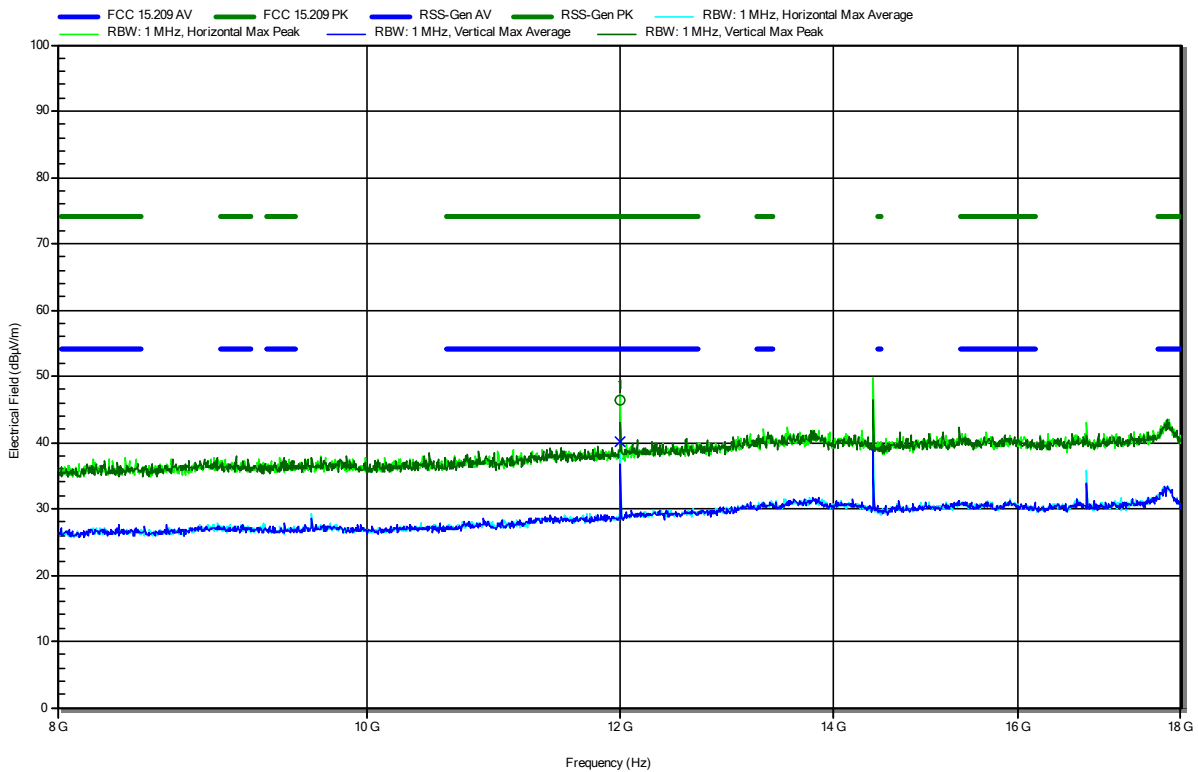
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
2.4866 GHz	54.9 dBµV/m	74 dBµV/m	-19.1 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
2.4866 GHz	42.84 dBµV/m	54 dBµV/m	-11.16 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2402 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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RadiMation



