

TEST REPORT

Report Number: 14982479-E1V2

Applicant : APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

Model : A3084 (Parent Model)
A3295, A3296, A3297 (Variant Models)

Brand : APPLE

FCC ID : BCG-E8684A (Parent Model)
BCG-E8685A, BCG-E8686A, BCG-E8687A
(Variant Models)

IC : 579C-E8684A (Parent Model)
579C-E8685A, 579C-E8686A, 579C-
E8687A (Variant Models)

EUT Description : Smartphone

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 3
ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:
2024/08/02

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888



REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions | Revised By |
|------|------------|--|------------|
| V1 | 2024/07/30 | Initial Issue | Chin Pang |
| V2 | 2024/08/02 | Addressed TCB Feedback on Section 7, 9 and page 74 | Tony Li |

TABLE OF CONTENTS

| | |
|---|-----------|
| REPORT REVISION HISTORY | 2 |
| TABLE OF CONTENTS | 3 |
| 1. ATTESTATION OF TEST RESULTS | 6 |
| 2. TEST SUMMARY | 8 |
| 3. TEST METHODOLOGY | 8 |
| 4. FACILITIES AND ACCREDITATION | 9 |
| 5. DECISION RULES AND MEASUREMENT UNCERTAINTY | 9 |
| 5.1. METROLOGICAL TRACEABILITY | 9 |
| 5.2. DECISION RULES..... | 9 |
| 5.3. MEASUREMENT UNCERTAINTY..... | 10 |
| 6. EQUIPMENT UNDER TEST | 11 |
| 6.1. EUT DESCRIPTION | 11 |
| 6.2. MAXIMUM OUTPUT POWER..... | 11 |
| 6.3. DESCRIPTION OF AVAILABLE ANTENNAS | 12 |
| 6.4. SOFTWARE AND FIRMWARE..... | 12 |
| 6.5. WORST-CASE CONFIGURATION AND MODE..... | 12 |
| 6.6. DESCRIPTION OF TEST SETUP..... | 14 |
| 7. TEST AND MEASUREMENT EQUIPMENT | 19 |
| 8. MEASUREMENT METHODS | 21 |
| 9. ANTENNA PORT TEST RESULTS | 22 |
| 9.1. ON TIME AND DUTY CYCLE..... | 22 |
| 9.2. 20 dB AND 99% BANDWIDTH | 24 |
| 9.2.1. HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 25 |
| 9.2.2. HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 26 |
| 9.2.3. HIGH POWER ENHANCED DATA RATE 8PSK MODULATION | 27 |
| 9.2.4. HIGH POWER ENHANCED DATA RATE TXBF 8PSK MODULATION | 28 |
| 9.3. HOPPING FREQUENCY SEPARATION | 29 |
| 9.3.1. HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 30 |
| 9.4. NUMBER OF HOPPING CHANNELS..... | 31 |
| 9.4.1. HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 32 |
| 9.5. AVERAGE TIME OF OCCUPANCY..... | 34 |
| 9.5.1. HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 35 |
| 9.6. OUTPUT POWER..... | 39 |

| | | |
|---------|--|------------|
| 9.6.1. | HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 41 |
| 9.6.2. | HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 41 |
| 9.6.3. | HIGH POWER ENHANCED DATA RATE QPSK MODULATION | 42 |
| 9.6.4. | HIGH POWER ENHANCED DATA RATE TXBF QPSK MODULATION | 42 |
| 9.6.5. | HIGH POWER ENHANCED DATA RATE 8PSK MODULATION | 43 |
| 9.6.6. | HIGH POWER ENHANCED DATA RATE TXBF 8PSK MODULATION | 43 |
| 9.6.7. | LOW POWER BASIC DATA RATE GFSK MODULATION..... | 44 |
| 9.6.8. | LOW POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 44 |
| 9.6.9. | LOW POWER ENHANCED DATA RATE QPSK MODULATION | 45 |
| 9.6.10. | LOW POWER ENHANCED DATA RATE TXBF QPSK MODULATION..... | 45 |
| 9.6.11. | LOW POWER ENHANCED DATA RATE 8PSK MODULATION | 46 |
| 9.6.12. | LOW POWER ENHANCED DATA RATE TXBF 8PSK MODULATION | 46 |
| 9.7. | AVERAGE POWER..... | 47 |
| 9.7.1. | HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 48 |
| 9.7.2. | HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 48 |
| 9.7.3. | HIGH POWER ENHANCED DATA RATE QPSK MODULATION | 49 |
| 9.7.4. | HIGH POWER BASIC DATA RATE TXBF QPSK MODULATION..... | 49 |
| 9.7.5. | HIGH POWER ENHANCED DATA RATE 8PSK MODULATION | 50 |
| 9.7.6. | HIGH POWER BASIC DATA RATE TXBF 8PSK MODULATION | 50 |
| 9.7.7. | LOW POWER BASIC DATA RATE GFSK MODULATION..... | 51 |
| 9.7.8. | LOW POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 51 |
| 9.7.9. | LOW POWER ENHANCED DATA RATE QPSK MODULATION | 52 |
| 9.7.10. | LOW POWER BASIC DATA RATE TXBF QPSK MODULATION..... | 52 |
| 9.7.11. | LOW POWER ENHANCED DATA RATE 8PSK MODULATION | 53 |
| 9.7.12. | LOW POWER BASIC DATA RATE TXBF 8PSK MODULATION..... | 53 |
| 9.8. | CONDUCTED SPURIOUS EMISSIONS..... | 54 |
| 9.8.1. | HIGH POWER BASIC DATA RATE GFSK MODULATION..... | 55 |
| 9.8.2. | HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 59 |
| 9.8.3. | HIGH POWER ENHANCED DATA RATE 8PSK MODULATION | 63 |
| 9.8.4. | HIGH POWER BASIC DATA RATE TXBF 8PSK MODULATION | 67 |
| 9.8.5. | LOW POWER BASIC DATA RATE GFSK MODULATION..... | 71 |
| 9.8.6. | LOW POWER BASIC DATA RATE TXBF GFSK MODULATION..... | 75 |
| 9.8.7. | LOW POWER ENHANCED DATA RATE 8PSK MODULATION | 79 |
| 9.8.8. | LOW POWER BASIC DATA RATE TXBF 8PSK MODULATION | 83 |
| 10. | RADIATED TEST RESULTS | 87 |
| 10.1. | TRANSMITTER ABOVE 1 GHz..... | 89 |
| 10.1.1. | HIGH POWER BASIC DATA RATE GFSK MODULATION | 89 |
| 10.1.2. | HIGH POWER BASIC DATA RATE TX BF GFSK MODULATION | 97 |
| 10.1.3. | HIGH POWER ENHANCED DATA RATE 8PSK MODULATION..... | 101 |
| 10.1.4. | HIGH POWER BASIC DATA RATE TXBF 8PSK MODULATION..... | 109 |
| 10.1.5. | LOW POWER BASIC DATA RATE GFSK MODULATION | 113 |
| 10.1.6. | LOW POWER BASIC DATA RATE TXBF GFSK MODULATION | 121 |
| 10.1.7. | LOW POWER ENHANCED DATA RATE 8PSK MODULATION | 125 |
| 10.1.8. | LOW POWER BASIC DATA RATE TXBF 8PSK MODULATION..... | 133 |
| 10.1.9. | WORST CASE TXBF HARMONICS AND SPURIOUS EMISSIONS | 137 |
| 10.2. | WORST CASE BELOW 1 GHZ..... | 143 |
| 10.3. | WORST CASE 18-26 GHZ..... | 145 |
| 11. | AC POWER LINE CONDUCTED EMISSIONS | 147 |

| | | |
|---------|--|-----|
| 11.1.1. | AC POWER LINE WITH LAPTOP | 148 |
| 11.1.2. | AC POWER LINE WITH AC/DC ADAPTER | 150 |
| 12. | SETUP PHOTOS | 152 |

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A

EUT DESCRIPTION: Smartphone

MODEL: A3084 (Parent Model)
A3295, A3296, A3297 (Variant Models)

BRAND: APPLE

SERIAL NUMBER: DP4Q0WG2IX

SAMPLE RECEIPT DATE: 2024/03/08

DATE TESTED: 2024/03/09 – 2024/07/24

| APPLICABLE STANDARDS | |
|--------------------------------|--------------|
| STANDARD | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Complies |
| ISED RSS-247 Issue 3 | Complies |
| ISED RSS-GEN Issue 5 + A1 + A2 | Complies |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested can demonstrate compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to ensure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not considered unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



Chin Pang
Senior Lab Engineer
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Tony Li
Test Engineer
Consumer Technology Division
UL Verification Services Inc.

2. TEST SUMMARY

| FCC Clause | ISED Clause | Requirement | Result | Comment |
|--------------------|-------------------|------------------------------|-------------------------|--------------------------------------|
| See Comment | | Duty Cycle | Reporting purposes only | Per ANSI C63.10, Section 11.6. |
| See Comment | RSS-GEN 6.7 | 20dB BW/99% OBW | Reporting purposes only | ANSI C63.10 Sections 6.9.2 and 6.9.3 |
| 15.247 (a)(1) | RSS-247 (5.1) (b) | Hopping Frequency Separation | | None. |
| 15.247 (a)(1)(iii) | RSS-247 (5.1) (d) | Number of Hopping Channels | | None. |
| 15.247 (a)(1)(iii) | RSS-247 (5.1) (d) | Average Time of Occupancy | | None. |
| 15.247 (b)(1) | RSS-247 (5.4) (b) | Output Power | | None. |
| See Comment | | Average Power | Reporting purposes only | Per ANSI C63.10, Section 11.9.2.3.2. |
| 15.247 (d) | RSS-247 (5.5) | Conducted Spurious Emissions | | None. |
| 15.209, 15.205 | RSS-GEN 8.9, 8.10 | Radiated Emissions | | None. |
| 15.207 | RSS-Gen 8.8 | AC Mains Conducted Emissions | | None. |

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, KDB 662911, RSS-GEN Issue 5 + A1 + A2, and RSS-247 Issue 3.

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, certification #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

| | Address | ISED CABID | ISED Company Number | FCC Registration |
|-------------------------------------|--|---------------|---------------------------|---------------------|
| <input type="checkbox"/> | Building 1: 47173 Benicia Street, Fremont, CA 94538, USA | US0104 | 2324A | 550739 |
| <input checked="" type="checkbox"/> | Building 2: 47266 Benicia Street, Fremont, CA 94538, USA | | | |
| <input checked="" type="checkbox"/> | Building 3: 843 Auburn Court, Fremont, CA 94538 USA | | | |
| <input type="checkbox"/> | Building 4: 47658 Kato Rd, Fremont, CA 94538 USA | | | |
| <input checked="" type="checkbox"/> | Building 5: 47670 Kato Rd, Fremont, CA 94538 USA | | | |

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | U _{LAB} |
|--|-------------------------|
| Conducted Antenna Port Emission Measurement | 1.94 |
| Time Domain Measurements Using SA | 3.39 |
| RF Power Measurement Direct Method Using Power Meter | 0.450 (Peak), 1.3 (Ave) |
| Radio Frequency (Spectrum Analyzer) | 141.16 Hz |
| Occupied Bandwidth | 1.22% |
| Carrier Frequency Separation | 19.70Hz |
| Number of Hopping Frequencies | 0.000dB |
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz | 3.78 dB |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz | 3.40 dB |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz | 2.87 dB |
| Worst Case Radiated Disturbance, 30 to 1000 MHz | 6.01 dB |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz | 4.73 dB |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.51 dB |

Uncertainty figures are valid to a confidence level of 95%.

SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable} \\ &\text{Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Final Voltage (dBuV)} &= \text{Measured Voltage (dBuV)} + \text{Cable Loss (dB)} + \text{Limiter Factor (dB)} + \\ &\text{LISN Insertion Loss.} \\ 36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} &= 46.6 \text{ dBuV} \end{aligned}$$

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The Apple iPhone is a smartphone with cellular GSM, GPRS, EGPRS, WCDMA, LTE, 5G NR1, 5G NR2, IEEE 802.11a/b/g/n/ac/ax/be, Bluetooth (BT), Ultra-Wideband (UWB), Global Positioning System (GPS), Near-Field Communication (NFC), Narrow-Band (NB) UNII, 802.15.4, 802.15.4ab-Narrow Band (NB) and Mobile Satellite Service (MSS) technologies. The rechargeable battery is not user accessible. This device is not user-serviceable and requires special tools to disassemble.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Antenna | Config | Frequency Range (MHz) | Mode | Output Power (dBm) | Output Power (mW) |
|-------------------|------------|-----------------------|--------------------|--------------------|-------------------|
| ANT 4 | High Power | 2402 - 2480 | Basic GFSK | 20.32 | 107.65 |
| | | 2402 - 2480 | DQPSK | 18.94 | 78.34 |
| | | 2402 - 2480 | Enhanced 8PSK | 19.13 | 81.85 |
| | Low Power | 2402 - 2480 | Basic GFSK | 11.80 | 15.14 |
| | | 2402 - 2480 | DQPSK | 9.39 | 8.69 |
| | | 2402 - 2480 | Enhanced 8PSK | 9.65 | 9.23 |
| ANT 3 | High Power | 2402 - 2480 | Basic GFSK | 20.25 | 105.93 |
| | | 2402 - 2480 | DQPSK | 18.99 | 79.25 |
| | | 2402 - 2480 | Enhanced 8PSK | 19.15 | 82.22 |
| | Low Power | 2402 - 2480 | Basic GFSK | 11.33 | 13.58 |
| | | 2402 - 2480 | DQPSK | 9.47 | 8.85 |
| | | 2402 - 2480 | Enhanced 8PSK | 9.66 | 9.25 |
| BF, ANT 4 + ANT 3 | High Power | 2402 - 2480 | Basic GFSK TxBF | 20.30 | 107.15 |
| | | 2402 - 2480 | DQPSK TxBF | 18.88 | 77.27 |
| | | 2402 - 2480 | Enhanced 8PSK TxBF | 19.14 | 82.04 |
| | Low Power | 2402 - 2480 | Basic GFSK TxBF | 14.63 | 29.04 |
| | | 2402 - 2480 | DQPSK TxBF | 12.46 | 17.62 |
| | | 2402 - 2480 | Enhanced 8PSK TxBF | 12.62 | 18.28 |

Note: GFSK, DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on these modes to showing compliance. For average power data please refer to section 9.7.

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) type is IFA type.

The antenna(s) gains, as provided by the manufacturer, are as follows:

| Frequency Range (GHz) | ANT 4 (dBi) | ANT 3 (dBi) |
|-----------------------|-------------|-------------|
| 2.4 | -2.0 | -1.7 |

SMA Cable used for RF conducted testing has a loss as follows:

Cable Loss used for Antenna 4 is 2.0 dB

Cable Loss used for Antenna 3 is 2.2 dB

The cables were used for RF antenna port tests that had been offset to the test equipment during testing.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware and software version is 22.1.93.334.

6.5. WORST-CASE CONFIGURATION AND MODE

The EUT was investigated in three orthogonal orientations X, Y and Z on ANT 4 and ANT 3, it was determined that X (Flatbed) was the worst-case orientation for ANT 4, ANT 3 and 2TX Beamforming.

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT was set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 30MHz, below 1GHz, 18-26GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario.

For below 30MHz, 30-1000MHz emissions spurious tests EUT was connected to AC power adapter and set at X orientation as the worst case; and for above 1GHz, the worst-case configuration reported was tested with EUT only. For AC line conducted emission, test was investigated with AC power adapter and with laptop.

For simultaneous transmission of multiple channels in the 2.4GHz BT and 5GHz bands, no noticeable emission was found.

GFSK, DQPSK, 8PSK average power are all investigated, The GFSK & 8PSK power are the worst case. For average power data please refer to section 9.7.

