



FCC PART 15C TEST REPORT

| Report Number | BWTR-1921-FCCBT | |
|--------------------|---|--|
| FCC ID | 2AUFM-S1 | |
| Applicant | Ningbo Wellcool Intelligent Technology Co., Ltd. | |
| Product Name | Bluetooth Earphones | |
| Marketing Name | MPOW M10 TURE WIRELESS EARBUDS | |
| Brand Name | SweiKuo | |
| Model Name | WellCool S1 | |
| Serial Number | No.1: 6932438111710 No.2: 6932438112144 | |
| Test Standard | FCC 47 CFR Part 15 Subpart C | |
| Tested Date | Aug. 20, 2019 - Dec. 09, 2019 | |



CONTENTS

| 1 | Sum | mary of Test Result | 4 |
|---|------|---|----|
| 2 | Gen | eral Information | 5 |
| | 2.1 | Applicant | |
| | 2.2 | Manufacturer | 5 |
| | 2.3 | Product Feature of Equipment Under Test | 5 |
| | 2.4 | Ancillary Equipment | 5 |
| | 2.5 | Description of Test Modes | 6 |
| | 2.6 | Duty Cycle of Test Signal | |
| | 2.7 | Applicable Standards | |
| | 2.8 | Test Facilities | 7 |
| 3 | Test | Result | |
| - | 3.1 | 20dB Bandwidth | |
| | 3.2 | Channel Separation | 14 |
| | 33 | Output Power | 16 |
| | 3.4 | Dwell Time | 17 |
| | 3.5 | Number of Hopping Frequencies | |
| | 3.6 | Conducted Out of Band Emission | 25 |
| | 37 | Authorized-hand Band-edge | 32 |
| | 3.8 | Spurious Radiated Emissions and Restricted-band Band-edge | 39 |
| | 3.9 | AC Power Line Conducted Emission | 51 |
| 4 | Test | Instruments | 53 |



Revision History

| Revision | Description | Issued Date |
|----------|---|-------------|
| А | Initial issue of report | 2019/11/28 |
| В | Correct the information of antenna type in section 2.3 from 'Fixed Internal' to 'Chip Antenna'; Add a note in section 2.3 to declare the device has a full compliant with the requirement of KDB558074; Update the test results of 20dB Bandwidth in section 3.1 due to the RBW setting in ANSI C63.10-2013, clause 6.9.2; Add the test mode information of channel separation in section 3.2; Add the test mode information of Number of Hopping Frequencies in section 3.5; Revise the limit setting of Spurious Radiated Emissions in section 3.8 according to the requirement of FCC part 15C; Update the information of test instruments in section 4; | 2019/12/10 |
| | | |



1 Summary of Test Result

| Report Section | FCC Section | Description | Result |
|----------------|---------------------------|---|--------|
| 3.1 | 15.247 (a)(1) | 20dB Bandwidth | Pass |
| 3.2 | 15.247 (a)(1) | Channel Separation | Pass |
| 3.3 | 15.247 (b)(1) | Output Power | Pass |
| 3.4 | 15.247 (a)(1)(iii) | Dwell Time | Pass |
| 3.5 | 15.247 (a)(1)(iii) | Number of Hopping Frequencies | Pass |
| 3.6 | 15.247 (d) | Conducted Out of Band Emission | Pass |
| 3.7 | 15.247 (d) | Authorized-band Band-edge | Pass |
| 3.8 | 15.247(d)/15.35(b)/15.209 | Spurious Radiated Emissions and Restricted-band Band-edge | Pass |
| 3.9 | 15.207 | AC Power Line Conducted Emission | N/A |
| 2.3 | 15.203 | Antenna Requirement | Pass |

Note: The test was not performed since the EUT is power off automatically when they are put into the earphone charging case (where the AC power port could only be obtained) as declared by manufacturer.

We, Beijing Boomwave Test Service Co. Ltd., would like to declare that the tested sample has been evaluated and in compliance with the requirements of applicable standards.

Prepared by:

Reviewed by:

Approved by:

Rationale:

The test results in this report apply exclusively to the tested model / sample.

The electrical copy of test report is invalid without the signatures. The hard copy is invalid without seal. The test report shall not be modified, republished or copied without the written authorization of the laboratory.



2 General Information

2.1 Applicant

Ningbo Wellcool Intelligent Technology Co., Ltd. 157 East Road revitalization of Zhangshui Town, Haishu District, Ningbo City, Zhejiang Province, P.R.China 315161

2.2 Manufacturer

Guangdong Seneasy Intelligent Technology Co., Ltd. No. 63, Huitai Industrial Park, Huizhou City, Guangdong Province, P.R. China

2.3 Product Feature of Equipment Under Test

| Product Name | Bluetooth Earphones |
|----------------------------------|--|
| Marketing Name | MPOW M10 TURE WIRELESS EARBUDS |
| Model Name | WellCool S1 |
| Sample Status | Production |
| Power Supply Rating | 5V, 110mA |
| Operating Frequency Range | 2402MHz~2480MHz |
| Type of Wireless Technology | Bluetooth V5.0 BR/EDR |
| Modulation Type and Data Rate | GFSK: 1Mbps, π/4DQPSK: 2Mbps, 8DPSK: 3Mbps |
| Number of Channels | 79 |
| Nominal Channel Bandwidth | 1MHz |
| Number of Antenna | 1 |
| Antenna Type | Chip Antenna |
| Antenna Gain | 1.72dBi |
| Hardware Version | YB1L1A1 / YB1R1A1 |
| Software Version | BES_2300_H_T80_BH_B34.2_0829_USER V1.0 |
| Sample Received Date | 2019/7/16 |

Note: The EUT is designed based on SIG specification. It has a full support to Medium Access Protocol and full compliant with KDB558074 requirements.

