



TEST REPORT

APPLICANT : MiMOMax Wireless Limited

PRODUCT NAME : 700MHz Upper A Block TornadoX Transceiver

MODEL NAME : MWL-TORNADOX-*H*D/E

BRAND NAME : MiMOMax Wireless

STANDARD(S) : 47 CFR Part 15 Subpart A and B

FCC ID : XMK-MMXTRNXB001

RECEIPT DATE : 2021-04-22

TEST DATE : 2021-05-14 to 2021-05-18

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DIRECTORY

- 1. Technical Information..... 3
 - 1.1. Applicant and Manufacturer Information..... 3
 - 1.2. Equipment Under Test (EUT) Description 3
- 2. Test Results 4
 - 2.1. Applied Reference Documents 4
 - 2.2. EUT Setup and Operating Conditions..... 5
- 3. 47 CFR Part 15B Requirements 6
 - 3.1. Radiated Emission..... 6
 - 3.2. Antenna Terminal Disturbance 16
- Annex A Test Uncertainty 25
- Annex B Testing Laboratory Information..... 26

Change History		
Version	Date	Reason for change
1.0	2021-07-06	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

Product Name:	700MHz Upper A Block TornadoX Transceiver
Serial No.:	N/A
Hardware Version:	P001
Software Version:	TRN_04.08.00.dev12
Tx Frequency:	757MHz ~ 758MHz; 787 MHz ~ 788 MHz
Rx Frequency:	757MHz ~ 758MHz; 787 MHz ~ 788 MHz
Operating Voltage:	10.5V~60V DC(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 27 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	2021.05.14	Yang Jie	PASS	No deviation
5	15.111	Antenna Terminal Disturbance	2021.05.18	HuangZhiye	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: TORNADOX 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.

Note 4: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.



2.2. EUT Setup and Operating Conditions

Test Item	
Radiated Emission	
Mode 1 :	EUT + RJ45 Link + 10.5V DC Power + 757.050 Rx
Mode 2 :	EUT + RJ45 Link + 24V DC Power + 787.95 Rx
Mode 3 :	EUT + RJ45 Link + 60V DC Power + 757.050 Tx
Remark: The above test mode in boldface (Mode 2) was the worst case of radiated emission test, only the test data of these modes were reported.	

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
757.050	787.950	12.5, 25.0, 50.0	QPSK,16QAM,64QAM,256QAM
787.950	757.050	12.5, 25.0, 50.0	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	
	($\mu\text{V/m}$)	($\text{dB}\mu\text{V/m}$)
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 $\text{dB}\mu\text{V/m}$ is calculated by $20\log$ Emission Level($\mu\text{V/m}$).



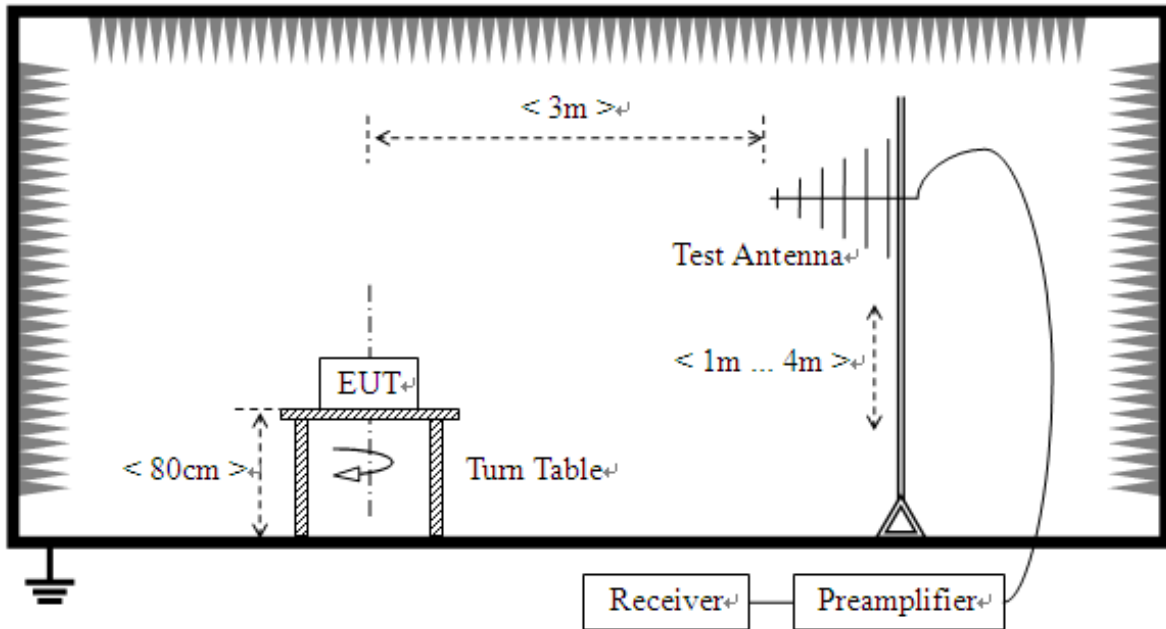
3.1.2. Frequency range of measurement

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

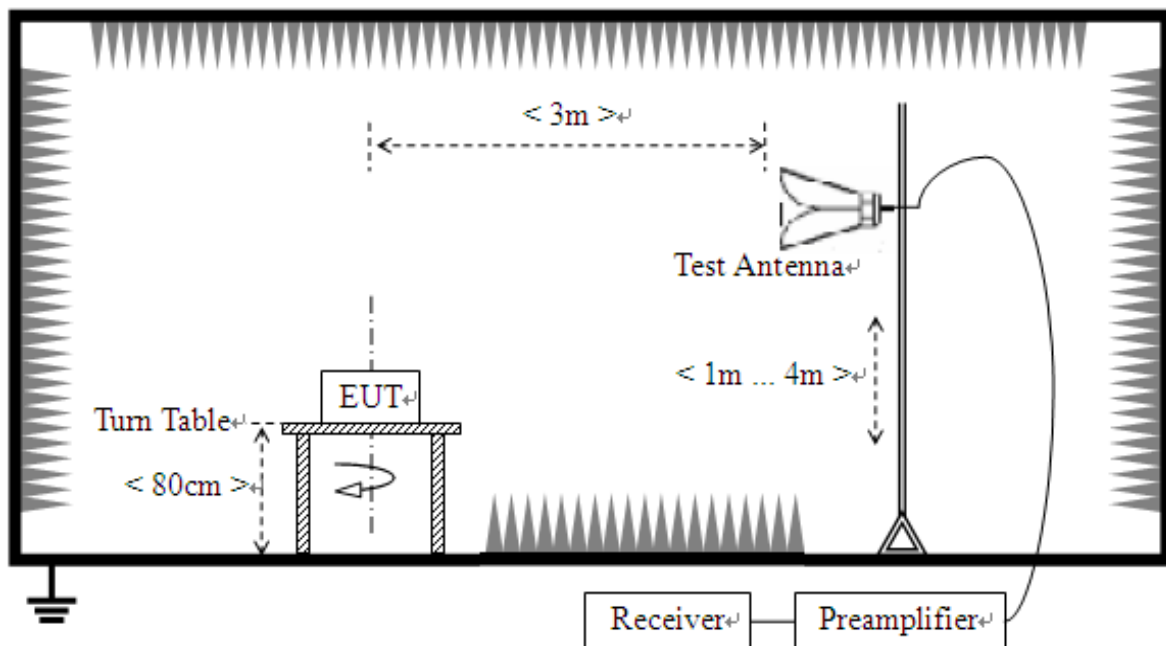
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30.
1.705 – 108	1000.
108 – 500	2000.
500 – 1000	5000.
Above 1000	5 th harmonic of the highest frequency or 40GHz, whichever is lower

3.1.3. Test Setup

- 1) For radiated emissions from 30MHz to 1GHz



- 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.

