

RADIO REPORT FCC 47 CFR Part 15C Digital transmission systems operating within the 2400.0 MHz - 2483.5 MHz band	
Report Reference No	G0M-2308-2203-TFC247BL-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	STEINER-Optik GmbH
Address	Dr.-Hans-Frisch-Str. 9 95448 Bayreuth GERMANY
Test Specification	47 CFR Part 15C
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Bluetooth Dongle
Model(s)	BT Dongle für das M830r LRF
Additional Model(s)	None
Brand Name(s)	STEINER Bluetooth Transceiver LRF (M830r LRF 1535)
Hardware Version(s)	EZ-BLE PSoC XT/XR module
Software Version(s)	PSoC® Creator™, EZ-Serial™ Bluetooth LE Firmware
FCC ID	2BDTF-LRFTRX
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	2023-08-30	
Report:		
Compiled by	Ehsan Sohrabi	
Tested by (+ signature) (Responsible for Test)	Ehsan Sohrabi	
Approved by (+ signature) (Senior Radio Expert)	Radwan Jaafar	
Date of Issue	2024-05-07	
Total number of pages	28	
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:		
None		

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2024-05-07	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

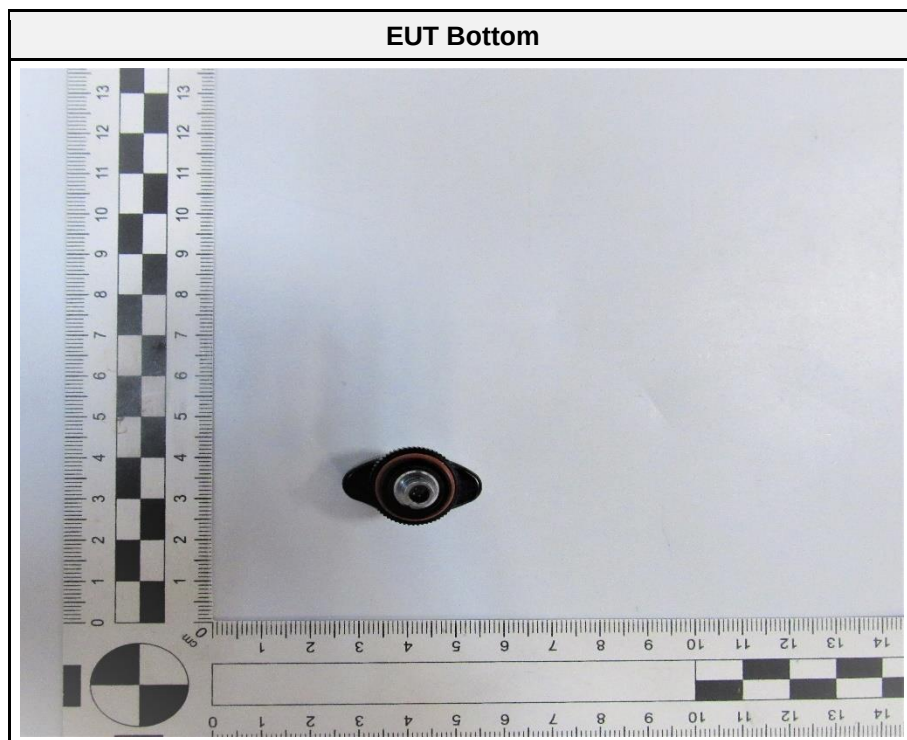
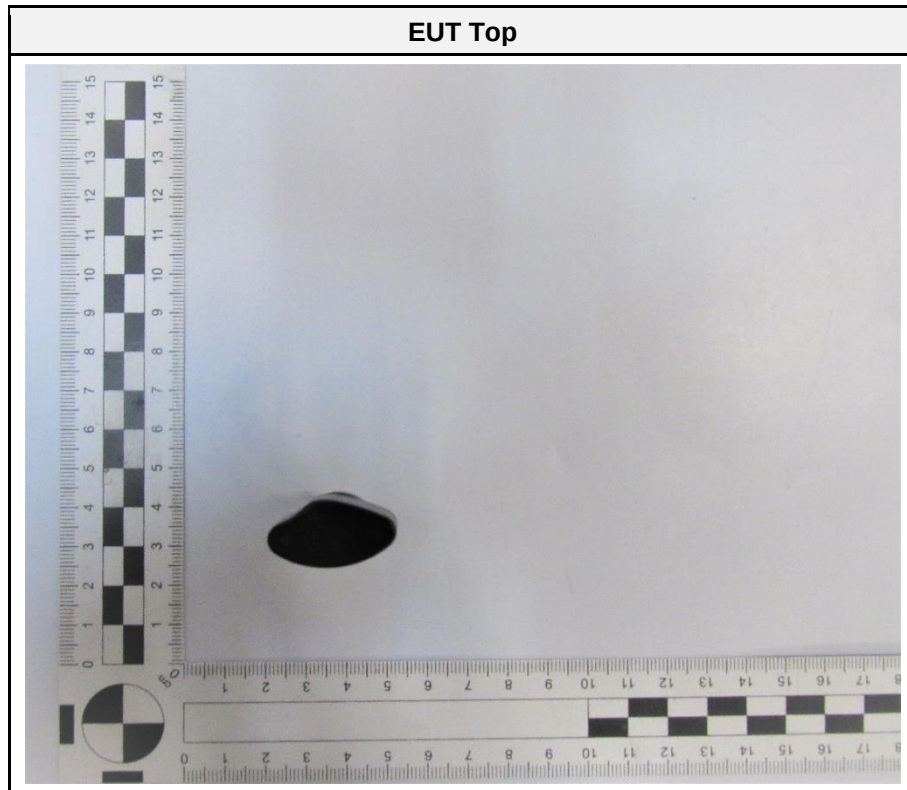
REPORT INDEX

1	Equipment (Test Item) Under Test.....	6
1.1	Photos – Equipment External	7
1.2	Photos – Equipment Internal	10
1.3	Support Equipment.....	12
1.4	Test Modes	13
1.5	Test Frequencies.....	14
1.6	Sample emission level calculation.....	15
2	Result Summary.....	16
3	Test Conditions and Results.....	17
3.1	Test Conditions and Results - Transmitter radiated emissions	17
ANNEX A	Transmitter spurious emissions	24

