



REPORT No.: SZ21010246E01

TEST REPORT

APPLICANT : MiMOMax Wireless Limited

PRODUCT NAME : 700MHz Upper A Block Tornado Transceiver

MODEL NAME : MWL-TORNADO-*H A/B/C *

BRAND NAME : MiMOMax Wireless

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

FCC ID : XMK-MMXTRNB006

RECEIPT DATE : 2021-01-28

TEST DATE : 2021-02-25 to 2021-04-15

ISSUE DATE : 2021-05-06

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| Change History | | |
|----------------|------------|-------------------|
| Version | Date | Reason for change |
| 1.0 | 2021-05-06 | 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 Tornado Transceiver |
| Serial No.: | N/A |
| Hardware Version: | IP001 |
| Software Version: | TRN-04.06.02 |
| 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 | 2021.02.25 | Yang Jie | PASS | No deviation |
| 5 | 15.111 | Antenna Terminal Disturbance | 2021.04.15 | Huang Zhiye | 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 + RJ45 Link + 10.5V DC Power + Working |
| Mode 2 | : EUT + RJ45 Link + 24V DC Power + Working |
| Mode 3 | : EUT + RJ45 Link + 60V DC Power + Working |
| Remark: The above test mode in boldface (Mode 3) 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 | |
|-----------------------|--|-----------------------|
| | ($\mu\text{V/m}$) | (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 dB $\mu\text{V/m}$ is calculated by $20\log \text{Emission Level}(\mu\text{V/m})$.



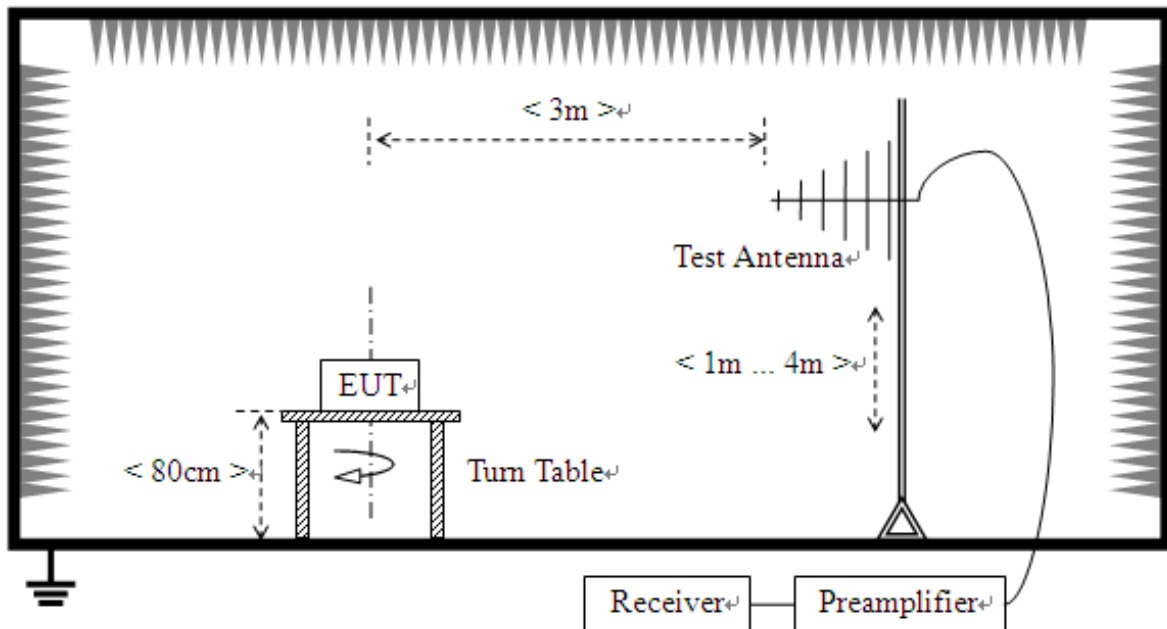
3.1.2. Frequency range of measurement

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

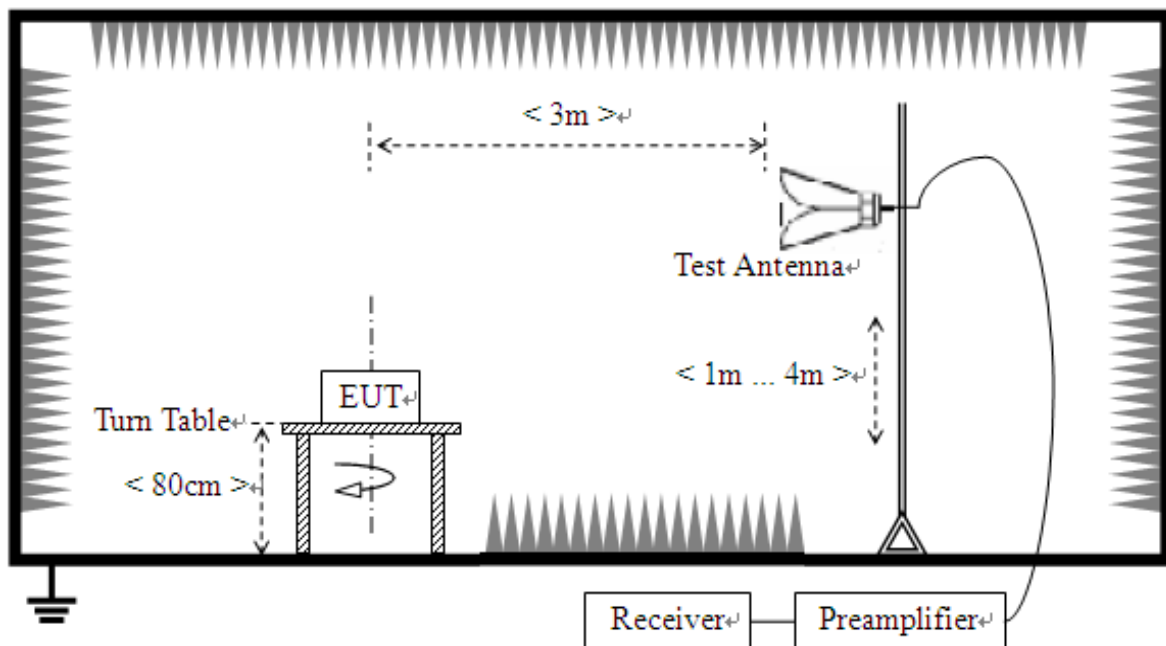
| Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz) |
|--|--|
| Below 1.705 | 30. |
| 1.705 – 108 | 1000. |
| 108 – 500 | 2000. |
| 500 – 1000 | 5000. |
| Above 1000 | 5 th harmonic of the highest frequency or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