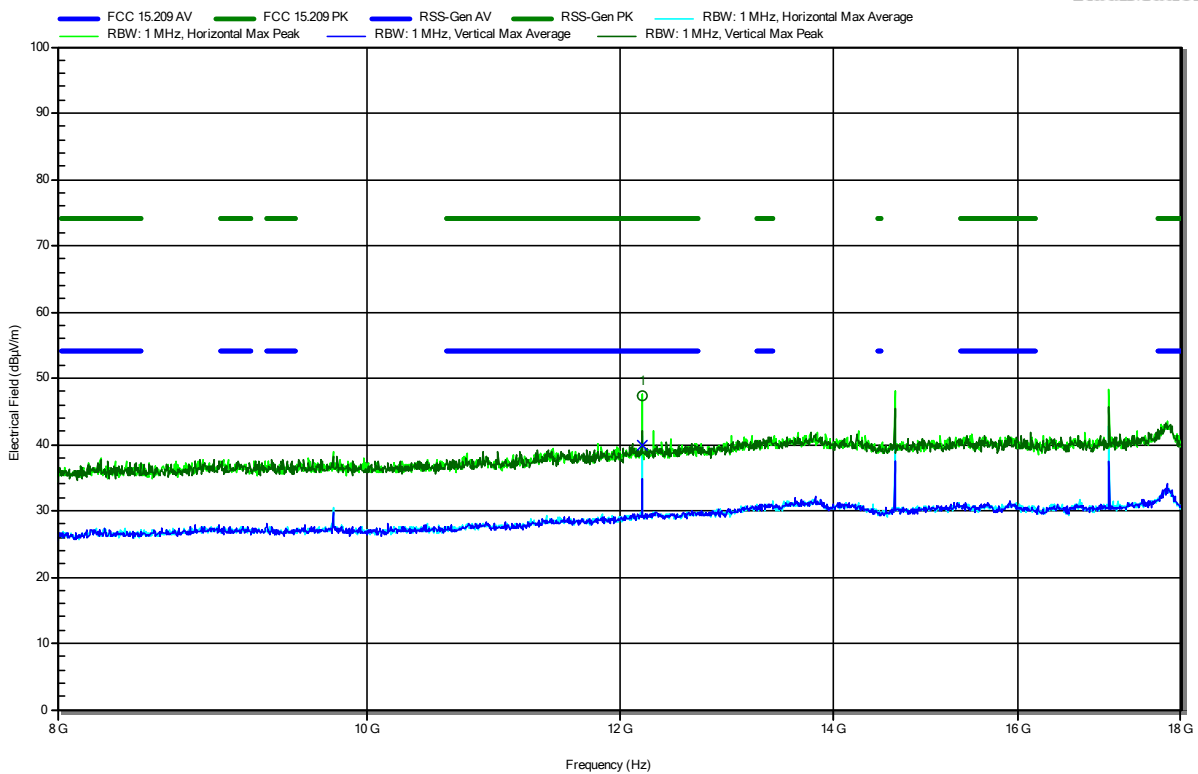
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
12.009 GHz	46.5 dBµV/m	74 dBµV/m	-27.5 dB	Pass	Horizontal
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
12.009 GHz	40.01 dBµV/m	54 dBµV/m	-13.99 dB	Pass	Horizontal

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2440 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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RadiMation



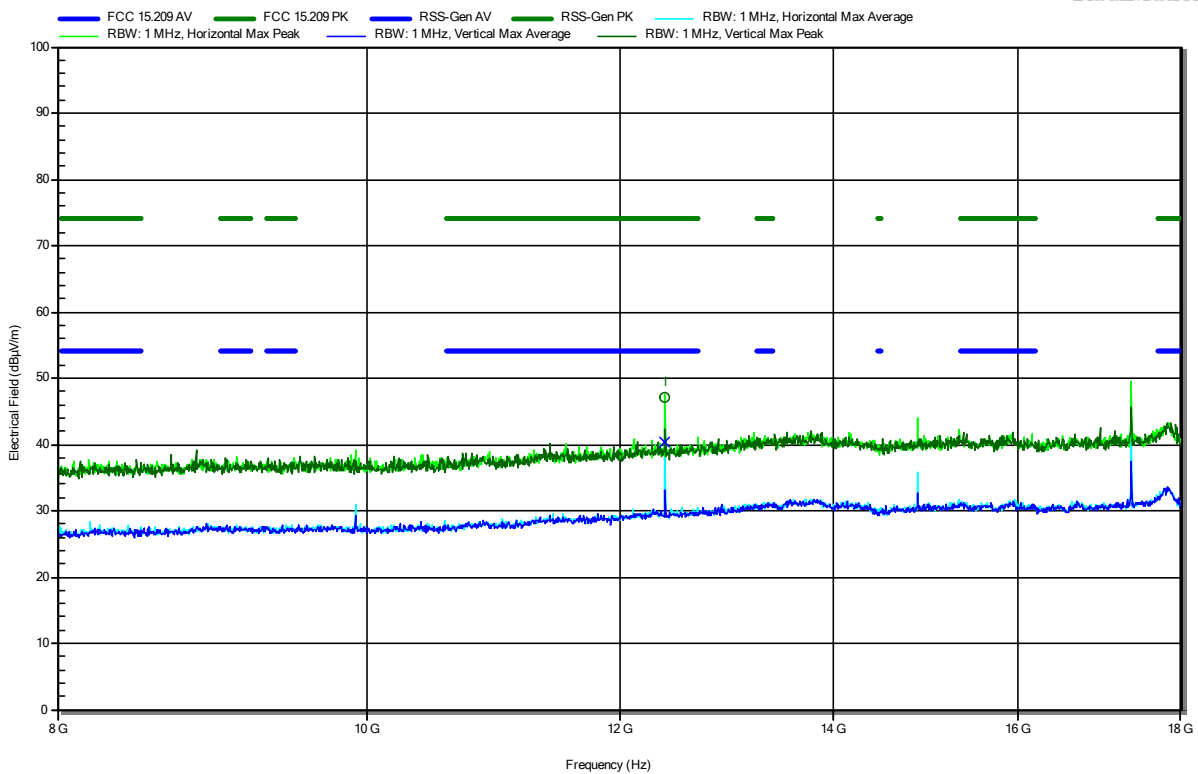
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
12.201 GHz	47.45 dBµV/m	74 dBµV/m	-26.55 dB	Pass	Horizontal
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
12.201 GHz	39.87 dBµV/m	54 dBµV/m	-14.13 dB	Pass	Horizontal

