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

FCC LISTED, REGISTRATION NUMBER: 2764.01

ISED LISTED REGISTRATION NUMBER: 23595-1

Test report No:
3704ERM.003A3

Test report

USA FCC Part 15.247, 15.209, 15.207
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 License-Exempt Local Area Network (LE-LAN) Devices.

(*) Identification of item tested	Whole home leak detection and water monitoring device
(*) Trademark	Water Dragon
(*) Model and /or type reference tested	ADC-SHM-100-A
Other identification of the product	FCC ID: YL6-143SHM100 IC: 9111A-143SHM100
(*) Features	Z-Wave Mesh, Z-Wave Long Range
Manufacturer	Alarm.com, Inc 8281 Greensboro Dr, Suite 100 Tyson, VA 22102, USA
Test method requested, standard	USA FCC Part 15.247, 10-1-20 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz USA FCC Part 15.209, 10-1-20 Edition: Radiated emission limits; general requirements CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (March 2019). 558074 D01 15.247 Meas. Guidance v05r02 (April 2019): Guidance for Compliance Measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under section §15.247 of the FCC Rules 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 Certification Inc., ou=Regulatory Lab, email=dgalvez@dekra.com, c=US
Date of issue	03-09-2023
Report template No	FDT08_23 (*) “Data provided by the client”

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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 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.

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.
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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 Certification internal document PODT000.

Test case	Frequency (MHz)	U (k=2)	Units
RF Power and PSD	900-925	0.88	dB
Occupied Bandwidth		1.87	%
Band Edge		0.64	dB
Radiated Spurious Emission	30-180	4.27	dB
	180-1000	3.14	dB
	1000-18000	3.30	dB
	18000-40000	3.49	dB

Data provided by the client

The Alarm.com Smart H2O Monitor is a non-intrusive water leakage detection device for residential and light commercial installation, giving property owners peace of mind. The Smart H2O Monitor supports whole home water leak detection and reporting to provide a comprehensive water solution. The primary use is for indoor-based water systems.

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 used for 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
3704/01	Conducted sample	-	146	05/04/2022

Following Accessories items were used with Sample S/01 to perform testing:

Control Nº	Description	Model	Serial Nº	Date of reception
3704/04	AC/DC Adapter	-	-	05/04/2022
3704/08	USB to TTL Serial cable (3.3V) - 1.8m	TTL-232R03V3	-	05/04/2022

1. Sample S/01 was used for following test(s)

   All Conducted tests indicated in appendix A.

Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
3704/02	Radiated sample	-	146	05/04/2022

Following Accessories items were used with Sample S/02 to perform testing:

Control Nº	Description	Model	Serial Nº	Date of reception
3704/04	AC/DC Adapter	-	-	05/04/2022
3704/07	USB to TTL Serial cable (3.3V) - 1.8m	TTL-232R03V3	-	05/04/2022

1. Sample S/02 was used for 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	Coupled to patient
	No Data Provided			☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
Supplementary information to the ports..... :	No Data Provided					
Rated power supply ..... :	Voltage and Frequency		Reference poles			
			L1	L2	L3	N	PE
	☐	AC:	☐	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐	☐
	☒	DC: 5Vdc					
	☐	DC:					
Rated Power..... :	5VDC						
Clock frequencies..... :	No Data Provided						
Other parameters ..... :	No Data Provided						
Software version ..... :	ZGM 0.24, MSP 0.20						
Hardware version ..... :	910-00060-001 Rev A						
Dimensions in cm (W x H x D) ... :	No Data Provided						
Mounting position ..... :	☐	*Table top equipment*					
	☐	*Wall/Ceiling mounted equipment*					
	☐	*Floor standing equipment*					
	☐	*Hand-held equipment*					
	☒	*Other: Water pipe*					
Modules/parts..... :	Module/parts of test item		Type		Manufacturer	
	Z-Wave 700 Series / ZGM130S037HGN2R		Module		Silicon Labs	

Accessories (not part of the test item) .....:	Description	Type	Manufacturer
	No Data Provided		
Documents as provided by the applicant.....:	Description	File name	Issue date
	FDT30_18 Declaration Equipment Data	FDT30_18 Declaration Equipment Data_AWACS.pdf	05/19/2022
Copy of marking plate:			
NO MARKING PLATE FOUND			

Identification of the client

Alarm.com, Inc
8281 Greensboro Dr, Suite 100
Tyson, VA 22102
USA

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	05-13-2022
Date (finish)	05-17-2022

Document history

Report number	Date	Description
3704ERM.003	5-31-2022	First release
3704ERM.003A1	11-18-2022	Second release. Model name changed from ADC-SHM-100-A to Water Dragon. This modification of test report cancels and replaces the test report 3704ERM.003.
3704ERM.003A2	01-06-2023	Third release. Descriptions about 18-26 GHz test in Test setup removed at page 26 and Spectrum analyzer parameters used for A.6 added at page 32. This modification of test report cancels and replaces the test report 3704ERM.003A1.
3704ERM.003A3	03-09-2023	Fourth release. Trademark and Model and /or type reference tested were updated per customer request. This modification of test report cancels and replaces the test report 3704ERM.003A2.

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 semi anechoic 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: Sravani Gollamudi, Nasir Khan, Yuri Barone and Koji Nishimoto.

Testing verdicts

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

Summary

FCC PART 15 PARAGRAPH (Z-wave)					
Section	**FCC Spec Clause**	**RSS Spec Clause**	**Test Description**	**Verdict**	**Remark**
A.1	§ 2.1049	RSS-GEN 6.7	99% Occupied Bandwidth	P	N/A
A.2	§15.247 (a) (2)	RSS-247 5.2 (a)	6dB Bandwidth	P	N/A
A.3	§ 15.247 (b) (3)	RSS-247 5.4 (d)	Maximum Output Power and antenna gain	P	N/A
A.4	§ 15.247 (d)	RSS-247 5.5	Band-edge conducted emissions compliance (Transmitter)	P	N/A
A.5	§ 15.247 (e)	RSS-247 5.2 (b)	Power Spectral Density	P	N/A
-	§15.247 (d)	RSS-247 5.5	Emission limitations Conducted (Transmitter)	N/A	Refer 1
A.6	§15.247 (d)	RSS-247 5.5	Emission limitations Radiated (Transmitter)	P	N/A

Supplementary information and remarks:

1. DUT has integral antenna.

List of equipment used during the test

Conducted Measurements

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	LAST CALIBRATION	NEXT CALIBRATION
1038	TS8997 TEST SYSTEM	Rohde & Schwarz	TS8997	N/A	N/A
1107	ETHERNET SNMP THERMOMETER	HW GROUP	HWg-STE Plain	2020/08	2022/08
1313	WIRELESS MEASUREMENT SOFTWARE R&S WMS32	Rohde & Schwarz	N/A	N/A	N/A

