

Dong Guan Jia Sheng Lighting Technology Co. Ltd.

TEST REPORT

SCOPE OF WORK

EMC TESTING—J6SLC RGBW, LD0000926-2

REPORT NUMBER

221125023GZU-001

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TEST REPORT

Applicant Name & : Dong Guan Jia Sheng Lighting Technology Co. Ltd.
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CHINA
Manufacturing Site : Same as applicant
Intertek Report No : 221125023GZU-001
FCC ID : 2AZYTJ6SLCRGBW

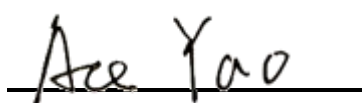
Test standards

47 CFR PART 15 Subpart C: 2021 section 15.247

Sample Description

Product : LED Retrofits
Model No. : J6SLC RGBW, LD0000926-2
Electrical Rating : 120Vac, 60Hz, Max.13W, 84PCS FOR NON-REPLACEABLE
LEDs and Max.5W FOR SPEAKER
Serial No. : Not Labeled
Date Received : 25 November 2022
Date Test : 16 May 2023-20 May 2023
Conducted

Prepared and Checked By



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Approved By:



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1.0 TEST RESULT SUMMARY

| Test Item | Test Requirement | Test Method | Result |
|---|---|---|--------|
| Antenna Requirement | FCC PART 15 C Clause 15.247 (c) and Clause 15.203 | FCC PART 15 C Clause 15.247 (c) and Clause 15.203 | PASS |
| 20 dB Bandwidth | FCC PART 15 C Clause 15.247 (a)(1) | ANSI C63.10: Clause 7.8.7 & 6.9.2 | PASS |
| Carrier Frequencies Separated | FCC PART 15 C Clause 15.247(a)(1) | ANSI C63.10: Clause 7.8.2 | PASS |
| Hopping Channel Number | FCC PART 15 C Clause 15.247(a)(1)(iii) | ANSI C63.10: Clause 7.8.3 | PASS |
| Dwell Time | FCC PART 15 C Clause 15.247(a)(1)(iii) | ANSI C63.10: Clause 7.8.4 | PASS |
| Pseudorandom Frequency Hopping Sequence | FCC PART 15 C Clause 15.247(a)(1) | FCC PART 15 C Clause 15.247(a)(1) | PASS |
| Maximum Peak Conducted Output Power | FCC PART 15 C Clause 15.247(b)(1) | ANSI C63.10: Clause 7.8.5 | PASS |
| Out of Band Conducted Emissions | FCC PART 15 C Clause 15.247(d) | ANSI C63.10: Clause 7.8.8 | PASS |
| Out of Band Radiated Emission | FCC PART 15 C Clause 15.247(d) | ANSI C63.10: Clause 6.4, 6.5 and 6.6 | N/A |
| Radiated Emissions in Restricted Bands | FCC PART 15 C Clause 15.209 & 15.247(d) | ANSI C63.10: Clause 6.4, 6.5 and 6.6 | PASS |
| Band Edges Measurement | FCC PART 15 C Clause 15.247 (d) & 15.205 | ANSI C63.10: Clause 7.8.6 & 6.10 | PASS |
| Conducted Emissions at Mains Terminals | FCC PART 15 C Clause 15.207 | ANSI C63.10: Clause 6.2 | PASS |

Remark:

N/A: not applicable. Refer to the relative section for the details.

EUT: In this whole report EUT means Equipment Under Test.

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radio Frequency.

ANSI C63.10: the detail version is ANSI C63.10:2013 in the whole report.

Model J6SLC RGBW and model LD0000926-2 are the same except for the model name.

Model J6SLC RGBW has two circuit designs, as shown in the internal photos and Component Alteration Description. Both versions were selected to test, the worst case was recorded.

TEST REPORT

2.0 General Description

2.1 Product Description

| | |
|----------------------|---------------------------------|
| Operating Frequency: | 2402 MHz – 2480MHz |
| Type of Modulation: | GFSK, ($\pi/4$)-DQPSK, 8-DPSK |
| Number of Channels: | 79 Channels |
| Channel Separation: | 1 MHz |
| Dwell Time: | Per channel is less than 0.4s |
| Antenna Type: | PCB antenna |
| Antenna Gain: | 2.6 dBi |
| Speciality: | Bluetooth 5.0 with EDR |
| Function: | LED Retrofits with BT function |
| Power Supply: | 120Vac,60Hz |

Power cord: wires unscreened AC supply cable

Remark: The device meets the requirements stated within Parts 15.247(g) & (h) in that they were developed under the Bluetooth protocol and operate as a true frequency hopping system. The device does not have the ability to be coordinated with other FHSS systems in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

EUT modulation and data packet during test:

For Normal mode:

The EUT has been tested on the Modulation of GFSK with DH1, DH3 and DH5 data packet.

For EDR mode:

1. The EUT has been tested on the Modulation of ($\pi/4$)-DQPSK with 2DH1, 2DH3 and 2DH5 data packet.
2. The EUT has been tested on the Modulation of 8-DPSK with 3DH1, 3DH3 and 3DH5 data packet.

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EUT channels and frequencies list:

Test frequencies are lowest channel 0: 2402 MHz, middle channel 39: 2441 MHz and highest channel 78: 2480 MHz.

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|
| 0 | 2402 | 27 | 2429 | 54 | 2456 |
| 1 | 2403 | 28 | 2430 | 55 | 2457 |
| 2 | 2404 | 29 | 2431 | 56 | 2458 |
| 3 | 2405 | 30 | 2432 | 57 | 2459 |
| 4 | 2406 | 31 | 2433 | 58 | 2460 |
| 5 | 2407 | 32 | 2434 | 59 | 2461 |
| 6 | 2408 | 33 | 2435 | 60 | 2462 |
| 7 | 2409 | 34 | 2436 | 61 | 2463 |
| 8 | 2410 | 35 | 2437 | 62 | 2464 |
| 9 | 2411 | 36 | 2438 | 63 | 2465 |
| 10 | 2412 | 37 | 2439 | 64 | 2466 |
| 11 | 2413 | 38 | 2440 | 65 | 2467 |
| 12 | 2414 | 39 | 2441 | 66 | 2468 |
| 13 | 2415 | 40 | 2442 | 67 | 2469 |
| 14 | 2416 | 41 | 2443 | 68 | 2470 |
| 15 | 2417 | 42 | 2444 | 69 | 2471 |
| 16 | 2418 | 43 | 2445 | 70 | 2472 |
| 17 | 2419 | 44 | 2446 | 71 | 2473 |
| 18 | 2420 | 45 | 2447 | 72 | 2474 |
| 19 | 2421 | 46 | 2448 | 73 | 2475 |
| 20 | 2422 | 47 | 2449 | 74 | 2476 |
| 21 | 2423 | 48 | 2450 | 75 | 2477 |
| 22 | 2424 | 49 | 2451 | 76 | 2478 |
| 23 | 2425 | 50 | 2452 | 77 | 2479 |
| 24 | 2426 | 51 | 2453 | 78 | 2480 |
| 25 | 2427 | 52 | 2454 | / | / |
| 26 | 2428 | 53 | 2455 | / | / |

2.2 Related Submittal(s) Grants

This is an application for certification of:

DSS-Part 15 Spread Spectrum Transmitter (BT transmitter portion)

Remaining portions are subject to the following procedures:

1. Receiver portion of BT: exempt from technical requirement of this Part.
2. The LED Retrofits without BT connection function: FCC SDOC requirement.

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2.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10:2013. Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans and final tests were performed in the semi-anechoic chamber to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise.

2.4 Test Facility

All tests were performed at:

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Room102/104, No 203, KeZhu Road, Science City, GETDD Guangzhou, China

Except Conducted Emissions was performed at:

Room 02, & 101/E201/E301/E401/E501/E601/E701/E801 of Room 01 1-8/F., No. 7-2. Caipin Road, Science City, GETDD, Guangzhou, Guangdong, China

A2LA Certificate Number 0078.10

Intertek Testing Services Shenzhen Ltd. Guangzhou Branch is accredited by A2LA and Listed in FCC website. FCC accredited test labs may perform both Certification testing under Parts 15 and 18 and Declaration of Conformity testing.

3.0 System Test Configuration

3.1 Justification

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, AC power line was manipulated to produce worst case emissions. It was powered by AC 120V/60Hz supply.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. The spurious emissions more than 20 dB below the permissible value are not reported.

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For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in the following table:

Frequency range of radiated emission measurements

| Lowest frequency generated in the device | Upper frequency range of measurement |
|--|---|
| 9 kHz to below 10 GHz | 10th harmonic of highest fundamental frequency or to 40 GHz, whichever is lower |
| At or above 10 GHz to below 30 GHz | 5th harmonic of highest fundamental frequency or to 100 GHz, whichever is lower |
| At or above 30 GHz | 5th harmonic of highest fundamental frequency or to 200 GHz, whichever is lower, unless otherwise specified |

Number of fundamental frequencies to be tested in EUT transmit band

| Frequency range in which device operates | Number of frequencies | Location in frequency range of operation |
|--|-----------------------|---|
| 1 MHz or less | 1 | Middle |
| 1 MHz to 10 MHz | 2 | 1 near top and 1 near bottom |
| More than 10 MHz | 3 | 1 near top, 1 near middle and 1 near bottom |

3.2 EUT Exercising Software

| Description | Manufacturer | Model No. | SN/Version | Supplied by |
|----------------------|--------------|-----------|-------------------------|-------------|
| For fixing frequency | -- | LSRT | Version:2.1.32.58 81 | Client |

3.3 Special Accessories

No special accessories used

3.4 Measurement Uncertainty

| No. | Item | Measurement Uncertainty |
|-----|-----------------|-------------------------|
| 1 | 20 dB Bandwidth | 2.3% |
| | 6dB Bandwidth | |

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| | | |
|----|--|-----------------------|
| | 99% Bandwidth | |
| 2 | Carrier Frequencies Separated | 2.3% |
| 3 | Dwell Time | 1.2% |
| 4 | Maximum Peak Conducted Output Power | 1.5dB |
| 5 | Peak Power Spectral Density | 1.5dB |
| 6 | Out of Band Conducted Emissions | 1.5dB |
| 7 | Band edges measurement | 1.5dB |
| 8 | Radiated Emissions | 4.7 dB (25 MHz-1 GHz) |
| | | 4.8 dB (1 GHz-18 GHz) |
| | | 5.21dB (18GZH-26GHz) |
| 9 | Conducted Emissions at Mains Terminals | 2.58dB |
| 10 | Temperature | 0.5 °C |
| 11 | Humidity | 0.4 % |
| 12 | Time | 1.2% |

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT.

Measurement uncertainty is calculated in accordance with ETSI TR 100 028-2001.

The measurement uncertainty is given with a confidence of 95%, k=2.

When determining of the test conclusion, the Measurement Uncertainty of test has been considered.

Uncertainty and Compliance – Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value

3.5 Equipment Modification

Any modifications installed previous to testing by Dong Guan Jia Sheng Lighting Technology Co. Ltd. will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch.

3.6 Support Equipment List and Description

This product was tested with corresponding support equipment as below:

Support Equipment

| Description | Manufacturer | Model No. | SN/Version/Rating | Supplied by |
|-------------|--------------|---------------|-------------------|-------------|
| NoteBook | Dell | Latitude 5400 | | Intertek |

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Cable

| Description | Model No. | Connector type | Cable length/type | Supplied by |
|---------------|-----------|----------------|-------------------|-------------|
| Antenna cable | RF-01 | SMA | 0.2 m | Intertek |

TEST REPORT

4.0 Measurement Results

4.1 Antenna Requirement

Standard requirement:

15.203 requirement:

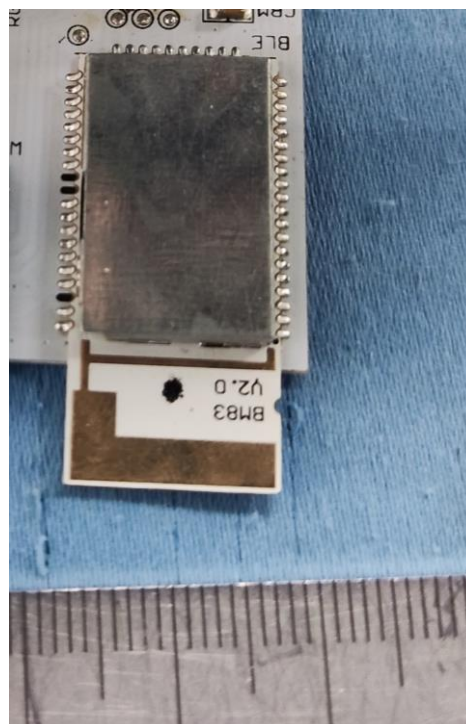
For intentional device. According to 15.203, an intentional radiator shall be designed to Ensure that no antenna other than that furnished by the responsible party shall be used with the device.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz bands that are used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi 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 6 dBi.

EUT Antenna

The antenna is an PCB antenna and no consideration of replacement. The best case gain of the antenna is 2.6 dBi

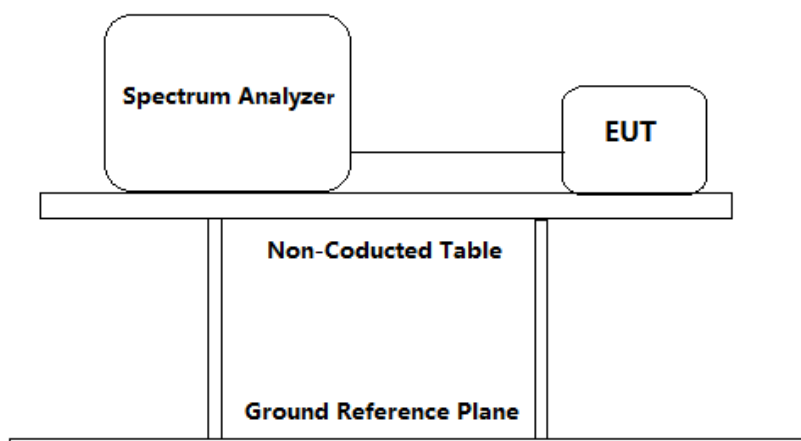


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4.2 20 dB Bandwidth

| | |
|-------------------|---|
| Test Requirement: | FCC Part 15 C section 15.247 (a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. |
| Test Method: | ANSI C63.10: Clause 7.8.7 & 6.9.2 |
| Test Status: | Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channels with different data package. Compliance test in normal mode (DH) and EDR mode (2DH1, 3DH1) as the worst case was found. |

Test Configuration:



Test Procedure:

Removed the antenna from the EUT and then connect a low RF cable(cable loss =1 dB, with 10dB attenuator) from the antenna port to the spectrum. The transmitter was operated at its maximum carrier power measured under normal test conditions.

1. The instrument center frequency was set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer was between two times and five times the OBW(20 dB Bandwidth).
2. The nominal IF filter bandwidth (3 dB RBW) was in the range of 1% to 5% of the OBW, and VBW was approximately three times the RBW.
3. Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope was more than $[10 \log (OBW/RBW)]$ below the reference level.
4. Step 1) through step 3) might require iteration to adjust within the specified range.

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5. The dynamic range of the instrument at the selected RBW was more than 10 dB below the target “-20 dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW was at least 30 dB below the reference value.
6. Peak detection and max hold mode (until the trace stabilizes) was used.
7. Used the 20dB bandwidth function of the instrument and reported the measured bandwidth.
8. The occupied bandwidth was reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division was clearly labeled. Tabular data was reported in addition to the plot(s).

Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

Test result:

Normal mode (DH1):

| Test Channel | Bandwidth(MHz) | 2/3 bandwidth(MHz) |
|--------------|----------------|--------------------|
| Lowest | 0.947 | 0.631 |
| Middle | 0.947 | 0.631 |
| Highest | 0.947 | 0.631 |

EDR mode (2DH1):

| Test Channel | bandwidth | 2/3 bandwidth |
|--------------|-----------|---------------|
| Lowest | 1.289 | 0.859 |
| Middle | 1.259 | 0.839 |
| Highest | 1.259 | 0.839 |

EDR mode (3DH1):

| Test Channel | bandwidth | 2/3 bandwidth |
|--------------|-----------|---------------|
| Lowest | 1.255 | 0.837 |
| Middle | 1.229 | 0.819 |
| Highest | 1.224 | 0.816 |

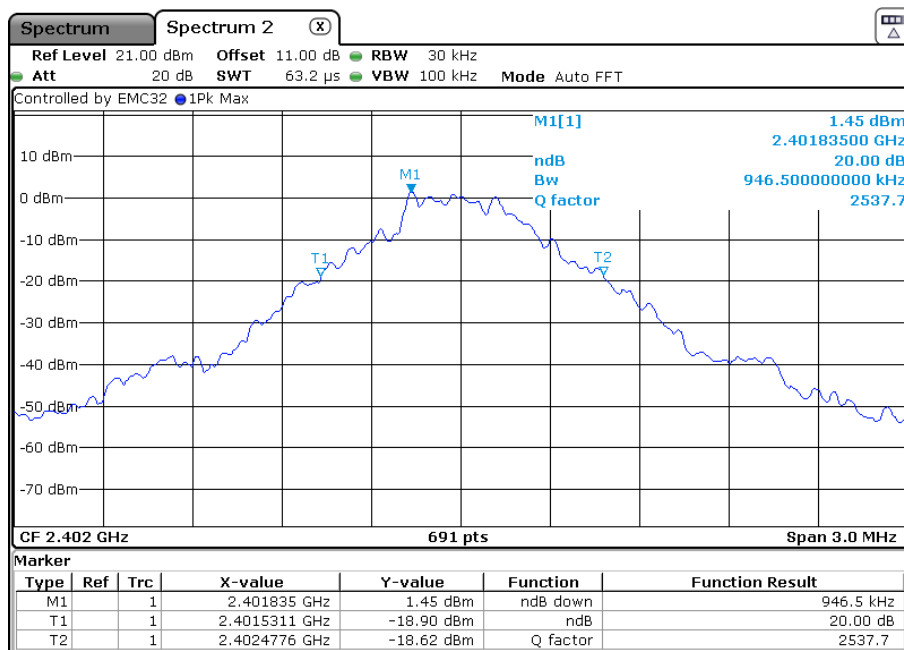
Test result: The unit does meet the FCC requirements.

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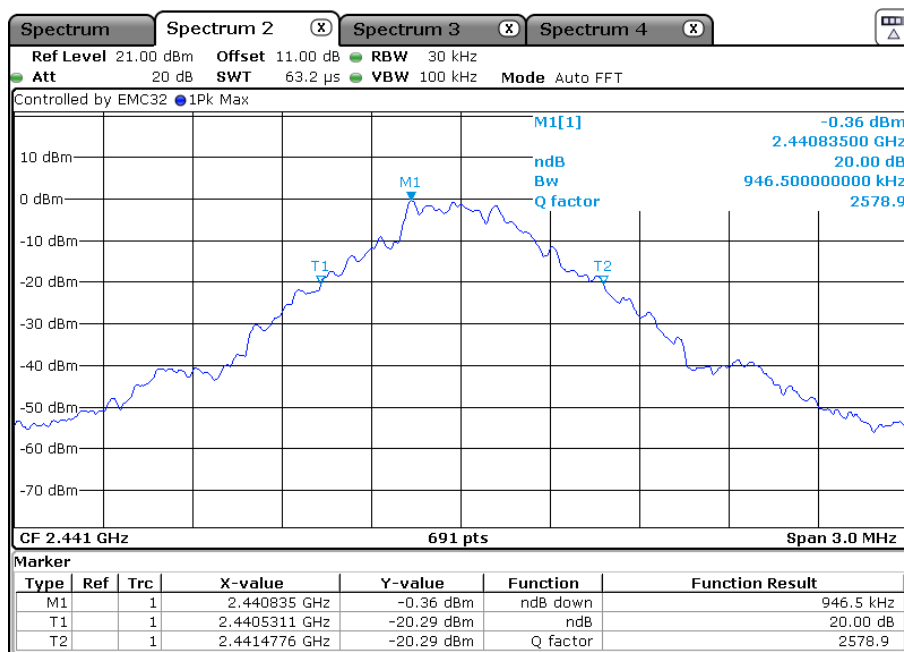
Result plot as follows:

Normal mode (DH1):

Lowest Channel(2.402 GHz):

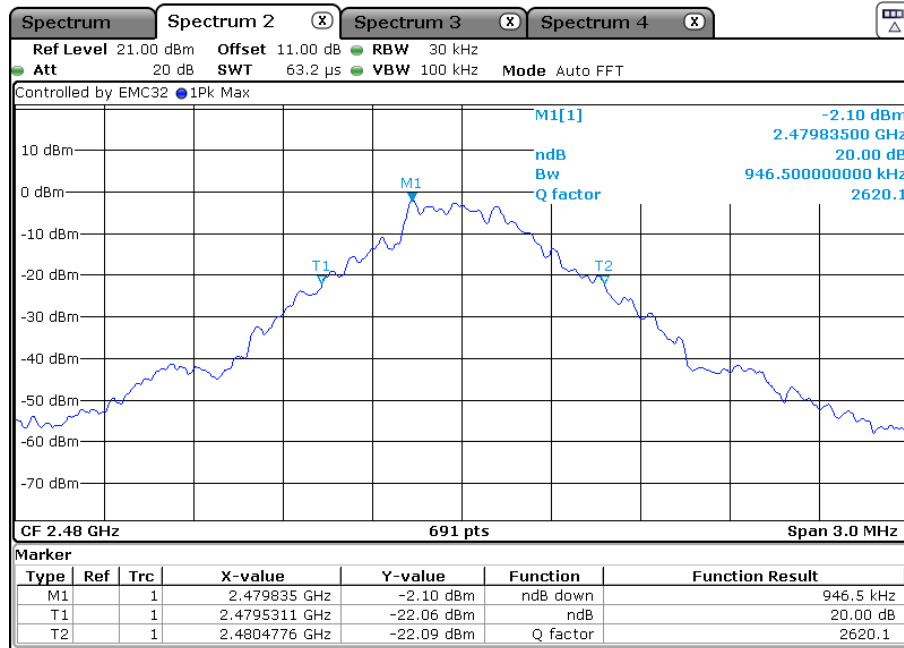


Middle Channel(2.441 GHz):



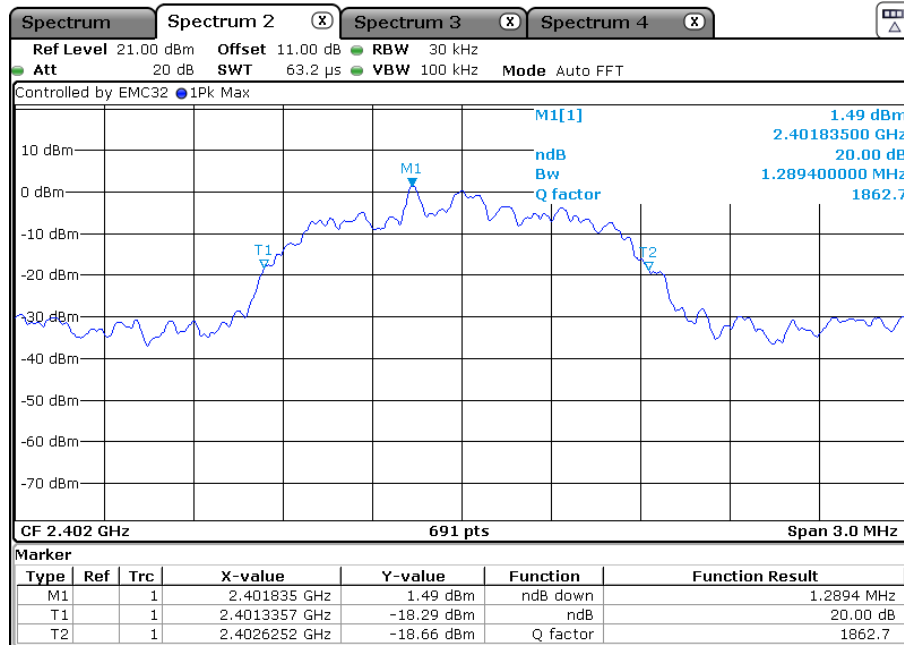
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Highest Channel(2.480 GHz):



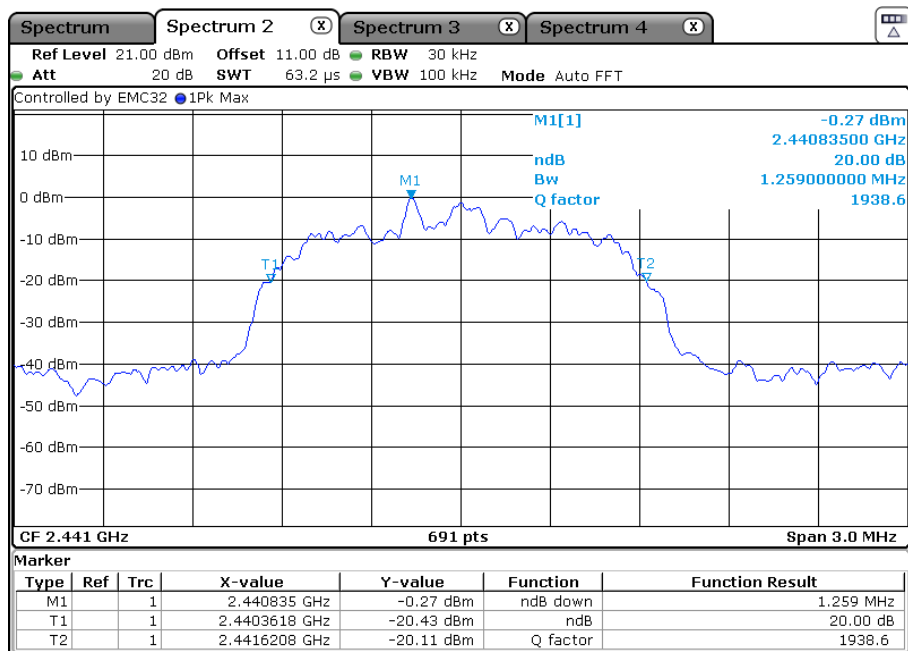
EDR mode (2DH1):

Lowest channel(2.402 GHz):