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
12.399 GHz	47.13 dBµV/m	74 dBµV/m	-26.87 dB	Pass	Horizontal
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
12.399 GHz	40.46 dBµV/m	54 dBµV/m	-13.54 dB	Pass	Horizontal

Test Report No.: G0M-2210-1706-TFC247BL-V01

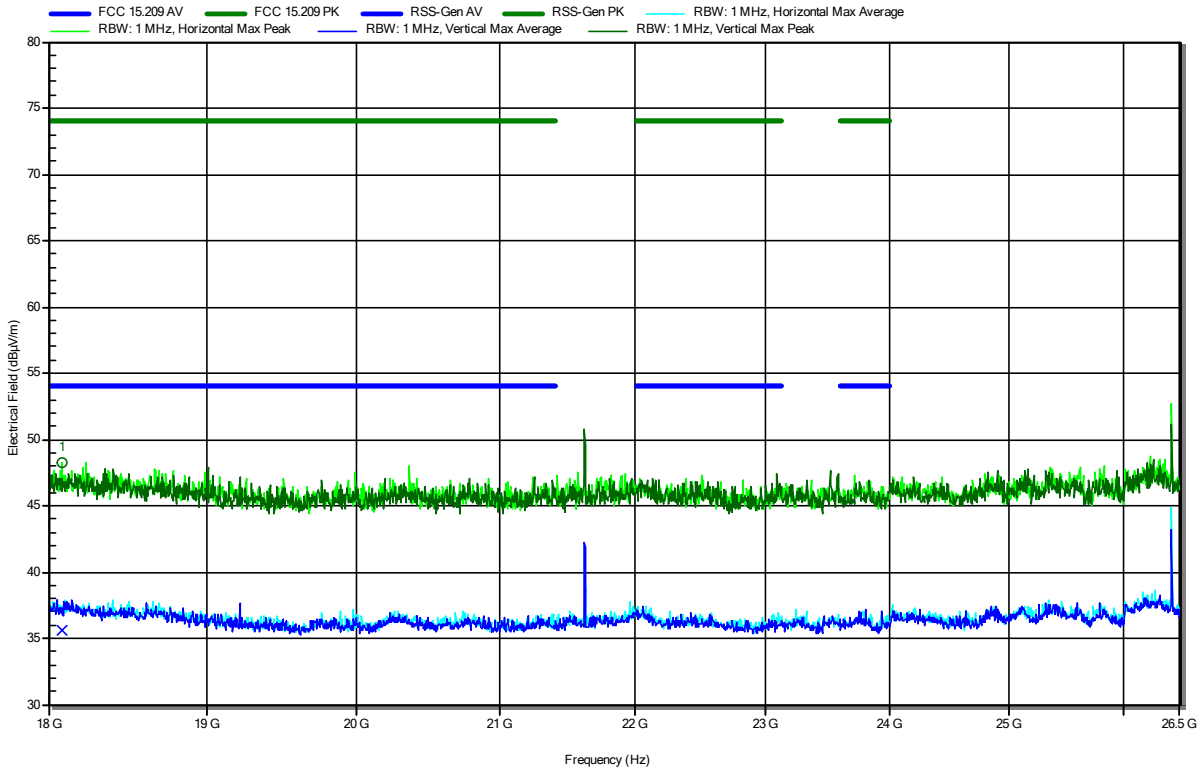
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2402 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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RadiMation