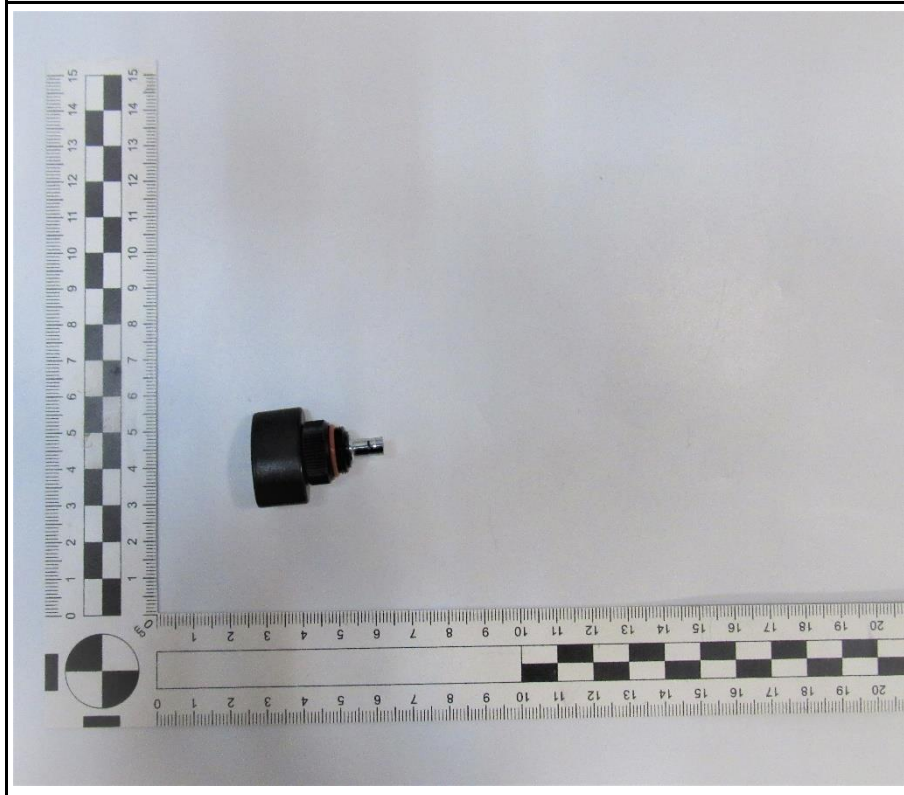
1 Equipment (Test Item) Under Test

Description	Bluetooth Dongle		
Model	BT Dongle für das M830r LRF		
Additional Model(s)	None		
Brand Name(s)	STEINER Bluetooth Transceiver LRF (M830r LRF 1535)		
Sample Identification	EUT 1	Sample-ID	Serial Number
		45223	prototype
Hardware Version(s)	EZ-BLE PSoC XT/XR module		
Software Version(s)	PSoC® Creator™, EZ-Serial™ Bluetooth LE Firmware		
FCC ID	2BDTF-LRFTRX		
Equipment type	End Product		
Radio type	Transceiver		
Assigned frequency bands	2402 MHz - 2480 MHz		
Radio technology	Bluetooth LE 5.1		
Bluetooth Specification	LE 1M PHY		Yes
	LE 2M PHY		No
	LE Coded PHY S=8 (125 kbit)		No
	LE Coded PHY S=2 (500 kbit)		No
	Stable Modulation Index - Transmitter		Yes
	Stable Modulation Index - Receiver		Yes
Modulation	GFSK		
Number of antenna ports	1		
Radio Module	Type	Bluetooth Low Energy	
	Model	CYBLE-224116-01	
	Manufacturer	CYPRESS	
	HW Version	Not Specified	
	SW Version	Not Specified	
	FCC-ID	WAP4110	
	IC	N/A	
Antenna	Type	Integrated	
	Model	2450AT18B100	
	Manufacturer	Johanson Technology	
	Gain	0.5 dBi	
Supply Voltage	V _{NOM}	3.3 VDC	
	V _{Min}	2.0VDC	
	V _{Max}	3.6 VDC	
Operating Temperature	T _{NOM}	20 °C	
	T _{Min}	-19 °C	
	T _{Max}	49 °C	
Manufacturer	Cypress Semiconductor 12230 World Trade Drive #200 CA 92128 San Diego USA		

