



FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No: 2280ERM.001A1

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
Date of issue	11-07-2018
Report template No	FDT08_21

Report No: 2280ERM.001A1 11-07-2018



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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
0,009 - 30	2.69	dB
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

2.4GHz Wireless Bluetooth with 1Mb and 2 Mb.

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

DEKRA Certification, Inc. 405 Glenn Dr. Suite 12, Sterling, VA 20164 United States of America



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 №	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:					Cable		
	Port name and description		Specified length [m]		Attached during test		Shielded
	Not p	rovided data					
Supplementary information to the ports:	Not p	rovided data					
Rated power supply:	Voltage and Frequency		Reference poles				
		, ,	L1	L2	L3	N	PE
		AC: 230Vac / 50Hz.					
		AC:					
		DC: 8-18 Vdc					
		DC: 3 (Battery)					
Rated Power:	Not provided data						
Clock frequencies:	Not provided data						
Other parameters:	Not provided data						



Software version:				
Hardware version:				
Dimensions in cm (L x W x D):	Not p	rovided data		
Mounting position:		Table top equipment		
		Wall/Ceiling mounted equipment		
		Floor standing equipment		
		Hand-held equipment		
	\square	Other:		
Modules/parts:	Modu	le/parts of test item	Туре	Manufacturer
Accessories (not part of the test item):		ription	Туре	Manufacturer
,	Not provided data			
Documents as provided by the applicant:	Description File name Issue date			
	Not p	rovided data		
		Copy of marking plate:		
Statement various 30 septembre 32 33 34 35 35 35 35 35 35 35 35 35 35 35 35 35	NO.	2 3 3 4 5 6 5 8 22 22 28 29 29 29 29 29 29 29 29 29 29 29 29 29		

Identification of the client

Airthings AS

Wergelandsveien 7 Oslo Norway 0167



Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	09-25-2018
Date (finish)	09-28-2018

Document history

Report number	Date	Description
2280ERM.001	10-26-2018	First release
2280ERM.001A1	11-07-2018	Modification the Model #

Modifications to the reference test report

It was introduced the following modifications in respect to the test report number 2280ERM.001 related with the same samples, in the next clauses and sub-clauses:

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

This modification test report cancels and replaces the test report 2280ERM.001



Environmental Conditions

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

Temperature	Min. = 15 °C Max. = 35 °C
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 °C Max. = 35 °C
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 °C Max. = 35 °C
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 and Nasir Khan.

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH / RSS-247 (Bluetooth Low Energy)						
Section	15.247 Spec Clause	RSS Spec Clause	ec Clause Test Description		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)	Р	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
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

Description
Other than FHSS
Non-Adaptive Equipment
Equipment with only one antenna
2402 – 2480 MHz
1 MHz & 2 MHz
4 °C to +40 °C
Integral antenna
+5 dBi
3 Vdc
DC voltage from battery
Bluetooth Low Energy
No

Test modes available:

- Continuous modulated carrier at 2402 MHz, 2440 MHz and 2480 MHz



DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
	Power supply (V):
	V _{nominal} = 3 Vdc
	Type of power suppl:
	DC voltage from internal rechargeable battery.
	Temperature ($^{\circ}$ C): $T_{nom} = +15 \text{ to } +35$ $T_{min} = 4 (^{*})$ $T_{max} = +40 (^{*})$
TC#01	The subscript nom indicates normal test conditions.
(1 Mbps)	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 range: 2402 MHz Middle range: 2440 MHz Highest range: 2480 MHz
	Power supply (V):
	V _{nominal} = 3 Vdc
	Type of power suppl:
	DC voltage from internal rechargeable battery.
	Temperature (°C): $T_{nom} = +15 \text{ to } + 35$ $T_{min} = 4 (*)$ $T_{max} = +40 (*)$
TC#02	The subscript nom indicates normal test conditions.
(2 Mbps)	The subscripts min and max indicates extreme test conditions (minimum and maximum respectively).
	N/A: Not Applicable.
	(*)Declared by applicant.
	Channel Bandwidth = 2MHz
	Test Frequencies for Radiated tests: Lowest range: 2402 MHz Middle range: 2440 MHz Highest range: 2480 MHz



TEST A.1: EMISSION LIMITATIONS RADIATED (TRANSMITTER)				
LIMITO.	Product standard :	Part 15 Subpart C §15.247 and RSS-247		
LIMITS:	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 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

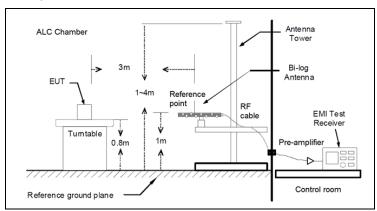
Measurements were made in both horizontal and vertical planes of polarization.