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	MANUFACTURER	MODEL	LAST CALIBRATION	NEXT CALIBRATION
0981	RF pre-amplifier	Bonn Elektronik	BLMA0118-2A	2020/11	2022/11
1012	EMI TEST RECEIVER	Rohde & Schwarz	ESR 26	2022/04	2024/04
1014	Spectrum analyzer	Rohde & Schwarz	FSV40	2021/05	2023/05
1057	Double-ridge Waveguide Horn antenna 1-18 GHz	ETS LINDGREN	3115	2020/06	2023/06
1065	Biconical Log antenna	ETS LINDGREN	3142E	2020/08	2023/08
1111	ETHERNET SNMP THERMOMETER	HW GROUP	HWg-STE Plain	2020/08	2022/08
1179	Semi anechoic Absorber Lined Chamber	Frankonia	SAC 3 plus “L”	N/A	N/A
1314	WIRELESS MEASUREMENT SOFTWARE R&S EMC32	Rohde & Schwarz	N/A	N/A	N/A

Appendix A: Test results (Z-wave)

Appendix A Content

PRODUCT INFORMATION

The following information is provided by the client

Information	**Description**
Modulation	O-QPSK
Adaptive	Non-adaptive equipment
Operation mode	
- Operating Frequency Range	912/920 MHz
- Nominal Channel Bandwidth	1 MHz
- RF Output Power	14 dBm
Antenna type	PCB trace antenna
Antenna gain	+ 2.6 dBi (Peak)
Nominal Voltage	
- Supply Voltage	5 V DC
- Type of power source	AC/DC Adapter
Equipment type	Z-wave Long Range
Geo-location capability	No

DESCRIPTION OF TEST CONDITIONS

TEST CONDITIONS	DESCRIPTION
TC#01	Power supply (V): $V_{nominal}$ = 5 V dc Bandwidth: 1 MHz Test Frequencies for Conducted/ Radiated tests: Lowest channel: 912 MHz Highest channel: 920 MHz

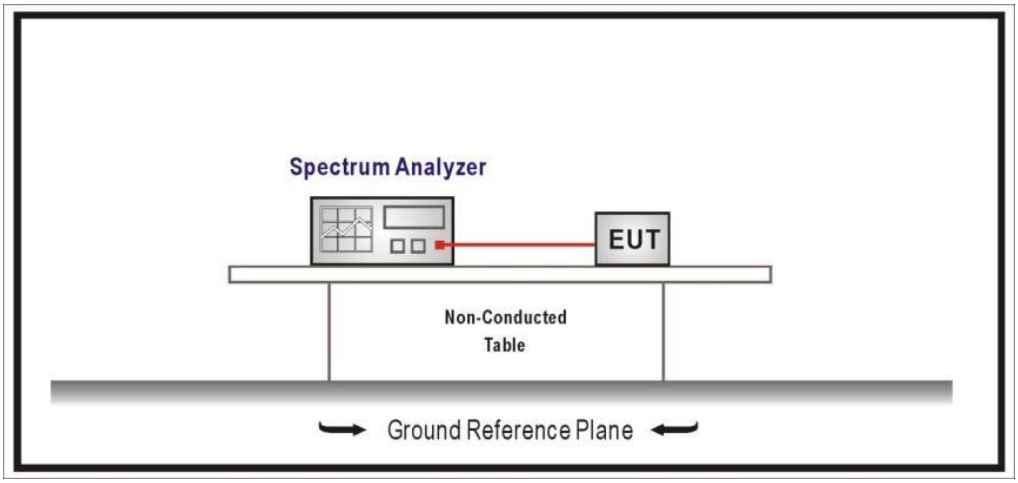
TEST A.1: 99% OCCUPIED BANDWIDTH

LIMITS:	Product standard:	§ 2.1049 and RSS-Gen
	Test standard:	§ 2.1049 and RSS-Gen 6.7

LIMITS

The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs

TEST SETUP	

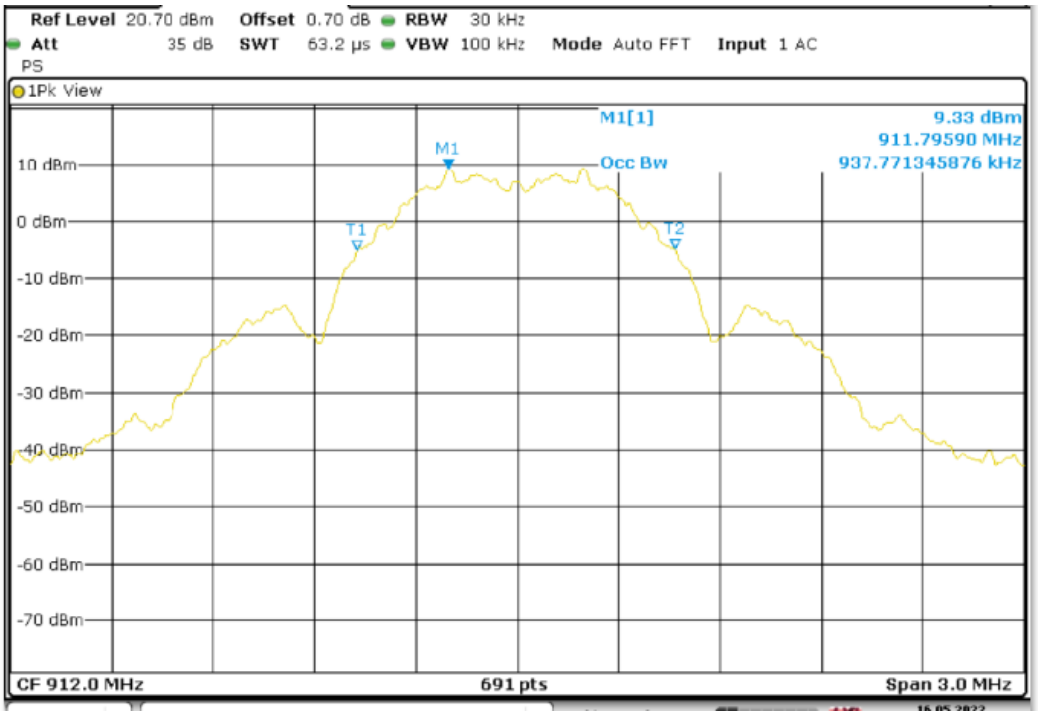


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS

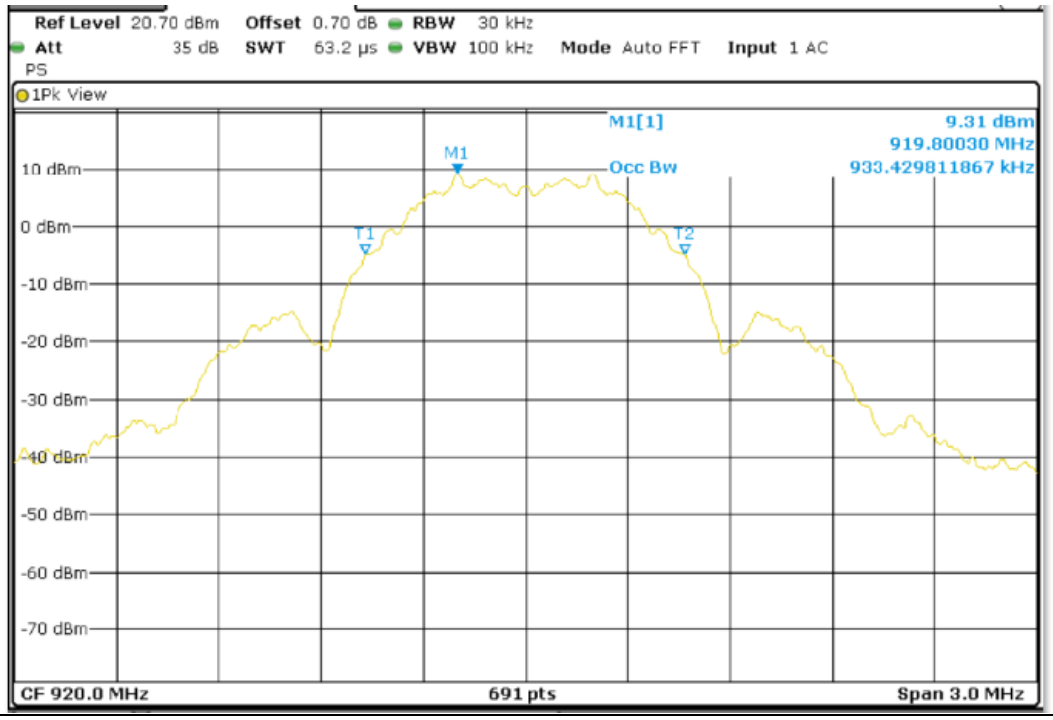
	Lowest frequency 912 MHz	Highest frequency 920 MHz
99% bandwidth (kHz)	937.77	933.43

