

FCC PART 15 SUBPART C TEST REPORT

for

NEXT-GEN UHF RFID Reader

Model No.: RU224-10

FCC ID: WXARU224TM

of

Applicant: **GIGA-TMS INC.**

Address: **8F, NO.31, LANE 169, KANG-NING ST.,HSI-CHIH,
NEW TAIPEI CITY, 22180 TAIWAN**

Tested and Prepared

by

Worldwide Testing Services (Taiwan) Co., Ltd.

FCC Registration No.: TW1477, TW0020, TW1072

Industry Canada filed test laboratory Reg. No.: 20037

A2LA Accredited No.: 2732.01



Report No.: W6M21907-19195-C-1

6F, NO. 58, LANE 188, RUEY-KUANG RD., NEIHU TAIPEI 114, TAIWAN, R.O.C.
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1 General Information

1.1 Notes

The purpose of conformity testing is to increase the probability of adherence to the essential requirements or conformity specifications, as appropriate.

The complexity of the technical specifications, however, means that full and thorough testing is impractical for both technical and economic reasons.

Furthermore, there is no guarantee that a test sample which has passed all the relevant tests conforms to a specification.

Neither is there any guarantee that such a test sample will interwork with other genuinely open systems.

The existence of the tests nevertheless provides the confidence that the test sample possesses the qualities as maintained and that its performance generally conforms to representative cases of communications equipment.

The test results of this test report relate exclusively to the item tested as specified in 1.5.

The test report may only be reproduced or published in full.

Reproduction or publication of extracts from the report requires the prior written approval of the Worldwide Testing Services(Taiwan) Co., Ltd.

Tester:

December 30, 2019

Spencer Yang

Date

WTS-Lab.

Name

Signature

Technical responsibility for area of testing:

December 30, 2019

Kevin Wang

Date

WTS

Name

Signature



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1.2 Testing laboratory

1.2.1 Location

OATS

No.5-1, Lishui, Shuang Sing Village,

Wanli Dist., New Taipei City 207,

Taiwan (R.O.C.)

3 meter semi-anechoic chamber

No.35, Aly. 21, Ln. 228, Ankang Rd., Neihu Dist., Taipei City 114, Taiwan (R.O.C.)

TEL:886-2-6613-0228

FAX:886-2-2791-5046

Company

Worldwide Testing Services(Taiwan) Co., Ltd.

6F, NO. 58, LANE 188, RUEY-KUANG RD.

NEIHU, TAIPEI 114, TAIWAN R.O.C.

Tel : 886-2-66068877

Fax : 886-2-66068879

1.2.2 Details of accreditation status

Accredited testing laboratory

A2LA accredited number: 2732.01

FCC filed test laboratory Reg. No. TW1477, TW0020, TW1072

Industry Canada filed test laboratory Reg. No. 20037

Test location, where different from Worldwide Testing Services (Taiwan) Co., Ltd. :

Name: ./.

Accredited number: ./.

Street: ./.

Town: ./.

Country: ./.

Telephone: ./.

Fax: ./.

1.3 Details of approval holder

Name: GIGA-TMS INC.

Street: 8F, NO.31, LANE 169, KANG-NING ST.,HSI-CHIH,

Town: NEW TAIPEI CITY, 22180

Country: TAIWAN

Telephone: +886-2-26954214

Fax: +886-2-26954213



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1.4 Application details

Date of receipt of test item: August 07, 2019

Date of test: from August 08, 2019 to December 30, 2019

1.5 General information of Test item

Type of test item: NEXT-GEN UHF RFID Reader

Model Number: RU224-10

Multi-listing model number: ./.

Photos: ./.

Technical data

Frequency band: 902-928 MHz

Transmitter

Unom

Power (ch A): Conducted: 29.57 dBm

Power (ch B): Conducted: 29.71 dBm

Power (ch C): Conducted: 29.68 dBm

Power supply: 12Vd.c.

Operation modes: duplex

Modulation Type: PR-ASK

Antenna Type: Patch Antenna

Antenna gain: FFP150-US: 3 dBi, FFP300-US: 6 dBi,
NFL150: -7.5 dBi, NFL300: -5 dBi

Host device: none

Classification:

Fixed Device	☒
Mobile Device (Human Body distance > 20cm)	☐
Portable Device (Human Body distance < 20cm)	☐
Modular Radio Device	☐



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Manufacturer: (if applicable)

Name: ./.
Street: ./.
Town: ./.
Country: ./.

Additional information: ./.

1.6 Test standards

Technical standard : FCC RULES PART 15 SUBPART C § 15.247 (2018-10)



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2 Technical test

2.1 Summary of test results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.



or

The deviations were ascertained in the course of the tests performed.



2.2 Test environment

Relative humidity content: 20 ... 75 %

Air pressure: 86 ... 103 kPa

Details of power supply: 12Vd.c.

Extreme conditions parameters: test voltage : -- extreme
min : -- V
max : -- V

Test item Name	Uncertainty
Estimation Result of Uncertainty of Conducted Emission	Expanded Uncertainty : AMN : 1.30 dB Voltage probe : 1.36 dB
Estimation Result of Uncertainty of Radiated Emission(3M)	Expanded Uncertainty : 0.009-30 MHz : 2.02 dB 30-1000 MHz : 3.49 dB 1-18 GHz : 3.01 dB 18-40 GHz : 2.43 dB
Estimation Result of Uncertainty of Bandwidth Measurement 20 dB Bandwidth, Occupied bandwidth, Channel bandwidth, Necessary Bandwidth	Expanded Uncertainty : 0.45 kHz
Estimation Result of Uncertainty of Conducted Output Power Measurement Output power	Expanded Uncertainty : 1.72 dB
Estimation Result of Uncertainty of Band Edge Measurement	Expanded Uncertainty : 0.98 dBc
Estimation Result of Uncertainty of Frequency Separation Measurement Hopping channel separation	Expanded Uncertainty : 554.14 Hz
Estimation Result of Uncertainty of Duty Cycle Measurement Dwell time	Expanded Uncertainty : 0.1 ms

The decision rule is : Measurement uncertainty is not taken into account.



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2.3 Test Equipment List

No.	Test equipment	Type	Serial No.	Manufacturer	Cal. Date	Next Cal. Date
ETSTW-CE 001	EMI TEST RECEIVER	ESHS10	842121/013	R&S	2019/6/4	2020/6/3
ETSTW-CE 003	AC POWER SOURCE	APS-9102	D161137	GW	Function Test	
ETSTW-CE 004	ZWEILEITER-V-NETZNACHBILDUNG TWO-LINE V-NETWORK	ESH3-Z5	840731/011	R&S	2019/10/31	2020/10/30
ETSTW-CE 006	IMPULSBEGRENZER PULSE LIMITER	ESH3-Z2	100226	R&S	2019/9/24	2020/9/23
ETSTW-CE 008	HF-EICHLITUNG RF STEP ATTENUATOR 139dB DPSP	334.6010.02	844581/024	R&S	Function Test	
ETSTW-CE 009	TEMP.&HUMIDITY CHAMBER	GTH-225-40-1P-U	MAA0305-009	GIANT FORCE	2019/7/23	2020/7/22
ETSTW-CE 016	TWO-LINE V-NETWORK	ENV216	100050	R&S	2019/10/3	2020/10/2
ETSTW-CE 028	MXE EMI Receiver	N9038A	MY53220110	Agilent	2019/7/18	2020/7/17
ETSTW-RE 003	EMI TEST RECEIVER	ESI 26	831438/001	R&S	2019/6/4	2020/6/3
ETSTW-RE 004	EMI TEST RECEIVER	ESI 40	832427/004	R&S	2019/5/29	2020/5/28
ETSTW-RE 012	TUNABLE BANDREJECT FILTER	D.C 0309	146	K&L	Function Test	
ETSTW-RE 013	TUNABLE BANDREJECT FILTER	D.C 0336	397	K&L	Function Test	
ETSTW-RE 018	MICROWAVE HORN ANTENNA	AT4560	27212	AR	2019/7/25	2020/7/24
ETSTW-RE 027	Passive Loop Antenna	6512	00034563	ETS-Lindgren	2019/7/22	2020/7/21
ETSTW-RE 030	Double-Ridged Guide Horn Antenna	3117	00035224	ETS-Lindgren	2019/4/2	2020/4/1
ETSTW-RE 042	Biconical Antenna	HK116	100172	R&S	2019/1/29	2020/1/28
ETSTW-RE 043	Log-Periodic Dipole Antenna	HL223	100166	R&S	2019/4/23	2020/4/22
ETSTW-RE 044	Log-Periodic Antenna	HL050	100094	R&S	2019/5/13	2020/5/12
ETSTW-RE 045	ESA-E SERIES SPECTRUM ANALYZER	E4404B	MY45111242	Agilent	Pre-test Use	
ETSTW-RE 050	Attenuator 10dB	50HF-010-1	None	JFW	2019/2/27	2020/2/26
ETSTW-RE 051	Attenuator 6dB	50HF-006-1	None	JFW	2019/2/27	2020/2/26
ETSTW-RE 053	Attenuator 3dB	50HF-003-1	None	JFW	2019/2/27	2020/2/26
ETSTW-RE 055	SPECTRUM ANALYZER	FSU 26	200074	R&S	2019/3/5	2020/3/4
ETSTW-RE 060	Attenuator 30dB	5015-30	F651012z-01	ATM	2019/2/27	2020/2/26
ETSTW-RE 062	Amplifier Module	CHC 2	None	KMIC	2019/5/16	2020/5/15
ETSTW-RE 064	Bluetooth Test Set	MT8852B-042	6K00005709	Anritsu	Function Test	
ETSTW-RE 069	Double-Ridged Guide Horn Antenna	3117	00069377	ETS-Lindgren	Function Test	
ETSTW-RE 072	CELL SITE TEST SET	8921A	3339A00375	HP	2019/9/23	2020/9/22
ETSTW-RE 088	SOLID STATE AMPLIFIER	KMA180265A01	99057	KMIC	2019/9/18	2020/9/17
ETSTW-RE 091	Match Pad	MDCS1500	None	WOKEN	2019/5/9	2020/5/8
ETSTW-RE 099	DC Block	50DB-007-1	None	JFW	2019/2/22	2020/2/21
ETSTW-RE 112	AC POWER SOURCE	TFC-1005	T-0A023536	T-Power	Function test	



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ETSTW-RE 115	2.4GHz Notch Filter	N0124411	473874	MICROWAVE CIRCUITS	2019/1/14	2020/1/13
ETSTW-RE 120	RF Player	MP9200	MP9210-111022	ADIVIC	Function test	
ETSTW-RE 122	SIGNAL GENERATOR	SMF100A	102149	R&S	2019/6/3	2020/6/2
ETSTW-RE 125	5GHz Notch filter	5NSL11-5200/E221.3-O/O	1	K&L Microwave	2019/8/8	2020/8/7
ETSTW-RE 126	5GHz Notch filter	5NSL12-5800/E221.3-O/O	1	K&L Microwave	2019/8/8	2020/8/7
ETSTW-RE 127	RF Switch Box	RFS-01	None	WTS	2019/2/26	2020/2/25
ETSTW-RE 128	5.3GHz Notch filter	N0153001	SN487233	Microwave Circuits	2019/8/8	2020/8/7
ETSTW-RE 129	5.5GHz Notch filter	N0555984	SN487234	Microwave Circuits	2019/8/8	2020/8/7
ETSTW-RE 130	Handheld RF Spectrum Analyzer	N9340A	CN0147000204	Agilent	Pre-test Use	
ETSTW-RE 142	Amplifier	8447D	2805A03378	Agilent	2019/5/16	2020/5/15
ETSTW-RE 147	Bi-log Hybrid Antenna	MCTD 2786B	BLB16M04005	ETC	2019/4/2	2020/4/1
ETSTW-RF 002	Electromagnetic field probe	LF-30	K-0007	STT	2019/5/27	2020/5/26
ETSTW-EMI 011	USB Compact Modulator	SFC-U	101689	R&S	2019/5/16	2020/5/15
ETSTW-GSM 002	Universal Radio Communication Tester	CMU 200	109439	R&S	2019/3/5	2020/3/4
ETSTW-GSM 003	Radio Communication Analyzer	MT8820C	6201342073	Anritsu	2019/3/26	2020/3/25
ETSTW-GSM 004	Wideband Radio Communication Tester	CMW500	128092	R&S	2019/10/18	2020/10/17
ETSTW-GSM 019	Band Reject Filter	WRCTF824/849-822/851-40 /12+9SS	3	WI	2019/1/14	2020/1/13
ETSTW-GSM 020	Band Reject Filter	WRCD1747/1748-1743/1752-32/5SS	1	WI	2019/1/14	2020/1/13
ETSTW-GSM 021	Band Reject Filter	WRCD1879.5/1880.5-1875.5/1884.5-32/5SS	3	WI	2019/1/14	2020/1/13
ETSTW-GSM 022	Band Reject Filter	WRCT901.9/903.1-904.25-50/8SS	1	WI	2019/1/14	2020/1/13
ETSTW-GSM 023	Power Divider	4901.19.A	None	SUHNER	2019/9/12	2020/9/11
ETSTW-GSM 024	Radio Communication Analyzer	MT8821C	None	Anritsu	2019/3/5	2020/3/4
ETSTW-GSM 025	Band Reject Filter	BRM19835	001	Micro-Tronics	2019/8/9	2020/8/8
ETSTW-Cable 011	SMA to N type Cable	RGU-400	None	THERMAX	Pre-test Use NCR	
ETSTW-Cable 016	BNC Cable	Switch Box	B Cable 1	Schwarz beck	2019/2/21	2020/2/20
ETSTW-Cable 017	BNC Cable	X Cable	B Cable 2	Schwarz beck	2019/2/21	2020/2/20
ETSTW-Cable 018	BNC Cable	Y Cable	B Cable 3	Schwarz beck	2019/2/21	2020/2/20
ETSTW-Cable 019	BNC Cable	Z Cable	B Cable 4	Schwarz beck	2019/2/21	2020/2/20
ETSTW-Cable 020	N TYPE Cable	OATS Cable 1	N30N30-L335-15M	JYE BAO CO.,LTD.	2019/7/2	2020/7/1
ETSTW-Cable 026	Microwave Cable	SUCOFLEX 104	279075	HUBER+SUHNER	2019/2/25	2020/2/24
ETSTW-Cable 027	Microwave Cable	SUCOFLEX 104	279083	HUBER+SUHNER	2019/5/14	2020/5/13
ETSTW-Cable 028	Microwave Cable	FA147A0015M2020	30064-2	UTIFLEX	2019/9/18	2020/9/17
ETSTW-Cable 029	Microwave Cable	FA147A0015M2020	30064-3	UTIFLEX	2019/9/18	2020/9/17
ETSTW-Cable 030	Microwave Cable	SUCOFLEX 104 (S. Cable 9)	279067	HUBER+SUHNER	2019/2/25	2020/2/24
ETSTW-Cable 043	Microwave Cable	SUCOFLEX 104	317576	HUBER+SUHNER	2019/5/16	2020/5/15
ETSTW-Cable 058	Microwave Cable	SUCOFLEX 104	none	HUBER+SUHNER	2019/6/6	2020/6/5



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ETSTW-Cable 064	Microwave Cable	SUCOFLEX 104	MY28891	HUBER+SUHNER	2019/5/16	2020/5/15
ETSTW-Cable 066	SMA type cable	32022	None	ASTROLAB	2019/9/24	2020/9/23
ETSTW-Cable 071	N TYPE CABLE	EMCCFD400-NM-NM-25000	170239	EMCI	2019/6/6	2020/6/5
ETSTW-Cable 072	SMA type cable (8m)	SUCOFLEX 104	805800/4	HUBER+SUHNER	2019/5/16	2020/5/15
ETSTW-Cable 074	SMA type cable (2m)	SUCOFLEX 104	802563/4	HUBER+SUHNER	2019/5/16	2020/5/15
WTSTW-SW 002	EMI TEST SOFTWARE	EZ EMC	None	Farad	Version ETS-03A1	
WTSTW-SW 006	EMI TEST SOFTWARE	e3	None	AUDIX	Version 9.161014	
WTSTW-SW 008	Signal studio	Agilent	None	AUDIX	Version 2.0.0.1	
ETSTW-TH 001	Thermohygrometer	608-H1	45204316	Testo	2019/9/9	2020/9/8
ETSTW-TH 002	Thermohygrometer	608-H1	45204317	Testo	2019/9/9	2020/9/8



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2.4 General Test Procedure

POWER LINE CONDUCTED INTERFERENCE: The procedure used was ANSI STANDARD C63.10-2013 6.2 using a LISN (if necessary). Both lines were observed. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

RADIATION INTERFERENCE: The test procedure used was according to ANSI STANDARD C63.10-2013 6.3 employing a spectrum analyzer. For investigated frequency is equal to or below 1GHz, the RBW and VBW of the spectrum analyzer was 100 kHz and 100kHz respectively with an appropriate sweep speed. For investigated frequency is above 1GHz, both of RBW and VBW of the spectrum analyzer were 1 MHz with an appropriate sweep speed. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The ambient temperature of the UUT was 23°C with a humidity of 40 %.

FORMULA OF CONVERSION FACTORS: The Field Strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBμV) to the antenna correction factor supplied by the antenna manufacturer. The antenna correction factors are stated in terms of dB.

Example:

Freq (MHz)	METER READING + ACF + CABLE LOSS (to the receiver) = FS
33	20 dBμV + 10.36 dB + 6 dB = 36.36 dBμV/m @3m

The EUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m (non metallic table) and arranged according to ANSI C63.10-2013 6.2.2. The table used for radiated measurements is capable of continuous rotation. The spectrum was scanned from 30 MHz to the frequency specified as follows:

- (1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- (2) If the intentional radiator operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
- (3) If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.
- (4) If the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to the range specified in paragraphs (a)(1)-(a)(3) of this section or the range applicable to the digital device, as shown in paragraph (b)(1) of this Section, whichever is the higher frequency range of investigation.

For hand-held devices, a exploratory test was performed with three (3) orthogonal planes to determine the highest emissions.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes.



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When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

The formula is as follows:

Average = Peak + Duty Factor

Duty Factor = $20 \log (\text{dwell time}/T)$

$T = 100\text{ms}$ when the pulse train period is over 100 ms or the period of the pulse train.

Modified Limits for peak according to 15.35 (b) = Max Permitted average Limits + 20dB

ANSI STANDARD C63.10-2013 B.2.7: Any measurements that utilize special test software shall be indicated and referenced in the test report. During testing, test software 'EZ EMC' was used for setting up different operation modes.



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3 Test results (enclosure)

TEST CASE	Para. Number	Required	Test passed	Test failed
Peak Output Power	15.247(b)	☒	☒	☐
Equivalent radiated Power	15.247(b)	☒	☒	☐
Spurious Emissions radiated – Transmitter operating	15.247(d)	☒	☒	☐
Spurious Emissions conducted – Transmitter operating	15.247	☐	☐	☐
Carrier Frequency Separation	15.247(a) (1)	☒	☒	☐
Number of Hopping Frequencies	15.247(a) (1)(i)	☒	☒	☐
Time of Occupancy (Dwell Time)	15.247(a) (1)(i)	☒	☒	☐
20 dB Bandwidth	15.247(a) (1)(i)	☒	☒	☐
Band-edge Compliance of RF Emission	15.247(d)	☒	☒	☐
Radiated Emission from Digital Part	15.109	☐	☐	☐
Power Line Conducted Emission	15.207(a)	☐	☐	☐

The follows is intended to leave blank.



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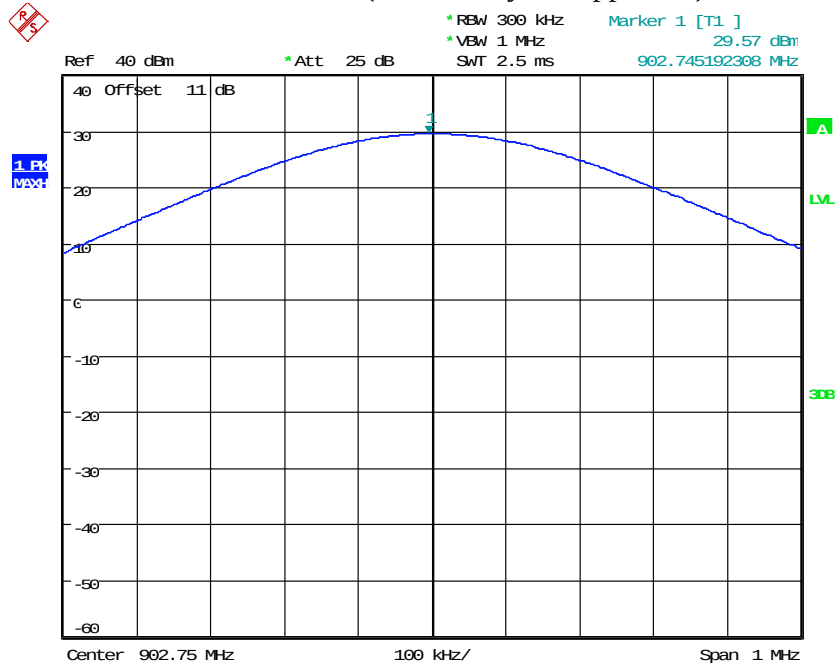
FCC ID: WXARU224TM

3.1 Peak Output Power (transmitter)

FCC Rule: 15.247

This measurement applies to equipment with an integral antenna and to equipment with an antenna connector and equipped with an antenna as declared by the applicant.

The power was measured with modulation (declared by the applicant).