Worst-case data rates as provided by the client were:

GFSK mode : DH5

8PSK mode : 3-DH5

Beamforming: GFSK, DH5, 8PSK, 3-DH5

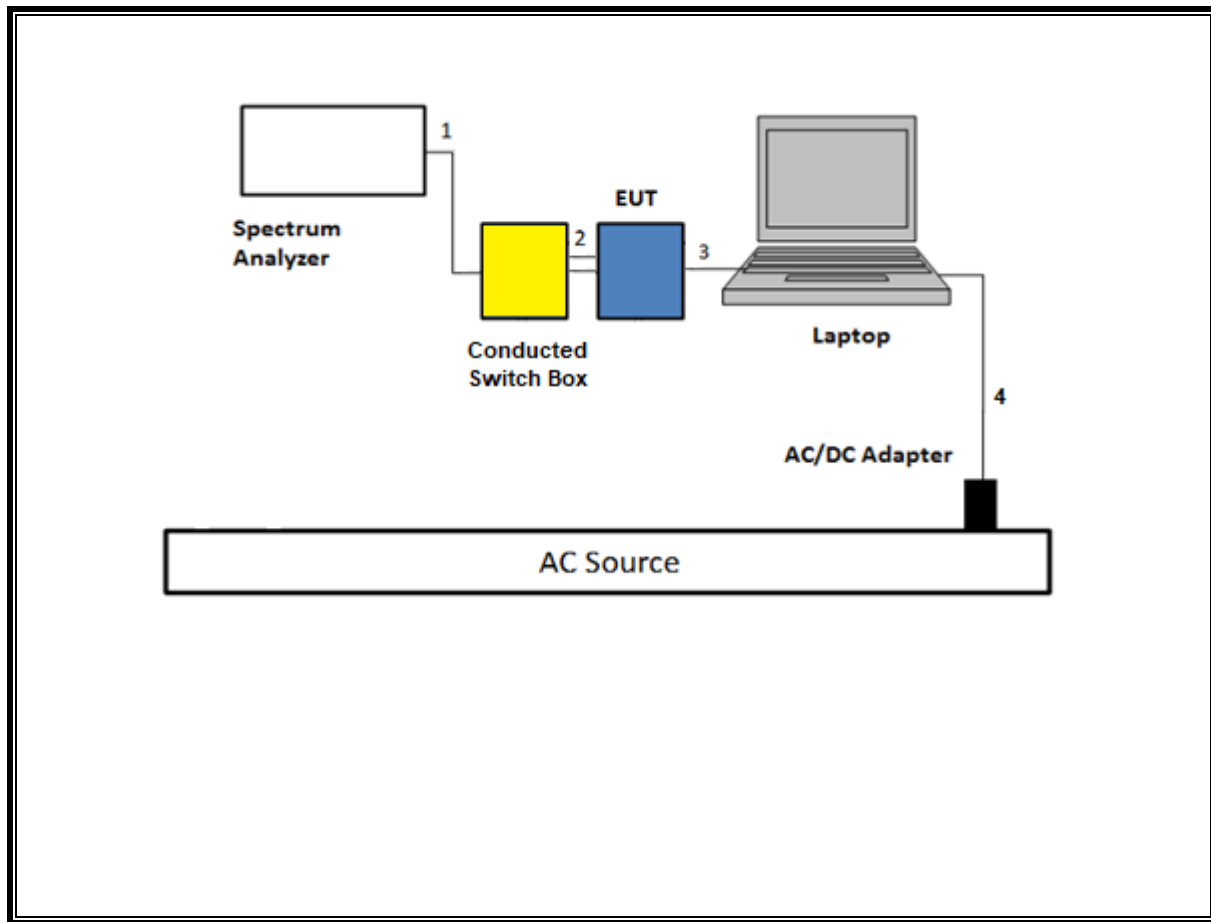
For radiated harmonic spurious emissions test, high power beamforming GFSK mode is set to maximum power per chain to cover both SISO and MIMO modes to complies with radiated spurious emissions limits in the restricted bands between 1GHz and 18GHz low/mid/high channel.

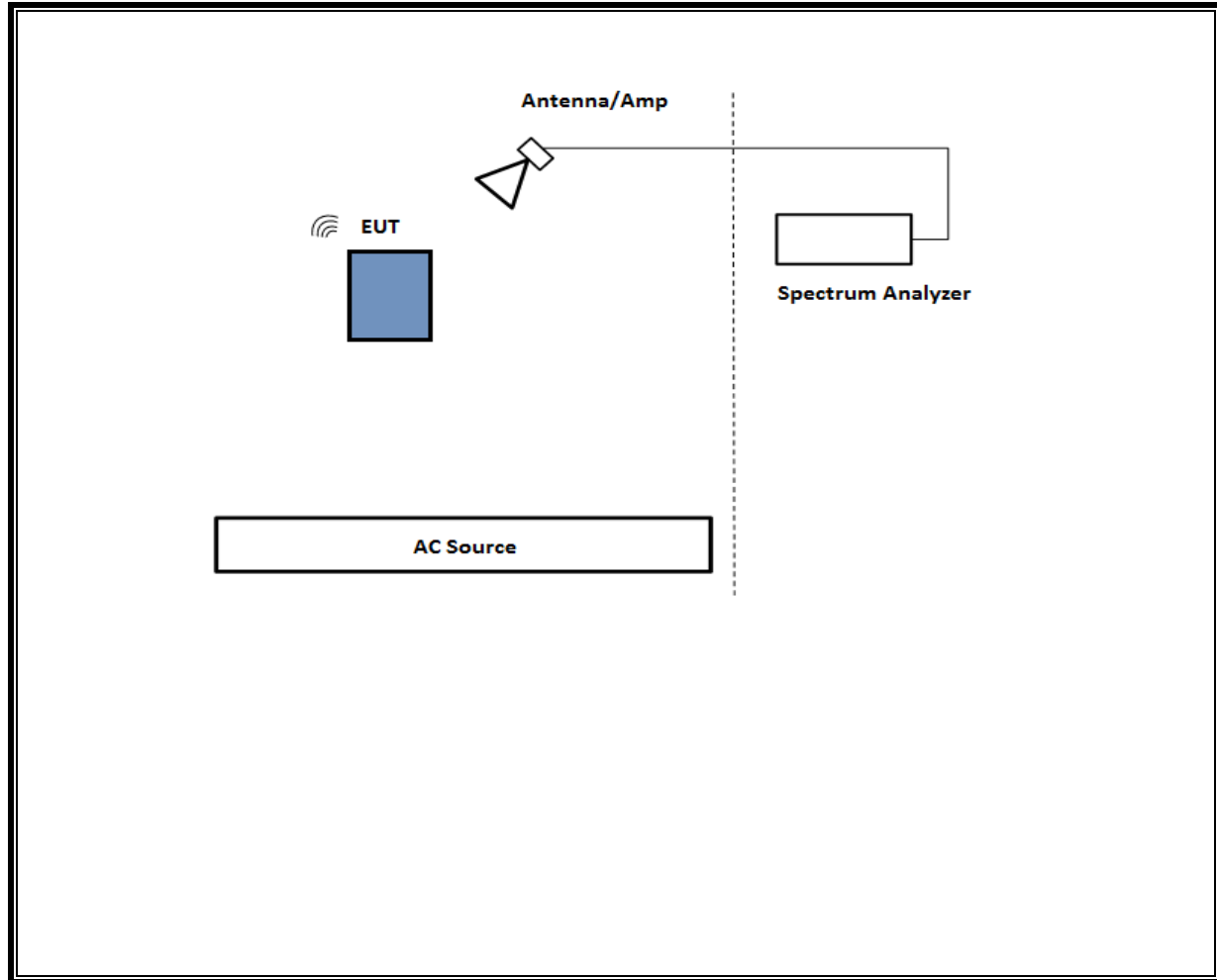
6.6. DESCRIPTION OF TEST SETUP

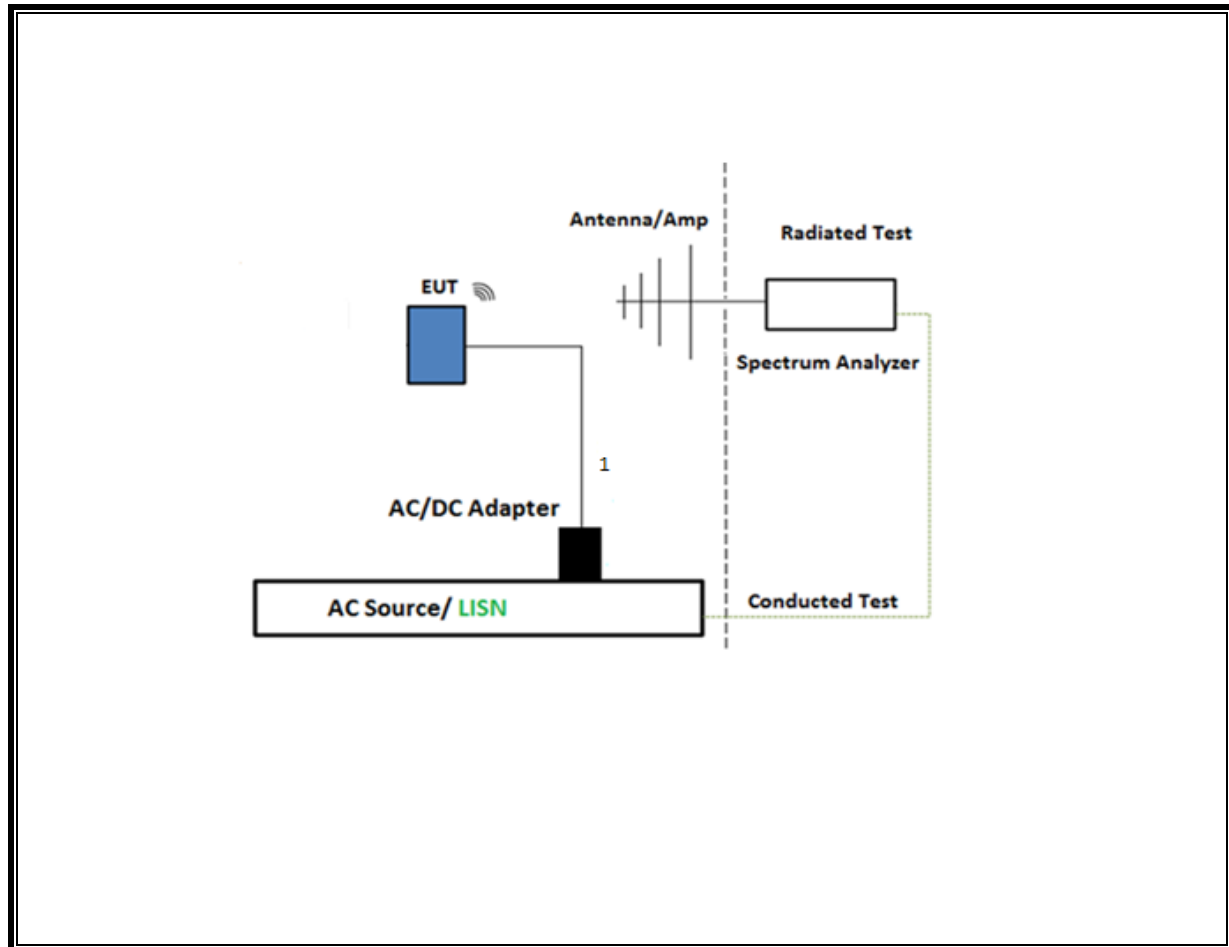
| SUPPORT TEST EQUIPMENT | | | | | | |
|--------------------------------|---------|----------------------|----------------|-------------------|------------------|-------------------------|
| Description | | Manufacturer | Model | Serial Number | | FCC ID/ DoC |
| Laptop | | Apple | Macbook Pro | C02VD7SAHV22 | | BCGA1708 |
| Laptop AC/DC adapter | | Liteon Technology | A1424 | NSW25679 | | DoC |
| EUT AC/DC adapter | | Apple | A1720 | C3D8417A7R93KVPA8 | | DoC |
| Conducted Switch Box | | UL | n/a | 208281 | | N/A |
| I/O CABLES (RF CONDUCTED TEST) | | | | | | |
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | SMA | 1 | SMA | Shielded | 0.75 | To spectrum Analyzer |
| 2 | Antenna | 2 | SMA | Un-shielded | 0.2 | To Conducted Switch Box |
| 3 | USB-C | 1 | USB-C | Shielded | 1.0 | N/A |
| 4 | AC | 1 | AC | Un-shielded | 2 | N/A |
| I/O CABLES (RF RADIATED TEST) | | | | | | |
| Cable No. | Port | # of Identical Ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1 | AC | 1 | AC | Un-shielded | 2 | N/A |
| 2 | USB | 1 | USB | Un-shielded | 1 | N/A |

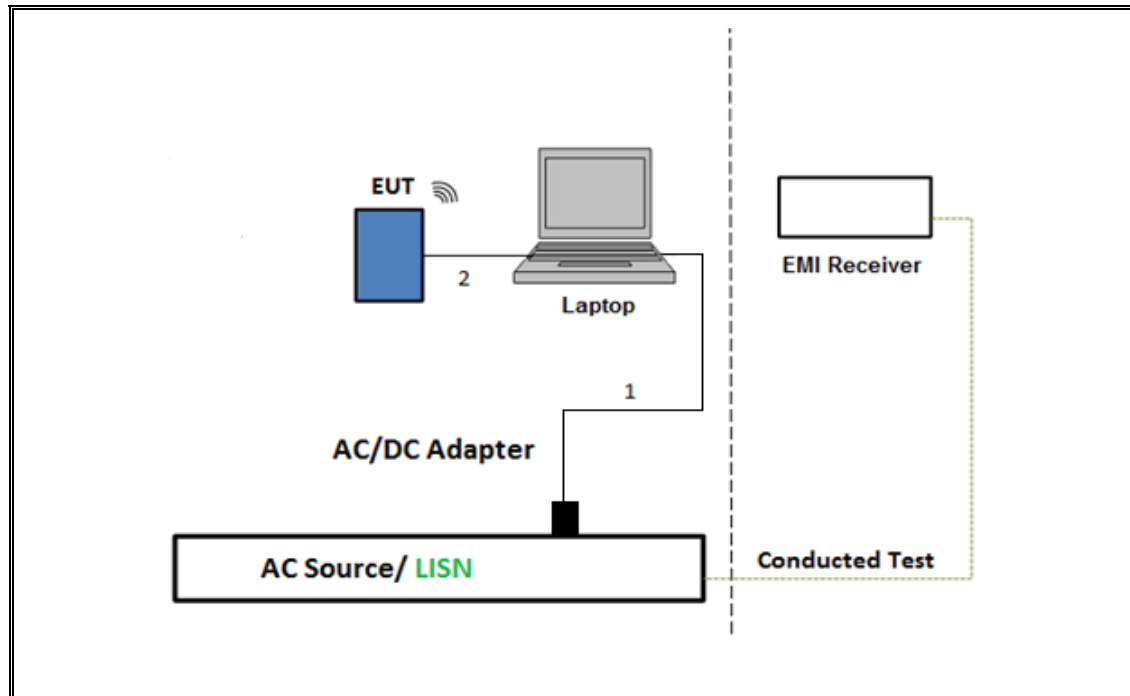
TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR CONDUCTED TESTS

SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz (1 to 26.5GHz)

SETUP DIAGRAM FOR 30-1000MHz and AC LINE CONDUCTED TEST

TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION

7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| Description | Manufacturer | Model | ID Num | Cal Due |
|--|---------------------------|----------------|--------|------------|
| *EMI TEST RECEIVER | Rohde & Schwarz | ESW44 | 235670 | 2024/04/30 |
| Antenna, Horn 1-18GHz | ETS-Lindgren | 3117 | 223084 | 2024/10/31 |
| *EMI TEST RECEIVER | Rohde & Schwarz | ESW44 | 235670 | 2024/04/30 |
| *RF Filter Box, 1-18GHz | Miteq | UL-FR1 | 171875 | 2024/05/31 |
| Antenna, Horn 1-18GHz | ETS-Lindgren | 3117 | 200896 | 2025/04/24 |
| RF Filter Box, 1-18GHz, 17 Ports | UL-FR1 | RATS 2 | 225474 | 2025/04/30 |
| EMI TEST RECEIVER | Rohde & Schwarz | ESW44 | 170063 | 2024/11/30 |
| Antenna, Horn 1-18GHz | ETS-Lindgren | 3117 | 226673 | 2025/01/31 |
| EMI Test Receiver | Rohde & Schwarz | ESW44 | 169936 | 2025/02/28 |
| RF Filter Box, 1-18GHz, 12 Ports | UL-FR1 | Frankenstein | 217521 | 2024/08/31 |
| *Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences Corp. | JB3 | 85151 | 2024/04/30 |
| Link File, @3m, 9kHz-1000MHz Hybrid Path Loss | UL-FR1 | Port 0 Factors | 232001 | 2025/02/28 |
| EMI TEST RECEIVER | Rohde & Schwarz | ESW44 | 169935 | 2025/02/28 |
| *Antenna, Horn 18 to 26.5GHz | A.R.A | MWH-1826/B | 172353 | 2024/06/30 |
| RF Amplifier Assembly, 18-26.5GHz, 60dB Gain | AMPLICAL | AMP18G26.5-60 | 171583 | 2025/03/31 |
| EMI TEST RECEIVER | Rohde & Schwarz | ESW44 | 223461 | 2024/08/29 |
| Antenna, Passive Loop 30Hz to 1MHz | Electro-Metrics | EM-6871 | 170014 | 2024/08/31 |
| Antenna, Passive Loop 100KHz - 30MHz | ELECTRO-METRICS | EM-6872 | 170016 | 2024/08/31 |
| Power Meter, P-series single channel | Keysight Technologies Inc | N1911A | 90731 | 2025/01/31 |
| Power Sensor, P - series, 50MHz to 18GHz, Wideband | Keysight Technologies Inc | N1921A | 80120 | 2025/01/31 |
| Power Meter, P-series single channel | Keysight Technologies Inc | N1911A | 90719 | 2025/01/31 |
| Power Sensor, P - series, 50MHz to 18GHz, Wideband | Keysight Technologies Inc | N1921A | 90389 | 2025/01/31 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight Technologies Inc | N9030A | 80397 | 2025/01/31 |
| Spectrum Analyzer, PXA, 3Hz to 50GHz w/Ext. Mixer | Keysight Technologies Inc | N9030A | 80400 | 2025/02/02 |
| 10dB Fixed Attenuator | Pasternack Enterprises | PE7087-10 | 178557 | |
| 10dB Fixed Attenuator | Pasternack Enterprises | PE7087-10 | 178558 | |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Keysight Technologies Inc | N9030A | 125178 | 2025/01/31 |
| *Conducted Switch Box | N/A | CSB | 208281 | 2024/04/30 |
| Conducted Switch Box | N/A | CSB | 208281 | 2025/05/08 |

| AC Line Conducted | | | | |
|--|----------------------------------|--------------------------------------|----------------------|------------|
| Description | Manufacturer | Model | ID Num | Cal Due |
| EMI Test Receiver 9kHz-7GHz | Rohde & Schwarz | ESR | 93091 | 2025/02/28 |
| LISN for Conducted Emissions CISPR-16 | FISCHER CUSTOM COMMUNICATIONS | FCC-LISN- 50/250-25-2-01- 480V | 175765 | 2025/01/31 |
| Transient Limiter | TE | TBFL1 | 207996 | 2024/08/31 |
| UL AUTOMATION SOFTWARE | | | | |
| Radiated Software | UL | UL EMC | Ver 9.5, May 1, 2023 | |
| Conducted Software | UL | UL EMC | 2023.2.23 | |
| AC Line Conducted Software | UL | UL EMC | Ver 9.5, Mar 3, 2023 | |