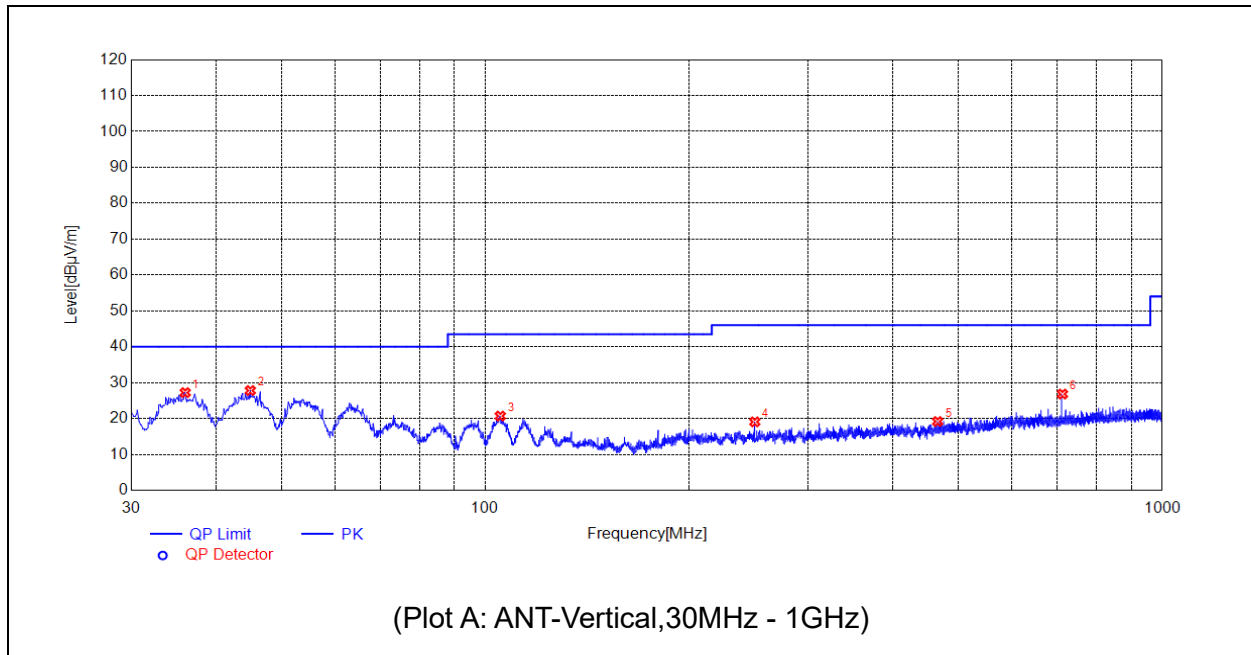


3.1.4. Test Result

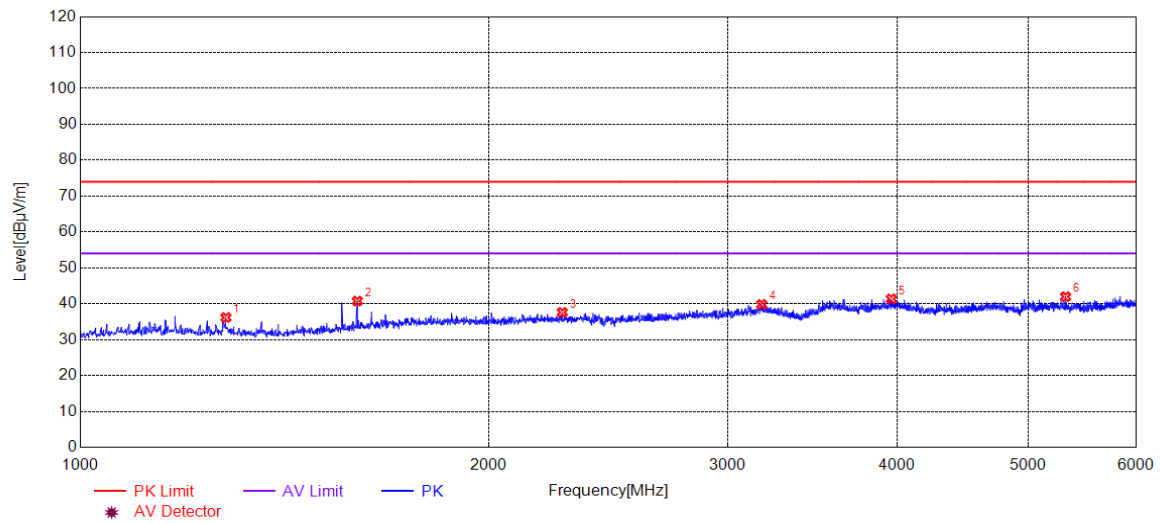
The maximum radiated emission is searched using PK, QP and AV detectors; the emission levels more than the limits, and that have narrow margins from the limits will be re-measured with AV and QP detectors. Both the vertical and the horizontal polarizations of the Test Antenna are considered to perform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

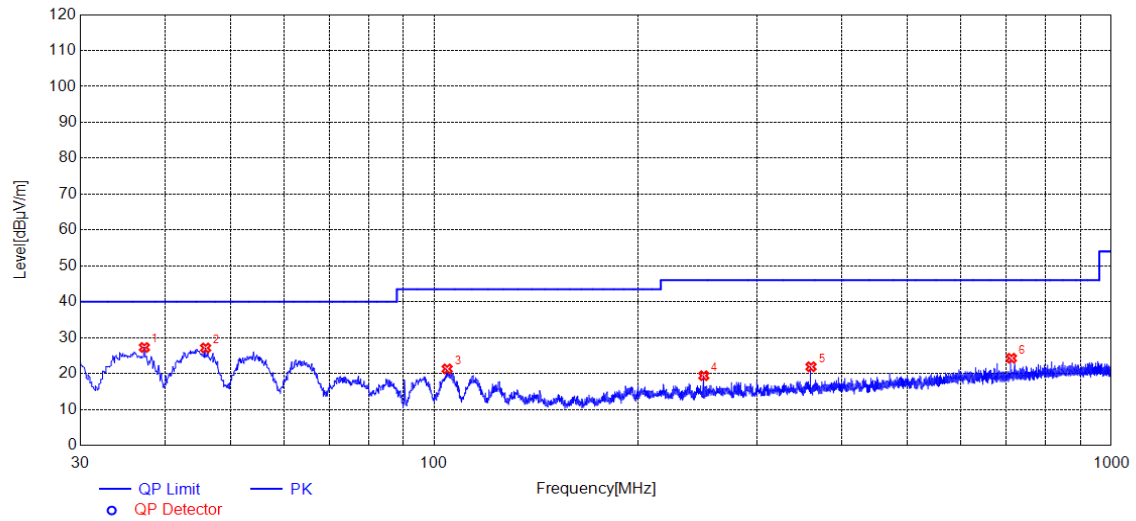


| No. | Fre. MHz | Pk dBμV/m | QP dBμV/m | AV dBμV/m | Limit-PK dBμV/m | Limit-QP dBμV/m | Limit-AV dBμV/m | ANT | Verdict |
|-----|-------------|--------------|--------------|--------------|--------------------|--------------------|--------------------|-----|---------|
| 1 | 36.0146 | 27.23 | N.A. | N.A. | N.A. | 40.00 | N.A. | V | PASS |
| 2 | 44.9395 | 27.80 | N.A. | N.A. | N.A. | 40.00 | N.A. | V | PASS |
| 3 | 105.1825 | 20.69 | N.A. | N.A. | N.A. | 43.50 | N.A. | V | PASS |
| 4 | 250.0180 | 19.07 | N.A. | N.A. | N.A. | 46.00 | N.A. | V | PASS |
| 5 | 465.6706 | 19.18 | N.A. | N.A. | N.A. | 46.00 | N.A. | V | PASS |
| 6 | 711.9782 | 26.82 | N.A. | N.A. | N.A. | 46.00 | N.A. | V | PASS |



