# FCC PART 15.249

# TEST REPORT

For

## DewertOkin GmbH

Weststr. 1, 32278 Kirchlengern, Germany

**FCC ID: O3YENH22**

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | RF-ENHANCE |

| | |
|---|---|
| **Report Number:** | RSZ190920551-00 |
| **Report Date:** | 2019-10-30 |
| **Reviewed By:** | Nancy Wang<br>RF Engineer |
| **Prepared By:** | Bay Area Compliance Laboratories Corp. (Shenzhen)<br>6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China<br>Tel: +86-755-33320018<br>Fax: +86-755-33320008<br>www.baclcorp.com.cn |

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# GENERAL INFORMATION

## Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Product | RF-ENHANCE |
| Model | ENH22 |
| Frequency Range | 2403MHz~2480MHz |
| Modulation Technique | GFSK |
| Antenna Specification | 1 dBi |
| Voltage Range | DC 1.5V*3 battery |
| Date of Test | 2019/10/09~2019/10/25 |
| Sample serial number | 190920551 (Assigned by BACL, Shenzhen) |
| Received date | 2019/09/20 |
| Sample/EUT Status | Good condition |

## Objective

This type approval report is prepared on behalf of *DewertOkin GmbH* in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209 and 15.249 rules.

## Related Submittal(s)/Grant(s)

Part of system with FCC ID: O3YHE150 which had been granted.

## Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## Measurement Uncertainty

| Parameter | | Uncertainty |
|---|---|---|
| Occupied Channel Bandwidth | | ±5% |
| Emissions, Radiated | Below 1GHz | ±4.75dB |
| | Above 1GHz | ±4.88dB |
| Temperature | | ±1℃ |
| Humidity | | ±6% |
| Supply voltages | | ±0.4% |

*Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.*

## Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 342867, the FCC Designation No.: CN1221.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062B.

# SYSTEM TEST CONFIGURATION

## Justification

The system was configured for testing by manufacturer.

78 channels are provided to testing:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---|---|---|---|---|---|---|---|
| 1 | 2403 | 21 | 2423 | 41 | 2443 | 61 | 2463 |
| 2 | 2404 | 22 | 2424 | 42 | 2444 | 62 | 2464 |
| 3 | 2405 | 23 | 2425 | 43 | 2445 | 63 | 2465 |
| 4 | 2406 | 24 | 2426 | 44 | 2446 | 64 | 2466 |
| 5 | 2407 | 25 | 2427 | 45 | 2447 | 65 | 2467 |
| 6 | 2408 | 26 | 2428 | 46 | 2448 | 66 | 2468 |
| 7 | 2409 | 27 | 2429 | 47 | 2449 | 67 | 2469 |
| 8 | 2410 | 28 | 2430 | 48 | 2450 | 68 | 2470 |
| 9 | 2411 | 29 | 2431 | 49 | 2451 | 69 | 2471 |
| 10 | 2412 | 30 | 2432 | 50 | 2452 | 70 | 2472 |
| 11 | 2413 | 31 | 2433 | 51 | 2453 | 71 | 2473 |
| 12 | 2414 | 32 | 2434 | 52 | 2454 | 72 | 2474 |
| 13 | 2415 | 33 | 2435 | 53 | 2455 | 73 | 2475 |
| 14 | 2416 | 34 | 2436 | 54 | 2456 | 74 | 2476 |
| 15 | 2417 | 35 | 2437 | 55 | 2457 | 75 | 2477 |
| 16 | 2418 | 36 | 2438 | 56 | 2458 | 76 | 2478 |
| 17 | 2419 | 37 | 2439 | 57 | 2459 | 77 | 2479 |
| 18 | 2420 | 38 | 2440 | 58 | 2460 | 78 | 2480 |
| 19 | 2421 | 39 | 2441 | 59 | 2461 | / | / |
| 20 | 2422 | 40 | 2442 | 60 | 2462 | / | / |

Channel 1, Channel 38 and Channel 78 were selected for testing.

## EUT Exercise Software

No software was used.

## Equipment Modifications

No modifications were made to the unit tested.

## Support Equipment List and Details

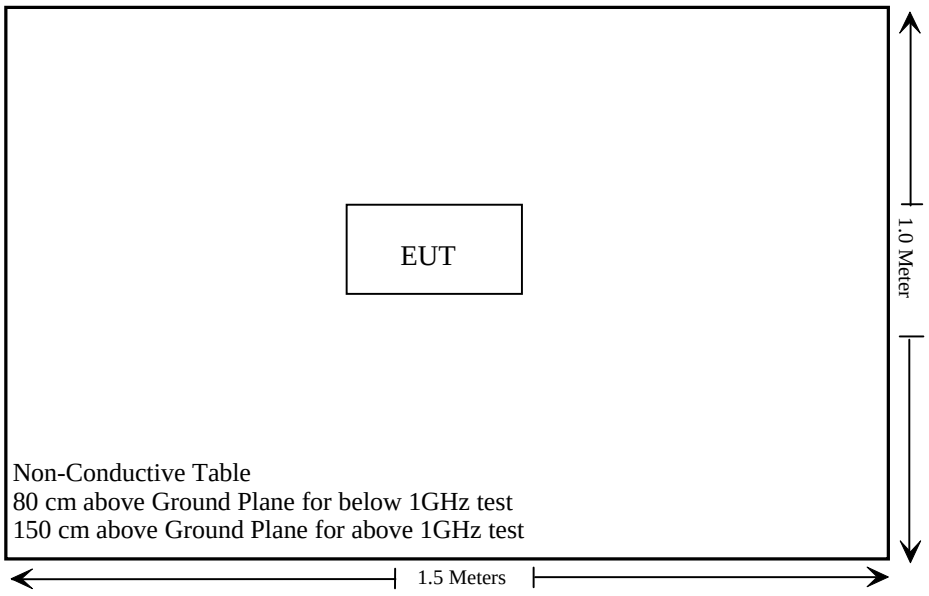
| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| N/A | N/A | N/A | N/A |

## Support Cable Descriptions

| Cable Description | Length (m) | From/Port | To |
|---|---|---|---|
| N/A | N/A | N/A | N/A |

## Block Diagram of Test Setup

For radiated emissions:



# SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Result |
|---|---|---|
| §15.203 | Antenna Requirement | Compliance |
| §15.207(a) | Conduction Emissions | Not Applicable |
| 15.205, §15.209, §15.249(d) | Radiated Emissions& Outside of Band Emission | Compliance |
| §15.215 (c) | 20 dB Bandwidth | Compliance |

**Note:**
Not Applicable: The device is powered by battery only.

# TEST EQUIPMENT LIST

| Manufacturer | Description | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| **Radiated Emission Test** | | | | | |
| A.H. System | Horn Antenna | SAS-200/571 | 135 | 2018-09-01 | 2021-08-31 |
| Rohde & Schwarz | Spectrum Analyzer | FSV40-N | 102259 | 2019-07-22 | 2020-07-21 |
| Sunol Sciences | Broadband Antenna | JB1 | A040904-1 | 2017-12-22 | 2020-12-21 |
| COM-POWER | Pre-amplifier | PA-122 | 181919 | 2018-11-12 | 2019-11-12 |
| Sonoma Instrument | Amplifier | 310N | 186238 | 2018-11-12 | 2019-11-12 |
| Rohde & Schwarz | EMI Test Receiver | ESR3 | 102455 | 2019-07-09 | 2020-07-08 |
| Ducommun technologies | RF Cable | UFA147A-2362-100100 | MFR64639 231029-003 | 2018-11-12 | 2019-11-12 |
| Ducommun technologies | RF Cable | 104PEA | 218124002 | 2018-11-12 | 2019-11-12 |
| Ducommun technologies | RF Cable | RG-214 | 1 | 2018-11-12 | 2019-11-12 |
| Ducommun technologies | RF Cable | RG-214 | 2 | 2018-11-12 | 2019-11-12 |
| Ducommun Technologies | Horn Antenna | ARH-4223-02 | 1007726-04 | 2017-12-29 | 2020-12-28 |
| Heatsink Required | Amplifier | QLW-18405536-J0 | 15964001002 | 2018-11-12 | 2019-11-12 |
| Sinoscite | Notch Filter | BSF2402-2480MN-0898-001 | 99632 | 2018-11-12 | 2019-11-12 |
| Rohde & Schwarz | Auto test software | EMC 32 | V9.10 | NCR | NCR |

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

# FCC§15.203 - ANTENNA REQUIREMENT

## Applicable Standard

According to FCC § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

## Antenna Connector Construction

The EUT has one internal antenna which was permanently attached and the antenna gain is 1 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result:** Compliance.

# FCC§15.205, §15.209 & §15.249(d) - RADIATED EMISSIONS

## Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|---|---|---|
| 902–928 MHz | 50 | 500 |
| 2400–2483.5 MHz | 50 | 500 |
| 5725–5875 MHz | 50 | 500 |
| 24.0–24.25 GHz | 250 | 2500 |

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

As per FCC§15.249 (d), Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

## Test Equipment Setup

The spectrum analyzer or receiver is set as:

Below 1000MHz:

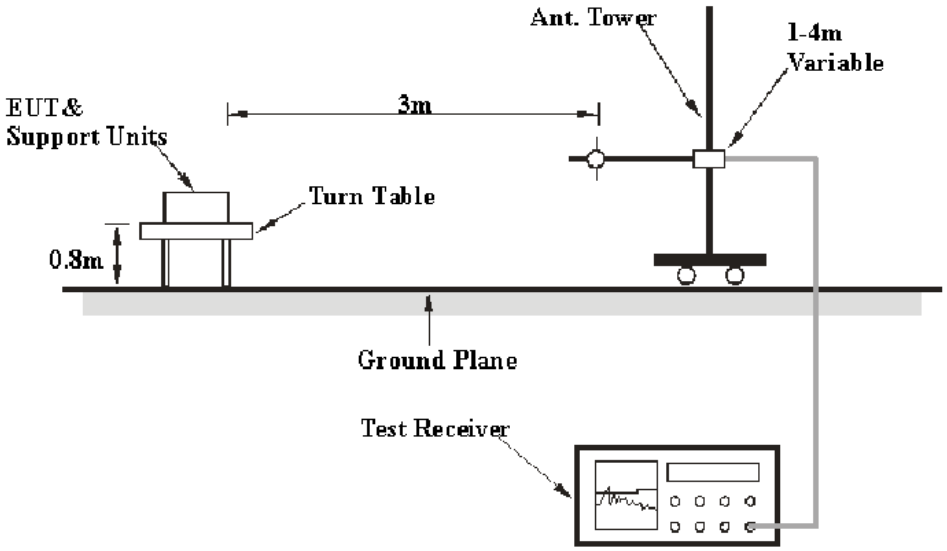
RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000MHz:

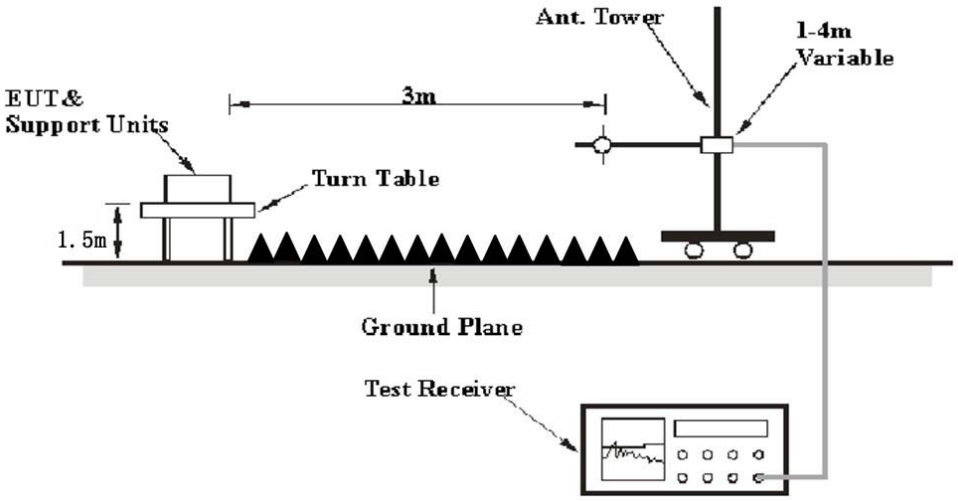
Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