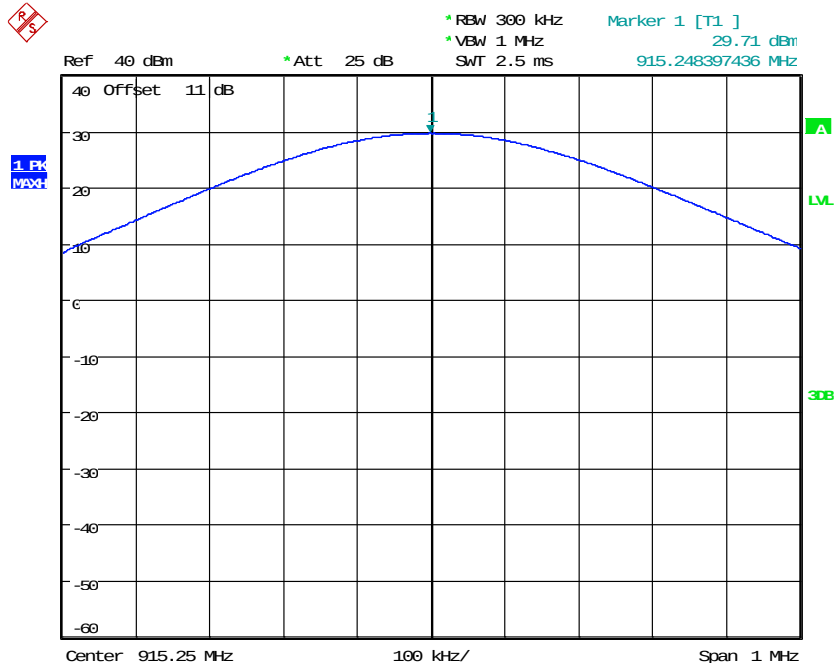
MAX OUTPUT POWER 902.75MHz
Date: 20.AUG.2019 09:02:04



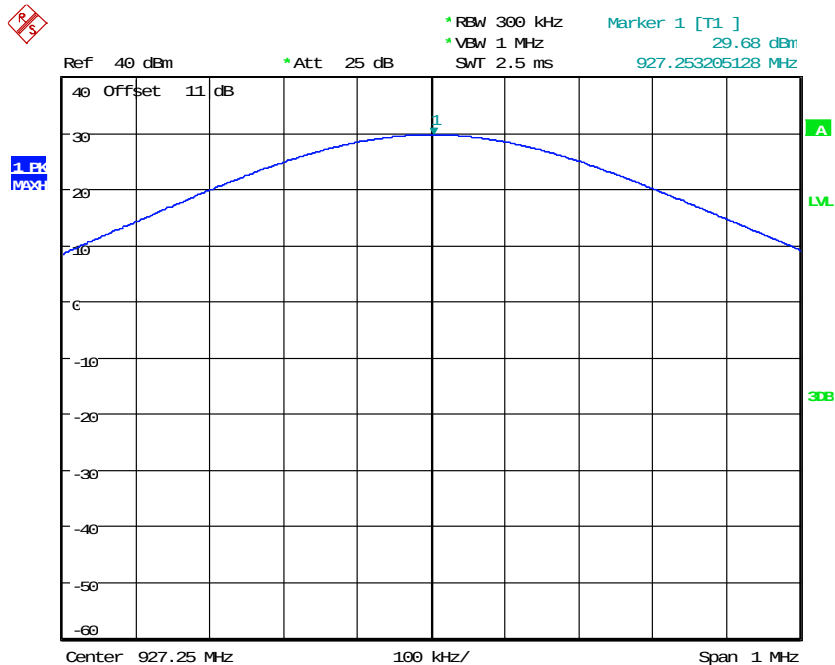
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MAX OUTPUT POWER 915.25MHz
Date: 20.AUG.2019 09:01:11



MAX OUTPUT POWER 927.25MHz
Date: 20.AUG.2019 09:00:34



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Maximum Peak Output Power

Limits:

Frequency MHz	Number of hopping channels			
	≥ 75	≥ 50	$49 \geq 25$	$74 \geq 15$
902-928	--	30 dBm	24 dBm	--
2400-2483.5 MHz	30 dBm	--	--	21 dBm
5725-5850 MHz	30 dBm	--	--	--

In case of employing transmitter antennas having antenna gain >dBi and using fixed point-to point operation consider §15.247 (b)(4).

Test equipment used: ETSTW-RE 055, ETSTW-RE 050, ETSTW-RE 064



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3.2 Equivalent isotropic radiated power (EIRP)

FCC Rule: 15.247(b)(3)

EIRP = max. conducted output power + antenna gain

UHF (902.75-927.25 MHz)

EIRP = 29.71 dBm+ (6 dBi [antenna gain claimed by manufacturer]) = 35.71 dBm = 3723.92 mW

3.3 Exemption Limits for Routine Evaluation according to

47 CFR FCC Part 2 Subpart J, section 2.1091

FCC OET Bulletin 65 Edition 97.01 determines the equations for predicting RF fields and applicable limits.

The prediction for power density in the far-field but will over-predict power density in the near field, where it could be used for walking a “worst case” or conservative prediction.

Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 25 cm normally can be maintained between the user and the device.

MPE Calculation Method

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz

*Plane-wave equivalent power density

E = Electric field (V/m) P = output power (W) G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

mW/m².



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UHF

Established separation distance is 25 cm.

Operating frequency band: 902.75-927.25 MHz

The product meets RF exposure requirement.

Because the power density of 0.4741 mW/cm^2 at 915.25 MHz is below the power density limit of 0.6102 mW/cm^2 .



Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

3.4 Transmitter Radiated Emissions in Restricted Bands

FCC Rules: 15.247 (d), 15.205, 15.209, 15.35

Radiated emission measurements were performed from 30 MHz to 26500 MHz.

For radiated emission tests, the analyzer setting was as followings:

Frequency $\leq$ 1 GHz, RBW:100 kHz, VBW: 100 kHz (Peak measurements)

Frequency $>$ 1 GHz, RBW: 1 MHz, VBW: 1 MHz (Peak measurements)

Frequency $>$ 1 GHz , RBW:1 MHz , VBW: 10 Hz (Average measurements)

Limits.

For frequencies below 1GHz:

Frequency of Emission (MHz)	Field strength (microvolts/meter)	Field Strength (dB microvolts/meter)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above	500	54.0

For frequencies above 1GHz (Average measurements).

Guidance on Measurement of Digit Transmission Systems:

“If the emission is pulsed, modify the unit for continuous operation, use the setting shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.”

The correction factor, based on the total channel dwell time in a 100 ms period, may be mathematically applied to a measurement made with an average detector, to further reduce the value.

Duty cycle correction = $20 \log (\text{dwell time} / 100\text{ms})$

Note: No duty cycle correction was added to the reading of this EUT.

Explanation: See attached diagrams in Appendix.



Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

3.5 Spurious emissions (tx)

Spurious emission was measured with modulation (declared by manufacturer).

In any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, 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))

SAMPLE CALCULATION OF LIMIT. All results will be updated by an automatic measuring system in accordance to point 2.3.

Calculation of test results:

Such factors like antenna correction, cable loss, external attenuation etc. are already included in the provided measurement results. This is done by using validated test software and calibrated test system according the accreditation requirements.

The peak and average spurious emission plots was measured with the average limits.

In the Table being listed the critical peak and average value an exhibit the compliance with the above calculated Limits.

If in the column's correction factor states a value then the max. Field strength in the same row is corrected by a value gained from the "Marker-Delta-Method" or the „Duty-Cycle Correction Factor“.

Summary table with radiated data of the test plots

Model: RU224-10

Date: --

Mode: --

Temperature: -- °C

Engineer: --

Polarization: Horizontal

Humidity: -- %

Frequency (MHz)	Reading (dBuV)	Detector	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (cm)
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--

Polarization: Vertical

Frequency (MHz)	Reading (dBuV)	Detector	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Table Degree (Deg.)	Ant. High (cm)
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--

- Note**
- 1. Correction Factor = Antenna factor + Cable loss - Preamplifier**
 - 2. The formula of measured value as: Test Result = Reading + Correction Factor**
 - 3. Detector function in the form : PK = Peak, QP = Quasi Peak, AV = Average**
 - 4. All not in the table noted test results are more than 20 dB below the relevant limits.**
 - 5. Please see attached diagrams in appendix.**

All other not noted test plots do not contain significant test results in relation to the limits.

TEST RESULT (Transmitter): The unit DOES meet the FCC requirements.

Test equipment used: ETSTW-RE 030, ETSTW-RE 111, ETSTW-RE 088, ETSTW-RE 018, ETSTW-RE 064



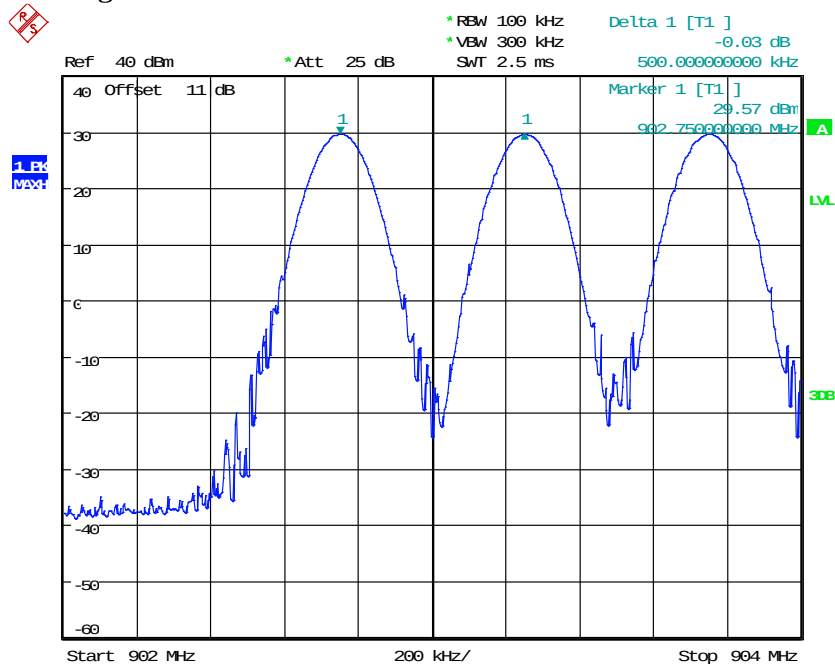
Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

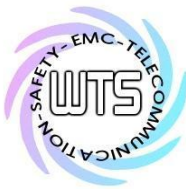
3.6 Carrier Frequency Separation

Carrier Frequency Separation was measured with modulation (declared by manufacturer).

According to FCC rules part 15 subpart C §15.247 frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or 20 dB bandwidth of the hopping channel, whichever is greater.

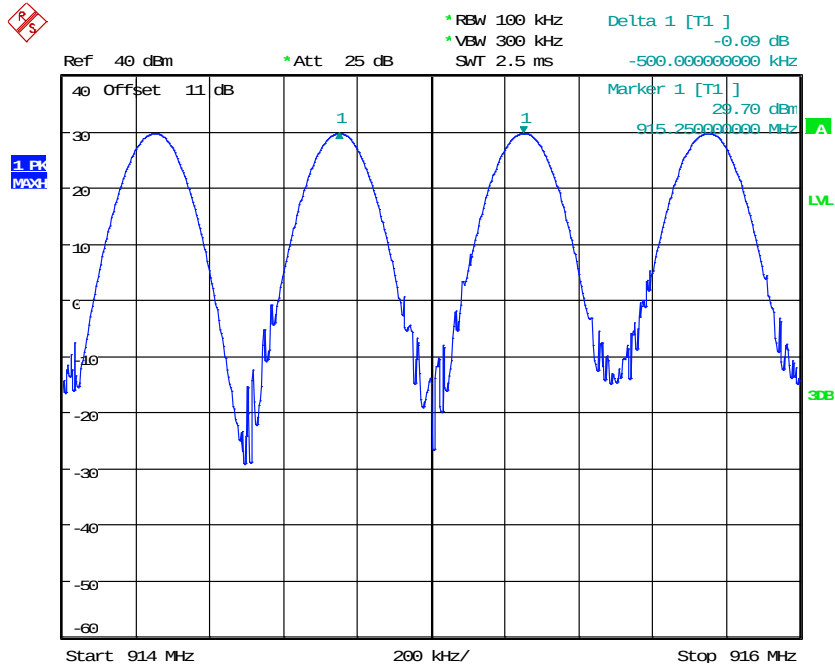


FREQUENCY SEPARATION
Date: 20.AUG.2019 09:10:11

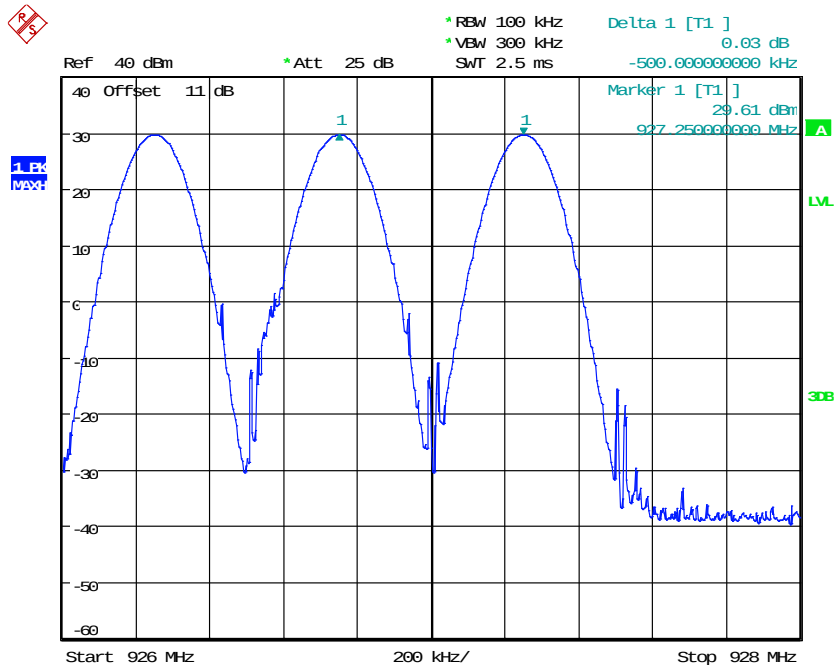


Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM



FREQUENCY SEPARATION
Date: 20.AUG.2019 09:10:59



FREQUENCY SEPARATION
Date: 20.AUG.2019 09:11:39



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Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

Limits:

Frequency Range MHz	Limits	
	20 dB bandwidth < 25 kHz	20 dB bandwidth > 25 kHz
902-928	25 kHz	20 dB bandwidth
2400-2483.5 5725-5850.0	25 kHz	20 dB bandwidth

Test equipment used: ETSTW-RE 055, ETSTW-RE 064



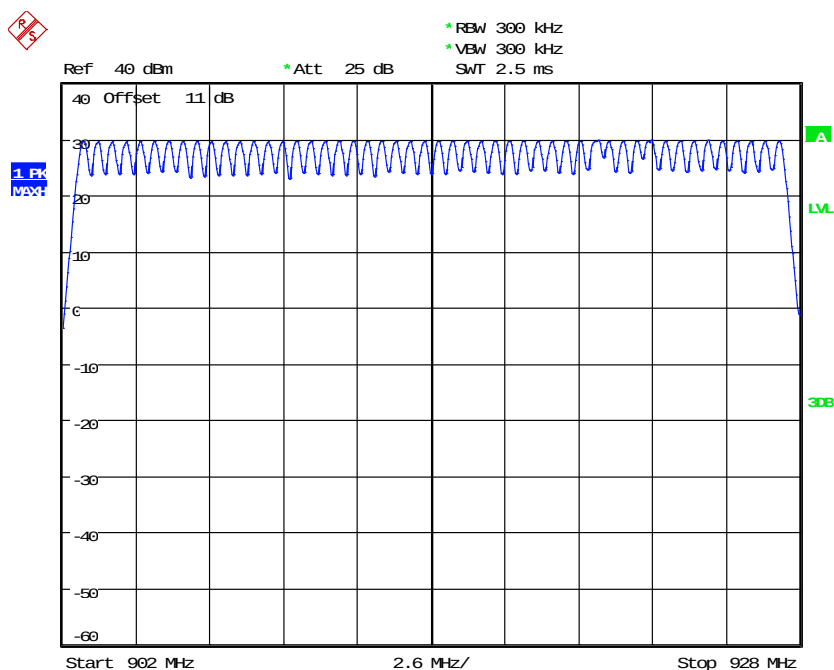
Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

3.7 Number of Hopping Frequencies

According to FCC rules part 15 subpart C §15.247 frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 hopping frequencies. Frequency hopping systems in 5725-5850 MHz bands shall use least 75 hopping frequencies.

For frequency hopping systems operating in the 902-928 MHz band: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20dB bandwidth of the hopping channel 250 kHz or greater, the system shall use at least 25 hopping frequencies.

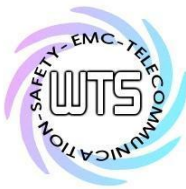


NUMBER OF HOPPING
Date: 20.AUG.2019 09:07:48

Limits:

Frequency Range MHz	Limit	
	20dB Bandwidth	Number of Channels
902-928 MHz	Bandwidth < 250 kHz	≥ 50
	Bandwidth ≥ 250 kHz	≥ 25
2400-2483.5	not defined	15
5725-5850.0 MHz	1 MHz	75

Test equipment used: ETSTW-RE 055, ETSTW-RE 064



Registration number: W6M21907-19195-C-1
FCC ID: WXARU224TM

3.7.1 Pseudorandom Frequency Hopping Sequence

The generation of the hopping sequence is determined by the Bluetooth core specification and complies with the FCC requirements.

3.7.2 Coordination of hopping sequences to other transmitters

According to the Bluetooth core specification such a coordination is not possible. During scatternet function only one of the two hopping sequences will be used at a definite moment.

3.7.3 System Receiver Hopping Capability

According to the Bluetooth core specification. The system receivers shift frequencies in synchronization with the transmitted signals.



Registration number: W6M21907-19195-C-1

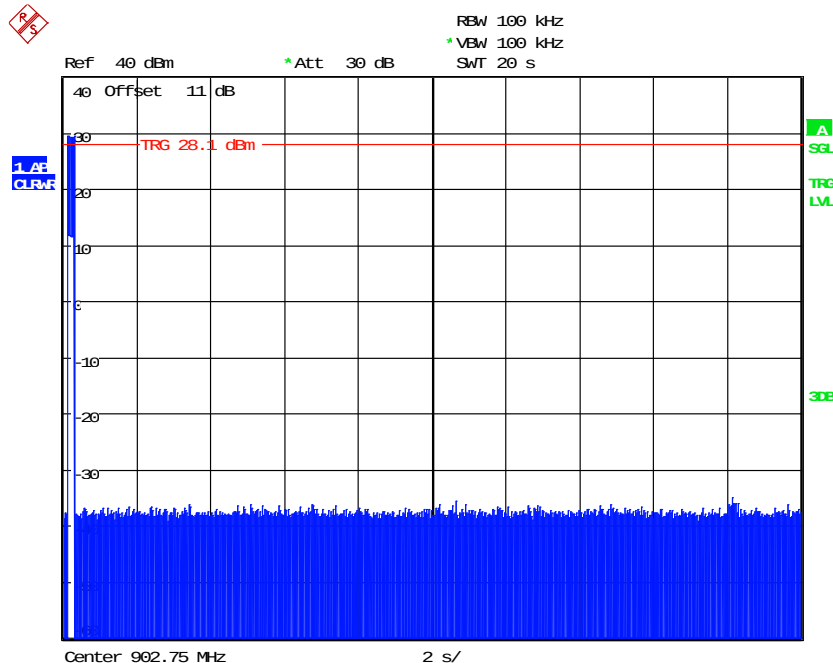
FCC ID: WXARU224TM

3.8 Time of Occupancy (Dwell Time)

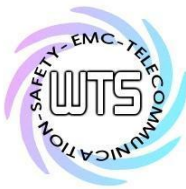
Frequency hopping systems operating in the 5725-5850 MHz band shall use an average time of occupancy on any frequency not greater than 0.4 seconds within a 30 second period.

In 2400-2483.5 MHz band the average time of occupancy on any channel shall not be greater than 0.4 seconds multiplied by the number of hopping channels employed.

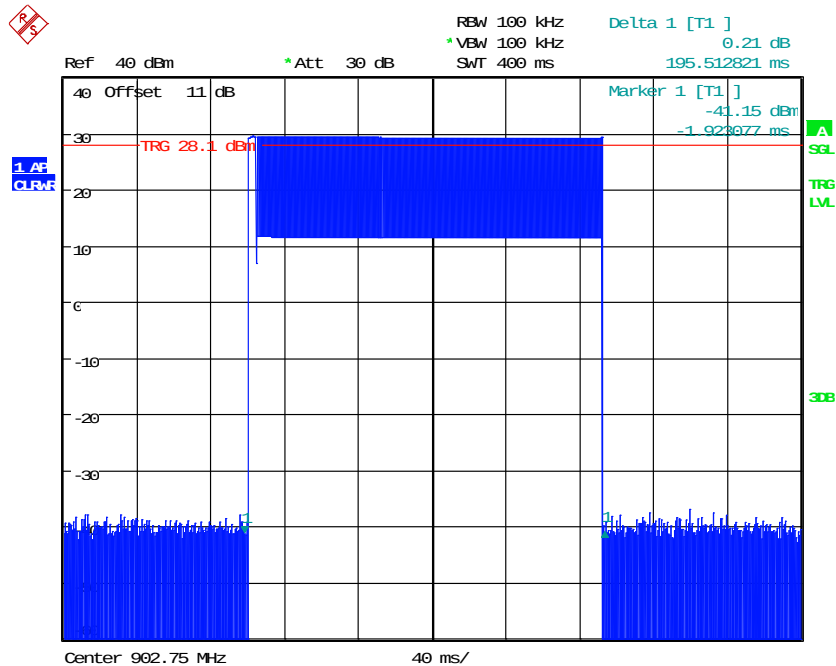
For frequency hopping systems operating in the 902-928 MHz band: if the 20dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not greater than 0.4 seconds within a 20 second period; if the 20dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.



