FCC Test Report

Report No.: AGC00213241002FR01

FCC ID	:	WSG-I15
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	Bluetooth Dongle
BRAND NAME	:	N/A
MODEL NAME	:	I15
APPLICANT	:	SKY WING Communication Electronics Co., Ltd
DATE OF ISSUE	:	Oct. 22, 2024
STANDARD(S)	:	FCC Part 15 Subpart C §15.247
REPORT VERSION	:	V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Oct. 22, 2024	Valid	Initial Release

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1. General Information

Applicant	SKY WING Communication Electronics Co., Ltd
Address	No.62, 10 Rd, Longyan, Humen Town, Dongguan City, Guangdong Province, China
Manufacturer	SKY WING Communication Electronics Co., Ltd
Address	No.62, 10 Rd, Longyan, Humen Town, Dongguan City, Guangdong Province, China
Factory	SKY WING Communication Electronics Co., Ltd
Address	No.62, 10 Rd, Longyan, Humen Town, Dongguan City, Guangdong Province, China
Product Designation	Bluetooth Dongle
Brand Name	N/A
Test Model	I15
Series Model(s)	N/A
Difference Description	N/A
Date of receipt of test item	Oct. 10, 2024
Date of Test	Oct. 10, 2024 to Oct. 22, 2024
Deviation from Standard	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Test Report Form No	AGCER-FCC-BR_EDR-V1

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

Prepared By	Thea Huang Thea Huang (Project Engineer)	Oct. 22, 2024
Reviewed By	Calvin Liu Calvin Liu (Reviewer)	Oct. 22, 2024
Approved By	Max Zhang Max Zhang (Authorized Officer)	Oct. 22, 2024

2. Product Information

2.1 Product Technical Description

Frequency Band	2400MHz-2483.5MHz
Operation Frequency Range	2402MHz-2480MHz
Bluetooth Version	V5.3
Modulation Type	BR ☒GFSK, EDR ☒π /4-DQPSK, ☒8DPSK
Number of channels	79 Channels
Channel Separation	1 MHz
Maximum Transmitter Power	1.089dBm
Hardware Version	V04
Software Version	V001
Antenna Designation	Ceramic Antenna
Antenna Gain	2.78dBi
Power Supply	DC 5V by PC

2.2 Test Frequency List

Frequency Band	Channel Number	Frequency
2400~2483.5MHz	0	2402 MHz
	1	2403 MHz
	:	:
	39	2441MHz
	:	:
	77	2479 MHz
	78	2480 MHz
Note: f = 2402 + 1k MHz, k = 0, …, 78 ; “f “is the operating frequency (MHz); “k“ is the operating channel.		

2.3 Related Submittal(S) / Grant (S)

This submittal(s) (test report) is intended for FCC ID: **WSG-I15,** filing to comply with Part 2, Part 15 of the Federal Communication Commission rules.

2.4 Test Methodology

The tests were performed according to following standards:

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules

2.5 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 multi slot 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.

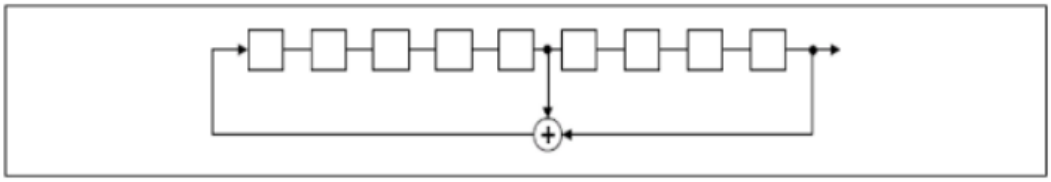
2.6 Equally Average Use of Frequencies and Behaviour.

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 behavior action with other units only offset is 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 bits 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 the Sequence. This will be done at the beginning of every new transmission.
Regarding short transmissions the Bluetooth system has the following behavior:
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.

2.7 Pseudorandom Frequency Hopping Sequence

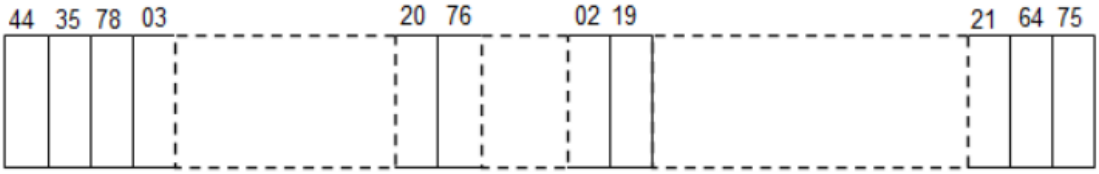
The pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONEs; i.e. the shift register is initialized with nine ones.

- Number of shift register stages: 9
- Length of pseudo-random sequence: 29 - 1 = 511 bits
- Longest sequence of zeros: 8 (non-inverted signal)



Linear Feedback Shift Register for Generation of The PRBS Sequence

An example of Pseudorandom Frequency Hopping Sequence as follow:



Each frequency used equally on the average by each transmitter.

The system receivers have input bandwidths that match the hopping channel bandwidths of their Corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

2.8 Special Accessories

Not available for this EUT intended for grant.

2.9 Equipment Modifications

Not available for this EUT intended for grant.

2.10 Antenna Requirement

Standard Requirement
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. **15.247(b) (4) requirement:** The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi
EUT Antenna:
The non-detachable antenna inside the device cannot be replaced by the user at will. The gain of the antenna is 2.78dBi.

3. Test Environment

3.1 Address of The Test Laboratory

Laboratory: Attestation of Global Compliance (Shenzhen) Co., Ltd.

Address: 1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L5488

Attestation of Global Compliance (Shenzhen) Co., Ltd. has been assessed and proved to follow CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories.)

A2LA-Lab Cert. No.: 5054.02

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to follow ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 975832

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files with Registration 975832.

IC-Registration No.: 24842(CAB identifier: CN0063)

Attestation of Global Compliance (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the Certification and Engineering Bureau of Industry Canada. The acceptance letter from the IC is maintained in our files with Registration 24842.

3.3 Environmental Conditions

	Normal Conditions
Temperature range (℃)	15 - 35
Relative humidity range	20 % - 75 %
Pressure range (kPa)	86 - 106
Power supply	DC 5V by PC

3.4 Measurement Uncertainty

The reported uncertainty of measurement y ±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%.

Item	Measurement Uncertainty
Uncertainty of Conducted Emission for AC Port	U_c = ±2.9 dB
Uncertainty of Radiated Emission below 1GHz	U_c = ±3.9 dB
Uncertainty of Radiated Emission above 1GHz	U_c = ±4.9 dB
Uncertainty of total RF power, conducted	U_c = ±0.8 dB
Uncertainty of RF power density, conducted	U_c = ±2.6 dB
Uncertainty of spurious emissions, conducted	U_c = ±2 %
Uncertainty of Occupied Channel Bandwidth	U_c = ±2 %

3.5 List of Equipment Used

● RF Conducted Test System							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-ER-E036	Spectrum Analyzer	Agilent	N9020A	MY49100060	2024-05-24	2025-05-23
☒	AGC-ER-E062	Power Sensor	Agilent	U2021XA	MY54110007	2024-02-01	2025-01-31
☒	AGC-ER-E063	Power Sensor	Agilent	U2021XA	MY54110009	2024-02-01	2025-01-31
☒	AGC-EM-A001	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-09-21	2025-09-20
☐	AGC-ER-E083	Signal Generator	Agilent	E4421B	US39340815	2024-05-23	2025-05-22
☒	N/A	RF Connection Cable	N/A	1#	N/A	Each time	N/A
☒	N/A	RF Connection Cable	N/A	2#	N/A	Each time	N/A

● Radiated Spurious Emission							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-EM-E046	EMI Test Receiver	R&S	ESCI	10096	2024-02-01	2025-01-31
☐	AGC-EM-E116	EMI Test Receiver	R&S	ESCI	100034	2024-05-24	2025-05-23
☒	AGC-EM-E061	Spectrum Analyzer	Agilent	N9010A	MY53470504	2024-05-28	2025-05-27
☒	AGC-EM-E086	Loop Antenna	ZHINAN	ZN30900C	18051	2024-03-05	2026-03-04
☒	AGC-EM-E001	Wideband Antenna	SCHWARZBECK	VULB9168	D69250	2023-05-11	2025-05-10
☒	AGC-EM-E029	Broadband Ridged Horn Antenna	ETS	3117	00034609	2024-03-31	2025-03-30
☒	AGC-EM-E082	Horn Antenna	SCHWARZBECK	BBHA 9170	#768	2023-09-24	2025-09-23
☒	AGC-EM-E146	Pre-amplifier	ETS	3117-PA	00246148	2024-07-24	2026-07-23
☒	AGC-EM-A119	2.4GHz Filter	SongYi	N/A	N/A	2024-05-23	2025-05-22
☒	AGC-EM-A138	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2025-06-08
☐	AGC-EM-A139	6dB Attenuator	Eeatsheep	LM-XX-6-5W	N/A	2023-06-09	2025-06-08

● AC Power Line Conducted Emission							
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal. Date (YY-MM-DD)	Next Cal. Date (YY-MM-DD)
☒	AGC-EM-E045	EMI Test Receiver	R&S	ESPI	101206	2024-05-28	2025-05-27
☒	AGC-EM-A130	6dB Attenuator	Eeatsheep	LM-XX-6-5W	DC-6GZ	2023-06-09	2025-06-08
☒	AGC-EM-E023	AMN	R&S	100086	ESH2-Z5	2024-05-28	2025-05-27

● Test Software					
Used	Equipment No.	Test Equipment	Manufacturer	Model No.	Version Information
☒	AGC-EM-S001	CE Test System	R&S	ES-K1	V1.71
☒	AGC-EM-S003	RE Test System	FARA	EZ-EMC	V.RA-03A
☐	AGC-EM-S004	RE Test System	Tonscend	TS$^+$ Ver2.1(JS32-RE)	4.0.0.0
☒	AGC-ER-S012	BT/WIFI Test System	Tonscend	JS1120-2	2.6
☒	AGC-EM-S011	RSE Test System	Tonscend	TS+-Ver2.1(JS36-RSE)	4.0.0.0

4. System Test Configuration

4.1 EUT Configuration

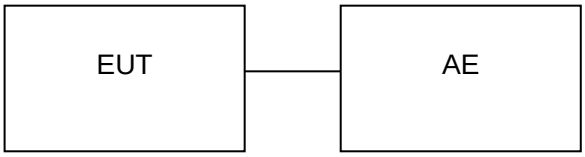
The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT Exercise

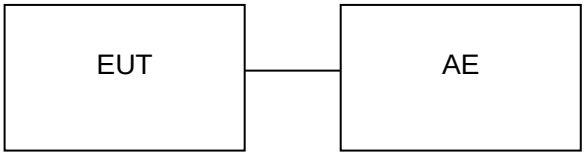
The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

4.3 Configuration of Tested System

Radiated Emission Configure:



Conducted Emission Configure:



4.4 Equipment Used in Tested System

The following peripheral devices and interface cables were connected during the measurement:

☒ Test Accessories Come From The Laboratory

No.	Equipment	Manufacturer	Model No.	Specification Information	Cable
1	Redmi Notebook Adapter	Redmi	AD100G	Input: 100-240V 50/60Hz 1.6A Output: 5V/3A;9V/3A;11V/5A;12V/3A;15V/3A;20V/5A	1.2m,unshielded
2	Redmi Notebook PC	Redmi	XMA2002-AB	--	1.2m,unshielded

☐ Test Accessories Come From The Manufacturer

No.	Equipment	Manufacturer	Model No.	Specification Information	Cable
1	--	--	--	--	--

4.5 Summary of Test Results

Item	FCC Rules	Description of Test	Result
1	§15.203&15.247(b)(4)	Antenna Equipment	Pass
2	§15.247 (b)(1)	RF Output Power	Pass
3	§15.247 (a)(1)	20 dB Bandwidth	Pass
4	§15.247 (d)	Conducted Band Edge and Out-of-Band Emissions	Pass
5	§15.209	Radiated Spurious Emission	Pass
6	§15.247 (a)(1)(iii)	Number of Hopping Frequency	Pass
7	§15.247 (a)(1)(iii)	Time of Occupancy	Pass
8	§15.247 (a)(1)	Frequency Separation	Pass
9	§15.207	AC Power Line Conducted Emission	Pass

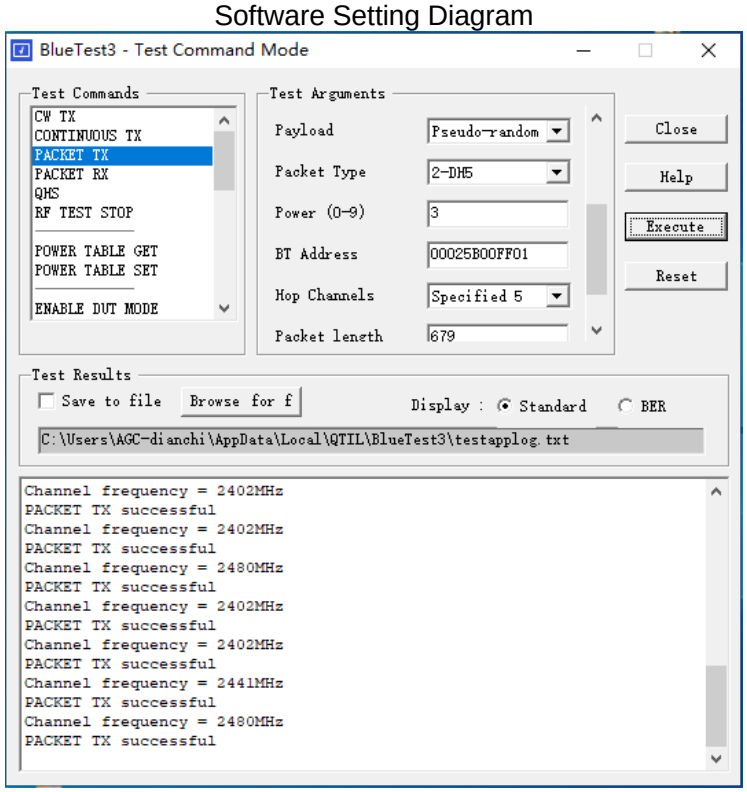
5. Description of Test Modes

Summary table of Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth – BR_EDR (GFSK/π /4-DQPSK/8DPSK)
Radiated & Conducted Test Cases	Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps (Connected PC) Mode 2: Bluetooth Tx CH39_2441 MHz_1Mbps (Connected PC) Mode 3: Bluetooth Tx CH78_2480 MHz_1Mbps (Connected PC) Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps (Connected PC) Mode 5: Bluetooth Tx CH39_2441 MHz_2Mbps (Connected PC) Mode 6: Bluetooth Tx CH78_2480 MHz_2Mbps (Connected PC) Mode 7: Bluetooth Tx CH00_2402 MHz_3Mbps (Connected PC) Mode 8: Bluetooth Tx CH39_2441 MHz_3Mbps (Connected PC) Mode 9: Bluetooth Tx CH78_2480 MHz_3Mbps (Connected PC) Mode10: Bluetooth Tx Hopping-1Mbps (Connected PC) Mode11: Bluetooth Tx Hopping-2Mbps (Connected PC) Mode12: Bluetooth Tx Hopping-3Mbps (Connected PC)
AC Conducted Emission	Mode 1: Bluetooth Link (Connected PC)

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 Diagram



6. RF Output Power Measurement

6.1 Provisions Applicable

The maximum out power permissible output power is 1 Watt for all frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels.

The maximum out power permissible output power is 0.125 watts for all other frequency hopping systems in the 2400-2483.5 MHz band.

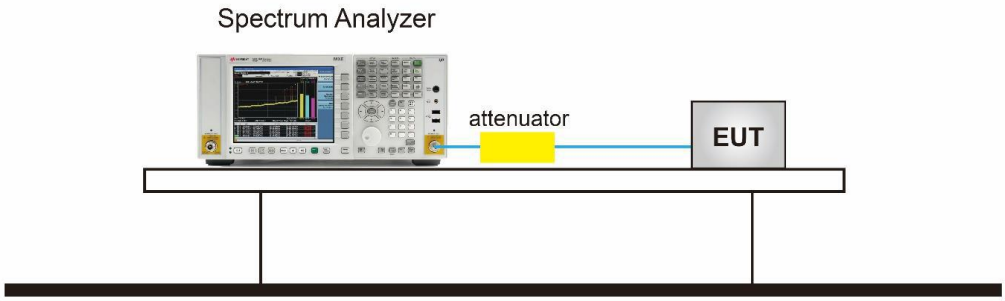
6.2 Measurement Procedure

☒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 ≥RBW.
5. Sweep: Auto.
6. Detector function: Peak.
7. Trace: Max hold.
8. 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.

6.3 Measurement Setup (Block Diagram of Configuration)

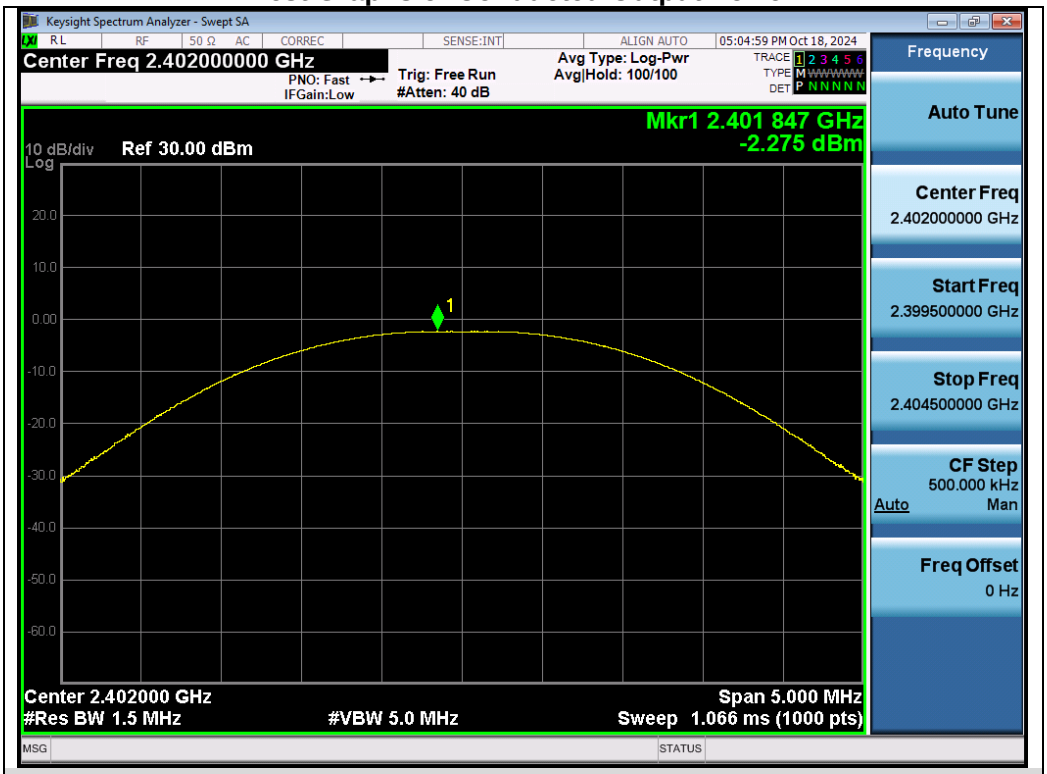
☒For peak power test setup



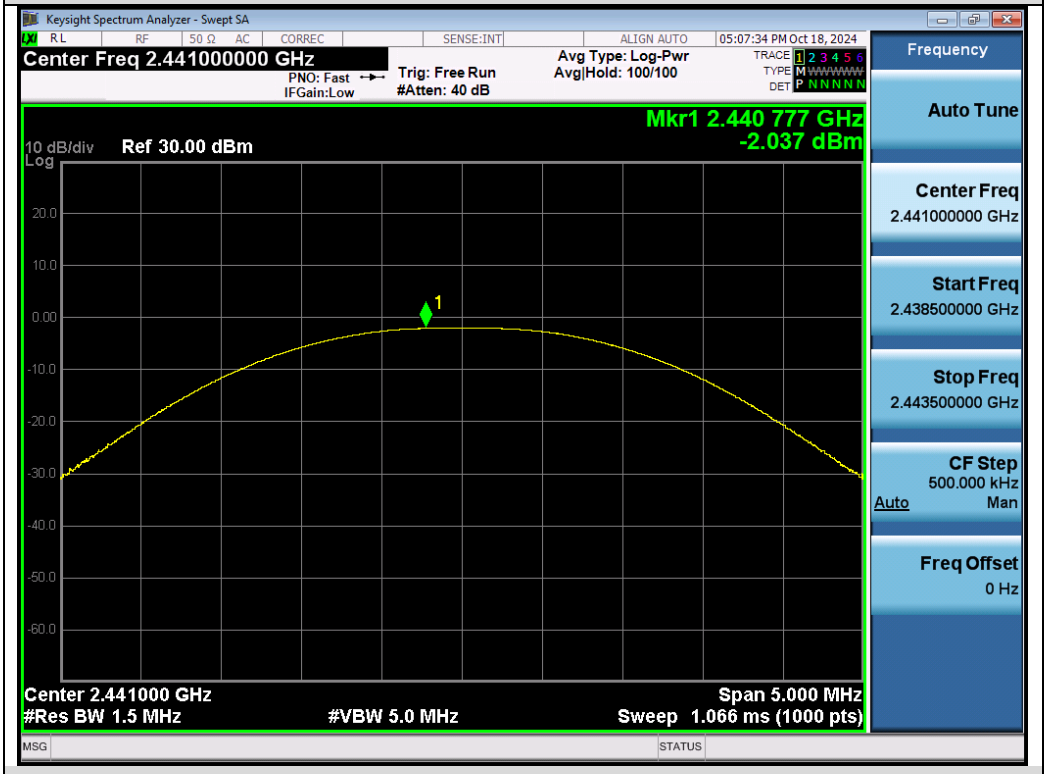
6.4 Measurement Result

Test Data of Conducted Output Power				
Test Mode	Test Frequency (MHz)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
GFSK	2402	-2.275	≤21	Pass
	2441	-2.037	≤21	Pass
	2480	-1.802	≤21	Pass
π /4-DQPSK	2402	-0.446	≤21	Pass
	2441	-0.151	≤21	Pass
	2480	0.083	≤21	Pass
8DPSK	2402	0.133	≤21	Pass
	2441	0.873	≤21	Pass
	2480	1.089	≤21	Pass