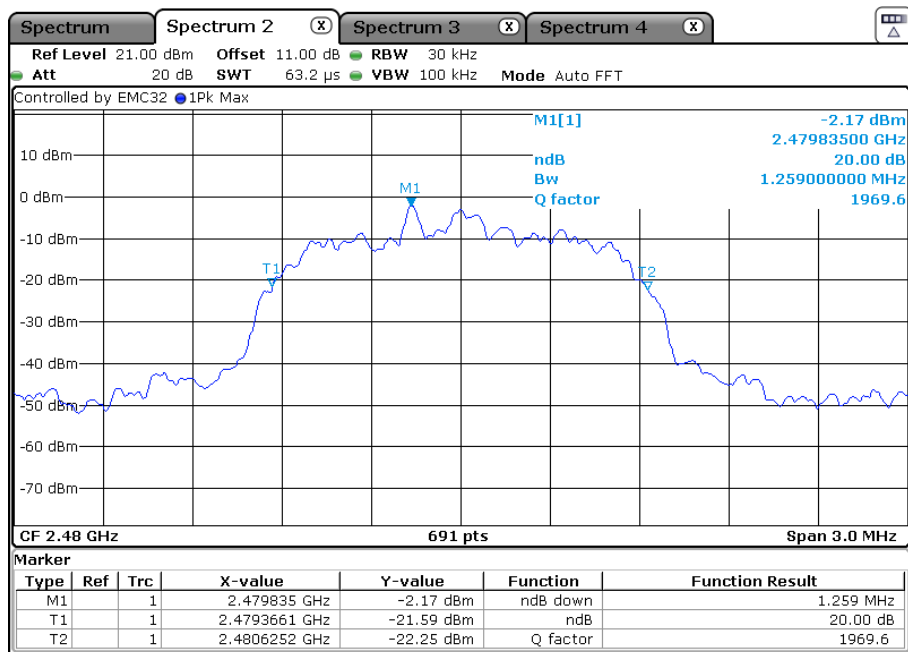


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Middle channel(2.441 GHz):



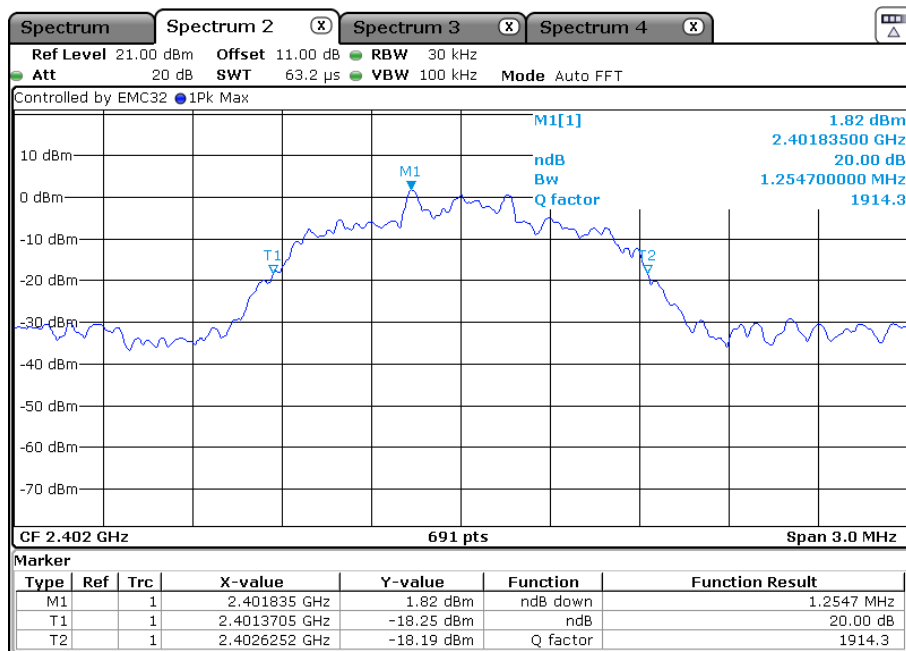
Highest channel(2.480 GHz):



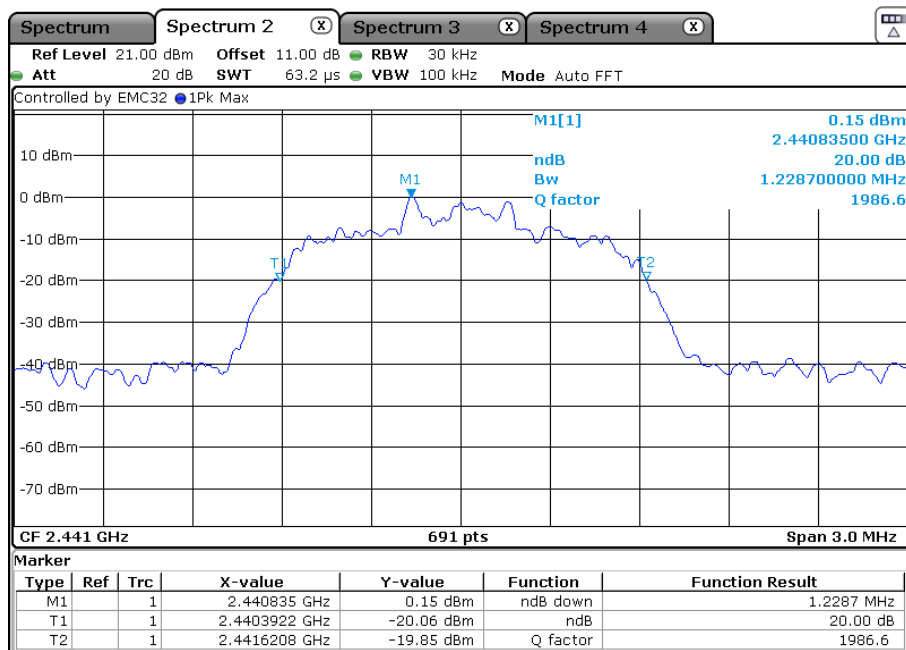
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EDR mode (3DH1):

Lowest channel(2.402 GHz):

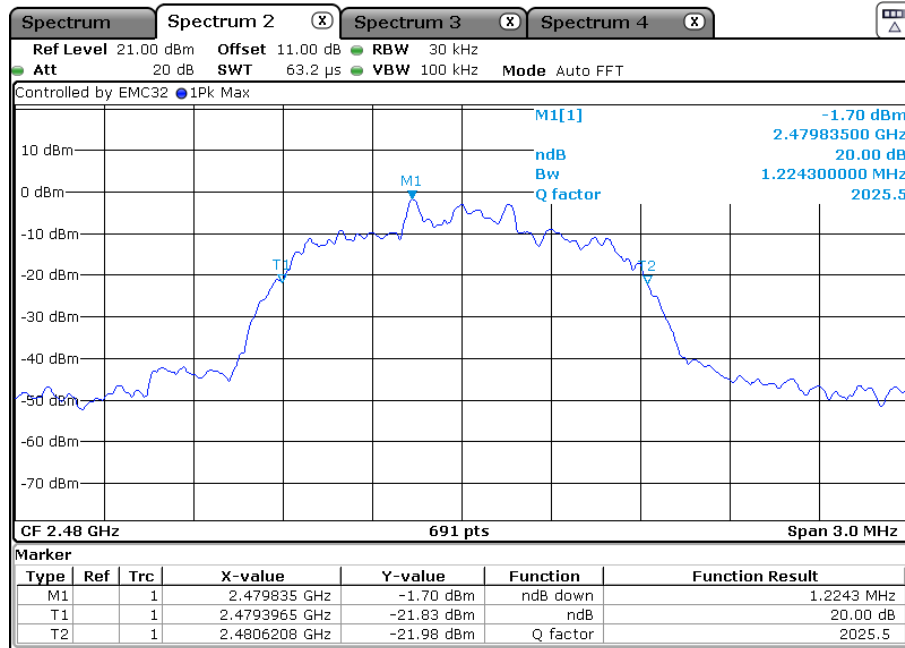


Middle channel(2.441 GHz):



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Highest channel(2.480 GHz):

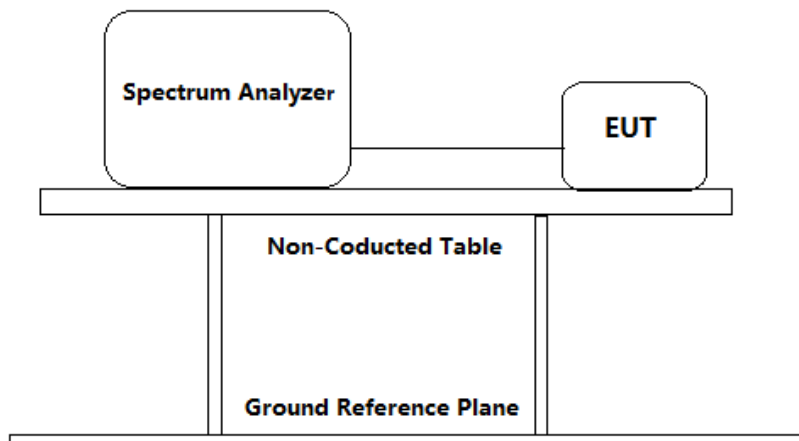


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4.3 Carrier Frequencies Separated

| | |
|-------------------|---|
| Test Requirement: | FCC Part 15 C section 15.247 (a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. |
| Test Method: | ANSI C63.10: Clause 7.8.2 |
| Test Status: | Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in hopping with normal mode (DH1) as the worst case was found. |

Test Configuration:



Test Procedure:

1. Removed the antenna from the EUT and then connect a low attenuation RF cable (cable loss = 1 dB, with 10dB attenuator) from the antenna port to the spectrum.
2. Span: Wide enough to capture the peaks of two adjacent channels.
3. Set the spectrum analyzer: RBW \geq 1% of the span, VBW \geq RBW, Sweep = auto; Detector Function = Peak. Trace = Max hold.
4. Allowed the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

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Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

Test result:

Normal mode (DH1):

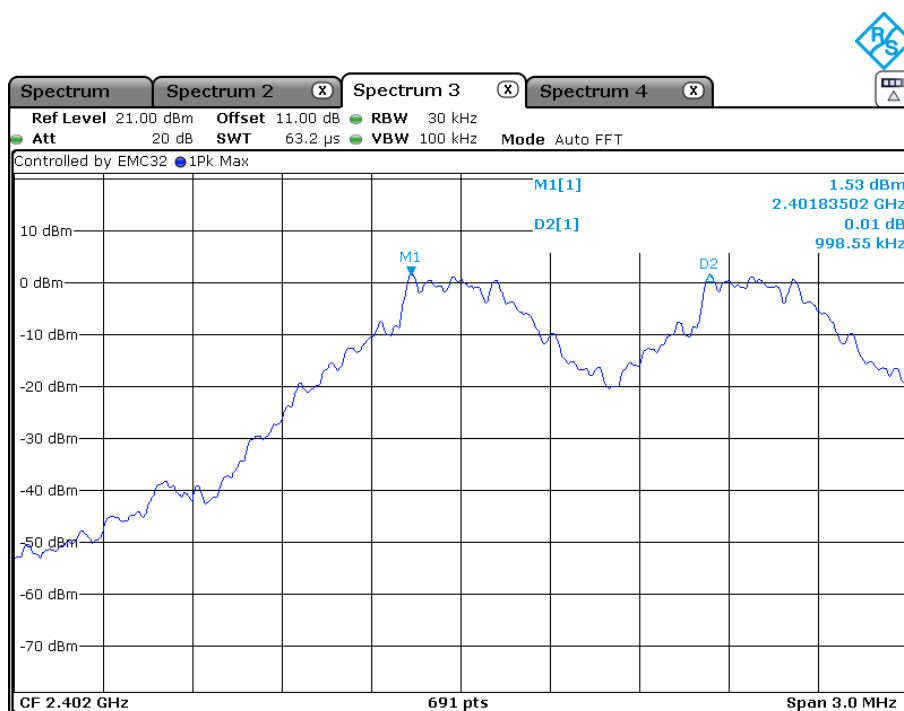
| Test Channel | Carrier Frequencies Separated | Pass/Fail |
|--|-------------------------------|-----------|
| Lower Channels (channel 0 and channel 1) | 0.999MHz | Pass |
| Middle Channels (channel 39 and channel 40) | 1.003MHz | Pass |
| Upper Channels (channel 77 and channel 78) | 0.999MHz | Pass |

Remark:

The limit is the maximum two-thirds of the 20 dB bandwidth: 859 KHz.

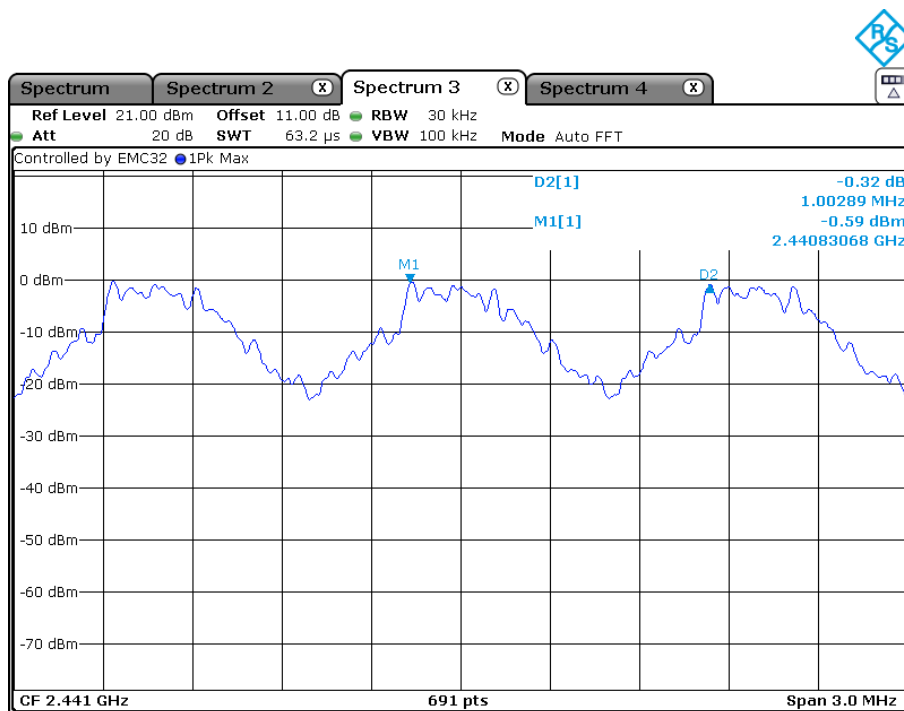
Result plot as follows:

Lowest Channels: Carrier Frequencies Separated:

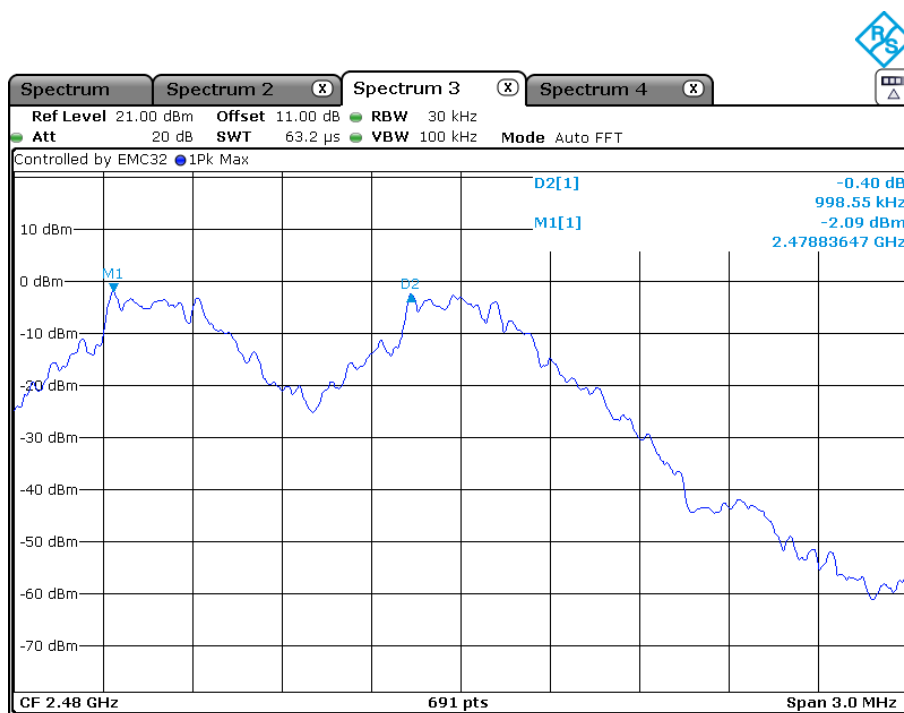


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Middle Channels: Carrier Frequencies Separated:



Highest Channels: Carrier Frequencies Separated:



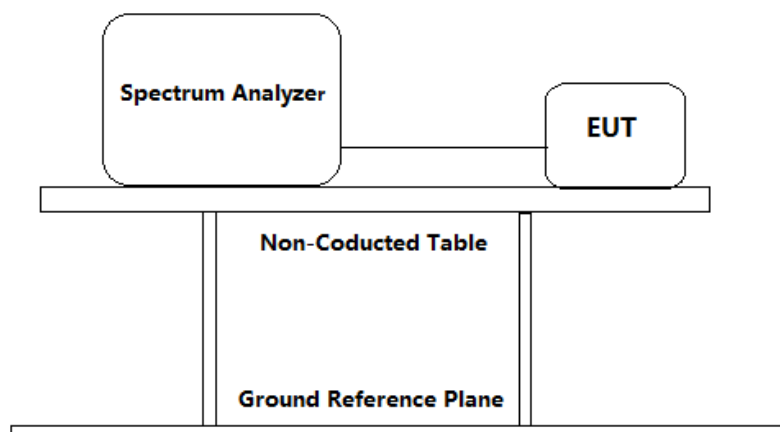
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Test result: The unit does meet the FCC requirements.

4.4 Hopping Channel Number

| | |
|-------------------|---|
| Test Requirement: | FCC Part15 C section 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. |
| Test Method: | NSI C63.10: Clause 7.8.3 |
| Test Status: | Pre-test the EUT in hopping mode with different data packet. Compliance test in normal mode (DH1) and EDR mode (2DH1,3DH1) as the worst case was found. |

Test Configuration:



Test Procedure:

1. Removed the antenna from the EUT and then connect a low attenuation RF cable(cable loss =1 dB, with 10dB attenuator) from the antenna port to the spectrum.
2. Span: The frequency band of operation
3. Set the spectrum analyzer: RBW = 300 kHz. VBW = 300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.
4. Allowed the trace to stabilize.
5. Set the spectrum analyzer: start frequency = 2400 MHz, stop frequency = 2483.5 MHz. Submit the test result graph.

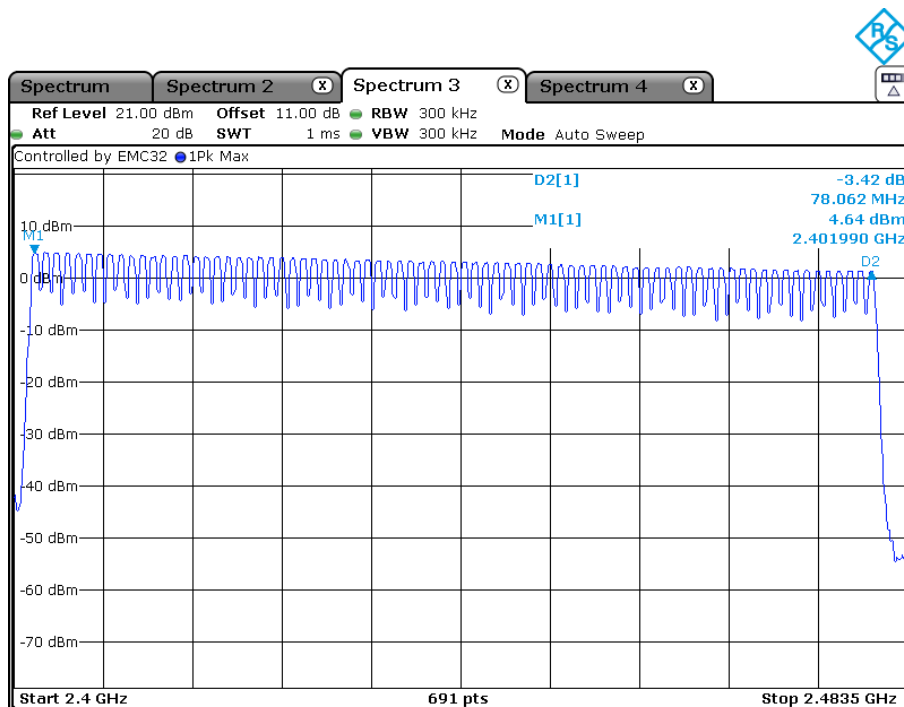
Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

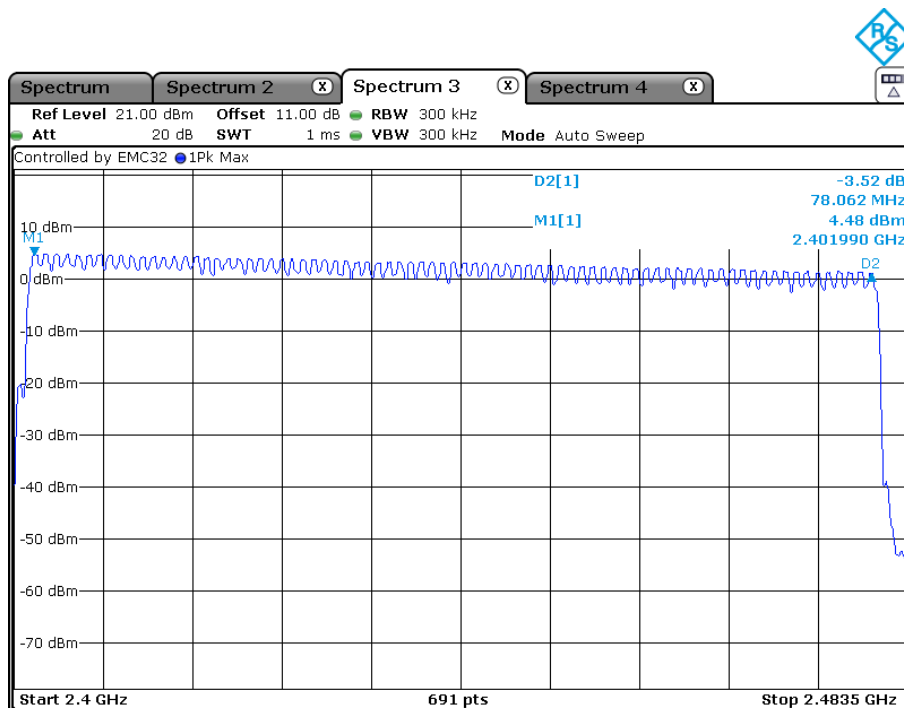
Test result: Total channels are 79 channels.

TEST REPORT

BDR mode (DH1):

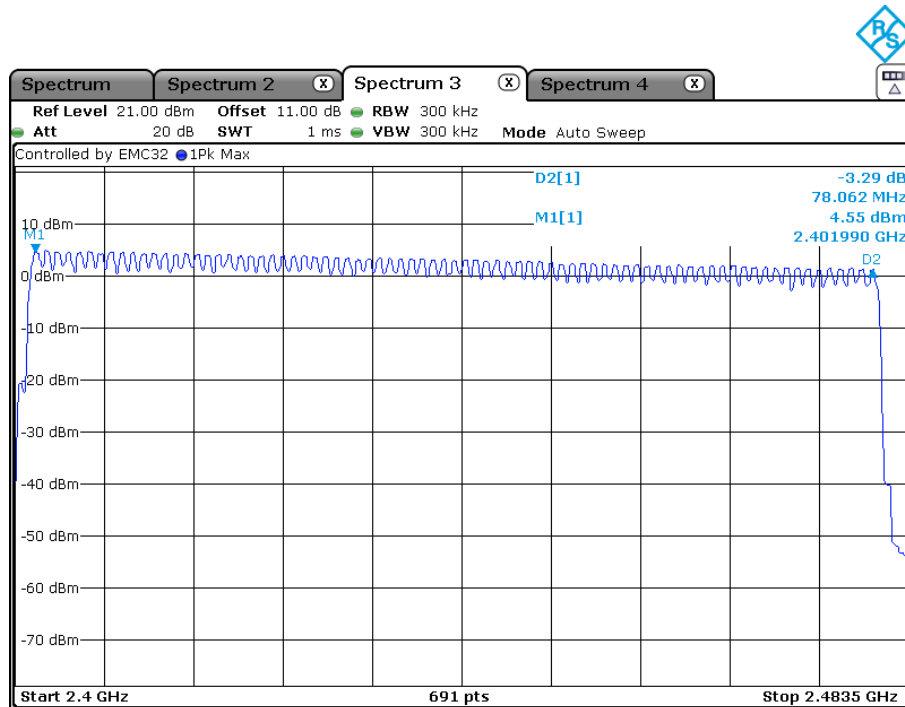


EDR mode (2DH1):



TEST REPORT

EDR mode (3DH1):

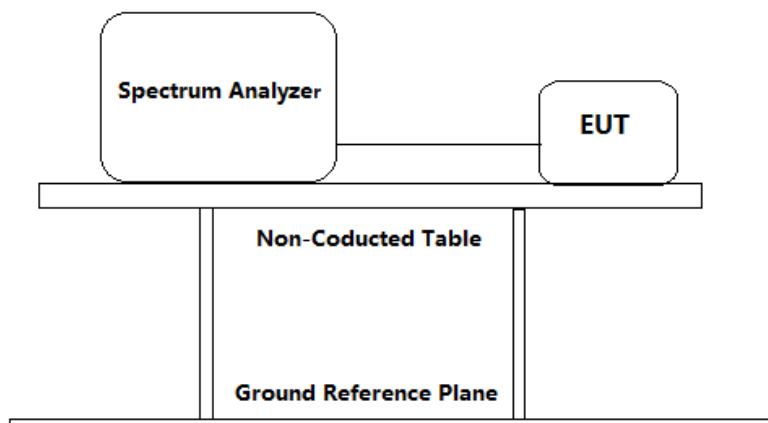


Test result: The unit does meet the FCC requirements.

TEST REPORT

4.5 Dwell Time

| | |
|---------------------|---|
| Test Requirement: | FCC Part 15 C section 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| Test Method: | ANSI C63.10: Clause 7.8.4 |
| Test Status: | Test the EUT in hopping mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in normal mode (DH1,DH3,DH5) and EDR mode (2DH1,2DH3, 3DH1,3DH3,2DH5,3DH5) as the worst case middle (2441MHz) was found. |
| Test Configuration: | |



Test Procedure:

1. Removed the antenna from the EUT and then connect a low attenuation RF cable(cable loss =1 dB, with 10dB attenuator) from the antenna port to the spectrum.
2. Set spectrum analyzer span = 0, centered on a hopping channel.
3. Set RBW = 3 MHz and VBW =3 MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = Max hold;
4. Used the marker-delta function to determine the dwell time.