## EUT Setup

**Below 1GHz:**




**Above 1GHz:**




The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

## Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane for below 1GHz or 1.5 meter for above 1GHz, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

## Test Results Summary

According to the data as following, the EUT complied with the FCC Part 15.205, 15.209 & §15.249

## Test Data

### Environmental Conditions

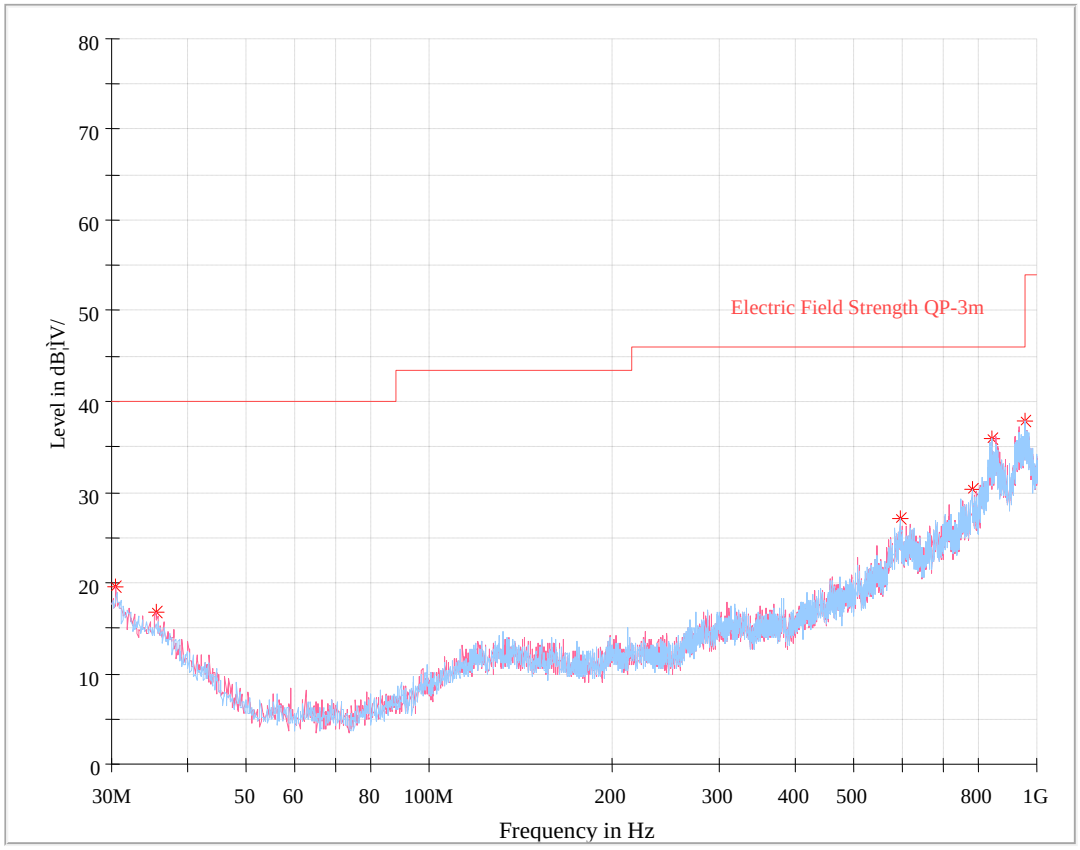
| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 52 % |
| **ATM Pressure:** | 101.0 kPa |

*The testing was performed by Zero Yan on 2019-10-09 and by Alan He on 2019-10-25.*

*Test Mode: Transmitting*

**Low Channel (Worst Mode):**

**30MHz – 1 GHz:**



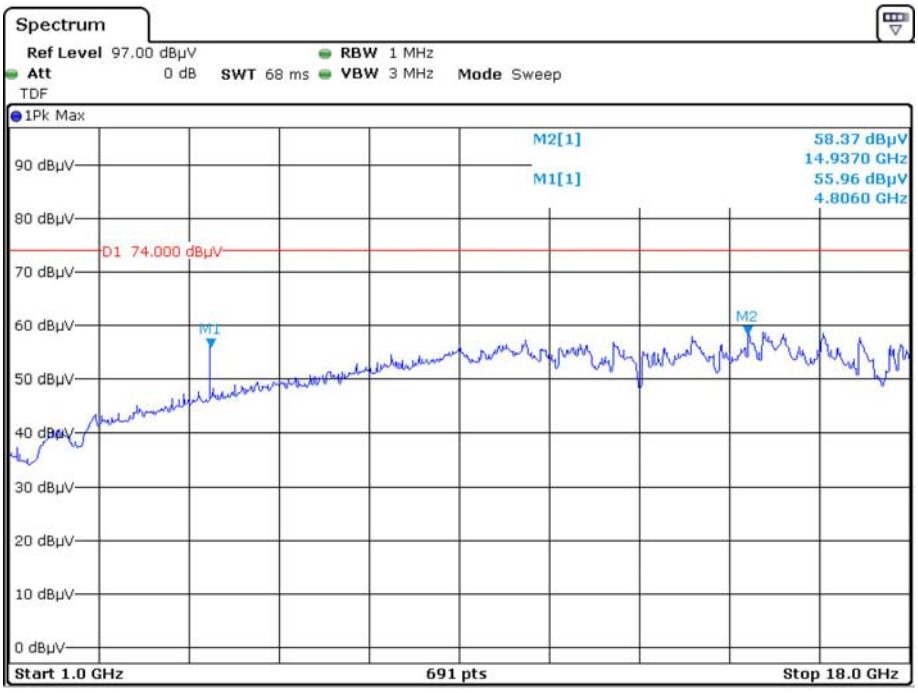

| Frequency (MHz) | Corrected Amplitude (dBµV/m) | Antenna height (cm) | Antenna Polarity | Turntable position (degree) | Correction Factor (dB/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 30.485000 | 19.48 | 102.0 | V | 36.0 | -7.9 | 40.00 | 20.52 |
| 35.456250 | 16.75 | 300.0 | V | 116.0 | -10.8 | 40.00 | 23.25 |
| 596.480000 | 27.13 | 300.0 | H | 0.0 | -1.8 | 46.00 | 18.87 |
| 781.022500 | 30.36 | 102.0 | H | 302.0 | 1.0 | 46.00 | 15.64 |
| 841.526250 | 35.99 | 202.0 | H | 322.0 | 6.1 | 46.00 | 10.01 |
| 953.318750 | 37.85 | 202.0 | H | 0.0 | 9.7 | 46.00 | 8.15 |