TEST RESULTS (Cont.):	

Lowest Channel



Highest Channel



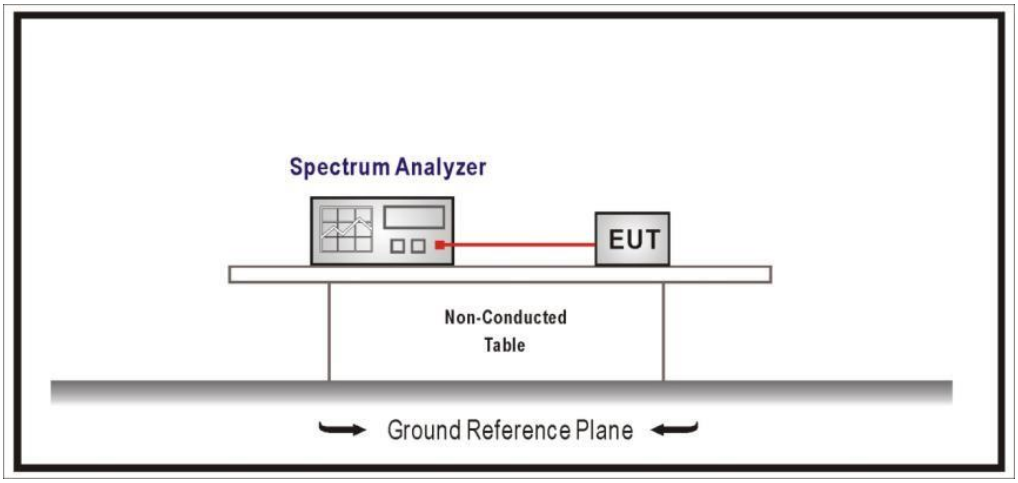
TEST A.2: 6DB BANDWIDTH

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(a)

LIMITS

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

TEST SETUP	

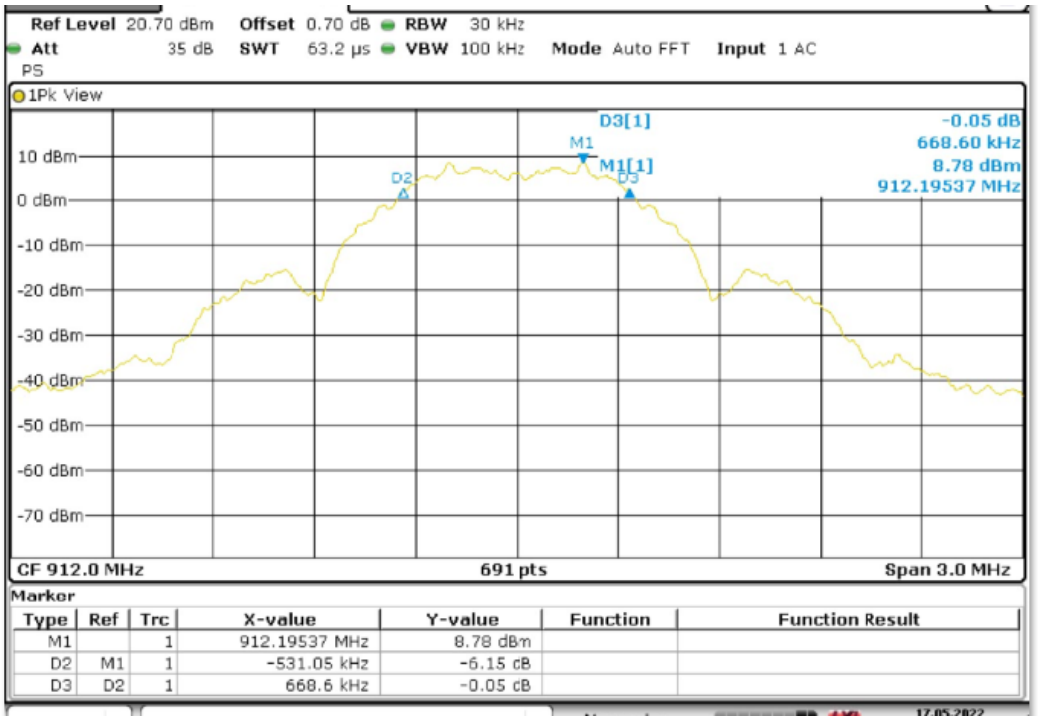


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS

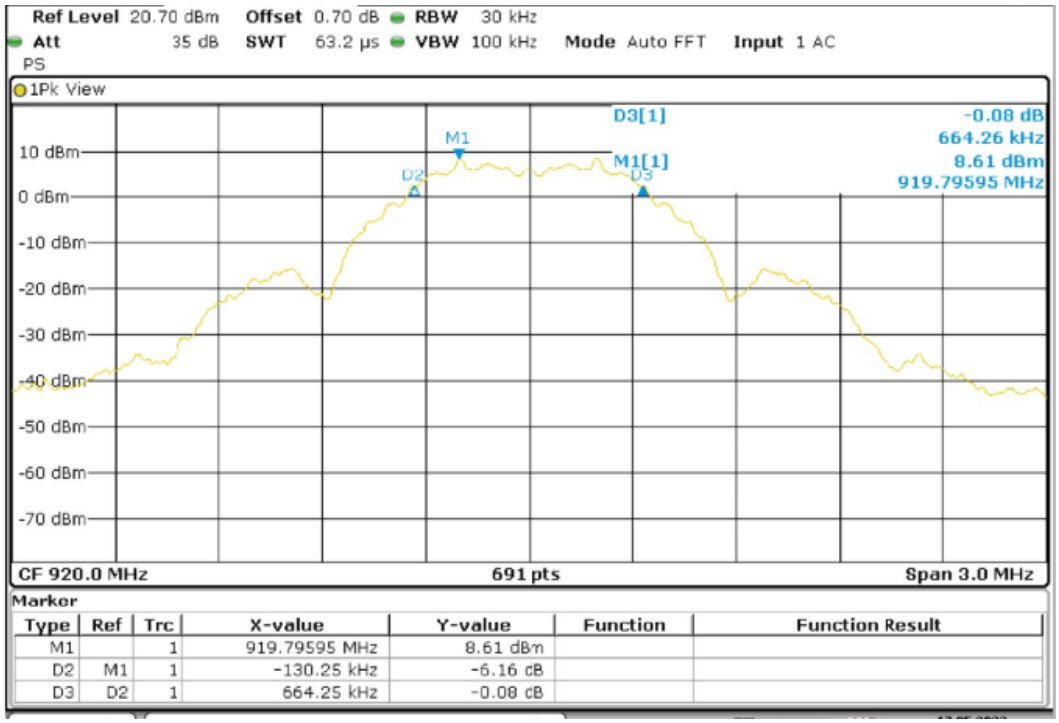
	Lowest frequency 912 MHz	Highest frequency 920 MHz
6 dB Spectrum bandwidth (kHz)	668.60	664.26