Used Test Equipment List

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

TEST REPORT

Test Result:

The test period: $T = 0.4 \text{ s} \times 79 \text{ Channel} = 31.6 \text{ s}$

Channel 39: 2.441 GHz

| | | | | | | | | | | |
|----------------|---|-------|------|---|----|---|-------------|---|-------|----|
| DH1 time slot | = | 0.410 | (ms) | * | 29 | * | (31.6/3.16) | = | 118.9 | ms |
| DH3 time slot | = | 1.674 | (ms) | * | 13 | * | (31.6/3.16) | = | 217.6 | ms |
| DH5 time slot | = | 2.928 | (ms) | * | 13 | * | (31.6/3.16) | = | 380.6 | ms |
| 2DH1 time slot | = | 0.419 | (ms) | * | 32 | * | (31.6/3.16) | = | 134.1 | ms |
| 2DH3 time slot | = | 1.683 | (ms) | * | 18 | * | (31.6/3.16) | = | 302.9 | ms |
| 2DH5 time slot | = | 2.928 | (ms) | * | 11 | * | (31.6/3.16) | = | 322.1 | ms |
| 3DH1 time slot | = | 0.419 | (ms) | * | 32 | * | (31.6/3.16) | = | 134.1 | ms |
| 3DH3 time slot | = | 1.674 | (ms) | * | 17 | * | (31.6/3.16) | = | 284.6 | ms |
| 3DH5 time slot | = | 2.935 | (ms) | * | 11 | * | (31.6/3.16) | = | 322.9 | ms |

The average time of occupancy in the specified 31.6 second period is equal to pulse width x (number of pulse in observation period) x (test period / observation period).

The results are not greater than 0.4 seconds.

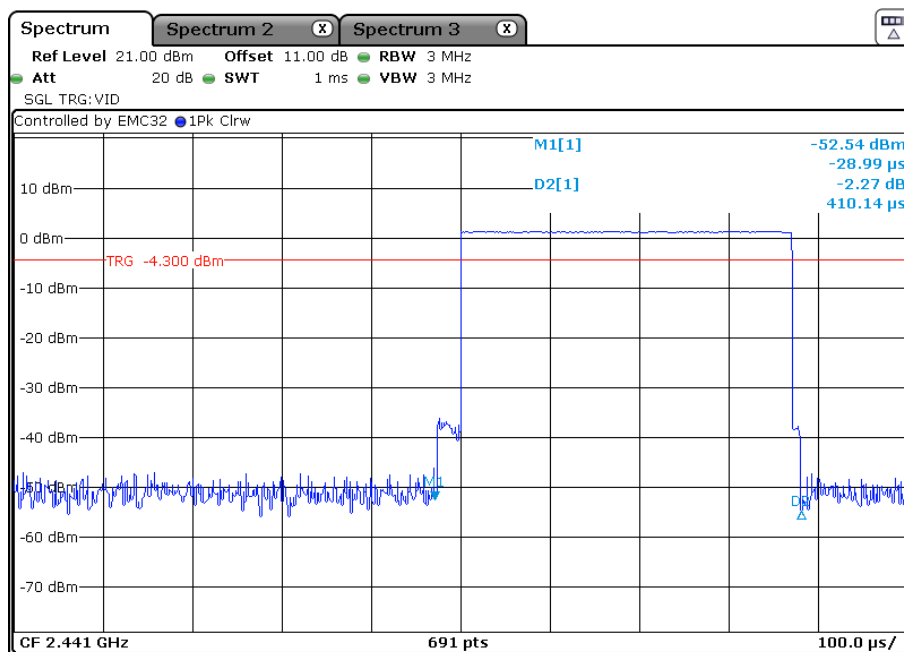
The unit does meet the FCC requirements.

Result plot as follows:

Middle Channel: 2.441 GHz

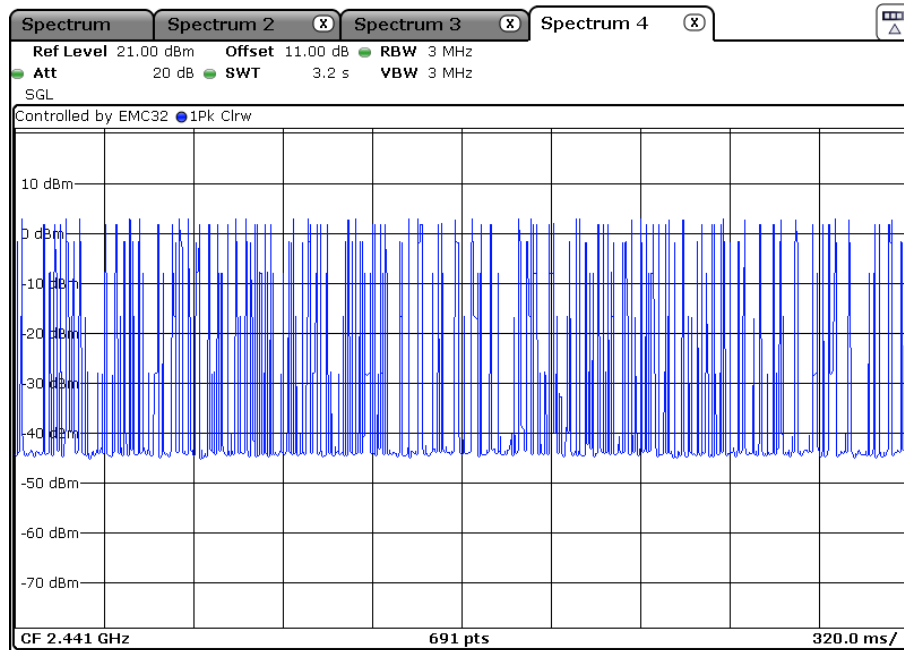
(1) DH1

Pulse Width:



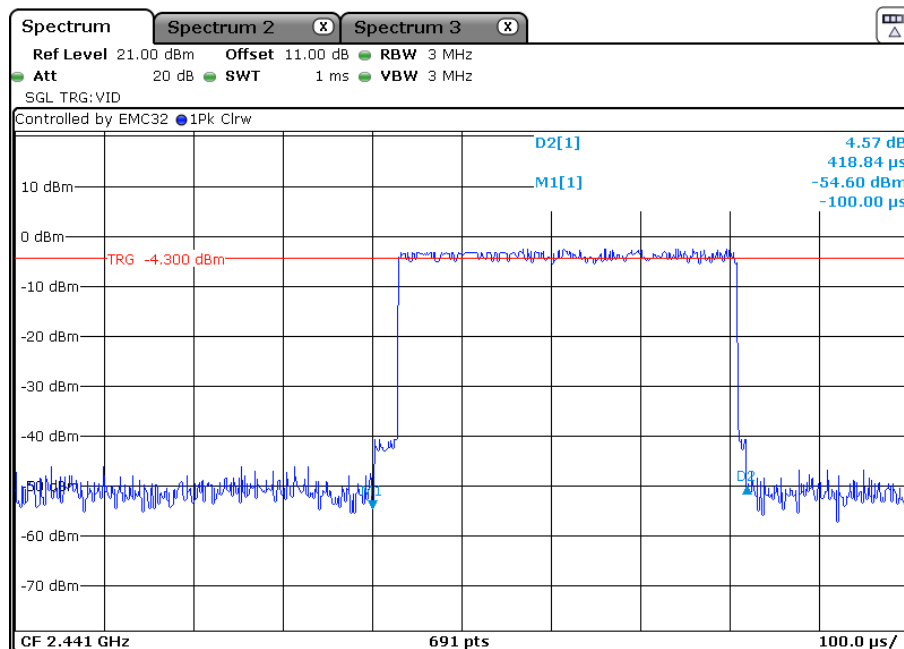
TEST REPORT

Number of Pulses in 3.16 S observation period:



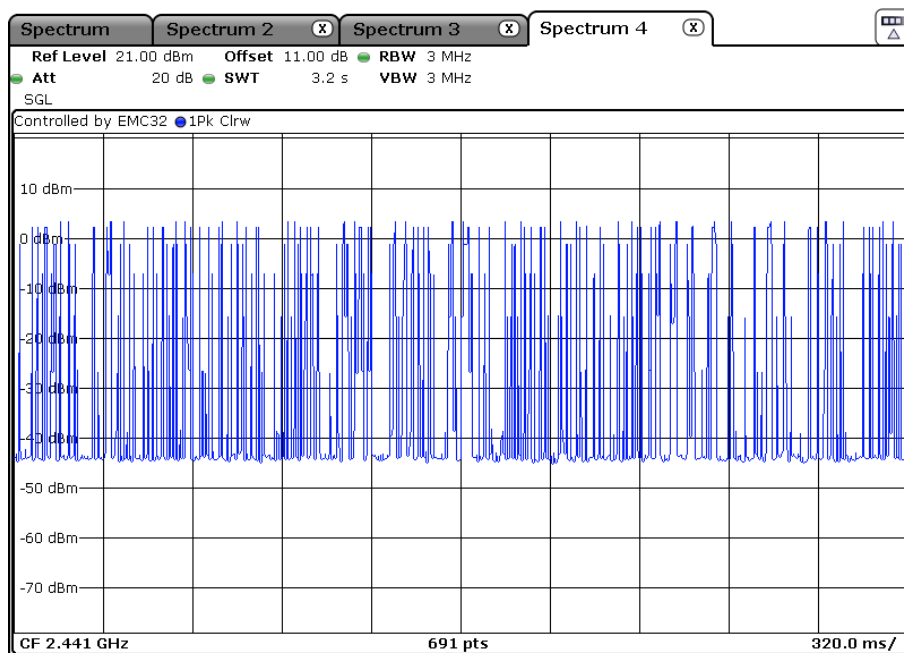
(2) 2DH1

Pulse Width:



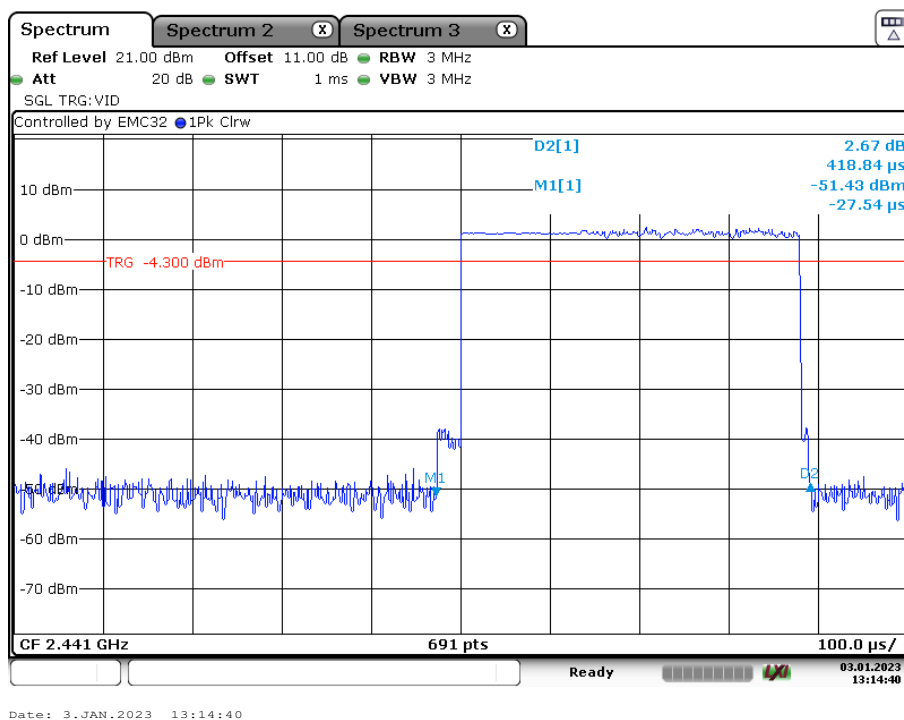
TEST REPORT

Number of Pulses in 3.16 S observation period:



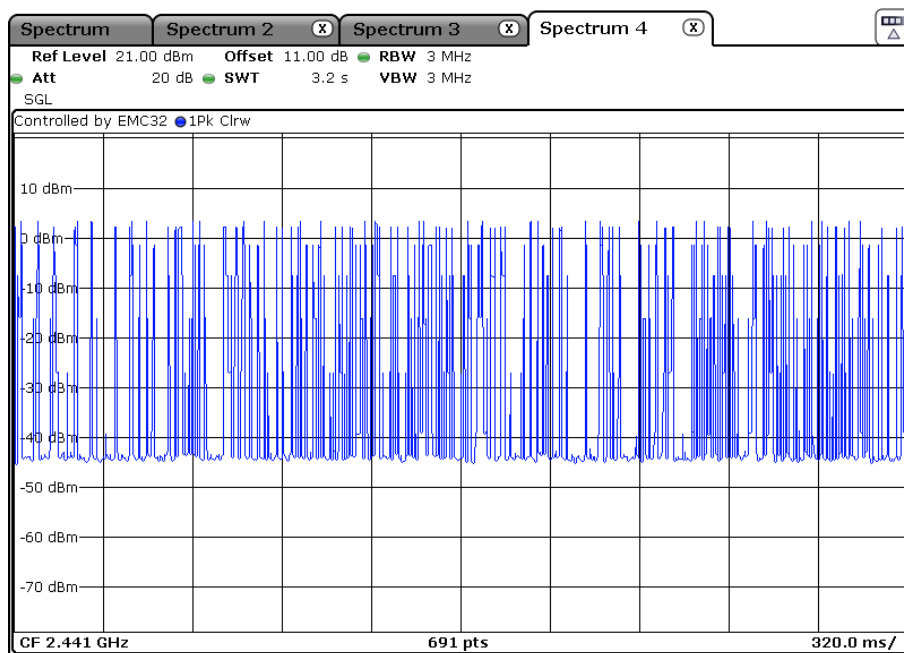
(3) 3DH1

Pulse Width:



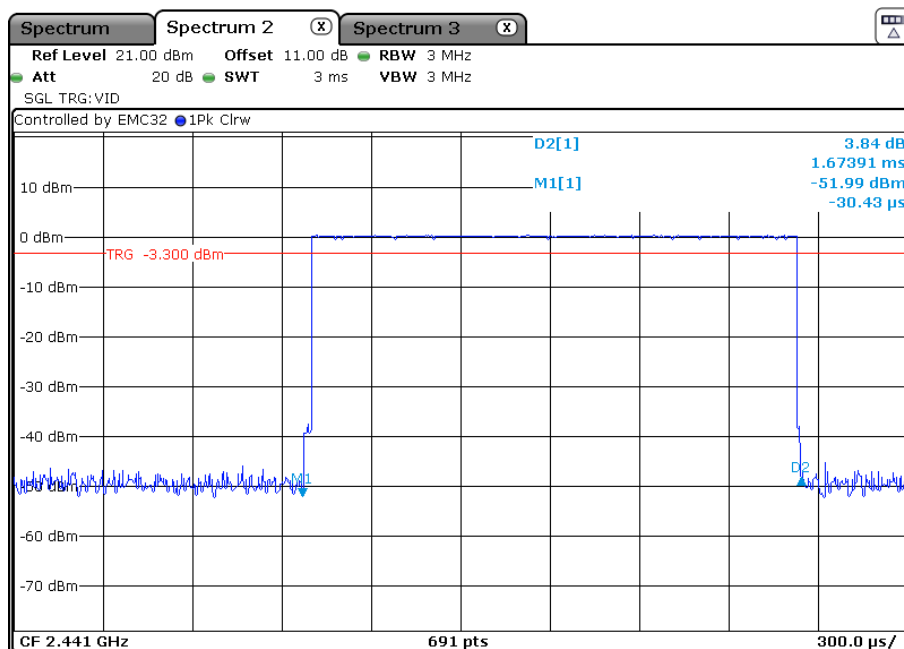
TEST REPORT

Number of Pulses in 3.16 S observation period:



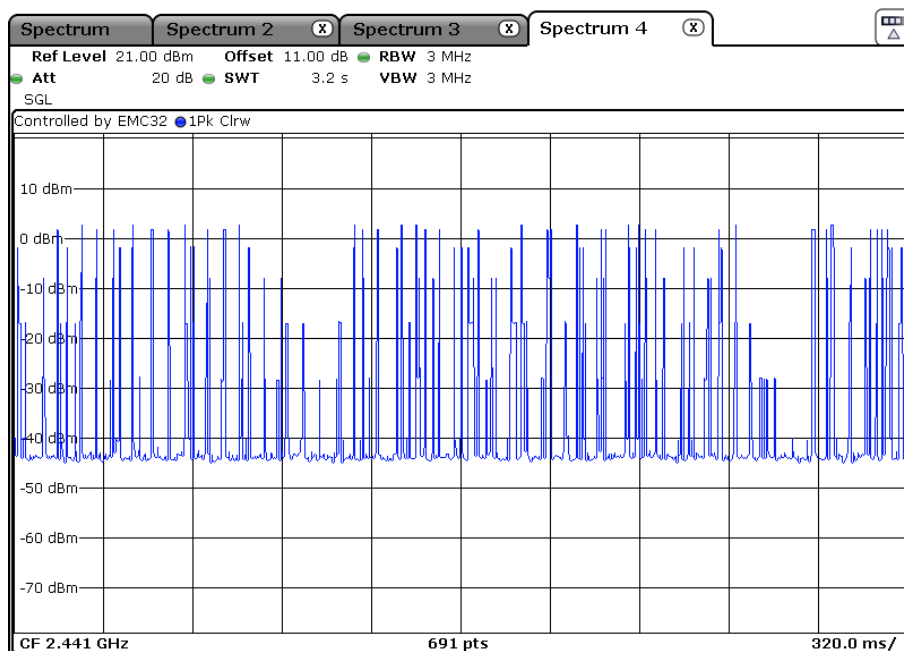
(4) DH3

Pulse Width:



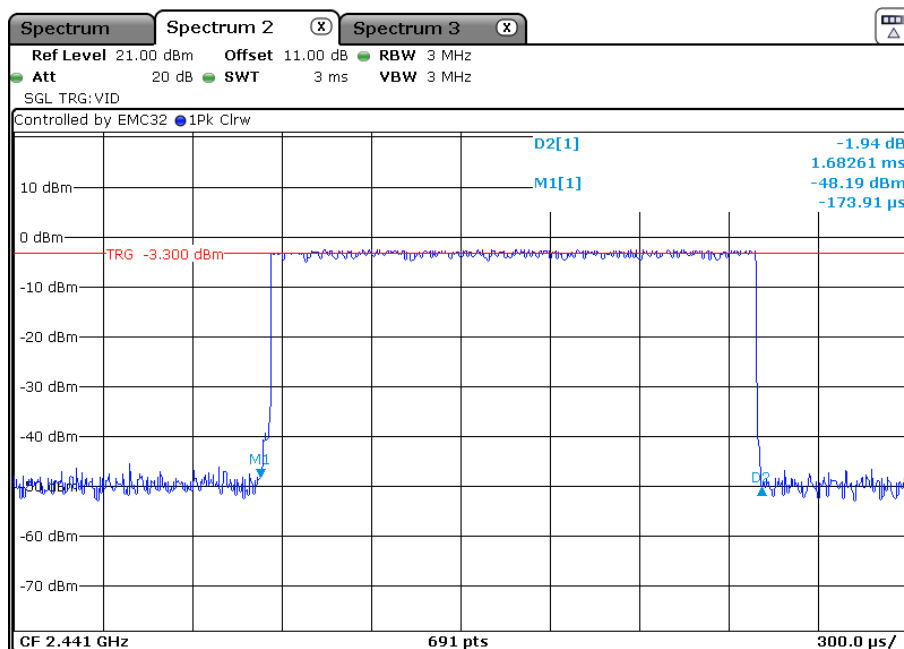
TEST REPORT

Number of Pulses in 3.16 S observation period:



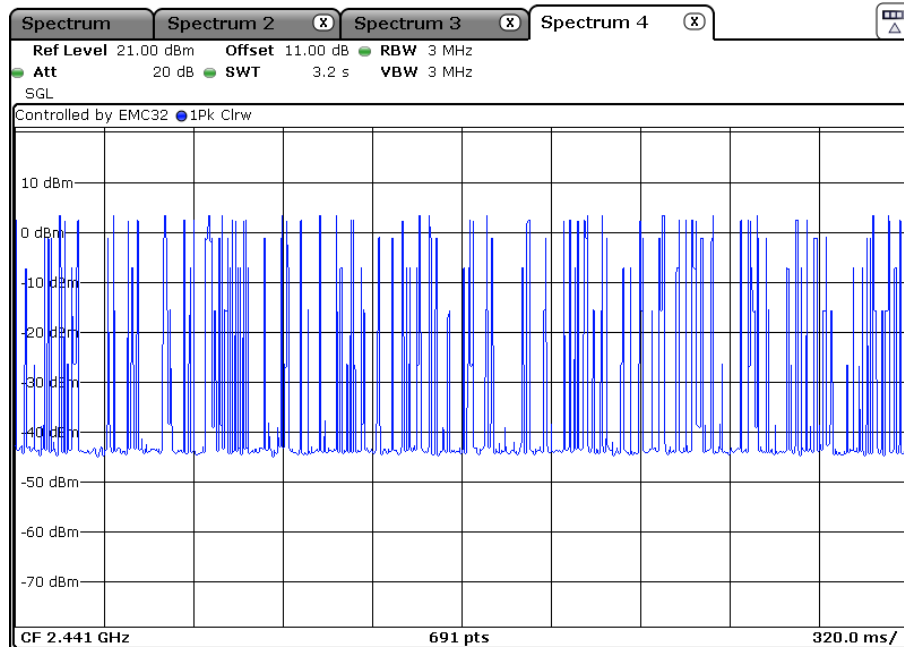
(5) 2DH3

Pulse Width:



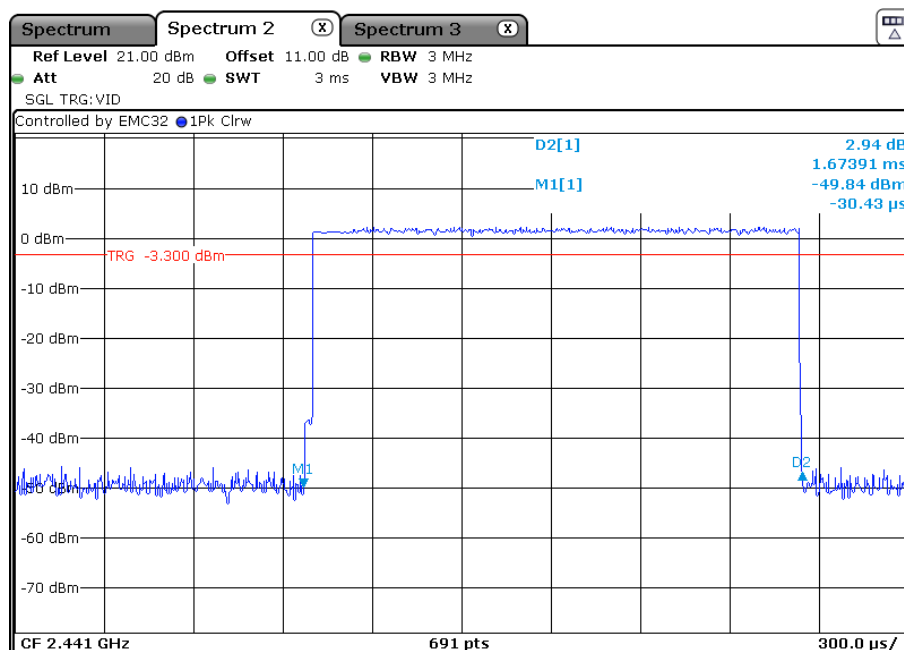
TEST REPORT

Number of Pulses in 3.16 S observation period:



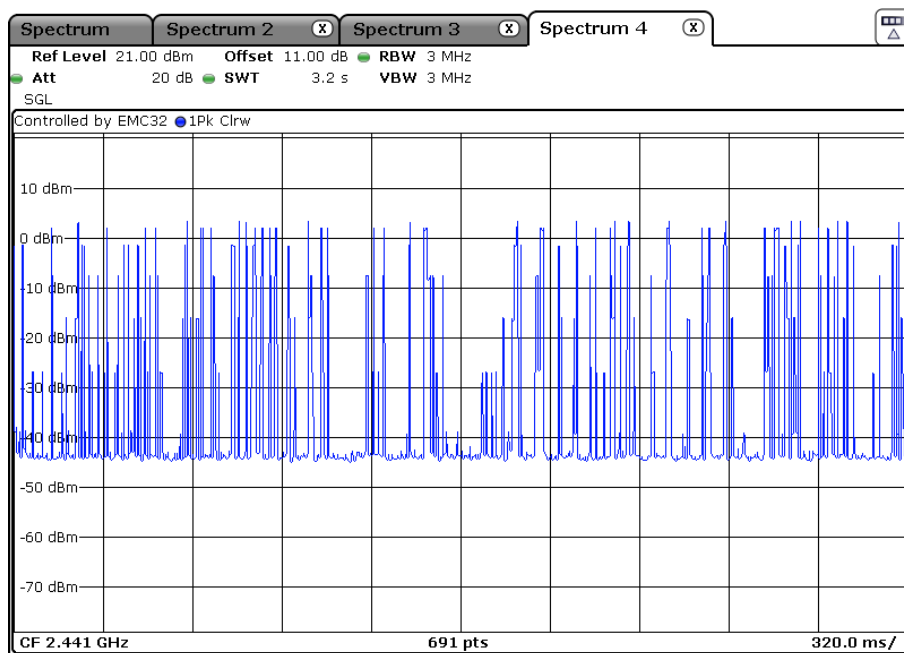
(6) 3DH3

Pulse Width:



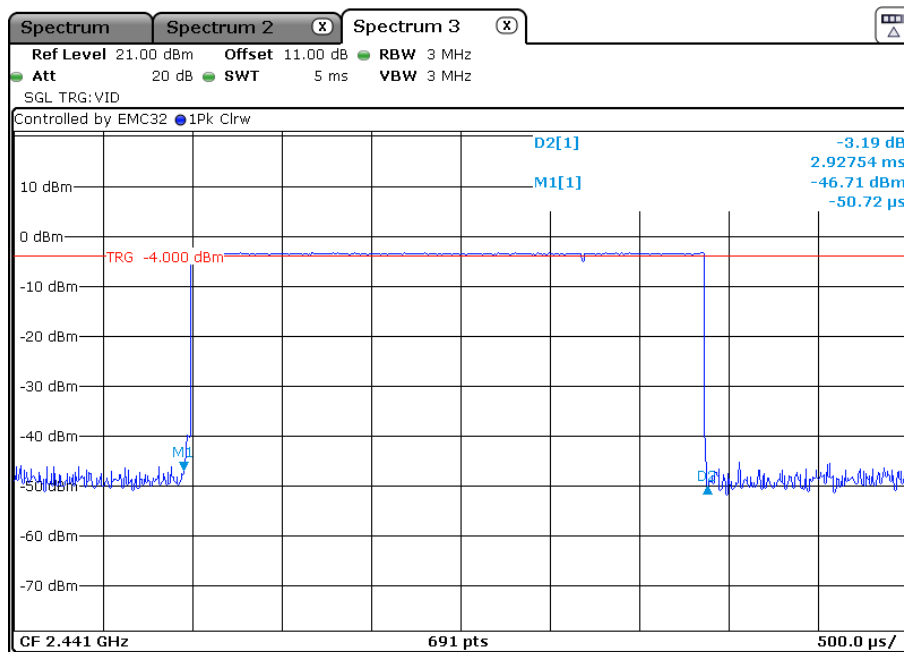
TEST REPORT

Number of Pulses in 3.16 S observation period:



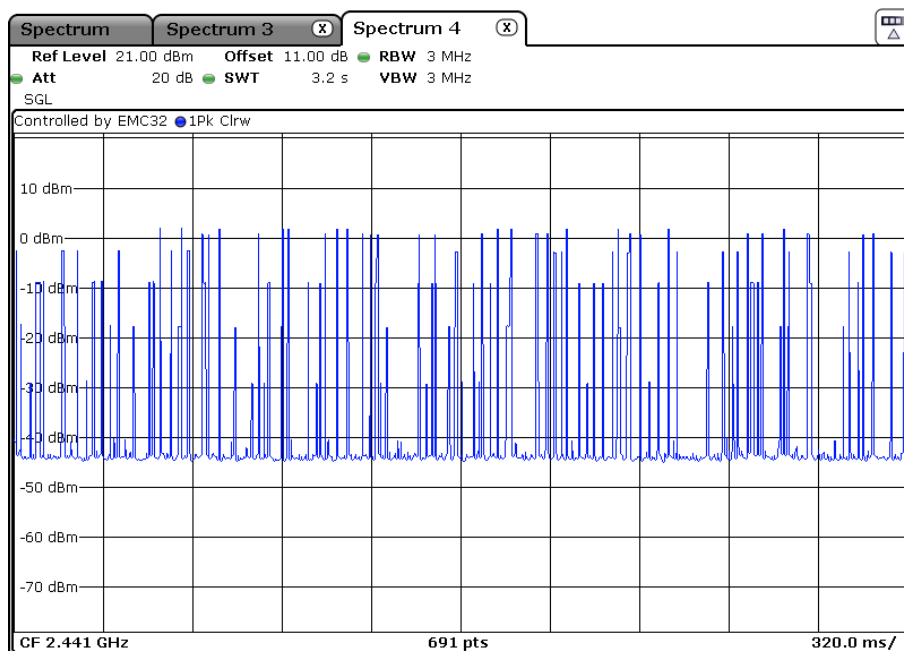
(7) DH5

Pulse Width:



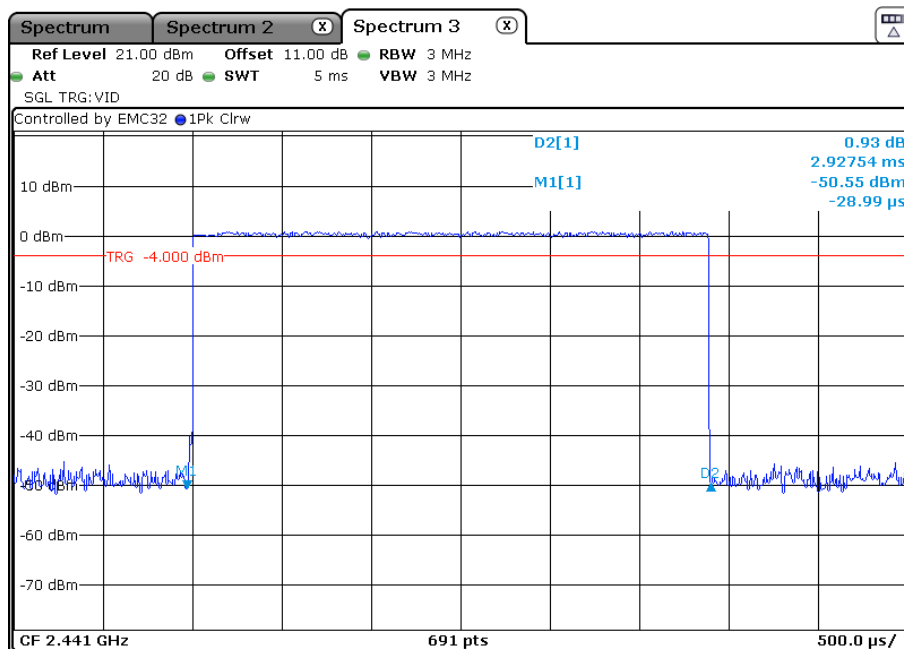
TEST REPORT

Number of Pulses in 3.16 S observation period:



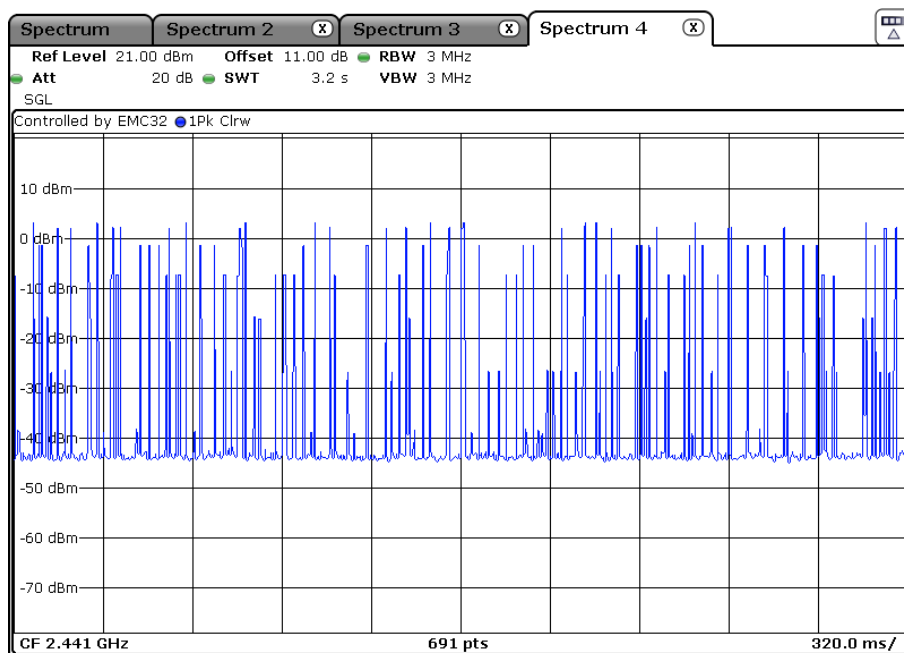
(8) 2DH5

Pulse Width:



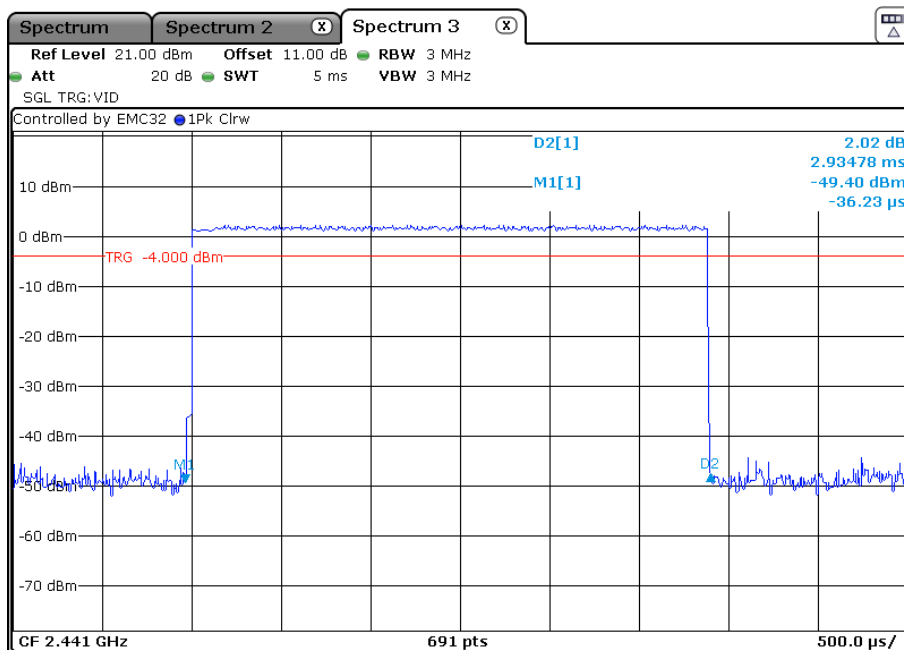
TEST REPORT

Number of Pulses in 3.16 S observation period:



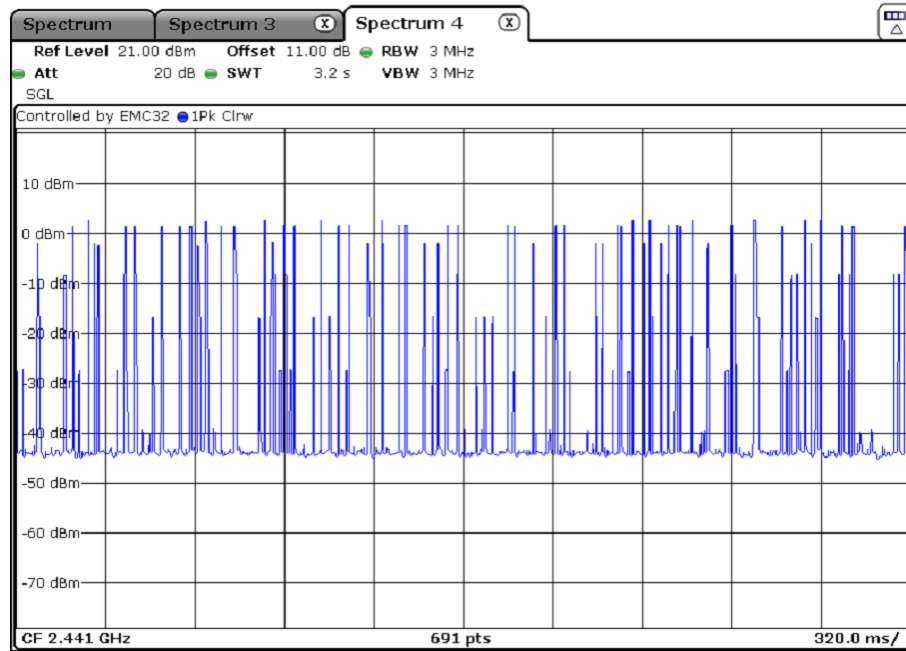
(9) 3DH5

Pulse Width:



TEST REPORT

Number of Pulses in 3.16 S observation period:



TEST REPORT

4.6 Pseudo random Frequency Hopping Sequence

4.6.1 Standard requirement

15.247(a)(1) requirement:

The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudo random ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

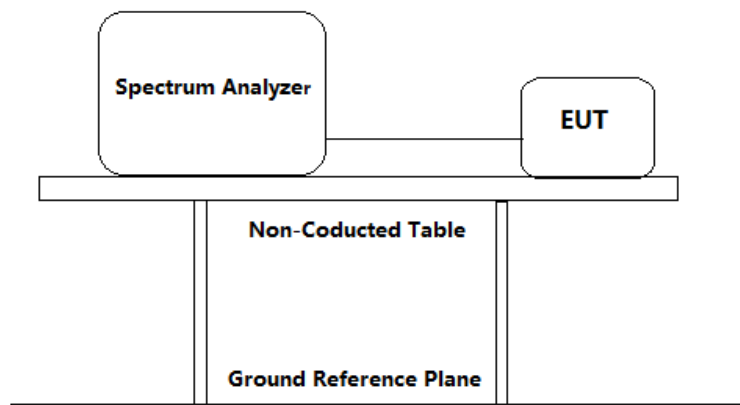
4.6.2 EUT Pseudo random Frequency Hopping Sequence

Bluetooth protocol is utilized by the EUT. It is shown that each frequency used equally on the average by the transmitter. The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

4.7 Maximum Peak Conducted Output Power

| | |
|---------------------|---|
| Test Requirement: | FCC Part 15 C section 15.247 (b)(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts. Refer to the result "Hopping channel number" of this report. The 1 watt (30.0 dBm) limit applies. |
| Test Method: | ANSI C63.10: Clause 7.8.5 |
| Test Status: | Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal (DH1) and EDR mode (2DH1,3DH1) as the worst case was found. |
| Test Configuration: | |

TEST REPORT



Test Procedure:

1. Removed the antenna from the EUT and then connect a low attenuation RF cable (cable loss = 1 dB, with 10dB attenuator) from the antenna port to the spectrum.
2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
3. Set the spectrum analyzer: RBW = 3 MHz (RBW > 20 dB bandwidth of the emission being measured), VBW = 10 MHz, Sweep = auto; Detector Function = Peak. Trace: Max hold.
4. Kept the EUT in transmitting at lowest, medium and highest channel with different data packet individually. Record the max value.

Used Test Equipment List:

Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details.

Test result:

| Normal mode (DH1): | | | | |
|--------------------|-----------------------------|--------------------|-------------|--------|
| Test Channel | Fundamental Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 2402 | 4.35 | 30.0 | Pass |
| Middle | 2441 | 2.64 | 30.0 | Pass |
| Highest | 2480 | 0.83 | 30.0 | Pass |
| EDR mode (2DH1): | | | | |
| Test Channel | Fundamental Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 2402 | 4.69 | 30.0 | Pass |
| Middle | 2441 | 3.45 | 30.0 | Pass |
| Highest | 2480 | 1.63 | 30.0 | Pass |
| EDR mode(3DH1): | | | | |
| Test Channel | Fundamental Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Result |
| Lowest | 2402 | 4.89 | 30.0 | Pass |

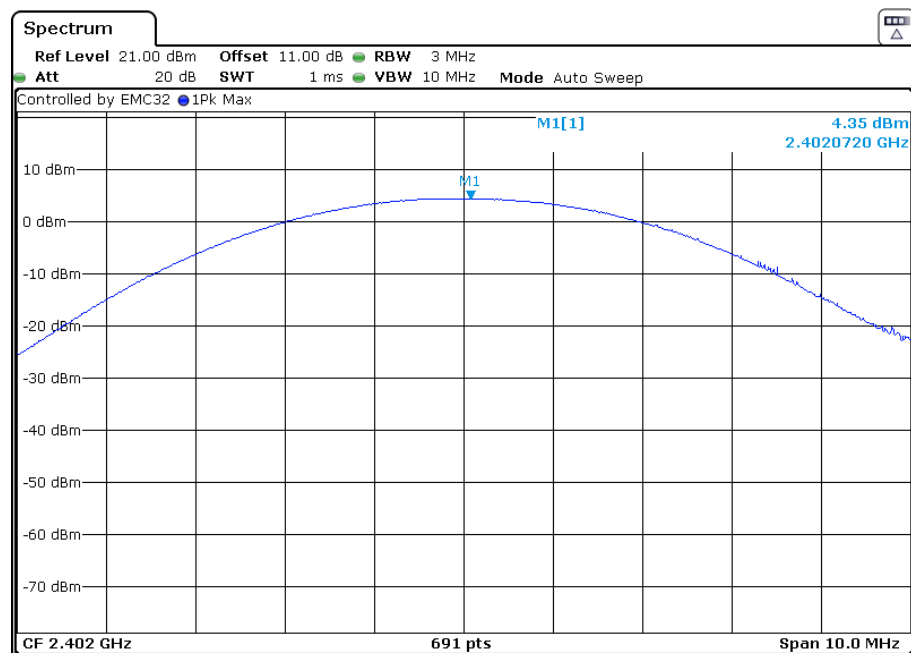
TEST REPORT

| | | | | |
|--|------|------|------|------|
| Middle | 2441 | 3.71 | 30.0 | Pass |
| Highest | 2480 | 2.13 | 30.0 | Pass |
| Remark: Cable lose=1.0 dB as declared by applicant. Level = Read Level + Cable Loss. | | | | |

Result plot as follows:

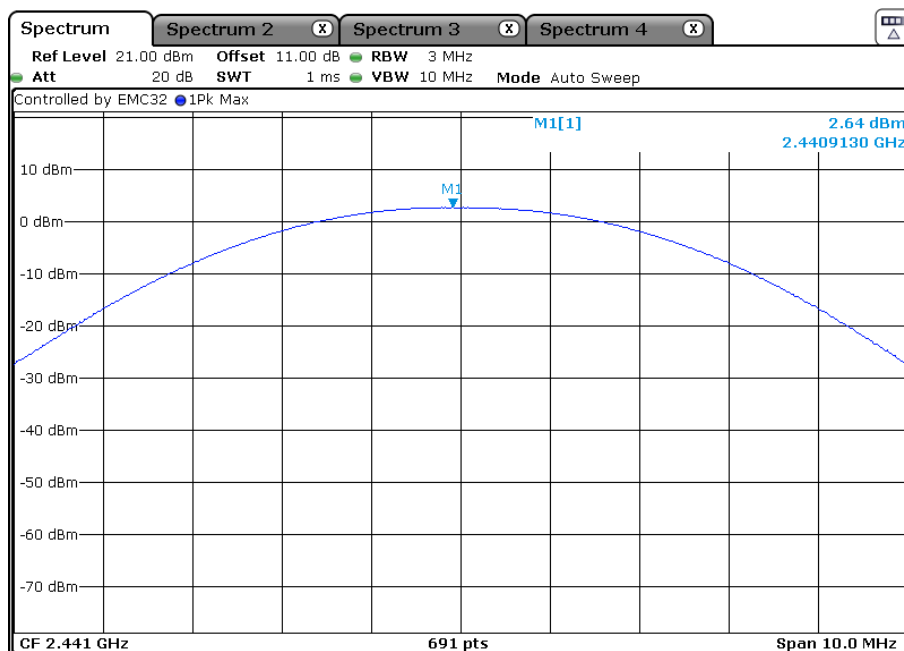
Normal mode(DH1):

The Lowest Channel(2.402 MHz):

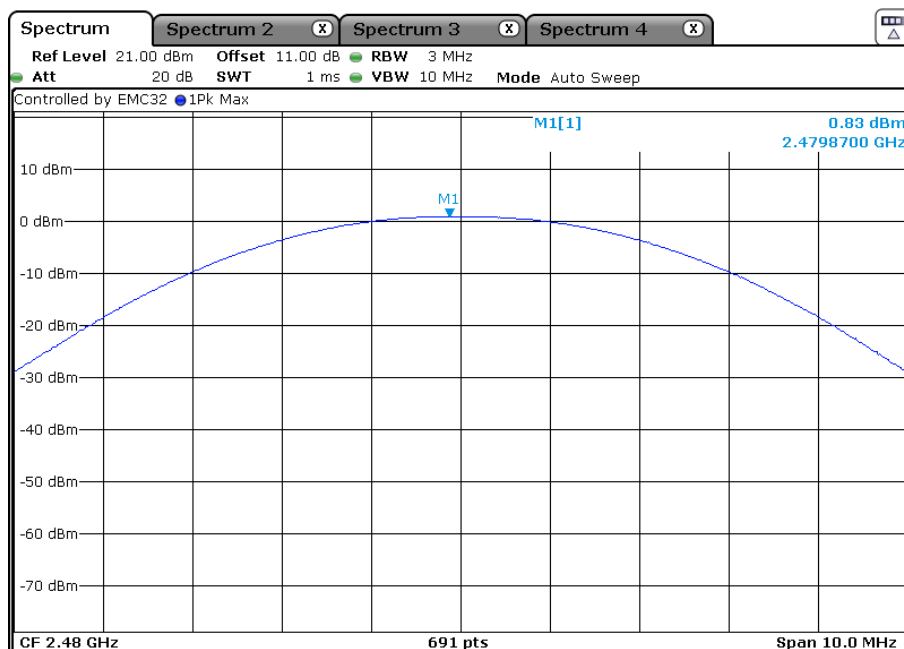


TEST REPORT

Middle Channel(2.441 GHz):



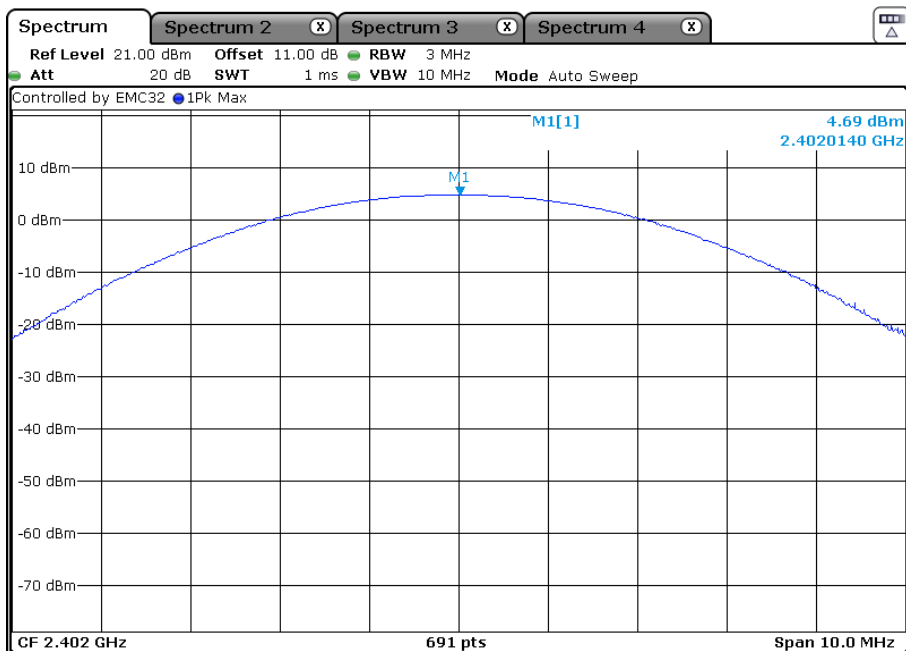
The Highest Channel(2.480 GHz):



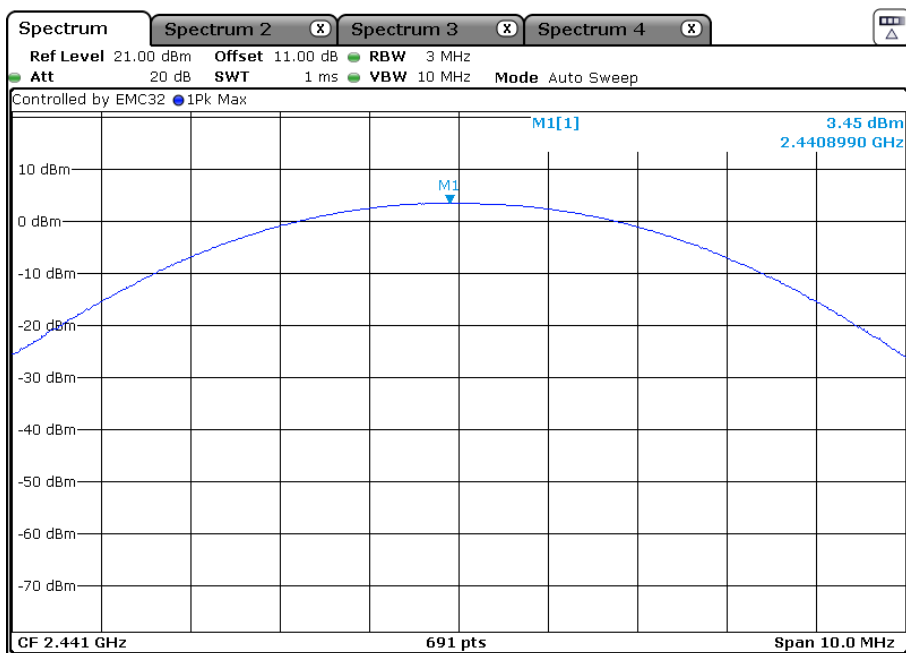
TEST REPORT

EDR mode (2DH1):

The Lowest channel(2.402 GHz):

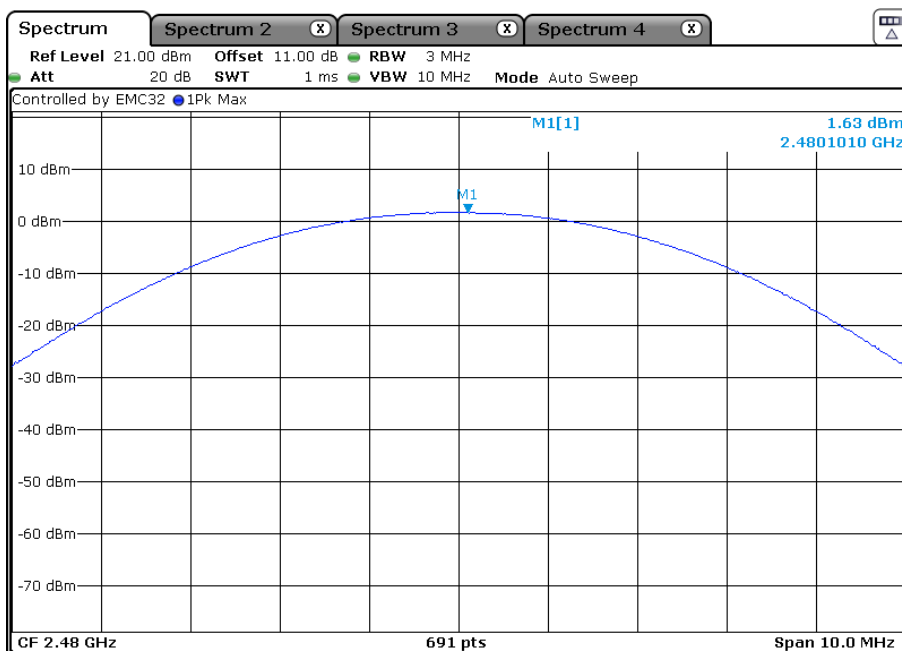


Middle channel(2.441 GHz):