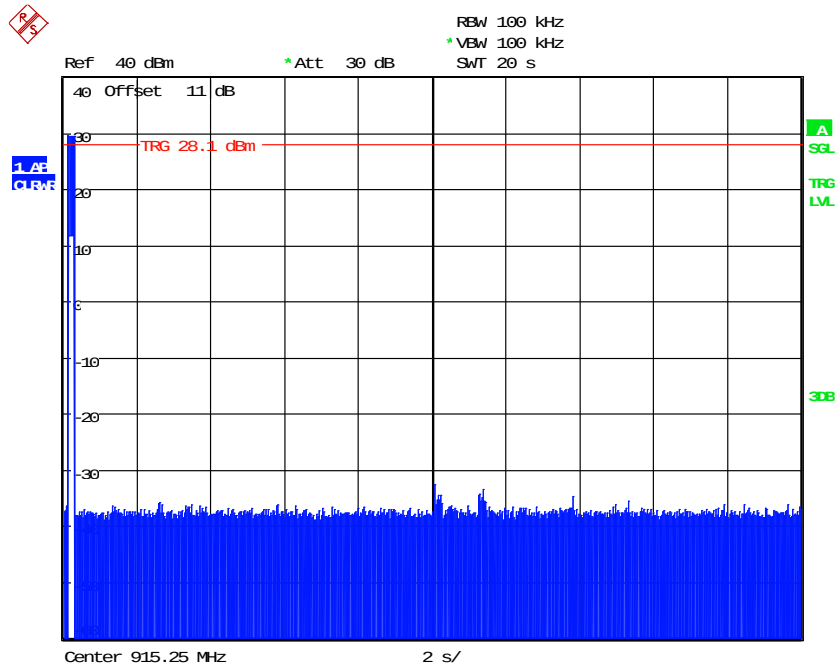
DWELL TIME 902.75MHZ
Date: 12.SEP.2019 15:47:20



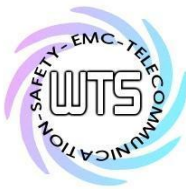
Registration number: W6M21907-19195-C-1
FCC ID: WXARU224TM



DWELL TIME 902.75MHZ (195.51ms * 1 events = 195.51ms)
Date: 12.SEP.2019 15:54:52

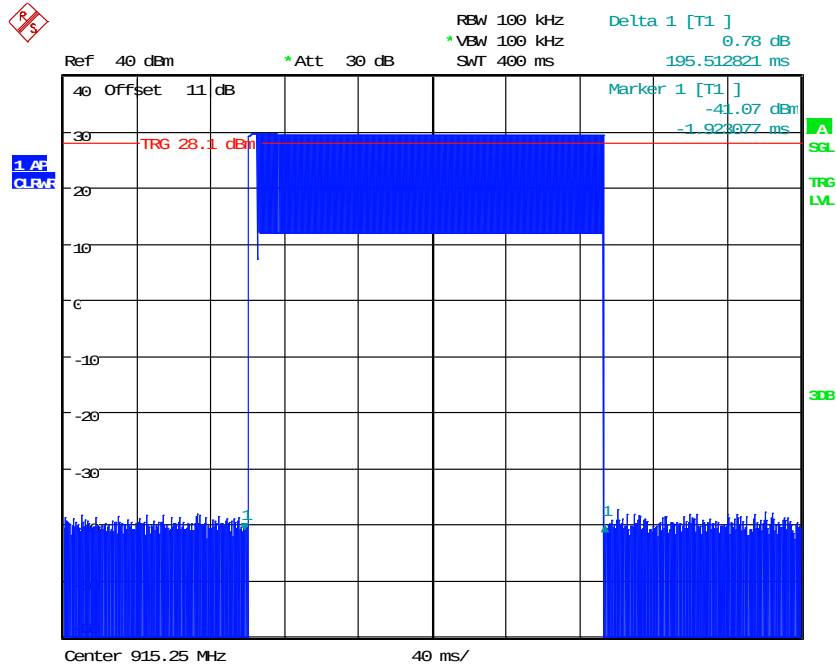


DWELL TIME 915.25MHZ
Date: 12.SEP.2019 15:49:40



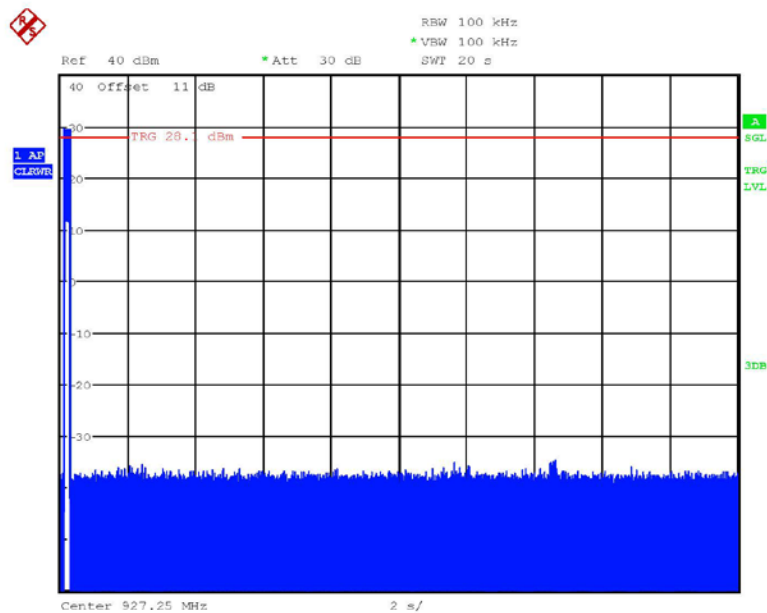
Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM



DWELL TIME 915.25MHZ (195.51ms * 1 events = 195.51ms)

Date: 12.SEP.2019 15:54:04



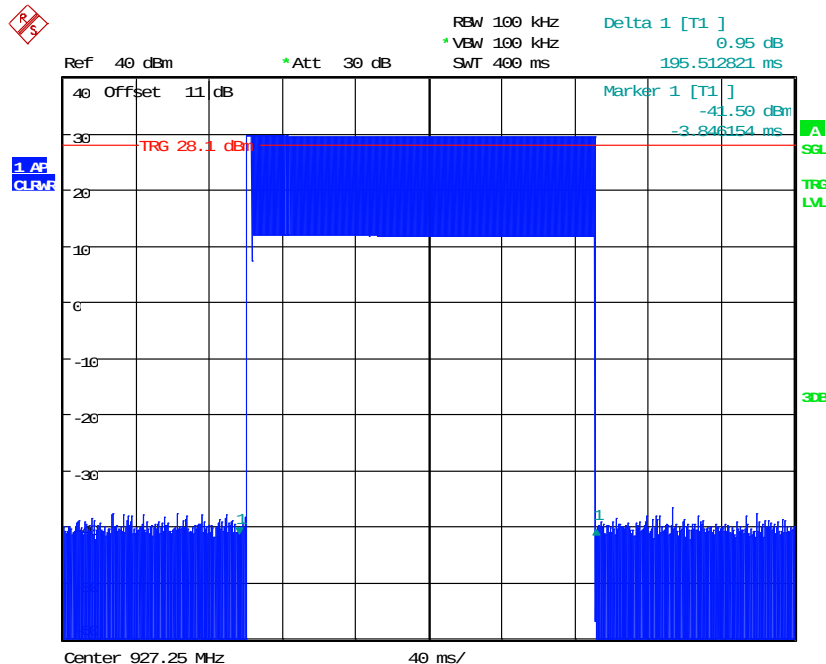
DWELL TIME 927.25MHZ

Date: 12.SEP.2019 15:50:35



Worldwide Testing Services(Taiwan) Co., Ltd.

Registration number: W6M21907-19195-C-1
FCC ID: WXARU224TM



DWELL TIME 927.25MHZ (195.51ms * 1 events = 195.51ms)
Date: 12.SEP.2019 15:52:25

Limits and measurement periods:

Frequency MHz	Number of channels	Measurement Periode	Limit
902 – 928	≥ 50	20 s	0.4 s
	$49 \geq 25$	10 s	0.4 s
2400 – 2483.5	≥ 15	0.4 s * number of used channels	0.4 s
5725- 5850	≥ 75	30 s	0.4s

Test equipment used: ETSTW-RE 055, ETSTW-RE 064



Registration number: W6M21907-19195-C-1

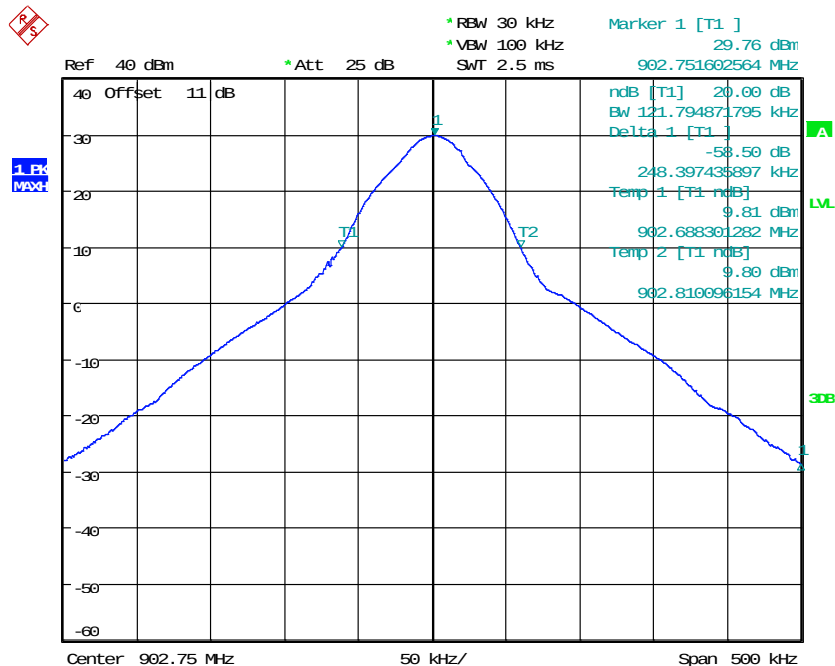
FCC ID: WXARU224TM

3.9 20dB Bandwidth

Frequency hopping systems operating in the 5725-5850 MHz bands shall use a maximum 20dB bandwidth of 1 MHz.

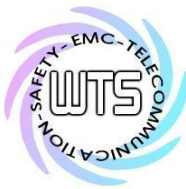
The 20dB bandwidth is measured on the lowest, middle and highest hopping channel.

For frequency hopping systems operating in the 902-928 MHz band the maximum 20dB bandwidth of the hopping channel is 500 kHz.

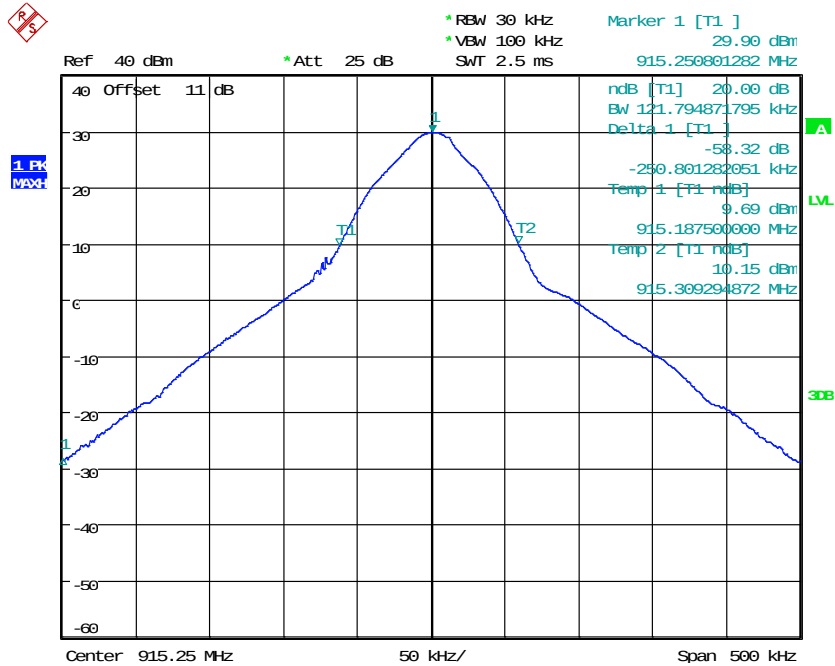


20DB BANDWIDTH 902.75MHz

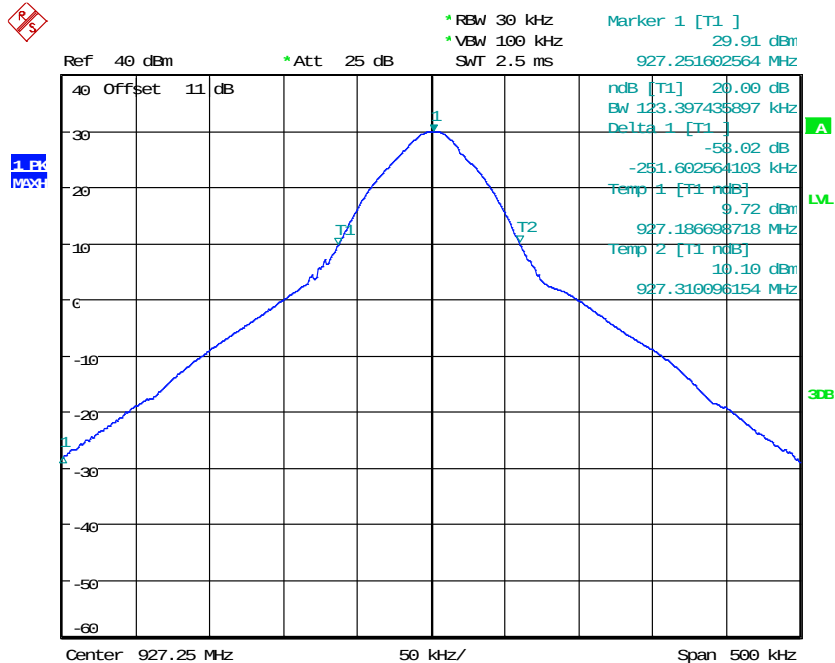
Date: 28.DEC.2019 09:29:39



Registration number: W6M21907-19195-C-1
FCC ID: WXARU224TM



20DB BANDWIDTH 915.25MHz
Date: 28.DEC.2019 09:30:46



20DB BANDWIDTH 927.25MHz
Date: 28.DEC.2019 09:32:10



Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

Limits:

Frequency Range / MHz	Limit
902-928	≤ 500 kHz
2400-2483.5	not defined
5725-5850	≤ 1 MHz

Test equipment used: ETSTW-RE 055, ETSTW-RE 064

3.9.1 System Receiver Input Bandwidth

It is determined in the Bluetooth core specification. The value matches to the bandwidth of transmitter signal.



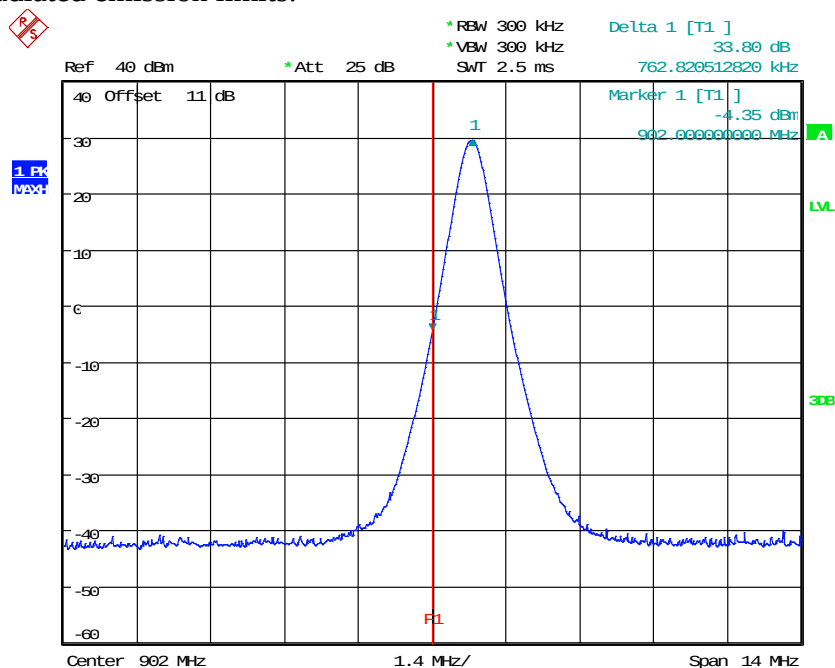
Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

3.10 Band-edge Compliance of RF Emissions

According to FCC rules part 15 subpart C §15.247(c) in any 100 kHz bandwidth outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required.

In addition radiated emission which fall in the restricted bands, as defined in section 15.205(a), must also with the radiated emission limits.

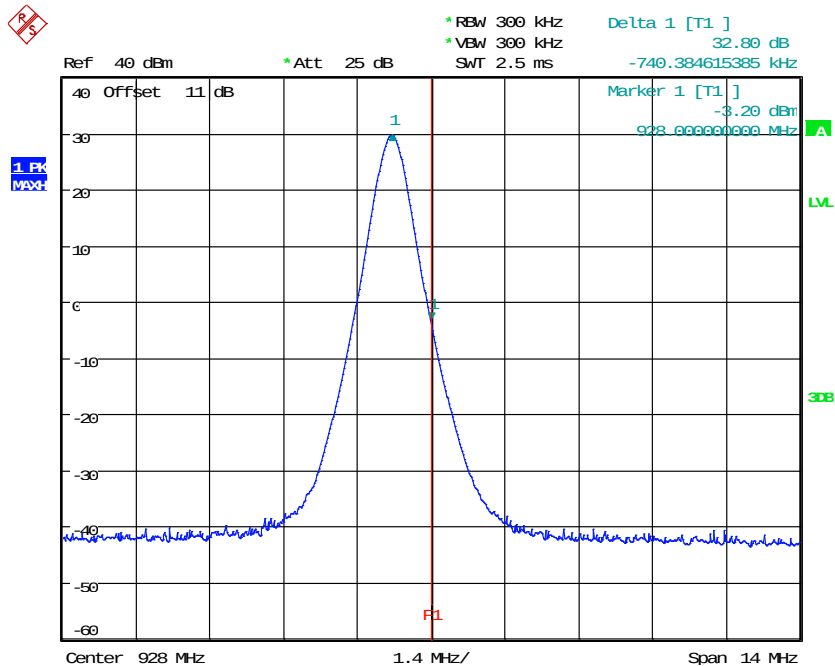


BANDEDGE 902.75MHz

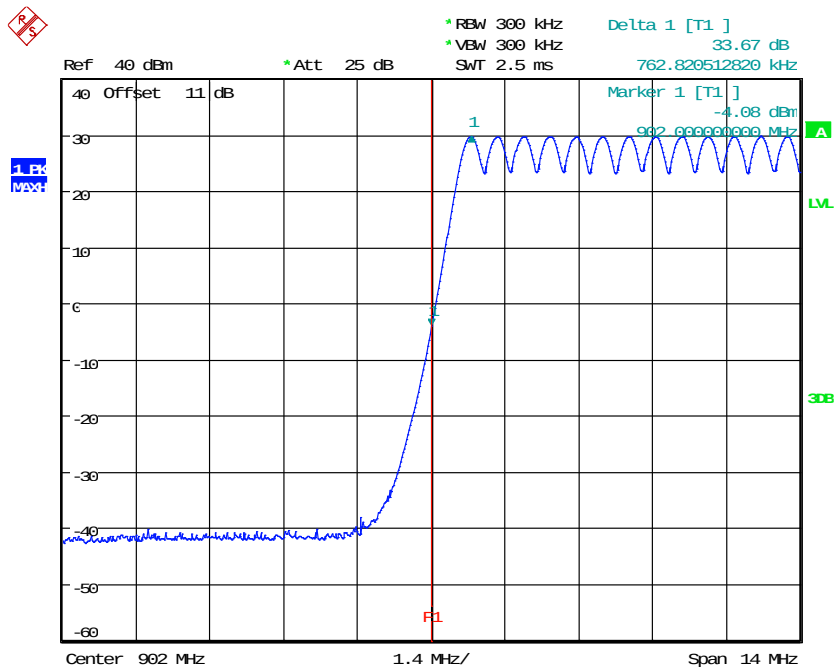
Date: 20.AUG.2019 08:41:28



Registration number: W6M21907-19195-C-1
FCC ID: WXARU224TM



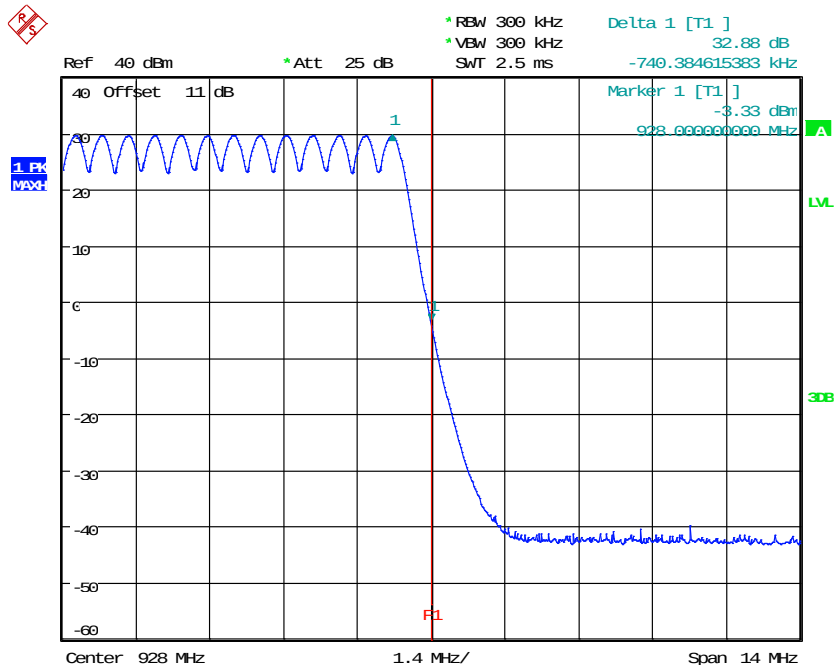
BANDEDGE 927.25MHz
Date: 20.AUG.2019 08:59:17



BANDEDGE HOPPING MODE 902.75MHz
Date: 20.AUG.2019 08:57:29



Registration number: W6M21907-19195-C-1
FCC ID: WXARU224TM



BANDEDGE HOPPING MODE 927.25MHZ
Date: 20.AUG.2019 08:58:36

Limits:

Frequency Range / MHz	Limit
902 –928	- 20 dB
2400 – 2483.5	
5725 - 5850	

Test equipment used: ETSTW-RE 055, ETSTW-RE 050, ETSTW-RE 064



Registration number: W6M21907-19195-C-1

FCC ID: WXARU224TM

3.11 Radiated Emissions from Digital Part

FCC Rule: 15.109

Summary table with radiated data of the test plots

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of Emission (MHz)	Field Strength (microvolts/meter)	Field Strength (dBmicrovolts/meter)
30 – 88	100	40.0
88 – 216	150	43.5
216 – 960	200	46.0
Above 960	500	54.0

Explanation: The test results are listed in the separated test report no.: W6M21907-19195-P-15B.

