REPORT No.：SZ18080066E01

TEST REPORT

APPLICANT	:	MiMOMax Wireless Limited
PRODUCT NAME	:	800MHz Tornado Transceiver
MODEL NAME	:	MWL-TORNADO-*E A/B/C*
BRAND NAME	:	MiMOMax Wireless
STANDARD(S)	:	47 CFR Part 15 Subpart A and B
FCC ID	:	XMK-MMXTRNB00
RECEIPT DATE	:	2018-08-16
TEST DATE	:	2018-09-17 to 2018-09-18
ISSUE DATE	:	2020-03-03

Edited by: Zeng Jianqing(Rapporteur)

Approved by: Jack Zheng(Supervisor)

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MORLAB

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DIRECTORY

Change History		
Version	**Date**	**Reason for change**
1.0	2020-03-03	First edition

1. Technical Information

Note: Provide by applicant

1.1. Applicant and Manufacturer Information

Applicant:	MiMOMax Wireless Limited
Applicant Address:	540 Wairakei Road, Christchurch, 8053 New Zealand
Manufacturer:	MiMOMax Wireless Limited
Manufacturer Address:	540 Wairakei Road, Christchurch, 8053 New Zealand

1.2. Equipment Under Test (EUT) Description

EUT Type:	800MHz Tornado Transceiver
Serial No:	UUT 1:23001213 UUT2:23001212
Hardware Version:	IP001
Software Version:	R04.03.04
Tx Frequency:	806.0~824.0MHz; 851.0~869.0MHz
Rx Frequency:	851.0~869.0MHz; 806.0~824.0MHz
Operating Voltage:	10.5-60Vdc(Isolated)

Note: For a more detailed description, please refer to specification or user's manual supplied by the applicant and/or manufacturer.

2. Test Results

2.1. Applied Reference Documents

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart A and B:

No.	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are listed as below:

No.	Section	Description	Test Date	Test Engineer	Result	Method determination Remark
1	15.101	Equipment authorization requirement	Receiver contained within a FCC Part 90 transceiver that has been certified. The receiver has therefore been verified.			No deviation
2	15.103	Exempted devices	Device is not exempt as it is a receiver that contains a digital device			No deviation
3	15.107	Conducted Emission	Not applicable			N/A Note 1
4	15.109	Radiated Emissions	2018.09.18	Wang Dalong	PASS	No deviation
5	15.111	Antenna Terminal Disturbance	2018.09.17	Wang Dalong	PASS	No deviation

Note 1: The test item is not applicable.

Note 2: Additions to, deviation, or exclusions from the method shall be judged in the"method determination" column of add,deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

Note 3: TORNADO TRANSCEIVER complies with FCC Part 15 Subparts A and B as a Class B Unintentional Radiator. Tests were performed according to the method of measurements prescribed in ANSI C63.4-2014.

2.2. EUT Setup and Operating Conditions

Test Item	
Radiated Emission	
Mode 1 :	EUT + Ethernet Line + DC Power + PC

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 - 60
Atmospheric Pressure (kPa):	86 - 106

Receiver Test Frequencies:

Transmit Frequency (MHz)	Receiver Frequency (MHz)	Channel Bandwidth (KHz)	Modes of operation
806.00625	851.00625	12.5	QPSK,16QAM,64QAM,256QAM
815.00000	860.00000	25	QPSK,16QAM,64QAM,256QAM
823.89750	868.98750	25	QPSK,16QAM,64QAM,256QAM
851.00625	806.00625	12.5	QPSK,16QAM,64QAM,256QAM
860.00000	815.00000	25	QPSK,16QAM,64QAM,256QAM
868.98750	823.98750	25	QPSK,16QAM,64QAM,256QAM

3. 47 CFR Part 15B Requirements

3.1. Radiated Emission

3.1.1. Requirement

According to FCC section 15.109 (a), the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency range (MHz)	Field Strength Limitation at 3m Measurement Distance	
	(μV/m)	(dBμV/m)
30.0 - 88.0	100	20log 100
88.0 - 216.0	150	20log 150
216.0 - 960.0	200	20log 200
Above 960.0	500	20log 500

As shown in FCC section 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector. When average radiated emission measurements are specified in this part, including emission measurements below 1000MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

Note:

1) The tighter limit shall apply at the boundary between two frequency range.
2) Limitation expressed in dBμV/m is calculated by 20log Emission Level(μV/m).