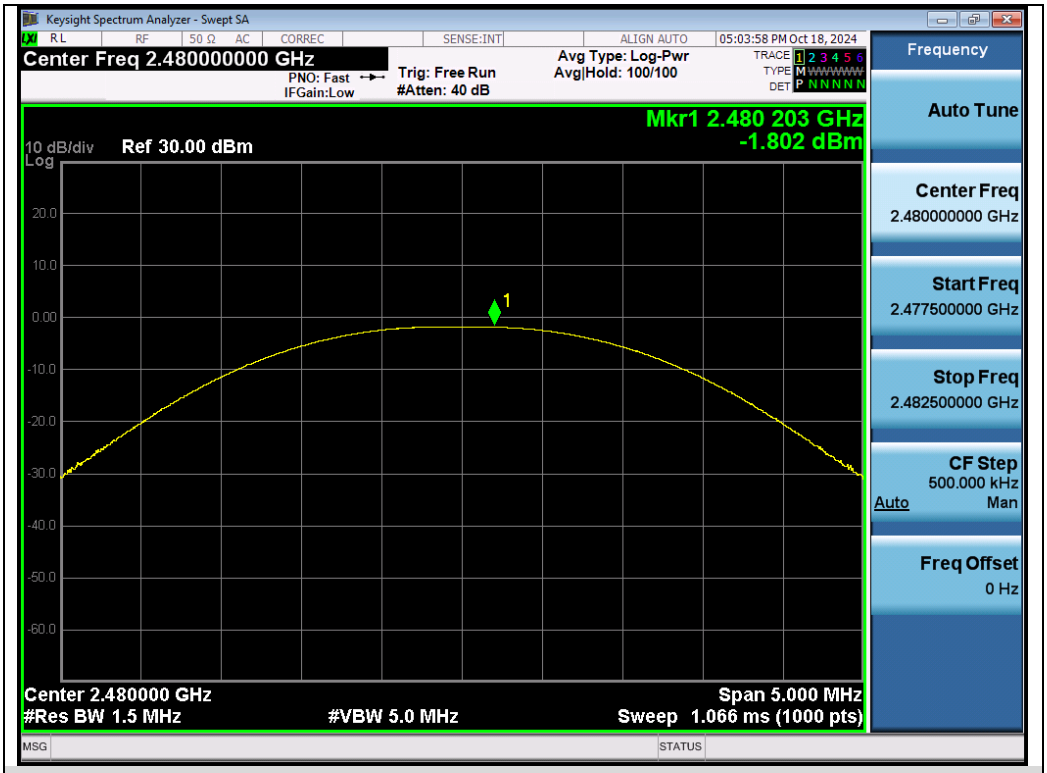
Test Graphs of Conducted Output Power



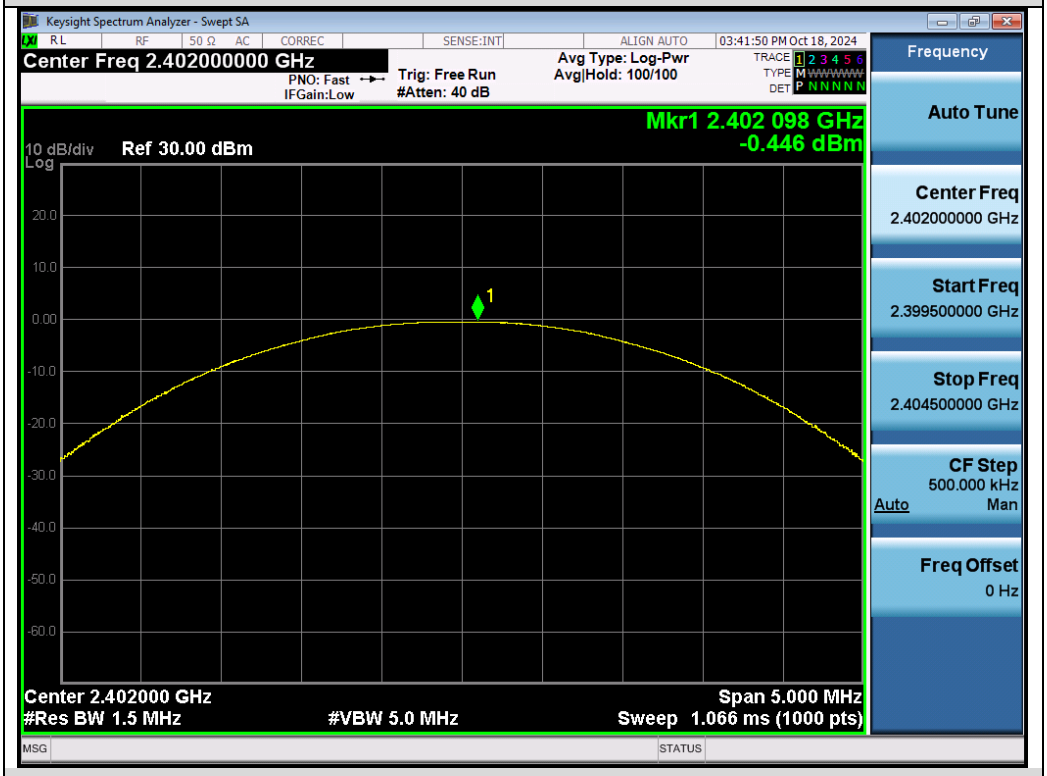
Test_Graph_BR_ANT1_2402_1Mbps_Peak Power



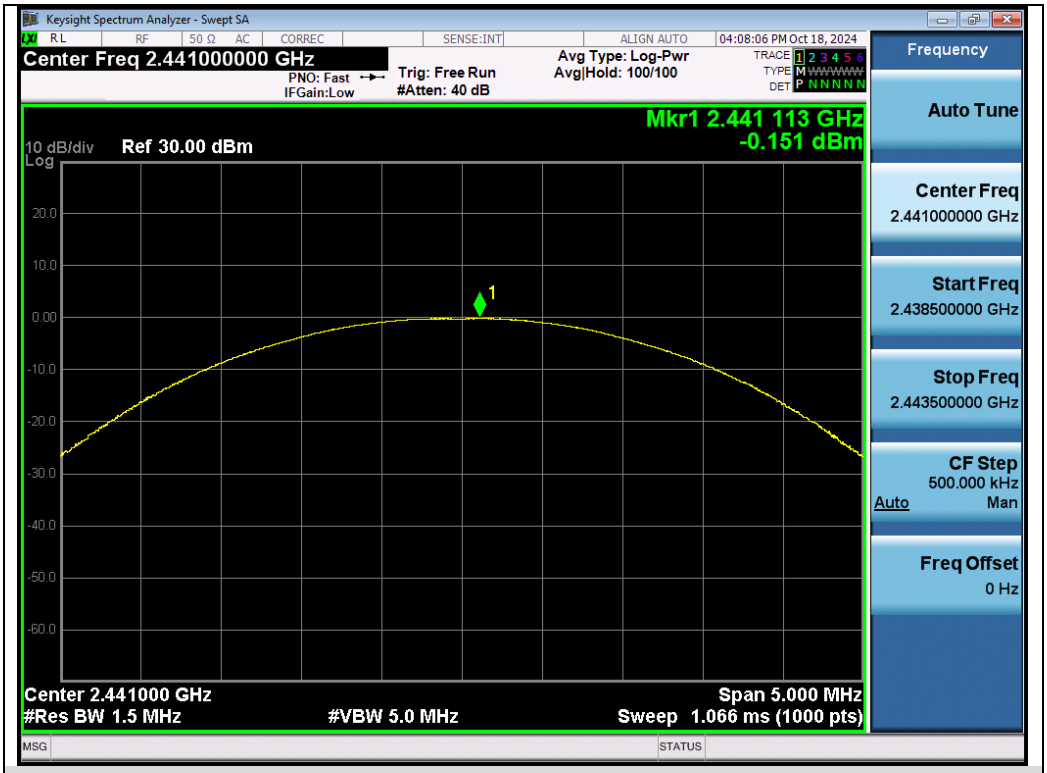
Test_Graph_BR_ANT1_2441_1Mbps_Peak Power



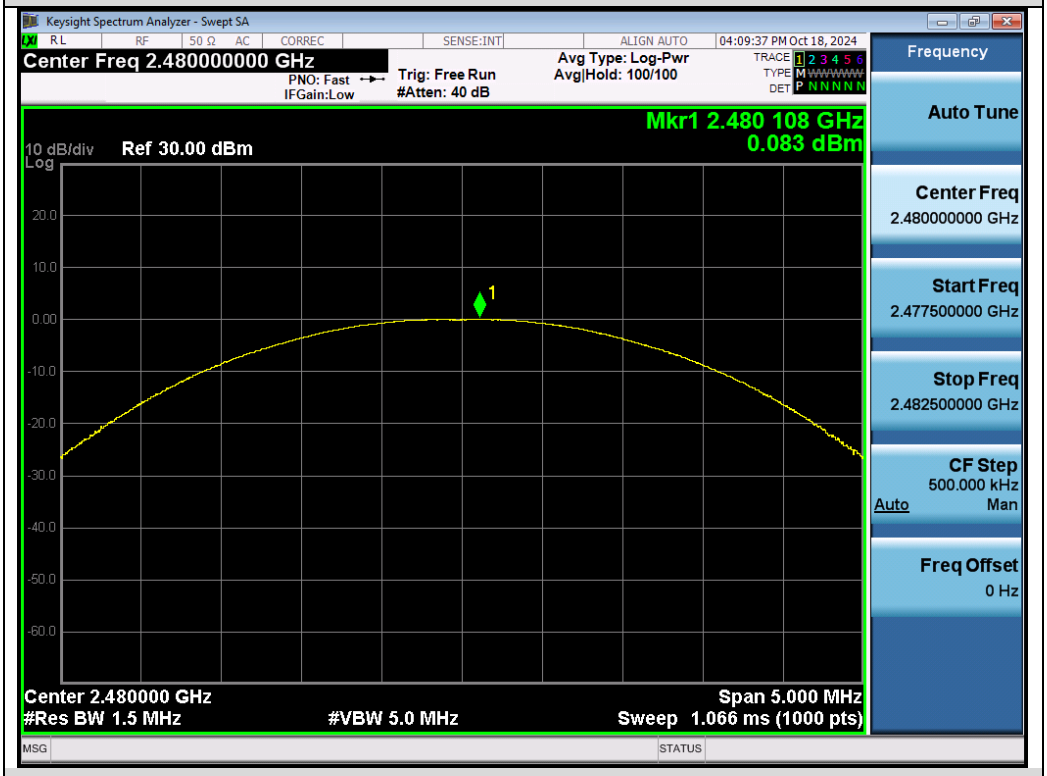
Test_Graph_BR_ANT1_2480_1Mbps_Peak Power



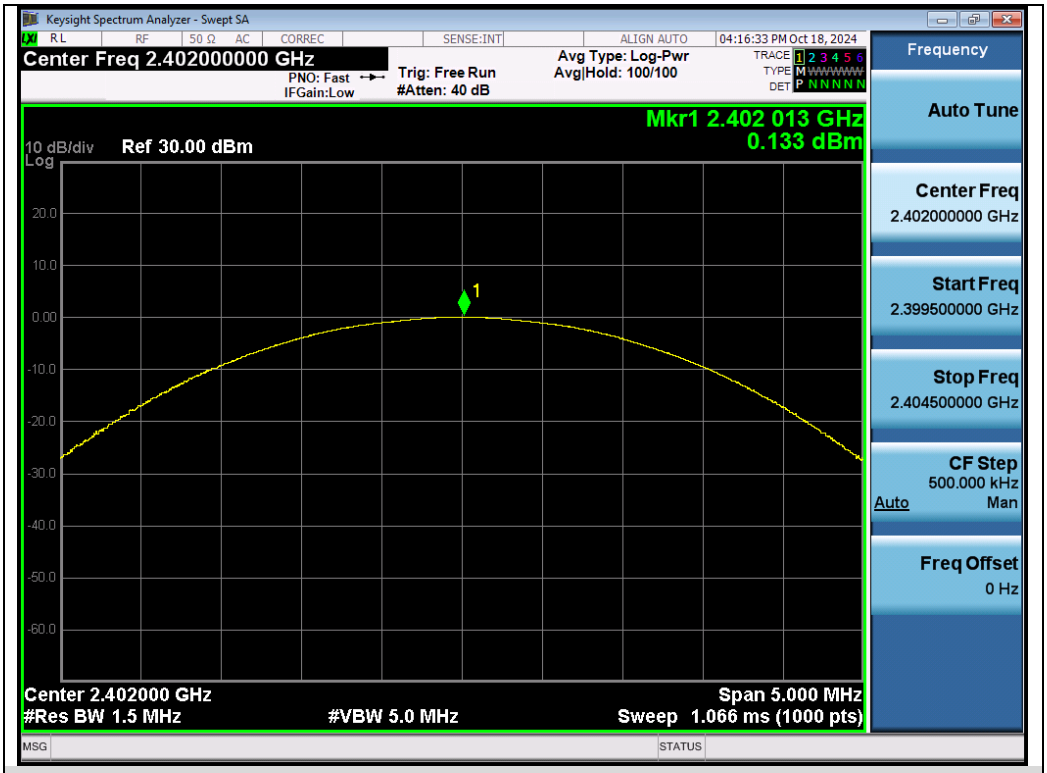
Test_Graph_EDR_ANT1_2402_2Mbps_Peak Power



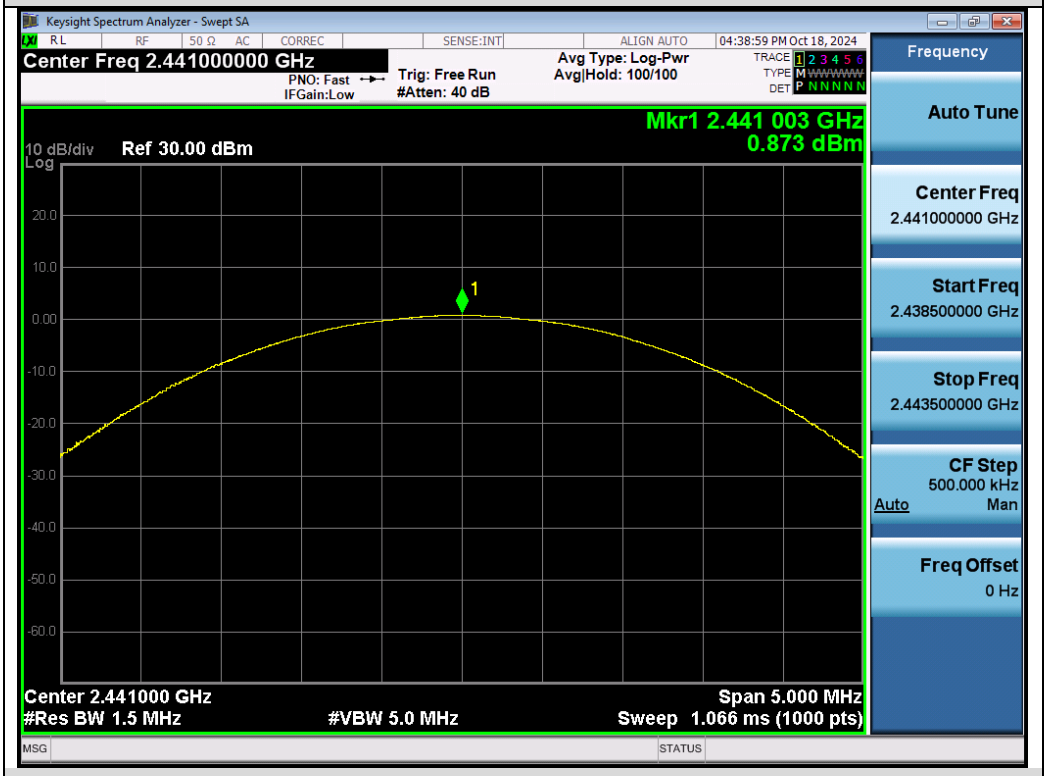
Test_Graph_EDR_ANT1_2441_2Mbps_Peak Power



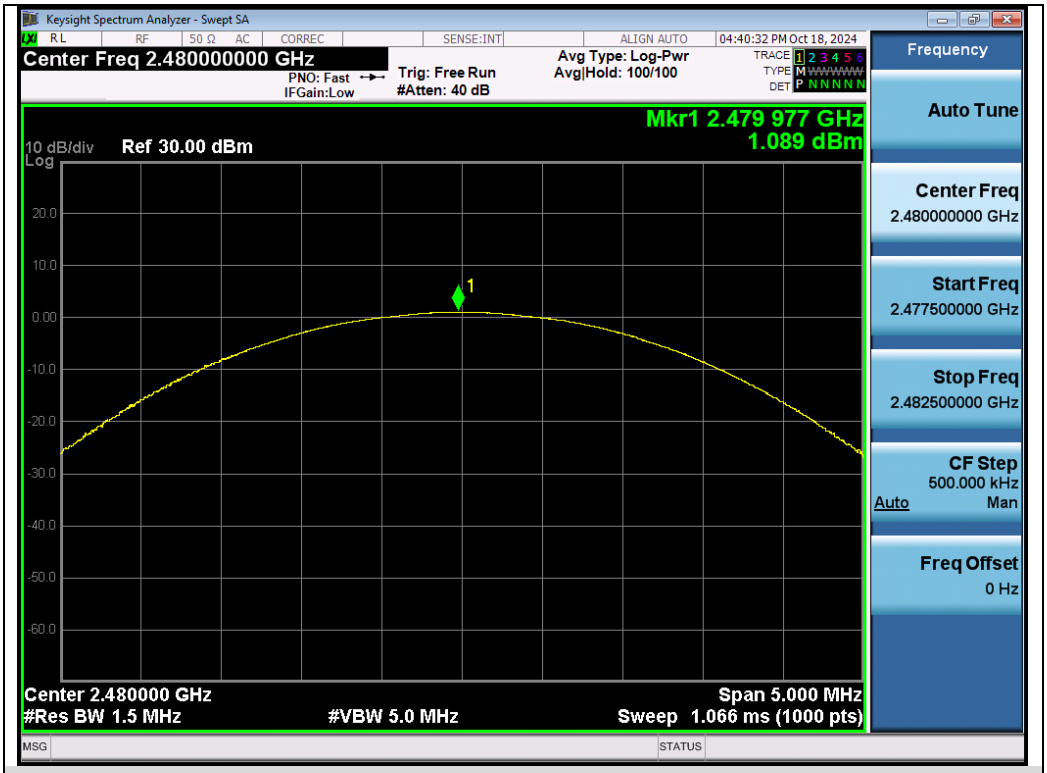
Test_Graph_EDR_ANT1_2480_2Mbps_Peak Power



Test_Graph_EDR_ANT1_2402_3Mbps_Peak Power



Test_Graph_EDR_ANT1_2441_3Mbps_Peak Power



Test_Graph_EDR_ANT1_2480_3Mbps_Peak Power

7. 20dB Bandwidth and 99% Occupied Bandwidth Measurement

7.1 Provisions Applicable

There is no corresponding limit requirement for this test item.

7.2 Measurement Procedure

The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 6.9.2 (20dB BW).

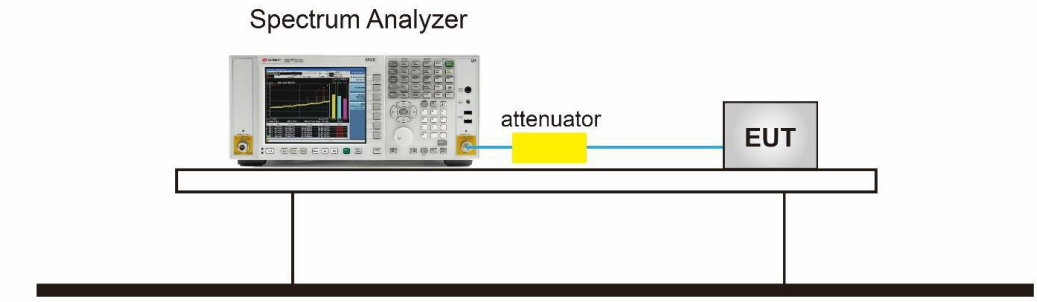
- The 20dB bandwidth spectrum analyzer setting reference is as follows:

1. Set RBW ≥ 1% to 5% of the 20dB bandwidth
2. VBW = Approximately three times RBW
3. Span = Approximately 2 to 5 times the 20dB bandwidth, centered on a hopping channel
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace to stabilize
8. Measure the maximum width of the emission that is constrained by the frequencies associated
9. with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 20
10. dB relative to the maximum level in the fundamental emission.

- The 99% bandwidth spectrum analyzer setting reference is as follows:

1. Span = 1.5 times to 5 times the OBW
2. Set RBW = 1% to 5% the OBW
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = Max hold
6. Sweep = Auto couple
7. Allow the trace was allowed to stabilize

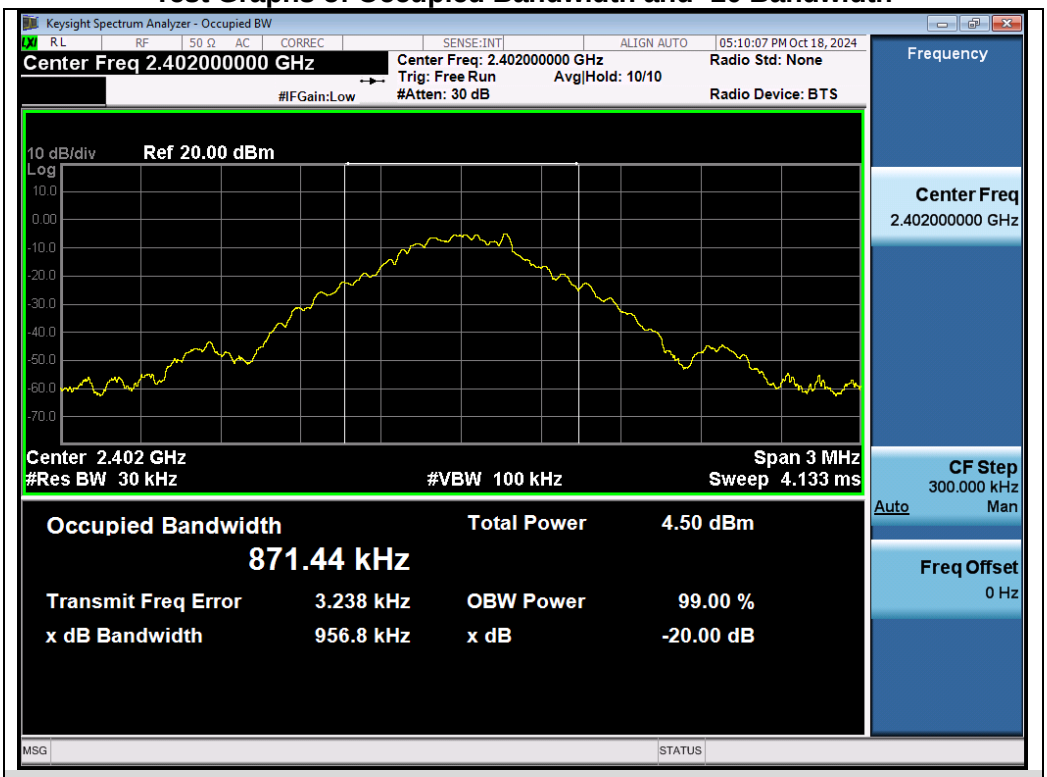
7.3 Measurement Setup (Block Diagram of Configuration)



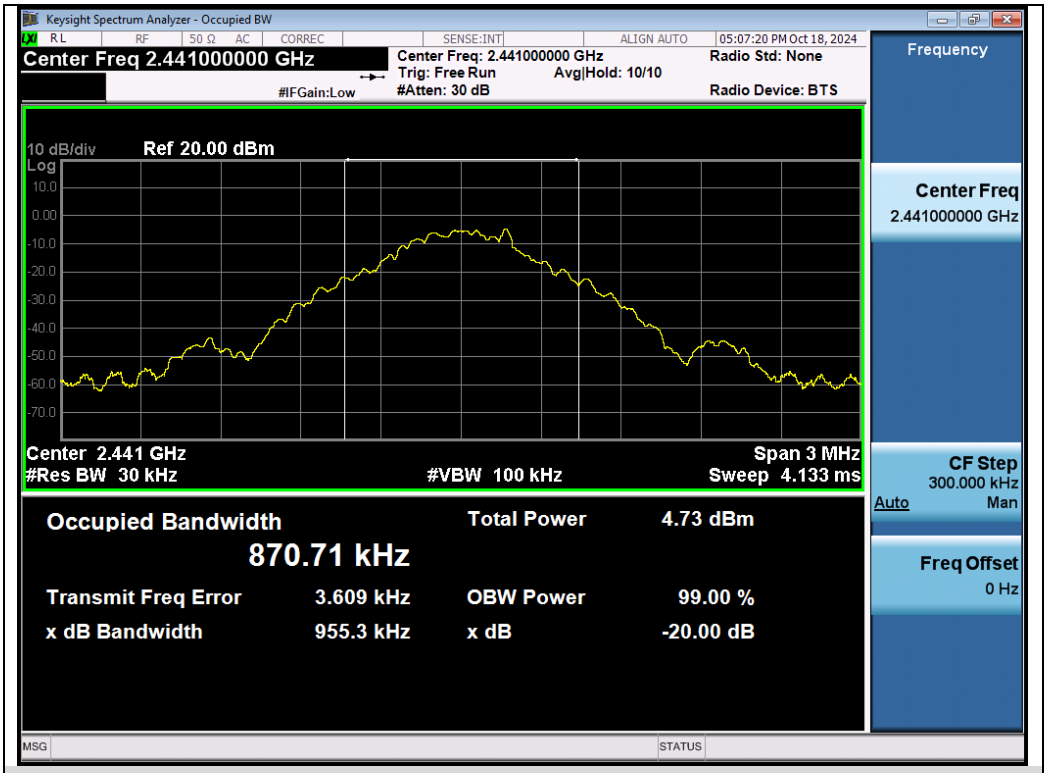
7.4 Measurement Results

Test Data of Occupied Bandwidth and -20dB Bandwidth					
Test Mode	Test Frequency (MHz)	99% Occupied Bandwidth (MHz)	-20dB Bandwidth (MHz)	Limits	Pass or Fail
GFSK	2402	0.871	0.957	N/A	Pass
	2441	0.871	0.955	N/A	Pass
	2480	0.868	0.955	N/A	Pass
π /4-DQPSK	2402	1.186	1.331	N/A	Pass
	2441	1.186	1.332	N/A	Pass
	2480	1.186	1.333	N/A	Pass
8DPSK	2402	1.184	1.305	N/A	Pass
	2441	1.185	1.305	N/A	Pass
	2480	1.184	1.305	N/A	Pass