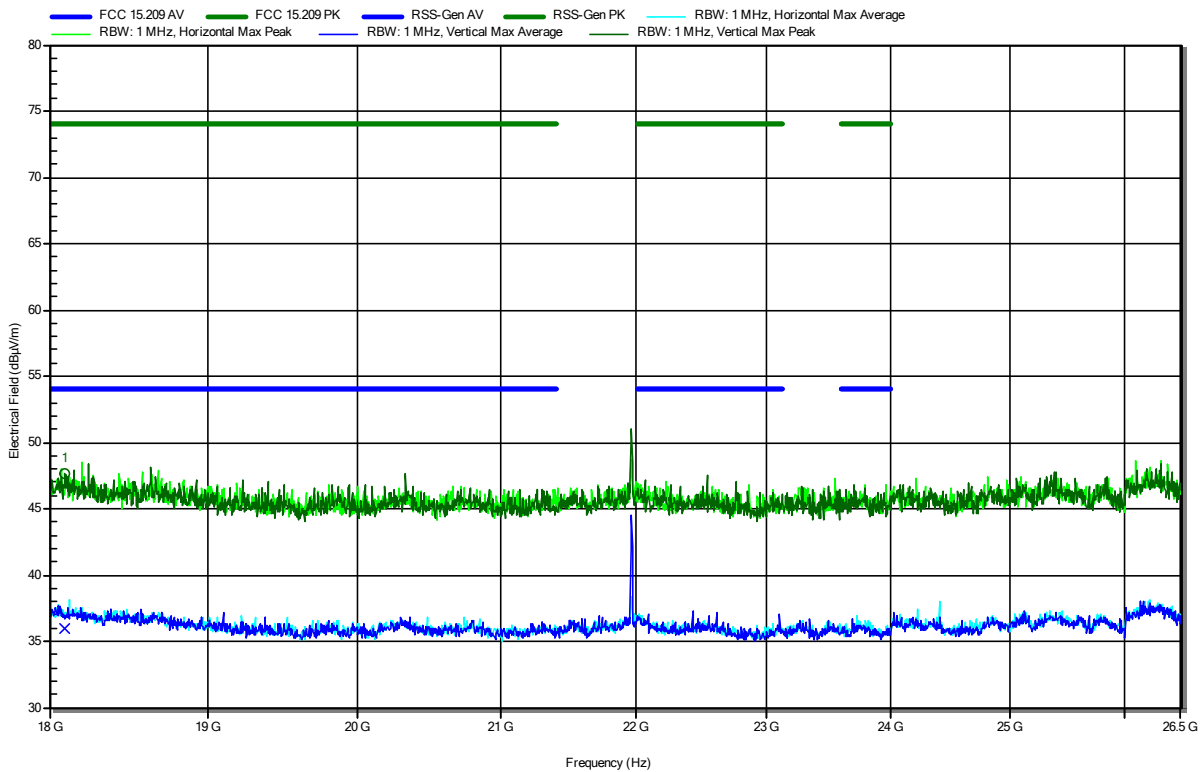
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
18.082 GHz	48.22 dBµV/m	74 dBµV/m	-25.78 dB	Pass	Horizontal
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
18.082 GHz	35.65 dBµV/m	54 dBµV/m	-18.35 dB	Pass	Horizontal

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2440 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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RadiMation