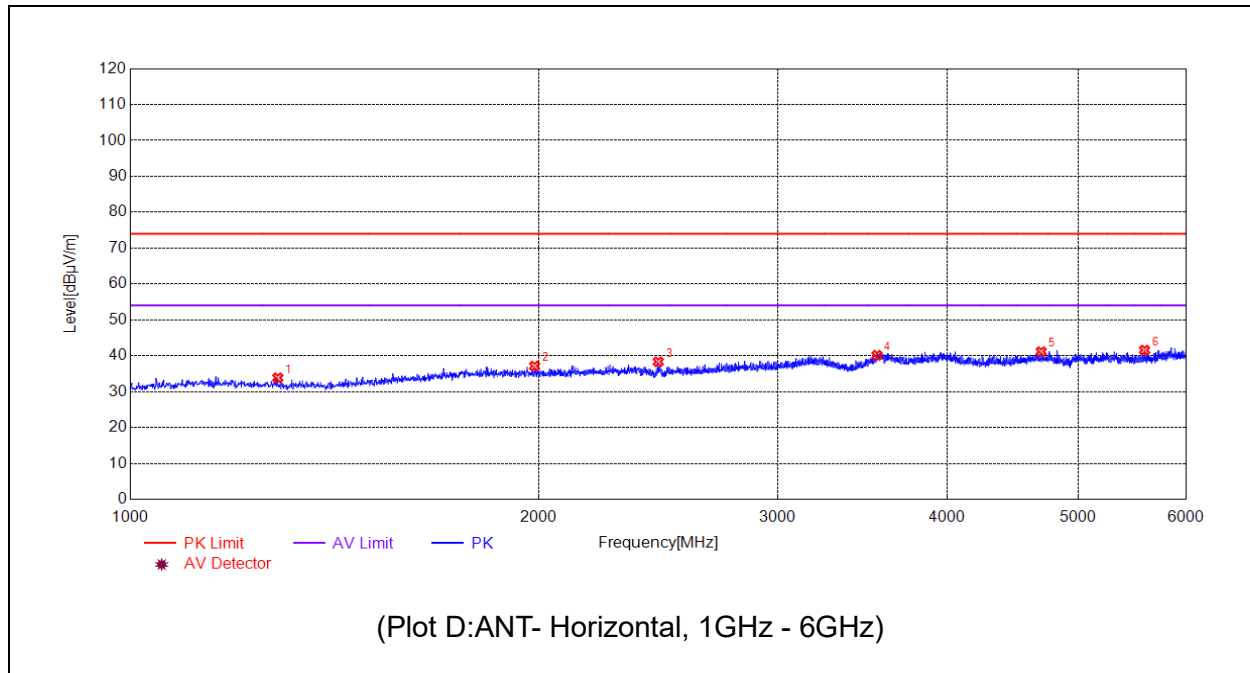
(Plot B: ANT-Vertical, 1GHz - 6GHz)

| 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 | 1280.0560 | 36.16 | N.A. | N.A. | 74.00 | N.A. | 54.00 | V | PASS |
| 2 | 1600.1200 | 40.74 | N.A. | N.A. | 74.00 | N.A. | 54.00 | V | PASS |
| 3 | 2266.2533 | 37.60 | N.A. | N.A. | 74.00 | N.A. | 54.00 | V | PASS |
| 4 | 3179.4359 | 39.82 | N.A. | N.A. | 74.00 | N.A. | 54.00 | V | PASS |
| 5 | 3962.5925 | 41.36 | N.A. | N.A. | 74.00 | N.A. | 54.00 | V | PASS |
| 6 | 5326.8654 | 41.97 | N.A. | N.A. | 74.00 | N.A. | 54.00 | V | PASS |



(Plot C:ANT- Horizontal, 30MHz - 1GHz)

| 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 | 37.2757 | 27.27 | N.A. | N.A. | N.A. | 40.00 | N.A. | H | PASS |
| 2 | 45.9096 | 27.13 | N.A. | N.A. | N.A. | 40.00 | N.A. | H | PASS |
| 3 | 104.4064 | 21.30 | N.A. | N.A. | N.A. | 43.50 | N.A. | H | PASS |
| 4 | 250.0180 | 19.40 | N.A. | N.A. | N.A. | 46.00 | N.A. | H | PASS |
| 5 | 360.0270 | 21.89 | N.A. | N.A. | N.A. | 46.00 | N.A. | H | PASS |
| 6 | 711.8812 | 24.28 | 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 | 1284.0568 | 33.86 | N.A. | N.A. | 74.00 | N.A. | 54.00 | H | PASS |
| 2 | 1986.1972 | 37.13 | N.A. | N.A. | 74.00 | N.A. | 54.00 | H | PASS |
| 3 | 2450.2901 | 38.33 | N.A. | N.A. | 74.00 | N.A. | 54.00 | H | PASS |
| 4 | 3552.5105 | 40.13 | N.A. | N.A. | 74.00 | N.A. | 54.00 | H | PASS |
| 5 | 4694.7389 | 41.14 | N.A. | N.A. | 74.00 | N.A. | 54.00 | H | PASS |
| 6 | 5595.9192 | 41.57 | 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 dBμV/m | Limit-QP dBμV/m | ANT | Verdict |
|-----------|-------------|--------------|--------------------|-----|---------|
| Mode 3 | 25.63 | 23.33 | 32.04 | V | PASS |
| | 26.11 | 23.15 | | | PASS |
| | 27.95 | 24.49 | | | PASS |
| | 28.33 | 23.24 | | | PASS |
| | 28.54 | 24.96 | | | PASS |
| | 29.29 | 23.48 | | | PASS |
| | 25.34 | 21.35 | 32.04 | H | PASS |
| | 26.55 | 21.73 | | | PASS |
| | 27.71 | 21.95 | | | PASS |
| | 28.18 | 20.45 | | | PASS |
| | 28.93 | 21.51 | | | PASS |
| | 29.42 | 20.96 | | | 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