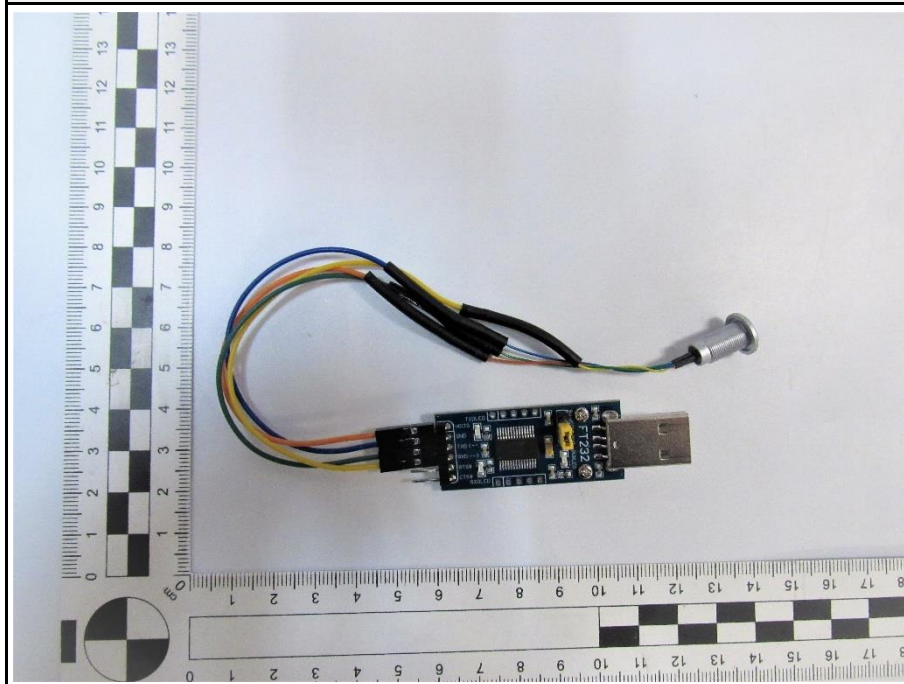
1.1 Photos – Equipment External

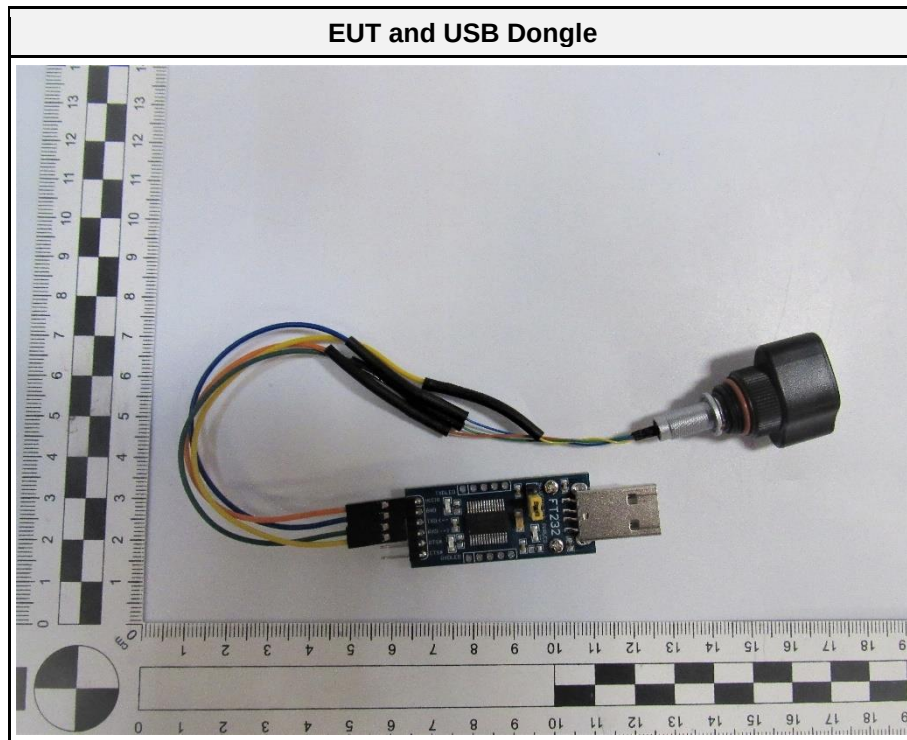


EUT Right side

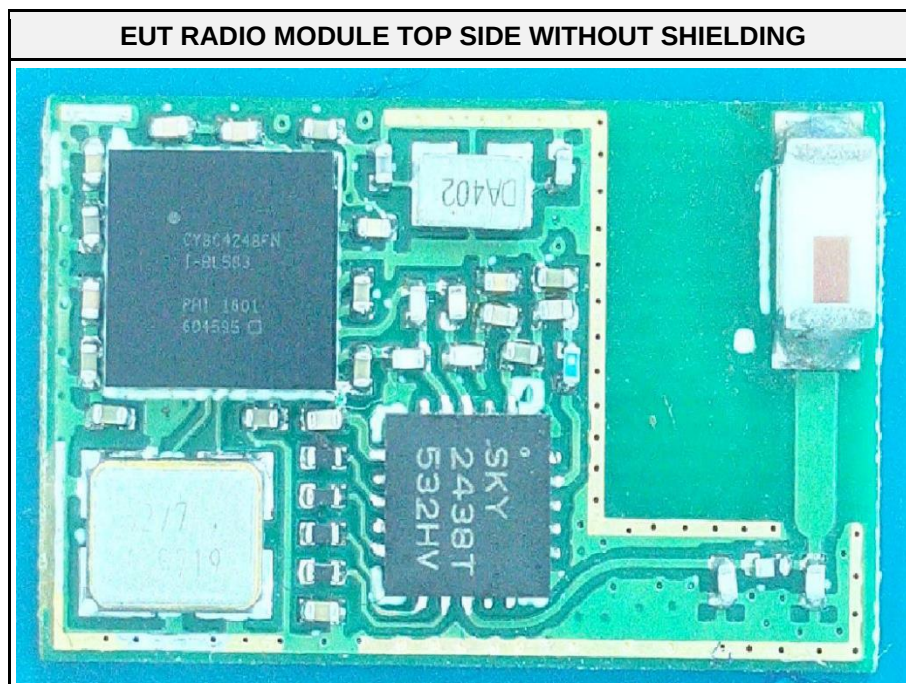
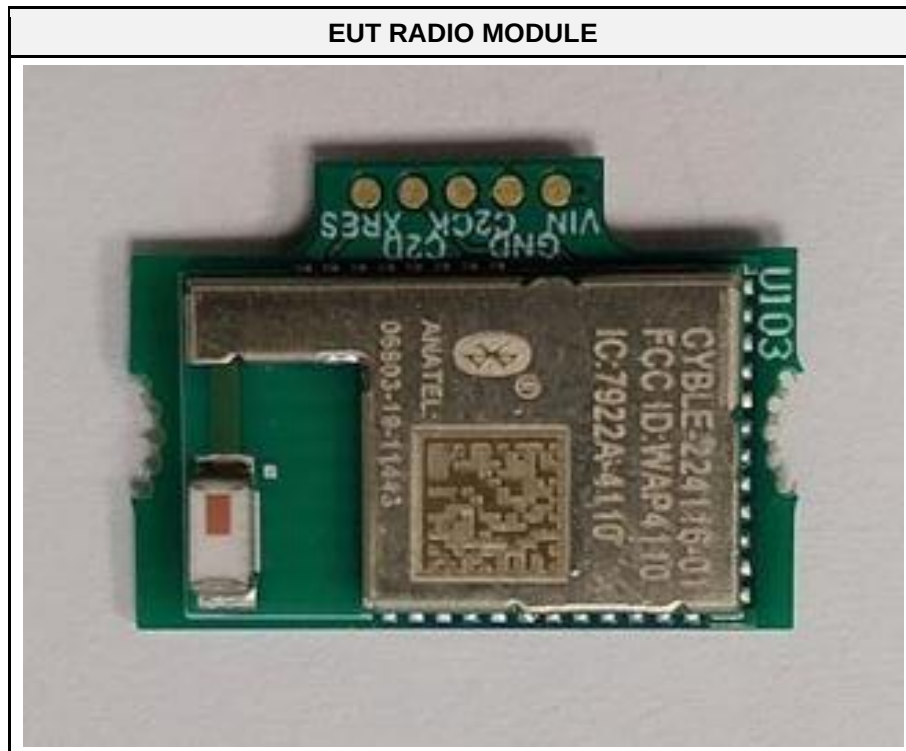


USD Dongle

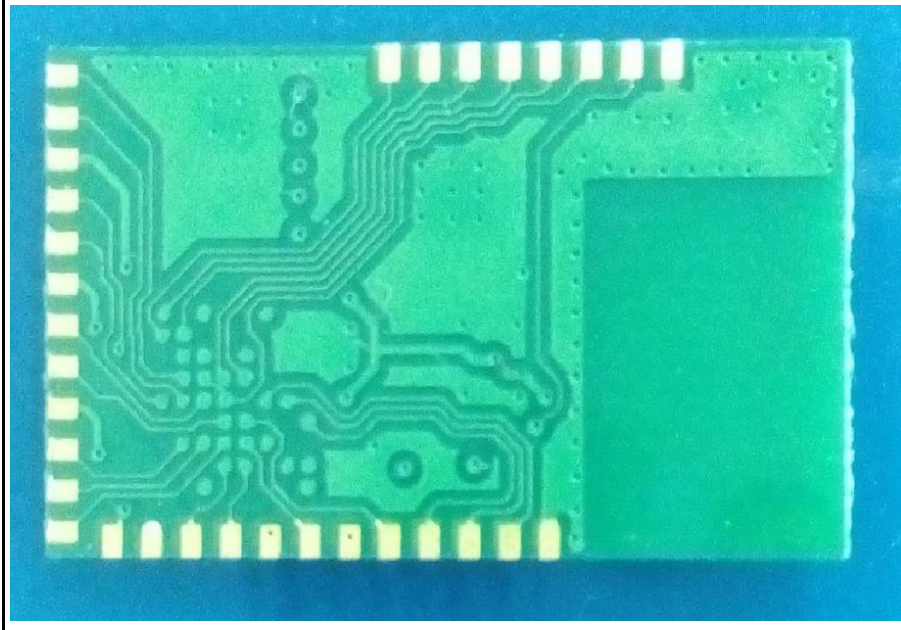




1.2 Photos – Equipment Internal



EUT RADIO MODULE BOTTOM SIDE WITHOUT SHIELDING



1.3 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	Laptop	--	Lenovo	For connecting the EUT
CBL	USD Dongle	--	--	For connection EUT to laptop
SFT	--	--	Bluetooth LE DTM	For configuration the EUT
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
SFT	Software			
Comment: --				

1.4 Test Modes

Mode	Description
1 Mbps	Mode = Transmit Modulation = GFSK Packet Type = PRBS9 Packet Length = 193 Bytes Spreading = None Duty cycle = 87 % Pmax = default setting
Comment: The above setting was found as worst case according to module report.	

1.5 Test Frequencies

Designator	Mode	Channel	Frequency [MHz]
F1	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).

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.

Field strength 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:

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

Example only for radiated field strength:

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

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/T	Informational only
FCC § 15.247(a)(2) ISED RSS-247, Issue 2 (section 5.2)	6 dB Bandwidth	ANSI C63.10-2013	N/T	1
FCC § 15.247(b) ISED RSS-247, Issue 2 (section 5.4)	Maximum peak conducted power	ANSI C63.10-2013	N/T	1
FCC § 15.247(e) ISED RSS-247, Issue 2 (section 5.2)	Power spectral density	ANSI C63.10-2013	N/T	1
FCC § 15.207 ISED RSS-247, Issue 2 (section 3.1)	AC power line conducted emissions	ANSI C63.10-2013	N/T	No relevant port
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Band edge compliance	ANSI C63.10-2013	N/T	1
FCC § 15.247(d) ISED RSS-247, Issue 2 (section 5.5)	Conducted spurious emissions	ANSI C63.10-2013	N/T	1
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	--
Comment: The Decision Rule is applied on the basis of ETSI TR 102 273 and ETSI TR 100 028. These standards provide guidance on how to calculate and apply measurement uncertainty whilst providing maximum uncertainties allowance. In all cases due consideration will be given to ILAC-G8:09/2019. Where a result is considered conditional in respect of its proximity to the limit line, the customer would be made aware of situation so that they can make an informed decision on how to proceed. 1 → Integration of certified module, for test results see Report No. 1632048R-RF-US-P06V01 issued by Quietek Corporation – Suzhou EMC Laboratory on 2016-05-24				

