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DEKRA

ACCREDITED
Test Lab
Cert 2764.01

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:
2280ERM.002A1

Partial Test report

USA FCC Part 15.247, 15.209,
CANADA RSS-247, RSS-Gen
Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz.
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

Identification of item tested	Wave
Trademark	AIRTHINGS AS
Model and /or type reference	2950
Other identification of the product	FCC ID:2APPT-2930 IC: 23900-2930
Features	2.4 GHz Wireless Bluetooth with 1Mb and 2Mb Short Range Device
Manufacturer	AIRTHINGS AS Wergelandsveien 7 Oslo Norway 0167
Test method requested, standard	USA FCC Part 15.247, 10-1-17 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209, 10-1-17 Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 4 (November 2014). Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v04 dated 05/04/2017.ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager Digitally signed by Domingo Galvez DN: cn=Domingo Galvez, o=DEKRA, ou=EMC-RF Lab Manager, email=domingo.galvez@dekra.com, c=US Date: 2018.11.07 13:47:21 -05'00'
Date of issue	2018-11-07
Report template No	FDT08_21

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Competences and guarantees

DEKRA Certification Inc. is a testing laboratory accredited by A2LA (The American Association for Laboratory Accreditation), to perform the tests indicated in the Certificate 2764.01

DEKRA Certification Inc. is a testing laboratory competent to carry out the tests described in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Certification Inc. has a calibration and maintenance program for its measurement equipment.

DEKRA Certification Inc. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

DEKRA Certification Inc. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Certification Inc.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Certification Inc.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Certification Inc. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification internal document PODT000.

Frequency (MHz)	U(k=2)	Units
30-180	3.82	dB
180-1000	2.61	dB
1000-18000	2.92	dB
18000-40000	2.15	dB

Data provided by the client

Short range device.

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
2280/01	Wave 2 CERT 1 Radiated Sample	2950	N/A	09/20/2018

1. Sample S/01 has undergone following test(s):

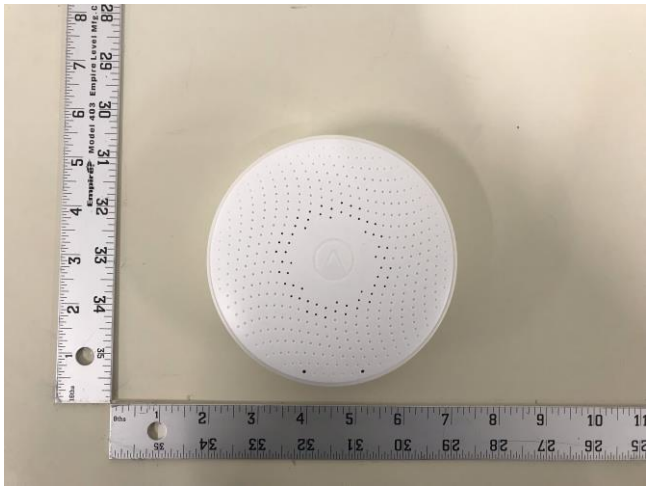
   All Radiated tests indicated in appendix A.

Test sample description

Ports…… :	Port name and description		Cable				
			Specified length [m]	Attached during test	Shielded		
	Mini USB Port		2m	☒	☐		
				☐	☐		
				☐	☐		
				☐	☐		
				☐	☐		
Supplementary information to the ports…… :	*Not provided data*						
Rated power supply .....:	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: Battery Operated 3V					
	☐	DC: 8-18 Vdc					
Rated Power .....:							
Clock frequencies .....:	*Not Provided*						
Other parameters.....:							
Software version .....:							
Hardware version.....:							
Dimensions in cm (L x W x D) ....:	*Not Provided*						

Mounting position.....:	☐	Table top equipment		
	☐	Wall/Ceiling mounted equipment		
	☐	Floor standing equipment		
	☐	Hand-held equipment		
	☒	Other:		
Modules/parts .....:	Module/parts of test item		Type	Manufacturer
Accessories (not part of the test item) .....:	Description		Type	Manufacturer
Documents as provided by the applicant.....:	Description		File name	Issue date
	Not provided data			

Copy of marking plate:



Identification of the client

Airthings AS

Wergelandsveien 7 Oslo Norway 0167

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	10-01-2018
Date (finish)	10-01-2018

Document history

Report number	Date	Description
2280ERM.002	10-26-2018	First release
2280ERM.002A1	11-07-2018	Modification to Model #

Modifications to the reference test report

It was introduced the following modifications in respect to the test report number 2280ERM.002 related with the same samples, in the next clauses and sub-clauses:

Clauses/ Sub-Clauses	Modification	Justification
Page 1/ Model #	Changed to 2950	Customer declaration

This modification test report cancels and replaces the test report 2280ERM.002

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 30 % Max. = 60 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Koji Nishimoto.

Testing verdicts

Not applicable :	N/A
Pass :	P
Fail :	F
Not measured :	N/M

Summary

FCC PART 15 PARAGRAPH / RSS-247 (Bluetooth Low Energy)					
Section	**15.247 Spec Clause**	**RSS Spec Clause**	**Test Description**	**Verdict**	**Remark**
A.1		RSS-Gen 6.7	99% Emission Bandwidth	N/M	Refer 2
A.2	§ 15.247 (a) (2)	RSS-247 5.2. (a)	Occupied Bandwidth	N/M	Refer 2
A.3	§ 15.247 (b) (3)	RSS-247 5.4. (d)	Maximum peak conducted output power and antenna gain	N/M	Refer 2
A.4	§ 15.247 (d)	RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	N/M	Refer 2
A.5	§ 15.247 (e)	RSS-247 5.2. (b)	Power spectral density	N/M	Refer 2
A.6	§ 15.247 (d)	RSS-Gen 8.9 & 8.10.	Emission limitations radiated (Transmitter)	P	N/A
A.7	§15.207 (a)	RSS Gen 8.8	Conducted Emission Limits	N/A	Refer 1

Supplementary information and remarks:

1. Testing is not applicable as the device does not transmit while charging.
2. Testing is not required by the customer.

List of equipment used during the test

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	LAST CALIBRATION	NEXT CALIBRATION
1179	Semi anechoic Absorber Lined Chamber Frankonia SAC 3 plus “L”	N/A	N/A
1065	BiconicalLog antenna ETS LINDGREN 3142E	2017/03	2020/03
1058	Double-ridge Waveguide Horn antenna 1-18 GHz	2017/03	2019/03
1012	Rohde & Schwarz ESR26 EMI Test Receiver	2018/07	2020/07
1014	Spectrum analyzer Rohde & Schwarz FSV40	2017/03	2019/03
1012	ROHDE & Schwarz ESR26 EMI Test Receiver	2018/07	2019/07
0980	RF pre-amplifier 30 MHz-6 GHz Bonn Elektronik BLMA 0360-01N	2017/05	2019/05
0981	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-2A	2017/05	2019/05
1015, 1017, 1019, 1020	Rohde & Schwarz EMC32 software	N/A	N/A

Appendix A: Test results

Appendix A Content

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PRODUCT INFORMATION

The following information is provided by the client

Information	**Description**
Modulation	Other than FHSS
Adaptive	Non-Adaptive Equipment
Operation mode 1: Single Antenna Equipment	Equipment with only one antenna
- Operating Frequency Range	905 - 926 MHz
- Nominal Channel Bandwidth	1 MHz
Extreme operating conditions	
- Temperature range	4 ºC to +40 ºC
Antenna type	Integral antenna
Antenna gain	+5 dBi
Nominal Voltage	
- Supply Voltage	3 Vdc
- Type of power source	DC voltage from battery
Equipment type	Short range device
Geo-location capability	No

Test modes available:

- Continuous modulated carrier at 905 MHz, 915 MHz and 926 MHz

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01	Power supply (V): Battery Operated : 3V Type of power suppl: DC voltage from internal rechargeable battery. Temperature (ºC): T_{nom} = +15 to + 35 T_{min} = 4 (*) T_{max} = +40 (*) The subscript nom indicates normal test conditions. The subscripts min and max indicates extreme test conditions (minimum and maximum respectively). N/A: Not Applicable. (*) Declared by applicant. Channel Bandwidth = 1MHz Test Frequencies for Radiated tests: Lowest channel: 905 MHz Middle channel: 915 MHz Highest channel: 926 MHz

TEST A.1: EMISSION LIMITATIONS RADIATED (TRANSMITTER)

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(d) and RSS-Gen 8.9 and 8.10

LIMITS

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c) / RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RSS-247. Attenuation below the general field strength limits specified in RSS-Gen is not required

TEST SETUP

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30-1000 MHz (Bilog antenna) and at a distance of 1m for the frequency range 1-40 GHz (1 GHz-18 GHz and 18 GHz-40 GHz Double ridge horn antennas).

For radiated emissions in the range 1-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

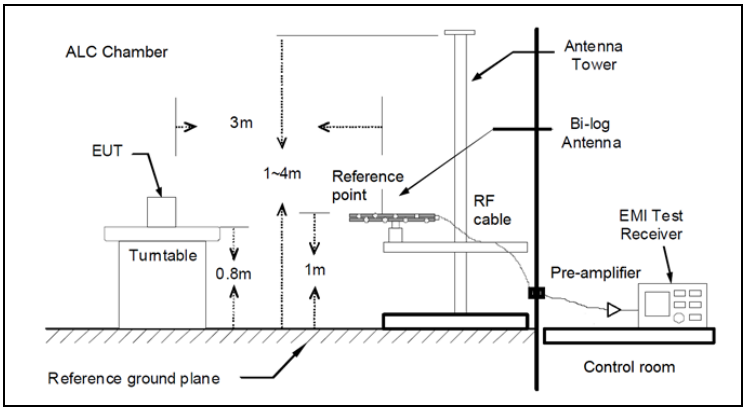
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

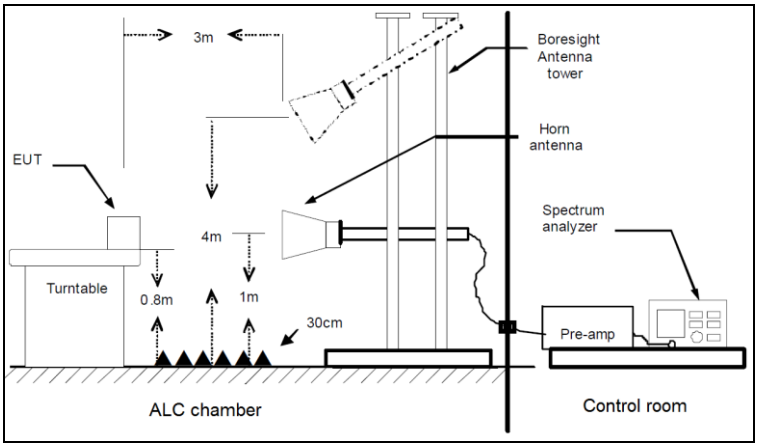
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)	

Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1 GHz



TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS :	PASS

Frequency range 30 MHz – 1000 MHz

The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

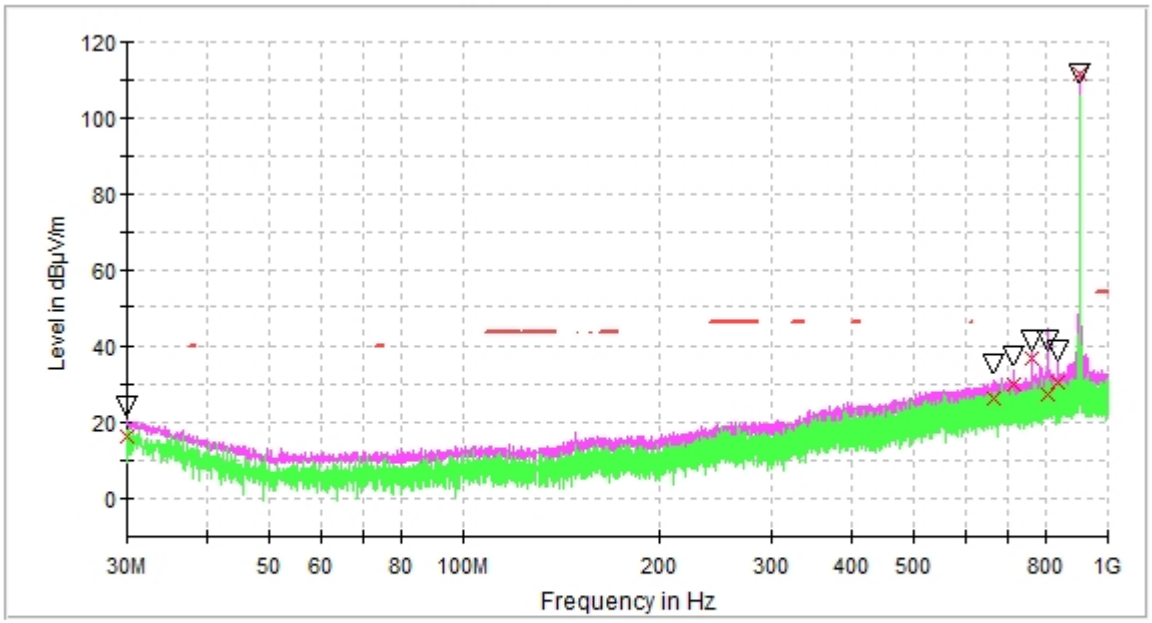
The radiated spurious signals detected at less than 20 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables of each frequency range.

Frequency range 1 GHz – 18 GHz

The spurious emissions above 1 GHz do not depend on the operating channel selected in the EUT.
The radiated spurious signals detected at less than 20 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables of each frequency range.

TEST RESULTS (Cont.):	30-1000 MHz (Lowest Channel)

30MHz_1GHz_HP & VP_CH Low



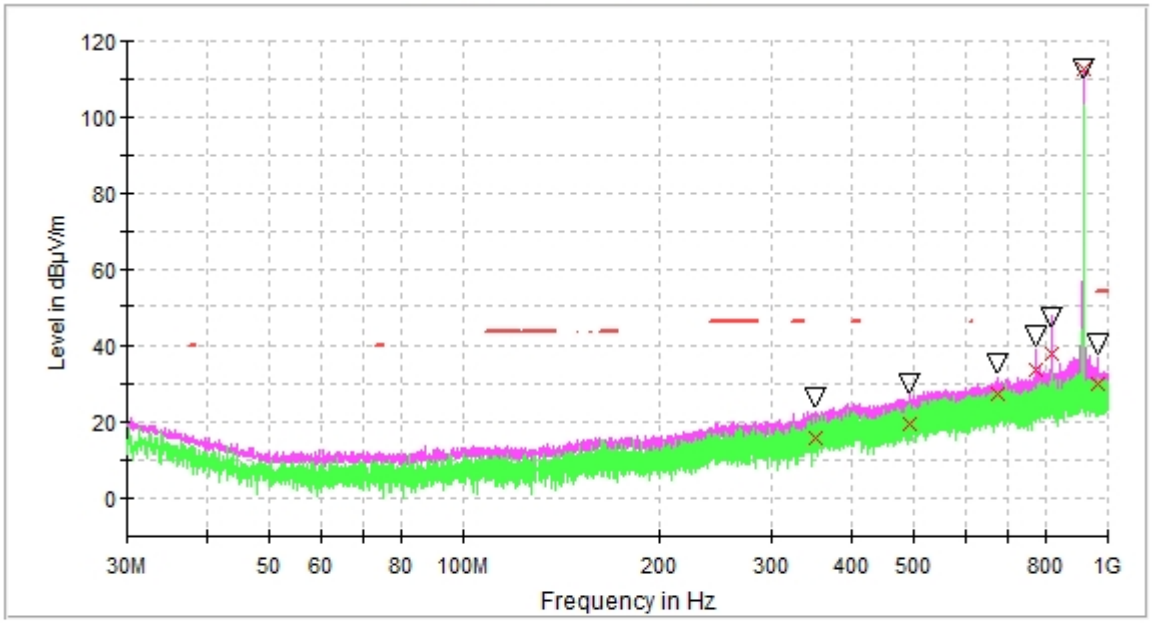
PK+_MAXH
PK+_CLRWR
TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit
MaxPeak-PK+ (Single)
QuasiPeak-QPK (Single)

Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)	Comment
30.000000	24.58	16.46	V	7.0	
664.962000	35.58	26.62	H	52.0	
713.025500	37.55	29.96	H	71.0	
763.611000	41.17	36.78	H	-114.0	
809.152500	41.48	27.76	H	71.0	
833.063000	38.38	30.62	H	-114.0	
905.037000	111.70	111.62	H	-122.0	Fundamental

TEST RESULTS (Cont.):	30-1000 MHz (Middle Channel)