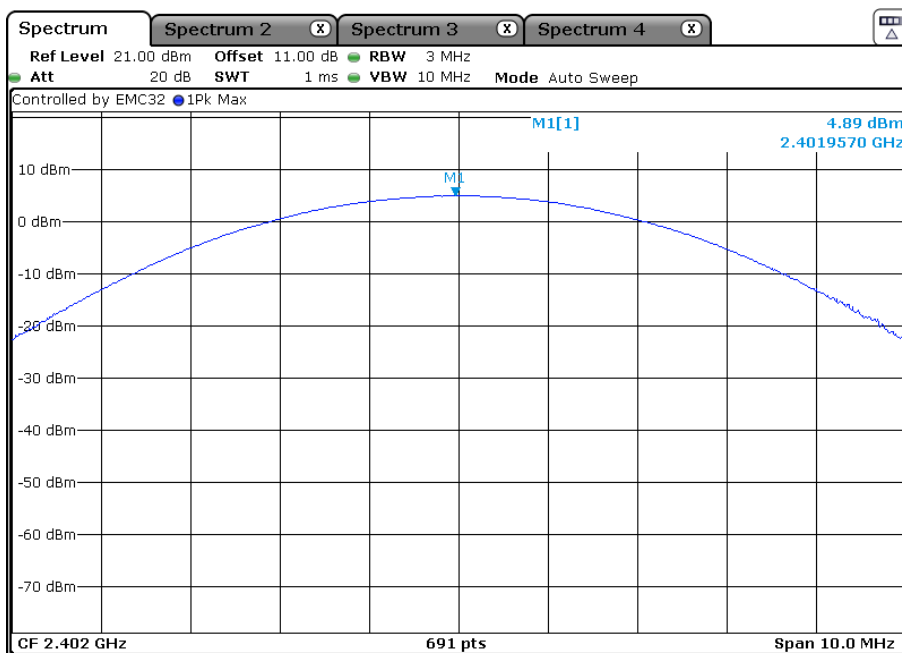
TEST REPORT

The Highest channel(2.480 GHz):



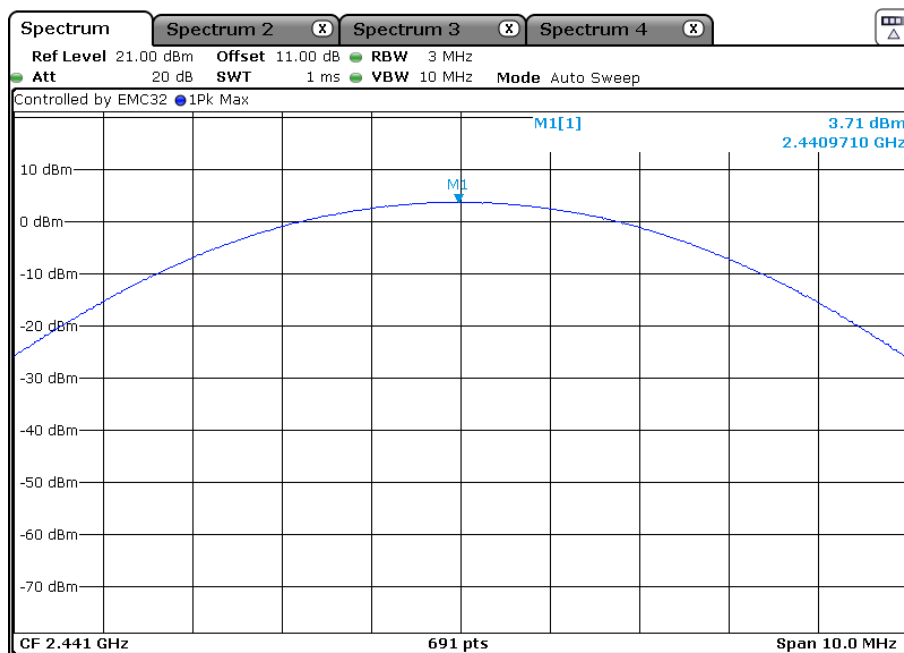
EDR mode (3DH1):

The Lowest channel(2.402 GHz):

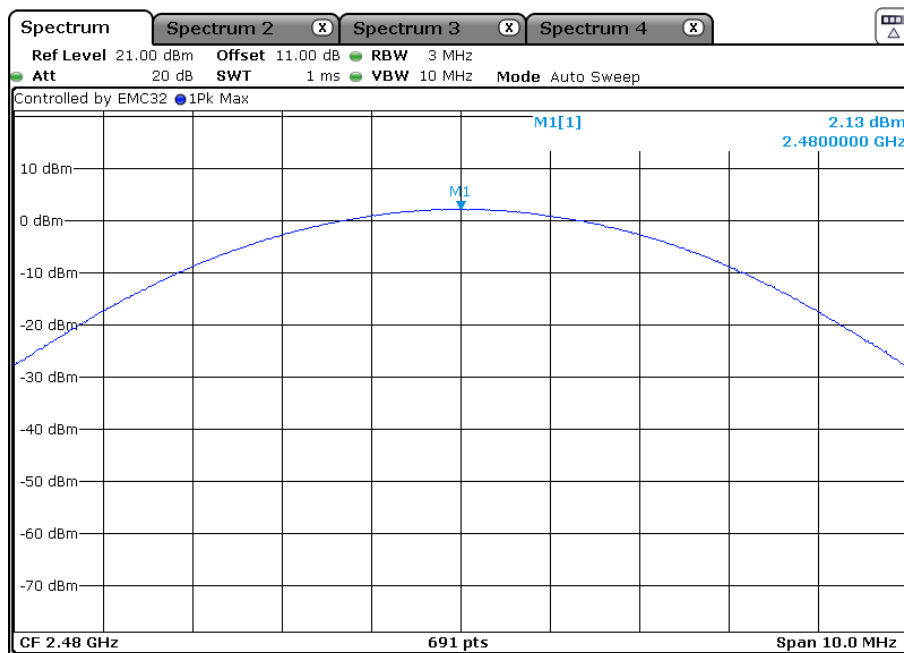


TEST REPORT

Middle channel(2.441 GHz):



The Highest channel(2.480 GHz):



TEST REPORT

4.8 Out of Band Conducted Emissions

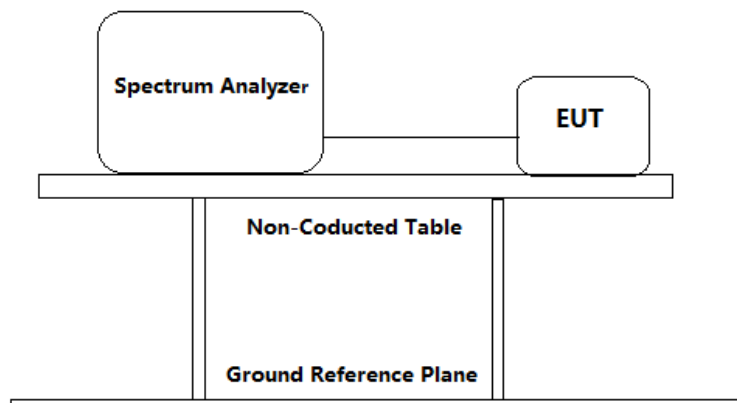
Test Requirement: FCC Part 15 C section 15.247

(d) 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.

Test Method: ANSI C63.10: Clause 7.8.8

Test Status: Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in continuous transmitting mode with normal mode (DH1) as the worst case was found.

Test Configuration:



Test Procedure:

1. Removed the antenna from the EUT and then connect a low RF cable (cable loss =1.0dB) from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer: RBW=100 kHz, VBW = 300 kHz. Sweep = auto; Detector Function = Peak. Trace = Max Hold, Scan up through 10th harmonic.
3. Measured the Conducted unwanted Emissions of the test frequency with special test status.
4. Repeated until all the test status was investigated.

Used Test Equipment List:

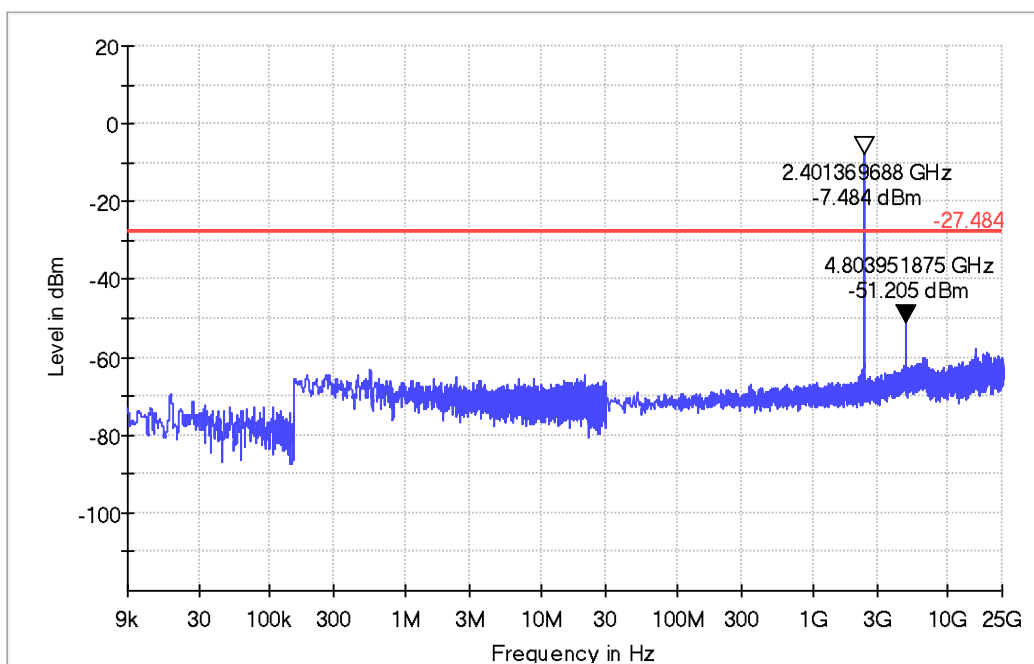
Spectrum Analyzer. Refer to Clause 5 Test Equipment List for details

TEST REPORT

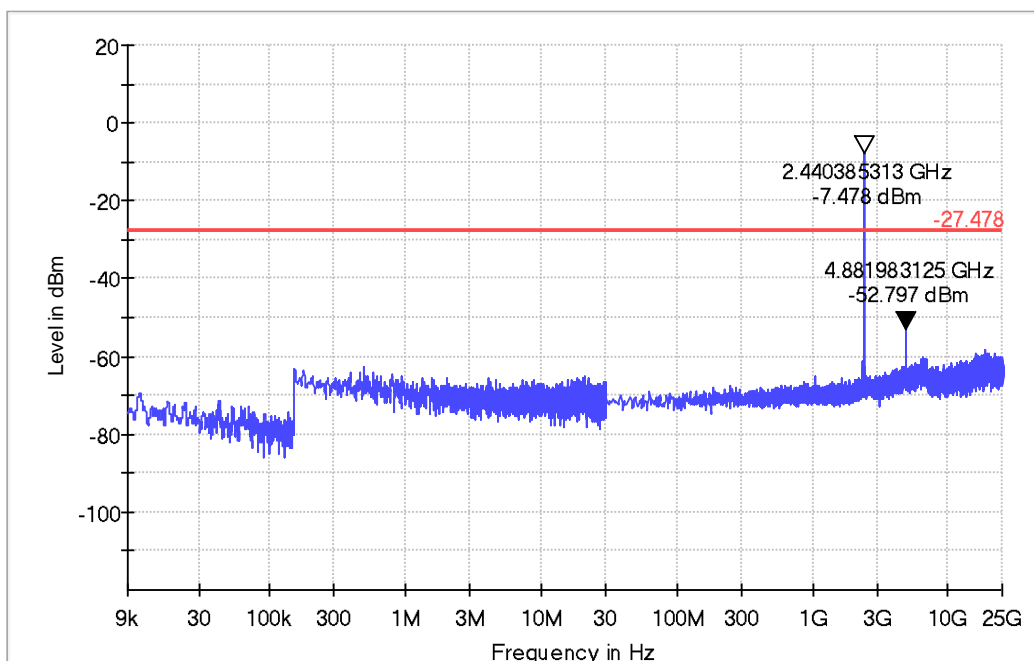
Result plot as follows:

Normal mode (DH1):

The Lowest Channel 2402MHz: 9 kHz to 25 GHz

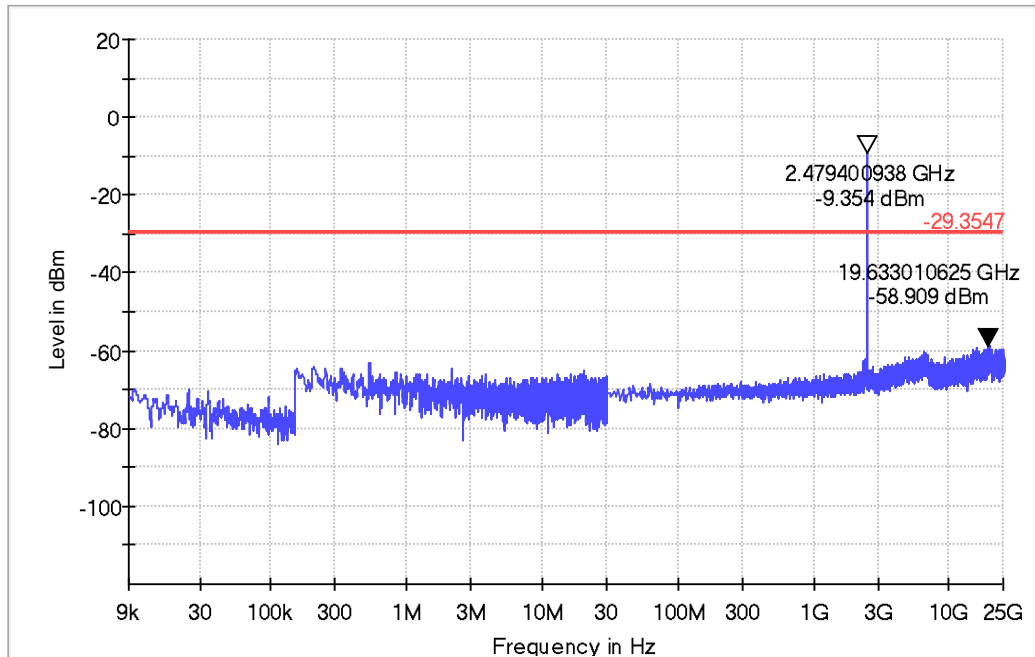


The Middle Channel 2441MHz: 9 kHz to 25 GHz



TEST REPORT

The Highest Channel 2480MHz: 9 kHz to 25 GHz



4.9 Out of Band Radiated Emissions

For out of band radiated emissions into Non-Restricted Frequency Bands were performed at a 3m separation distance to determine whether these emissions complied with the 20dB attenuation requirement.

- ☒ Not required, since all emissions are more than 20dB below fundamental
- ☐ See attached data sheet

TEST REPORT

4.10 Radiated Emissions in Restricted Bands

| | |
|-----------------------------|---|
| Test Requirement: | <p>FCC Part 15 C section 15.247</p> <p>(d) In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c).</p> |
| Test Method: | ANSI C63.10: Clause 6.4, 6.5 and 6.6 |
| Test Status: | Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), middle (2441 MHz) and highest (2480 MHz) channel with different data packet. Compliance test in normal mode (DH1) and EDR mode (2DH1) as the worst case was found. |
| Test site: | Measurement Distance: 3m (Semi-Anechoic Chamber) |
| Limit: | <p>Section 15.209</p> <p>40.0 dBμV/m between 30MHz & 88MHz;</p> <p>43.5 dBμV/m between 88MHz & 216MHz;</p> <p>46.0 dBμV/m between 216MHz & 960MHz;</p> <p>54.0 dBμV/m above 960MHz.</p> |
| Detector: | <p>For Peak and Quasi-Peak value:</p> <p>RBW =</p> <p>1 MHz for $f \geq 1$ GHz,</p> <p>200 Hz for 9 kHz to 150 kHz</p> <p>9 kHz for 150 kHz to 30 MHz</p> <p>120 kHz for 30 MHz to 1GHz</p> <p>VBW \geq RBW</p> <p>Sweep = auto</p> <p>Detector function = peak for $f \geq 1$ GHz, QP for $f < 1$ GHz</p> <p>Trace = max hold</p> <p>For AV value:</p> <p>RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz</p> <p>VBW=10 Hz</p> <p>Sweep = auto</p> <p>Trace = max hold</p> |
| Field Strength Calculation: | <p>The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below:</p> <p>$FS = RA + AF + CF - AG + PD + AV$</p> <p>$FS = RA + \text{Correct Factor} + AV$</p> |

TEST REPORT

Where:

FS = Field Strength in dB μ V/m
RA = Receiver Amplitude (including preamplifier) in dB μ V
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in -dB
Correct Factor = AF + CF - AG + PD

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

$$FS = RA + AF + CF - AG + PD + AV$$

Assume a receiver reading of 62.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dB μ V/m.

$$RA = 62.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$PD = 0 \text{ dB}$$

$$AV = -10 \text{ dB}$$

$$\text{Correct Factor} = 7.4 + 1.6 - 29.0 + 0 = -20 \text{ dB}$$

$$FS = 62 + (-20) + (-10) = 32 \text{ dB}\mu\text{V/m}$$

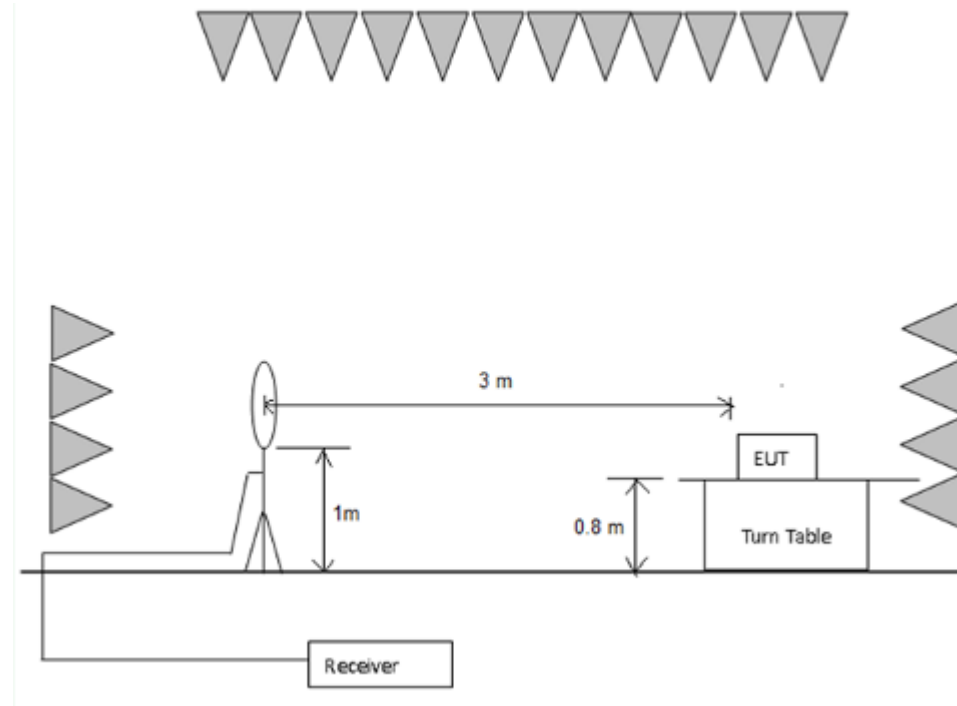
Section 15.205 Restricted bands of operation.

| MHz | MHz | MHz | GHz |
|---------------------|---------------------|-----------------|---------------|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| 10.495 - 0.505 | 16.69475 - 16.69525 | 608 - 614 | 5.35 - 5.46 |
| 2.1735 - 2.1905 | 16.80425 - 16.80475 | 960 - 1240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1300 - 1427 | 8.025 - 8.5 |
| 4.17725 - 4.17775 | 37.5 - 38.25 | 1435 - 1626.5 | 9.0 - 9.2 |
| 4.20725 - 4.20775 | 73 - 74.6 | 1645.5 - 1646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1660 - 1710 | 10.6 - 12.7 |
| 6.26775 - 6.26825 | 108 - 121.94 | 1718.8 - 1722.2 | 13.25 - 13.4 |
| 6.31175 - 6.31225 | 123 - 138 | 2200 - 2300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2310 - 2390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.52475 - | 2483.5 - 2500 | 17.7 - 21.4 |
| 8.37625 - 8.38675 | 156.52525 | 2655 - 2900 | 22.01 - 23.12 |
| 8.41425 - 8.41475 | 156.7 - 156.9 | 3260 - 3267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 162.0125 - 167.17 | 3332 - 3339 | 31.2 - 31.8 |
| 12.51975 - 12.52025 | 167.72 - 173.2 | 3345.8 - 3358 | 36.43 - 36.5 |
| 12.57675 - 12.57725 | 240 - 285 | 3600 - 4400 | |
| 13.36 - 13.41 | 322 - 335.4 | | |

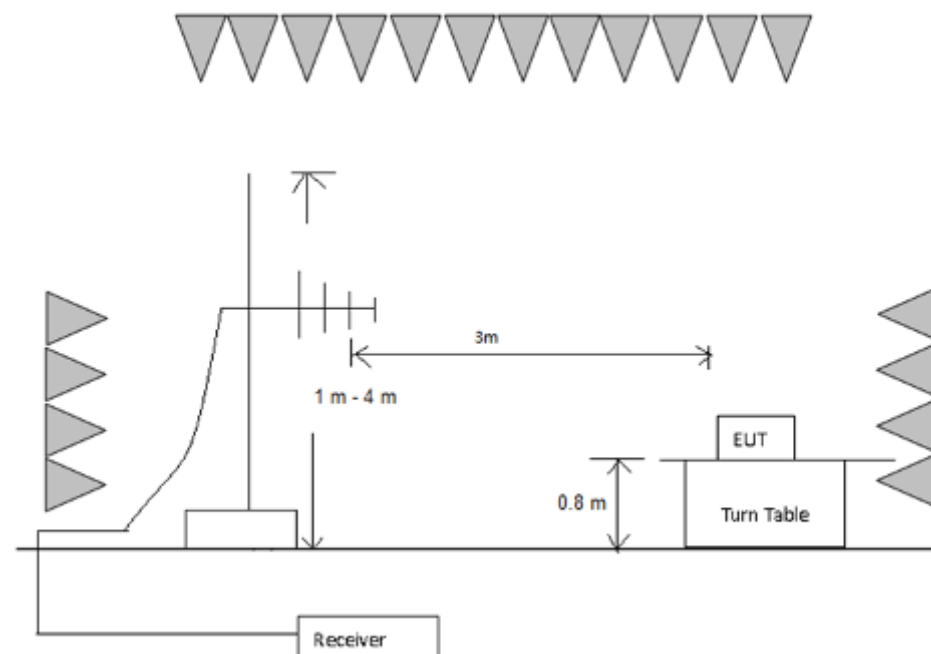
TEST REPORT

Test Configuration:

1) 9 kHz to 30 MHz emissions:

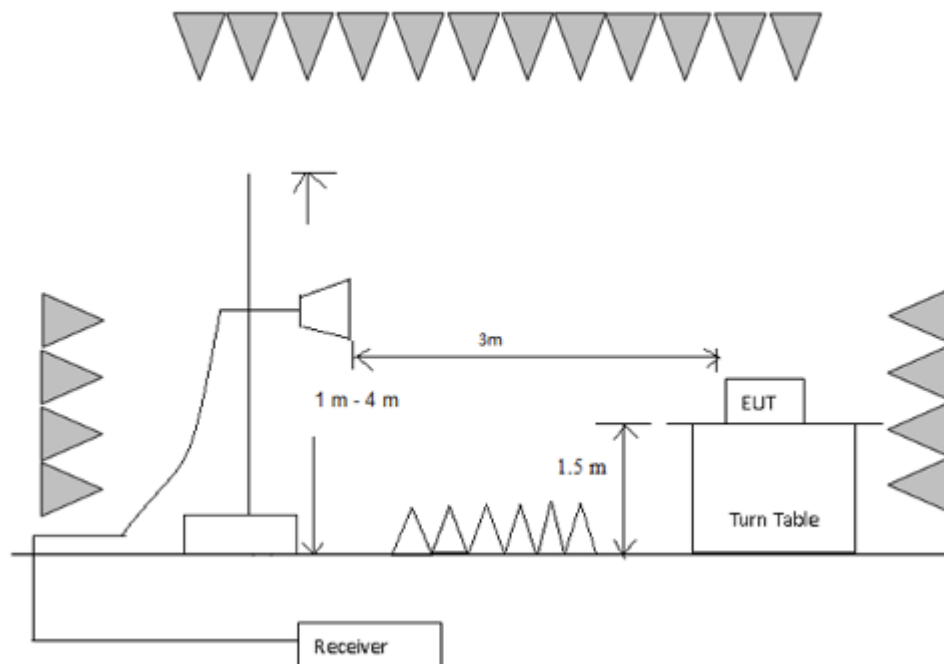


2) 30 MHz to 1 GHz emissions:



3) 1 GHz to 40 GHz emissions:

TEST REPORT



Test Procedure:

1) 9 kHz to 30 MHz emissions:

For testing performed with the loop antenna. The lowest of the loop was positioned 1 m above the ground and positioned with its plane vertical at the special distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

2) 30 MHz to 1 GHz emissions:

For testing performed with the bi-log type antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

3) 1 GHz to 25 GHz emissions:

Test site with RF absorbing material covering the ground plane that met the site validation criterion called out in CISPR 16-1-4:2010 was used to perform radiated emission test above 1 GHz.

For testing performed with the horn antenna. The measurement is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurement for both the horizontal and vertical antenna polarizations.

4) The receiver was scanned from 9 kHz to 25 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. An initial pre-scan was performed for in peak detection mode using the receiver. The EUT was measured for both the Horizontal and Vertical polarities and performed a pre-test three orthogonal planes. For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. The worst case emissions were reported.