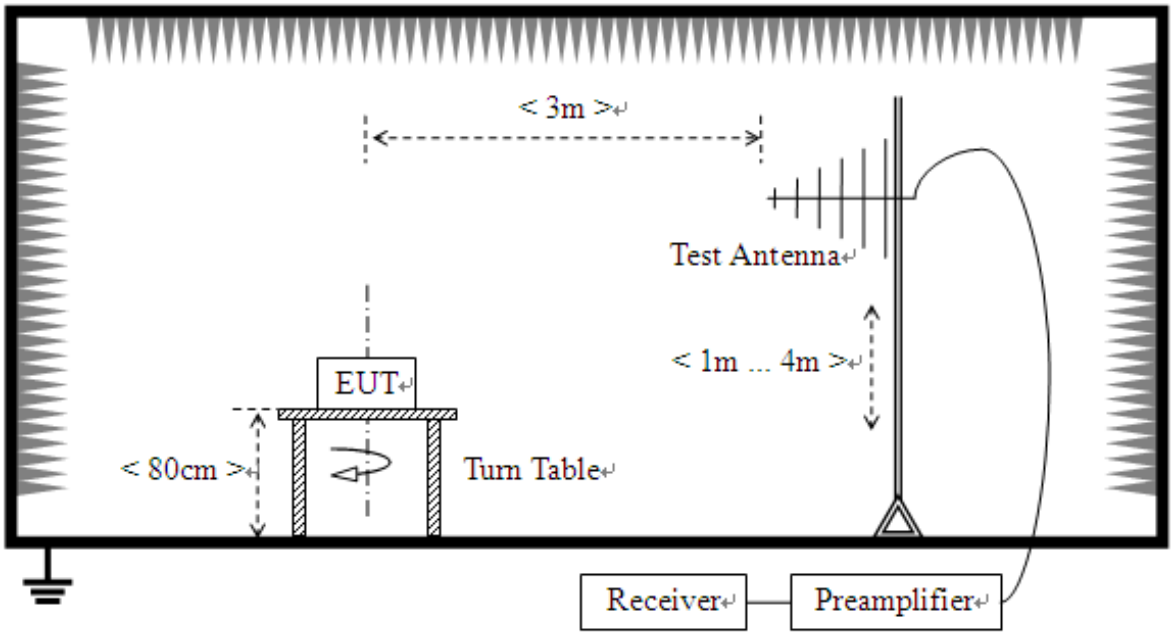
3.1.2. Frequency range of measurement

According to 15.33(b)(1), the frequency range of radiated measurement for the EUT is listed in the following table:

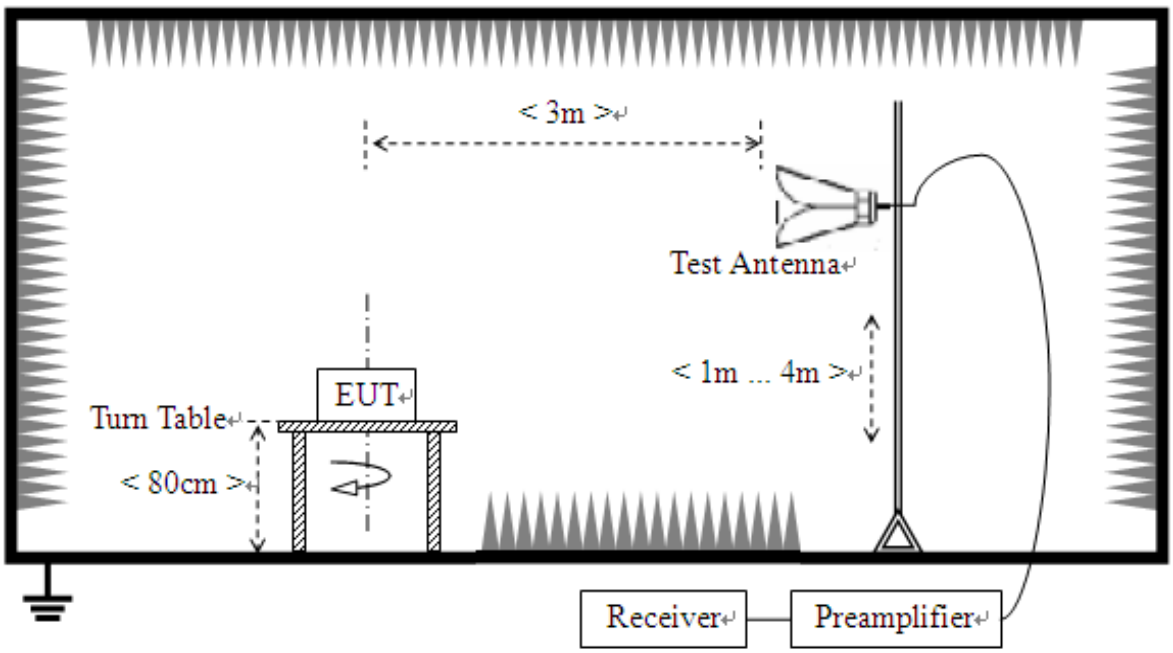
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30.
1.705 – 108	1000.
108 – 500	2000.
500 – 1000	5000.
Above 1000	5^{th} harmonic of the highest frequency or 40GHz, whichever is lower