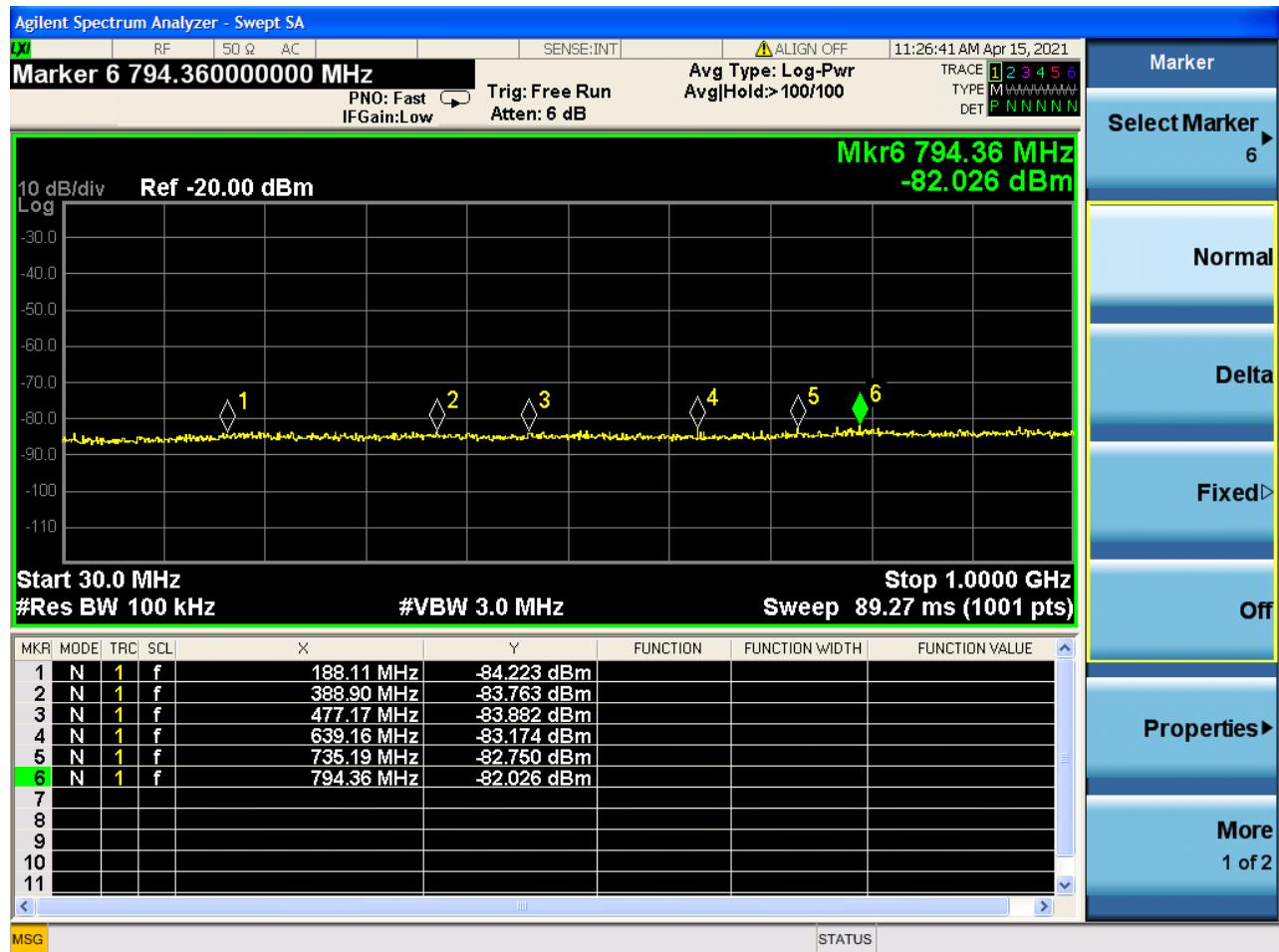
3.2.2. Test Result

Note: $P_{\text{Final value}}(\text{dBm}) = P_{\text{Reading value}}(\text{dBm}) + \text{Factor}(\text{dB})$,
Factor = 6dB (6 dB attenuator is used)+ 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 |
|----------|--------------------------------|-----------|------------------------------|-----------|---------|
| 188.11 | -84.223 | 6.17 | -78.053 | -57 | PASS |
| 388.9 | -83.763 | 6.24 | -77.523 | -57 | PASS |
| 477.17 | -83.882 | 6.27 | -77.612 | -57 | PASS |
| 639.16 | -83.174 | 6.33 | -76.844 | -57 | PASS |
| 735.19 | -82.75 | 6.36 | -76.39 | -57 | PASS |
| 794.36 | -82.026 | 6.38 | -75.646 | -57 | PASS |