TEST RESULTS (Cont.):	

Lowest Channel:



High Channel:



TEST A.3: MAXIMUM PEAK CONDUCTED OUTPUT POWER AND ANTENNA GAIN

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(b)(3) and RSS-247 5.4(d)

LIMITS

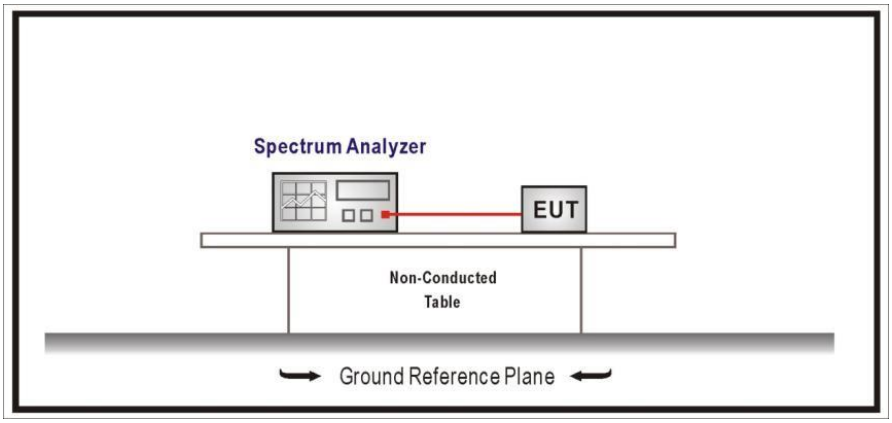
§15.247(b)(3) and RSS-247 5.4(d): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 watt (30 dBm).

RSS-247 5.4(d): The e.i.r.p. shall not exceed 4 W (36 dBm)

TEST SETUP	

The maximum peak conducted output power was measured using the method according to point 9.1.1. of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v04 dated 05/04/2017.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.



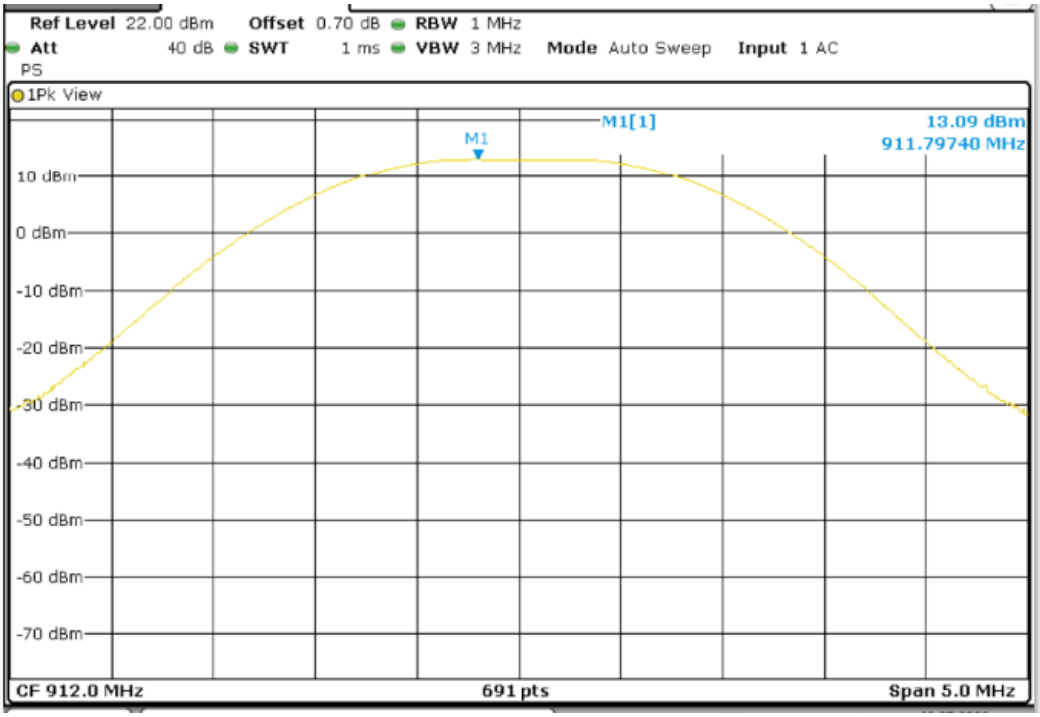
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS

Maximum declared antenna gain: +2.6 dBi

	Lowest frequency 912 MHz	Highest frequency 920 MHz
Maximum conducted power (dBm)	13.09	13.20
Maximum EIRP power (dBm)	15.69	15.80

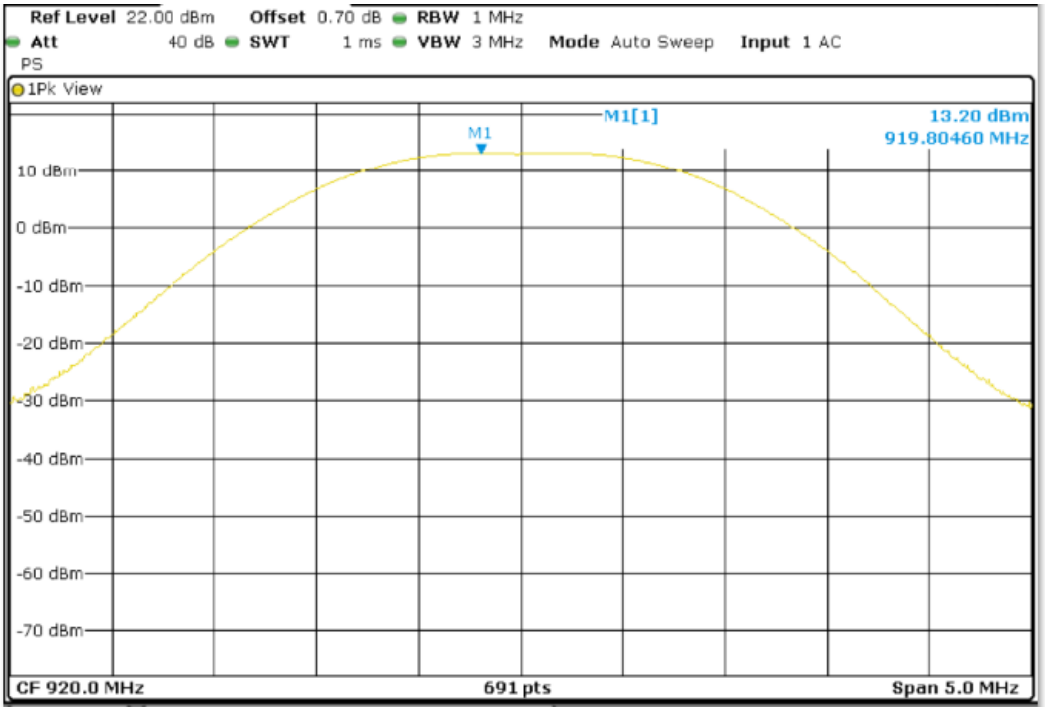
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power limit is not required to be reduced from the stated values.