3.1.3. Test Setup

1) For radiated emissions from 30MHz to1GHz



2) For radiated emissions above 1GHz



The test is performed in a 3m Semi-Anechoic Chamber, the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading. The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from the Test Antenna, which is mounted on a variable-height antenna master tower.

For the test Antenna:

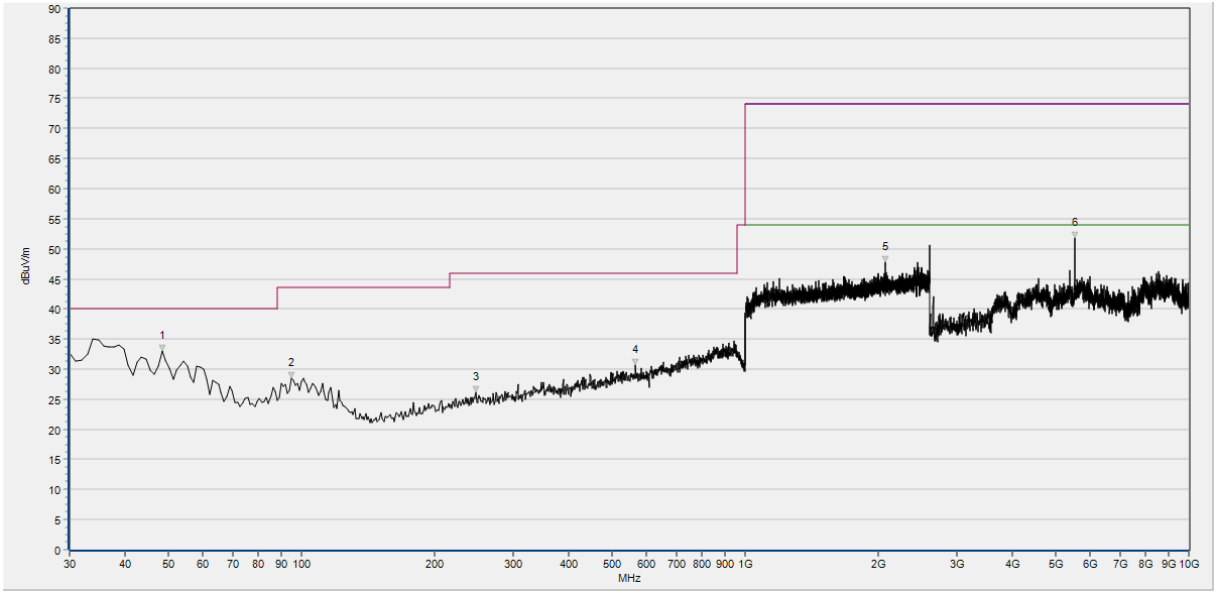
In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz)are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

3.1.4. Test Result

The maximum radiated emission is searched using PK, QP and AV detectors; the emission levels more than the limits, and that have narrow margins from the limits will be re-measured with AV and QP detectors. Both the vertical and the horizontal polarizations of the Test Antenna are considered to perform the tests. All test modes are considered, refer to recorded points and plots below.