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

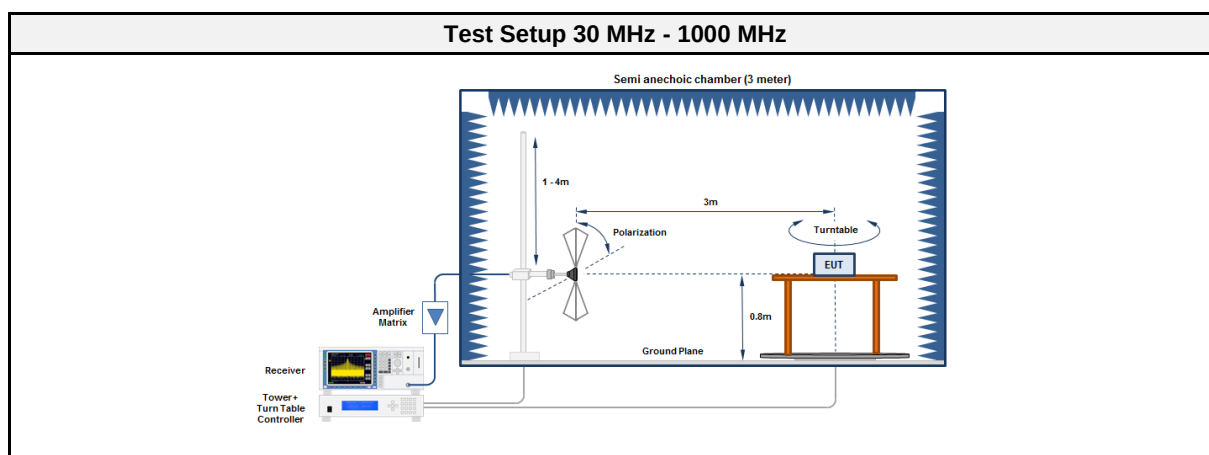
3.1.1 Information

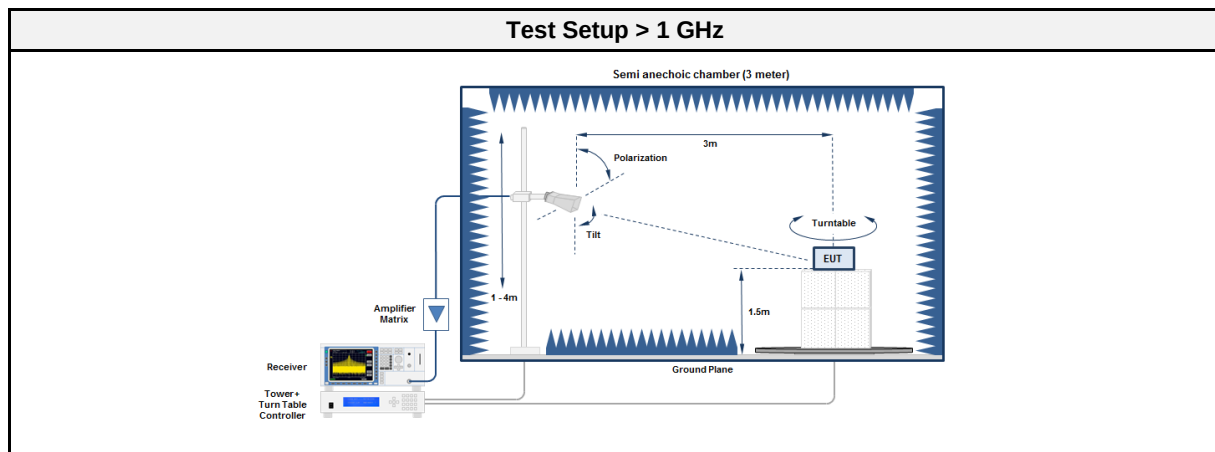
Test Information	
Reference	FCC § 15.247(d); FCC § 15.209
Measurement Uncertainty	± 5.95 dB
Measurement Method	ANSI C63.10 6.4, 6.5, 6.6, 11.12
Operator	Ehsan Sohrabi
Date	2023-12-19_2023-12-20

3.1.2 Limits

Limits			
Frequency range [MHz]	Detector	Field strength [$\mu\text{V/m}$]	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 MHz - 1000 MHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC1	EF00062	2022-11	2025-11
Measurement Receiver	R&S	ESU 26	EF00887	2023-08	2024-08
Trilog Broadband Antenna	Schwarzbeck	VULB 9168	EF01824	2022-10	2025-10

Test Equipment > 1 GHz					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic Chamber	Frankonia	AC2	EF01616	--	--
Spectrum Analyzer	Frankonia	FSW 43	EF00896	2023-08	2024-08
Antenna	Schwarzbeck	BBHA 9120B	EF01678	2021-03	2024-03
Antenna	Schwarzbeck	HWRD 650	EF01679	2021-03	2024-03
Antenna	Amplifier Research	AT4560	EF00302	2023-09	2025-09

3.1.5 Procedure

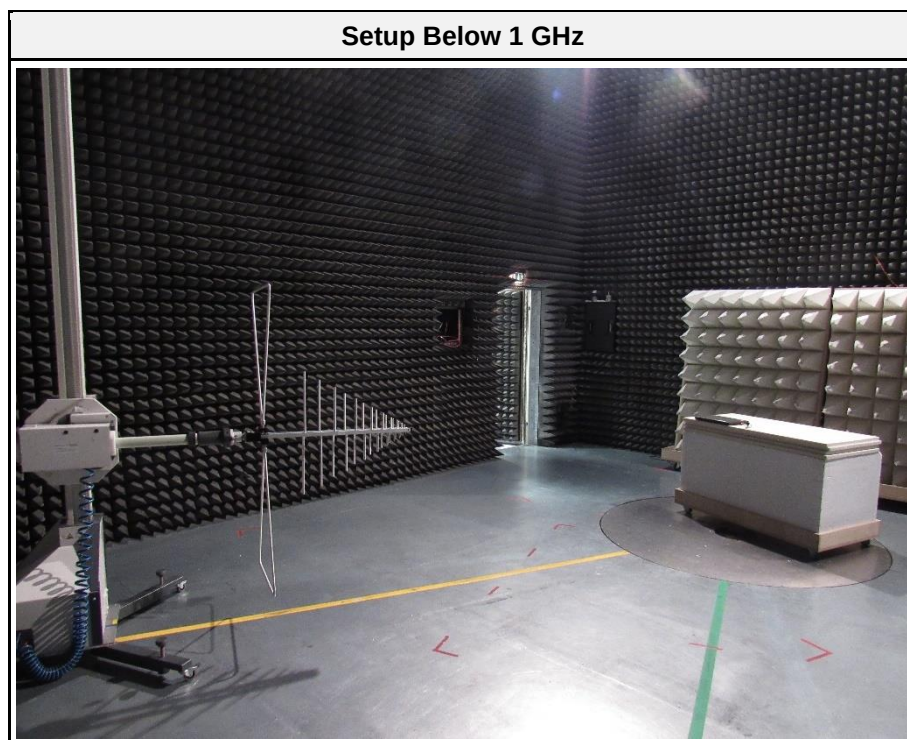
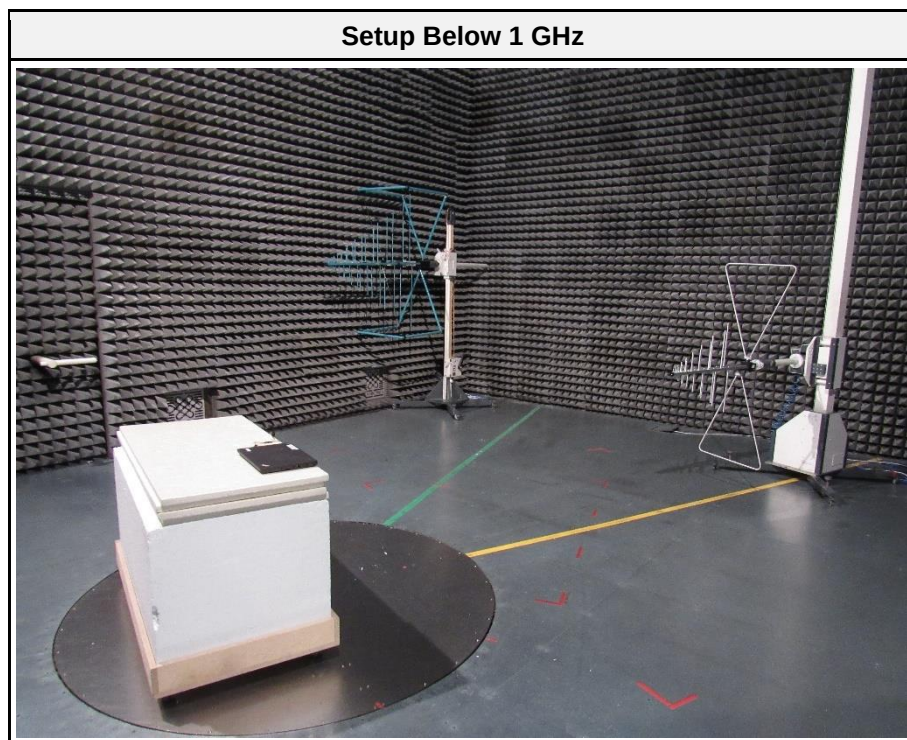
Test Procedure 30 MHz - 1000 MHz	
- EUT is placed on a non conducting support at the center of a turn table 0.8 m above the ground - EUT set to test mode - The receiver is set to peak detection with max hold - The EUT is rotated through 360° and the height of the antenna is varied from 1 m to 4 m - All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

