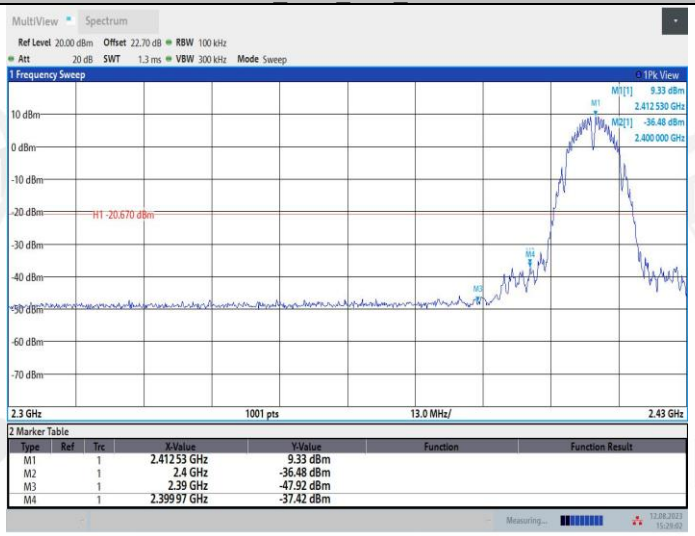
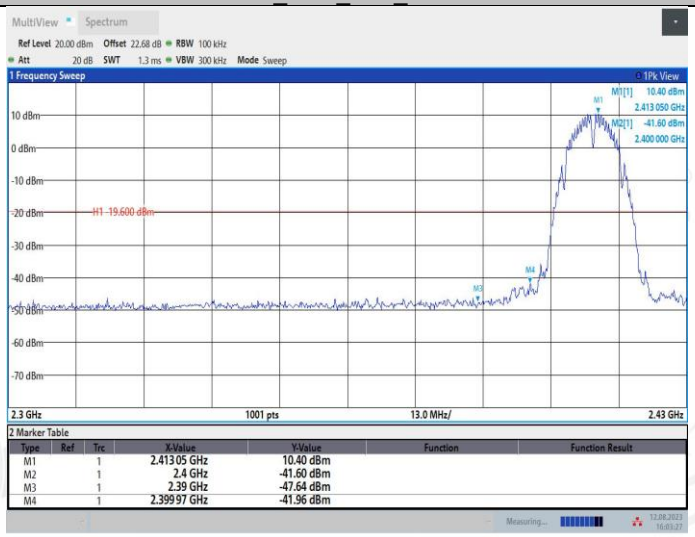
## 8.5. Test graphs

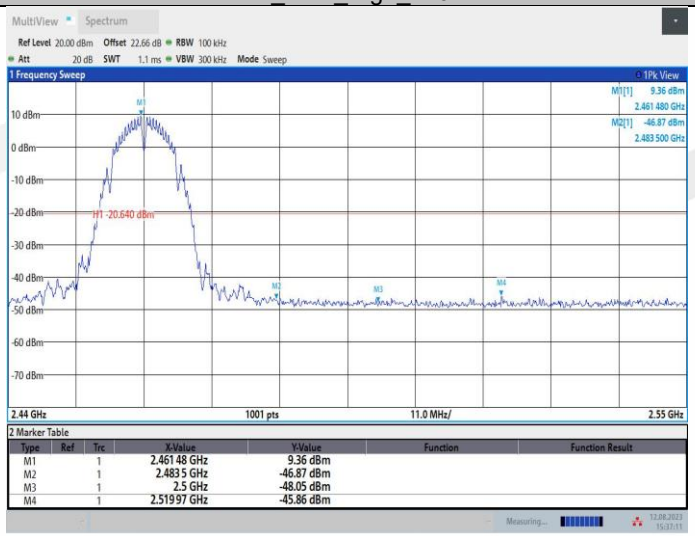
11B_Ant1_Low_2412



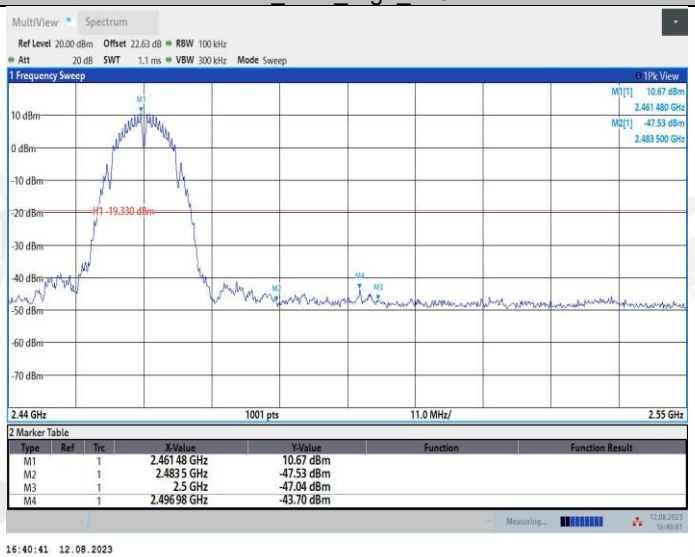

11B_Ant2_Low_2412



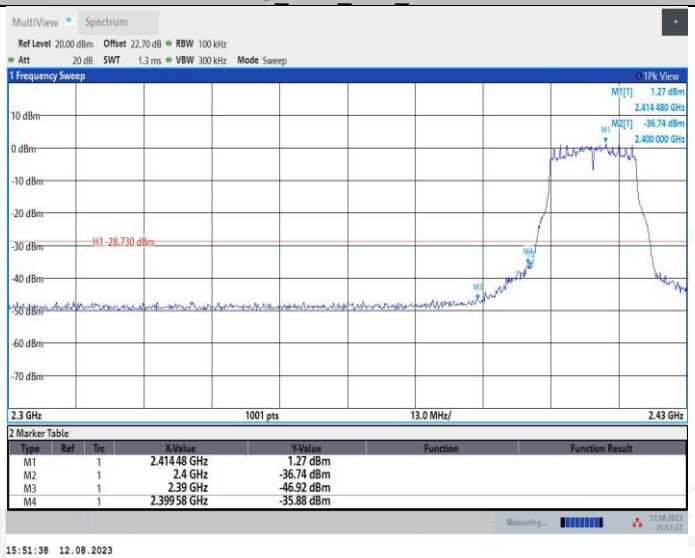

11B_Ant1_High_2462



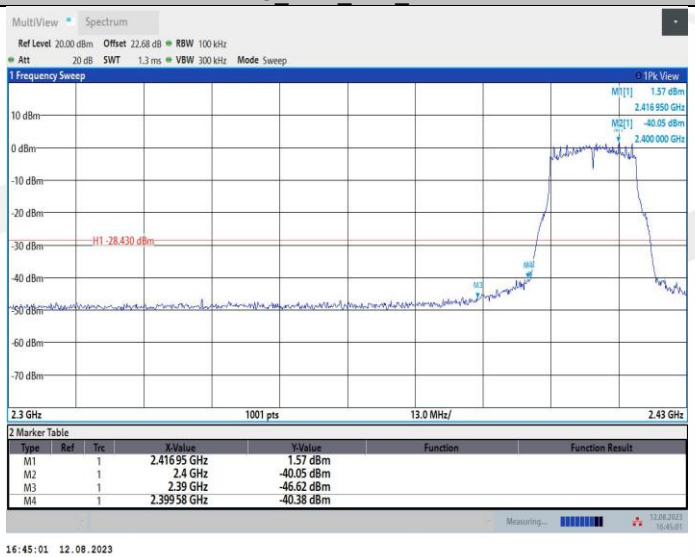
11B_Ant2_High_2462



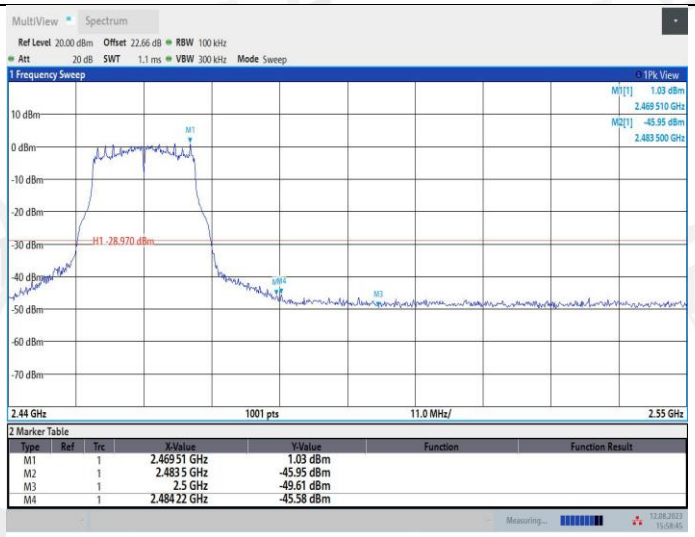

11G_Ant1_Low_2412



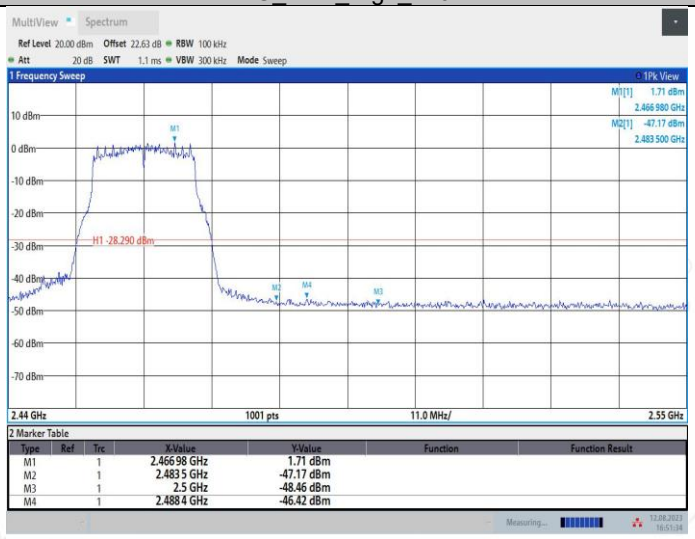

11G_Ant2_Low_2412



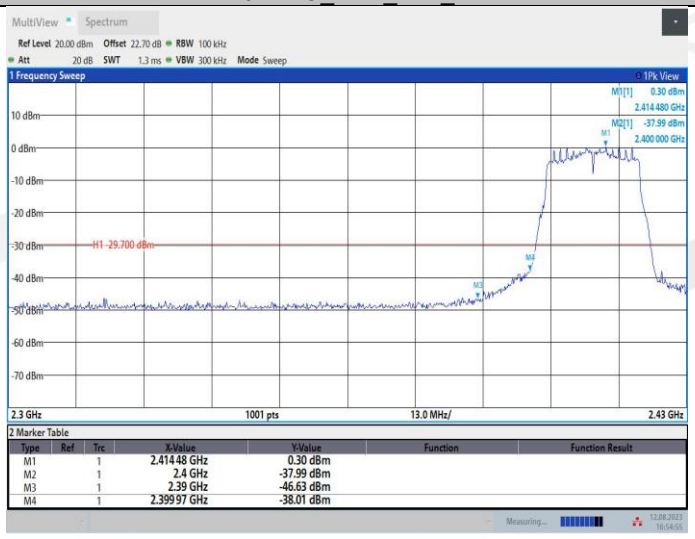

11G_Ant1_High_2462




11G_Ant2_High_2462

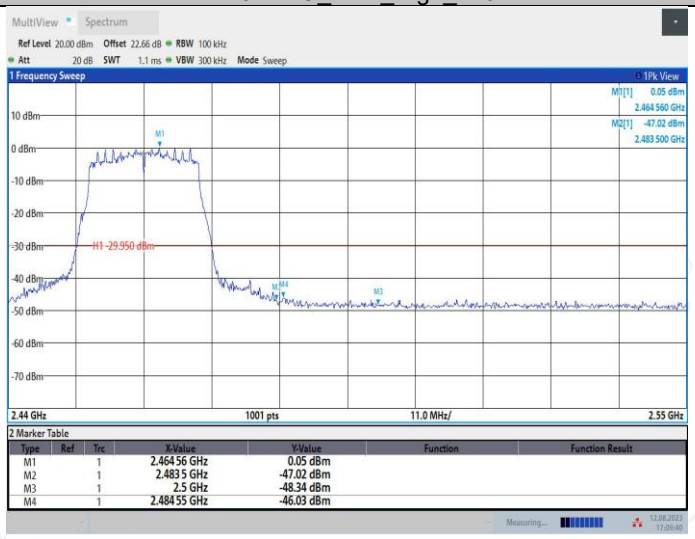



11N20MIMO_Ant1_Low_2412

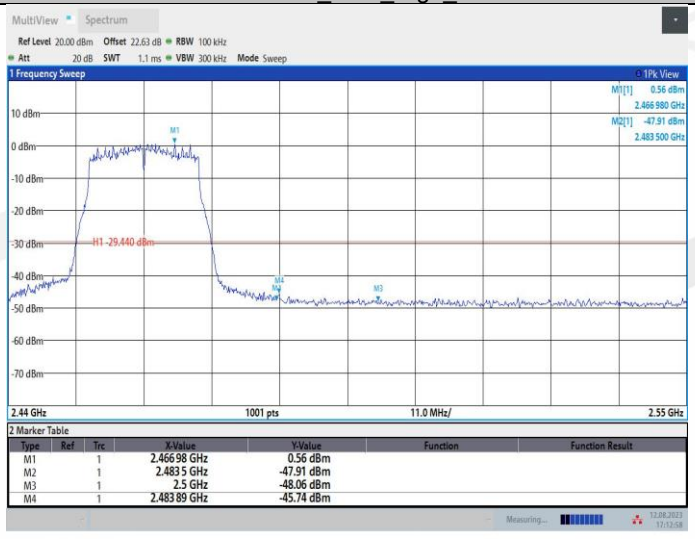



11N20MIMO_Ant2_Low_2412


11N20MIMO_Ant1_High_2462

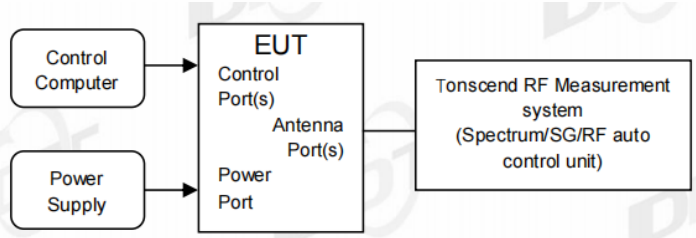



11N20MIMO_Ant2_High_2462



# 9. RF Conducted Spurious Emissions

## 9.1. Block diagram of test setup




## 9.2. Limits

In any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

## 9.3. Test procedure

(1) Connect EUT's antenna output to spectrum analyzer by RF cable.

(2) Establish a reference level by using the following procedure:

| | |
|---|---|
| Center frequency | Test frequency |
| RBW: | 100 kHz |
| VBW: | 300 kHz |
| Span | Wide enough to capture the peak level of the in-band emission |
| Detector Mode: | Peak |
| Sweep time: | auto |
| Trace mode | Max hold |

(3) Allow the trace to stabilize, use the peak marker function to determine the maximum peak power level to establish the reference level.