2.4 Ancillary Equipment

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following ancillary equipment were used to form a representative test configuration during the tests.

| Accessory | Earphone Charging Case |
|---------------------|---|
| Manufacturer | ZHONGSHAN ZHONGWANGDE NEW ENERGY TECHNOLOGY CO., LTD. |
| Model Name | ZWD802424 |
| Input Power | 5V, 500mA |
| Output Power | 5V, 220mA |
| Serial Number | |

| Support Unit | Adapter | |
|---------------|---|--|
| Manufacturer | Smartisan | |
| Model Name | CD101 | |
| Input Power | 100-240Vac, 50/60Hz, 0.5A | |
| Output Power | 5V, 3A / 9V, 2A / 12V, 1.5A | |
| Power Line | 1m non-shielded AC cable without core attached on | |
| Serial Number | 17481115901 | |



| Support Unit | Laptop | |
|---------------|--------------------|--|
| Manufacturer | DELL | |
| Model Name | Name Inspiron 5488 | |
| Serial Number | 42635157158 | |

2.5 Description of Test Modes

79 channels are provided to this EUT:

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

The EUT was linked by Bluetooth simulator or controlled by engineering test software to work in continious trasmitting and receiving mode. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports.

Following channels were selected for test:

| Channel | No. | Frequency (MHz) |
|------------|-----|-----------------|
| CH Lowest | 0 | 2402 |
| CH Middle | 39 | 2441 |
| CH Highest | 78 | 2480 |

2.6 Duty Cycle of Test Signal

| Modulation Type | Duty Cycle |
|--------------------|------------|
| GFSK (DH1) | 14.12% |
| GFSK (DH3) | 42.54% |
| GFSK (DH5) | 57.04% |
| $\pi/4DQPSK$ (DH1) | 14.05% |
| $\pi/4DQPSK$ (DH3) | 42.91% |
| $\pi/4DQPSK$ (DH5) | 56.18% |
| 8DPSK (DH1) | 13.53% |
| 8DPSK (DH3) | 42.88% |
| 8DPSK (DH5) | 57.02% |

Note: GFSK (DH5) and 8PSK (DH5) are the worst-case modulation type due to their duty cycle shown above.

2.7 Applicable Standards

| Standard | Version | Title |
|------------------------------|---------|--|
| FCC 47 CFR Part 15 Subpart C | 2019 | Requirements for Intentional Radiators |
| ANSI C63.10 | 2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices - Electromagnetic Compatibility |

2.8 Test Facilities

Company Name: Beijing Boomwave Test Service Co. Ltd

Address: EMC Building, No.1 Wang Jing East Road, Chao Yang District Beijing, P.R. China 100102

FCC Test Firm Registration Number: 613197

ISED Canada Registration No.: 24289 (CAB Identifier: CN0010)

VCCI Registration No.: R-20062, G-20063, C-20050, T-20049

| Test Site | Description | Dimension | Ground Plane Size |
|-----------|-----------------------------|-------------------|-------------------|
| SAC10 | 10m semi-anechoic chamber | 19.5m×12.9m×8.6m | 4m×4m |
| SAC3 | 3m semi-anechoic chamber | 9.6m×6.4m×6.0m | |
| □ SR#1 | Shielding Room for EMS test | 8.1m×4.05m×2.755m | 8.1m×4.05m |
| SR#2 | Shielding Room for RF test | 8.1m×4.05m×2.755m | |



3 Test Result

3.1 20dB Bandwidth

3.1.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.247 (a)(1) For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

3.1.2. Test Setup



3.1.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 6.9.2;
- 2) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 3) Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- 4) Measure the frequency difference of two frequencies that were attenuated 30dB from the reference level. Record the frequency difference as the emission bandwidth.
- 5) Repeat above procedures until all frequencies measured were complete.

3.1.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.12.09 |
|---------------|-----------|--------------------------|------------|
| Temperature | 24.0°C | Relative Humidity | 48.3% |
| Pressure | 100.2kPa | Test Sample Selected | No.1 |

| Modulation Type | Channel | Frequency (MHz) | 20dB Bandwidth (kHz) |
|-----------------|--------------------|-----------------|----------------------|
| | CH Lowest (No.0) | 2402 | 842.30 |
| GFSK | CH Middle (No.39) | 2441 | 837.90 |
| | CH Highest (No.78) | 2480 | 837.90 |
| π/4DQPSK | CH Lowest (No.0) | 2402 | 1180.90 |
| | CH Middle (No.39) | 2441 | 1180.90 |
| | CH Highest (No.78) | 2480 | 1180.90 |
| | CH Lowest (No.0) | 2402 | 1193.90 |
| 8DPSK | CH Middle (No.39) | 2441 | 1198.30 |
| | CH Highest (No.78) | 2480 | 1193.90 |





Date: 9.DEC.2019 11:17:14

Carrier Frequency (MHz): 2402 CH Lowest (No.0) Modulation Type: GFSK



Date: 9.DEC.2019 11:22:27

Carrier Frequency (MHz): 2441 CH Middle (No.39) Modulation Type: GFSK





Date: 9.DEC.2019 11:25:24

Carrier Frequency (MHz): 2480 CH Highest (No.78) Modulation Type: GFSK



Date: 9.DEC.2019 11:10:53

Carrier Frequency (MHz): 2402 CH Lowest (No.0) Modulation Type: π/4DQPSK





Date: 9.DEC.2019 11:27:39

Carrier Frequency (MHz): 2441 CH Middle (No.39) Modulation Type: π/4DQPSK



Date: 9.DEC.2019 11:33:54

Carrier Frequency (MHz): 2480 CH Highest (No.78) Modulation Type: π/4DQPSK





Date: 9.DEC.2019 11:40:52

Carrier Frequency (MHz): 2402 CH Lowest (No.0) Modulation Type: 8DQPSK



Date: 9.DEC.2019 11:42:47

Carrier Frequency (MHz): 2441 CH Middle (No.39) Modulation Type: 8DQPSK





Date: 9.DEC.2019 11:45:01



3.1.5. Uncertainty

| Frequency (MHz) | Ulab | k |
|-----------------|----------|---|
| 2402 | 187.46Hz | 2 |
| 2441 | 190.40Hz | 2 |
| 2480 | 193.35Hz | 2 |



3.2 Channel Separation

3.2.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.247 (a)(1) Frequency hopping systems operating in the 2400-2483.5MHz band may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

3.2.2. Test Setup



3.2.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 7.8.2;
- 2) The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
 - a) Span: Wide enough to capture the peaks of two adjacent channels;
 - b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel;
 - c) Video (or average) bandwidth (VBW) \geq RBW;
 - d) Sweep: Auto;
 - e) Detector function: Peak;
 - f) Trace: Max hold;
 - g) Allow the trace to stabilize.
- 3) Use the marker-delta function to determine the separation between the peaks of the adjacent channels.
- 4) The EUT is investigated with its worst-case modulation type (defined in section 2.6 of this report).

3.2.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.8.23 |
|---------------|-----------|--------------------------|-----------|
| Temperature | 20.7°C | Relative Humidity | 48.7% |
| Pressure | 100.1kPa | Test Sample Selected | No.1 |





Date: 23.AUG.2019 16:32:07

GFSK (DH5) Mode: Channel Separation 1MHz



8PSK (DH5) Mode: Channel Separation 1MHz

3.2.5. Uncertainty

| Frequency (MHz) | U_{lab} | k |
|-----------------|-----------|---|
| 2402 | 187.46Hz | 2 |
| 2441 | 190.40Hz | 2 |
| 2480 | 193.35Hz | 2 |



3.3 Output Power

3.3.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.247 (b)(1) For frequency hopping systems operating in the 2400-2483.5MHz band employing at least 75 nonoverlapping hopping channels: 1watt (30dBm). For all other frequency hopping systems in the 2400-2483.5MHz band: 0.125watts (21dBm).

3.3.2. Test Setup



3.3.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 7.8.5;
- 2) The transmitter output power is measured using a wideband peak and average power meter.

3.3.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.9.12 |
|---------------|-----------|----------------------|-----------|
| Temperature | 24.2°C | Relative Humidity | 44.1% |
| Pressure | 100.1kPa | Test Sample Selected | No.1 |

| Modulation Type | Channel | Frequency (MHz) | Average Power Output (dBm) | Peak Power Output (dBm) |
|-----------------|--------------------|--------------------|-------------------------------|----------------------------|
| | CH Lowest (No.0) | 2402 | 2.84 | 5.47 |
| GFSK | CH Middle (No.39) | 2441 | 0.58 | 3.23 |
| | CH Highest (No.78) | 2480 | 1.76 | 4.41 |
| | CH Lowest (No.0) | 2402 | -0.20 | 5.39 |
| π/4DQPSK | CH Middle (No.39) | 2441 | -2.22 | 3.41 |
| | CH Highest (No.78) | 2480 | -1.25 | 4.33 |
| | CH Lowest (No.0) | 2402 | -0.18 | 5.44 |
| 8DPSK | CH Middle (No.39) | 2441 | -2.38 | 3.25 |
| | CH Highest (No.78) | 2480 | -1.39 | 4.23 |

3.3.5. Uncertainty

U_{lab}=1.48dB (k=2)



3.4 Dwell Time

3.4.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.247 (a)(1)(iii)

Frequency hopping systems in the 2400-2483.5MHz 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.