Test equipment used: ETSTW-RE 030, ETSTW-RE 055, ETSTW-RE 064, ETSTW-RE 111



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FCC ID: WXARU224TM

3.12 Power Line Conducted Emission

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the table bellows with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

This measurement was transact first with instrumentation using an average and peak detector and a 10 kHz bandwidth. If the peak detector achieves a calculated level, the measurement is repeated by an instrumentation using a quasi-peak detector.

Model: RU224-10 Date: --
 Mode: -- Temperature: -- °C Engineer: --
 Polarization: N Humidity: -- %

Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)		Margin
	QP	Ave.	Corr.	QP	Ave.	QP	Ave.	(dB)
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--

Polarization: L1

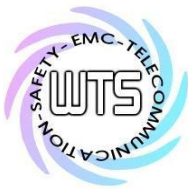
Frequency (MHz)	Reading (dBuV)		Factor (dB)	Result (dBuV)		Limit (dBuV)		Margin
	QP	Ave.	Corr.	QP	Ave.	QP	Ave.	(dB)
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--

Limits:

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
0.15-0.5 0.5-5 5-30	Quasi Peak	Average
	66 to 56	56 to 46
	56	46
	60	50

- Note:
1. The formula of measured value as: Test Result = Reading + Correction Factor
 2. The Correction Factor = Cable Loss + LISN Insertion Loss + Pulse Limit Loss
 3. Detector function in the form : PK = Peak, QP = Quasi Peak, AV = Average
 4. All not in the table noted test results are more than 20 dB below the relevant limits.
 5. This test is not required because it powered up by DC.

Test equipment used: ETSTW-CE 001, ETSTW-CE 016, ETSTW-RE 045.



Appendix

Measurement diagrams

Spurious Emissions radiated



Address: 6F., No. 58, Ln 188, Ruey Kuang Rd, Neihu, Taipei
Tel: +886-2-6606-8877
Fax: +886-2-6606-8875

Radiated Emission Measurement

Operator: Allen

File :1

Data :#1

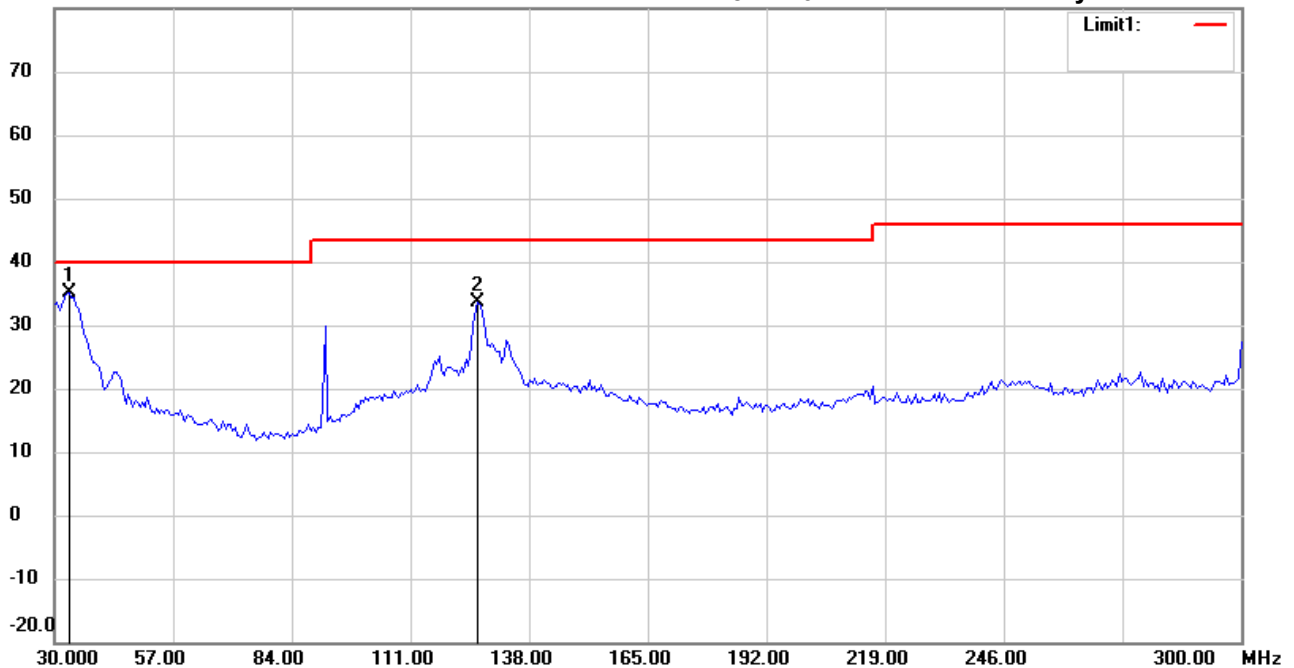
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:16:41 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	33.2465	43.60	peak	-8.59	35.01	40.00	100	125	-4.99	
	126.3126	40.08	peak	-6.40	33.68	43.50	100	240	-9.82	

*:Maximum data x:Over limit !:over margin



Address: 6F., No. 58, Ln 188, Ruey Kuang Rd, NeiHu, Taipei
Tel: +886-2-6606-8877
Fax: +886-2-6606-8875

Radiated Emission Measurement

Operator: Allen

File :1

Data :#2

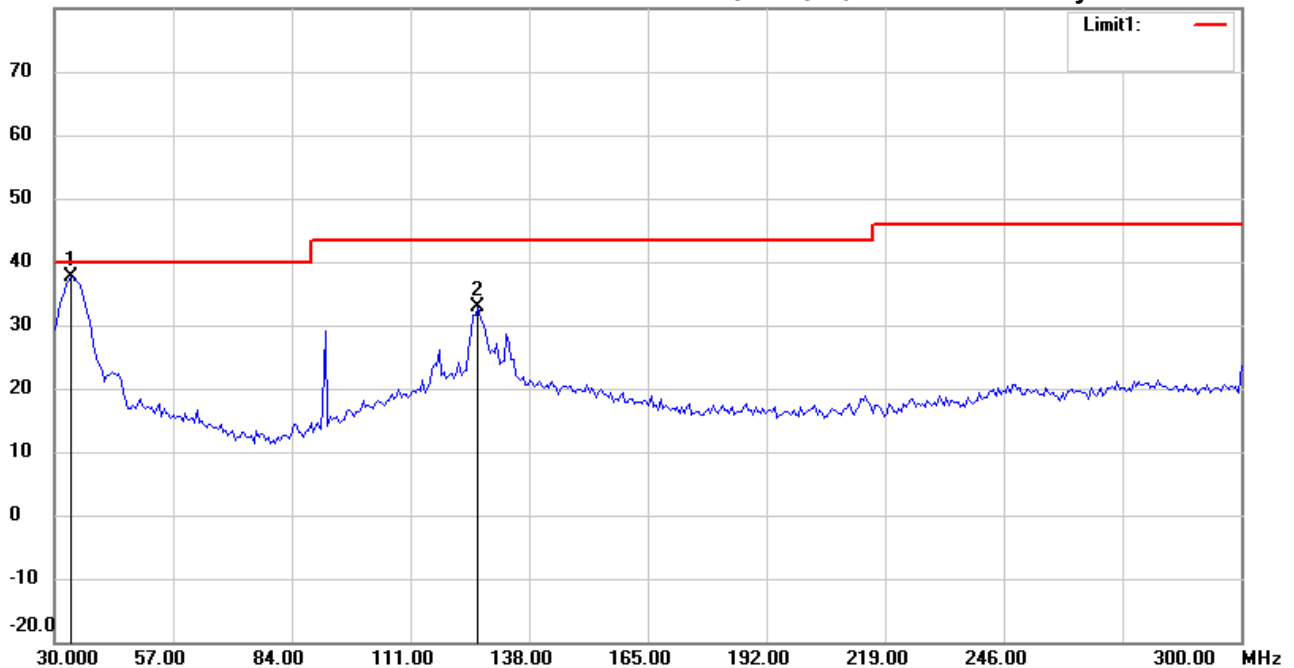
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:18:26 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: *Vertical*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	33.7876	46.29	peak	-8.68	37.61	40.00	100	295	-2.39	
	126.3126	39.31	peak	-6.40	32.91	43.50	100	100	-10.59	

*:Maximum data x:Over limit !:over margin



Address: 6F., No. 58, Ln 188, Ruey Kuang Rd, Neihu, Taipei
Tel: +886-2-6606-8877
Fax: +886-2-6606-8875

Radiated Emission Measurement

Operator: Allen

File : 2

Data : #1

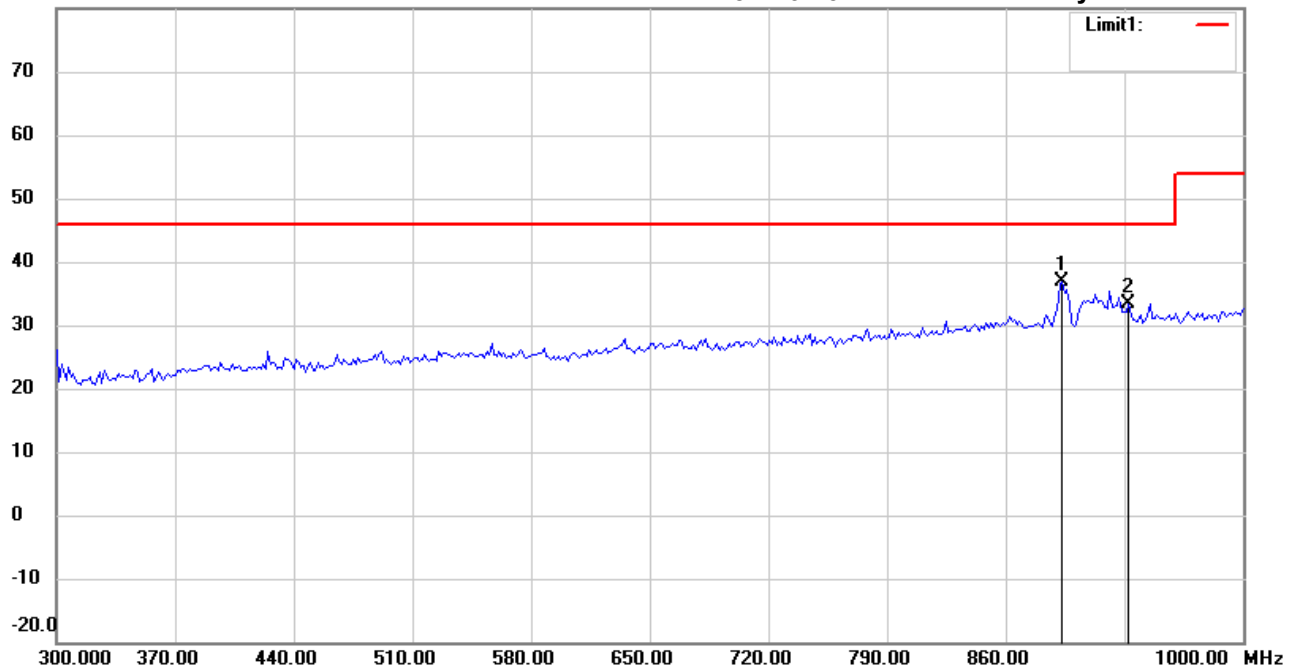
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:31:54 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: **Horizontal**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	893.3868	33.70	peak	3.13	36.83	46.00	100	355	-9.17	
	932.6653	29.49	peak	3.87	33.36	46.00	100	279	-12.64	

*:Maximum data x:Over limit !:over margin



Address: 6F., No. 58, Ln 188, Ruey Kuang Rd, Neihsu, Taipei
Tel: +886-2-6606-8877
Fax: +886-2-6606-8875

Radiated Emission Measurement

Operator: Allen

File : 2

Data : #2

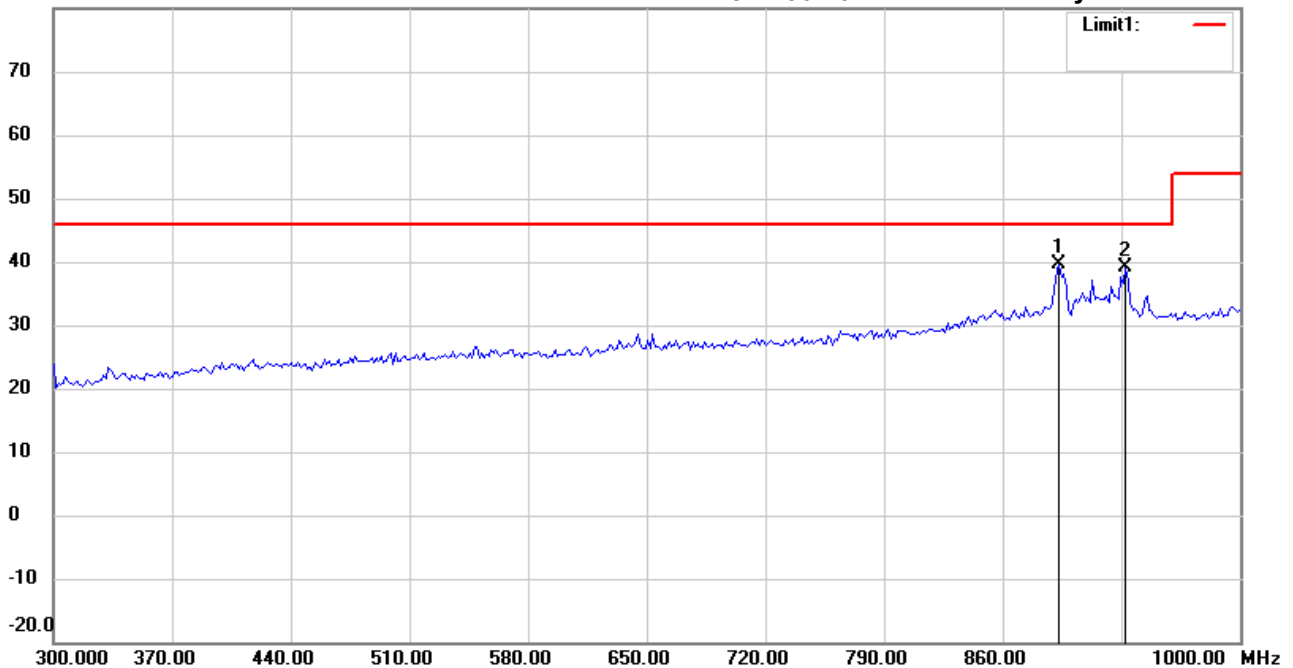
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:36:20 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	893.3868	36.51	peak	3.13	39.64	46.00	100	275	-6.36	
	932.6653	35.28	peak	3.87	39.15	46.00	100	37	-6.85	

*:Maximum data x:Over limit !:over margin



Address: 6F., No. 58, Ln 188, Ruey Kuang Rd, NeiHu, Taipei
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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #1

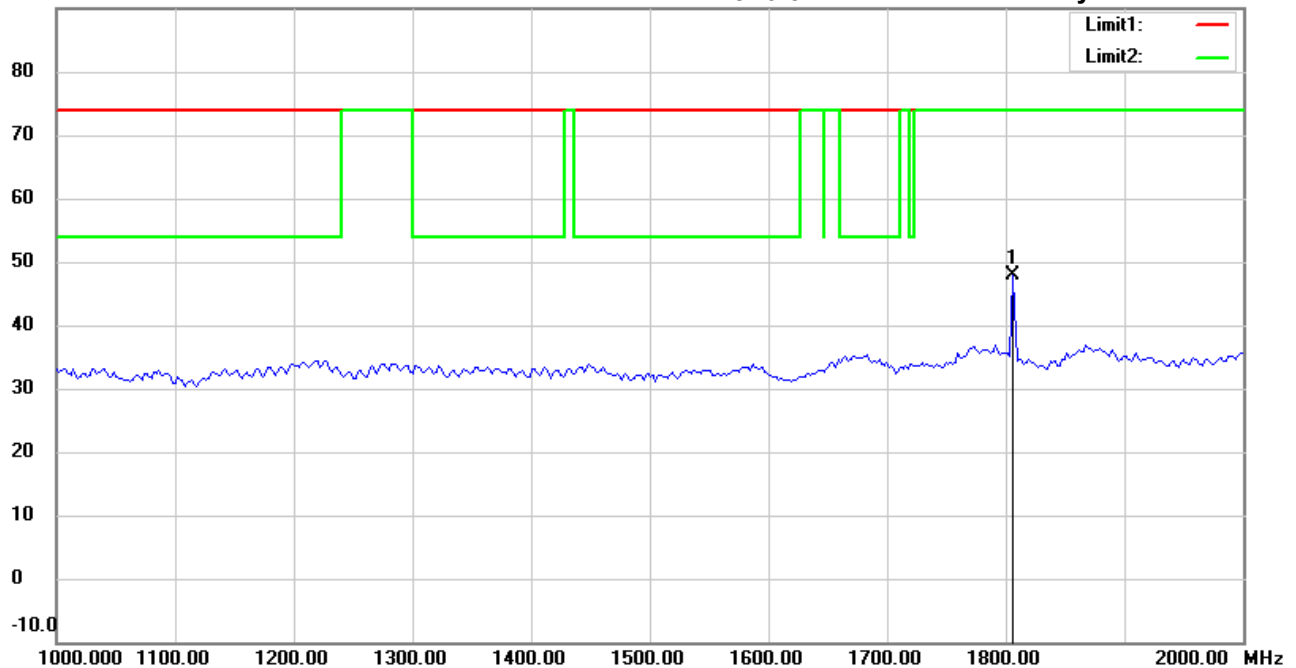
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:52:17 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	1805.611	55.51	peak	-7.62	47.89	74.00	150	20	-26.11	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #5

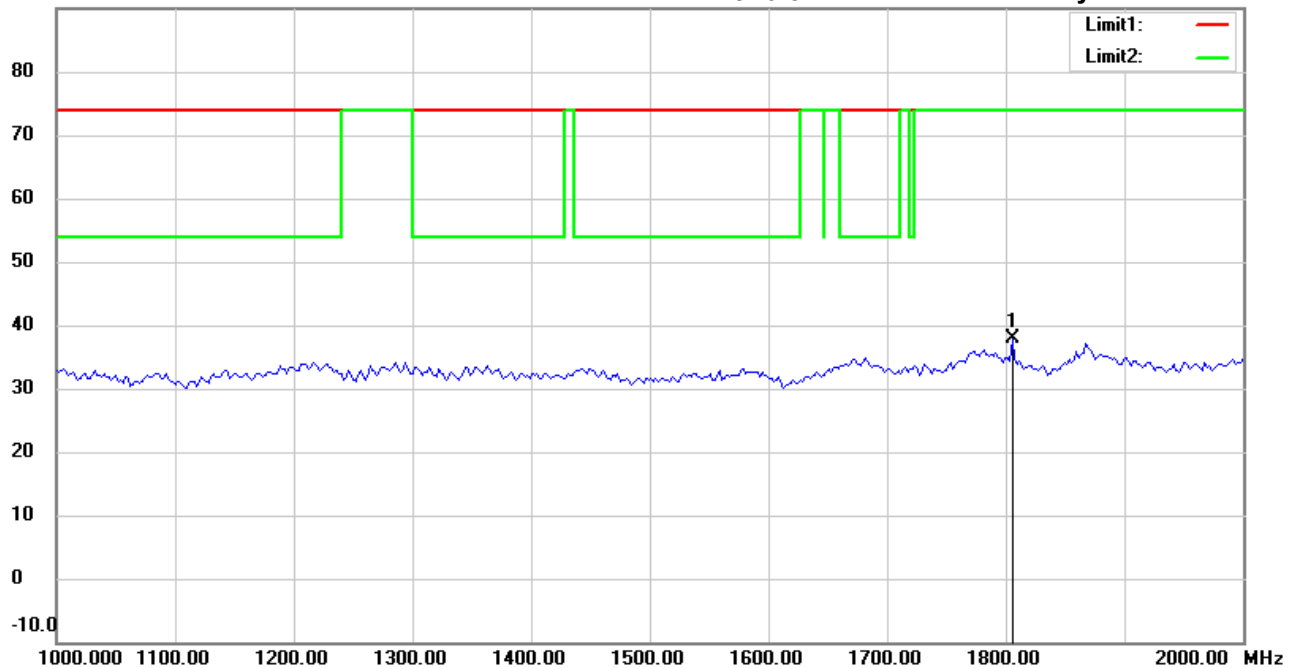
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:57:47 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	1805.611	45.46	peak	-7.62	37.84	74.00	150	70	-36.16	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #2