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

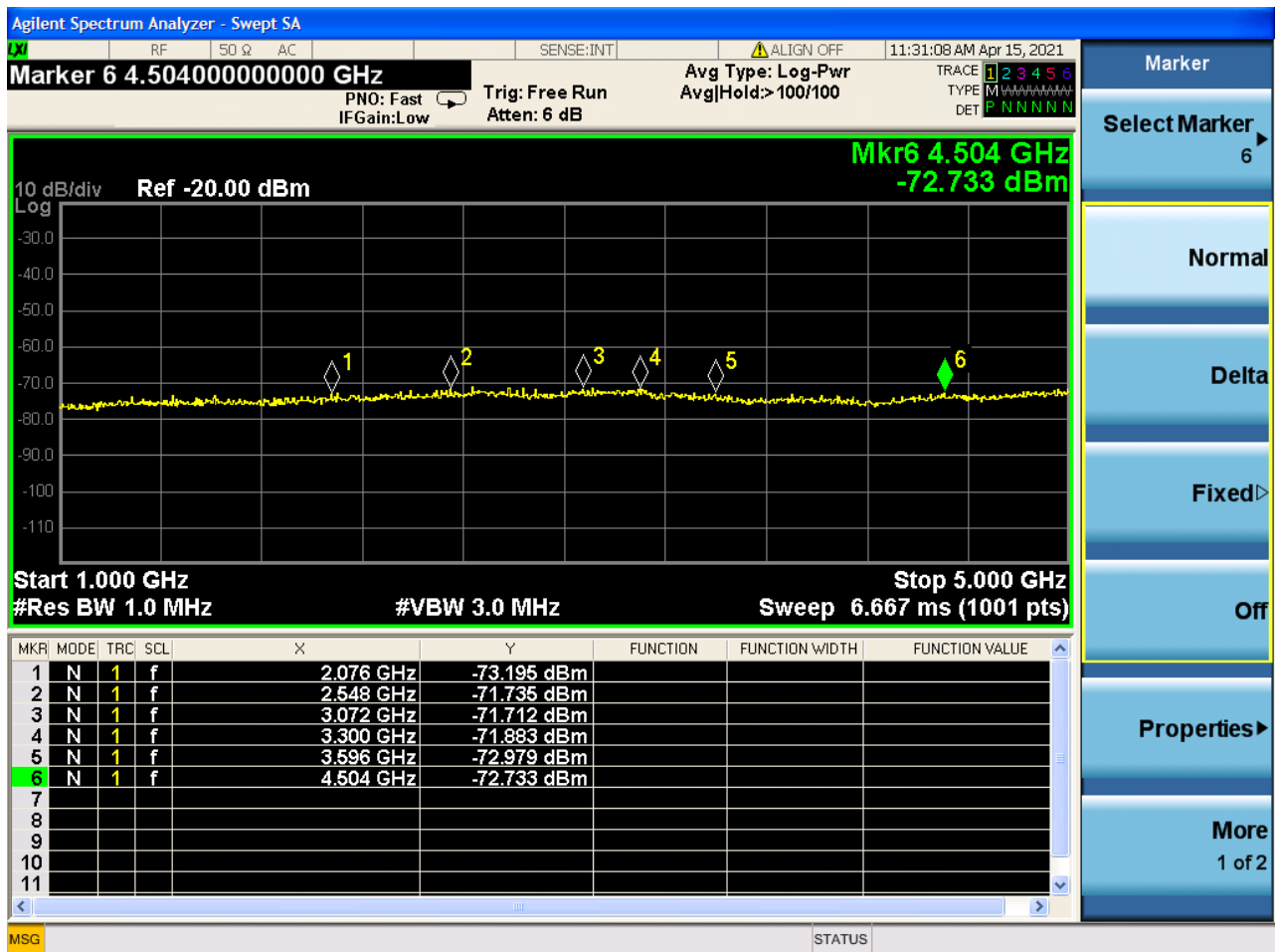




H port, Operate at 757.050MHz, 1GHz -5GHz

| Fre. GHz | PReading value dBm | Factor dB | PFinal value dBm | Limit dBm | Verdict |
|----------|--------------------|-----------|------------------|-----------|---------|
| 2.076 | -73.195 | 6.83 | -66.365 | -57 | PASS |
| 2.548 | -71.935 | 6.99 | -64.945 | -57 | PASS |
| 3.072 | -71.712 | 7.17 | -64.542 | -57 | PASS |
| 3.3 | -71.883 | 7.25 | -64.633 | -57 | PASS |
| 3.596 | -72.979 | 7.36 | -65.619 | -57 | PASS |
| 4.504 | -72.733 | 7.67 | -65.063 | -57 | PASS |

Attach spectrum pictures of PReading value for this test here:

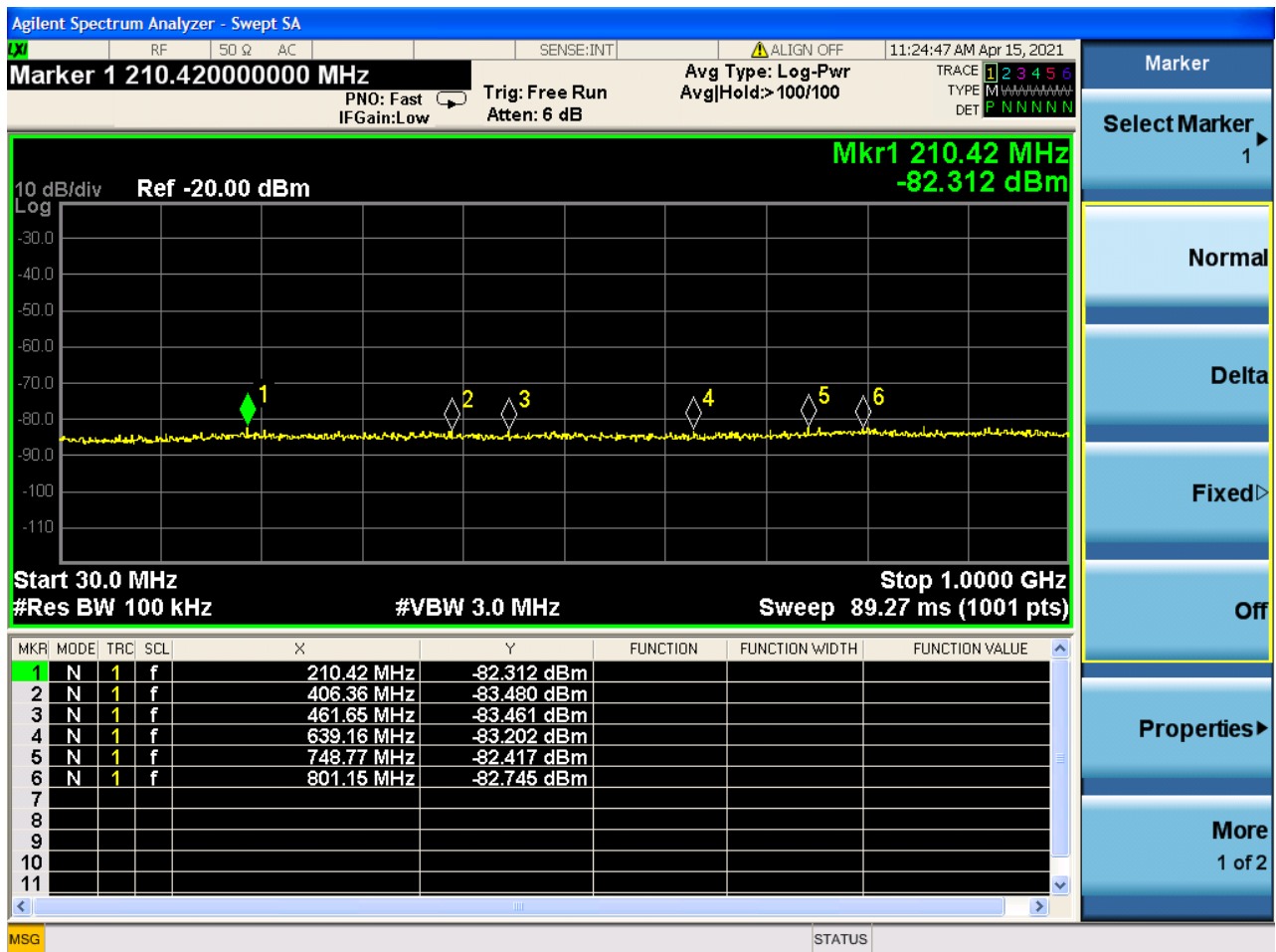




V port, Operate at 757.050MHz, 30MHz -1000MHz

| Fre. MHz | P _{Reading} value dBm | Factor dB | P _{Final} value dBm | Limit dBm | Verdict |
|-------------|-----------------------------------|--------------|---------------------------------|--------------|---------|
| 210.42 | -82.312 | 6.18 | -76.132 | -57 | PASS |
| 406.36 | -83.48 | 6.25 | -77.23 | -57 | PASS |
| 461.65 | -83.461 | 6.27 | -77.191 | -57 | PASS |
| 639.16 | -83.202 | 6.33 | -76.872 | -57 | PASS |
| 748.77 | -82.417 | 6.37 | -76.047 | -57 | PASS |
| 801.15 | -82.745 | 6.38 | -76.365 | -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 |
|-------------|-----------------------------------|--------------|---------------------------------|--------------|---------|
| 2.108 | -74.093 | 6.84 | -67.253 | -57 | PASS |
| 2.528 | -70.894 | 6.98 | -63.914 | -57 | PASS |
| 3.056 | -71.764 | 7.17 | -64.594 | -57 | PASS |
| 3.192 | -71.382 | 7.22 | -64.162 | -57 | PASS |
| 3.576 | -73.684 | 7.35 | -66.334 | -57 | PASS |
| 4.344 | -73.182 | 7.62 | -65.562 | -57 | PASS |