**1 GHz - 25 GHz:**

| Frequency (MHz) | Receiver | | Turntable Degree | Rx Antenna | | Corrected Factor (dB/m) | Corrected Amplitude (dBμV/m) | FCC Part 15.249&15.209 | |
|---|---|---|---|---|---|---|---|---|---|
| | Reading (dBμV) | PK/QP/Ave. | | Height (m) | Polar (H/V) | | | Limit (dBμV/m) | Margin (dB) |
| **Low Channel (2403 MHz)** | | | | | | | | | |
| 2403.00 | 42.56 | PK | 6 | 1.1 | H | 31.87 | 74.43 | 114 | 39.57 |
| 2403.00 | 39.49 | Ave. | 6 | 1.1 | H | 31.87 | 71.36 | 94 | 22.64 |
| 2403.00 | 40.57 | PK | 66 | 1.3 | V | 31.87 | 72.44 | 114 | 41.56 |
| 2403.00 | 38.24 | Ave. | 66 | 1.3 | V | 31.87 | 70.11 | 94 | 23.89 |
| 2389.13 | 27.77 | PK | 313 | 2.1 | H | 31.87 | 59.64 | 74 | 14.36 |
| 2389.13 | 13.92 | Ave. | 313 | 2.1 | H | 31.87 | 45.79 | 54 | 8.21 |
| 2497.42 | 28.16 | PK | 160 | 1.8 | H | 32.13 | 60.29 | 74 | 13.71 |
| 2497.42 | 14.03 | Ave. | 160 | 1.8 | H | 32.13 | 46.16 | 54 | 7.84 |
| 4806.00 | 54.44 | PK | 172 | 1.5 | H | 5.40 | 59.84 | 74 | 14.16 |
| 4806.00 | 46.98 | Ave. | 172 | 1.5 | H | 5.40 | 52.38 | 54 | 1.62 |
| **Middle Channel (2440 MHz)** | | | | | | | | | |
| 2440.00 | 42.67 | PK | 95 | 2.1 | H | 31.97 | 74.64 | 114 | 39.36 |
| 2440.00 | 39.58 | Ave. | 95 | 2.1 | H | 31.97 | 71.55 | 94 | 22.45 |
| 2440.00 | 40.69 | PK | 227 | 1.4 | V | 31.97 | 72.66 | 114 | 41.34 |
| 2440.00 | 38.44 | Ave. | 227 | 1.4 | V | 31.97 | 70.41 | 94 | 23.59 |
| 4880.00 | 52.38 | PK | 321 | 1.5 | H | 6.43 | 58.81 | 74 | 15.19 |
| 4880.00 | 45.25 | Ave. | 321 | 1.5 | H | 6.43 | 51.68 | 54 | 2.32 |
| **High Channel (2480 MHz)** | | | | | | | | | |
| 2480.00 | 42.85 | PK | 182 | 2.3 | H | 32.13 | 74.98 | 114 | 39.02 |
| 2480.00 | 39.63 | Ave. | 182 | 2.3 | H | 32.13 | 71.76 | 94 | 22.24 |
| 2480.00 | 41.22 | PK | 336 | 1.0 | V | 32.13 | 73.35 | 114 | 40.65 |
| 2480.00 | 38.68 | Ave. | 336 | 1.0 | V | 32.13 | 70.81 | 94 | 23.19 |
| 2310.75 | 28.04 | PK | 148 | 1.9 | H | 31.64 | 59.68 | 74 | 14.32 |
| 2310.75 | 14.13 | Ave. | 148 | 1.9 | H | 31.64 | 45.77 | 54 | 8.23 |
| 2483.53 | 36.73 | PK | 64 | 1.5 | H | 32.13 | 68.86 | 74 | 5.14 |
| 2483.53 | 15.11 | Ave. | 64 | 1.5 | H | 32.13 | 47.24 | 54 | 6.76 |
| 4960.00 | 52.58 | PK | 157 | 1.4 | H | 6.95 | 59.53 | 74 | 14.47 |
| 4960.00 | 45.25 | Ave. | 157 | 1.4 | H | 6.95 | 52.20 | 54 | 1.80 |

**Note:**
Corrected Amplitude = Corrected Factor + Reading
Corrected Factor=Antenna factor (RX) +cable loss – amplifier factor
Margin = Limit- Corr. Amplitude
The emission more than20dB below the limit was not required to be recorded.

**Pre-scan with Low channel Peak**
**Horizontal**

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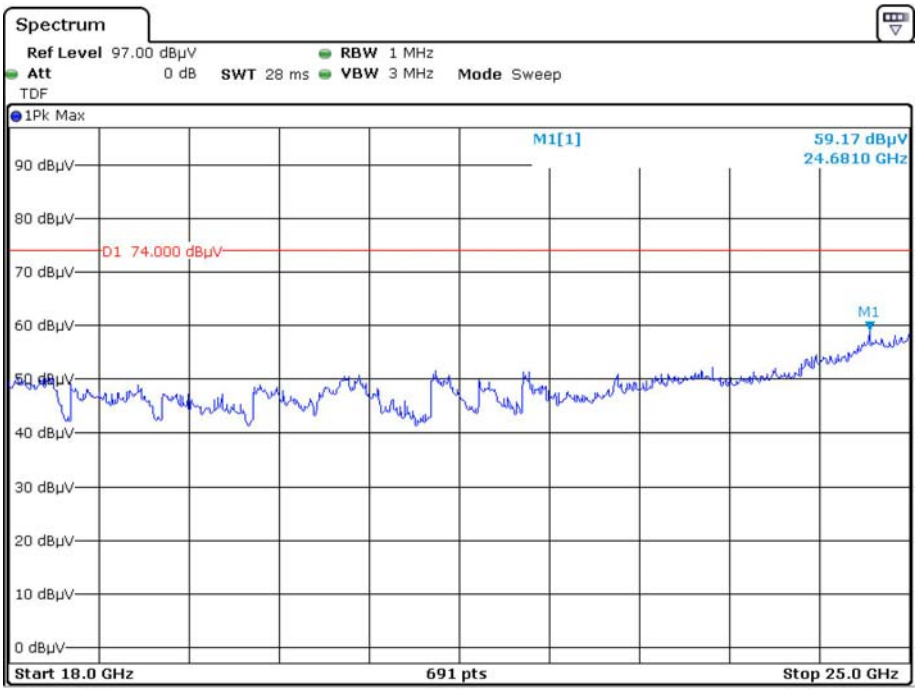