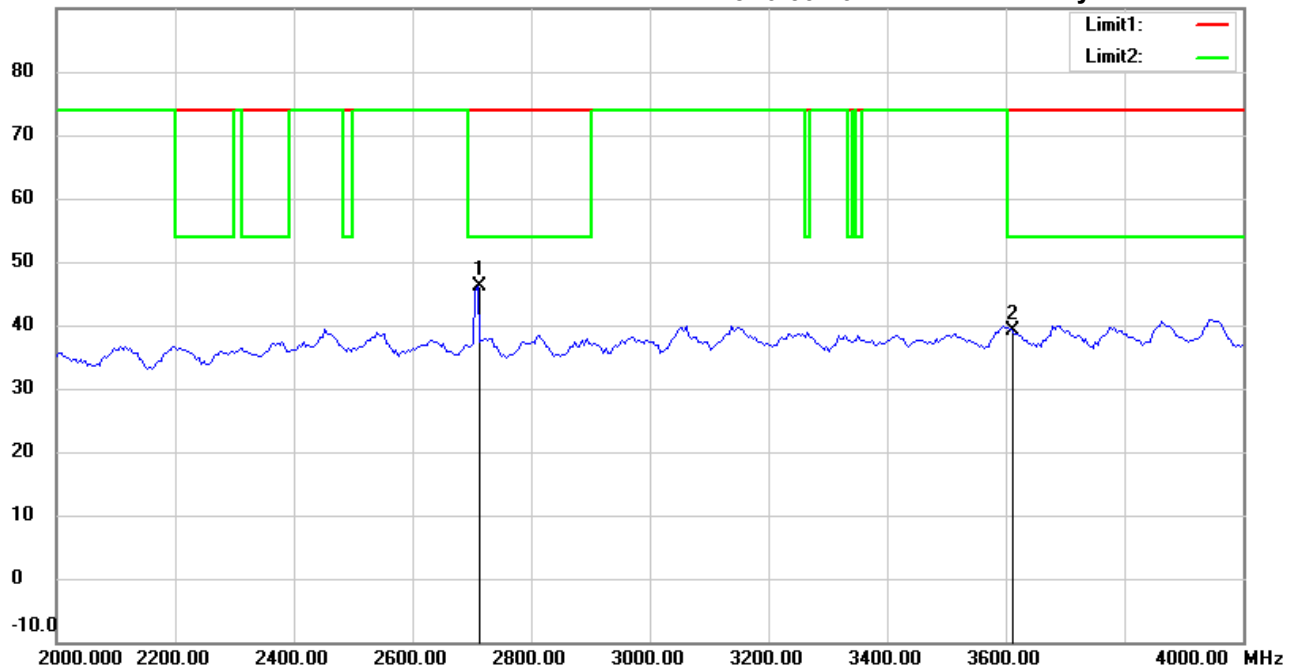
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:53:19 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: **Horizontal**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	2709.419	51.31	peak	-5.29	46.02	74.00	150	185	-27.98	
	3611.000	41.68	peak	-2.64	39.04	74.00	150	290	-34.96	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :3

Data :#6

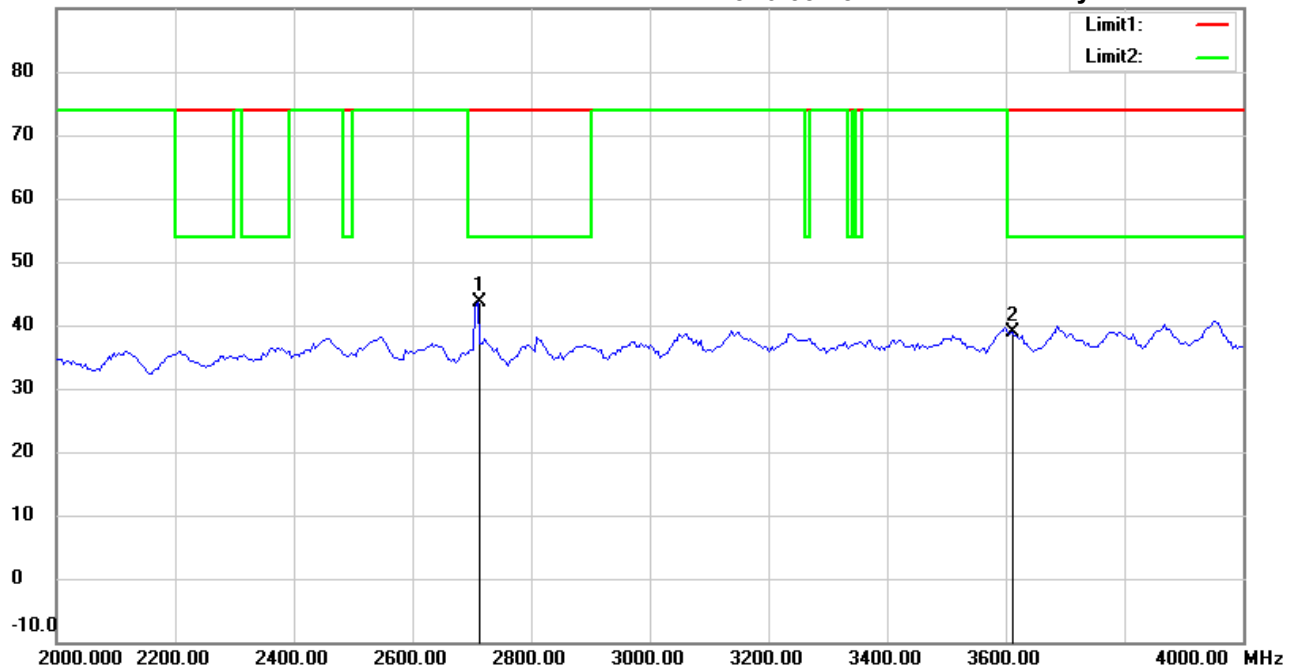
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:58:48 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	2709.419	48.83	peak	-5.29	43.54	74.00	150	70	-30.46	
	3611.000	41.40	peak	-2.64	38.76	74.00	150	325	-35.24	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #3

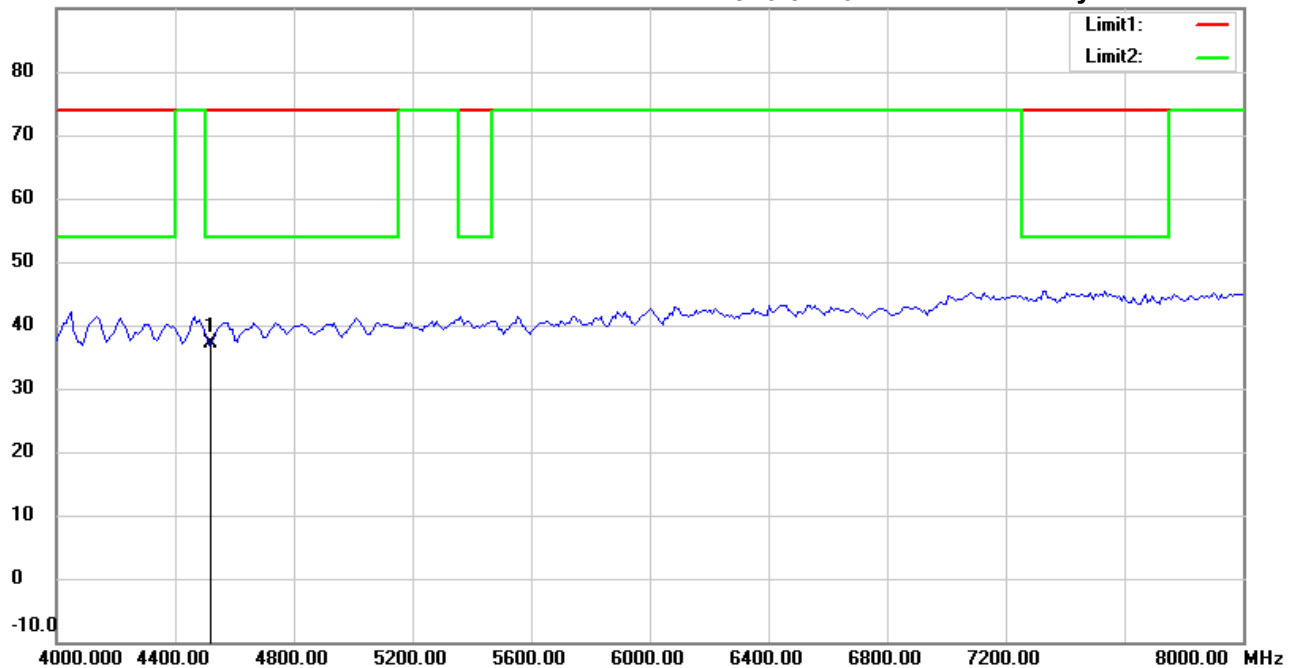
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:54:20 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: **Horizontal**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	4513.750	39.62	peak	-2.46	37.16	74.00	150	310	-36.84	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #7

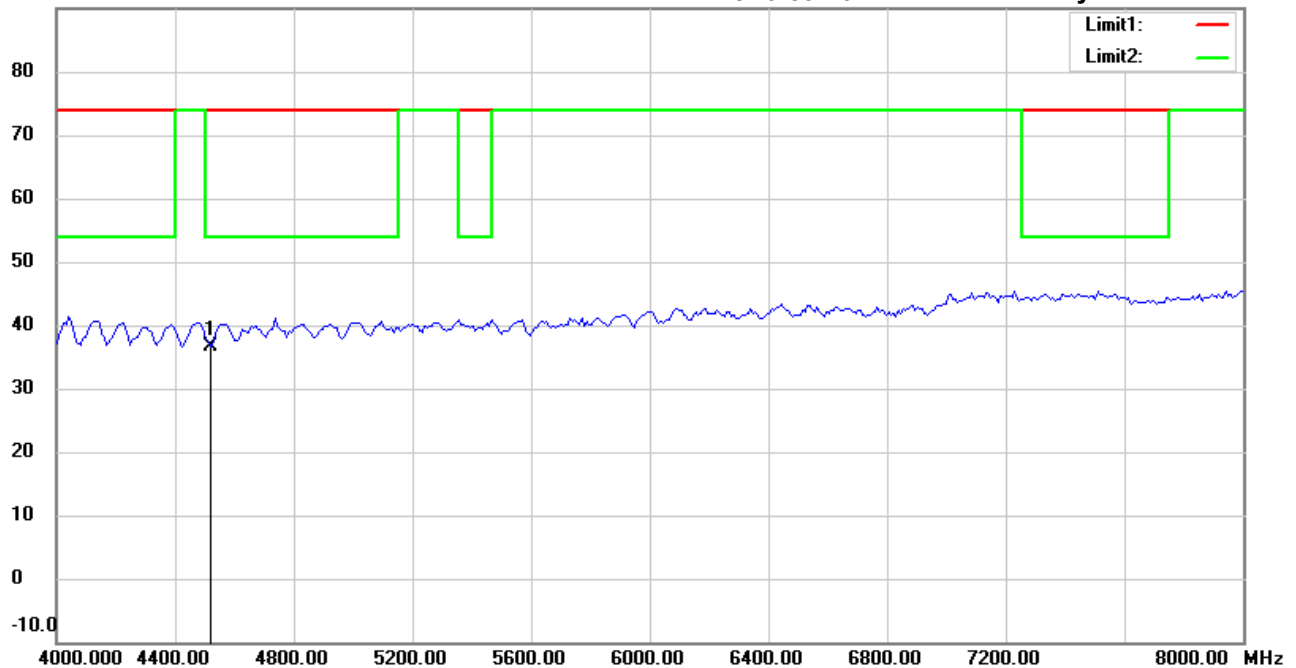
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:59:49 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	4513.750	39.16	peak	-2.46	36.70	74.00	150	10	-37.30	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #4

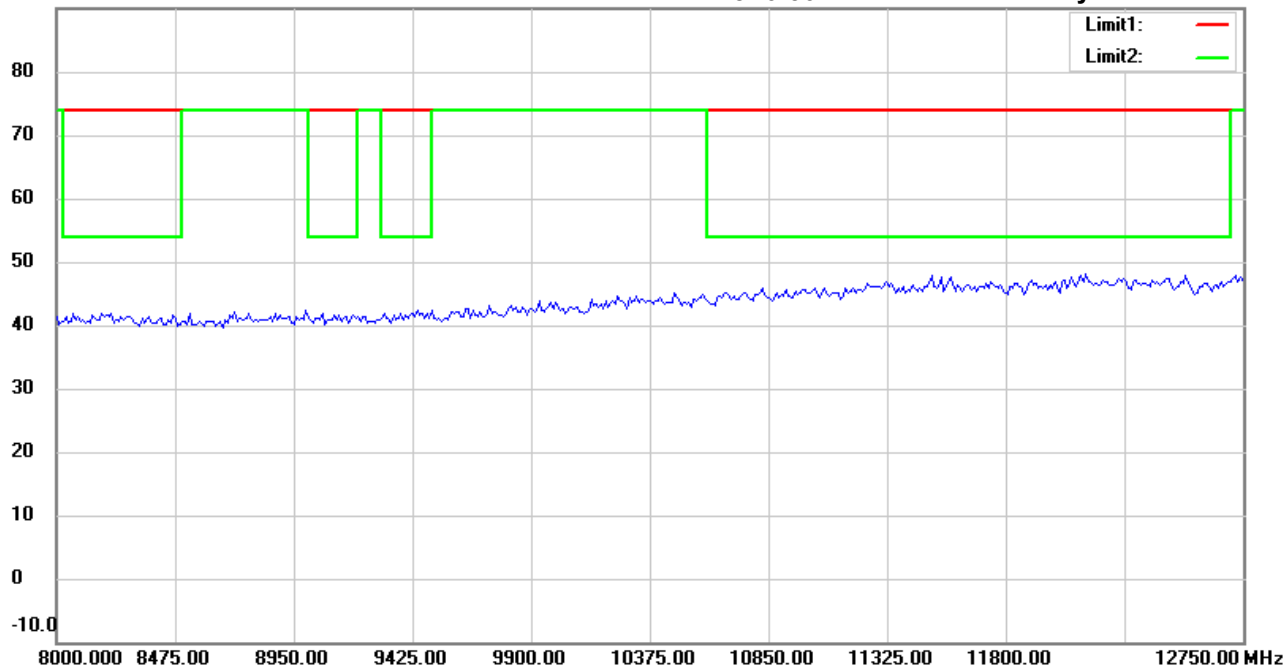
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 6:56:11 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
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*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #8

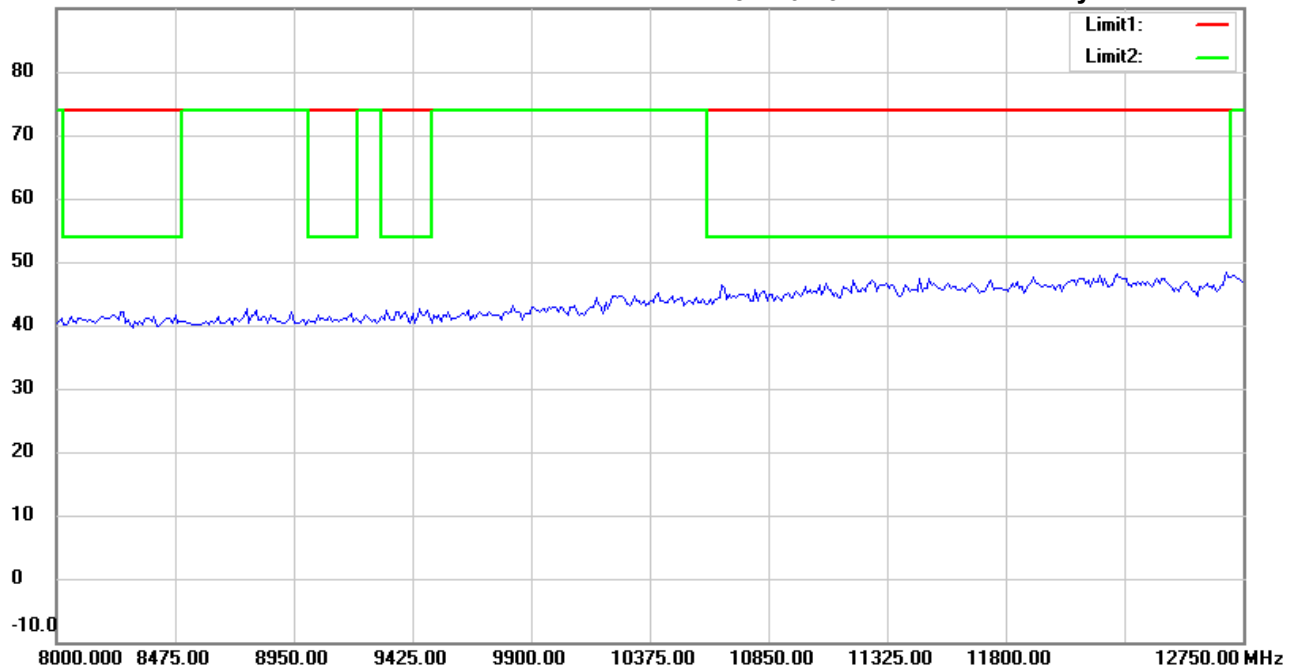
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:01:37 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 902.75MHz

Note :

Polarization: **Vertical**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
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*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :1

Data :#1

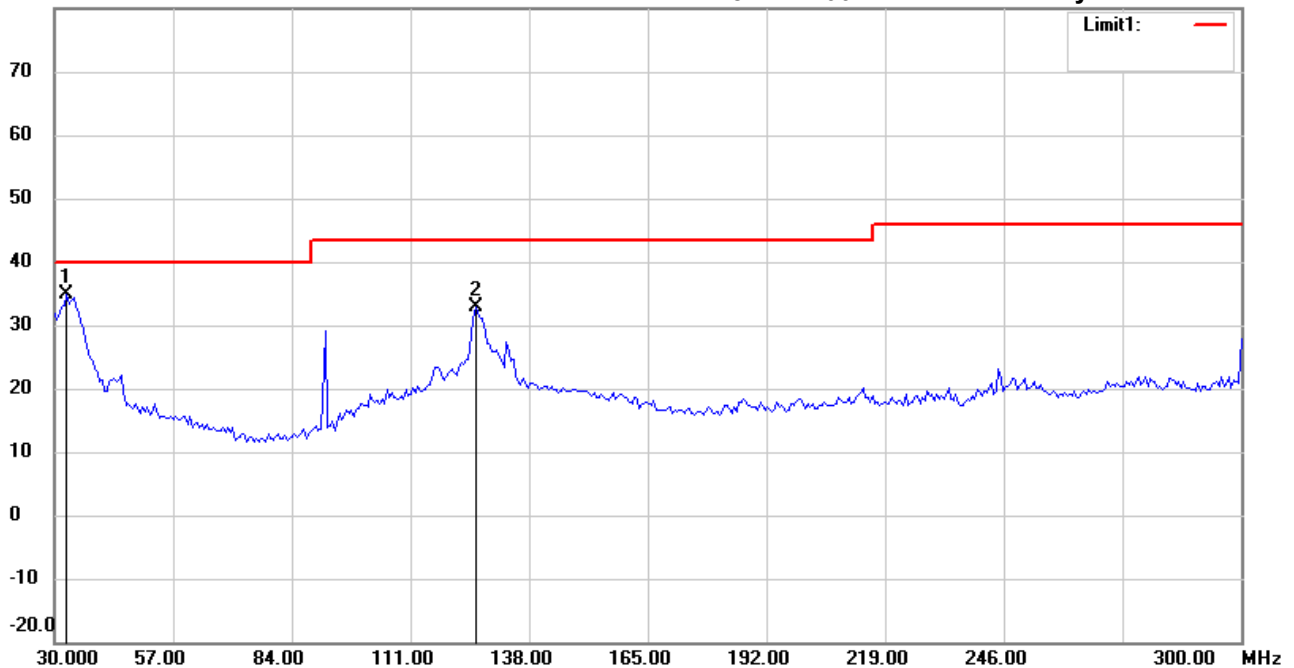
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:11:00 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	32.7054	43.44	peak	-8.50	34.94	40.00	100	215	-5.06	
	125.7715	39.37	peak	-6.41	32.96	43.50	100	70	-10.54	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :1

Data :#2

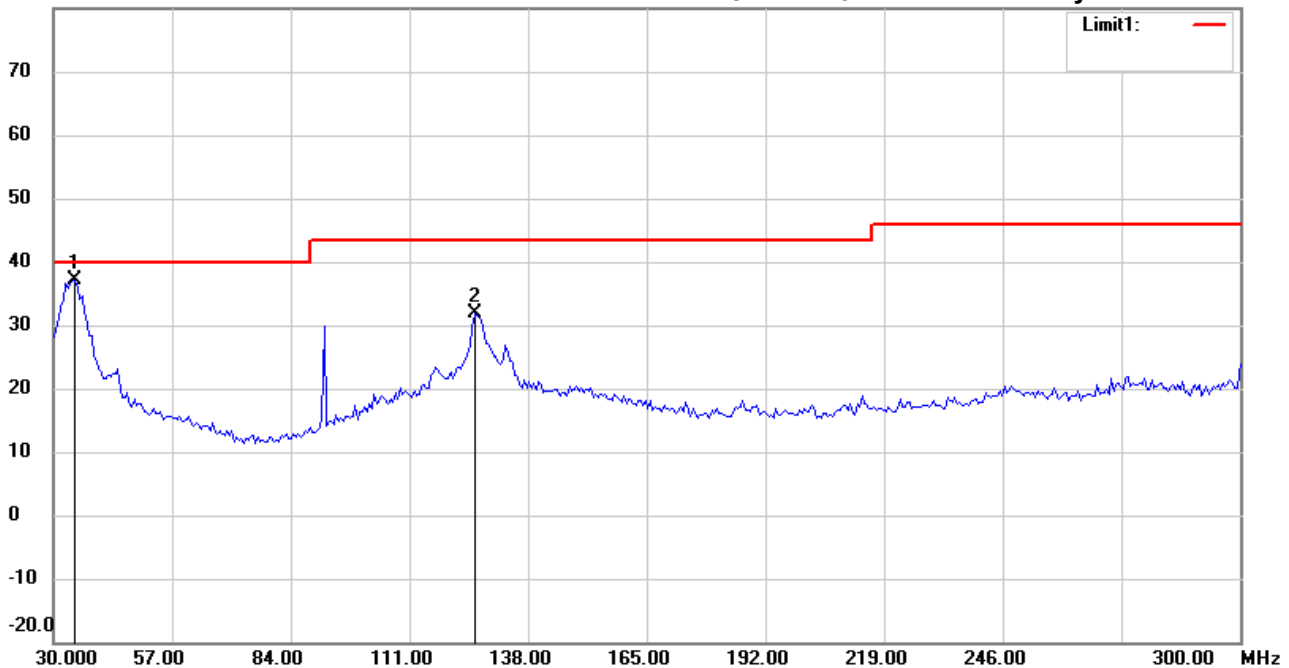
Date: 12/12/2019

Temperature:22.9 °C

80.0 dBuV/m

Time: 4:12:15 AM

Humidity:54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	34.8697	46.04	peak	-8.86	37.18	40.00	100	55	-2.82	
	125.7715	38.33	peak	-6.41	31.92	43.50	100	300	-11.58	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 2