For measurements below 1GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video bandwidth is set to 3MHz for peak measurements and as applicable for average measurements.

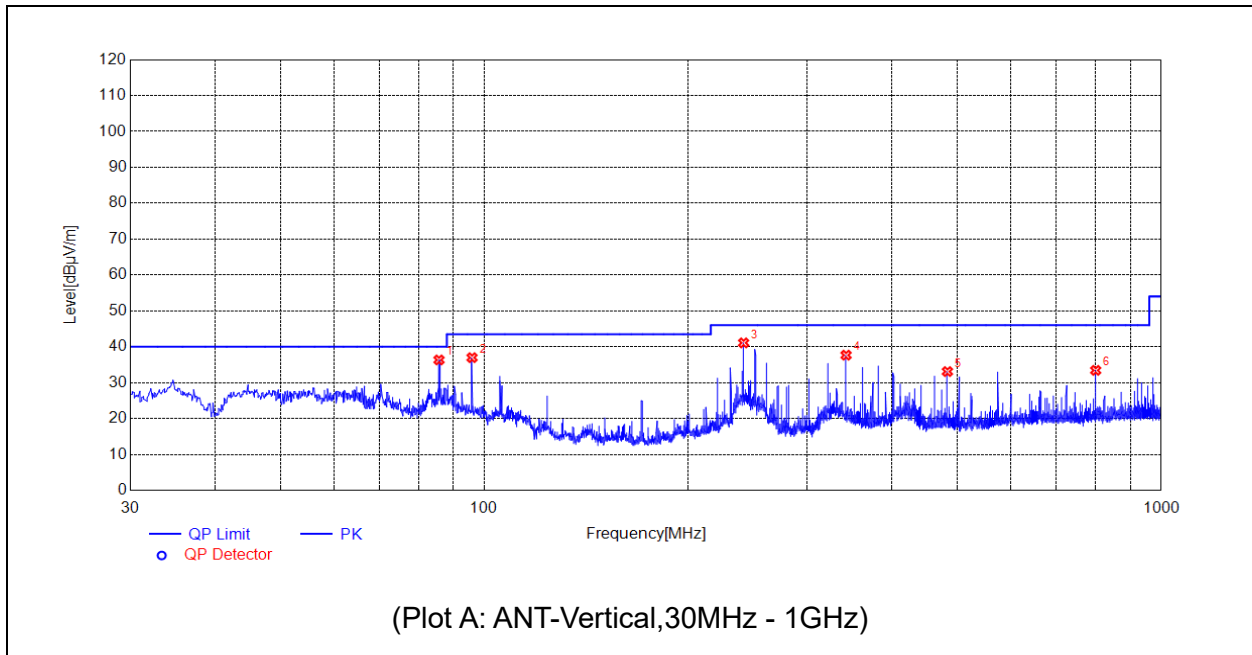


3.1.4. Test Result

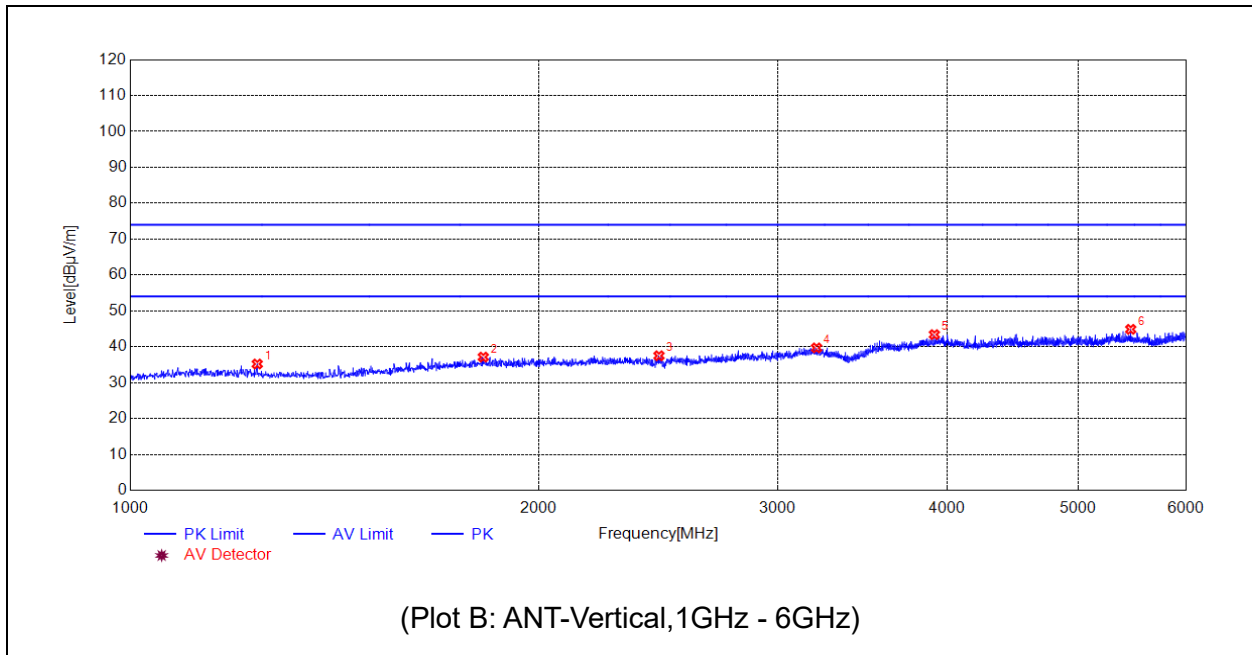
The maximum radiated emission is searched using PK, QP and AV detectors; the emission levels more than the limits, and that have narrow margins from the limits will be re-measured with AV and QP detectors. Both the vertical and the horizontal polarizations of the Test Antenna are considered to perform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