*Testing was completed before equipment calibration date

8. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Occupied BW (20dB): ANSI C63.10-2013 Section 6.9.2

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Carrier Frequency Separation: ANSI C63.10-2013 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2013 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2013 Section 7.8.4

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2013 Section 7.8.8

Conducted Band-Edge: ANSI C63.10-2013 Section 6.10.4

&
Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4 & 13

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3, 6.5 & 13

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3, 6.6 & 13

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5 & 13

AC Power-line conducted emissions: ANSI C63.10-2013, Section 6.2.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

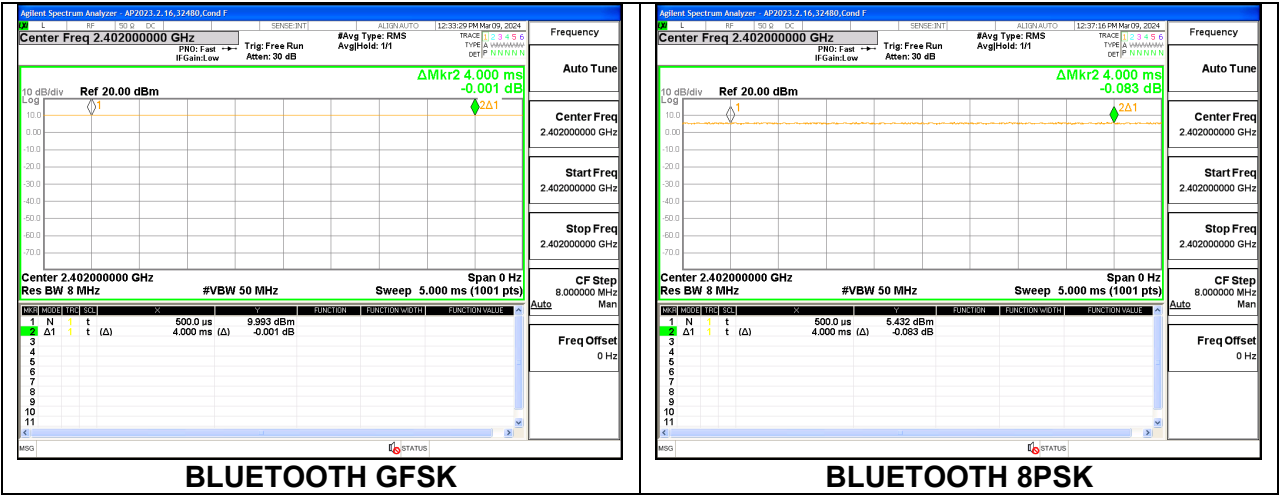
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/T Minimum VBW (kHz) |
|----------------|------------------------|------------------|-----------------------------|----------------------|---|-----------------------------|
| Bluetooth GFSK | 4.00 | 4.00 | 1.000 | 100.0% | 0.00 | 0.010 |
| Bluetooth 8PSK | 4.00 | 4.00 | 1.000 | 100.0% | 0.00 | 0.010 |

Note: There is the same DC factor on 1TX and 2TX.

DUTY CYCLE PLOTS



9.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq 3 \times \text{RBW}$. The sweep time is coupled.

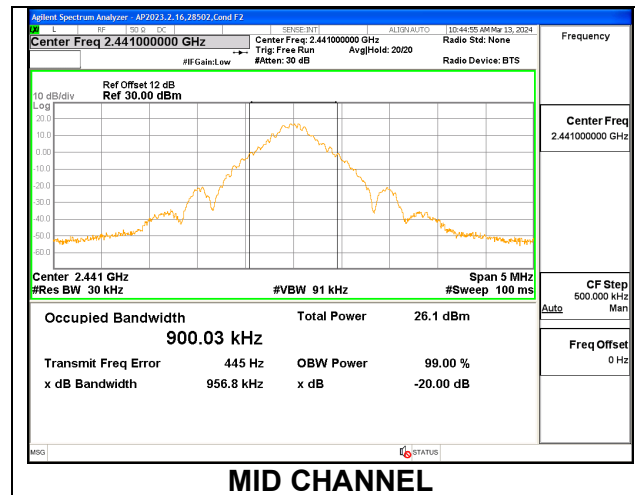
RESULTS

Only High-Power modes result is reported, it covers all Low Power modes. Only Mid channel plot is reported to show setting parameter complies with testing method/procedure.

9.2.1. HIGH POWER BASIC DATA RATE GFSK MODULATION

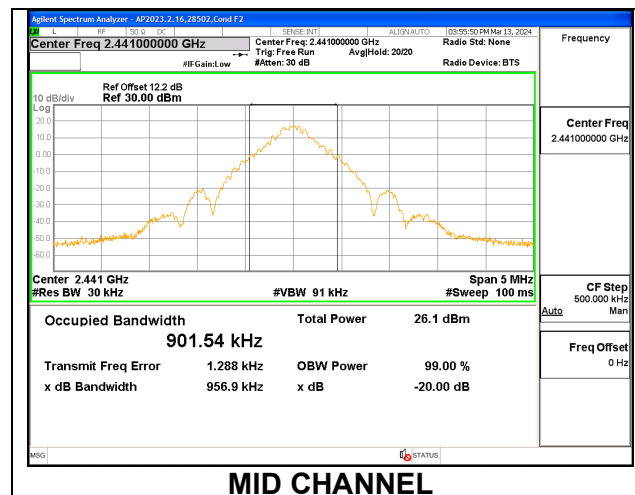
ANT 4

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 0.95510 | 0.89815 |
| Mid | 2441 | 0.95680 | 0.90003 |
| High | 2480 | 0.95840 | 0.89827 |



ANT 3

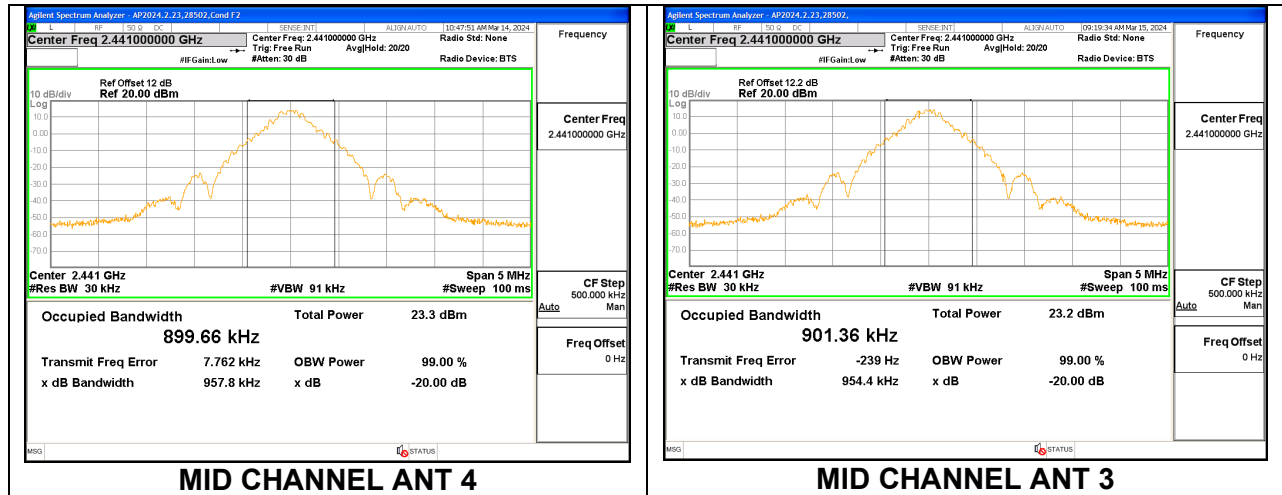
| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 0.95140 | 0.90185 |
| Mid | 2441 | 0.95690 | 0.90154 |
| High | 2480 | 0.95890 | 0.89972 |



9.2.2. HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION

| Channel | Frequency (MHz) | 20dB Bandwidth ANT 4 (MHz) | 20dB Bandwidth ANT 3 (MHz) | 99% Bandwidth ANT 4 (MHz) | 99% Bandwidth ANT 3 (MHz) |
|---------|--------------------|----------------------------------|----------------------------------|---------------------------------|---------------------------------|
| Low | 2402 | 0.95630 | 0.95680 | 0.90025 | 0.89953 |
| Mid | 2441 | 0.95780 | 0.95440 | 0.89966 | 0.90136 |
| High | 2480 | 0.95720 | 0.95670 | 0.89796 | 0.89957 |

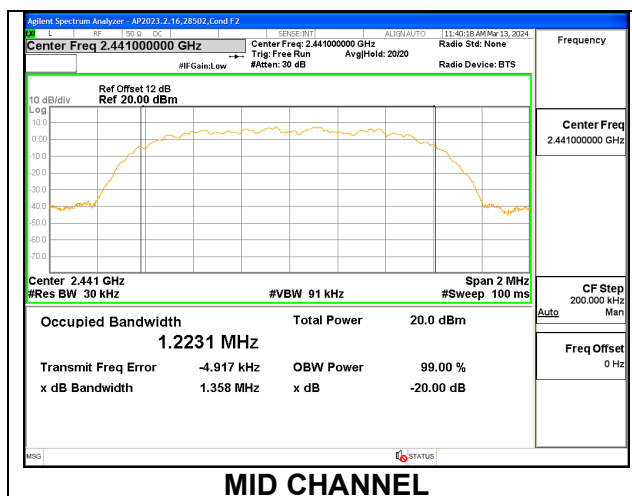
Note: Test procedures and setting on beamforming mode are same as BT basic and EDR mode



9.2.3. HIGH POWER ENHANCED DATA RATE 8PSK MODULATION

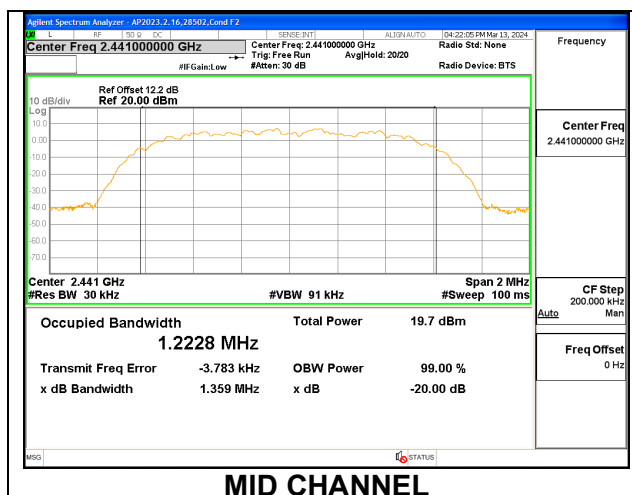
ANT 4

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 1.3590 | 1.2216 |
| Mid | 2441 | 1.3580 | 1.2231 |
| High | 2480 | 1.3590 | 1.2226 |



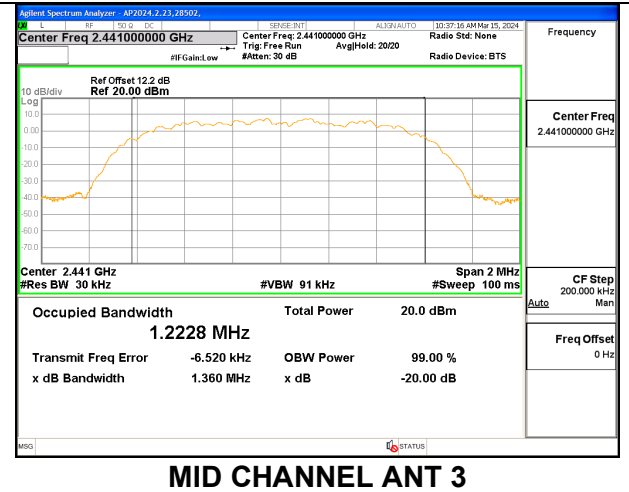
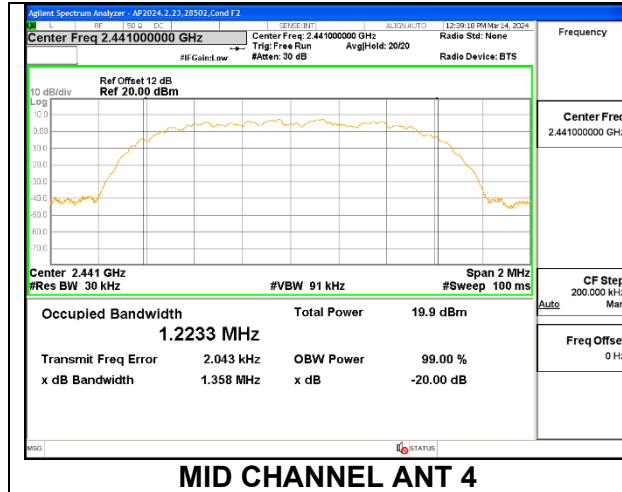
ANT 3

| Channel | Frequency (MHz) | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low | 2402 | 1.3590 | 1.2224 |
| Mid | 2441 | 1.3590 | 1.2228 |
| High | 2480 | 1.3590 | 1.2225 |



9.2.4. HIGH POWER ENHANCED DATA RATE TXBF 8PSK MODULATION

| Channel | Frequency (MHz) | 20dB Bandwidth ANT 4 (MHz) | 20dB Bandwidth ANT 3 (MHz) | 99% Bandwidth ANT 4 (MHz) | 99% Bandwidth ANT 3 (MHz) |
|---------|--------------------|----------------------------------|----------------------------------|---------------------------------|---------------------------------|
| Low | 2402 | 1.3590 | 1.3590 | 1.2225 | 1.2211 |
| Mid | 2441 | 1.3580 | 1.3600 | 1.2233 | 1.2228 |
| High | 2480 | 1.3600 | 1.3590 | 1.2224 | 1.2224 |



9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

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 PROCEDURE

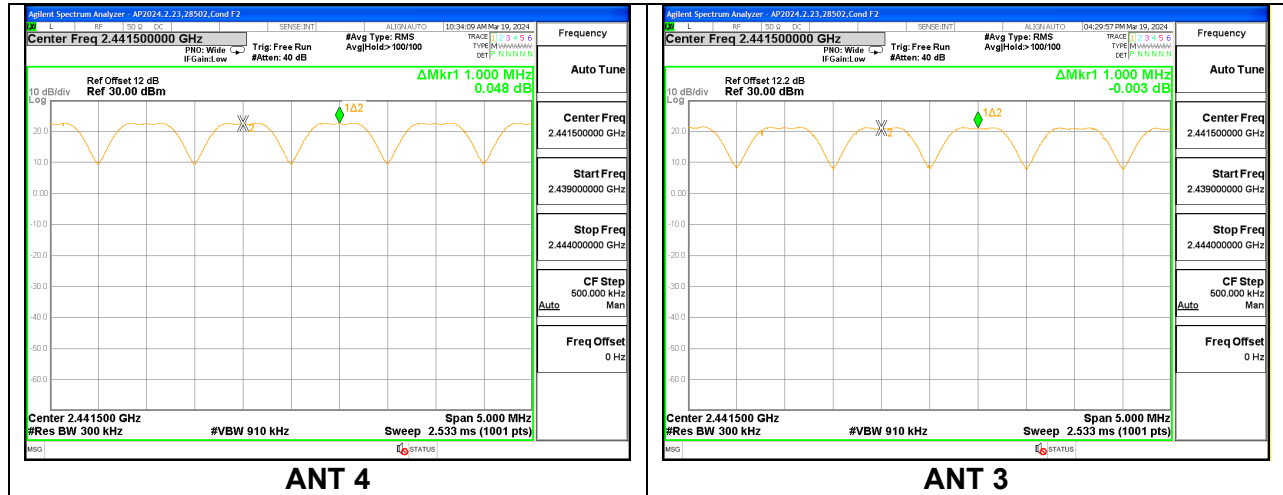
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq 3 \times RBW$. The sweep time is coupled.

RESULTS

Only High-Power GFSK mode result is reported since EDR (QPSK/8PSK) has exact same channel plan.