Data : #1

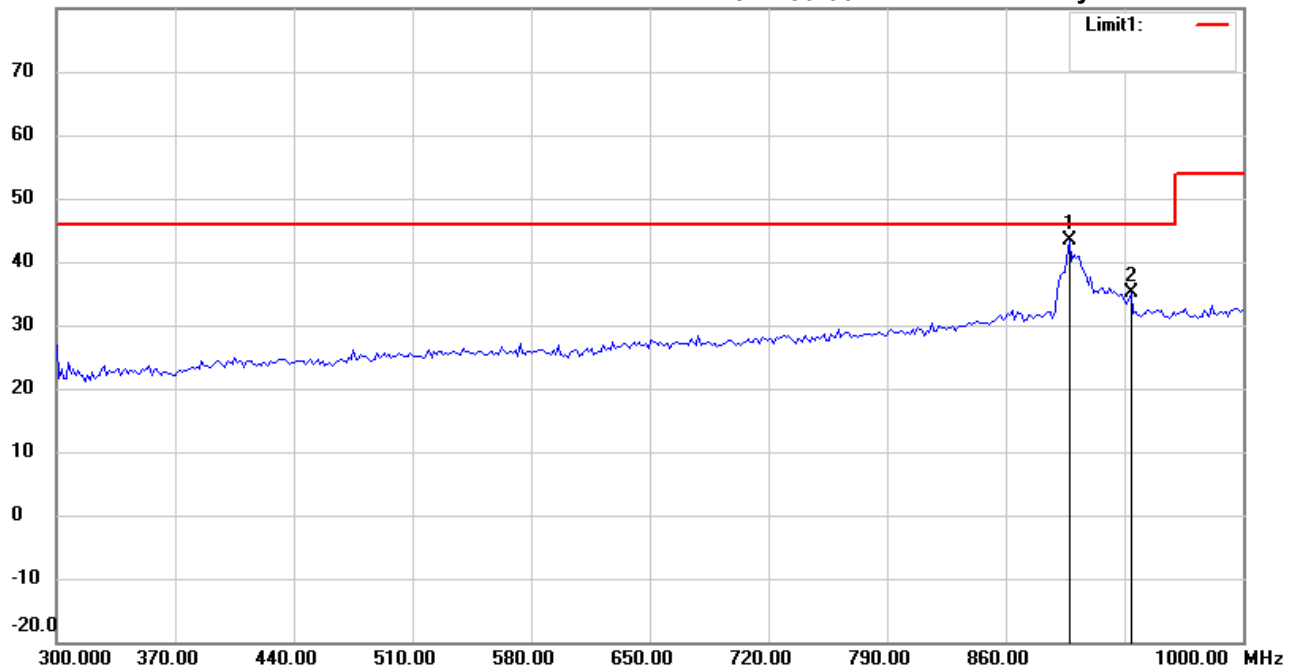
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:50:06 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	897.5952	40.23	peak	3.18	43.41	46.00	100	45	-2.59	
	934.0680	31.16	peak	3.90	35.06	46.00	100	170	-10.94	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 2

Data : #2

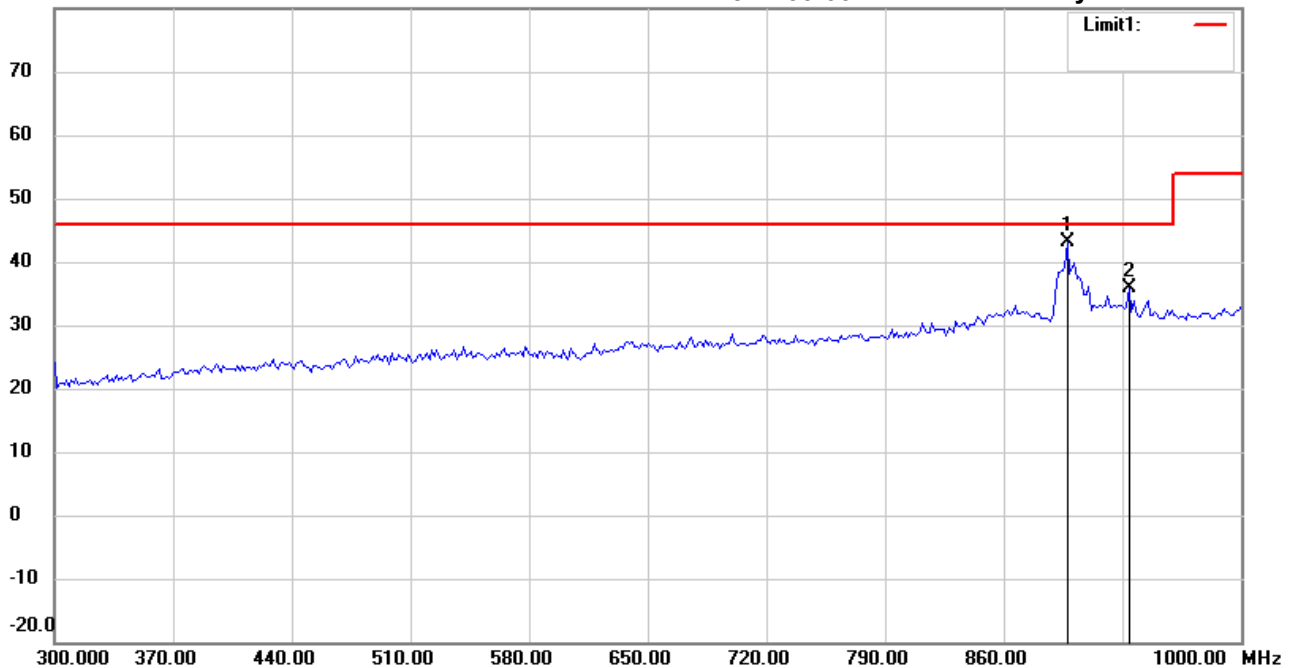
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:55:33 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	897.5952	39.95	peak	3.18	43.13	46.00	100	270	-2.87	
	934.0680	31.95	peak	3.90	35.85	46.00	100	155	-10.15	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #1

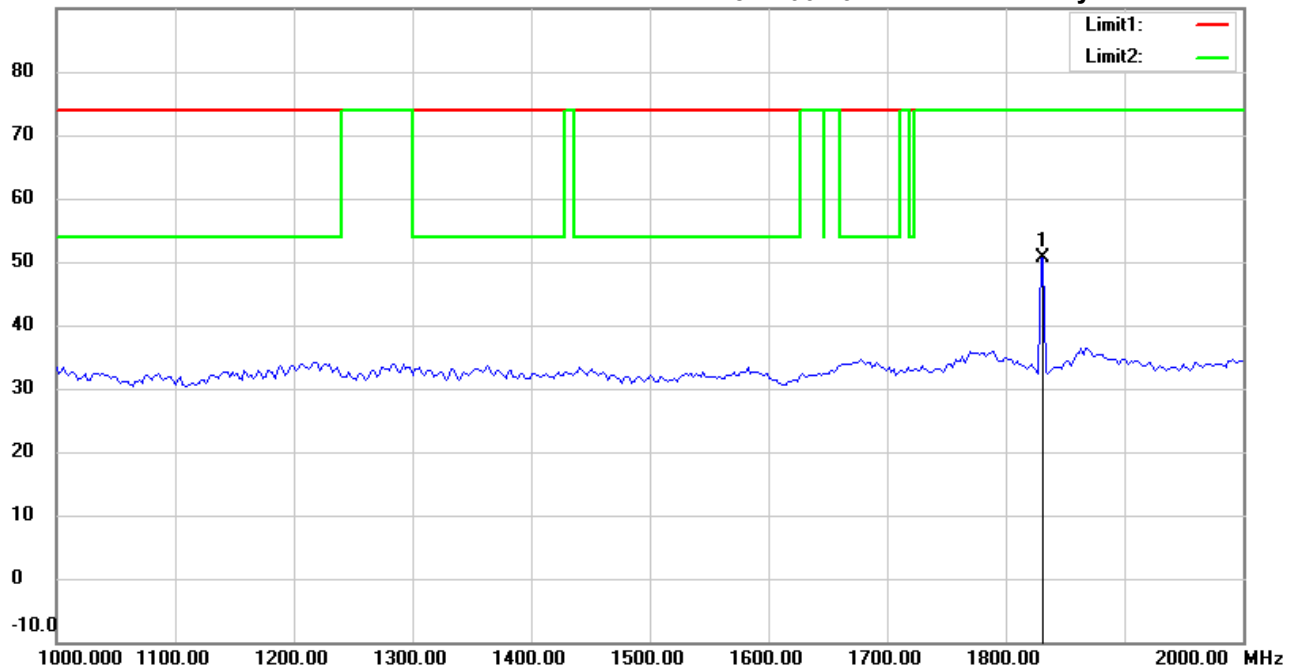
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:06:29 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: **Horizontal**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	1831.663	58.31	peak	-7.63	50.68	74.00	150	165	-23.32	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :3

Data :#5

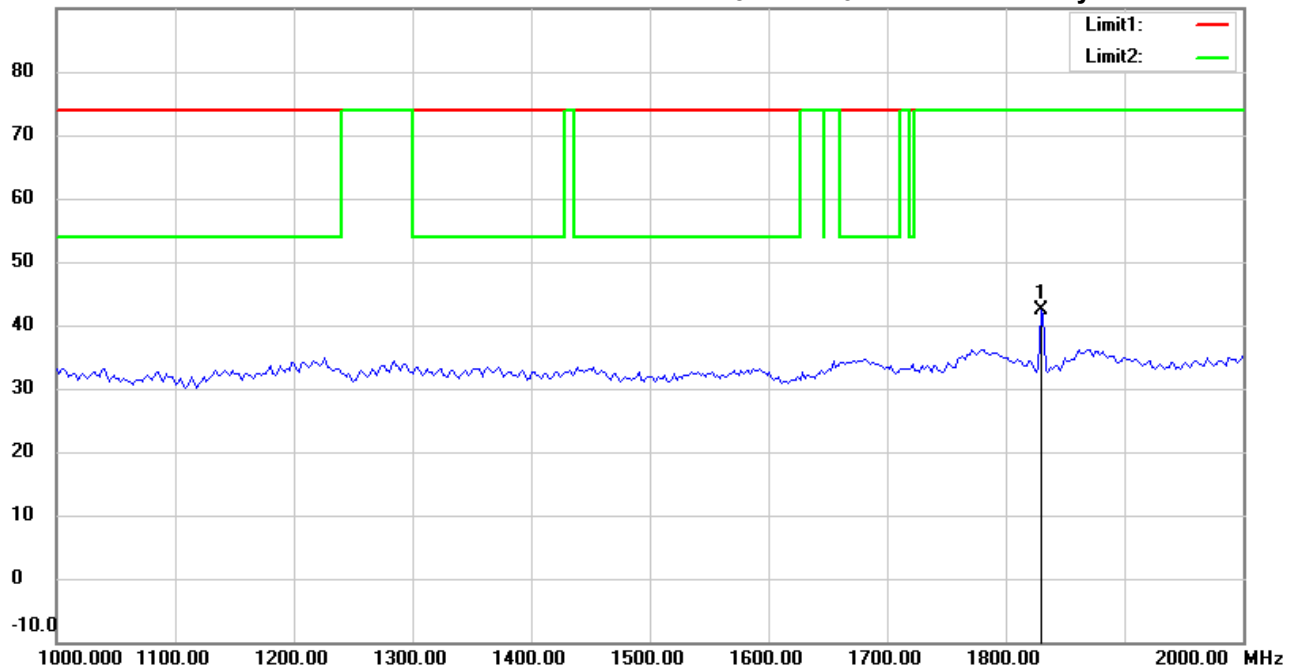
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:12:43 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	1829.659	49.96	peak	-7.63	42.33	74.00	150	20	-31.67	



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Radiated Emission Measurement

Operator: Allen

File :3

Data :#2

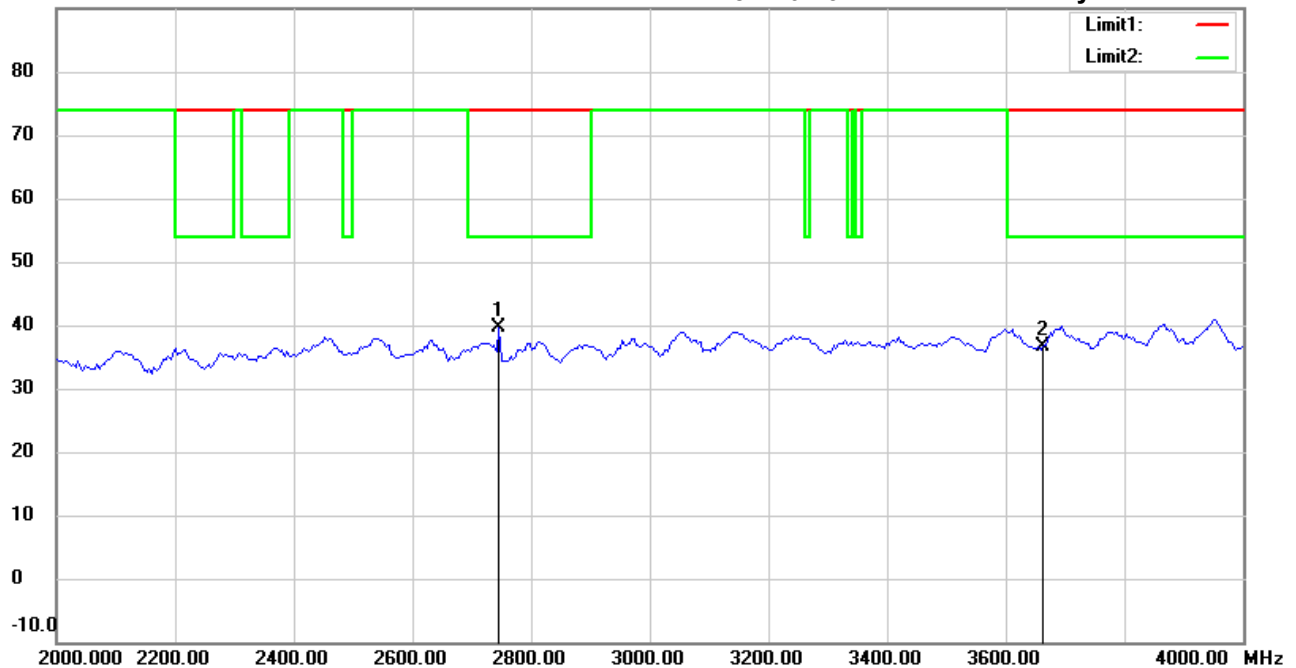
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:07:31 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: **Horizontal**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	2745.491	44.87	peak	-5.24	39.63	74.00	150	230	-34.37	
	3660.000	39.23	peak	-2.60	36.63	74.00	150	0	-37.37	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #6

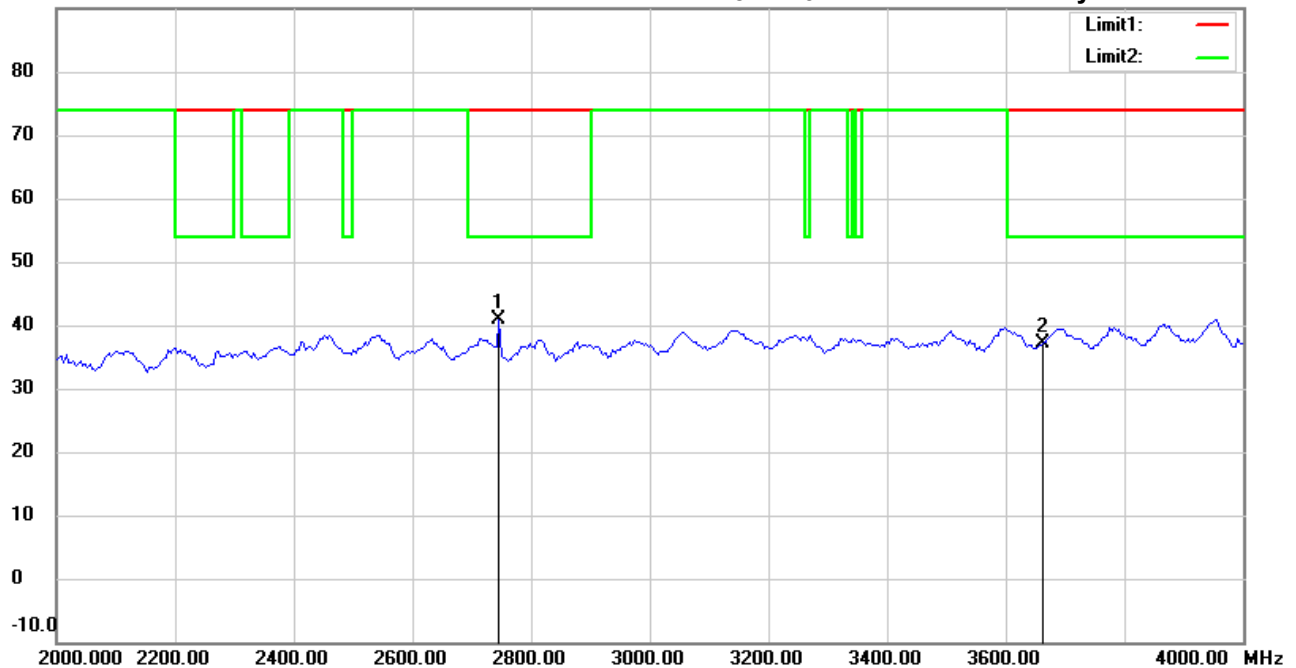
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:13:44 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: **Vertical**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	2745.491	46.04	peak	-5.24	40.80	74.00	150	160	-33.20	
	3660.000	39.64	peak	-2.60	37.04	74.00	150	245	-36.96	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #3

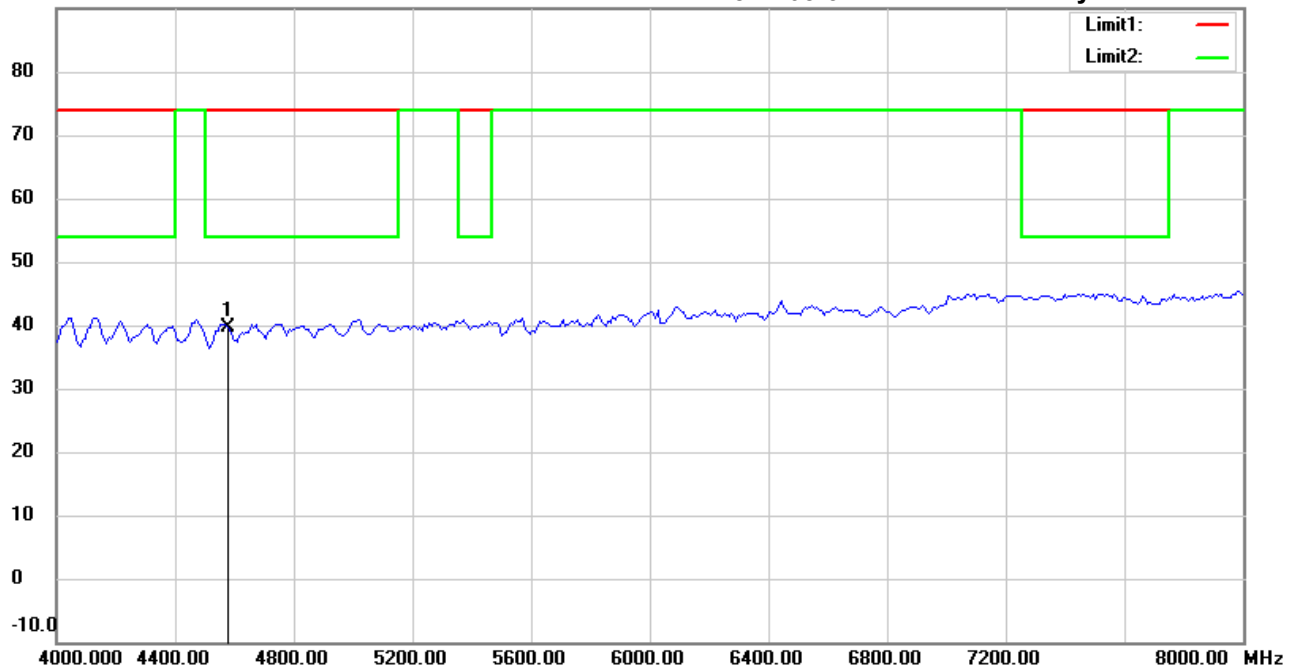
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:08:32 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	4575.000	42.08	peak	-2.42	39.66	74.00	150	205	-34.34	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #7

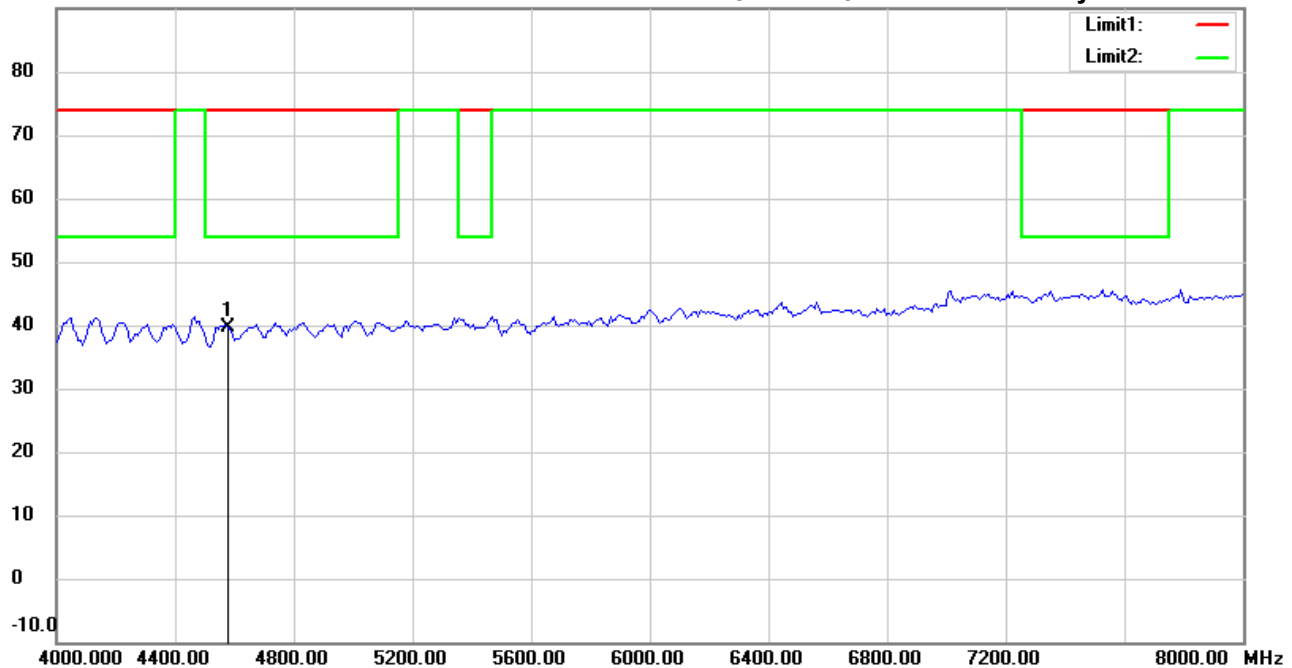
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:14:45 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	4575.000	42.09	peak	-2.42	39.67	74.00	150	155	-34.33	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #4

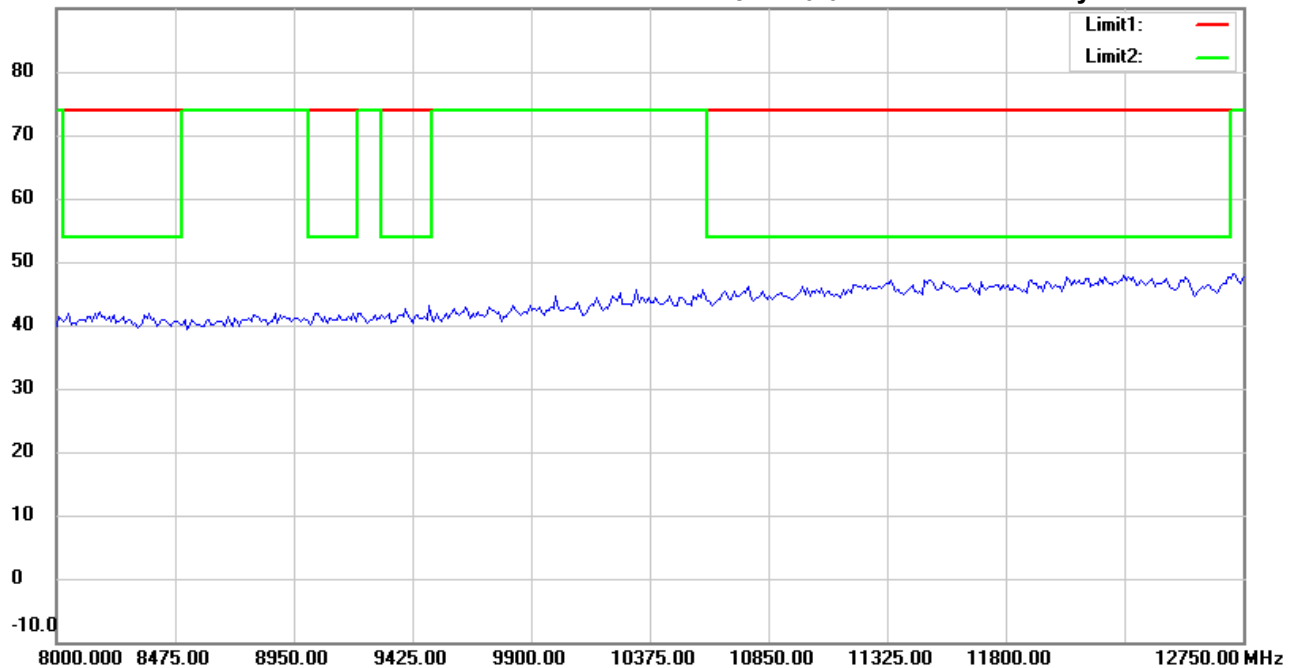
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:10:02 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
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*:Maximum data x:Over limit !:over margin



Address: 6F., No. 58, Ln 188, Ruey Kuang Rd, NeiHu, Taipei
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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #8

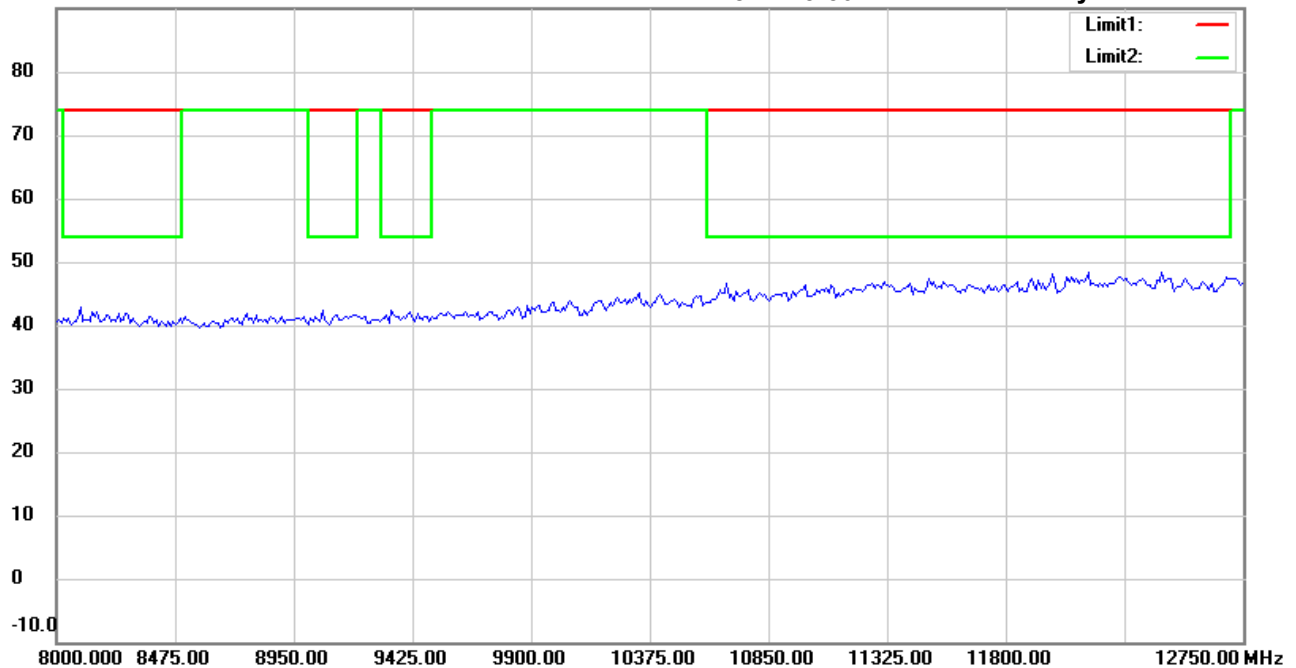
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:15:50 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 915.25MHz

Note :

Polarization: **Vertical**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
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*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :1

Data :#1

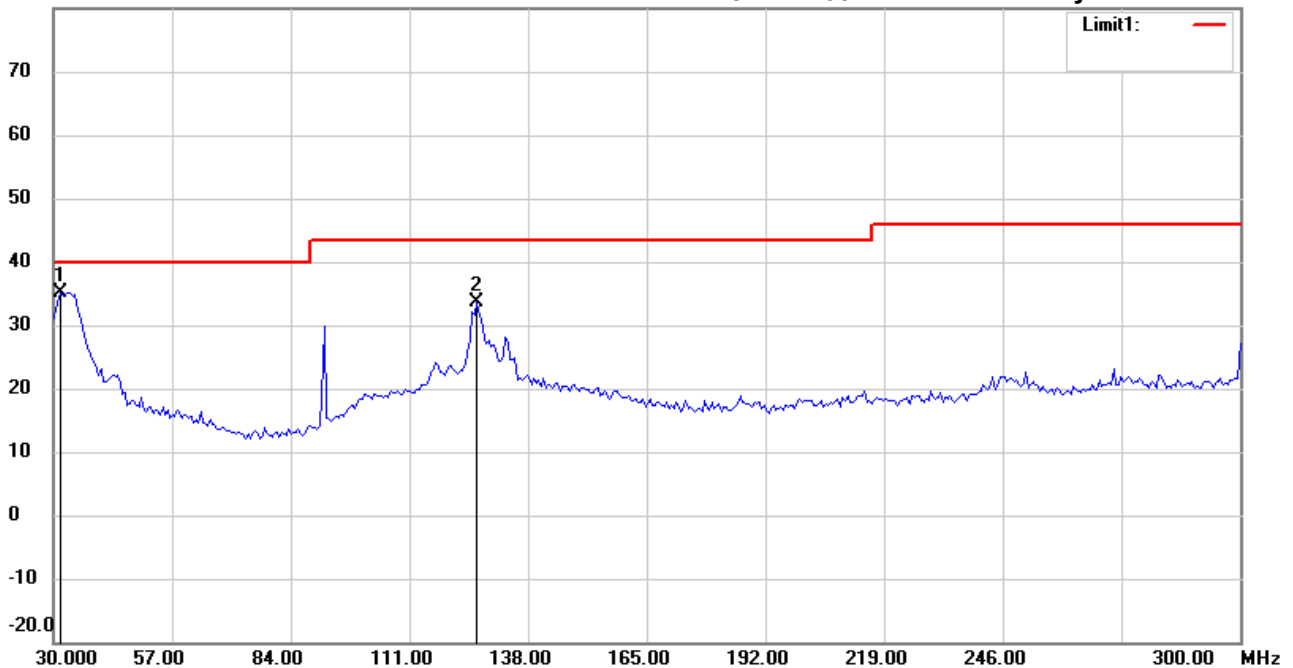
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:24:38 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	31.6232	43.57	peak	-8.32	35.25	40.00	100	65	-4.75	
	126.3126	40.06	peak	-6.40	33.66	43.50	100	40	-9.84	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :1

Data :#2

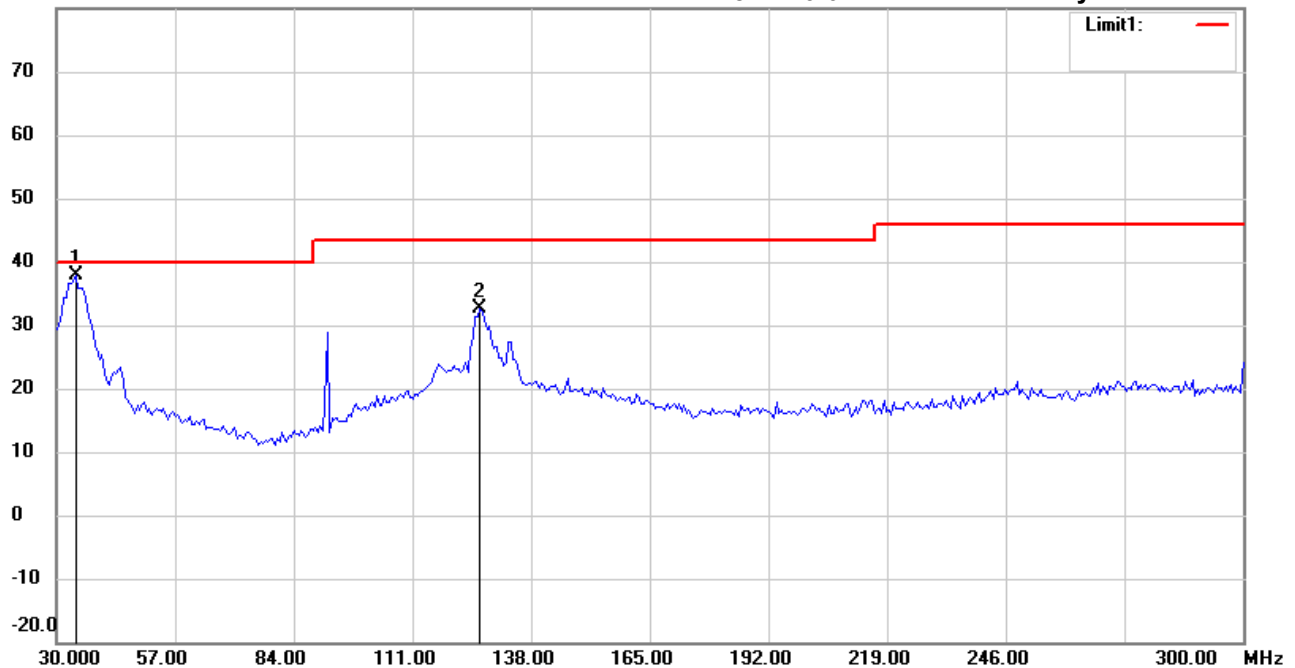
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 4:26:02 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	34.3287	46.74	peak	-8.77	37.97	40.00	100	100	-2.03	
	126.3126	38.95	peak	-6.40	32.55	43.50	100	345	-10.95	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 2

Data : #1

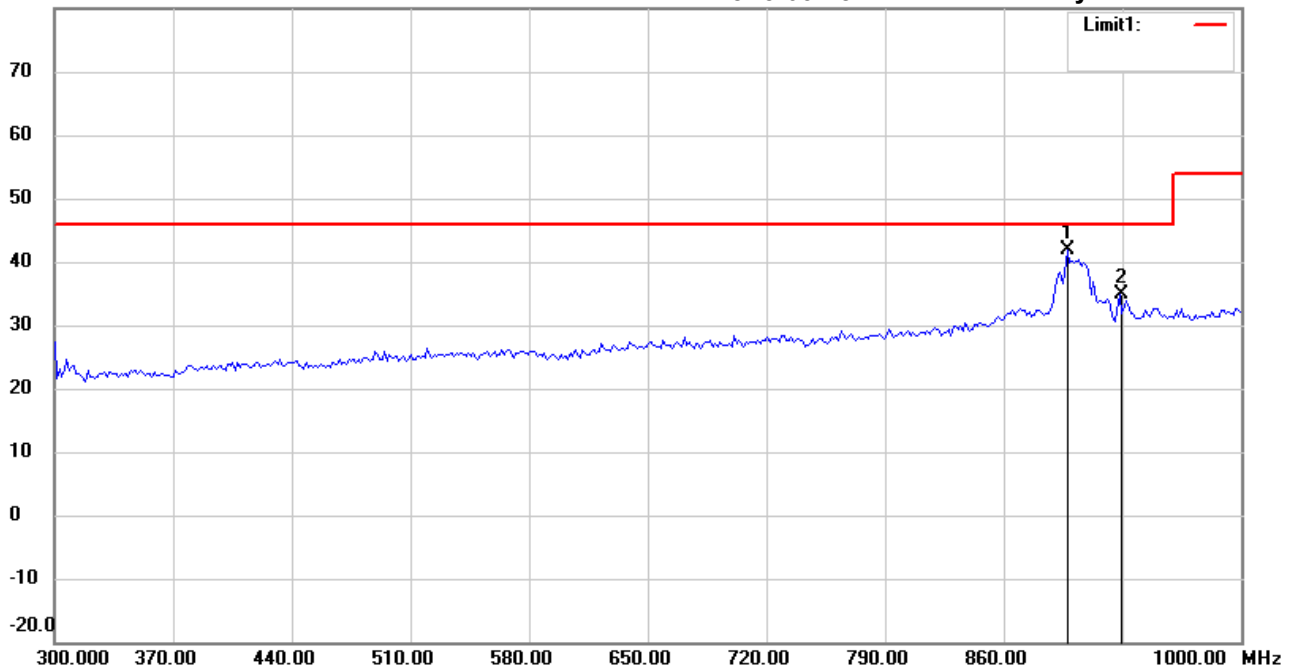
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 5:03:28 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	897.5952	38.78	peak	3.18	41.96	46.00	100	230	-4.04	
	928.4570	31.22	peak	3.78	35.00	46.00	100	145	-11.00	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 2

Data : #2

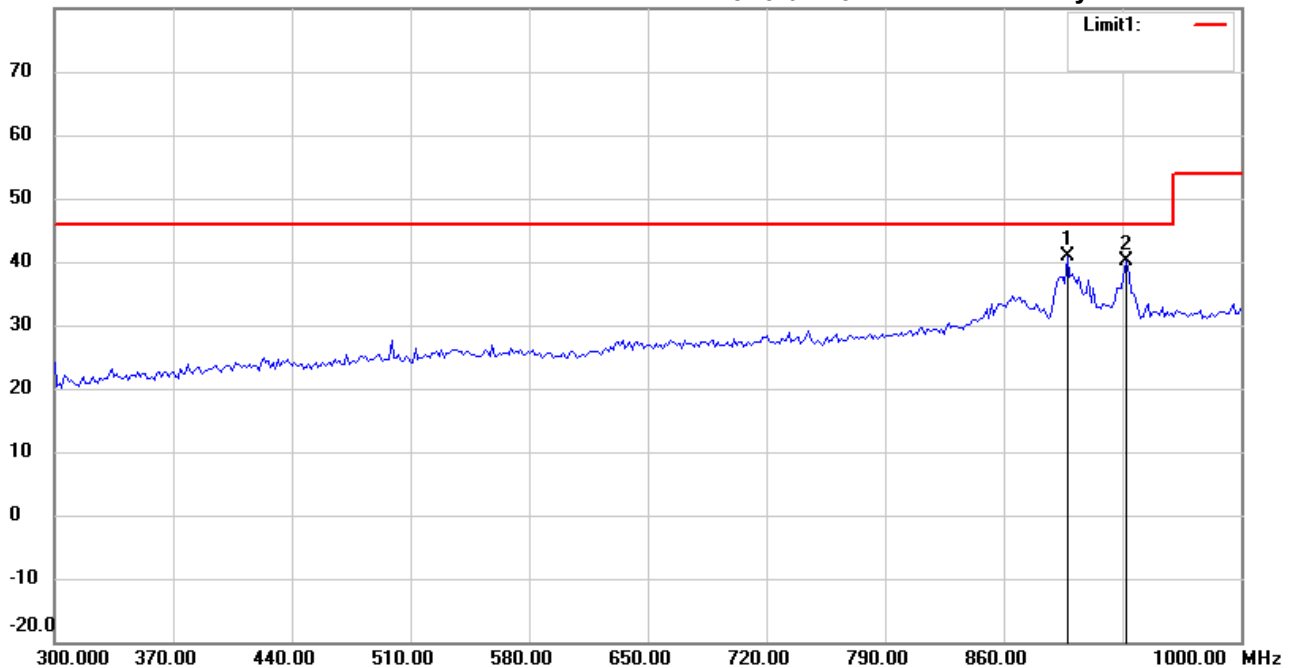
Date: 12/12/2019

Temperature: 22.9 °C

80.0 dBuV/m

Time: 5:07:43 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_30-1000MHz

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	897.5952	37.59	peak	3.18	40.77	46.00	100	250	-5.23	
	932.6653	36.26	peak	3.87	40.13	46.00	100	136	-5.87	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #1

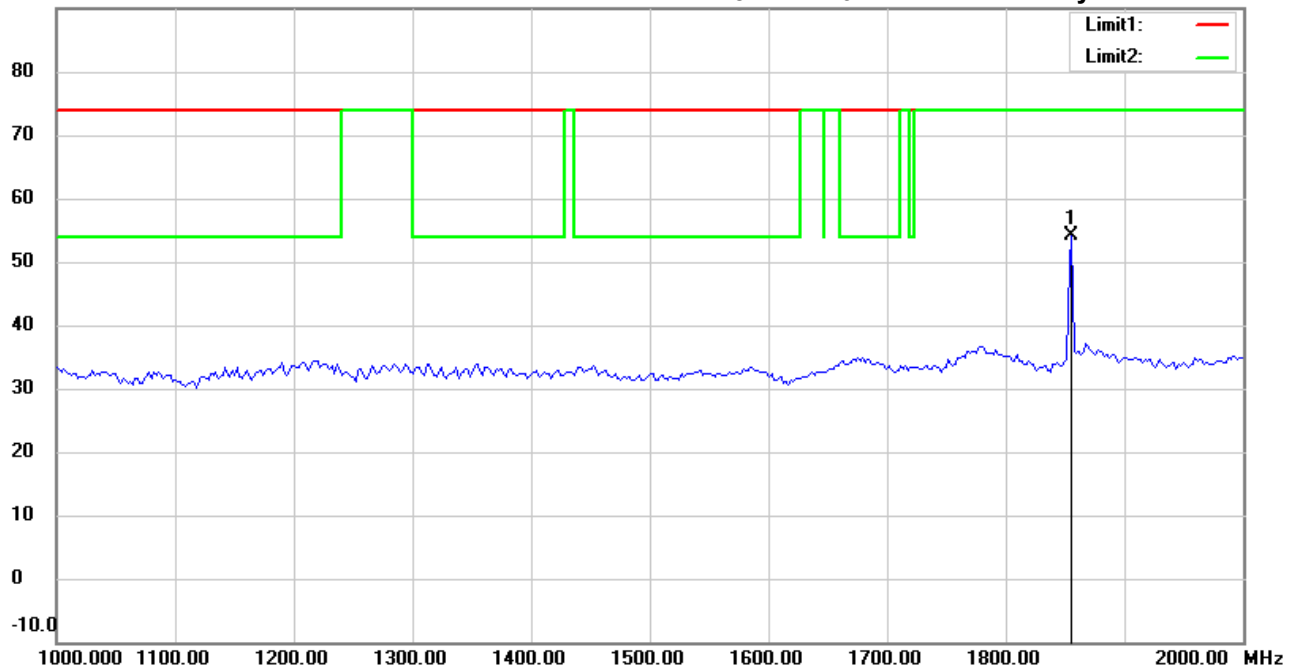
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:21:19 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: **Horizontal**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	1855.711	61.75	peak	-7.63	54.12	74.00	150	180	-19.88	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #5