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.

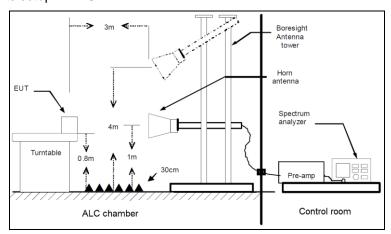


TEST SETUP (CONT.)

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

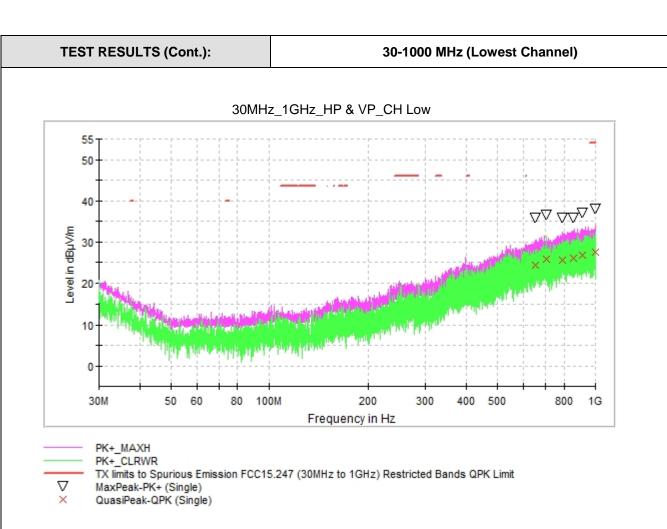
The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT. The radiated spurious signals detected at less than 20 dB respect to the limit for the lowest, middle and highest operating channels are showed in the tables of each frequency range.

Frequency range 1 GHz - 26 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.