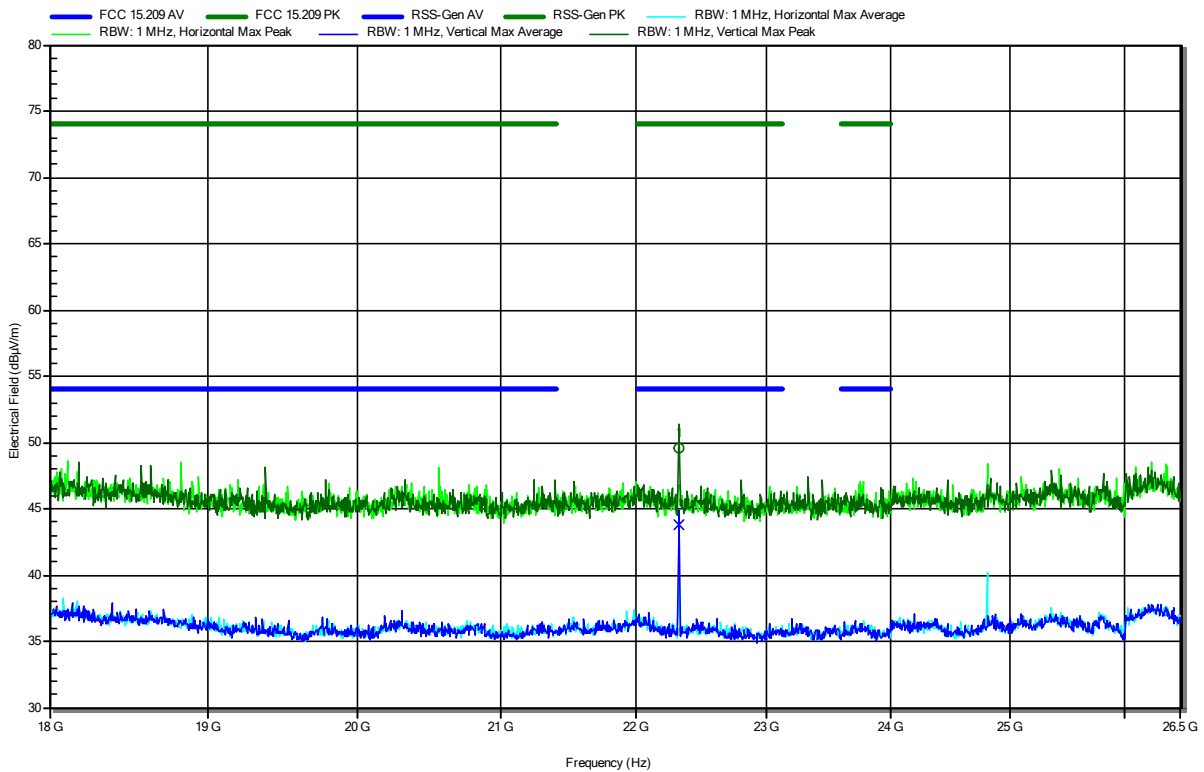
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
18.094 GHz	47.69 dBµV/m	74 dBµV/m	-26.31 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
18.094 GHz	35.99 dBµV/m	54 dBµV/m	-18.01 dB	Pass	Vertical

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

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, GFSK, PRBS9, 193 Bytes, 1 Mbit/s, 88% DC
 Test Date: 2022-11-01
 Note:

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Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
22.321 GHz	49.57 dBµV/m	74 dBµV/m	-24.43 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
22.321 GHz	43.83 dBµV/m	54 dBµV/m	-10.17 dB	Pass	Vertical