Lowest Channel



TEST RESULTS (Cont.):	

Highest Channel



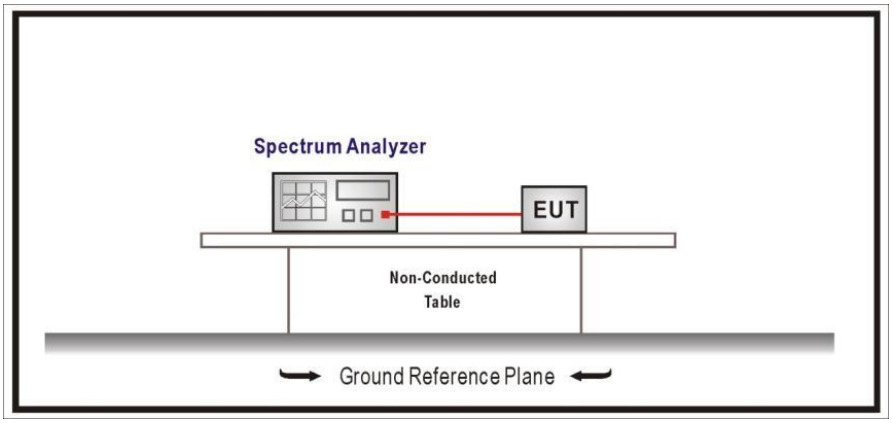
TEST A.4: BAND-EDGE EMISSIONS COMPLIANCE (TRANSMITTER)

LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(d) and RSS-247 5.5

LIMITS

In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

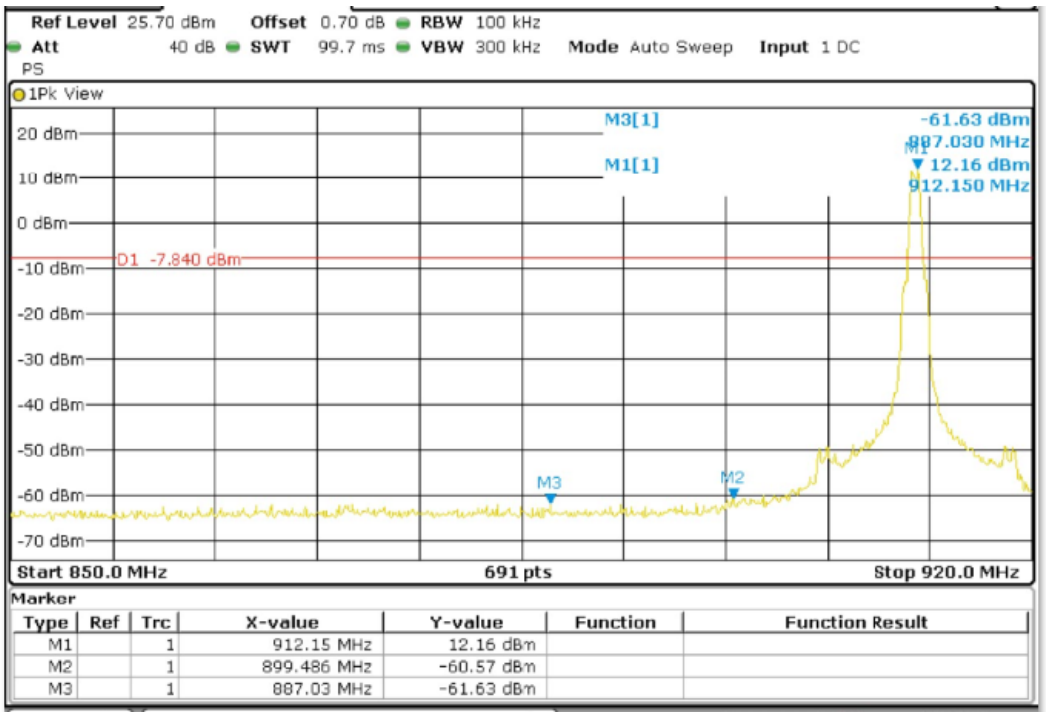
TEST SETUP	



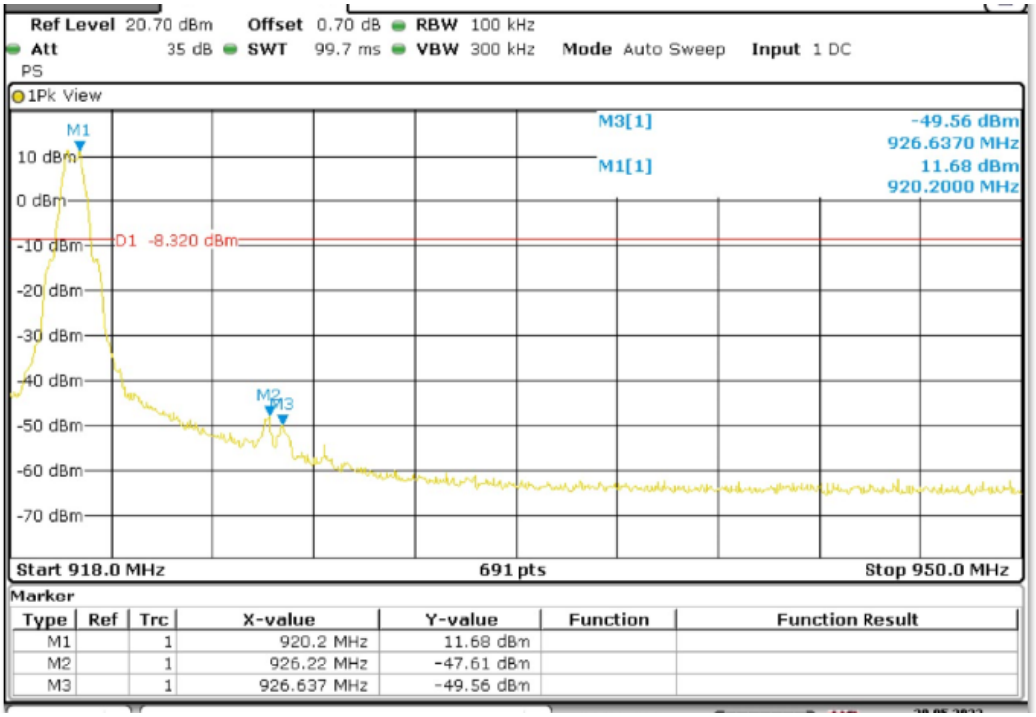
TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS

Note: Radiated measurements are also used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