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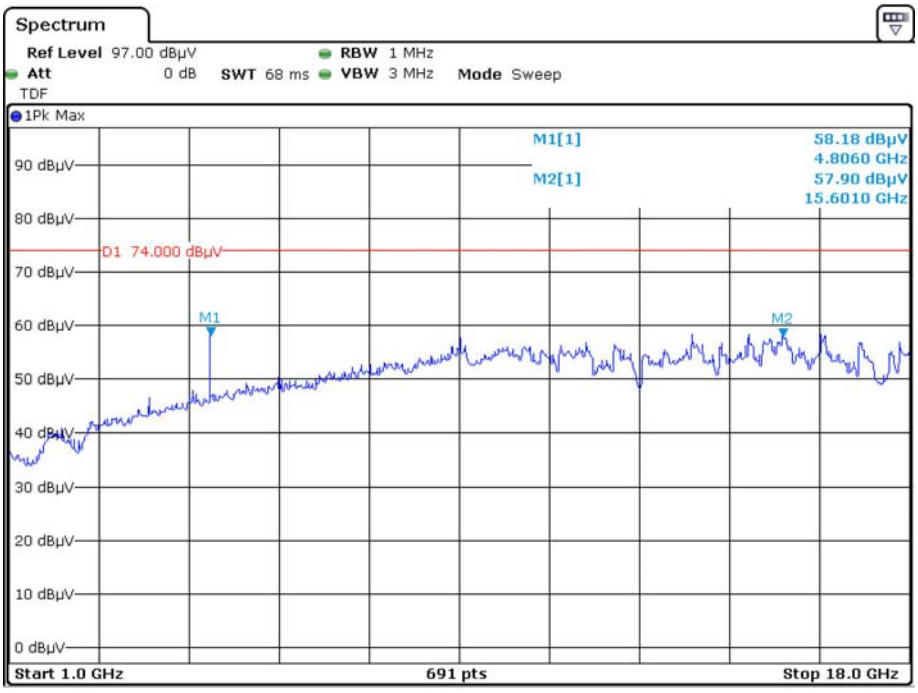
**Vertical**

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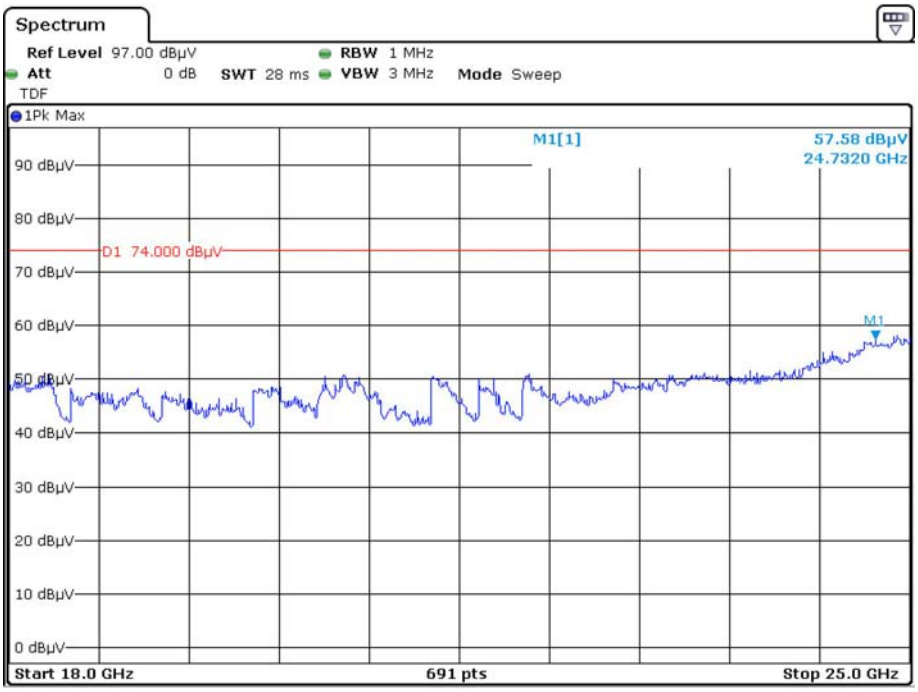


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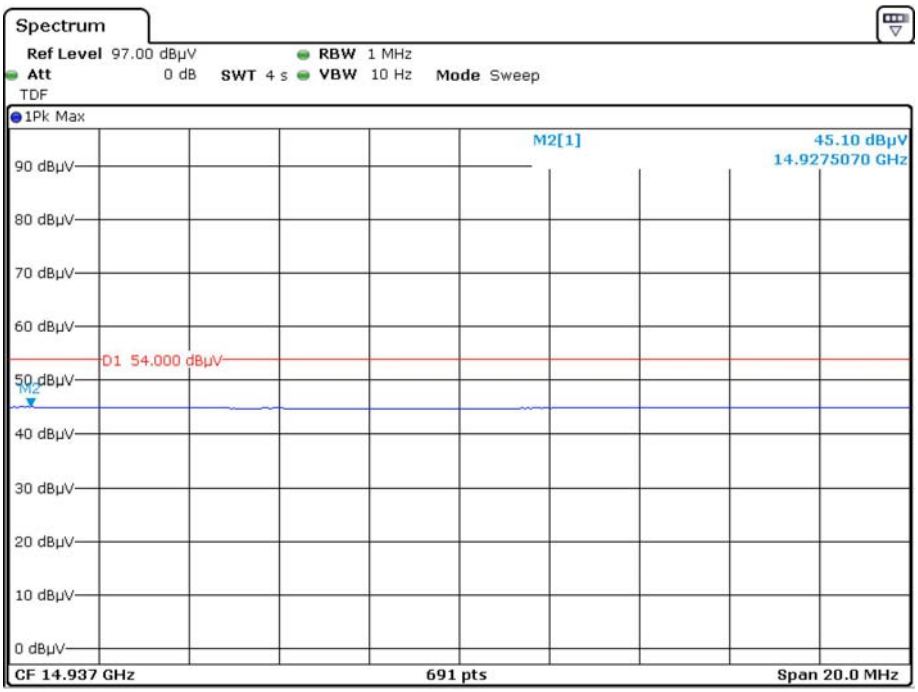
**Average value for the peak point at pre-scan**
**Horizontal**

