

FCC Test Report

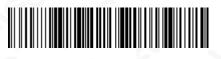
Report No.: AGC06904200702FE03

| FCC ID | : 2AHYV-JAIRJ |
|---------------------|----------------------------|
| APPLICATION PURPOSE | : Original Equipment |
| PRODUCT DESIGNATION | : TRUE WIRELESS EARBUDS |
| BRAND NAME | : JLAB |
| MODEL NAME | : JBuds Air |
| APPLICANT | : PEAG, LLC dba JLab Audio |
| DATE OF ISSUE | : July 22, 2020 |
| STANDARD(S) | : FCC Part 15.247 |
| REPORT VERSION | : V1.0 |

Attestation of Global Compliance (Shenzhen) Co., Ltd

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REPORT REVISE RECORD

| Report Version | Revise Time | Issued Date | Valid Version | Notes |
|----------------|-------------|---------------|---------------|-----------------|
| V1.0 | | July 22, 2020 | Valid | Initial Release |





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1. VERIFICATION OF CONFORMITY

| Applicant | PEAG, LLC dba JLab Audio | |
|---|---|--|
| Address | 2281 Las Palmas Drive, Suite 101, Carlsbad, CA 92011, USA | |
| Manufacturer | PEAG, LLC dba JLab Audio | |
| Address 2281 Las Palmas Drive, Suite 101, Carlsbad, CA 92011, USA | | |
| Factory | Actory PEAG, LLC dba JLab Audio | |
| Address | 2281 Las Palmas Drive, Suite 101, Carlsbad, CA 92011, USA | |
| Product Designation | TRUE WIRELESS EARBUDS | |
| Brand Name | JLAB | |
| Test Model | JBuds Air | |
| Date of test | July 14, 2020 to July 22, 2020 | |
| Deviation | No any deviation from the test method | |
| Condition of Test Sample | Normal | |
| Test Result | Pass | |
| Report Template | AGCRT-US-BR/RF | |

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC PART 15.247.

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July 22, 2020

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July 22, 2020



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2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is designed as "TRUE WIRELESS EARBUDS". It is designed by way of utilizing the GFSK, Pi/4 DQPSK and 8DPSK technology to achieve the system operation.

A major technical description of EUT is described as following

| Operation Frequency | 2.402GHz to 2.480GHz |
|----------------------------|--|
| RF Output Power | 2.074dBm(Max) |
| Bluetooth Version | V5.0 |
| Modulation | BR ⊠GFSK, EDR ⊠π /4-DQPSK, ⊠8DPSK BLE □GFSK 1Mbps □GFSK 2Mbps |
| Number of Channels | 79 Channels |
| Hardware Version | V5.0 |
| Software Version | V5.0 |
| Antenna Designation | FPC Antenna(Comply with requirements of the FCC part 15.203) |
| Antenna Gain | 1.2dBi |
| Power Supply | DC 3.7V by battery |
| Note: 1.The EUT doesn't su | pport BLE. |

2. The EUT comprises left and right channel earphone, both are the same and have been tested, Only the test data right earphone recorded in this report.

2.2. TABLE OF CARRIER FREQUENCYS

| Frequency Band | Channel Number | Frequency |
|------------------|----------------|-----------|
| G ^C C | 0 | 2402MHZ |
| | 1 | 2403MHZ |
| | | |
| | 38 | 2440 MHZ |
| 2402~2480MHZ | 39 | 2441 MHZ |
| 0 | 40 | 2442 MHZ |
| | | |
| | 77 | 2479 MHZ |
| | 78 | 2480 MHZ |





2.3. RECEIVER INPUT BANDWIDTH

The input bandwidth of the receiver is 1.3MHZ, In every connection one Bluetooth device is the master and the other one is slave. The master determines the hopping sequence. The slave follows this sequence. Both devices shift between RX and TX time slot according to the clock of the master. Additionally the type of connection(e.g. single of multislot packet) is set up at the beginning of the

connection. The master adapts its hopping frequency and its TX/RX timing according to the packet type of the connection. Also the slave of the connection will use these settings.

Repeating of a packet has no influence on the hopping sequence. The hopping sequence generated by the master of the connection will be followed in any case. That means, a repeated packet will not be send on the same frequency, it is send on the next frequency of the hopping sequence.

2.4. EXAMPLE OF A HOPPING SEQUENCY IN DATA MODE

Example of a 79 hopping sequence in data mode: 40,21,44,23,42,53,46,55,48,33,52,35,50,65,54,67 56,37,60,39,58,69,62,71,64,25,68,27,66,57,70,59 72,29,76,31,74,61,78,63,01,41,05,43,03,73,07,75 09,45,13,47,11,77,15,00,64,49,66,53,68,02,70,06 01, 51, 03, 55, 05, 04

2.5. EQUALLY AVERAGE USE OF FREQUENCIES AND BEHAVIOUR

The generation of the hopping sequence in connection mode depends essentially on two input values: 1. LAP/UAP of the master of the connection.

2. Internal master clock

The LAP(lower address part) are the 24 LSB's of the 48 BD_ADDRESS. The BD_ADDRESS is an unambiguous number of every Bluetooth unit. The UAP(upper address part) are the 24MSB's of the 48BD_ADDRESS

The internal clock of a Bluetooth unit is derived from a free running clock which is never adjusted and is never turned off. For ehavior zation with other units only offset are used. It has no relation to the time of the day. Its resolution is at least half the RX/TX slot length of 312.5us.The clock has a cycle of about one day(23h30).In most case it is implemented as 28 bit counter. For the deriving of the hopping sequence the entire. LAP(24 bits),4LSB's(4bits)(Input 1) and the 27MSB's of the clock(Input 2) are used. With this input values different mathematical procedures(permutations, additions, XOR-operations)are performed to generate te Sequence. This will be done at the beginning of every new transmission.