TEST RESULTS (Cont.):	Lowest Channel



TEST RESULTS (Cont.):	Highest Channel



TEST A.5: POWER SPECTRAL DENSITY

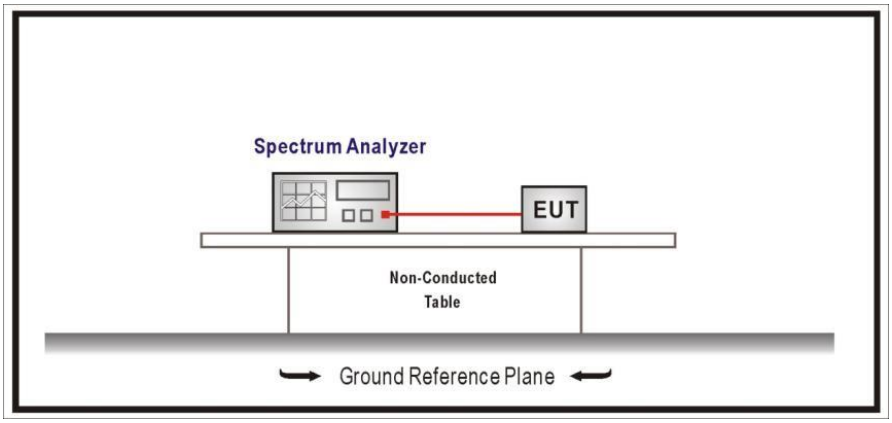
LIMITS:	Product standard:	Part 15 Subpart C §15.247 and RSS-247
	Test standard:	Part 15 Subpart C §15.247(e) and RSS-247 5.2 (b)

LIMITS

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST SETUP	

The maximum power spectral density level in the fundamental emission was measured using the method PKPSD (Peak PSD) according to point 10.2. of Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v05r02 (April 2019).

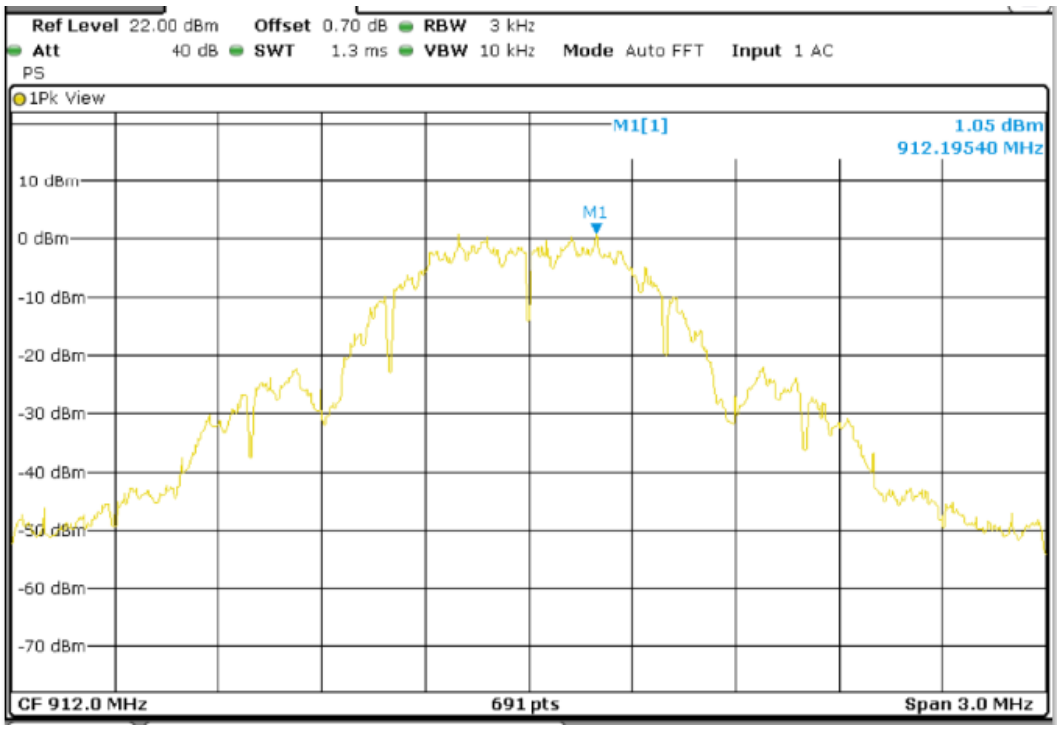


TESTED SAMPLES:	S/01
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS

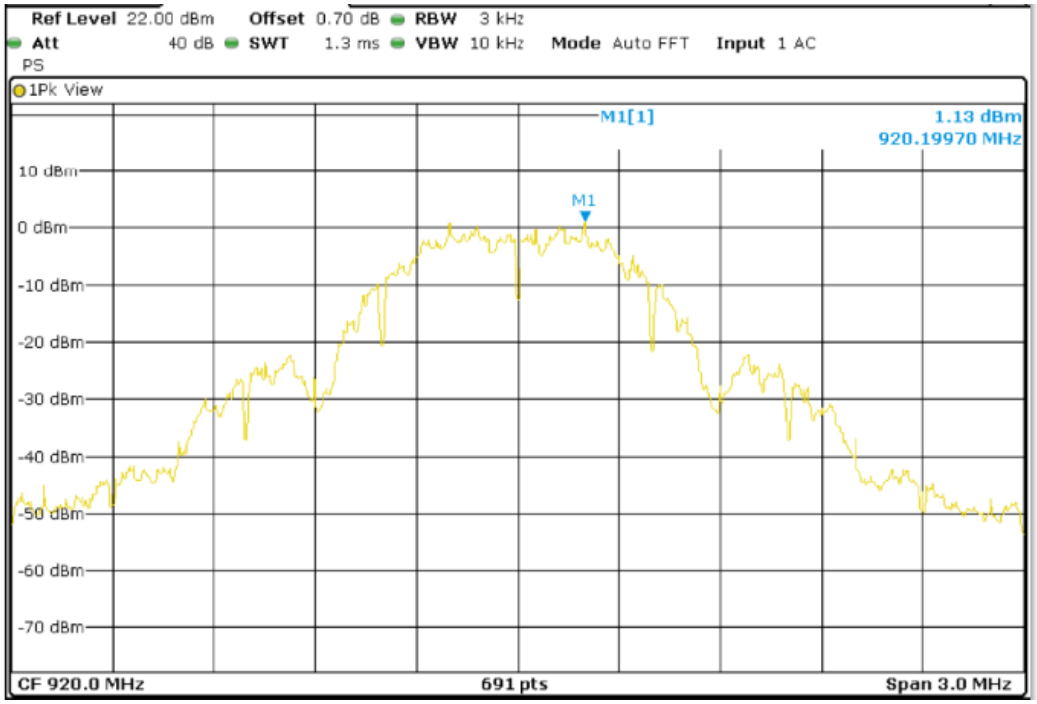
	Lowest frequency 912 MHz	Highest frequency 920 MHz
Power spectral density (dBm)	1.05	1.13

TEST RESULTS (Cont.):	

Lowest Channel:



High Channel:



TEST A.6: 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.