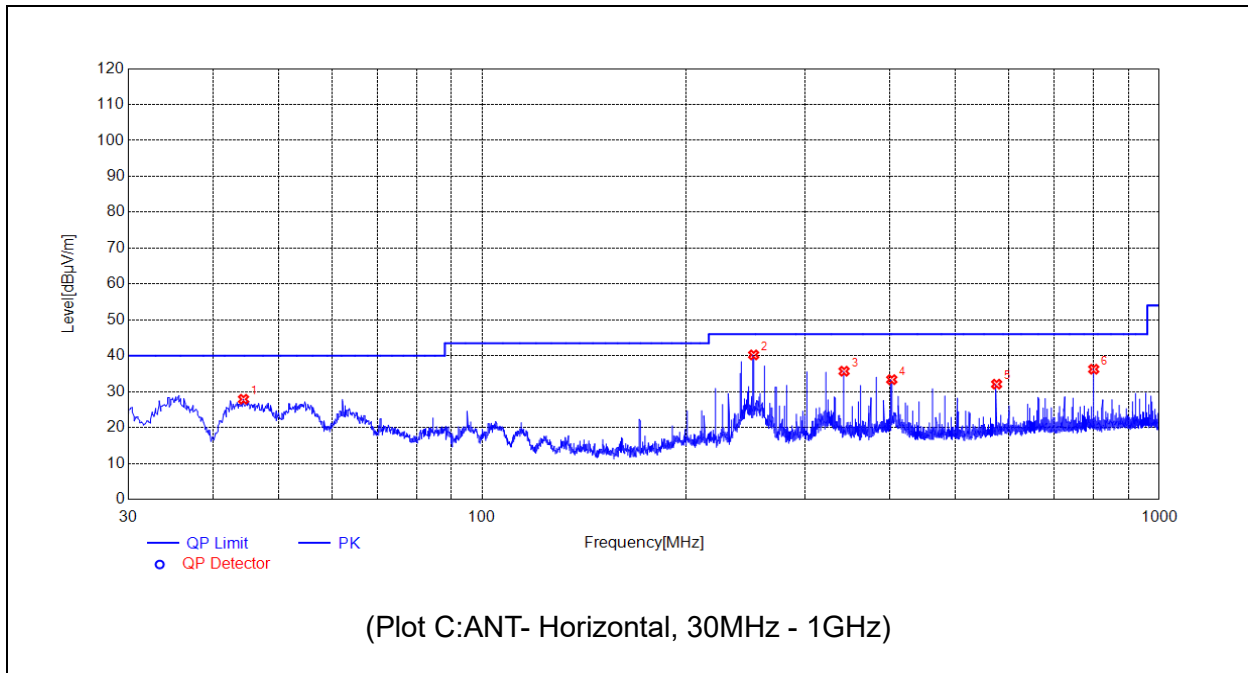
Note: All radiated emission tests were performed in X, Y, Z axis direction, and only the worst axis test condition was recorded in this test report.



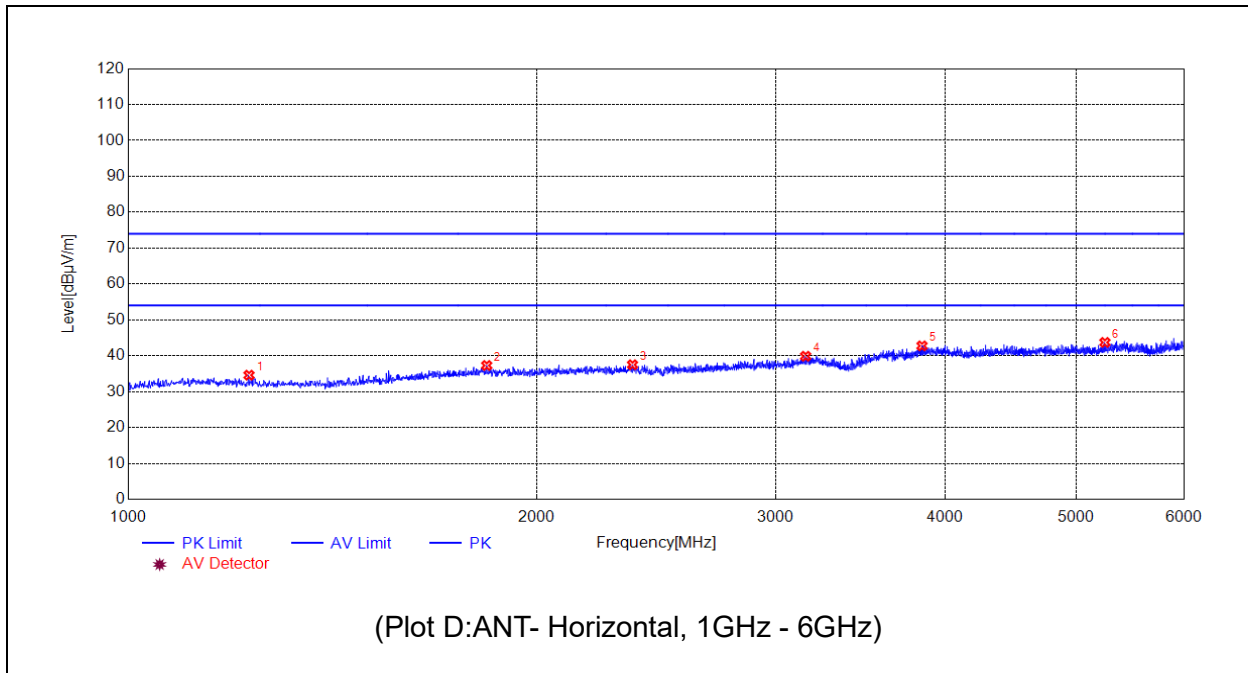
No.	Fre. MHz	Pk dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	85.6836	36.33	N.A.	N.A.	N.A.	40.00	N.A.	V	PASS
2	95.8696	36.97	N.A.	N.A.	N.A.	43.50	N.A.	V	PASS
3	241.4811	41.08	N.A.	N.A.	N.A.	46.00	N.A.	V	PASS
4	342.1772	37.66	N.A.	N.A.	N.A.	46.00	N.A.	V	PASS
5	483.0353	33.10	N.A.	N.A.	N.A.	46.00	N.A.	V	PASS
6	799.9660	33.43	N.A.	N.A.	N.A.	46.00	N.A.	V	PASS



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	1240.0480	35.20	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
2	1820.1640	37.12	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
3	2453.2907	37.49	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
4	3205.4411	39.68	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
5	3915.5831	43.39	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
6	5465.8932	44.86	N.A.	N.A.	74.00	N.A.	54.00	V	PASS



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	44.3574	27.89	N.A.	N.A.	N.A.	40.00	N.A.	H	PASS
2	251.5702	40.24	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS
3	342.1772	35.69	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS
4	402.5173	33.35	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS
5	575.0005	32.09	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS
6	799.9660	36.25	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS



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	1227.0454	34.59	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
2	1837.1674	37.29	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
3	2353.2707	37.50	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
4	3157.4315	39.86	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
5	3847.5695	42.76	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
6	5248.8498	43.72	N.A.	N.A.	74.00	N.A.	54.00	H	PASS



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

Test mode	Fre. MHz	QP dB μ V/m	Limit-QP dB μ V/m	ANT	Verdict
Mode 2	26.56	23.42	32.04	V	PASS
	27.22	19.48			PASS
	28.23	25.43			PASS
	29.05	23.48			PASS
	28.72	26.68			PASS
	30.24	20.71			PASS
	25.71	19.64	32.04	H	PASS
	26.86	22.48			PASS
	28.5	21.43			PASS
	29.05	20.77			PASS
	28.91	26.25			PASS
	30.06	23.48			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 MHz– 5 GHz