TEST REPORT

Used Test Equipment List:

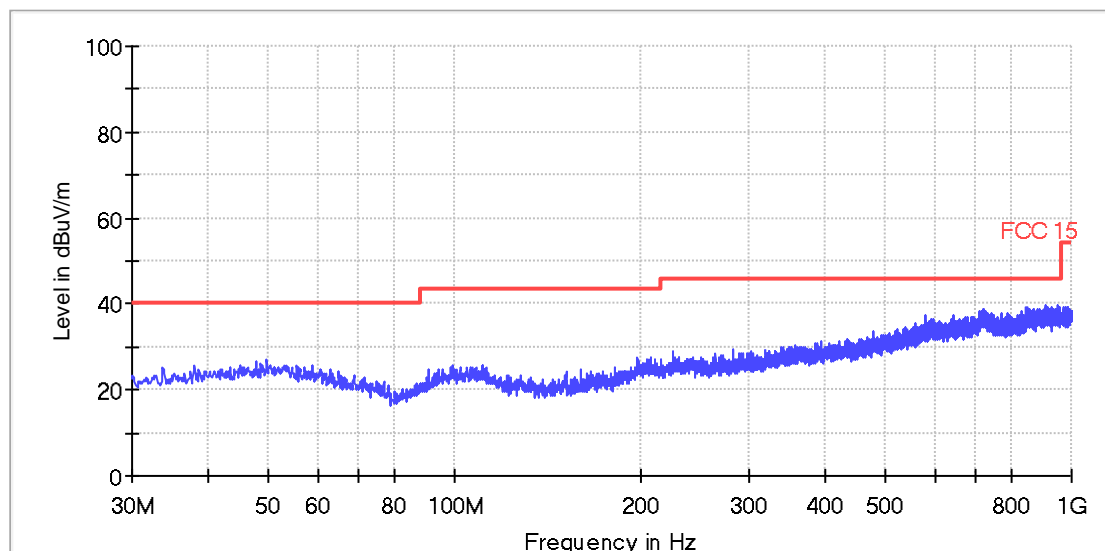
3m Semi-Anechoic Chamber, EMI Test Receiver (9 kHz~7 GHz), Signal and Spectrum Analyzer (10 Hz~40 GHz), Loop antenna (9 kHz-30 MHz). TRILOG Super Broadband test Antenna(30 MHz-3 GHz) (RX), Double-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX) and High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX). Refer to Clause 5 Test Equipment List for details.

9 kHz~30 MHz Field Strength of Unwanted Emissions. Quasi-Peak Measurement

The measurements with active loop antenna were greater than 20dB below the limit, so the test data were not recorded in the test report.

30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement, Pre-scan all modes, worst case as below:

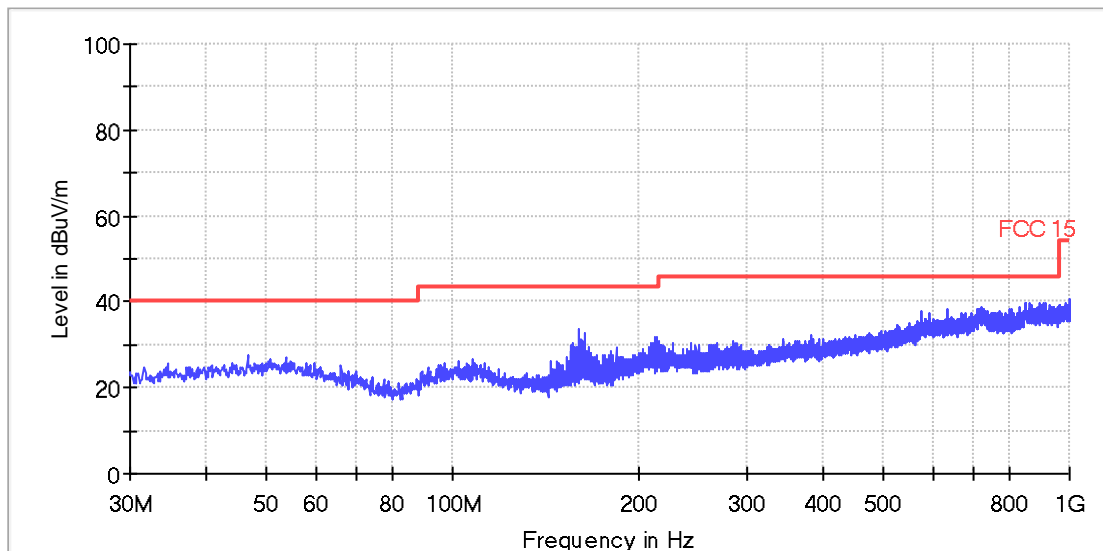
EDR mode (DH1), Test at Lowest Channel (2.402 GHz) in transmitting status
Vertical:



All emission levels are more than 10 dB below the limit.

TEST REPORT

Horizontal:



All emission levels are more than 10 dB below the limit.

1~25 GHz Radiated Emissions. Peak & Average Measurement

BDR mode (DH1)

Test at Lowest Channel (2.402 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4803.8 | 57.5 | -1.1 | 56.4 | 74 | V |
| 11285.0 | 42.1 | 6.5 | 48.6 | 74 | V |
| 4803.8 | 53.8 | -1.1 | 52.7 | 74 | H |
| 9400.1 | 42.8 | 4.7 | 47.5 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4803.8 | 37.6 | -1.1 | 36.5 | 54 | V |
| 11285.0 | / | 6.5 | / | 54 | V |
| 4803.8 | / | -1.1 | / | 54 | H |
| 9400.1 | / | 4.7 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

TEST REPORT

Test at Middle Channel (2.441 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4880.3 | 56.9 | -1.0 | 55.9 | 74 | V |
| 11295.6 | 41.4 | 6.5 | 47.9 | 74 | V |
| 4880.3 | 54.8 | -1.0 | 53.8 | 74 | H |
| 10282.0 | 42.6 | 6.8 | 49.4 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4880.3 | 37.9 | -1.0 | 36.9 | 54 | V |
| 11295.6 | / | 6.5 | / | 54 | V |
| 4880.3 | / | -1.0 | / | 54 | H |
| 10282.0 | / | 6.8 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

Test at Highest Channel (2.480 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4961.0 | 58.5 | -0.9 | 57.6 | 74 | V |
| 8405.6 | 43.0 | 4.3 | 47.3 | 74 | V |
| 4958.9 | 55.7 | -0.9 | 54.8 | 74 | H |
| 9085.6 | 42.3 | 4.6 | 46.9 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4961.0 | 37.3 | -0.9 | 36.4 | 54 | V |
| 8405.6 | / | 4.3 | / | 54 | V |
| 4958.9 | 35.5 | -0.9 | 34.6 | 54 | H |
| 9085.6 | / | 4.6 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

TEST REPORT

EDR mode (2DH1)

Test at Lowest Channel (2.402 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4803.8 | 59.2 | -1.1 | 58.1 | 74 | V |
| 10245.9 | 41.4 | 6.7 | 48.1 | 74 | V |
| 4903.8 | 53.7 | -1.0 | 52.7 | 74 | H |
| 12634.4 | 42.3 | 7.2 | 49.5 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4803.8 | 37.6 | -1.1 | 36.5 | 54 | V |
| 10245.9 | / | 6.7 | / | 54 | V |
| 4903.8 | / | -1.0 | / | 54 | H |
| 12634.4 | / | 7.2 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

Test at Middle Channel (2.441 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4878.1 | 56.0 | -1.0 | 55.0 | 74 | V |
| 11217.0 | 41.4 | 6.6 | 48.0 | 74 | V |
| 4880.3 | 51.9 | -1.0 | 50.9 | 74 | H |
| 10214.0 | 41.3 | 6.7 | 48.0 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4878.1 | 36.9 | -1.0 | 35.9 | 54 | V |
| 11217.0 | / | 6.6 | / | 54 | V |
| 4880.3 | / | -1.0 | / | 54 | H |
| 10214.0 | / | 6.7 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

TEST REPORT

Test at Highest Channel (2.480 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4958.9 | 58.3 | -0.9 | 57.4 | 74 | V |
| 10065.3 | 41.5 | 6.6 | 48.1 | 74 | V |
| 4958.9 | 54.4 | -0.9 | 53.5 | 74 | H |
| 9085.6 | 39.9 | 4.6 | 44.5 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4958.9 | 37.3 | -0.9 | 36.4 | 54 | V |
| 10065.3 | / | 6.6 | / | 54 | V |
| 4958.9 | / | -0.9 | / | 54 | H |
| 9085.6 | / | 4.6 | / | 54 | H |

EDR mode (3DH1)

Test at Lowest Channel (2.402 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4803.8 | 58.0 | -1.1 | 56.9 | 74 | V |
| 7927.5 | 42.7 | 3.8 | 46.5 | 74 | V |
| 4803.8 | 51.3 | -1.1 | 50.2 | 74 | H |
| 9561.6 | 43.4 | 4.9 | 48.3 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4803.8 | 37.4 | -1.1 | 36.3 | 54 | V |
| 7927.5 | / | 3.8 | / | 54 | V |
| 4803.8 | / | -1.1 | / | 54 | H |
| 9561.6 | / | 4.9 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

TEST REPORT

Test at Middle Channel (2.441 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4880.3 | 56.3 | -1.0 | 55.3 | 74 | V |
| 11295.6 | 39.2 | 6.5 | 45.7 | 74 | V |
| 4880.3 | 52.0 | -1.0 | 51.0 | 74 | H |
| 9869.8 | 41.7 | 6.1 | 47.8 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4880.3 | 36.9 | -1.0 | 35.9 | 54 | V |
| 11295.6 | / | 6.5 | / | 54 | V |
| 4880.3 | / | -1.0 | / | 54 | H |
| 9869.8 | / | 6.1 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

Test at Highest Channel (2.480 GHz) in transmitting status

Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4958.9 | 57.3 | -0.9 | 56.4 | 74 | V |
| 9640.3 | 43.2 | 5.2 | 48.4 | 74 | V |
| 4958.9 | 56.2 | -0.9 | 55.3 | 74 | H |
| 10001.5 | 41.8 | 6.6 | 48.4 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 4958.9 | 37.7 | -0.9 | 36.8 | 54 | V |
| 9640.3 | / | 5.2 | / | 54 | V |
| 4958.9 | 36.7 | -0.9 | 35.8 | 54 | H |
| 10001.5 | / | 6.6 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

TEST REPORT

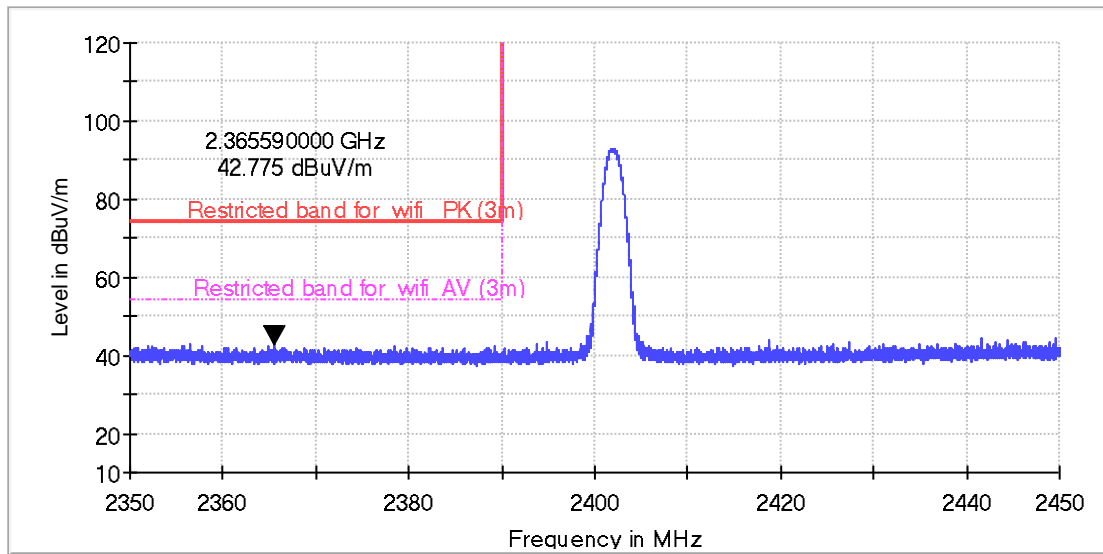
* Band Edges Emission

Band Edges Emission

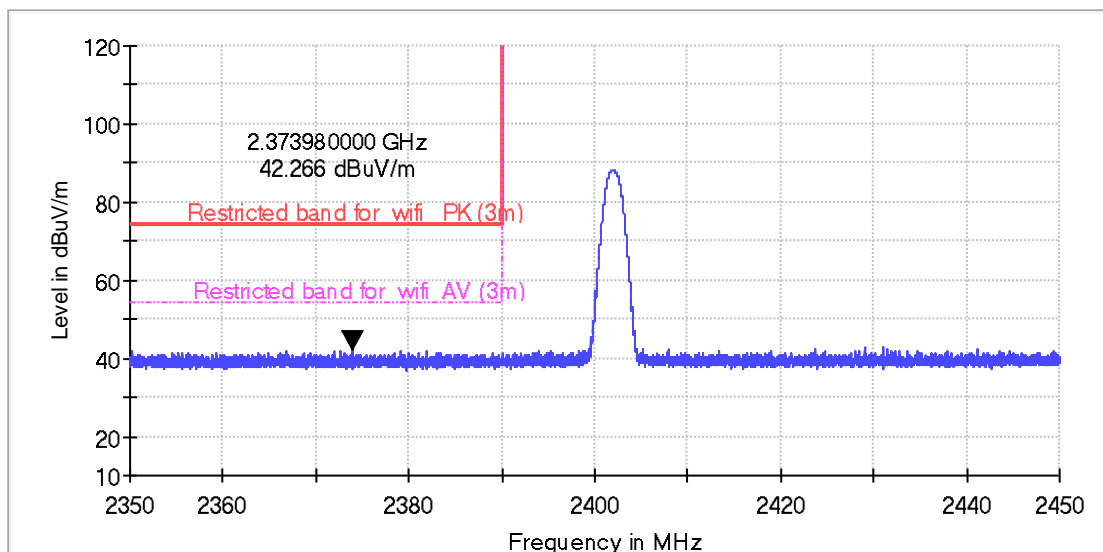
BDR mode (DH1)

Test at Lowest Channel (2.402 GHz) in transmitting status

Vertical:



Horizontal



TEST REPORT

Peak Measurement:

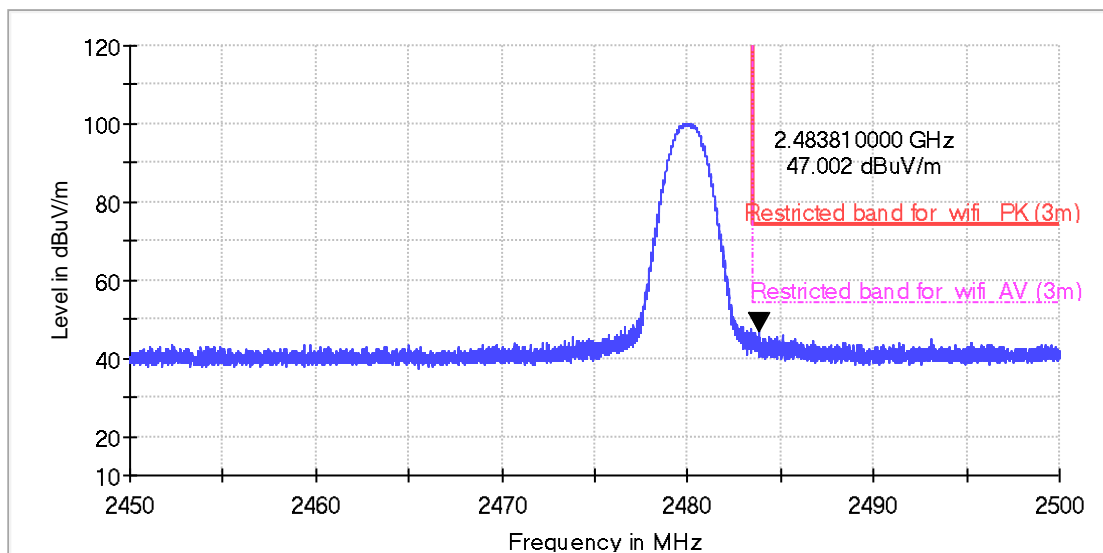
| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 2365.6 | 51.0 | -8.2 | 42.8 | 74 | V |
| 2374.0 | 50.5 | -8.2 | 42.3 | 74 | H |

Remark:

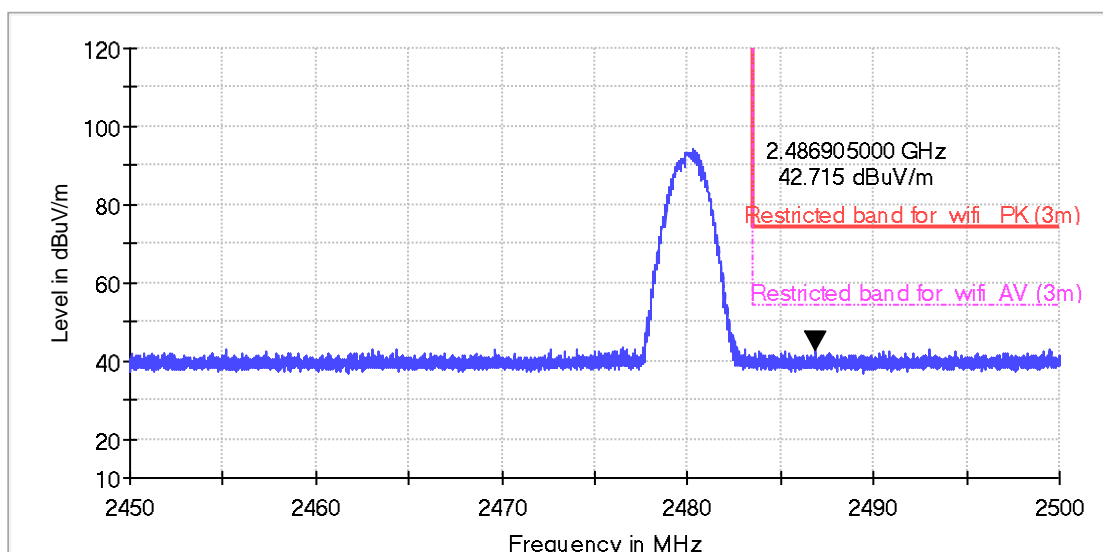
When Peak emission level was below AV limit, the AV emission level did not be recorded.

Test at Highest Channel (2.480 GHz) in transmitting status

Vertical:



Horizontal



TEST REPORT

Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 2483.8 | 54.8 | -7.8 | 47.0 | 74 | V |
| 2486.9 | 50.5 | -7.8 | 42.7 | 74 | H |

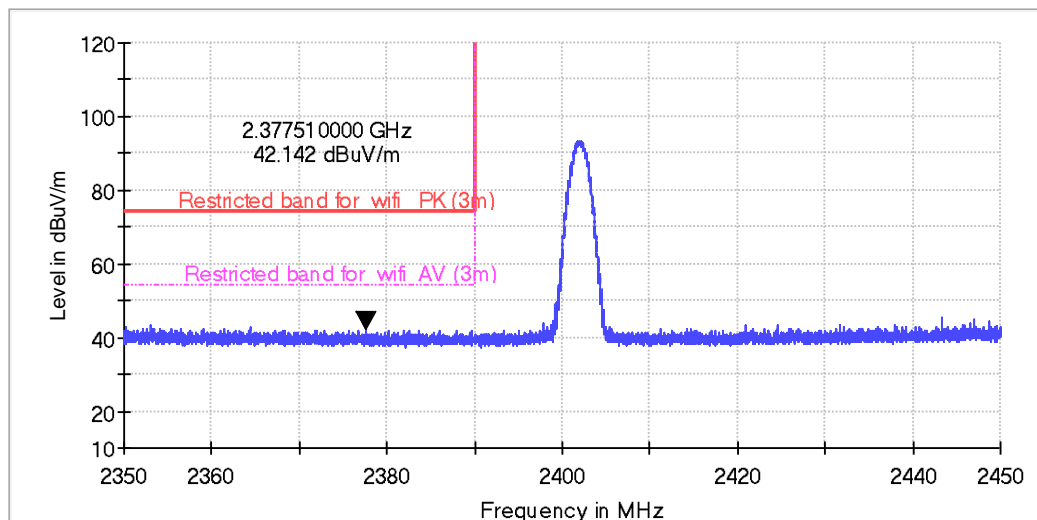
Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

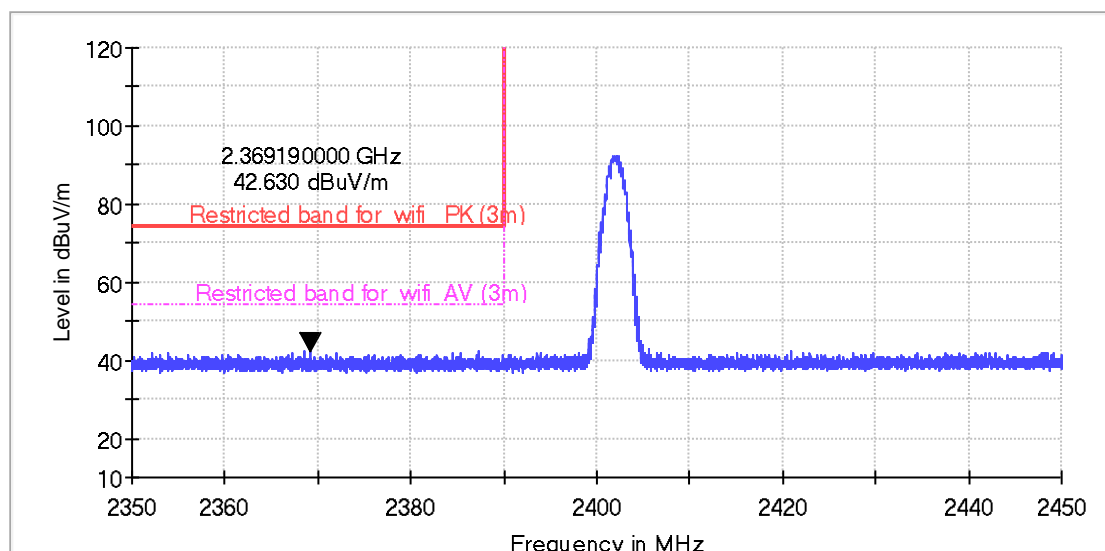
EDR mode (2DH1)

Test at Lowest Channel (2.402 GHz) in transmitting status

Vertical:



Horizontal:



TEST REPORT

Peak Measurement:

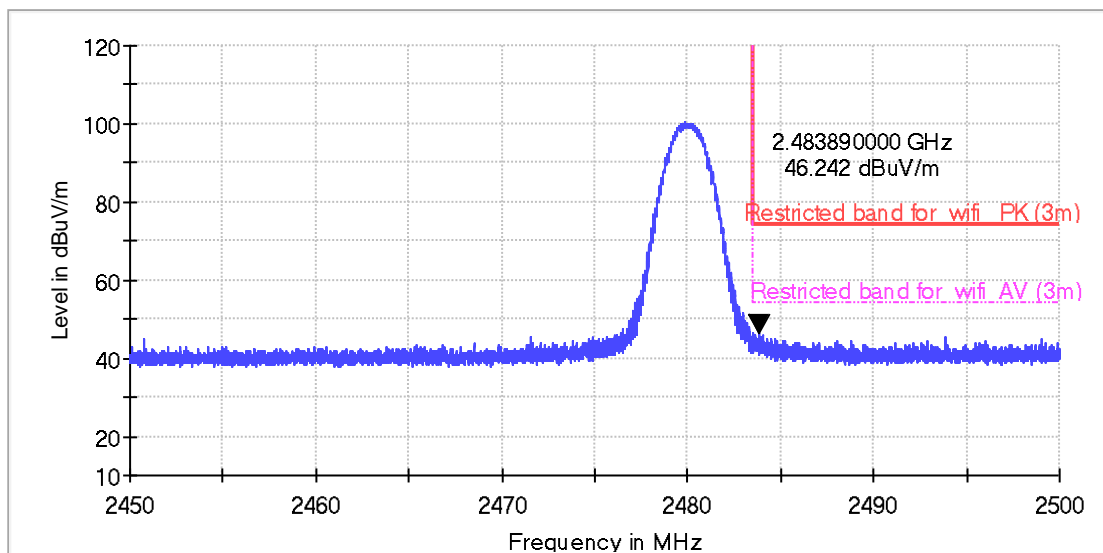
| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 2377.5 | 50.3 | -8.2 | 42.1 | 74 | V |
| 2369.2 | 50.8 | -8.2 | 42.6 | 74 | H |

Remark:

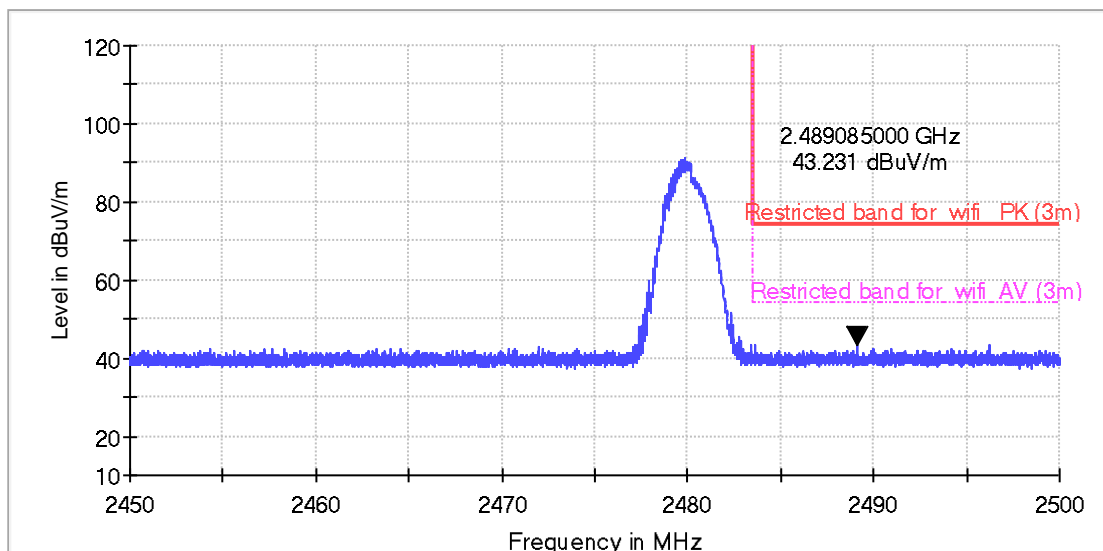
When Peak emission level was below AV limit, the AV emission level did not be recorded.