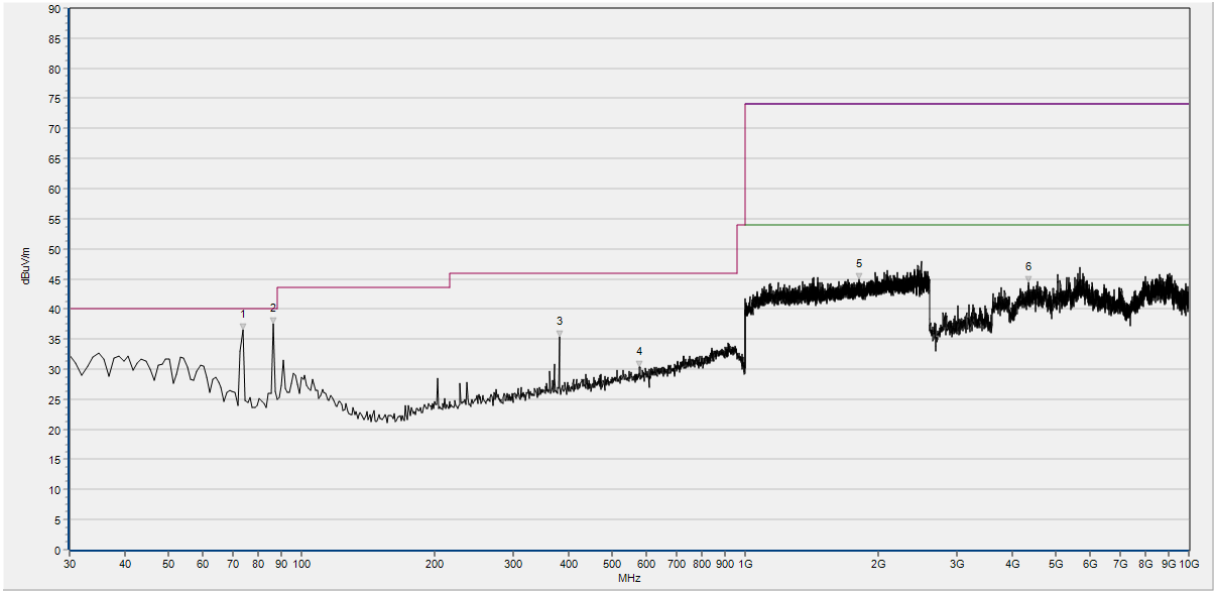
The amplitude of emissions which are attenuated more than 20 dB below the permissible value need not be reported.

Note: All radiated emission tests were performed in X, Y, Z axis direction, and only the worst axis test condition was recorded in this test report.



(Plot A: ANT-Vertical,30MHz - 6GHz)

No.	Fre. MHz	Pk dBμV/m	QP dBμV/m	AV dBμV/m	Limit-PK dBμV/m	Limit-QP dBμV/m	Limit-AV dBμV/m	ANT	Verdict
1	48.430	N.A.	33.08	N.A.	N.A.	40.00	N.A.	V	PASS
2	94.990	N.A.	28.49	N.A.	N.A.	43.50	N.A.	V	PASS
3	247.280	N.A.	26.11	N.A.	N.A.	46.00	N.A.	V	PASS
4	566.410	N.A.	30.64	N.A.	N.A.	46.00	N.A.	V	PASS
5	2067.200	47.80	N.A.	36.41	74.00	N.A.	54.00	V	PASS
6	5526.000	51.73	N.A.	39.88	74.00	N.A.	54.00	V	PASS



(Plot B:ANT- Horizontal, 30MHz - 6GHz)

No.	Fre. MHz	Pk dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	73.650	N.A.	36.02	N.A.	N.A.	40.00	N.A.	H	PASS
2	86.260	N.A.	36.18	N.A.	N.A.	40.00	N.A.	H	PASS
3	381.140	N.A.	35.34	N.A.	N.A.	46.00	N.A.	H	PASS
4	578.050	N.A.	30.34	N.A.	N.A.	46.00	N.A.	H	PASS
5	1808.000	44.89	N.A.	33.65	74.00	N.A.	54.00	H	PASS
6	4361.760	44.37	N.A.	33.51	74.00	N.A.	54.00	H	PASS

The test result for CB receiver RSE（25-30MHz）.

Test mode	Fre. MHz	QP dBμV/m	Limit-QP dBμV/m	ANT	Verdict
Mode 1	25.120	23.57	32.04	V	PASS
	26.584	24.36			PASS
	27.452	22.26			PASS
	28.557	21.58			PASS
	29.621	23.66			PASS
	29.961	23.54			PASS
	25.133	21.65	32.04	H	PASS
	25.682	20.79			PASS
	26.258	21.55			PASS
	27.518	23.65			PASS
	28.612	23.64			PASS
	29.592	24.13			PASS