Test Procedure > 1 GHz	
- 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	

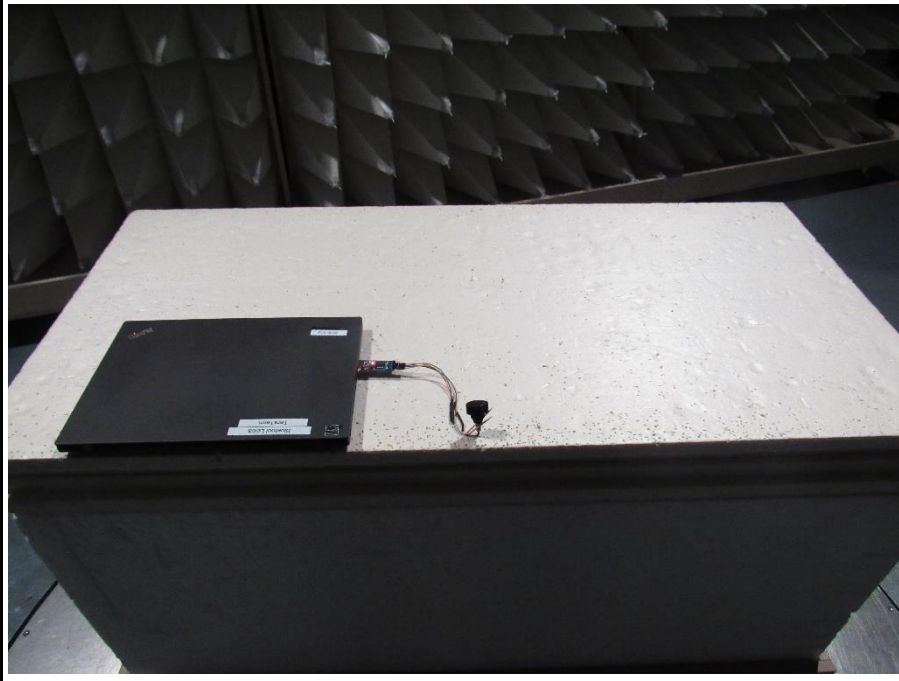
3.1.6 Results

Test Results						
Channel [MHz]	Emission [MHz]	Level [dBμV/m]	Det.	Pol.	Limit [dBμV/m]	Margin [dB]
2480	271.4361	44.40	pk	hor	46.00	-01.58
2480	271.4361	39.20	qpk	hor	46.00	-06.78
2480	2494.8	54.48	pk	hor	74.00	-19.52
2480	2494.8	41.26	avg	hor	54.00	-12.74
2480	4985	44.68	pk	ver	74.00	-29.32
2480	4985	28.04	avg	ver	54.00	-25.96