Regarding short transmissions the Bluetooth system has the following ehavior:

The first connection between the two devices is established, a hopping sequence was generated. For Transmitting the wanted data the complete hopping sequence was not used. The connection ended. The second connection will be established. A new hopping sequence is generated. Due to the fact the Bluetooth clock has a different value, because the period between the two transmission is longer(and it Cannot be shorter) than the minimum resolution of the clock(312.5us). The hopping sequence will always Differ from the first one.





2.6. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: 2AHYV-JAIRJ** filing to comply with the FCC PART 15.247 requirements.

2.7. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 (2013). Radiated testing was performed at an antenna to EUT distance 3 meters.

2.8. SPECIAL ACCESSORIES

Refer to section 5.2.

2.9. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.





3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y \pm U, where expended uncertainty U is based on a standard

uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

- Uncertainty of Conducted Emission, Uc = ±3.1 dB
- Uncertainty of Radiated Emission below 1GHz, Uc = ±4.0 dB
- Uncertainty of Radiated Emission above 1GHz, Uc = ±4.8 dB
- Uncertainty of total RF power, conducted, $Uc = \pm 0.8$ dB
- Uncertainty of spurious emissions, conducted, Uc = ±2.7dB
- Uncertainty of Occupied Channel Bandwidth: Uc = ± 2 %
- Uncertainty of Dwell Time: Uc = $\pm 2\%$
- Uncertainty of Frequency: $Uc = \pm 2\%$





4. DESCRIPTION OF TEST MODES

| NO. | TEST MODE DESCRIPTION | |
|-----|--------------------------|--|
| 1 | Low channel GFSK | |
| 2 | Middle channel GFSK | |
| 3 | High channel GFSK | |
| 4 | Low channel π/4-DQPSK | |
| 5 | Middle channel π/4-DQPSK | |
| 6 | High channel π/4-DQPSK | |
| 7 | Low channel 8DPSK | |
| 8 | Middle channel 8DPSK | |
| 9 | High channel 8DPSK | |
| 10 | Hopping mode GFSK | |
| 11 | Hopping mode π/4-DQPSK | |
| 12 | Hopping mode 8DPSK | |

Note: 1. Only the result of the worst case was recorded in the report, if no other cases.

2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

3. For Conducted Test method, a temporary antenna connector is provided by the manufacture. Software Setting

| | Bluetooth RF Test Tool (RtlBluetoothMP.dll Version :5,2,2,1 RTLBTAPP Version :5,2,2,1) Adde About Control Co | - D REALTEK |
|--------|---|---------------------------------------|
| R | Non Link Mode Hopping LE Test Tx Settings Battery Resistance Cal | Hot Key Mode |
| TM FCC | Channel 0 Image: Certification Image: Certification Image: Certification Packet Type 30H5 Image: Certification Image: Certification Image: Certification Payload Type PRBS3 Image: Certification Image: Certification Image: Certification Tx Packet Count 0 Image: Certification Image: Certification Image: Certification Tx Packet Count 0 Image: Certification Image: Certification Image: Certification Tx Level 0x30 Image: Certification Image: Certification Image: Certification PHY LE 1M PHY Image: Certification Image: Certification Image: Certification Hit Target (0x00000c6967e Image: Certification Image: Certification Parameter 1 Parameter 2 Celtification | HCI Reset Test Mode |
| | Message >>ActionControlExcute[Tx (for Certification)] Success!! >>ActionControlExcute[Tx (for Certification)] Stop!! | Power Tracking C OFF © ON Ge |





5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Radiated Emission Configure :

EUT

Conducted Emission Configure :

| | 0 | |
|-----|---|----|
| EUT | | AE |

5.2 EQUIPMENT USED IN TESTED SYSTEM

| Item | Equipment | Model No. | ID or Specification | Remark |
|------|--------------------------|-----------|---------------------|--------|
| 1 | TRUE WIRELESS EARBUDS | JBuds Air | 2AHYV-JAIRJ | EUT |

5.3. SUMMARY OF TEST RESULTS

| FCC RULES | DESCRIPTION OF TEST | RESULT |
|--------------------|-----------------------------|-----------|
| 15.247 (b)(1) | Peak Output Power | Compliant |
| 15.247 (a)(1) | 20 dB Bandwidth | Compliant |
| 15.247 (d) | Conducted Spurious Emission | Compliant |
| 15.209 | Radiated Emission | Compliant |
| 15.247 (a)(1)(iii) | Number of Hopping Frequency | Compliant |
| 15.247 (a)(1)(iii) | Time of Occupancy | Compliant |
| 15.247 (a)(1) | Frequency Separation | Compliant |
| 15.207 | Conducted Emission | N/A |

Note: 1.N/A means not applicable in this report.

2. The EUT is powered by battery.





6. TEST FACILITY

| Test Site | Attestation of Global Compliance (Shenzhen) Co., Ltd | | | |
|--------------------------------------|---|--|--|--|
| Location | 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China | | | |
| Designation Number | CN1259 | | | |
| FCC Test Firm Registration Number | 975832 | | | |
| A2LA Cert. No. | 5054.02 | | | |
| Description | Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA | | | |

TEST EQUIPMENT OF RADIATED EMISSION TEST

| Equipment | Manufacturer | Model | S/N | Cal. Date | Cal. Due |
|-----------------------------------|-------------------|------------------------|------------|---------------|---------------|
| TEST RECEIVER | R&S | ESCI | 10096 | May 15, 2020 | May 14, 2022 |
| EXA Signal Analyzer | Aglient | N9010A | MY53470504 | Dec. 12, 2019 | Dec. 11, 2020 |
| 2.4GHz Fliter | EM Electronics | 2400-2500MHz | N/A | Mar. 23, 2020 | Mar. 22, 2022 |
| Attenuator | ZHINAN | E-002 | N/A | Sep. 09, 2019 | Sep. 08, 2020 |
| Horn antenna | SCHWARZBE CK | BBHA 9170 | #768 | Sep. 09, 2019 | Sep. 08, 2021 |
| Active loop antenna (9K-30MHz) | ZHINAN | ZN30900C | 18051 | May 22, 2020 | May 21, 2022 |
| Double-Ridged Waveguide Horn | ETS LINDGREN | 3117 | 00034609 | May 17, 2019 | May 16, 2021 |
| Broadband Preamplifier | ETS LINDGREN | 3117PA | 00225134 | Oct. 15, 2019 | Oct. 16, 2020 |
| ANTENNA | SCHWARZBE CK | VULB9168 | 494 | Jan. 09, 2019 | Jan. 08, 2021 |
| Test software | FARA | EZ-EMC (Ver RA-03A) | N/A | N/A | N/A |