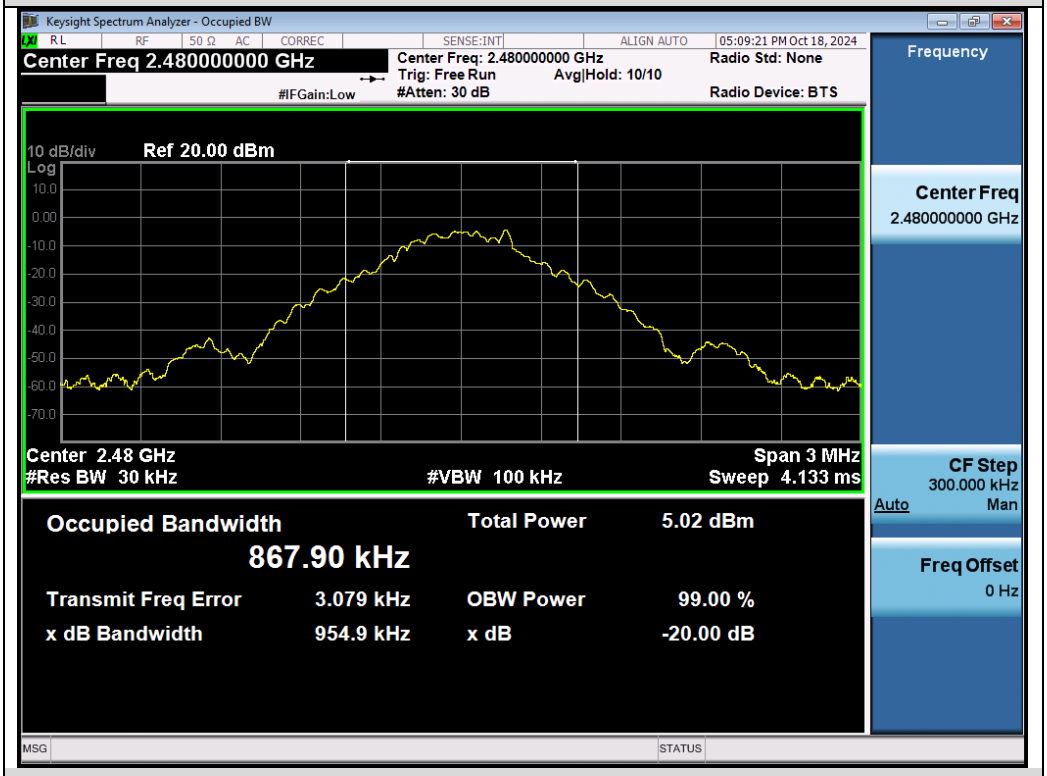
Test Graphs of Occupied Bandwidth and -20 Bandwidth



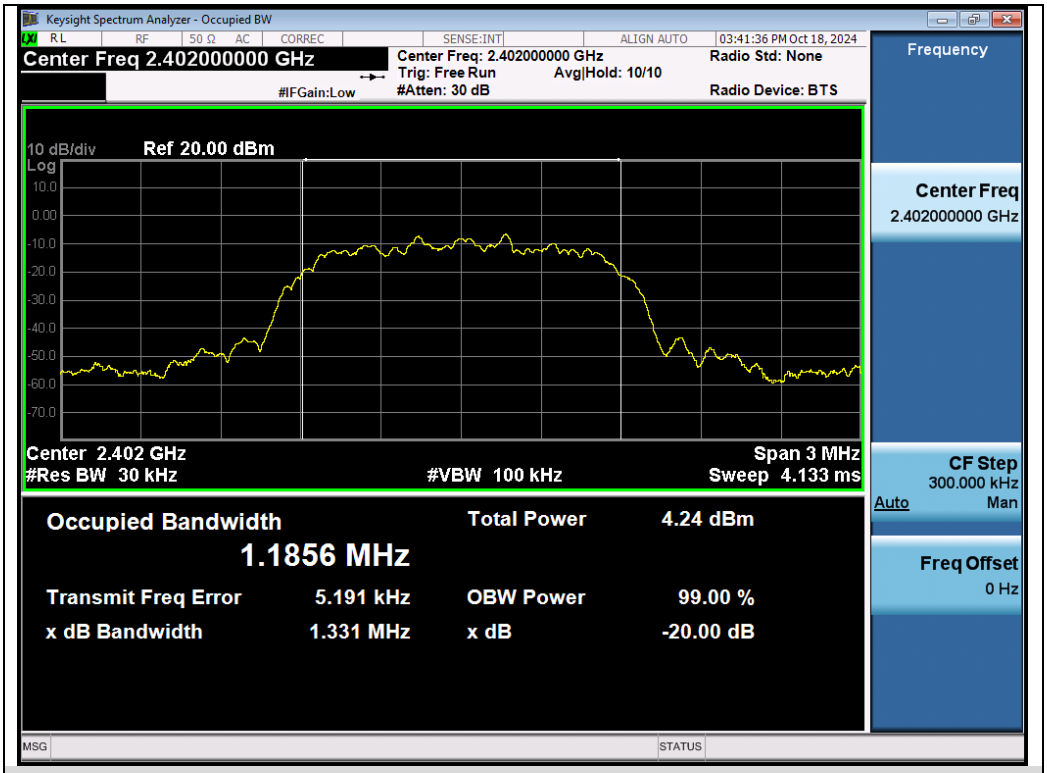
Test_Graph_BR_ANT1_2402_1Mbps_OBW



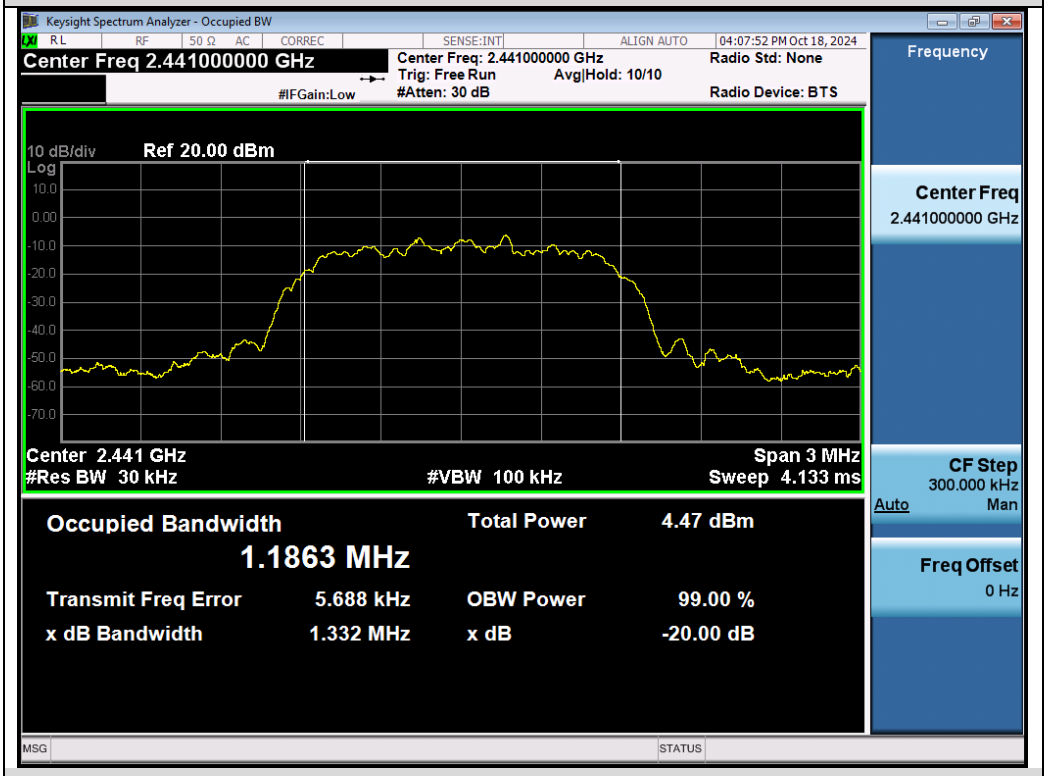
Test_Graph_BR_ANT1_2441_1Mbps_OBW



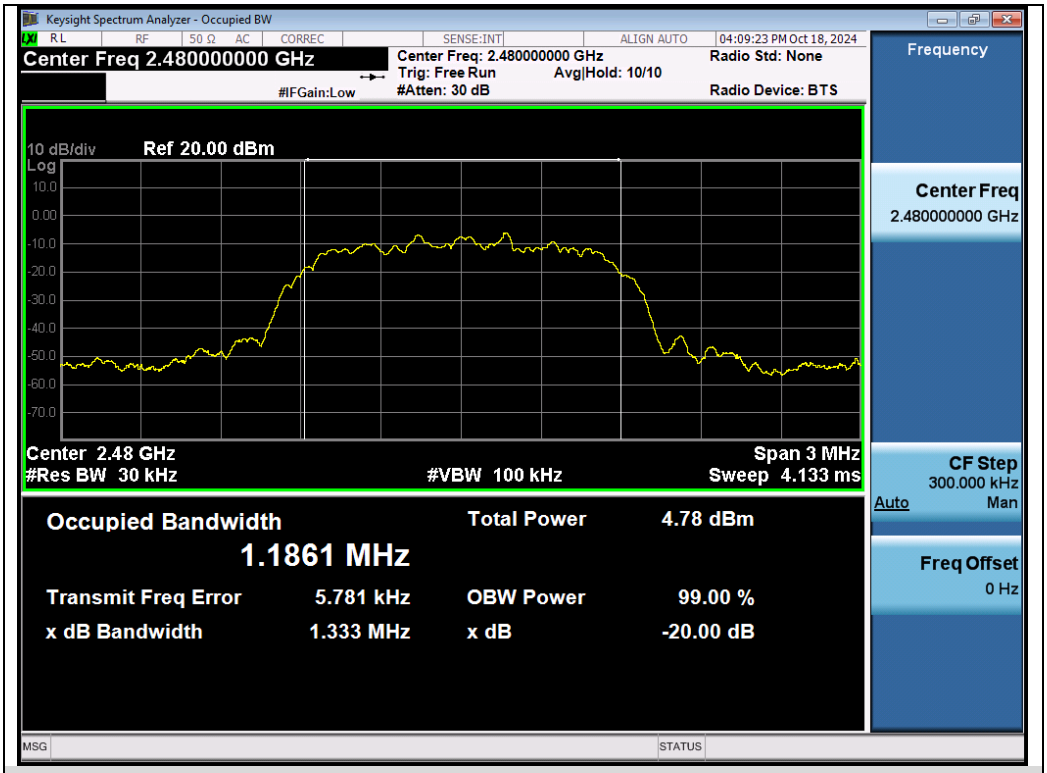
Test_Graph_BR_ANT1_2480_1Mbps_OBW



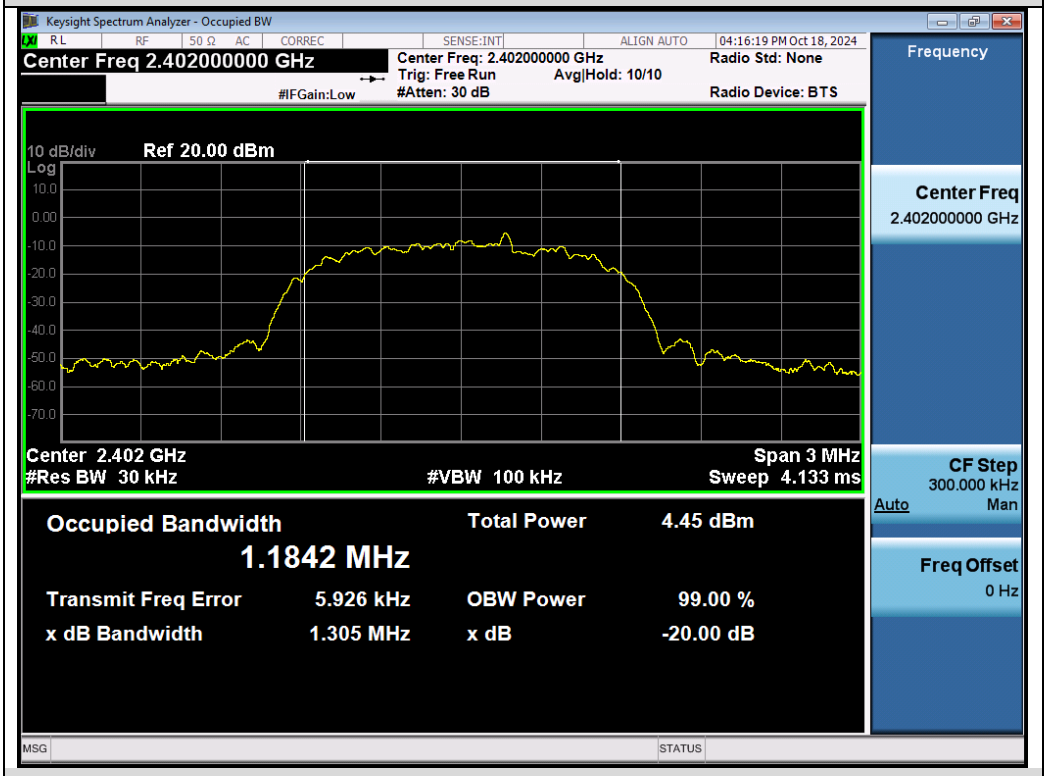
Test_Graph_EDR_ANT1_2402_2Mbps_OBW



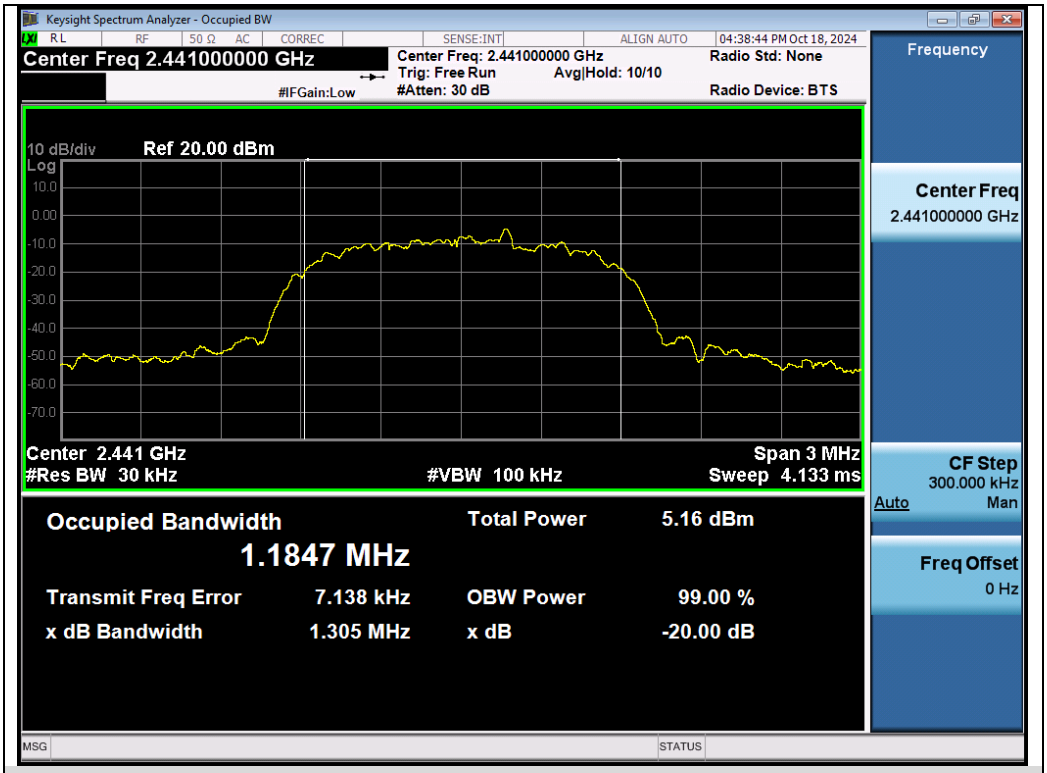
Test_Graph_EDR_ANT1_2441_2Mbps_OBW



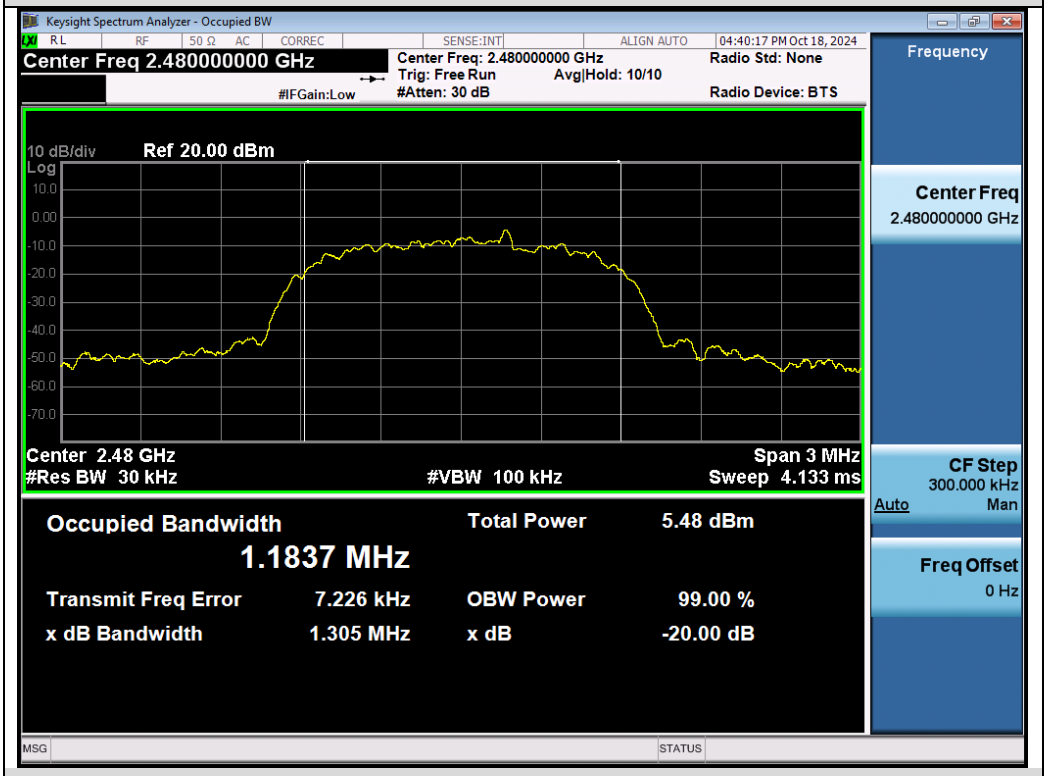
Test_Graph_EDR_ANT1_2480_2Mbps_OBW



Test_Graph_EDR_ANT1_2402_3Mbps_OBW



Test_Graph_EDR_ANT1_2441_3Mbps_OBW



Test_Graph_EDR_ANT1_2480_3Mbps_OBW

8. Conducted Band Edge and Out-of-Band Emissions

8.1 Provisions Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

8.2 Measurement Procedure

The testing follows the ANSI C63.10 Section 6.10.4 and 7.8.8:

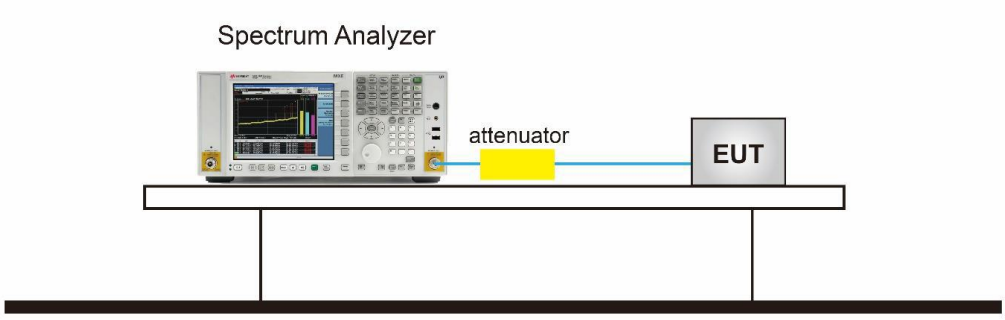
- Reference level measurement

1. Span = Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = Peak
5. Sweep time = Auto couple
6. Trace mode = Max hold
7. Allow the trace to stabilize. Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.

- Emission level measurement

1. Span = Wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
2. RBW = 100kHz
3. VBW = 300kHz
4. Detector = Peak
5. Sweep time = Auto couple
6. Trace mode = Max hold
7. Trace was allowed to stabilize
8. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this section.