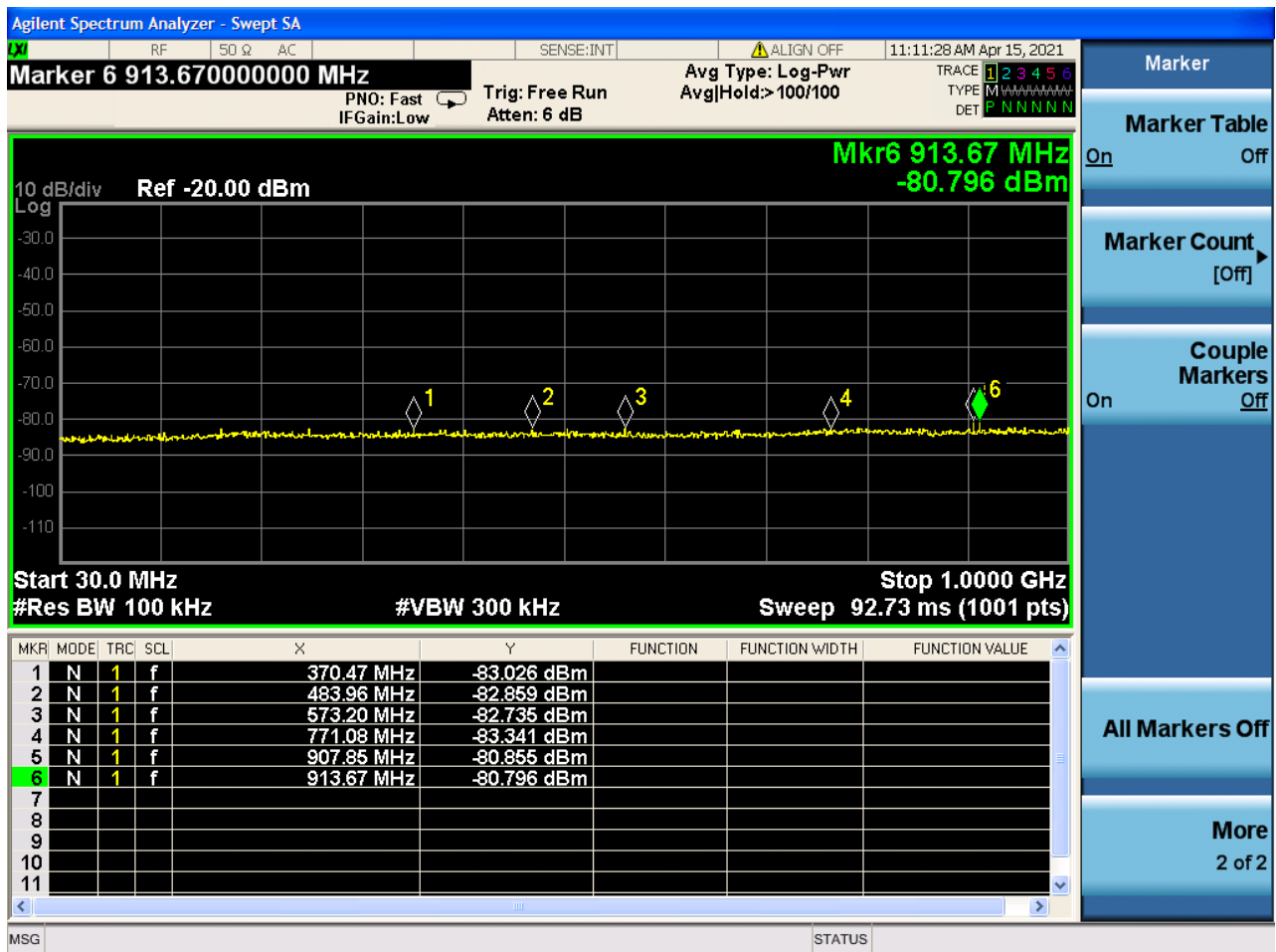
Attach spectrum pictures of P_{Reading} value for this test here:



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

| Fre. MHz | P _{Reading} value dBm | Factor dB | P _{Final} value dBm | Limit dBm | Verdict |
|-------------|-----------------------------------|--------------|---------------------------------|--------------|---------|
| 370.47 | -83.026 | 6.23 | -76.796 | -57 | PASS |
| 483.96 | -82.859 | 6.27 | -76.589 | -57 | PASS |
| 573.2 | -82.735 | 6.3 | -76.435 | -57 | PASS |
| 771.08 | -83.341 | 6.37 | -76.971 | -57 | PASS |
| 907.85 | -80.855 | 6.42 | -74.435 | -57 | PASS |
| 913.67 | -80.796 | 6.43 | -74.366 | -57 | PASS |