9.3.1. HIGH POWER BASIC DATA RATE GFSK MODULATION

HOPPING FREQUENCY SEPARATION



9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

TEST PROCEDURE

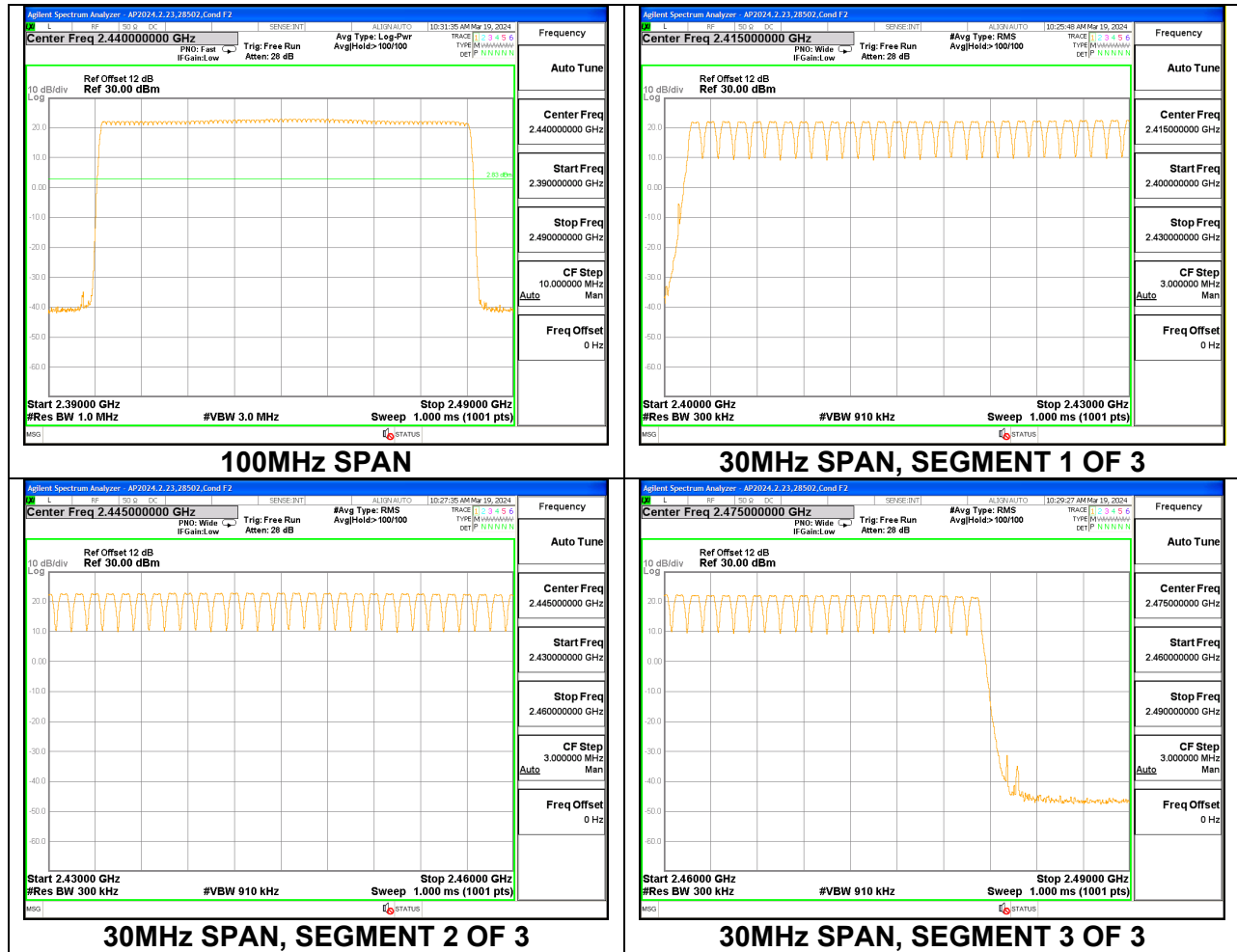
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

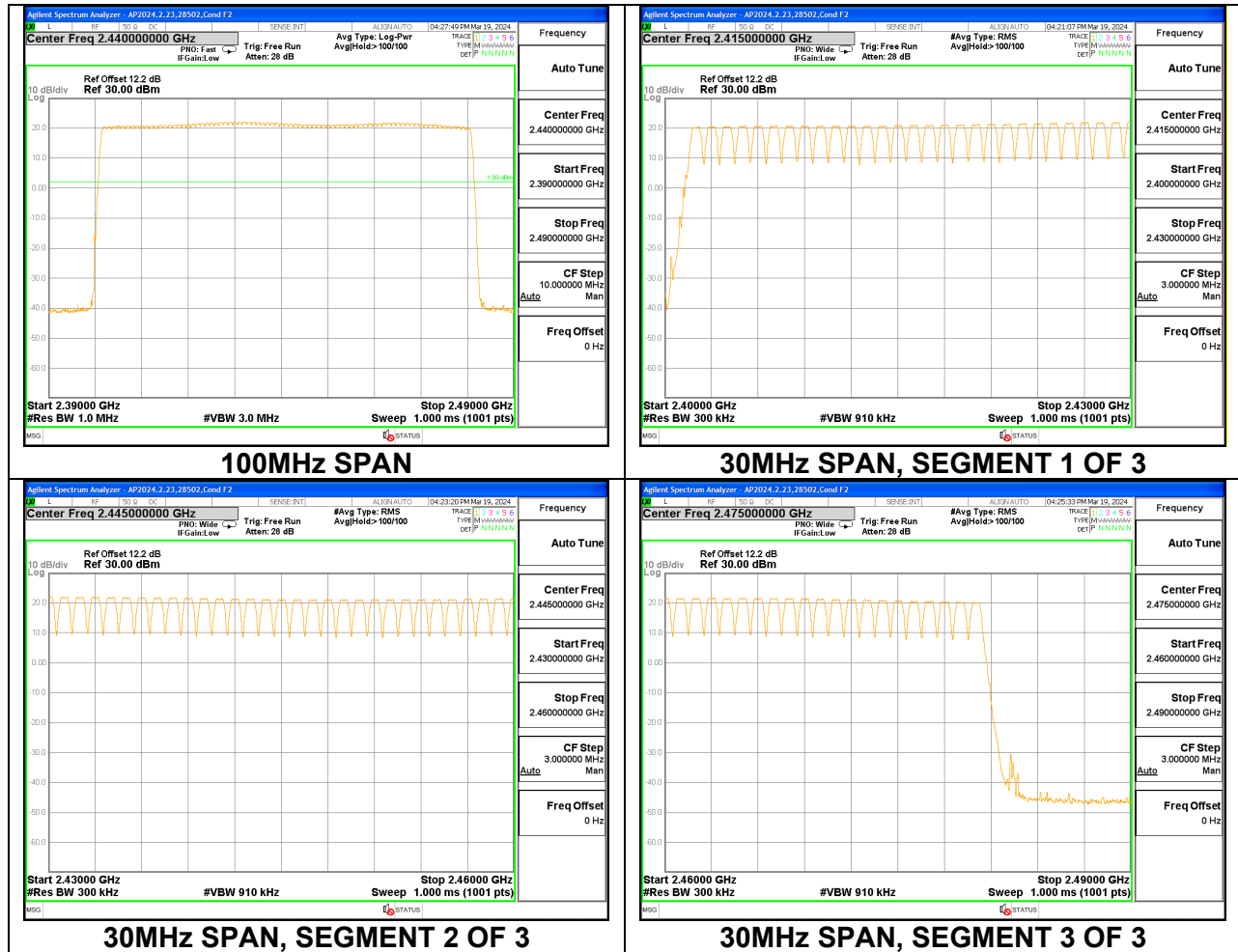
RESULTS

Normal Mode: 79 Channels Observed. Only High-Power GFSK mode result is reported since EDR (QPSK/8PSK) has exact same channel plan.

9.4.1. HIGH POWER BASIC DATA RATE GFSK MODULATION

ANT 4



ANT 3

9.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

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.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

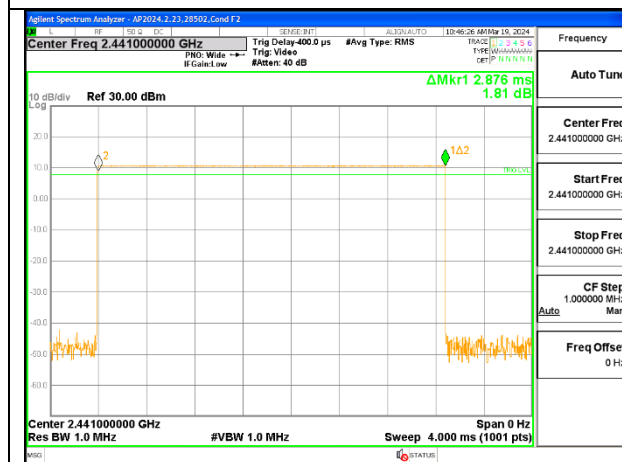
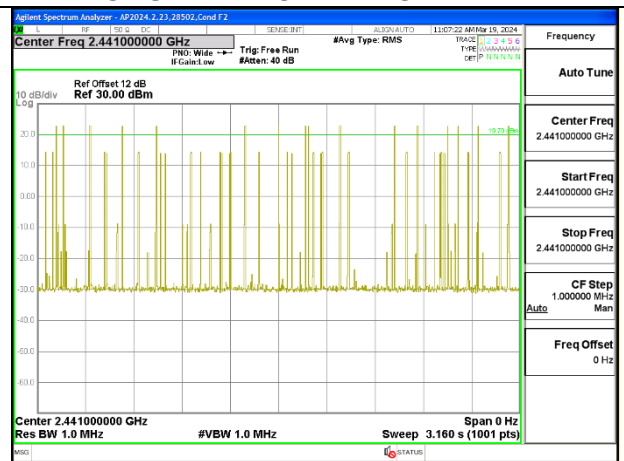
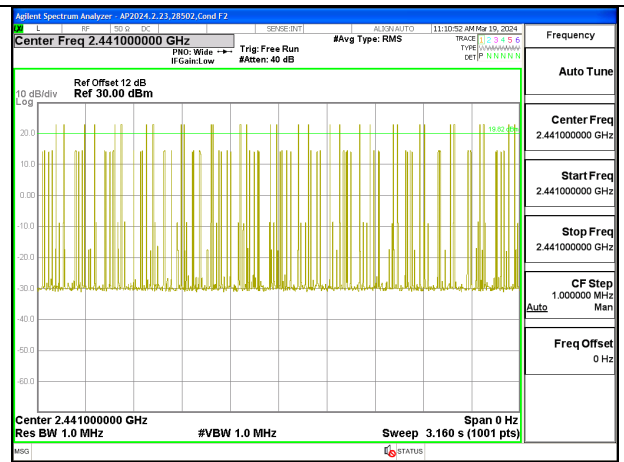
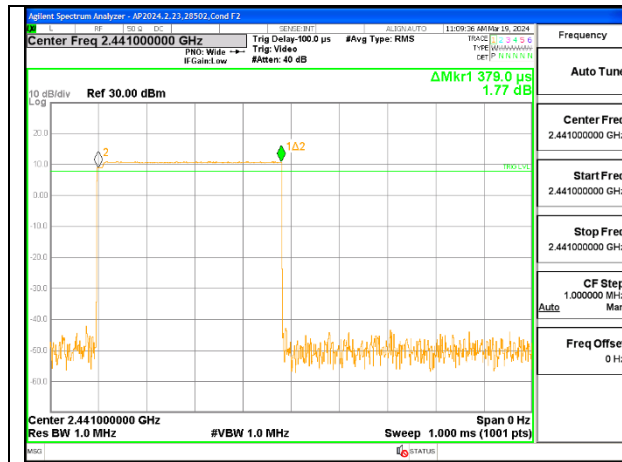
RESULTS

Only High-Power GFSK mode result is reported since EDR (QPSK/8PSK) has exact same timing.

9.5.1. HIGH POWER BASIC DATA RATE GFSK MODULATION

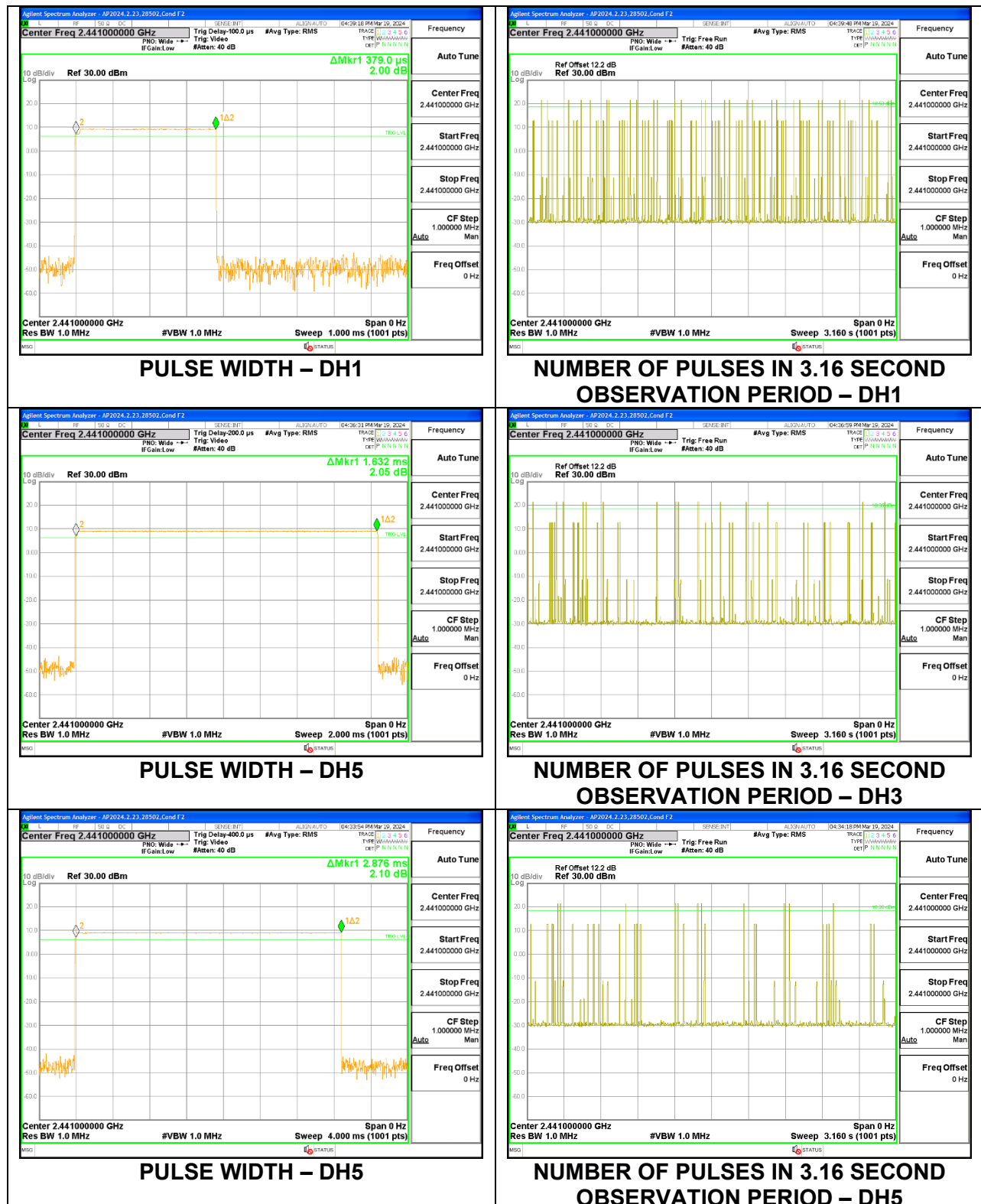
ANT 4

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|------------------|--------------------|----------------------------------|---------------------------------|-------------|--------------|
| GFSK Normal Mode | | | | | |
| DH1 | 0.379 | 30 | 0.114 | 0.4 | -0.286 |
| DH3 | 1.632 | 15 | 0.245 | 0.4 | -0.155 |
| DH5 | 2.876 | 12 | 0.345 | 0.4 | -0.055 |
| | | | | | |
| DH Packet | Pulse Width (sec) | Number of Pulses in 0.8 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
| GFSK AFH Mode | | | | | |
| DH1 | 0.379 | 7.5 | 0.028 | 0.4 | -0.372 |
| DH3 | 1.632 | 3.75 | 0.061 | 0.4 | -0.339 |
| DH5 | 2.876 | 3 | 0.086 | 0.4 | -0.314 |



ANT 3

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|------------------|--------------------|----------------------------------|---------------------------------|-------------|--------------|
| GFSK Normal Mode | | | | | |
| DH1 | 0.379 | 30 | 0.114 | 0.4 | -0.286 |
| DH3 | 1.632 | 15 | 0.245 | 0.4 | -0.155 |
| DH5 | 2.876 | 11 | 0.316 | 0.4 | -0.084 |
| | | | | | |
| DH Packet | Pulse Width (sec) | Number of Pulses in 0.8 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
| GFSK AFH Mode | | | | | |
| DH1 | 0.379 | 7.5 | 0.028 | 0.4 | -0.372 |
| DH3 | 1.632 | 3.75 | 0.061 | 0.4 | -0.339 |
| DH5 | 2.876 | 2.75 | 0.079 | 0.4 | -0.321 |



9.6. OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm. 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.

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

TEST PROCEDURE

Measurements perform using a wideband RF power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband peak power sensor. Peak output power was read directly from the power meter.