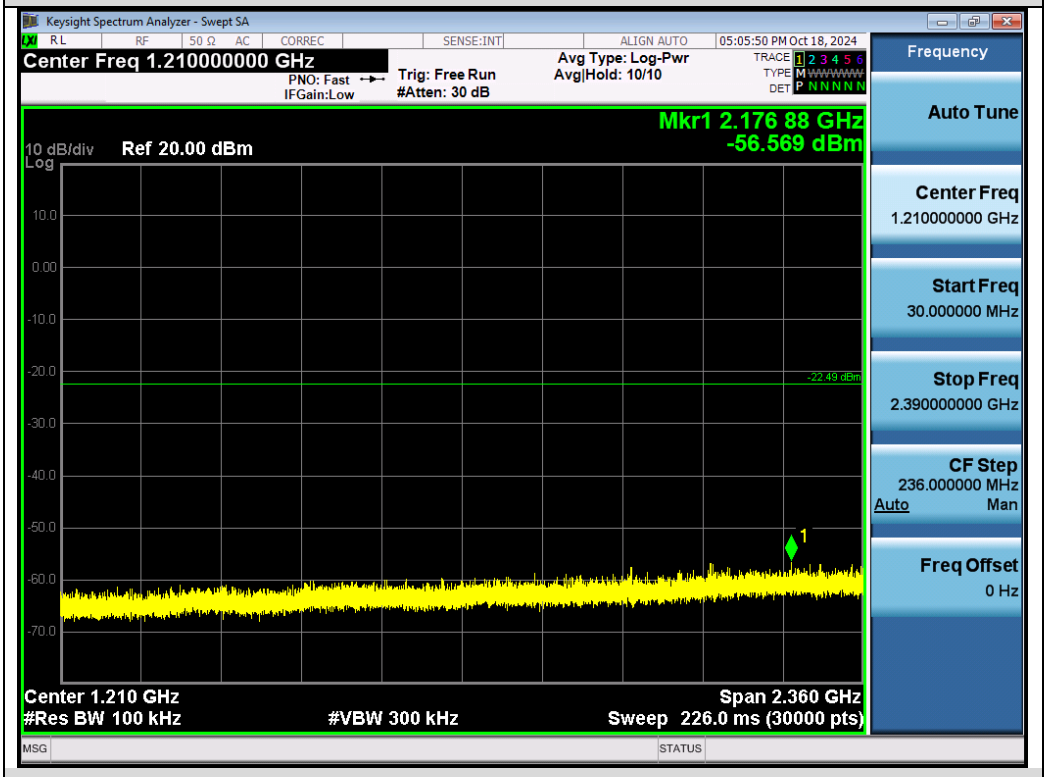
8.3 Measurement Setup (Block Diagram of Configuration)



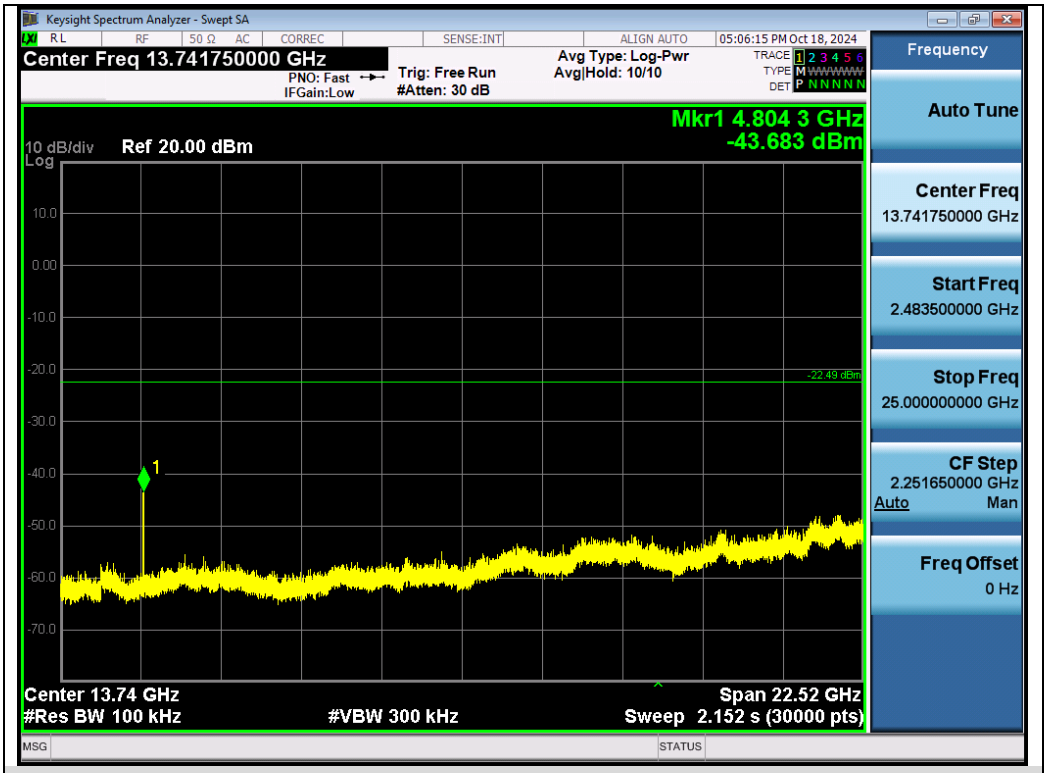
8.4 Measurement Results

Test Graphs of Spurious Emissions in Non-Restricted Frequency Bands

Test_Graph_BR_ANT1_2402_1Mbps_Reference Level

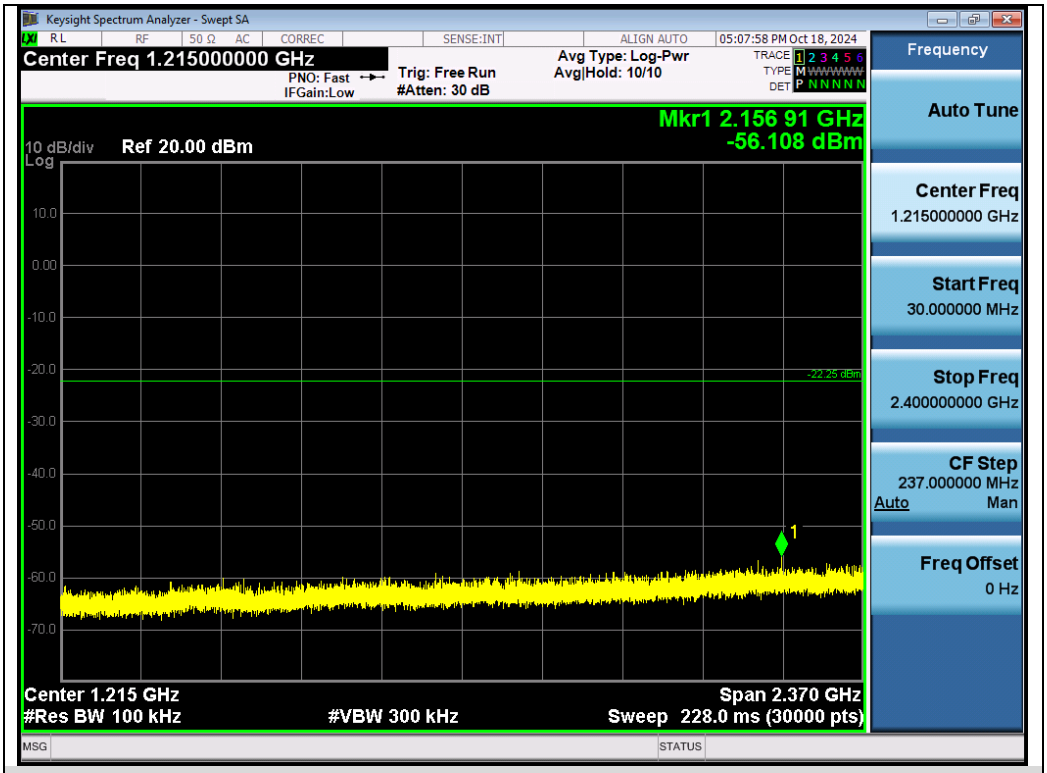


Test_Graph_BR_ANT1_2402_1Mbps_Lower Band Emissions

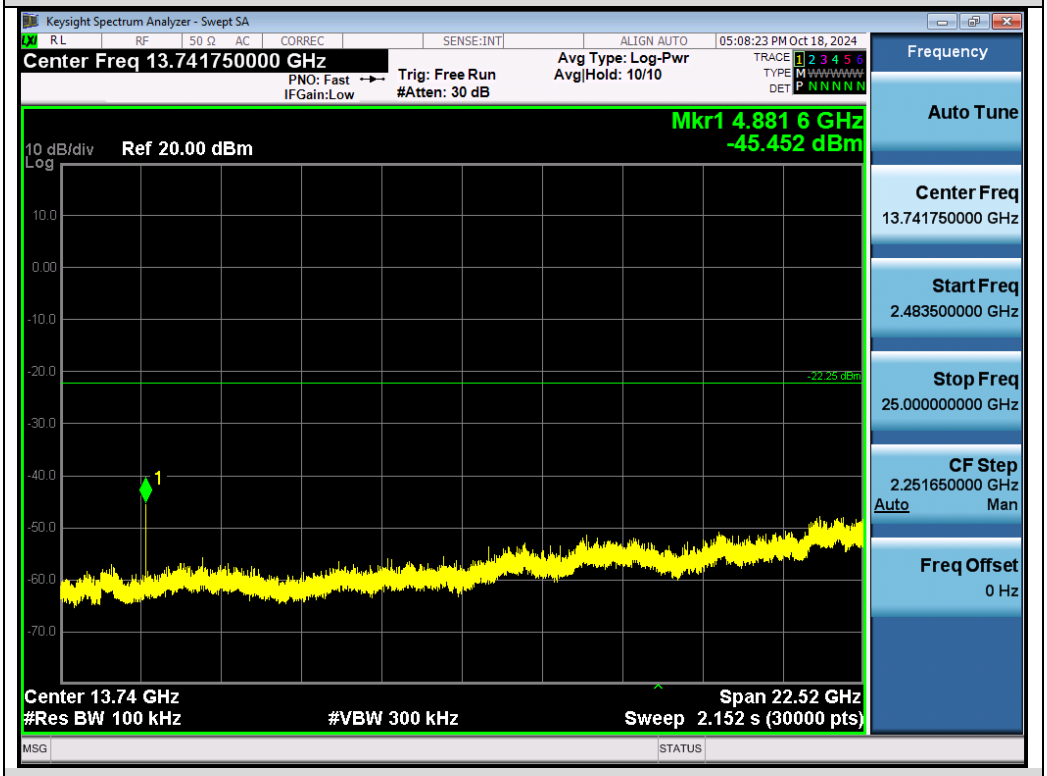


Test_Graph_BR_ANT1_2402_1Mbps_Higher Band Emissions

Test_Graph_BR_ANT1_2441_1Mbps_Reference Level

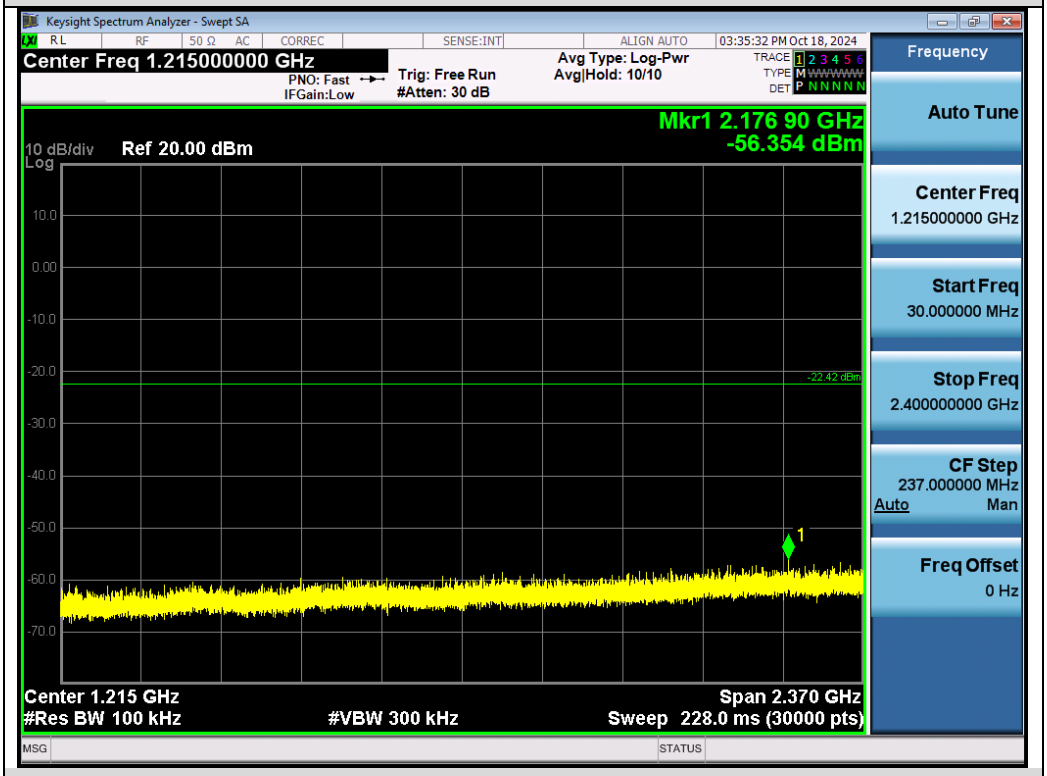


Test_Graph_BR_ANT1_2441_1Mbps_Lower Band Emissions



Test_Graph_BR_ANT1_2441_1Mbps_Higher Band Emissions

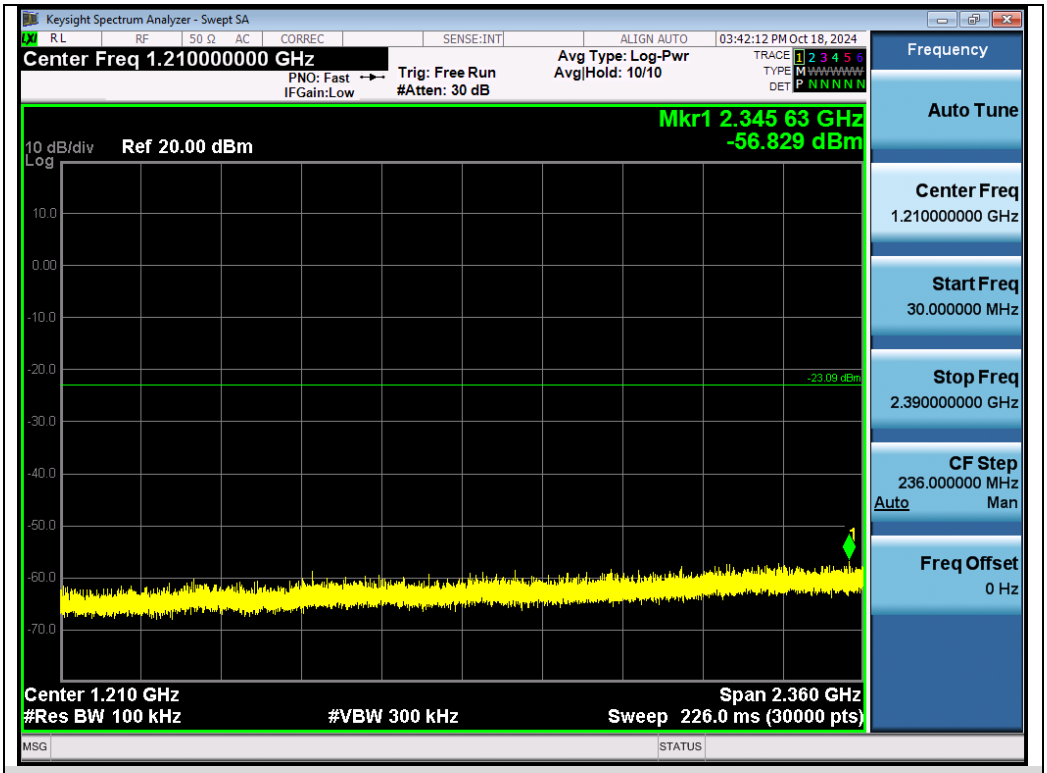
Test_Graph_BR_ANT1_2480_1Mbps_Reference Level



Test_Graph_BR_ANT1_2480_1Mbps_Lower Band Emissions

Test_Graph_BR_ANT1_2480_1Mbps_Higher Band Emissions

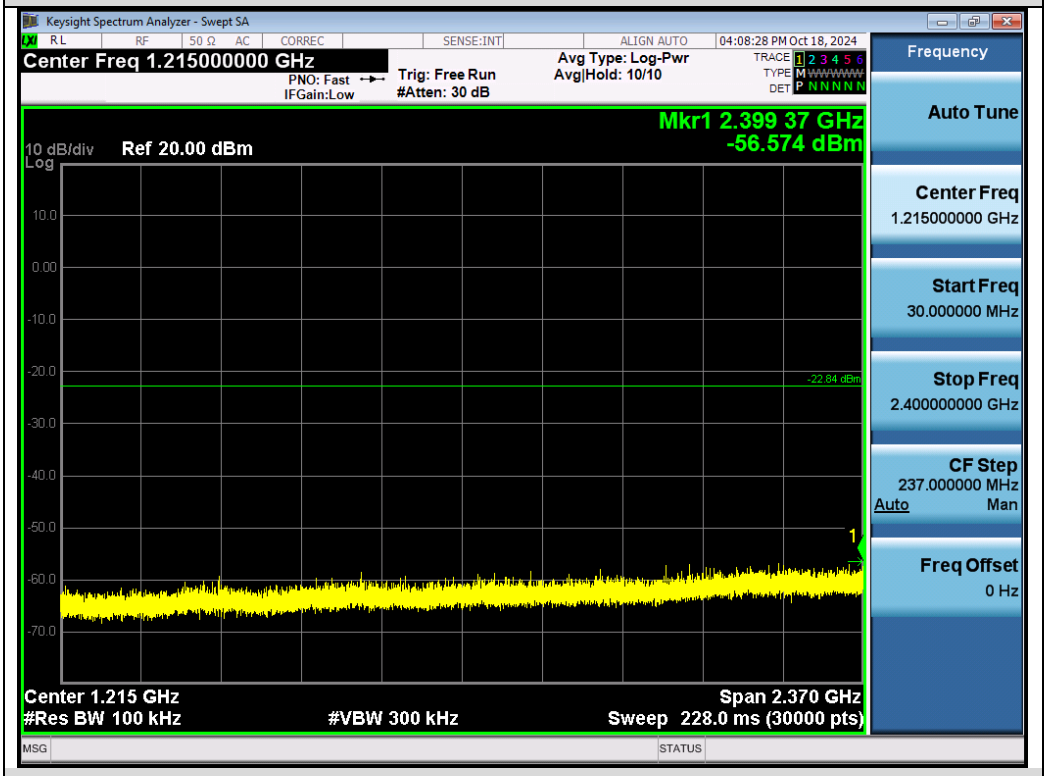
Test_Graph_EDR_ANT1_2402_2Mbps_Reference Level



Test_Graph_EDR_ANT1_2402_2Mbps_Lower Band Emissions

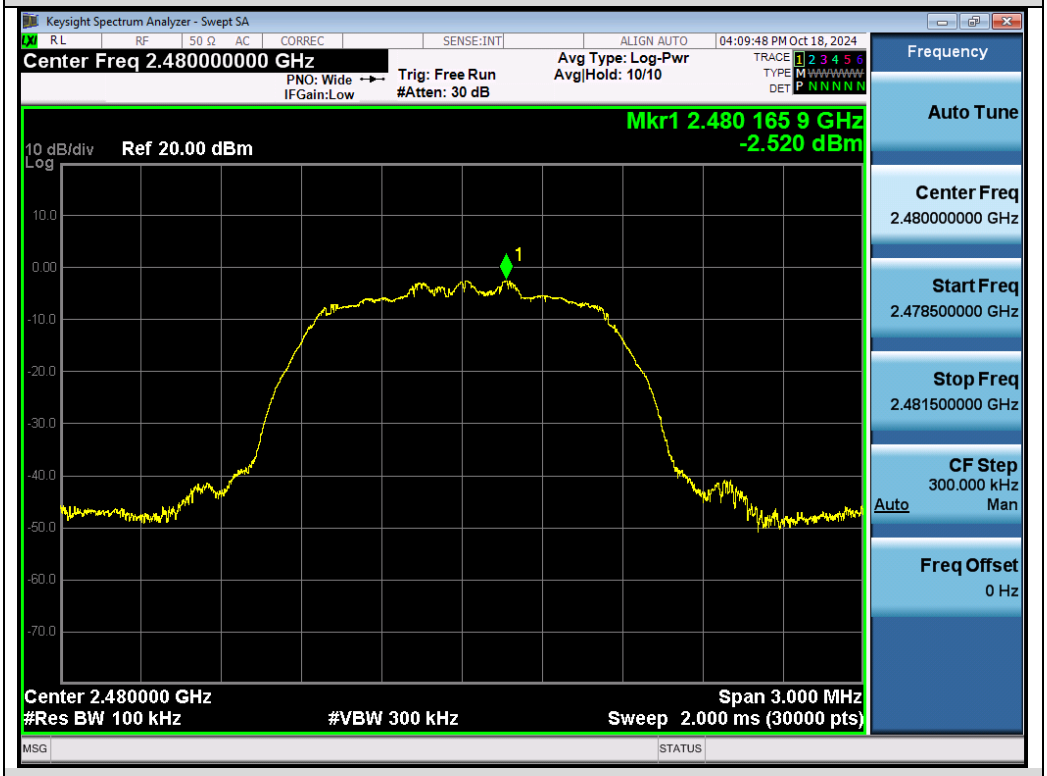
Test_Graph_EDR_ANT1_2402_2Mbps_Higher Band Emissions

Test_Graph_EDR_ANT1_2441_2Mbps_Reference Level

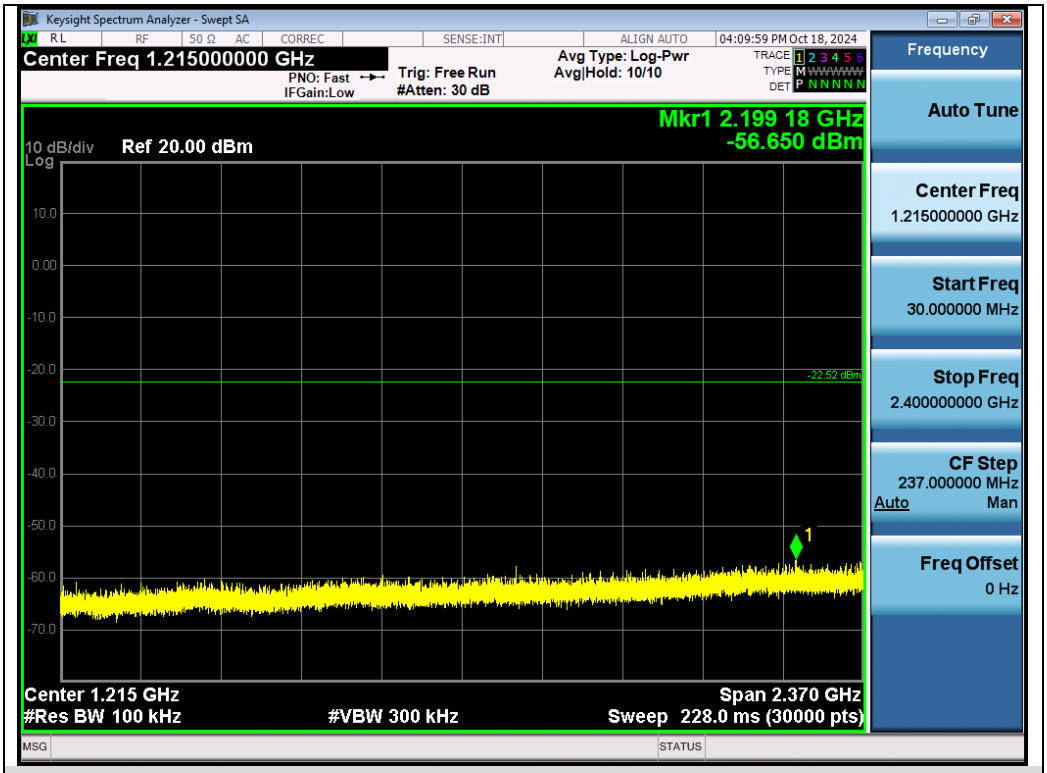


Test_Graph_EDR_ANT1_2441_2Mbps_Lower Band Emissions

Test_Graph_EDR_ANT1_2441_2Mbps_Higher Band Emissions



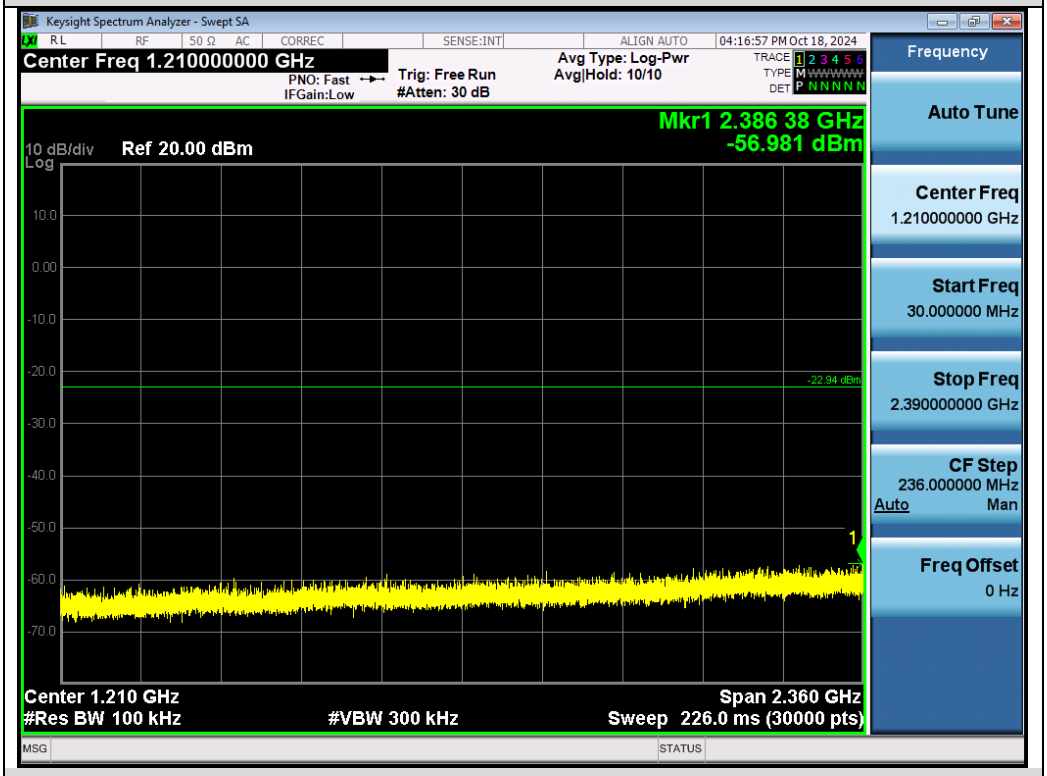
Test_Graph_EDR_ANT1_2480_2Mbps_Reference Level