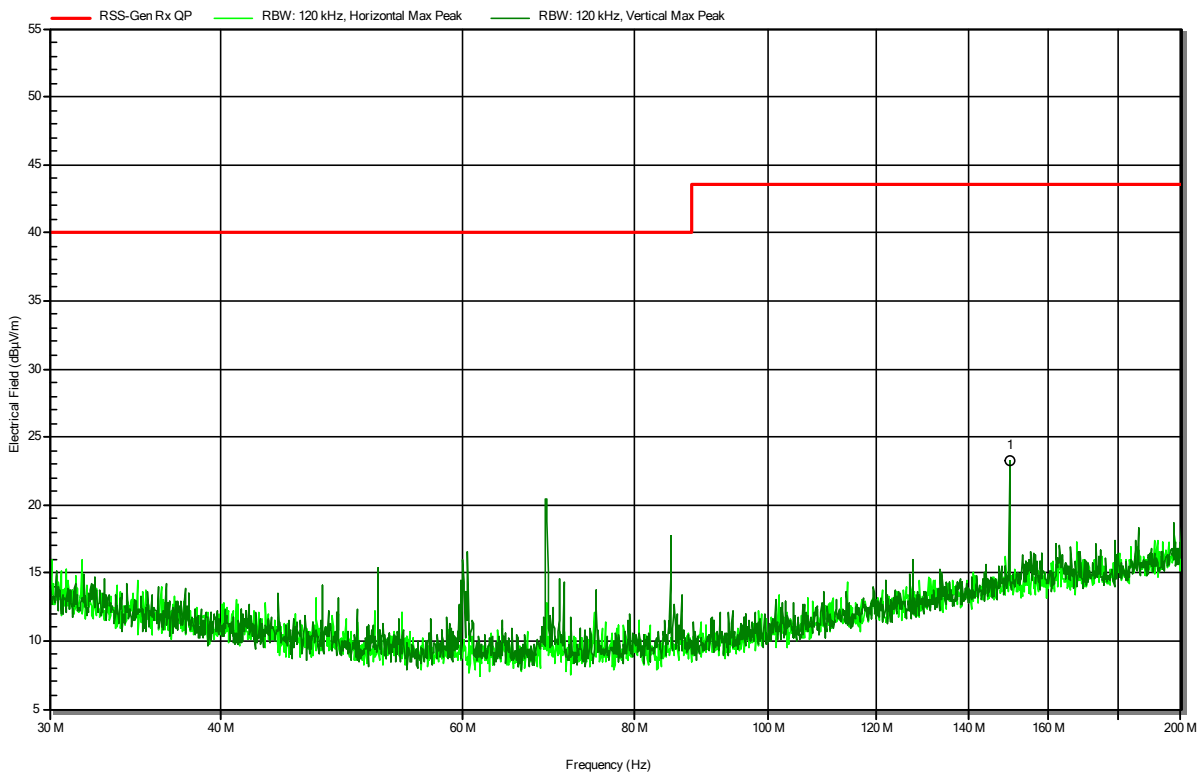
ANNEX B Receiver spurious emissions

Radiated Spurious Emissions according to RSS-247, RSS-Gen Issue 5

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HK 116
 Measurement distance: 3 m
 Mode: Rx; BT-LE, 2440 MHz
 Test Date: 2022-11-11
 Note:

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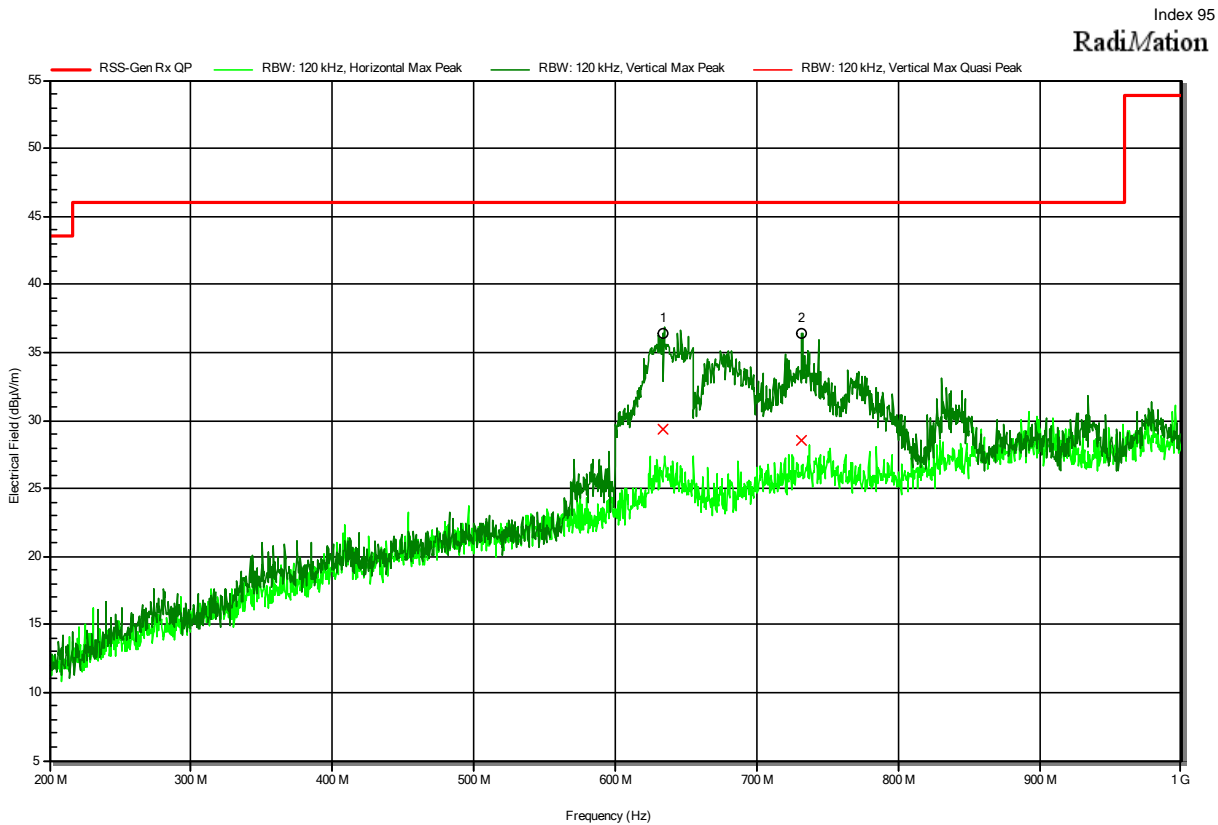
RadiMation