DIRECTIONAL ANTENNA GAIN

For 1 TX:

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

For 2 TX:

Tx chains are correlated for power due to the device supporting Beamforming. The directional gains are as follows:

| Band (GHz) | ANT 4 Antenna Gain (dBi) | ANT 3 Antenna Gain (dBi) | Uncorrelated Chains Directional Gain (dBi) | Correlated Chains Directional Gain (dBi) |
|---------------|-----------------------------------|-----------------------------------|---|---|
| 2.4 | -2.00 | -1.70 | -1.85 | 1.16 |

DIRECTIONAL GAIN CALCULATION:

ANSI C63.10-2013 section 14.4.3

Uncorrelated directional gain= $10 \cdot \text{LOG}((10^{(\text{Ant1}/10)} + 10^{(\text{Ant2}/10)})/2)$

Correlated directional Gain= $10 \cdot \text{LOG}(((10^{(\text{Ant1}/20)} + 10^{(\text{Ant2}/20)})^2)/2)$

Sample Calculation:

Ant4=-2.0, Ant3=-1.70

Uncorrelated Antenna gain= $10 \log[(10^{(-2.0/10)} + 10^{(-1.7/10)})/2] = -1.85 \text{dBi}$

Correlated Antenna gain= $10 \log[(10^{(-2.0/20)} + 10^{(-1.7/20)})^2/2] = 1.16$

RESULTS

9.6.1. HIGH POWER BASIC DATA RATE GFSK MODULATION**ANT 4**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 20.32 | 21 | -0.68 |
| Middle | 2441 | 20.23 | 21 | -0.77 |
| High | 2480 | 20.10 | 21 | -0.9 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 20.16 | 21 | -0.84 |
| Middle | 2441 | 20.25 | 21 | -0.75 |
| High | 2480 | 20.21 | 21 | -0.79 |

9.6.2. HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION**ANT 4 + ANT 3**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power ANT 4 (dBm) | Output Power ANT 3 (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|--------------------------------|--------------------------------|----------------------|----------------|----------------|
| Low | 2402 | 17.12 | 17.24 | 20.19 | 21 | -0.81 |
| Middle | 2441 | 17.29 | 17.29 | 20.30 | 21 | -0.70 |
| High | 2480 | 17.11 | 17.19 | 20.16 | 21 | -0.84 |

9.6.3. HIGH POWER ENHANCED DATA RATE QPSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 18.81 | 21 | -2.19 |
| Middle | 2441 | 18.94 | 21 | -2.06 |
| High | 2480 | 18.91 | 21 | -2.09 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 18.99 | 21 | -2.01 |
| Middle | 2441 | 18.90 | 21 | -2.1 |
| High | 2480 | 18.98 | 21 | -2.02 |

9.6.4. HIGH POWER ENHANCED DATA RATE TXBF QPSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power ANT 4 (dBm) | Output Power ANT 3 (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|--------------------------------|--------------------------------|----------------------|----------------|----------------|
| Low | 2402 | 15.87 | 15.87 | 18.88 | 21 | -2.12 |
| Middle | 2441 | 15.72 | 15.63 | 18.69 | 21 | -2.31 |
| High | 2480 | 15.77 | 15.82 | 18.81 | 21 | -2.19 |

9.6.5. HIGH POWER ENHANCED DATA RATE 8PSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 19.02 | 21 | -1.98 |
| Middle | 2441 | 19.12 | 21 | -1.88 |
| High | 2480 | 19.13 | 21 | -1.87 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 19.15 | 21 | -1.85 |
| Middle | 2441 | 18.94 | 21 | -2.06 |
| High | 2480 | 19.09 | 21 | -1.91 |

9.6.6. HIGH POWER ENHANCED DATA RATE TXBF 8PSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power ANT 4 (dBm) | Output Power ANT 3 (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|--------------------------------|--------------------------------|----------------------|----------------|----------------|
| Low | 2402 | 16.1 | 16.15 | 19.14 | 21 | -1.86 |
| Middle | 2441 | 16.05 | 16.15 | 19.11 | 21 | -1.89 |
| High | 2480 | 16.05 | 16.07 | 19.07 | 21 | -1.93 |

9.6.7. LOW POWER BASIC DATA RATE GFSK MODULATION**ANT 4**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 11.78 | 21 | -9.22 |
| Middle | 2441 | 11.80 | 21 | -9.2 |
| High | 2480 | 11.68 | 21 | -9.32 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 11.25 | 21 | -9.75 |
| Middle | 2441 | 11.33 | 21 | -9.67 |
| High | 2480 | 11.31 | 21 | -9.69 |

9.6.8. LOW POWER BASIC DATA RATE TXBF GFSK MODULATION**ANT 4 + ANT 3**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power ANT 4 (dBm) | Output Power ANT 3 (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|--------------------------------|--------------------------------|----------------------|----------------|----------------|
| Low | 2402 | 11.84 | 11.13 | 14.51 | 21 | -6.49 |
| Middle | 2441 | 11.77 | 11.38 | 14.59 | 21 | -6.41 |
| High | 2480 | 11.9 | 11.33 | 14.63 | 21 | -6.37 |

9.6.9. LOW POWER ENHANCED DATA RATE QPSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 9.38 | 21 | -11.62 |
| Middle | 2441 | 9.37 | 21 | -11.63 |
| High | 2480 | 9.39 | 21 | -11.61 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 9.38 | 21 | -11.62 |
| Middle | 2441 | 9.44 | 21 | -11.56 |
| High | 2480 | 9.47 | 21 | -11.53 |

9.6.10. LOW POWER ENHANCED DATA RATE TXBF QPSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power ANT 4 (dBm) | Output Power ANT 3 (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|--------------------------------|--------------------------------|----------------------|----------------|----------------|
| Low | 2402 | 9.41 | 9.45 | 12.44 | 21 | -8.56 |
| Middle | 2441 | 9.46 | 9.43 | 12.46 | 21 | -8.54 |
| High | 2480 | 9.44 | 9.45 | 12.46 | 21 | -8.54 |

9.6.11. LOW POWER ENHANCED DATA RATE 8PSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 9.65 | 21 | -11.35 |
| Middle | 2441 | 9.58 | 21 | -11.42 |
| High | 2480 | 9.60 | 21 | -11.4 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low | 2402 | 9.53 | 21 | -11.47 |
| Middle | 2441 | 9.58 | 21 | -11.42 |
| High | 2480 | 9.66 | 21 | -11.34 |

9.6.12. LOW POWER ENHANCED DATA RATE TXBF 8PSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Output Power ANT 4 (dBm) | Output Power ANT 3 (dBm) | Total Power (dBm) | Limit (dBm) | Margin (dB) |
|---------|--------------------|--------------------------------|--------------------------------|----------------------|----------------|----------------|
| Low | 2402 | 9.57 | 9.63 | 12.61 | 21 | -8.39 |
| Middle | 2441 | 9.65 | 9.55 | 12.61 | 21 | -8.39 |
| High | 2480 | 9.61 | 9.60 | 12.62 | 21 | -8.38 |

9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband RF power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

RESULTS

9.7.1. HIGH POWER BASIC DATA RATE GFSK MODULATION**ANT 4**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 20.00 |
| Middle | 2441 | 19.92 |
| High | 2480 | 19.78 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 19.85 |
| Middle | 2441 | 19.93 |
| High | 2480 | 19.89 |

9.7.2. HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION**ANT 4 + ANT 3**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power ANT 4 (dBm) | Average Power ANT 3 (dBm) | Total Power (dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low | 2402 | 16.82 | 16.93 | 19.89 |
| Middle | 2441 | 16.99 | 16.98 | 20.00 |
| High | 2480 | 16.81 | 16.89 | 19.86 |

9.7.3. HIGH POWER ENHANCED DATA RATE QPSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 16.40 |
| Middle | 2441 | 16.49 |
| High | 2480 | 16.47 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 16.49 |
| Middle | 2441 | 16.39 |
| High | 2480 | 16.46 |

9.7.4. HIGH POWER BASIC DATA RATE TXBF QPSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power ANT 4 (dBm) | Average Power ANT 3 (dBm) | Total Power (dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low | 2402 | 13.39 | 13.36 | 16.39 |
| Middle | 2441 | 13.24 | 13.13 | 16.20 |
| High | 2480 | 13.27 | 13.32 | 16.31 |

9.7.5. HIGH POWER ENHANCED DATA RATE 8PSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 16.37 |
| Middle | 2441 | 16.47 |
| High | 2480 | 16.48 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 16.50 |
| Middle | 2441 | 16.28 |
| High | 2480 | 16.43 |

9.7.6. HIGH POWER BASIC DATA RATE TXBF 8PSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power ANT 4 (dBm) | Average Power ANT 3 (dBm) | Total Power (dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low | 2402 | 13.46 | 13.49 | 16.49 |
| Middle | 2441 | 13.40 | 13.48 | 16.45 |
| High | 2480 | 13.39 | 13.42 | 16.42 |

9.7.7. LOW POWER BASIC DATA RATE GFSK MODULATION**ANT 4**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 11.48 |
| Middle | 2441 | 11.47 |
| High | 2480 | 11.30 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 10.85 |
| Middle | 2441 | 10.95 |
| High | 2480 | 10.92 |

9.7.8. LOW POWER BASIC DATA RATE TXBF GFSK MODULATION**ANT 4 + ANT 3**

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power ANT 4 (dBm) | Average Power ANT 3 (dBm) | Total Power (dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low | 2402 | 11.44 | 10.73 | 14.11 |
| Middle | 2441 | 11.38 | 10.99 | 14.20 |
| High | 2480 | 11.50 | 10.93 | 14.23 |

9.7.9. LOW POWER ENHANCED DATA RATE QPSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 6.91 |
| Middle | 2441 | 6.90 |
| High | 2480 | 6.92 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 6.91 |
| Middle | 2441 | 6.95 |
| High | 2480 | 7.00 |

9.7.10. LOW POWER BASIC DATA RATE TXBF QPSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power ANT 4 (dBm) | Average Power ANT 3 (dBm) | Total Power (dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low | 2402 | 6.94 | 6.98 | 9.97 |
| Middle | 2441 | 6.99 | 6.96 | 9.99 |
| High | 2480 | 6.97 | 6.98 | 9.99 |

9.7.11. LOW POWER ENHANCED DATA RATE 8PSK MODULATION

ANT 4

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 7.00 |
| Middle | 2441 | 6.93 |
| High | 2480 | 6.94 |

ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power (dBm) |
|---------|--------------------|------------------------|
| Low | 2402 | 6.88 |
| Middle | 2441 | 6.92 |
| High | 2480 | 7.00 |

9.7.12. LOW POWER BASIC DATA RATE TXBF 8PSK MODULATION

ANT 4 + ANT 3

| | |
|------------|-----------|
| Tested By: | 28502 AY |
| Date: | 3/21/2024 |

| Channel | Frequency (MHz) | Average Power ANT 4 (dBm) | Average Power ANT 3 (dBm) | Total Power (dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low | 2402 | 6.91 | 6.98 | 9.96 |
| Middle | 2441 | 6.99 | 6.89 | 9.95 |
| High | 2480 | 6.95 | 6.94 | 9.96 |

9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

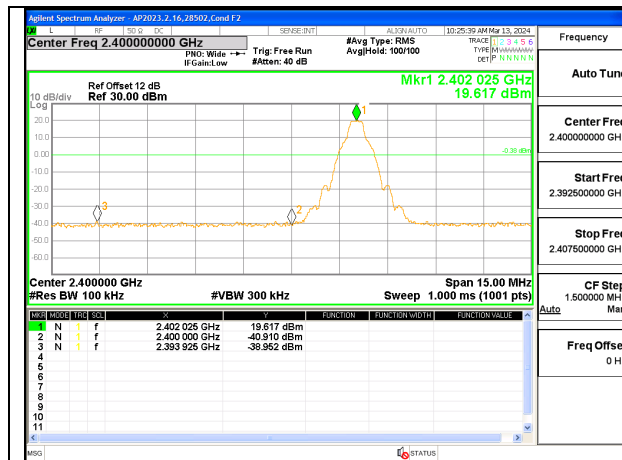
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The band edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