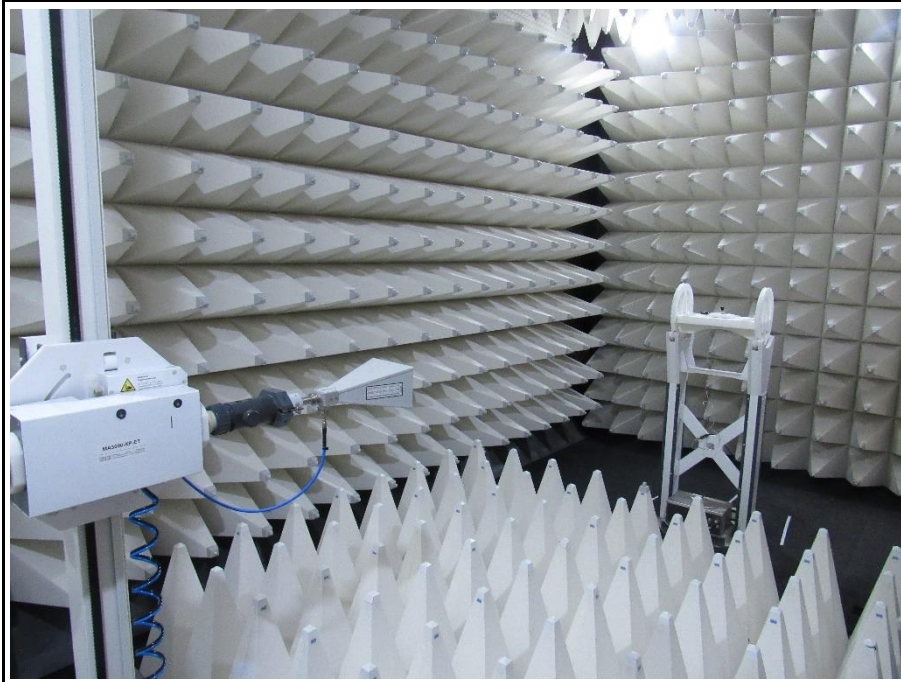
3.1.7 Setup Photos



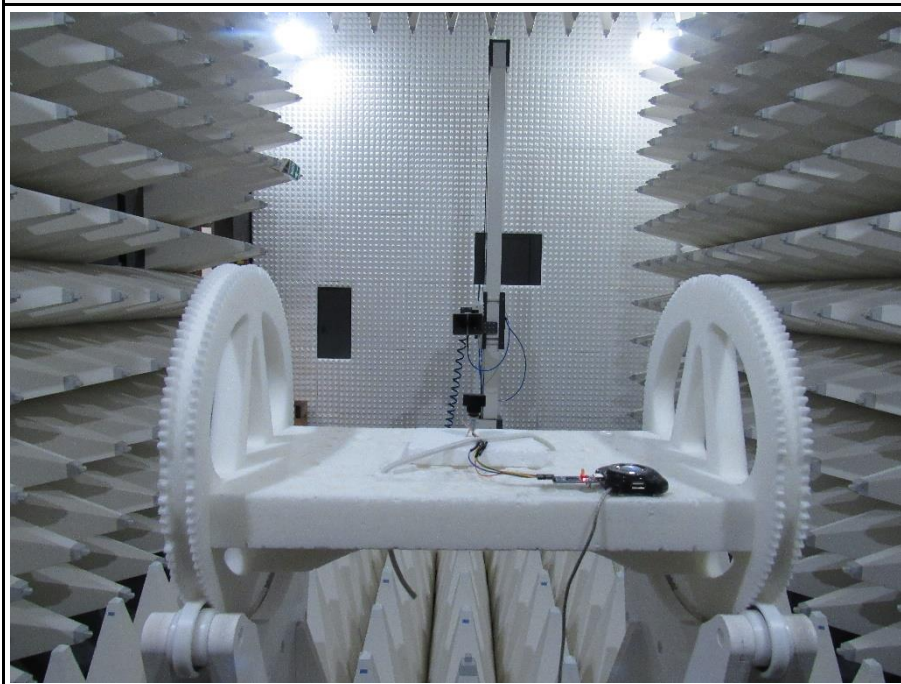
Setup Below 1GHz



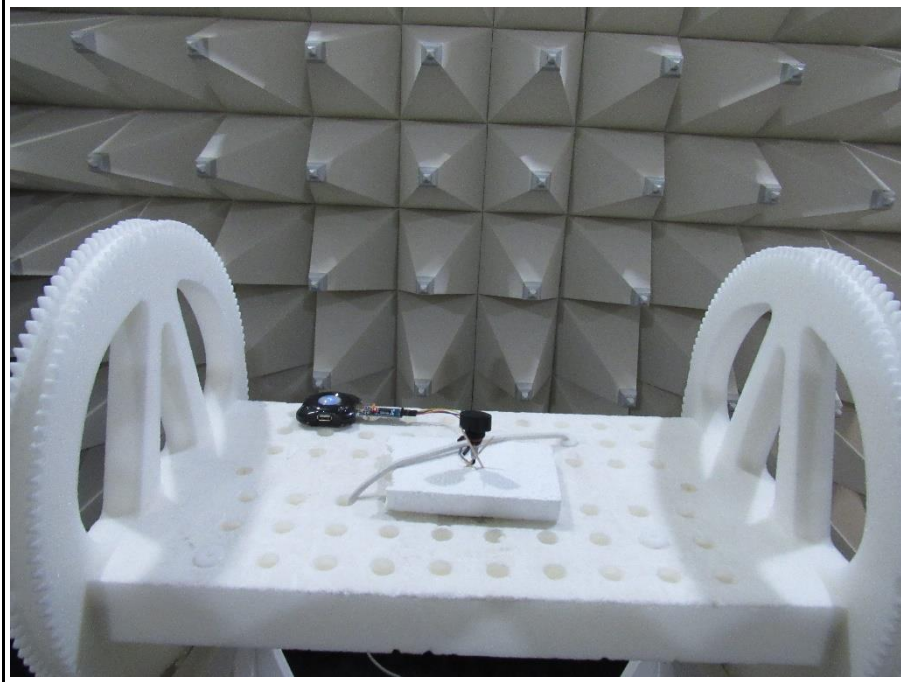
Setup Above 1 GHz



Setup Above 1 GHz..



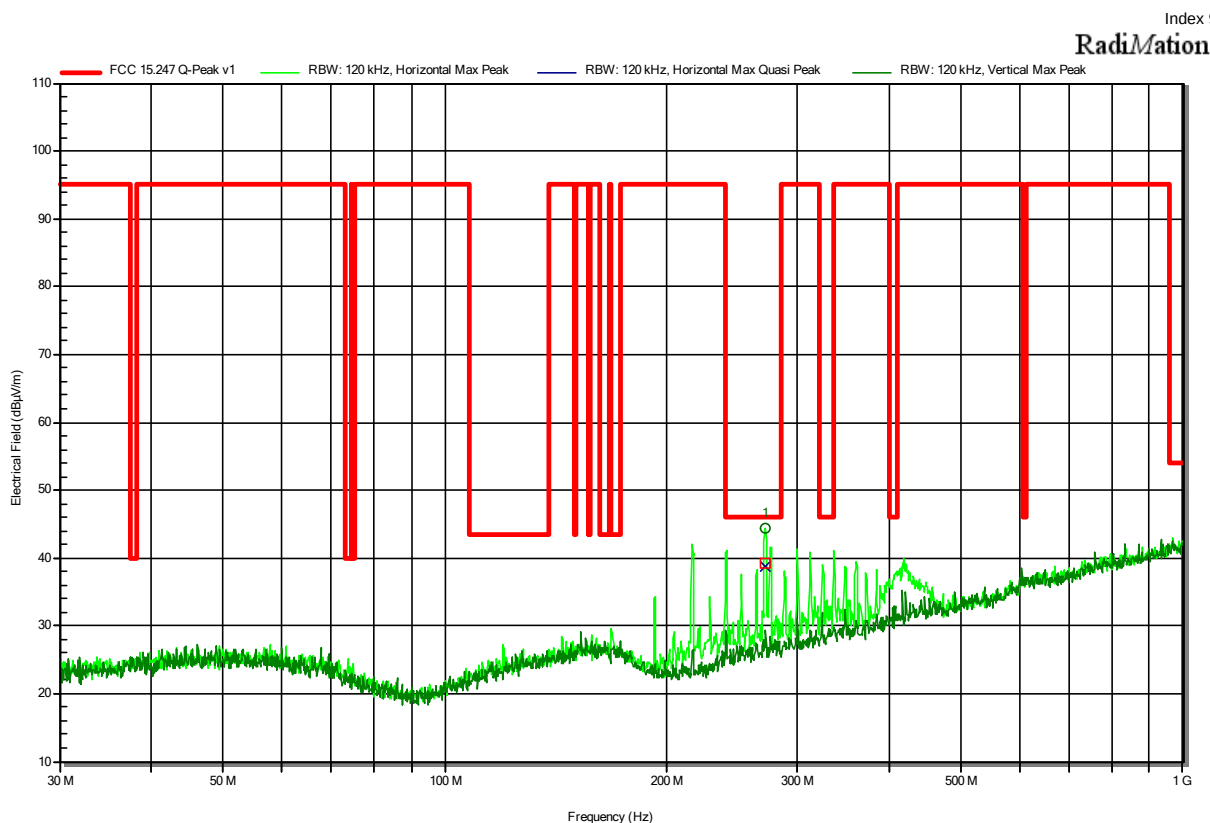
Setup Above 1 GHz....



ANNEX A Transmitter spurious emissions

Radiated Spurious Emissions according to 47 CFR Part 15.247

Project Number: G0M-2308-2203
 Applicant: STEINER-Optik GmbH
 Model Description: Bluetooth Dongle
 Model: BT Dongle für das M830r LRF
 Test Sample ID: 46934
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Sohrabi
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.3 VDC
 Antenna: Schwarzbeck VULB 9168
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, PRBS9, 193 Bytes, 1 Mbit/s
 Test Date: 2023-12-20
 Note: --



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
271.4361 MHz	44.4 dBµV/m	46 dBµV/m	-1.58 dB	Pass	Horizontal
Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Polarization
271.4361 MHz	39.2 dBµV/m	46 dBµV/m	-6.78 dB	Pass	Horizontal