(4) Set the spectrum analyzer as follows:

| | |
|---|---|
| RBW: | 100 kHz |
| VBW: | 300 kHz |
| Span | Encompass frequency range to be measured |
| Number of measurement points | ≥Span/RBW |
| Detector Mode: | Peak |
| Sweep time: | auto |
| Trace mode | Max hold |

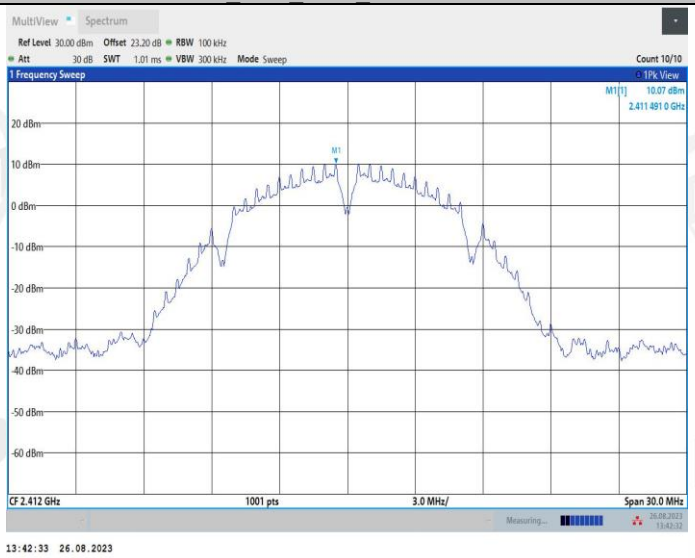
(5) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude of all unwanted emissions outside of the authorized frequency band

## 9.4. Test result

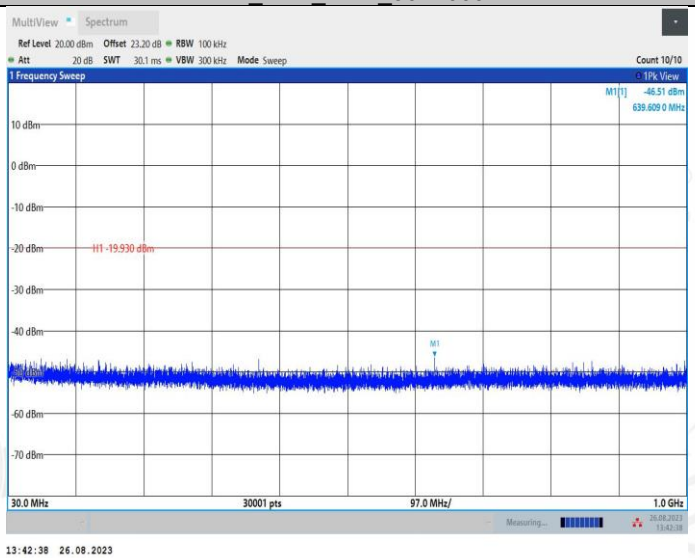
| EUT Set Mode | CH or Frequency | Result (dBm) | EUT Set Mode | CH or Frequency | Result (dBm) |
|---|---|---|---|---|---|
| 11b | CH1 | Pass | 11g | CH1 | Pass |
| | CH6 | Pass | | CH6 | Pass |
| | CH11 | Pass | | CH11 | Pass |
| 11n HT 20 | CH1 | Pass | / | / | / |
| | CH6 | Pass | | / | / |
| | CH11 | Pass | | / | / |