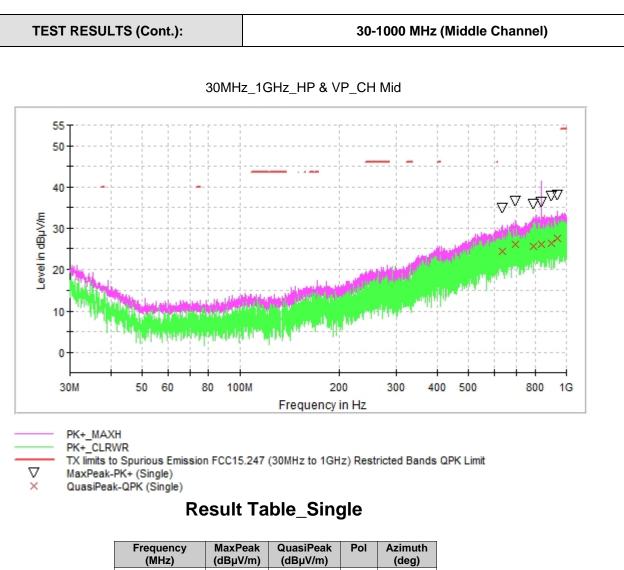




Result Table_Single

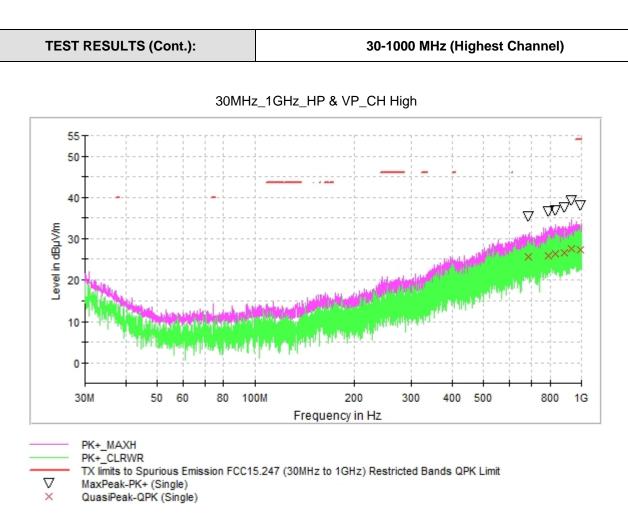
Frequency	MaxPeak	QuasiPeak	Pol	Azimuth
(MHz)	(dBµV/m)	(dBµV/m)		(deg)
652.934000	35.6	24.4	٧	-172.0
708.030000	36.6	25.7	٧	-179.0
789.704000	35.7	25.5	Н	45.0
855.421500	35.8	26.1	٧	149.0
911.390500	36.9	26.8	Н	180.0
997.914500	37.9	27.4	٧	-52.0





Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)
637.074500	34.8	24.3	Н	163.0
697.505500	36.6	25.9	Н	132.0
788.928000	35.7	25.6	Н	163.0
836.506500	36.1	26.1	Н	21.0
899.362500	37.6	26.2	Н	58.0
940.830000	37.8	27.4	٧	149.0

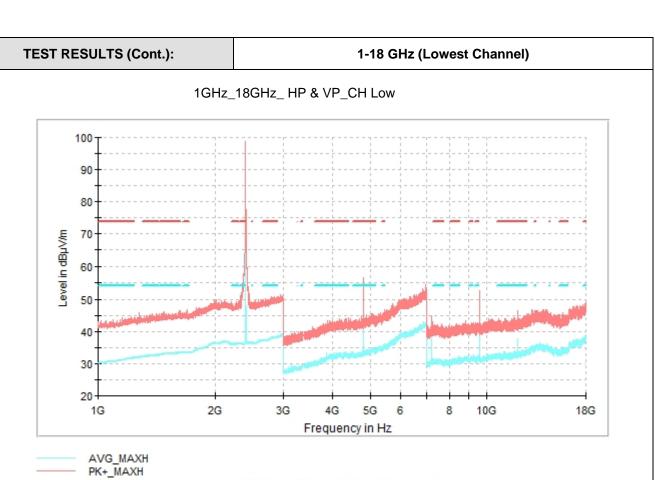




Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)
686.544500	35.2	25.6	Н	180.0
789.849500	36.6	25.6	Н	180.0
884.230500	37.5	26.4	Н	180.0
994.568000	38.0	27.3	Н	180.0
934.282500	39.1	27.3	٧	-82.0
831.365500	36.6	26.1	٧	180.0



