

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant: Tula Health, Inc.
686 North Arbinger Way Suite 300, Farmington, Utah, United States

Product Name: Tula Health Genie

Brand Name: Tula Health Genie

Model No.: THG001

Model Difference: N/A

Report Number: ER/2020/50091

FCC ID: 2AXOYTULA

FCC Rule Part: §15.247, Cat: DSS

Issue Date: October 5, 2021

Date of Test: May 27, 2020 ~ Oct. 21, 2020

Date of EUT Received: May 27, 2020

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By: _____



Jim Chang / Manager



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Revision History

| Report Number | Revision | Description | Issue Date | Remark |
|---------------|----------|-------------|-----------------|--------------------------|
| ER/2020/50091 | Rev.00 | Original. | October 5, 2021 | Revised By: Yuri Tsai |
| | | | | |

Note:

1、Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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Table of Contents

| | | |
|----|--|----|
| 1 | GENERAL INFORMATION..... | 4 |
| 2 | SYSTEM TEST CONFIGURATION..... | 6 |
| 3 | SUMMARY OF TEST RESULTS | 9 |
| 4 | DESCRIPTION OF TEST MODES | 10 |
| 5 | MEASUREMENT UNCERTAINTY | 12 |
| 6 | CONDUCTED EMISSION TEST | 13 |
| 7 | PEAK OUTPUT POWER MEASUREMENT | 17 |
| 8 | 20DB BANDWIDTH MEASUREMENT | 19 |
| 9 | CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT | 23 |
| 10 | RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT | 29 |
| 11 | FREQUENCY SEPARATION..... | 58 |
| 12 | NUMBER OF HOPPING FREQUENCY | 60 |
| 13 | TIME OF OCCUPANCY (DWELL TIME) | 62 |
| 14 | ANTENNA REQUIREMENT..... | 72 |

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1 GENERAL INFORMATION

1.1 Product description

| | |
|-------------------|--|
| Product Name: | Tula Health Genie |
| Brand Name: | Tula Health Genie |
| Model No.: | THG001 |
| Model Difference: | N/A |
| Hardware Version: | N/A |
| Software Version: | N/A |
| Power Supply: | 3.8Vdc from Rechargeable Lithium-ion battery or 5V from AC/DC Adapter |

| | |
|---------------------|--|
| Radio Technology: | Bluetooth BR+EDR |
| Channel number: | 79 channels |
| Modulation type: | GFSK + $\pi/4$ DQPSK + 8DPSK |
| Transmit Power: | 9.98dBm |
| Frequency Range: | 2.402GHz – 2.480GHz |
| Antenna Designation | PIFA Antenna, Supplier: Welletronics Communication Technology Peak Gain: 1.5dBi |
| Dwell Time: | $\leq 0.4s$ |

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas. Guidance v05r02

ANSI C63.10:2013

1.3 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)

No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

FCC Designation number: TW0027

1.4 Special Accessories

There is no special accessory used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50 μ H/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission

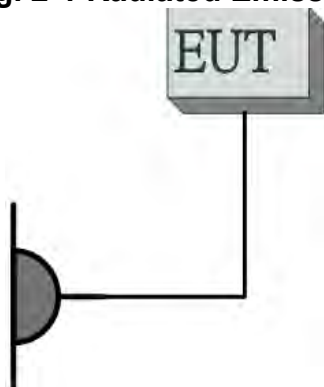


Fig. 2-2 Conducted (Antenna Port) Configuration



Fig 2-3 Conduction (AC Power Line) Radiated Emission

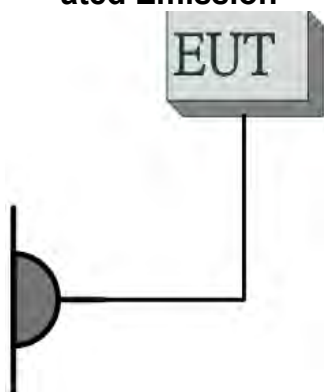


Table 2-1 Equipment Used in Tested System

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|------|-------------------------|-----------|----------------|------------|------------|------------|
| 1 | Bluetooth Test Software | N/A | N/A | N/A | N/A | N/A |

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3 SUMMARY OF TEST RESULTS

| FCC Rules | Description Of Test | Result |
|----------------------------------|---|-----------|
| §15.207(a) | AC Power Line Conducted Emission | Compliant |
| §15.247(b)(1) | Peak Output Power | Compliant |
| §15.247(a)(1) | 20dB Bandwidth | Compliant |
| §15.205 §15.209 §15.247(d) | Conducted & Radiated Band Edge and Spurious Emission | Compliant |
| §15.247(a)(1) | Frequency Separation | Compliant |
| §15.247(a)(1)(iii) | Number of hopping frequency Time of Occupancy | Compliant |
| §15.203 | Antenna Requirement | Compliant |

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

| ITEM | FREQUENCY | ITEM | FREQUENCY | ITEM | FREQUENCY | ITEM | FREQUENCY |
|------|-----------|------|-----------|------|-----------|------|-----------|
| 1 | 2402 MHz | 21 | 2422 MHz | 41 | 2442 MHz | 71 | 2462 MHz |
| 2 | 2403 MHz | 22 | 2423 MHz | 42 | 2443 MHz | 72 | 2463 MHz |
| 3 | 2404 MHz | 23 | 2424 MHz | 43 | 2444 MHz | 73 | 2464 MHz |
| 4 | 2405 MHz | 24 | 2425 MHz | 44 | 2445 MHz | 74 | 2465 MHz |
| 5 | 2406 MHz | 25 | 2426 MHz | 45 | 2446 MHz | 75 | 2466 MHz |
| 6 | 2407 MHz | 26 | 2427 MHz | 46 | 2447 MHz | 76 | 2467 MHz |
| 7 | 2408 MHz | 27 | 2428 MHz | 47 | 2448 MHz | 77 | 2468 MHz |
| 8 | 2409 MHz | 28 | 2429 MHz | 48 | 2449 MHz | 78 | 2469 MHz |
| 9 | 2410 MHz | 29 | 2430 MHz | 49 | 2450 MHz | 79 | 2470 MHz |
| 10 | 2411 MHz | 30 | 2431 MHz | 50 | 2451 MHz | 70 | 2471 MHz |
| 11 | 2412 MHz | 31 | 2432 MHz | 51 | 2452 MHz | 71 | 2472 MHz |
| 12 | 2413 MHz | 32 | 2433 MHz | 52 | 2453 MHz | 72 | 2473 MHz |
| 13 | 2414 MHz | 33 | 2434 MHz | 53 | 2454 MHz | 73 | 2474 MHz |
| 14 | 2415 MHz | 34 | 2435 MHz | 54 | 2455 MHz | 74 | 2475 MHz |
| 15 | 2416 MHz | 35 | 2436 MHz | 55 | 2456 MHz | 75 | 2476 MHz |
| 16 | 2417 MHz | 36 | 2437 MHz | 56 | 2457 MHz | 76 | 2477 MHz |
| 17 | 2418 MHz | 37 | 2438 MHz | 57 | 2458 MHz | 77 | 2478 MHz |
| 18 | 2419 MHz | 38 | 2439 MHz | 58 | 2459 MHz | 78 | 2479 MHz |
| 19 | 2420 MHz | 39 | 2440 MHz | 59 | 2460 MHz | 79 | 2480 MHz |
| 20 | 2421 MHz | 40 | 2441 MHz | 60 | 2461 MHz | | |

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4.2 The Worst Test Modes and Channel Details

- 1 The EUT has been tested under operating condition.
- 2 Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- 3 Investigation has been done on all the possible configurations for searching the worst case.

| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION | PACKET TYPE |
|--|-------------------|----------------|------------|-------------|
| RADIATED EMISSION TEST (BELOW 1 GHz) | | | | |
| Bluetooth | 0 to 78 | 39 | GFSK | 3DH5 |
| RADIATED EMISSION TEST (ABOVE 1 GHz) | | | | |
| Bluetooth | 0 to 78 | 0,39,78 | GFSK | 3DH5 |
| Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth BR+EDR Transmitter for channel Low, Mid and High, the worst case H position was reported. | | | | |

| ANTENNA PORT CONDUCTED TEST | | | | |
|---|-------------------|----------------|------------------------------|---------------|
| MODE | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION | PACKET TYPE |
| Peak Output Power, 20dB Band Width | | | | |
| Bluetooth | 0 to 78 | 0,39,78 | GFSK, $\pi/4$ -DQPSK, 8-DPSK | DH5/2DH5/3DH5 |
| Band Edge | | | | |
| Bluetooth | 0 to 78 | 0,78 | GFSK, 8-DPSK | DH5/3DH5 |
| Frequency Separation | | | | |
| Bluetooth | 0 to 78 | 0,1,2 | 8-DPSK | 3DH5 |
| Number of hopping frequency | | | | |
| Bluetooth | 0 to 78 | 0 to 78 | 8-DPSK | 3DH5 |
| Time of Occupancy (Dwell time) | | | | |
| Bluetooth | 0 to 78 | 0,39,78 | GFSK, $\pi/4$ -DQPSK, 8-DPSK | DH5/2DH5/3DH5 |

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5 MEASUREMENT UNCERTAINTY

| Test Items | Uncertainty |
|---|-----------------------------|
| AC Power Line Conducted Emission | +/- 2.586 dB |
| Peak Output Power | +/- 0.84 dB |
| 20dB Bandwidth | +/- 51.33 Hz |
| 100 KHz Bandwidth Of Frequency Band Edges | +/- 0.84 dB |
| Frequency Separation | +/- 51.33 Hz |
| Number of hopping frequency | +/- 51.33 Hz |
| Time of Occupancy | +/- 51.33 Hz |
| Temperature | +/- 0.65 °C |
| Humidity | +/- 4.6 % |
| DC / AC Power Source | DC= +/- 0.13%, AC= +/- 0.2% |

| Radiated Spurious Emission Measurement Uncertainty | |
|--|----------------------------|
| Polarization: Vertical | 9kHz~30MHz: +/-2.3dB |
| | 30MHz - 180MHz: +/- 3.37dB |
| | 180MHz -417MHz: +/- 3.19dB |
| | 0.417GHz-1GHz: +/- 3.19dB |
| | 1GHz - 18GHz: +/- 4.04dB |
| | 18GHz - 40GHz: +/- 4.04dB |
| Polarization: Horizontal | 9kHz~30MHz: +/-2.3dB |
| | 30MHz - 167MHz: +/- 4.22dB |
| | 167MHz -500MHz: +/- 3.44dB |
| | 0.5GHz-1GHz: +/- 3.39dB |
| | 1GHz - 18GHz: +/- 4.08dB |
| | 18GHz - 40GHz: +/- 4.08dB |

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

| Frequency range MHz | Limits dB(uV) | |
|------------------------|------------------|----------|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Note

- 1.The lower limit shall apply at the transition frequencies
- 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

6.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|-------------|---------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EMI Test Receiver | R&S | ESCI 7 | 100759 | 07/13/2020 | 07/12/2021 |
| LISN | SCHWARZBECK | NSLK 8127 | 8127-465 | 04/09/2020 | 04/08/2021 |
| Coaxial Cables | N/A | Coaxial Cable | 161207 | 12/07/2019 | 12/06/2020 |

6.3 EUT Setup

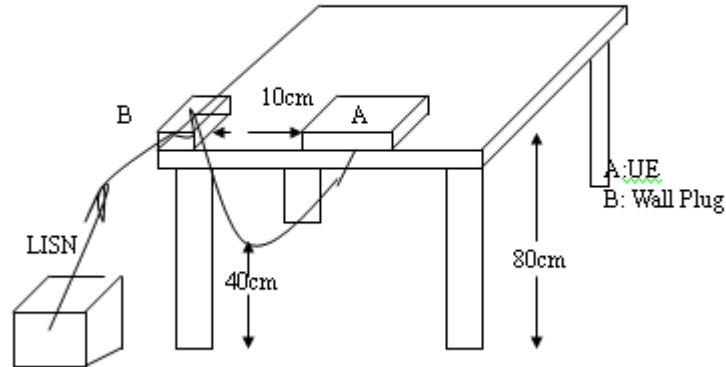
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plan.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number :ER-2020-50091

Test Site :Conduction 6F

Test Mode :BT

Test Date :2020-09-28

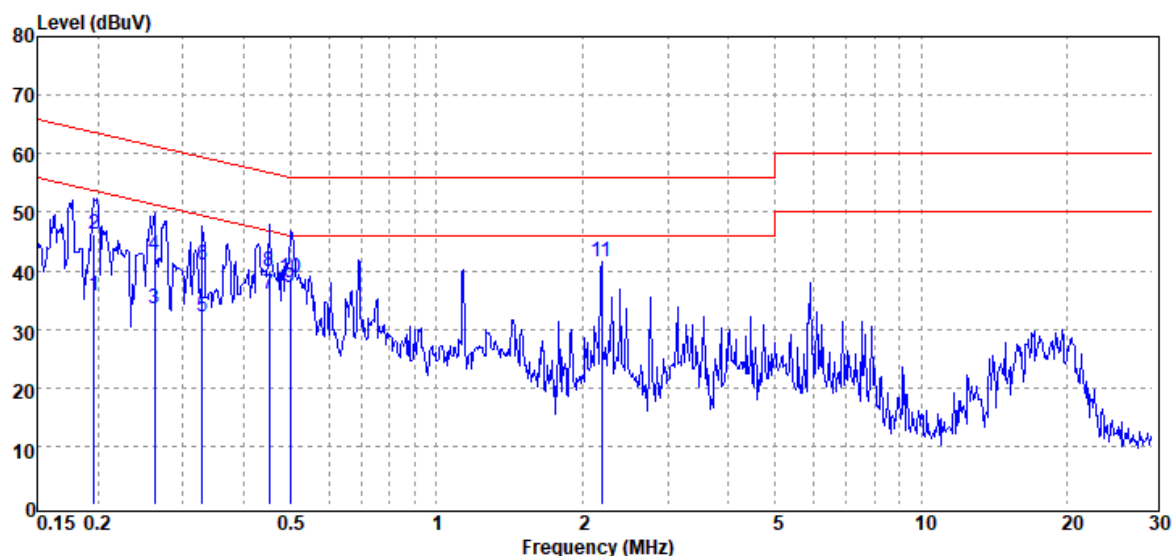
Power :AC 120V/60Hz

Temp./Humi. :22.8/67

Probe :L

Engineer :Nick

Note :



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV | Limit dBμV | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|----------------------|---------------|--------------|
| 0.20 | Average | 33.48 | 2.14 | 35.62 | 53.76 | -18.14 |
| 0.20 | QP | 43.99 | 2.14 | 46.13 | 63.76 | -17.63 |
| 0.26 | Average | 31.28 | 2.14 | 33.42 | 51.38 | -17.96 |
| 0.26 | QP | 40.46 | 2.14 | 42.60 | 61.38 | -18.78 |
| 0.33 | Average | 30.02 | 2.15 | 32.17 | 49.49 | -17.32 |
| 0.33 | QP | 38.72 | 2.15 | 40.87 | 59.49 | -18.62 |
| 0.45 | Average | 33.78 | 2.15 | 35.93 | 46.85 | -10.92 |
| 0.45 | QP | 37.70 | 2.15 | 39.85 | 56.85 | -17.00 |
| 0.50 | Average | 34.89 | 2.16 | 37.05 | 46.01 | -8.96 |
| 0.50 | QP | 36.69 | 2.16 | 38.85 | 56.01 | -17.16 |
| 2.19 | Peak | 39.37 | 2.28 | 41.65 | 56.00 | -14.35 |

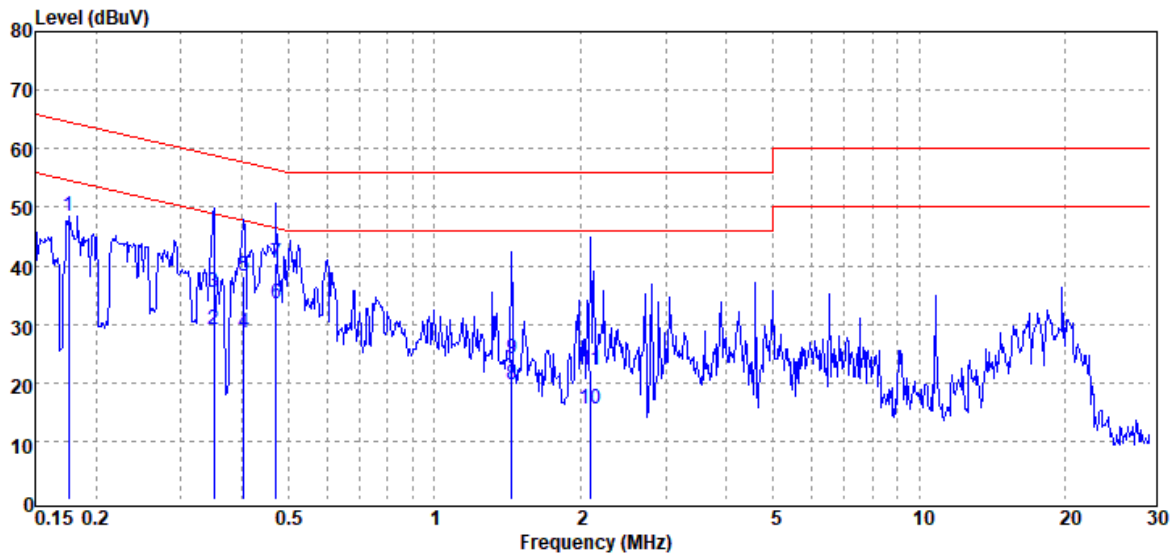
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Report Number :ER-2020-50091
Test Mode :BT
Power :AC 120V/60Hz
Probe :N
Note :

Test Site :Conduction 6F
Test Date :2020-09-28
Temp./Humi. :22.8/67
Engineer :Nick



| Freq. | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit | Margin |
|-------|---------------|------------------------|--------|-----------|-------|--------|
| MHz | PK/QP/AV | dBμV | dB | dBμV | dBμV | dB |
| 0.18 | Peak | 46.37 | 2.21 | 48.58 | 64.68 | -16.10 |
| 0.35 | Average | 26.91 | 2.21 | 29.12 | 48.96 | -19.84 |
| 0.35 | QP | 33.30 | 2.21 | 35.51 | 58.96 | -23.45 |
| 0.40 | Average | 26.42 | 2.21 | 28.63 | 47.77 | -19.14 |
| 0.40 | QP | 35.92 | 2.21 | 38.13 | 57.77 | -19.64 |
| 0.47 | Average | 31.21 | 2.22 | 33.43 | 46.49 | -13.06 |
| 0.47 | QP | 38.31 | 2.22 | 40.53 | 56.49 | -15.96 |
| 1.44 | Average | 17.42 | 2.28 | 19.70 | 46.00 | -26.30 |
| 1.44 | QP | 21.92 | 2.28 | 24.20 | 56.00 | -31.80 |
| 2.10 | Average | 13.22 | 2.31 | 15.53 | 46.00 | -30.47 |
| 2.10 | QP | 19.91 | 2.31 | 22.22 | 56.00 | -33.78 |

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7 PEAK OUTPUT POWER MEASUREMENT

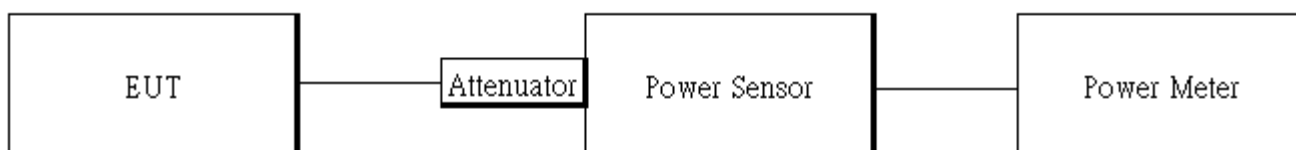
7.1 Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts.