Test Report No.: G0M-2308-2203-TFC247BL-V01

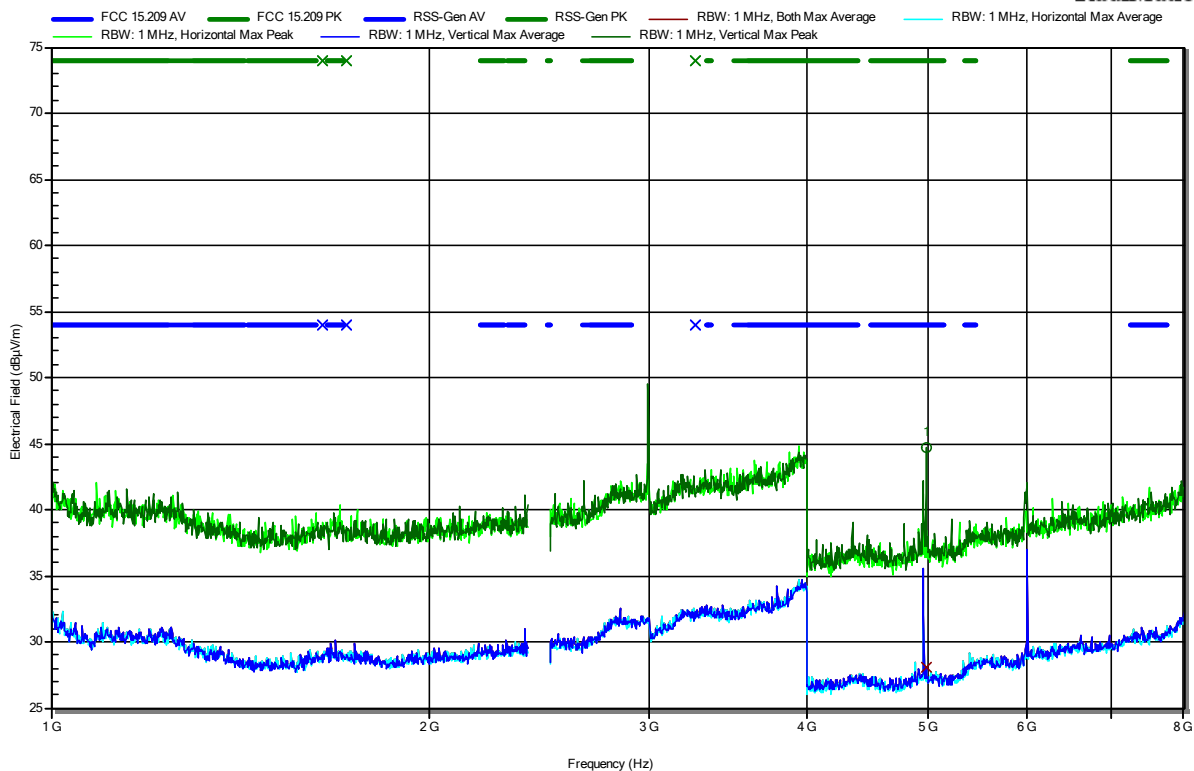
Eurofins Product Service GmbH
 Storkower Str. 38c, D-15526 Reichenwalde, Germany

Radiated Spurious Emissions according to 47 CFR Part 15.247

Project Number: G0M-2308-2203
 Applicant: STEINER-Optik GmbH
 Model Description: Bluetooth Dongle
 Model: BT Dongle für das M830r LRF
 Test Sample ID: 46934
 Test Site: Eurofins Product Service GmbH
 Operator: Ehsan Sohrabi
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, PRBS9, 193 Bytes, 1 Mbit/s
 Test Date: 2023-12-19
 Note: --

Index 5

RadiMation



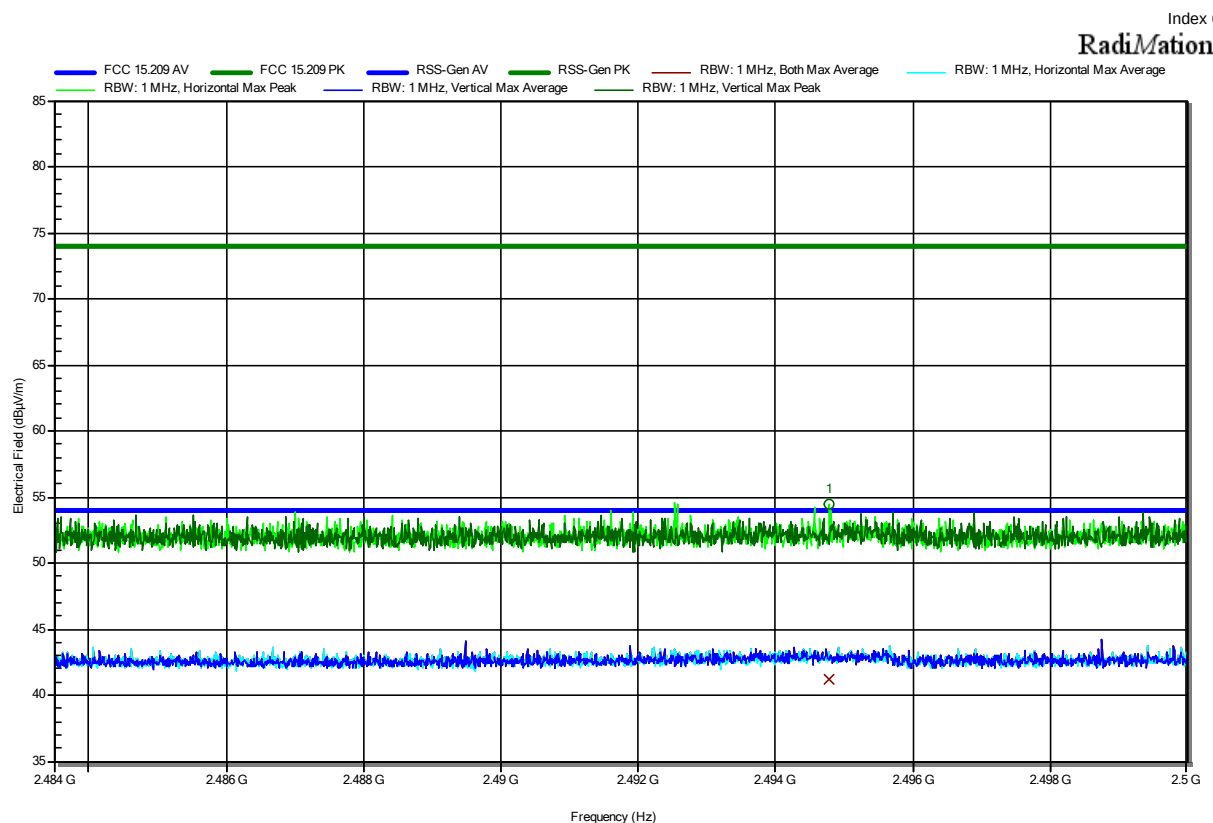
Frequency 4.985 GHz	Peak 44.68 dBµV/m	Peak Limit 74 dBµV/m	Peak Difference -29.32 dB	Peak Status Pass	Polarization Vertical
Frequency 4.985 GHz	Average 28.04 dBµV/m	Average Limit 54 dBµV/m	Average Difference -25.96 dB	Average Status Pass	Polarization Vertical