Test at Highest Channel (2.480 GHz) in transmitting status

Vertical:



Horizontal:



TEST REPORT

Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 2483.9 | 54.0 | -7.8 | 46.2 | 74 | V |
| 2489.1 | 51.0 | -7.8 | 43.2 | 74 | H |

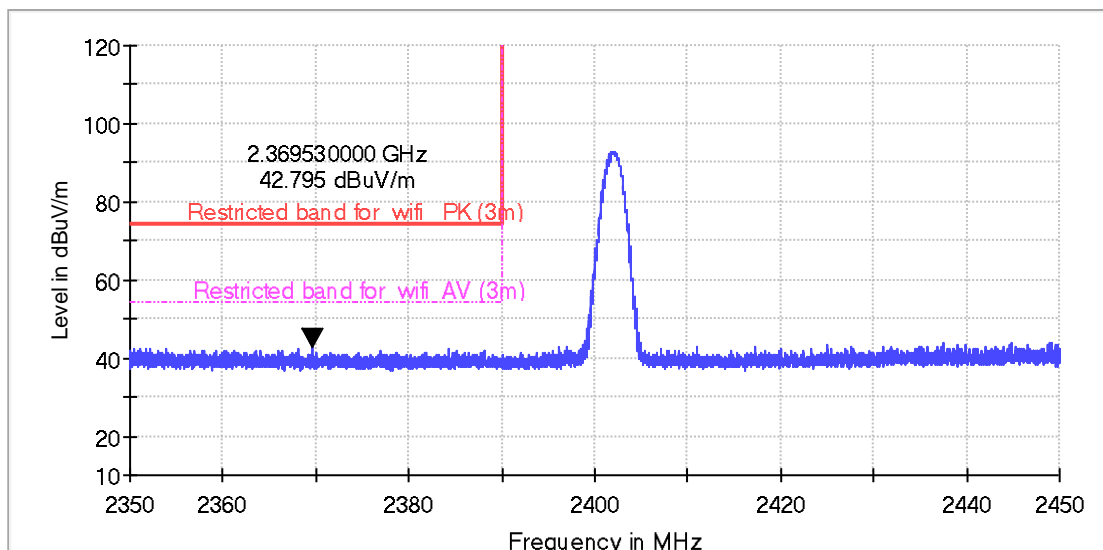
Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

EDR mode (3DH1)

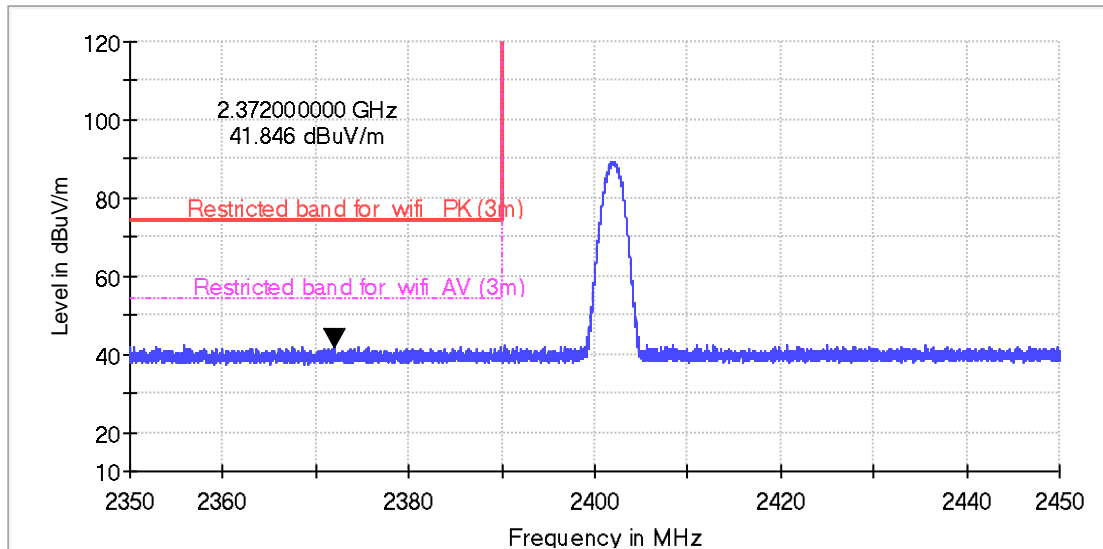
Test at Lowest Channel (2.402 GHz) in transmitting status

Vertical:



TEST REPORT

Horizontal:



Peak Measurement:

| Frequency (MHz) | Reading Level (dB μ V) | Correct Factor | Emission Level (dB μ V/m) | Limit (dB μ V/m) | Antenna polarization |
|-----------------|----------------------------|----------------|-------------------------------|----------------------|----------------------|
| 2369.5 | 51.0 | -8.2 | 42.8 | 74 | V |
| 2372.0 | 50.0 | -8.2 | 41.8 | 74 | H |

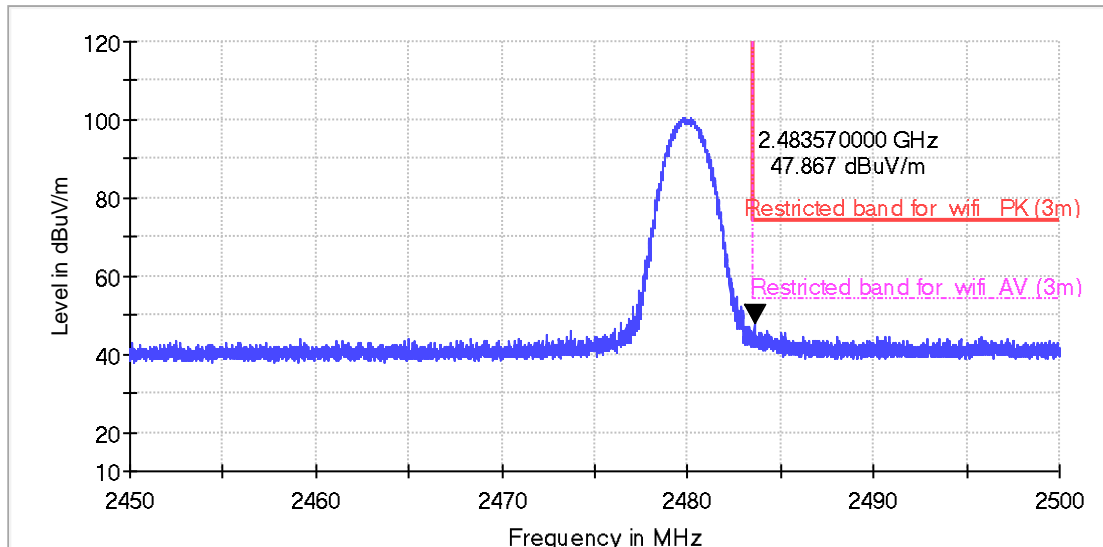
Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

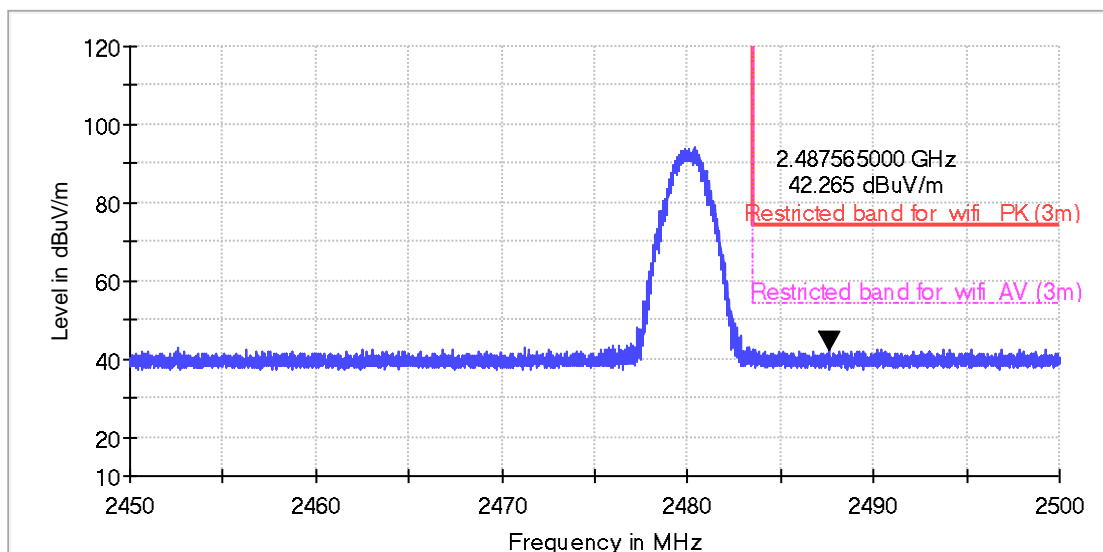
TEST REPORT

Test at Highest Channel (2.480 GHz) in transmitting status

Vertical:



Horizontal:



Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 2483.6 | 55.7 | -7.8 | 47.9 | 74 | V |
| 2487.6 | 50.1 | -7.8 | 42.3 | 74 | H |

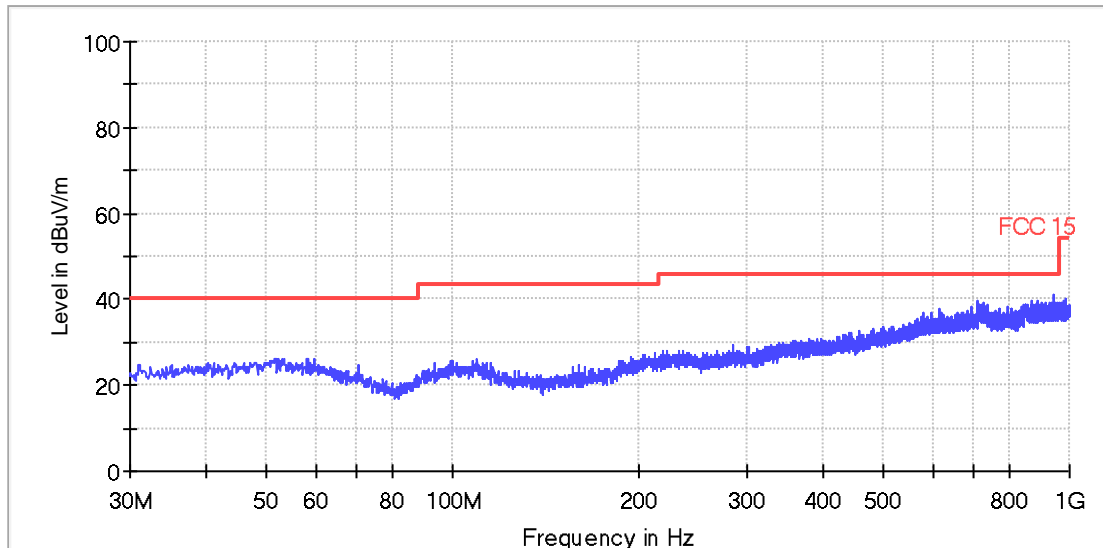
Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

TEST REPORT

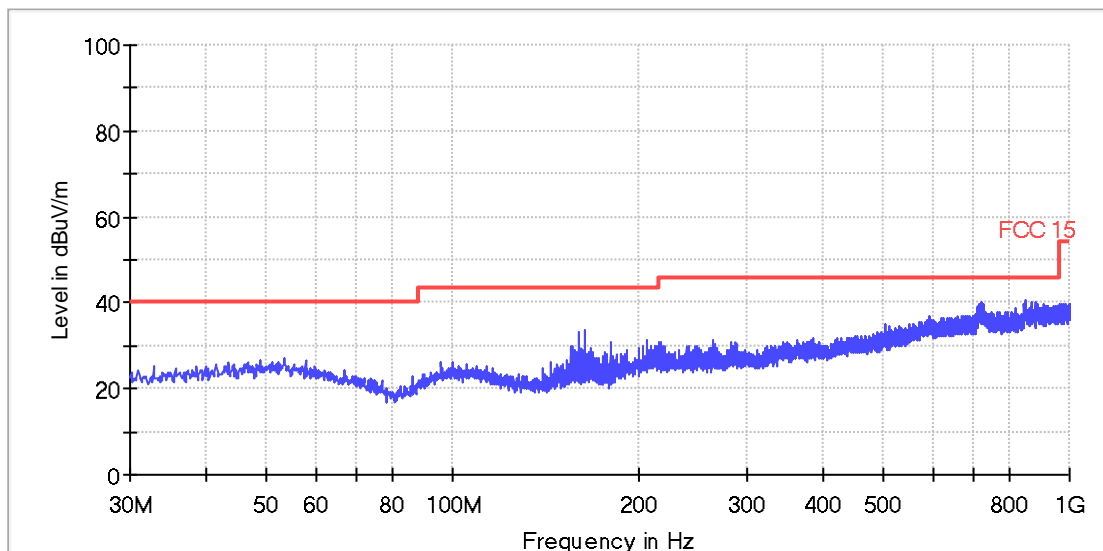
Both RF module transmit simultaneously, the worst case is recorded as follow
30 MHz~1 GHz Spurious Emissions .Quasi-Peak Measurement,

Vertical:



All emission levels are more than 10 dB below the limit.

Horizontal:



TEST REPORT

All emission levels are more than 10 dB below the limit.

1~25 GHz Radiated Emissions. Peak & Average Measurement

Peak Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4803.8 | 58.2 | -1.1 | 57.1 | 74 | V |
| 10277.8 | 40.5 | 6.8 | 47.3 | 74 | V |
| 4803.8 | 50.0 | -1.1 | 48.9 | 74 | H |
| 10058.9 | 40.7 | 6.6 | 47.3 | 74 | H |

AV Measurement:

| Frequency (MHz) | Reading Level (dBμV) | Correct Factor | Emission Level (dBμV/m) | Limit (dBμV/m) | Antenna polarization |
|-----------------|----------------------|----------------|-------------------------|----------------|----------------------|
| 4803.8 | 38.4 | -1.1 | 37.3 | 54 | V |
| 10277.8 | / | 6.8 | / | 54 | V |
| 4803.8 | / | -1.1 | / | 54 | H |
| 10058.9 | / | 6.6 | / | 54 | H |

Remark:

When Peak emission level was below AV limit, the AV emission level did not be recorded.

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Final Test Level = Receiver Reading + Antenna Factor + Cable Loss – Preamplifier Factor.

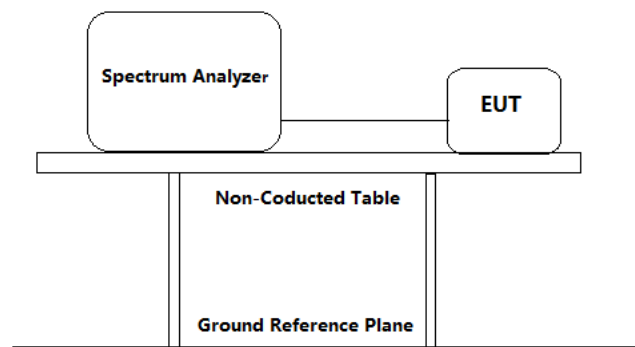
As shown in Section, for frequencies above 1000 MHz. the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

No any other emissions level which are attenuated less than 20dB below the limit.

TEST REPORT

4.11 Band Edges Requirement

| | |
|---------------------|---|
| Test Requirement: | FCC Part 15 C section 15.247 (d) 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. |
| Frequency Band: | 2400 MHz to 2483.5 MHz |
| Test Method: | ANSI C63.10: Clause 7.8.6 & 6.10 |
| Test Status: | Pre-test the EUT in continuous transmitting mode at the lowest (2402 MHz), and highest (2480 MHz) channel and hopping mode with different data packet. Compliance test in normal mode (DH1) and EDR mode (2DH1,3DH1) as the worst case was found. |
| Test Configuration: | For Band Edges Emission in Radiated mode, Please refer to clause 4.7 |



Test Procedure: For Band Edges Emission in Radiated mode, Please refer to clause 4.7

1. Removed the antenna from the EUT and then connect a low RF cable(cable loss =1 dB, with 10dB attenuator) from the antenna port to the spectrum analyzer or power meter.
2. Set RBW of spectrum analyzer to 100 kHz and VBW of spectrum analyzer to 300 kHz with suitable frequency span including 100 kHz bandwidth from band edge.
3. Repeated until all the test status was investigated.
4. Reported the worst case.

Used Test Equipment List:

3m Semi-Anechoic Chamber, EMI Test Receiver (9 kHz~7 GHz), Signal and Spectrum Analyzer (10 Hz~40 GHz), Loop antenna (9 kHz-30 MHz). TRILOG Super Broadband test Antenna(30 MHz-3 GHz) (RX), Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX) and High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX). Refer to Clause 5 Test Equipment List for details.

TEST REPORT

Test result with plots as follows:

For conducted mode:

The band edges was measured and recorded Result:

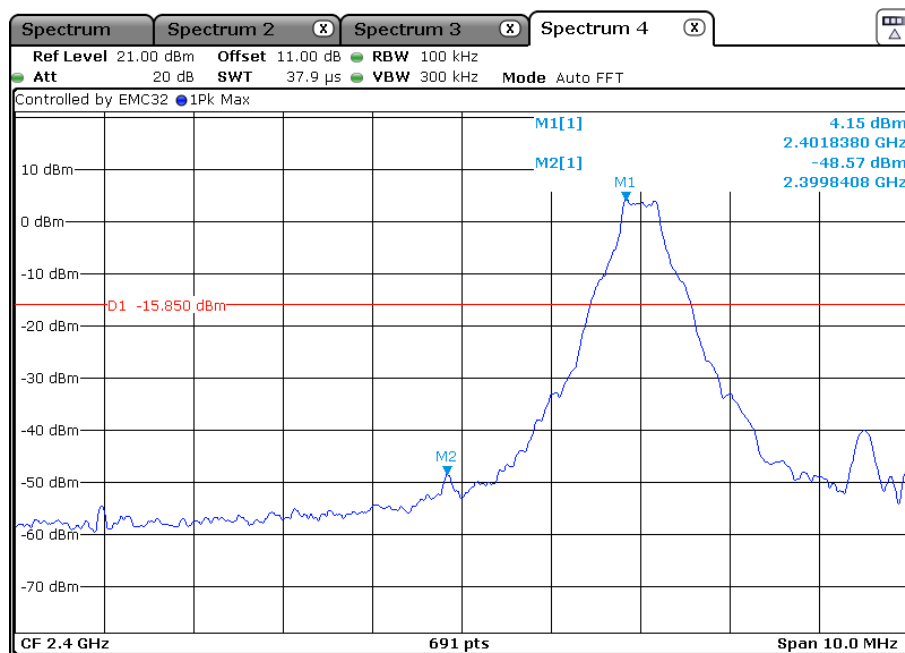
The Lower Edges attenuated more than 20dB.

The Upper Edges attenuated more than 20dB.

Result plot as follows:

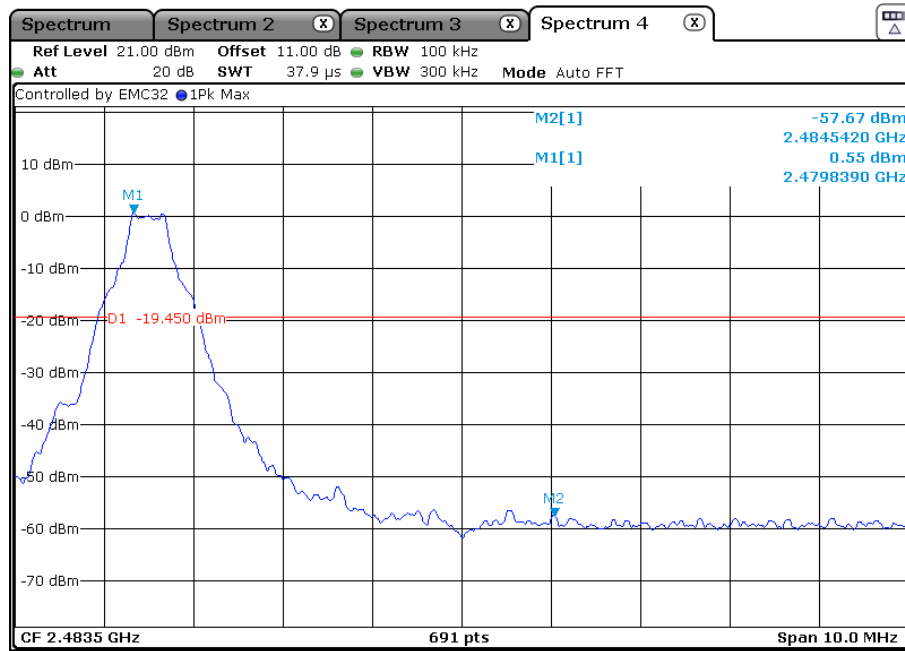
BDR mode(DH1):

Lowest channel: 2.402 GHz



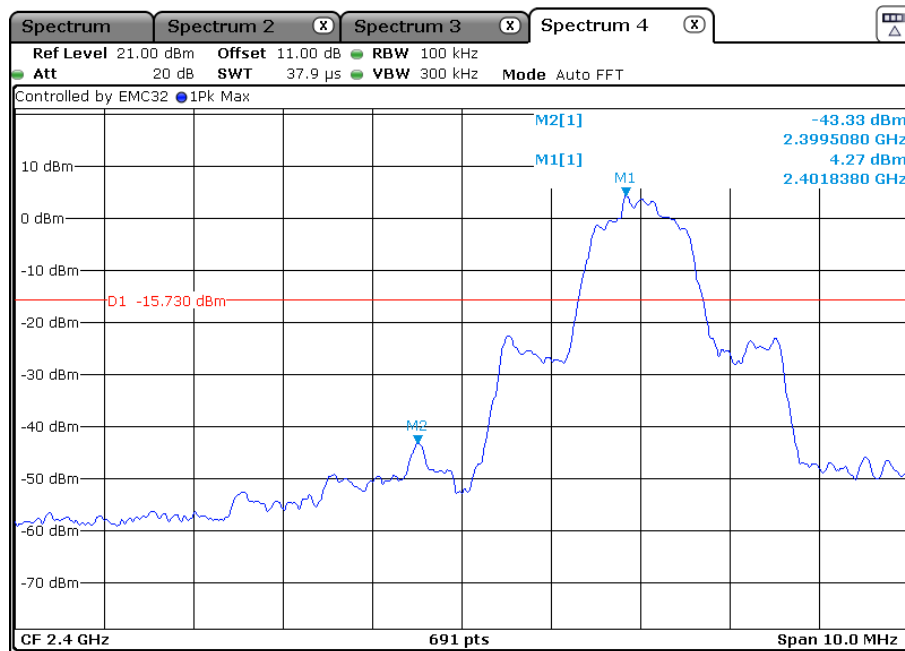
Highest Channel: 2.480 GHz:

TEST REPORT



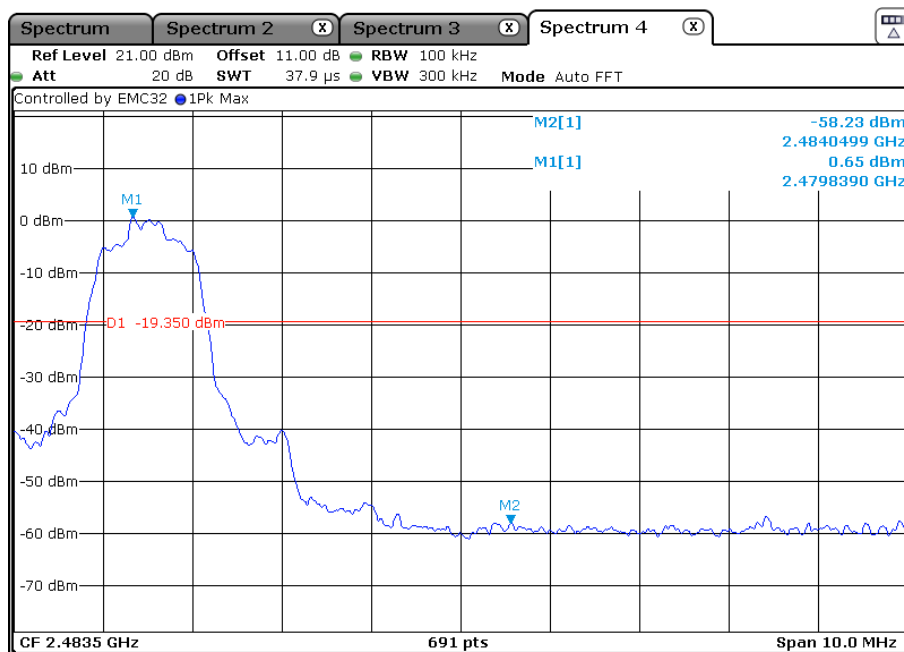
EDR mode (2DH1):

Lowest channel: 2.402 GHz



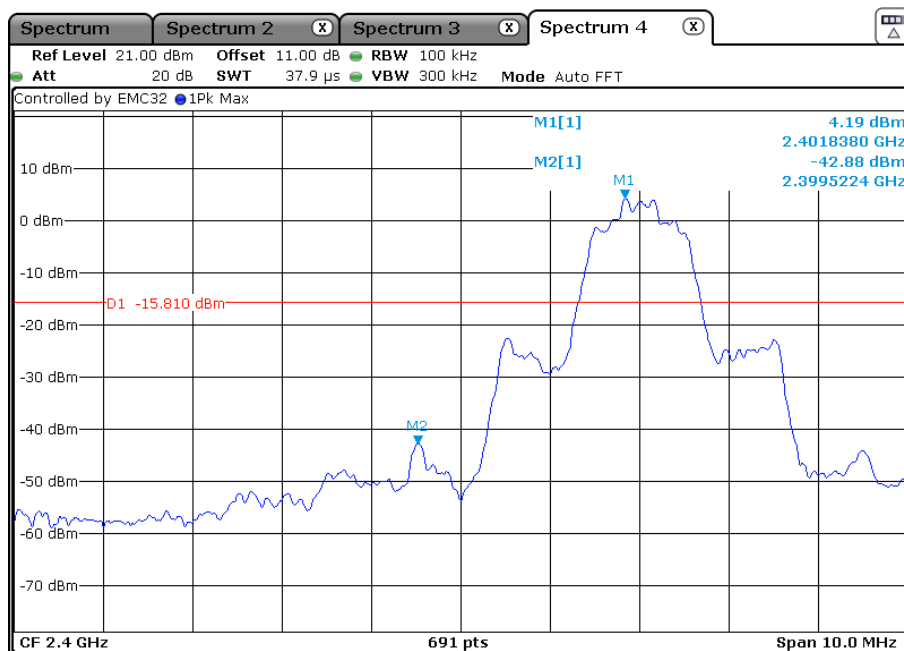
Highest Channel: 2.480 GHz:

TEST REPORT



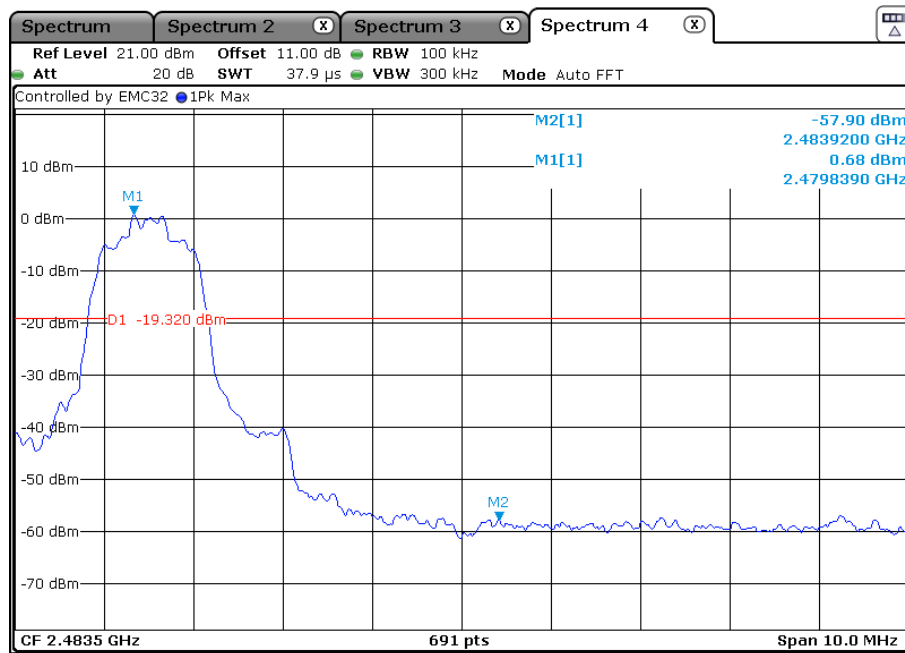
EDR mode (3DH1):

Lowest channel: 2.402 GHz



Highest Channel: 2.480 GHz:

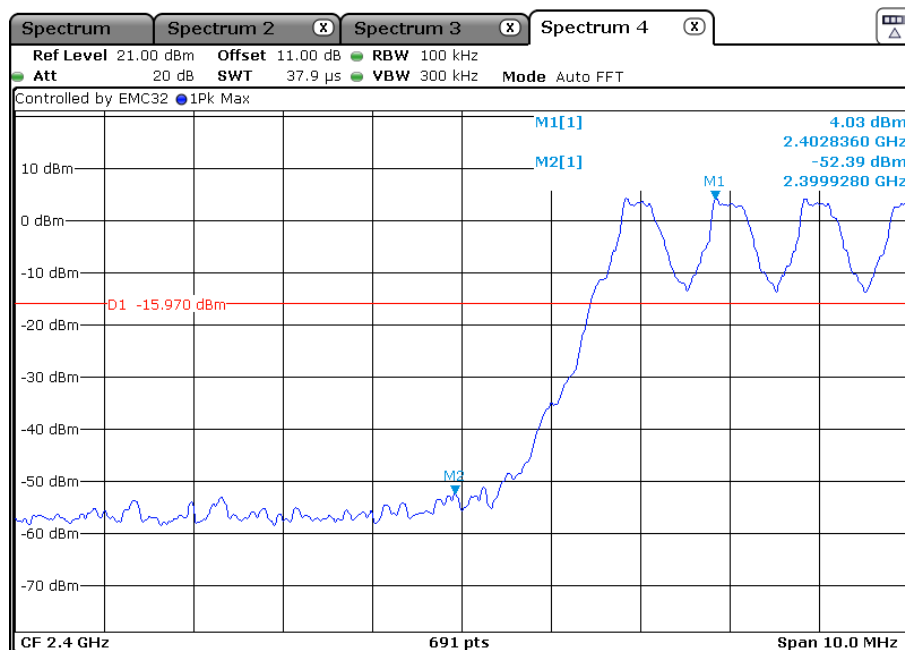
TEST REPORT



HOPPING

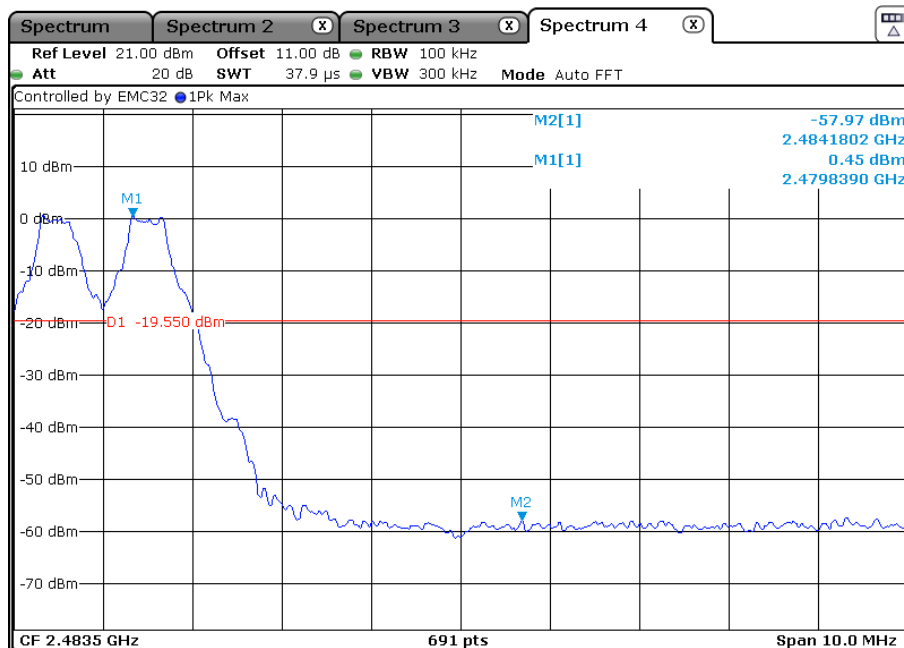
BDR mode(DH1):

Lowest channel: 2.402 GHz



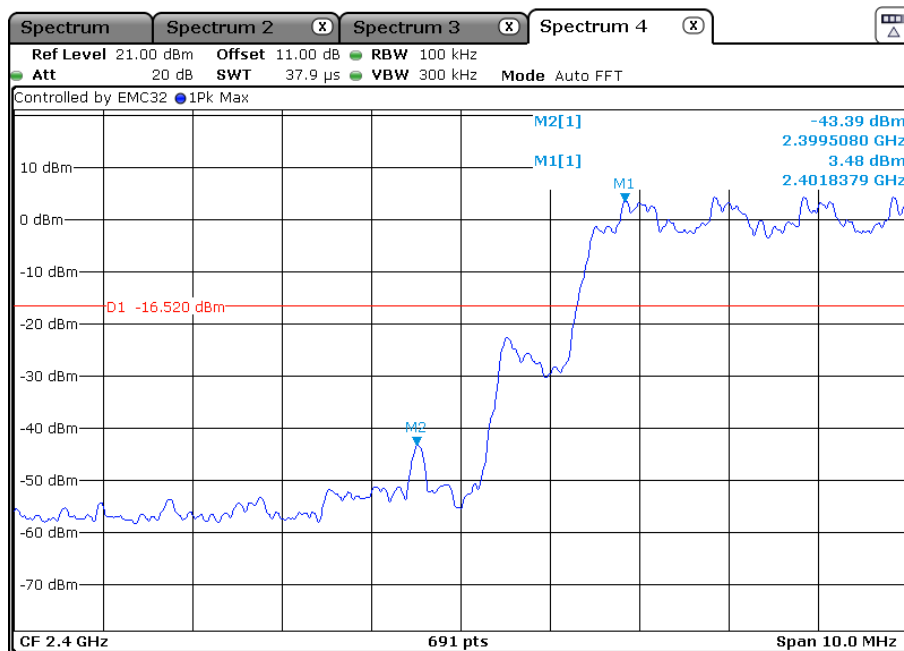
TEST REPORT

Highest Channel: 2.480 GHz:



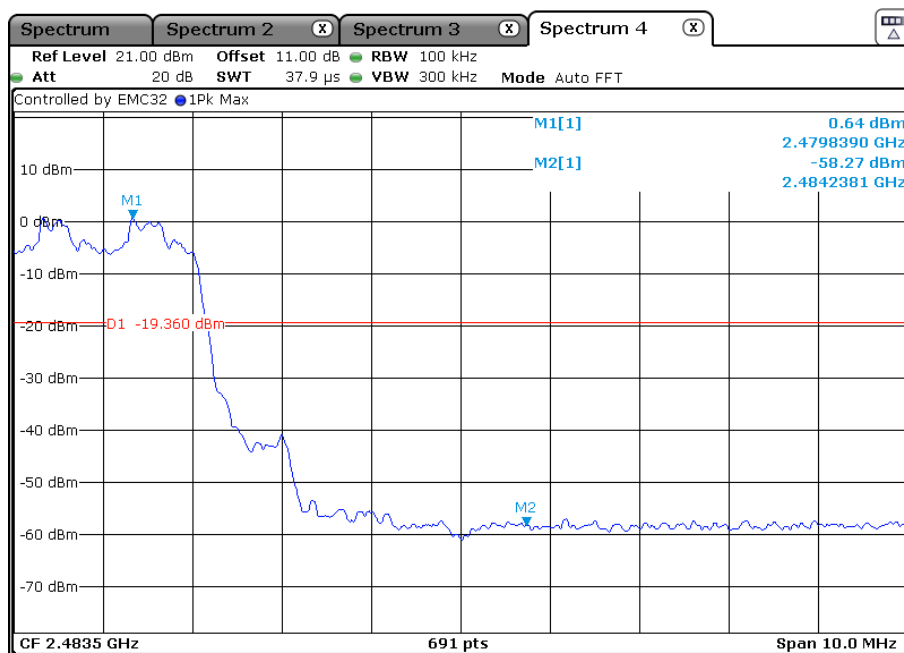
EDR mode (2DH1):

Lowest channel: 2.402 GHz



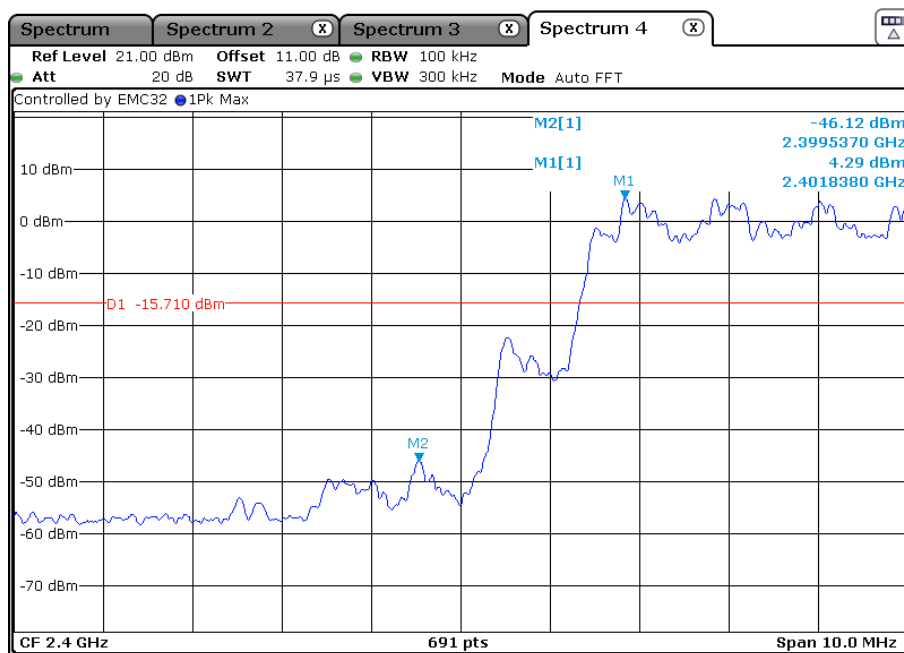
TEST REPORT

Highest Channel: 2.480 GHz:



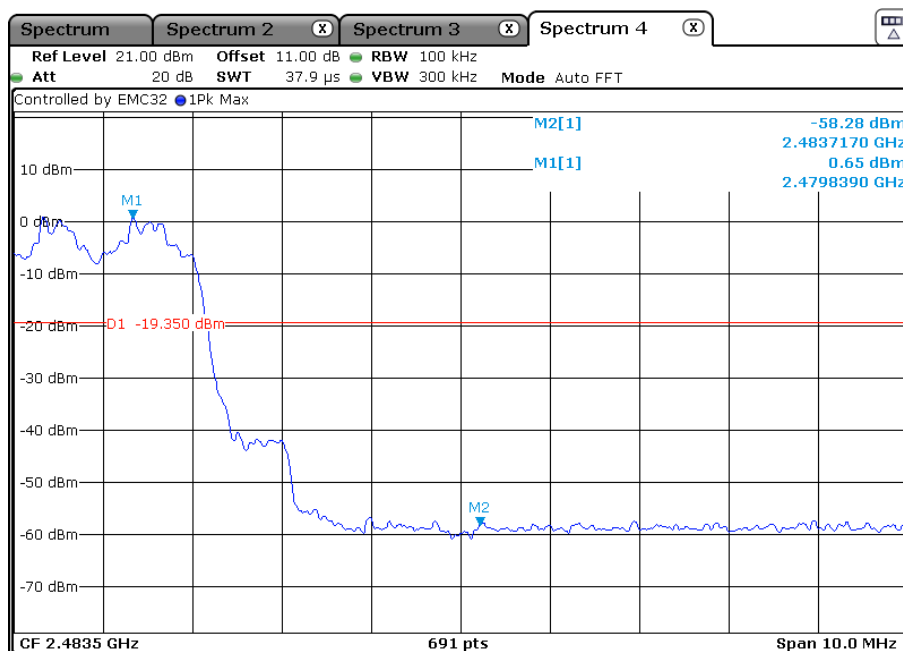
EDR mode (3DH1):

Lowest channel: 2.402 GHz



TEST REPORT

Highest Channel: 2.480 GHz:

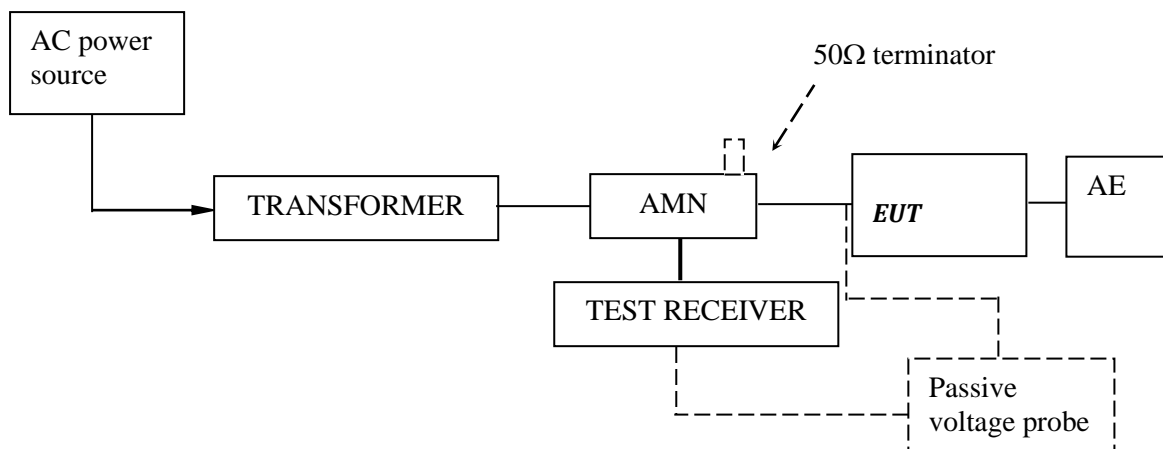


For radiated mode:

Please refer Clause 4.7 Radiated Emissions in Restricted Bands of this test report for more details. The resultant field strength in band edges meet the general radiated emission limit in section 15.209, which does not exceed 74 dBμV/m (Peak Limit) and 54dBμV/m (Average Limit).

4.12 Conducted Emission Test

Test Configuration:



Test Setup and Procedure:

TEST REPORT

Test was performed according to ANSI C63.10 Clause 6.2. The EUT was set to achieve the maximum emission level. The mains terminal disturbance voltage was measured with the EUT in a shielded room. The EUT was connected to AC power source through an Artificial Mains Network which provides a 50Ω linear impedance. Artificial hand is used if appropriate (for handheld apparatus). The load/control terminal disturbance voltage was measured with passive voltage probe if appropriate.

The table-top EUT was placed on a 0.8m high non-metallic table above earthed ground plane (Ground Reference Plane). And for floor standing EUT, was placed on a 0.1m high non-metallic supported on GRP. The EUT keeps a distance of at least 0.8m from any other of the metallic surface. The Artificial Mains Network is situated at a distance of 0.8m from the EUT.

During the test, mains lead of EUT excess 0.8m was folded back and forth parallel to the lead so as to form a horizontal bundle with a length between 0.3m and 0.4m

The bandwidth of test receiver was set at 9 kHz. The frequency range from 150 kHz to 30MHz was checked.

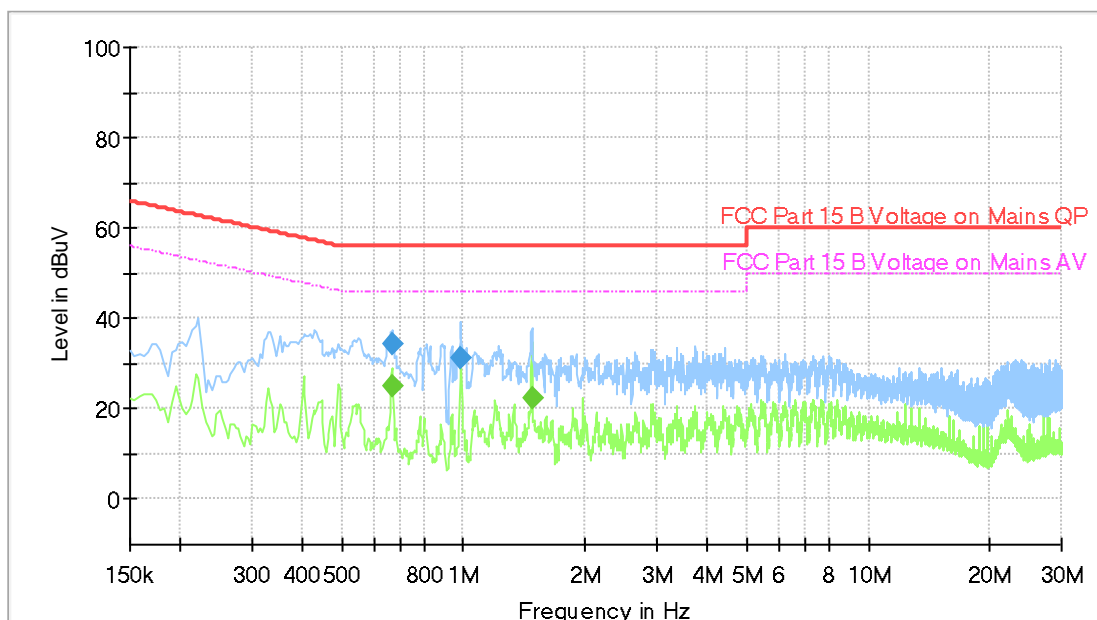
Test Data and Curve

At main terminal: Pass

Tested Wire: Live

Operation Mode: transmitting mode

Full Spectrum



TEST REPORT

Final_Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|--------|------------|
| 0.666000 | --- | 24.94 | 46.00 | 21.06 | 1000.0 | 9.000 | L1 | ON | 9.6 |
| 0.670000 | 34.57 | --- | 56.00 | 21.43 | 1000.0 | 9.000 | L1 | ON | 9.6 |
| 0.982000 | 31.16 | --- | 56.00 | 24.84 | 1000.0 | 9.000 | L1 | ON | 9.6 |
| 1.474000 | --- | 22.58 | 46.00 | 23.42 | 1000.0 | 9.000 | L1 | ON | 9.6 |

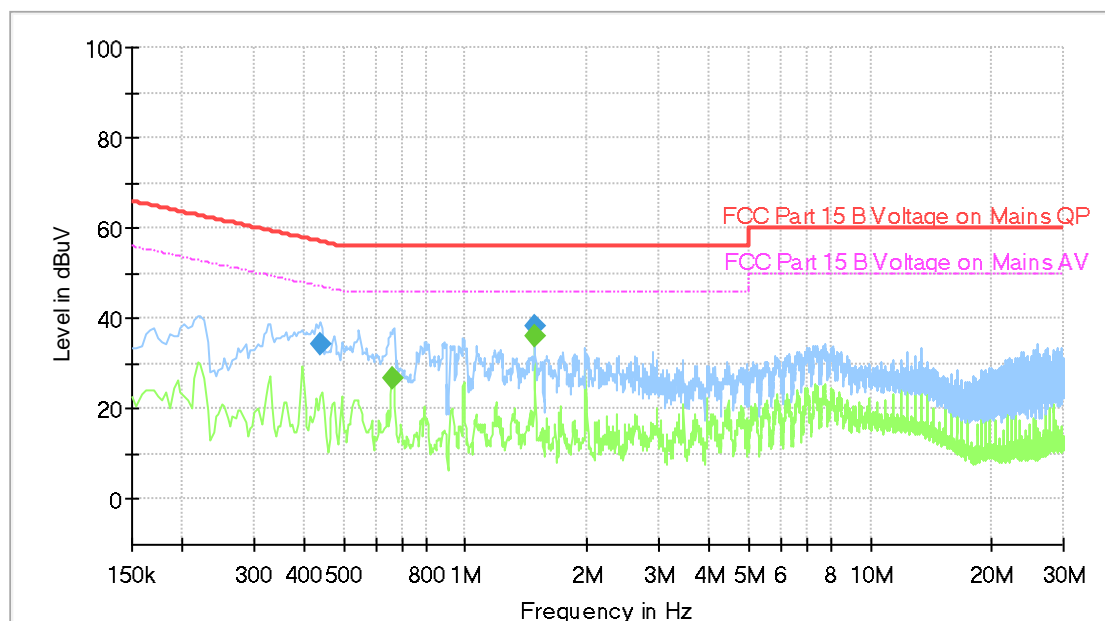
Remark:

1. Corr. (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBμV) = Corr. (dB) + Read Level (dBμV)
3. Delta Limit (dB) = Level (dBμV)-Limit (dBμV)

Tested Wire: Neutral

Operation Mode: transmitting mode

Full Spectrum



Final_Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|--------|------------|
| 0.438000 | 34.48 | --- | 57.10 | 22.62 | 1000.0 | 9.000 | N | ON | 9.5 |
| 0.658000 | --- | 26.88 | 46.00 | 19.12 | 1000.0 | 9.000 | N | ON | 9.5 |
| 1.482000 | --- | 36.30 | 46.00 | 9.70 | 1000.0 | 9.000 | N | ON | 9.5 |
| 1.482000 | 38.42 | --- | 56.00 | 17.58 | 1000.0 | 9.000 | N | ON | 9.5 |

Remark:

1. Corr. (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBμV) = Corr. (dB) + Read Level (dBμV)
3. Delta Limit (dB) = Level (dBμV)-Limit (dBμV)

TEST REPORT

5.0 Test Equipment List

Radiated Emission/Radio

| Equipment No. | Equipment | Model | Manufacturer | Cal. Due date (YYYY-MM-DD) | Calibration Interval |
|---------------|---|----------------------|------------------|-------------------------------|-------------------------|
| EM030-04 | 3m Semi-Anechoic Chamber | 9×6×6 m ³ | ETS•LINDGRE N | 2024-04-10 | 1Y |
| EM031-02 | EMI Test Receiver (9 kHz~7 GHz) | R&S ESR7 | R&S | 2023-11-15 | 1Y |
| EM031-03 | Signal and Spectrum Analyzer (10 Hz~40 GHz) | R&S FSV40 | R&S | 2023-11-15 | 1Y |
| EM011-04 | Loop antenna (9 kHz-30 MHz) | HFH2-Z2 | R&S | 2023-06-27 | 1Y |
| EM061-03 | TRILOG Super Broadband test Antenna (30 MHz-1.5 GHz) (TX) | VULB 9161 | SCHWARZBECK | 2023-06-26 | 1Y |
| EM033-01 | TRILOG Super Broadband test Antenna(30 MHz-3 GHz) (RX) | VULB 9163 | SCHWARZBECK | 2023-12-04 | 1Y |
| EM033-02 | Bouble-Ridged Waveguide Horn Antenna (800 MHz-18 GHz)(RX) | R&S HF907 | R&S | 2023-06-26 | 1Y |
| EM033-03 | High Frequency Antenna & preamplifier(18 GHz~26.5 GHz) (RX) | R&S SCU-26 | R&S | 2024-04-22 | 1Y |
| EM033-04 | High Frequency Antenna & preamplifier (26 GHz-40 GHz) | R&S SCU-40 | R&S | 2024-04-22 | 1Y |
| EM031-02-01 | Coaxial cable(9 kHz-1 GHz) | N/A | R&S | 2024-04-10 | 1Y |
| EM033-02-02 | Coaxial cable(1 GHz-18 GHz) | N/A | R&S | 2024-04-10 | 1Y |
| EM033-04-02 | Coaxial cable(18 GHz~40 GHz) | N/A | R&S | 2024-04-22 | 1Y |
| EM031-01 | Signal Generator (9 kHz~6 GHz) | SMB100A | R&S | 2023-07-17 | 1Y |
| EM040-01 | Band Reject/Notch Filter | WRHFV | Wainwright | N/A | 1Y |
| EM040-02 | Band Reject/Notch Filter | WRCGV | Wainwright | N/A | 1Y |
| EM040-03 | Band Reject/Notch Filter | WRCGV | Wainwright | N/A | 1Y |
| EM022-03 | 2.45 GHz Filter | BRM50702 | Micro-Tronics | 2024-05-09 | 1Y |
| SA016-29 | Climatic Test Chamber | MHU-80L | JIANQIAO | 2024-01-03 | 1Y |
| SA012-74 | Digital Multimeter | FLUKE175 | FLUKE | 2023-10-07 | 1Y |
| EM010-01 | Regulated DC Power supply | PAB-3003A | GUANHUA | N/A | 1Y |
| SA040-22 | Regulated DC Power supply | IT6721 | ITECH | 2023-09-04 | 1Y |
| EM046-05 | Power meter | NPR6A | R&S | 2024-04-19 | 1Y |
| EM046-06 | Power meter | NPR6A | R&S | 2024-04-19 | 1Y |
| EM045-01-01 | EMC32 software (RE/RS) | V10.01.00 | R&S | N/A | N/A |
| EM045-01-09 | EMC32 software (328/893) | V9.26.01 | R&S | N/A | N/A |

Conducted emission at the mains terminals

| Equipment No. | Equipment | Model | Manufacturer | Cal. Due date (YYYY-MM-DD) | Calibration Interval |
|---------------|-----------------|----------|--------------|-------------------------------|-------------------------|
| EM080-05 | EMI receiver | ESCI | R&S | 2023-06-08 | 1Y |
| EM006-05 | LISN | ENV216 | R&S | 2023-06-05 | 1Y |
| EM006-06 | LISN | ENV216 | R&S | 2023-09-05 | 1Y |
| EM006-06-01 | Coaxial cable | / | R&S | 2024-04-10 | 1Y |
| EM004-04 | EMC shield Room | 8m×3m×3m | Zhongyu | 2024-01-03 | 1Y |

*****End of the test report*****