Test_Graph_EDR_ANT1_2480_2Mbps_Lower Band Emissions

Test_Graph_EDR_ANT1_2480_2Mbps_Higher Band Emissions

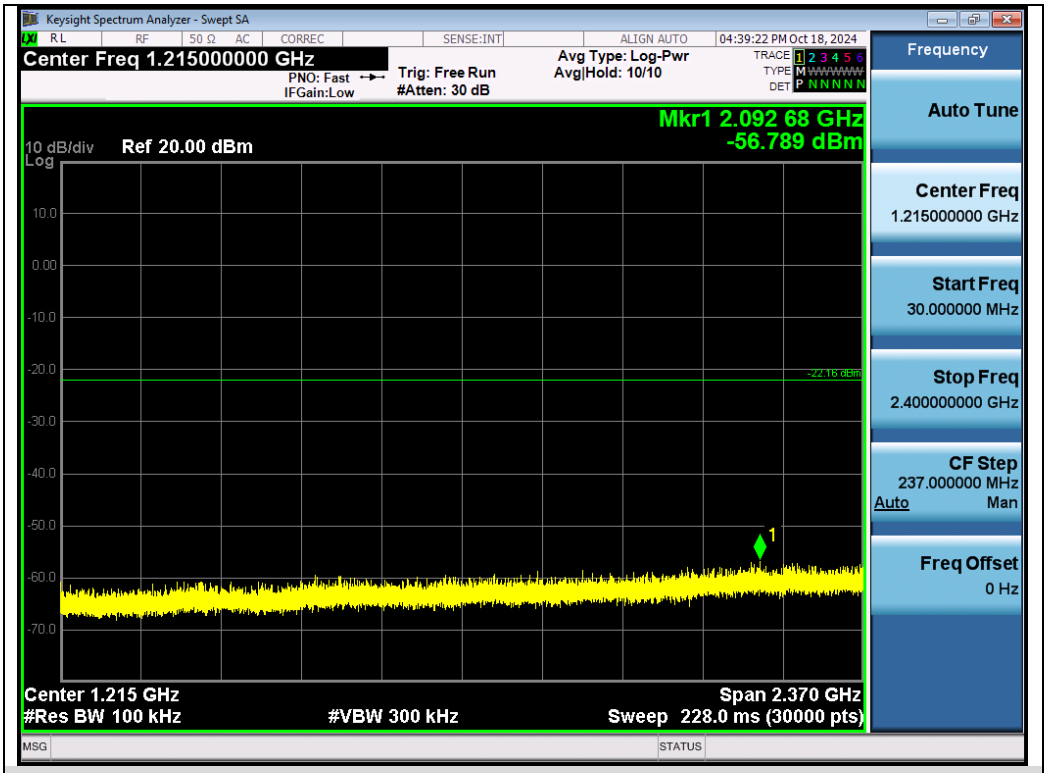
Test_Graph_EDR_ANT1_2402_3Mbps_Reference Level



Test_Graph_EDR_ANT1_2402_3Mbps_Lower Band Emissions

Test_Graph_EDR_ANT1_2402_3Mbps_Higher Band Emissions

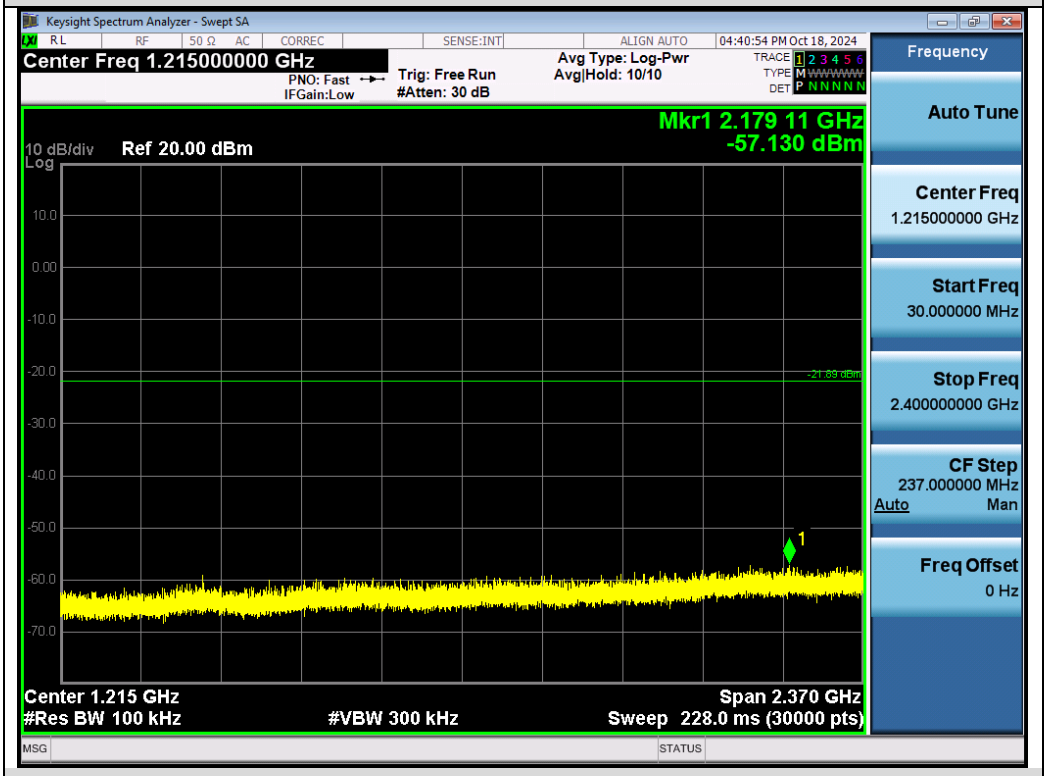
Test_Graph_EDR_ANT1_2441_3Mbps_Reference Level



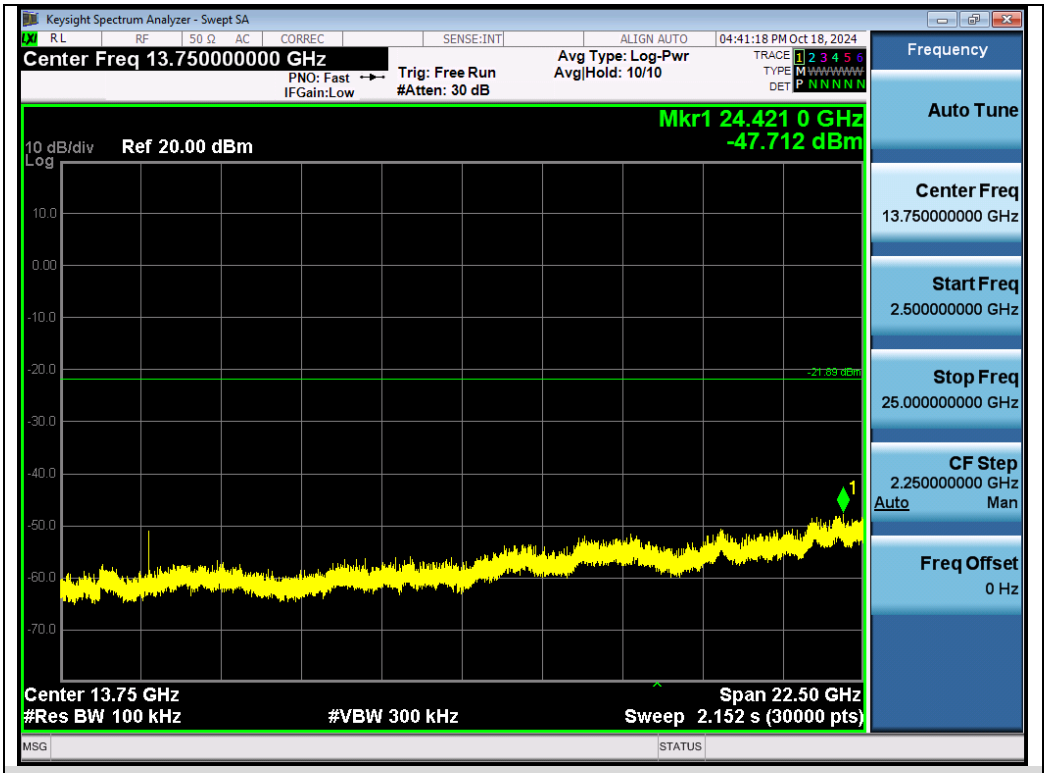
Test_Graph_EDR_ANT1_2441_3Mbps_Lower Band Emissions

Test_Graph_EDR_ANT1_2441_3Mbps_Higher Band Emissions

Test_Graph_EDR_ANT1_2480_3Mbps_Reference Level

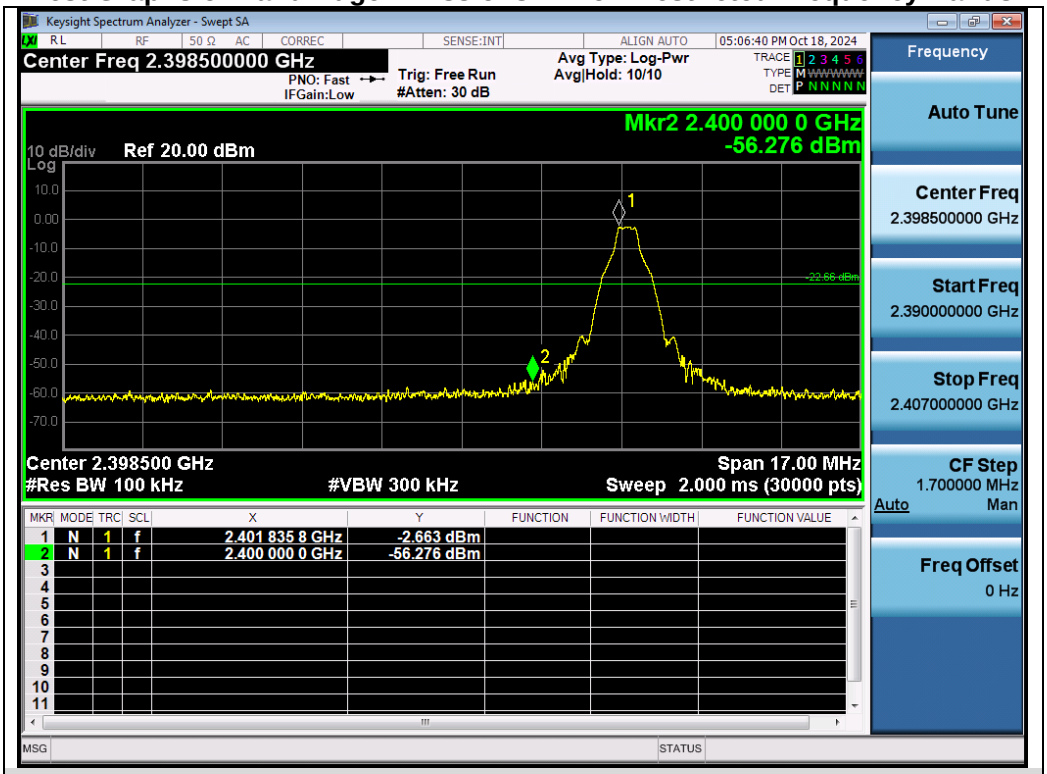


Test_Graph_EDR_ANT1_2480_3Mbps_Lower Band Emissions

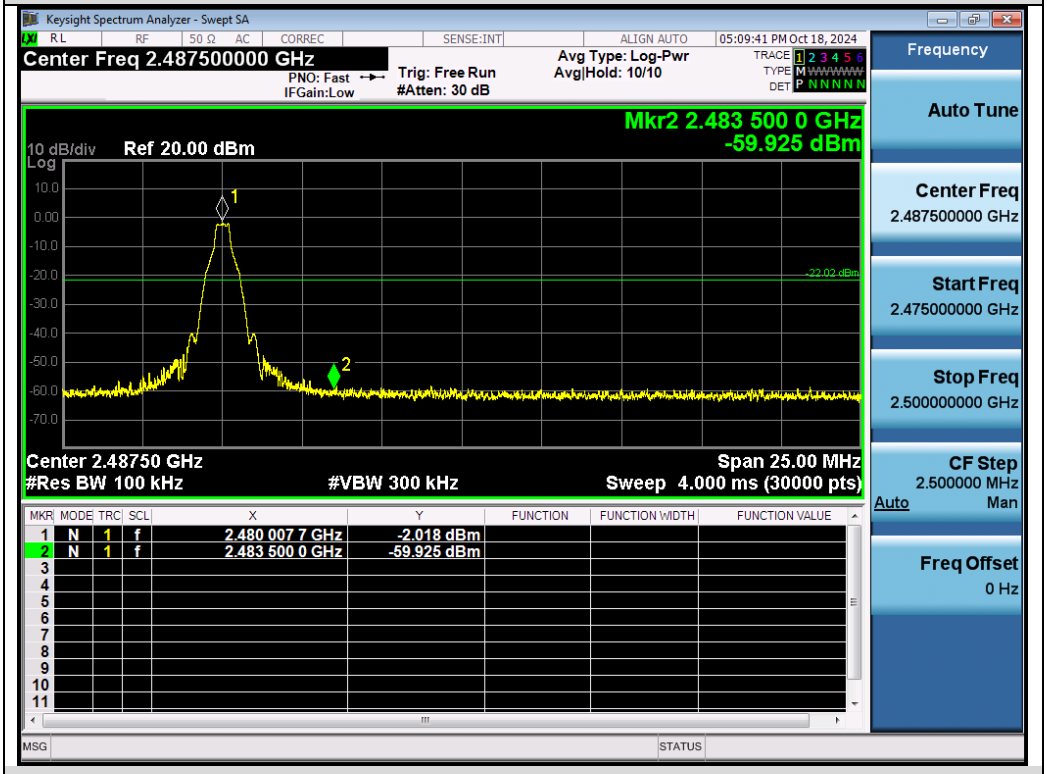


Test_Graph_EDR_ANT1_2480_3Mbps_Higher Band Emissions

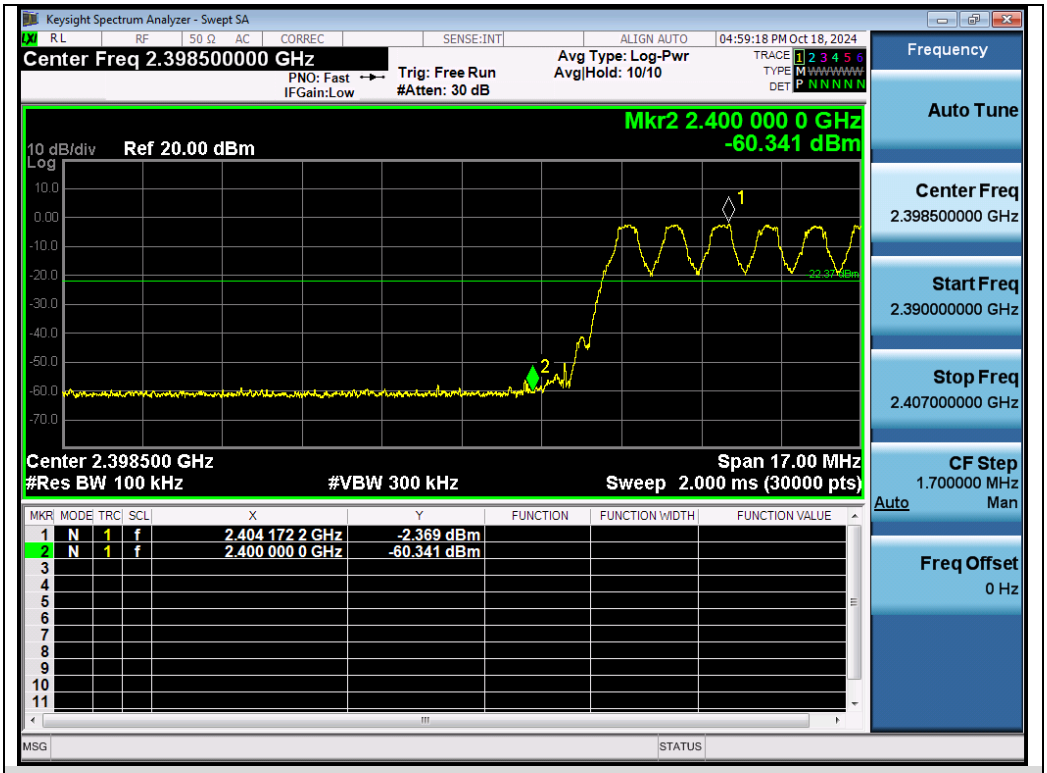
Test Graphs of Band Edge Emissions in Non-Restricted Frequency Bands



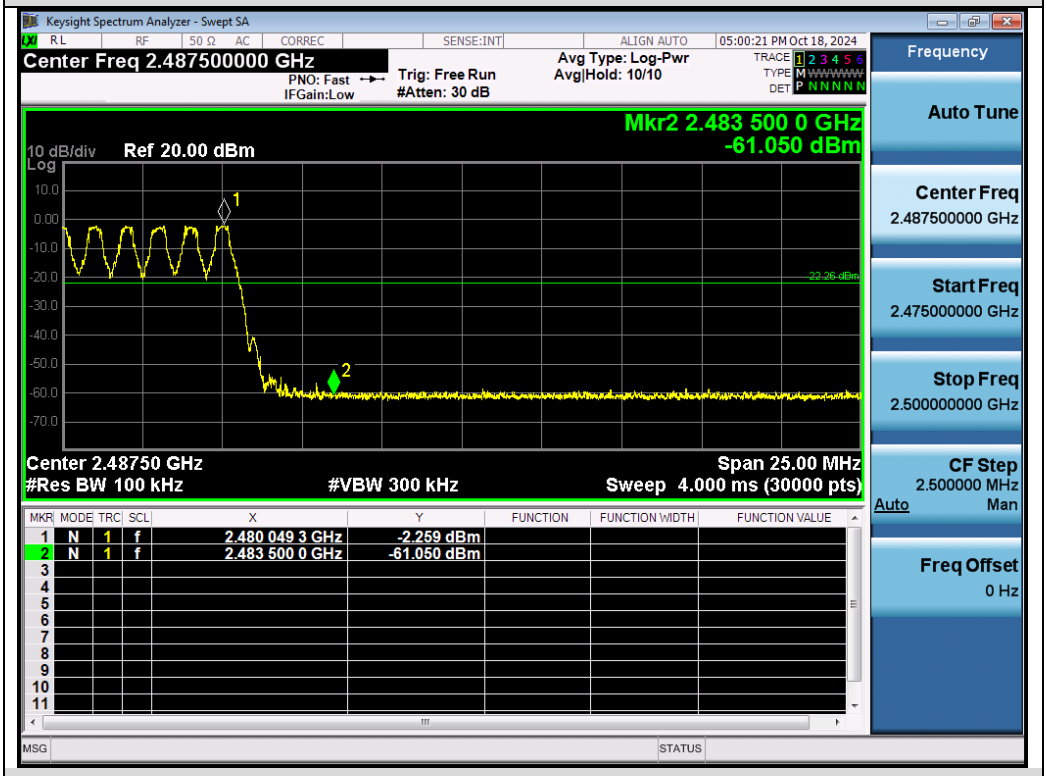
Test_Graph_BR_ANT1_2402_1Mbps_Lower Band Edge Emissions



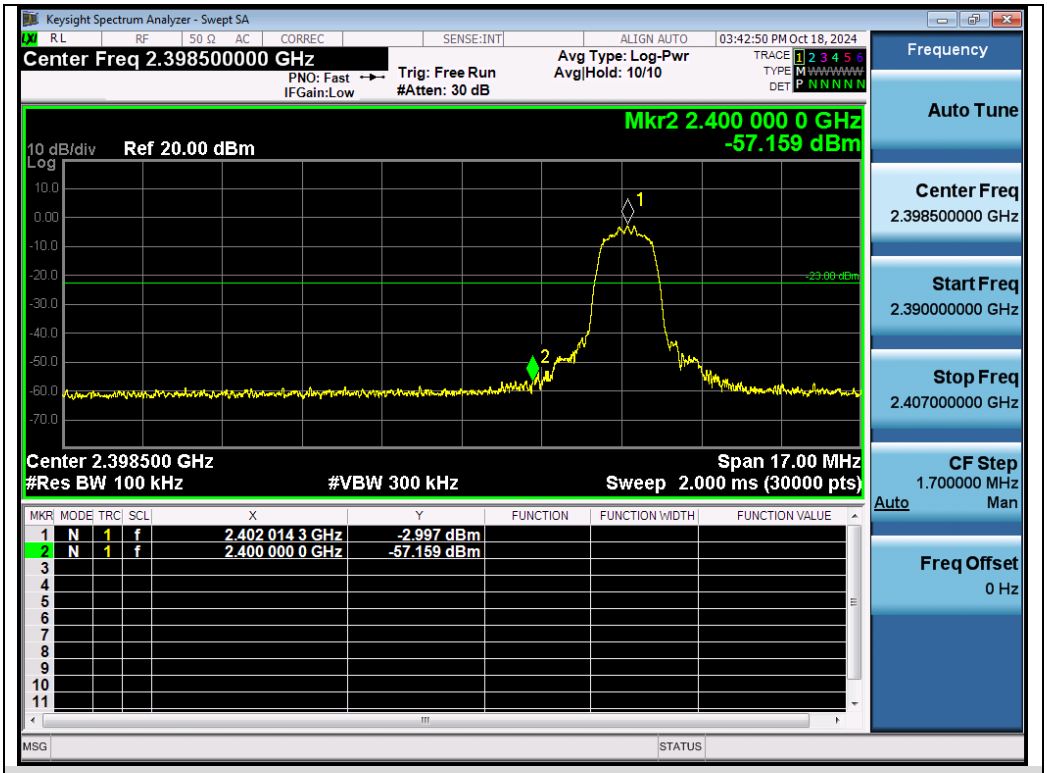
Test_Graph_BR_ANT1_2480_1Mbps_Higher Band Edge Emissions