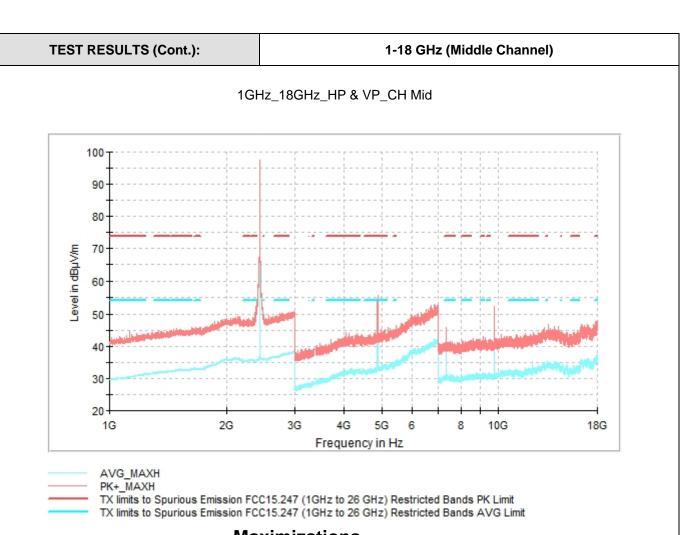


Maximizations

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

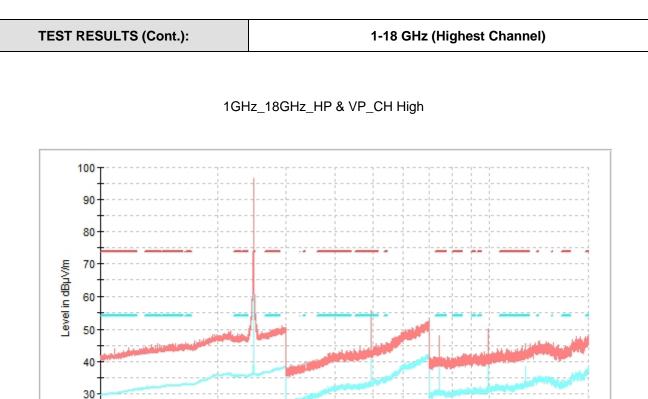
Frequency	PK+_MAXH	AVG_MAXH	Pol	Azimuth	Comment
(MHz)	(dBµV/m)	(dBµV/m)		(deg)	
2402.000000	98.66	89.57	Н	69.0	Fundamental
4803.000000	56.33	51.61	Н	-89.0	
7205.500000	43.08	39.00	Н	139.0	
9607.500000	52.08	48.95	٧	4.0	
12009.000000	46.51	36.76	٧	-179.0	





Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)	Comment
2440.500000	96.68	86.82	Н	4.0	Fundamental
4880.000000	54.33	51.59	Н	180.0	
7320.000000	45.68	40.18	٧	-34.0	
9759.000000	52.47	47.73	٧	-140.0	
12198.500000	41.96	35.14	٧	150.0	