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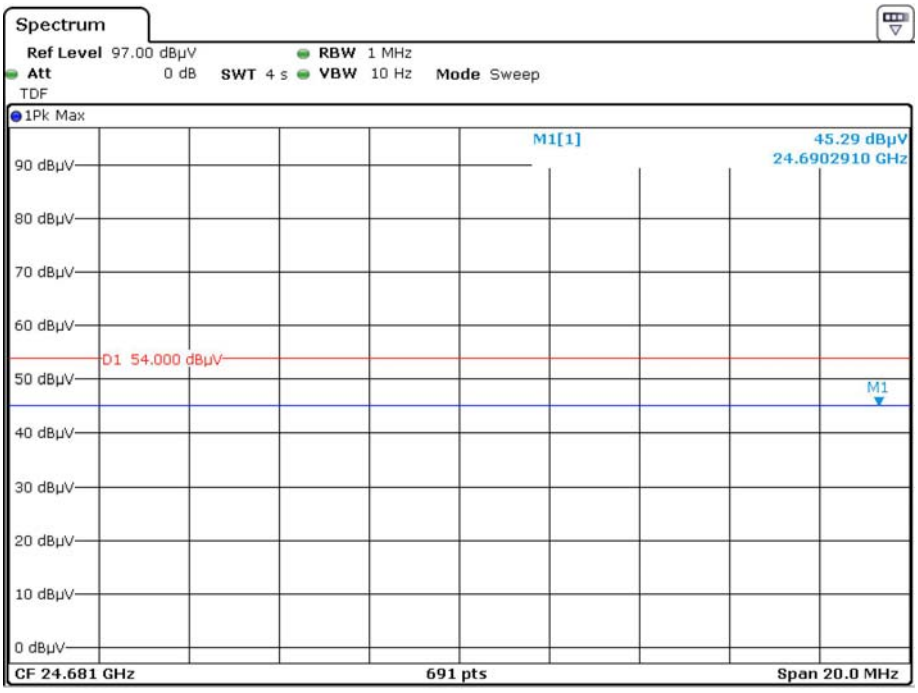


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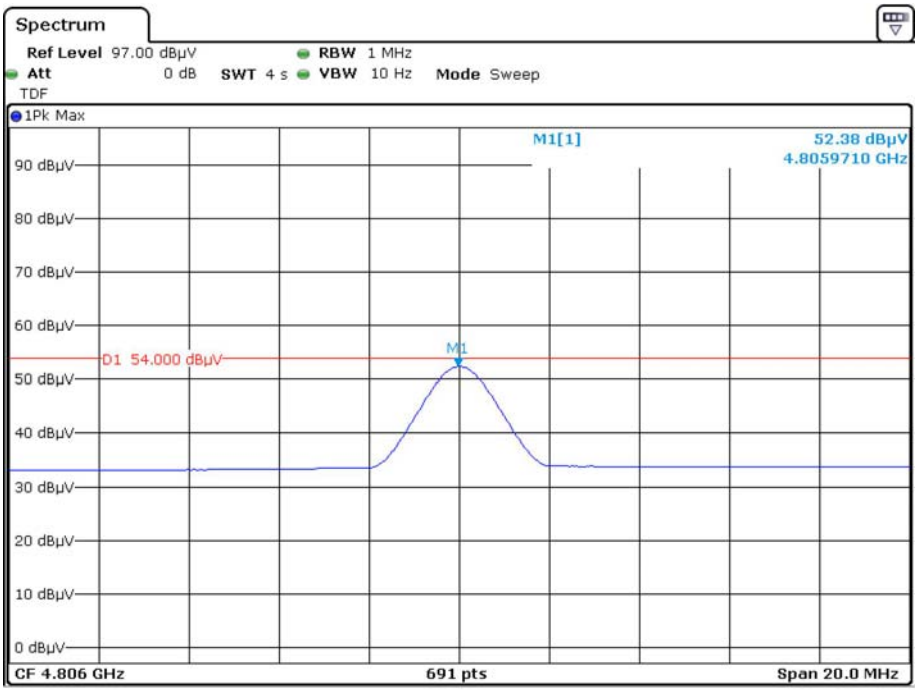


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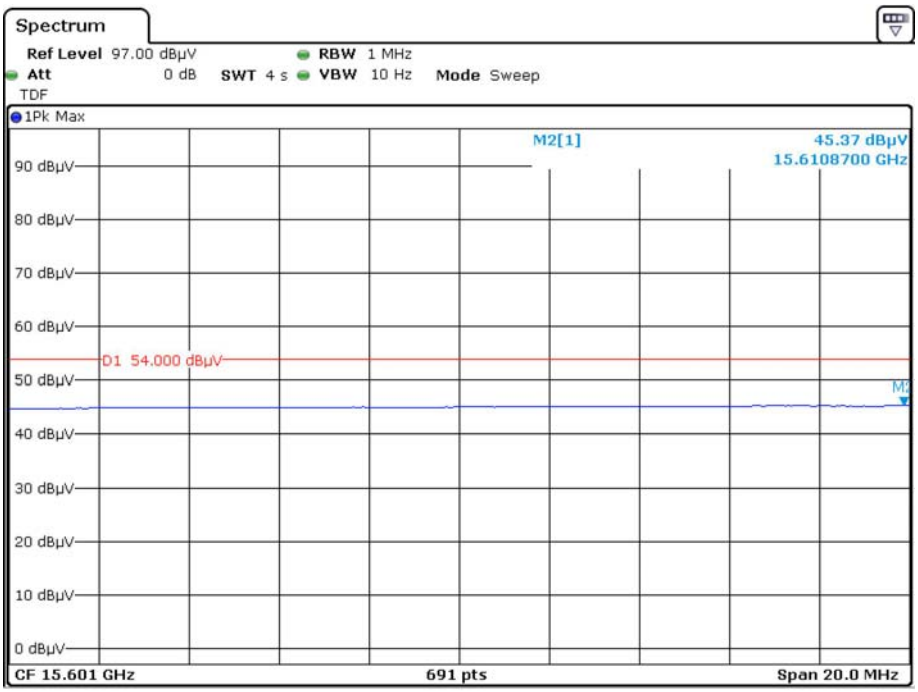
**Vertical**