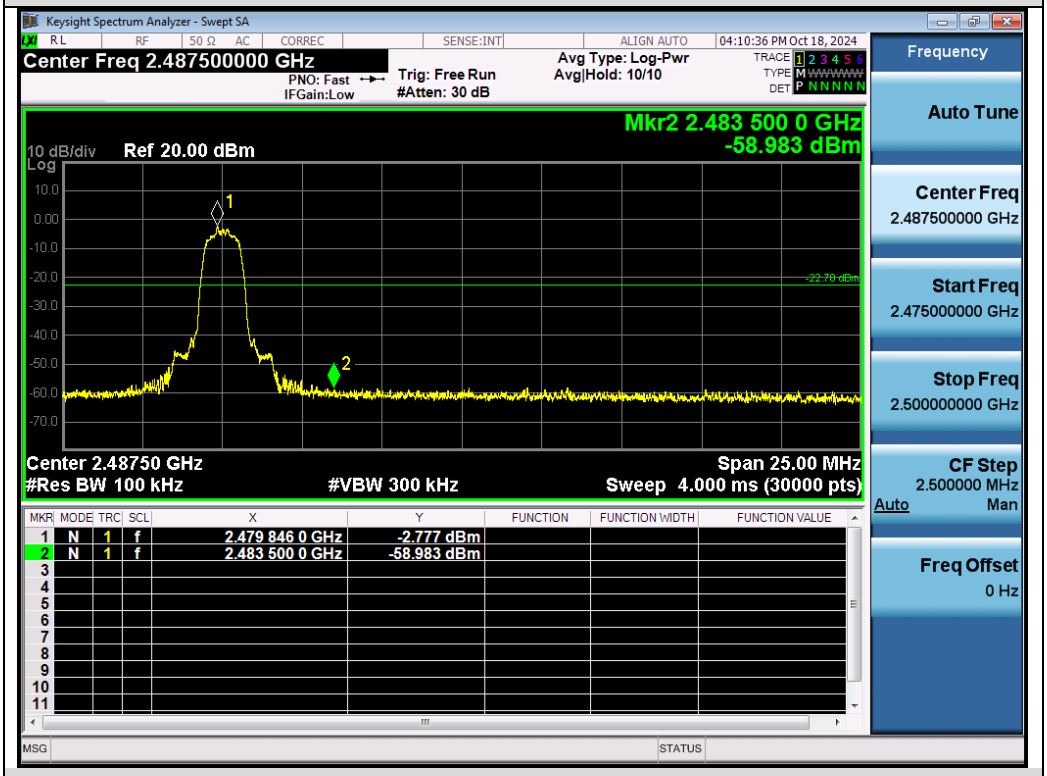
Test_Graph_BR_HOP_ANT1_NA_1Mbps_Lower Band Edge Emissions



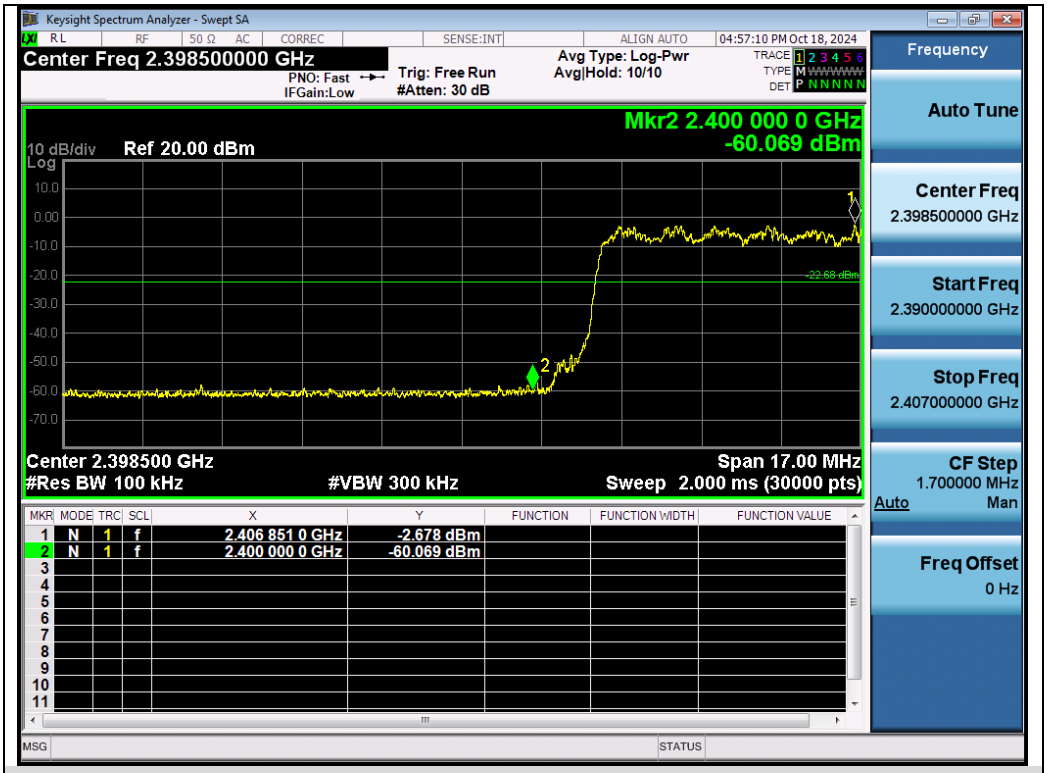
Test_Graph_BR_HOP_ANT1_NA_1Mbps_Higher Band Edge Emissions



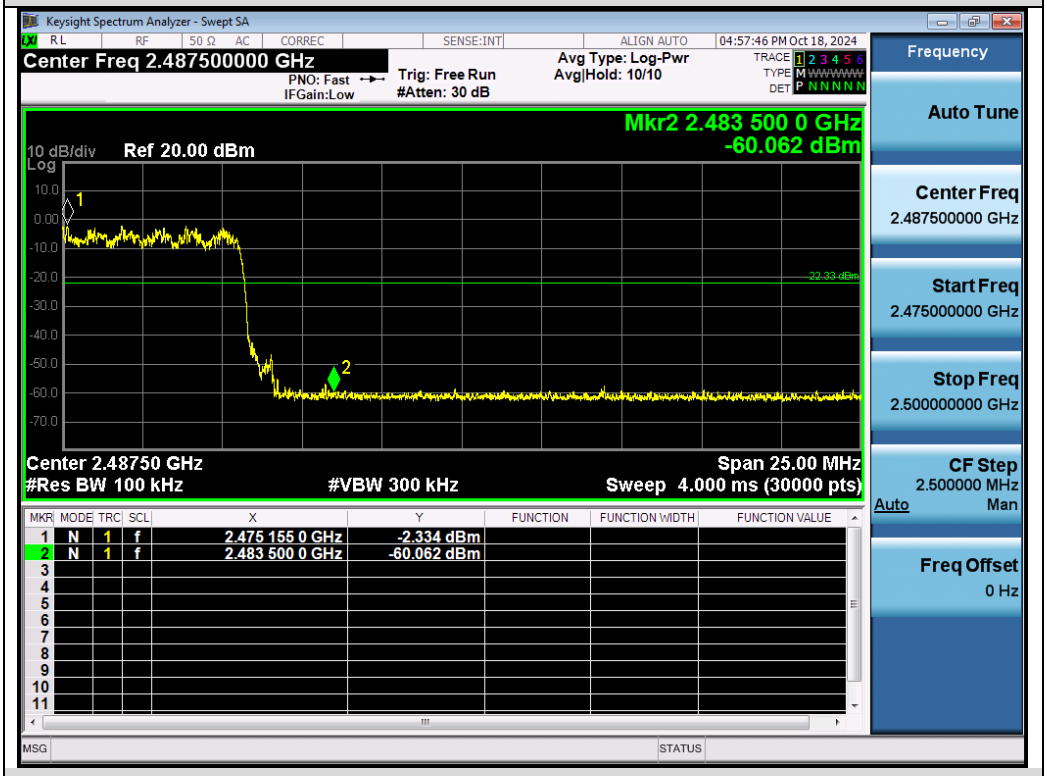
Test_Graph_EDR_ANT1_2402_2Mbps_Lower Band Edge Emissions



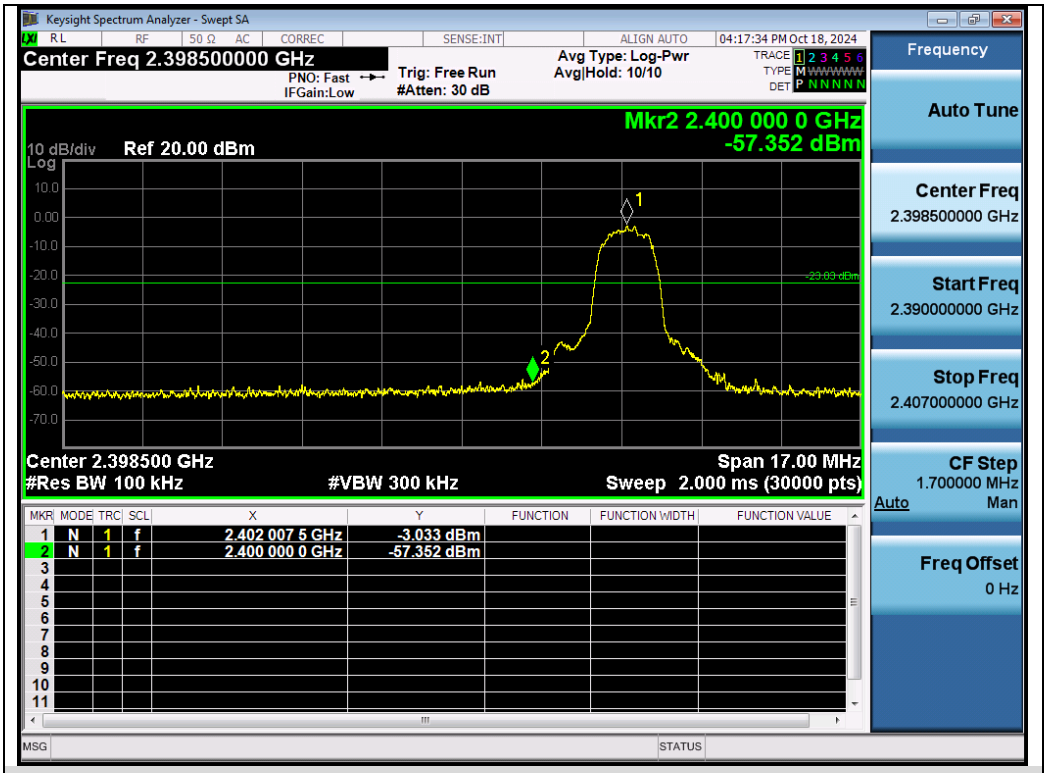
Test_Graph_EDR_ANT1_2480_2Mbps_Higher Band Edge Emissions



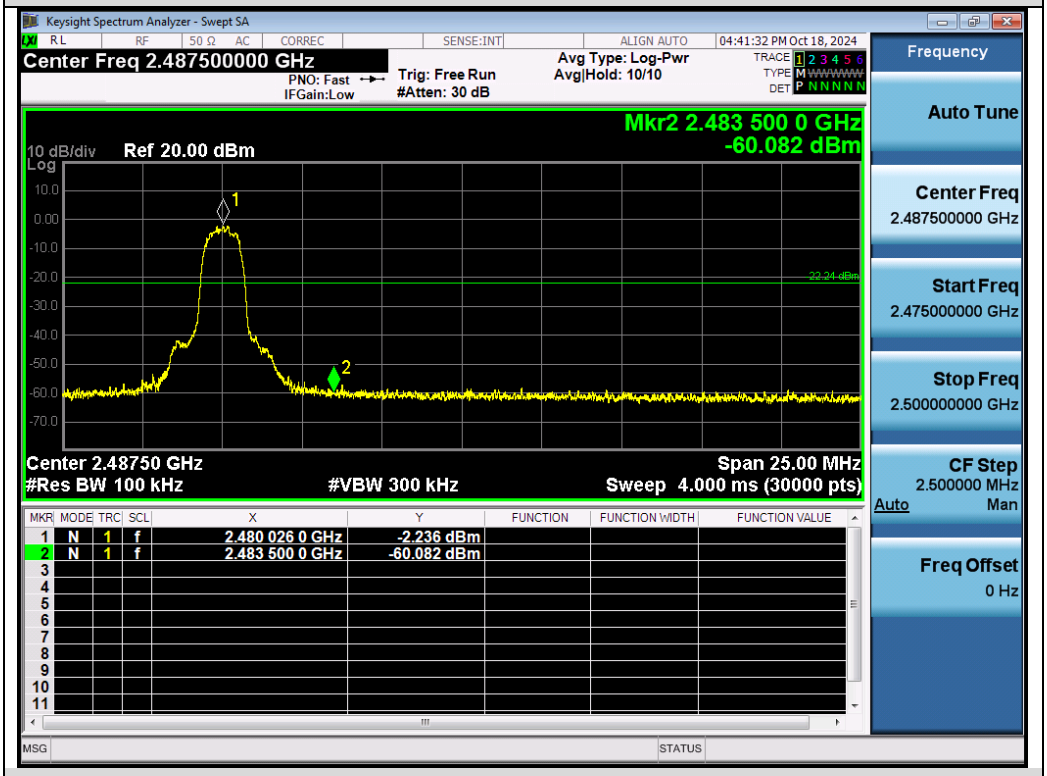
Test_Graph_EDR_HOP_ANT1_NA_2Mbps_Lower Band Edge Emissions



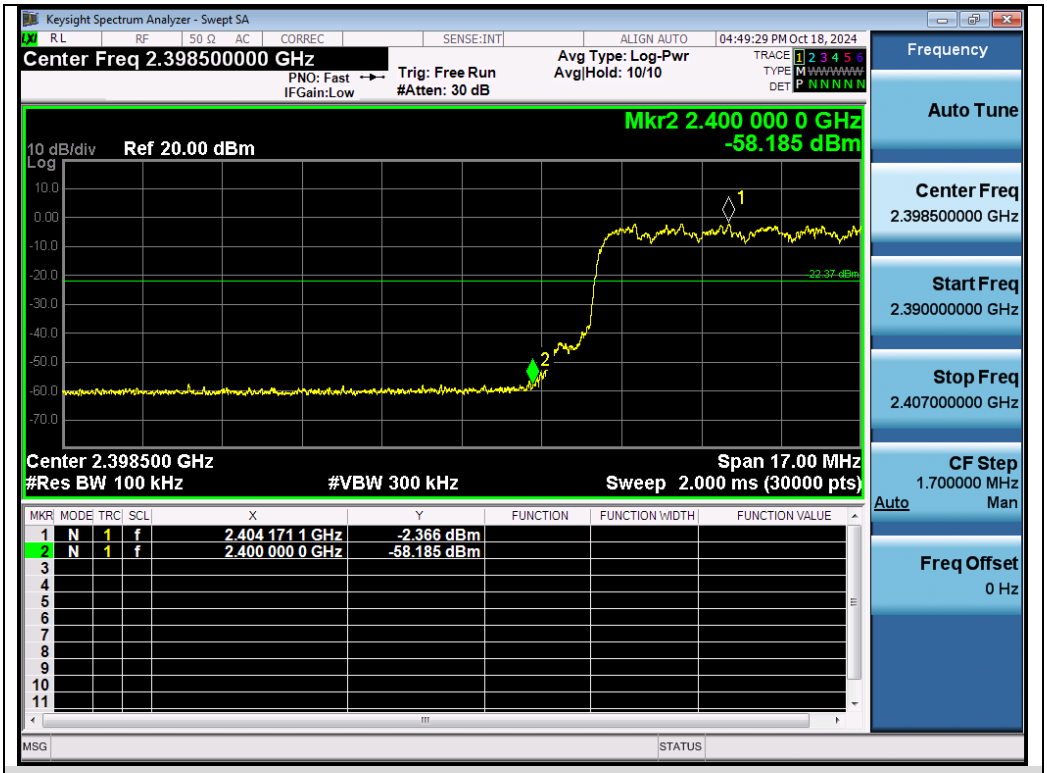
Test_Graph_EDR_HOP_ANT1_NA_2Mbps_Higher Band Edge Emissions



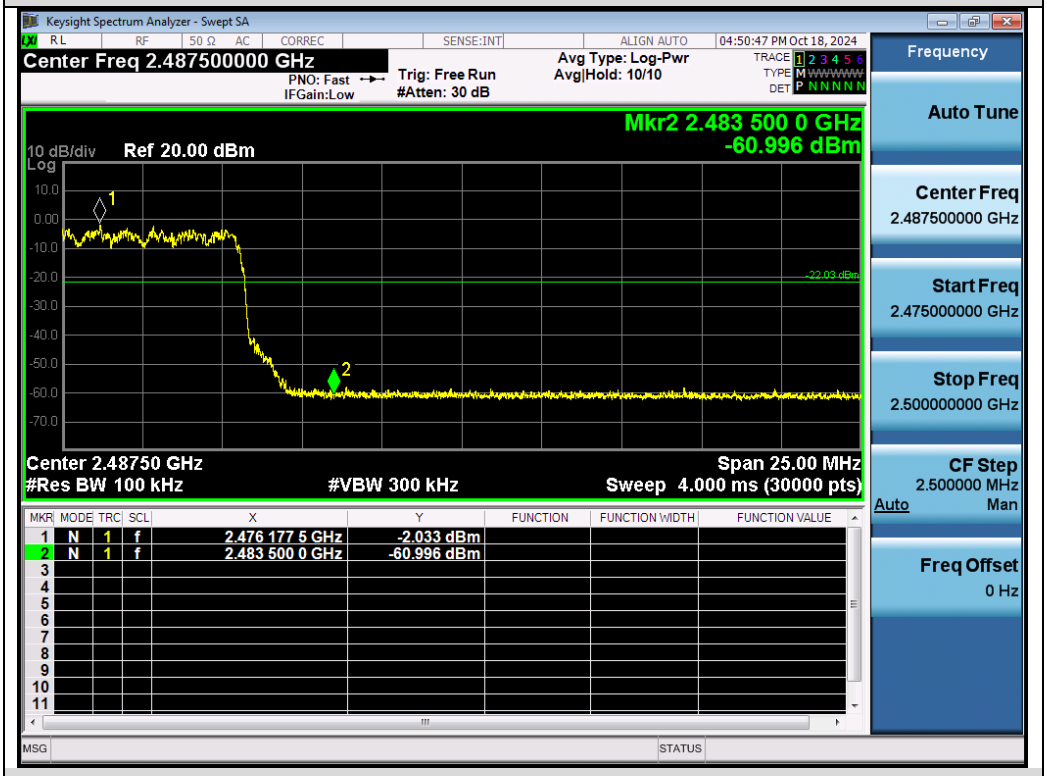
Test_Graph_EDR_ANT1_2402_3Mbps_Lower Band Edge Emissions



Test_Graph_EDR_ANT1_2480_3Mbps_Higher Band Edge Emissions



Test_Graph_EDR_HOP_ANT1_NA_3Mbps_Lower Band Edge Emissions



Test_Graph_EDR_HOP_ANT1_NA_3Mbps_Higher Band Edge Emissions

9. Radiated Spurious Emission

9.1 Measurement Limit

15.209 Limit in the below table has to be followed

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

Note: All modes were tested for restricted band radiated emission, the test records reported below are the worst result compared to other modes.

9.2 Measurement Procedure

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average

absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.

8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/3MHz for Peak, 1MHz/3MHz for Average

Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

- **Quasi-Peak Measurements below 1GHz**

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = as shown in the table above
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

- **Peak Measurements above 1GHz**

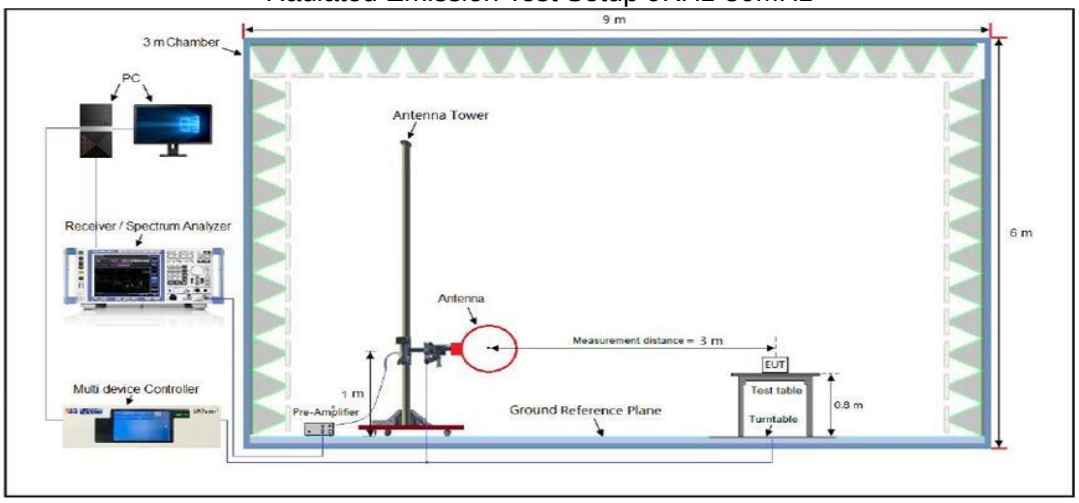
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

- **Average Measurements above 1GHz**

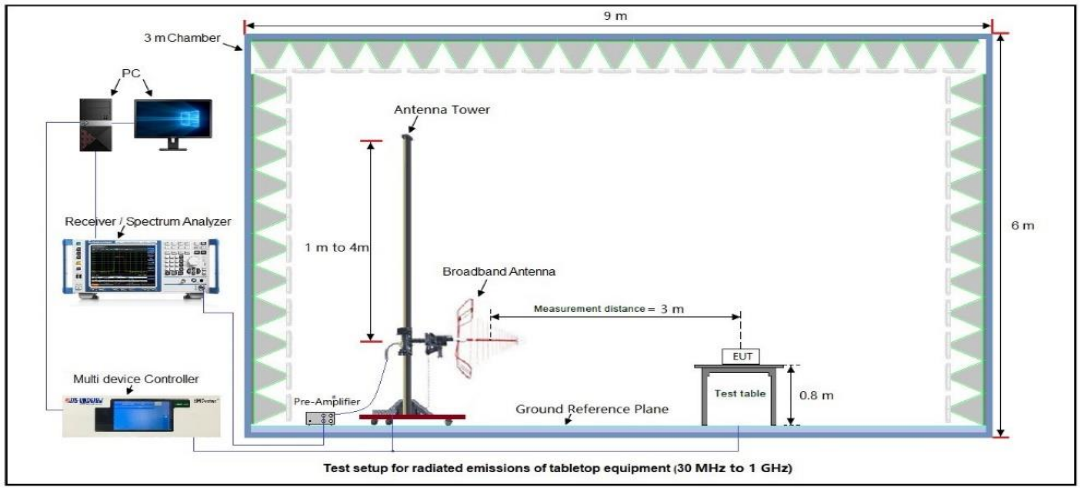
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW ≥ [3 × RBW]
4. Detector = Power averaging (rms)
5. Averaging type = power (i.e., rms)
6. Sweep time = auto
7. Perform a trace average of at least 100 traces.
8. The applicable correction factor is [10*log (1 / D)], where D is the duty cycle. The factor had been edited in the “Input Correction” of the Spectrum Analyzer.