AVG_MAXH PK+_MAXH

20 ∔ 1G

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

4G

Frequency in Hz

5G

8

10G

18G

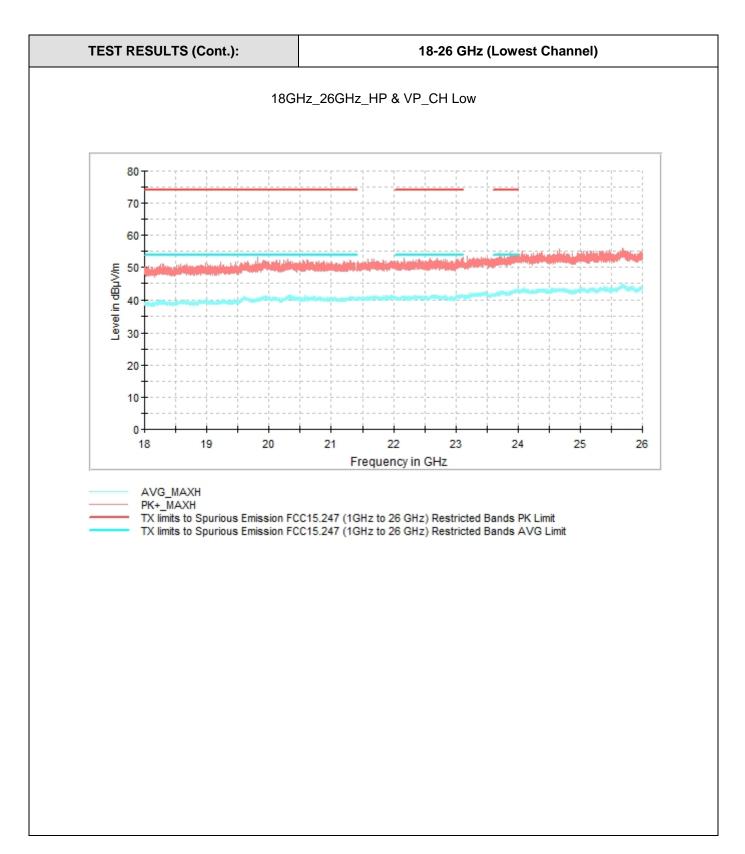
3G

Maximizations

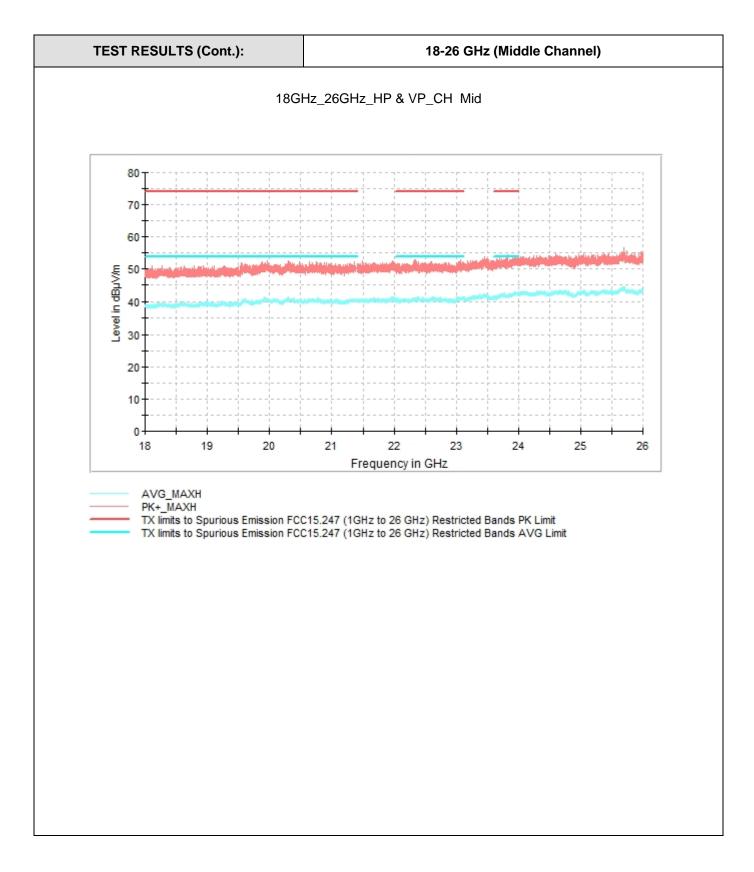
2G

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)	Comment
2480.000000	96.71	87.10	Н	-33.0	Fundamental
4960.000000	53.68	51.45	Н	180.0	
7440.000000	47.92	43.12	٧	-72.0	
9919.500000	49.84	45.28	٧	-92.0	
12399.500000	45.23	38.38	٧	-165.0	