## 9.5. Test graphs

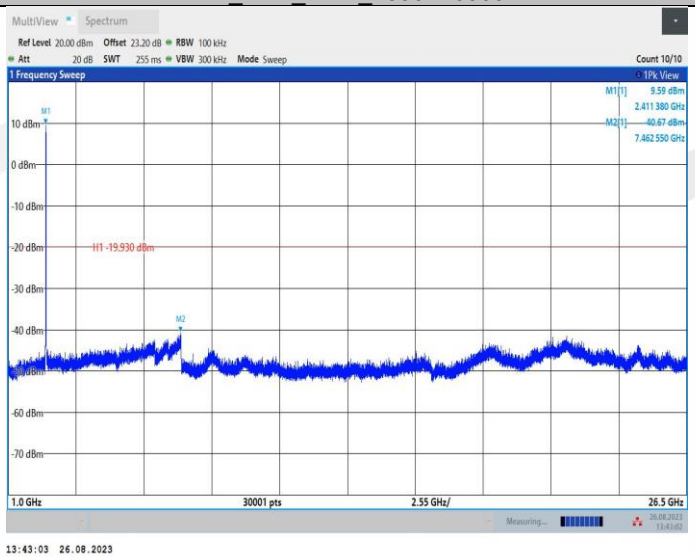
11B_Ant1_2412_0~Reference



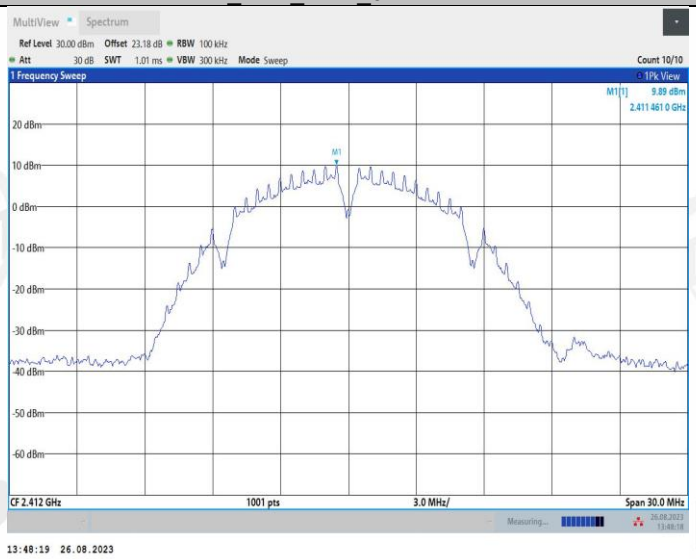

11B_Ant1_2412_30~1000



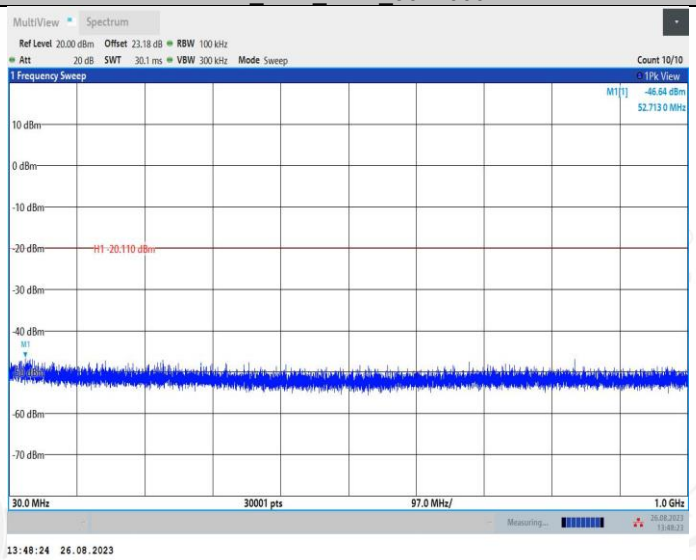

11B_Ant1_2412_1000~26500



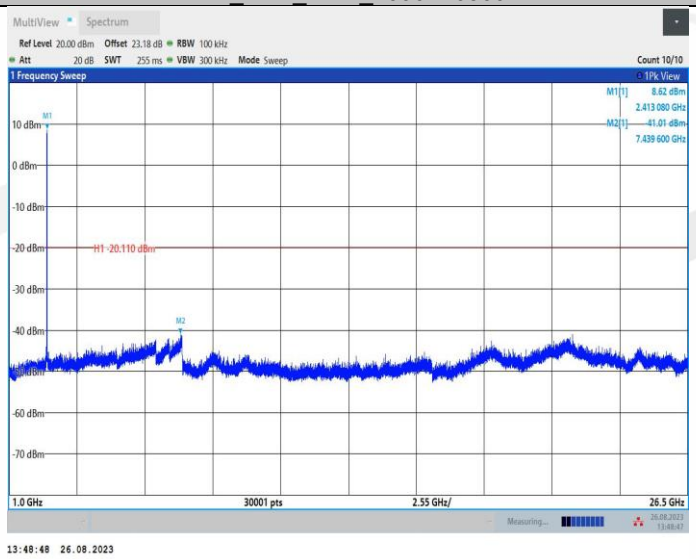
11B_Ant2_2412_0~Reference



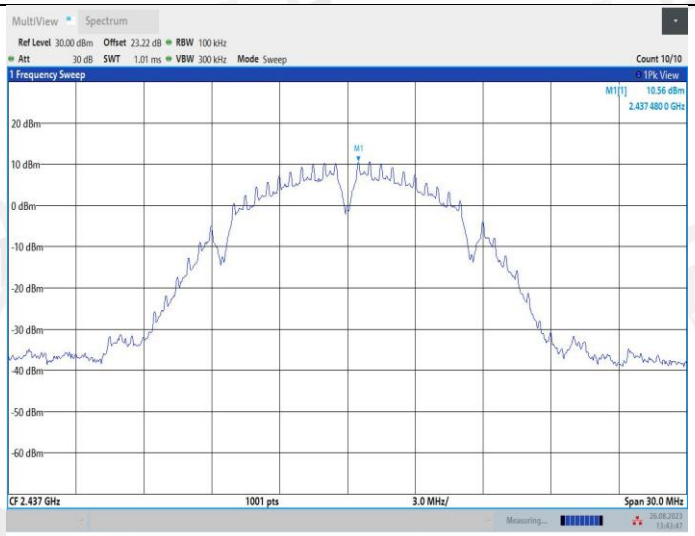

11B_Ant2_2412_30~1000



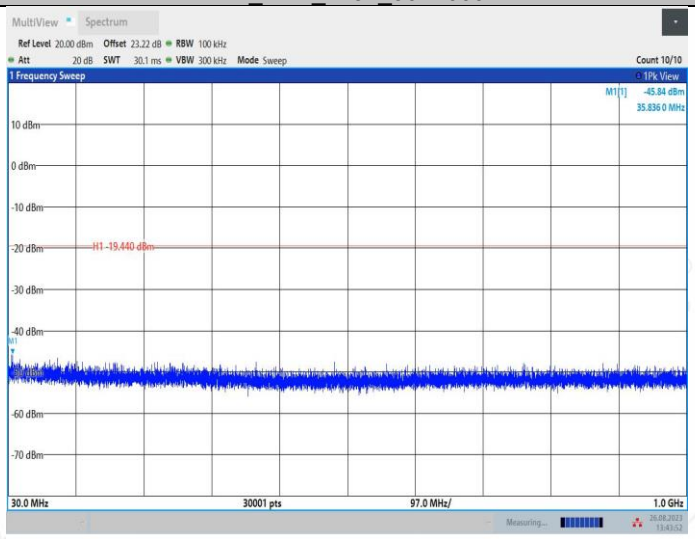

11B_Ant2_2412_1000~26500



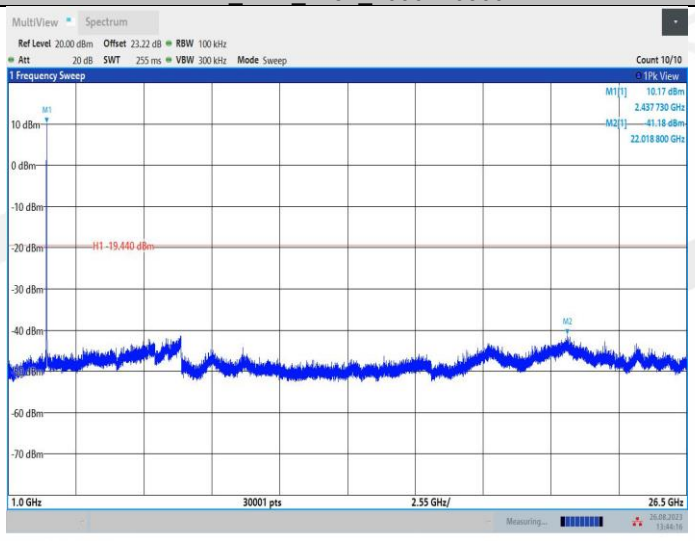

11B_Ant1_2437_0~Reference



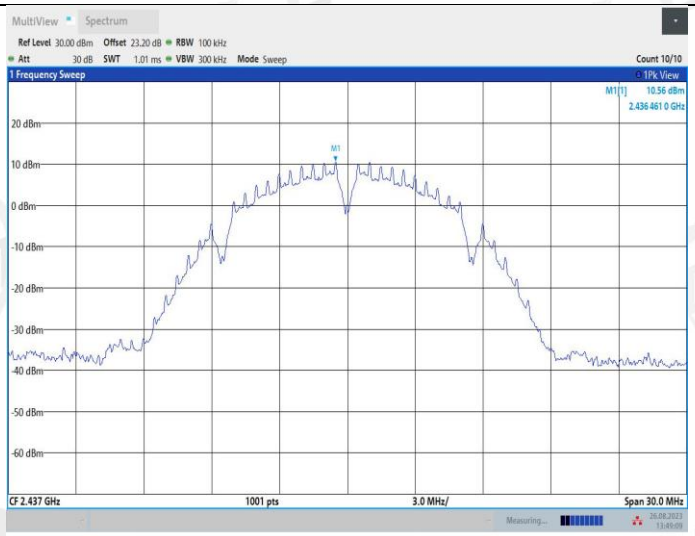

11B_Ant1_2437_30~1000



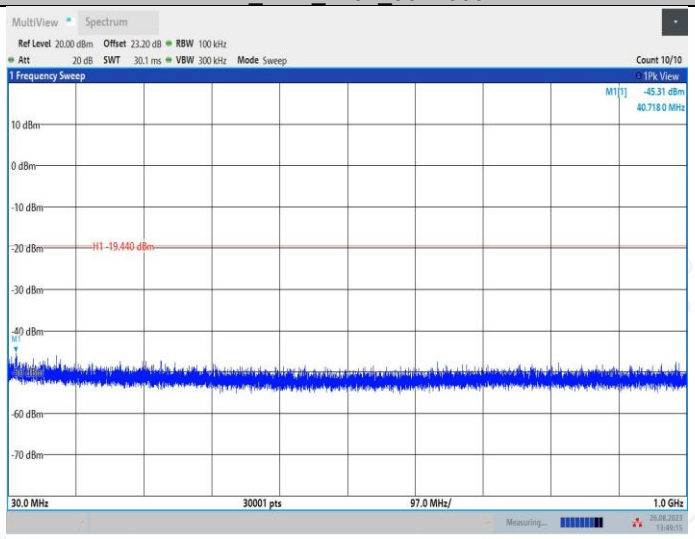

11B_Ant1_2437_1000~26500



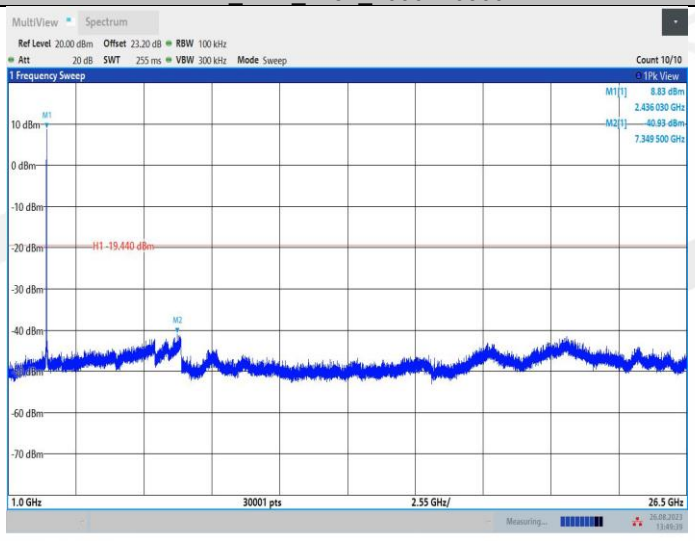

11B_Ant2_2437_0~Reference



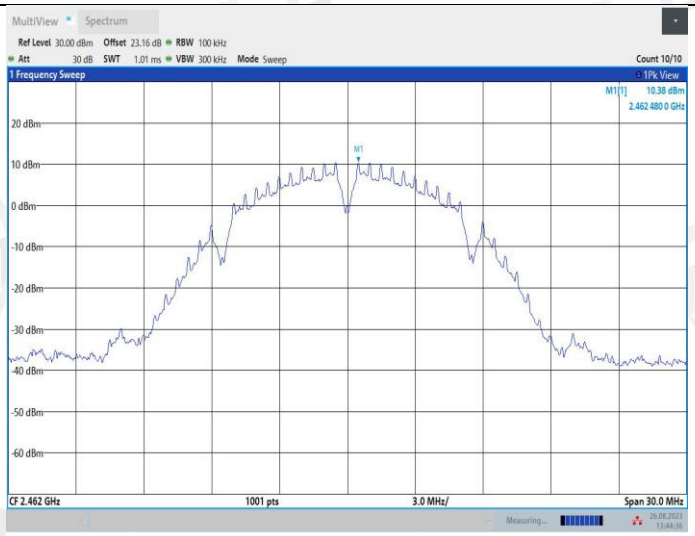

11B_Ant2_2437_30~1000



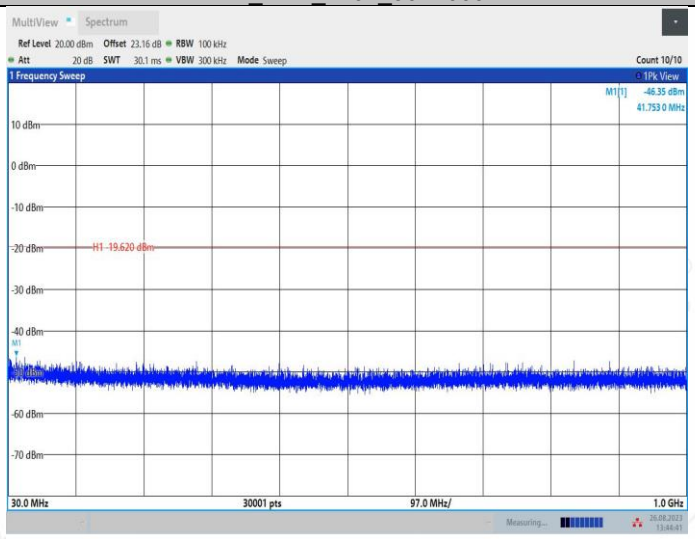

11B_Ant2_2437_1000~26500



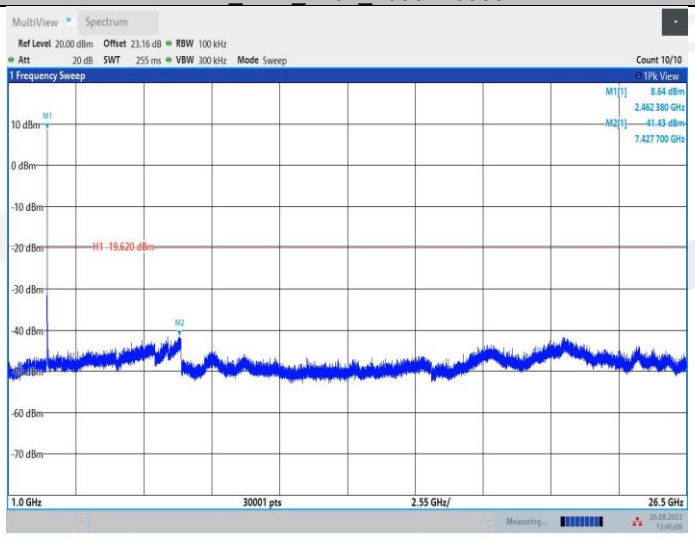

11B_Ant1_2462_0~Reference



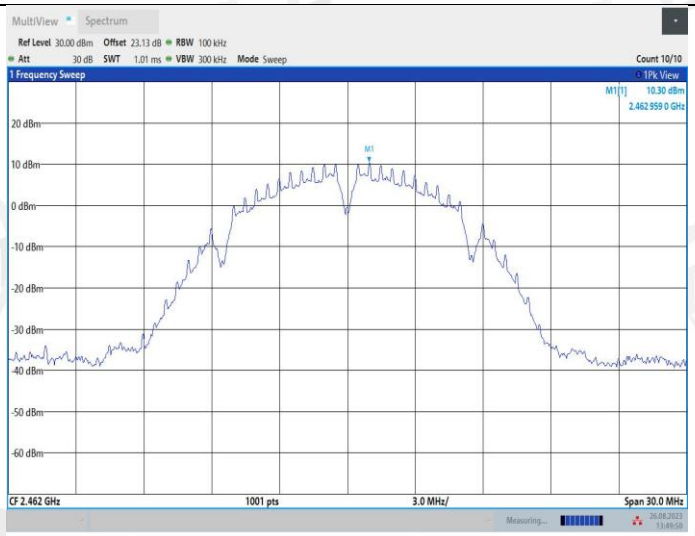

11B_Ant1_2462_30~1000



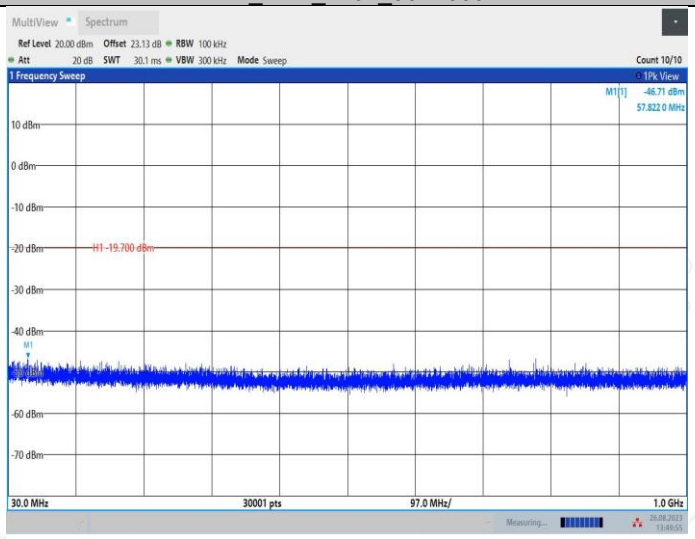

11B_Ant1_2462_1000~26500



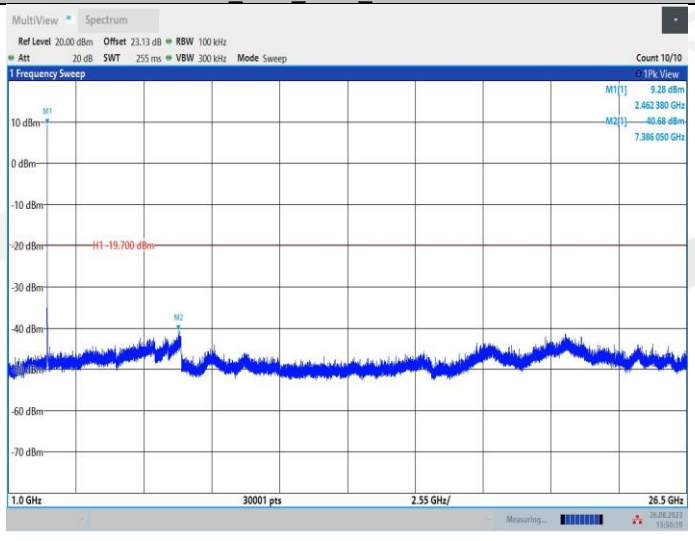

11B_Ant2_2462_0~Reference



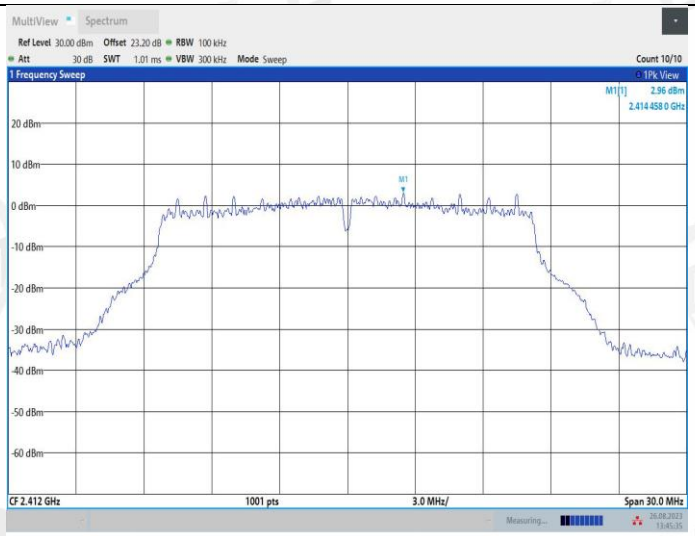

11B_Ant2_2462_30~1000



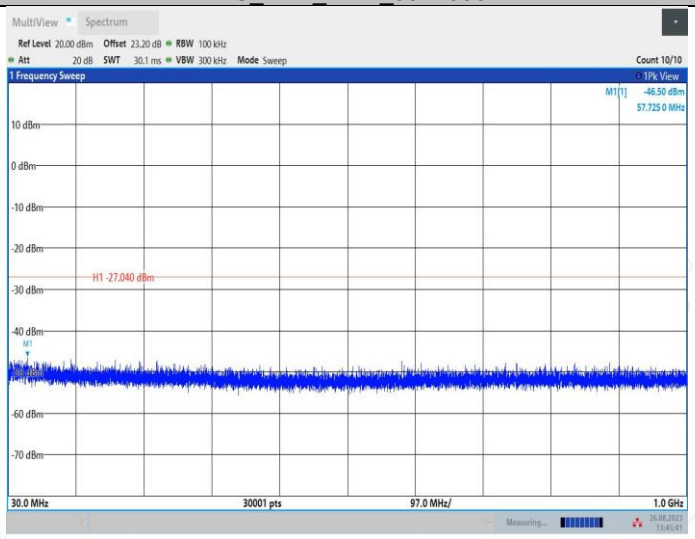

11B_Ant2_2462_1000~26500



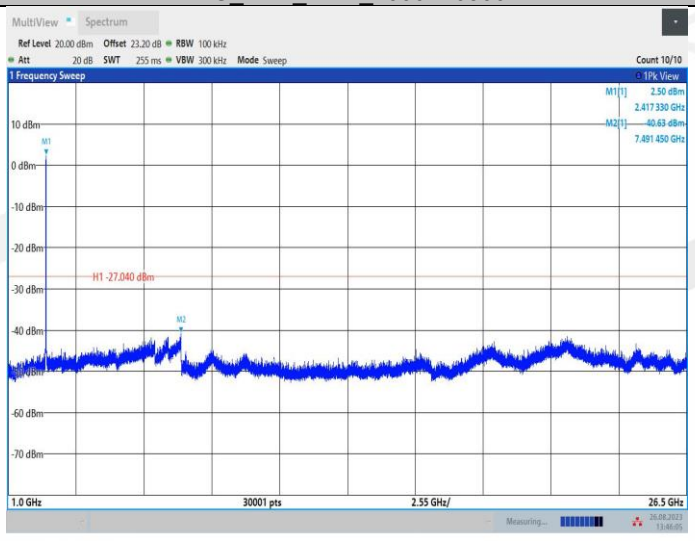

11G_Ant1_2412_0~Reference



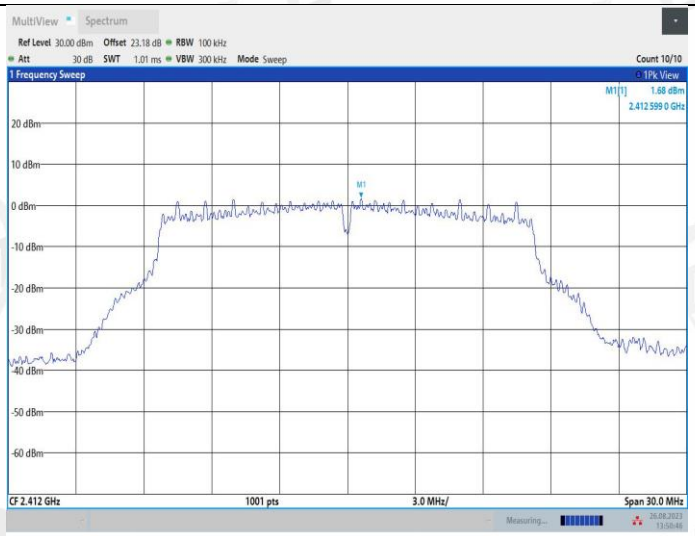

11G_Ant1_2412_30~1000



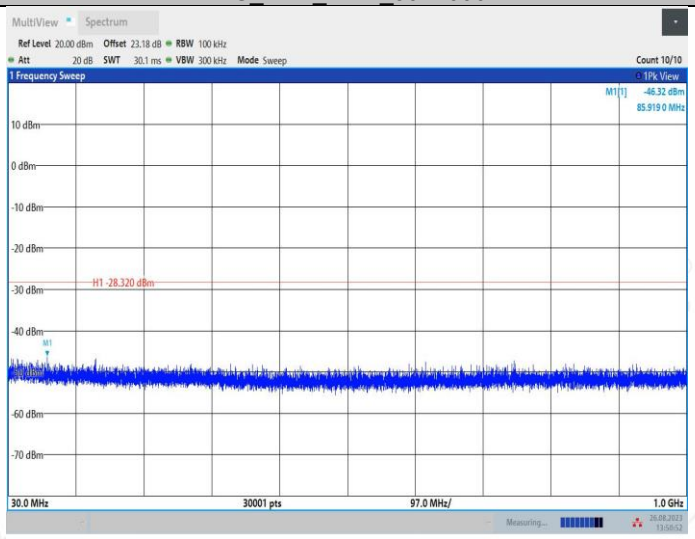

11G_Ant1_2412_1000~26500



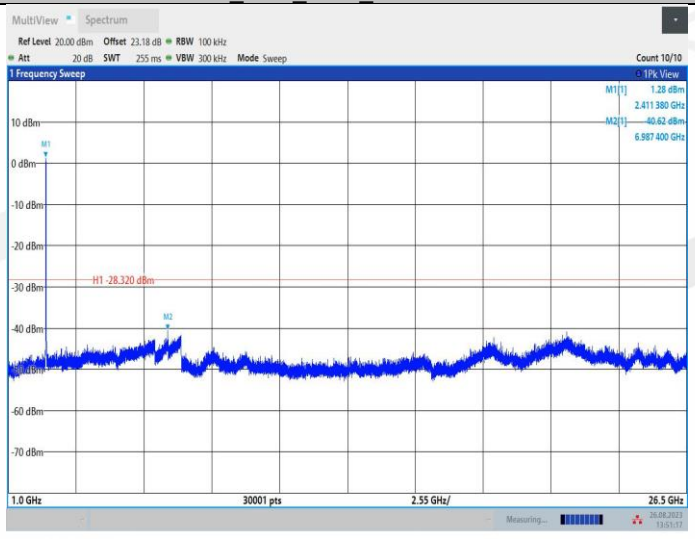

11G_Ant2_2412_0~Reference



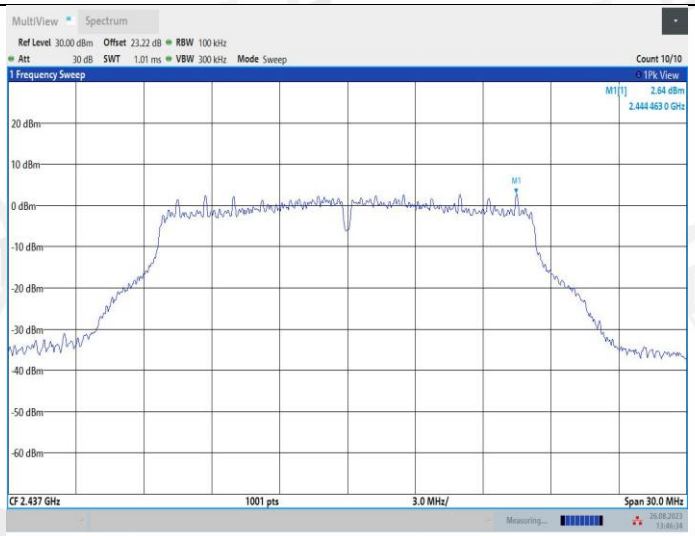

11G_Ant2_2412_30~1000



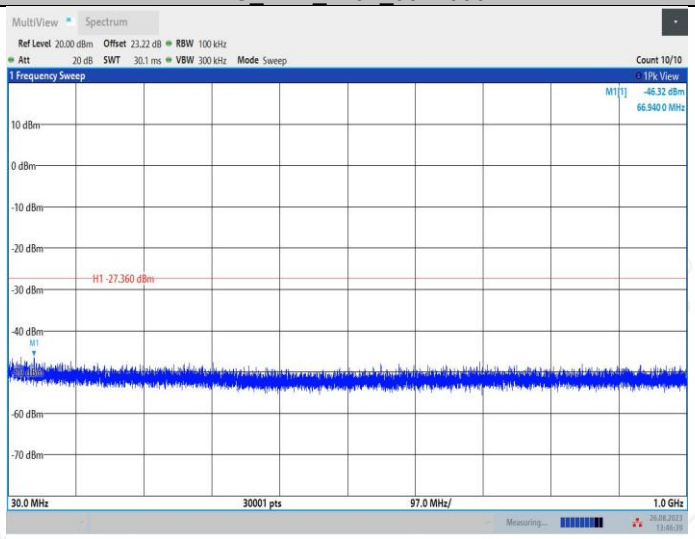

11G_Ant2_2412_1000~26500



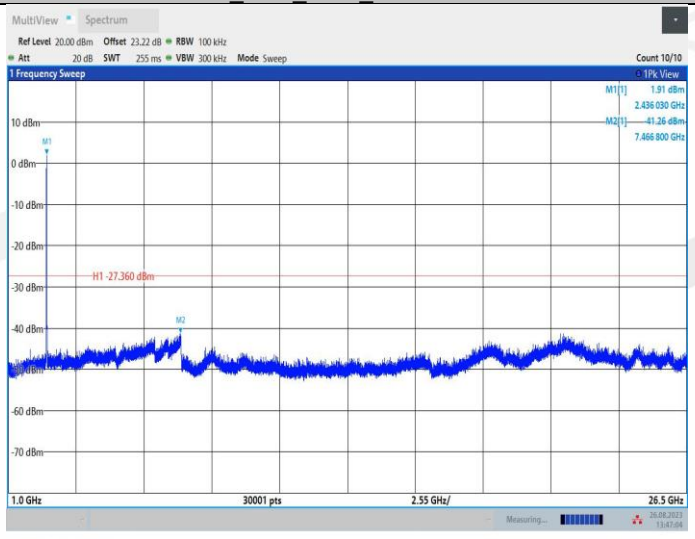

11G_Ant1_2437_0~Reference



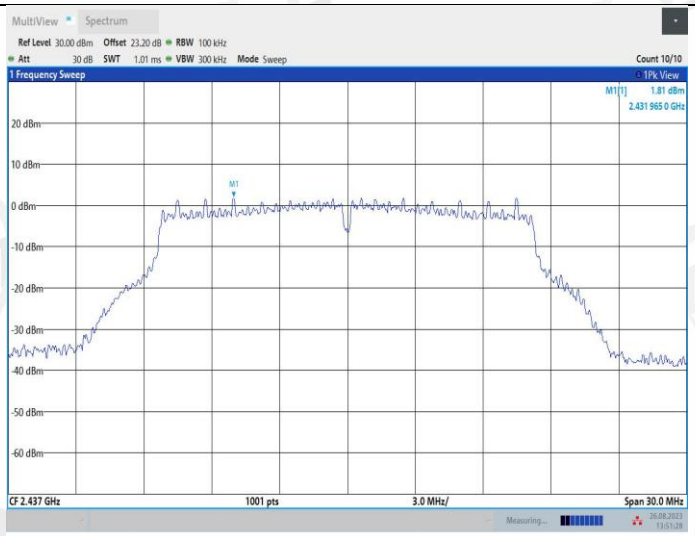

11G_Ant1_2437_30~1000



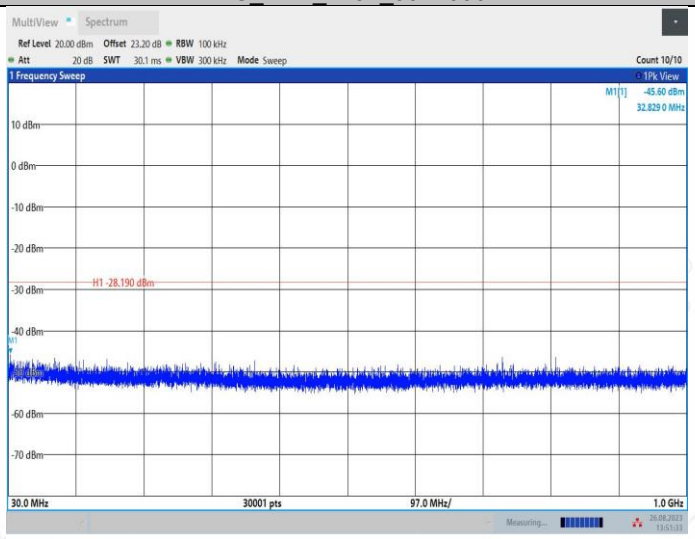

11G_Ant1_2437_1000~26500



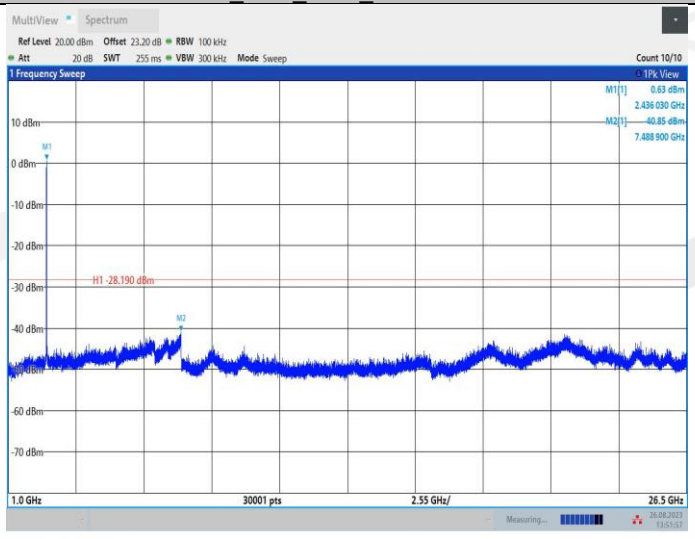

11G_Ant2_2437_0~Reference



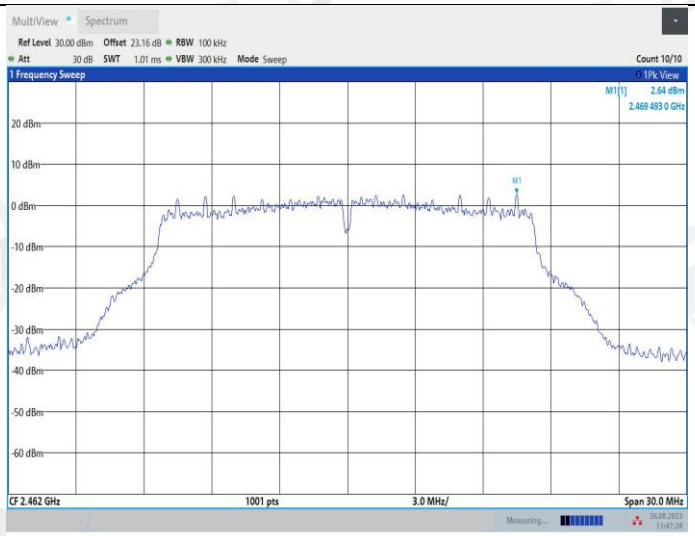

11G_Ant2_2437_30~1000



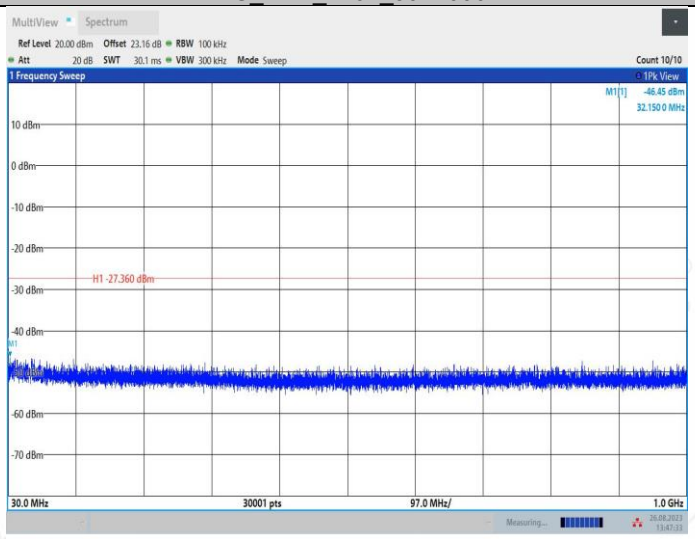

11G_Ant2_2437_1000~26500



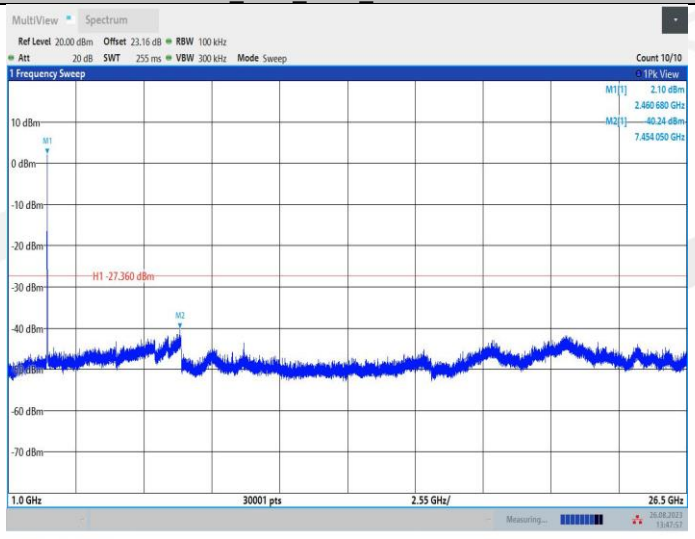

11G_Ant1_2462_0~Reference



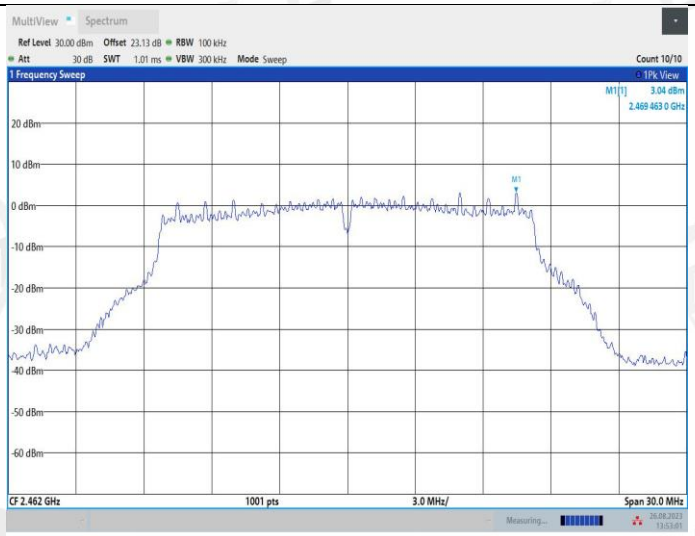

11G_Ant1_2462_30~1000



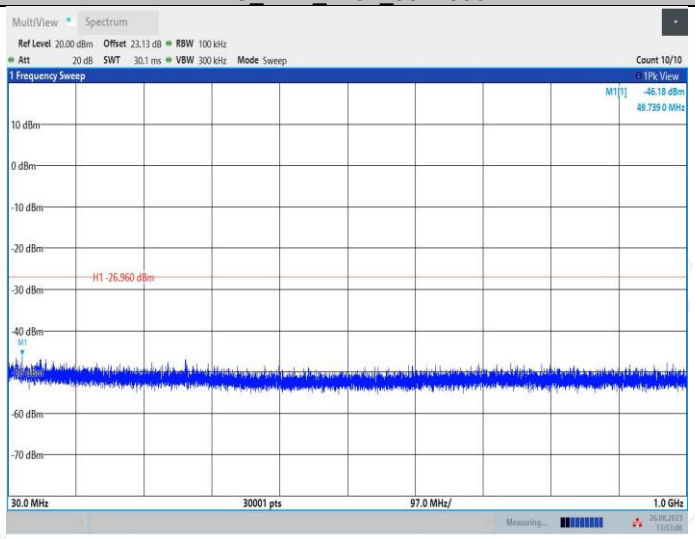

11G_Ant1_2462_1000~26500



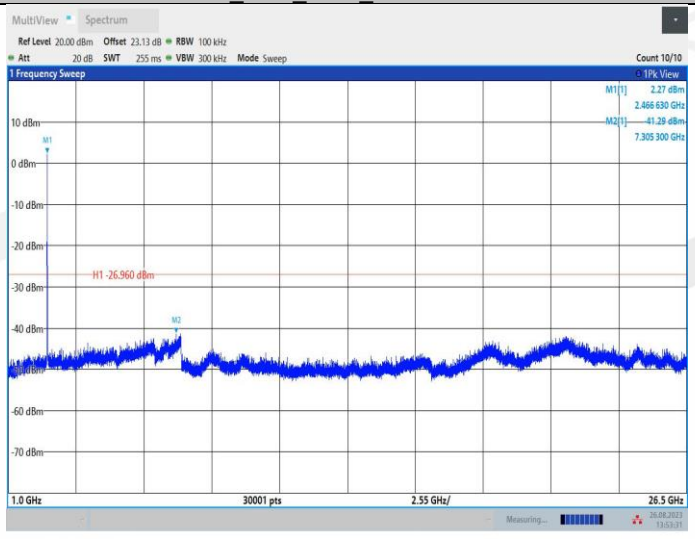

11G_Ant2_2462_0~Reference



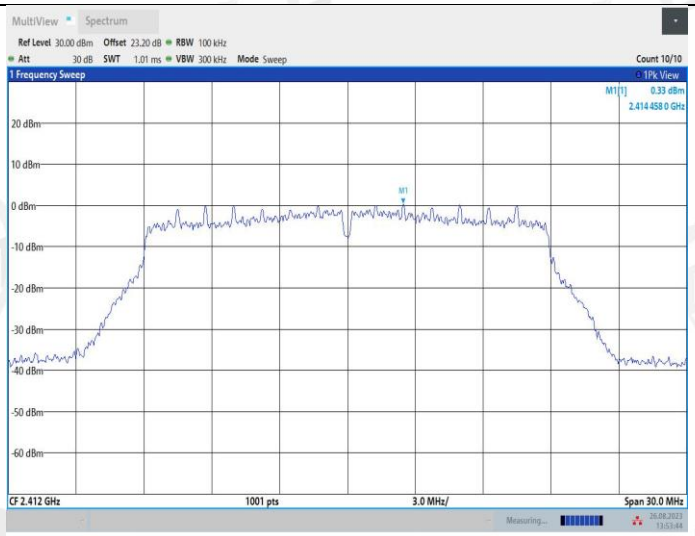

11G_Ant2_2462_30~1000



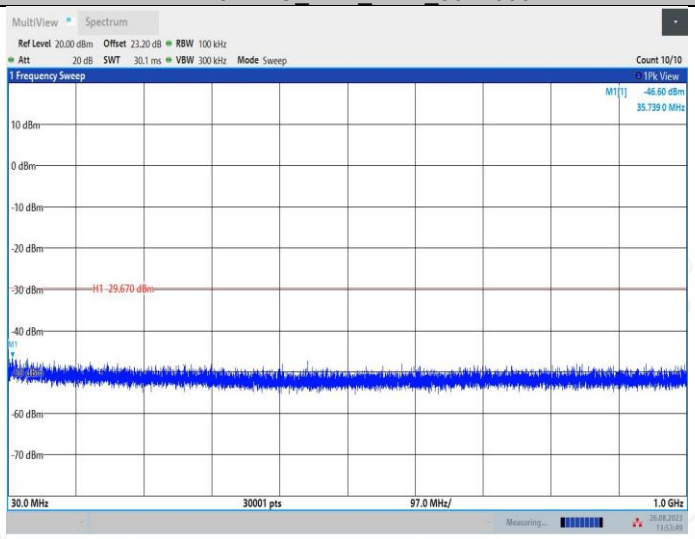

11G_Ant2_2462_1000~26500



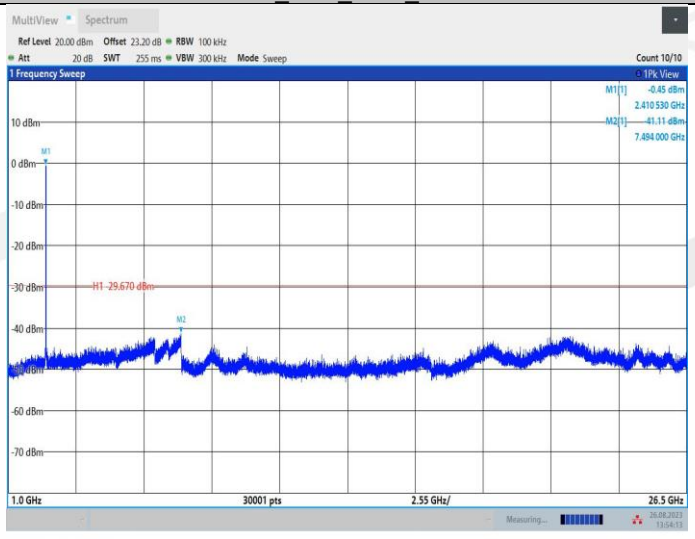

11N20MIMO_Ant1_2412_0~Reference



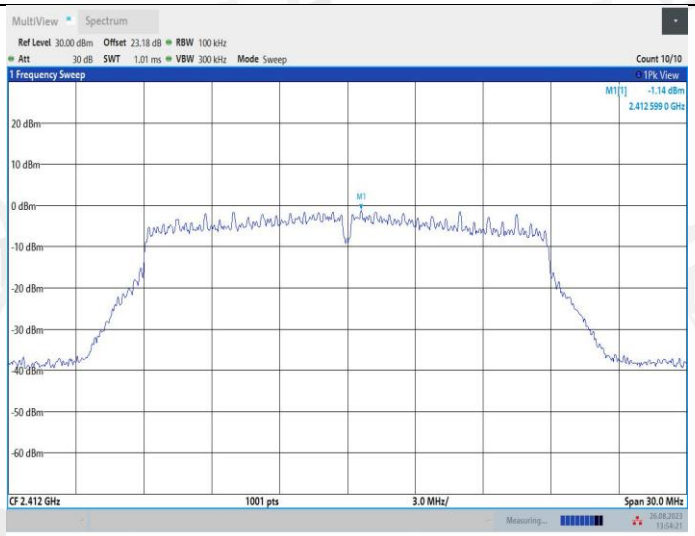

11N20MIMO_Ant1_2412_30~1000



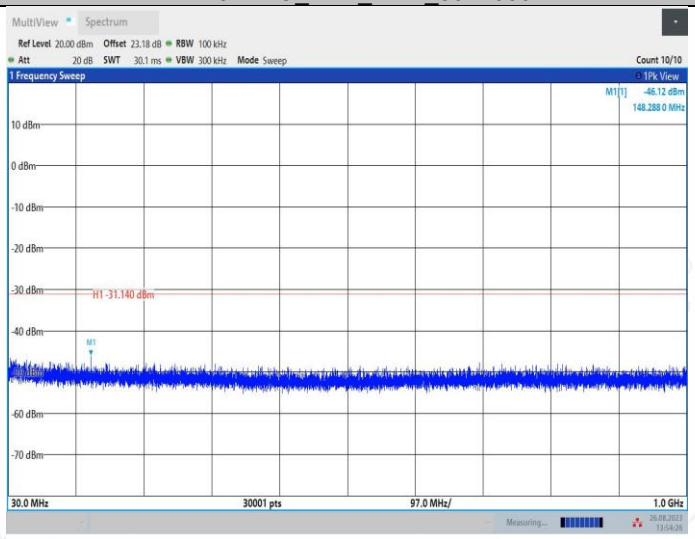

11N20MIMO_Ant1_2412_1000~26500



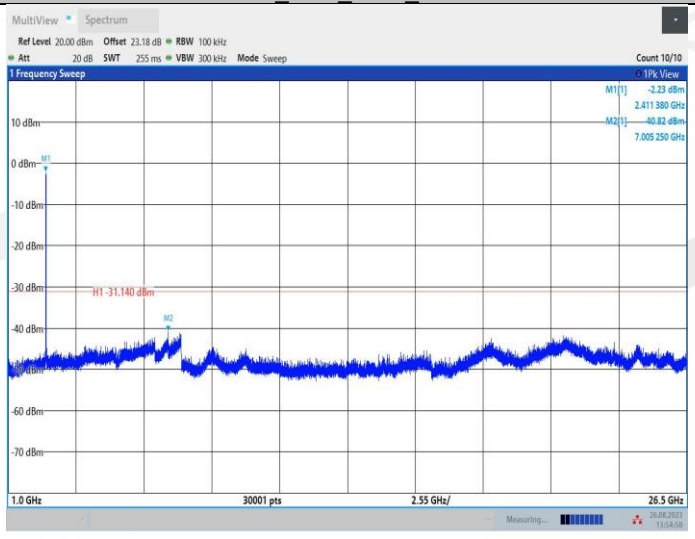

11N20MIMO_Ant2_2412_0~Reference



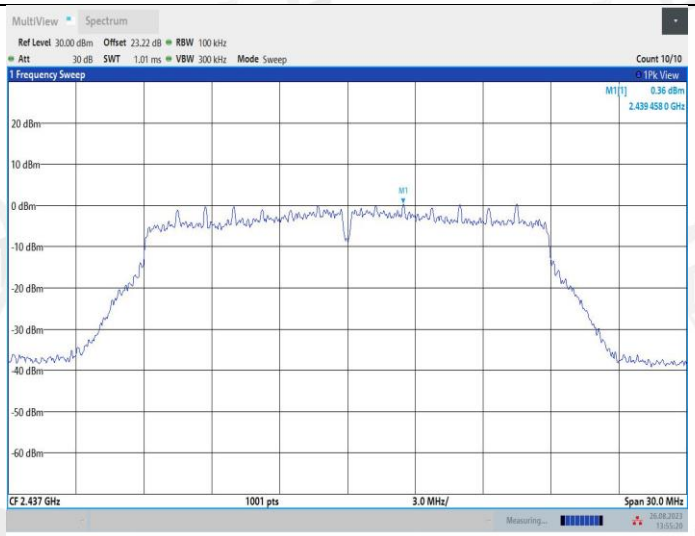

11N20MIMO_Ant2_2412_30~1000



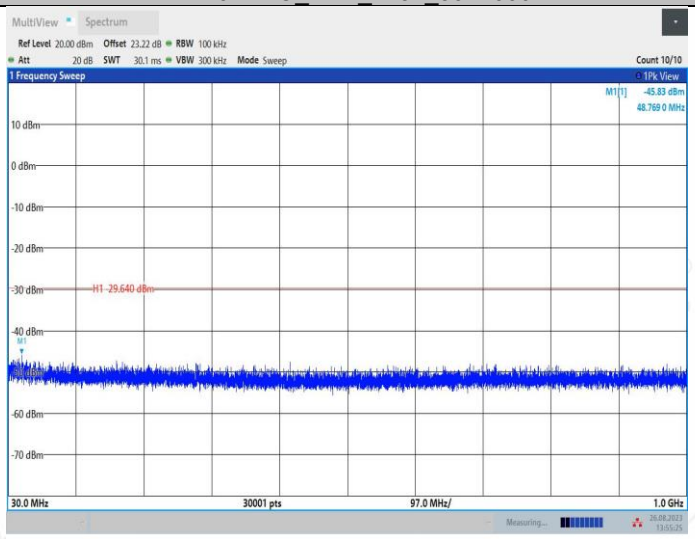

11N20MIMO_Ant2_2412_1000~26500



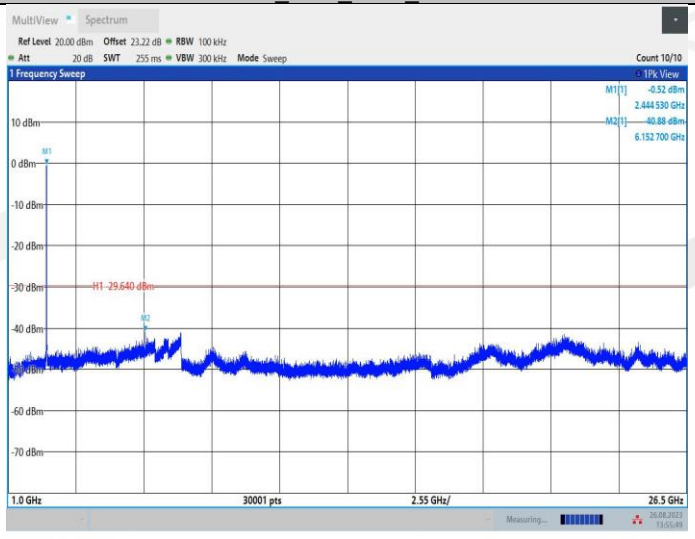

11N20MIMO_Ant1_2437_0~Reference



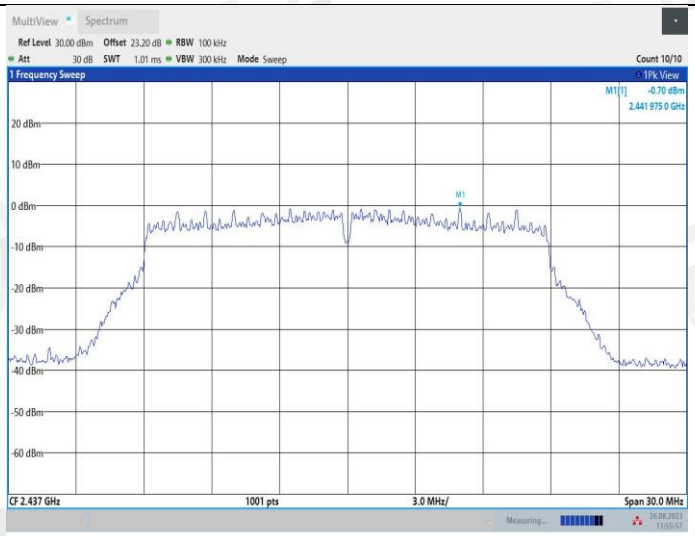

11N20MIMO_Ant1_2437_30~1000



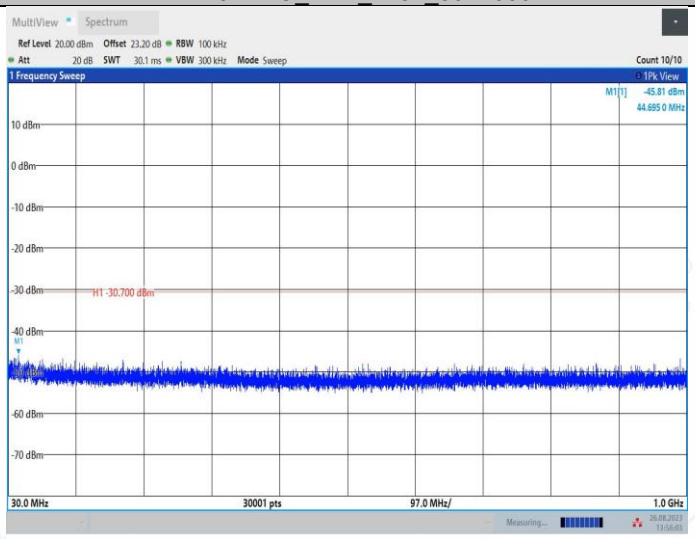

11N20MIMO_Ant1_2437_1000~26500



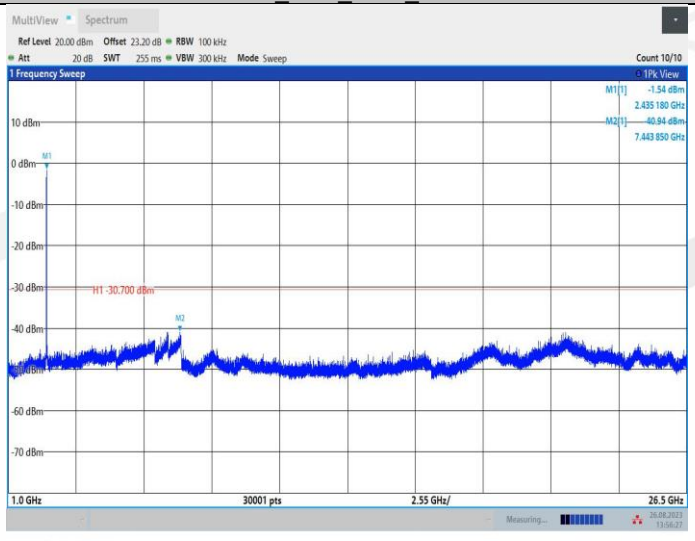

11N20MIMO_Ant2_2437_0~Reference



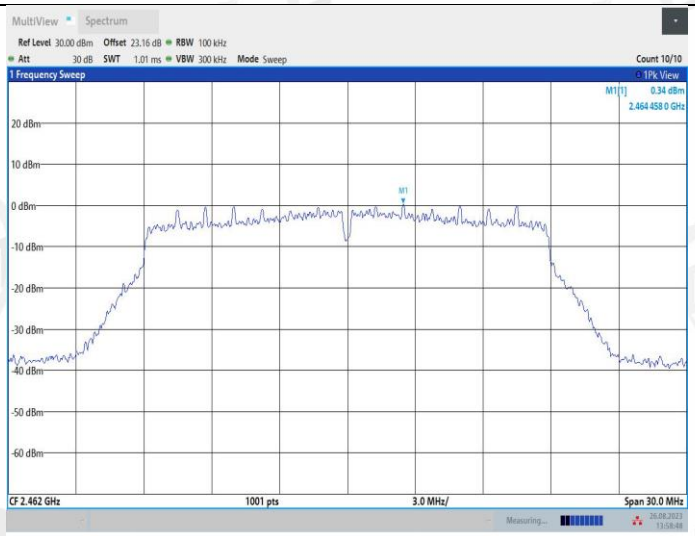

11N20MIMO_Ant2_2437_30~1000



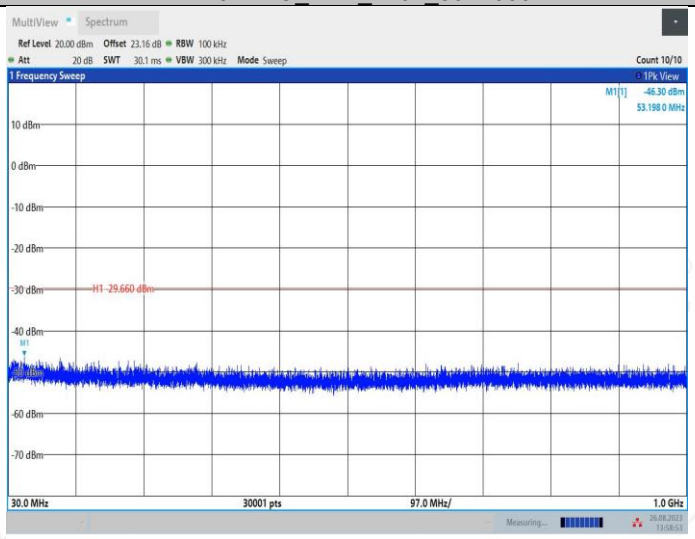

11N20MIMO_Ant2_2437_1000~26500



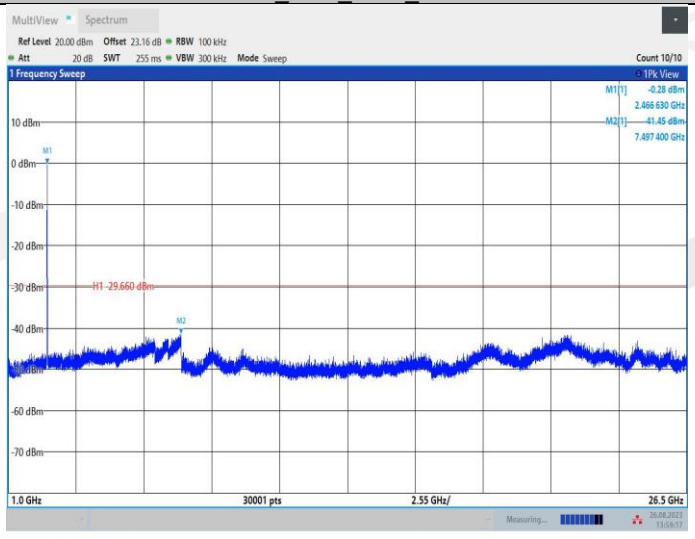

11N20MIMO_Ant1_2462_0~Reference



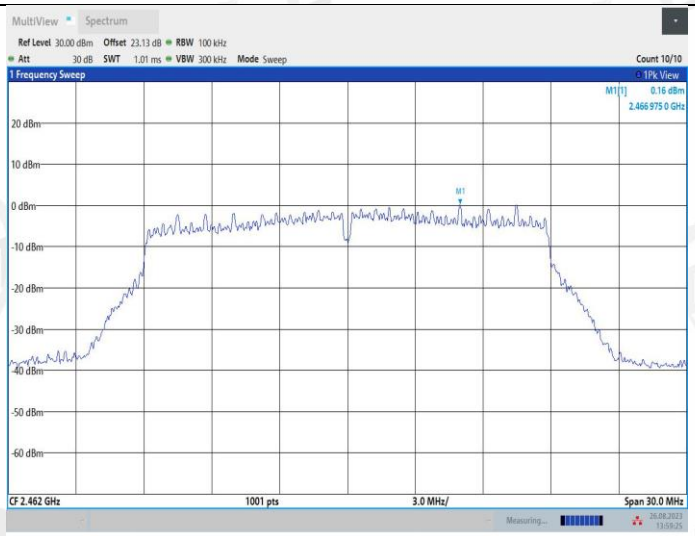

11N20MIMO_Ant1_2462_30~1000



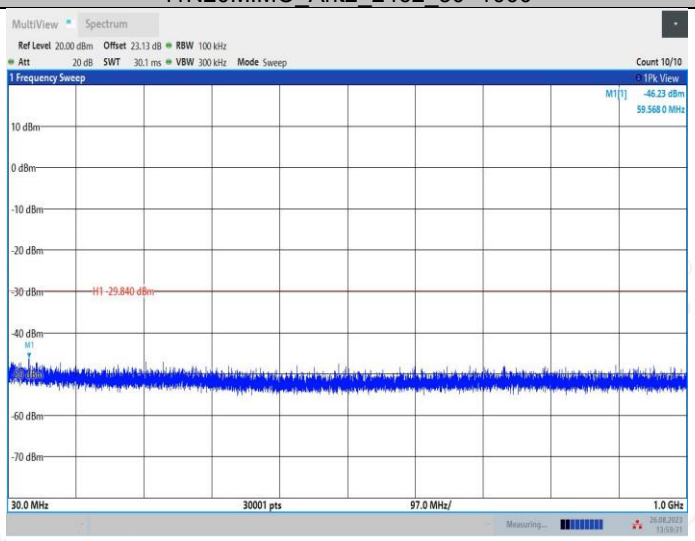

11N20MIMO_Ant1_2462_1000~26500



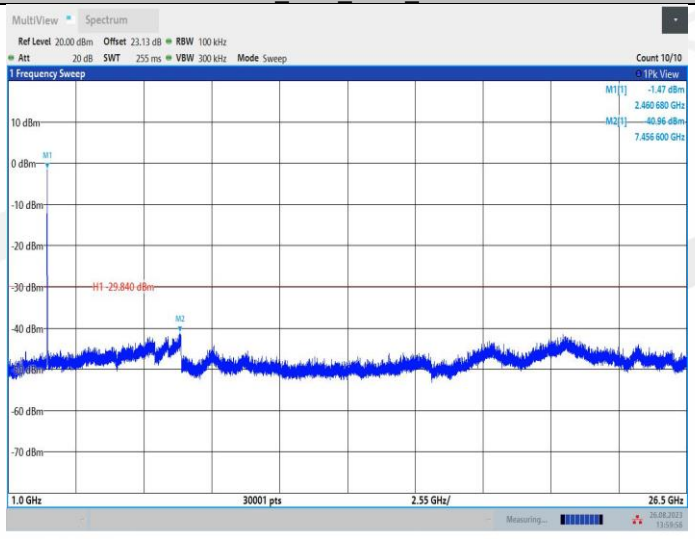

11N20MIMO_Ant2_2462_0~Reference




11N20MIMO_Ant2_2462_30~1000

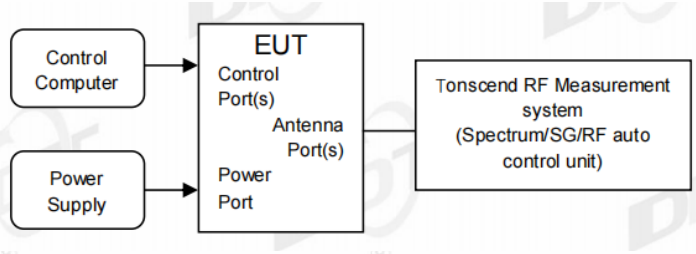



11N20MIMO_Ant2_2462_1000~26500



# 10. Duty Cycle

## 10.1. Block diagram of test setup




## 10.2. Limit

Just for Report.

## 10.3. Test procedure

(1) Connected the EUT's antenna port to the Spectrum Analyzer by suitable attenuator, The cable loss and attenuator loss have been put into spectrum analyzer as amplitude offset.
set the Spectrum Analyzer as below:

Centre Frequency: The centre frequency of the middle hopping channel.
Resolution BW: 10 MHz.
Video BW: 10 MHz.
Span: Zero span.
Detector: Peak.
Trace Mode: Clear Write.
Sweep: Video Trigger

(2) When the trace is complete, measure the sending time of 1 burst and the duty cycle of 1 burst cycle.

(3) Calculate dwell time follow below formula:

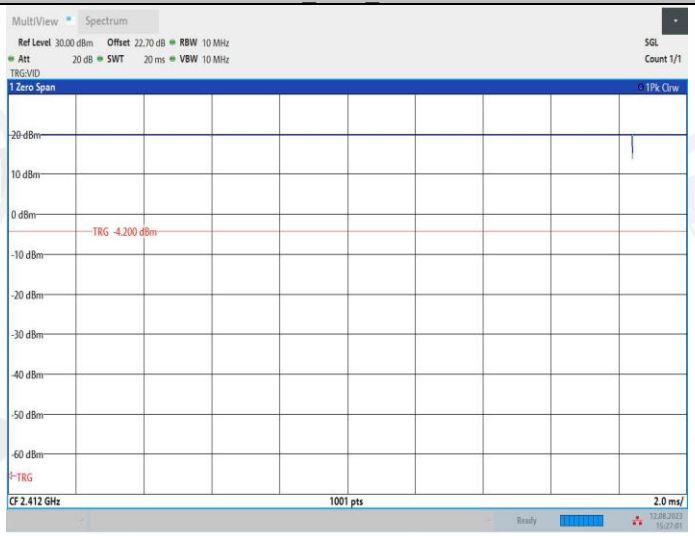
Duty cycle= Pulse's on time / Burst cycle

## 10.4. Test result

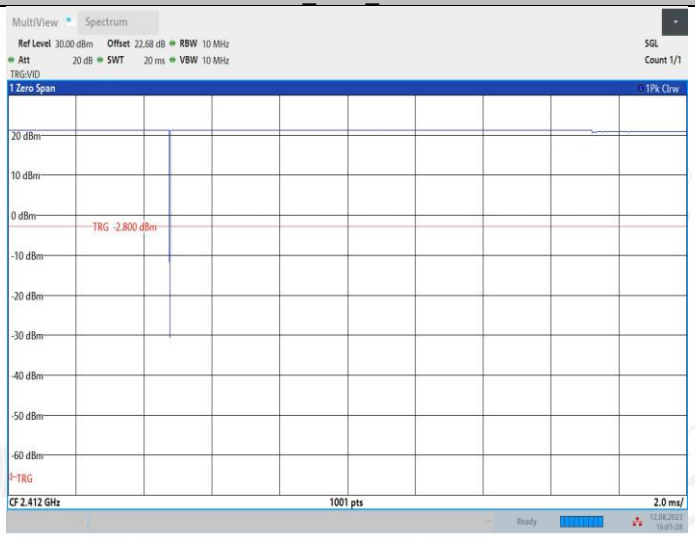
| Test Mode | Antenna | Frequency [MHz] | Transmission Duration [ms] | Transmission Period [ms] | Duty Cycle [%] |
|---|---|---|---|---|---|
| 11B | Ant1 | 2412 | 20.00 | 20.00 | 100.00 |
| | Ant2 | 2412 | 20.00 | 20.00 | 100.00 |
| | Ant1 | 2437 | 20.00 | 20.00 | 100.00 |
| | Ant2 | 2437 | 20.00 | 20.00 | 100.00 |
| | Ant1 | 2462 | 20.00 | 20.00 | 100.00 |
| | Ant2 | 2462 | 20.00 | 20.00 | 100.00 |
| 11G | Ant1 | 2412 | 2.07 | 2.09 | 99.04 |
| | Ant2 | 2412 | 2.07 | 2.09 | 99.04 |
| | Ant1 | 2437 | 2.06 | 2.08 | 99.04 |
| | Ant2 | 2437 | 2.07 | 2.09 | 99.04 |
| | Ant1 | 2462 | 2.07 | 2.09 | 99.04 |
| | Ant2 | 2462 | 2.07 | 2.09 | 99.04 |
| 11N20MIMO | Ant1 | 2412 | 1.92 | 1.94 | 98.97 |
| | Ant2 | 2412 | 1.93 | 1.95 | 98.97 |
| | Ant1 | 2437 | 1.92 | 1.94 | 98.97 |
| | Ant2 | 2437 | 1.92 | 1.94 | 98.97 |
| | Ant1 | 2462 | 1.93 | 1.95 | 98.97 |
| | Ant2 | 2462 | 1.92 | 1.94 | 98.97 |

## 10.5. Test graphs

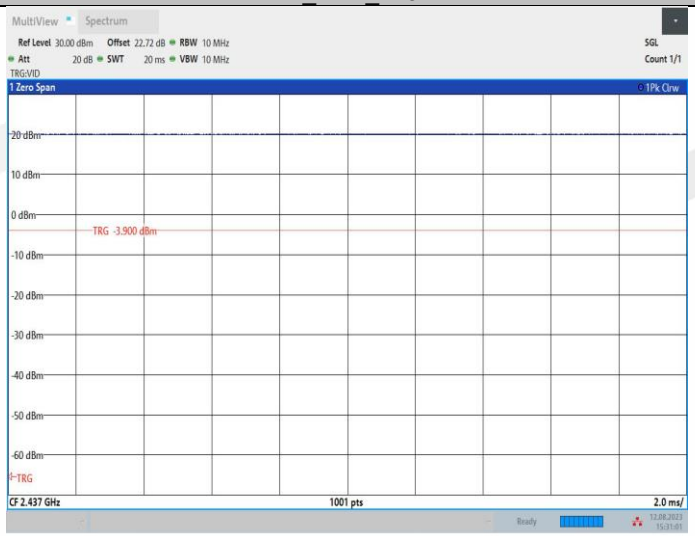
11B_Ant1_2412

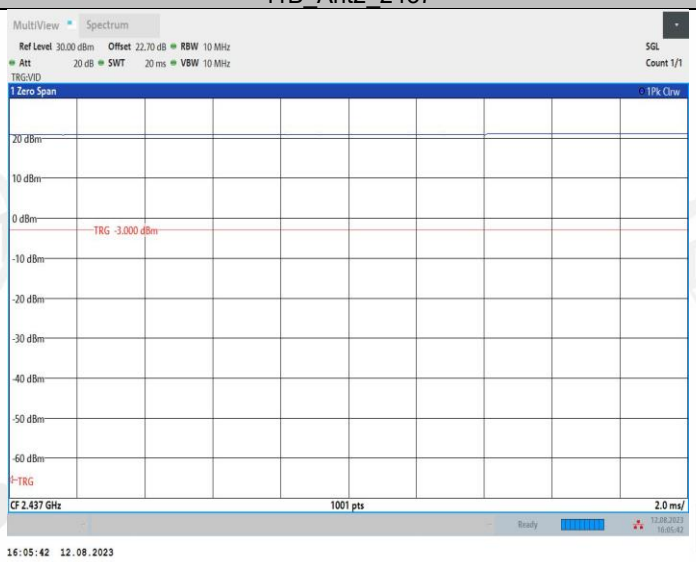
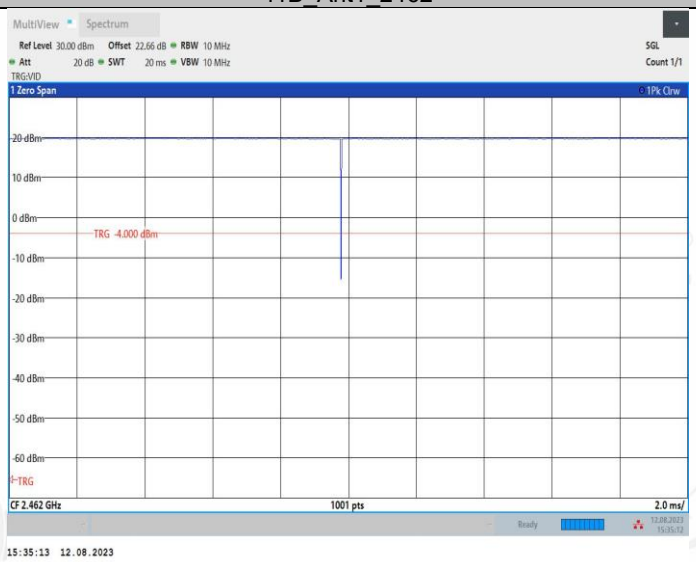
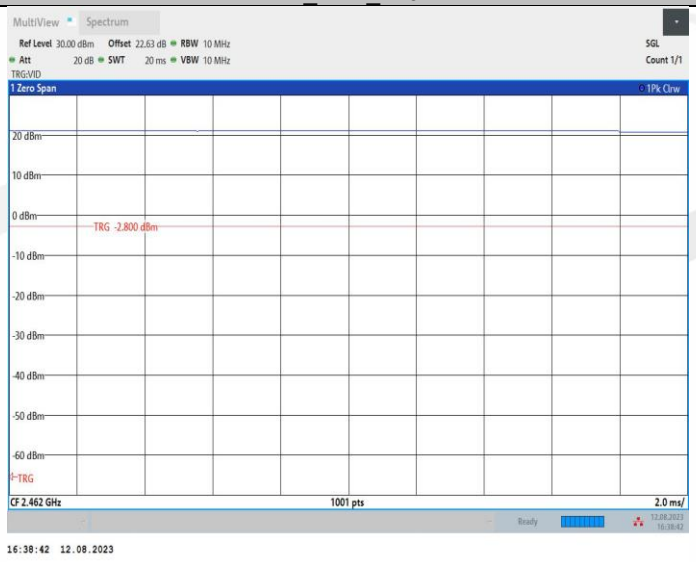


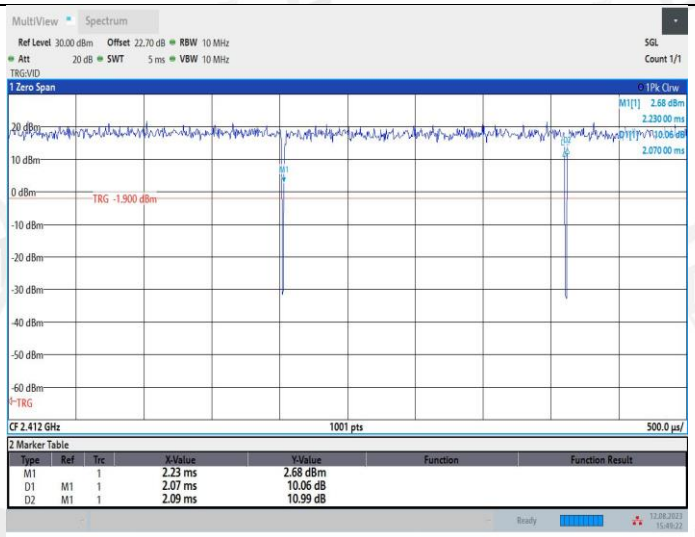

11B_Ant2_2412



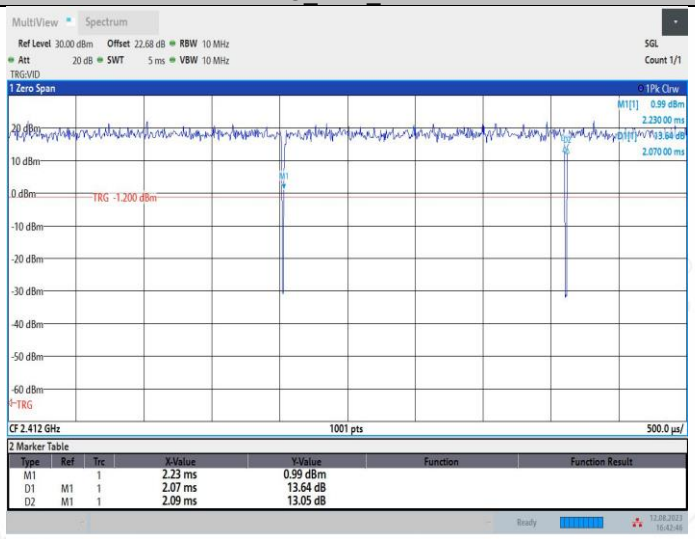

11B_Ant1_2437



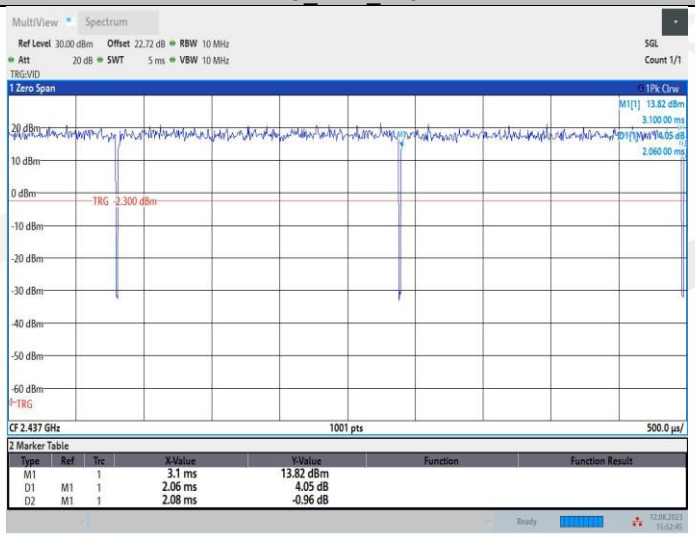
| 11B_Ant2_2437 |
| --- |
|  |
| 11B_Ant1_2462 |
|  |
| 11B_Ant2_2462 |
|  |
| 11G_Ant1_2412 |



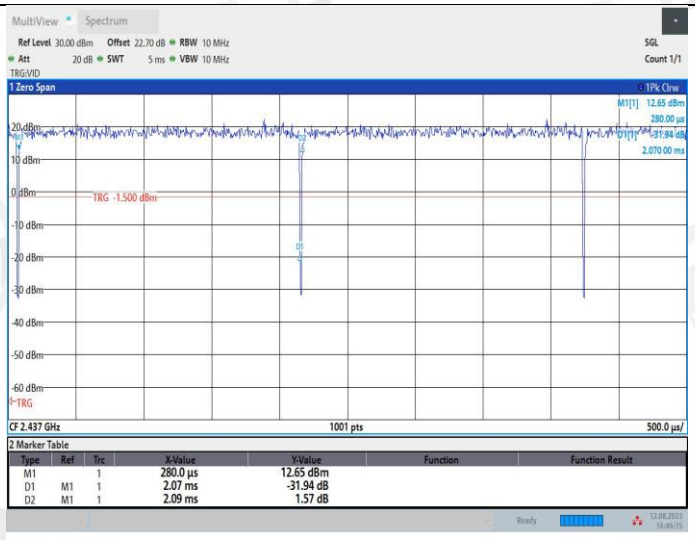

11G_Ant2_2412



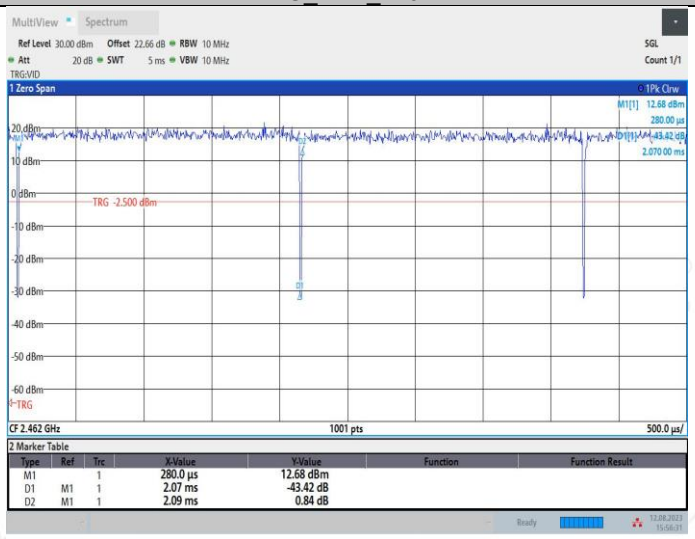

11G_Ant1_2437



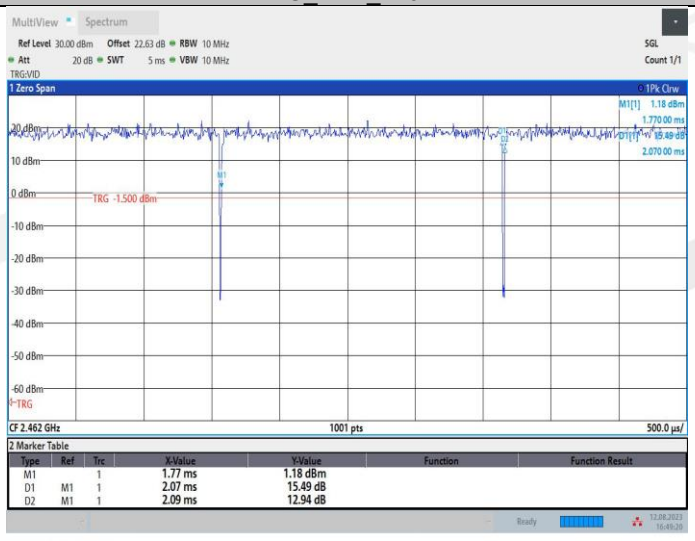

11G_Ant2_2437



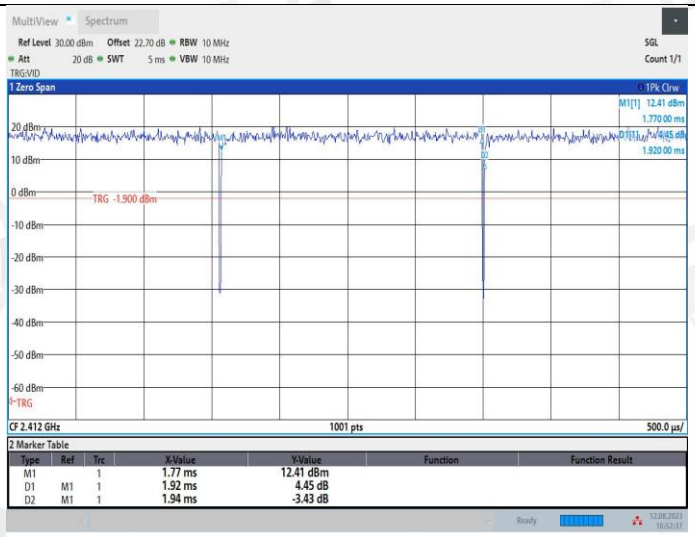

11G_Ant1_2462



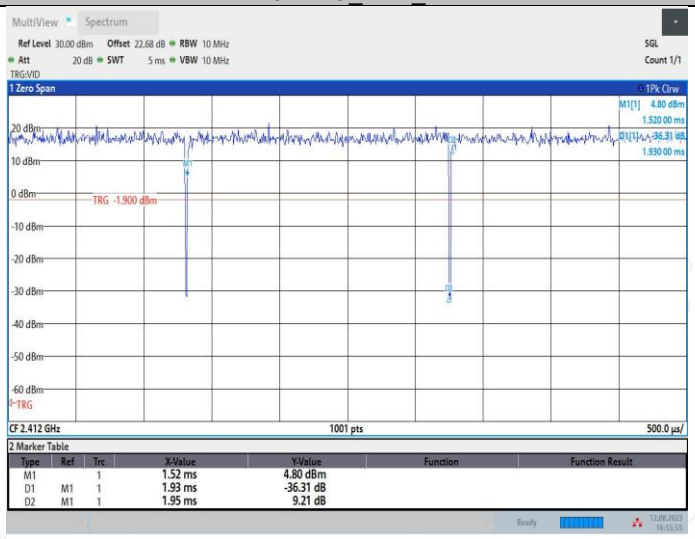

11G_Ant2_2462



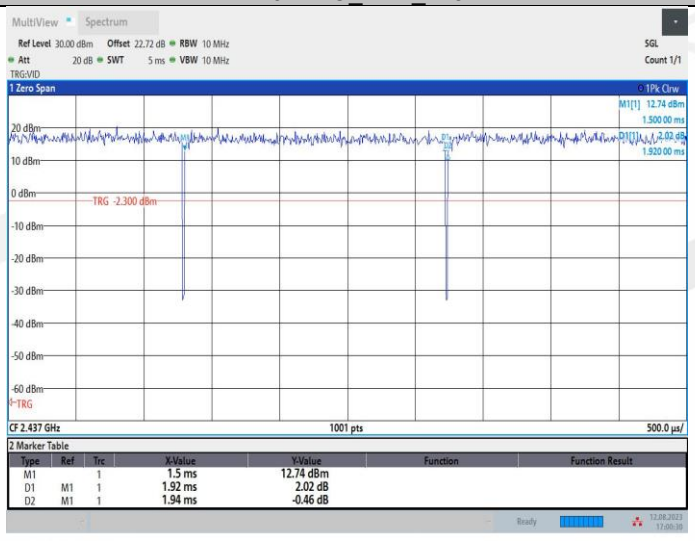

11N20MIMO_Ant1_2412



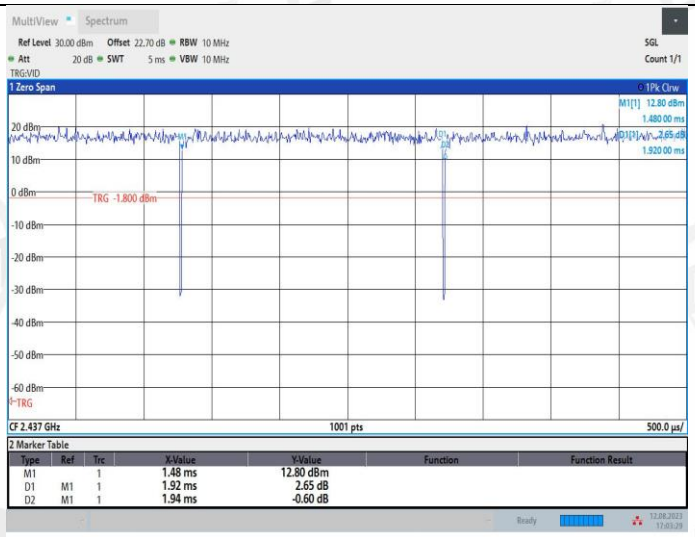

11N20MIMO_Ant2_2412



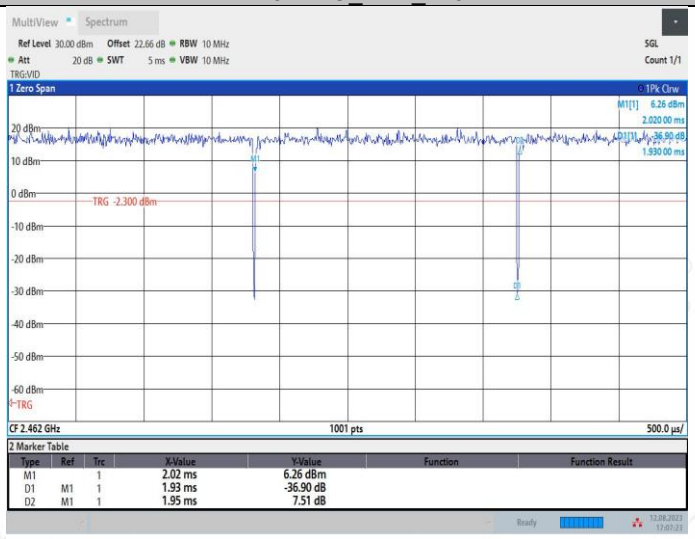

11N20MIMO_Ant1_2437



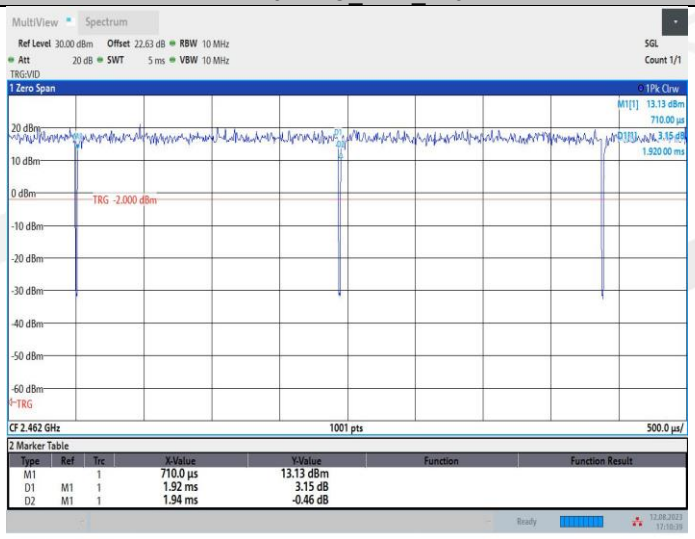

11N20MIMO_Ant2_2437




11N20MIMO_Ant1_2462



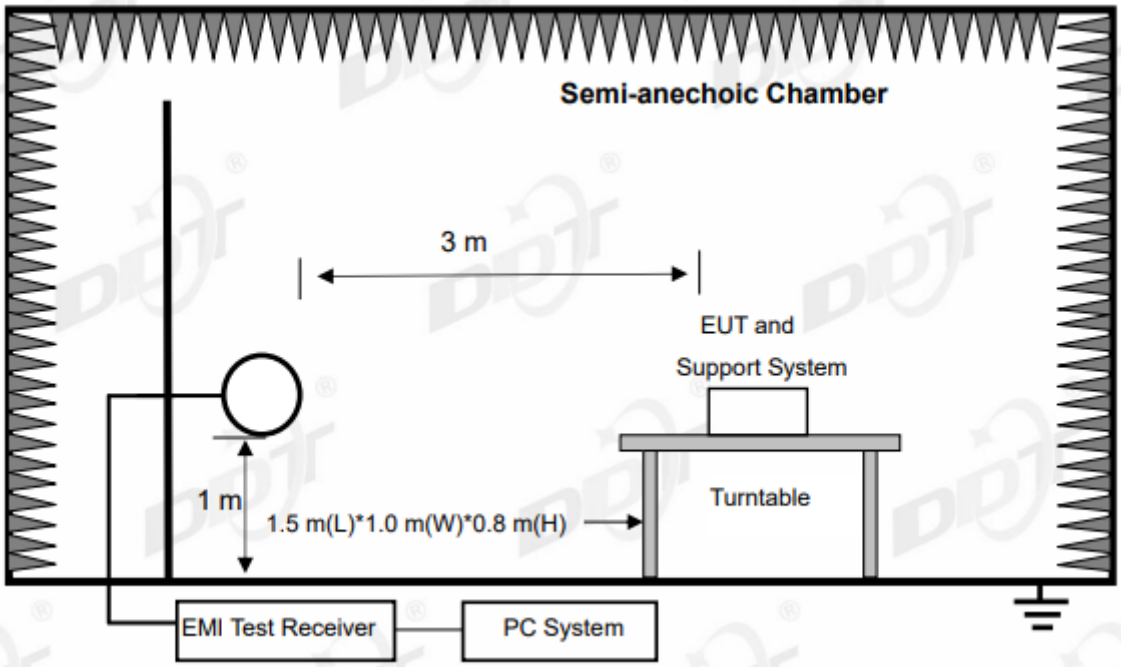

11N20MIMO_Ant2_2462



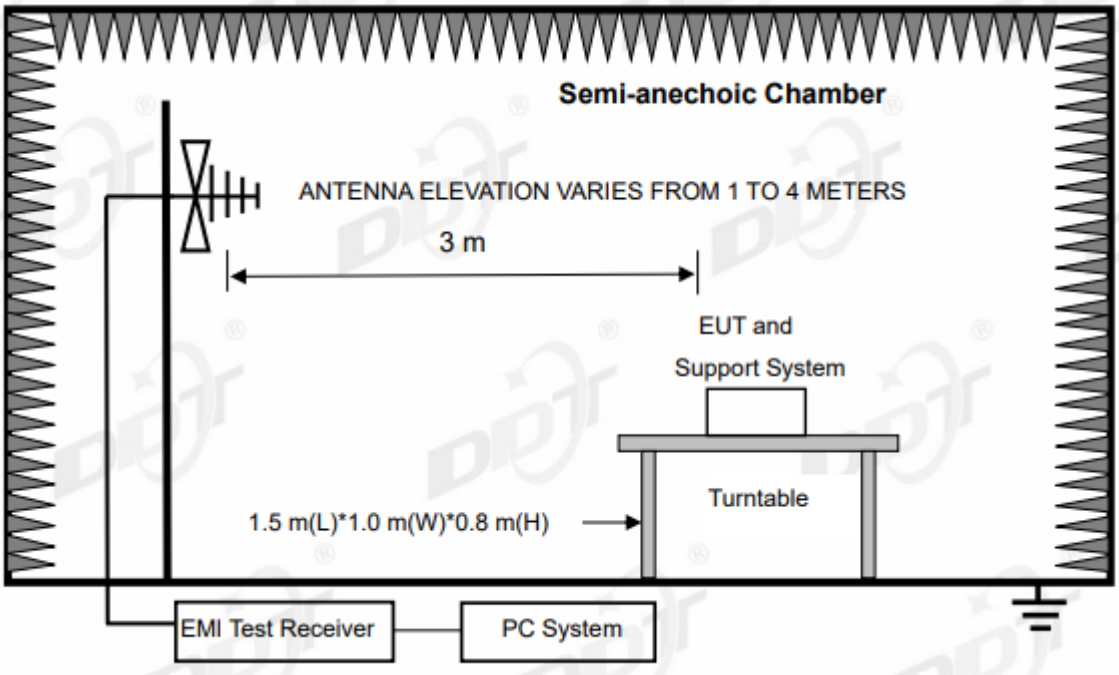
# 11. Radiated Spurious Emissions

## 11.1. Block diagram of test setup

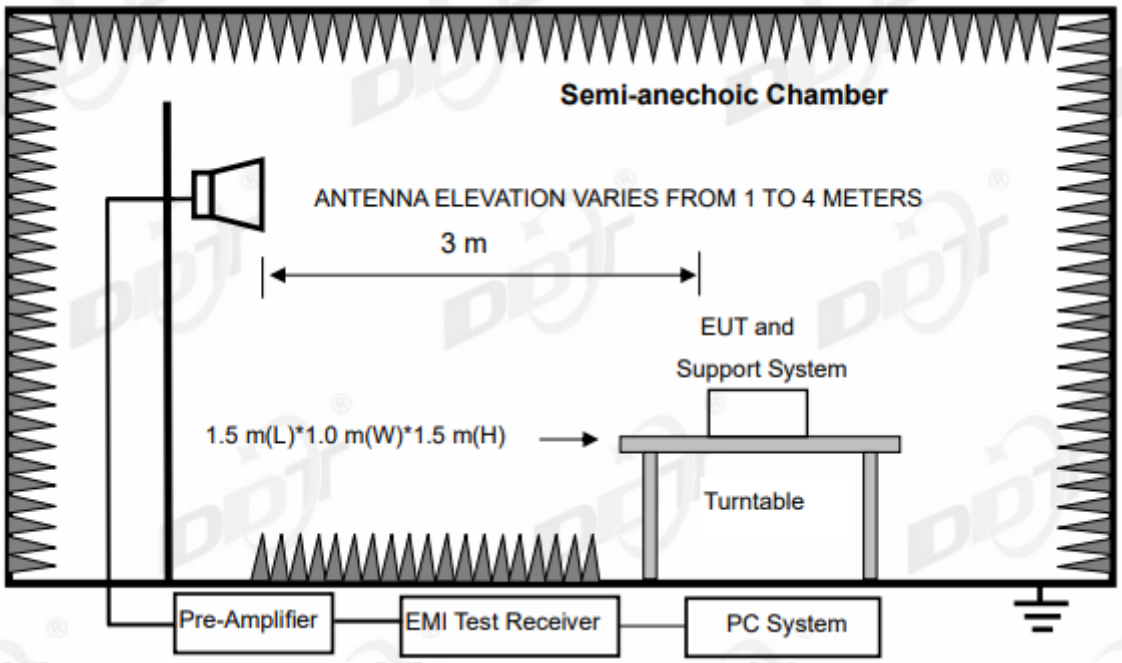
In 3 m Anechoic Chamber, test setup diagram for 9 kHz - 30 MHz:




In 3 m Anechoic Chamber, test setup diagram for 30 MHz - 1 GHz:



In 3 m Anechoic Chamber, test setup diagram for frequency above 1 GHz:




Note: For harmonic emissions test an appropriate high pass filter was inserted in the input port of AMP.

## 11.2. Limit

(1) FCC 15.205 Restricted frequency band:

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| [1]0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.1772&4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.2072&4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | ([2]) |
| 13.36-13.41 | | | |

[1]Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2]Above 38.6

RSS-Gen section 8.10 Restricted frequency bands*

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090-0.110 | 12.51975-12.52025 | 240-285 | 3.5-4.4 |
| 0.495-0.505 | 12.57675-12.57725 | 322-335.4 | 4.5-5.15 |
| 2.1735-2.1905 | 13.36-13.41 | 399.9-410 | 5.35-5.46 |
| 3.020-3.026 | 16.42-16.423 | 608-614 | 7.25-7.75 |
| 4.125-4.128 | 16.69475-16.69525 | 960-1427 | 8.025-8.5 |
| 4.1772&4.17775 | 16.80425-16.80475 | 1435-1626.5 | 9.0-9.2 |
| 4.2072&4.20775 | 25.5-25.67 | 1645.5-1646.5 | 9.3-9.5 |
| 5.677-5.683 | 37.5-38.25 | 1660-1710 | 10.6-12.7 |
| 6.215-6.218 | 73-74.6 | 1718.8-1722.2 | 13.25-13.4 |
| 6.26775-6.26825 | 74.8-75.2 | 2200-2300 | 14.47-14.5 |
| 6.31175-6.31225 | 108-138 | 2310-2390 | 15.35-16.2 |
| 8.291-8.294 | 149.9-150.05 | 2483.5-2500 | 17.7-21.4 |
| 8.362-8.366 | 156.52475-156.52525 | 2655-2900 | 22.01-23.12 |
| 8.37625-8.38675 | 156.7-156.9 | 3260-3267 | 23.6-24.0 |
| 8.41425-8.41475 | 162.0125-167.17 | 3332-3339 | 31.2-31.8 |
| 12.29-12.293 | 167.72-173.2 | 3345.8-3358 | 36.43-36.5 |
| | | | Above 38.6 |

* Certain frequency bands listed in table and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

(2) FCC 15.209 Limit.

| Frequency (MHz) | Measurement distance (meters) | Field strength limit | |
|---|---|---|---|
| | | μV/m | dB(μV)/m |
| 0.009 ~ 0.490 | 300 | 2400/F(kHz) | 67.6-20log(F) |
| 0.490 ~ 1.705 | 30 | 24000/F(kHz) | 87.6-20log(F) |
| 1.705 ~ 30.0 | 30 | 30 | 29.54 |
| 30 ~ 88 | 3 | 100 | 40.0 |
| 88 ~ 216 | 3 | 150 | 43.5 |
| 216 ~ 960 | 3 | 200 | 46.0 |
| 960 ~ 1000 | 3 | 500 | 54.0 |
| Above 1000 | 3 | 74.0 dB(μV)/m (Peak), 54.0 dB(μV)/m (Average) | |

Note:

(1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000MHz, radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer than that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$$Limit_{3m}(dBuV/m) = Limit_{30m}(dBuV/m) + 40Log(30m/3m)$$

(3) Limit for this EUT

The emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, and the emissions appearing within RSS-Gen section 8.10 Restricted frequency bands shall not exceed the limits shown in RSS-Gen section 8.9, all the other emissions shall be at least 20 dB below the fundamental emissions or comply with 15.209 limits and RSS-Gen section 8.9 limits.

## 11.3. Test procedure

(1) EUT height should be 0.8 m for below 1 GHz at a semi‐anechoic chamber while EUT height should be 1.5 m for above 1 GHz at full chamber or semi‐anechoic chamber ground with absorbers.

(2) The antenna used as below table.

| Test frequency range | Test antenna used | Test antenna distance |
|---|---|---|
| 9kHz-30MHz | Active Loop antenna | 3m |
| 30MHz-1GHz | Trilog Broadband Antenna | 3m |
| 1GHz-18GHz | Double Ridged Horn Antenna (1GHz-18GHz) | 3m |
| 18GHz-40GHz | Horn Antenna (18GHz-40GHz) | 1m |

According ANSI C63.10:2013 clause 6.4.6 and 6.5.3, for measurements below 30 MHz, Antenna was located 3 m from EUT, the loop antenna was positioned in three antenna orientations (parallel, perpendicular, and round-parallel), for each measurement antenna alignment, the EUT shall be rotated through 0°to 360°on a turntable, and the lowest height of the magnetic antenna shall be 1 m above the ground. For measurement above 30MHz, the trilog Broadband Antenna or Horn Antenna was located 3m from EUT, Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

(3) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9 kHz to 25 GHz:

(a) Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1 m to 4 m (Except loop antenna, it's fixed 1m above ground.)

(b) Change work frequency or channel of device if practicable.

(c) Change modulation type of device if practicable.

(d) Change power supply range from 85% to 115% of the rated supply voltage

(e) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions.

Spectrum frequency from 9 kHz to 25 GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 18GHz to 25GHz, so below final test was performed with frequency range from 9kHz to 18GHz.

(4) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10 2013 on Radiated Emission test.

(5) The emissions from 9 kHz to 1 GHz were measured based on CISPR QP detector except for the frequency bands 9-90 kHz, 110-490 kHz, for emissions from 9 kHz-90 kHz,110 kHz-490 kHz and above 1 GHz were measured based on average detector, for emissions above 1 GHz, peak emissions also be measured and need comply with Peak limit.

(6) The emissions from 9 kHz to 1 GHz, QP or average values were measured with EMI receiver with below RBW

| Frequency band | RBW |
|---|---|
| 9 kHz-150 kHz | 200 Hz |
| 150 kHz-30 MHz | 9 kHz |
| 30 MHz-1 GHz | 120 kHz |

(7) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1 MHz, VBW is set at 3 MHz for Peak measure; RMS detector RBW 1 MHz VBW 10 Hz for Average measure (according ANSI C63.10:2013 clause 4.2.3.2.3 procedure for average measure).

(8) For portable device, X axis, Y axis, Z axis are tested, and worse axis is reported.

## 11.4. Test result

## Pass. (See below detailed test result)

All the emissions except fundamental emission from 9 kHz to 25 GHz were comply with 15.209 limits and RSS-Gen section 8.9 limits.

Note 1: According exploratory test, the emission levels are 20 dB below the limit detected from 9 kHz to 30 MHz and 18 GHz to 25 GHz, so the final test was performed with frequency range from 30 MHz to 18 GHz and recorded in below.

Note 2: 30 MHz ~ 25 GHz: (Scan with all mode, the worst case is 802.11b Ant 2 mode)

Note 3: For emissions below 1 GHz, according exploratory explorer test, when change Tx mode and channel, have no distinct influence on emissions level, so for emissions below 1 GHz, the final test was only performed with EUT working in 802.11b Ant 2 Tx 2412 MHz mode.

Note 4: For emissions above 1 GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit, only recorded the worst case in this report.