9.3 Measurement Setup (Block Diagram of Configuration)

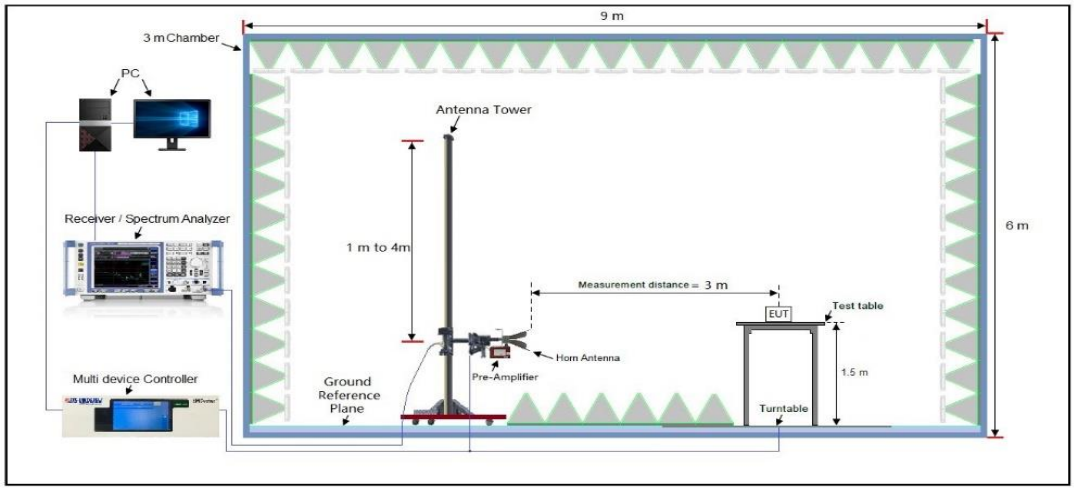
Radiated Emission Test Setup 9KHz-30MHz



Radiated Emission Test Setup 30MHz-1000MHz



Radiated Emission Test Setup Above 1000MHz

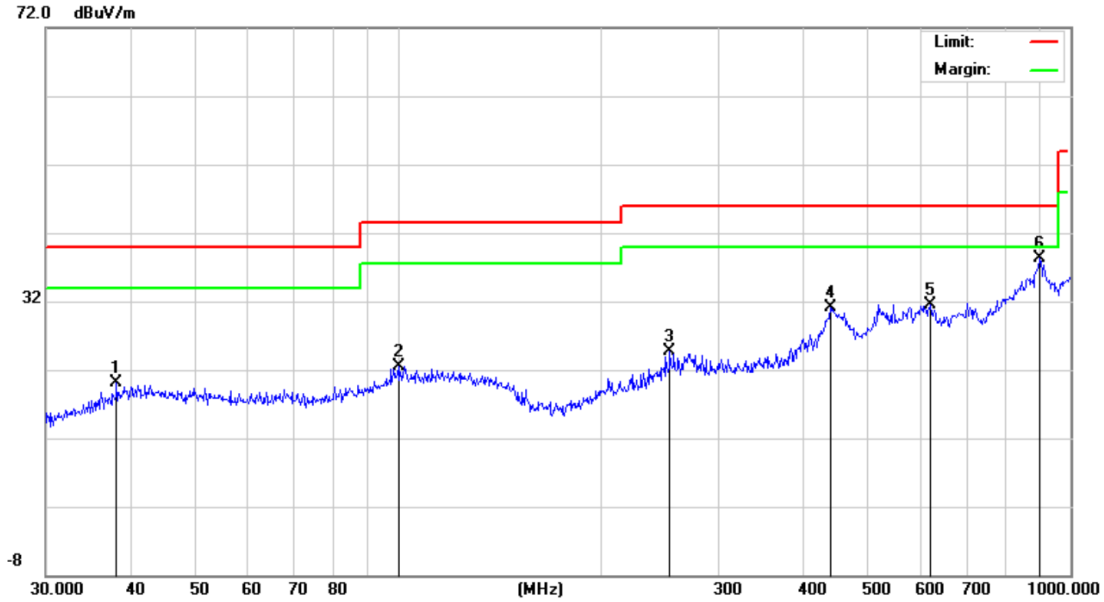


9.4 Measurement Result

Radiated Emission Below 30MHz

The amplitude of spurious emissions from 9kHz to 30MHz which are attenuated more than 20 dB below the permissible value need not be reported.

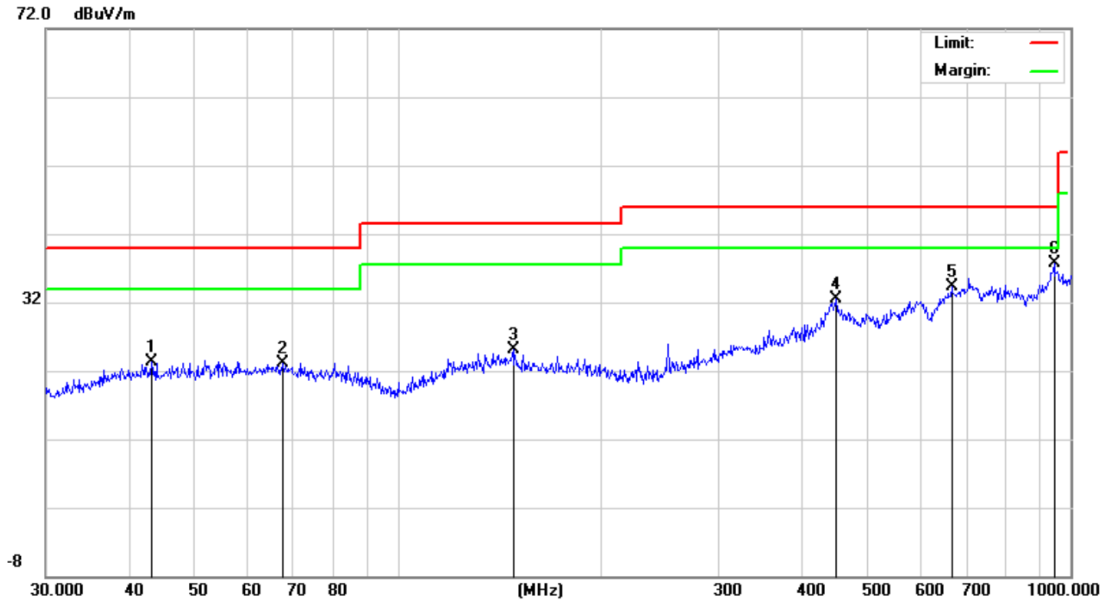
Radiated Emission Test Results at 30MHz-1GHz			
EUT Name	Bluetooth Dongle	**Model Name**	I15
Temperature	23.2℃	**Relative Humidity**	58.6%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 9	**Antenna Polarity**	Horizontal



Final Data List

NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	38.2120	20.17	13.13	40.00	19.83	100	130	Horizontal
2	100.2286	22.59	16.20	43.50	20.91	100	147	Horizontal
3	253.8367	24.75	14.98	46.00	21.25	100	162	Horizontal
4	440.1963	31.16	25.09	46.00	14.84	100	208	Horizontal
5	618.5369	31.48	25.19	46.00	14.52	100	175	Horizontal
6	900.1474	38.34	31.78	46.00	7.66	100	83	Horizontal

Radiated Emission Test Results at 30MHz-1GHz			
EUT Name	Bluetooth Dongle	**Model Name**	I15
Temperature	23.2℃	**Relative Humidity**	58.6%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 9	**Antenna Polarity**	Vertical



Final Data List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	43.0505	23.29	16.93	40.00	16.71	100	72	Vertical
2	67.4382	23.11	17.03	40.00	16.89	100	130	Vertical
3	148.4410	25.03	18.20	43.50	18.47	100	156	Vertical
4	447.9822	32.51	25.74	46.00	13.49	100	42	Vertical
5	665.8035	34.38	27.56	46.00	11.62	100	182	Vertical
6	945.4399	37.61	30.78	46.00	8.39	100	125	Vertical

RESULT: Pass

Note: 1. Factor=Antenna Factor + Cable loss, Margin= Limit-Level.

2. All test modes had been pre-tested. The mode 9 is the worst case and recorded in the report.

Radiated Emissions Test Results Above 1GHz

EUT Name	Bluetooth Dongle	**Model Name**	I15
Temperature	23.2℃	**Relative Humidity**	58.6%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 7	**Antenna Polarity**	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4804.000	45.82	0.08	45.9	74	-28.1	peak
4804.000	38.64	0.08	38.72	54	-15.28	AVG
7206.000	42.51	2.21	44.72	74	-29.28	peak
7206.000	31.79	2.21	34	54	-20	AVG

Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT Name	Bluetooth Dongle	**Model Name**	I15
Temperature	23.2℃	**Relative Humidity**	58.6%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 7	**Antenna Polarity**	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4804.000	45.71	0.08	45.79	74	-28.21	peak
4804.000	38.27	0.08	38.35	54	-15.65	AVG
7206.000	42.19	2.21	44.4	74	-29.6	peak
7206.000	33.66	2.21	35.87	54	-18.13	AVG

Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

RESULT: Pass

Radiated Emissions Test Results for Above 1GHz

EUT Name	Bluetooth Dongle	Model Name	I15
Temperature	23.2℃	Relative Humidity	58.6%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 8	Antenna Polarity	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4882.000	45.24	0.14	45.38	74	-28.62	peak
4882.000	38.56	0.14	38.7	54	-15.3	AVG
7323.000	41.81	2.36	44.17	74	-29.83	peak
7323.000	34.37	2.36	36.73	54	-17.27	AVG

Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

EUT Name	Bluetooth Dongle	Model Name	I15
Temperature	23.2℃	Relative Humidity	58.6%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 8	Antenna Polarity	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4882.000	45.28	0.14	45.42	74	-28.58	peak
4882.000	37.95	0.14	38.09	54	-15.91	AVG
7323.000	41.72	2.36	44.08	74	-29.92	peak
7323.000	32.38	2.36	34.74	54	-19.26	AVG

Remark:
Factor = Antenna Factor + Cable Loss – Pre-amplifier.

RESULT: Pass

Radiated Emissions Test Results for Above 1GHz

EUT Name	Bluetooth Dongle	**Model Name**	I15
Temperature	23.2℃	**Relative Humidity**	58.6%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 9	**Antenna Polarity**	Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4960.000	46.25	0.22	46.47	74	-27.53	peak
4960.000	38.41	0.22	38.63	54	-15.37	AVG
7440.000	41.28	2.64	43.92	74	-30.08	peak
7440.000	32.56	2.64	35.2	54	-18.8	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

EUT Name	Bluetooth Dongle	**Model Name**	I15
Temperature	23.2℃	**Relative Humidity**	58.6%
Pressure	960hPa	**Test Voltage**	Normal Voltage
Test Mode	Mode 9	**Antenna Polarity**	Vertical

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Value Type
4960.000	46.19	0.22	46.41	74	-27.59	peak
4960.000	38.27	0.22	38.49	54	-15.51	AVG
7440.000	41.95	2.64	44.59	74	-29.41	peak
7440.000	31.74	2.64	34.38	54	-19.62	AVG
Remark:						
Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

RESULT: Pass

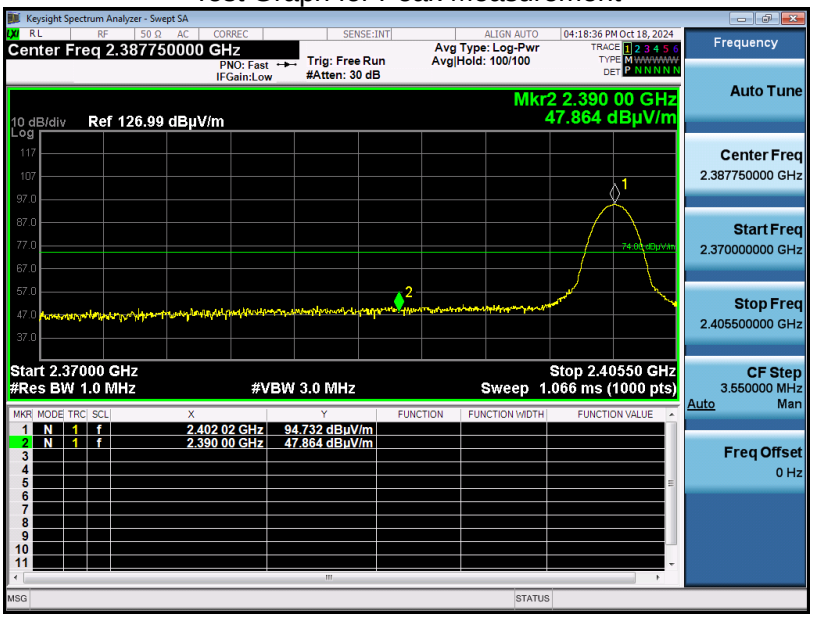
Note:

1. The amplitude of other spurious emissions from 1G to 25 GHz which are attenuated more than 20 dB below the permissible value need not be reported.
2. Factor = Antenna Factor + Cable loss – Pre-amplifier gain, Margin =Emission Level-Limit.
3. The “Factor” value can be calculated automatically by software of measurement system.
4. All mode rates are tested and evaluated, 8DPSK modulated 3DH5 mode is the worst case and documented in the report.

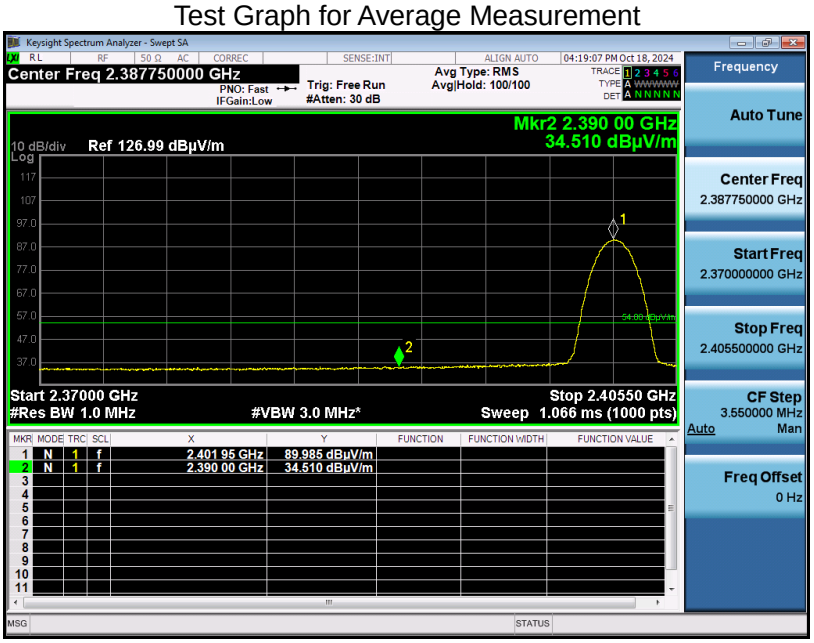
Band Edge Emission Test Results for Restricted Bands

EUT Name	Bluetooth Dongle	Model Name	I15
Temperature	26.2℃	Relative Humidity	59.0%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 7	Antenna Polarity	Horizontal

Test Graph for Peak Measurement



Test Graph for Average Measurement

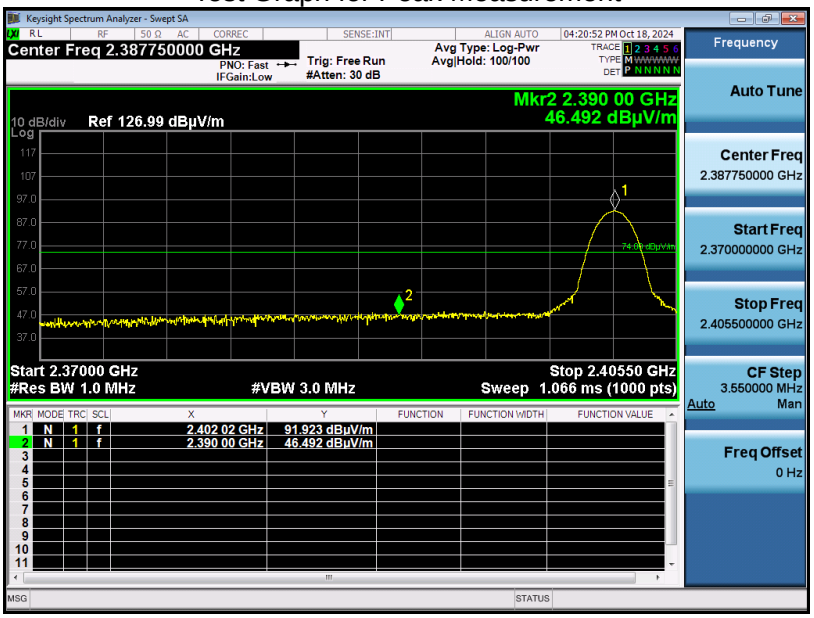


RESULT: Pass

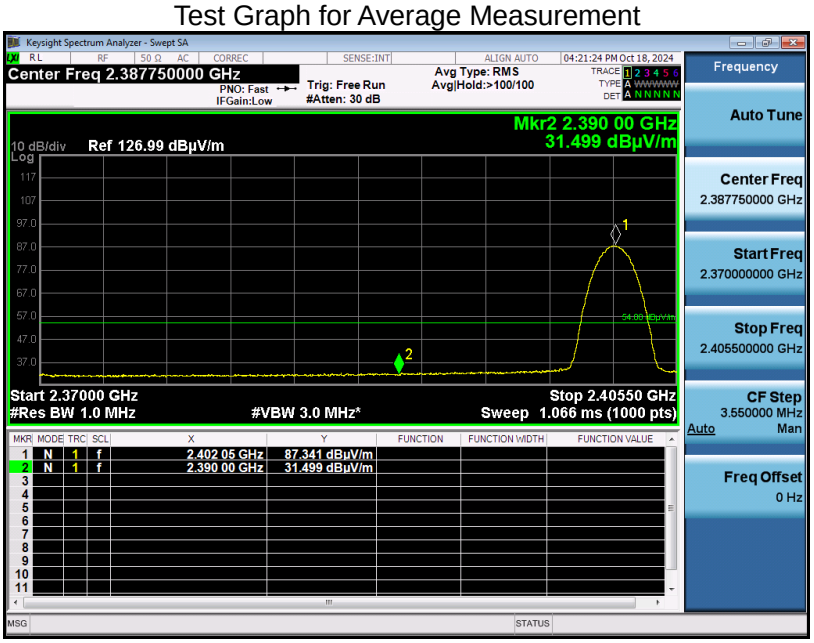
Band Edge Emission Test Results for Restricted Bands

EUT Name	Bluetooth Dongle	Model Name	I15
Temperature	26.2℃	Relative Humidity	59.0%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 7	Antenna Polarity	Vertical

Test Graph for Peak Measurement



Test Graph for Average Measurement

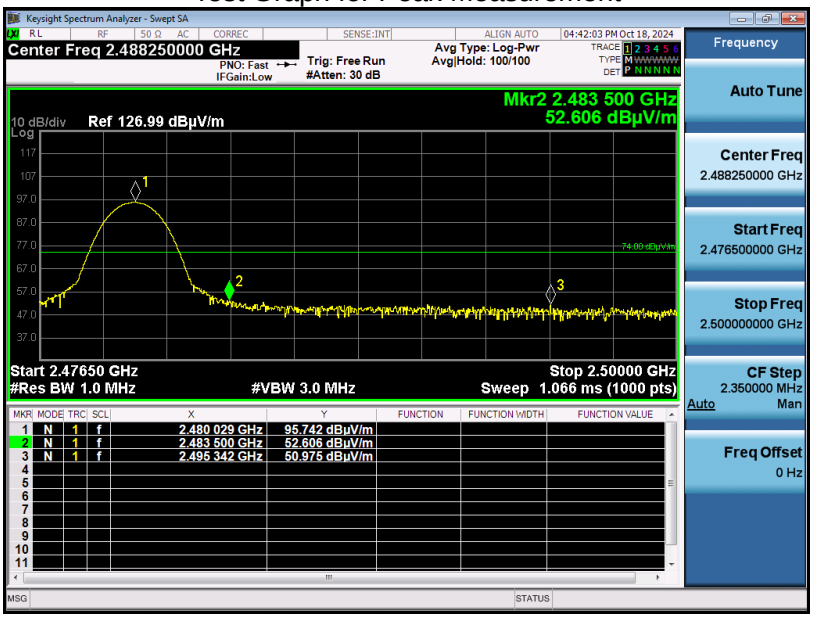


RESULT: Pass

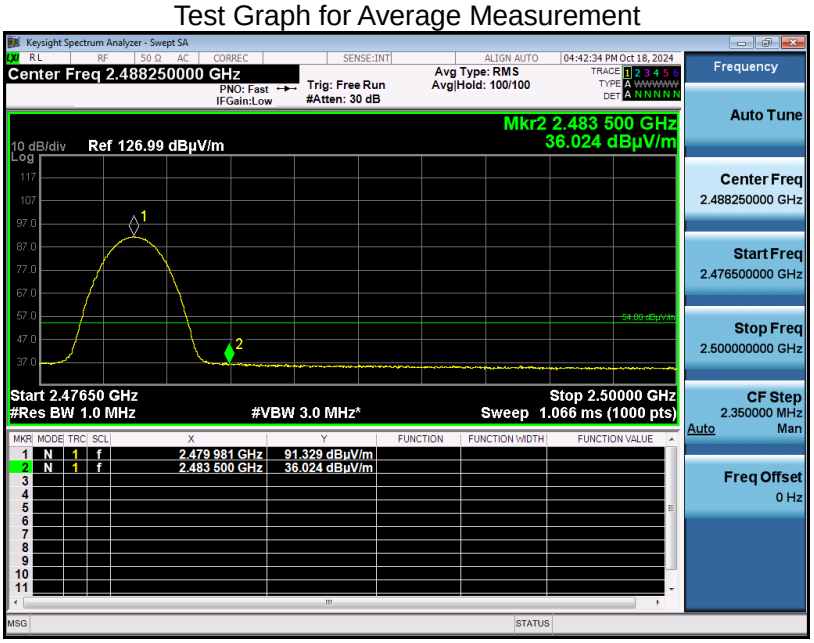
Band Edge Emission Test Results for Restricted Bands

EUT Name	Bluetooth Dongle	Model Name	I15
Temperature	26.2℃	Relative Humidity	59.0%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 9	Antenna Polarity	Horizontal

Test Graph for Peak Measurement



Test Graph for Average Measurement

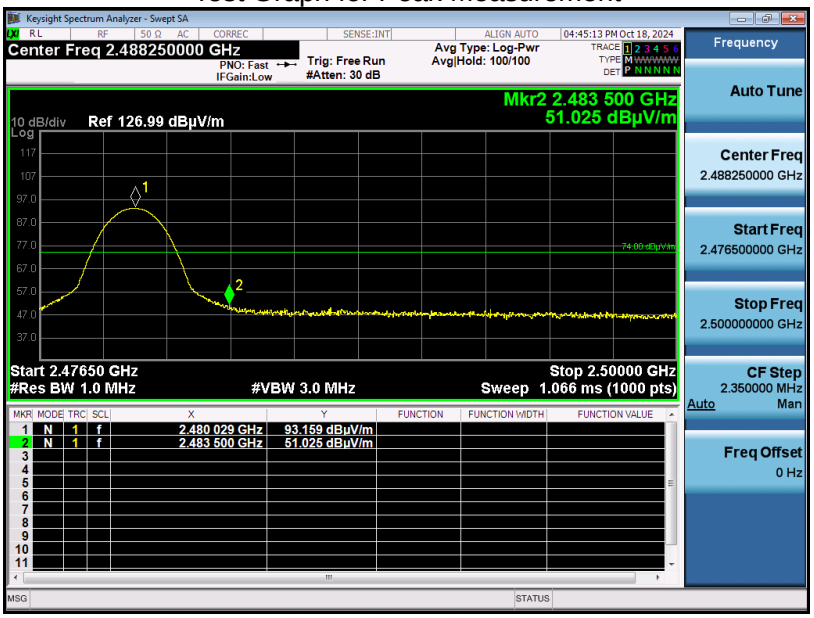


RESULT: Pass

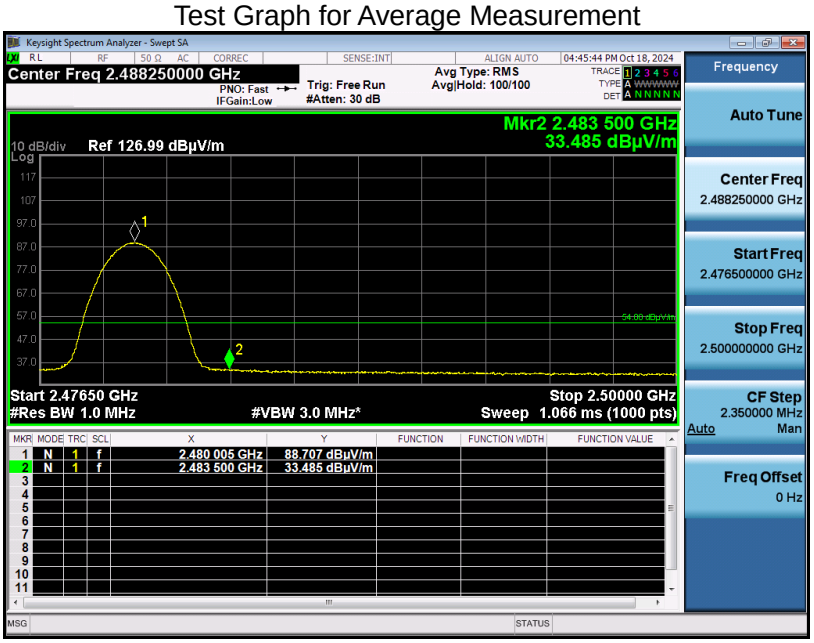
Band Edge Emission Test Results for Restricted Bands

EUT Name	Bluetooth Dongle	Model Name	I15
Temperature	26.2℃	Relative Humidity	59.0%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 9	Antenna Polarity	Vertical

Test Graph for Peak Measurement



Test Graph for Average Measurement



RESULT: Pass

Note: The factor had been edited in the “Input Correction” of the Spectrum Analyzer. All mode rates are tested and evaluated, 8DPSK modulated 3DH5 mode is the worst case and documented in the report.