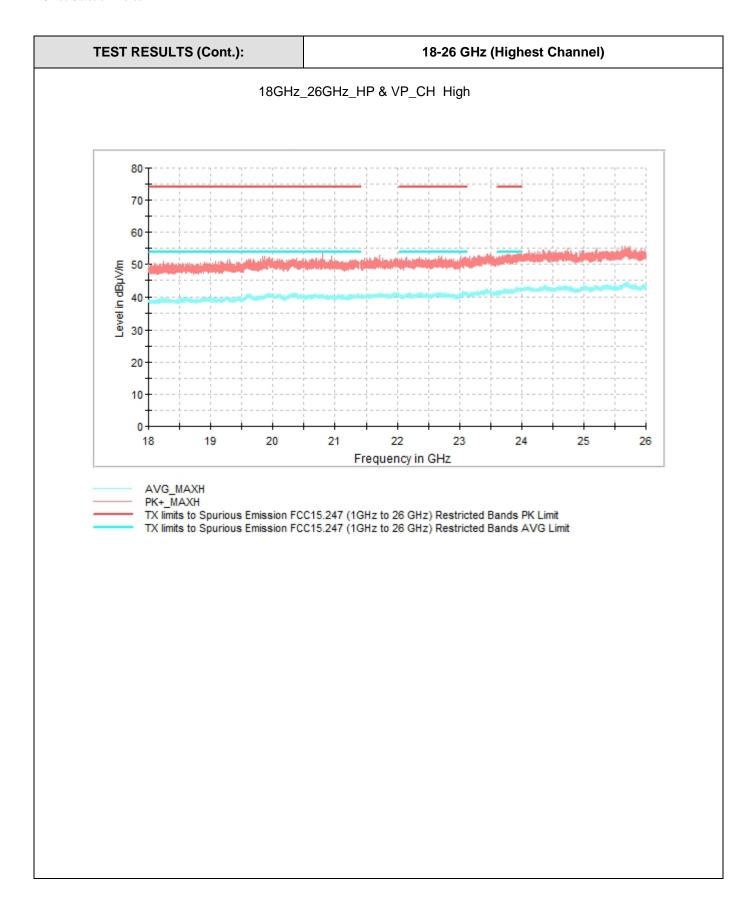




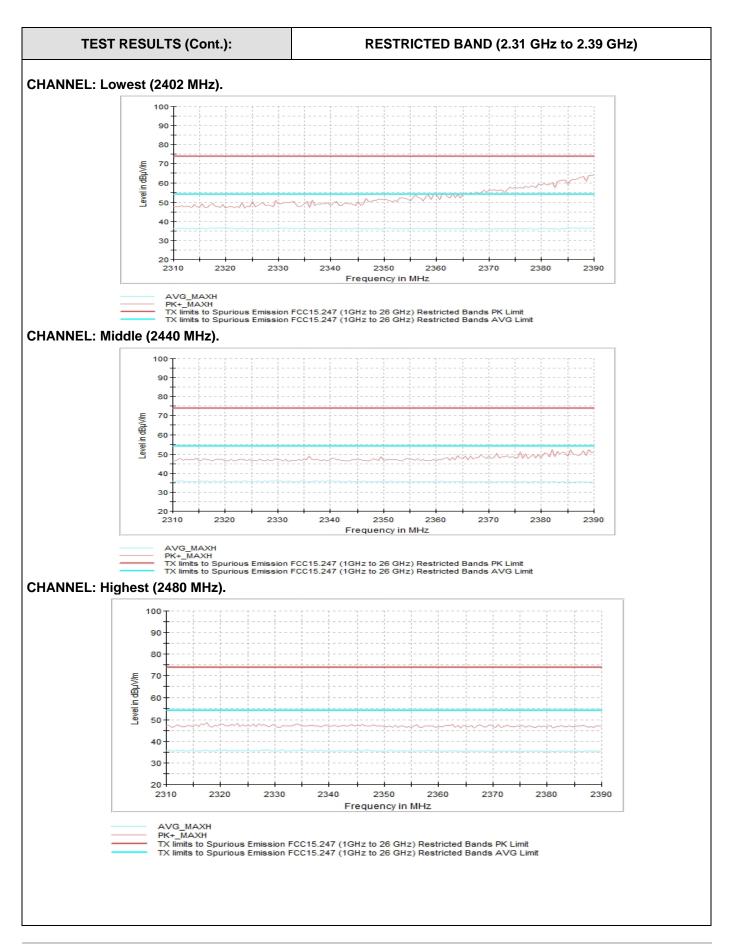




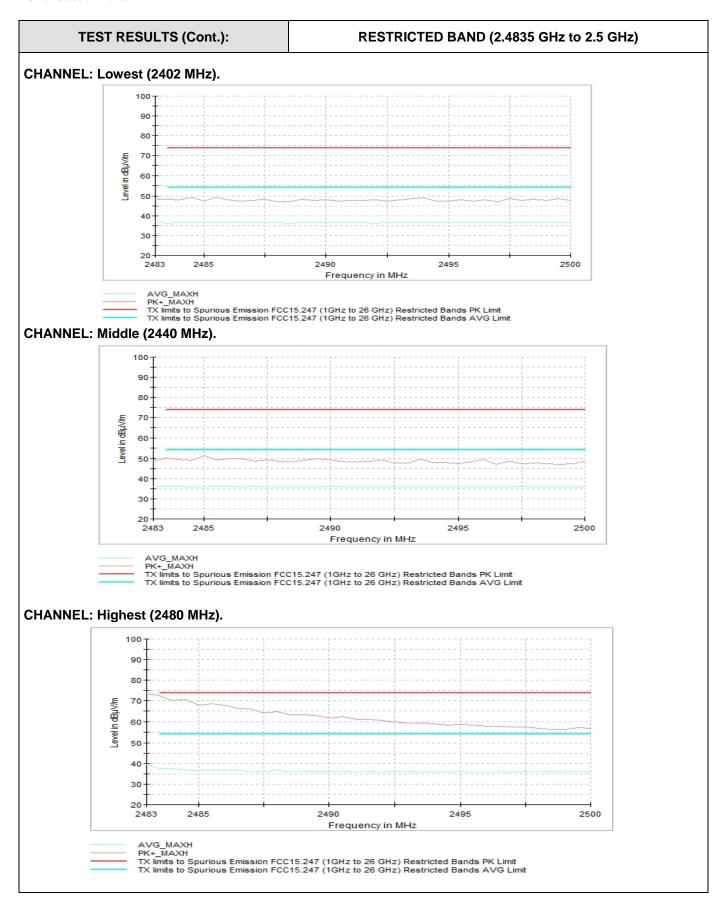










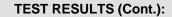


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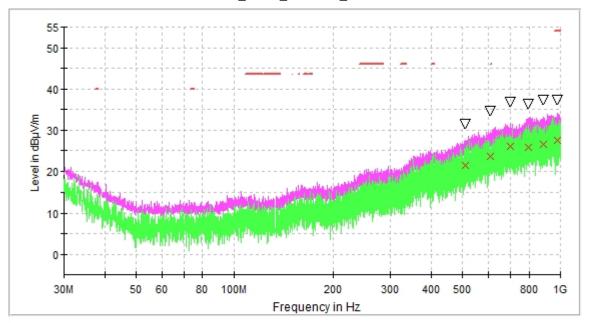
TEST RESULTS (Cont.):						
TESTED SAMPLES:	S/01					
TESTED CONDITIONS MODES:	TC#02					
TEST RESULTS :	PASS					
Frequency range 30 MHz – 1000 MHz						
The spurious emissions above 1 GHz do not	depend on the operating channel selected in the EUT. less than 20 dB respect to the limit for the lowest, middle and e tables of each frequency range.					
Frequency range 1 GHz – 26 GHz						
	depend on the operating channel selected in the EUT. less than 20 dB respect to the limit for the lowest, middle and e tables of each frequency range.					