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
150.0115 MHz	23.2 dBµV/m	43.5 dBµV/m	-20.28 dB	Pass	Vertical

Radiated Spurious Emissions according to RSS-247, RSS-Gen Issue 5

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Rohde & Schwarz HL 223
 Measurement distance: 3 m
 Mode: Rx; BT-LE, 2440 MHz
 Test Date: 2022-11-11
 Note:



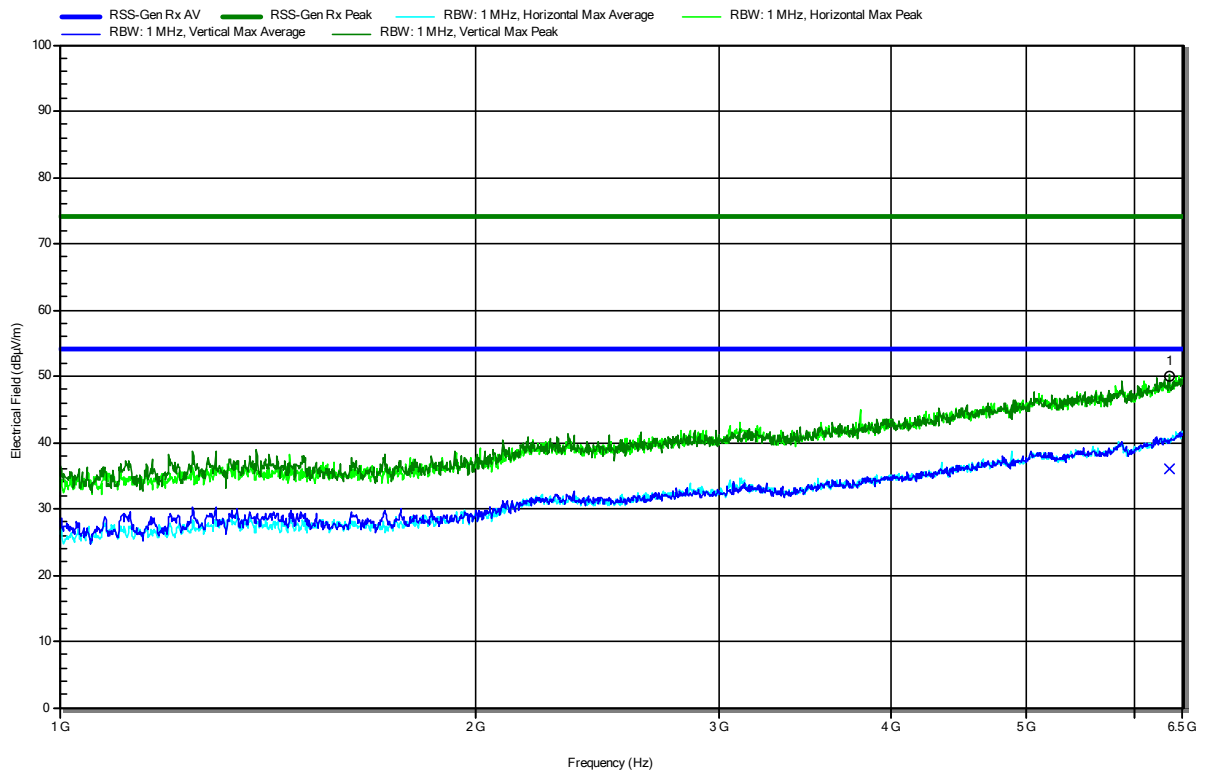
Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
634.12 MHz	29.3 dBµV/m	46 dBµV/m	-16.68 dB	Pass	Vertical
732.06 MHz	28.5 dBµV/m	46 dBµV/m	-17.5 dB	Pass	Vertical