3.2. Antenna Terminal Disturbance

3.2.1. Requirement

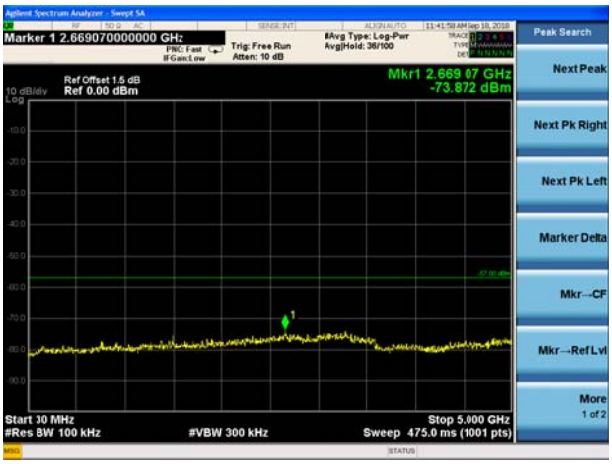
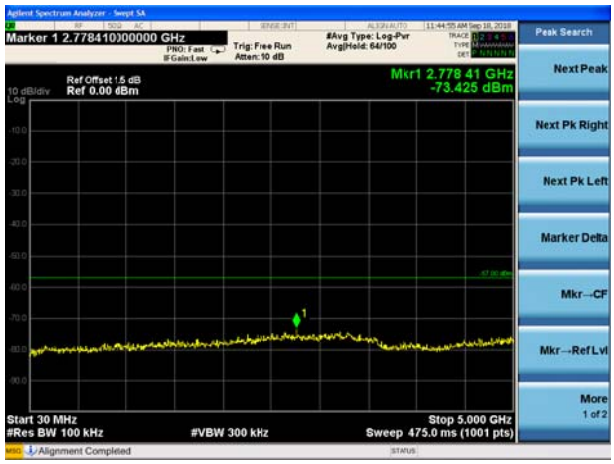
In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of §15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in §15.33 shall not exceed 2.0 nanowatts(-57dBm).

Measurements were attempted over the range of 30 - 5000 MHz

3.2.2. Test Result

Receive Frequency (MHz)	Emission Power Level(dBm)	Limit(dBm)	Result
806.00625	-73.60	-57	Pass
815.00000	-73.87		Pass
823.89750	-74.28		Pass
851.00625	-74.55		Pass
860.00000	-73.43		Pass
868.98750	-72.28		Pass

attach spectrum pictures for this test here:

806.00625 MHz	815.00000 MHz
	
823.89750 MHz	**851.00625 MHz**
	
860.00000 MHz	**868.98750 MHz**
	

Annex A Test Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

Uncertainty of Conducted Emission Measurement

Measuring Uncertainty for a Level of Confidence of 95%(U=2Uc(y))	30MHz-200MHz	±0.8dB
	200MHz-1000MHz	±1.1dB
	1GHz-6GHz	±1.4dB
	6GHz-18GHz	±1.9dB

Uncertainty of Radiated Emission Measurement

Measuring Uncertainty for a Level of Confidence of 95%(U=2Uc(y))	30MHz-200MHz	±5.06dB
	200MHz-1000MHz	±5.24dB
	1GHz-6GHz	±5.18dB
	6GHz-18GHz	±5.48dB

Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Laboratory Address:	FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd. Morlab Laboratory
Address:	FL1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block67, BaoAn District, ShenZhen , GuangDong Province, P. R. China

3. Accreditation Certificate

Accredited Testing Laboratory:	The FCC designation number is CN1192. Test firm registration number is 226174. (Shenzhen Morlab Communications Technology Co., Ltd.)

4. Test Software Utilized

Model	Version Number	Producer
MORLAB EMCR V1.2	Version 1.0	MORLAB
TS+ -[JS32-CE]	Version2.5.0.0	Tonscend

5. Test Equipments Utilized

Description	Manufacturer	Model	Serial No.	Cal. Date	Due. Date
MXE EMI Receiver	Agilent	N9038A	MY54130016	2018.05.08	2019.05.07
Receiver	KEYSIGHT	N9038A	MY56400093	2018.05.08	2019.05.07
LISN	Schwarzbeck	NSLK 8127	812744	2018.05.08	2019.05.07
Pulse Limiter (20dB)	VTSD	9561D	9537	2018.05.08	2019.05.07
Test Antenna - Bi-Log	Schwarzbeck	VULB 9163	9163-519	2018.05.08	2019.05.07
Test Antenna - Horn	Schwarzbeck	BBHA 9120D	1774	2018.03.03	2019.03.02
Semi-Anechoic Chamber	CRT	9m*6m*6m	N/A	2017.11.19	2020.11.18
PC	Lenovo	ThinkPad T430i	0B68192JS	N/A	N/A

END OF REPORT