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

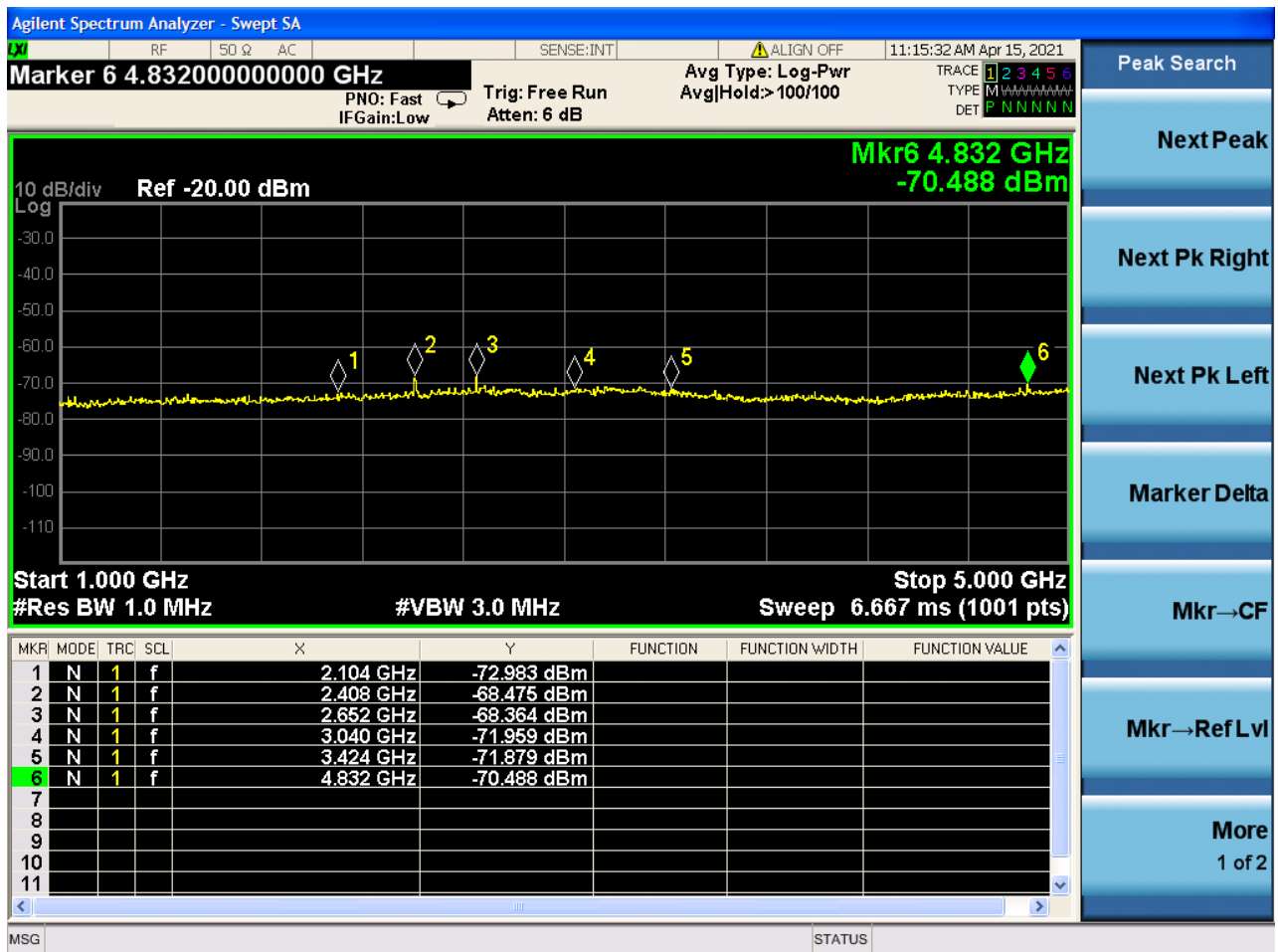




H port, Operate at 787.950MHz, 1GHz -5GHz

| Fre. GHz | P _{Reading} value dBm | Factor dB | P _{Final} value dBm | Limit dBm | Verdict |
|----------|--------------------------------|-----------|------------------------------|-----------|---------|
| 2.104 | -72.983 | 6.84 | -66.143 | -57 | PASS |
| 2.408 | -68.475 | 6.94 | -61.535 | -57 | PASS |
| 2.652 | -71.959 | 7.32 | -64.639 | -57 | PASS |
| 3.04 | -71.879 | 7.16 | -64.719 | -57 | PASS |
| 3.424 | -71.897 | 7.3 | -64.597 | -57 | PASS |
| 4.832 | -70.488 | 7.79 | -62.698 | -57 | PASS |

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

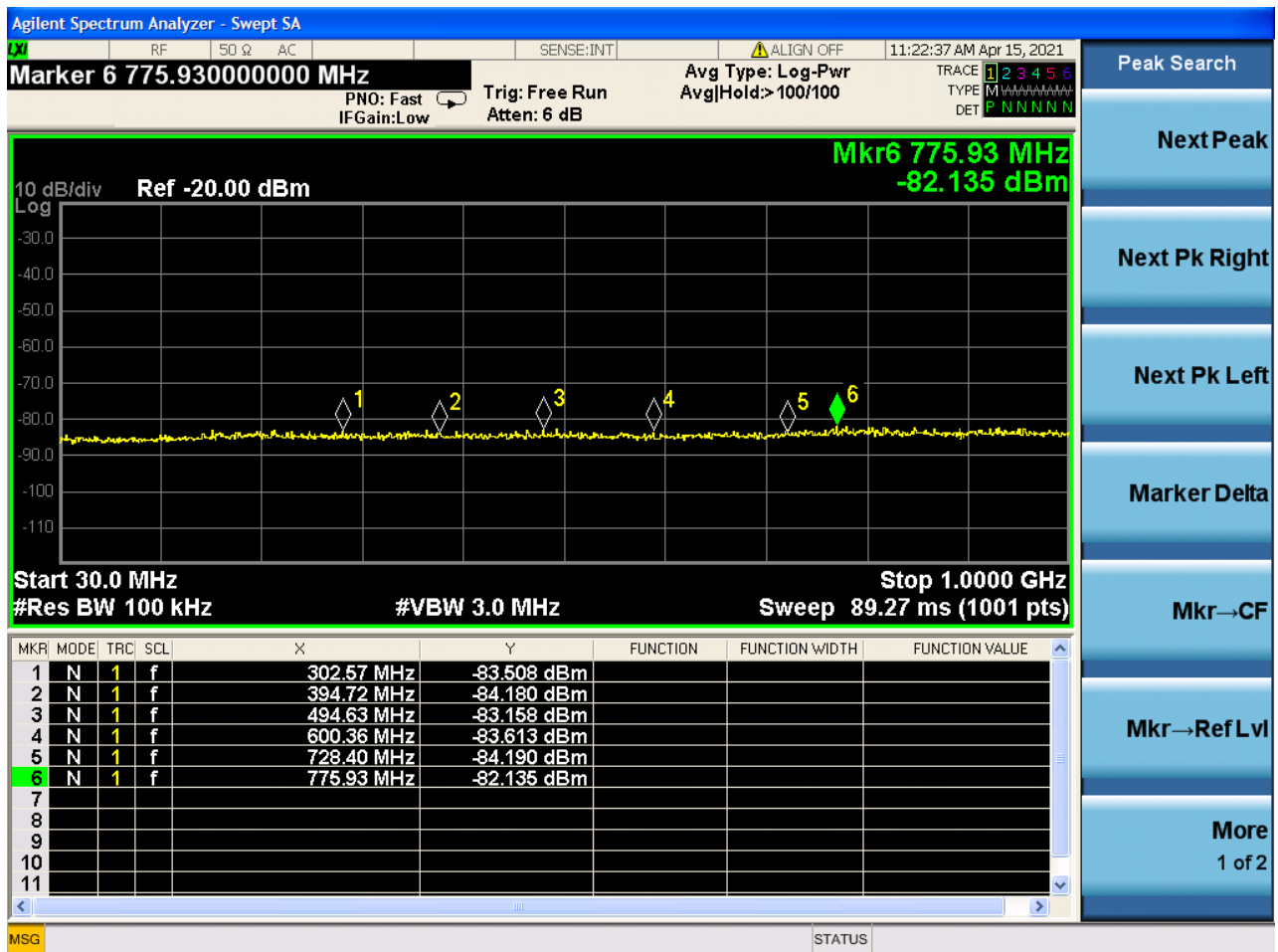




V port, Operate at 787.950MHz, 30MHz -1000MHz

| Fre. MHz | P _{Reading} value dBm | Factor dB | P _{Final} value dBm | Limit dBm | Verdict |
|-------------|-----------------------------------|--------------|---------------------------------|--------------|---------|
| 302.57 | -83.508 | 6.21 | -77.298 | -57 | PASS |
| 394.72 | -84.18 | 6.24 | -77.94 | -57 | PASS |
| 494.63 | -83.158 | 6.28 | -76.878 | -57 | PASS |
| 600.36 | -83.613 | 6.31 | -77.303 | -57 | PASS |
| 728.4 | -84.19 | 6.36 | -77.83 | -57 | PASS |
| 775.93 | -82.135 | 6.38 | -75.755 | -57 | PASS |