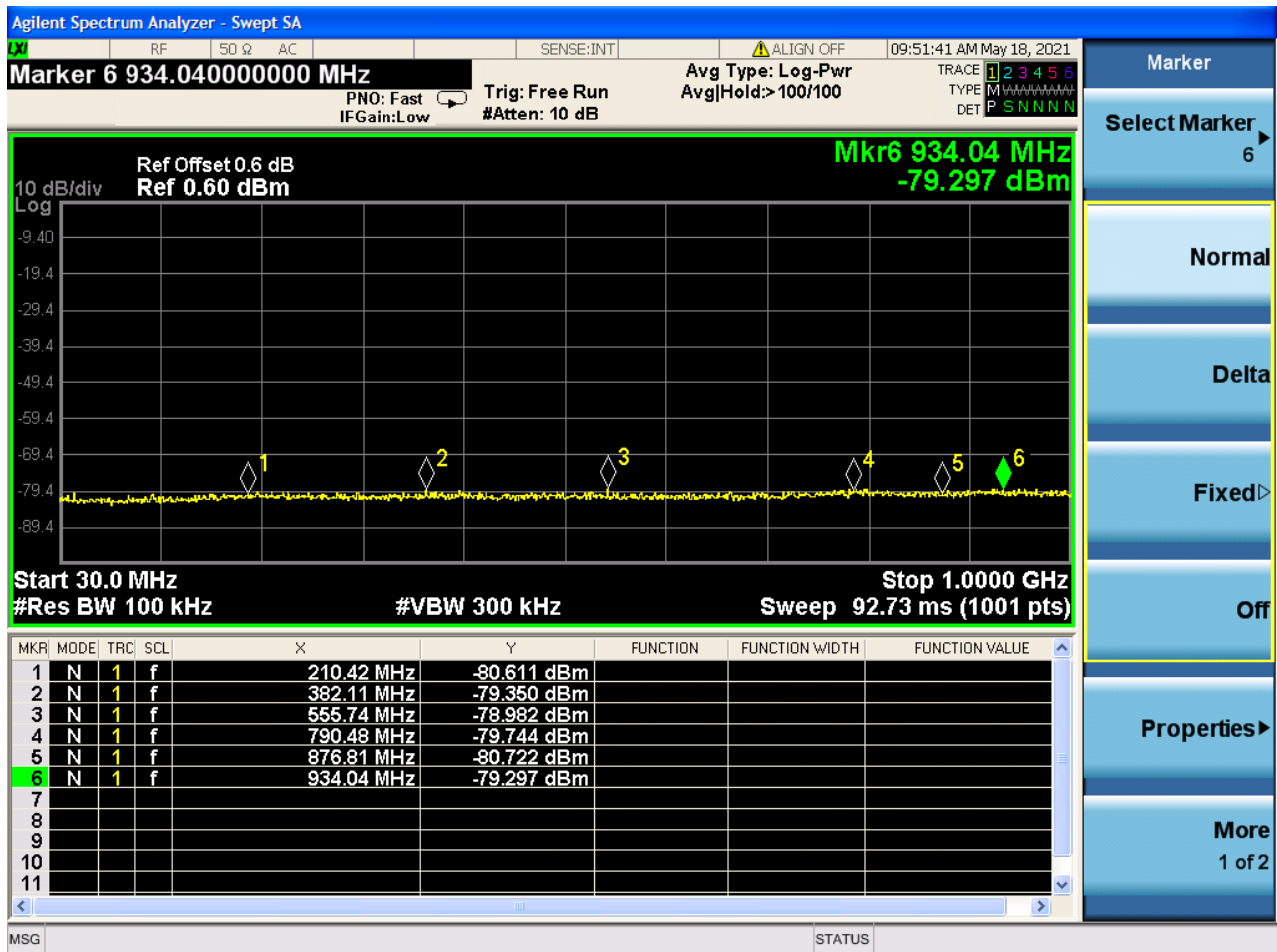
3.2.2. Test Result

Note: $P_{Final\ value}(dBm) = P_{Reading\ value}(dBm) + Factor(dB)$,
 Factor = Cable loss(dB)

H port, Operate at 757.050MHz, 30MHz -1000MHz

Fre. MHz	P _{Reading} value dBm	Factor dB	P _{Final} value dBm	Limit dBm	Verdict
210.42	-80.611	0.6	-80.011	-57	PASS
382.11	-79.35	0.6	-78.75	-57	PASS
555.74	-78.982	0.6	-78.382	-57	PASS
790.48	-79.744	0.6	-79.144	-57	PASS
876.81	-80.722	0.6	-80.122	-57	PASS
934.04	-79.297	0.6	-78.697	-57	PASS

Attach spectrum pictures of P_{Reading} value for this test here:

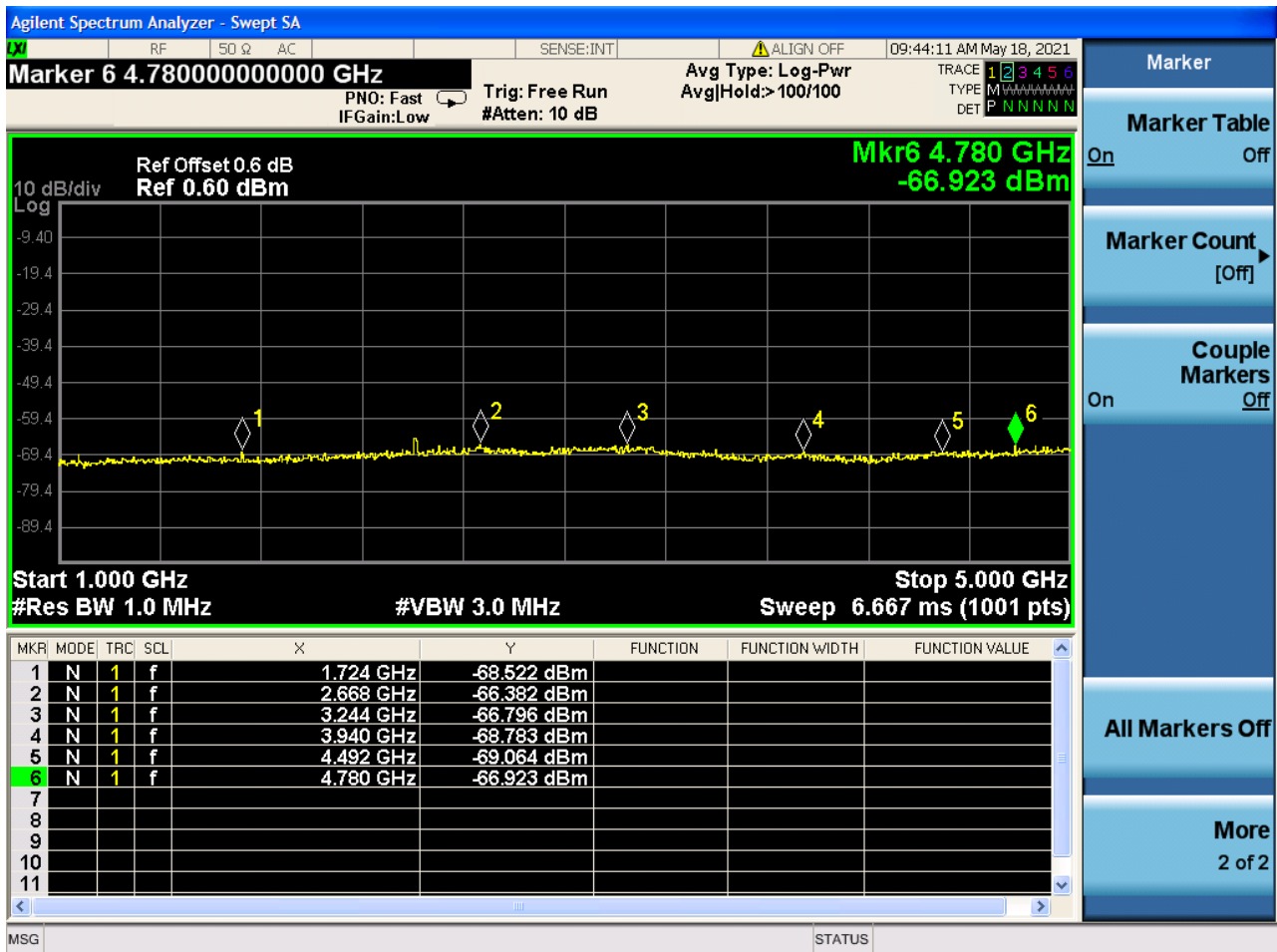




H port, Operate at 757.050MHz, 1GHz -5GHz

Fre. GHz	P _{Reading} value dBm	Factor dB	P _{Final} value dBm	Limit dBm	Verdict
1.724	-68.522	0.6	-67.922	-57	PASS
2.668	-66.382	0.6	-65.782	-57	PASS
3.244	66.796	0.6	67.396	-57	PASS
3.94	-68.783	0.6	-68.183	-57	PASS
4.492	-69.064	0.6	-68.464	-57	PASS
4.78	-66.923	0.6	-66.323	-57	PASS

Attach spectrum pictures of P_{Reading}value for this test here:

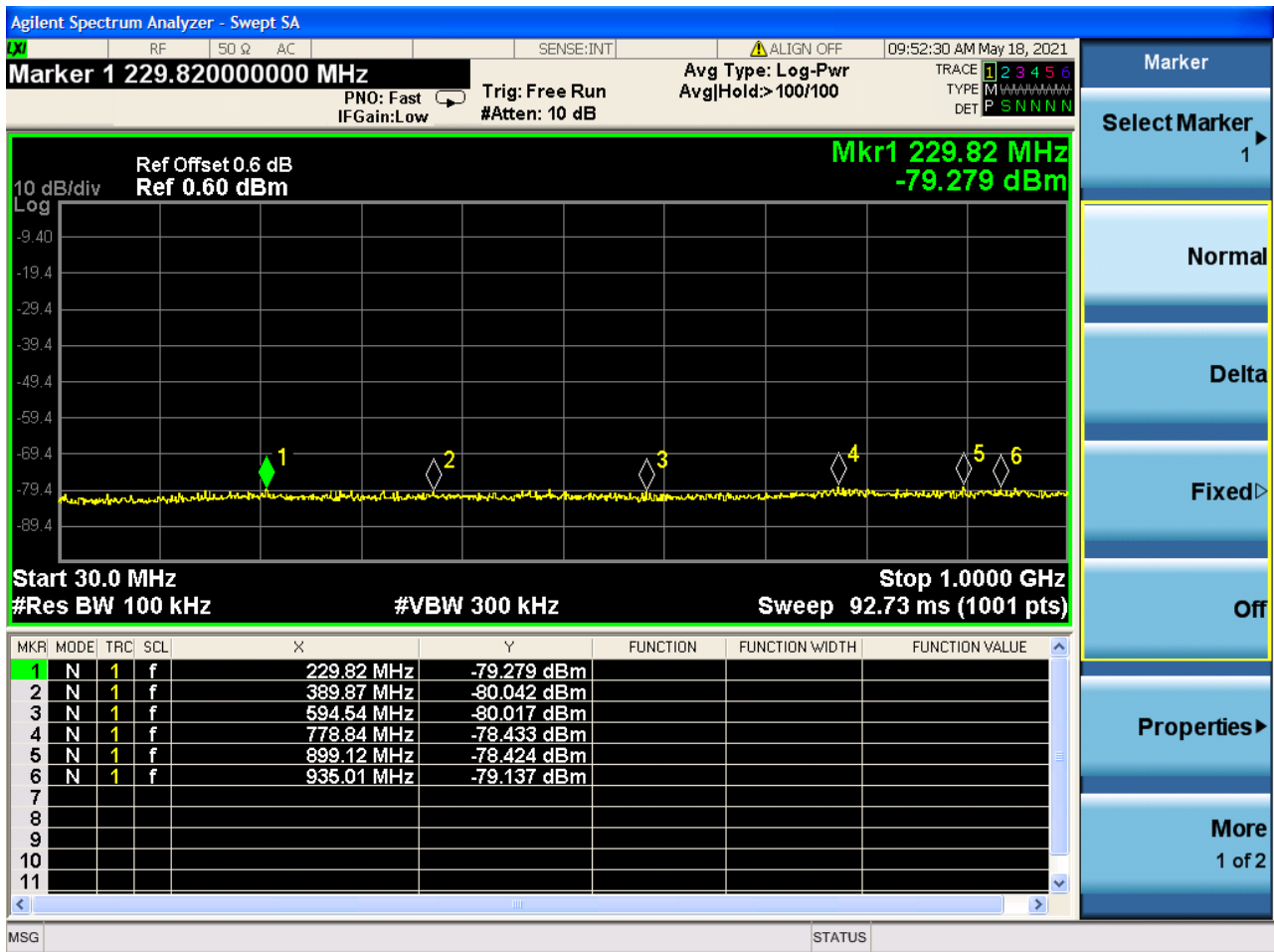




V port, Operate at 757.050MHz, 30MHz -1000MHz

Fre. MHz	P _{Reading} value dBm	Factor dB	P _{Final} value dBm	Limit dBm	Verdict
229.82	-79.279	0.6	-78.679	-57	PASS
389.87	-80.042	0.6	-79.442	-57	PASS
594.54	-80.017	0.6	-79.417	-57	PASS
778.84	-78.433	0.6	-77.833	-57	PASS
899.12	-78.424	0.6	-77.824	-57	PASS
935.01	-79.137	0.6	-78.537	-57	PASS

Attach spectrum pictures of P_{Reading}value for this test here:

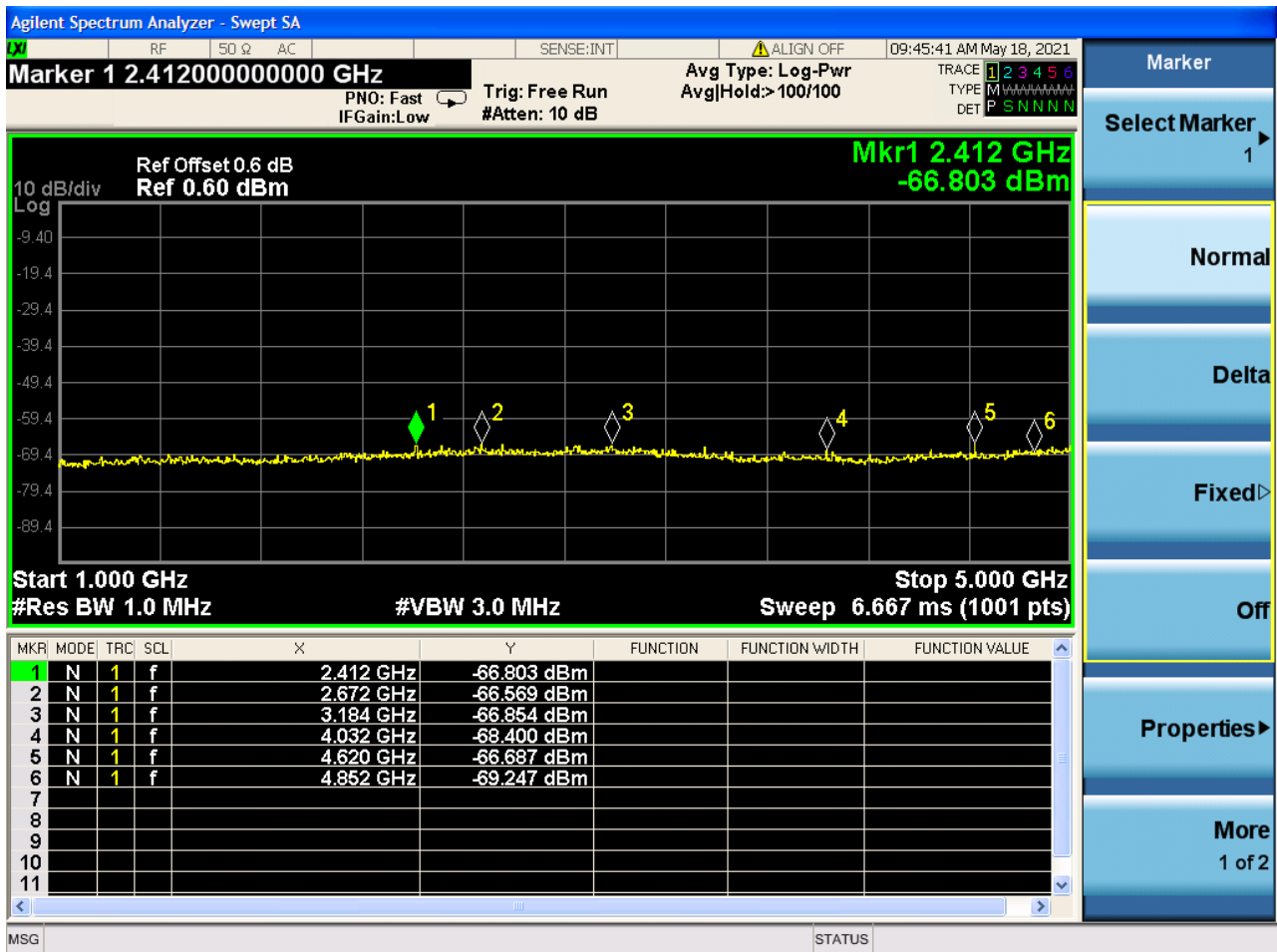




V port, Operate at 757.050MHz, 1GHz -5GHz

Fre. GHz	P _{Reading} value dBm	Factor dB	P _{Final} value dBm	Limit dBm	Verdict
2.412	-66.803	0.6	-66.203	-57	PASS
2.672	-66.569	0.6	-65.969	-57	PASS
3.184	-66.854	0.6	-66.254	-57	PASS
4.032	-68.4	0.6	-67.8	-57	PASS
4.62	-66.687	0.6	-66.087	-57	PASS
4.852	-69.247	0.6	-68.647	-57	PASS

Attach spectrum pictures of P_{Reading}value for this test here:

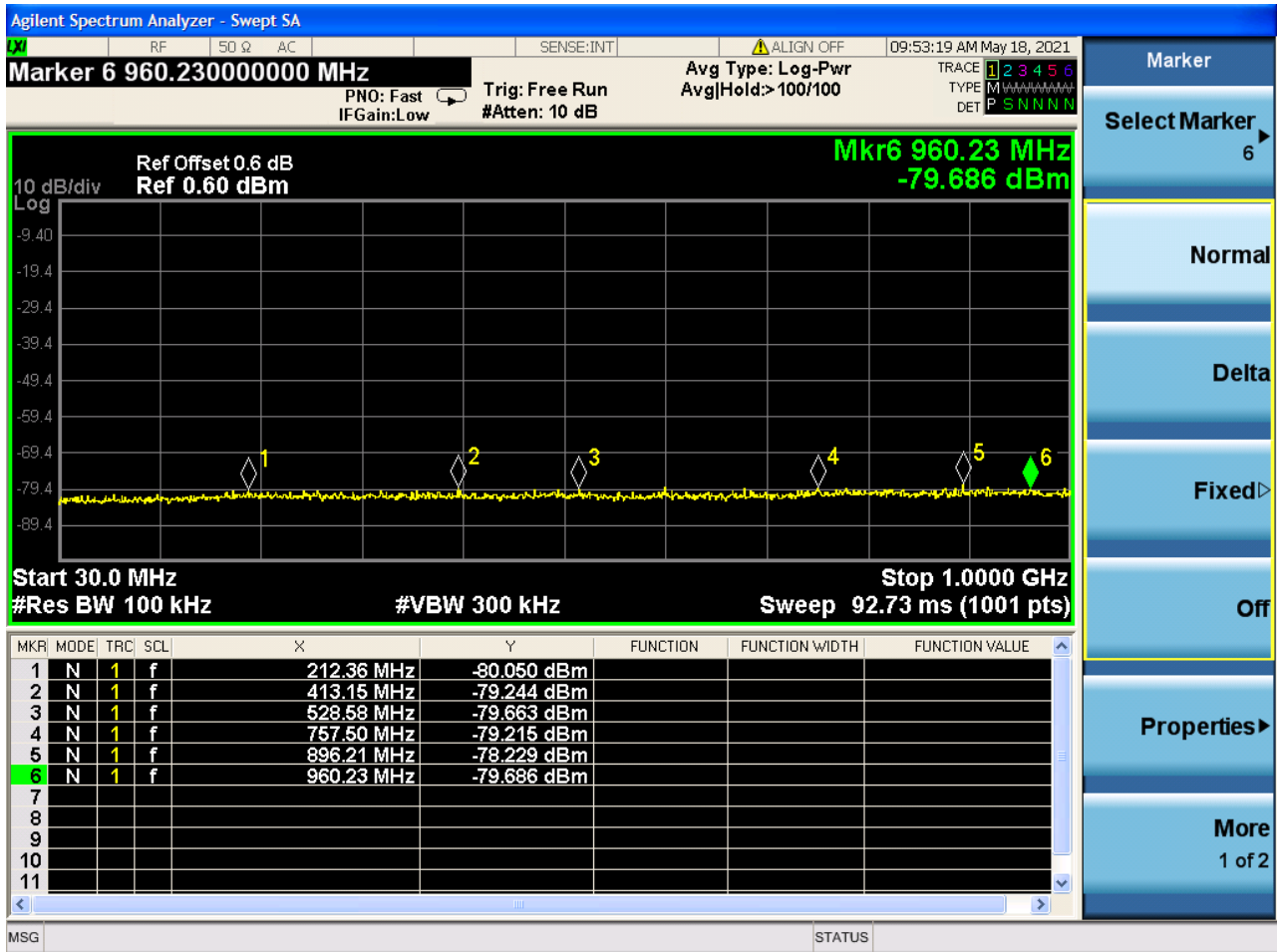




H port, Operate at 787.950MHz, 30MHz -1000MHz

Fre. MHz	PReading value dBm	Factor dB	PFinal value dBm	Limit dBm	Verdict
212.36	-80.05	0.6	-79.45	-57	PASS
413.15	-79.244	0.6	-78.644	-57	PASS
528.58	-79.663	0.6	-79.063	-57	PASS
757.5	-79.215	0.6	-78.615	-57	PASS
896.21	-78.229	0.6	-77.629	-57	PASS
960.23	-79.686	0.6	-79.086	-57	PASS

Attach spectrum pictures of PReadingvalue for this test here:

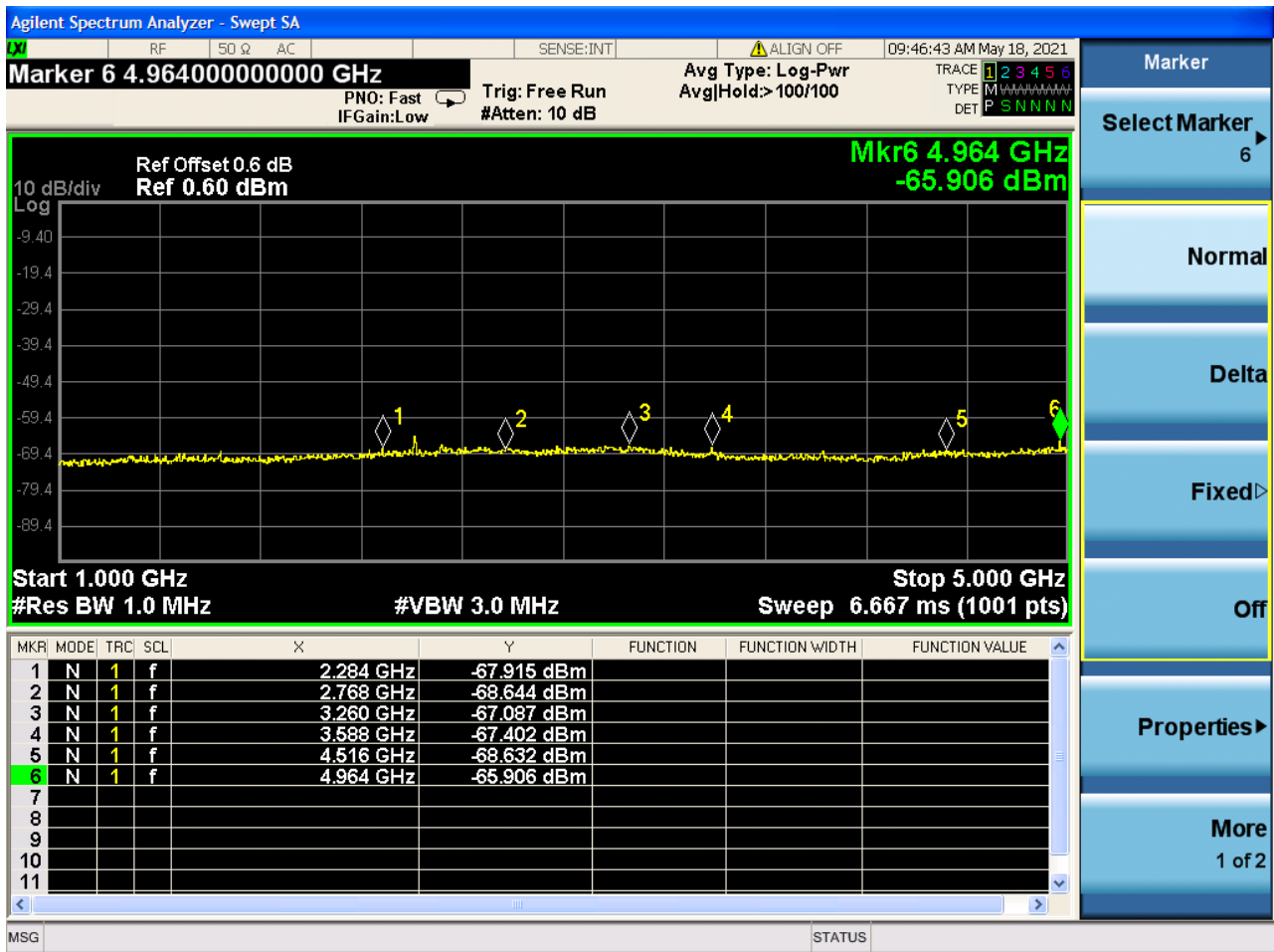




H port, Operate at 787.950MHz, 1GHz -5GHz

Fre. GHz	P _{Reading} value dBm	Factor dB	P _{Final} value dBm	Limit dBm	Verdict
2.284	-67.915	0.6	-67.315	-57	PASS
2.768	-68.644	0.6	-68.044	-57	PASS
3.26	-67.087	0.6	-66.487	-57	PASS
3.588	-67.402	0.6	-66.802	-57	PASS
4.516	-68.632	0.6	-68.032	-57	PASS
4.964	-65.906	0.6	-65.306	-57	PASS

Attach spectrum pictures of P_{Reading}value for this test here:

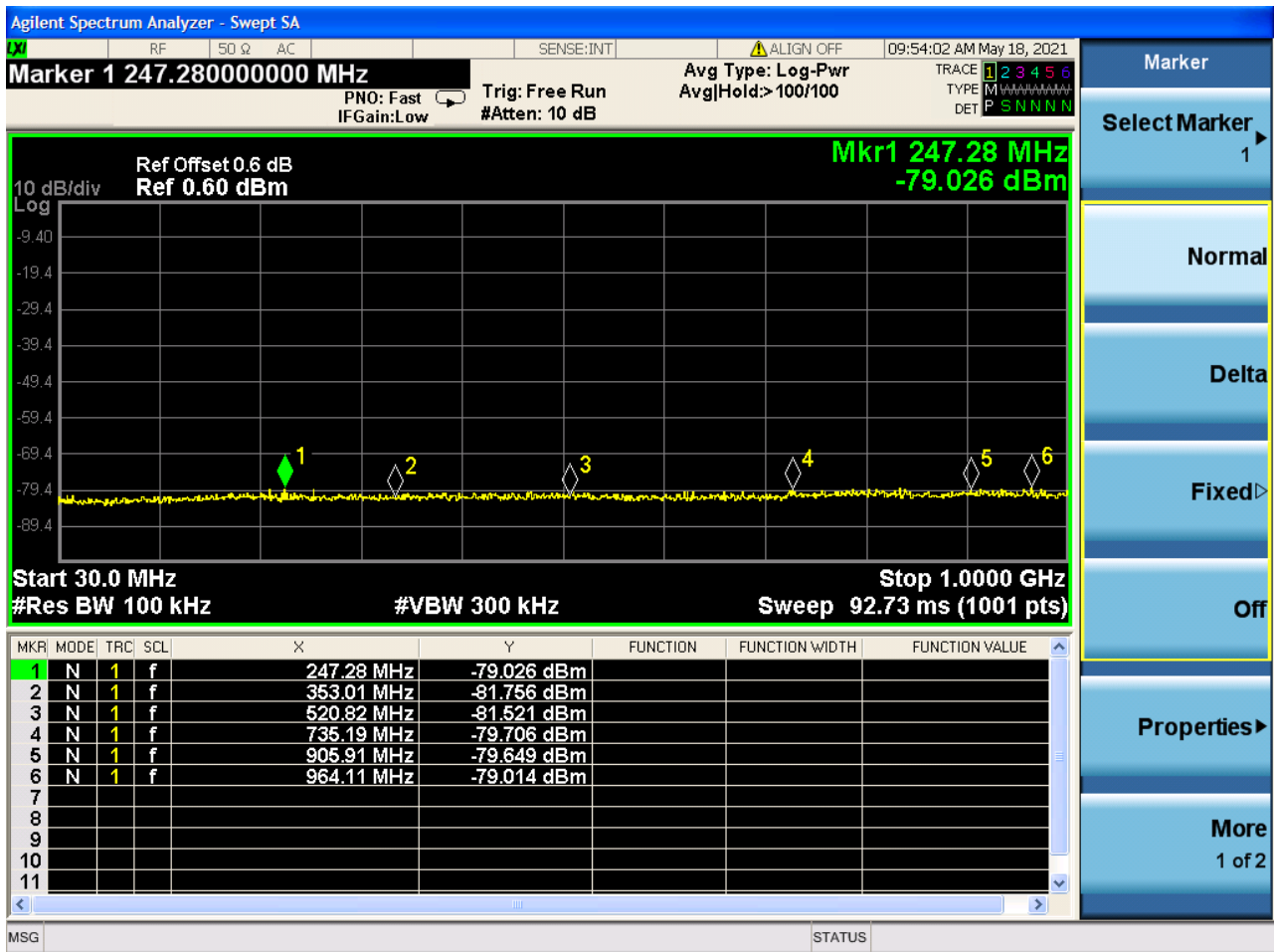




V port, Operate at 787.950MHz, 30MHz -1000MHz

Fre. MHz	P _{Reading} value dBm	Factor dB	P _{Final} value dBm	Limit dBm	Verdict
247.28	-79.026	0.6	-78.426	-57	PASS
353.01	-81.756	0.6	-81.156	-57	PASS
520.82	-81.521	0.6	-80.921	-57	PASS
735.19	-79.706	0.6	-79.106	-57	PASS
905.91	79.649	0.6	80.249	-57	PASS
964.11	-79.014	0.6	-78.414	-57	PASS

Attach spectrum pictures of P_{Reading}value for this test here:

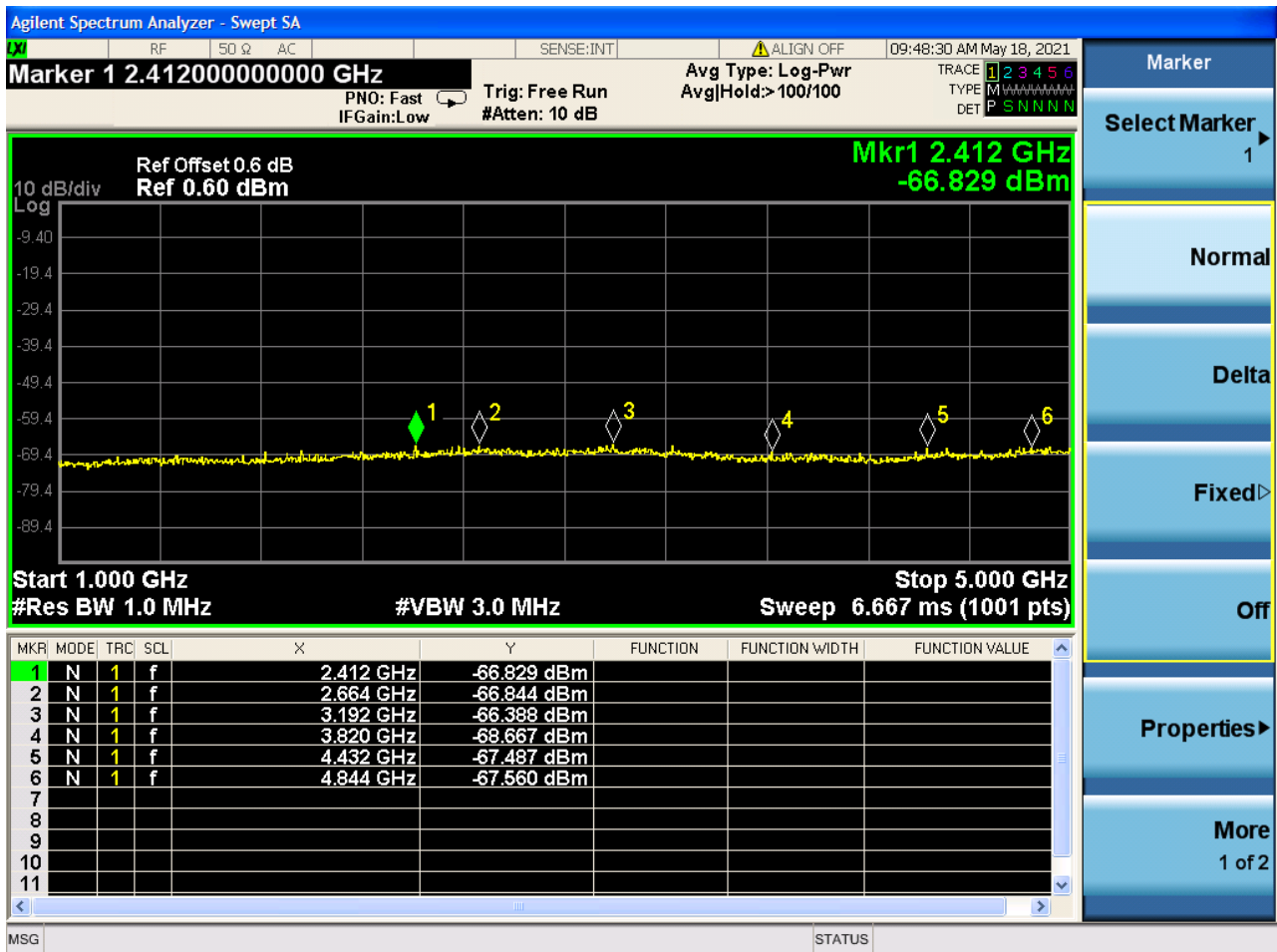




V port, Operate at 787.950MHz, 1GHz -5GHz

Fre. GHz	PReading value dBm	Factor dB	PFinal value dBm	Limit dBm	Verdict
2.412	-66.829	0.6	-66.229	-57	PASS
2.664	-66.844	0.6	-66.244	-57	PASS
3.192	-66.388	0.6	-65.788	-57	PASS
3.82	-68.667	0.6	-68.067	-57	PASS
4.432	-67.487	0.6	-66.887	-57	PASS
4.844	-67.56	0.6	-66.96	-57	PASS

Attach spectrum pictures of PReadingvalue for this test here:





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 Radiated Emission Measurement

Measuring Uncertainty for a Level of Confidence of 95%(U=2Uc(y))	30MHz-200MHz	±5.06dB
	200MHz-1000MHz	±5.04dB
	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.
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.
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.)
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4. Test Software Utilized

Model	Version Number	Producer
TS+ -[JS32-RE]	Version 2.5.1.5	Tonscend

**5. Test Equipments Utilized**

Description	Model	Serial No.	Manufacturer	Cal. Date	Due. Date
Bi-Log Antenna	VULB 9163	9163-519	SCHWARZBEC K	2019/5/24	2022/5/23
Horn Antenna	BBHA 9120D	01774	SCHWARZBEC K	2019/7/26	2022/7/25
Receiver	N9038A	MY564000 93	KEYSIGHT	2021/3/9	2022/3/8
6db Attenuator	BW-N6W5+	E191001	Mini-circuits	2020/10/20	2021/10/19
Preamplifier	S020180L320 3	61171/6117 2	LUCIX CORP.	2020/7/21	2021/7/20
Preamplifier	S10M100L380 2	46732	LUCIX CORP.	2020/7/21	2021/7/20

————— END OF REPORT —————