Test Report No.: G0M-2308-2203-TFC247BL-V01

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

Radiated Spurious Emissions according to 47 CFR Part 15.247

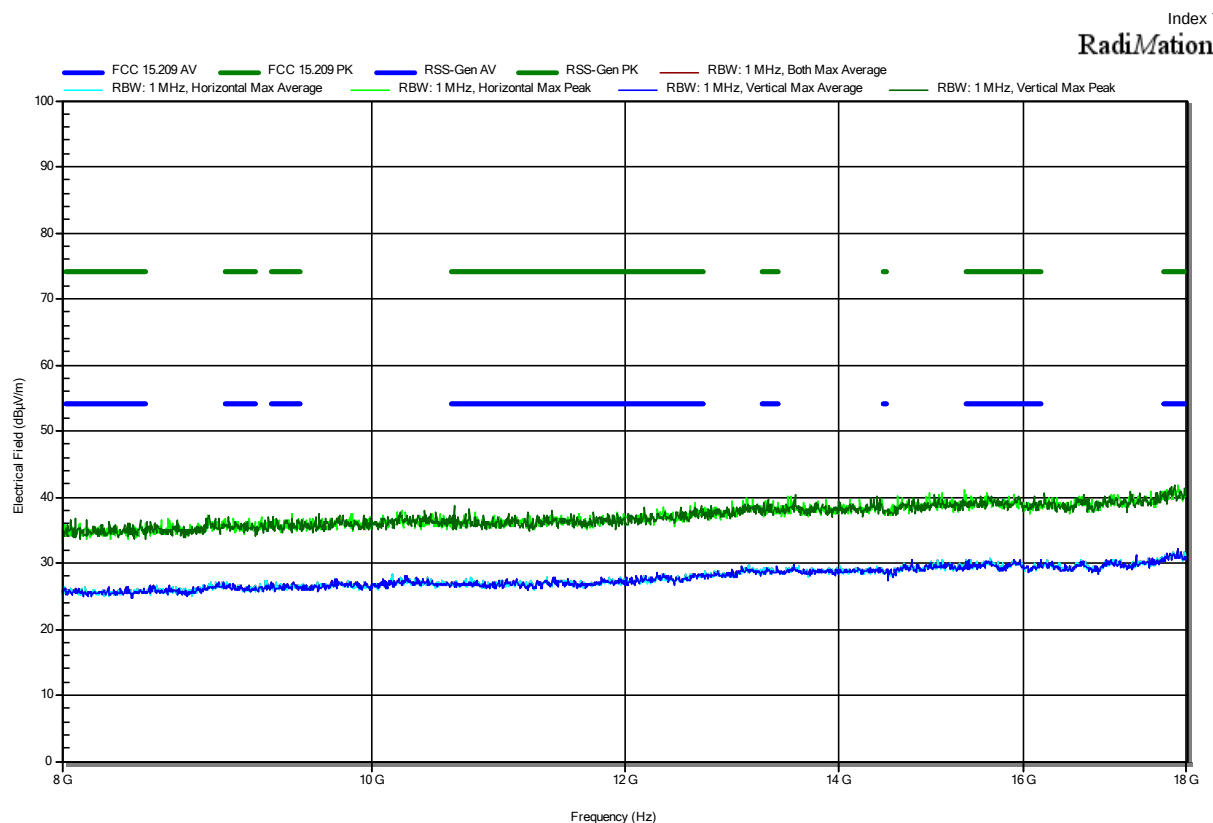
Project Number: G0M-2308-2203
 Applicant: STEINER-Optik GmbH
 Model Description: Bluetooth Dongle
 Model: BT Dongle für das M830r LRF
 Test Sample ID: 46934
 Test Site: Eurofins Product Service GmbH
 Operator: Ehsan Sohrabi
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.3 VDC
 Antenna: Schwarzbeck BBHA 9120B
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, PRBS9, 193 Bytes, 1 Mbit/s
 Test Date: 2023-12-19
 Note: upper bandedge



Frequency	Peak	Peak Limit	Peak Difference	Peak Status	Polarization
2.4948 GHz	54.48 dBµV/m	74 dBµV/m	-19.52 dB	Pass	Horizontal
Frequency	Average	Average Limit	Average Difference	Average Status	Polarization
2.4948 GHz	41.26 dBµV/m	54 dBµV/m	-12.74 dB	Pass	Horizontal

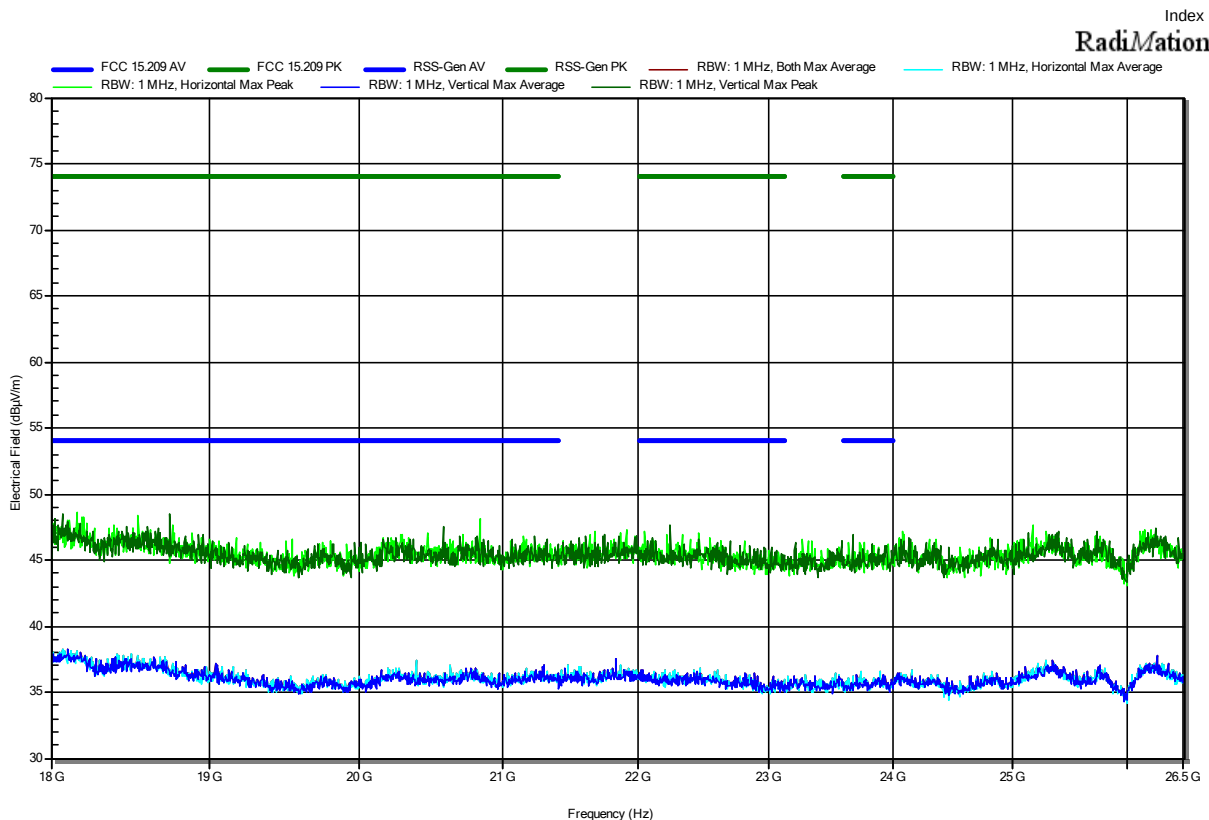
Radiated Spurious Emissions according to 47 CFR Part 15.247

Project Number: G0M-2308-2203
 Applicant: STEINER-Optik GmbH
 Model Description: Bluetooth Dongle
 Model: BT Dongle für das M830r LRF
 Test Sample ID: 46934
 Test Site: Eurofins Product Service GmbH
 Operator: Ehsan Sohrabi
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.3 VDC
 Antenna: Schwarzbeck HWRD 650
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, PRBS9, 193 Bytes, 1 Mbit/s
 Test Date: 2023-12-19
 Note: --



Radiated Spurious Emissions according to 47 CFR Part 15.247

Project Number: G0M-2308-2203
 Applicant: STEINER-Optik GmbH
 Model Description: Bluetooth Dongle
 Model: BT Dongle für das M830r LRF
 Test Sample ID: 46934
 Test Site: Eurofins Product Service GmbH
 Operator: Ehsan Sohrabi
 Measurement software: RadiMation, version 2020.1.8
 Test Conditions: Tnom: 24 °Celsius, Vnom: 3.3 VDC
 Antenna: Amplifier Research AT4560
 Measurement distance: 3 m
 Mode: Tx; BT-LE, 2480 MHz, PRBS9, 193 Bytes, 1 Mbit/s
 Test Date: 2023-12-19
 Note: --



== = END OF TEST REPORT == =