TEST SETUP

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

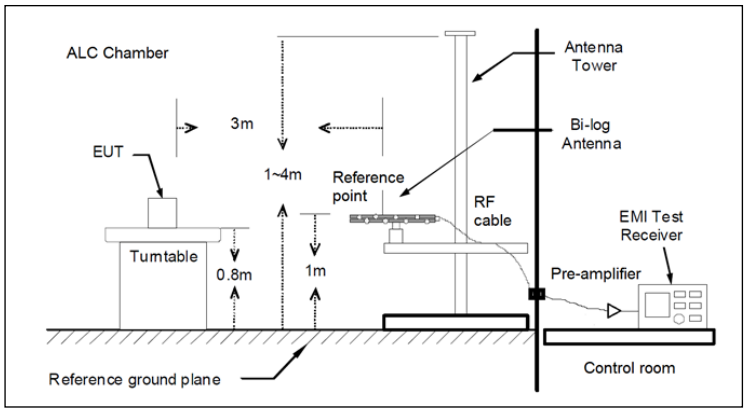
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

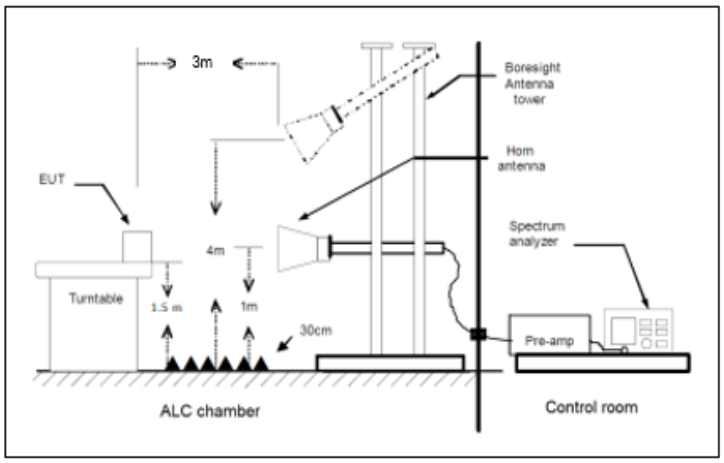
The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

TEST SETUP (CONT.)

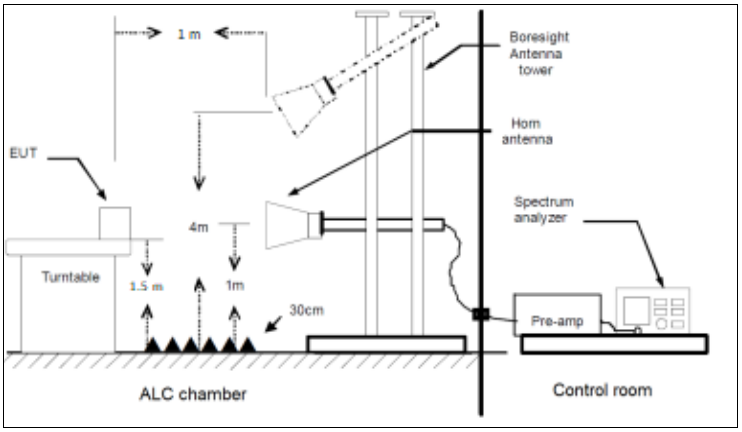
Radiated measurements Setup f < 1 GHz



Radiated measurements setup f > 1-18 GHz



Radiated measurements setup f > 18 GHz



TESTED SAMPLES:	S/02
TESTED CONDITIONS MODES:	TC#01
TEST RESULTS:	PASS

The preliminary test was performed in three different DUT orientations (X, Y and Z) to determine the worst case. The worst case results were shown in the following test results.

Frequency range 30 MHz – 1000 MHz

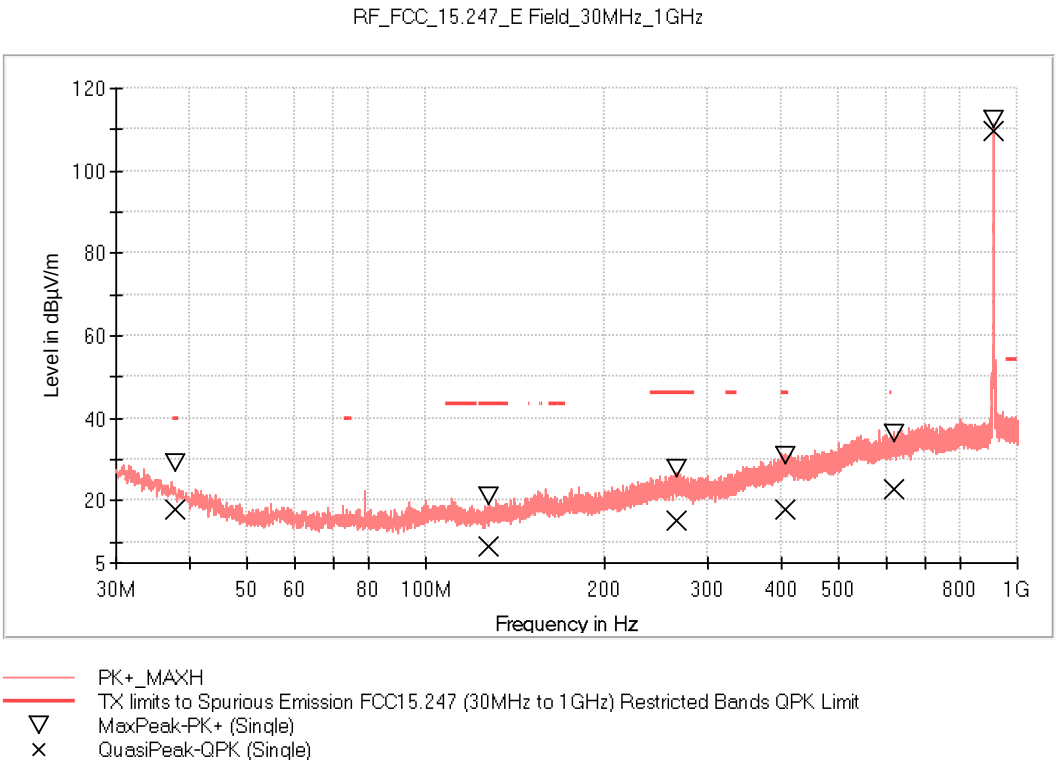
The spurious emissions below 1 GHz do not depend on the operating channel selected in the DUT.

Frequency range 1 GHz – 18 GHz

The results in the next tables show the maximum measured levels in the 1-18 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