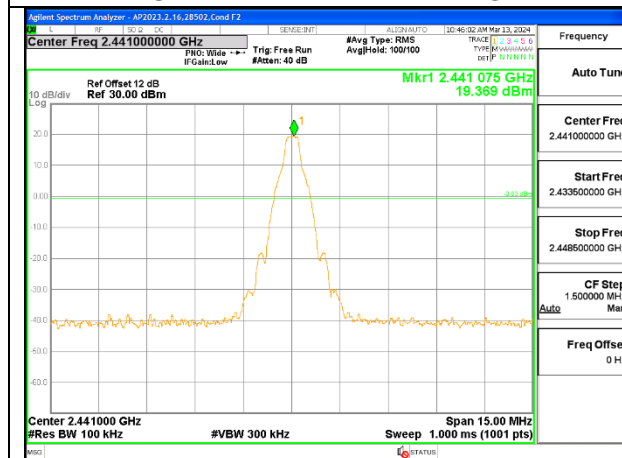
RESULTS

9.8.1. HIGH POWER BASIC DATA RATE GFSK MODULATION

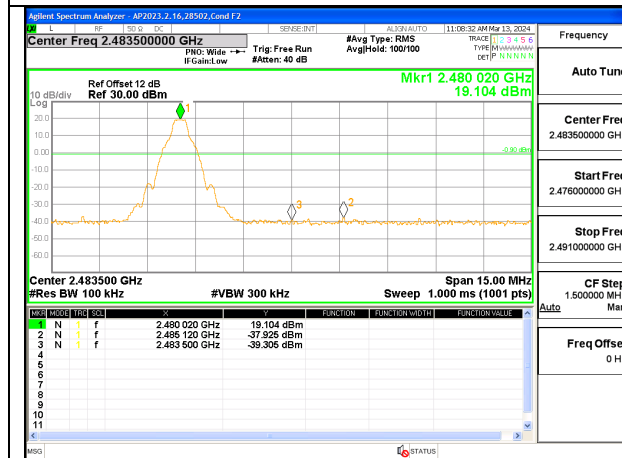
ANT 4 SPURIOUS EMISSIONS, NON-HOPPING



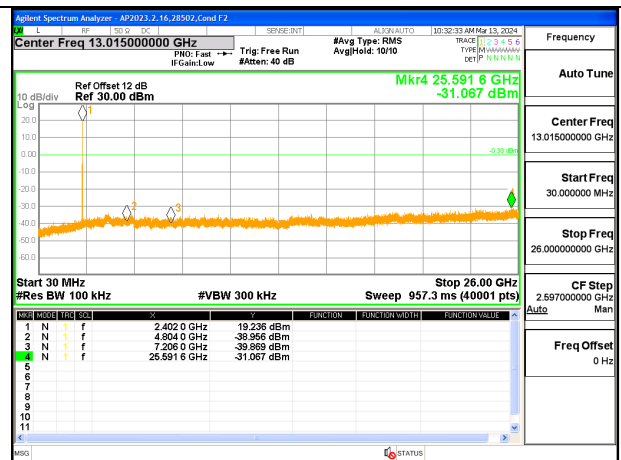
LOW CHANNEL BANDEDGE



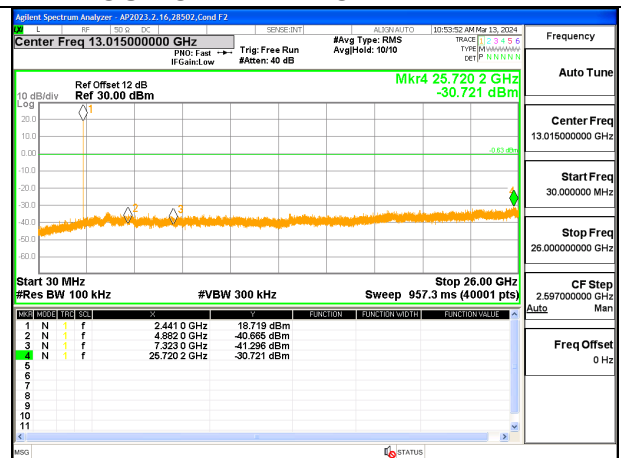
IN-BAND REFERENCE LEVEL



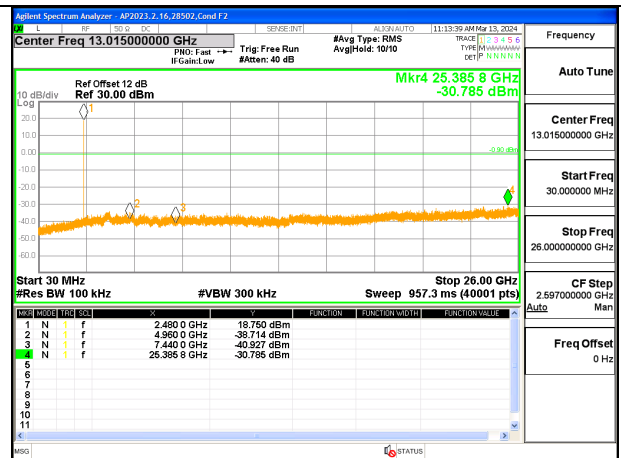
HIGH CHANNEL BANDEDGE



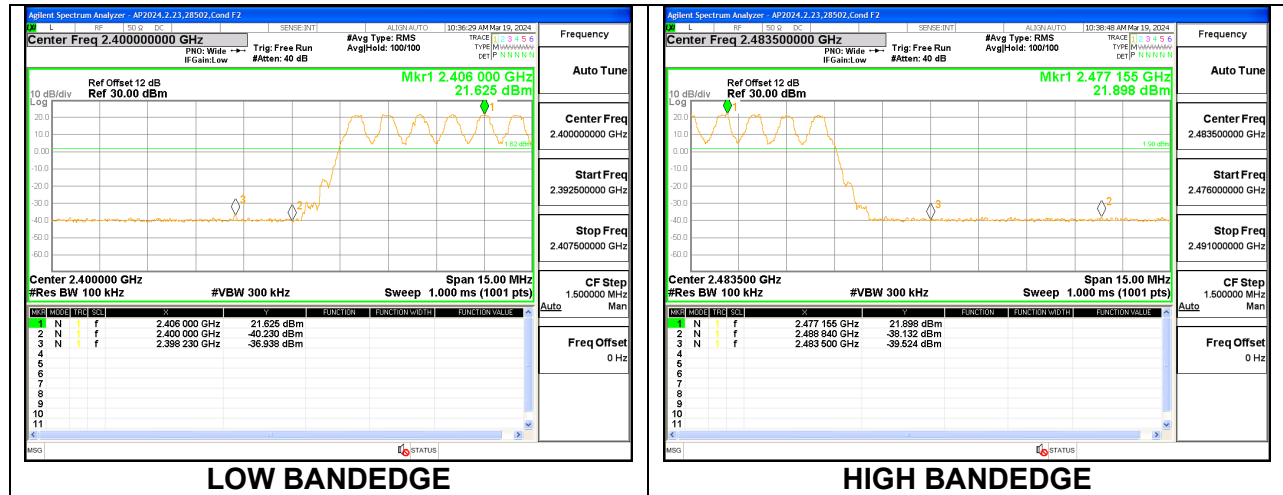
OUT-OF-BAND LOW CHANNEL

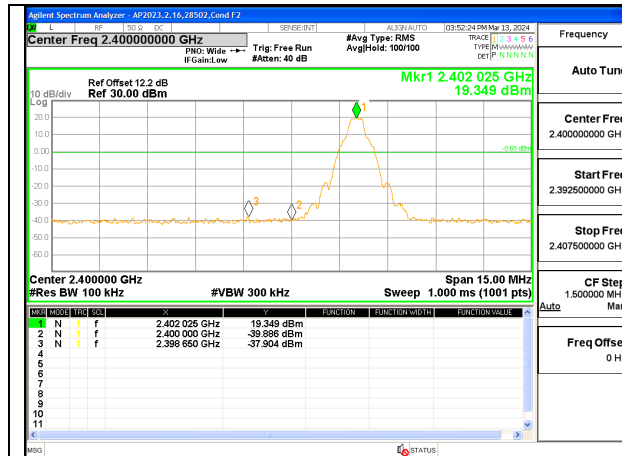
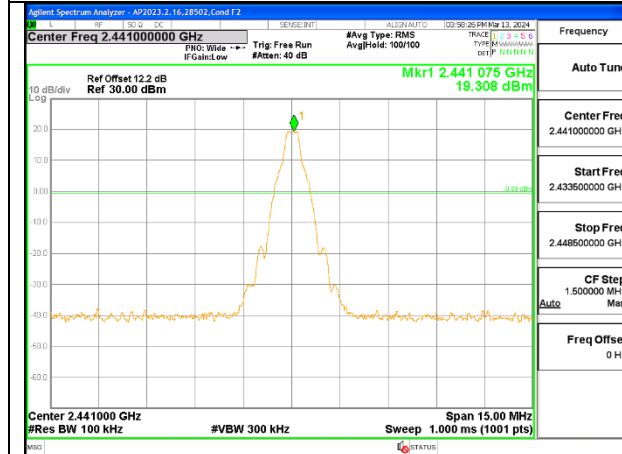
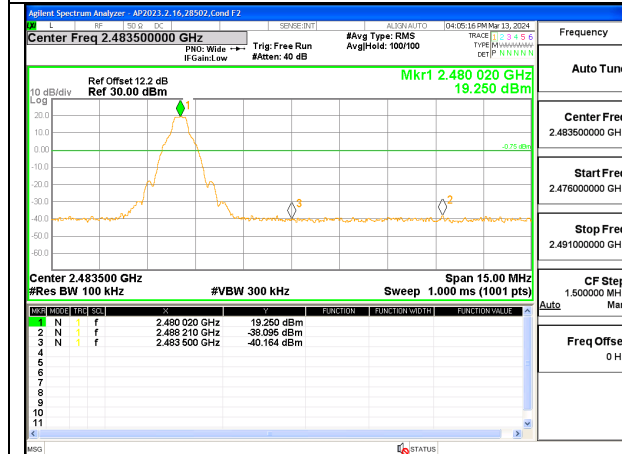
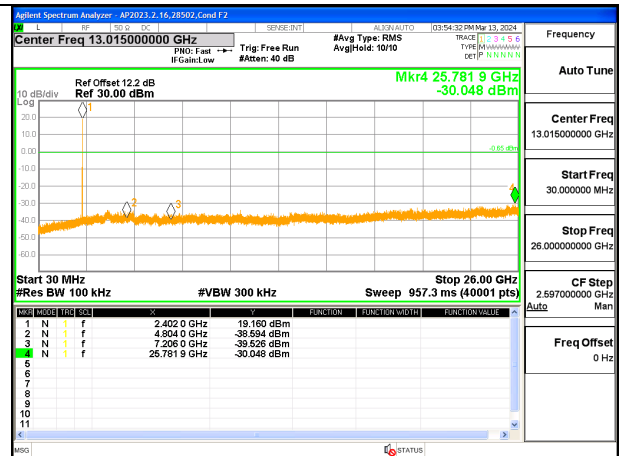
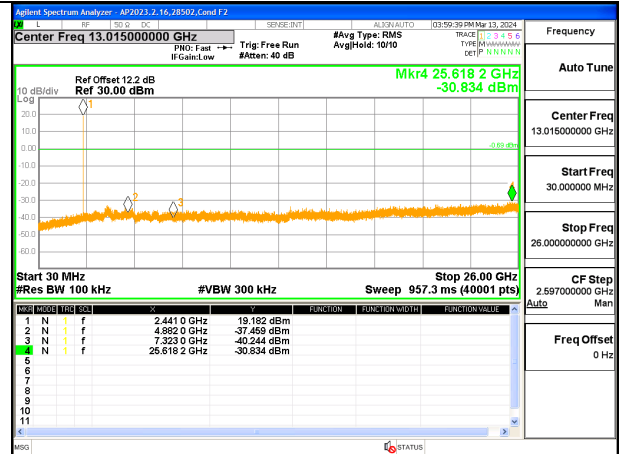
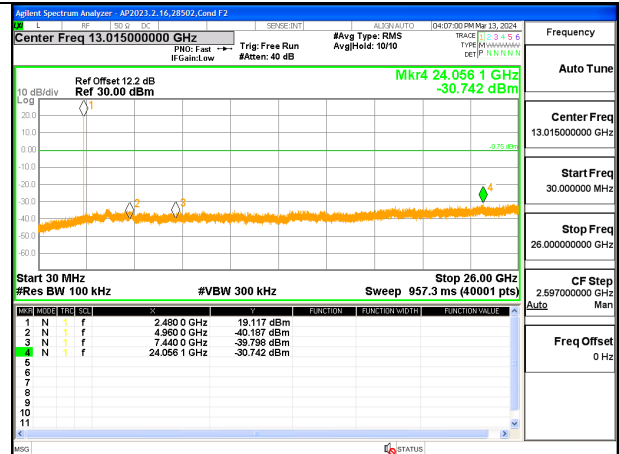


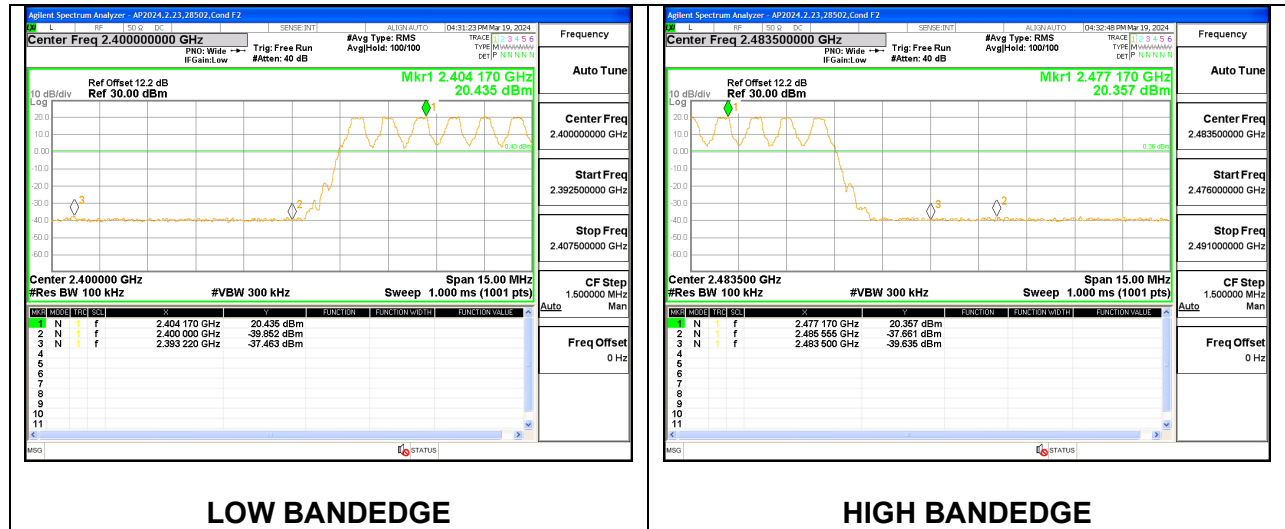
OUT-OF-BAND MID CHANNEL



OUT-OF-BAND HIGH CHANNEL

ANT 4 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

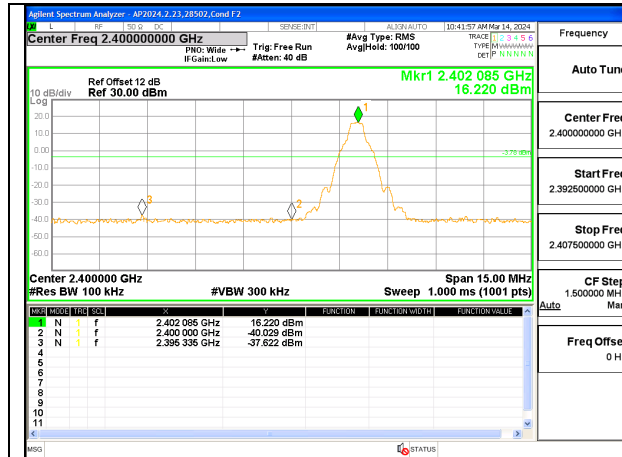
ANT 3 SPURIOUS EMISSIONS, NON-HOPPING**LOW CHANNEL BANDEDGE****IN-BAND REFERENCE LEVEL****HIGH CHANNEL BANDEDGE****OUT-OF-BAND LOW CHANNEL****OUT-OF-BAND MID CHANNEL****OUT-OF-BAND HIGH CHANNEL**

