

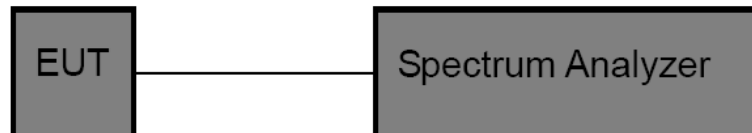


3.4. Band edge and Spurious Emissions (Conducted)

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Test Configuration



Test Procedure

1. The transmitter output was connected to the spectrum analyzer through an attenuator, the path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following spectrum analyzer settings:
RBW = 100 kHz, VBW ≥ RBW, scan up through 10th harmonic.
Sweep = auto, Detector function = peak, Trace = max hold
4. Measure and record the results in the test report.

Test Mode

Please refer to the clause 2.3.

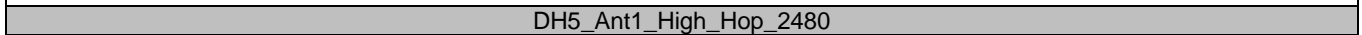
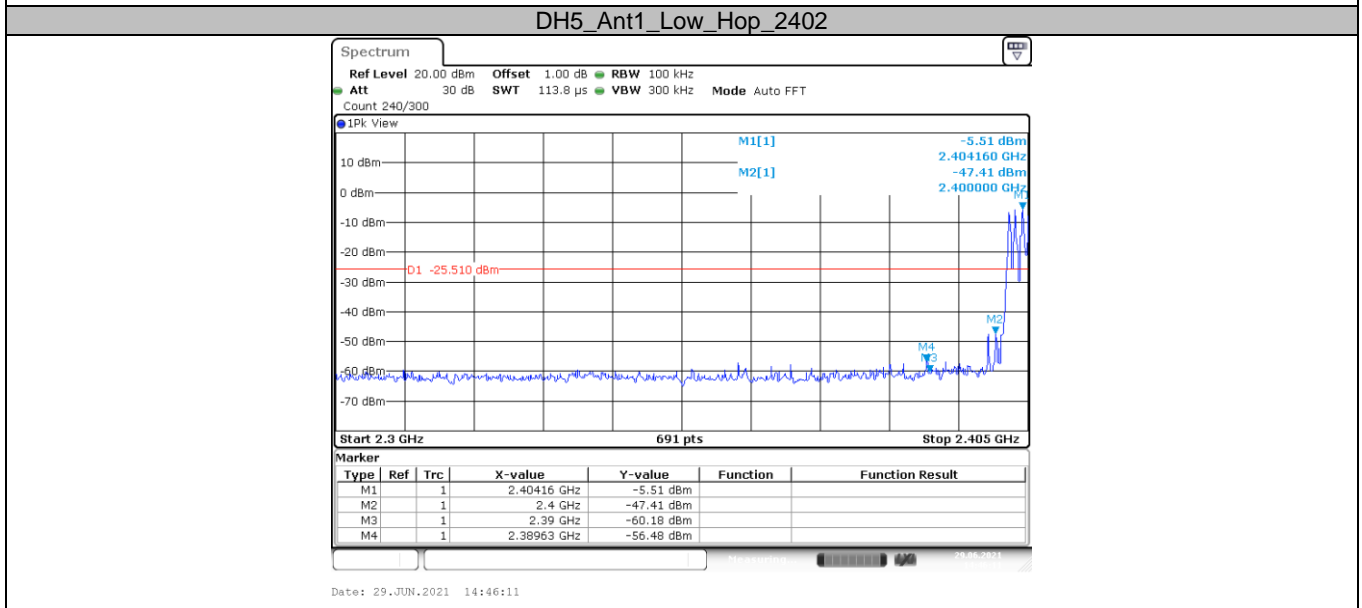
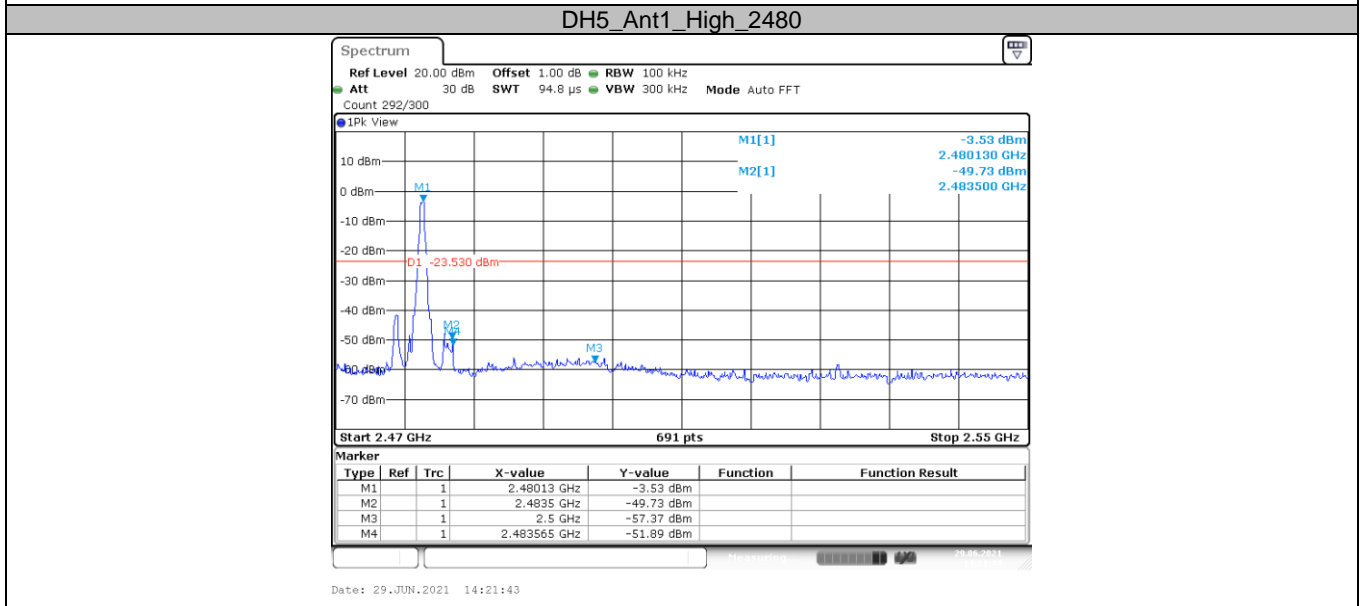
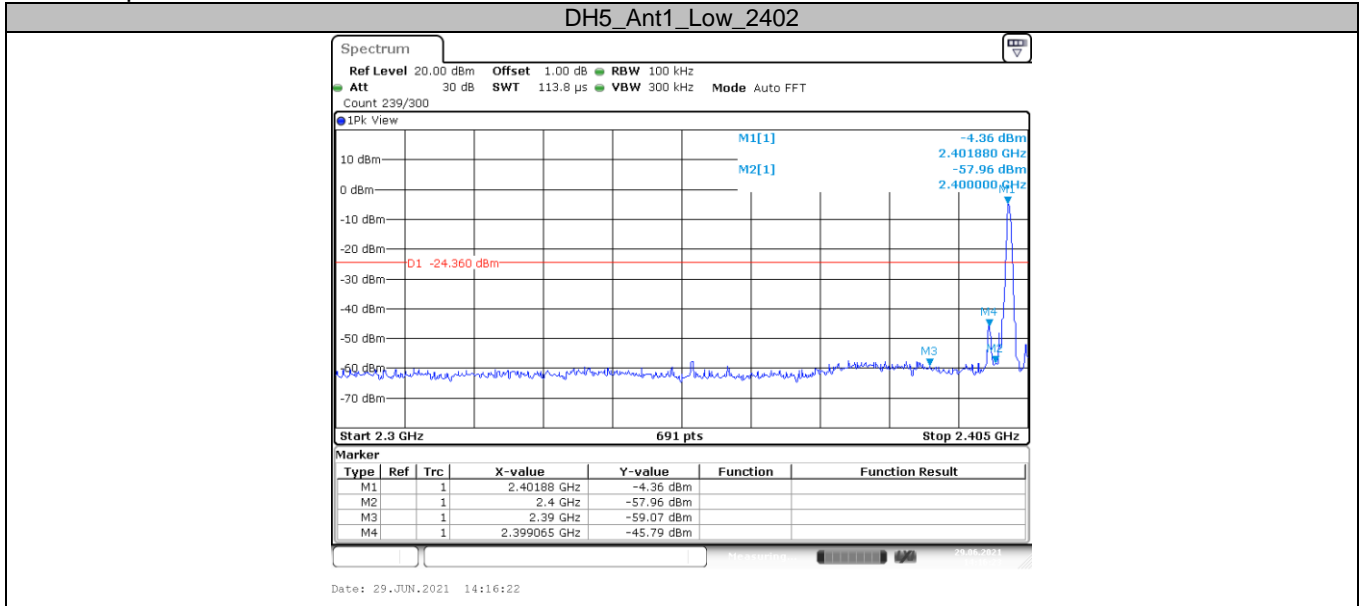
Test Result

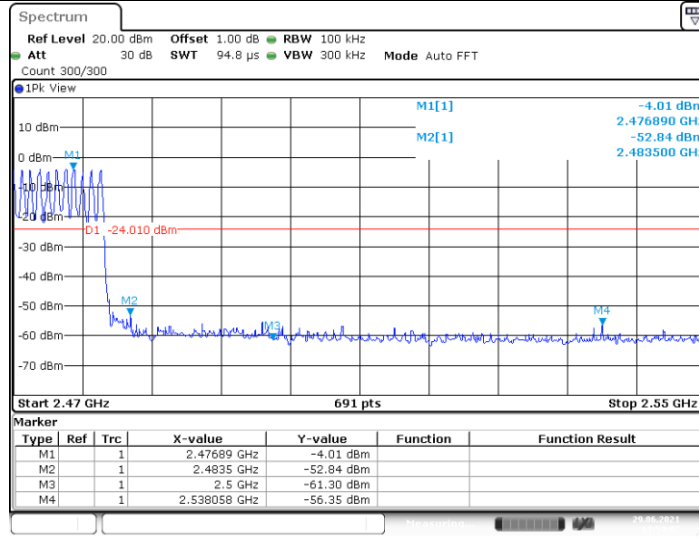
(1) Band edge Conducted Test

| Test Mode | Antenna | ChName | Frequency (MHz) | RefLevel [dBm] | Result [dBm] | Limit [dBm] | Verdict |
|-----------|---------|--------|-----------------|----------------|--------------|-------------|---------|
| DH5 | Ant1 | Low | 2402 | -4.36 | -45.79 | <=-24.36 | PASS |
| | | High | 2480 | -3.53 | -51.89 | <=-23.53 | PASS |
| | | Low | Hop_2402 | -5.51 | -56.48 | -25.51 | PASS |
| | | High | Hop_2480 | -4.01 | -56.35 | -24.01 | PASS |
| 2DH5 | Ant1 | Low | 2402 | -4.38 | -45.70 | <=-24.38 | PASS |
| | | High | 2480 | -4.62 | -51.16 | <=-24.62 | PASS |
| | | Low | Hop_2402 | -8.64 | -57.63 | -28.64 | PASS |
| | | High | Hop_2480 | -5.39 | -56.82 | -25.39 | PASS |
| 3DH5 | Ant1 | Low | 2402 | -4.37 | -45.90 | <=-24.37 | PASS |
| | | High | 2480 | -3.37 | -55.68 | <=-23.37 | PASS |
| | | Low | Hop_2402 | -5.49 | -57.44 | -25.49 | PASS |
| | | High | Hop_2480 | -3.42 | -57.76 | -23.42 | PASS |

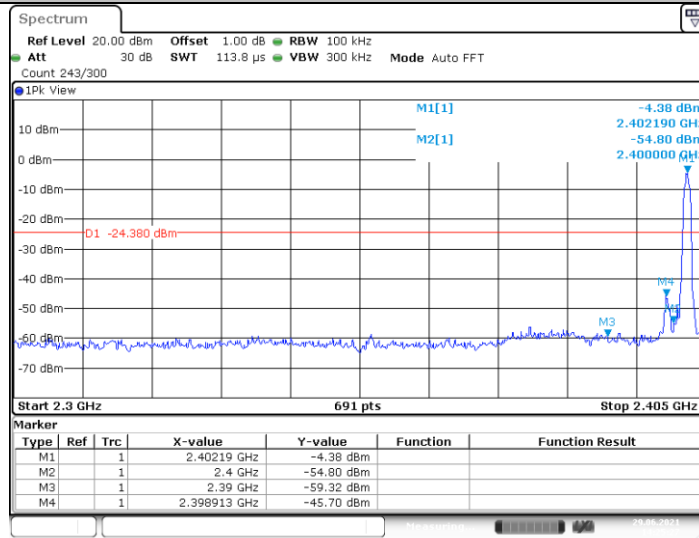


Test Graphs:

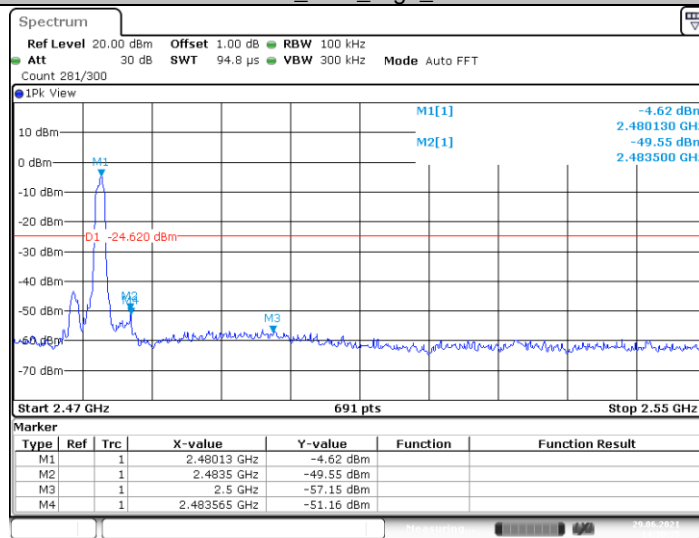




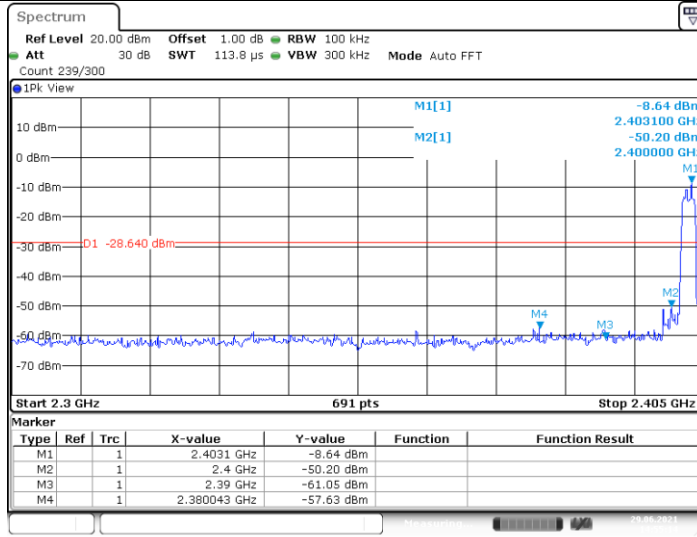
2DH5_Ant1_Low_2402



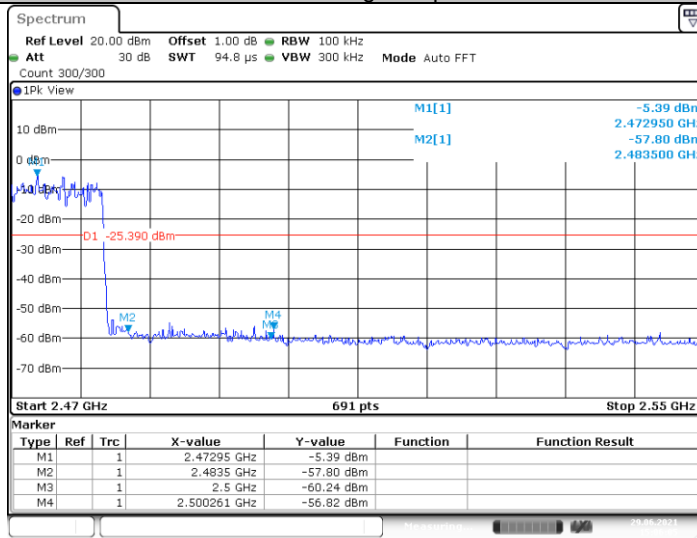
2DH5_Ant1_High_2480



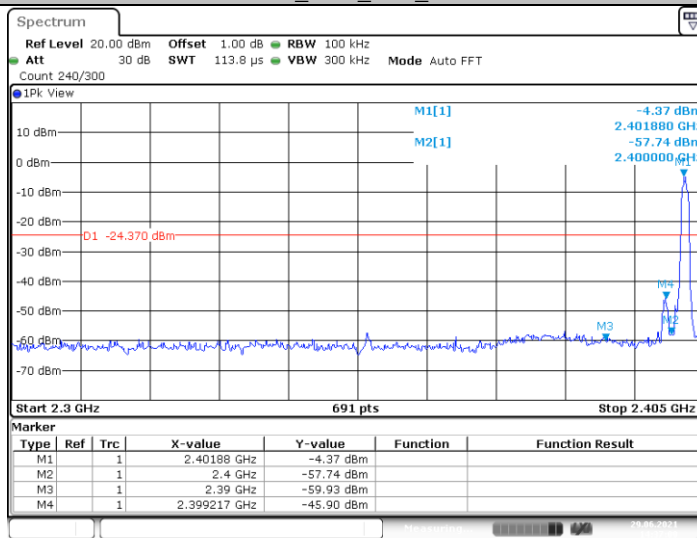
2DH5_Ant1_Low_Hop_2402



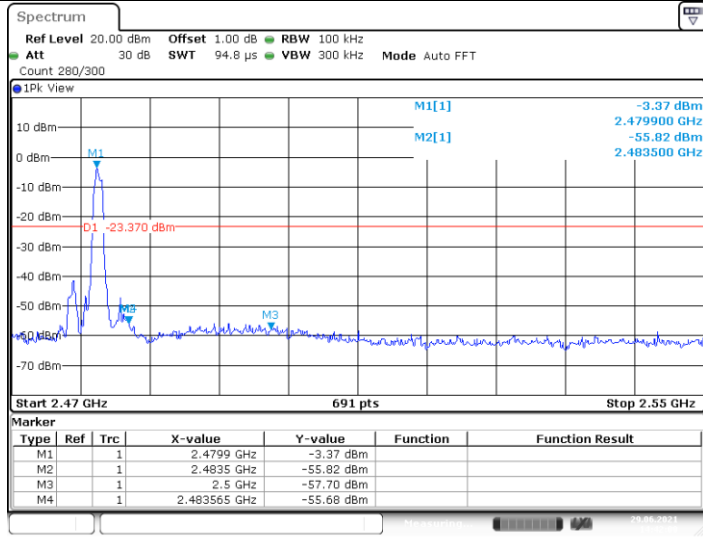
2DH5_Ant1_High_Hop_2480



3DH5_Ant1_Low_2402

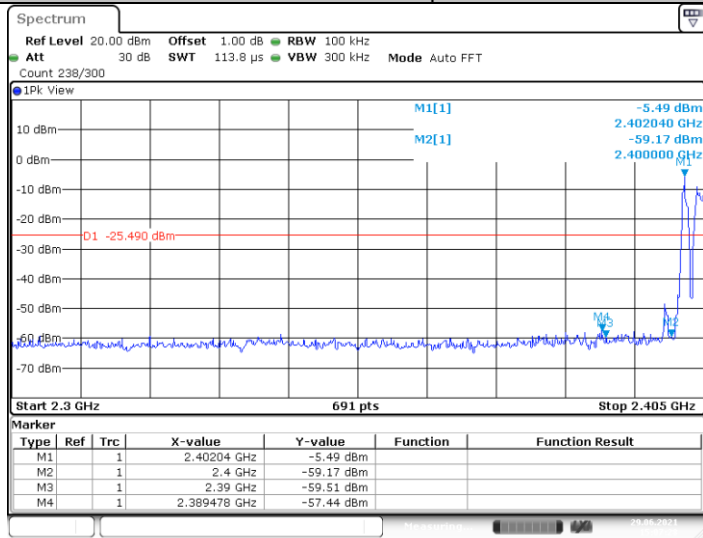


3DH5_Ant1_High_2480



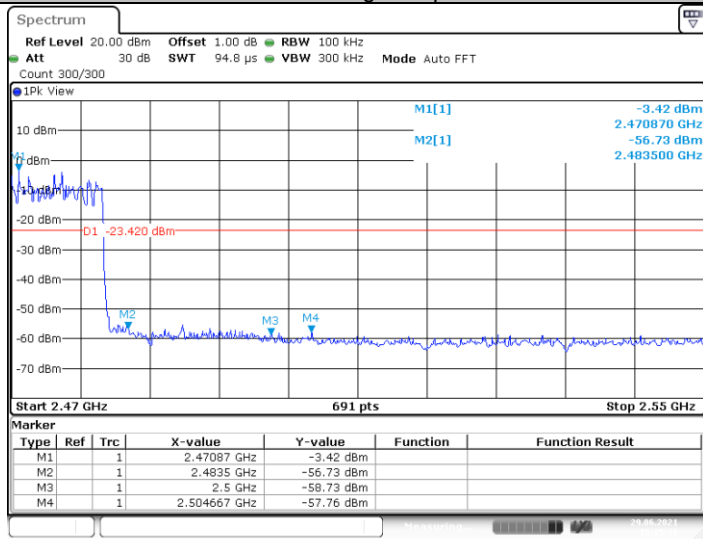
Date: 29 JUN 2021 14:42:00

3DH5_Ant1_Low_Hop_2402



Date: 29 JUN 2021 15:07:27

3DH5_Ant1_High_Hop_2480



Date: 29 JUN 2021 15:15:30

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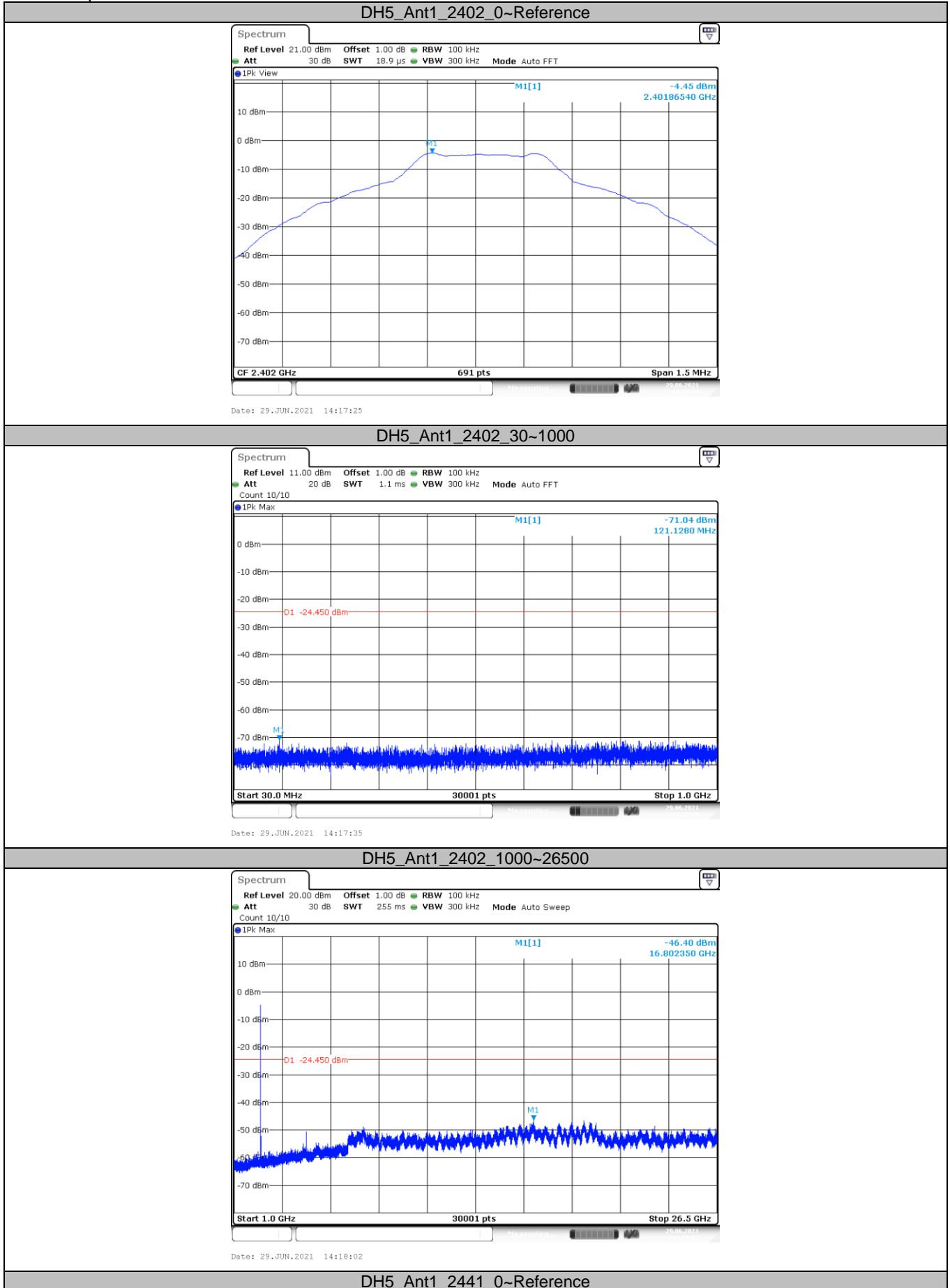


(2) Conducted Spurious Emissions Test

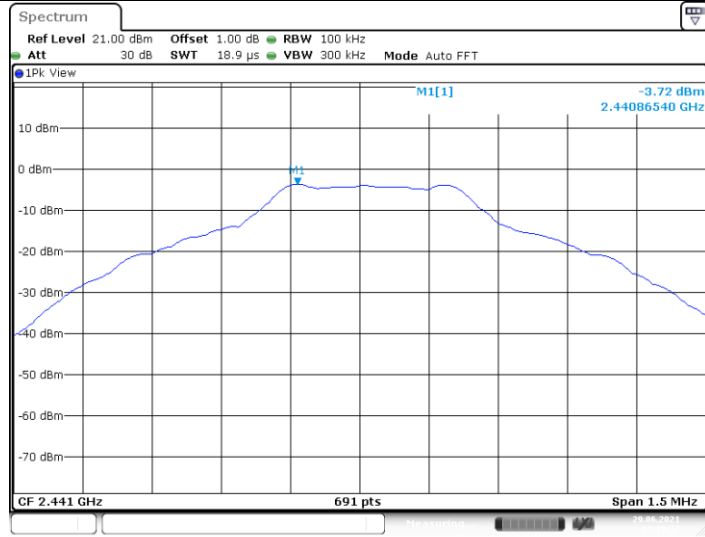
| Test Mode | Antenna | Frequency (MHz) | FreqRange [MHz] | RefLevel [dBm] | Result [dBm] | Limit [dBm] | Verdict |
|-----------|---------|-----------------|-----------------|----------------|--------------|-------------|---------|
| DH5 | Ant1 | 2402 | Reference | -4.45 | -4.45 | --- | PASS |
| | | | 30~1000 | 30~1000 | -71.04 | <=-24.45 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.40 | <=-24.45 | PASS |
| | | 2441 | Reference | -3.72 | -3.72 | --- | PASS |
| | | | 30~1000 | 30~1000 | -70.41 | <=-23.72 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.06 | <=-23.72 | PASS |
| | | 2480 | Reference | -3.33 | -3.33 | --- | PASS |
| | | | 30~1000 | 30~1000 | -69.88 | <=-23.33 | PASS |
| | | | 1000~26500 | 1000~26500 | -45.96 | <=-23.33 | PASS |
| 2DH5 | Ant1 | 2402 | Reference | -4.51 | -4.51 | --- | PASS |
| | | | 30~1000 | 30~1000 | -70.93 | <=-24.51 | PASS |
| | | | 1000~26500 | 1000~26500 | -45.81 | <=-24.51 | PASS |
| | | 2441 | Reference | -3.77 | -3.77 | --- | PASS |
| | | | 30~1000 | 30~1000 | -69.61 | <=-23.77 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.39 | <=-23.77 | PASS |
| | | 2480 | Reference | -3.38 | -3.38 | --- | PASS |
| | | | 30~1000 | 30~1000 | -69.98 | <=-23.38 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.88 | <=-23.38 | PASS |
| 3DH5 | Ant1 | 2402 | Reference | -4.46 | -4.46 | --- | PASS |
| | | | 30~1000 | 30~1000 | -70.72 | <=-24.46 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.27 | <=-24.46 | PASS |
| | | 2441 | Reference | -3.81 | -3.81 | --- | PASS |
| | | | 30~1000 | 30~1000 | -70.99 | <=-23.81 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.68 | <=-23.81 | PASS |
| | | 2480 | Reference | -3.33 | -3.33 | --- | PASS |
| | | | 30~1000 | 30~1000 | -70.90 | <=-23.33 | PASS |
| | | | 1000~26500 | 1000~26500 | -46.94 | <=-23.33 | PASS |



Test Graphs:

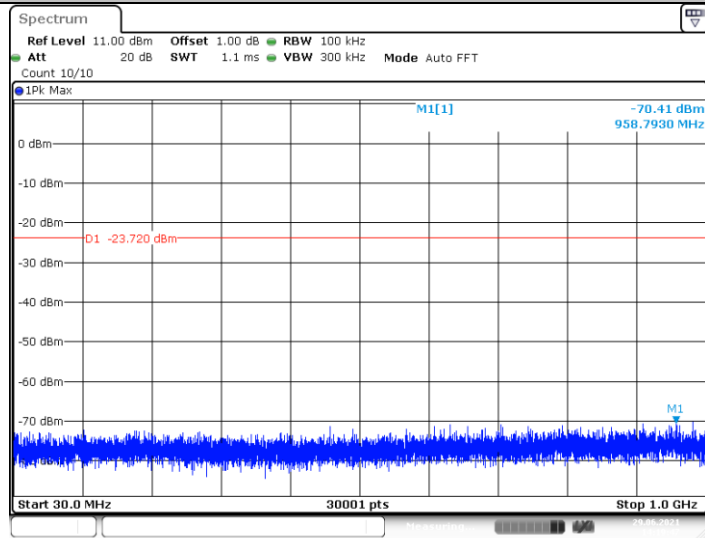


DH5_Ant1_2441_0~Reference



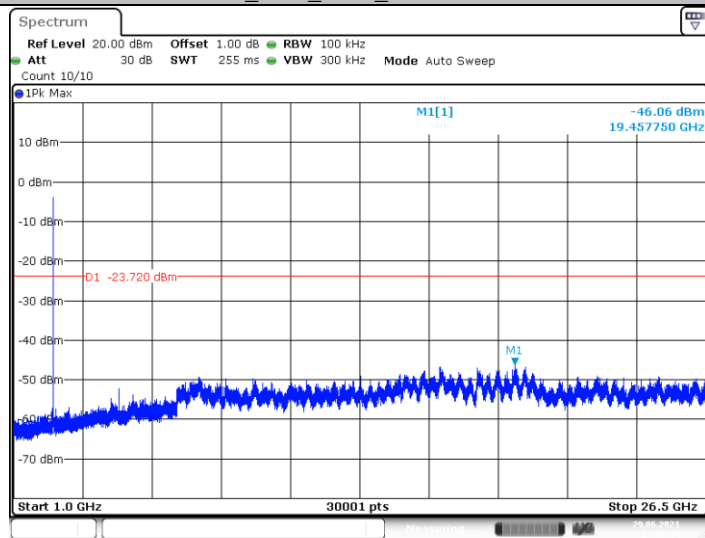
Date: 29.JUN.2021 14:19:37

DH5_Ant1_2441_30~1000



Date: 29.JUN.2021 14:19:47

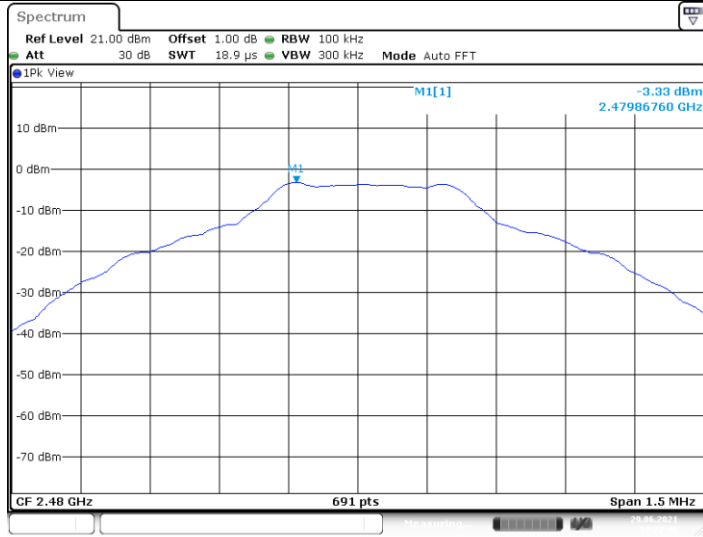
DH5_Ant1_2441_1000~26500



Date: 29.JUN.2021 14:20:14

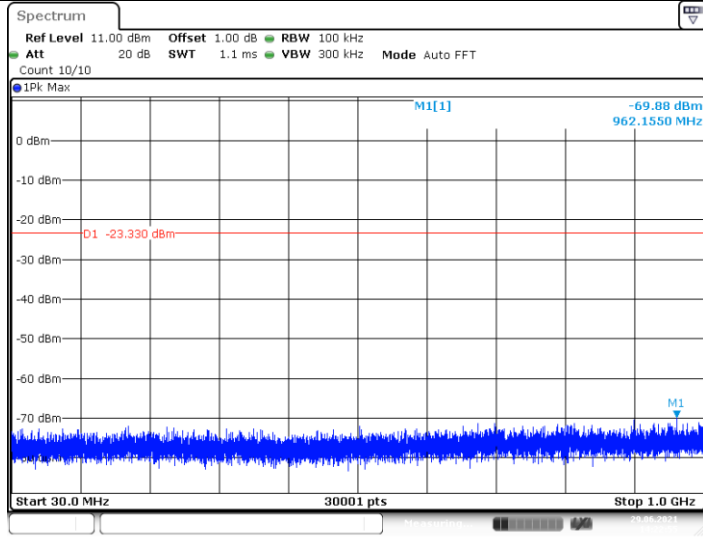
DH5_Ant1_2480_0~Reference





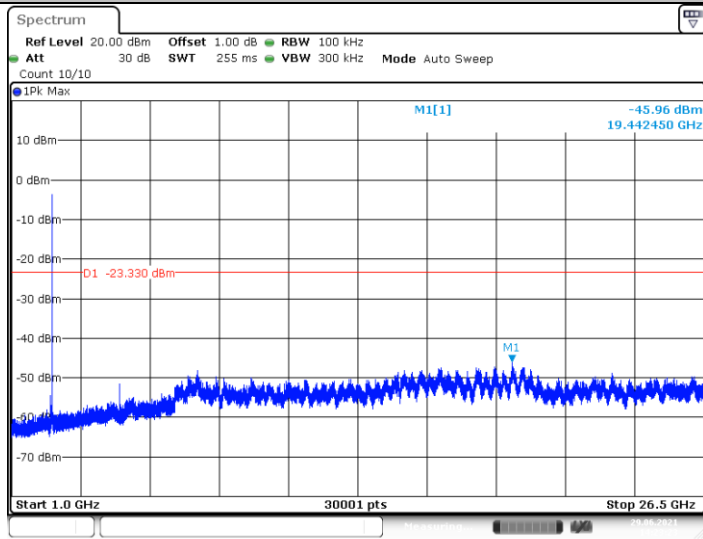
Date: 29 JUN 2021 14:22:46

DH5_Ant1_2480_30~1000



Date: 29 JUN 2021 14:22:56

DH5_Ant1_2480_1000~26500



Date: 29 JUN 2021 14:23:23

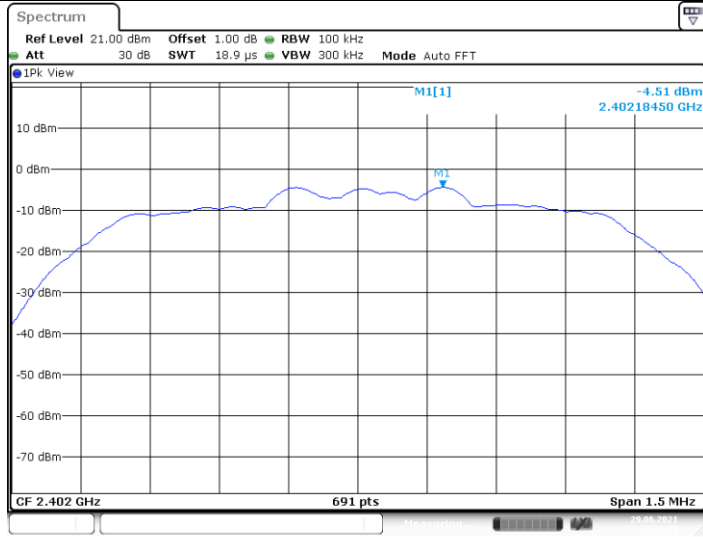
2DH5_Ant1_2402_0~Reference

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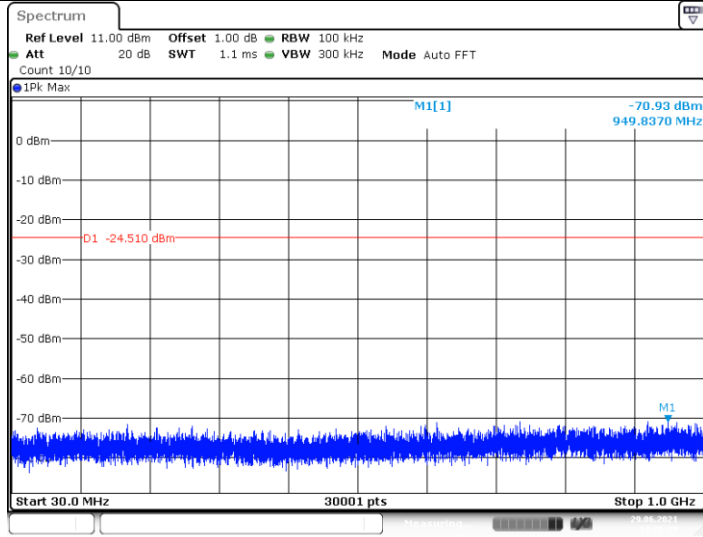


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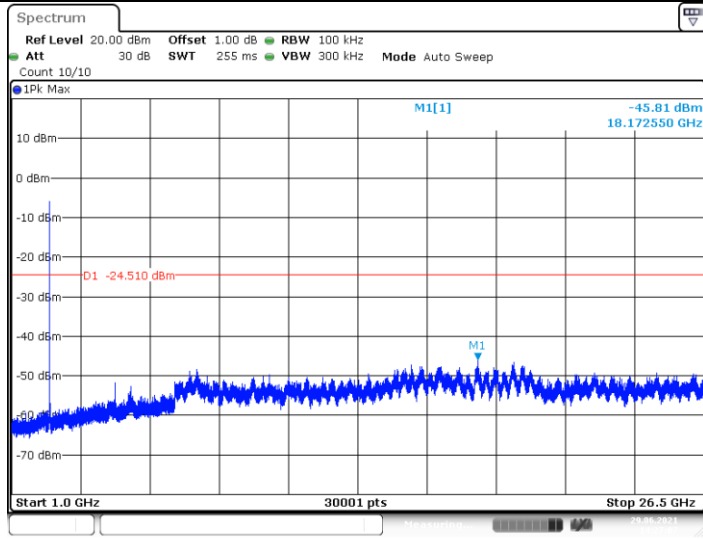
Date: 29 JUN 2021 14:26:30

2DH5_Ant1_2402_30~1000



Date: 29 JUN 2021 14:26:39

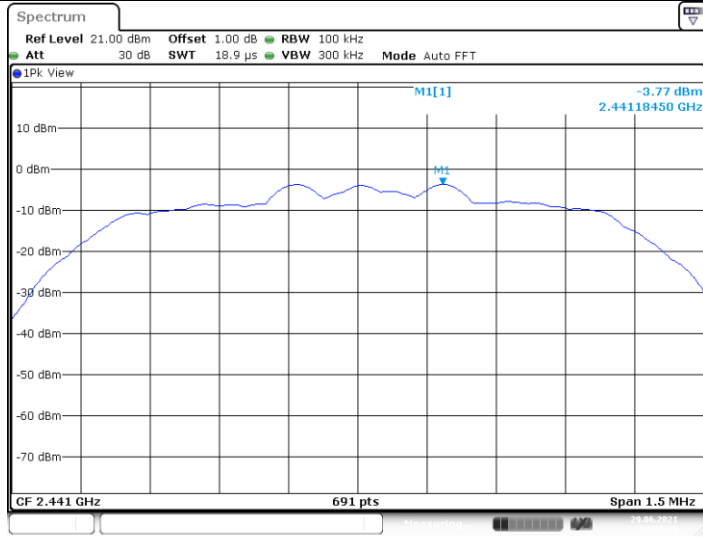
2DH5_Ant1_2402_1000~26500



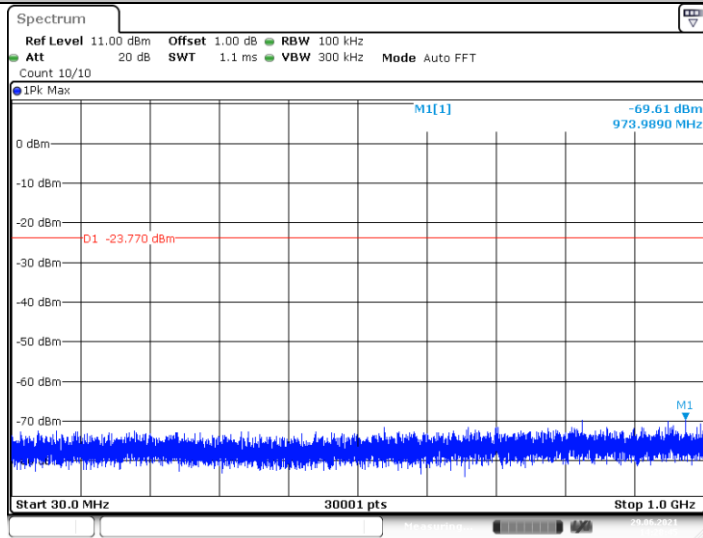
Date: 29 JUN 2021 14:27:07

2DH5_Ant1_2441_0~Reference

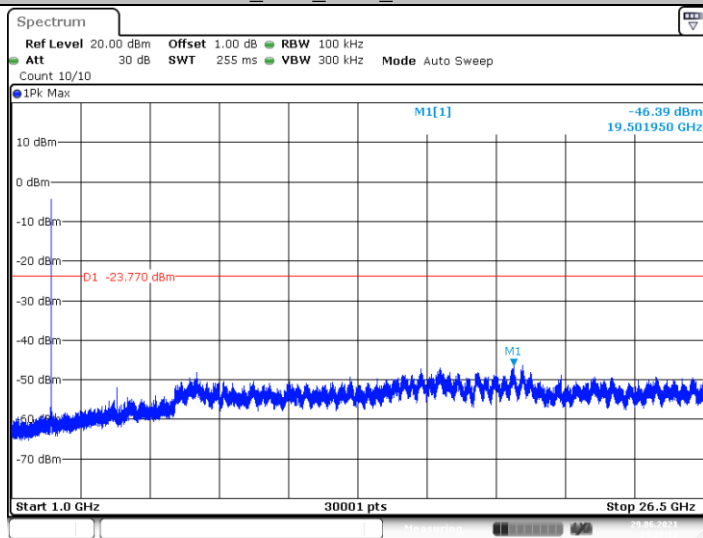




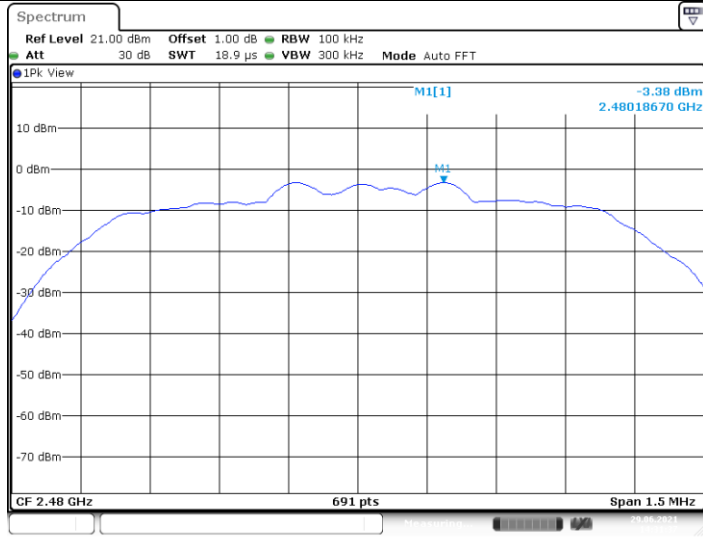
2DH5_Ant1_2441_30~1000



2DH5_Ant1_2441_1000~26500

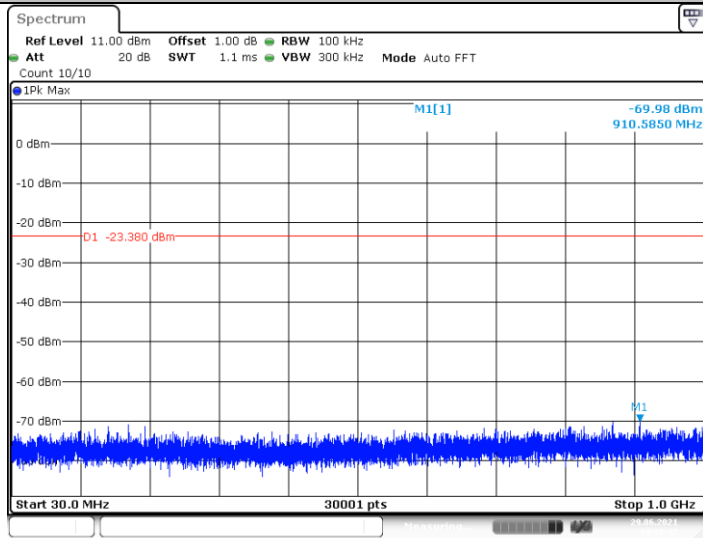


2DH5_Ant1_2480_0~Reference



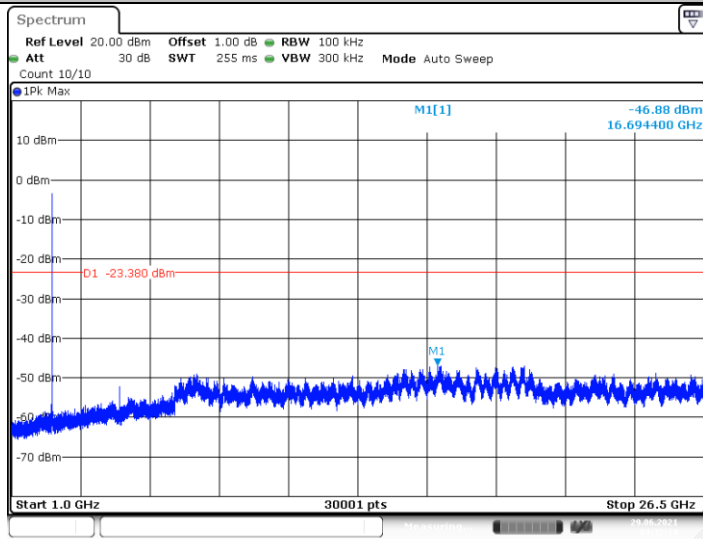
Date: 29 JUN 2021 14:31:38

2DH5_Ant1_2480_30~1000



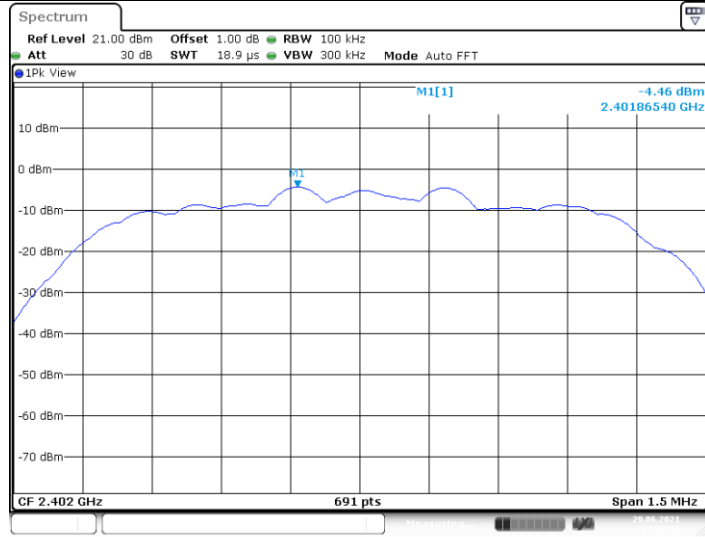
Date: 29 JUN 2021 14:31:47

2DH5_Ant1_2480_1000~26500



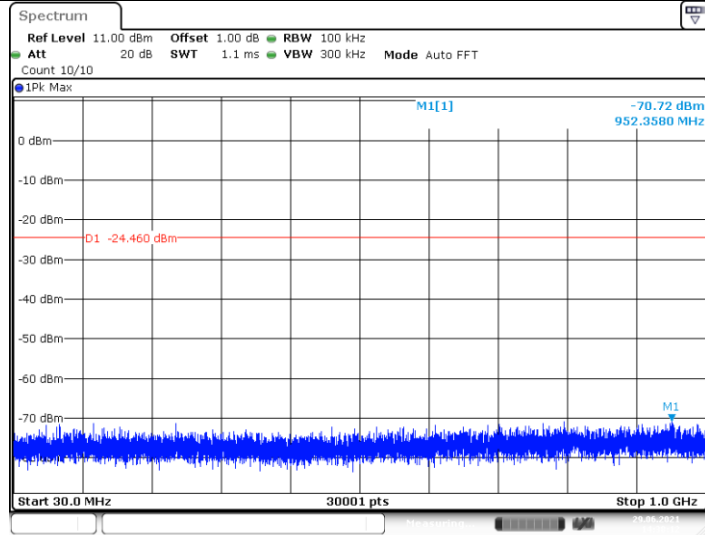
Date: 29 JUN 2021 14:32:14

3DH5_Ant1_2402_0~Reference



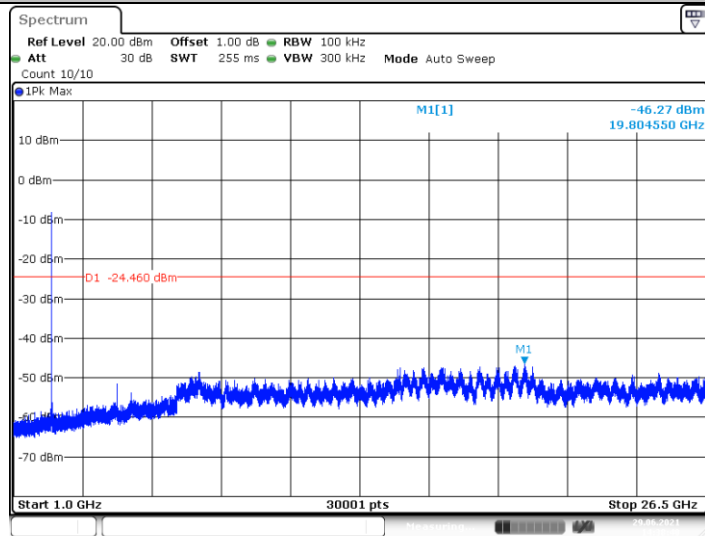
Date: 29 JUN 2021 14:38:03

3DH5_Ant1_2402_30~1000



Date: 29 JUN 2021 14:38:12

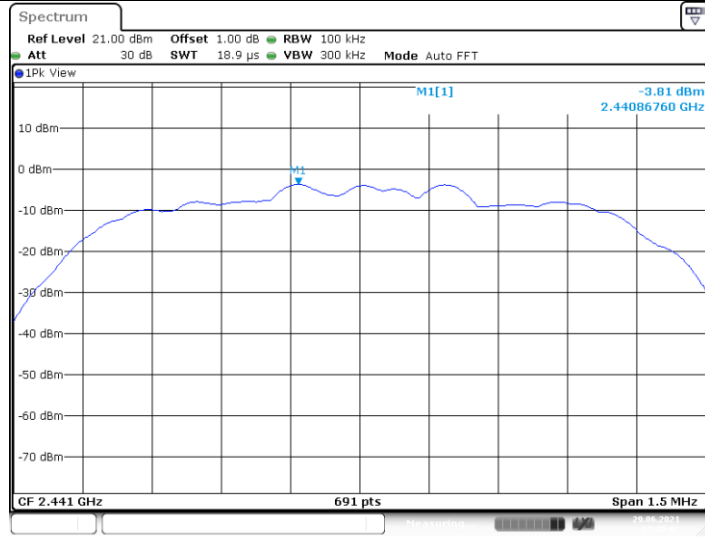
3DH5_Ant1_2402_1000~26500



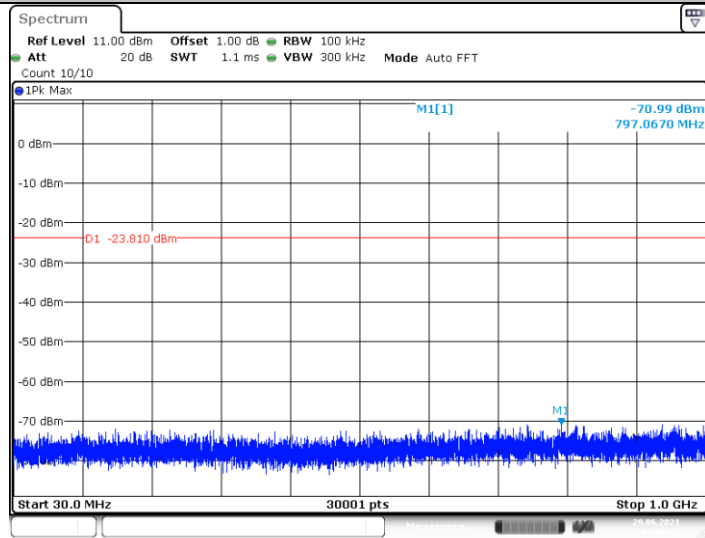
Date: 29 JUN 2021 14:38:40

3DH5_Ant1_2441_0~Reference

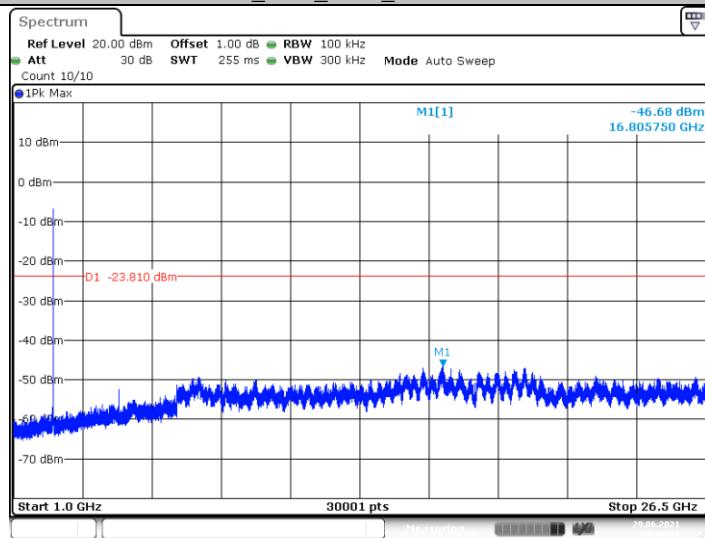




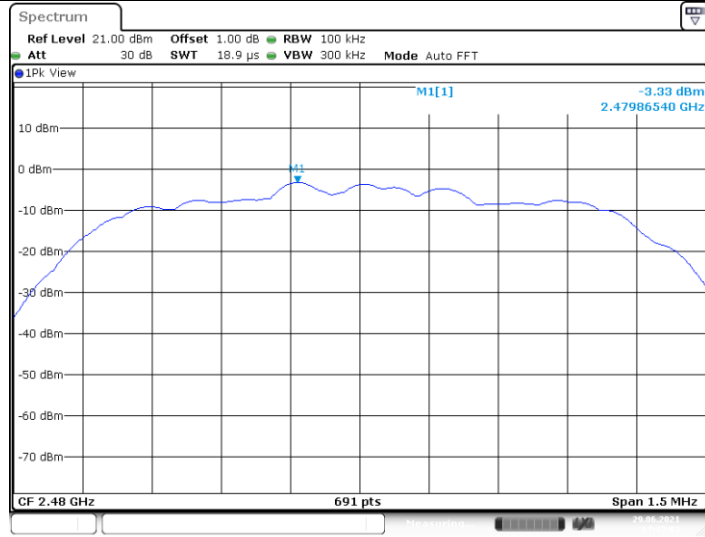
3DH5_Ant1_2441_30~1000



3DH5_Ant1_2441_1000~26500

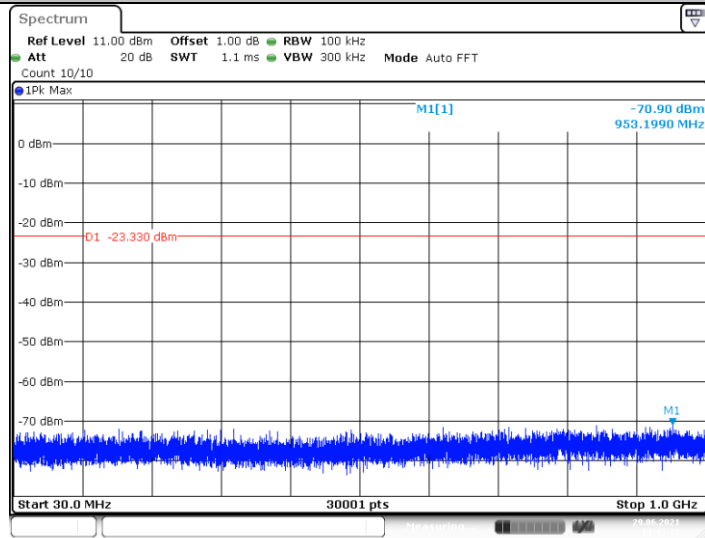


3DH5_Ant1_2480_0~Reference



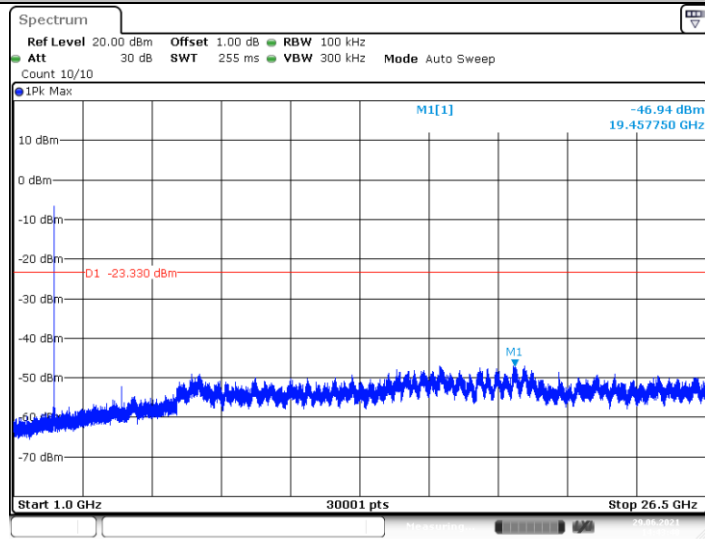
Date: 29 JUN 2021 14:43:03

3DH5_Ant1_2480_30~1000



Date: 29 JUN 2021 14:43:12

3DH5_Ant1_2480_1000~26500



Date: 29 JUN 2021 14:43:10

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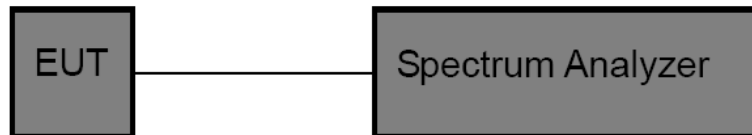
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3.5. Bandwidth

Limit

N/A

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
2. Spectrum Setting:
 - (1) Set RBW = 100 kHz.
 - (2) Set the video bandwidth (VBW) ≥ 3 RBW.
 - (3) Detector = Peak.
 - (4) Trace mode = Max hold.
 - (5) Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

Test Mode

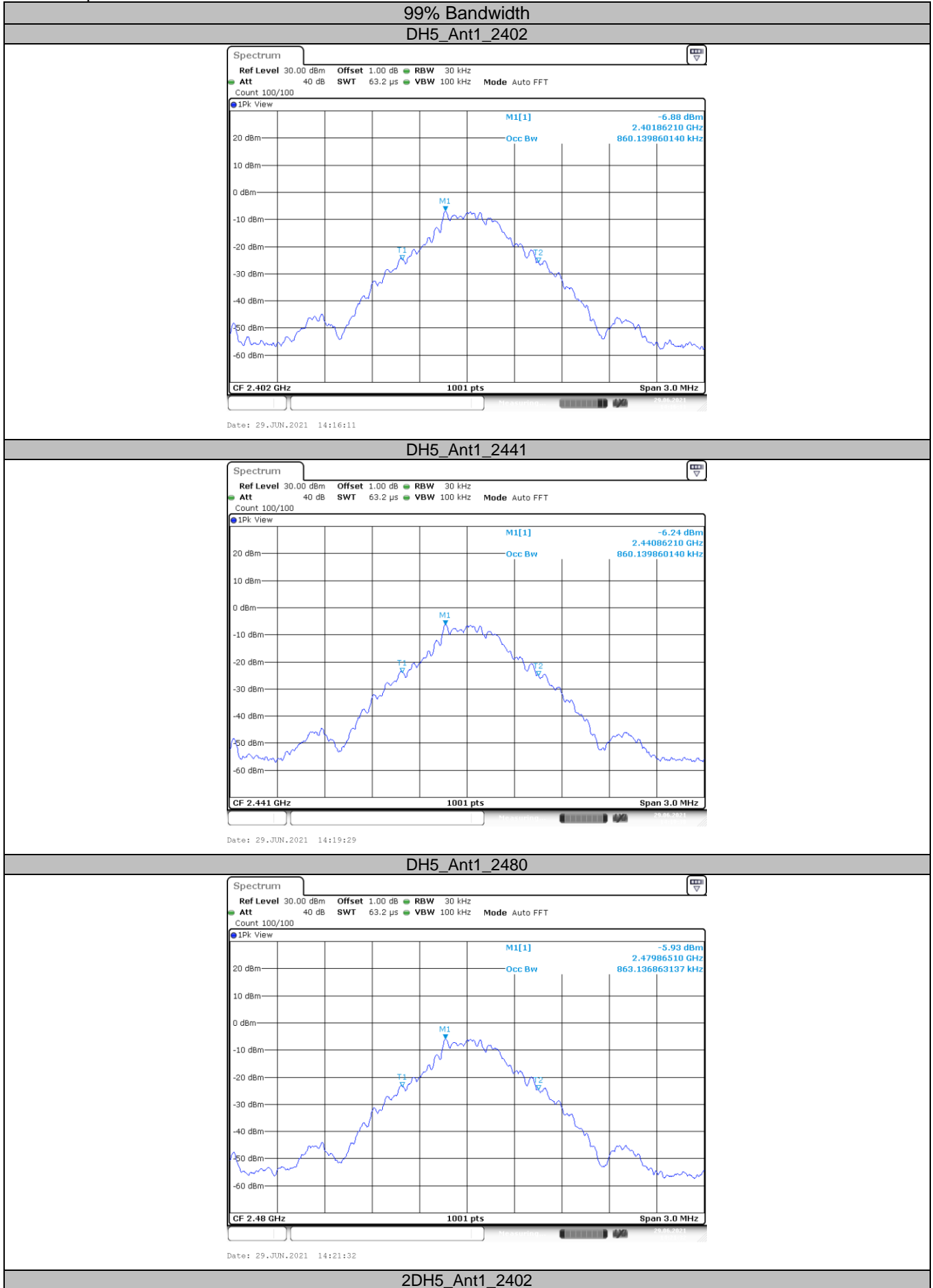
Please refer to the clause 2.3.

Test Result

| Modulation type | Channel | 99% Bandwidth (kHz) | 20dB Bandwidth (kHz) | 20dB Bandwidth *2/3 (kHz) |
|-----------------|---------|---------------------|----------------------|---------------------------|
| GFSK | 00 | 0.860 | 0.954 | 636.00 |
| | 39 | 0.860 | 0.954 | 636.00 |
| | 78 | 0.863 | 0.951 | 634.00 |
| $\pi/4$ -DQPSK | 00 | 1.169 | 1.287 | 858.00 |
| | 39 | 1.172 | 1.284 | 856.00 |
| | 78 | 1.169 | 1.287 | 858.00 |
| 8-DPSK | 00 | 1.172 | 1.290 | 860.00 |
| | 39 | 1.172 | 1.293 | 862.00 |
| | 78 | 1.172 | 1.293 | 862.00 |



Test Graphs:

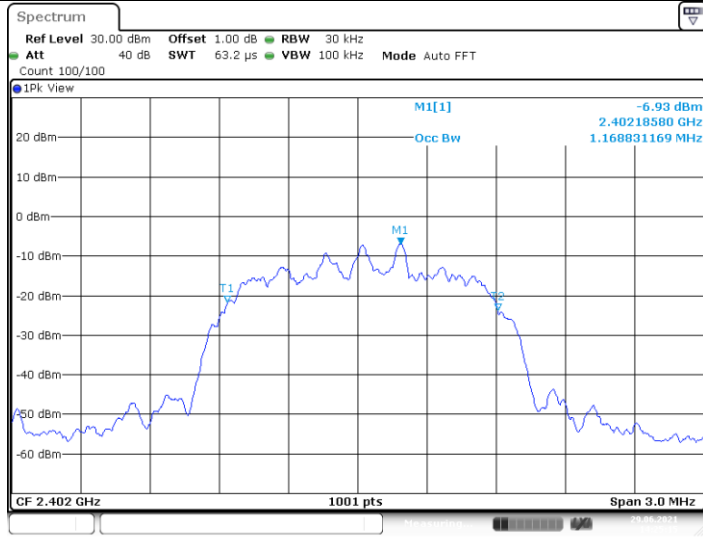


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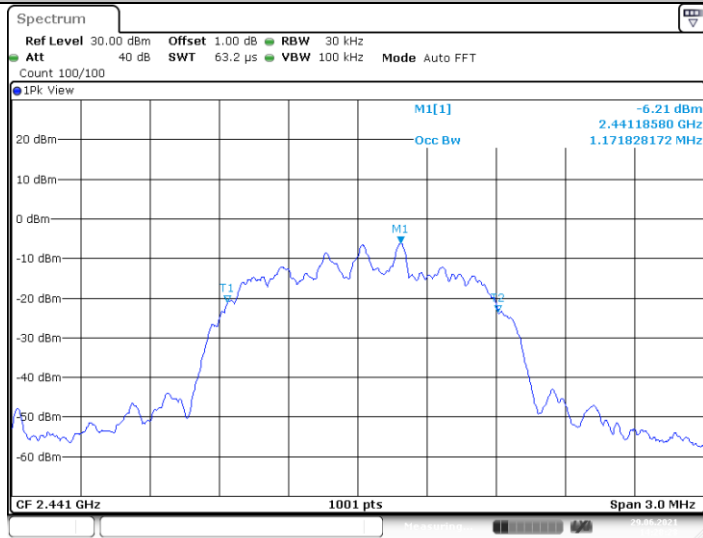


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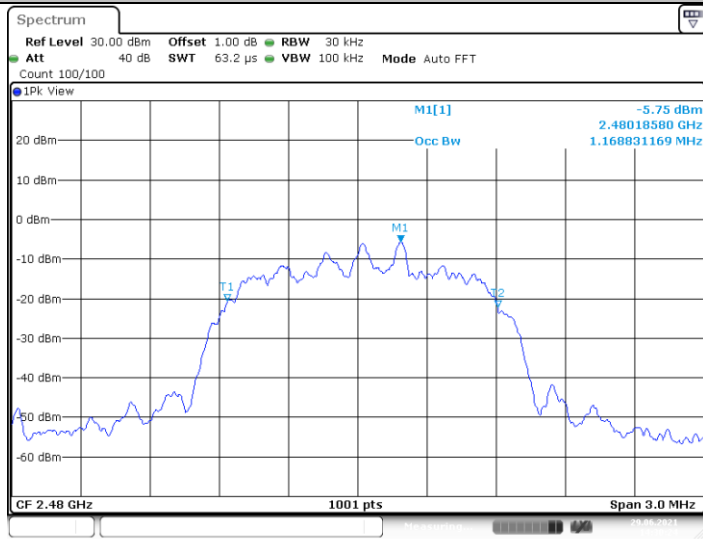
Date: 29 JUN 2021 14:25:16

2DH5_Ant1_2441



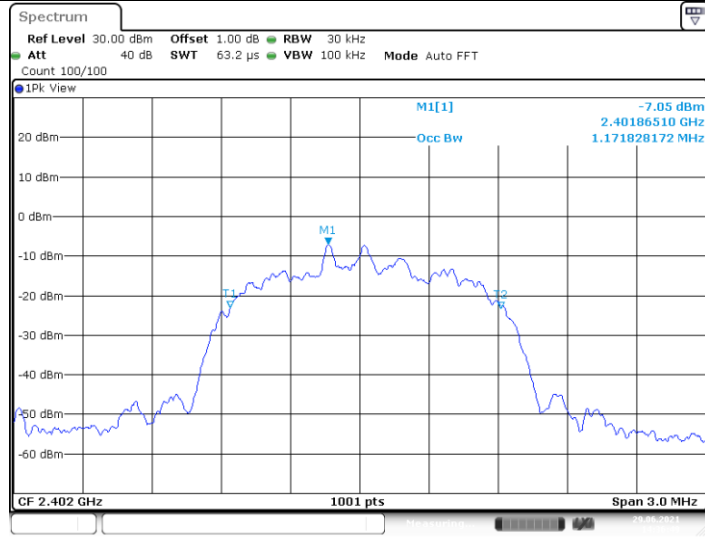
Date: 29 JUN 2021 14:28:28

2DH5_Ant1_2480



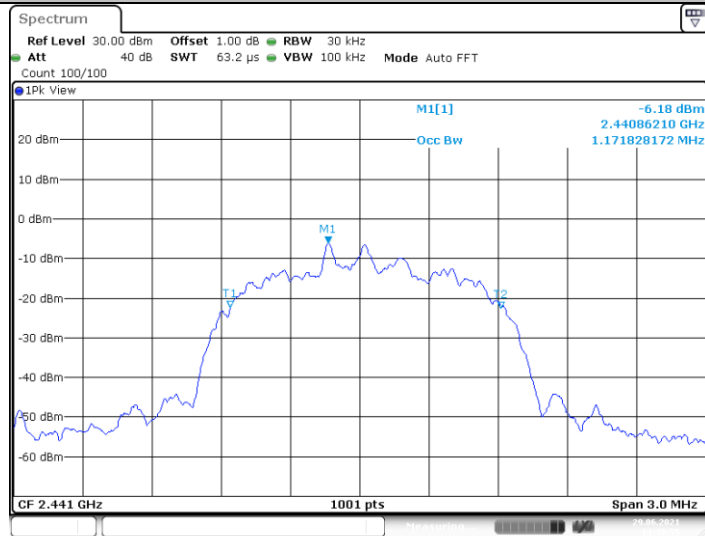
Date: 29 JUN 2021 14:30:23

3DH5_Ant1_2402



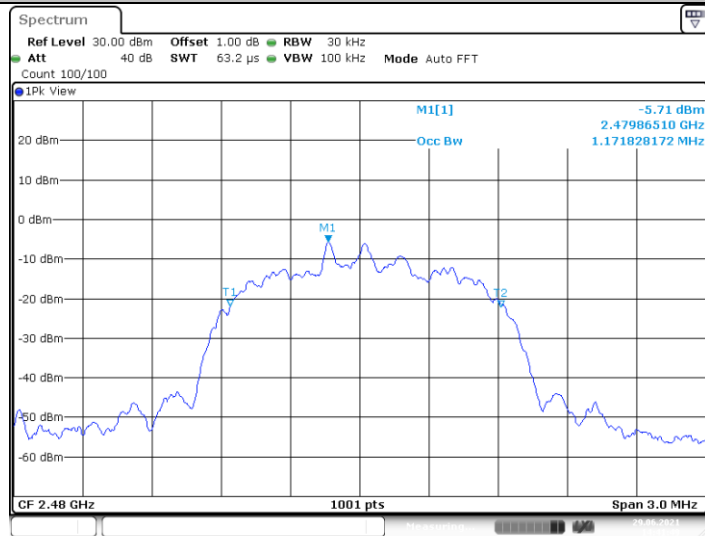
Date: 29 JUN 2021 14:36:49

3DH5_Ant1_2441



Date: 29 JUN 2021 14:39:55

3DH5_Ant1_2480



Date: 29 JUN 2021 14:41:48

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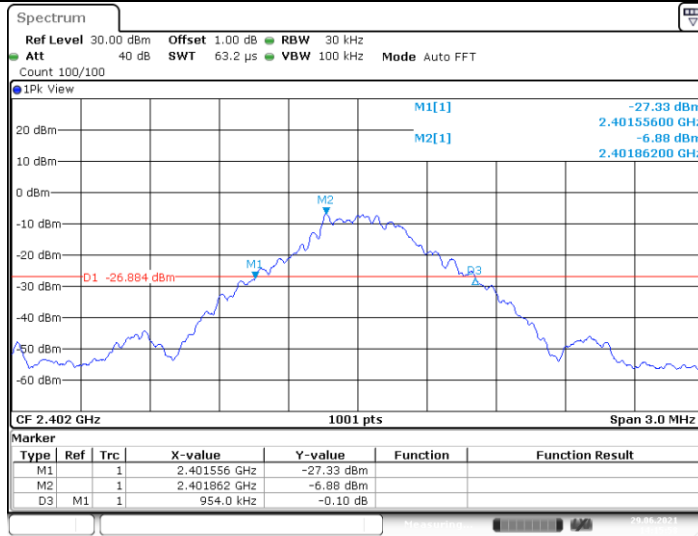
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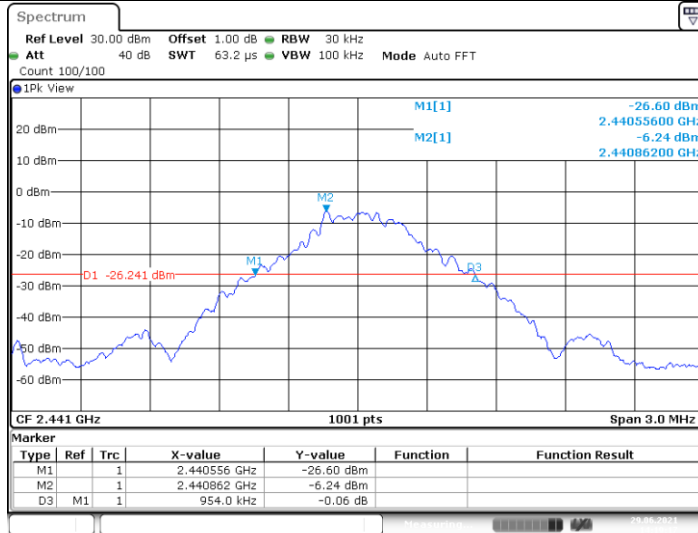


20dB Bandwidth
DH5_Ant1_2402



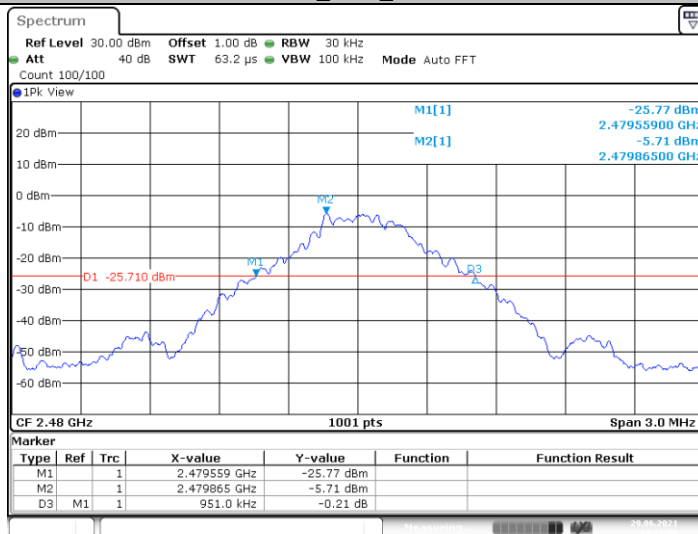
Date: 29.JUN.2021 14:15:58

DH5_Ant1_2441



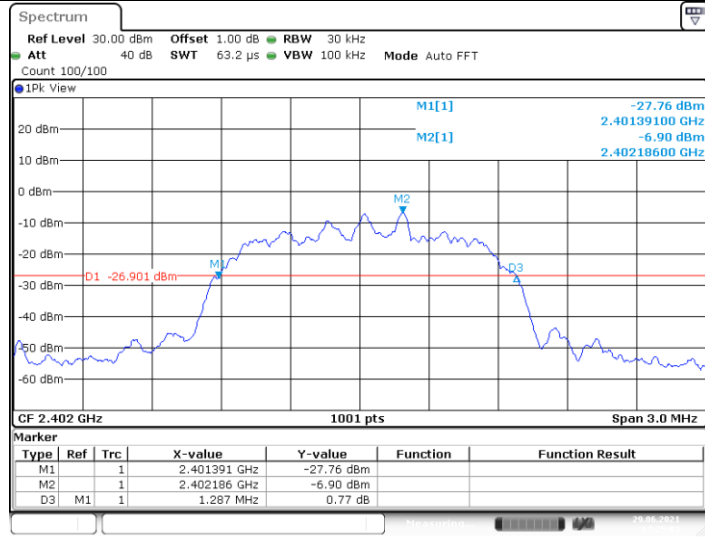
Date: 29.JUN.2021 14:19:16

DH5_Ant1_2480



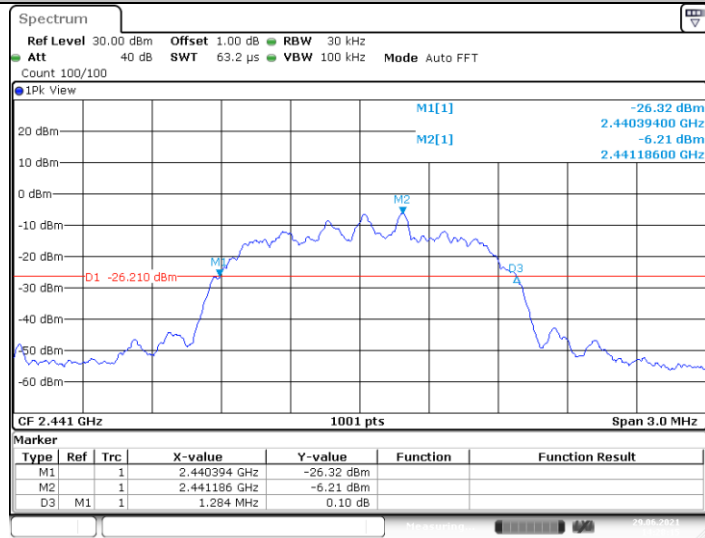
Date: 29.JUN.2021 14:21:19

2DH5_Ant1_2402



Date: 29 JUN 2021 14:25:03

2DH5_Ant1_2441



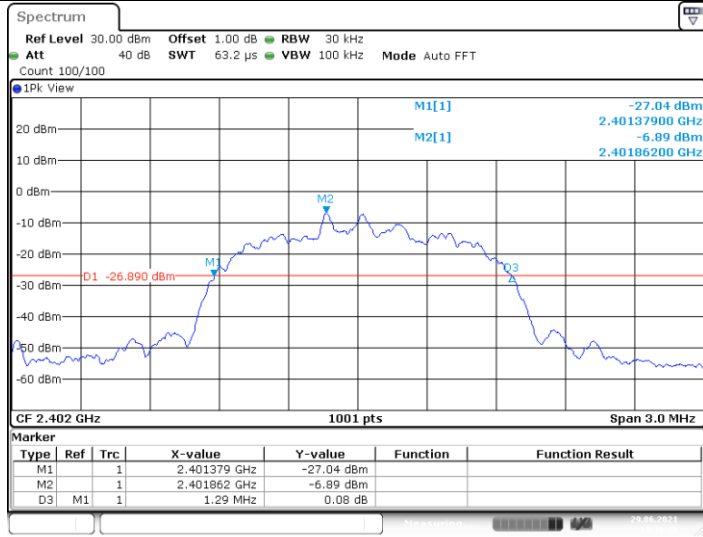
Date: 29 JUN 2021 14:28:15

2DH5_Ant1_2480



Date: 29 JUN 2021 14:30:10

3DH5_Ant1_2402



3DH5_Ant1_2441



3DH5_Ant1_2480





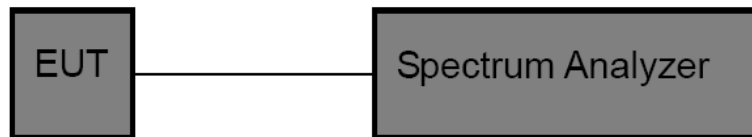
3.6. Channel Separation

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(1)/ RSS-247 5.1 b :

| Test Item | Limit | Frequency Range(MHz) |
|--------------------|---|----------------------|
| Channel Separation | >25kHz or >two-thirds of the 20 dB bandwidth Which is greater | 2400~2483.5 |

Test Configuration



Test Procedure

1. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.

2. Spectrum Setting:

- (1) Set RBW = 100 kHz.
- (2) Set the video bandwidth (VBW) ≥ 3 RBW.
- (3) Detector = Peak.
- (4) Trace mode = Max hold.
- (5) Sweep = Auto couple.

NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

Test Mode

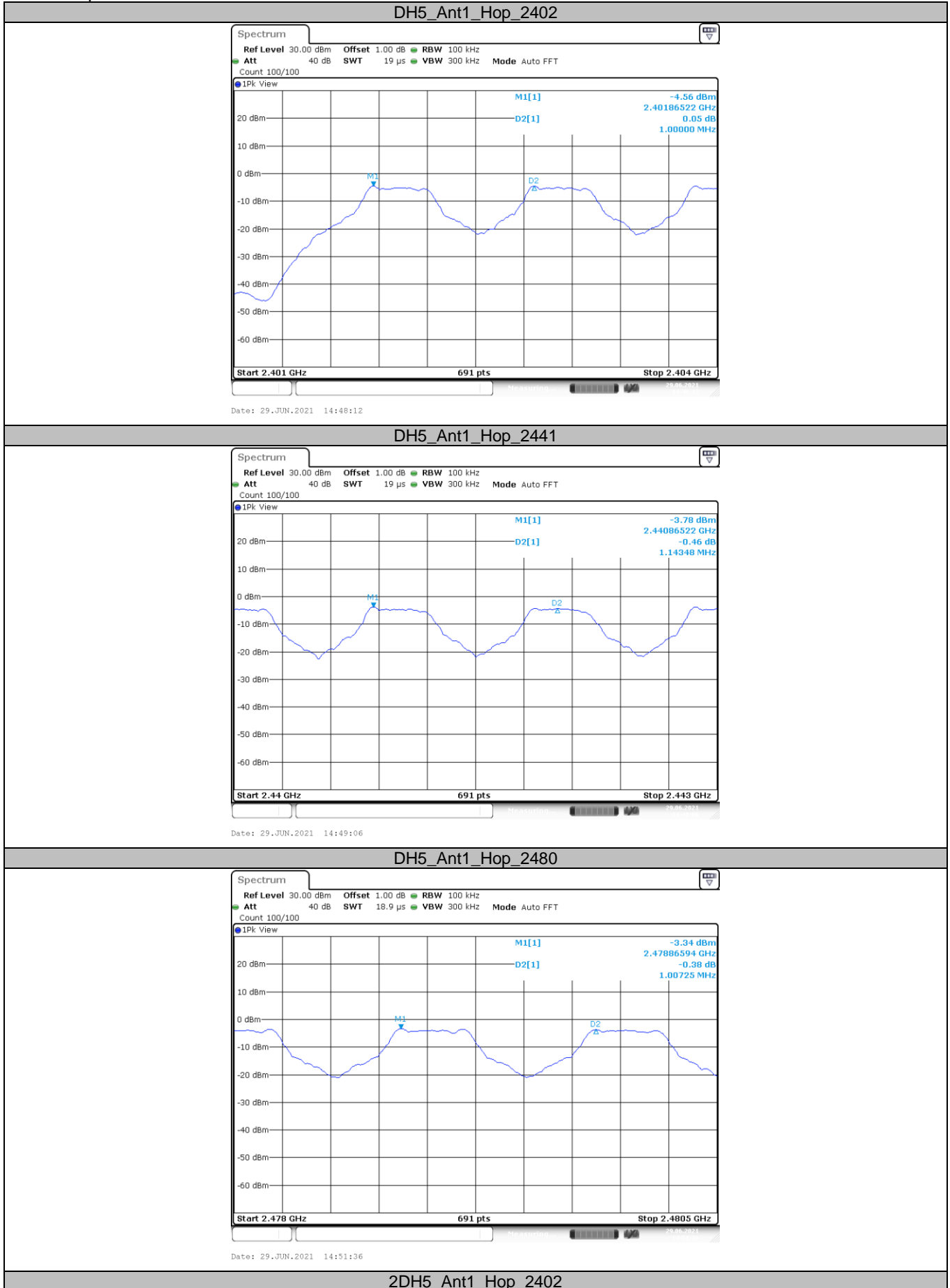
Please refer to the clause 2.3.

Test Result

| Modulation type | Channel | Carrier Frequencies Separation (MHz) | Limit (kHz) | Result |
|-----------------|---------|--------------------------------------|-------------|--------|
| GFSK | 00 | 1.000 | >636.00 | Pass |
| | 39 | 1.143 | >636.00 | |
| | 78 | 1.007 | >634.00 | |
| $\pi/4$ -DQPSK | 00 | 1.004 | >858.00 | Pass |
| | 39 | 1.000 | >856.00 | |
| | 78 | 1.004 | >858.00 | |
| 8-DPSK | 00 | 1.000 | >860.00 | Pass |
| | 39 | 1.143 | >862.00 | |
| | 78 | 1.000 | >862.00 | |

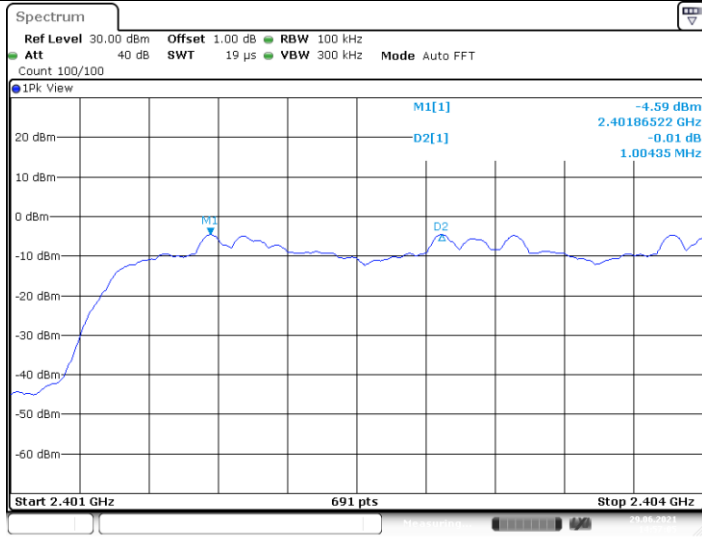


Test Graphs:



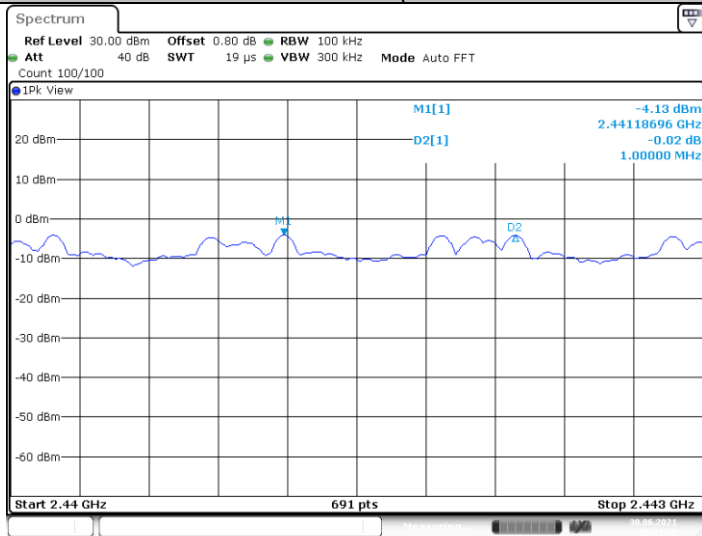
2DH5_Ant1_Hop_2402





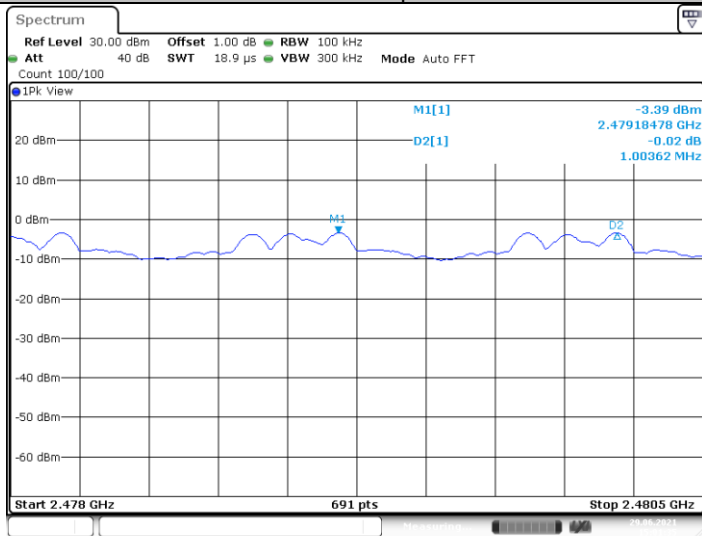
Date: 29 JUN.2021 14:57:05

2DH5_Ant1_Hop_2441



Date: 30 JUN.2021 10:41:49

2DH5_Ant1_Hop_2480



Date: 29 JUN.2021 15:01:35

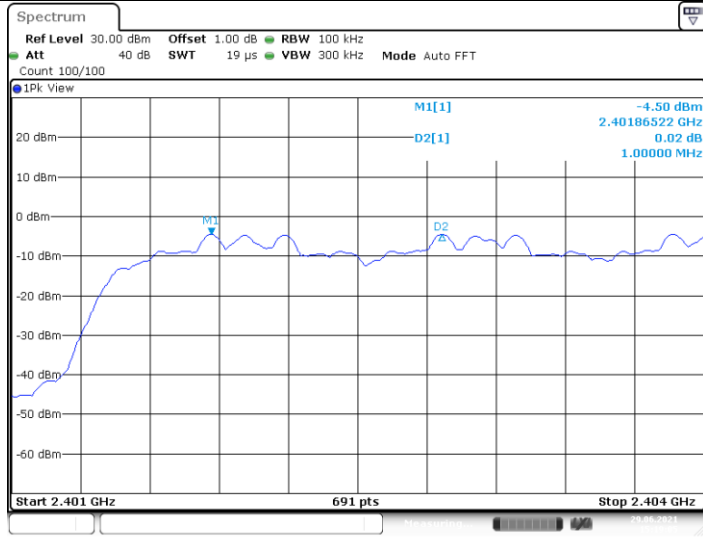
3DH5_Ant1_Hop_2402

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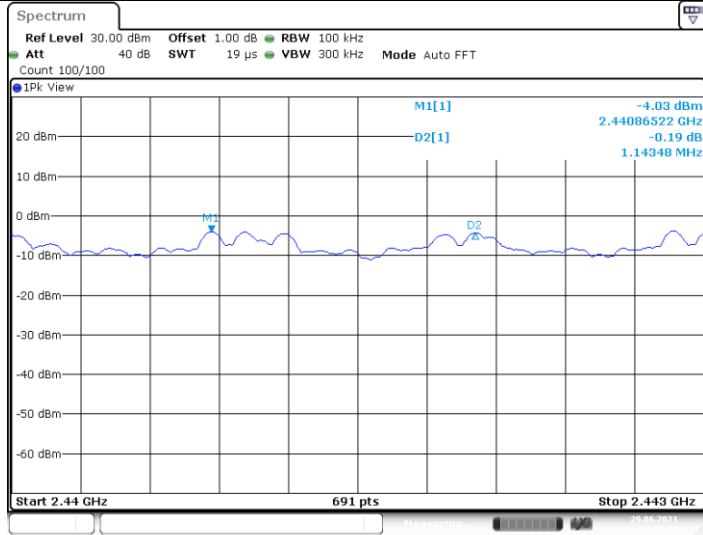


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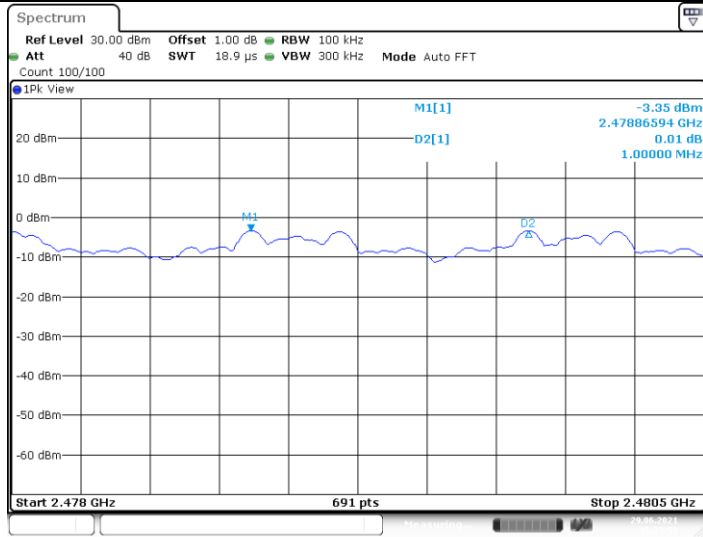
Date: 29 JUN 2021 15:19:05

3DH5_Ant1_Hop_2441



Date: 29 JUN 2021 15:10:44

3DH5_Ant1_Hop_2480



Date: 29 JUN 2021 15:23:59

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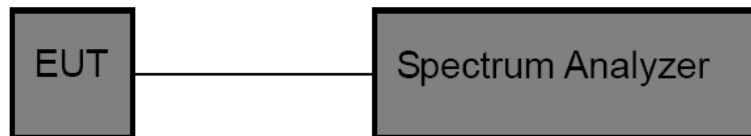
3.7. Number of Hopping Channel

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (a)(iii)/ RSS-247 5.1 d:

| Section | Test Item | Limit |
|---------------------------------|---------------------------|-------|
| 15.247 (a)(iii)/ RSS-247 5.1 d: | Number of Hopping Channel | >15 |

Test Configuration



Test Procedure

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- Spectrum Setting:
 - Peak Detector: RBW=100 kHz, VBW ≥ RBW, Sweep time= Auto.

Test Mode

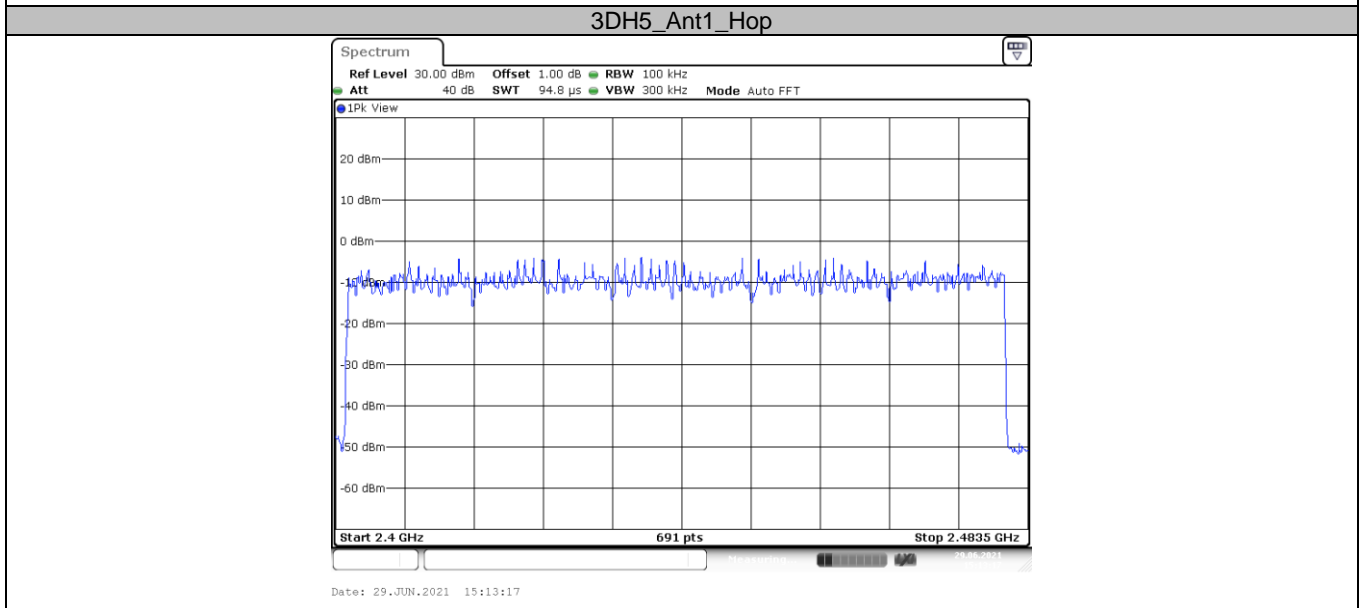
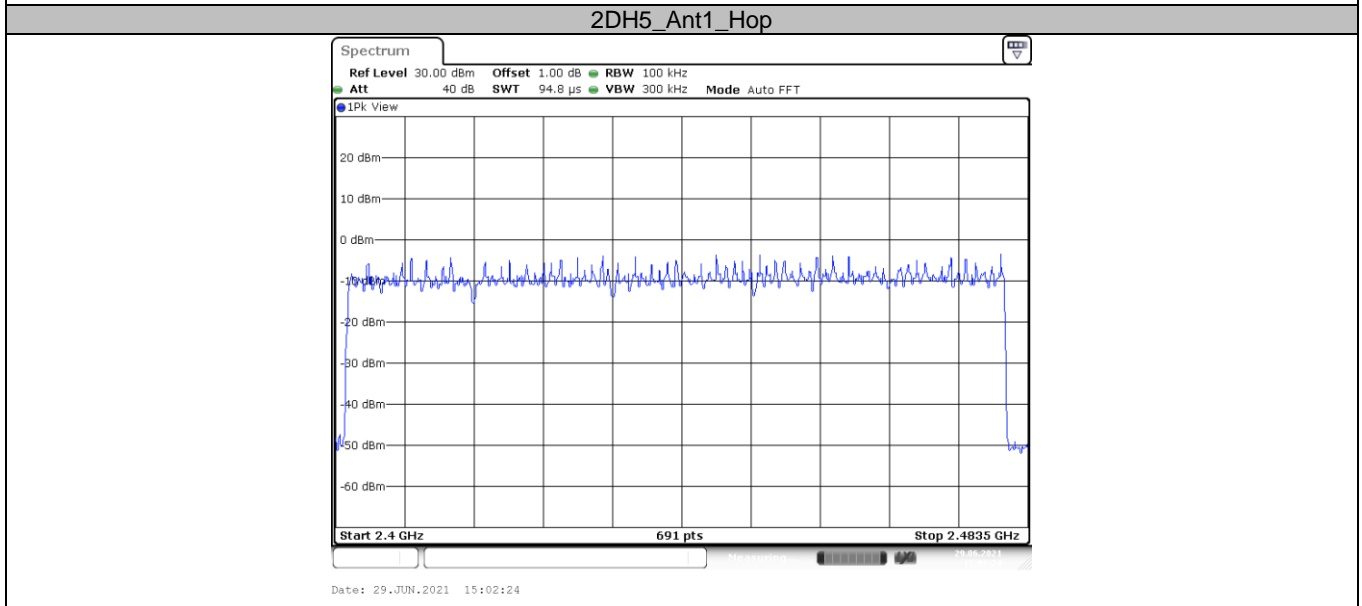
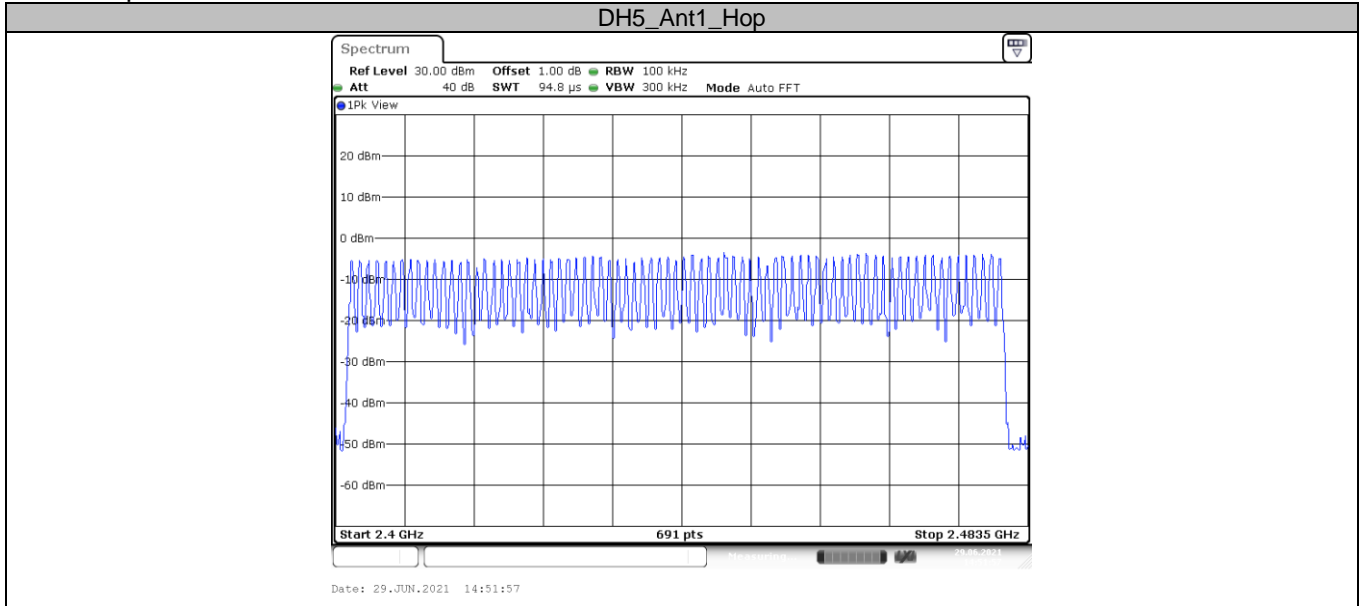
Please refer to the clause 2.3.

Test Result

| Modulation type | Channel number | Limit | Result |
|-----------------|----------------|-------|--------|
| GFSK | 79 | >15 | Pass |
| $\pi/4$ -DQPSK | 79 | | |
| 8DPSK | 79 | | |



Test Graphs:



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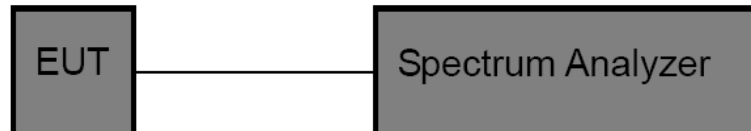


3.8. Dwell Time

Limit

| Section | Test Item | Limit |
|-------------------------------|---------------------------|---------|
| 15.247(a)(iii)/ RSS-247 5.1 d | Average Time of Occupancy | 0.4 sec |

Test Configuration



Test Procedure

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- Spectrum Setting:
 - Spectrum Setting: RBW=1MHz, VBW ≥ RBW.
 - Use video trigger with the trigger level set to enable triggering only on full pulses.
 - Sweep Time is more than once pulse time.
 - Set the center frequency on any frequency would be measure and set the frequency span to zero.
 - Measure the maximum time duration of one single pulse.
 - Set the EUT for packet transmitting.

Test Mode

Please refer to the clause 2.3.

Test Result

| Modulation type | Channel | Channel (MHz) | Pulse Time (ms) | Total of Dwell (ms) | Period Time (ms) | Limit (Second) | Result |
|-----------------|---------|---------------|-----------------|---------------------|------------------|----------------|--------|
| GFSK | DH1 | 2441 | 0.37 | 118.40 | 31.60 | < 0.40 | Pass |
| | DH3 | 2441 | 1.63 | 260.80 | 31.60 | | |
| | DH5 | 2441 | 2.87 | 306.13 | 31.60 | | |
| π/4-DQPSK | 2DH1 | 2441 | 0.38 | 121.60 | 31.60 | < 0.40 | Pass |
| | 2DH3 | 2441 | 1.63 | 260.80 | 31.60 | | |
| | 2DH5 | 2441 | 2.88 | 307.20 | 31.60 | | |
| 8-DPSK | 3DH1 | 2441 | 0.38 | 121.60 | 31.60 | < 0.40 | Pass |
| | 3DH3 | 2441 | 1.63 | 260.80 | 31.60 | | |
| | 3DH5 | 2441 | 2.88 | 307.20 | 31.60 | | |

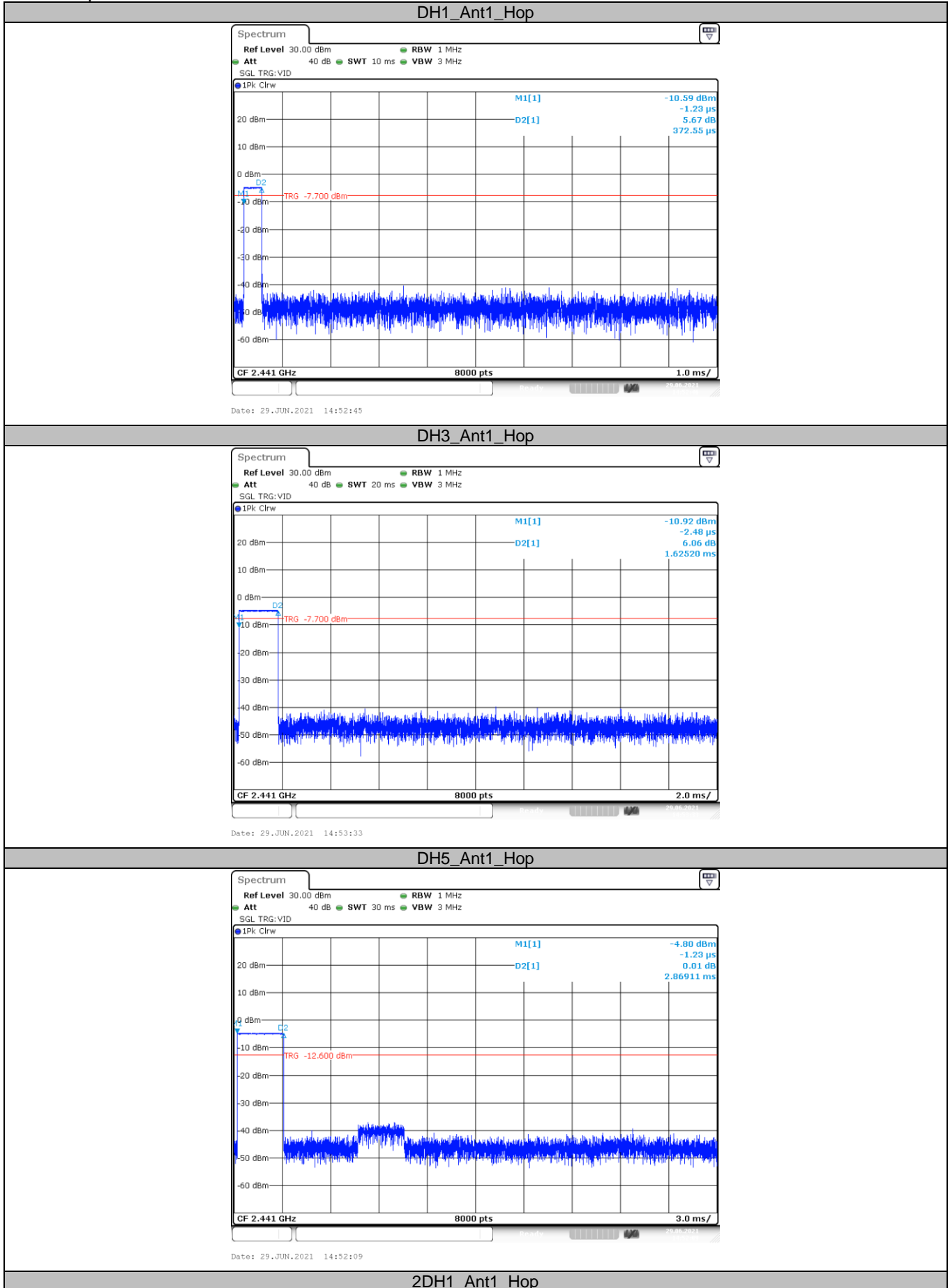
Note: 1DH1/2DH1/3DH1 Total of Dwell= Pulse Time*(1600/2)*31.6/79

1DH3/2DH3/3DH3 Total of Dwell= Pulse Time*(1600/4)*31.6/79

1DH5/2DH5/3DH5 Total of Dwell= Pulse Time*(1600/6)*31.6/79



Test Graphs:

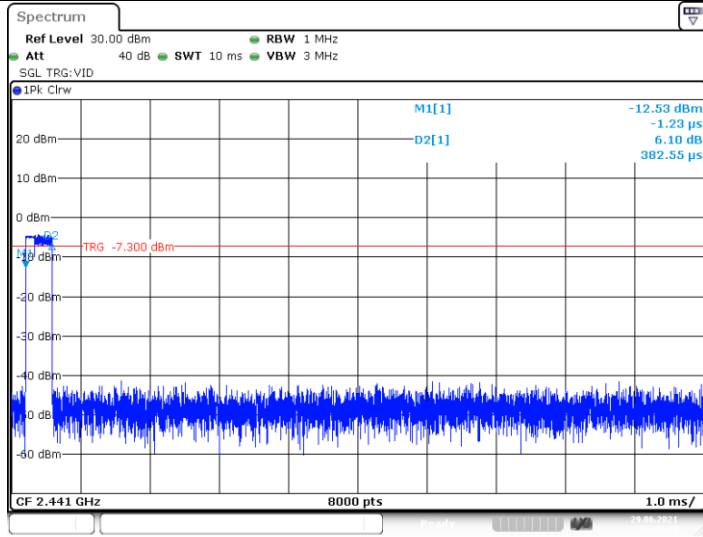


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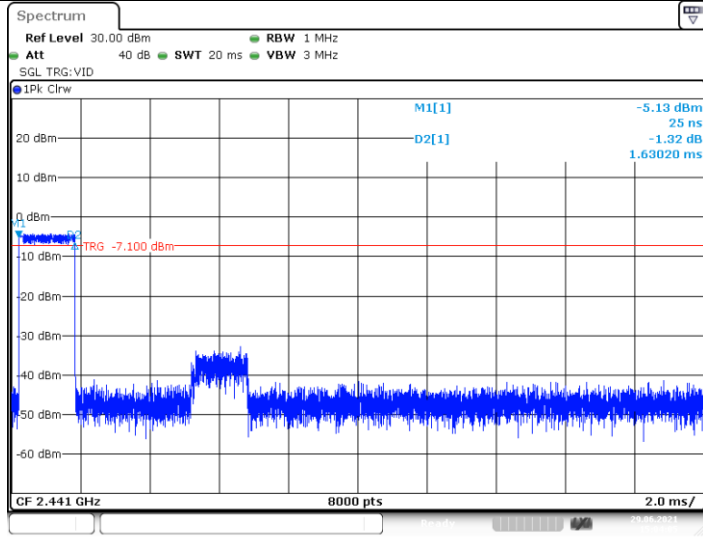


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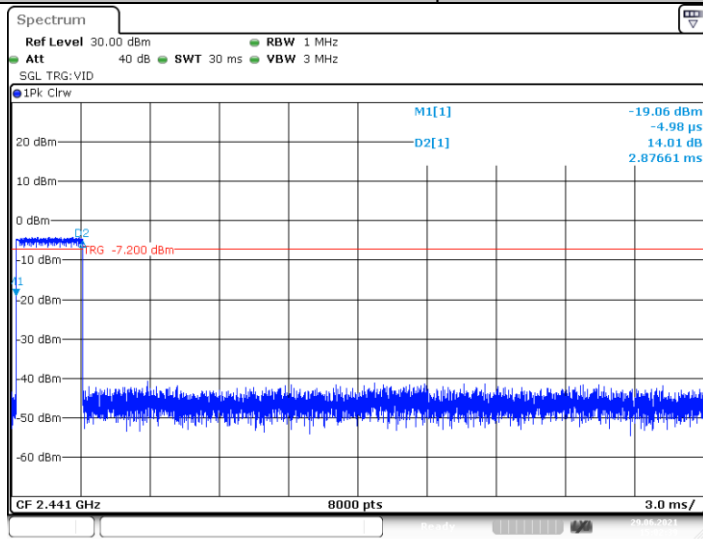
Date: 29 JUN 2021 15:03:23

2DH3_Ant1_Hop



Date: 29 JUN 2021 15:04:04

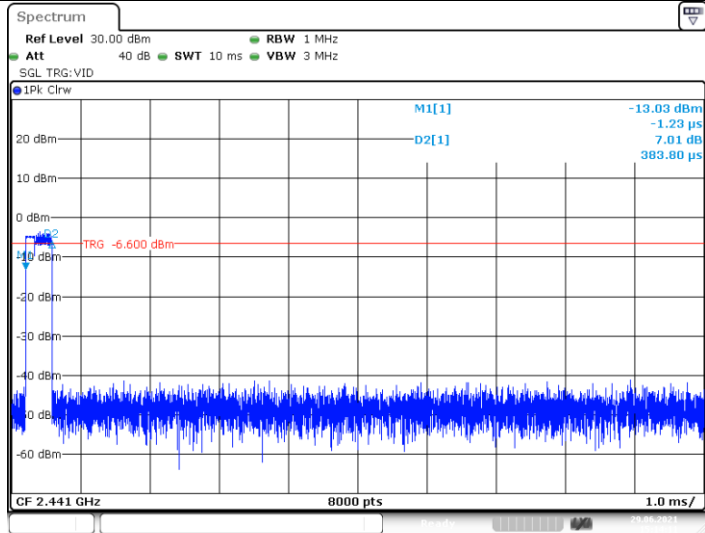
2DH5_Ant1_Hop



Date: 29 JUN 2021 15:02:38

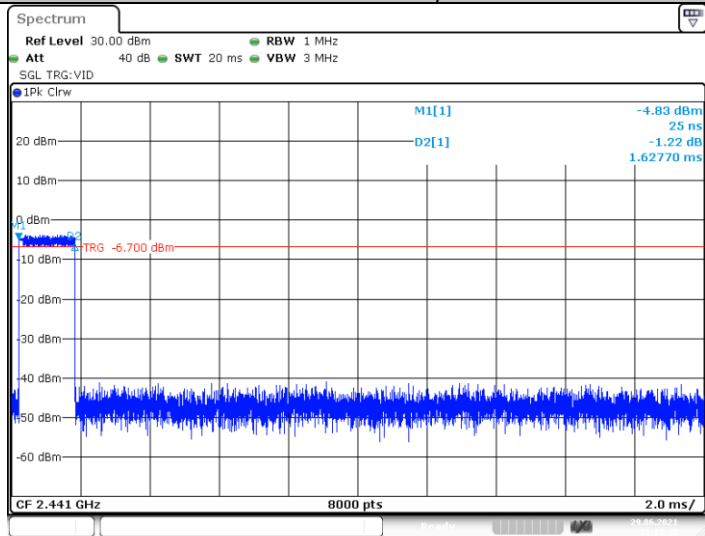
3DH1_Ant1_Hop





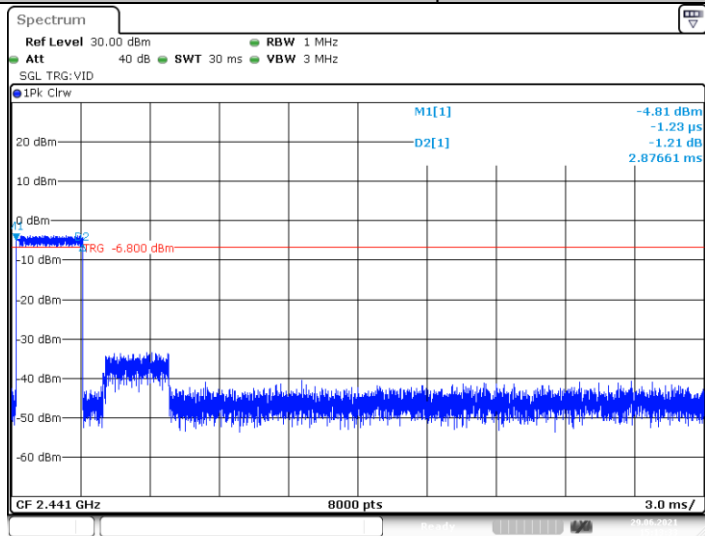
Date: 29.JUN.2021 15:14:11

3DH3_Ant1_Hop



Date: 29.JUN.2021 15:14:45

3DH5_Ant1_Hop



Date: 29.JUN.2021 15:13:32

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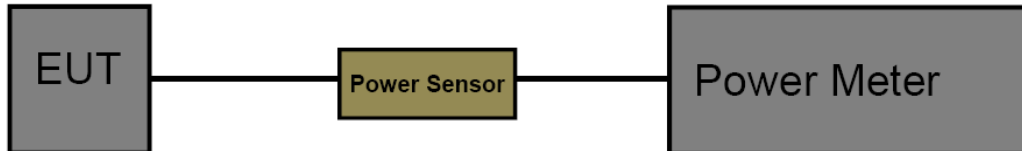
3.9. Peak Output Power

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (b)(1) / RSS-247 5.4 b:

| Test Item | Limit | Frequency Range(MHz) |
|-------------------|---|----------------------|
| Peak Output Power | Hopping Channels>75 Power<1W(30dBm) Other <125mW(21dBm) | 2400~2483.5 |

Test Configuration



Test Procedure

1. The maximum conducted output power may be measured using a broadband Peak RF power meter.
2. Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor.
3. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter.
4. Record the measurement data.

Test Mode

Please refer to the clause 2.3.

Test Result

| Modulation type | Channel | Output power (dBm) | Limit (dBm) | Result |
|-----------------|---------|--------------------|-------------|--------|
| GFSK | 00 | -4.39 | < 21.00 | Pass |
| | 39 | -3.64 | | |
| | 78 | -3.20 | | |
| $\pi/4$ -DQPSK | 00 | -3.54 | < 21.00 | Pass |
| | 39 | -2.80 | | |
| | 78 | -2.38 | | |
| 8-DPSK | 00 | -3.40 | < 21.00 | Pass |
| | 39 | -2.54 | | |
| | 78 | -1.89 | | |



3.10. Antenna Requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C Section 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 antenna that uses a unique coupling to the intentional radiator, 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.

FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.

*****THE END*****