7. PEAK OUTPUT POWER

7.1. MEASUREMENT PROCEDURE

For peak power test:

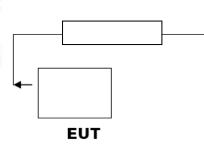
- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2. Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- 3. RBW > 20 dB bandwidth of the emission being measured.
- 4. VBW \geq RBW.
- 5. Sweep: Auto.
- 6. Detector function: Peak.
- 7. Trace: Max hold.

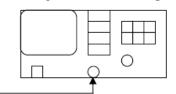
Allow trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power, after any corrections for external attenuators and cables.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

RF Attenuator

PEAK POWER TEST SETUP





Spectrum Analyzer







Frequency

Auto Tune

Center Freq 2.402000000 GHz

Start Freq 2.399500000 GHz

Stop Freq 2.404500000 GHz

CF Step 500.000 kHz

Freq Offset 0 Hz

Ma

7.3. LIMITS AND MEASUREMENT RESULT

Cent

10 dB/div Loa

| PEAK OUTPUT POWER MEASUREMENT RESULT FOR GFSK MOUDULATION | | | | | |
|--|---------------------|----------------------------|--------------|--|--|
| Frequency (GHz) | Peak Power (dBm) | Applicable Limits (dBm) | Pass or Fail | | |
| 2.402 | 2.074 | 21 | Pass | | |
| 2.441 | 1.903 | 21 | Pass | | |
| 2.480 | 1.247 | 21 | Pass | | |

CH0

RF 50 Ω AL CONSEC cq 2.4020000000 GHz PNO: Fast ↔ IFGain:Low Avg Type: Log-Pwi Avg|Hold: 100/100 Trig: Free Run Atten: 30 dB Mkr1 2.401 885 GHz 2.074 dBm Ref 20.00 dBm **≜**¹

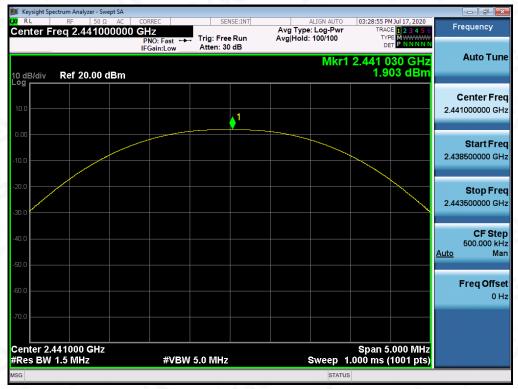
<u>Auto</u> Center 2.402000 GHz #Res BW 1.5 MHz Span 5.000 MHz Sweep 1.000 ms (1001 pts)

#VBW 5.0 MHz

G



CH39



CH78

| Keysight Spectrum Analyzer | - Swept SA 50 Ω AC CORRE | C SEI | NSE:INT | ALIGN AUTO | 03:29:19 PM Jul 17, 202 | |
|------------------------------------|-----------------------------|---------------------|-----------------------|------------------------------|-------------------------------------|--------------------------------|
| enter Freq 2.480 | 0000000 GHz | : Fast 🛶 Trig: Free | Avg T e Run Avg Ho | ype: Log-Pwr old: 100/100 | TRACE 1234 TYPE MWWW DET PNNN | Frequency |
| 0 dB/div Ref 20.0 | | n:Low Atten: 30 |) dB | Mkr1 | 2.479 810 GH 1.247 dBi | Auto Tu |
| 10.0 | | 1 | | | | Center F 2.480000000 0 |
| .00 | | | | | | Start F 2.477500000 |
| 0.0 | | | | | | Stop F 2.482500000 |
| 0.0 | | | | | | CF S 500.000 <u>Auto</u> |
| 0.0 | | | | | | Freq Off |
| 0.0 | | | | | | |
| enter 2.480000 G Res BW 1.5 MHz | Hz | #VBW 5.0 MHz | | Sweep 1. | Span 5.000 MH 000 ms (1001 pt | lz s) |
| 6G | | | | STATUS | | |



| | PEAK OUTPUT POWER MEA FOR II /4-DQPSK M | | |
|--------------------|--|----------------------------|--------------|
| Frequency (GHz) | Peak Power (dBm) | Applicable Limits (dBm) | Pass or Fail |
| 2.402 | 0.955 | 21 | Pass |
| 2.441 | 0.696 | 21 | Pass |
| 2.480 | 0.005 | 21 | Pass |

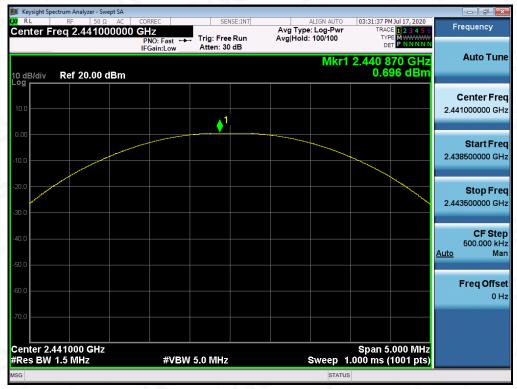
CH0







CH39



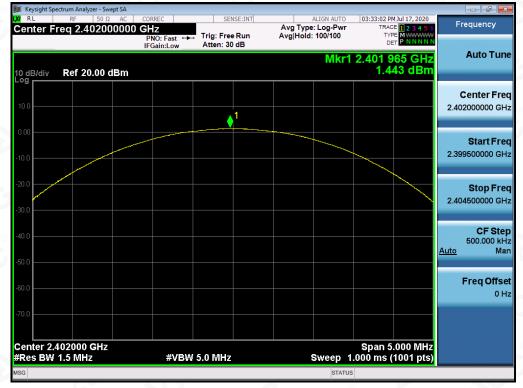
CH78

| Keysight Spectrum Ana RL RF | lyzer - Swept SA 50 Ω AC | CORREC | SENSE:INT | ALIGN AUT | 03:32:13 PM Jul 17, 2020 | |
|---------------------------------|-----------------------------|--------------------|----------------|---------------------------------------|---------------------------------------|----------------------------|
| enter Freq 2. | | GHz PNO: Fast ↔ | Trig: Free Run | Avg Type: Log-Pv Avg Hold: 100/100 | Vr TRACE 1 2 3 4 5 6 | Frequency |
| 0 dB/div Ref 2 | 20.00 dBm | IFGain:Low | Atten: 30 dB | Mk | r1 2.480 095 GHz 0.005 dBm | Auto Tu |
| 10.0 | | | | | | Center Fr 2.480000000 0 |
| 0.00 | | | | | | Start F 2.477500000 |
| 0.0 | | | | | | Stop F 2.482500000 |
| 0.0 | | | | | | CF S 500.000 |
| 0.0 | | | | | | Auto Freg Off |
| 0.0 | | | | | | (|
| enter 2.480000 Res BW 1.5 MH | | #VBM | / 5.0 MHz | Sweep | Span 5.000 MHz 1.000 ms (1001 pts) | |
| iG | | | | STA | ATUS | |



| PEAK OUTPUT POWER MEASUREMENT RESULT FOR 8DPSK MODULATION | | | | | |
|--|---------------------|----------------------------|--------------|--|--|
| Frequency (GHz) | Peak Power (dBm) | Applicable Limits (dBm) | Pass or Fail | | |
| 2.402 | 1.443 | 21 | Pass | | |
| 2.441 | 1.206 | 21 | Pass | | |
| 2.480 | 0.522 | 21 | Pass | | |

CH0

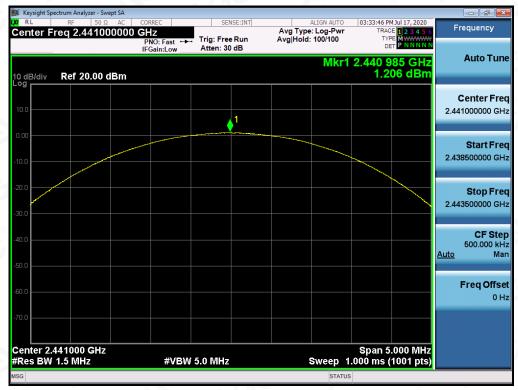




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CH39



CH78

| 💓 Keysight S | pectrum Analyzer - S RF 50 | | CORREC | CENCEJNE | | | 02:24:14.0 | 11.117.2020 | |
|------------------|-------------------------------|-----|----------------------------|----------------|------------------------|--------|----------------|--|----------------------------------|
| | req 2.4800 | | GHz | Trig: Free Run | Avg Type: Avg Hold: | | TRAC | M Jul 17, 2020 E 1 2 3 4 5 6 PE M WWWW | Frequency |
| | | | PNO: Fast ++ IFGain:Low | Atten: 30 dB | Avginoid. | | DE | | Auto Tu |
| 10 dB/div Log | Ref 20.00 | dBm | | | | Mkr1 | 2.479 9 0.5 | 90 GHz 22 dBm | Auto Tu |
| | | | | | | | | | Center Fr |
| 10.0 | | | | .1 | | | | | 2.480000000 G |
| 0.00 | | | | · · · · · | | | | | 04 |
| -10.0 | | | | | | | | | Start Fr 2.477500000 G |
| -10.0 | | | | | | | | | |
| -20.0 | | | | | | | | | Stop Fr |
| -30.0 | | | | | | | | | 2.482500000 G |
| -40.0 | | | | | | | | | CF St |
| -40.0 | | | | | | | | | 500.000 k <u>Auto</u> M |
| -50.0 | | | | | | | | | |
| -60.0 | | | | | | | | | Freq Offs 0 |
| | | | | | | | | | U |
| -70.0 | | | | | | | | | |
| Center 2 | .480000 GH: | z | | | | | Span 5 | .000 MHz | |
| | / 1.5 MHz | | #VBW | / 5.0 MHz | S | weep 1 | .000 ms (| 1001 pts) | |
| MSG | | | | | | STATUS | 3 | | |



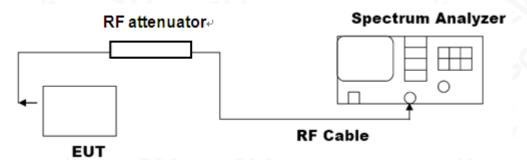


8. 20DB BANDWIDTH

8.1. MEASUREMENT PROCEDURE

- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
- 3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hoping channel The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
- 4. Set SPA Trace 1 Max hold, then View.

8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



8.3. LIMITS AND MEASUREMENT RESULTS

| MEASUREMENT RESULT FOR GFSK MOUDULATION | | | | | |
|---|----------------|--------------------|------|--|--|
| Angliashta Linsita | | Measurement Result | | | |
| Applicable Limits | Test Data | Criteria | | | |
| E DO GO | Low Channel | 1.028 | PASS | | |
| N/A | Middle Channel | 1.029 | PASS | | |
| | High Channel | 1.023 | PASS | | |







TEST PLOT OF BANDWIDTH FOR LOW CHANNEL

TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL







TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL





| MEASUREMENT RESULT FOR II /4-DQPSK MODULATION | | | | | |
|---|----------------|--------------------|----------|--|--|
| Angliachte Limite | | Measurement Result | | | |
| Applicable Limits | Test Data | (MHz) | Criteria | | |
| | Low Channel | 1.374 | PASS | | |
| N/A | Middle Channel | 1.375 | PASS | | |
| | High Channel | 1.373 | PASS | | |

TEST PLOT OF BANDWIDTH FOR LOW CHANNEL







TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL







| MEASUREMENT RESULT FOR 8DPSK MODULATION | | | | | | |
|---|----------------|--------------------|------|--|--|--|
| Appliachta Limita | | Measurement Result | | | | |
| Applicable Limits | Test Data | Test Data (MHz) | | | | |
| | Low Channel | 1.355 | PASS | | | |
| N/A | Middle Channel | 1.356 | PASS | | | |
| .C 2 | High Channel | 1.354 | PASS | | | |

TEST PLOT OF BANDWIDTH FOR LOW CHANNEL







TEST PLOT OF BANDWIDTH FOR MIDDLE CHANNEL

TEST PLOT OF BANDWIDTH FOR HIGH CHANNEL







9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

- 1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
- 2. Set the EUT Work on the top, the Middle and the bottom operation frequency individually.
- 3. Set the Span = wide enough to capture the peak level of the in-band emission and all spurious emissions from the lowest frequency generated in the EUT up through the 10th harmonic.
 RBW = 100 kHz; VBW= 300 kHz; Sweep = auto; Detector function = peak.
- 4. Set SPA Trace 1 Max hold, then View.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2

9.3. MEASUREMENT EQUIPMENT USED

The same as described in section 6

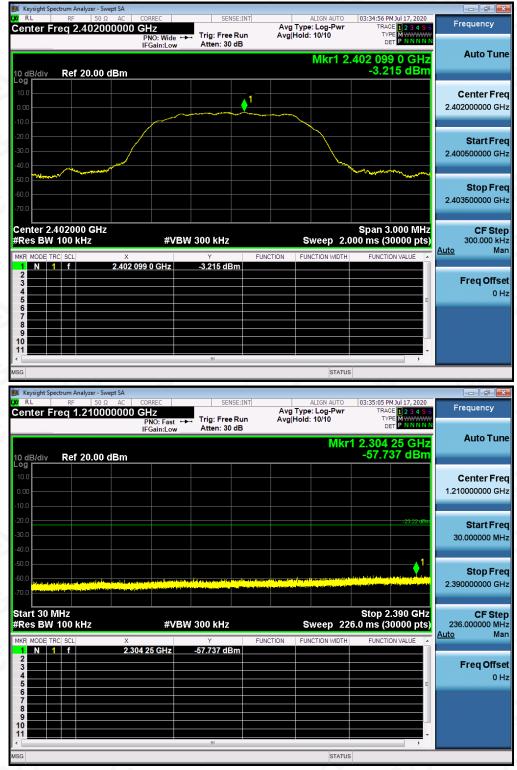
9.4. LIMITS AND MEASUREMENT RESULT

| LIMITS AND MEASUREMENT RESULT | | | | | | |
|---|---|----------|--|--|--|--|
| Applieghte Limite | Measurement Result | | | | | |
| Applicable Limits | Test Data | Criteria | | | | |
| In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum | At least -20dBc than the limit Specified on the BOTTOM Channel | PASS | | | | |
| intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a)) | At least -20dBc than the limit Specified on the TOP Channel | PASS | | | | |





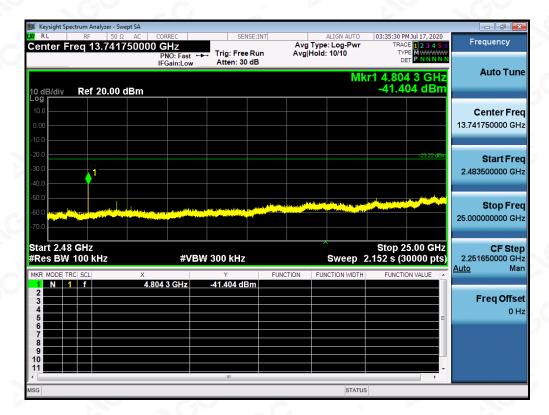
TEST RESULT FOR ENTIRE FREQUENCY RANGE TEST PLOT OF OUT OF BAND EMISSIONS WITH THE WORST CASE OF GFSK MODULATION IN LOW CHANNEL





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📕 Keysight Sp ept SA Center Freq 2.441000000 GHz PNO: Wide IFGain:Low ctrum Analy Jul 17, 20 Frequency Avg Type: Log-Pwi Avg|Hold: 10/10 Trig: Free Run Atten: 30 dB Auto Tune Mkr1 2.441 -3.483 dBm Ref 20.00 dBm Center Freq 2.441000000 GHz Start Freq 2.439500000 GHz Stop Freq 2.442500000 GHz Center 2.441000 GHz #Res BW 100 kHz Span 3.000 MHz Sweep 2.000 ms (30000 pts) CF Step 300.000 kHz Man #VBW 300 kHz <u>Auto</u> FUNCTION EUNCTIO 2.441 092 1 GHz -3.483 dBm **Freq Offset** 0 Hz 📕 Keysight Sp 03:38:33 PM Jul 17, 2020 Center Freq 1.215000000 GHz PNO: Fast IFGain:Low R Frequency Avg Type: Log-Pwr Avg|Hold: 10/10 Trig: Free Run Atten: 30 dB Auto Tune Mkr1 2.048 75 GHz -57.364 dBm Ref 20.00 dBm 0 dB/div .od **Center Freq** 1.215000000 GHz Start Freq 30.000000 MHz 1 **Stop Freq** 2.40000000 GHz Start 30 MHz #Res BW 100 kHz Stop 2.400 GHz Sweep 228.0 ms (30000 pts) CF Step 237.000000 MHz #VBW 300 kHz <u>Auto</u> Mar 2.048 75 GHz -57.364 dBm Freq Offset 0 Hz STATUS

TEST PLOT OF OUT OF BAND EMISSIONS OF GFSK MODULATION IN MIDDLE CHANNEL



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| 🔰 Keysight Spectrum Analyzer - Swept SA | | | | |
|---|--|-------------------------|---|--|
| RL RF 50 Ω AC Center Freq 13.74175000 | CORREC SENSE: | Avg Type: Log-Pwr | 03:38:57 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 | Frequency |
| | PNO: Fast ↔ Trig: Free Ro IFGain:Low Atten: 30 dE | 3 | | Auto Tune |
| 10 dB/div Ref 20.00 dBm | | | -42.486 dBm | Center Freq 13.741750000 GHz |
| -20.0 -30.0 -40.0 | | | -23:48 dBm | Start Freq 2.483500000 GHz |
| -50.0 | | | | Stop Freq 25.000000000 GHz |
| Start 2.48 GHz #Res BW 100 kHz | #VBW 300 kHz 881 6 GHz -42.486 dBm | FUNCTION FUNCTION WIDTH | Stop 25.00 GHz 2.152 s (30000 pts) FUNCTION VALUE | CF Step 2.251650000 GHz <u>Auto</u> Man |
| | | | =E | Freq Offset 0 Hz |
| 7 8 9 10 11 | | | | |
| MSG | m | STATU | 3 | |



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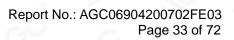


| | Ω AC CORREC | SENSE:INT | ALIGN AUTO | 03:40:03 PM Jul 17, 2020 | Frequency |
|--|--|---|---|---|--|
| enter Freq 2.480 | 000000 GHz PNO: Wide ↔ IFGain:Low | Trig: Free Run Atten: 30 dB | Avg Type: Log-Pwr Avg Hold: 10/10 | TRACE 123456 TYPE MWWWW DET PNNNN | |
| | | | Mkr1 2 | 480 099 8 GHz | Auto Tu |
| 10 dB/div Ref 20.0 | 0 dBm | | | -4.229 dBm | |
| 10.0 | | | | | Center Fr |
| 0.00 | | ↓ ↓ 1 | | | 2.48000000 G |
| -10.0 | | | | | |
| -20.0 | | | + | | Start Fro |
| -30.0 | | | \rightarrow | | 2.478500000 G |
| -40.0 | mar and a second | | - han, | | |
| -50.0 | | | | ALCON A MARKED AND AND AND AND AND AND AND AND AND AN | Stop Fr |
| -60.0 | | | | | 2.481500000 G |
| -70.0 | | | | | |
| Center 2.480000 GH #Res BW 100 kHz | | V 300 kHz | Sween 2 (| Span 3.000 MHz 00 ms (30000 pts) | CF Ste 300.000 k |
| MKR MODE TRC SCL | X | | JNCTION FUNCTION WIDTH | FUNCTION VALUE | Auto M |
| 1 N 1 f | 2.480 099 8 GHz | -4.229 dBm | | | |
| 3 | | | | | Freq Offs |
| 4 5 | | | | E | 01 |
| 6 | | | | | |
| 8 | | | | | |
| 10 11 | | | | | |
| | | | | ~ | |
| < ISG | | m | STATUS | * | |
| Keysight Spectrum Analyzer - | Swept SA | m | STATUS | | |
| Keysight Spectrum Analyzer - | Ω AC CORREC | m SENSE:INT | ALIGN AUTO | 03:40:12 PM Jul 17, 2020 | Frequency |
| Keysight Spectrum Analyzer - | Ω AC CORREC 0000000 GHz PNO: Fast ↔ | SENSE:INT | | | |
| Keysight Spectrum Analyzer - | Ω AC CORREC | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PMJul 17, 2020 TRACE 1 2 3 4 5 6 TYPE M | Frequency |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 10 dB/div Ref 20 0 | Ω AC CORREC 0000000 GHz PN0: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 | Frequency |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 10 dB/div Ref 20.00 | Ω AC CORREC 0000000 GHz PN0: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PMJul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MUNICAL DET P NN NN N 1 2.233 46 GHZ | Frequency Auto Tur |
| I Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 10 dB/div Ref 20.00 -99 10.0 | Ω AC CORREC 0000000 GHz PN0: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PMJul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MUNICAL DET P NN NN N 1 2.233 46 GHZ | Frequency Auto Tur Center Fre |
| Keysight Spectrum Analyzer - RF St RL RF St Center Freq 1.215 R St 10 dB/div Ref 20.00 St -00 -00 -00 | Ω AC CORREC 0000000 GHz PN0: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PMJul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MUNICAL DET P NN NN N 1 2.233 46 GHZ | Frequency Auto Tur Center Fre |
| I Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 10 dB/div Ref 20.00 -99 10.0 | Ω AC CORREC 0000000 GHz PN0: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW OET PNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fre 1.215000000 G |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.2151 0 dB/div Ref 20.00 0 0 0 0 0.00 0 | Ω AC CORREC 0000000 GHz PNO: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PMJul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MUNICAL DET P NN NN N 1 2.233 46 GHZ | Frequency Auto Tur Center Fre 1.215000000 Gi Start Fre |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.2151 IO dB/div Ref 20.00 00 00 00 00 00 00 000 000 000 000 000 000 000 000 000 000 000 000 | Ω AC CORREC 0000000 GHz PNO: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW OET PNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fre |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.2151 IO dB/div Ref 20.01 -99 | Ω AC CORREC 0000000 GHz PNO: Fast → IFGain:Low | SENSE:INT | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW OET PNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fre 1.21500000 GI Start Fre 30.00000 Mi |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.2151 IO dB/div Ref 20.01 -9 | Ω AC CORREC 0000000 GHz PNO: Fast → IFGain:Low | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 MKr | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW OET PNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fre 1.215000000 GI Start Fre 30.000000 MI Stop Fre |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.2151 IO dB/div Ref 20.01 -9 | Ω AC CORREC 000000 GHz PNO: Fast → IFGain:Low | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 MKr | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW OET PNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fre 1.215000000 GI Start Fre 30.000000 MI Stop Fre |
| Keysight Spectrum Analyzer - Stress G RL RF 50 Center Freq 1.215 1.215 1.215 10 dB/div Ref 20.00 1.215 -0 0 0.00 1.0.0 1.0.0 -10.0 0.00 1.215 1.215 -20.0 0.00 1.215 1.215 -30.0 0.00 1.215 1.215 -40.0 0.00 1.215 1.215 -70.0 1.215 1.215 1.215 | Ω AC CORREC 000000 GHz PNO: Fast → IFGain:Low | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 MKr | 03:40:12 PM Jul 17, 2020 TRACE 12 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24.23 dbn -24.23 dbn 1 | Frequency Auto Tur Center Frr 1.215000000 G Start Frr 30.000000 M Stop Frr 2.400000000 G |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.2151 10 dB/div Ref 20.01 -9 | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 17, 2020 TRACE 1 2 3 4 5 6 TYPE MWWWW OET PNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fr 1.215000000 G Start Fr 30.000000 M Stop Fr 2.400000000 G CF Str 237.000000 M |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 IO dB/div Ref 20.00 Og IO IO IO Og IO IO IO | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low 0 dBm 0 0 #VBW X | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 17, 2020 TRACE 12 3 4 5 6 TYPE NNNNN 1 2.233 46 GHz -58.397 dBm | Frequency Auto Tur Center Fre 1.215000000 GI Start Fre 30.000000 MI Stop Fre 2.400000000 GI CF Ste 237.000000 MI |
| Keysight Spectrum Analyzer - Sc RL RF 50 Center Freq 1.215 50 -00 | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low 0 BM | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts) | Frequency Auto Tur Center Fre 1.215000000 GI Start Frr 30.000000 MI Stop Frr 2.400000000 GI CF Ste 237.000000 MI Auto Tur |
| Keysight Spectrum Analyzer 50 Center Freq 1.215 50 O dB/div Ref 20.00 -00 -00< | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low 0 dBm 0 0 #VBW X | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts) | Frequency Auto Tur Center Fr 1.215000000 G Start Fr 30.000000 M Stop Fr 2.400000000 G CF Str 237.000000 M Auto Auto Tur Treq Offs |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 IO dE/div Ref 20.04 00 20 20 10.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 30.0 20.0 20.0 50.0 20.0 20.0 Start 30 MHz 4 5 #Res BW 100 kHz MKR MODE TRC SCL 1 1 1 2 3 3 4 3 3 | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low 0 dBm 0 0 #VBW X | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts) | Frequency Auto Tur Center Fre 1.215000000 GI Start Fre 30.000000 MI Stop Fre 2.400000000 GI CF Ste 237.000000 MI |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 50 -00 | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low 0 dBm 0 0 #VBW X | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts) | Frequency Auto Tur Center Fr 1.215000000 G Start Fr 30.000000 M Stop Fr 2.400000000 G CF Str 237.000000 M Auto Auto Tur Treq Offs |
| Keysight Spectrum Analyzer - Sc Center Freq 1.215 Sc 0 dB/div Ref 20.00 0 0 Ref 20.00 | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts) | Frequency Auto Tur Center Fr 1.215000000 G Start Fr 30.000000 M Stop Fr 2.400000000 G CF Str 237.000000 M Auto Auto Tur Treq Offs |
| Keysight Spectrum Analyzer - RL RF 50 Center Freq 1.215 IO dB/div Ref 20.00 Og Io IO dB/div Ref 20.00 Og Io IO dB/div Ref 20.00 IO dB/div Io IO dB/div Ref 20.00 IO dB/div Io IO dB/div <t< td=""><td>Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low</td><td>SENSE:INT Trig: Free Run Atten: 30 dB</td><td>ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr</td><td>03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts)</td><td>Frequency Auto Tu Center Fr 1.215000000 G Start Fr 30.000000 M Stop Fr 2.400000000 G CF Str 237.000000 M Auto Auto Tu Stop Fr 2.400000000 G CF Str Auto Auto Freq Offs</td></t<> | Ω AC CORREC 000000 GHz PN0: Fast → IFGain:Low | SENSE:INT Trig: Free Run Atten: 30 dB | ALIGN AUTO Avg Type: Log-Pwr Avg Hold: 10/10 Mkr | 03:40:12 PM Jul 37, 2020 TRACE 2 3 4 5 6 TYPE NINNIN 1 2.233 46 GHz -58.397 dBm -24 23 dBm -24 23 dBm -1 Stop 2.400 GHz 8.0 ms (30000 pts) | Frequency Auto Tu Center Fr 1.215000000 G Start Fr 30.000000 M Stop Fr 2.400000000 G CF Str 237.000000 M Auto Auto Tu Stop Fr 2.400000000 G CF Str Auto Auto Freq Offs |

TEST PLOT OF OUT OF BAND EMISSIONS OF GFSK MODULATION IN HIGH CHANNEL



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| | ectrum Analyzer - | | | | | | | | | | × |
|------------------------------|-------------------|------------|--------------------------|-------------------------|---------|----------------|--------------------------|----------------------|-----------------------|-----------------------------|------------------------|
| Center F | | | | SEN | ISE:INT | Avg Typ | ALIGN AUTO e: Log-Pwr | | M Jul 17, 2020 | Frequenc | у |
| | | | PNO: Fast ↔ FGain:Low | Trig: Free Atten: 30 | | Avg Hold | | D | | Auto 1 | Гune |
| 10 dB/div | Ref 20.0 | 0 dBm | | | | | | | 11 dBm | | |
| Log 10.0 0.00 -10.0 | | | | | | | | | | Center 13.750000000 | • |
| -20.0 -30.0 -40.0 | 1 | | | | | | | | -24.23 dBm | Start 2.500000000 | |
| -50.0 -60.0 -70.0 | | | | | | a had a los of | | | | Stop 25.000000000 | |
| Start 2.50 #Res BW | | | #VBV | V 300 kHz | | ^ | Sweep 2 | Stop 2 2.152 s (3 | 5.00 GHz 0000 pts) | CF 2.250000000 Auto | Step GHz Man |
| MKR MODE TI | RC SCL | × 4.960 |) 1 GHz | ۲ -44.611 dE | | TION FU | NCTION WIDTH | FUNCTI | ON VALUE | | |
| 2 3 4 5 6 7 | | | | | | | | | = | Freq O | o ffset 0 Hz |
| 8 9 10 11 | | | | | | | | | - | | |
| MSG | | | | | | | STATUS | 3 | | | |

Note: The GFSK modulation is the worst case and only those data recorded in the report.

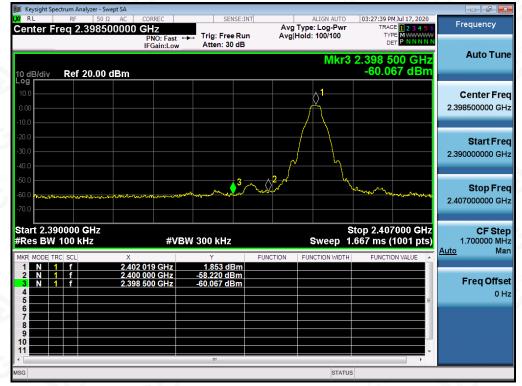




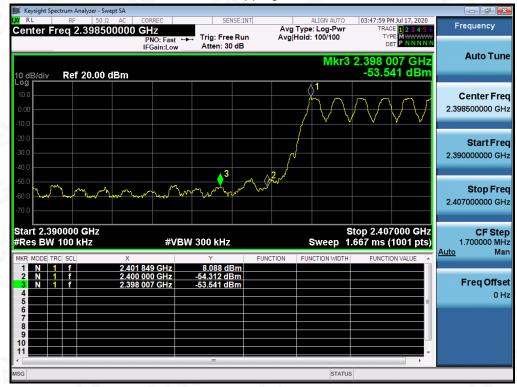
TEST RESULT FOR BAND EDGE

GFSK MODULATION IN LOW CHANNEL

Hopping off



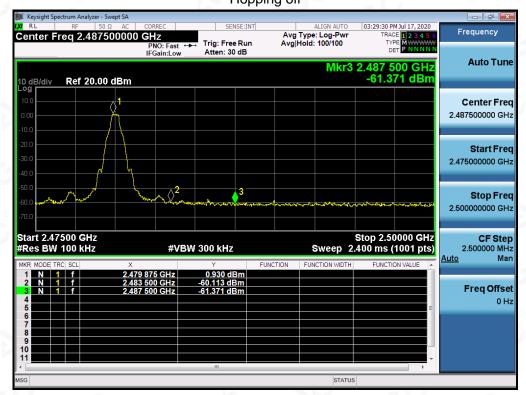
Hopping on





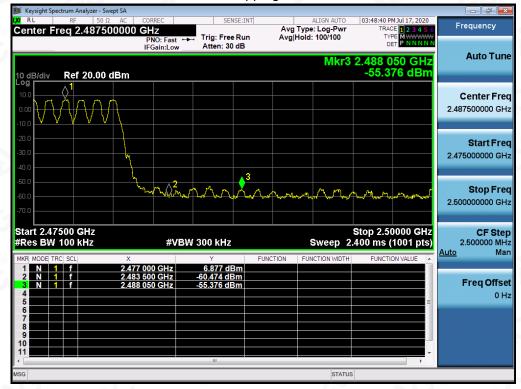
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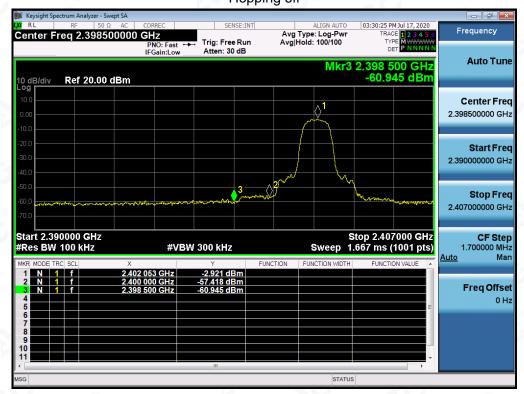
GFSK MODULATION IN HIGH CHANNEL Hopping off

Hopping on









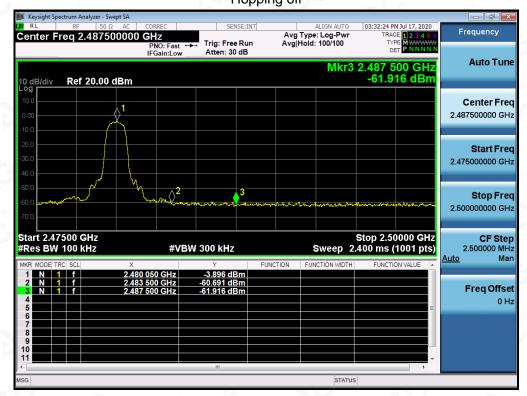
π /4-DQPSK MODULATION IN LOW CHANNEL Hopping off

Hopping on









π /4-DQPSK MODULATION IN HIGH CHANNEL Hopping off

Hopping on