10. Number of Hopping Frequency Measurement

10.1 Provisions Applicable

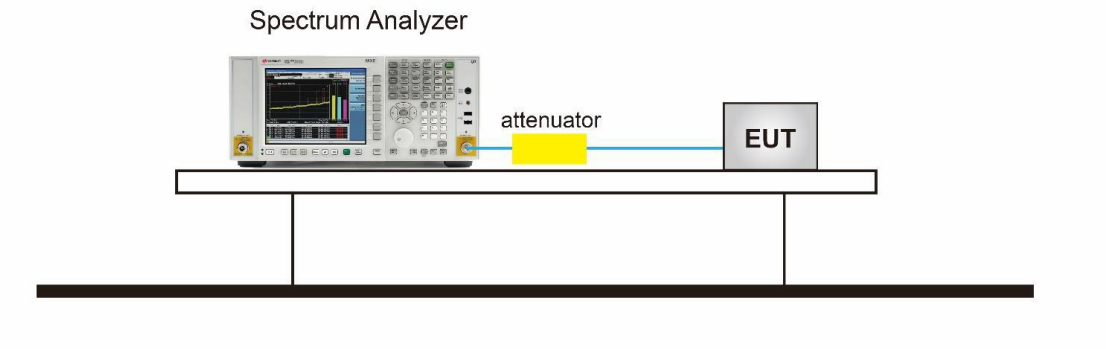
This frequency hopping system must employ a minimum of 15 hopping channels.

10.2 Measurement Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span = The frequency band of operation. Depending on the number of channels the device
2. supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
3. RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
4. VBW ⩾ RBW
5. Sweep time = Auto couple
6. Detector = Peak
7. Trace mode = Max hold
8. Allow the trace to stabilize

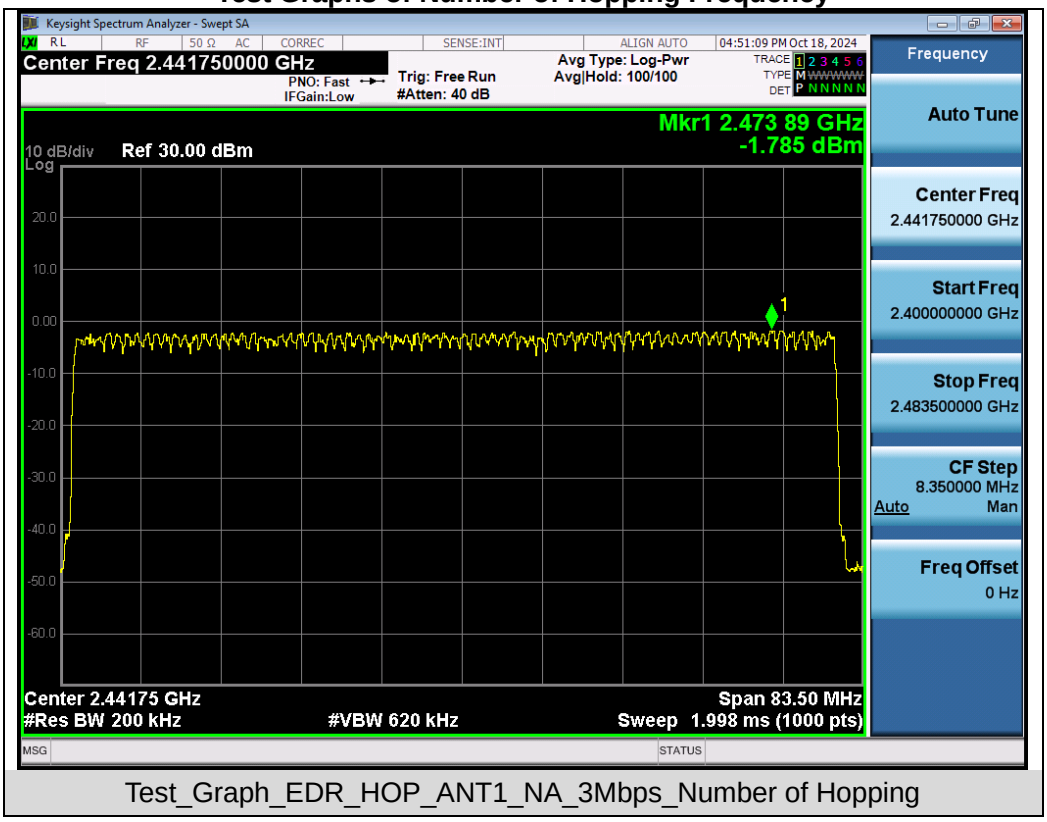
10.3 Measurement Setup (Block Diagram of Configuration)



10.4 Measurement Result

Test Data of Number of Hopping Frequency			
Test Mode	Number of Hopping Frequency	Limits	Pass or Fail
8DPSK Hopping	79	>=15	Pass

Test Graphs of Number of Hopping Frequency



Test_Graph_EDR_HOP_ANT1_NA_3Mbps_Number of Hopping

Note: All mode rates are tested and evaluated, 8DPSK modulated 3DH5 mode is the worst case and documented in the report.

11. Time of Occupancy (Dwell Time) Measurement

11.1 Provisions Applicable

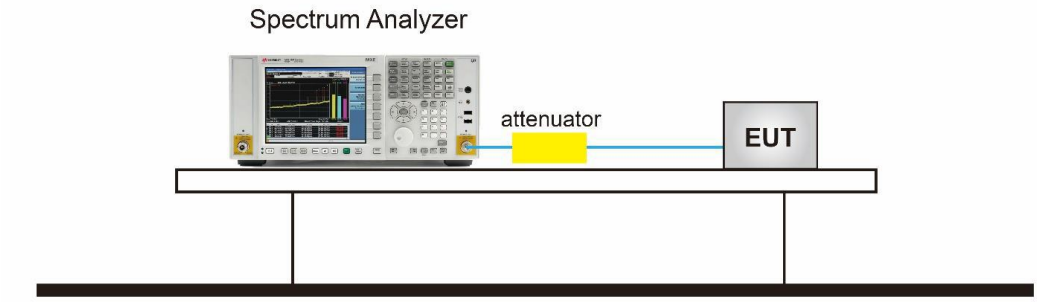
The maximum permissible time of occupancy is 400ms within a period of 400ms multiplied by the number of hopping channels employed.

11.2 Measurement Procedure

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1. Span = Zero span, centered on a hopping channel.
2. RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
3. VBW ≥ RBW
4. Sweep time = As necessary to capture the entire dwell time per hopping channel
5. Detector = Peak
6. Trace mode = Free Run
7. Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time. An oscilloscope may be used instead of a spectrum analyzer. The EUT shall show compliance with the appropriate regulatory limit for the number of hopping channels. A plot of the data shall be included in the test report.

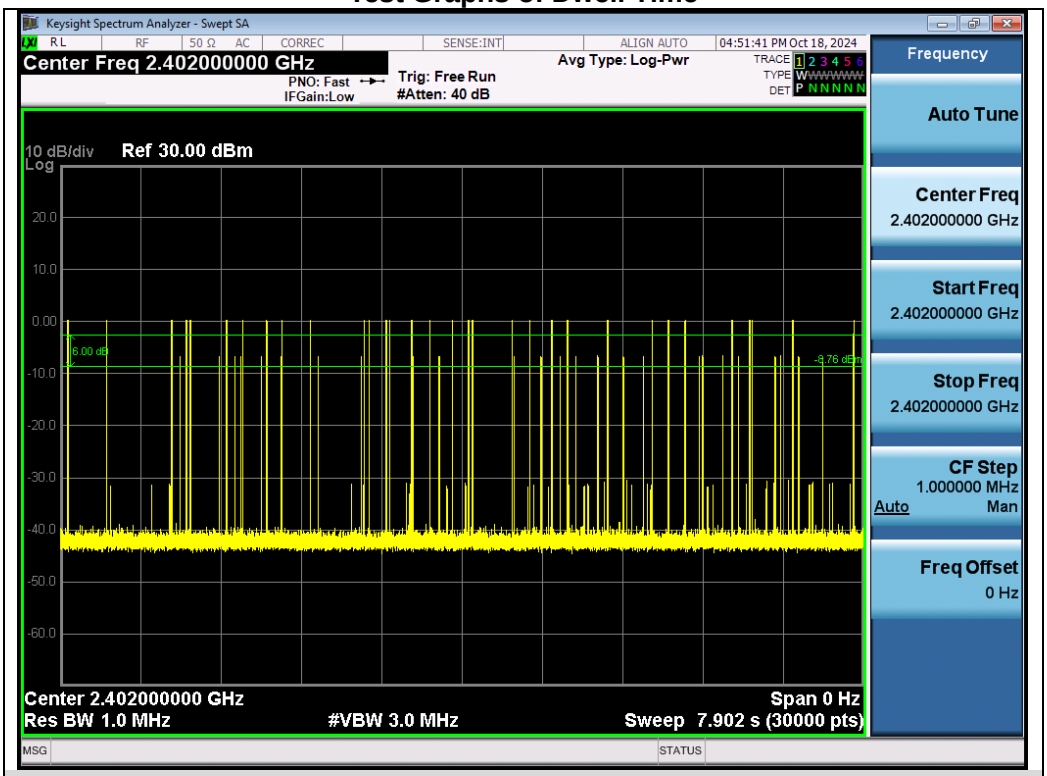
11.3 Measurement Setup (Block Diagram of Configuration)



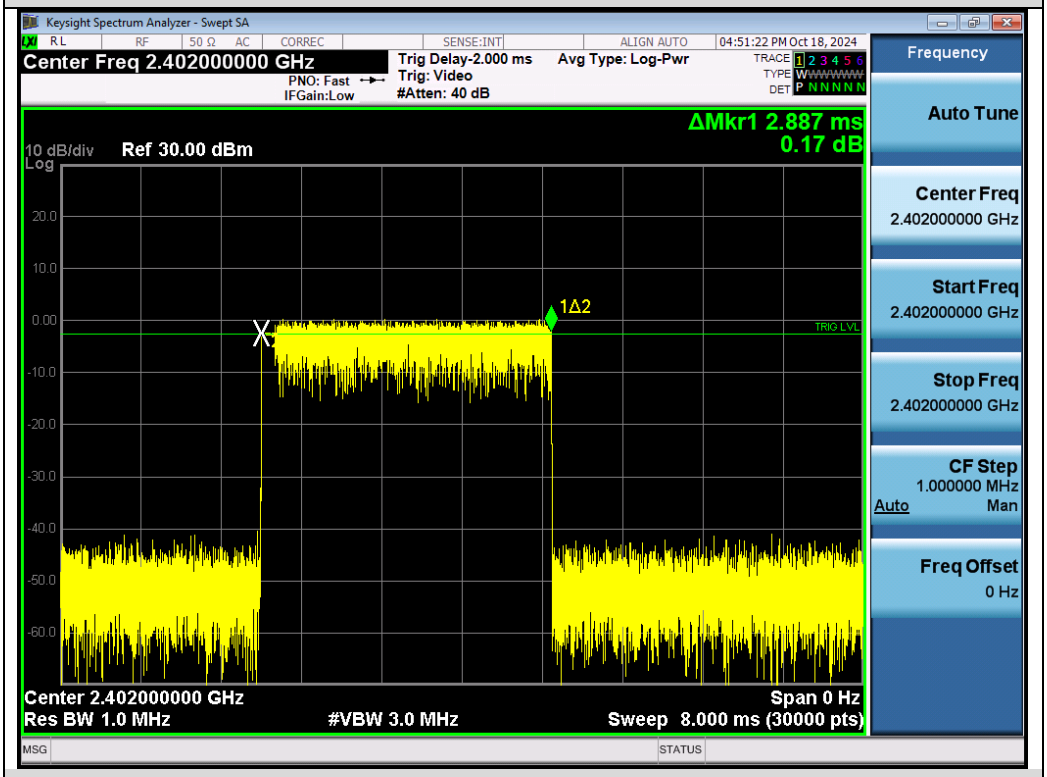
11.4 Measurement Result

Test Data of Dwell Time					
Channel	Time of Pulse for 3DH5 (ms)	Number of hops in the period specified in the requirements	Dwell Time (ms)	Limit (ms)	Pass or Fail
2402	2.887	32.0*4	369.536	400	Pass
2441	2.887	22.0*4	254.056	400	Pass
2480	2.887	24.0*4	277.152	400	Pass

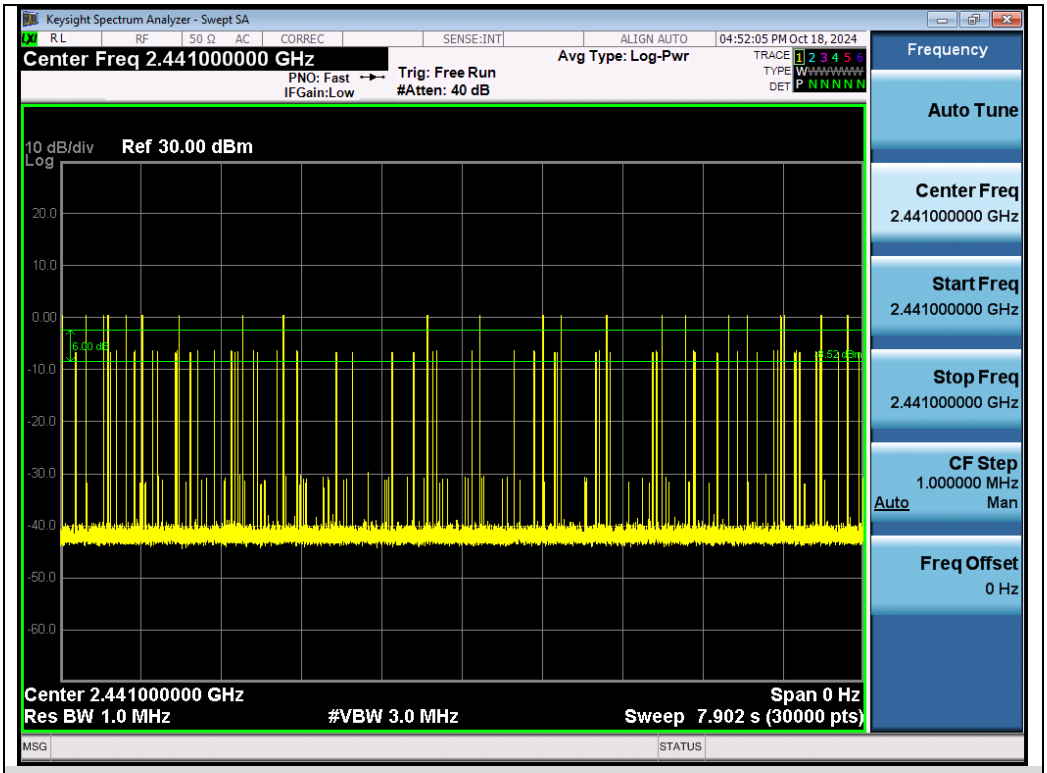
Test Graphs of Dwell Time



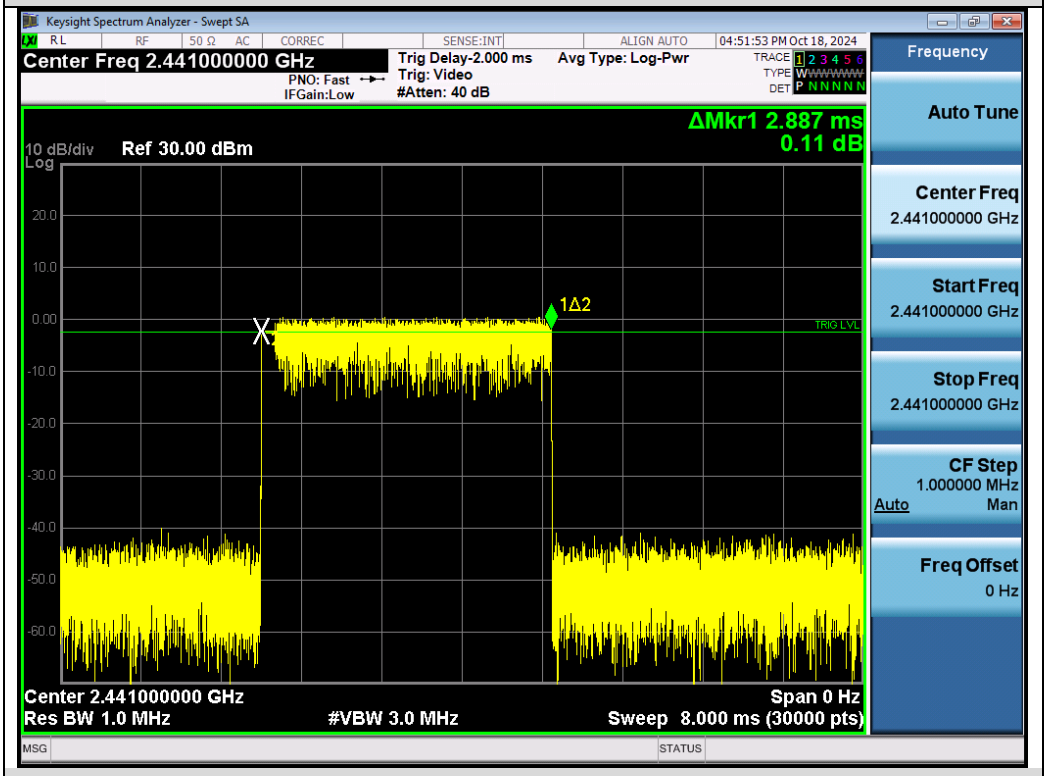
Test_Graph_EDR_HOP_ANT1_NA_3Mbps_2402_Number of Busrt



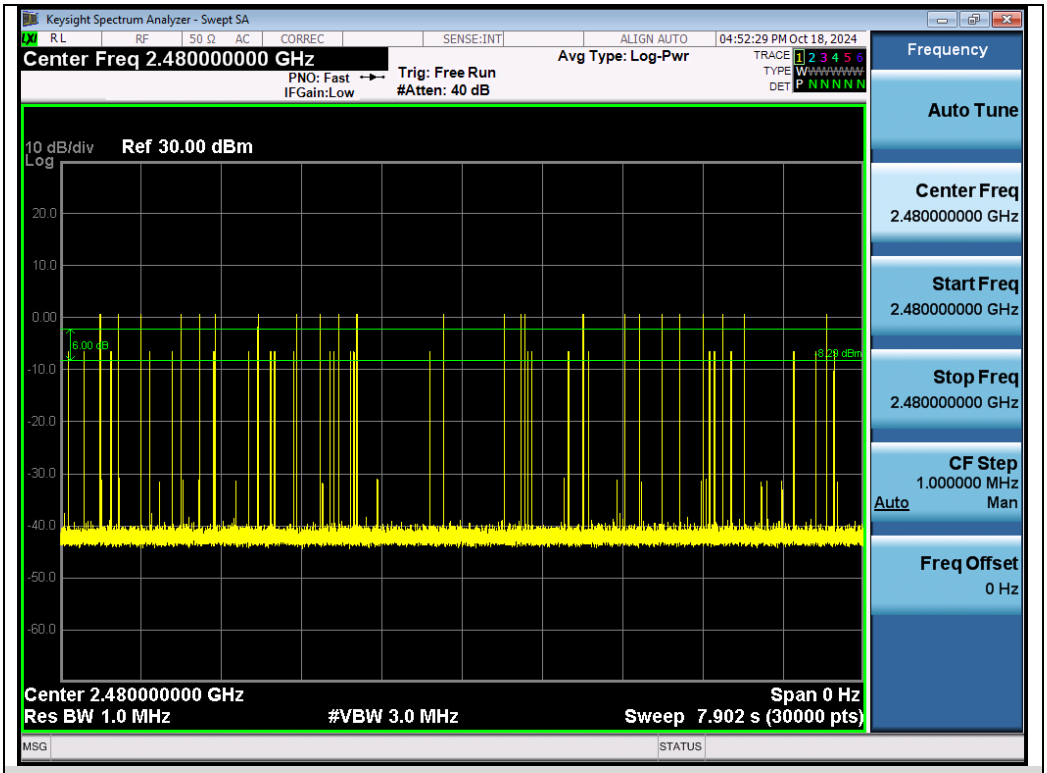
Test_Graph_EDR_HOP_ANT1_NA_3Mbps_2402_Time per Burst



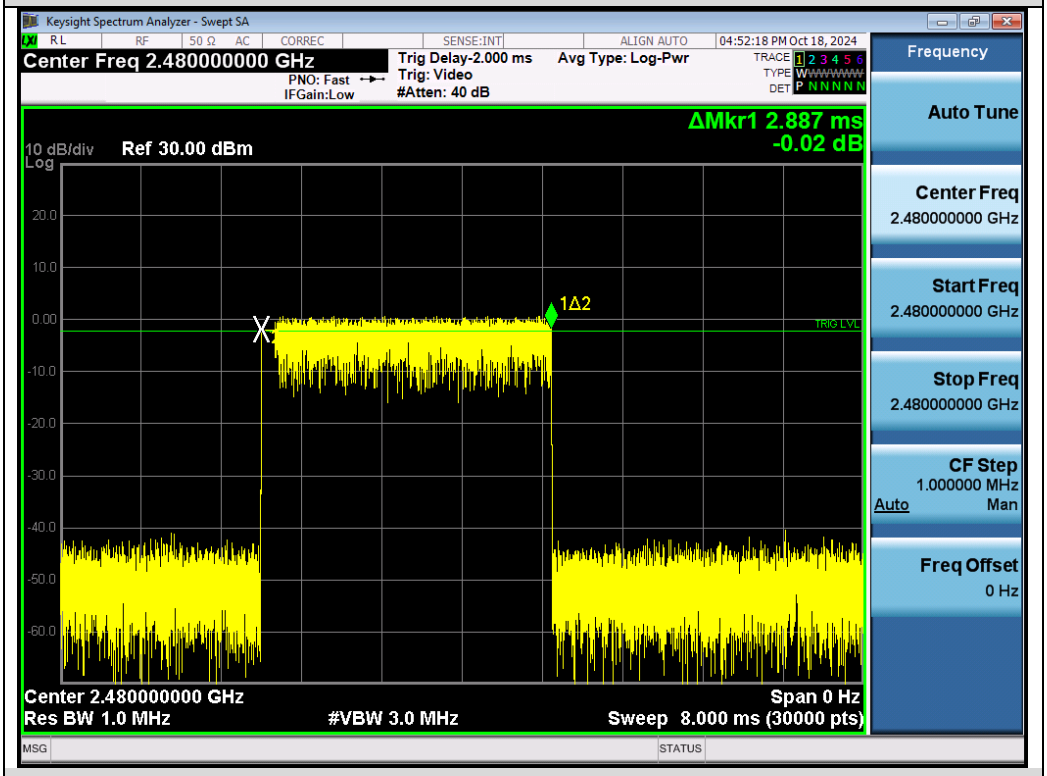
Test_Graph_EDR_HOP_ANT1_NA_3Mbps_2441_Number of Busrt



Test_Graph_EDR_HOP_ANT1_NA_3Mbps_2441_Time per Burst



Test_Graph_EDR_HOP_ANT1_NA_3Mbps_2480_Number of Busrt



Test_Graph_EDR_HOP_ANT1_NA_3Mbps_2480_Time per Burst

Note: All mode rates are tested and evaluated, 8DPSK modulated 3DH5 mode is the worst case and documented in the report.