Radiated Spurious Emissions according to RSS-247, RSS-Gen Issue 5

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck BBHA 9120D
 Measurement distance: 3 m
 Mode: Rx; BT-LE, 2440 MHz
 Test Date: 2022-11-10
 Note:

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RadiMation



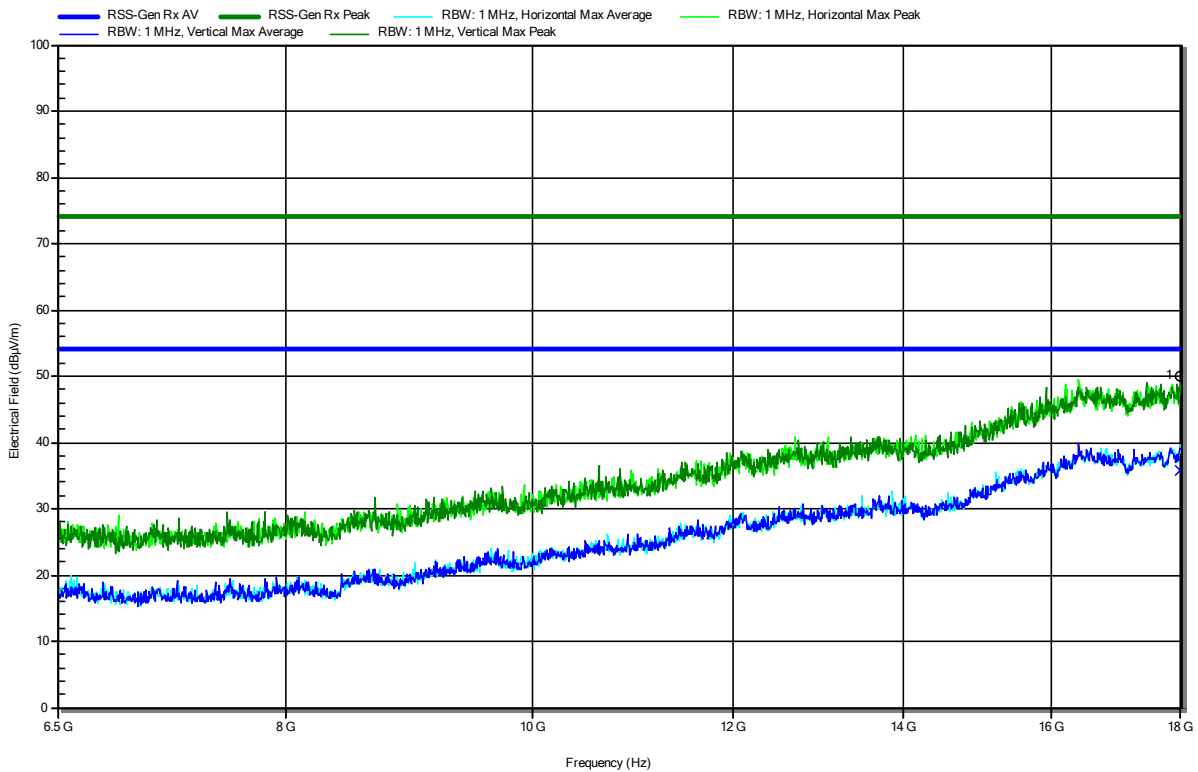
Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
6.353 GHz	50.11 dBµV/m	74 dBµV/m	-23.89 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
6.353 GHz	36.11 dBµV/m	53.98 dBµV/m	-17.87 dB	Pass	Vertical

Radiated Spurious Emissions according to RSS-247, RSS-Gen Issue 5

Project Number: G0M-2210-1706
 Applicant: Haltian Oy
 Model Description: Asset tracking tag
 Model: TTG
 Test Sample ID: 41732
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Qawasmeh
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.0 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Rx; BT-LE, 2440 MHz
 Test Date: 2022-11-10
 Note:

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RadiMation



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
17.995 GHz	49.9 dBµV/m	74 dBµV/m	-24.1 dB	Pass	Vertical
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
17.995 GHz	35.85 dBµV/m	53.98 dBµV/m	-18.13 dB	Pass	Vertical

== = END OF TEST REPORT == =

Test Report No.: G0M-2210-1706-TFC247BL-V01

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