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

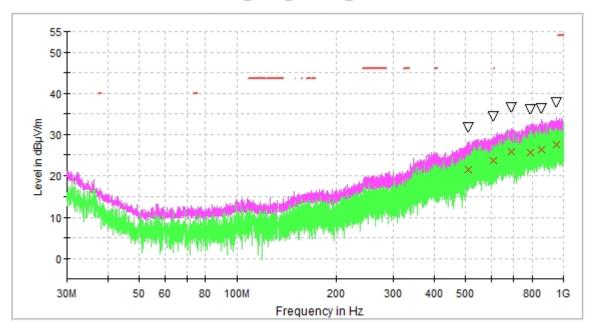
Frequency	MaxPeak	QuasiPeak	Pol	Azimuth
(MHz)	(dBµV/m)	(dBµV/m)		(deg)
795.330000	36.3	25.8	Н	-179.0
889.080500	37.3	26.4	Н	-146.0
509.083000	31.2	21.2	Н	180.0
699.494000	36.8	26.0	Н	180.0
609.575000	34.6	23.5	٧	-179.0
982.443000	37.1	27.3	٧	15.0



TEST RESULTS (Cont.):

30-1000 MHz (Middle Channel)

30MHz_1GHz_HP & VP_CH Mid



PK+_MAXH

 ∇

PK+_CLRWR

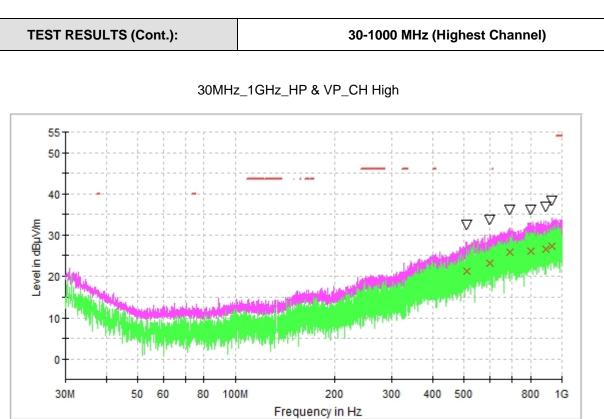
TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit MaxPeak-PK+ (Single)

QuasiPeak-QPK (Single)

Result Table_Single

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)
511.459500	31.6	21.3	Н	171.0
610.787500	34.3	23.6	٧	-179.0
789.364500	36.0	25.5	٧	-179.0
857.410000	36.3	26.1	٧	-179.0
953.537000	37.7	27.3	٧	-179.0
689.745500	36.4	25.7	٧	-91.0