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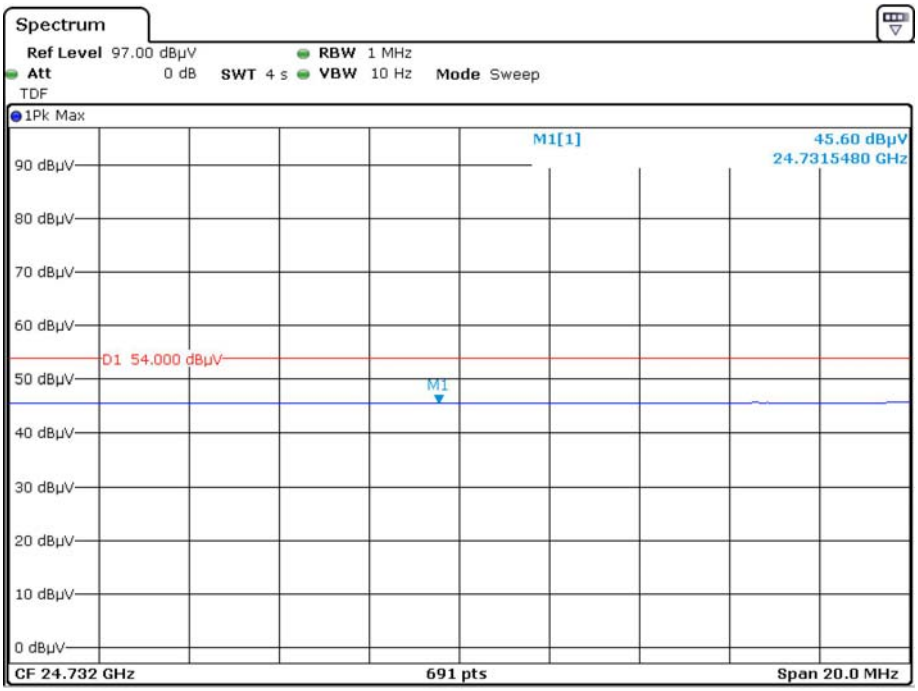


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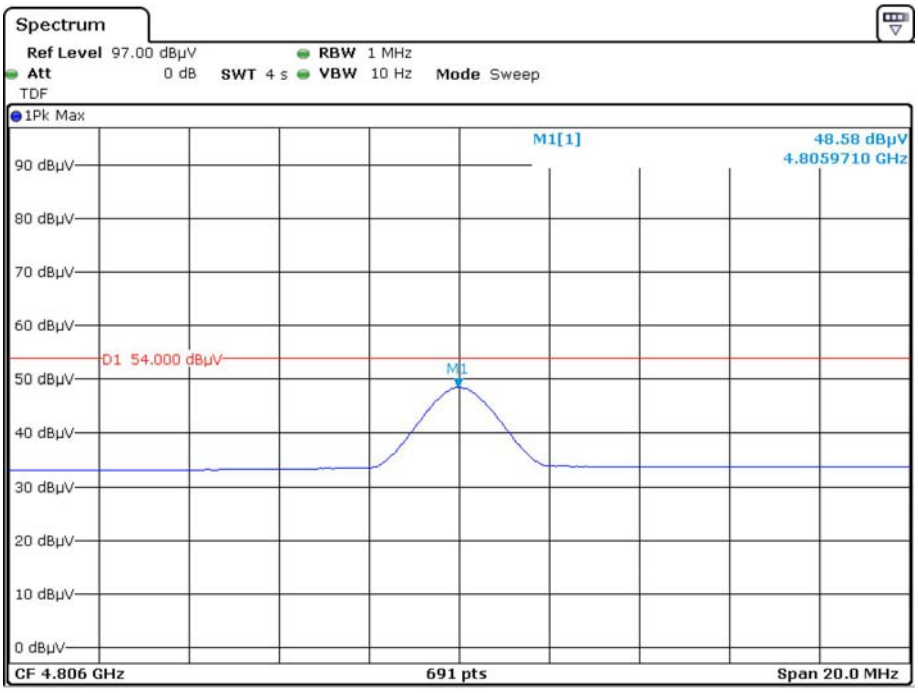


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# FCC§15.215(c) - 20dB EMISSION BANDWIDTH

## Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

## Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

3. Measure the frequency difference of two frequencies that indicated 20dB bandwidth.

4. Repeat above procedures until all frequencies measured were complete.

## Test Data

### Environmental Conditions

| | |
|---|---|
| **Temperature:** | 25 ℃ |
| **Relative Humidity:** | 52 % |
| **ATM Pressure:** | 101.0 kPa |

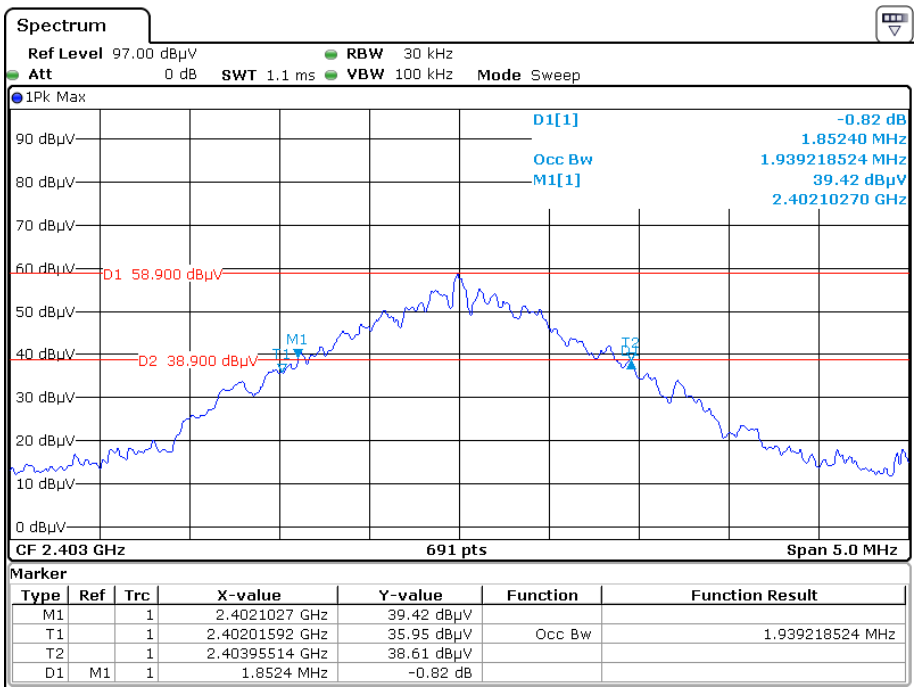
*The testing was performed by Alan He on 2019-10-10*