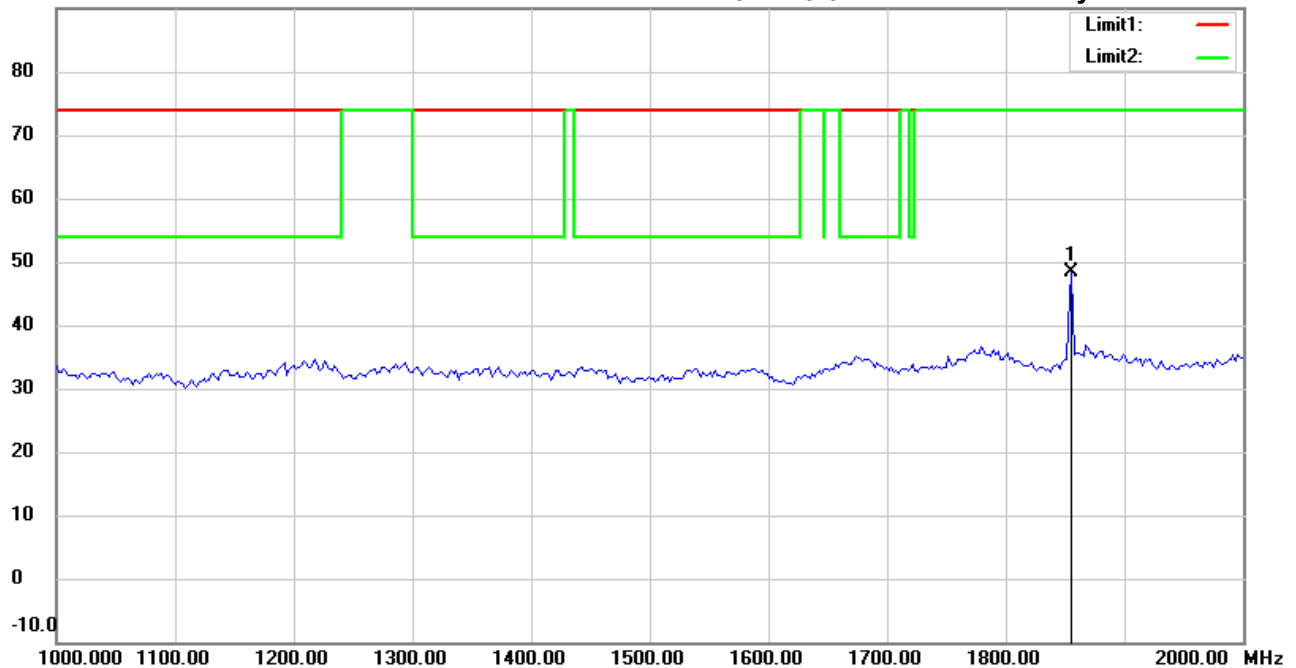
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:25:52 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: Vertical

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	1855.711	55.93	peak	-7.63	48.30	74.00	150	150	-25.70	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :3

Data :#2

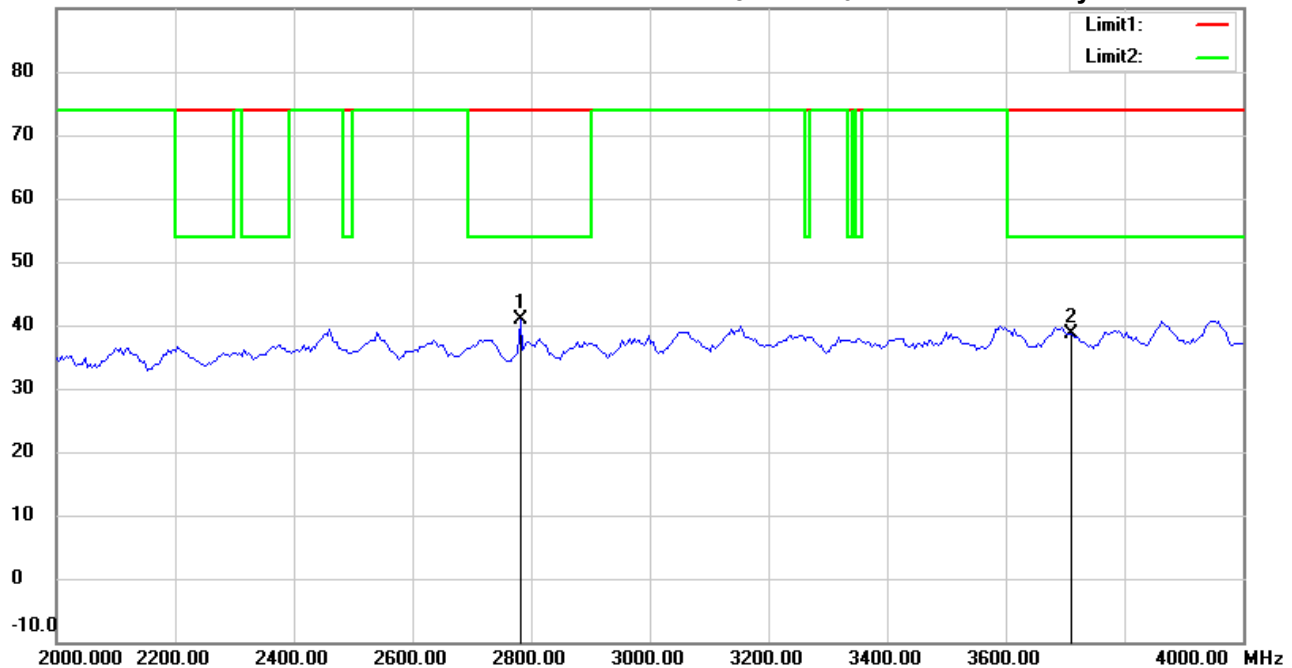
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:22:20 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	2781.563	46.01	peak	-5.19	40.82	74.00	150	55	-33.18	
	3709.000	41.23	peak	-2.61	38.62	74.00	150	330	-35.38	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #6

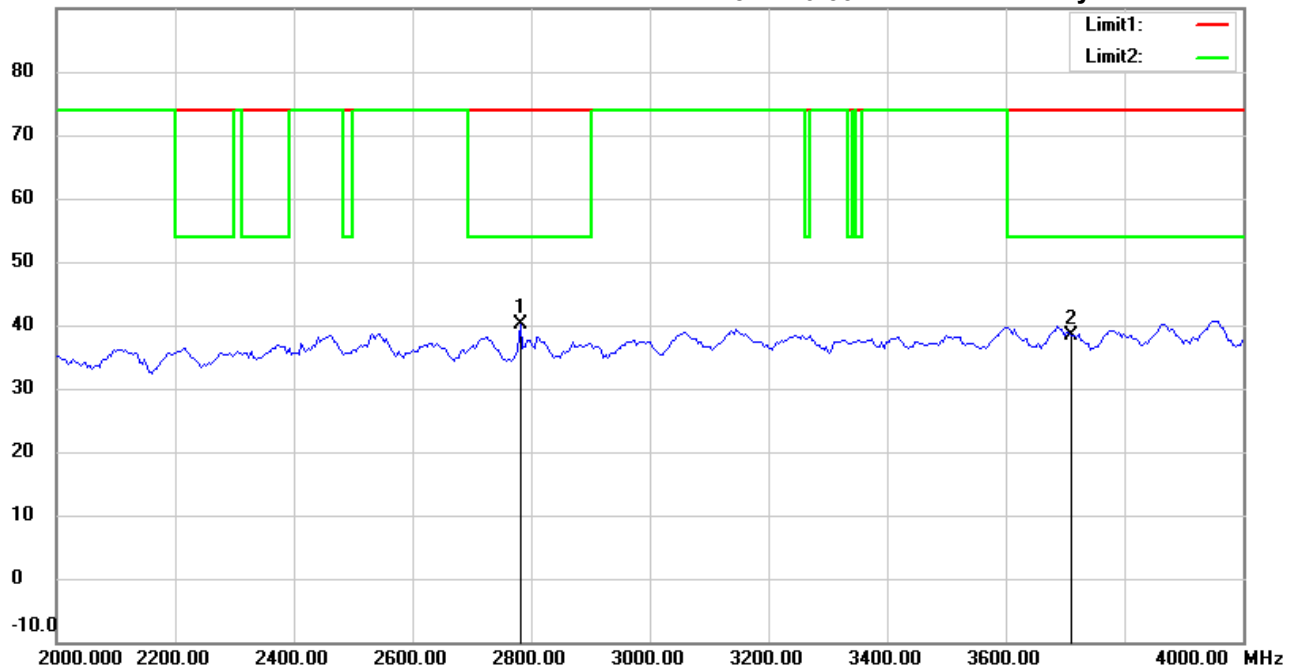
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:26:53 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: **Vertical**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	2781.563	45.24	peak	-5.19	40.05	74.00	150	260	-33.95	
	3709.000	41.09	peak	-2.61	38.48	74.00	150	95	-35.52	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #3

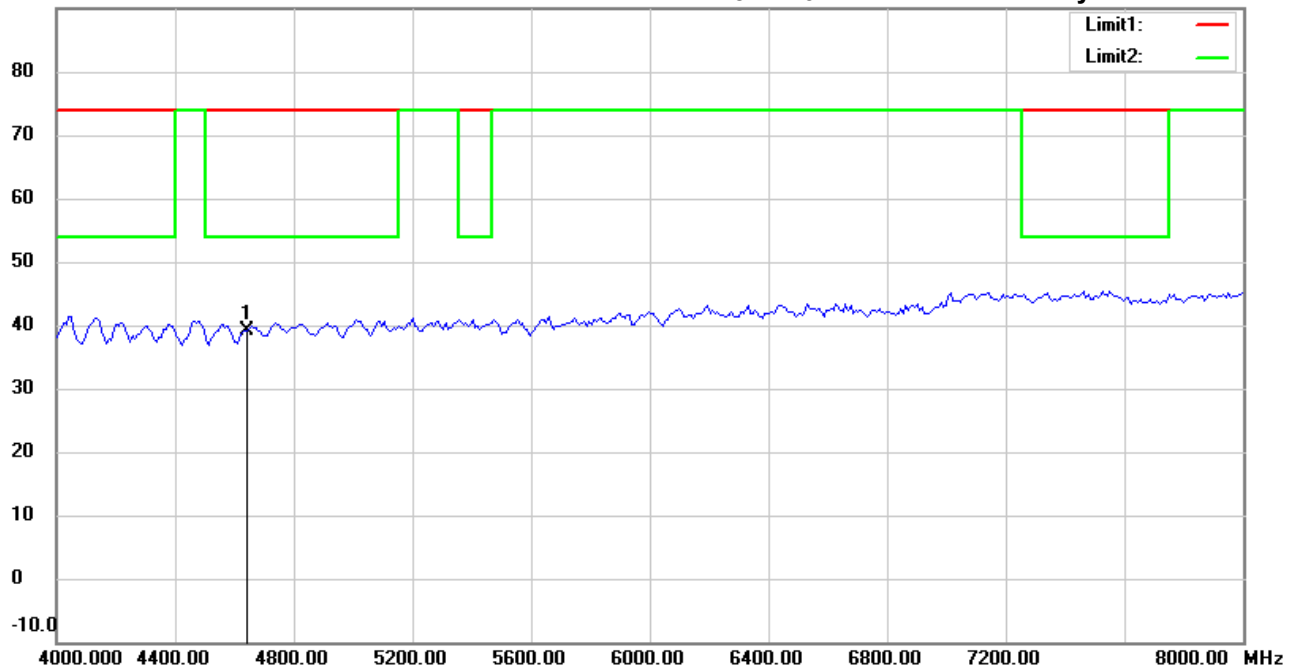
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:23:21 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	4636.250	41.71	peak	-2.49	39.22	74.00	150	215	-34.78	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File : 3

Data : #7

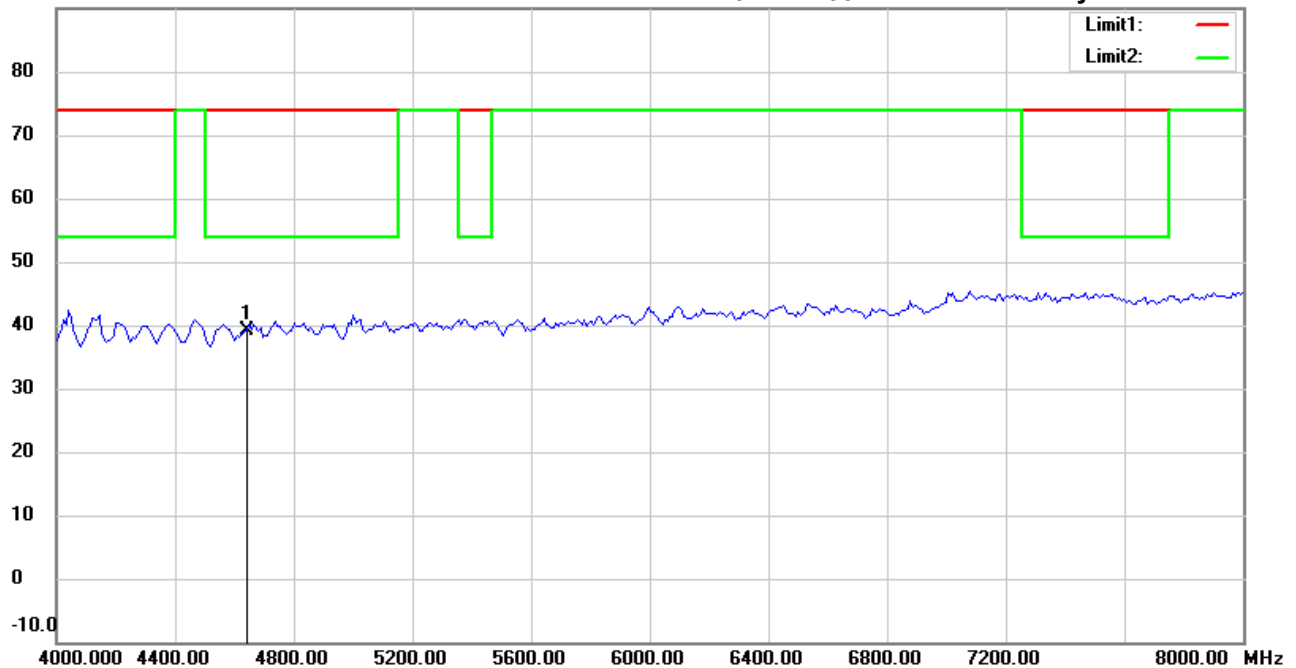
Date: 12/12/2019

Temperature: 22.9 °C

90.0 dBuV/m

Time: 7:27:55 AM

Humidity: 54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: **Vertical**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
*	4636.250	41.68	peak	-2.49	39.19	74.00	150	70	-34.81	

*:Maximum data x:Over limit !:over margin



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Radiated Emission Measurement

Operator: Allen

File :3

Data :#4

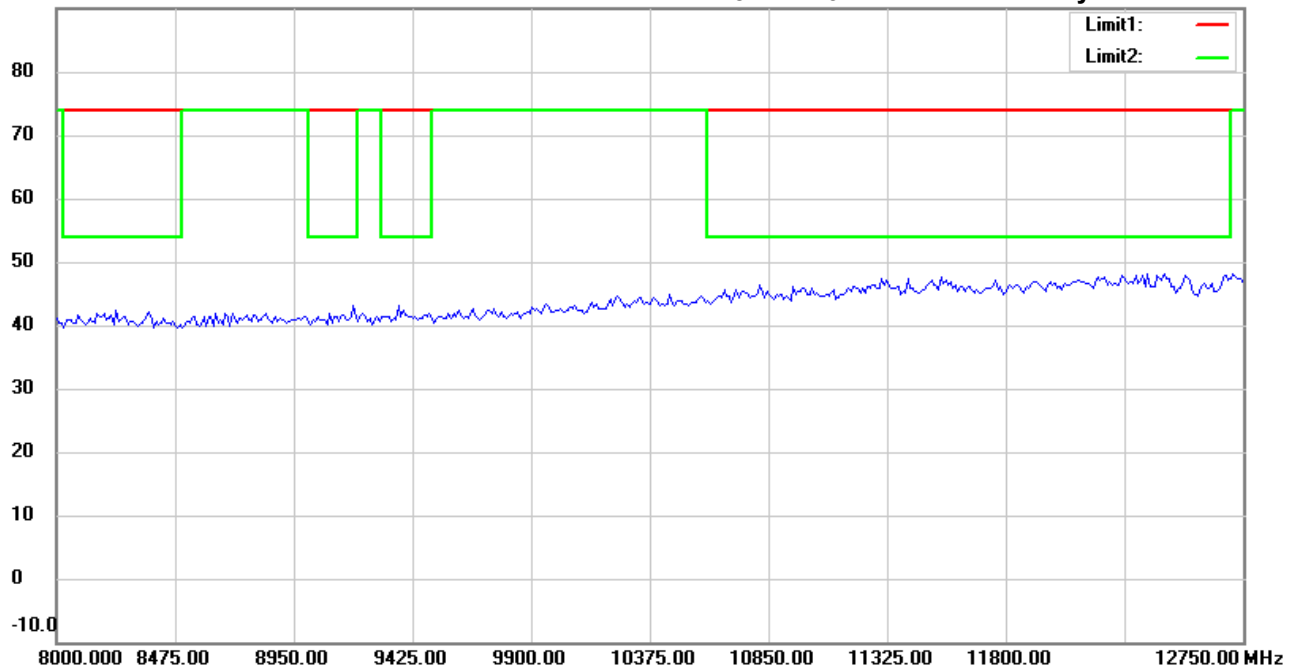
Date: 12/12/2019

Temperature:22.9 °C

90.0 dBuV/m

Time: 7:24:34 AM

Humidity:54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: *Horizontal*

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
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Radiated Emission Measurement

Operator: Allen

File :3

Data :#8

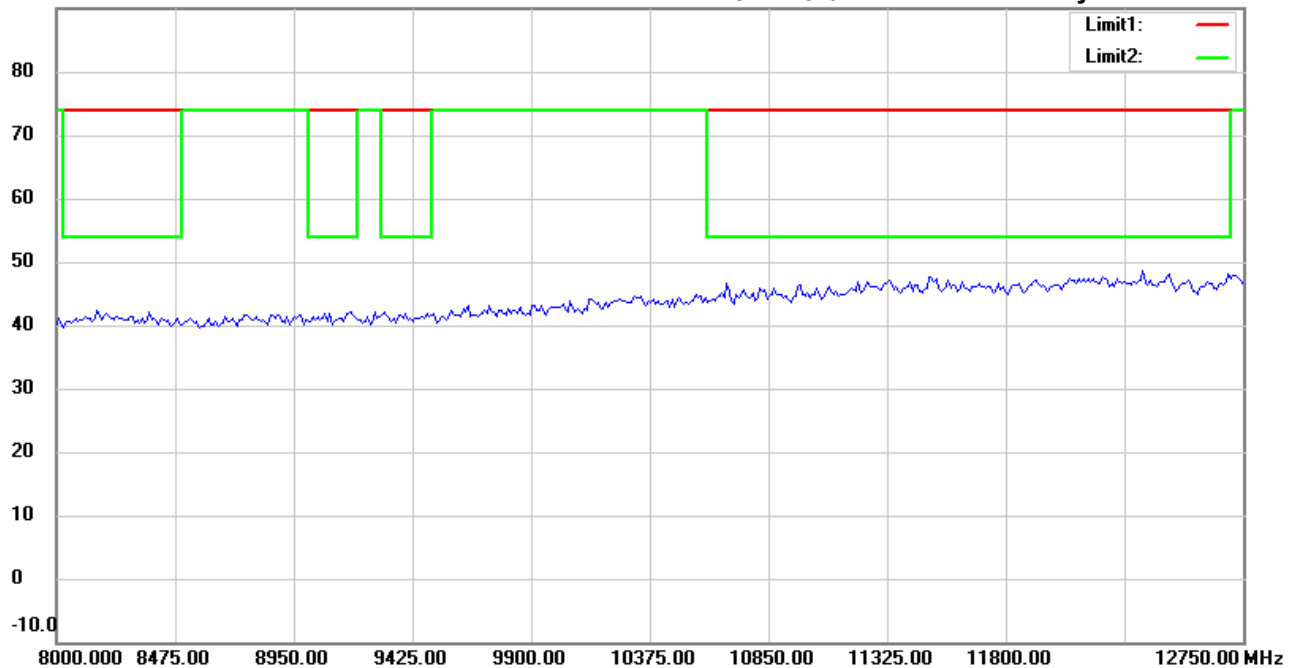
Date: 12/12/2019

Temperature:22.9 °C

90.0 dBuV/m

Time: 7:29:07 AM

Humidity:54.3 %



Site : Chamber

Condition : FCC_part 15 RE-Class C_Above 1GHz_PK

EUT : W6M21907-19195

M/N:

Test Mode : TX 927.25MHz

Note :

Polarization: **Vertical**

Power : 12 Vd.c.

Distance: 3m

Mk.	Frequency (MHz)	Reading (dBuV)	Detector	Corr. factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Ant.Pos (cm)	Tab.Pos (deg.)	Margin (dB)	Comment
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*:Maximum data x:Over limit !:over margin