7.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Meter | Anritsu | ML2496A | 1804001 | 02/20/2020 | 02/19/2021 |
| Power Sensor | Anritsu | MA2411B | 1726104 | 02/20/2020 | 02/19/2021 |
| Power Sensor | Anritsu | MA2411B | 1726107 | 02/20/2020 | 02/19/2021 |

7.3 Test Set-up:



7.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10 Measurement Guidelines.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
4. Record the max. reading.
5. Repeat above procedures until all default test channel is completed.

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7.5 Peak & Average Power Measurement Result

1M BR mode (Peak):

| CH | Freq. (MHz) | Peak Output Power (dBm) | Output Power (mW) | Limit (mW) |
|------|-------------|-------------------------|-------------------|------------|
| Low | 2402 | 7.63 | 5.794 | 125 |
| Mid | 2441 | 9.78 | 9.506 | 125 |
| High | 2480 | 9.46 | 8.831 | 125 |

1M BR mode (Average):

| CH | Freq. (MHz) | Max. Output include tune up tolerance Power (dBm) | Output Power (mW) | Limit (mW) |
|------|-------------|---|-------------------|------------|
| Low | 2402 | 7.19 | 5.232 | 125 |
| Mid | 2441 | 9.35 | 8.603 | 125 |
| High | 2480 | 9.00 | 7.937 | 125 |

2M EDR mode (Peak):

| CH | Freq. (MHz) | Peak Output Power (dBm) | Output Power (mW) | Limit (mW) |
|------|-------------|-------------------------|-------------------|------------|
| Low | 2402 | 7.81 | 6.039 | 125 |
| Mid | 2441 | 9.92 | 9.817 | 125 |
| High | 2480 | 9.57 | 9.057 | 125 |

2M EDR mode (Average):

| CH | Freq. (MHz) | Max. Avg. Output include tune up tolerance Power (dBm) | Output Power (mW) | Limit (mW) |
|------|-------------|--|-------------------|------------|
| Low | 2402 | 5.33 | 3.409 | 125 |
| Mid | 2441 | 7.51 | 5.632 | 125 |
| High | 2480 | 6.51 | 4.473 | 125 |

3M EDR mode (Peak):

| CH | Freq. (MHz) | Peak Output Power (dBm) | Output Power (mW) | Limit (mW) |
|------|-------------|-------------------------|-------------------|------------|
| Low | 2402 | 7.89 | 6.152 | 125 |
| Mid | 2441 | 9.98 | 9.954 | 125 |
| High | 2480 | 9.62 | 9.162 | 125 |

3M EDR mode (Average):

| CH | Freq. (MHz) | Max. Avg. Output include tune up tolerance Power (dBm) | Output Power (mW) | Limit (mW) |
|------|-------------|--|-------------------|------------|
| Low | 2402 | 5.40 | 3.470 | 125 |
| Mid | 2441 | 7.56 | 5.707 | 125 |
| High | 2480 | 7.15 | 5.193 | 125 |

NOTE: cable loss as 1dB that offsets in the spectrum

*Note: Max. Output include tune up tolerance Power measured by using average detector.

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8 20dB BANDWIDTH MEASUREMENT

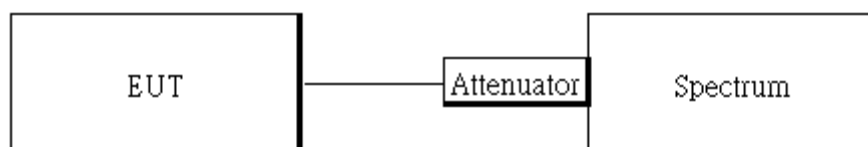
8.1 Standard Applicable

For frequency hopping systems operating in the 2400 MHz-2483.5 MHz no limit for 20dB bandwidth.

8.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/06/2020 | 05/05/2021 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2020 | 01/01/2021 |

8.3 Test Set-up



8.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer as
RBW= 1 % to 5% of OBW ,
VBW = 3 X RBW,
Span= 2 to 5 times of the OBW,
Sweep=auto,
Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and -20dB (upper and lower) frequency
6. Repeat above procedures until all test default channel is completed

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8.5 20dB Bandwidth

GFSK

| CH | Frequency (MHz) | 20 dB BW (MHz) | Offset | 2/3 BW (MHz) |
|------|-----------------|----------------|--------|--------------|
| Low | 2402 | 0.7924 | 1 | 0.53 |
| Mid | 2441 | 0.7908 | 1 | 0.53 |
| High | 2480 | 0.7929 | 1 | 0.53 |

$\pi/4$ -DQPSK

| CH | Frequency (MHz) | 20 dB BW (MHz) | Offset | 2/3 BW (MHz) |
|------|-----------------|----------------|--------|--------------|
| Low | 2402 | 1.223 | 1 | 0.82 |
| Mid | 2441 | 1.250 | 1 | 0.83 |
| High | 2480 | 1.254 | 1 | 0.84 |

8-DPSK

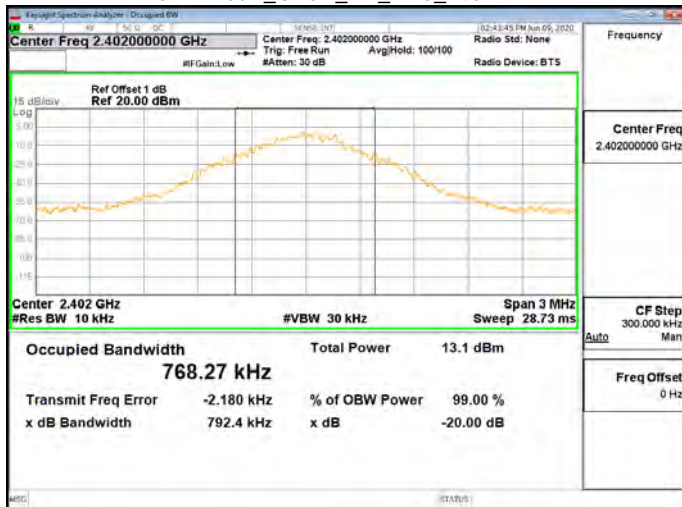
| CH | Frequency (MHz) | 20 dB BW (MHz) | Offset | 2/3 BW (MHz) |
|------|-----------------|----------------|--------|--------------|
| Low | 2402 | 1.257 | 1 | 0.84 |
| Mid | 2441 | 1.257 | 1 | 0.84 |
| High | 2480 | 1.255 | 1 | 0.84 |

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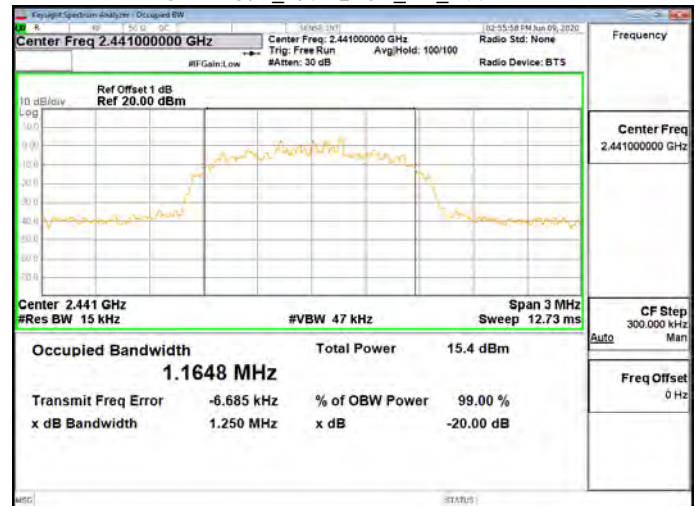
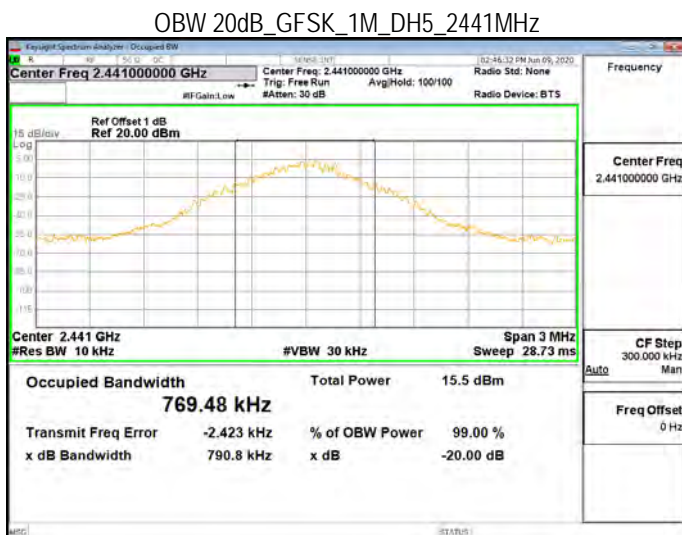
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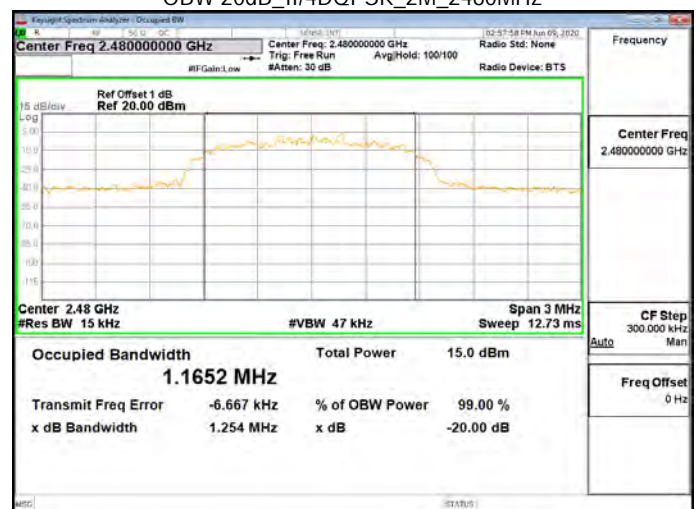
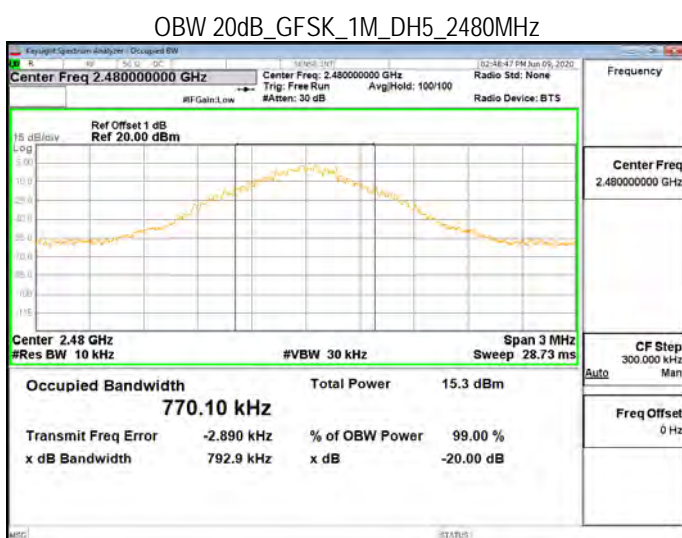
OBW 20dB_GFSK_1M_DH5_2402MHz



OBW 20dB_π/4QPSK_2M_2441MHz



OBW 20dB_π/4QPSK_2M_2480MHz



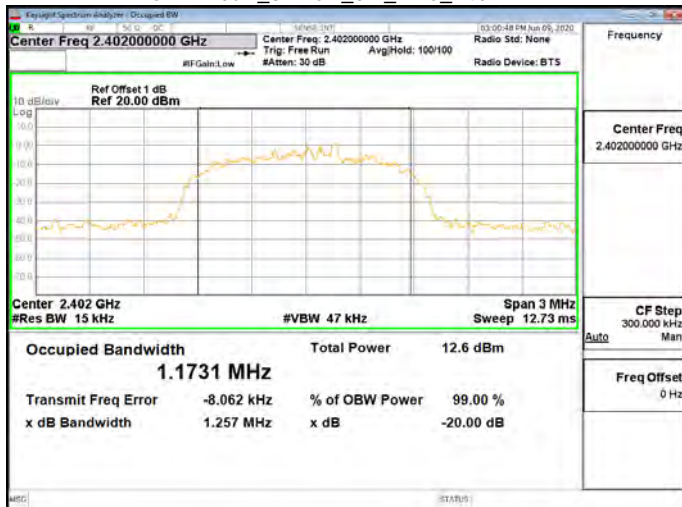
OBW 20dB_π/4QPSK_2M_2402MHz

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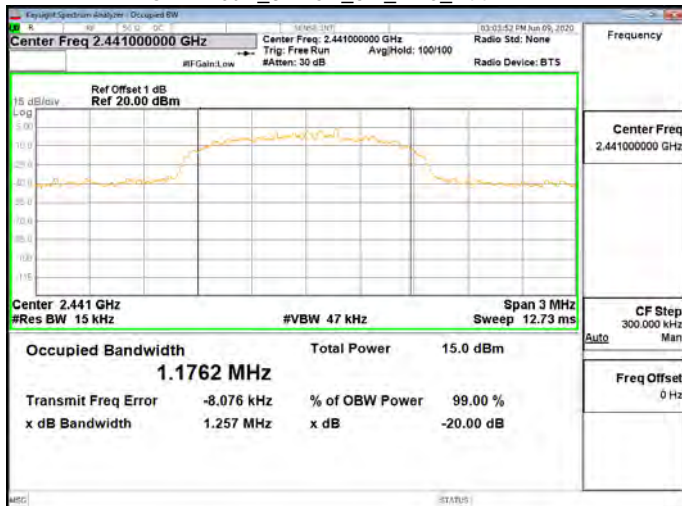
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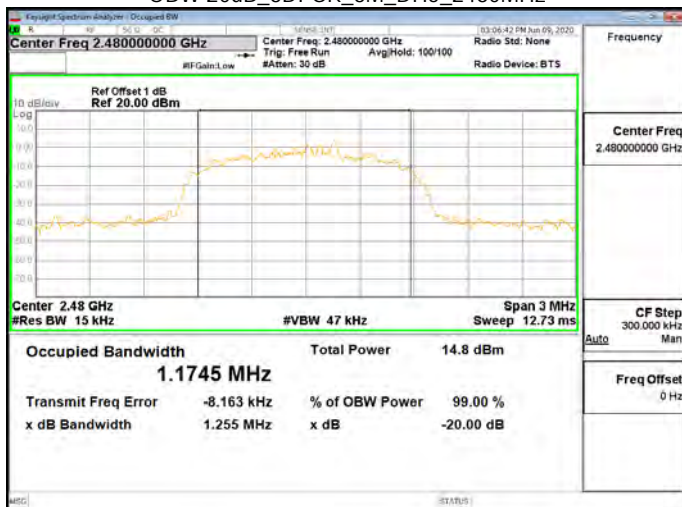
OBW 20dB_8DPSK_3M_DH5_2402MHz



OBW 20dB_8DPSK_3M_DH5_2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz



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9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

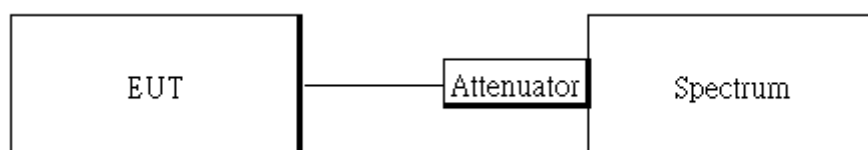
9.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

9.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/06/2020 | 05/05/2021 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2020 | 01/01/2021 |

9.3 Test SET-UP



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9.4 Measurement Procedure

9.4.1 Conducted Band Edge:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
6. Mark Peak, 2.3999GHz and 2.4836GHz and record the max. level.
7. Repeat above procedures until all frequency measured were complete.

9.4.2 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows ANSI C63.10:2013.
3. Set RBW = 100 kHz & VBW = 300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

9.5 Measurement Result

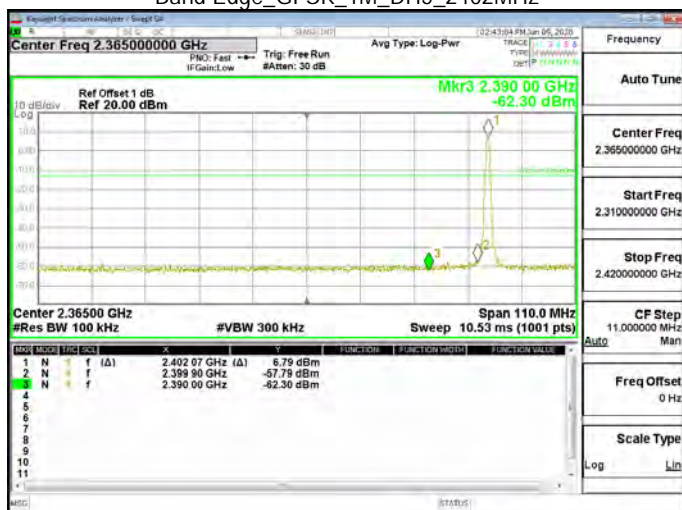
See next page for test plots.

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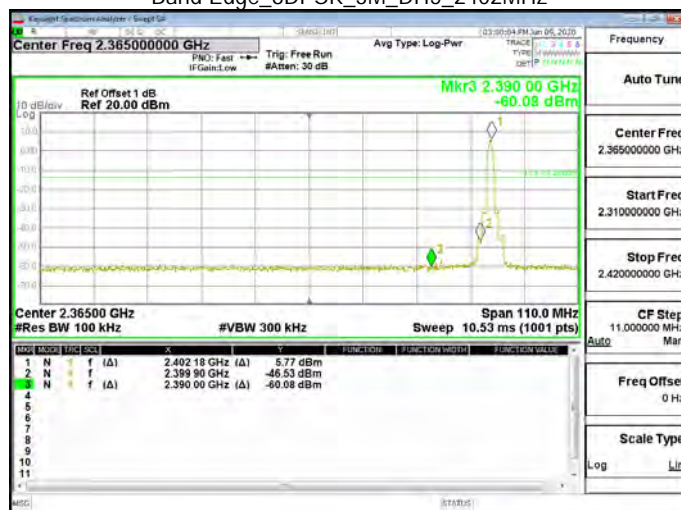
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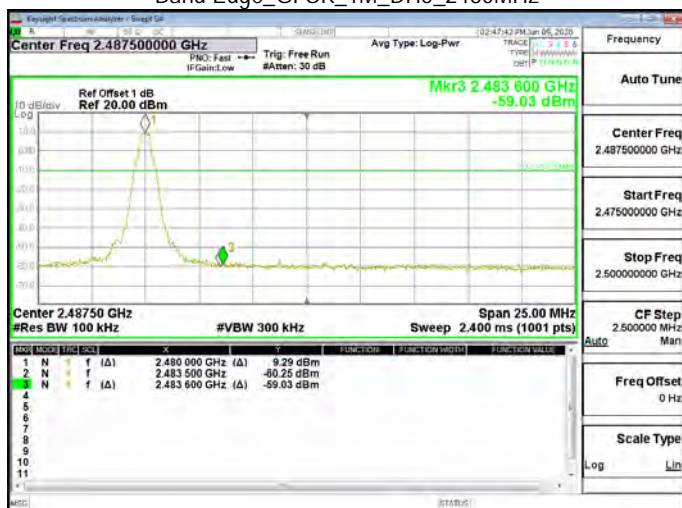
Band Edge_GFSK_1M_DH5_2402MHz



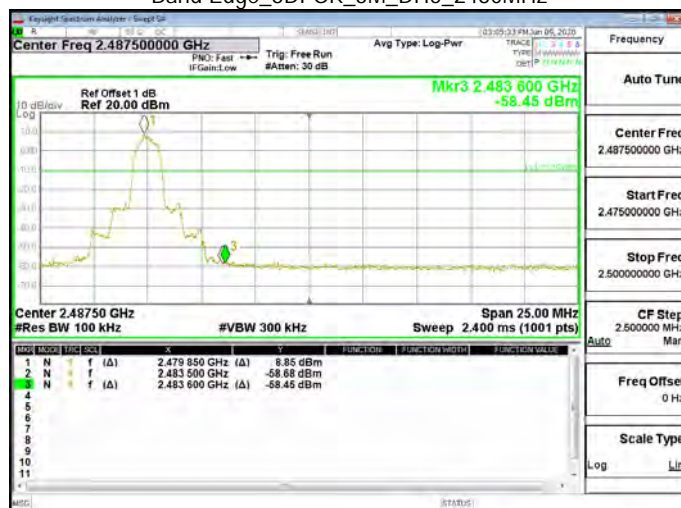
Band Edge_8DPSK_3M_DH5_2402MHz



Band Edge_GFSK_1M_DH5_2480MHz



Band Edge_8DPSK_3M_DH5_2480MHz



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Hopping Band Edge_GFSK_1M_DH5_2402MHz



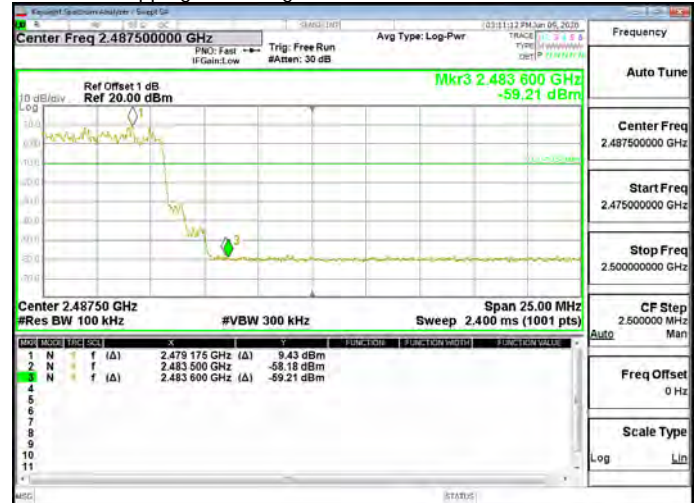
Hopping Band Edge_8DPSK_3M_DH5_2402MHz



Hopping Band Edge_GFSK_1M_DH5_2480MHz



Hopping Band Edge_8DPSK_3M_DH5_2480MHz

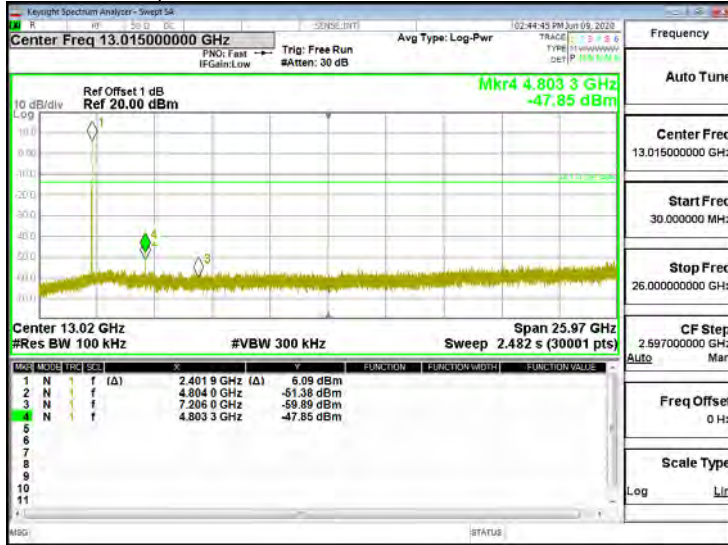


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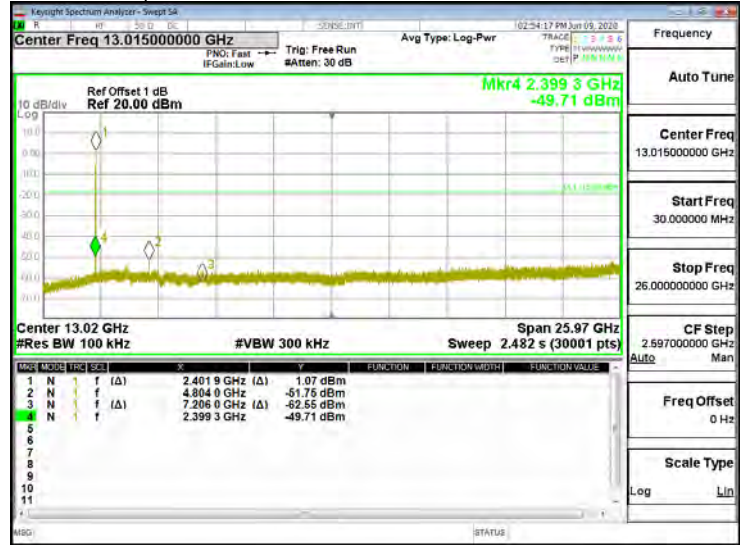
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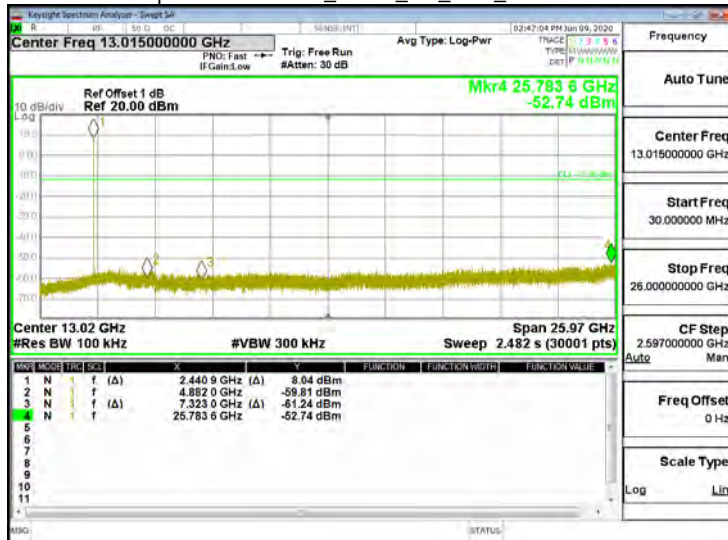
Spurious Emission_GFSK_1M_DH5_2402MHz



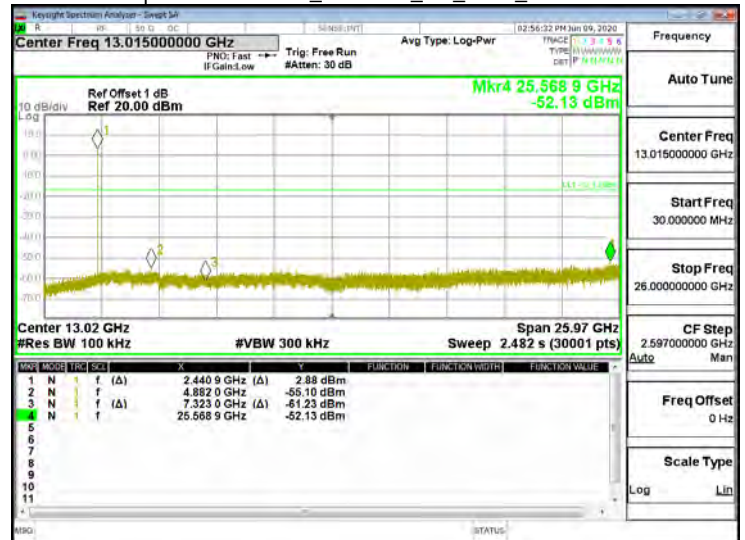
Spurious Emission_4DQPSK_2M_DH5_2402MHz



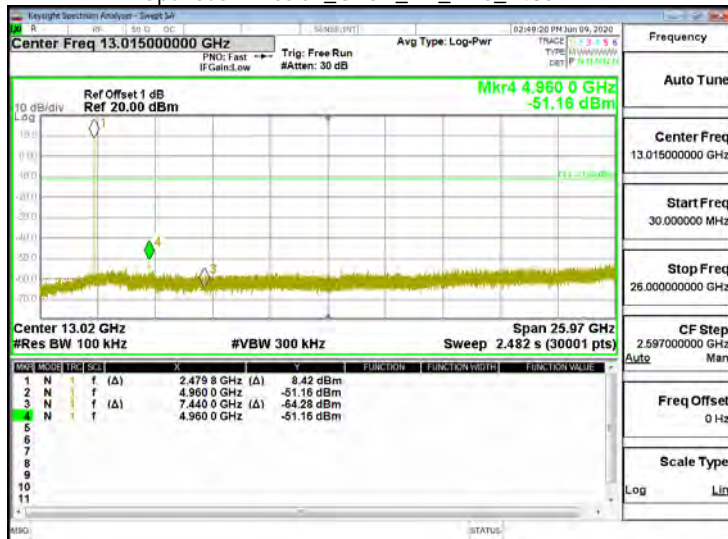
Spurious Emission_GFSK_1M_DH5_2441MHz



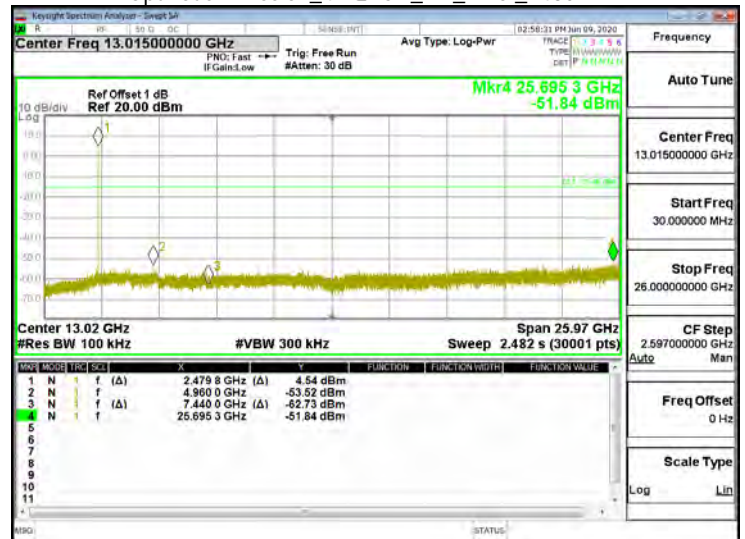
Spurious Emission_4DQPSK_2M_DH5_2441MHz



Spurious Emission_GFSK_1M_DH5_2480MHz



Spurious Emission_4DQPSK_2M_DH5_2480MHz

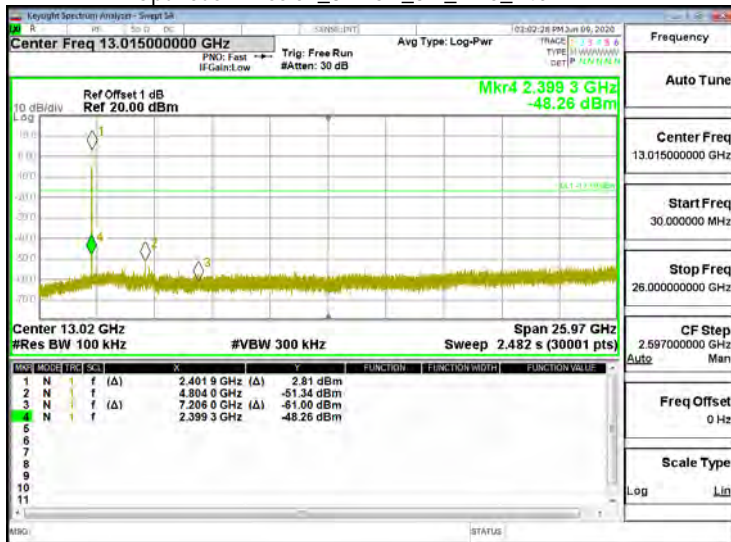


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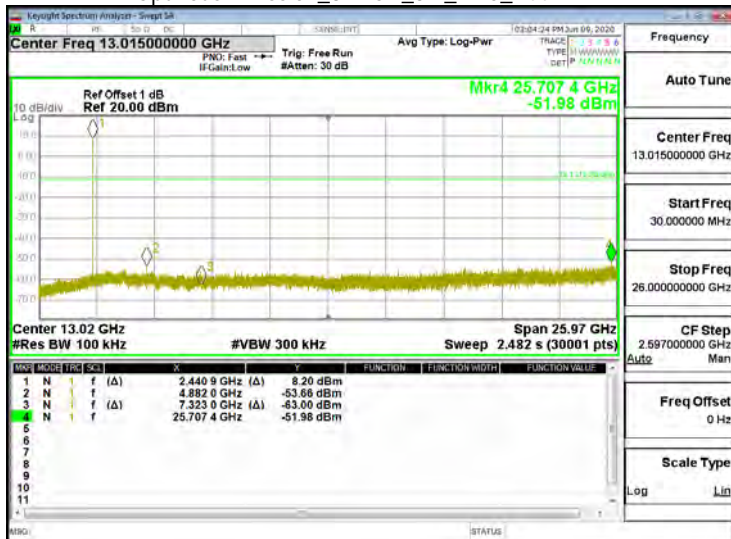
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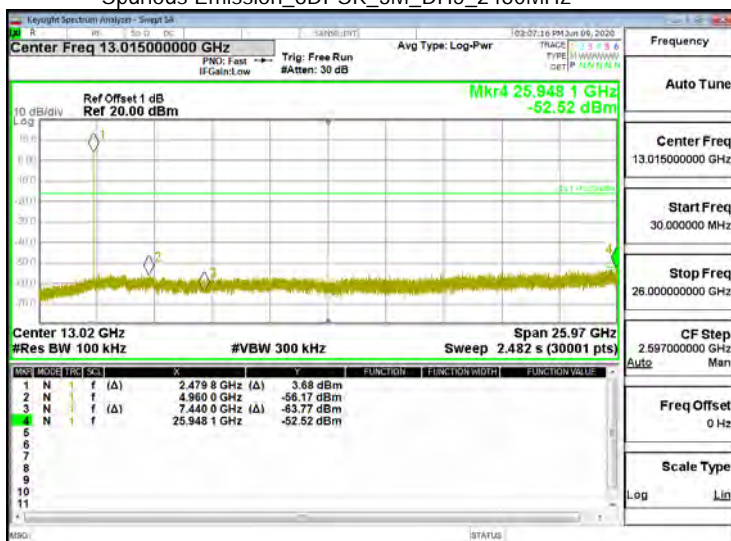
Spurious Emission_8DPSK_3M_DH5_2402MHz



Spurious Emission_8DPSK_3M_DH5_2441MHz



Spurious Emission_8DPSK_3M_DH5_2480MHz



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10 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

| Frequency (MHz) | Field strength (microvolts/meter) | Distance (meters) |
|-----------------|-----------------------------------|-------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m)

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10.2 Measurement Equipment Used

| 966 Chamber | | | | | |
|------------------------|------------------|--------------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Horn Antenna | Schwarzbeck | BBHA9170 | 184 | 12/25/2019 | 12/24/2020 |
| Horn Antenna | Schwarzbeck | BBHA9120D | 603 | 04/29/2020 | 04/28/2021 |
| Bi-log Antenna | SCHWAZBECK | VULB9168 | 378 | 08/06/2020 | 08/05/2021 |
| Loop Antenna | ETS.LINDGREN | 6502 | 148045 | 10/15/2019 | 10/14/2020 |
| 3m Site NSA | SGS | 966 chamber | N/A | 01/02/2020 | 01/01/2021 |
| PXA Spectrum Analyzer | Agilent | N9030A | MY53120760 | 04/21/2020 | 04/20/2021 |
| EMI Test Receiver | R&S | ESCI 7 | 100759 | 07/13/2020 | 07/12/2021 |
| Pre-Amplifier | EMC Instru-ments | EMC184045B | 980135 | 01/02/2020 | 01/01/2021 |
| Pre-Amplifier | HP | 8447D | 2944A09469 | 01/02/2020 | 01/01/2021 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 4 | 01/02/2020 | 01/01/2021 |
| Filter 2400-2483.5 MHz | EWT | EWT-14-0166 | M1 | 01/02/2020 | 01/01/2021 |
| High Pass Filter | WI | WHKX4.0/18G-10SS | 22 | 01/02/2020 | 01/01/2021 |
| Coaxial Cable | Huber Suhner | succoflex 102 | MY2622/2 | 01/02/2020 | 01/01/2021 |
| Coaxial Cable | Huber Suhner | succoflex 104A | 800086/4a | 01/02/2020 | 01/01/2021 |
| Coaxial Cable | Huber Suhner | EMC 104-SM-SM-2000 | 160123 | 01/02/2020 | 01/01/2021 |

NOTE: N.C.R refers to Not Calibrated Required.

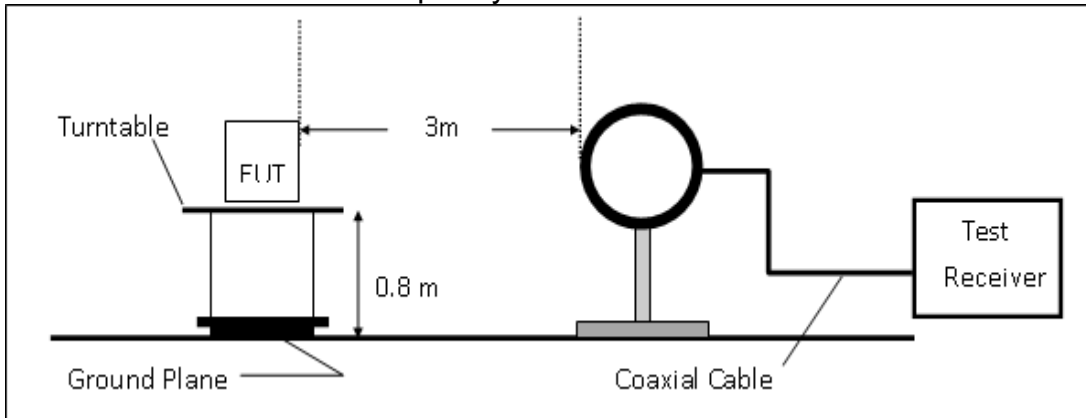
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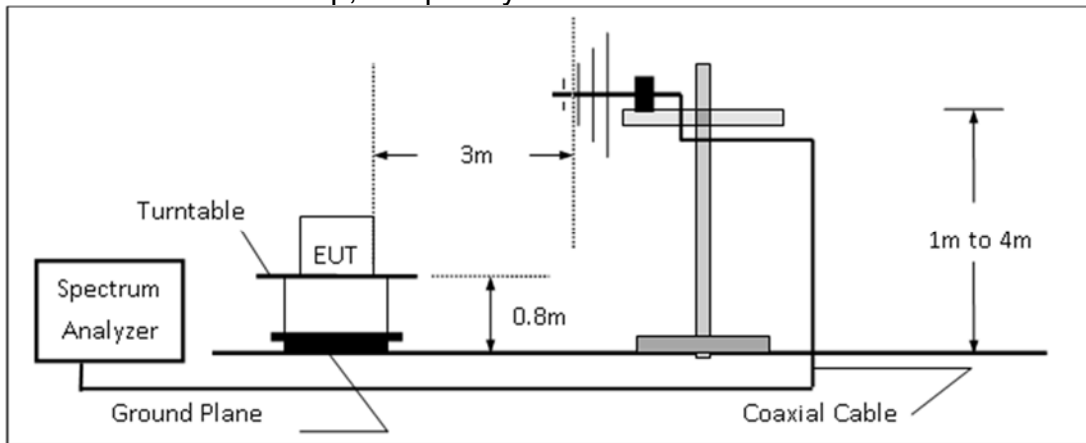
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10.3 Test SET-UP

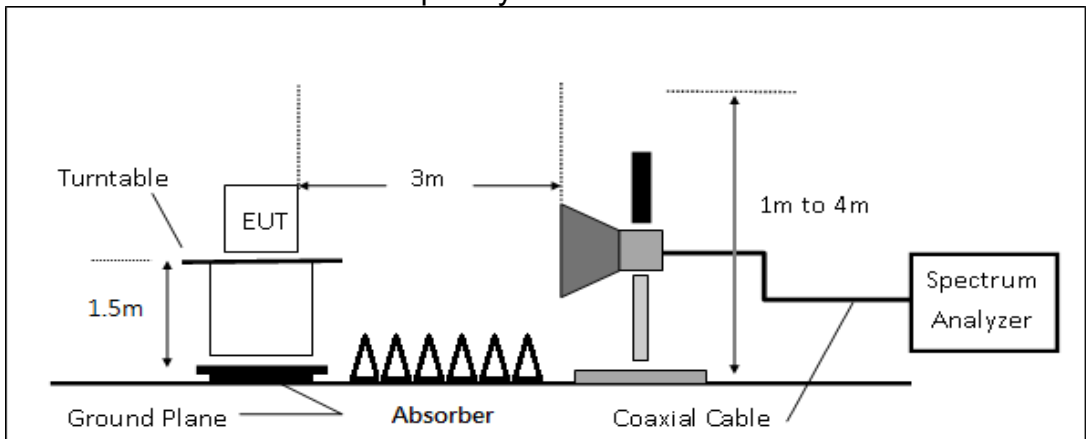
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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10.4 Measurement Procedure

10.4.1 Radiated Emission

1. The testing follows the Measurement Procedure of ANSI C63.10:2013.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plan.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
8. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
11. Repeat above procedures until all default test channel measured were complete.

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10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS* = Field Strength

RA = Reading Amplitude

AF = Antenna Factor

CL = Cable Attenuation Factor (Cable Loss)

AG = Amplifier Gain

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(uV/m)$

Actual FS(dBuV/m) = SPA. Reading level(dBuV) + Factor(dB)

Factor(dB) = Antenna Factor(dBuV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

10.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

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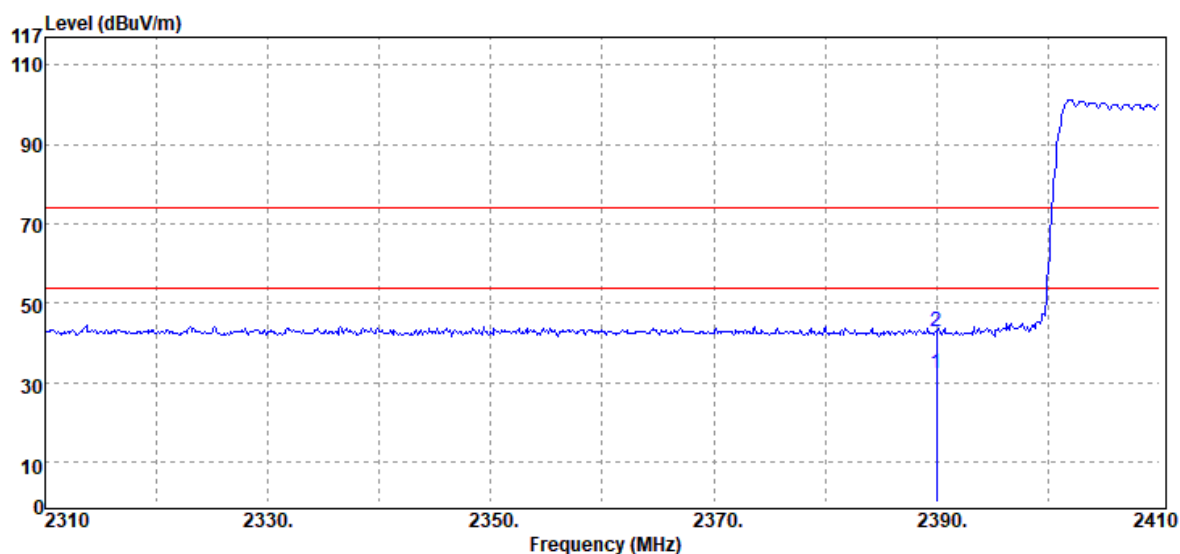
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10.7 Measurement Result:

10.7.1 Radiated Bandedge Result (Hopping Mode)

| | | | |
|----------------|------------------|--------------|------------------|
| Report Number | :ER-2020-50091 | Test Site | :SAC III Chamber |
| Operation Mode | :BT BR Hopping | Test Date | :2020-06-24 |
| Test Frequency | :2402 MHz | Temp./Humi. | :25.4/64 |
| Test Mode | :Bandedge CH Low | Antenna Pol. | :VERTICAL |
| EUT Pol | :H Plane | Engineer | :Nick |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBuV | Factor dB | Actual FS dBuV/m | Limit @3m dBuV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 31.36 | 0.92 | 32.28 | 54.00 | -21.72 |
| 2390.00 | Peak | 41.96 | 0.92 | 42.88 | 74.00 | -31.12 |

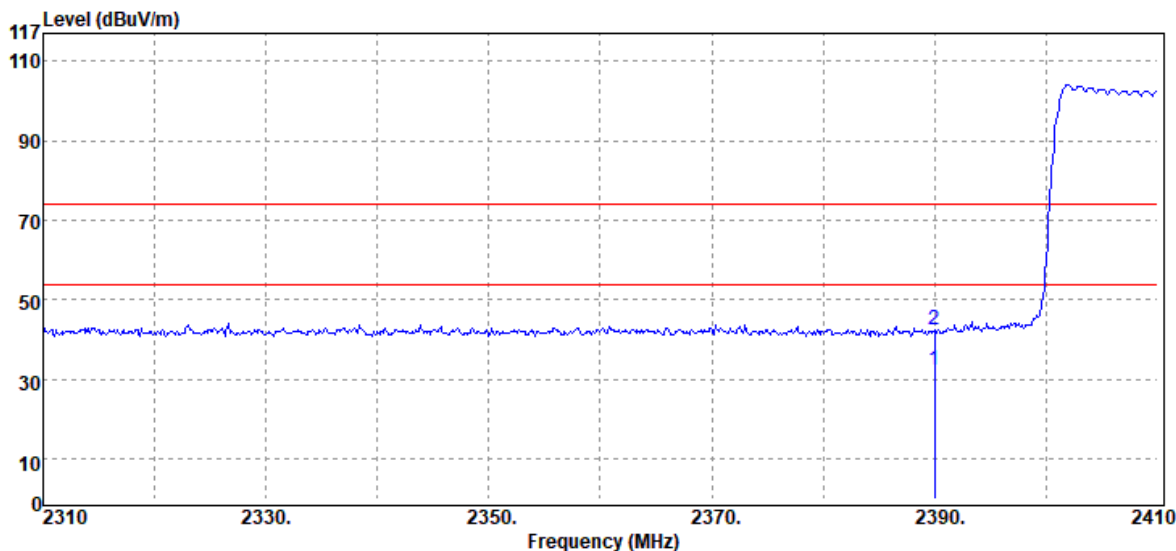
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Report Number :ER-2020-50091
Operation Mode :BT BR Hopping
Test Frequency :2402 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25.4/64
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBUV | Factor dB | Actual FS dBUV/m | Limit @3m dBUV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 31.57 | 0.92 | 32.49 | 54.00 | -21.51 |
| 2390.00 | Peak | 41.71 | 0.92 | 42.63 | 74.00 | -31.37 |

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Report Number :ER-2020-50091

Operation Mode :BT BR Hopping

Test Frequency :2480 MHz

Test Mode :Bandedge CH High

EUT Pol :H Plane

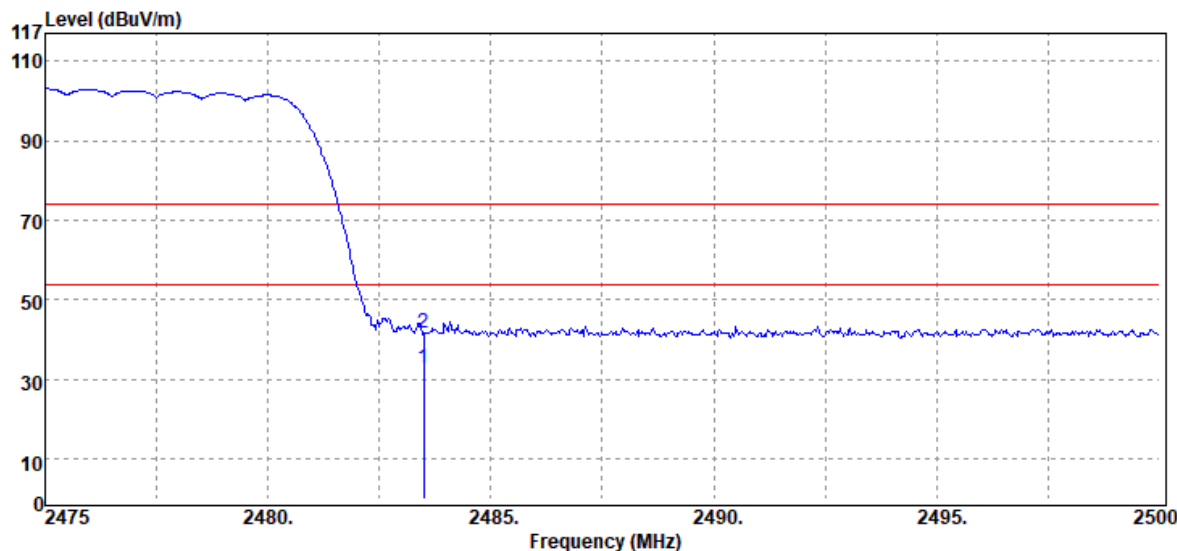
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :VERTICAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 32.13 | 0.67 | 32.80 | 54.00 | -21.20 |
| 2483.50 | Peak | 40.99 | 0.67 | 41.66 | 74.00 | -32.34 |

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Report Number :ER-2020-50091

Operation Mode :BT BR Hopping

Test Frequency :2480 MHz

Test Mode :Bandedge CH High

EUT Pol :H Plane

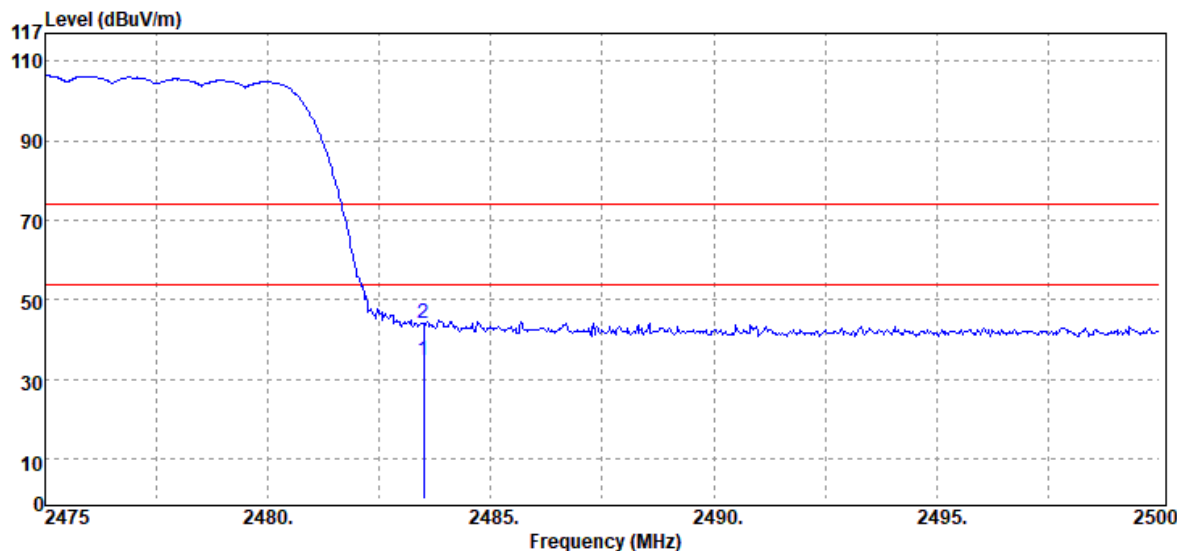
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :HORIZONTAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 34.24 | 0.67 | 34.91 | 54.00 | -19.09 |
| 2483.50 | Peak | 43.59 | 0.67 | 44.26 | 74.00 | -29.74 |