Result Table_Single

TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit

PK+_MAXH PK+_CLRWR

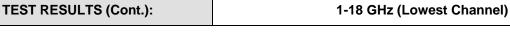
 ∇

MaxPeak-PK+ (Single)

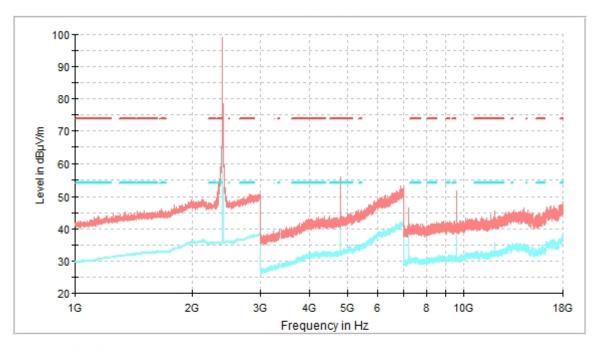
QuasiPeak-QPK (Single)

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Azimuth (deg)
694.110500	35.9	25.8	Н	159.0
801.538000	36.0	26.0	Н	180.0
598.371500	33.6	23.1	٧	-179.0
892.766500	36.8	26.4	٧	-179.0
929.626500	38.1	27.1	٧	-179.0
510.198500	32.3	21.2	٧	180.0





1GHz_18GHz_ HP & VP_CH Low



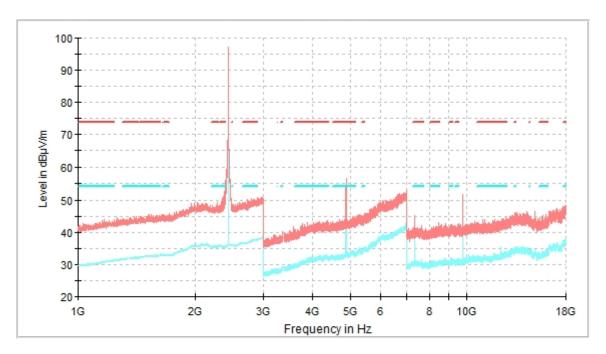
AVG_MAXH
PK+_MAXH

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

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)	Comment
2402.000000	99.03	85.61	Н	59.0	Fundamental
4803.000000	55.71	50.15	Н	-94.0	
7206.000000	46.51	41.19	Н	-131.0	
9607.500000	51.82	46.58	٧	-107.0	
12010.000000	45.44	35.56	Н	110.0	



TEST RESULTS (Cont.): 1-18 GHz (Middle Channel) 1GHz_18GHz_HP & VP_CH Mid



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

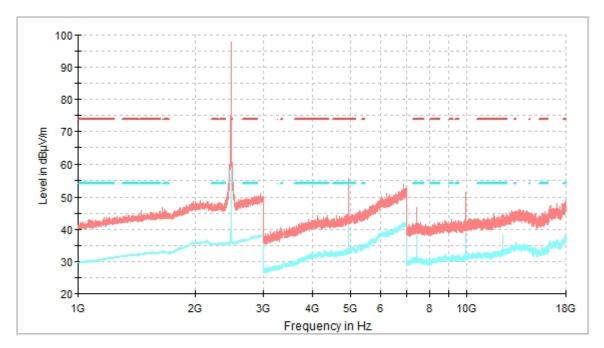
Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Azimuth (deg)	Comment
2439.500000	97.06	83.06	Н	-76.0	Fundamental
4880.000000	53.09	49.68	Н	143.0	
7320.000000	45.09	40.40	٧	-119.0	
9760.000000	51.70	48.74	٧	-136.0	
12200.000000	43.41	35.55	Н	-16.0	





1-18 GHz (Highest Channel)

1GHz_18GHz_HP & VP_CH High



AVG_MAXH
PK+_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

Frequency	PK+_MAXH	AVG_MAXH	Pol	Azimuth	Comment
(MHz)	(dBµV/m)	(dBµV/m)		(deg)	
2480.000000	97.80	84.06	Н	-21.0	Fundamental
4960.000000	52.68	49.11	Н	180.0	
7438.500000	46.75	40.32	٧	-51.0	
9920.500000	49.65	44.27	٧	46.0	
12400.000000	45.03	38.19	٧	133.0	