30MHz_1GHz_HP & VP_CH Mid



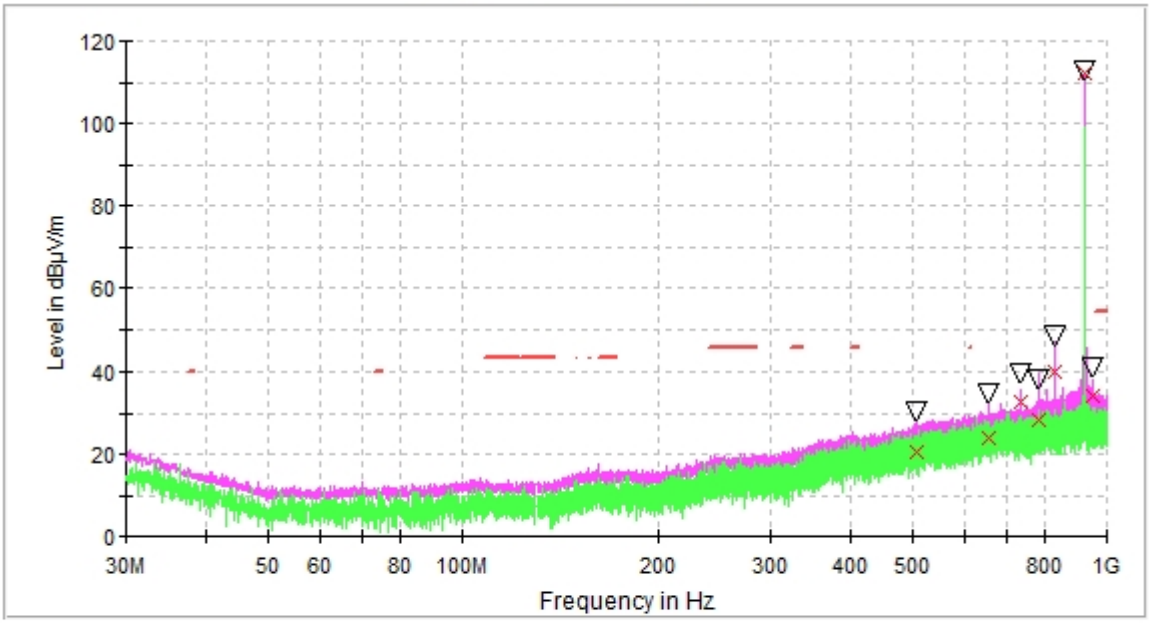
PK+_MAXH
PK+_CLRWR
TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit
MaxPeak-PK+ (Single)
QuasiPeak-QPK (Single)

Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)	Comment
350.051500	26.24	15.76	H	180.0	
491.623000	30.10	19.54	H	-131.0	
675.050000	35.66	27.67	H	-93.0	
771.031500	42.23	33.65	H	56.0	
819.046500	46.87	38.21	H	-131.0	
915.028000	112.58	112.51	H	88.0	Fundamental
963.043000	40.30	30.41	H	45.0	

TEST RESULTS (Cont.):	30-1000 MHz (Highest Channel)

30MHz_1GHz_HP & VP_CH High



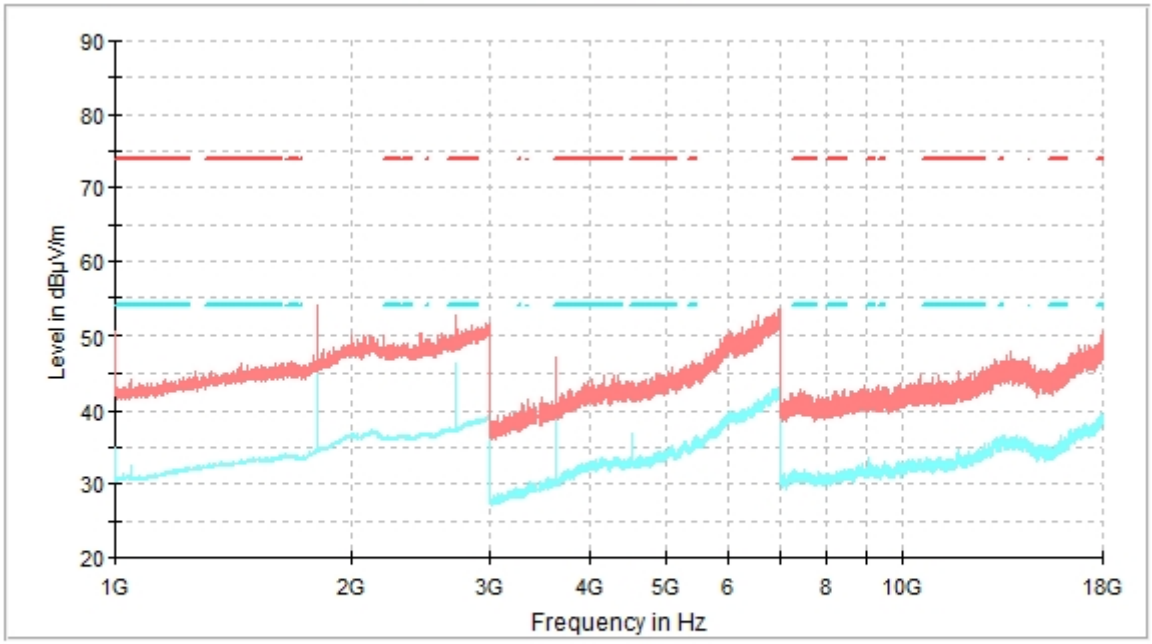
PK+_MAXH
PK+_CLRWR
TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit
MaxPeak@RE0103_LR_30-1000MHz
QuasiPeak@RE0103_LR_30-1000MHz

Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)	Comment
506.318500	30.4	20.5	V	180.0	
656.911000	34.6	24.1	H	-127.0	
734.026000	39.7	32.5	H	-118.0	
782.089500	38.1	28.1	H	-18.0	
830.007500	48.1	40.2	H	-134.0	
926.037500	112.5	112.4	H	-97.0	Fundamental
950.045000	41.1	34.2	H	-89.0	

TEST RESULTS (Cont.):	1-18 GHz (Lowest Channel)

1GHz_18GHz_ HP & VP_CH Low



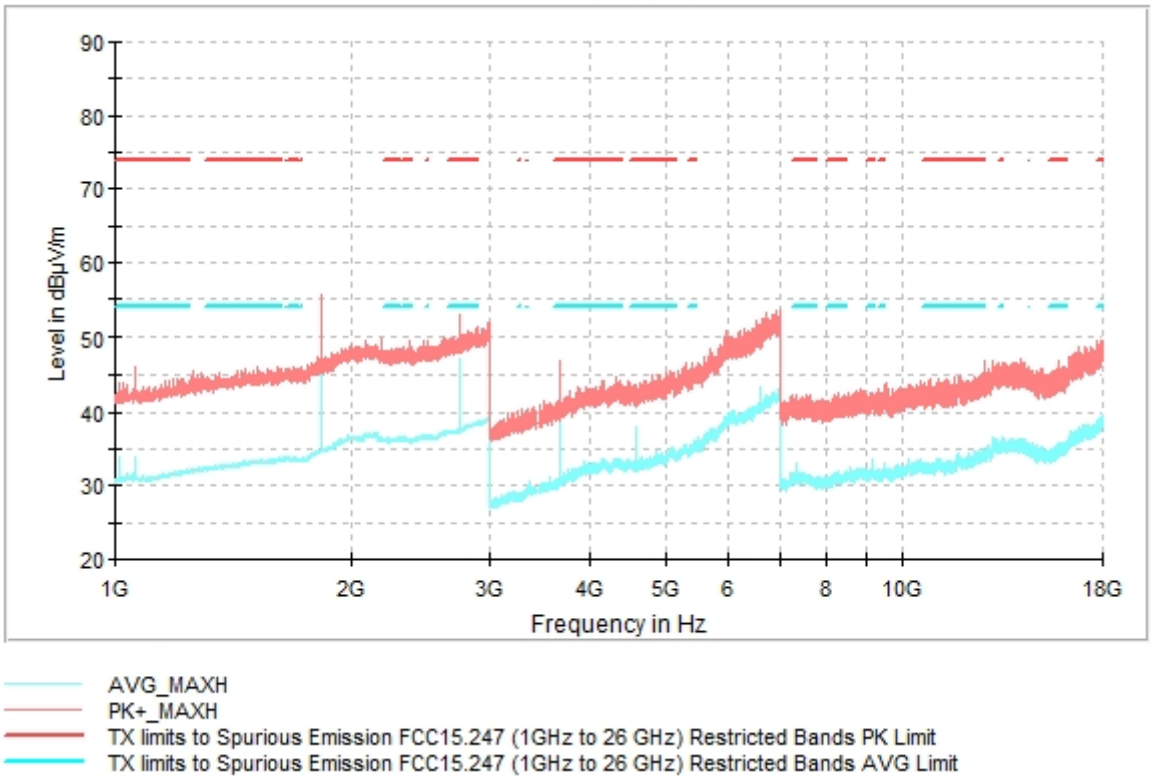
AVG_MAXH
PK+_MAXH
TX limits to Spurious Emission FCC15.247 (1GHz to 26 GHz) Restricted Bands PK Limit
TX limits to Spurious Emission FCC15.247 (1GHz to 26 GHz) Restricted Bands AVG Limit

Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)
1810.000000	54.08	51.23	H	-117.0
2715.000000	52.61	46.36	H	-52.0
3620.000000	47.12	44.51	V	27.0
4525.000000	43.90	36.97	V	-158.0
9050.000000	41.22	33.67	V	79.0

TEST RESULTS (Cont.):	1-18 GHz (Middle Channel)

1GHz_18GHz_HP & VP_CH Mid

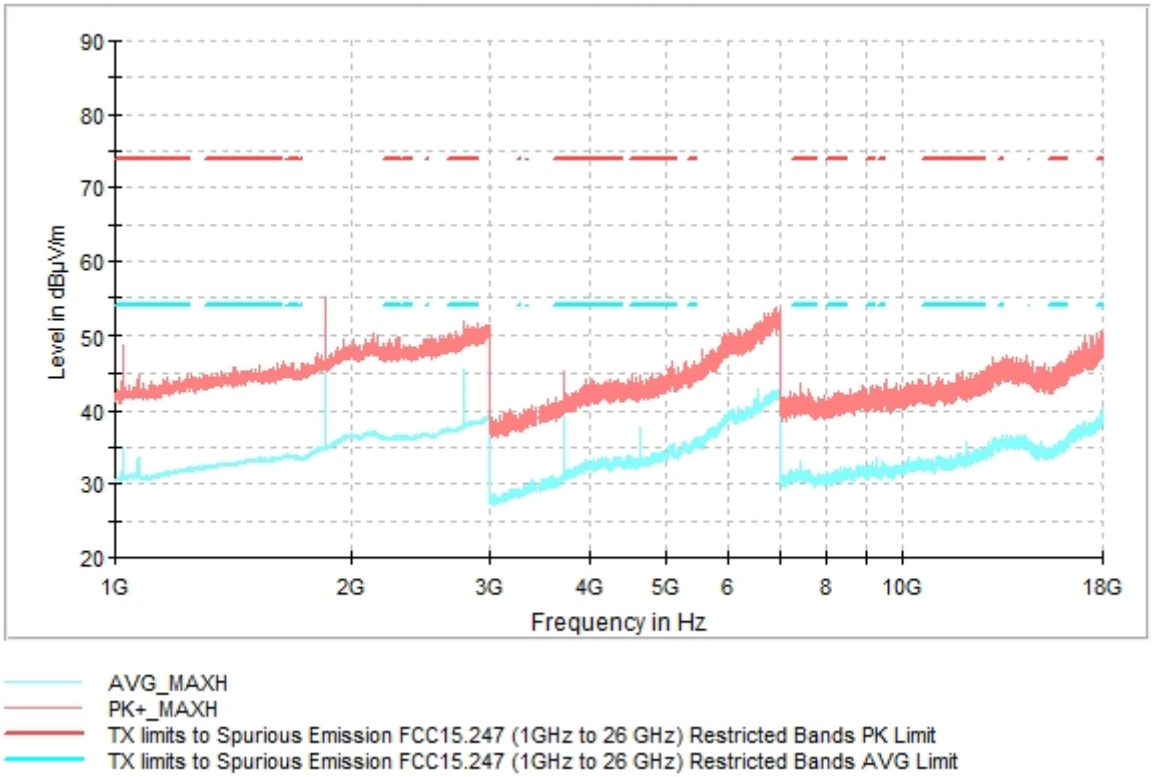


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)
1830.000000	55.69	53.47	H	-54.0
2745.000000	53.00	47.21	V	173.0
3660.000000	46.86	43.18	V	140.0
4575.000000	43.53	38.08	H	180.0
6581.500000	51.03	43.37	H	180.0
7320.000000	41.20	32.96	V	-179.0
9150.000000	42.48	33.69	V	-179.0

TEST RESULTS (Cont.):	1-18 GHz (Highest Channel)

1GHz_18GHz_HP & VP_CH High



Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)
1852.000000	55.19	52.00	H	-75.0
2778.000000	51.83	45.63	V	-77.0
3704.000000	45.20	39.86	V	8.0
4630.000000	44.88	37.59	V	-179.0
6560.000000	50.93	42.78	H	180.0
12038.000000	43.25	35.68	V	-179.0