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

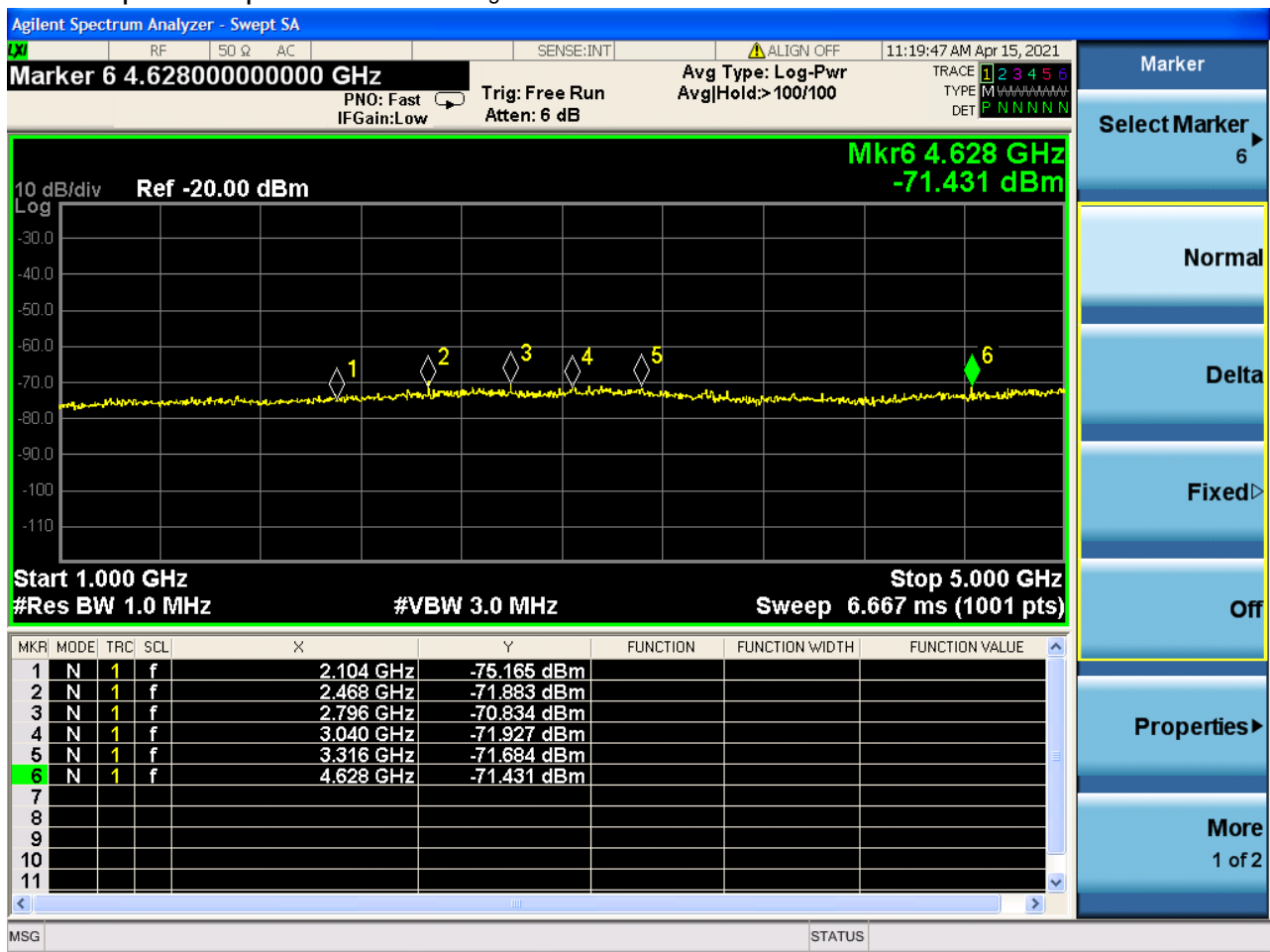




V port, Operate at 787.950MHz, 1GHz -5GHz

| Fre. GHz | P _{Reading} value dBm | Factor dB | P _{Final} value dBm | Limit dBm | Verdict |
|----------|--------------------------------|-----------|------------------------------|-----------|---------|
| 2.104 | -75.165 | 6.84 | -68.325 | -57 | PASS |
| 2.468 | -71.463 | 6.96 | -64.503 | -57 | PASS |
| 2.796 | -70.834 | 7.08 | -63.754 | -57 | PASS |
| 3.04 | -71.927 | 7.16 | -64.767 | -57 | PASS |
| 3.316 | -71.684 | 7.26 | -64.424 | -57 | PASS |
| 4.628 | -71.431 | 7.72 | -63.711 | -57 | PASS |

Attach spectrum pictures of P_{Reading} value 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 | ±5.24dB |
| | 1GHz-6GHz | ±5.18dB |
| | 6GHz-18GHz | ±5.48dB |



Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

| | |
|----------------------------|--|
| Laboratory Name: | Morlab Laboratory of 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 |
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2. Identification of the Responsible Testing Location

| | |
|-----------------|--|
| Name: | Morlab Laboratory of 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.) |
|---------------------------------------|--|

4. Test Software Utilized

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

**5. Test Equipments Utilized**

| Description | Manufacturer | Model | Serial No. | Cal. Date | Due. Date |
|-----------------------|---------------|-------------|--------------------|------------|------------|
| MXE EMI Receiver | Agilent | N9038A | MY54130016 | 2020.07.21 | 2021.07.20 |
| Test Receiver | R&S | ESPI | 101052 | 2020.07.21 | 2021.07.20 |
| LISN | Schwarzbeck | NSLK 8127 | 8127449 | 2021.03.09 | 2022.03.08 |
| Pulse Limiter (10dB) | Schwarzbeck | VTSD 9561-F | VTSD 9561 F-B #206 | 2020.07.24 | 2021.07.23 |
| Test Antenna - Bi-Log | Schwarzbeck | VULB 9163 | 9163-519 | 2019.05.24 | 2022.05.23 |
| Test Antenna - Horn | Schwarzbeck | BBHA 9120D | 01774 | 2019.07.26 | 2022.07.25 |
| 6 dB attenuator | Mini-circuits | BW-N6W5+ | E191001 | 2020.10.20 | 2021.10.19 |
| Semi-Anechoic Chamber | CRT | 9m*6m*6m | N/A | 2020.01.06 | 2023.01.05 |

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