ANT 3 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

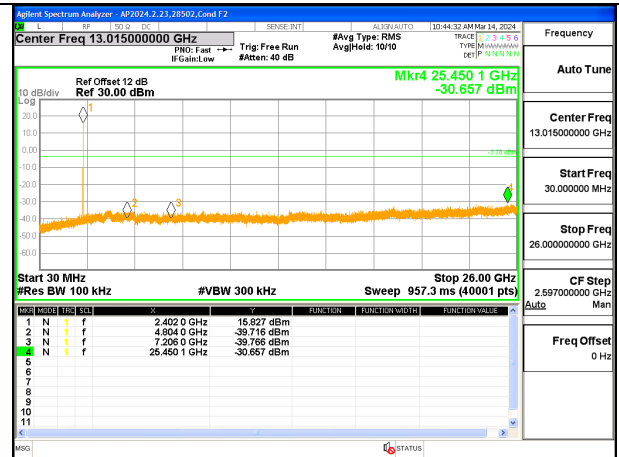
9.8.2. HIGH POWER BASIC DATA RATE TXBF GFSK MODULATION

Note: Test procedure on beamforming mode is same as BT basic and EDR mode

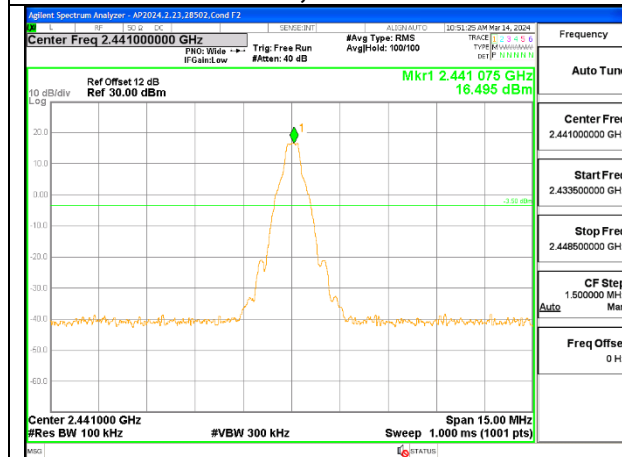
ANT 4



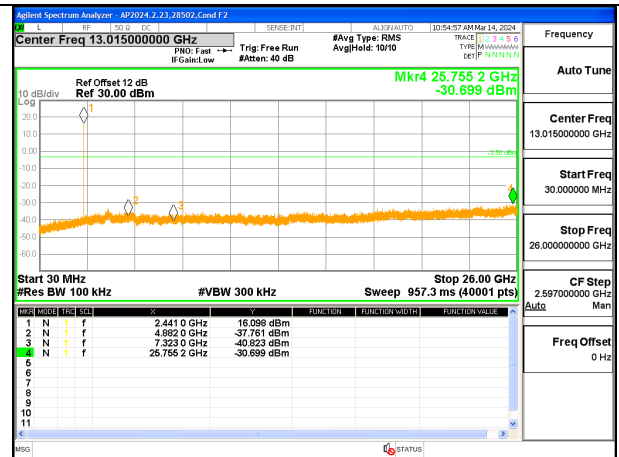
LOW CHANNEL, BANDEDGE ANT 4



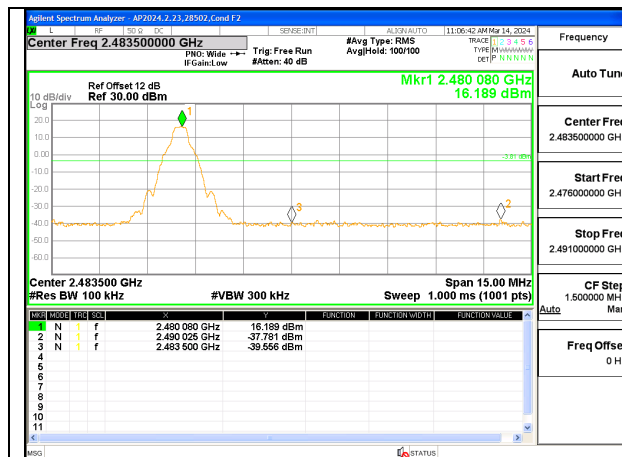
LOW CHANNEL OUT-OF-BAND ANT 4



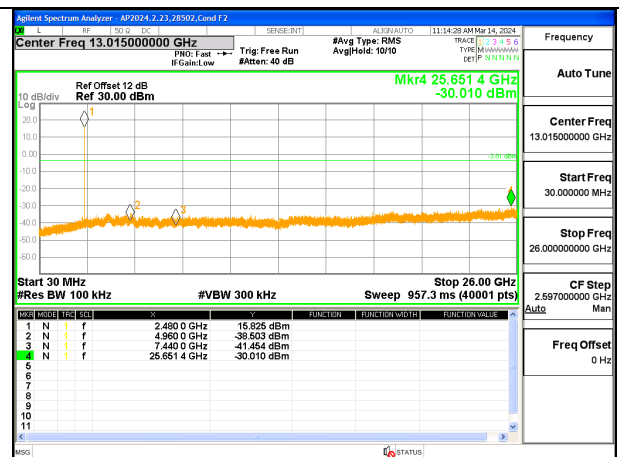
MID CHANNEL REFERENCE ANT 4



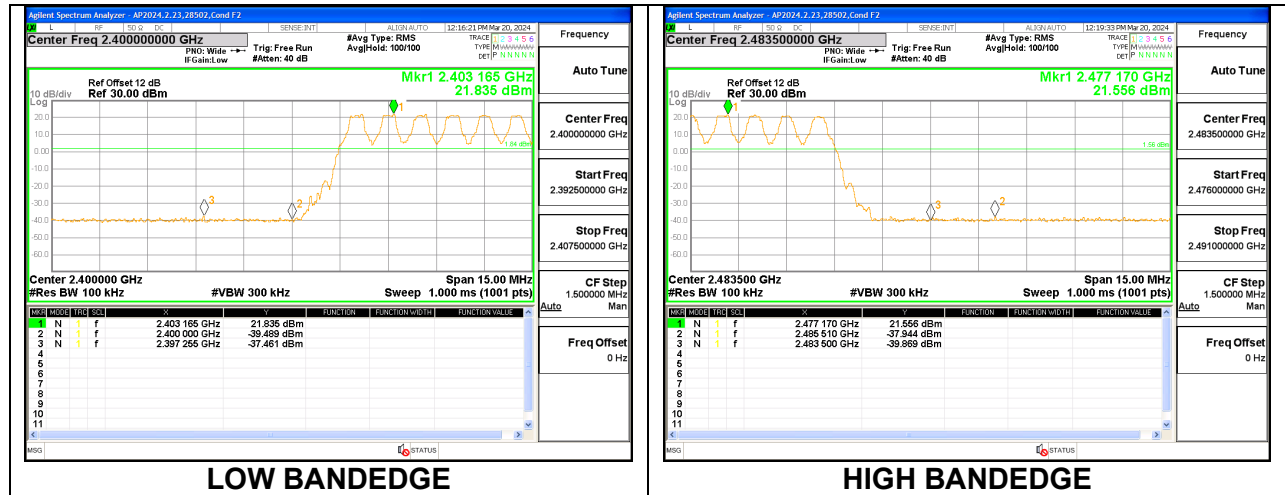
MID CHANNEL OUT-OF-BAND ANT 4

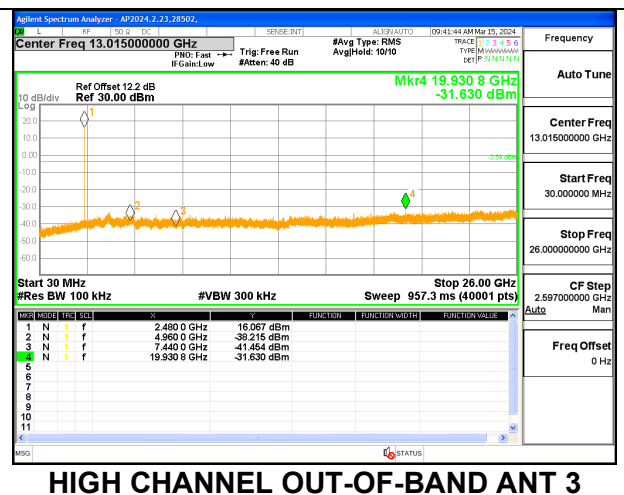
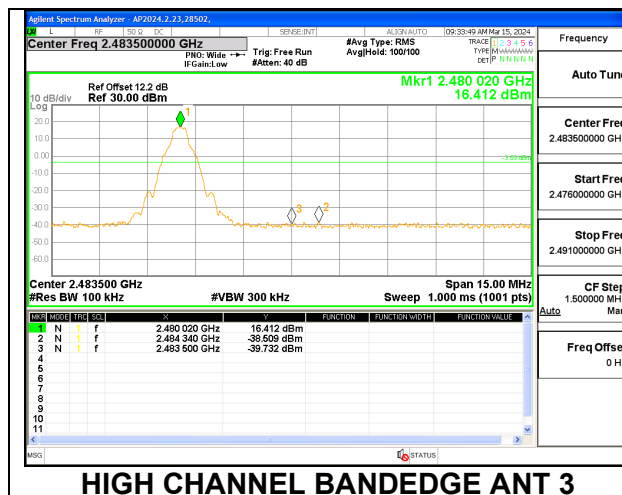
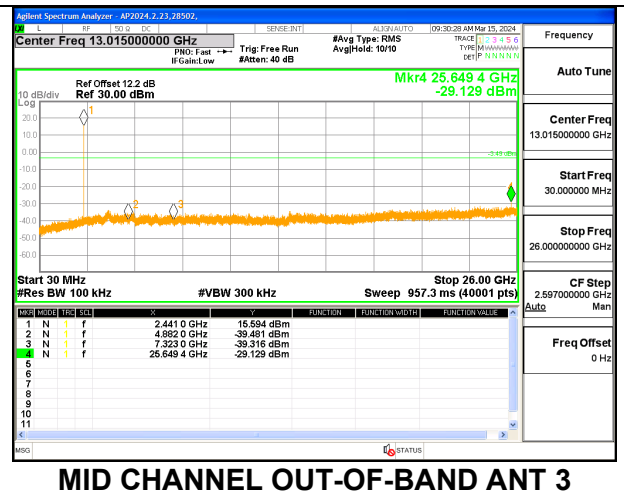
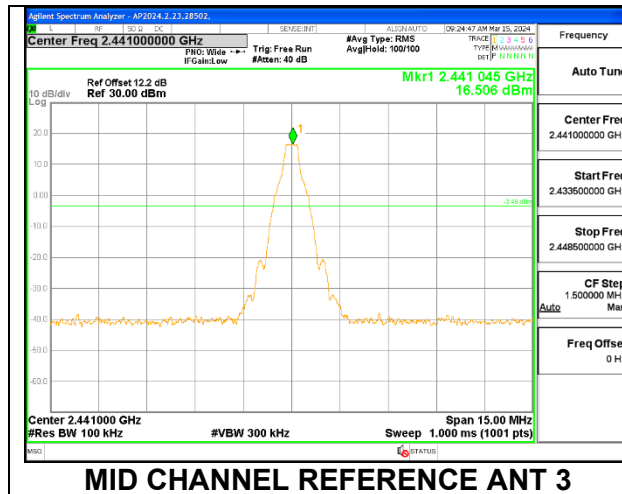
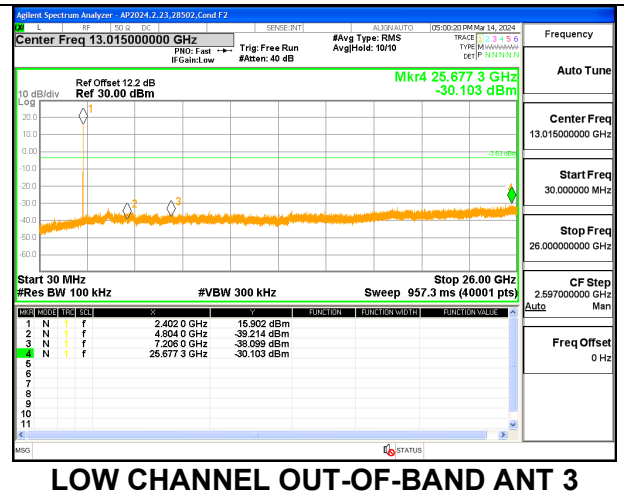
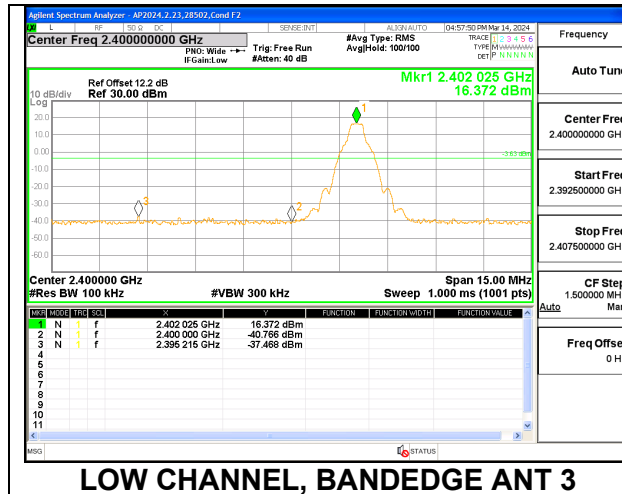


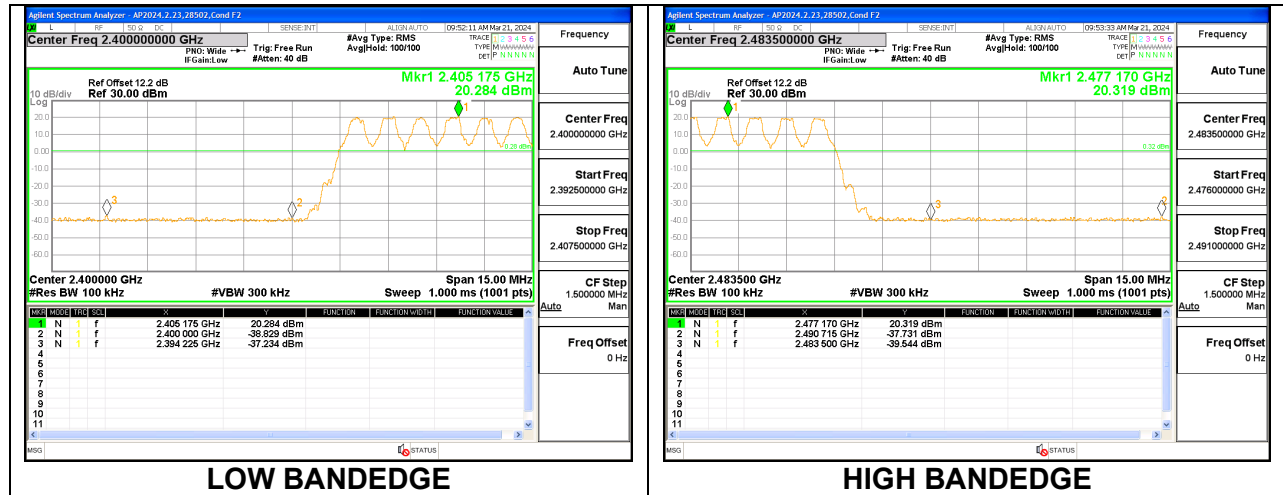
HIGH CHANNEL BANDEDGE ANT 4



HIGH CHANNEL OUT-OF-BAND ANT 4

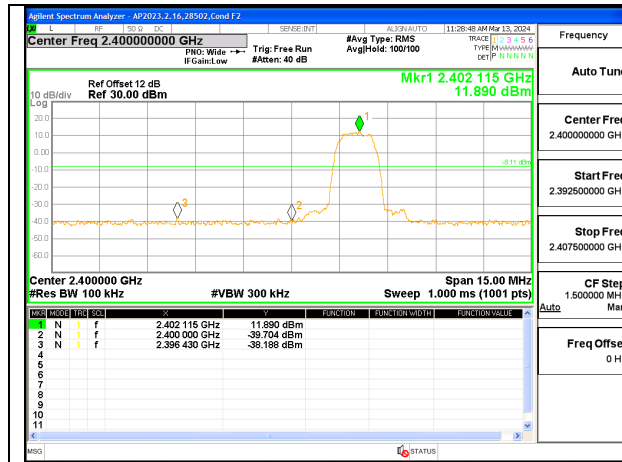
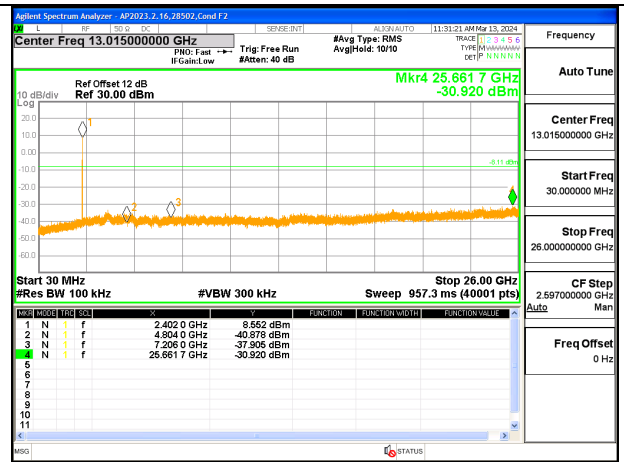
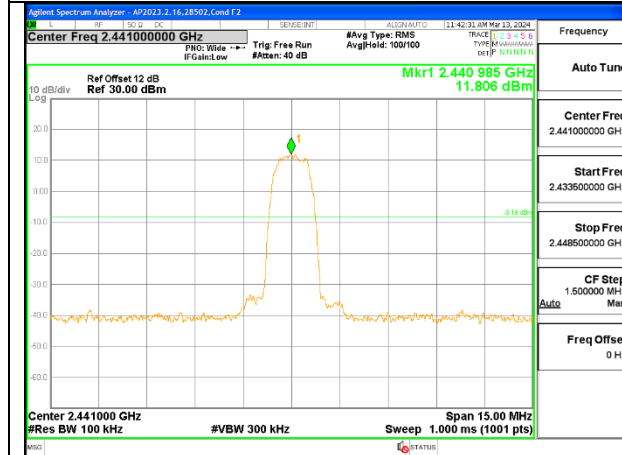
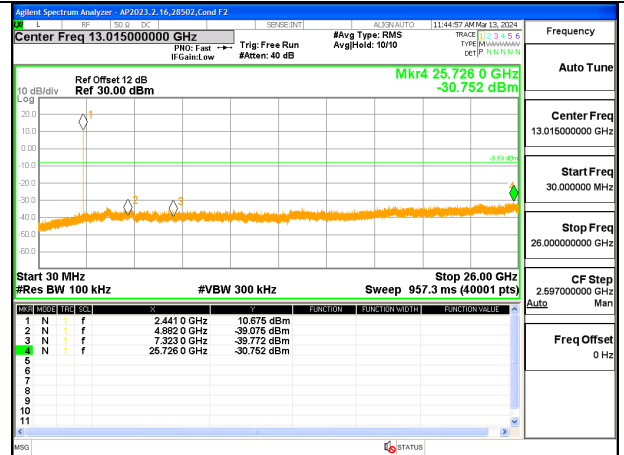
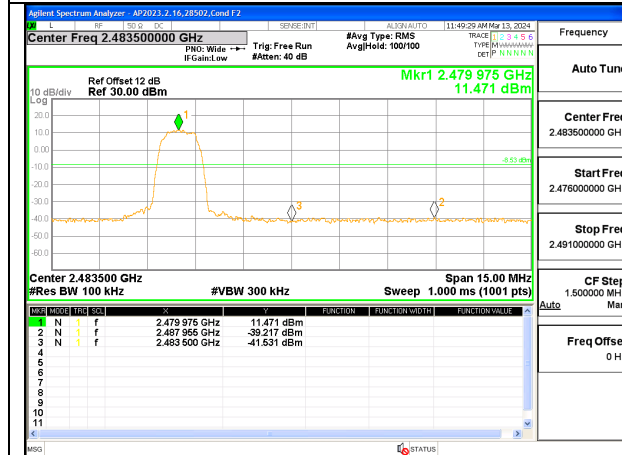
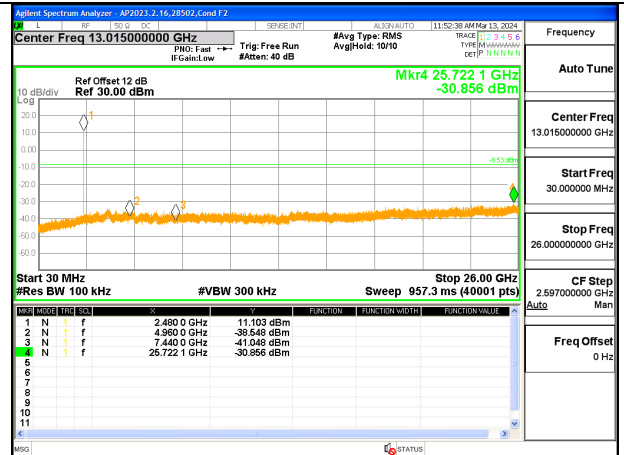
ANT 4 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

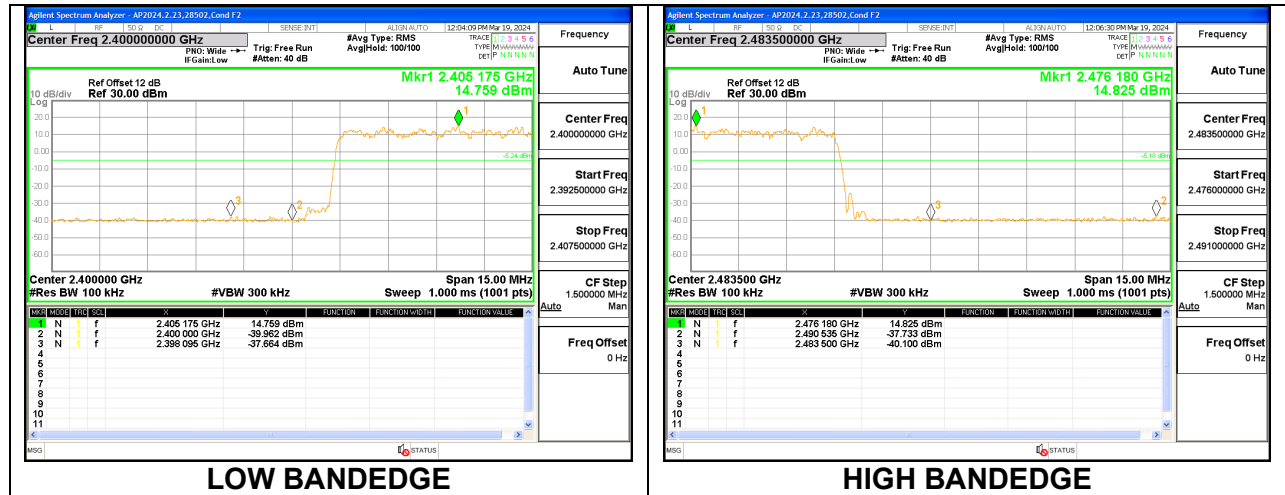
ANT 3

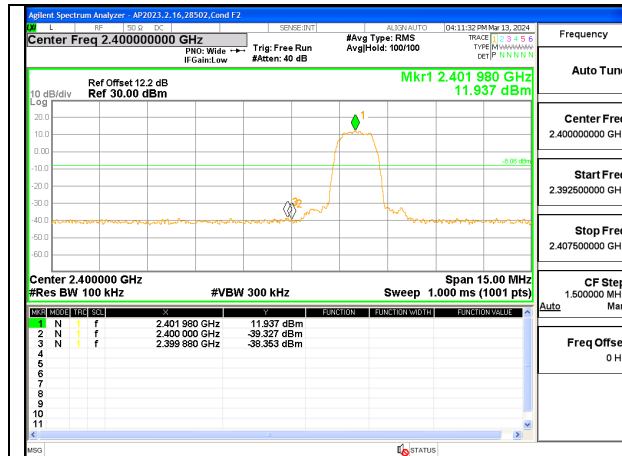
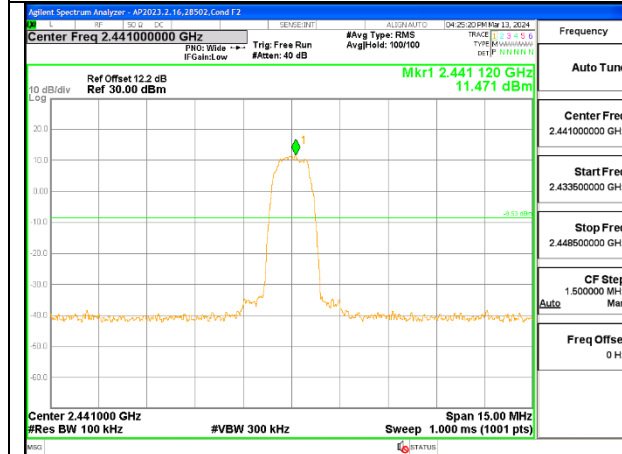
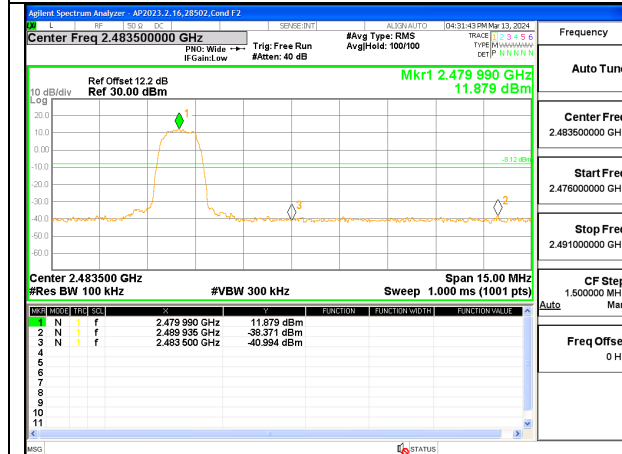
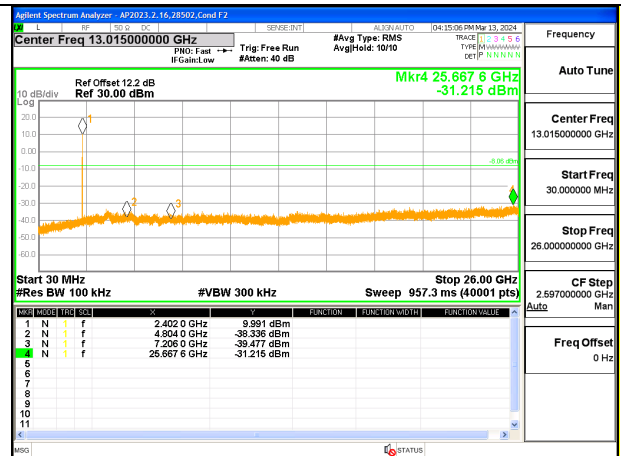
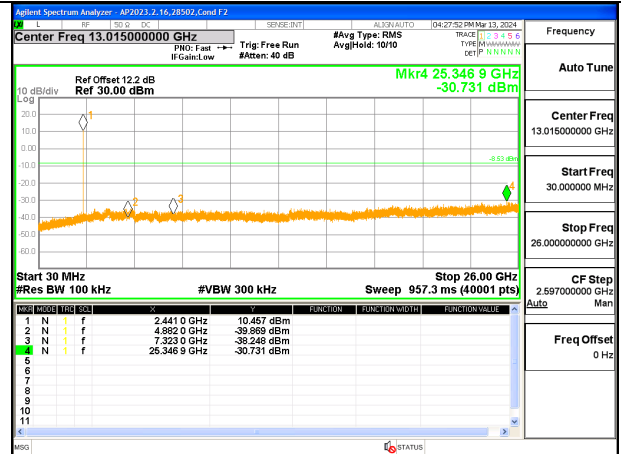
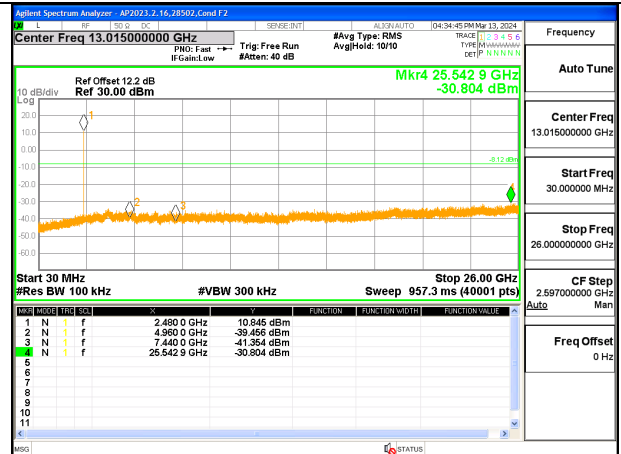
ANT 3 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