The time slot length is measured of DH1, DH3 and DH5 packets. The dwell time is calculated by: Dwell time = time slot length * hop rate * 31.6/ number of hopping channels with:

- hop rate=1600/2 * 1/s for DH1 packets =800
- hop rate=1600/4 * 1/s for DH3 packets =400
- hop rate=1600/6 * 1/s for DH5 packets =266.67
- number of hopping channels=79
- 31.6 s=0.4 seconds multiplied by the number of hopping channels=0.4s * 79

3.4.2. Test Setup



3.4.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 7.8.4;
- 2) The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
 - a) Span: Zero span, centered on a hopping channel;
 - b) RBW: shall be \leq channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel;
 - c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel;
 - d) Detector function: Peak;
 - e) Trace: Max hold.
- 3) Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

3.4.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.8.23 |
|---------------|-----------|--------------------------|-----------|
| Temperature | 20.7°C | Relative Humidity | 48.7% |
| Pressure | 100.1kPa | Test Sample Selected | No.1 |



| Modulation Type | Packet Type | Time Slot Length (ms) | Dwell Time (ms) |
|-----------------|-------------|-----------------------|-----------------|
| | DH1 | 0.362 | 116 |
| GFSK | DH3 | 1.623 | 260 |
| | DH5 | 2.855 | 305 |
| π/4DQPSK | DH1 | 0.362 | 116 |
| | DH3 | 1.623 | 260 |
| | DH5 | 2.855 | 305 |
| | DH1 | 0.377 | 121 |
| 8DPSK | DH3 | 1.623 | 260 |
| | DH5 | 2.870 | 306 |



Date: 23.AUG.2019 18:36:34





Date: 23.AUG.2019 18:41:27

Carrier Frequency (MHz): 2441 Packet Type: DH3 Modulation Type: GFSK





Date: 23.AUG.2019 18:44:48

Carrier Frequency (MHz): 2441 Packet Type: DH5 Modulation Type: GFSK



Date: 23.AUG.2019 19:00:40

Carrier Frequency (MHz): 2441 Packet Type: DH1 Modulation Type: π/4DQPSK





Date: 23.AUG.2019 19:09:32

Carrier Frequency (MHz): 2441 Packet Type: DH3 Modulation Type: π/4DQPSK



Date: 23.AUG.2019 19:12:22

Carrier Frequency (MHz): 2441 Packet Type: DH5 Modulation Type: π/4DQPSK





Date: 23.AUG.2019 19:16:58

Carrier Frequency (MHz): 2441 Packet Type: DH1 Modulation Type: 8DPSK



Carrier Frequency (MHz): 2441 Packet Type: DH3 Modulation Type: 8DPSK





Carrier Frequency (MHz): 2441 Packet Type: DH5 Modulation Type: 8DPSK

3.4.5. Uncertainty

N/A



3.5 Number of Hopping Frequencies

3.5.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.247 (a)(1)(iii) For frequency hopping systems operating in the 2400-2483.5MHz band shall use at least 15 hopping frequencies.

3.5.2. Test Setup



3.5.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 7.8.3;
- 2) The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
 - a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen;
 - b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20dB bandwidth, whichever is smaller;
 - c) VBW \geq RBW;
 - d) Sweep: Auto;
 - e) Detector function: Peak;
 - f) Trace: Max hold;
 - g) Allow the trace to stabilize.
- 3) The EUT is investigated with its worst-case modulation type (defined in section 2.6 of this report).

3.5.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.8.23 |
|---------------|-----------|--------------------------|-----------|
| Temperature | 20.7°C | Relative Humidity | 48.7% |
| Pressure | 100.1kPa | Test Sample Selected | No.1 |





GFSK (DH5) Mode: 79 hopping channels



8PSK (DH5) Mode: 79 hopping channels

3.5.5. Uncertainty

N/A



3.6 Conducted Out of Band Emission

3.6.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

3.6.2. Test Setup



3.6.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 7.8.8;
- 2) Connect the primary antenna port through an attenuator to the spectrum analyzer input; in the results, account for all losses between the unlicensed wireless device output and the spectrum analyzer. The instrument shall span 30MHz to 10 times the operating frequency in GHz, with a resolution bandwidth of 100kHz, video bandwidth of 300kHz, and a coupled sweep time with a peak detector. The band 30MHz to the highest frequency may be split into smaller spans, as long as the entire spectrum is covered.

3.6.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.8.26 |
|---------------|-----------|--------------------------|-----------|
| Temperature | 18.2°C | Relative Humidity | 50.6% |
| Pressure | 100.2kPa | Test Sample Selected | No.1 |

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

GFSK (Hopping off): CH Lowest (No.0)



Date: 26.AUG.2019 11:45:25





GFSK (Hopping off): CH Middle (No.39)

| Ref Level 10.00 dBm Att 20 dB Count 10001/10001 | Offset 6.10 dB ⊕ RB 3 SWT 18.9 µs ⊕ VB | W 100 kHz W 300 kHz Mode Auto FFT | 2 ¹ |
|---|---|--------------------------------------|----------------|
| 1Pk Max | | | |
| | | MH1] | 3.35 dBr |
| 0 dBm | | | 2.44113410 GH |
| | | | |
| -10 dBm | | | |
| 20 dam | | | |
| 20 0011 | | | |
| 30 dBm | | | |
| | | | |
| -40 dBm | | | |
| -50 dBm | | | |
| -so dom | | | |
| -60 dBm | | | |
| | | | |
| -70 dBm | | | |
| -80 dBm | | | |
| | | | |
| CF 2.441 GHz | | 691 pts | Span 1.5 MHz |

This is my shreenshot comment Date: 26.AUG.2019 10:55:26

| Spectru | n | Offeet | 5 10 dB 👄 | PRW 100 H | 2 | | | | |
|-------------------|--------------|---------|-----------|--------------|-----------|------------|-------|-----------|-------------------------|
| Att | 40 dB | SWT | 250 ms e | VBW 300 kH | z Mode | Auto Sweep | | | |
| Count 14/ | 10001 | | | | | | | | |
| 1Pk Max | r | | ī — | - | | | | | 04.45.40 |
| | | | | | M | 1[1] | | 2 | -34.46 dBn 0.2480 GH |
| l0 dBm | | | | - | | <u> </u> | | - ^ | - |
| Decordense of the | D1 2 260 des | | | | | | | | |
| dBm | D1 3.300 08 | | - | | | | | | - |
| | | | | | | | | | |
| 10 dBm- | | | | - | | | - | - | - |
| | D2 -16.6 | 40 dBm- | | | | | | | - |
| 20 dBm- | | | | - | | | | | |
| | | | | | | | | | |
| -30 dBm | | | | | | | | 11 | |
| 10 10 | | mund. | | with A arash | menor | with | mahan | When when | emenen |
| 40 asm | | | ama-tilla | | · · · · · | | | | |
| 50 dBm- | 1.1 | | | | | - | | | |
| So dom | | | | | | | | | |
| 60 dBm- | | | | | | | | | |
| | | | | | | | | | |
| 70 dBm- | | | | - | | - | | | |
| | | | | | | | | | |
| Start 30.0 | MHz | | | 691 | nts | | | Sto | a 25.0 GHz |
| | Yr | | | | 1 | | | - | 26.88.2819 |

Date: 26.AUG.2019 11:19:01



GFSK (Hopping off): CH Highest (No.78)



This is my shreenshot commen Date: 26.AUG.2019 12:10:55



This is my shreenshot comment Date: 26.AUG.2019 12:13:36

π /4DQPSK (Hopping off): CH Lowest (No.0)



This is my shreenshot comment Date: 26.AUG.2019 14:28:47



| Ref Leve Att | el 20.00 dBm 40 dB | Offset SWT | 6.10 dB 👄 250 ms 👄 | RBW 100 kH VBW 300 kH | iz Iz Mode | Auto Sweep | | | |
|-----------------|-----------------------|---------------|-----------------------|--------------------------|---------------|------------|----|----------------|-------------------------|
| 1Pk Max | | | | | _ | | | | |
| | | | | | M | 1[1] | | 20 | -33.32 dBn .22000 GH |
| 10 dBm | | | | - | | | - | | |
|) dBm | +D1 5.930 d | Bm- | | | | | | | |
| 10 dBm— | | | | | | | | | |
| 20 dBm— | | .070 dBm- | | | | | | | |
| -30 dBm | | | | | | | | 41 Y | |
| 40 dBm- | - | - | - | - | - | www.hitema | - | Manager States | with a field of |
| 50 dBm- | | | | | | | | | |
| 60 dBm | | | | - | | | | | |
| 70 dBm— | | | | | | | | | |
| Start 30.0 | MHz | | | 1000 | 1 pts | | vi | Stop | p 25.0 GHz |

This is my shreenshot comment Date: 26.AUG.2019 14:30:24

π /4DQPSK (Hopping off): CH Middle (No.39)

| Att 40 dB SWT 18.9 µs | VBW 300 kHz Mode Auto FFT | |
|-----------------------|---------------------------|----------------------------|
| 1Pk Max | | |
| | M1[1] | 3.30 dBr 2.441152380 GH |
| 10 dBm | MI | |
| 0 dBm | | |
| -10 dBm | | |
| -20 dBm- | | |
| | | |
| -30 dBm- | | |
| 40 dBm | | |
| -50 dBm | | |
| -60 dBm | | |
| 70 dBm | | |
| (5-0)-2-5-1 | | |
| CF 2.441 GHz | 10001 pts | Span 1.5 MHz |

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π /4DQPSK (Hopping off): CH Highest (No.78)



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This is my shreenshot comment Date: 26.AUG.2019 14:39:52

8DPSK (Hopping off): CH Lowest (No.0)





| Ref Leve | 1 20.00 dBm 40 dB | Offset SWT | 6.10 dB 🖷 1 250 ms 🖷 1 | RBW 100 ki VBW 300 ki | Hz Hz Mode | Auto Sweep | 3 | | 22 |
|------------|----------------------|---------------|---------------------------|--------------------------|---------------|---------------|------|---------|------------|
| 1Pk Max | | 2 | | | | | | | |
| | | | | | M | 11[1] | | 20 | -33.81 dBn |
| 10 dBm | | | - | | - | 1 | I | 20 | |
| | D1 6.090 d | Bm | | | | | | | |
| 0 dBm | - | - | - | | | | | - | |
| 10 40 m | | | | | | | | | |
| -10 dBm- | D2 -13 | 3.910 dBm- | | | | | | | |
| -20 dBm | | | | | - | | | | |
| | | | | | | | | | |
| -30 dBm | | <u> </u> | | | - | 1.1.1.1 | | M1 | |
| 10 10 | | , and | And a line | A ALASIA | A MARCH | 11+++++++++++ | HVWW | ANTHONY | - |
| -40 dBm- | A CONTRACTOR | | | | | | | | |
| -50 dBm- | | | | | | | | | |
| | | | | | | | | | |
| -60 dBm | | | | | - | | | | + |
| 70 d8m- | | | | | | | | | |
| -vo usin- | | | | | | | | | |
| Start 30.0 | MHz | | | 1000 |)1 pts | | | Sto | p 25.0 GHz |

Date: 26.AUG.2019 15:05:53

8DPSK (Hopping off): CH Middle (No.39)



This is my shreenshot comment Date: 26.AUG.2019 15:00:59

| Att | el 20.00 dBm 40 dB | SWT | 250 ms 👄 | VBW 300 k | Hz Hz Mode | Auto Sweer | , | | |
|-----------|-----------------------|---------------------|----------|-----------|---------------|--------------|---------------------------------------|--------------|---------------------------|
| 1Pk Max | | | | | | | | | |
| | | | | | M | 11[1] | | 2 | -33.02 dBr 0.27740 GH |
| 10 dBm- | | | - | | - | - | + | | + |
| | D1 3.420 dBn | n | - | - | - | | | | - |
| aBm- | | | | | | | | | |
| 10 dBm— | | | | | - | - | | | + |
| | D2 -16.5 | i80 dBm- | | | | | | | |
| 20 dBm— | | | | | | - | | | |
| 30 dBm- | | | | | | - | - | 41 | - |
| | | | 100 | | | A HARRA BALL | - damenter | Anastain | and and press press |
| 40 dBm- | - And the state | North Street of the | - | - | - | | A A A A A A A A A A A A A A A A A A A | a particular | the plant has been deeped |
| 50 dBm- | | | | | | | | | |
| 00 0011 | | | | | | | | | |
| 60 dBm- | | | | + | - | - | | | |
| 70 dBm- | | | | | | | | | |
| vo ubili- | | | | | | | | | |
| Start 30. | D MHz | | | 100 | 01 pts | <u> </u> | | Sto | op 25.0 GHz |
| | T. | | | | Mea | asuring | COLUMN 1 | 444 | 26.08.2019 |



8DPSK (Hopping off): CH Highest (No.78)



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| S Col. B.S. Days | | | | | | | | | |
|------------------|-------------|-------------------------|---|-----------------|------|---|---|--------------|------------|
| IPK Mdx | | | | | M | 1[1] | | 20 | -32.87 dBr |
| LO dBm | | | | | | | | | |
|) dBm |)1 4.360 dB | m | | | | | | | |
| 10 dBm | | | | | | | | | |
| 20 dBm | | 640 dBm | | | | | | | - |
| 30 dBm | | | | | | 1000000 | | A1 Y | |
| 40 dBm | - | No. of Concession, Name | - | angle spinister | **** | ANA AND AND AND AND AND AND AND AND AND | - | Manadoline . | |
| 50 dBm | | | | - | | | | | |
| 60 dBm | | | | | | | | | |
| 70 dBm | | | | | | | | - | |

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3.6.5. Uncertainty

Ulab=1.48dB (k=2)



3.7 Authorized-band Band-edge

3.7.1. Limit

FCC 47 CFR Part 15 Subpart C - §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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

3.7.2. Test Setup



3.7.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 6.10.4;
- 2) Disable the hopping function of EUT. Use the following spectrum analyzer settings:
 - a) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation;
 - b) RBW $\ge 1\%$ of the Span;
 - c) VBW \geq RBW;
 - d) Sweep: Auto;
 - e) Detector function: Peak;
 - f) Trace: Max hold;
- 3) Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- 4) Enable the hopping function of EUT. Use the spectrum analyzer settings in step 2) and allow the trace to stabilize. Repeat step 3) to determine if any spurious emissions caused by the hopping function also comply with the limit.

3.7.4. Test Result

| Test Engineer | Xu Dongxu | Test Date | 2019.8.26 |
|---------------|-----------|--------------------------|-----------|
| Temperature | 18.2°C | Relative Humidity | 50.6% |
| Pressure | 100.2kPa | Test Sample Selected | No.1 |

The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.



GFSK (Hopping off): CH Lowest (No.0)

| BW 100 kHz BW 300 kHz Mode Auto FFT | |
|--|---|
| M1[1] | 5 07 dBr |
| (inter) | 2.40215410 GH |
| MI | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | M 100 kHz BW 300 kHz Made Auto FFT M1[1] 11 11 11 11 11 11 11 11 11 11 11 11 1 |

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| Att | 40 08 SWI | 227.4 µs 🖷 | VBW 300 K | H2 Mode | Auto FFT | | | | |
|--|----------------------|---------------|-------------------|--------------|----------------|---------------|--------------------|-------|-----|
| 1РК Мах | | 1 | | M | 2[1] | | - | 42 39 | dBn |
| | | | | | ~[~] | | 2.400 | 00000 | GH |
| 0 dBm | | | | M | 1[1] | | 0.000 | 43.23 | dBn |
| 01 5 | .940 dBm | | | | 1 | | 2.399 | 90000 | GH |
| dBm | - | - | 7 | - | | - | | | - |
| | | | | | | | | | |
| 10 dBm | 14 060 dBm | | | | | | | | |
| 20 dBm | -14.000 dom | | | | | _ | | | |
| | | | | | | | | | 1 |
| 30 d8m | | | | | | | | | |
| | | | | | | | | 1 | 1 |
| 40 dBm | | to at 1 | | | | - | | M | 1 |
| and a second s | any monomentum which | within an and | se and the second | denadelaiste | ministring the | side in a lot | line particulation | H.M | YNA |
| 50 dBm | | | | | | | | | _ |
| | | | | | | | | | |
| 60 dBm | - | | | | | | | | |
| 70 d8m | | | | | | | | | |
| / o ubiii | | | | | | | | F2 | |
| | | | | | | | | 1 | |

This is my shreenshot comment Date: 26.AUG.2019 12:05:27

GFSK (Hopping on): CH Lowest (No.0)





GFSK (Hopping off): CH Highest (No.78)



This is my shreenshot comment Date: 26.AUG.2019 12:10:55



This is my shreenshot comment Date: 26.AUG.2019 12:19:54

GFSK (Hopping on): CH Highest (No.78)



Date: 26.AUG.2019 12:22:46



π /4DQPSK (Hopping off): CH Lowest (No.0)



This is my shreenshot commer Date: 26.AUG.2019 14:28:47



π/4DQPSK (Hopping on): CH Lowest (No.0)



This is my shreenshot commer Date: 26.AUG.2019 14:35:42



π /4DQPSK (Hopping off): CH Highest (No.78)



This is my shreenshot commer Date: 26.AUG.2019 14:37:39



π/4DQPSK (Hopping on): CH Highest (No.78)





8DPSK (Hopping off): CH Lowest (No.0)



This is my shreenshot comment Date: 26.AUG.2019 15:04:27



8DPSK (Hopping on): CH Lowest (No.0)



This is my shreenshot comment Date: 26.AUG.2019 15:09:45



8DPSK (Hopping off): CH Highest (No.78)



This is my shreenshot comment Date: 26.AUG.2019 15:11:54

| ALL 40 0B SWI | 227.4 µs 🖶 VBW | 300 KHZ Mode Auto FF | • 1 | |
|-------------------|-------------------|----------------------------|--|--|
| 10 dBm- | | M2[1] M1[1] | | -44.35 dBn 2.48360000 GH -44.43 dBn 2.48350000 GH |
|) dBm | | | | |
| 10 d5m | | | | |
| 20 d9m | | | | |
| 30 d8m | | | | |
| 40 gBmt m | manyaministration | utation and fillen and the | موردو المراجع والمعالم والمراجع والمراجع | Manana mangal |
| 50 dBm | | | | |
| 50 dBm | | | | |
| 70 dBm - F2 F1 | | | | |
| CF 2.524 GHz | | 10001 pts | | Span 100.0 MHz |

This is my shreenshot commen Date: 26.AUG.2019 15:15:52

8DPSK (Hopping on): CH Highest (No.78)



3.7.5. Uncertainty

*U*_{*lab*}=1.48dB (*k*=2)



3.8 Spurious Radiated Emissions and Restricted-band Band-edge

3.8.1. Limit

FCC 47 CFR Part 15 Subpart C - §15.205, §15.209 and §15.247 (d) All out of band emissions appearing in a restricted band as specified in §15.205 must not exceed the limits shown in below table per §15.209:

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

FCC 47 CFR Part 15 Subpart C - §15.35 (b)

There is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit. Used conversion factor: Limit $(dB\mu V/m) = 20\log (\text{Limit} (\mu V/m)/1\mu V/m)$

| Frequency (MHz) | Detector | Unit (dBµV/m) | |
|--|------------|---------------|--|
| 30-88 | Quasi-Peak | 40.0 | |
| 88-216 | Quasi-Peak | 43.5 | |
| 216-960 | Quasi-Peak | 46.0 | |
| 960-1000 | Quasi-Peak | 54.0 | |
| 1000~5th harmonic of the highest frequency or 40GHz, | Average | 54.0 | |
| whichever is lower | Peak | 74.0 | |

3.8.2. Test Setup







Above 1GHz Test Setup

3.8.3. Test Procedures

- 1) The measurement procedure follows ANSI C63.10-2013, clause 6.3, 6.5, 6.6, 6.10.5 and 6.10.6;
- 2) The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing;
- 3) EUT is placed on a non-conducting table 80cm above the ground plane for measurement below 1GHz;



1.5m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters;

4) For measurements below 30MHz, the resolution bandwidth and video bandwidth is set to 9kHz for quasi-peak detection measurements;

For measurements from 30MHz to 1GHz, the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak;

For pre-scans above 1GHz, the resolution bandwidth is set to 1MHz; the video bandwidth is set to 30kHz for peak measurements;

For final scans above 1GHz, the resolution bandwidth is set to 1MHz and video bandwidth is set to 30MHz for peak measurements. And 1MHz resolution bandwidth with 1/T (10Hz) video bandwidth with peak detector for average measurements;

- 5) The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and horizontal positions;
- 6) The spectrum from 1GHz to 18GHz is investigated with the EUT set to transmit at the lowest, middle and highest channels with the highest output power and worst-case modulation type (defined in section 2.6 of this report). Below 1GHz and above 18GHz emissions were performed with the EUT set to transmit at the channel and modulation type with the highest output power as worst-case scenario.

3.8.4. Test Result

Restricted-band Band-edge:

| Test Engineer | Lu Huansen | Test Date | 2019.9.23 |
|---------------|------------|-----------------------------|-----------|
| Temperature | 25.3°C | Relative Humidity | 48.2% |
| Pressure | 100.1kPa | Test Sample Selected | No.2 |

The measurement results are obtained as described below:

Measure Level = Reading Level + Factor;

Factor = cable loss + antenna factor + preamplifier gain;

Sample calculation: $(35.80 \text{dBuV/m}) = (46.20 \text{dB}\mu\text{V}) + (-10.40 \text{dB})$, the corresponding frequency is 2350MHz.

Carrier Frequency (MHz): 2402 CH Lowest (No.0) Modulation Type: GFSK





| No. | Horizontal Frequency [MHz] 2350.000 2390.000 | Polarizatio Reading [dB(µV)] 46.2 39.1 | on (PK) c.f [dB(1/m)] -10.4 -11.0 | Result [dB(µV/m)] 35.8 28.1 | Limit [dB(µV/m)] 74.0 74.0 | Margin [dB] 38.2 45.9 |
|-------------------------|--|---|---|--|---|--|
| 3 No. 1 2 3 | 2402.000 Horizontal Frequency [MHz] 2350.000 2390.000 2402.000 | 102.2 Polarizatio Reading [dB(µV)] 35.0 25.1 91.9 | -11.0 on (AV) c.f [dB(1/m)] -10.4 -11.0 -11.0 | 91.2 Result [dB(µV/m)] 24.6 14.1 80.9 | 74.0 Limit [dB(µV/m)] 54.0 54.0 54.0 54.0 | -17.2 Margin [dB] 29.4 39.9 -26.9 |
| No. 1 2 3 | Vertical Po Frequency [MHz] 2350.000 2390.000 2402.000 | blarization Reading [dB(μV)] 46.7 39.5 102.2 | (PK) c.f [dB(1/m)] -10.4 -11.0 -11.0 | Result [dB(µV/m)] 36.3 28.5 91.2 | Limit [dB(µV/m)] 74.0 74.0 74.0 74.0 | Margin [dB] 37.7 45.5 -17.2 |
| No. 1 2 3 | Vertical Po Frequency [MHz] 2350.000 2390.000 2402.000 | olarization Reading [dB(µV)] 35.3 25.2 91.9 | (AV) c.f [dB(1/m)] -10.4 -11.0 -11.0 | Result [dB(µV/m)] 24.9 14.2 80.9 | Limit [dB(µV/m)] 54.0 54.0 54.0 54.0 | Margin [dB] 29.1 39.8 -26.9 |

Carrier Frequency (MHz): 2480 CH Highest (No.78) Modulation Type: GFSK



Final Result

| No. 1 2 3 | Horizontal Frequency [MHz] 2531.952 2483.500 2480.000 | Polarizatio Reading [dB(µV)] 48.2 46.0 106.7 | on (PK) c.f [dB(1/m)] -10.6 -10.1 -10.0 | Result [dB(µV/m)] 37.6 35.9 96.7 | Limit [dB(µV/m)] 74.0 74.0 74.0 | Margin [dB] 36.4 38.1 -22.7 |
|------------------------|---|---|--|--|---|---|
| No. 1 2 3 | Horizontal Frequency [MHz] 2531.952 2483.500 2480.000 | Polarizatic Reading [dB(µV)] 36.6 30.1 96.4 | on (AV) c.f [dB(1/m)] -10.6 -10.1 -10.0 | Result [dB(µV/m)] 26.0 20.0 86.4 | Limit [dB(µV/m)] 54.0 54.0 54.0 54.0 | Margin [dB] 28.0 34.0 -32.4 |
| No. 1 2 3 | Vertical Po Frequency [MHz] 2532.012 2483.500 2480.000 | Dlarization Reading [dB(μV)] 36.8 37.5 103.9 | (PK) c.f [dB(1/m)] -10.6 -10.1 -10.0 | Result [dB(µV/m)] 26.2 27.4 93.9 | Limit [dB(µV/m)] 74.0 74.0 74.0 74.0 | Margin [dB] 47.8 46.6 -19.9 |
| No. | Vertical P Frequency [MHz] 2532.012 2483.500 2480.000 | olarization Reading [dB(µV)] 24.2 23.7 93.5 | (AV) c.f [dB(1/m)] -10.6 -10.1 -10.0 | Result [dB(µV/m)] 13.6 13.6 83.5 | Limit [dB(µV/m)] 54.0 54.0 54.0 54.0 | Margin [dB] 40.4 40.4 -29.5 |



Carrier Frequency (MHz): 2402 CH Lowest (No.0) Modulation Type: π/4DQPSK



CH Highest (No.78) Modulation Type: π/4DQPSK