TEST RESULTS (Cont.):	30-1000 MHz

Lowest Channel

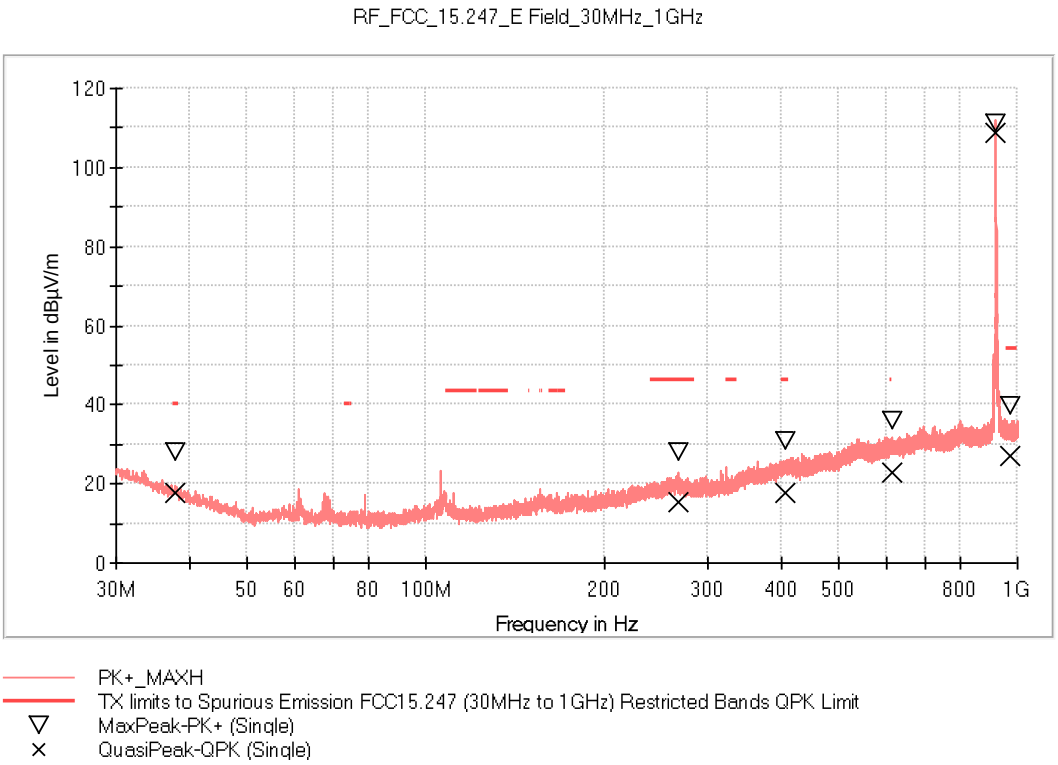


Maximizations

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)	Comment
37.808500	29.0	17.8	H	11.1	40.0	
127.824500	21.0	9.0	H	22.5	43.5	
266.049500	27.6	15.4	H	18.4	46.0	
405.099000	31.0	17.8	H	15.0	46.0	
620.293500	36.2	23.1	H	---	---	
911.827000	112.2	109.7	H	---	---	Fundamental

TEST RESULTS (Cont.):	30-1000 MHz

Highest Channel

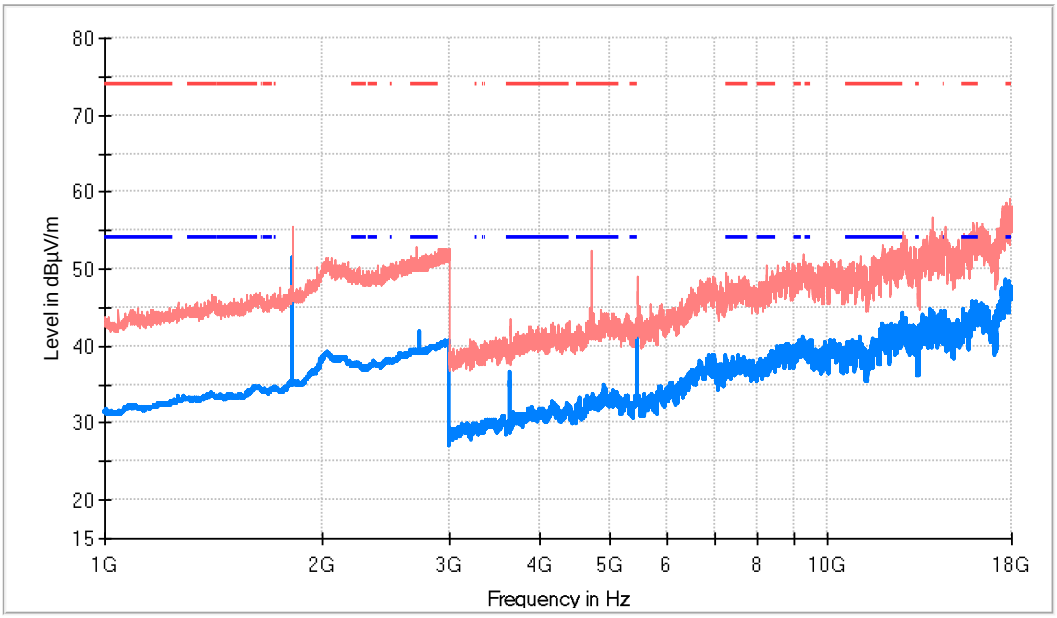


Maximizations

Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBµV/m)	Comment
37.857000	28.1	17.8	H	22.2	40.0	
266.825500	27.8	15.4	H	30.6	46.0	
406.554000	30.7	17.9	H	28.1	46.0	
613.794500	36.0	22.9	H	23.1	46.0	
920.169000	111.2	108.6	H	---	---	Fundamental
970.609000	39.6	26.9	H	27.1	54.0	

TEST RESULTS (Cont.):	1-18 GHz

Lowest Channel

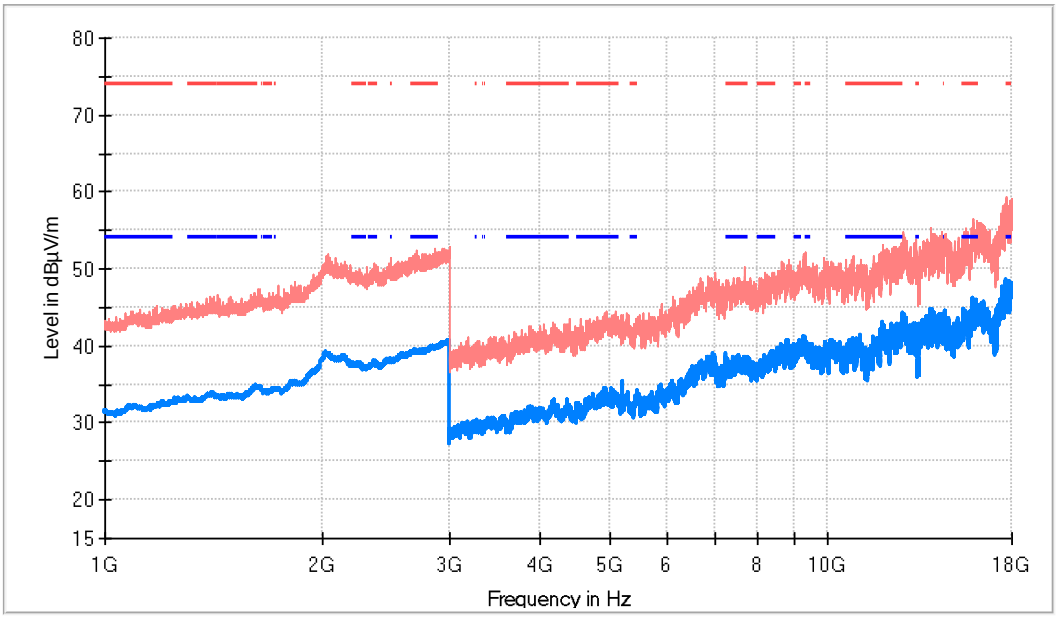


Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
1824.000000	55.4	51.5	H	---	---
2736.000000	51.5	41.9	V	12.1	54.0
3632.500000	37.7	29.6	V	24.4	54.0
5473.000000	49.0	42.3	H	---	---

TEST RESULTS (Cont.):	1-18 GHz

Highest Channel



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

Maximizations

Frequency (MHz)	PK+_MAXH (dBµV/m)	AVG_MAXH (dBµV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBµV/m)
17923.000000	57.5	48.3	H	5.7	54.0

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time
30 MHz - 1 GHz	48.5 kHz	PK+	100 kHz	1 s
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s