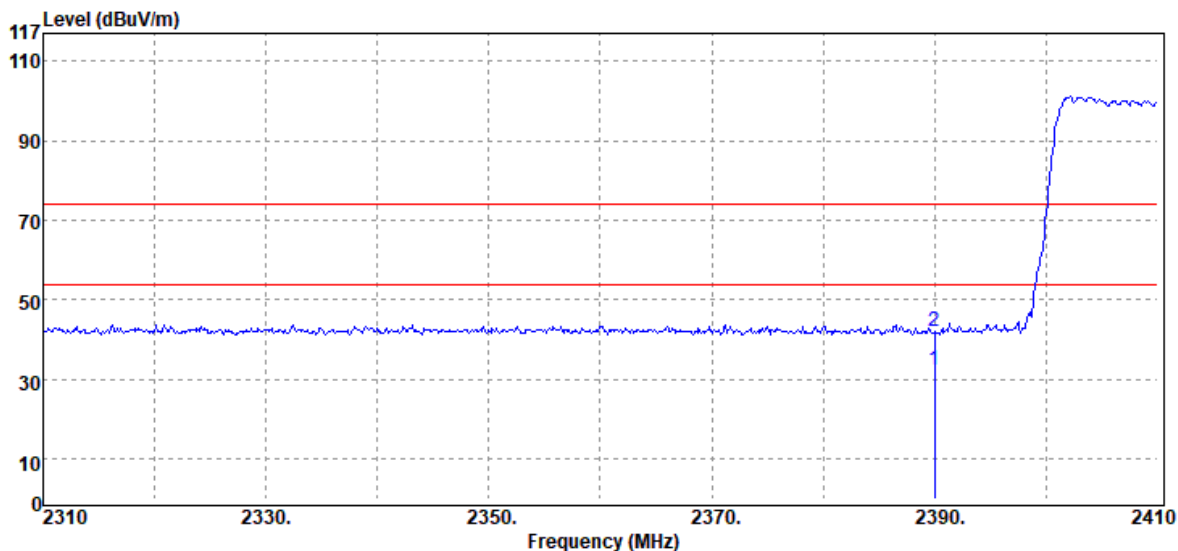
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Report Number :ER-2020-50091
Operation Mode :BT EDR Hopping
Test Frequency :2402 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25.4/64
Antenna Pol. :VERTICAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 31.34 | 0.92 | 32.26 | 54.00 | -21.74 |
| 2390.00 | Peak | 41.06 | 0.92 | 41.98 | 74.00 | -32.02 |

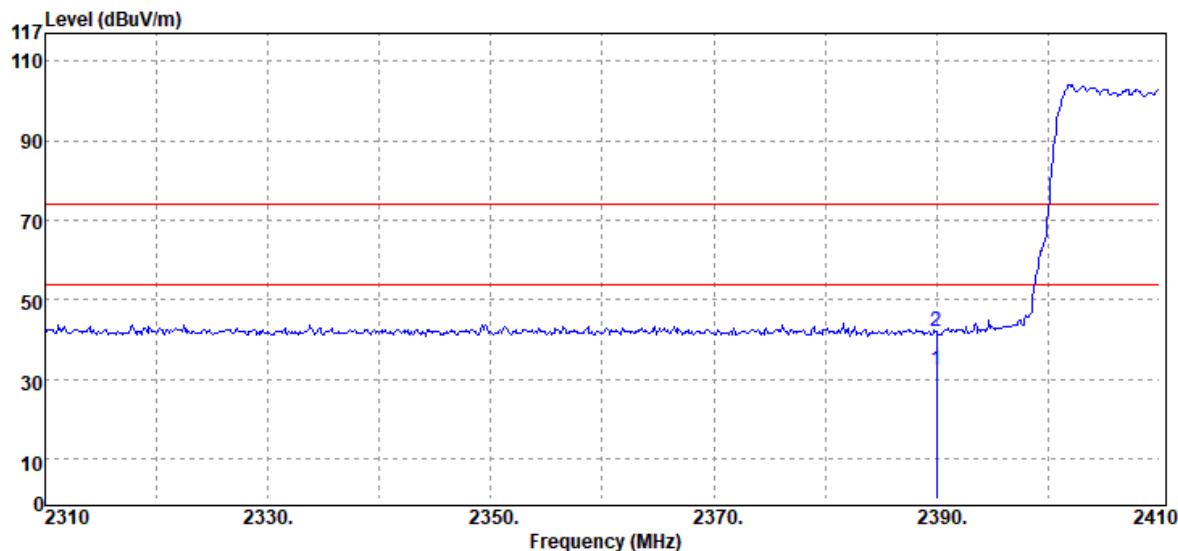
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Report Number :ER-2020-50091
Operation Mode :BT EDR Hopping
Test Frequency :2402 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25.4/64
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 31.56 | 0.92 | 32.48 | 54.00 | -21.52 |
| 2390.00 | Peak | 41.19 | 0.92 | 42.11 | 74.00 | -31.89 |

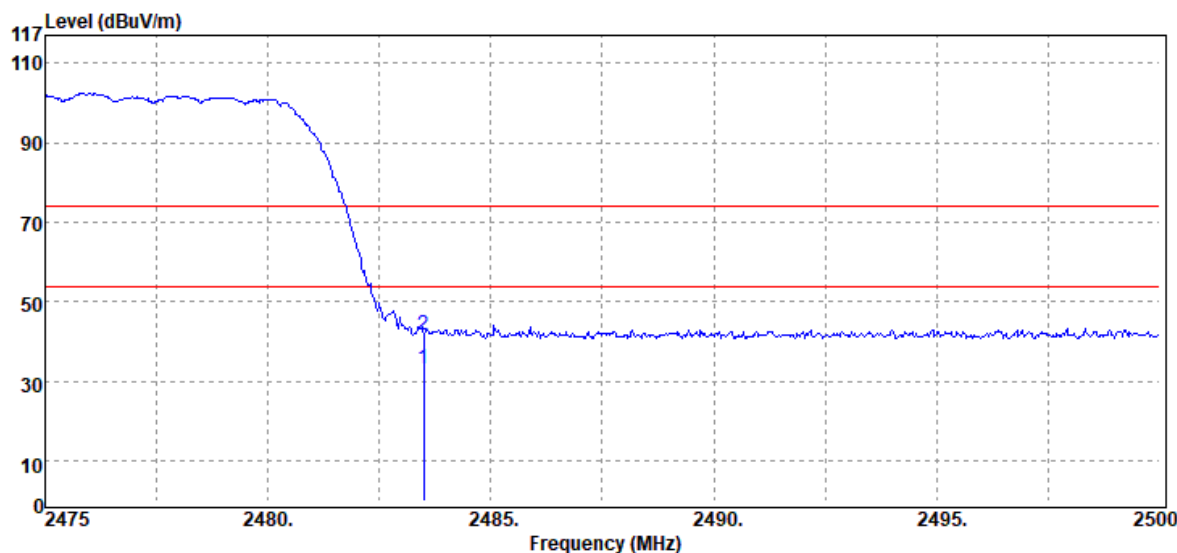
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Report Number :ER-2020-50091
 Operation Mode :BT EDR Hopping
 Test Frequency :2480 MHz
 Test Mode :Bandedge CH High
 EUT Pol :H Plane

Test Site :SAC III Chamber
 Test Date :2020-06-24
 Temp./Humi. :25.4/64
 Antenna Pol. :VERTICAL
 Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 32.37 | 0.67 | 33.04 | 54.00 | -20.96 |
| 2483.50 | Peak | 41.14 | 0.67 | 41.81 | 74.00 | -32.19 |

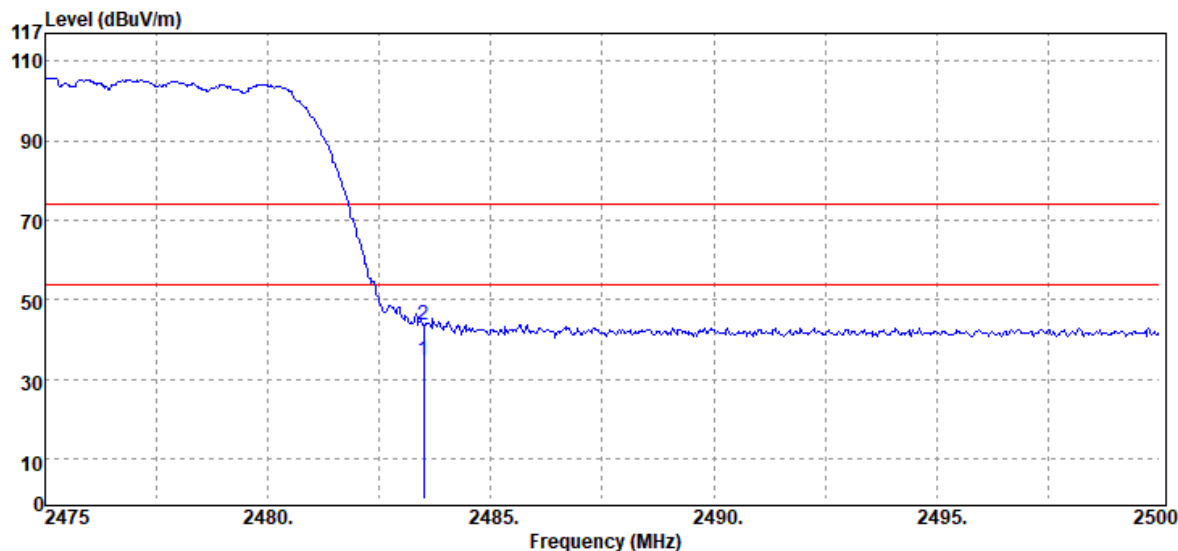
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Report Number :ER-2020-50091
Operation Mode :BT EDR Hopping
Test Frequency :2480 MHz
Test Mode :Bandedge CH High
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25.4/64
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 34.04 | 0.67 | 34.71 | 54.00 | -19.29 |
| 2483.50 | Peak | 42.86 | 0.67 | 43.53 | 74.00 | -30.47 |

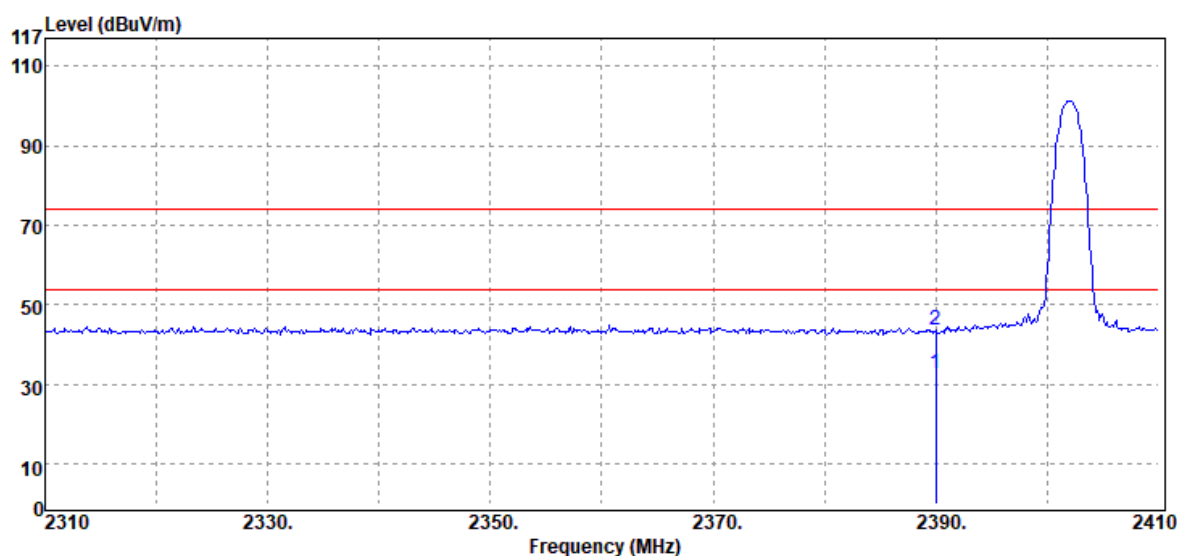
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10.7.2 Radiated Bandedge Result (Non-Hopping Mode)

| | | | |
|----------------|------------------|--------------|------------------|
| Report Number | :ER-2020-50091 | Test Site | :SAC III Chamber |
| Operation Mode | :BT BR | Test Date | :2020-06-24 |
| Test Frequency | :2402 MHz | Temp./Humi. | :25.4/64 |
| Test Mode | :Bandedge CH Low | Antenna Pol. | :VERTICAL |
| EUT Pol | :H Plane | Engineer | :Nick |



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 31.69 | 0.92 | 32.61 | 54.00 | -21.39 |
| 2390.00 | Peak | 42.91 | 0.92 | 43.83 | 74.00 | -30.17 |

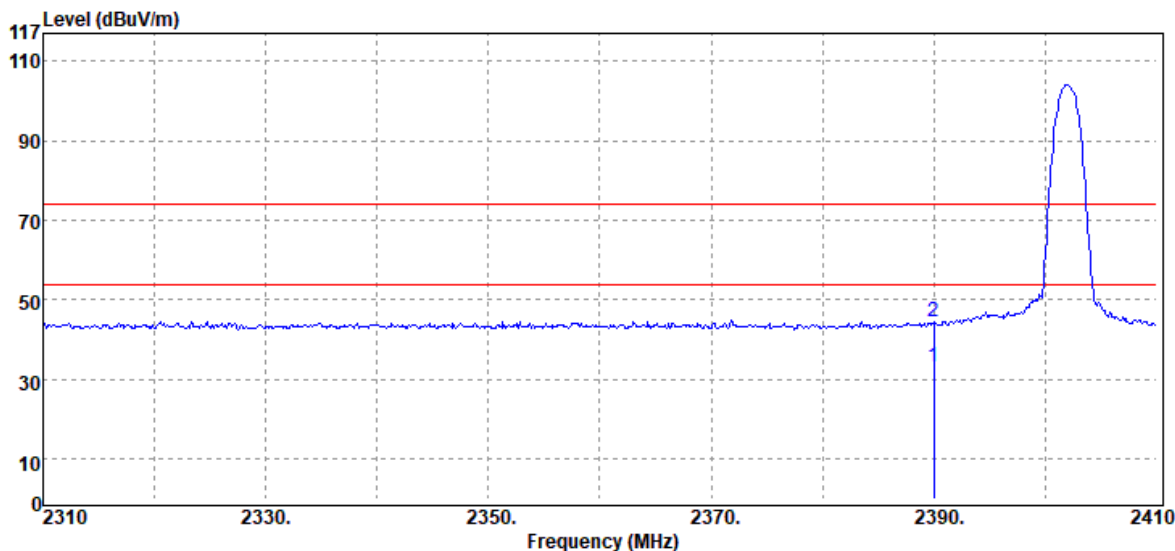
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Report Number :ER-2020-50091
Operation Mode :BT BR
Test Frequency :2402 MHz
Test Mode :Bandedge CH Low
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25.4/64
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 32.11 | 0.92 | 33.03 | 54.00 | -20.97 |
| 2390.00 | Peak | 43.53 | 0.92 | 44.45 | 74.00 | -29.55 |

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Report Number :ER-2020-50091

Operation Mode :BT BR

Test Frequency :2480 MHz

Test Mode :Bandedge CH High

EUT Pol :H Plane

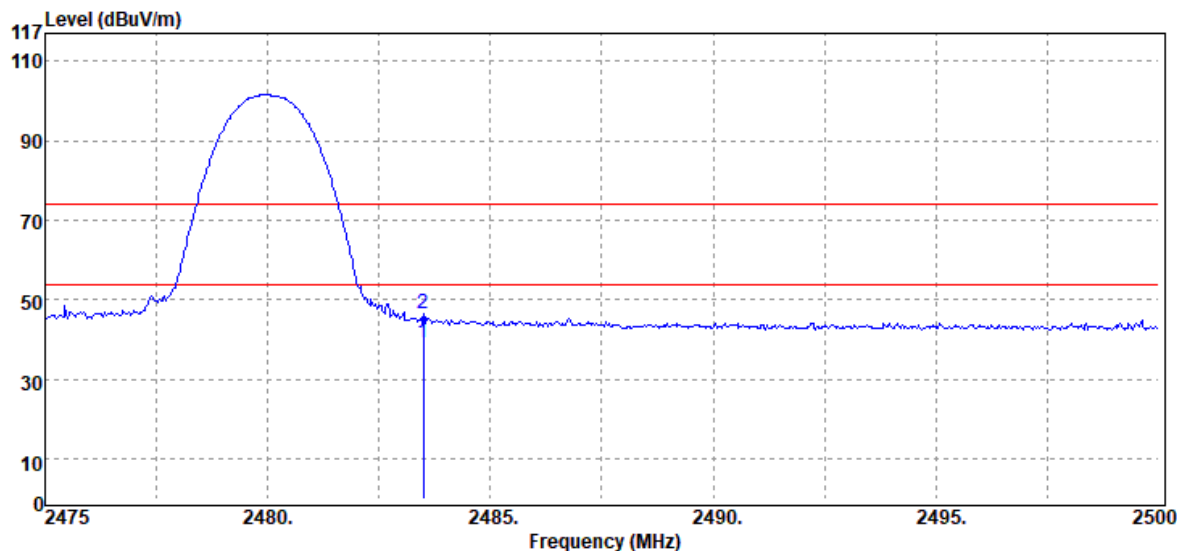
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :VERTICAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 38.74 | 0.67 | 39.41 | 54.00 | -14.59 |
| 2483.50 | Peak | 45.99 | 0.67 | 46.66 | 74.00 | -27.34 |

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Report Number :ER-2020-50091

Operation Mode :BT BR

Test Frequency :2480 MHz

Test Mode :Bandedge CH High

EUT Pol :H Plane

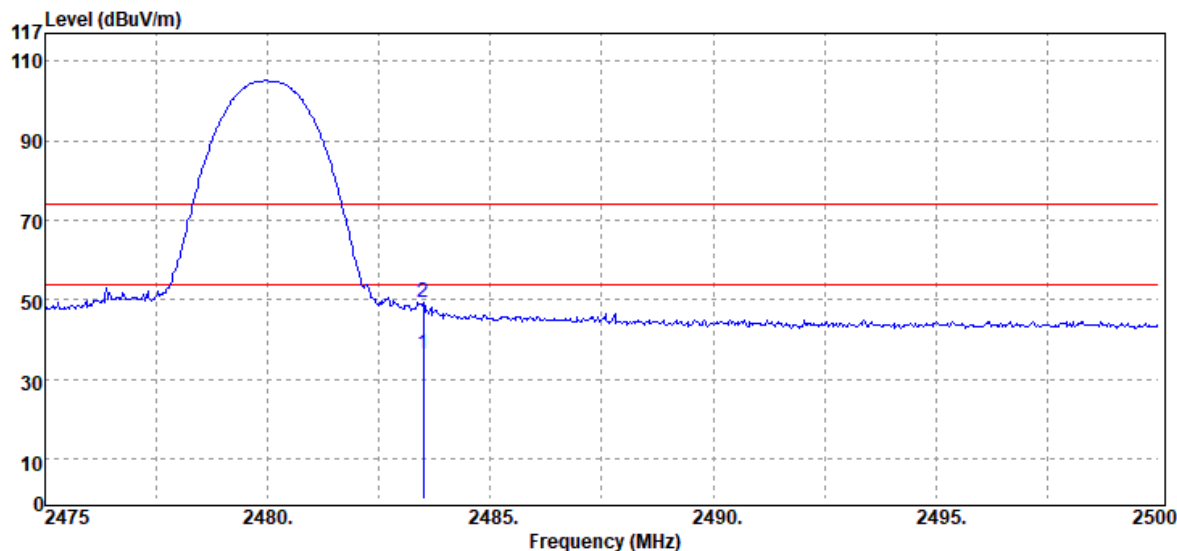
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :HORIZONTAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 35.84 | 0.67 | 36.51 | 54.00 | -17.49 |
| 2483.50 | Peak | 48.54 | 0.67 | 49.21 | 74.00 | -24.79 |

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Report Number :ER-2020-50091

Operation Mode :BT EDR

Test Frequency :2402 MHz

Test Mode :Bandedge CH Low

EUT Pol :H Plane

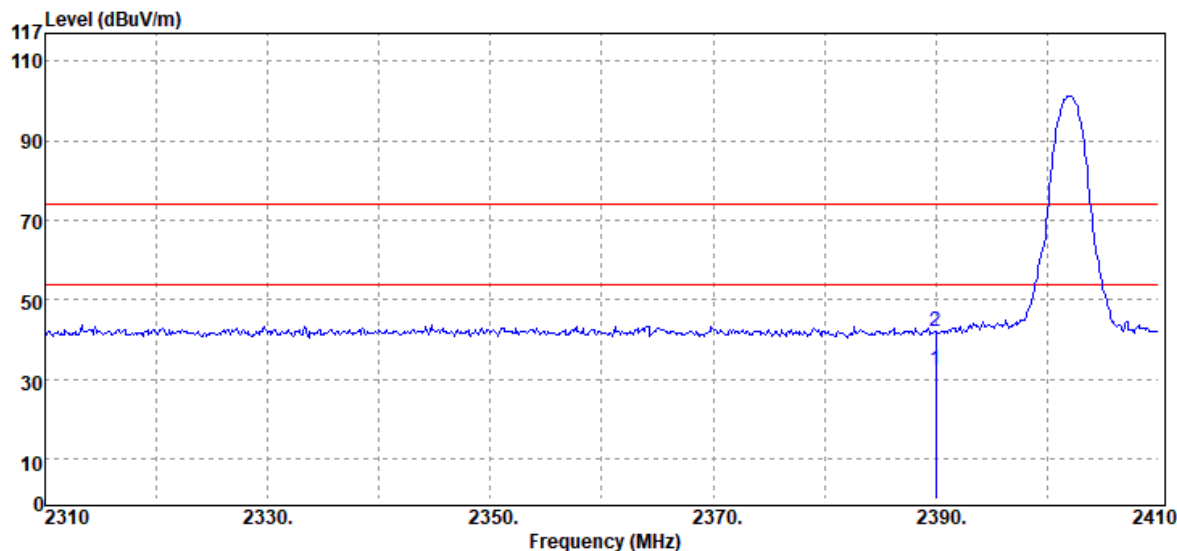
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :VERTICAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 31.61 | 0.92 | 32.53 | 54.00 | -21.47 |
| 2390.00 | Peak | 41.27 | 0.92 | 42.19 | 74.00 | -31.81 |

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Report Number :ER-2020-50091

Operation Mode :BT EDR

Test Frequency :2402 MHz

Test Mode :Bandedge CH Low

EUT Pol :H Plane

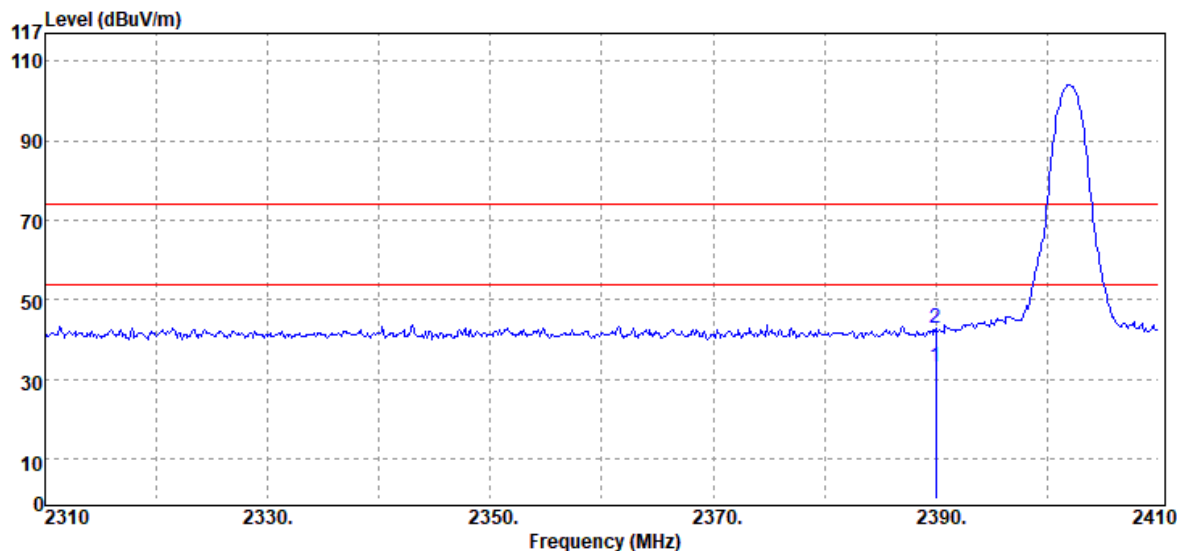
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :HORIZONTAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00 | Average | 32.11 | 0.92 | 33.03 | 54.00 | -20.97 |
| 2390.00 | Peak | 42.03 | 0.92 | 42.95 | 74.00 | -31.05 |

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Report Number :ER-2020-50091

Operation Mode :BT EDR

Test Frequency :2480 MHz

Test Mode :Bandedge CH High

EUT Pol :H Plane

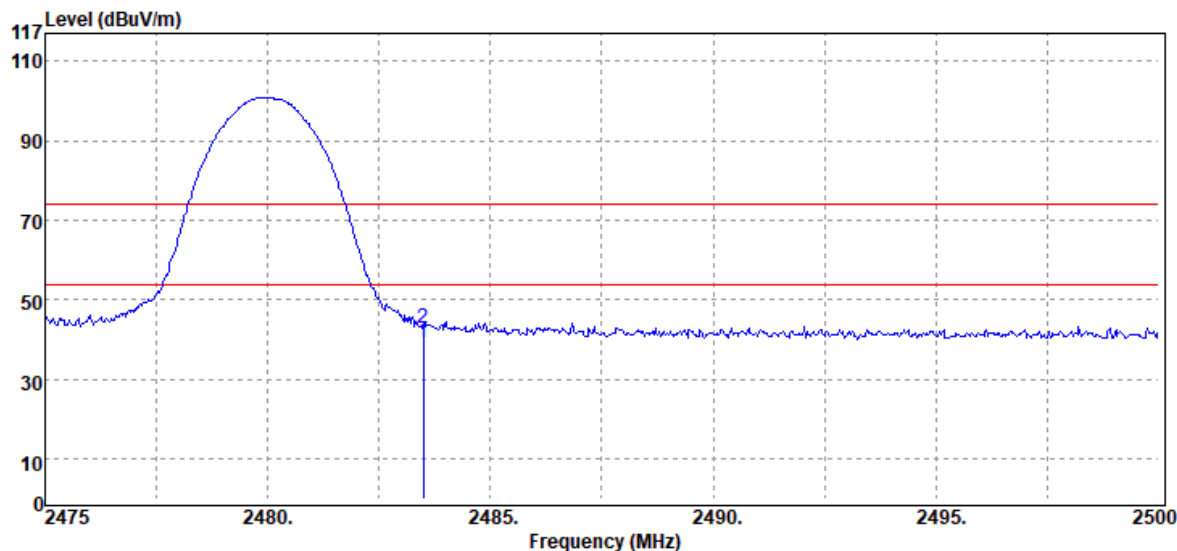
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :VERTICAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 38.77 | 0.67 | 39.44 | 54.00 | -14.56 |
| 2483.50 | Peak | 42.10 | 0.67 | 42.77 | 74.00 | -31.23 |

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Report Number :ER-2020-50091

Operation Mode :BT EDR

Test Frequency :2480 MHz

Test Mode :Bandedge CH High

EUT Pol :H Plane

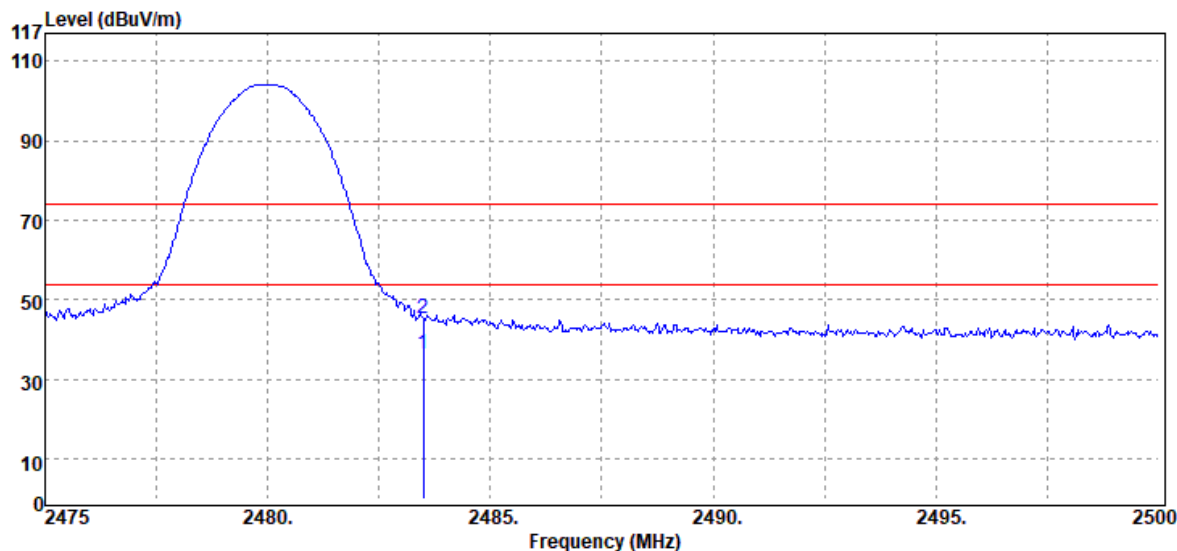
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25.4/64

Antenna Pol. :HORIZONTAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50 | Average | 35.65 | 0.67 | 36.32 | 54.00 | -17.68 |
| 2483.50 | Peak | 44.84 | 0.67 | 45.51 | 74.00 | -28.49 |

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10.7.3 Radiated Spurious Emission form 30MHz to 1000MHz:

Report Number :ER-2020-50091

Test Site :SAC III Chamber

Operation Mode :BT EDR

Test Date :2020-06-24

Test Frequency :2441 MHz

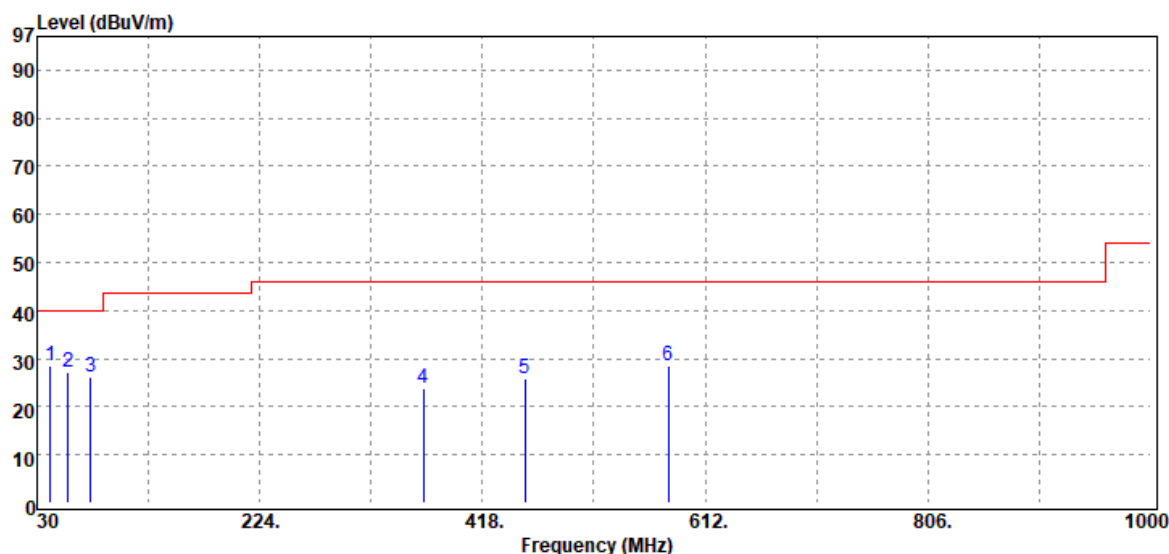
Temp./Humi. :25/66

Test Mode :Tx CH Mid

Antenna Pol. :VERTICAL

EUT Pol :H Plane

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 41.64 | Peak | 36.78 | -8.37 | 28.41 | 40.00 | -11.59 |
| 57.16 | Peak | 35.64 | -8.53 | 27.11 | 40.00 | -12.89 |
| 76.56 | Peak | 37.67 | -11.51 | 26.16 | 40.00 | -13.84 |
| 366.59 | Peak | 28.44 | -4.76 | 23.68 | 46.00 | -22.32 |
| 454.86 | Peak | 28.32 | -2.40 | 25.92 | 46.00 | -20.08 |
| 579.99 | Peak | 28.83 | -0.19 | 28.64 | 46.00 | -17.36 |

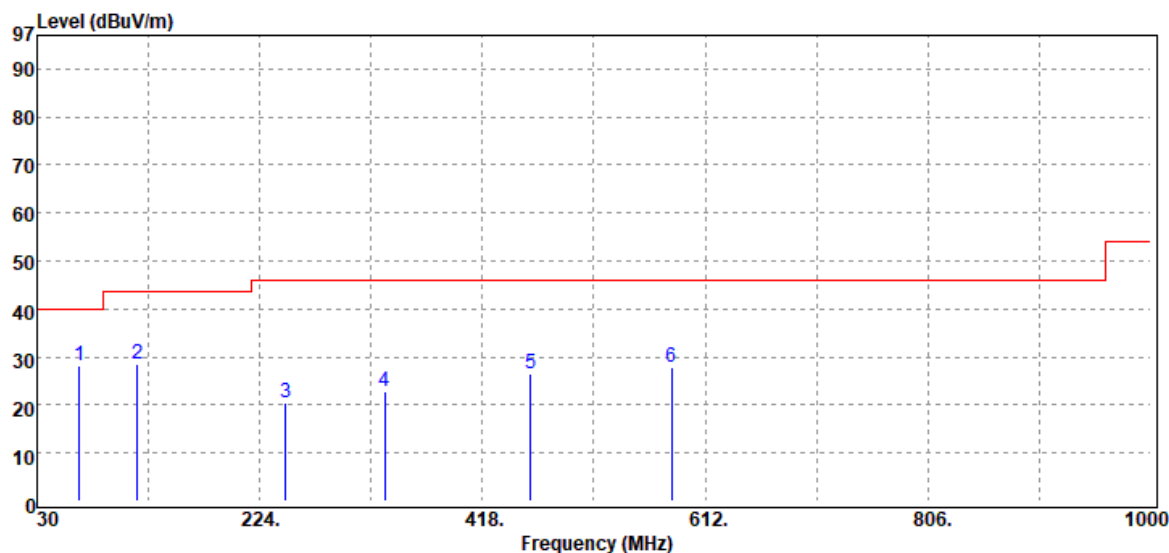
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Report Number :ER-2020-50091
Operation Mode :BT EDR
Test Frequency :2441 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25/66
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 66.86 | Peak | 37.82 | -9.71 | 28.11 | 40.00 | -11.89 |
| 117.30 | Peak | 38.64 | -10.00 | 28.64 | 43.50 | -14.86 |
| 246.31 | Peak | 28.43 | -7.99 | 20.44 | 46.00 | -25.56 |
| 332.64 | Peak | 28.03 | -5.09 | 22.94 | 46.00 | -23.06 |
| 459.71 | Peak | 29.02 | -2.39 | 26.63 | 46.00 | -19.37 |
| 582.90 | Peak | 27.96 | -0.14 | 27.82 | 46.00 | -18.18 |

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10.7.4 Radiated Spurious Emission above 1 GHz:

Report Number :ER-2020-50091

Operation Mode :BT EDR

Test Frequency :2402 MHz

Test Mode :Tx CH Low

EUT Pol :H Plane

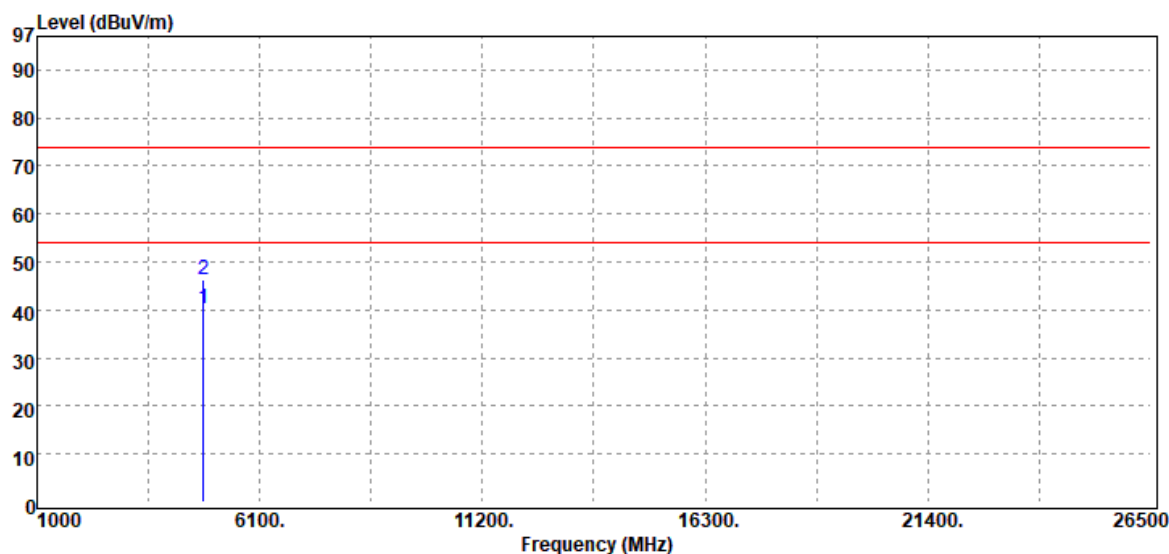
Test Site :SAC III Chamber

Test Date :2020-06-24

Temp./Humi. :25/66

Antenna Pol. :VERTICAL

Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4804.00 | Average | 33.22 | 7.14 | 40.36 | 54.00 | -13.64 |
| 4804.00 | Peak | 39.25 | 7.14 | 46.39 | 74.00 | -27.61 |

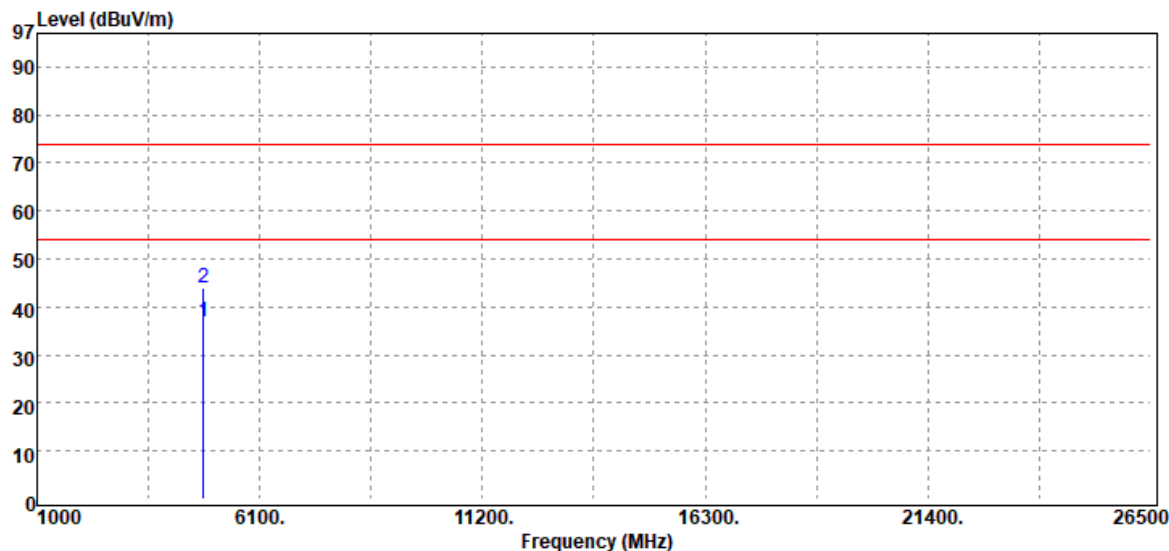
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Report Number :ER-2020-50091
Operation Mode :BT EDR
Test Frequency :2402 MHz
Test Mode :Tx CH Low
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25/66
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4804.00 | Average | 30.09 | 6.88 | 36.97 | 54.00 | -17.03 |
| 4804.00 | Peak | 37.10 | 6.88 | 43.98 | 74.00 | -30.02 |

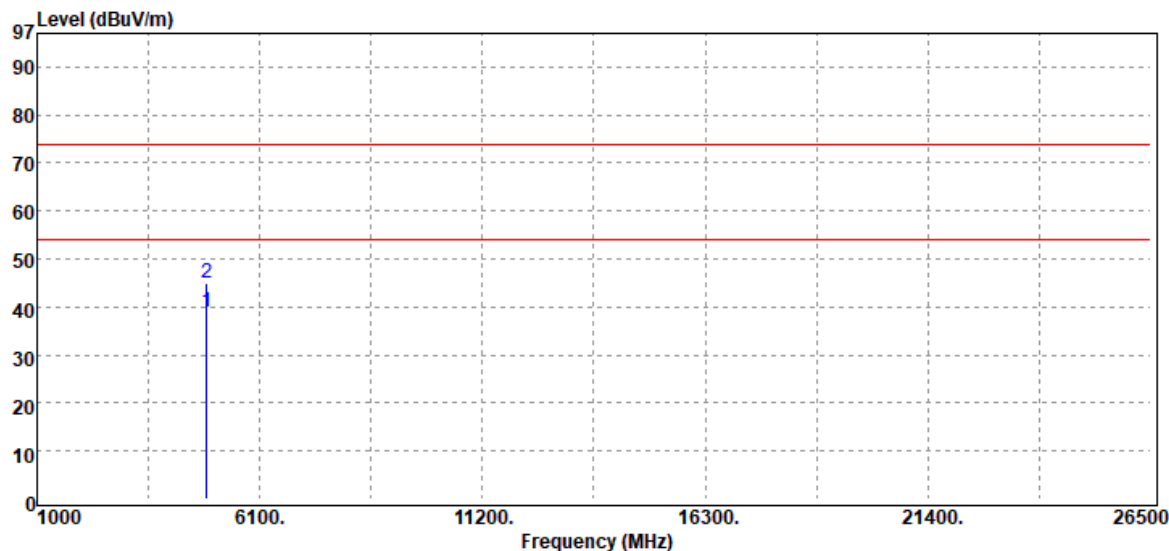
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Report Number :ER-2020-50091
Operation Mode :BT EDR
Test Frequency :2441 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25/66
Antenna Pol. :VERTICAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4882.00 | Average | 31.28 | 7.65 | 38.93 | 54.00 | -15.07 |
| 4882.00 | Peak | 37.34 | 7.65 | 44.99 | 74.00 | -29.01 |

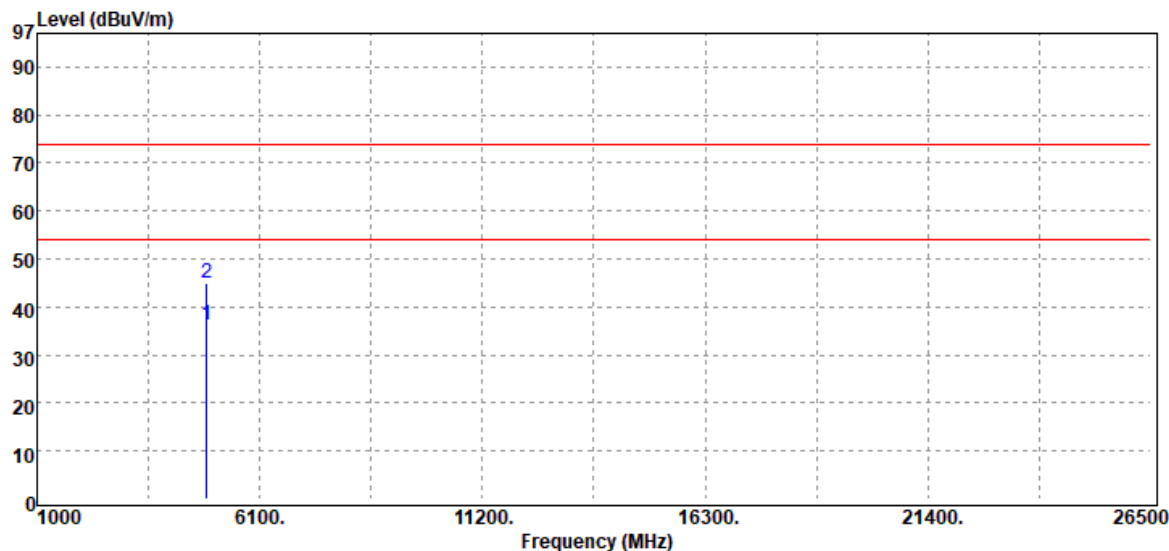
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Report Number :ER-2020-50091
Operation Mode :BT EDR
Test Frequency :2441 MHz
Test Mode :Tx CH Mid
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25/66
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dBμV | Factor dB | Actual FS dBμV/m | Limit @3m dBμV/m | Margin dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4882.00 | Average | 28.95 | 7.24 | 36.19 | 54.00 | -17.81 |
| 4882.00 | Peak | 37.57 | 7.24 | 44.81 | 74.00 | -29.19 |

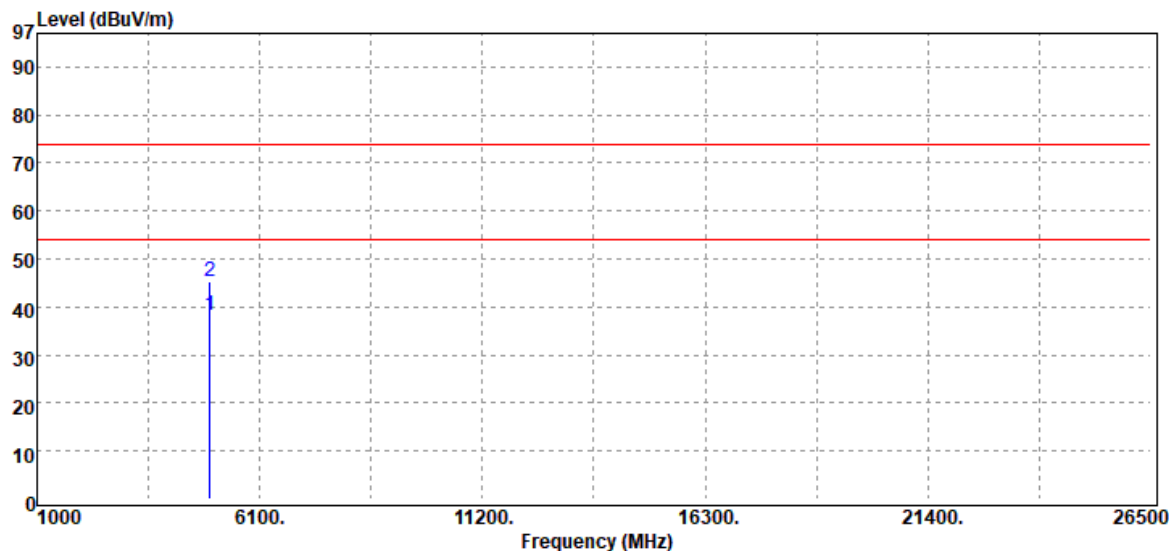
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Report Number :ER-2020-50091
Operation Mode :BT EDR
Test Frequency :2480 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25/66
Antenna Pol. :VERTICAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4960.00 | Average | 30.18 | 7.94 | 38.12 | 54.00 | -15.88 |
| 4960.00 | Peak | 37.33 | 7.94 | 45.27 | 74.00 | -28.73 |

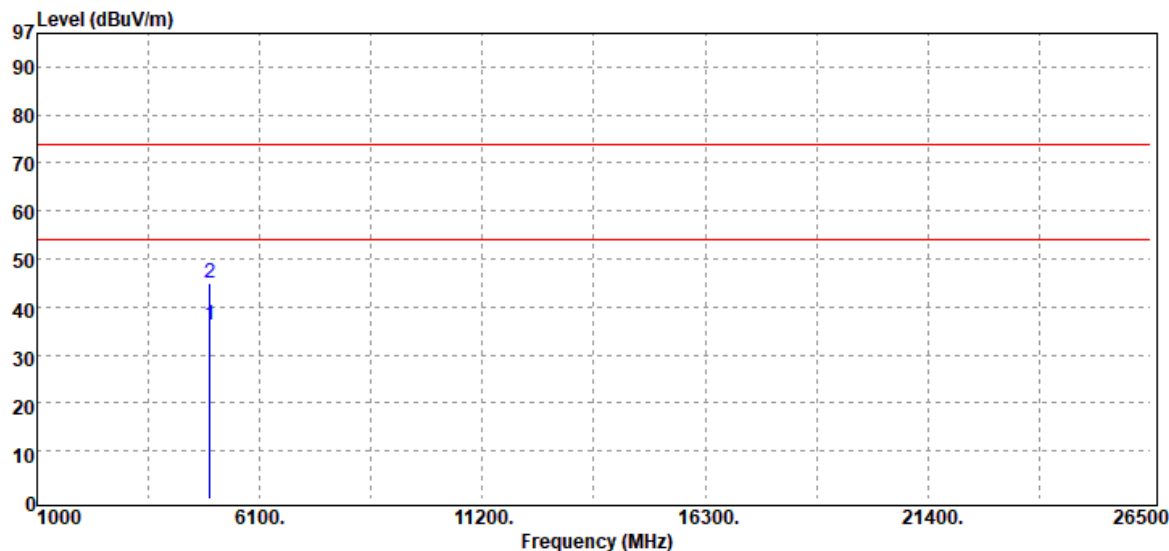
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Report Number :ER-2020-50091
Operation Mode :BT EDR
Test Frequency :2480 MHz
Test Mode :Tx CH High
EUT Pol :H Plane

Test Site :SAC III Chamber
Test Date :2020-06-24
Temp./Humi. :25/66
Antenna Pol. :HORIZONTAL
Engineer :Nick



| Freq. MHz | Detector Mode PK/QP/AV | Spectrum Reading Level dB μ V | Factor dB | Actual FS dB μ V/m | Limit @3m dB μ V/m | Margin dB |
|--------------|------------------------------|---|--------------|------------------------------|------------------------------|--------------|
| 4960.00 | Average | 28.56 | 7.67 | 36.23 | 54.00 | -17.77 |
| 4960.00 | Peak | 37.22 | 7.67 | 44.89 | 74.00 | -29.11 |

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11 FREQUENCY SEPARATION

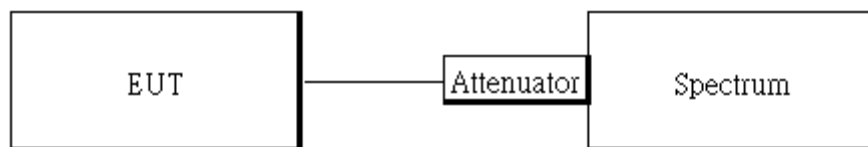
11.1 Standard Applicable

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the $2/3 \times 20\text{dB}$ bandwidth of the hopping channel, whichever is greater.

11.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/06/2020 | 05/05/2021 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2020 | 01/01/2021 |

11.3 Test Set-up



11.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = middle of hopping channel.
5. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

11.5 Measurement Result

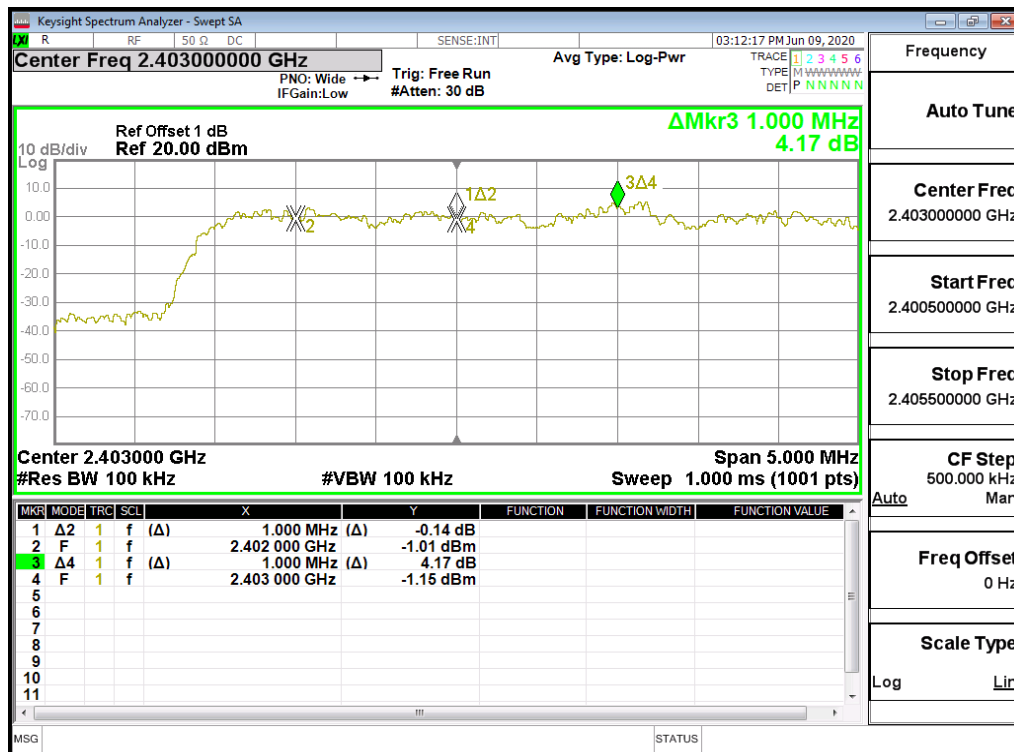
| Channel separation (MHz) | Limit | Result |
|--------------------------|--|--------|
| 1 | $\geq 25\text{ kHz}$ or $2/3\text{ times } 20\text{dB bandwidth}$ | PASS |

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11.6 Frequency Separation Test Plots



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12 NUMBER OF HOPPING FREQUENCY

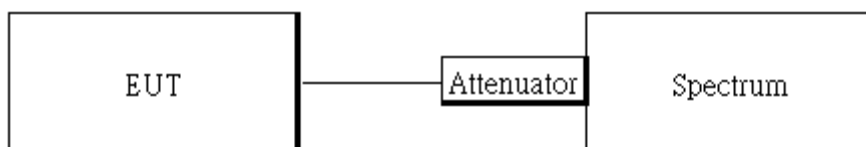
12.1 Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

12.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 05/06/2020 | 05/05/2021 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2020 | 01/01/2021 |

12.3 Test Set-up



12.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
5. Set the spectrum analyzer as RBW=430kHz, VBW=1.5MHz., Detector = Peak
6. Max hold, view and count how many channel in the band.

12.5 Measurement Result

Tabular Data of Total Channel Number

| | Channel Number | Limit |
|------------------------|----------------|-------|
| 2.4 GHz – 2.441 GHz | 40 | >15 |
| 2.441 GHz – 2.4835 GHz | 39 | |
| 2.4 GHz ~2.4835 GHz | (40+39) = 79 | |

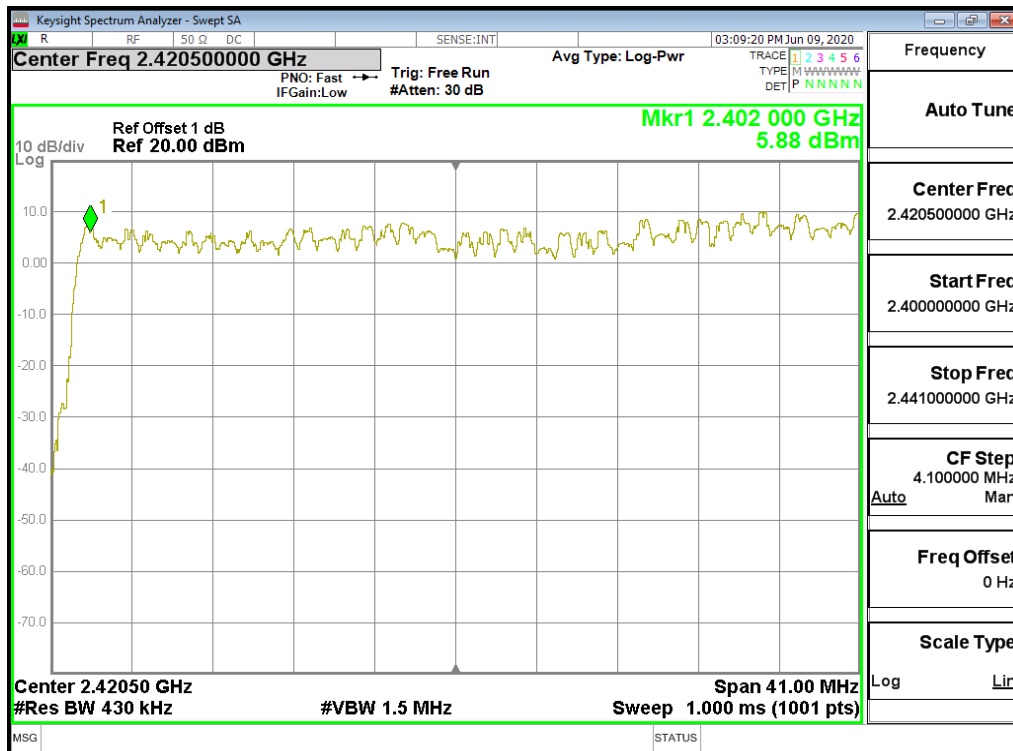
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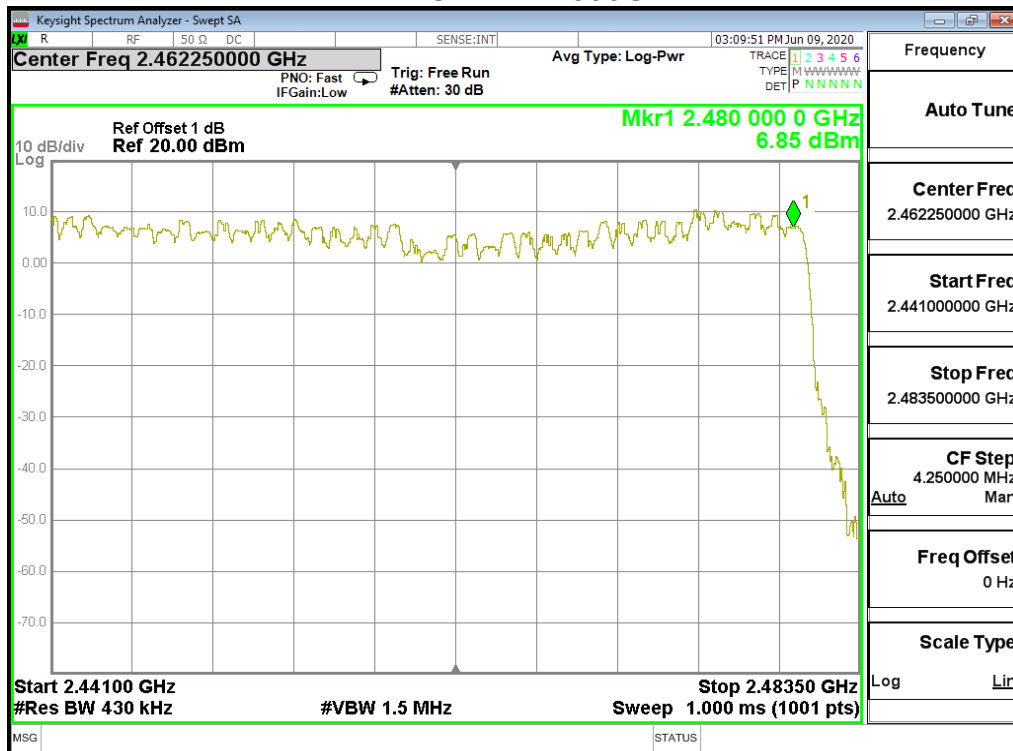
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12.6 Channel Number Test Plots

2.402GHz – 2.441GHz



2.441GHz – 2.4835GHz



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13 TIME OF OCCUPANCY (DWELL TIME)

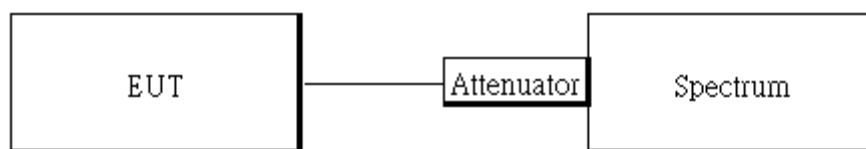
13.1 Standard Applicable

Frequency hopping systems operating in the 2400MHz-2483.5MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

13.2 Measurement Equipment Used

| Conducted Emission Test Site | | | | | |
|------------------------------|---------------|--------------|----------------|------------|------------|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EXA Spectrum Analyzer | Agilent | N9010A | MY5042019 5 | 05/06/2020 | 05/05/2021 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 01/02/2020 | 01/01/2021 |

13.3 Test Set-up



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13.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C6310:2015.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz , Detector = Peak, Adjust Sweep = 2~8ms.
6. Repeat above procedures until all frequency of the interest measured were complete.

Formula Deduced: time occupancy of one time slot X Hopping rate / total slot in one channel / total channel that hops X period of working channels.

Where, standard hopping rate is 1600 hops/s, slot in one channel for DH1, DH3, and DH5 is 2, 4, and 6, respectively.

DH1 consists of single time slot of the uplink, and one slot of the downlink Total Slot: 2

DH3 consists of three time slot of the uplink, and one slot of the downlink. Total Slot: 4

DH5 consists of five time slot of the uplink, and one slot of the downlink. Total Slot: 6

In AFH mode, hopping rate is 800 hop/s with 6 slots in 20 hopping channels with channel hopping rate $(800 / 6 / 20)$ in Occupancy Time Limit $(0.4 * 20)$ (S), Hop Over Occupancy Time comes to $(800 / 6 / 20) * (0.4 * 20) = 53.33$

Note: the result of the complete test default channel at 1Mbps is recorded on the test report, 2Mbps, and 3Mbps only records the measurement result at middle channel that reveals no much deviation.

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13.5 Tabular Result of the Measurement

GFSK (1Mbps)

| Channel | PACKET TYPE | Measurement Result (ms) | Limit (ms) | 1/T (kHz) | VBW setting (kHz) |
|---------|-------------|-------------------------|------------|-----------|-------------------|
| Low | DH1 | 120.00 | 400ms | 2.667 | 3.00 |
| | DH3 | 260.80 | 400ms | 0.613 | 1.00 |
| | DH5 | 307.20 | 400ms | 0.347 | 1.00 |
| Mid | DH1 | 121.60 | 400ms | 2.632 | 3.00 |
| | DH3 | 262.40 | 400ms | 0.610 | 1.00 |
| | DH5 | 307.20 | 400ms | 0.347 | 1.00 |
| High | DH1 | 121.60 | 400ms | 2.632 | 3.00 |
| | DH3 | 262.40 | 400ms | 0.610 | 1.00 |
| | DH5 | 307.20 | 400ms | 0.003 | 1.00 |

$\pi/4$ DQPSK (2Mbps)

| Channel | PACKET TYPE | Measurement Result (ms) | Limit (ms) | 1/T (kHz) | VBW setting (kHz) |
|---------|-------------|-------------------------|------------|-----------|-------------------|
| Mid | 2DH1 | 123.20 | 400ms | 2.597 | 3.00 |
| | 2DH3 | 260.80 | 400ms | 0.613 | 1.00 |
| | 2DH5 | 307.20 | 400ms | 0.347 | 1.00 |

8-DPSK (3Mbps)

| Channel | PACKET TYPE | Measurement Result (ms) | Limit (ms) | 1/T (kHz) | VBW setting (kHz) |
|---------|-------------|-------------------------|------------|-----------|-------------------|
| Mid | 3DH1 | 123.20 | 400ms | 2.597 | 3.00 |
| | 3DH3 | 260.80 | 400ms | 0.613 | 1.00 |
| | 3DH5 | 307.20 | 400ms | 0.347 | 1.00 |

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GFSK (1Mbps):

| | | | | | | | | | | |
|---------|---------------|---|-------|---|-------------|---|------|---|--------|------|
| CH Low | DH1 time slot | = | 0.375 | * | (1600/2/79) | * | 31.6 | = | 120.00 | (ms) |
| | DH3 time slot | = | 1.630 | * | (1600/4/79) | * | 31.6 | = | 260.80 | (ms) |
| | DH5 time slot | = | 2.880 | * | (1600/6/79) | * | 31.6 | = | 307.20 | (ms) |
| CH Mid | DH1 time slot | = | 0.380 | * | (1600/2/79) | * | 31.6 | = | 121.60 | (ms) |
| | DH3 time slot | = | 1.640 | * | (1600/4/79) | * | 31.6 | = | 262.40 | (ms) |
| | DH5 time slot | = | 2.880 | * | (1600/6/79) | * | 31.6 | = | 307.20 | (ms) |
| CH High | DH1 time slot | = | 0.380 | * | (1600/2/79) | * | 31.6 | = | 121.60 | (ms) |
| | DH3 time slot | = | 1.640 | * | (1600/4/79) | * | 31.6 | = | 262.40 | (ms) |
| | DH5 time slot | = | 2.880 | * | (1600/6/79) | * | 31.6 | = | 307.20 | (ms) |

$\pi/4$ -DQPSK (2Mbps):

| | | | | | | | | | | |
|--------|----------------|---|-------|---|-------------|---|------|---|--------|------|
| CH Mid | 2DH1 time slot | = | 0.385 | * | (1600/2/79) | * | 31.6 | = | 123.20 | (ms) |
| | 2DH3 time slot | = | 1.630 | * | (1600/4/79) | * | 31.6 | = | 260.80 | (ms) |
| | 2DH5 time slot | = | 2.880 | * | (1600/6/79) | * | 31.6 | = | 307.20 | (ms) |

8-DPSK (3Mbps):

| | | | | | | | | | | |
|--------|----------------|---|-------|---|-------------|---|------|---|--------|------|
| CH Mid | 3DH1 time slot | = | 0.385 | * | (1600/2/79) | * | 31.6 | = | 123.20 | (ms) |
| | 3DH3 time slot | = | 1.630 | * | (1600/4/79) | * | 31.6 | = | 260.80 | (ms) |
| | 3DH5 time slot | = | 2.880 | * | (1600/6/79) | * | 31.6 | = | 307.20 | (ms) |

A period time = 0.4 (s) * 79 = 31.6 (s)

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| GFSK (1Mbps) for AFH Mode | | | |
|------------------------------------|-------------|-------------------------|------------|
| Hopping Channel Number | PACKET TYPE | Measurement Result (ms) | Limit (ms) |
| 20 | DH5 | 153.60 | 400ms |
| $\pi/4$ DQPSK (2Mbps) for AFH Mode | | | |
| Hopping Channel Number | PACKET TYPE | Measurement Result (ms) | Limit (ms) |
| 20 | 2DH5 | 153.60 | 400ms |
| 8-DPSK (3Mbps) for AFH Mode | | | |
| Hopping Channel Number | PACKET TYPE | Measurement Result (ms) | Limit (ms) |
| 20 | 3DH5 | 153.60 | 400ms |

13.6 Measurement Result

Note: Refer to next page for plots.

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Dwell Time_GFSK_1M_DH1_2402MHz



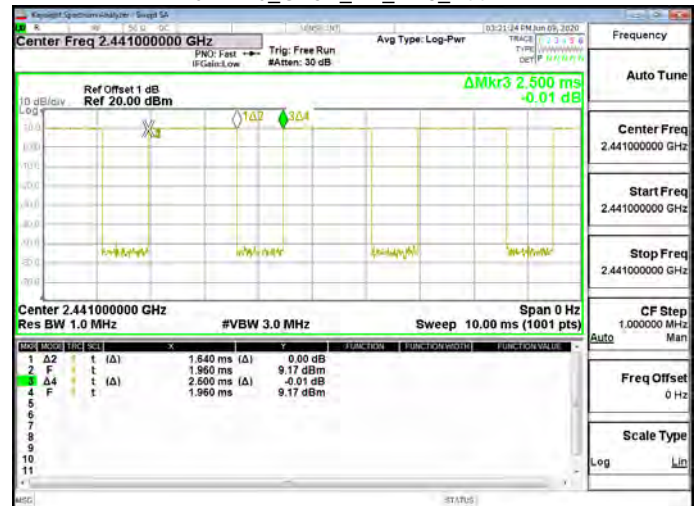
Dwell Time_GFSK_1M_DH3_2402MHz



Dwell Time_GFSK_1M_DH1_2441MHz



Dwell Time_GFSK_1M_DH3_2441MHz



Dwell Time_GFSK_1M_DH1_2480MHz



Dwell Time_GFSK_1M_DH3_2480MHz



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Dwell Time_GFSK_1M_DH5_2402MHz



Dwell Time_π/4QPSK_2M_DH1_2402MHz



Dwell Time_GFSK_1M_DH5_2441MHz



Dwell Time_π/4QPSK_2M_DH1_2441MHz



Dwell Time_GFSK_1M_DH5_2480MHz



Dwell Time_π/4QPSK_2M_DH1_2480MHz



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Dwell Time_π/4QPSK_2M_DH3_2402MHz



Dwell Time_π/4QPSK_2M_DH5_2402MHz



Dwell Time_π/4QPSK_2M_DH3_2441MHz



Dwell Time_π/4QPSK_2M_DH5_2441MHz



Dwell Time_π/4QPSK_2M_DH3_2480MHz



Dwell Time_π/4QPSK_2M_DH5_2480MHz

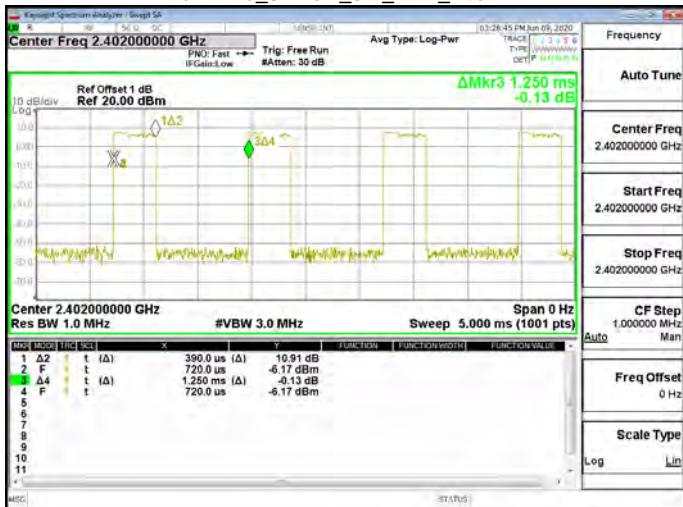


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Dwell Time_8DPSK_3M_DH1_2402MHz



Dwell Time_8DPSK_3M_DH3_2402MHz



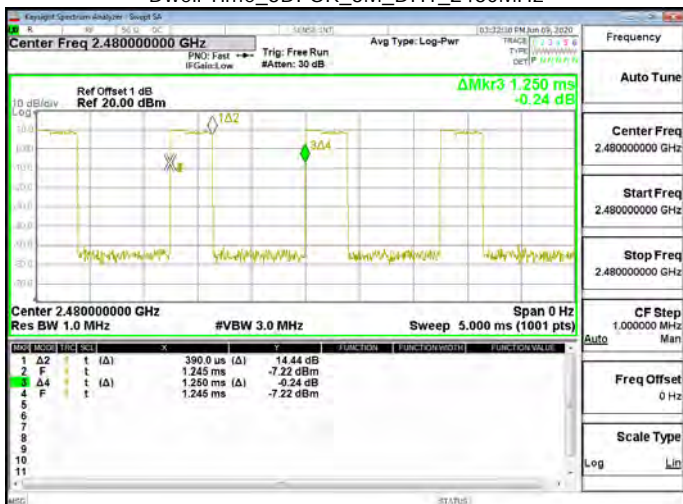
Dwell Time_8DPSK_3M_DH1_2441MHz



Dwell Time_8DPSK_3M_DH3_2441MHz



Dwell Time_8DPSK_3M_DH1_2480MHz



Dwell Time_8DPSK_3M_DH3_2480MHz



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Dwell Time_8DPSK_3M_DH5_2402MHz



Dwell Time_8DPSK_3M_DH5_2441MHz



Dwell Time_8DPSK_3M_DH5_2480MHz



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14 ANTENNA REQUIREMENT

14.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

14.2 Antenna Connected Construction

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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