*Test Mode: Transmitting*

*Please refer to the following table and plots.*

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|---|---|---|
| Low | 2403 | 1.852 |
| Middle | 2440 | 1.802 |
| High | 2480 | 1.751 |

## Low Channel




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4021027 GHz | 39.42 dBµV | | |
| T1 | | 1 | 2.40201592 GHz | 35.95 dBµV | Occ Bw | 1.939218524 MHz |
| T2 | | 1 | 2.40395514 GHz | 38.61 dBµV | | |
| D1 | M1 | 1 | 1.8524 MHz | -0.82 dB | | |

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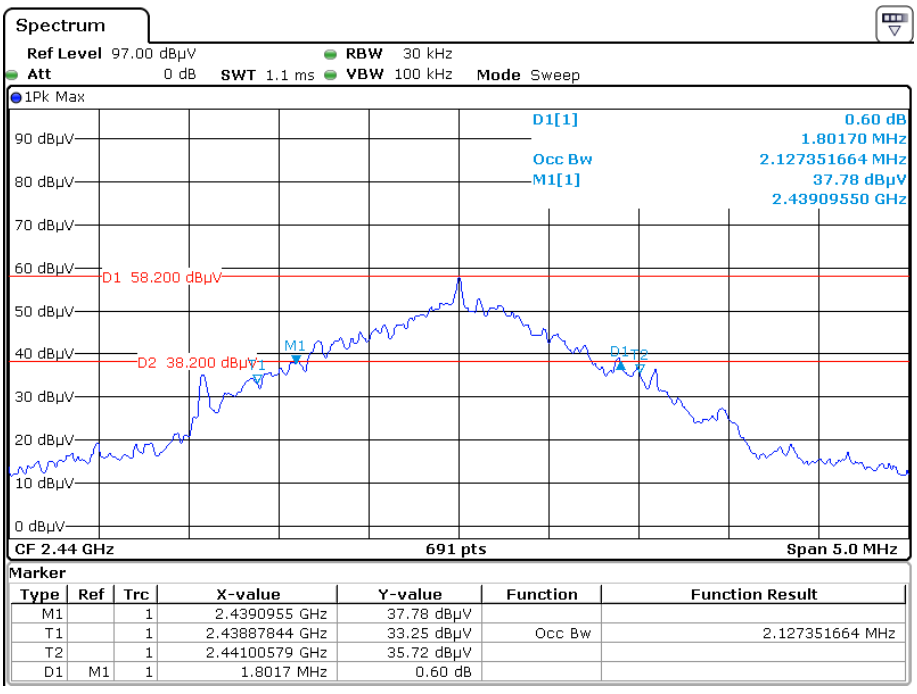
## Middle Channel




Marker

| Type | Ref | Trc | X-value | Y-value | Function | Function Result |
|---|---|---|---|---|---|---|
| M1 | | 1 | 2.4390955 GHz | 37.78 dBµV | | |
| T1 | | 1 | 2.43887844 GHz | 33.25 dBµV | Occ Bw | 2.127351664 MHz |
| T2 | | 1 | 2.44100579 GHz | 35.72 dBµV | | |
| D1 | M1 | 1 | 1.8017 MHz | 0.60 dB | | |

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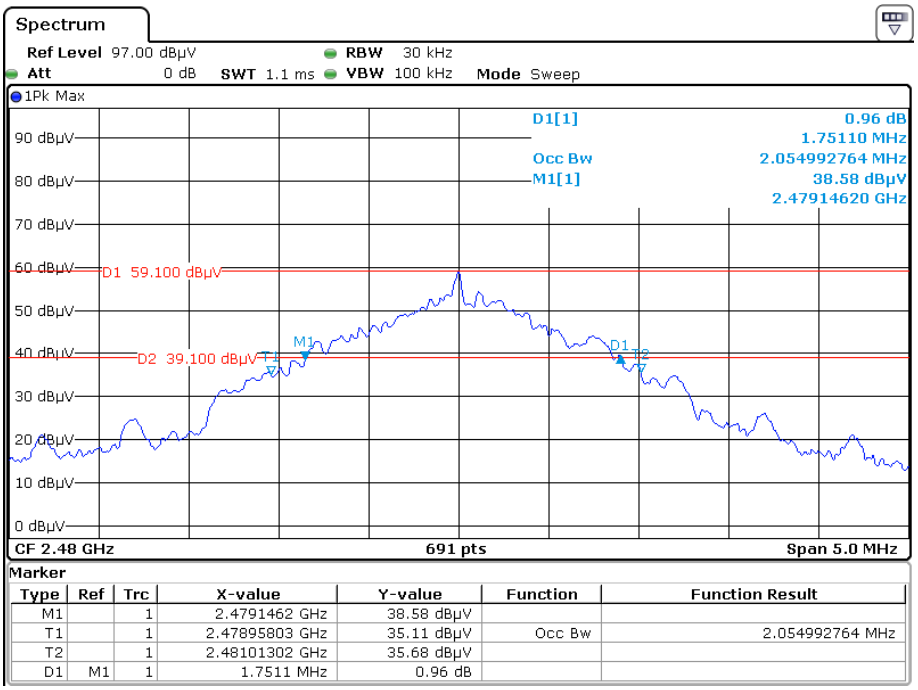
**High Channel**

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