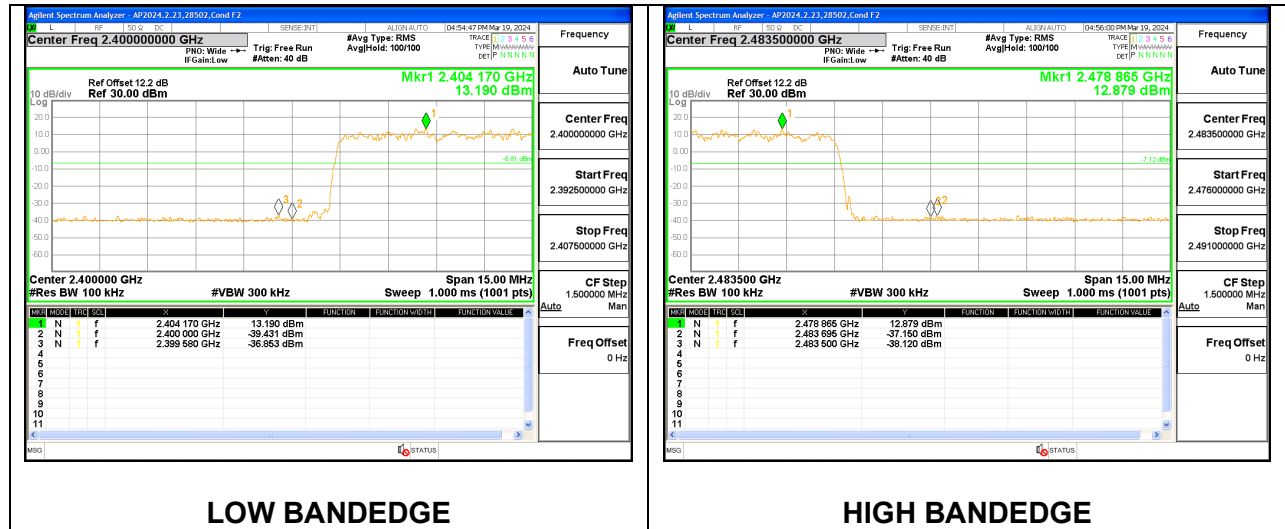
9.8.3. HIGH POWER ENHANCED DATA RATE 8PSK MODULATION

ANT 4 SPURIOUS EMISSIONS, NON-HOPPING

**LOW CHANNEL BANDEDGE****OUT-OF-BAND LOW CHANNEL****IN-BAND REFERENCE LEVEL****OUT-OF-BAND MID CHANNEL****HIGH CHANNEL BANDEDGE****OUT-OF-BAND HIGH CHANNEL**

ANT 4 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

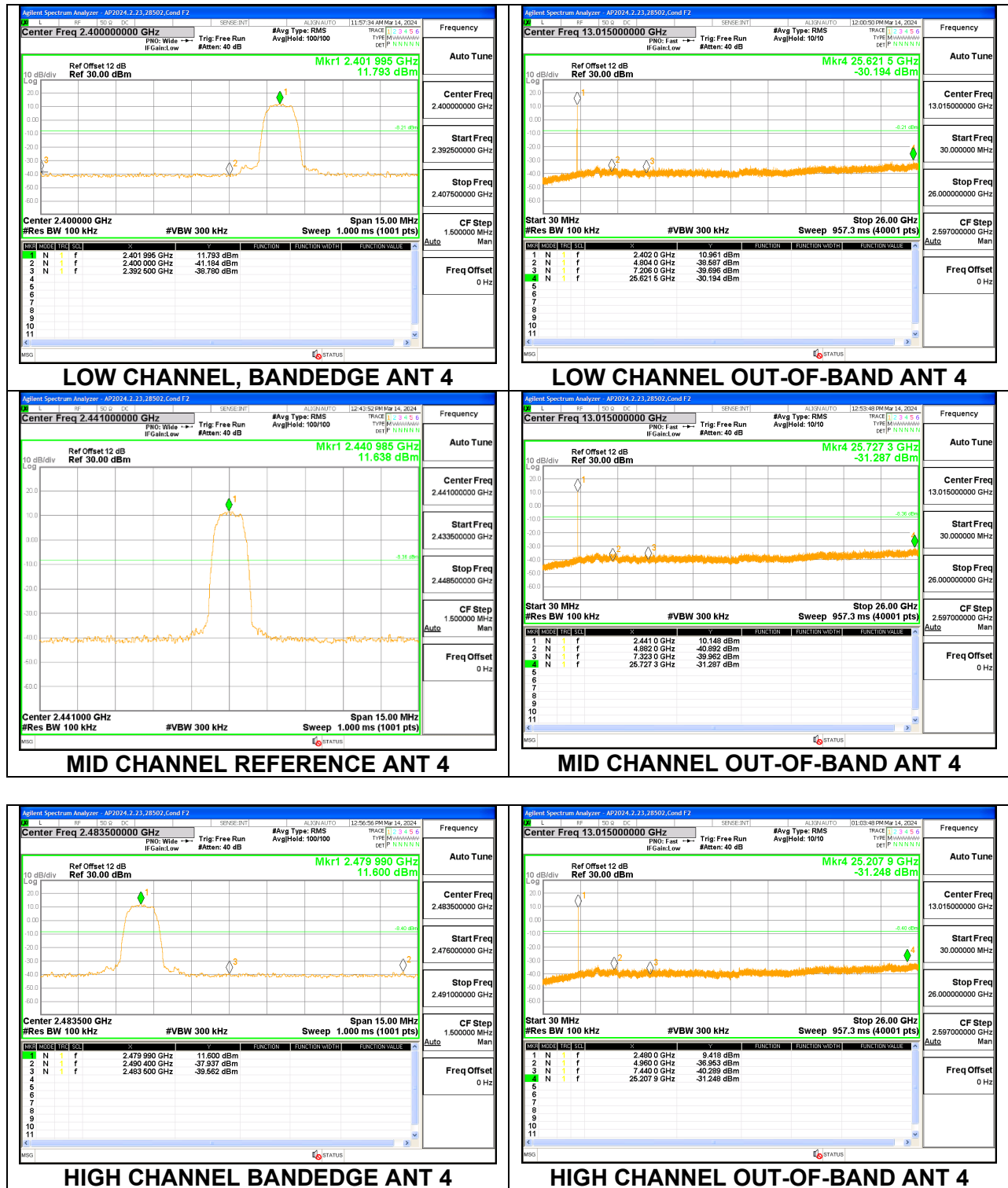
ANT 3 SPURIOUS EMISSIONS, NON-HOPPING**LOW CHANNEL BANDEDGE****IN-BAND REFERENCE LEVEL****HIGH CHANNEL BANDEDGE****OUT-OF-BAND LOW CHANNEL****OUT-OF-BAND MID CHANNEL****OUT-OF-BAND HIGH CHANNEL**

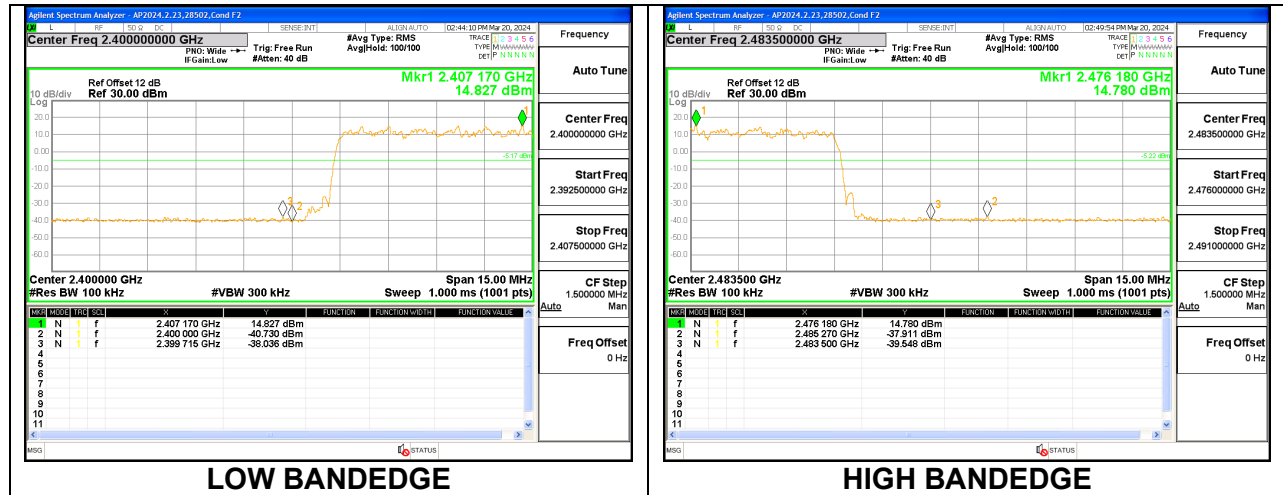
ANT 3 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

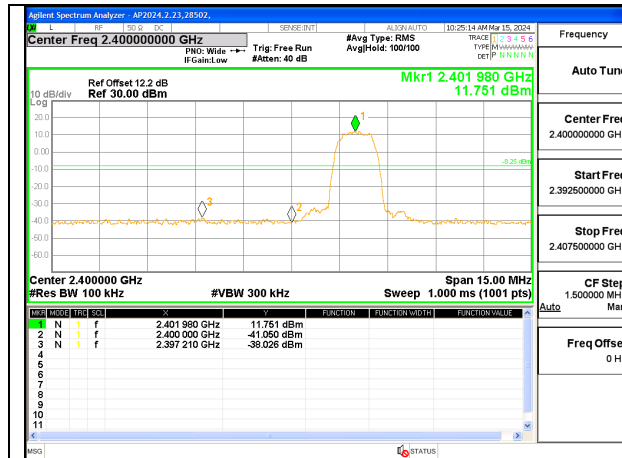
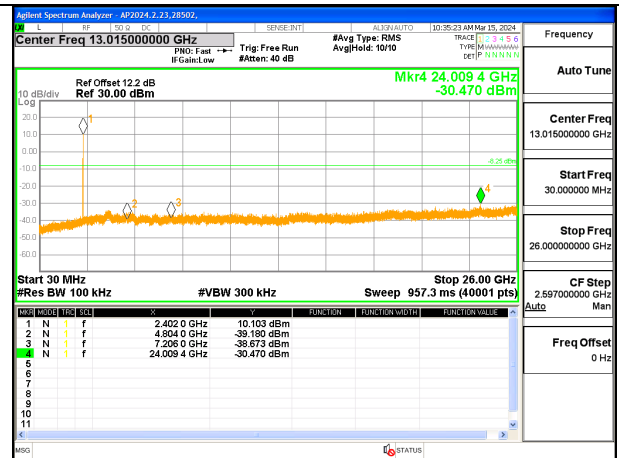
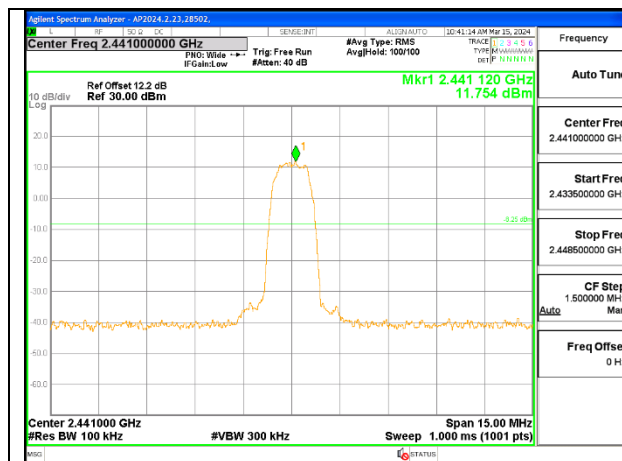
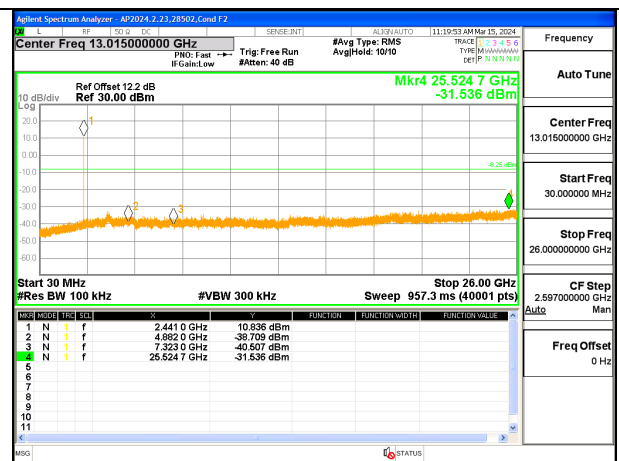
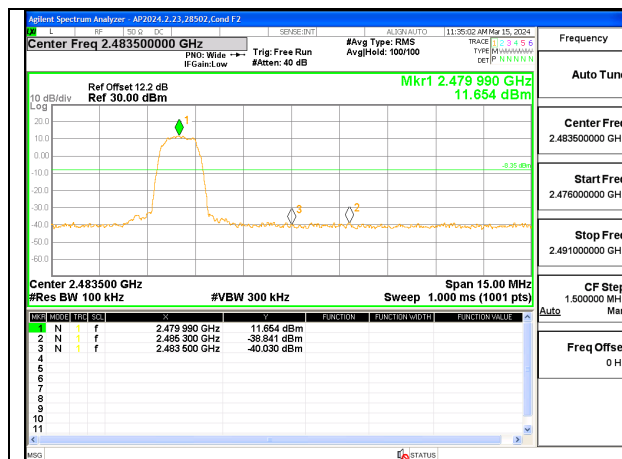
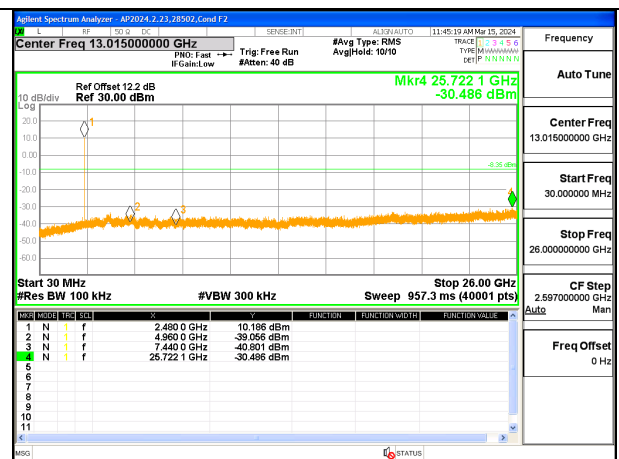
9.8.4. HIGH POWER BASIC DATA RATE TXBF 8PSK MODULATION

Note: Test procedure on beamforming mode is same as BT basic and EDR mode

ANT 4



ANT 4 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

ANT 3**LOW CHANNEL, BANDEDGE ANT 3****LOW CHANNEL OUT-OF-BAND ANT 3****MID CHANNEL REFERENCE ANT 3****MID CHANNEL OUT-OF-BAND ANT 3****HIGH CHANNEL BANDEDGE ANT 3****HIGH CHANNEL OUT-OF-BAND ANT 3**

ANT 3 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON