

TEST REPORT

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94085
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America
Report Number: 2501S51596E-RFA
FCC ID: 2APWA-VZ23GE
IC: 4478A-VZ23GE

Test Standard (s)

FCC PART 15.247; RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2;
RSS-247 ISSUE 3, AUGUST 2023

Sample Description

Product Type: Gigabit SIP IP Phone
Model No.: Z 23GE
Multiple Model(s) No.: N/A
Trade Mark: N/A
Date Received: 2025-04-03
Issue Date: 2025-06-13

Test Result:	Pass▲
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▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

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Ekko Wu
RF Engineer

Approved By:

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2501S51596E-RFA	Original Report	2025-06-13

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

HVIN	VZ23GE
FVIN	Z 23GE
Frequency Range	2402~2480MHz
Transmit Peak Power	10.17dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification[#]	2.2dBi (provided by the applicant)
Voltage Range	DC 5V from adapter or DC 48V from PoE
Sample serial number	30WR-2 for Conducted and Radiated Emissions Test 30WR-1 for RF Conducted Test (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	Model: DCT12W050200US-A2 Input: AC 100-240V, 50/60Hz 0.3A max. Output: DC 5.0V, 2.0A

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commissions rules and RSS-247 Issue 3, August 2023, RSS-GEN Issue 5, Feb. 2021Amendment 2 of the Innovation, Science and Economic Development Canada rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2020, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and RSS-247 Issue 3, August 2023, RSS-GEN Issue 5, Feb. 2021Amendment 2 of the Innovation, Science and Economic Development Canada rules.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		109.2kHz(k=2, 95% level of confidence)
RF output power, conducted		0.86dB(k=2, 95% level of confidence)
Dwell Time		±1%(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz-150kHz	3.63dB(k=2, 95% level of confidence)
	150kHz-30MHz	3.66dB(k=2, 95% level of confidence)
Radiated Emissions	0.009MHz~30MHz	3.60dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	5.32dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	5.43dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	5.77dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.73dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.34dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.40dB(k=2, 95% level of confidence)
	18GHz - 40GHz	5.64dB(k=2, 95% level of confidence)
Temperature		±1°C
Humidity		±1%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0023.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	40	2442
1	2403	41	2443
2	2404	42	2444
...
...
36	2438	75	2477
37	2439	76	2478
38	2440	77	2479
39	2441	78	2480

EUT was tested with Channel 0, 39 and 78.

EUT Exercise Software

Exercise Software [#]	SecureCRTPortable.exe
Power Level [#]	0

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	PC	Latitude E5430	37K4X AOO
HIKVISION	Router	DS-3WR03	10021642429
GOSPEL	PoE	G0720-480-050	200200019
SUOSHI	USB disk	S1256J	/
snom	Earphone	A100D	100D4342013597
BULL	Receptacle	GN-415K	5503290068073

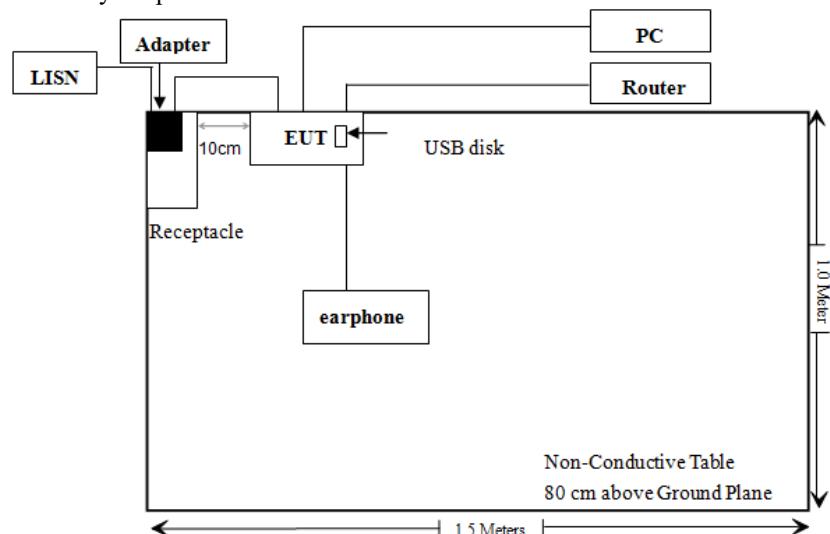
External I/O Cable

Cable Description	Length (m)	From Port	To
Unshielded detachable AC cable	1.0	Receptacle	LISN/AC Mains
Unshielded un-detachable DC cable	1.5	adapter	EUT
Unshielded un-detachable audio cable	1.0	EUT	Earphone
Unshielded detachable RJ45 cable	5.0	EUT	PC
Unshielded detachable RJ45 cable	5.0	EUT	Router
Unshielded detachable AC cable	1.0	Receptacle	PoE
Unshielded detachable RJ45 cable	1.0	PoE	EUT

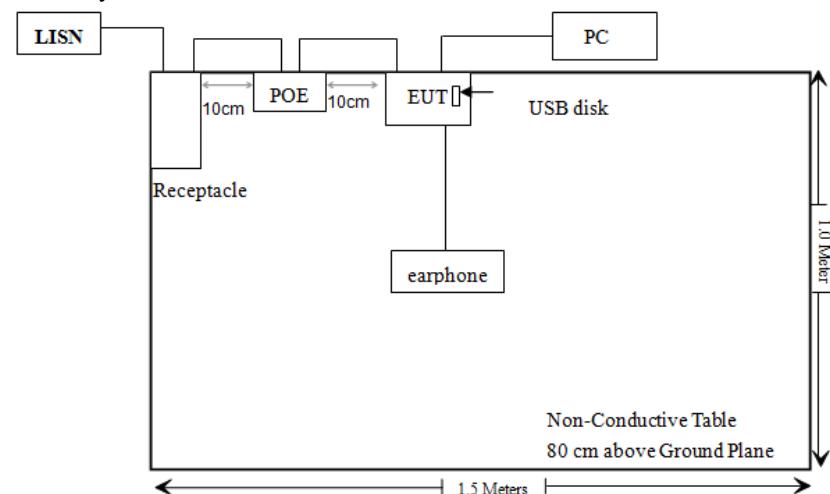
Block Diagram of Test Setup

For Conducted Emissions:

Power by adapter

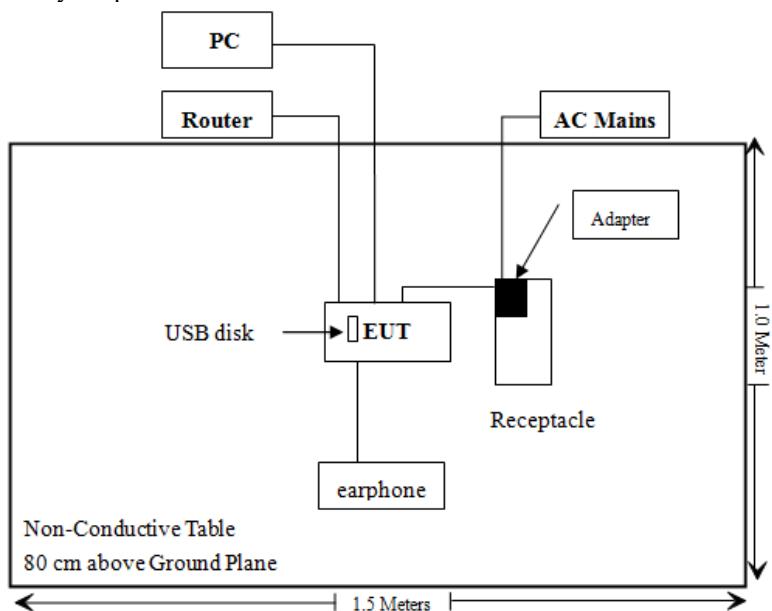


Power by PoE

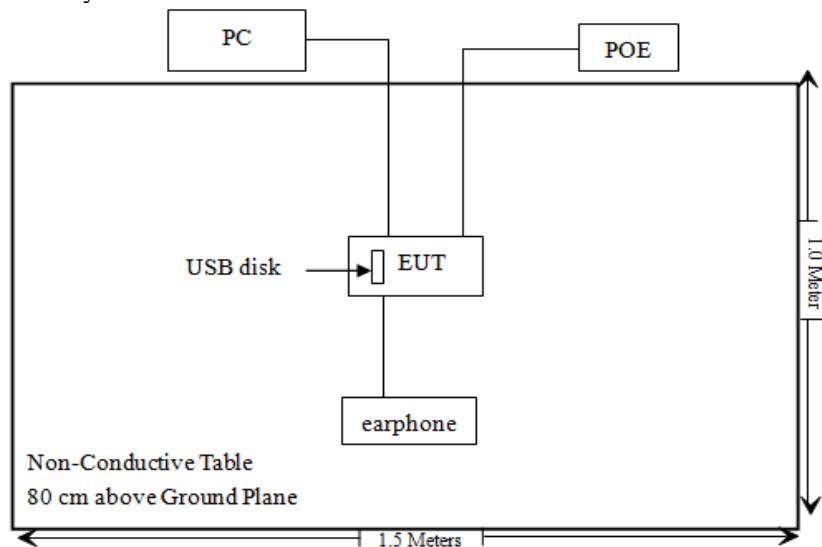


For Radiated Emissions below 1GHz:

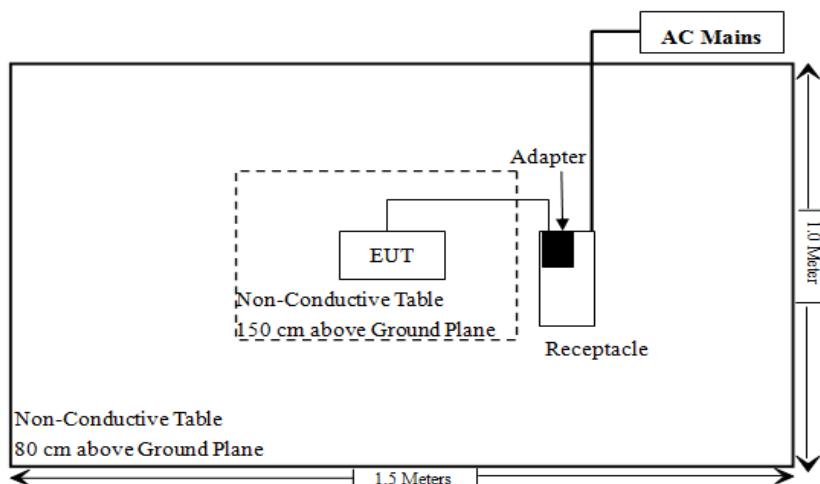
Power by adapter



Power by PoE



For Radiated Emissions above 1GHz:



SUMMARY OF TEST RESULTS

FCC Rules	RSS Rules	Description of Test	Result
FCC §15.203	RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207(a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d)	RSS-247 § 5.5, RSS-GEN § 8.10	Radiated Emissions	Compliant
FCC §15.247(a)(1)	RSS-247 § 5.1(a), RSS-GEN § 6.7	20 dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
FCC §15.247(a)(1)	RSS-247 § 5.1 (b)	Channel Separation Test	Compliant
FCC §15.247(a)(1)(iii)	RSS-247 § 5.1 (d)	Quantity of hopping channel Test	Compliant
FCC §15.247(b)(1)	RSS-247 § 5.1(b) &§ 5.4(b)	Peak Output Power Measurement	Compliant
FCC §15.247(d)	RSS-247 § 5.5	Band edges	Compliant
FCC §15.247(a)(1)(iii)	RSS-247 § 5.1 (d)	Time of Occupancy (Dwell Time)	Compliant
FCC §2.1091	/	MPE-Based Exemption	Compliant
/	RSS-102 § 6.6	Field reference level exposure exemption limits	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2024/12/04	2025/12/03
Rohde & Schwarz	LISN	ENV216	101613	2024/12/04	2025/12/03
Unknown	CE Cable	Unknown	UF A210B-1-0720-504504	2024/05/21	2025/05/20
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2024/05/21	2025/05/20
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
Radiated Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESR3	102455	2024/12/04	2025/12/03
Sonoma instrument	Pre-amplifier	310N	186238	2024/05/21	2025/05/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2026/07/19
Unknown	Cable	XH500C	J-10M-A	2024/06/18	2025/06/17
Unknown	Cable	Chamber Cable 1	F-03-EM236	2024/06/18	2025/06/17
BACL	Active Loop Antenna	1313-1A	4031911	2024/05/14	2027/05/13
Unknown	Cable	PNG214	1354	2024/12/04	2025/12/03
Unknown	Cable	2Y194	0735	2024/12/04	2025/12/03
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde&Schwarz	Spectrum Analyzer	FSV40	101605	2025/03/26	2026/03/25
COM-POWER	Pre-amplifier	PA-122	181919	2024/06/18	2025/06/17
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2026/07/25
Unknown	RF Cable	KMSE	0735	2024/12/06	2025/12/05
Unknown	RF Cable	UFA147	219661	2024/12/06	2025/12/05
Unknown	RF Cable	XH750A-N	J-10M	2024/12/06	2025/12/05
JD	Multiplex Switch Test Control Set	DT7220FSU	DQ77926	2024/06/18	2025/06/17
A.H.System	Pre-amplifier	PAM-1840VH	190	2024/06/18	2025/06/17
Electro-Mechanics Co	Horn Antenna	3116	9510-2270	2023/09/18	2026/09/17
UTIFLEX	RF Cable	NO. 13	232308-001	2024/12/18	2025/12/17

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV40-N	102259	2024/12/04	2025/12/03
Unknown	10dB Attenuator	Unknown	F-03-EM065	2024/06/27	2025/06/26

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

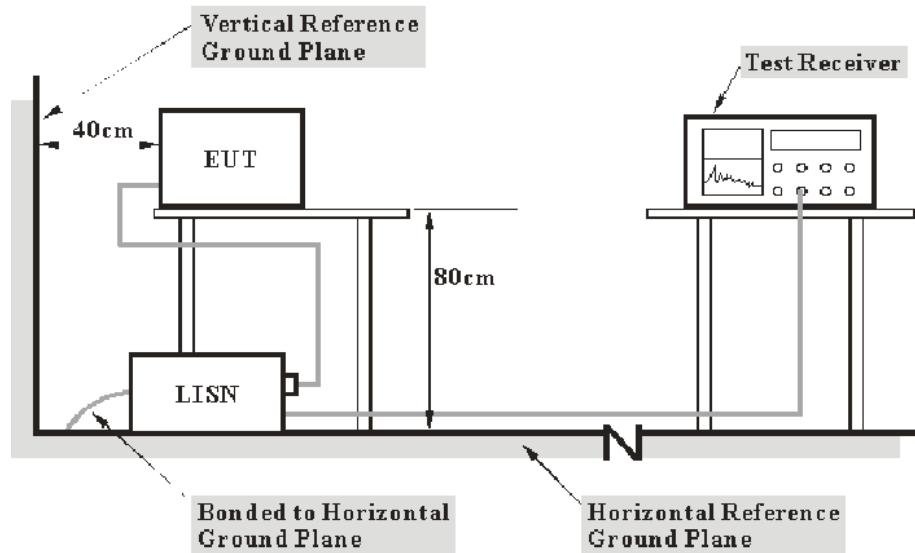
REQUIREMENTS AND TEST PROCEDURES

AC Line Conducted Emissions

Applicable Standard

FCC §15.207(a), RSS-GEN § 8.8

EUT Setup



Note:

1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The measurement procedure of EUT setup is according with ANSI C63.10-2020. The related limit was specified in FCC Part 15.207 & RSS-Gen.

The spacing between the peripherals was 10 cm.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF RBW
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “**Over limit**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

$$\text{Over Limit} = \text{Level} - \text{Limit}$$

$$\text{Level} = \text{Read Level} + \text{Factor}$$

Note: The term "cable loss" refers to the combination of a cable and a 10dB transient limiter (attenuator).

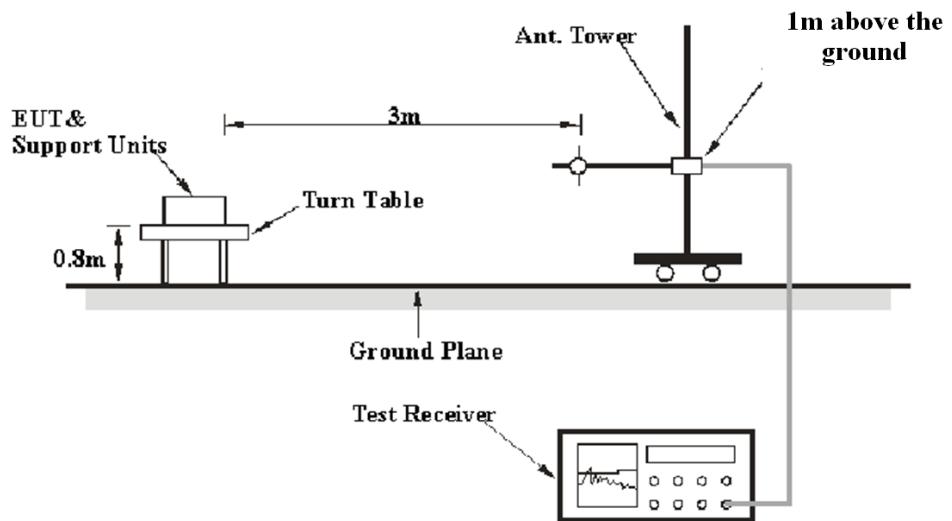
Radiated Emissions

Applicable Standard

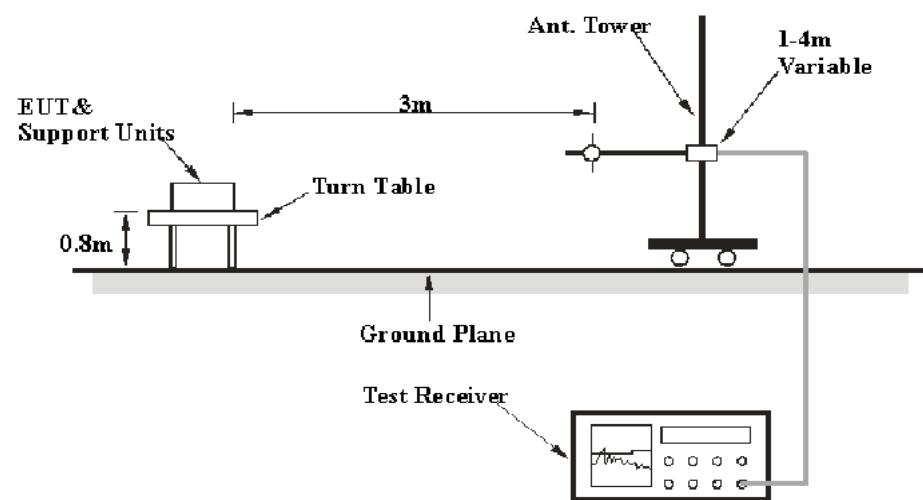
FCC §15.205; §15.209; §15.247(d); RSS-247§ 5.5; RSS-GEN § 8.10

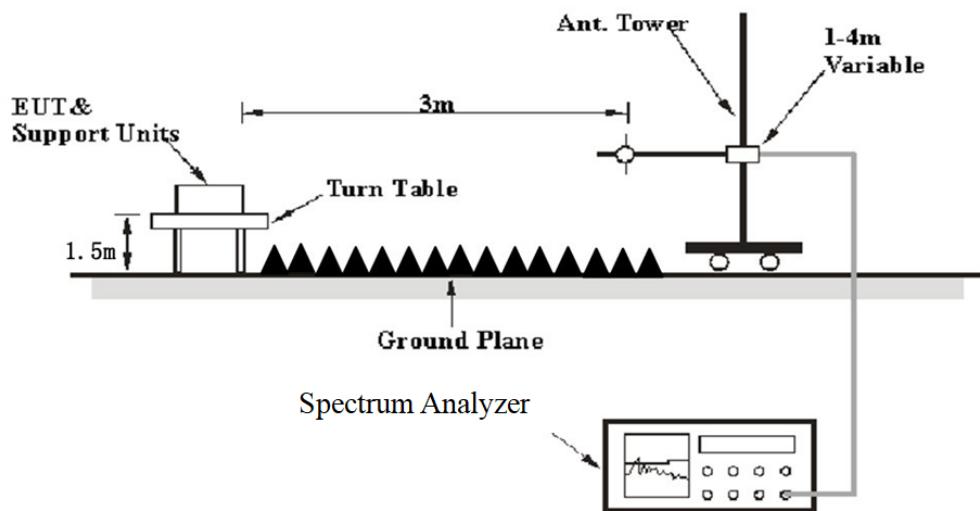
EUT Setup

9 kHz-30MHz:



30MHz-1GHz:



Above 1GHz:

The radiated emission performed in the 3 meters, using the setup accordance with the ANSI C63.10-2020. The specification used was the FCC 15.209, FCC 15.247, RSS-247, RSS-Gen limits.

EMI Test Receiver & Spectrum Analyzer Setup

The EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measuremen t	Detector
9 kHz – 150 kHz	/	/	200 Hz	QP	QP
	300 Hz	1 kHz	/	PK	Peak
150 kHz – 30 MHz	/	/	9 kHz	QP	QP
	10 kHz	30 kHz	/	PK	Peak
30 MHz – 1000 MHz	/	/	120 kHz	QP	QP
	100 kHz	300 kHz	/	PK	Peak
Above 1 GHz	Harmonics				
	1MHz	3 MHz	/	PK	Peak
	Average Emission Level=Peak Emission Level+20*log(Duty cycle)				
	Band Edge & Other Emissions				
	1MHz	3 MHz	/	PK	Peak
	1MHz	≥ 10 Hz	/	Average	Peak

For Duty cycle measurement:

Use the duty cycle factor correction factor method per 15.35(c).

Duty cycle=On time/100milliseconds, On time=N1*L1+N2*L2+...Nn-1*Ln-1+Nn*Ln,
Where N1 is number of type 1 pulses, L1 is length of type 1 pulse, etc.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz, average detection modes for frequency bands 9–90 kHz and 110–490 kHz, peak and average detection modes for frequencies above 1 GHz.

For 9 kHz-30MHz, the report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB.

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

All emissions under the average limit and under the noise floor have not recorded in the report.

Factor & Over Limit/Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit/Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

$$\begin{aligned}\text{Over Limit/Margin} &= \text{Level/Corrected Amplitude} - \text{Limit} \\ \text{Level / Corrected Amplitude} &= \text{Read Level} + \text{Factor}\end{aligned}$$

20 dB Emission Bandwidth & 99% Occupied Bandwidth

According to FCC §15.247(a) (1):

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.

According to RSS-247 § 5.1 (a), RSS-GEN § 6.7:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “20 dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 20 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

Test Procedure

Test Method: ANSI C63.10-2020 Clause 6.9.2

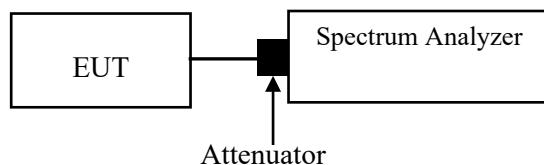
- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be at least three times RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level. Specific guidance is given in 4.1.6.2.
- d) Steps a) through c) might require iteration to adjust within the specified tolerances.
- e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
- f) Set detection mode to peak and trace mode to max-hold.
- g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the “-xx dB down amplitude” using [(reference value) - xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an unmodulated carrier, then turn the EUT modulation ON, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-xx dB down amplitude” determined in step h). If a marker is below this “-xx dB down amplitude” value, then it shall be as close as possible to this value. The dBc bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the “-xx dB down amplitude” determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The dBc bandwidth shall be reported by providing spectral plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).



Channel Separation Test

According to FCC §15.247(a) (1):

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

According to RSS-247 § 5.1 (b):

Frequency hopping systems (FHSs) 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, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

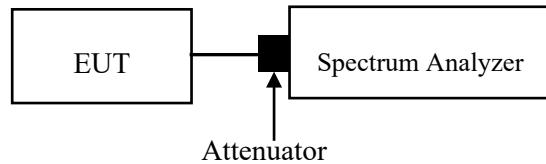
Test Method: ANSI C63.10-2020 Clause 7.8.2

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

- a) Span: Wide enough to capture the peaks of two adjacent channels.
- b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- c) Video (or average) bandwidth (VBW) \geq RBW.
- d) Sweep: No faster than coupled (auto) time.
- e) Detector function: Peak.
- f) Trace: Max-hold.
- g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A spectral plot of the data shall be included in the test report.

Where the device shares the same channel plan (carrier frequencies and number of channels) across multiple data rates or modulation schemes then the carrier separation need only be measured for one of those modulation schemes or data rates.



Note: The limit is $2/3 \times 20$ dB bandwidth

Quantity of Hopping Channel Test

Applicable Standard

According to FCC §15.247(a) (1) (iii):

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

According to RSS-247 § 5.1 (d):

Frequency hopping systems (FHSS) operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Test Procedure

Test Method: ANSI C63.10-2020 Clause 7.8.3

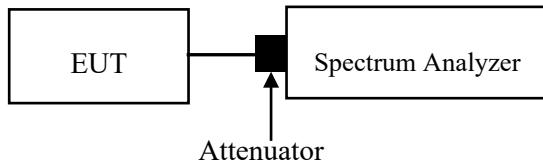
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- a) Span: The frequency band of operation. Depending on the number of channels the device supports, it could be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- c) VBW \geq RBW.
- d) Sweep: No faster than coupled (auto) time.
- e) Detector function: Peak.
- f) Trace: Max-hold.
- g) Allow the trace to stabilize.

It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies.

Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A spectral plot of the data shall be included in the test report.

Where the device shares the same channel plan (carrier frequencies and number of channels) across multiple data rates or modulation schemes then the number of channels need only be measured for one of those modulation schemes or data rates.



Time of Occupancy (Dwell Time)

Applicable Standard

According to FCC §15.247(a) (1) (iii):

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

According to RSS-247 § 5.1 (d):

Frequency hopping systems (FHSs) operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

Test Procedure

Test Method: ANSI C63.10-2020 Clause 7.8.4

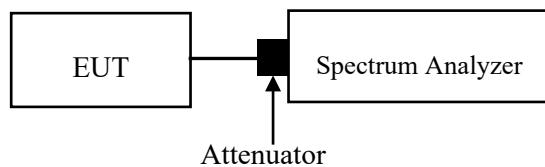
Use the following spectrum analyzer settings to determine the dwell time per hop:

- a) Span: Zero span, centered on a hopping channel.
- b) RBW shall be \leq channel spacing and where possible RBW should be set $\gg 1 / T$, where T is the expected transmission time per hop.
- c) Sweep time: Set so that the start of the first transmission and end of the last transmission for the hop are clearly captured. Setting the sweep time to be slightly longer than the hopping period per channel (hopping period = 1/hopping rate) should achieve this.
- d) Use a video trigger, where possible with a trigger delay, so that the start of the transmission is clearly observed. The trigger level might need adjustment to reduce the chance of triggering when the system hops on an adjacent channel.
- e) Detector function: Peak.
- f) Trace: Clear-write, single sweep.
- g) Place markers at the start of the first transmission on the channel and at the end of the last transmission. The dwell time per hop is the time between these two markers.

To determine the number of hops on a channel in the regulatory observation period repeat the measurement using a longer sweep time. When the device uses a single hopping sequence the period of measurement should be sufficient to capture at least 2 hops. When the device uses a dynamic hopping sequence, or the sequence varies, the period of measurement may need to capture multiple hops to better determine the average time of occupancy. Count the number of hops on the channel across the sweep time.

The average number of hops on the same channel within the regulatory observation period is calculated from the number of hops on the channel divided by the spectrum analyzer sweep time multiplied by the regulatory observation period. For example, if three hops are counted with an analyzer sweep time of 500 ms and the regulatory observation period is 10 s, then the number of hops in that ten seconds is $3 / 0.5 \times 10$, or 60 hops.

The average time of occupancy is calculated by multiplying the dwell time per hop by the number of hops in the observation period.



Peak Output Power Measurement

Applicable Standard

According to FCC §15.247(b) (1):

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

According to RSS-247§ 5.1(b) &§ 5.4(b):

For frequency hopping systems (FHSs) operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W (see Section 5.4(e) for exceptions).

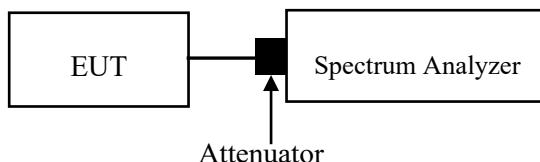
Frequency hopping systems (FHSs) shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

Test Procedure

Test Method: ANSI C63.10-2020 Clause 7.8.5

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. Frequency hopping shall be disabled for this test. Use the following spectrum analyzer settings:

- a) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- b) RBW > 20 dB bandwidth of the emission being measured.
- c) VBW \geq RBW.
- d) Sweep: No faster than coupled (auto) time.
- e) Detector function: Peak.
- f) Trace: Max-hold.
- g) Allow trace to stabilize.
- h) Use the marker-to-peak function to set the marker to the peak of the emission.
- i) The indicated level is the peak output power, after any corrections for external attenuators and cables.
- j) A spectral plot of the test results and setup description shall be included in the test report.



Note: A short RF cable with low cable loss connected to the EUT antenna port, which was provided by client or lab, the cable loss was add with offset into test equipment, the total offset consists of attenuator and/or RF cable loss

Band Edges

Applicable Standard

According to FCC §15.247(d).

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

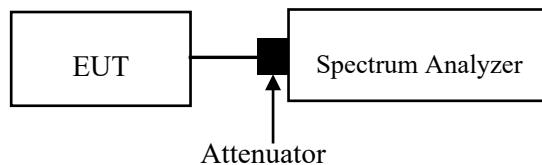
According to RSS-247 § 5.5.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(e), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Procedure

Test Method: ANSI C63.10-2020 Clause 7.8.7.2 & Clause 6.10

- 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 that fall outside of the authorized band of operation.
- 2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.6.2.
- 3) Attenuation: Auto (at least 10 dB preferred).
- 4) Sweep time: No faster than coupled (auto) time.
- 5) Resolution bandwidth: 100 kHz.
- 6) Video bandwidth: 300 kHz.
- 7) Detector: Peak.
- 8) Trace: Max-hold.



ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. 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.

Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device. Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has one internal antenna arrangement which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	Antenna Gain [#]	Impedance	Frequency Range
FPC	2.2dBi	50Ω	2.4~2.5GHz

Result: Compliant

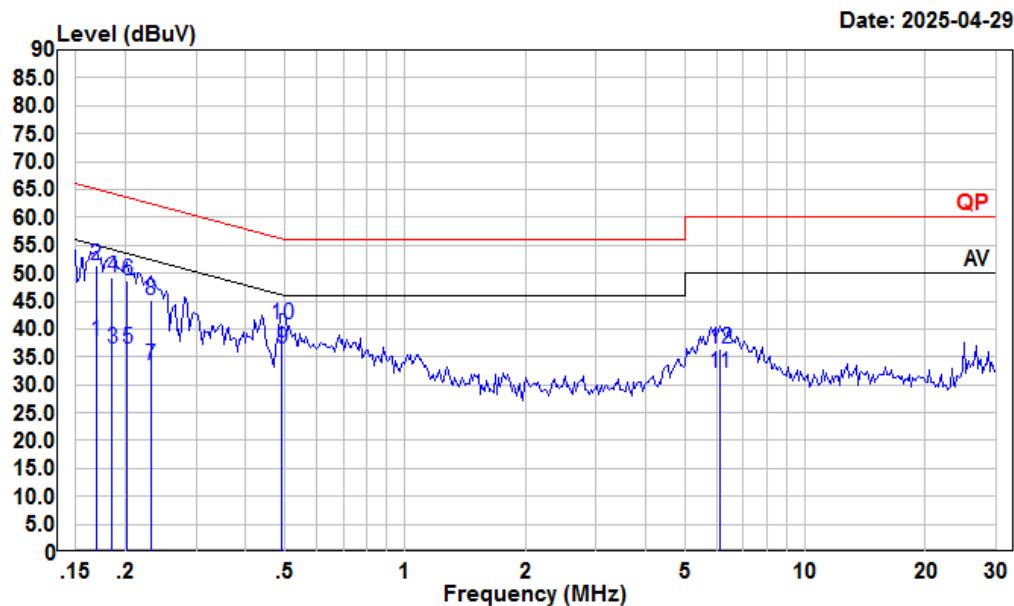
TEST DATA AND RESULTS

AC Line Conducted Emissions

Environmental Conditions

Temperature (°C)	26.5	Relative Humidity (%)	59
ATM Pressure (kPa)	100.6	Test engineer	Macy.shi
Test date	2025.4.29		
EUT operation mode	Transmitting(Maximum output power mode, EDR (8DPSK) High Channel)		

Power by adapter
AC 120V 60 Hz, Line



Condition: Line

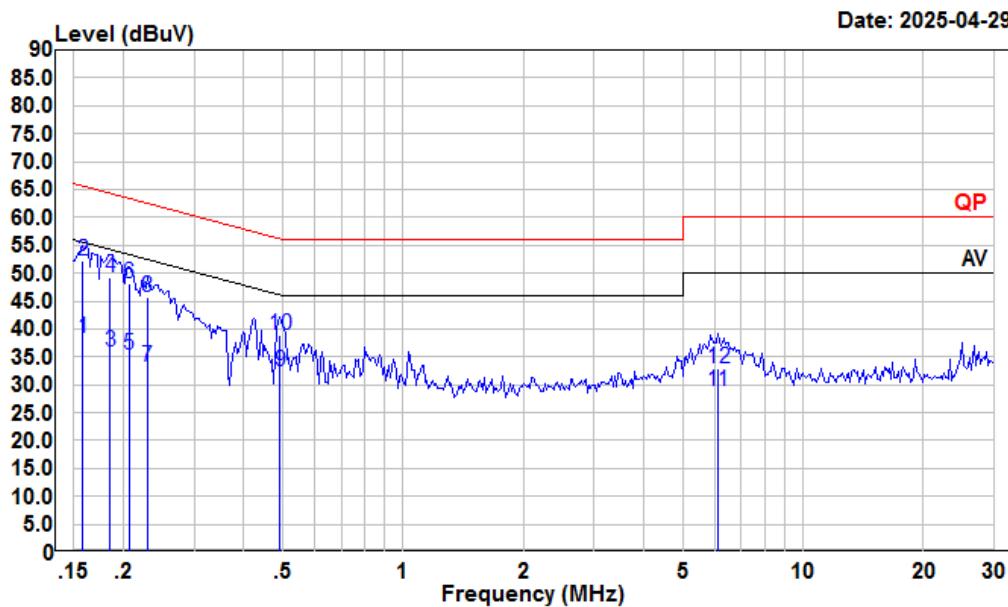
Project : 2501S51596E-RF

tester : Macy.shi Note: BT Transmitting

Setting : RBW:9kHz

Freq	Read		LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV					
1	0.169	17.27	37.89	10.52	10.10	55.03	-17.14 Average
2	0.169	30.84	51.46	10.52	10.10	65.03	-13.57 QP
3	0.185	15.71	36.42	10.62	10.09	54.24	-17.82 Average
4	0.185	28.51	49.22	10.62	10.09	64.24	-15.02 QP
5	0.202	15.54	36.33	10.70	10.09	53.54	-17.21 Average
6	0.202	28.02	48.81	10.70	10.09	63.54	-14.73 QP
7	0.232	12.70	33.45	10.67	10.08	52.39	-18.94 Average
8	0.232	24.30	45.05	10.67	10.08	62.39	-17.34 QP
9	0.491	15.74	36.38	10.50	10.14	46.14	-9.76 Average
10	0.491	20.19	40.83	10.50	10.14	56.14	-15.31 QP
11	6.121	11.15	32.01	10.67	10.19	50.00	-17.99 Average
12	6.121	15.58	36.44	10.67	10.19	60.00	-23.56 QP

AC 120V 60 Hz, Neutral



Condition: Neutral

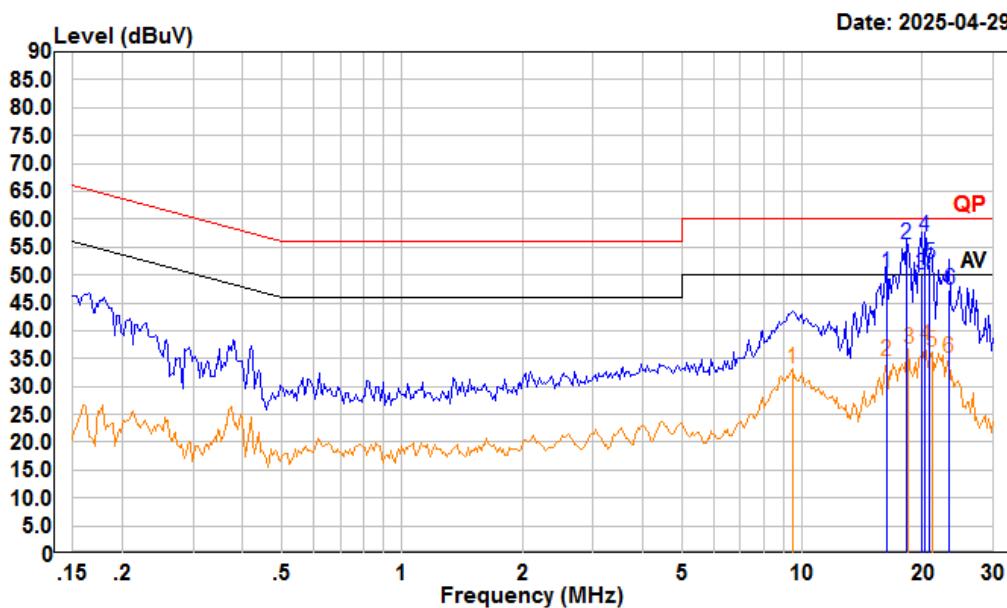
Project : 2501S51596E-RF

tester : Macy.shi Note: BT Transmitting

Setting : RBW:9kHz

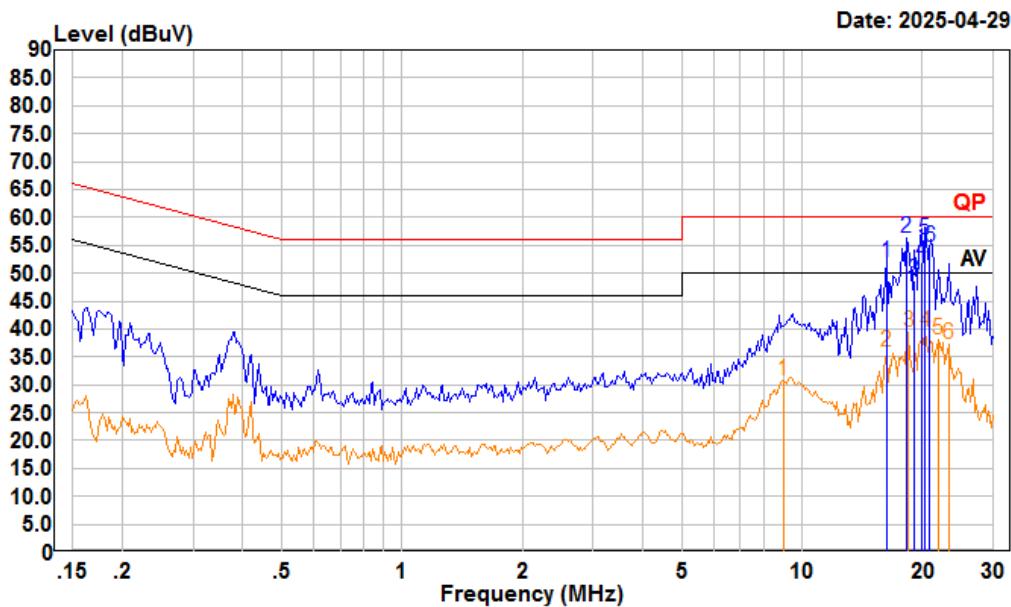
Freq	Read		LISN Level	Cable Factor	Limit Loss	Line Limit	Over Limit	Remark
	MHz	dBuV						
1	0.158	17.88	38.47	10.47	10.12	55.56	-17.09	Average
2	0.158	31.74	52.33	10.47	10.12	65.56	-13.23	QP
3	0.185	15.11	35.89	10.69	10.09	54.24	-18.35	Average
4	0.185	28.41	49.19	10.69	10.09	64.24	-15.05	QP
5	0.206	14.42	35.30	10.79	10.09	53.36	-18.06	Average
6	0.206	27.28	48.16	10.79	10.09	63.36	-15.20	QP
7	0.229	12.30	33.14	10.76	10.08	52.48	-19.34	Average
8	0.229	24.80	45.64	10.76	10.08	62.48	-16.84	QP
9	0.491	11.81	32.46	10.51	10.14	46.14	-13.68	Average
10	0.491	18.33	38.98	10.51	10.14	56.14	-17.16	QP
11	6.121	7.99	28.88	10.70	10.19	50.00	-21.12	Average
12	6.121	11.99	32.88	10.70	10.19	60.00	-27.12	QP

Power by PoE
AC 120V 60 Hz, Line



Freq	Read		LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV					
1	16.226	29.70	50.40	10.49	10.21	60.00	-9.60 QP
2	18.243	34.39	55.36	10.78	10.19	60.00	-4.64 QP
3	19.890	28.80	49.96	10.99	10.17	60.00	-10.04 QP
4	20.258	35.81	56.96	10.98	10.17	60.00	-3.04 QP
5	20.870	30.90	52.02	10.95	10.17	60.00	-7.98 QP
6	23.309	26.30	47.29	10.81	10.18	60.00	-12.71 QP
Read		LISN	Cable	Limit	Over	Remark	
Freq	Level	Level	Factor	Loss	Line	Limit	Remark
1	9.451	12.59	33.15	10.35	10.21	50.00	-16.85 Average
2	16.226	13.84	34.54	10.49	10.21	50.00	-15.46 Average
3	18.426	15.86	36.85	10.80	10.19	50.00	-13.15 Average
4	20.270	16.04	37.19	10.98	10.17	50.00	-12.81 Average
5	21.147	15.21	36.31	10.93	10.17	50.00	-13.69 Average
6	23.263	14.09	35.08	10.81	10.18	50.00	-14.92 Average

AC 120V 60 Hz, Neutral

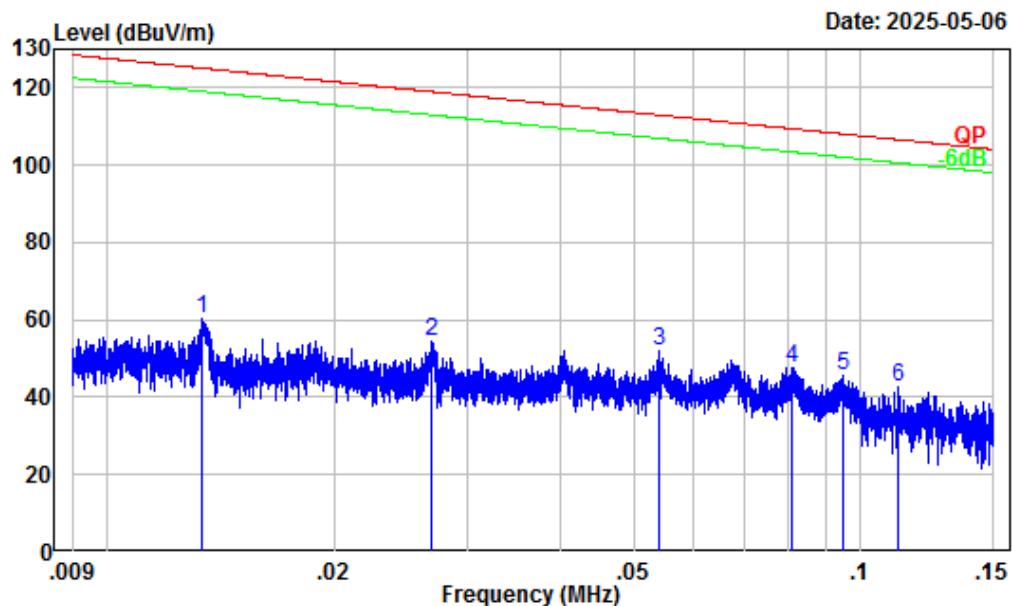


	Read Freq	Level dBuV	LISN Level dBuV	Cable Factor	Loss dB	Line dBuV	Over dB	Limit Remark
	MHz							
1	16.226	31.20	51.93	10.52	10.21	60.00	-8.07	QP
2	18.244	35.20	56.23	10.84	10.19	60.00	-3.77	QP
3	19.037	27.50	48.64	10.96	10.18	60.00	-11.36	QP
4	19.890	30.81	52.06	11.08	10.17	60.00	-7.94	QP
5	20.258	34.70	55.96	11.09	10.17	60.00	-4.04	QP
6	20.870	33.30	54.53	11.06	10.17	60.00	-5.47	QP
	Read Freq	Level dBuV	LISN Level dBuV	Cable Factor	Loss dB	Line dBuV	Over dB	Limit Remark
	MHz							
1	8.964	9.93	30.66	10.53	10.20	50.00	-19.34	Average
2	16.226	15.28	36.01	10.52	10.21	50.00	-13.99	Average
3	18.426	18.41	39.47	10.87	10.19	50.00	-10.53	Average
4	20.270	18.14	39.40	11.09	10.17	50.00	-10.60	Average
5	21.830	16.99	38.18	11.01	10.18	50.00	-11.82	Average
6	23.263	16.03	37.16	10.95	10.18	50.00	-12.84	Average

Radiated Emissions

Environmental Conditions

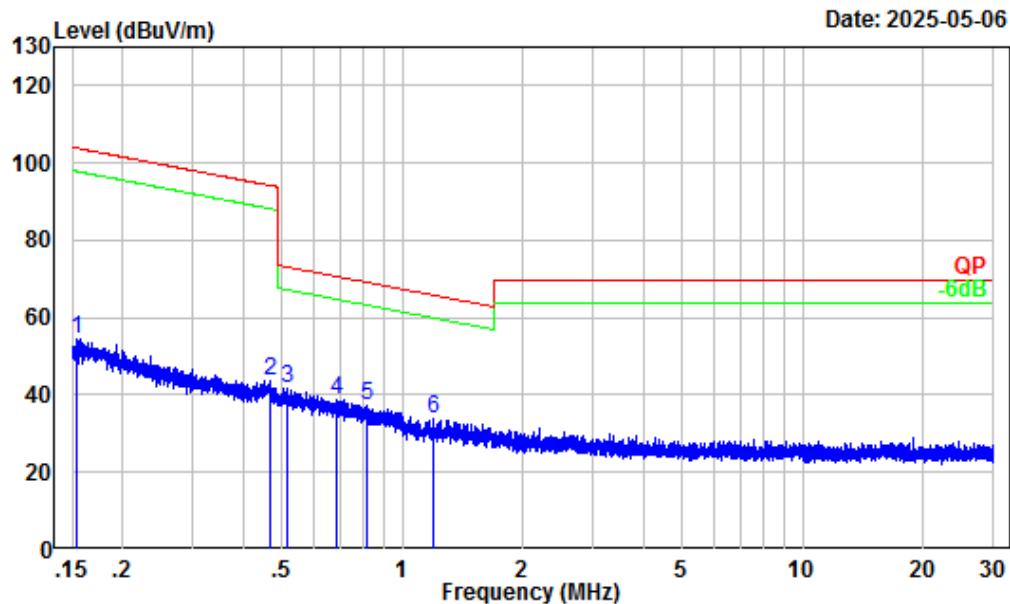
Temperature (°C)	24.3&21.9	Relative Humidity (%)	42.5&61
ATM Pressure (kPa):	101.1&101.3	Test engineer:	Alex Yan & Wing K.Ji
Test date:	2025.04.28~2025.05.09		
EUT operation mode:	Below 1GHz: Transmitting(Maximum output power mode, EDR (8DPSK) High Channel) Above 1GHz: Transmitting		
Note:	11. For the radiated spurious emission below 30MHz, only the worst case (parallel) was recorded. 2. The spurious emission from 9 kHz-30MHz of IC RSS-GEN standard, the unit of final result on the test plots are dB μ V/m, so the limit should be added by 51,5 dB from dB μ A/m to dB μ V/m. 3. For the radiated spurious emission below 1 GHz, When the test result of peak was less than the limit of QP/Average more than 6dB, just peak value were recorded. 4. After pre-scan in the X, Y and Z axes of orientation, the worst case z-axis of orientation were recorded.		

Below 1GHz:**Power by adapter**
9kHz-150kHz

Site : Chamber A
 Condition : 3m
 Project Number : 2501S51596E-RF
 Test Mode : BT Transmitting
 Detector: Peak RBW/VBW: 0.3/1kHz
 Tester : Alex Yan

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	0.013	31.66	28.49	60.15	125.07	-64.92	Peak
2	0.027	29.07	25.57	54.64	118.97	-64.33	Peak
3	0.054	26.01	26.05	52.06	112.97	-60.91	Peak
4	0.081	23.33	24.30	47.63	109.43	-61.80	Peak
5	0.095	22.38	23.40	45.78	108.09	-62.31	Peak
6	0.112	21.28	21.22	42.50	106.61	-64.11	Peak

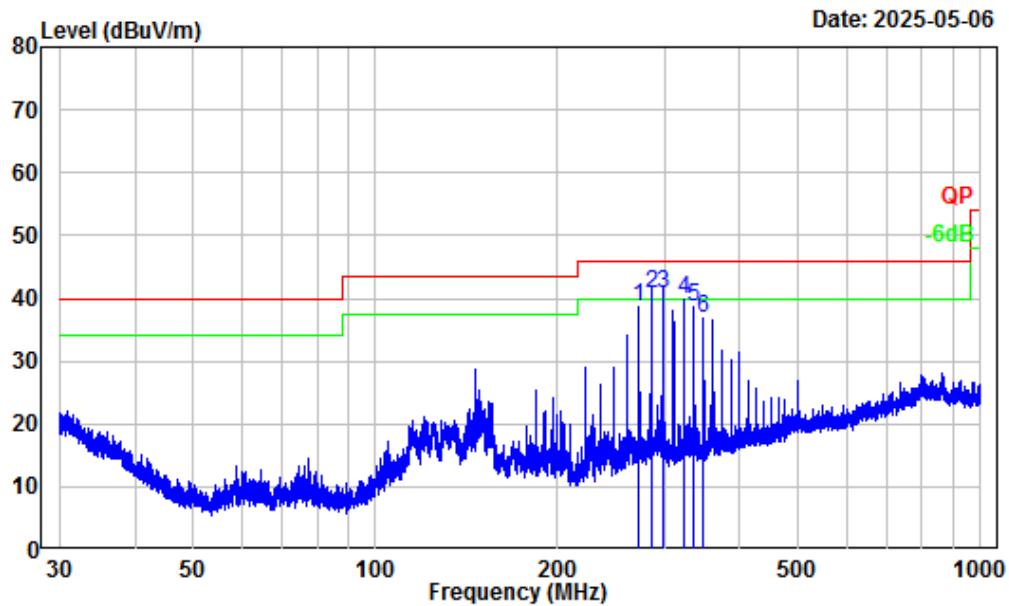
150kHz-30MHz



Site : Chamber A
Condition : 3m
Project Number : 2501S51596E-RF
Test Mode : BT Transmitting
Detector: Peak RBW/VBW: 10/30kHz
Tester : Alex Yan

Freq	Factor	Read	Limit	Over	Remark
		Level	Level	Line	
1	0.155	18.78	35.58	54.36	103.82 -49.46 Peak
2	0.466	7.05	36.71	43.76	94.24 -50.48 Peak
3	0.515	6.21	35.37	41.58	73.36 -31.78 Peak
4	0.689	4.07	34.81	38.88	70.78 -31.90 Peak
5	0.819	2.56	34.75	37.31	69.24 -31.93 Peak
6	1.199	0.64	33.34	33.98	65.86 -31.88 Peak

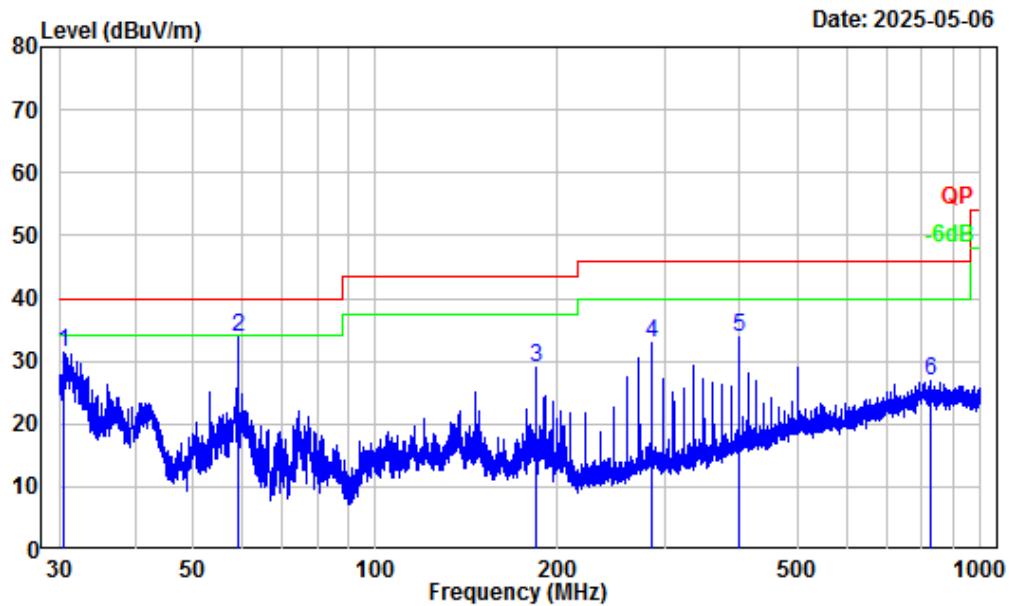
30MHz-1GHz_Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number : 2501S51596E-RF
Test Mode : BT Transmitting
Detector: Peak RBW/VBW: 100/300kHz
Tester : Alex Yan

Freq	Factor	Read	Limit	Over	Remark	
		Level	Level	Line		
		MHz	dB/m	dB _{UV}	dB _{UV} /m	
1	272.76	-11.57	50.14	38.57	46.00	-7.43 Peak
2	285.48	-11.23	52.04	40.81	46.00	-5.19 QP
3	298.14	-11.20	51.82	40.62	46.00	-5.38 QP
4	323.46	-10.71	50.47	39.76	46.00	-6.24 Peak
5	336.18	-10.50	49.05	38.55	46.00	-7.45 Peak
6	348.94	-10.18	46.94	36.76	46.00	-9.24 Peak

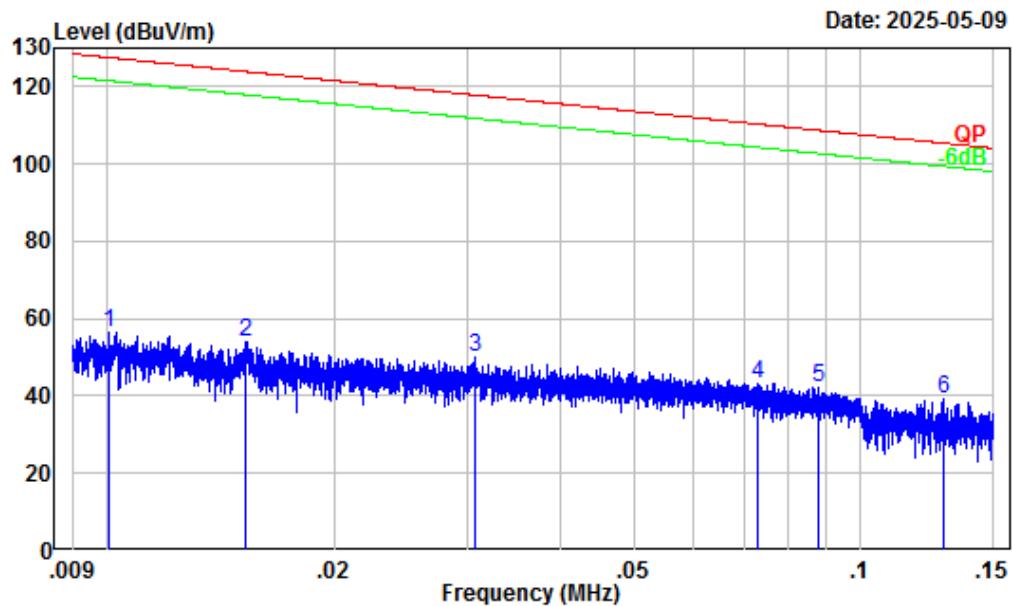
30MHz-1GHz_Verical



Site : Chamber A
Condition : 3m Vertical
Project Number : 2501S51596E-RF
Test Mode : BT Transmitting
Detector: Peak RBW/VBW: 100/300kHz
Tester : Alex Yan

Freq	Factor	Read		Limit		Over	Remark
		Level	Level	Line	Line		
1	30.60	-6.27	37.53	31.26	40.00	-8.74	Peak
2	59.08	-18.21	51.93	33.72	40.00	-6.28	Peak
3	183.92	-13.93	42.77	28.84	43.50	-14.66	Peak
4	285.48	-11.23	44.17	32.94	46.00	-13.06	Peak
5	400.08	-8.41	42.08	33.67	46.00	-12.33	Peak
6	827.86	-1.93	28.79	26.86	46.00	-19.14	Peak

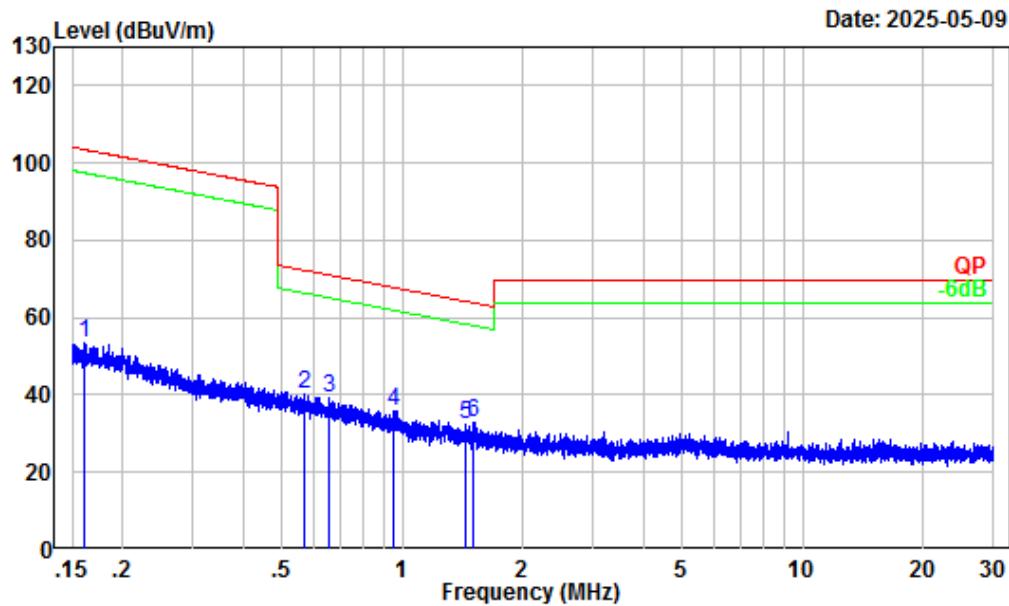
Power by PoE
9kHz-150kHz



Site : Chamber A
Condition : 3m
Project Number : 2501S51596E-RF
Test Mode : Transmitting
Detector: Peak RBW/VBW: 0.3/1kHz
Tester : Alex Yan

	Freq	Factor	Read Level	Limit Level	Over Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.010	32.28	24.17	56.45	127.54	-71.09	Peak
2	0.015	31.31	22.58	53.89	123.95	-70.06	Peak
3	0.031	28.41	21.41	49.82	117.82	-68.00	Peak
4	0.073	24.11	19.06	43.17	110.35	-67.18	Peak
5	0.088	22.86	19.42	42.28	108.74	-66.46	Peak
6	0.129	20.31	19.08	39.39	105.41	-66.02	Peak

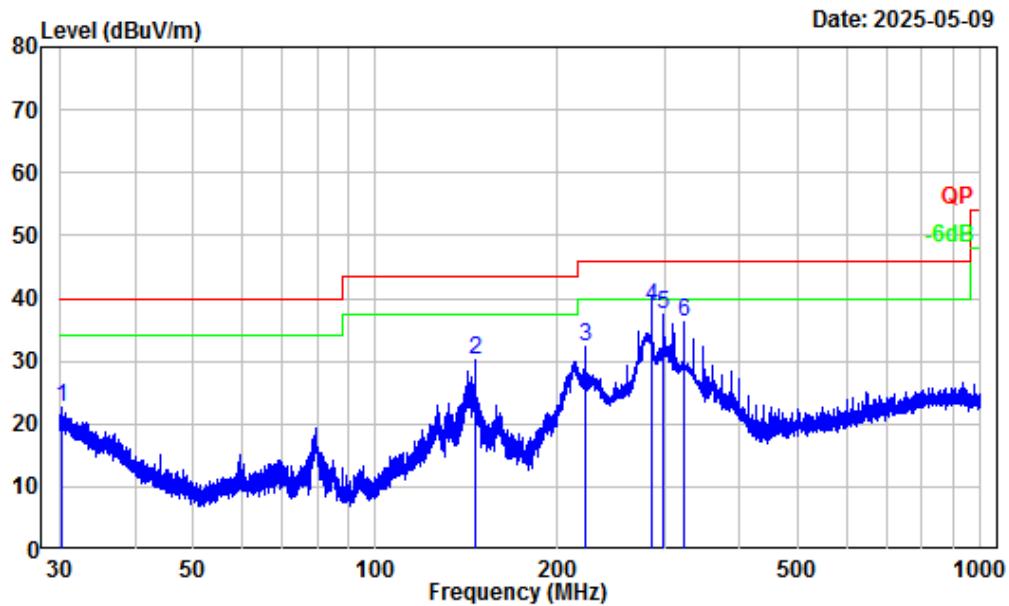
150kHz-30MHz



Site : Chamber A
Condition : 3m
Project Number : 2501S51596E-RF
Test Mode : Transmitting
Detector: Peak RBW/VBW: 10/30kHz
Tester : Alex Yan

Freq	Factor	Read	Limit	Over	Remark	
		Level	Level	Line		
		MHz	dB/m	dBuV	dBuV/m	dB
1	0.161	18.37	35.01	53.38	103.44	-50.06 Peak
2	0.569	5.55	34.78	40.33	72.47	-32.14 Peak
3	0.654	4.50	34.67	39.17	71.24	-32.07 Peak
4	0.949	1.58	34.32	35.90	67.94	-32.04 Peak
5	1.434	-0.02	32.34	32.32	64.27	-31.95 Peak
6	1.512	-0.23	33.04	32.81	63.80	-30.99 Peak

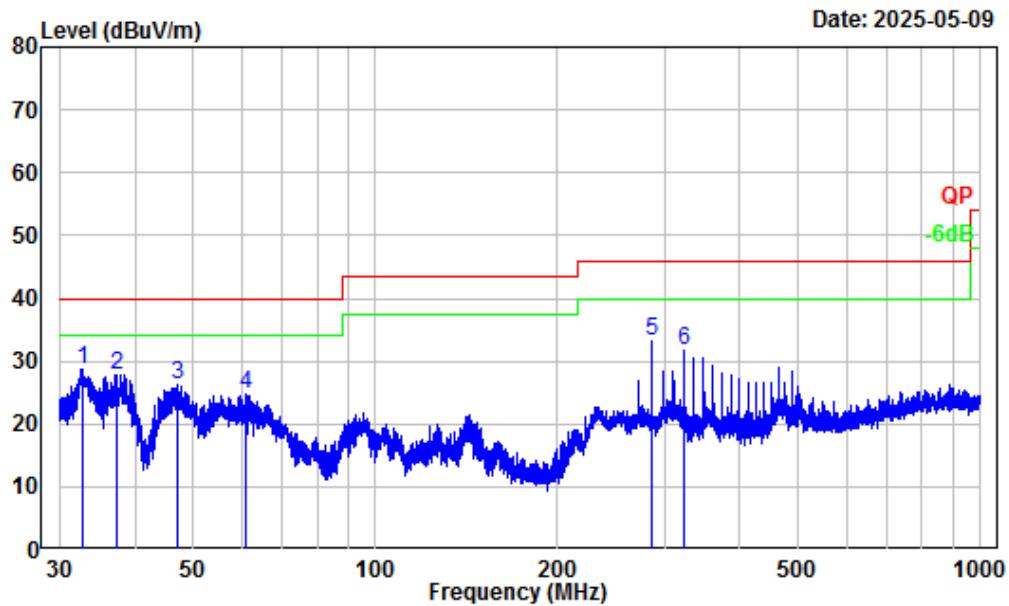
30MHz-1GHz_Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number : 2501S51596E-RF
Test Mode : Transmitting
Detector: Peak RBW/VBW: 100/300kHz
Tester : Alex Yan

Freq	Factor	Read		Limit		Over	Remark
		Level	Level	Line	Line		
		MHz	dB/m	dBuV	dBuV/m		
1	30.36	-6.14	28.89	22.75	40.00	-17.25	Peak
2	145.93	-12.26	42.31	30.05	43.50	-13.45	Peak
3	222.07	-14.15	46.42	32.27	46.00	-13.73	Peak
4	285.48	-11.23	49.82	38.59	46.00	-7.41	QP
5	298.14	-11.20	48.59	37.39	46.00	-8.61	Peak
6	323.46	-10.71	46.98	36.27	46.00	-9.73	Peak

30MHz-1GHz_Verical



Site : Chamber A
Condition : 3m Vertical
Project Number : 2501S51596E-RF
Test Mode : Transmitting
Detector: Peak RBW/VBW: 100/300kHz
Tester : Alex Yan

Freq	Factor	Read	Limit	Over	Remark	
		Level	Level	Line		
		MHz	dB/m	dBuV	dBuV/m	dB
1	32.79	-7.48	36.12	28.64	40.00	-11.36 Peak
2	37.24	-10.45	38.36	27.91	40.00	-12.09 Peak
3	47.08	-16.98	43.17	26.19	40.00	-13.81 Peak
4	61.08	-18.12	42.73	24.61	40.00	-15.39 Peak
5	285.48	-11.23	44.53	33.30	46.00	-12.70 Peak
6	323.46	-10.71	42.35	31.64	46.00	-14.36 Peak

Above 1GHz:

Frequency (MHz)	Reading (dB μ V)	PK/Ave	Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
GFSK							
Low Channel							
4804	65.26	PK	H	-7.79	57.47	74	-16.53
4804	59.79	PK	V	-7.79	52	74	-22
Middle Channel							
4882	63.17	PK	H	-7.58	55.59	74	-18.41
4882	59.49	PK	V	-7.58	51.91	74	-22.09
High Channel							
4960	62.36	PK	H	-7.56	54.8	74	-19.2
4960	57.93	PK	V	-7.56	50.37	74	-23.63

Note:

Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude/Level = Factor + Reading

Margin = Corrected Amplitude/Level - Limit

The other spurious emission which is in the noise floor level was not recorded.

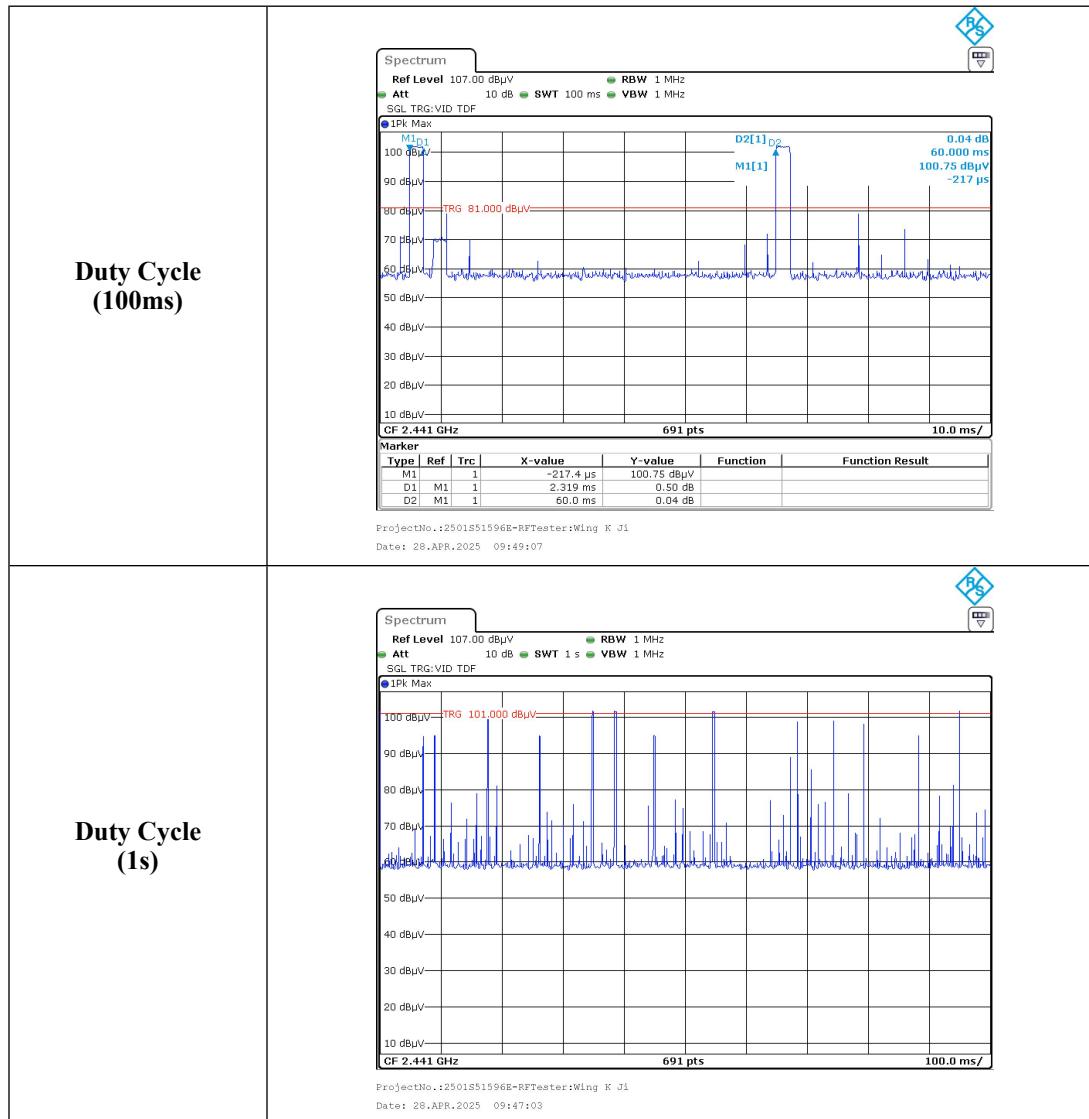
Field Strength of Average							
Frequency (MHz)	Peak Measurement @3m (dB μ V/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Average Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Comment
Low Channel							
4804	57.47	H	-26.67	30.8	54	-23.2	Harmonic
4804	52	V	-26.67	25.33	54	-28.67	Harmonic
Middle Channel							
4882	55.59	H	-26.67	28.92	54	-25.08	Harmonic
4882	51.91	V	-26.67	25.24	54	-28.76	Harmonic
High Channel							
4960	54.8	H	-26.67	28.13	54	-25.87	Harmonic
4960	50.37	V	-26.67	23.7	54	-30.3	Harmonic

Note: Average level= Peak level + Duty Cycle Corrected Factor

Margin = Average level - Limit

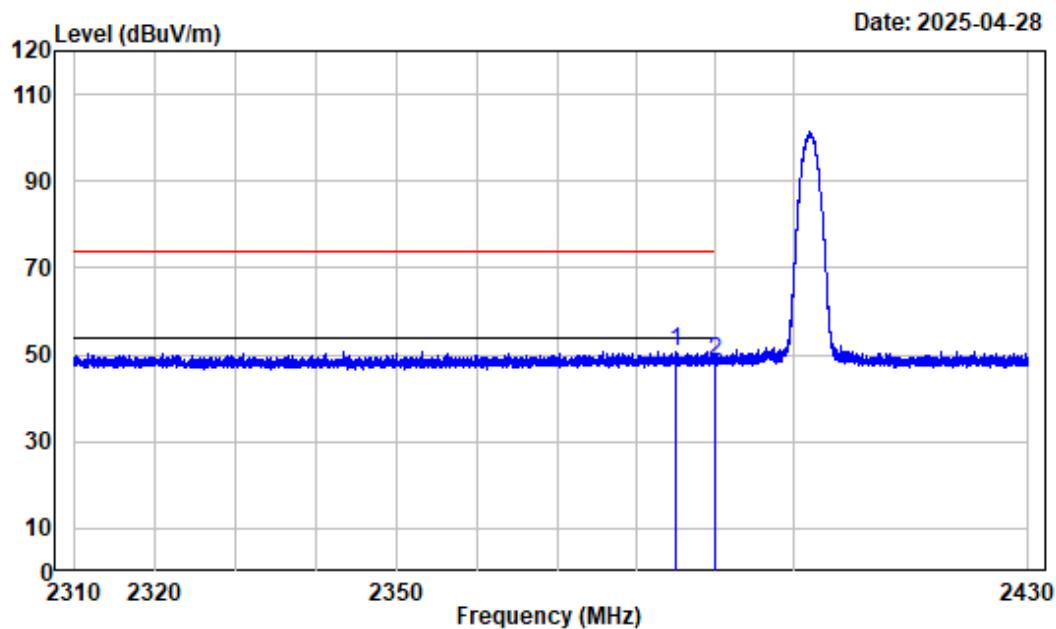
Worst case duty cycle:

Duty cycle = Ton/100ms = $2.319*2/100=0.04638$ Duty Cycle Corrected Factor = $20\lg(\text{Duty cycle}) = 20\lg 0.04638 = -26.67$



Test plots

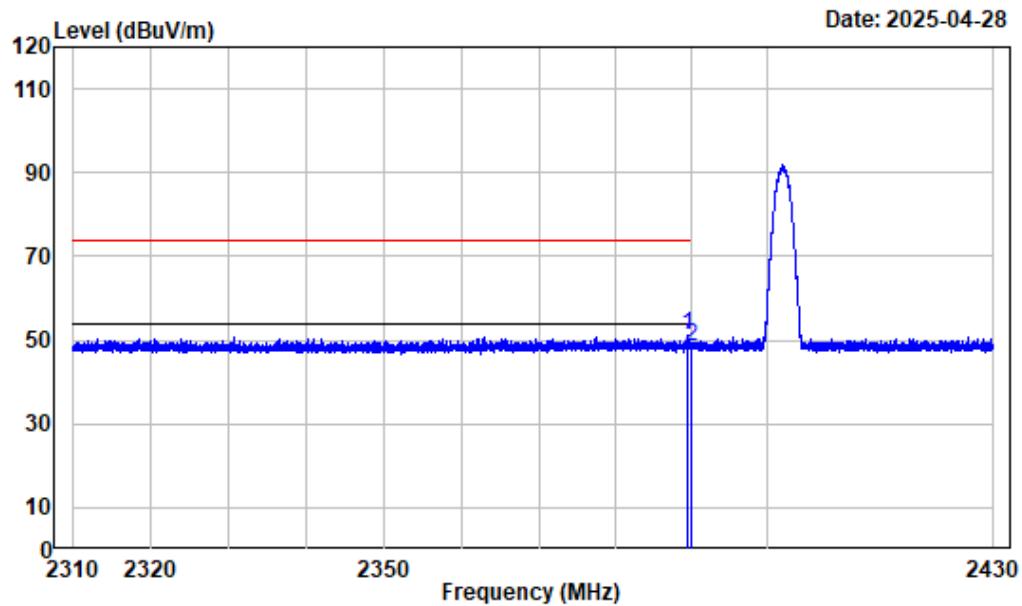
Left Band edge_Horizontal_Peak



Condition : Horizontal
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit	Over	Remark	
		MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	2385.039	-10.97	61.77	50.80	74.00	-23.20	Peak
2	2390.000	-10.98	59.50	48.52	74.00	-25.48	Peak

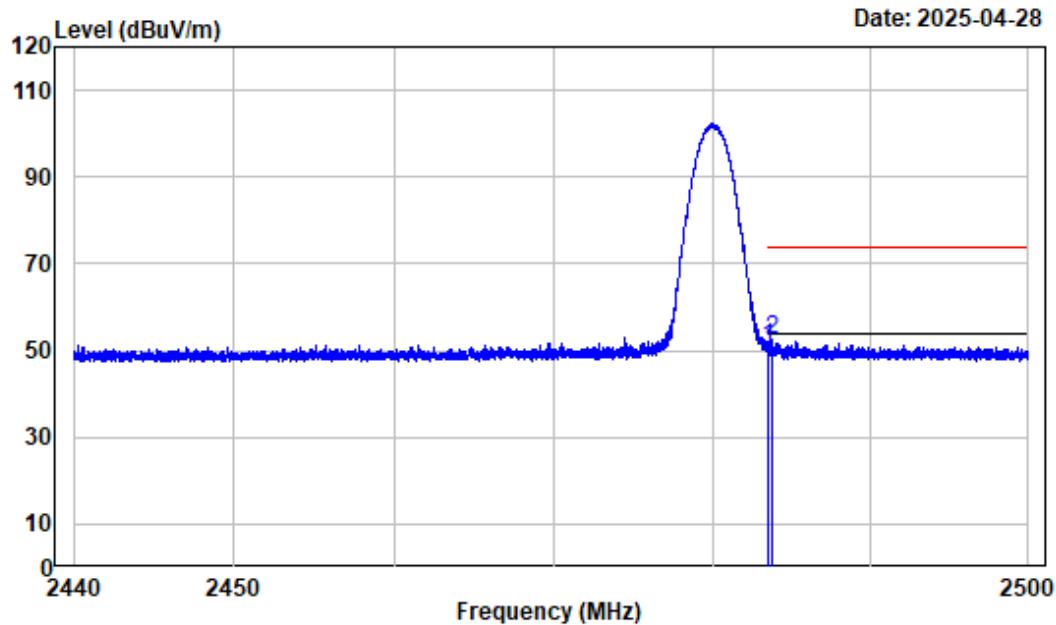
Left Band edge_Vertical_Peak



Condition : Vertical
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq Factor	MHz	dB/m	Read	Limit	Over	Remark
			Level	Level	Line	
1	2389.540	-10.98	62.00	51.02	74.00	-22.98 Peak
2	2390.000	-10.98	59.37	48.39	74.00	-25.61 Peak

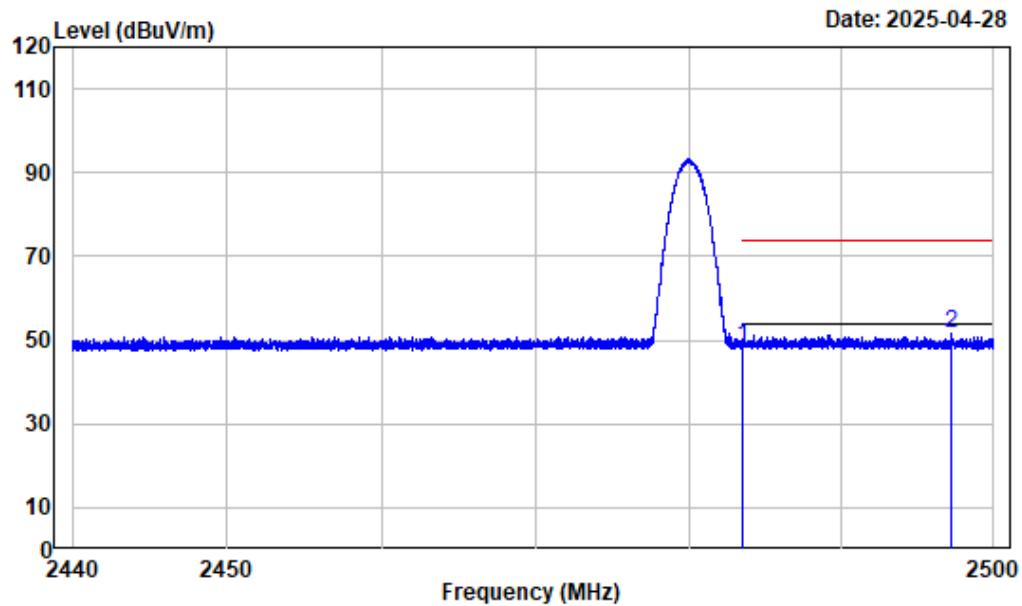
Right Band edge_Horizontal_Peak



Condition : Horizontal
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2480

Freq	Factor	Read		Limit		Over	Remark
		Level	Level	Line	Limit		
1	2483.500	-10.97	61.60	50.63	74.00	-23.37	Peak
2	2483.760	-10.97	63.31	52.34	74.00	-21.66	Peak

Right Band edge_Vertical_Peak

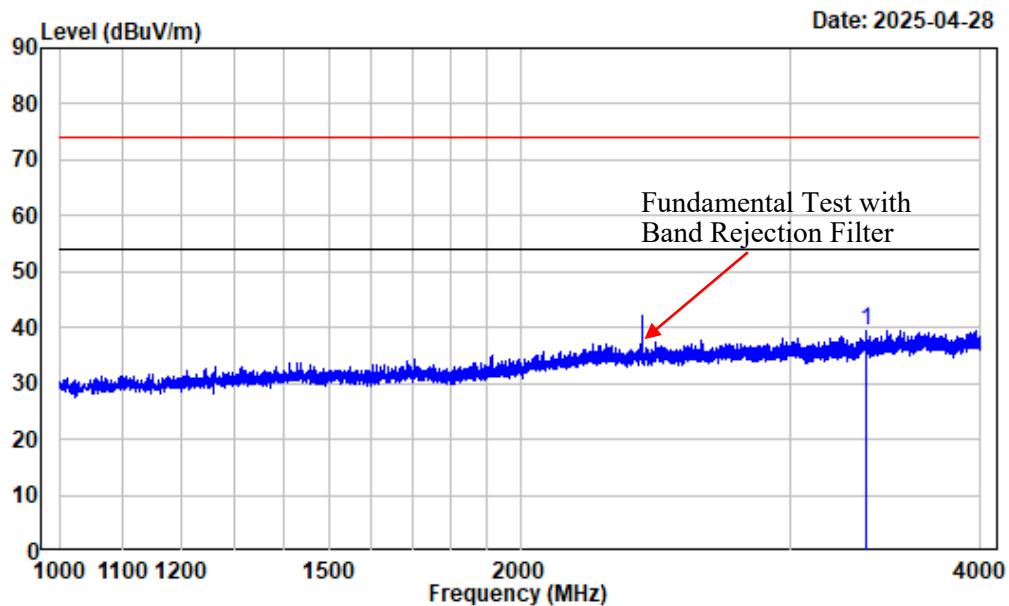


Condition : Vertical
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2480

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m		
1	2483.500	-10.97	59.25	48.28	74.00	-25.72	Peak
2	2497.195	-10.99	62.42	51.43	74.00	-22.57	Peak

Listed with the worst harmonic margin test plot

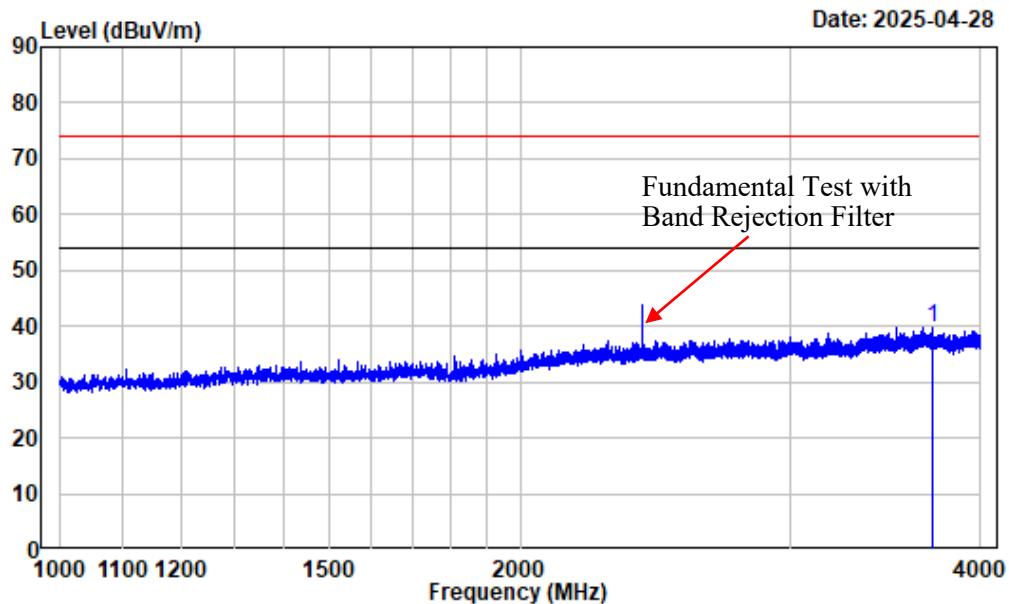
1-4GHz Horizontal



Condition : Horizontal
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read	Limit	Over	Remark		
		Level	Level	Line			
		MHz	dB/m	dB _{uV}	dB _{uV/m}	dB _{uV/m}	dB
1		3366.546	-10.25	49.58	39.33	74.00	-34.67 Peak

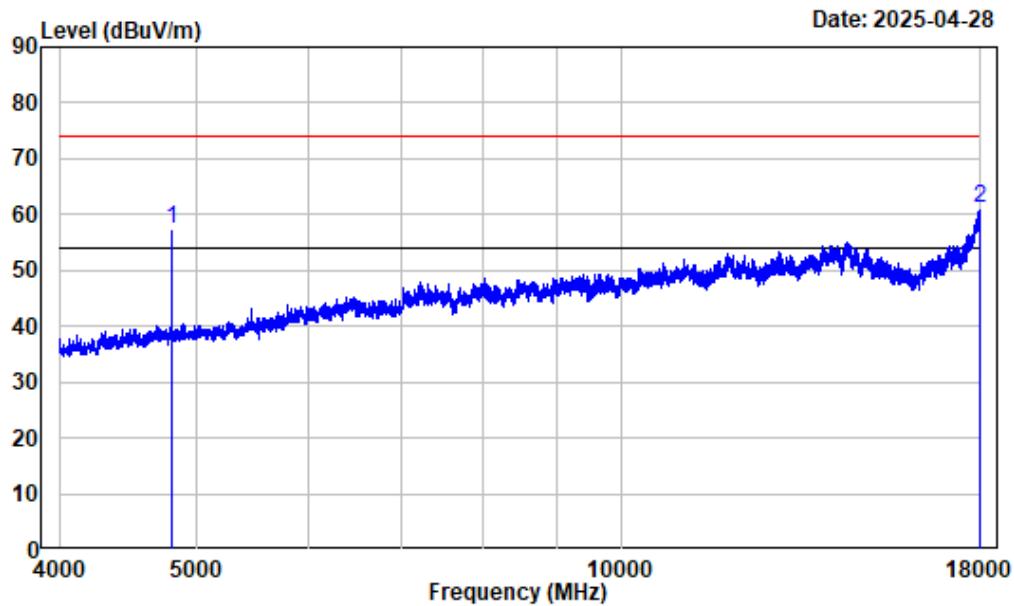
1-4GHz_Verical



Condition : Vertical
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m		
1	3720.215	-9.53	49.30	39.77	74.00	-34.23	Peak

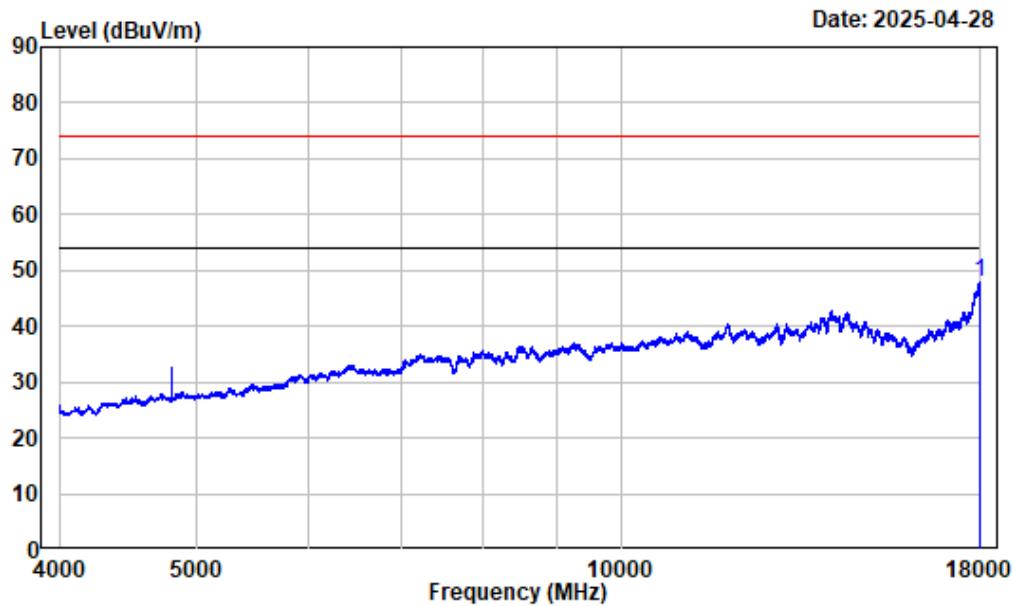
4-18GHz_Horizontal_Peak



Condition : Horizontal
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m		
1	4804.000	-7.79	65.26	57.47	74.00	-16.53	Peak
2	17994.900	13.20	47.88	61.08	74.00	-12.92	Peak

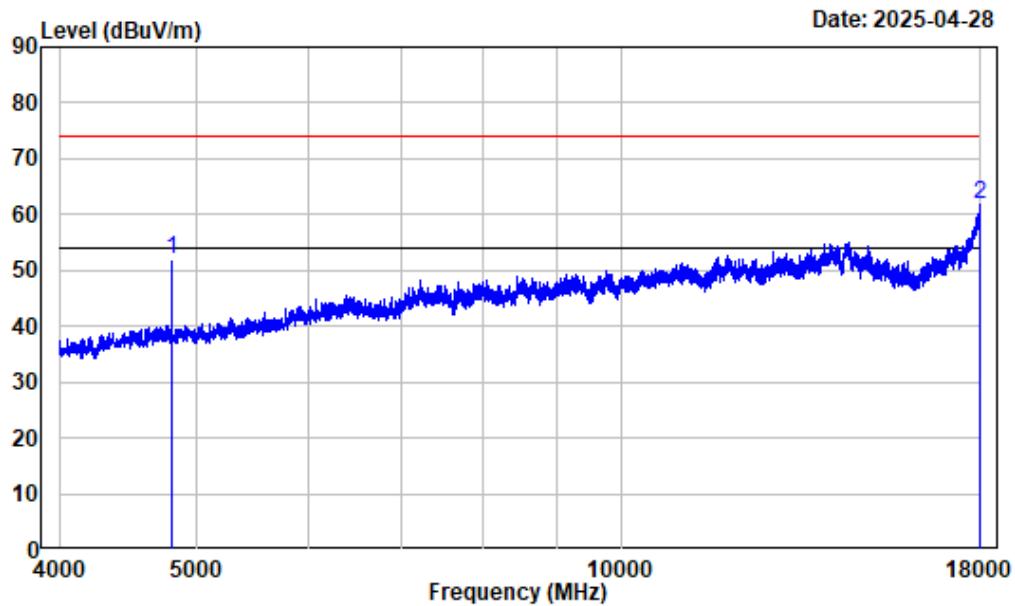
4-18GHz_Horizontal_Average



Condition : Horizontal
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Average reading: RBW:1MHz VBW:3kHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dB _{uV}	dB _{uV/m}		
1	17994.750	13.17	34.67	47.84	54.00	-6.16	Average

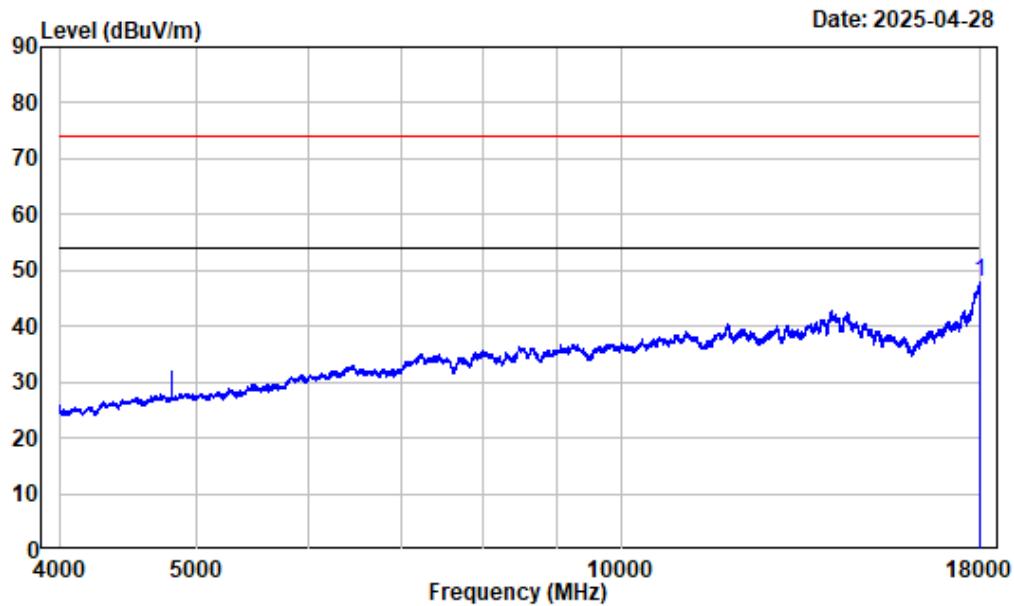
4-18GHz_Vertical_Peak



Condition : Vertical
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m		
1	4804.000	-7.79	59.79	52.00	74.00	-22.00	Peak
2	17977.250	13.09	48.72	61.81	74.00	-12.19	Peak

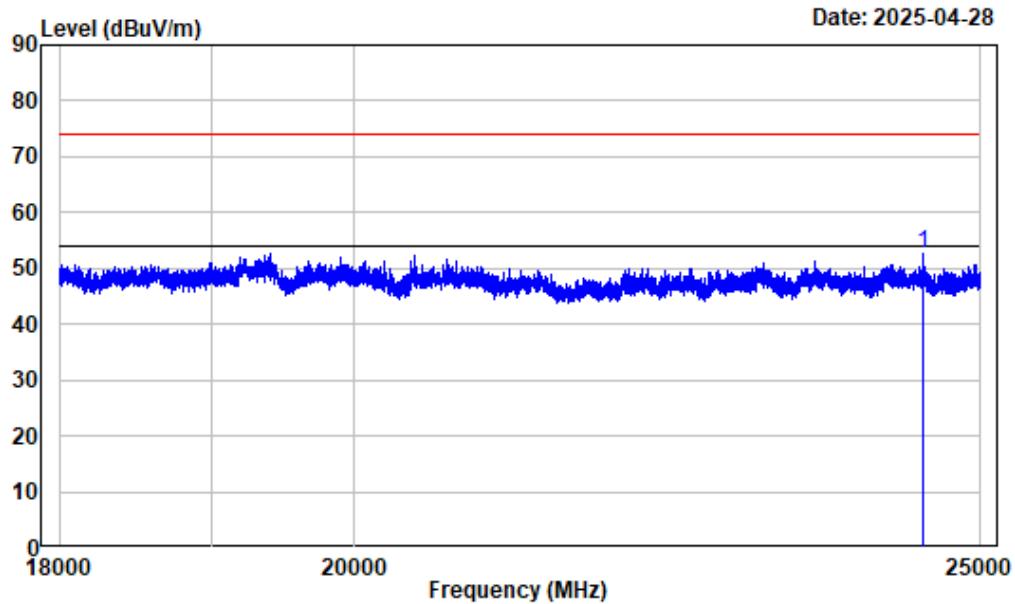
4-18GHz_Vertical_Average



Condition : Vertical
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Average reading: RBW:1MHz VBW:3kHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m		
1	17996.500	13.19	34.63	47.82	54.00	-6.18	Average

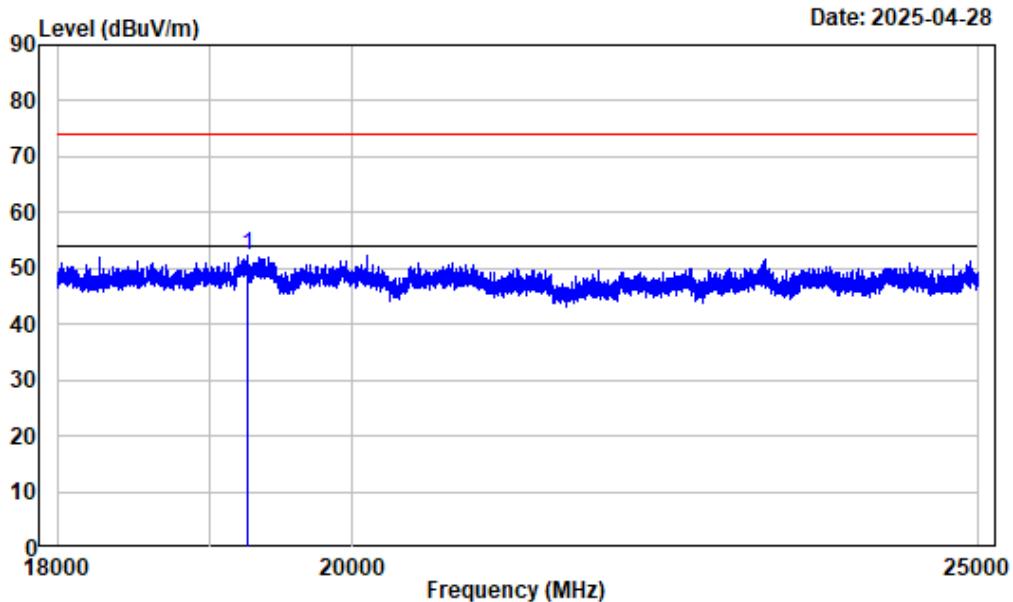
18-25GHz_Horizontal



Condition : Horizontal
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dB _{uV}	dB _{uV/m}		
1	24494.190	16.77	35.79	52.56	74.00	-21.44	peak

18-25GHz_Vertical



Condition : Vertical
Project No. : 2501S51596E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BT_2402

Freq	Factor	Read		Limit		Over	Remark
		MHz	dB/m	dBuV	dBuV/m		
1	19261.910	15.41	36.99	52.40	74.00	-21.60	peak

20 dB Emission Bandwidth**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

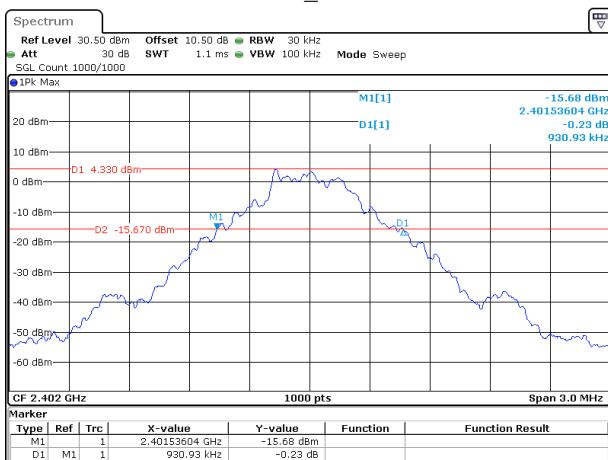
Environmental Conditions:

Temperature: (°C)	26.1	Relative Humidity: (%)	46	ATM Pressure: (kPa)	100.1
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Test Data:

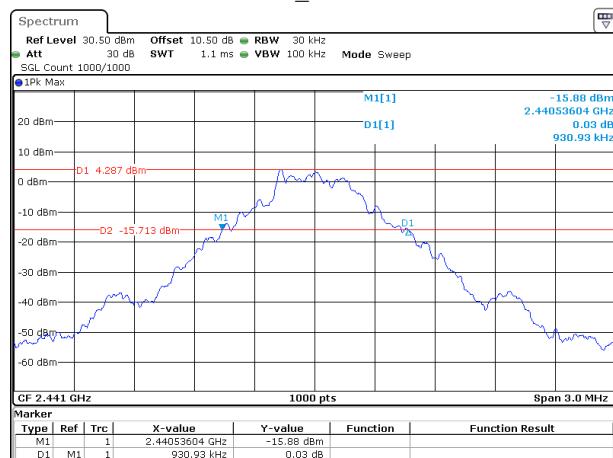
Mode	Channel	Result (MHz)
DH1	Low Channel	0.931
	Middle Channel	0.931
	High Channel	0.931
2DH1	Low Channel	1.231
	Middle Channel	1.234
	High Channel	1.231
3DH1	Low Channel	1.216
	Middle Channel	1.216
	High Channel	1.216

DH1_Low



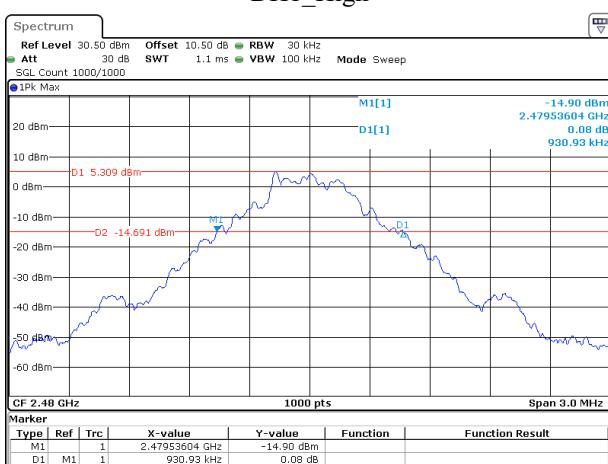
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 15:18:11

DH1_Middle



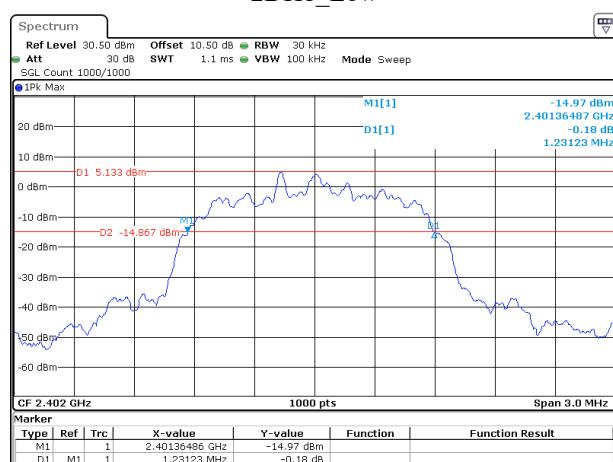
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 15:24:38

DH1_High



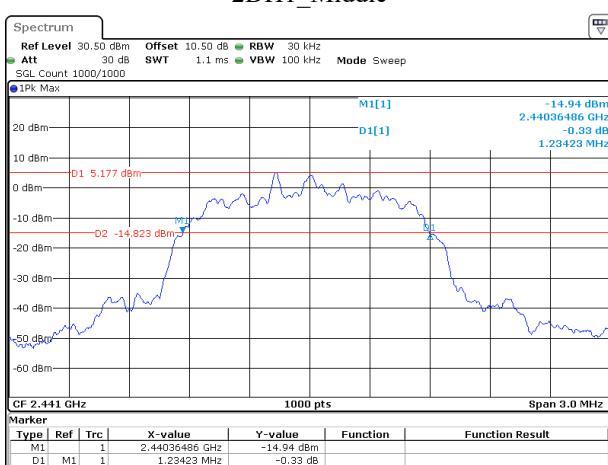
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 15:26:16

2DH1_Low



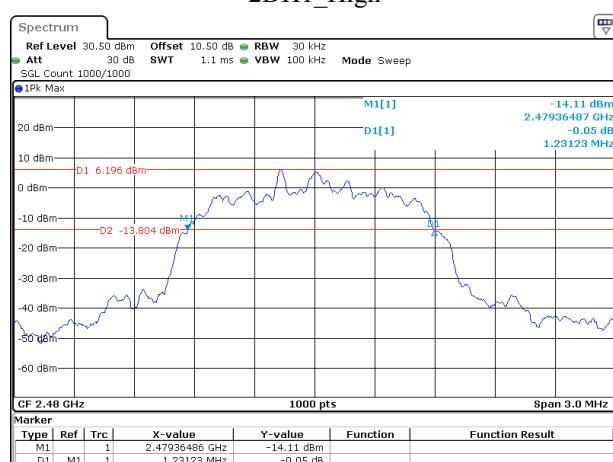
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 15:29:14

2DH1_Middle



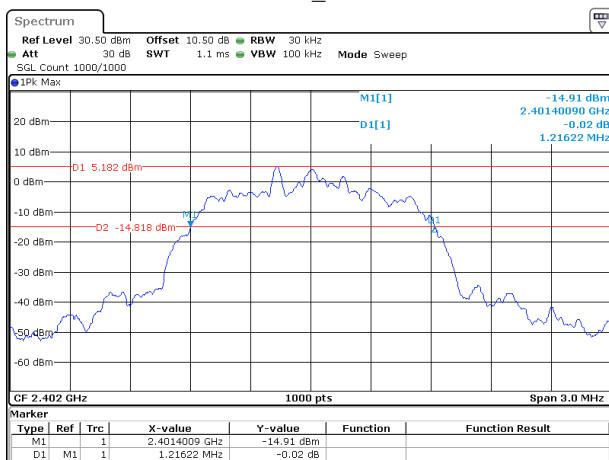
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 15:33:05

2DH1_High



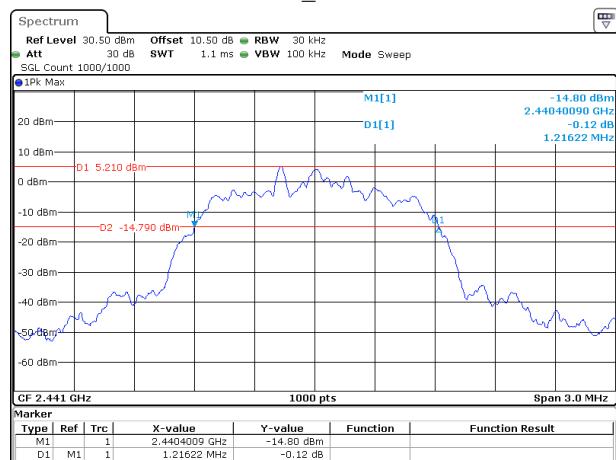
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 15:34:07

3DH1_Low



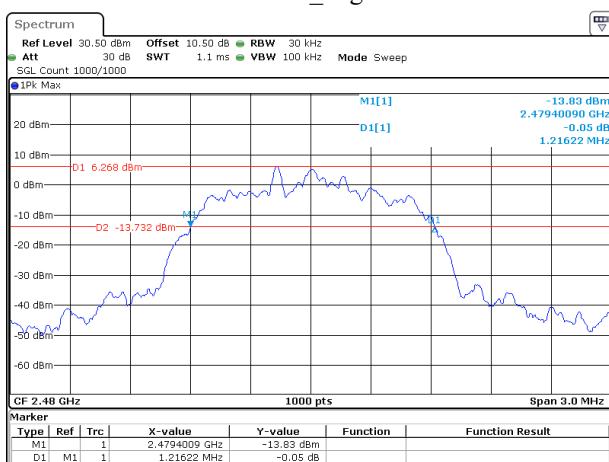
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:37:07

3DH1_Middle



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:40:59

3DH1_High



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:41:53

99% Occupied Bandwidth**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09~2025/05/19
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

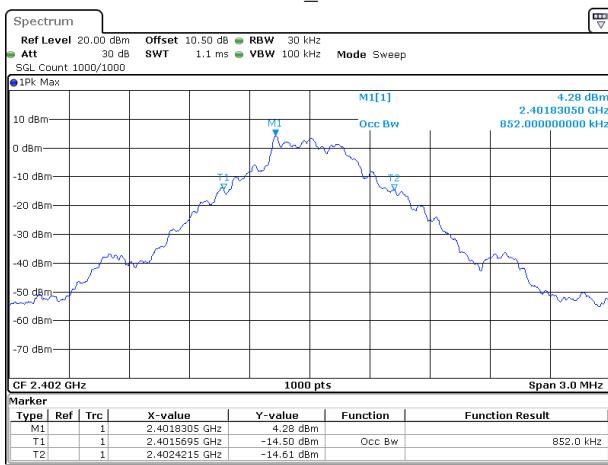
Environmental Conditions:

Temperature: (°C)	24.9~26.1	Relative Humidity: (%)	46~50	ATM Pressure: (kPa)	100.1~100.3
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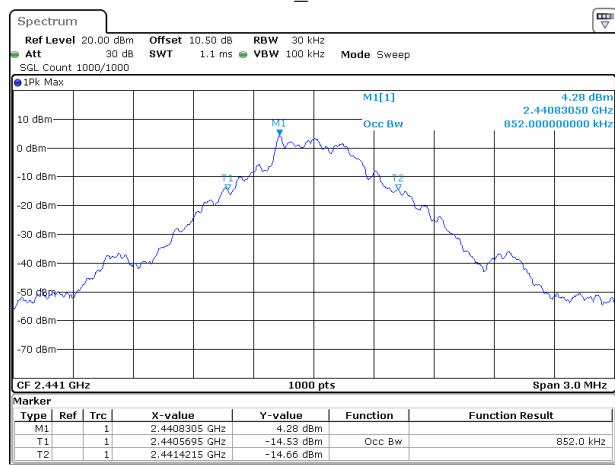
Test Data:

Mode	Channel	99% OBW (MHz)
DH1	Low Channel	0.852
	Middle Channel	0.852
	High Channel	0.849
2DH1	Low Channel	1.155
	Middle Channel	1.155
	High Channel	1.155
3DH1	Low Channel	1.134
	Middle Channel	1.134
	High Channel	1.134

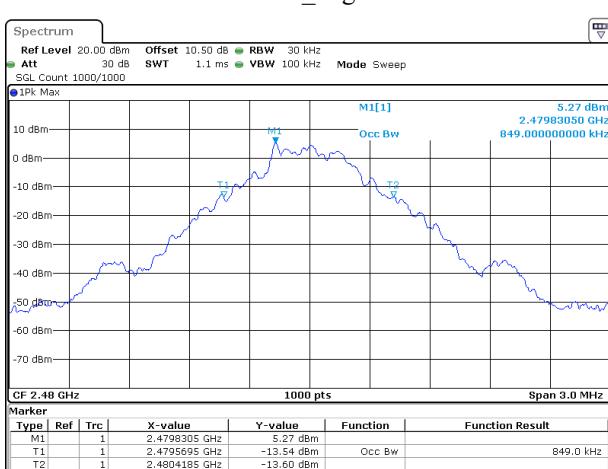
DH1_Low



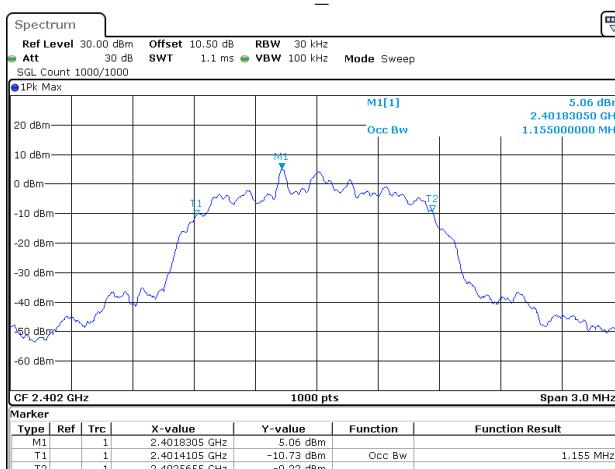
DH1_Middle



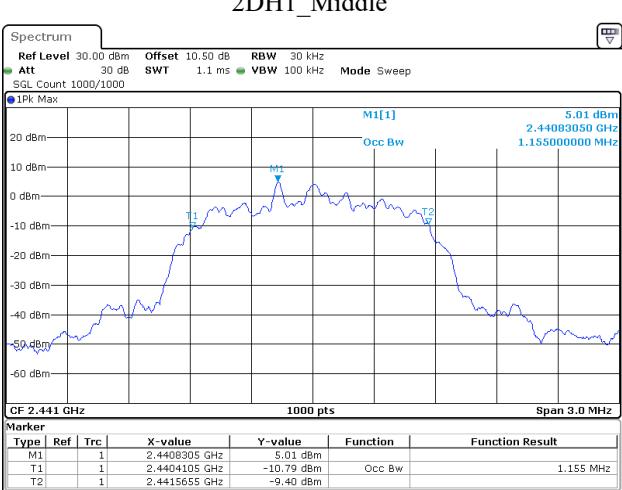
DH1_High



2DH1_Low



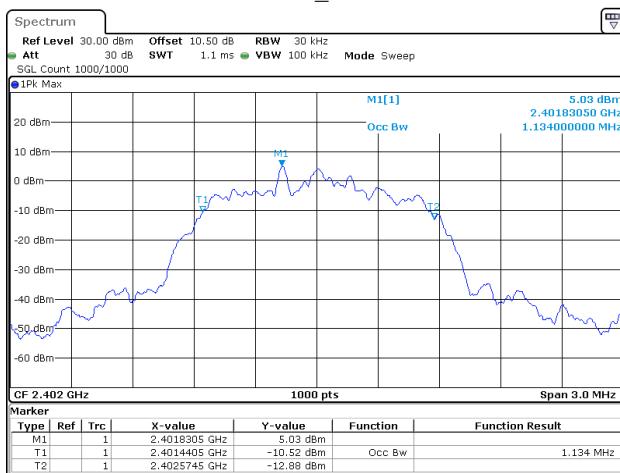
2DH1_Middle



2DH1_High



3DH1_Low



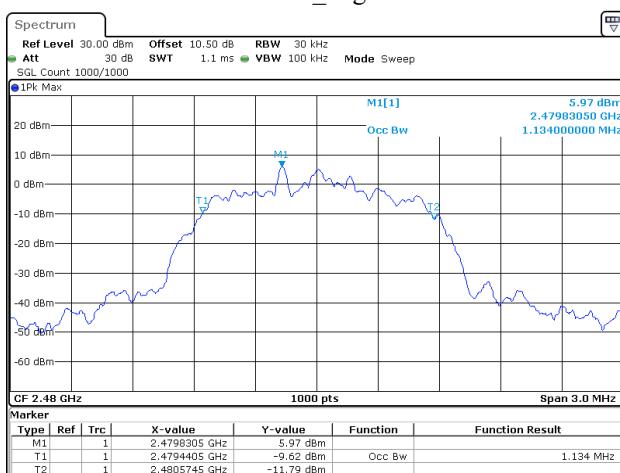
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 19.MAY.2025 10:19:05

3DH1_Middle



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 19.MAY.2025 10:19:46

3DH1_High



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 19.MAY.2025 10:20:34

Channel Separation**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

Environmental Conditions:

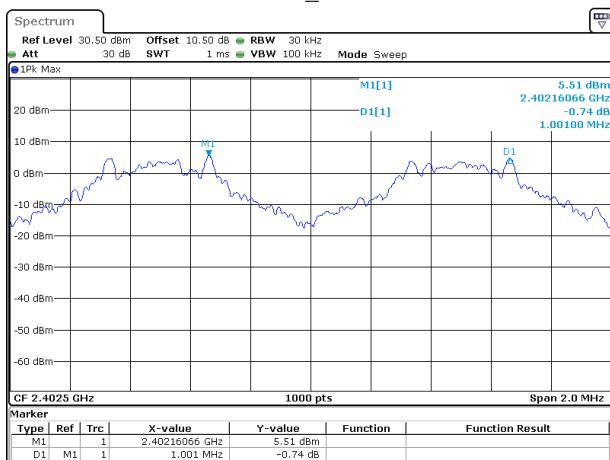
Temperature: (°C)	26.1	Relative Humidity: (%)	46	ATM Pressure: (kPa)	100.1
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Test Data:

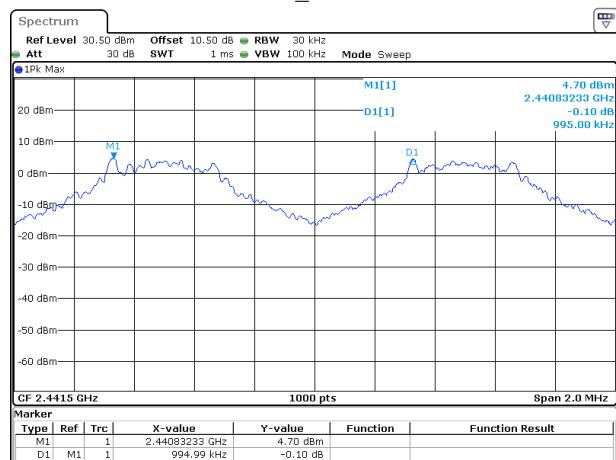
Mode	Channel	Result (MHz)	Limit (MHz)	Verdict
DH1	Low Channel	1.001	0.823	Pass
	Middle Channel	0.995		Pass
	High Channel	1.003		Pass

Note: Only the BDR (GFSK) mode result is reported since EDR ($\pi/4$ -DQPSK) and EDR (8DPSK) modes have the exact same channel plan, and the limit is the maximum 20dB bandwidth *2/3.

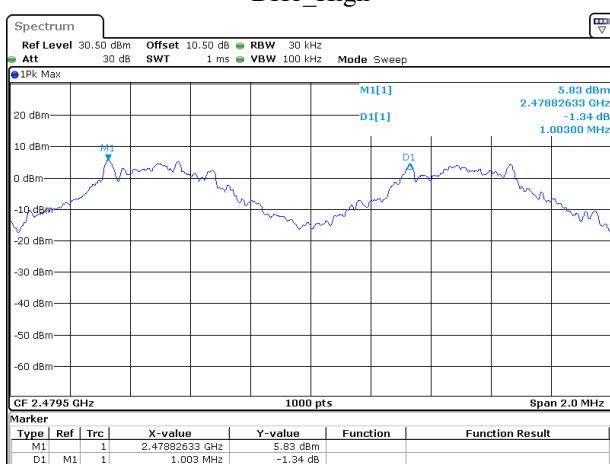
DH1_Low



DH1_Middle



DH1_High



Number of Hopping Frequency**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

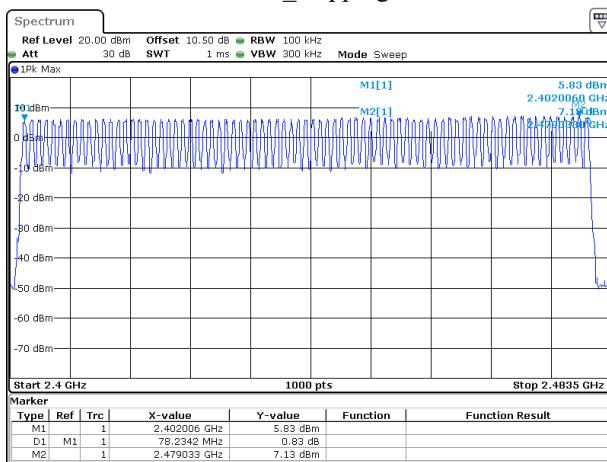
Environmental Conditions:

Temperature: (°C)	26.1	Relative Humidity: (%)	46	ATM Pressure: (kPa)	100.1
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Test Data:

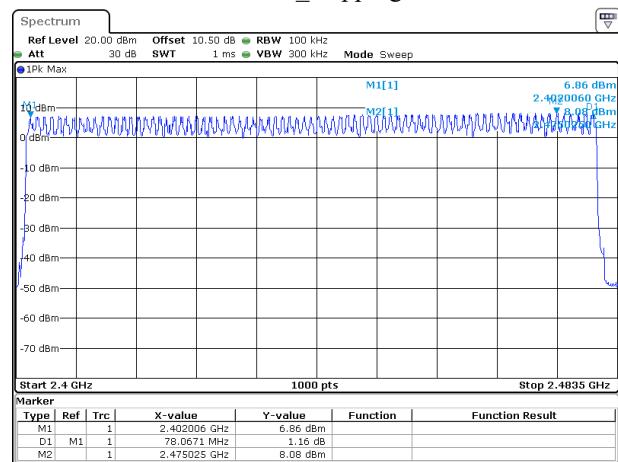
Mode	Channel	Result	Limit	Verdict
DH1	Hopping Channel	79	15	Pass
2DH1	Hopping Channel	79	15	Pass
3DH1	Hopping Channel	79	15	Pass

DH1_Hopping



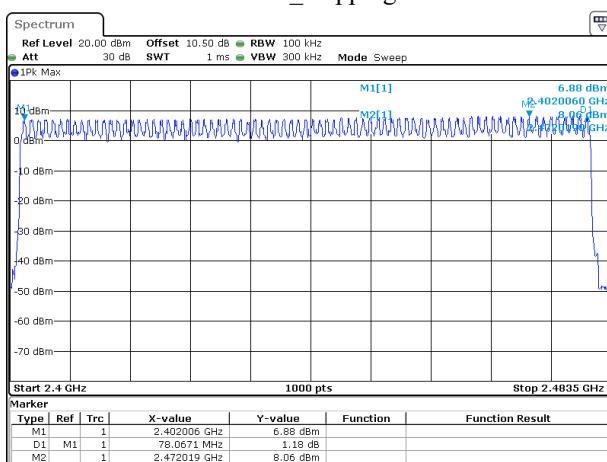
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 16:24:33

2DH1_Hopping



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 16:26:27

3DH1_Hopping



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
Date: 9.MAY.2025 16:28:10

Maximum Conducted Output Power**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

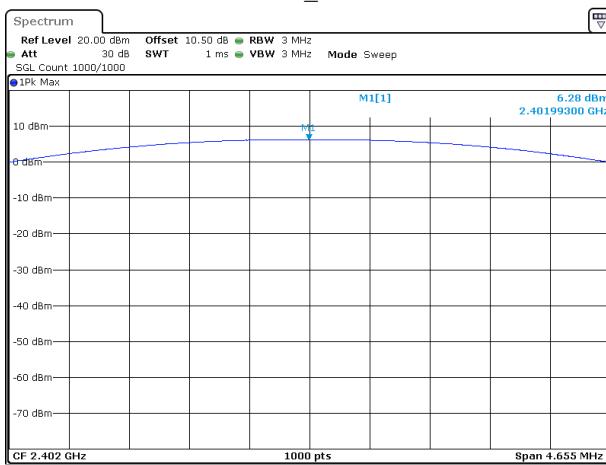
Environmental Conditions:

Temperature: (°C)	26.1	Relative Humidity: (%)	46	ATM Pressure: (kPa)	100.1
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Test Data:

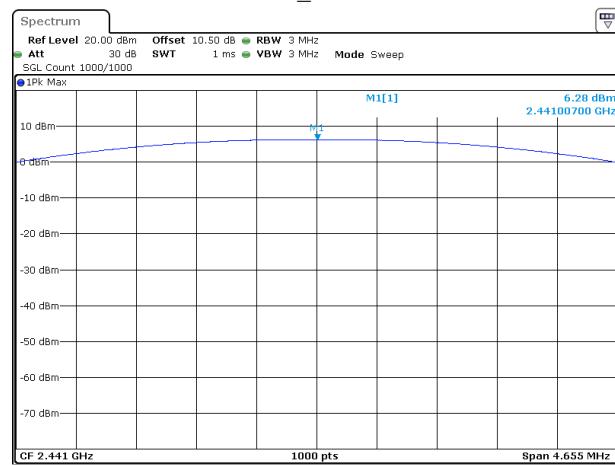
Mode	Test Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Verdict
DH1	2402	6.28	21.00	2.2	8.48	36	Pass
	2441	6.28	21.00	2.2	8.48	36	Pass
	2480	7.31	21.00	2.2	9.51	36	Pass
2DH1	2402	8.41	21.00	2.2	10.61	36	Pass
	2441	8.49	21.00	2.2	10.69	36	Pass
	2480	9.50	21.00	2.2	11.7	36	Pass
3DH1	2402	9.11	21.00	2.2	11.31	36	Pass
	2441	9.22	21.00	2.2	11.42	36	Pass
	2480	10.17	21.00	2.2	12.37	36	Pass

DH1_Low



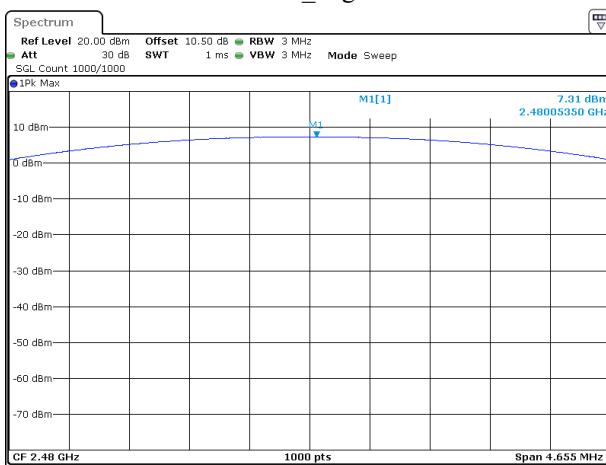
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:21:28

DH1_Middle



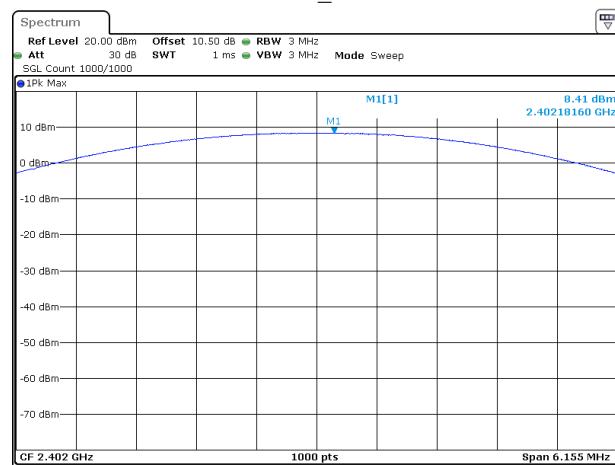
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:25:46

DH1_High



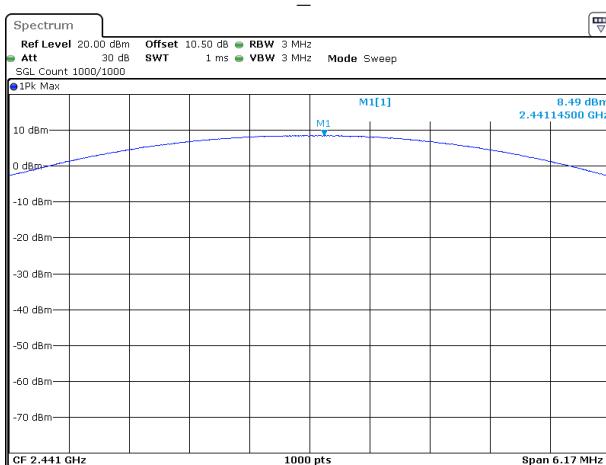
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:28:38

2DH1_Low



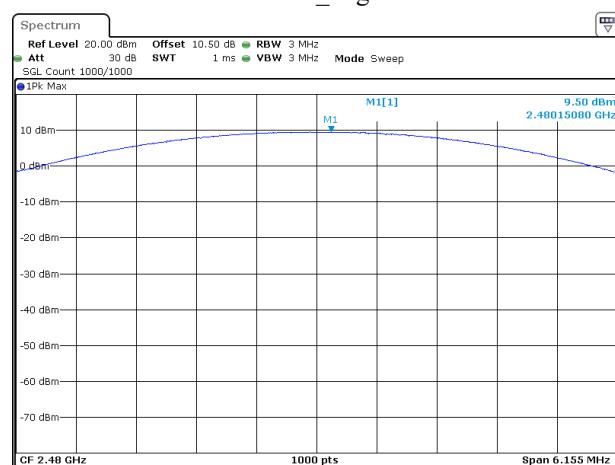
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:32:31

2DH1_Middle



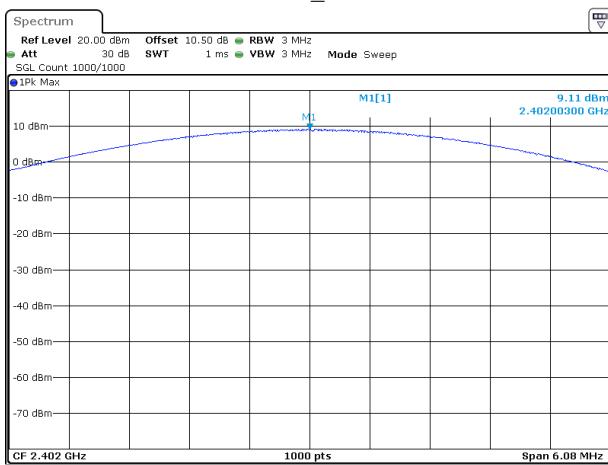
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:33:33

2DH1_High



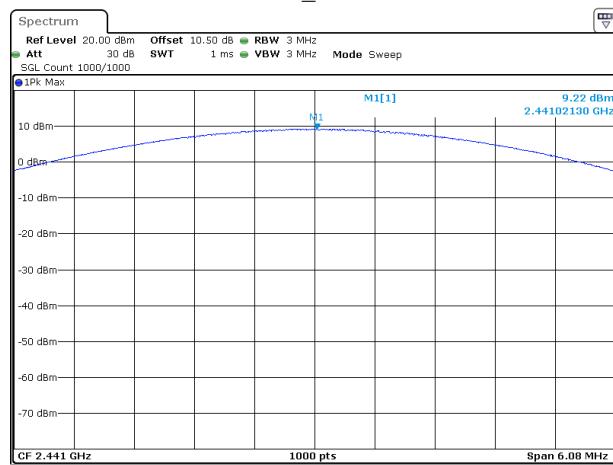
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:36:27

3DH1_Low



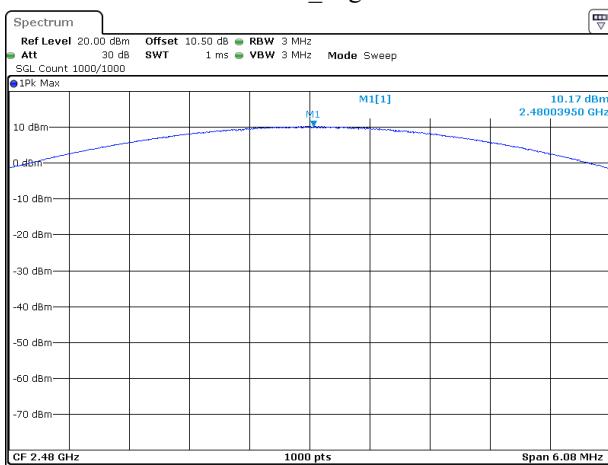
ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:40:32

3DH1_Middle



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:41:27

3DH1_High



ProjectNo.:2501S51596E-RF Tester:Rainbow Zhu
 Date: 9.MAY.2025 15:44:14

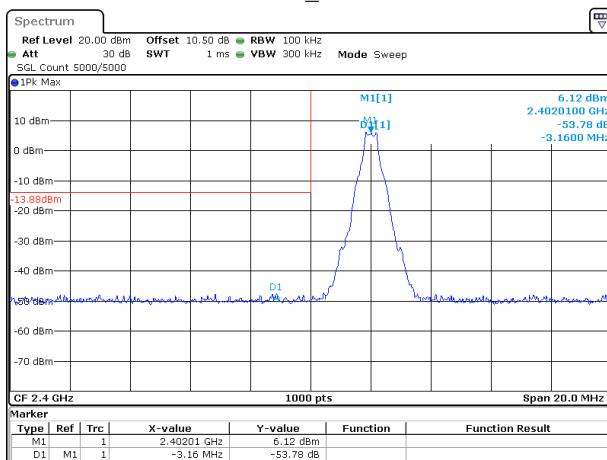
100 kHz Bandwidth of Frequency Band Edge**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

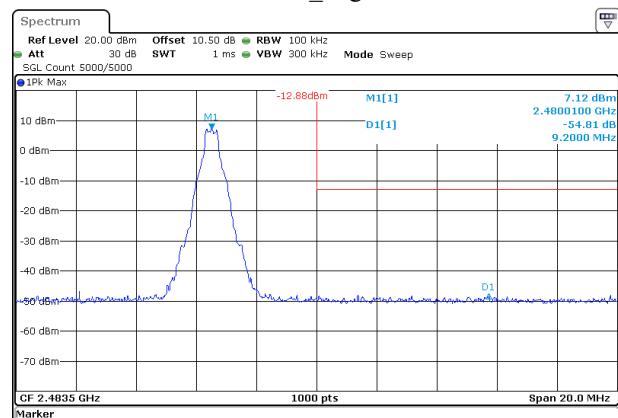
Environmental Conditions:

Temperature: (°C)	26.1	Relative Humidity: (%)	46	ATM Pressure: (kPa)	100.1
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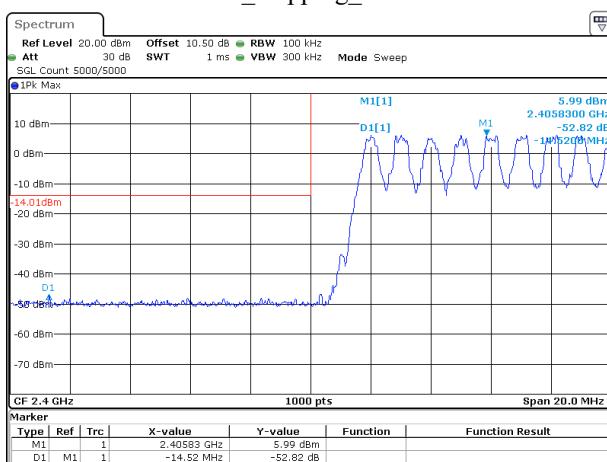
DH1_Low



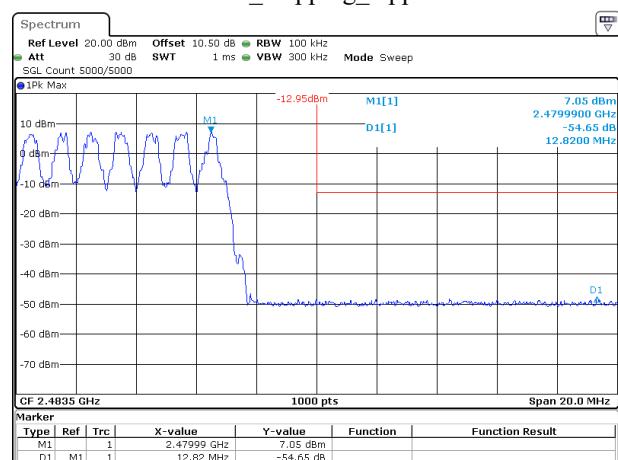
DH1_High



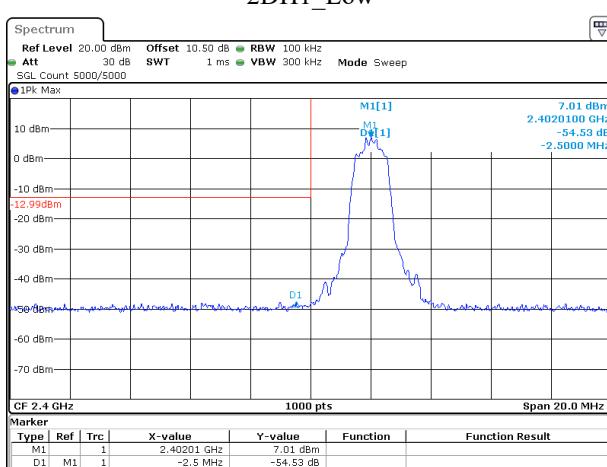
DH1_Hopping_Lower



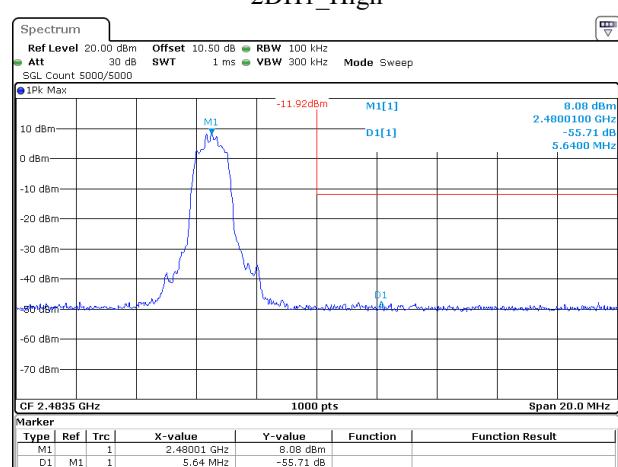
DH1_Hopping_Upper



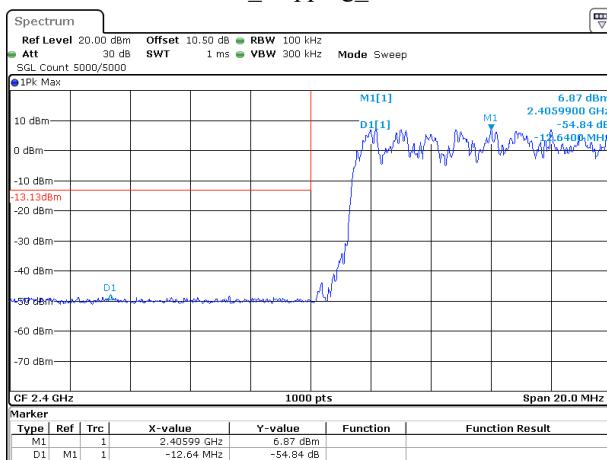
2DH1_Low



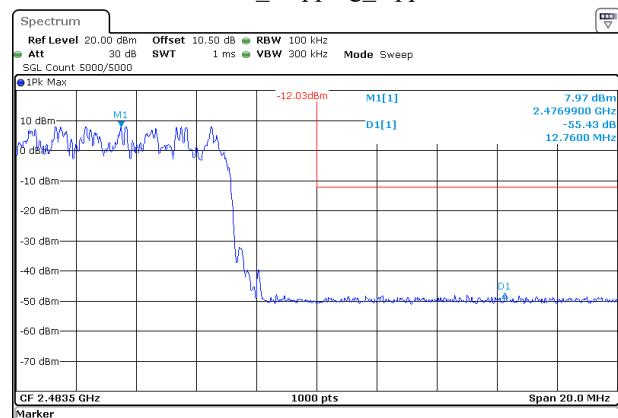
2DH1_High



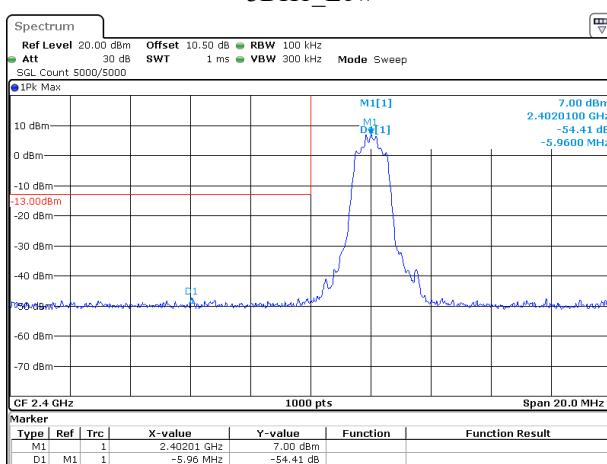
2DH1_Hopping_Lower



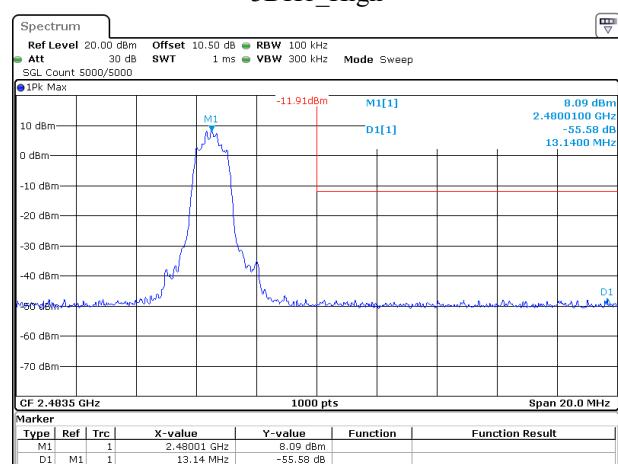
2DH1_Hopping_Upper



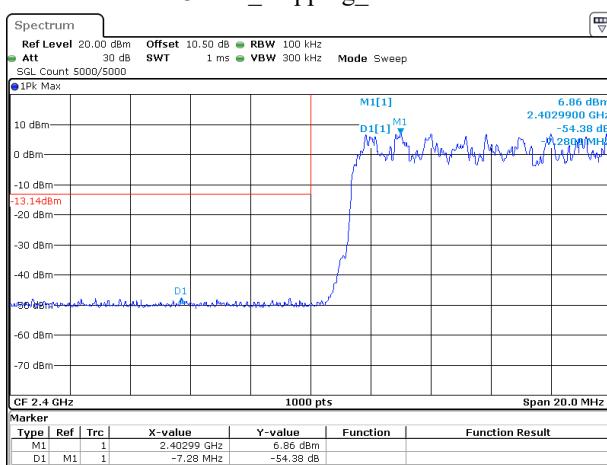
3DH1_Low



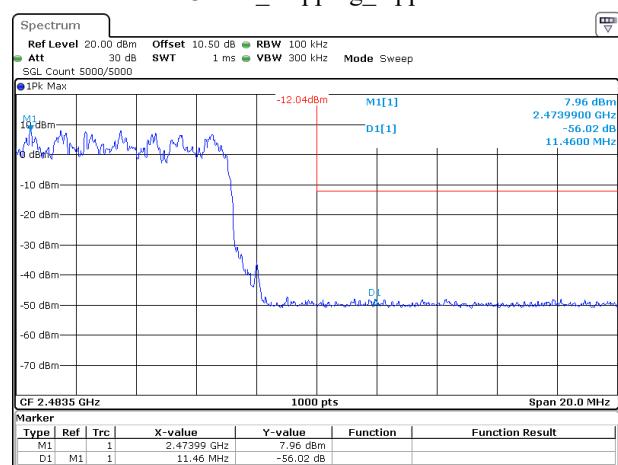
3DH1_High



3DH1_Hopping_Lower



3DH1_Hopping_Upper



Time of Occupancy (dwell time)**Test Information:**

Sample No.:	30WR-1	Test Date:	2025/05/09
Test Site:	RF	Test Mode:	Transmitting
Tester:	Rainbow Zhu	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	26.1	Relative Humidity: (%)	46	ATM Pressure: (kPa)	100.1
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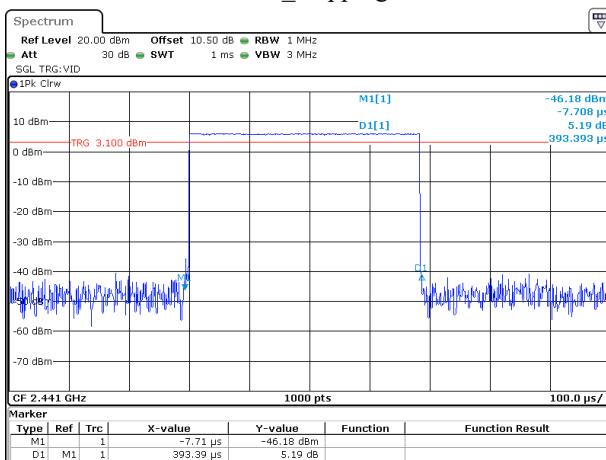
Test Data:

Mode	Channel	Pulse width (ms)	Dwell time (s)	Limit (s)	Verdict
DH1	Hopping Channel	0.393	0.126	0.400	Pass
DH3	Hopping Channel	1.646	0.263	0.400	Pass
DH5	Hopping Channel	2.898	0.309	0.400	Pass
2DH1	Hopping Channel	0.406	0.130	0.400	Pass
2DH3	Hopping Channel	1.661	0.266	0.400	Pass
2DH5	Hopping Channel	2.918	0.311	0.400	Pass
3DH1	Hopping Channel	0.406	0.130	0.400	Pass
3DH3	Hopping Channel	1.661	0.266	0.400	Pass
3DH5	Hopping Channel	2.918	0.311	0.400	Pass

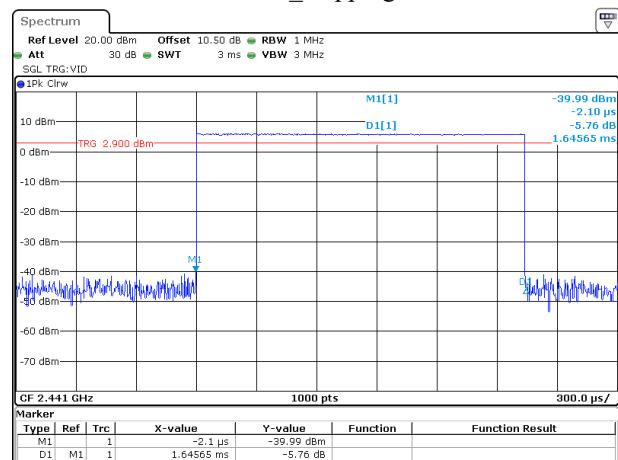
Note:

DH1: Dwell time=Pulse width (ms) \times (1600/2/79) \times 31.6 s
DH3: Dwell time=Pulse width (ms) \times (1600/4/79) \times 31.6 s
DH5: Dwell time=Pulse width (ms) \times (1600/6/79) \times 31.6 s
2DH1: Dwell time=Pulse width (ms) \times (1600/2/79) \times 31.6 s
2DH3: Dwell time=Pulse width (ms) \times (1600/4/79) \times 31.6 s
2DH5: Dwell time=Pulse width (ms) \times (1600/6/79) \times 31.6 s
3DH1: Dwell time=Pulse width (ms) \times (1600/2/79) \times 31.6 s
3DH3: Dwell time=Pulse width (ms) \times (1600/4/79) \times 31.6 s
3DH5: Dwell time=Pulse width (ms) \times (1600/6/79) \times 31.6 s

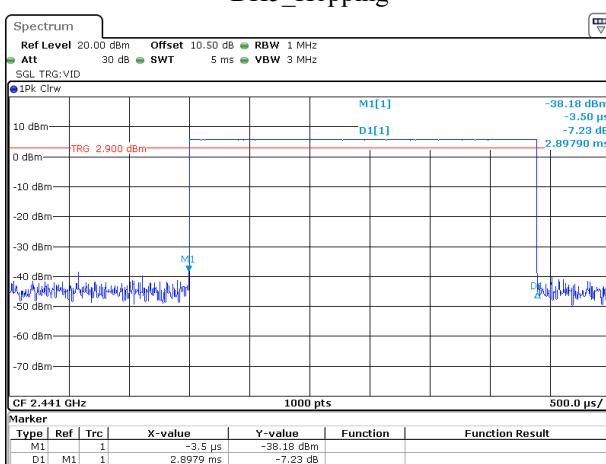
DH1_Hopping



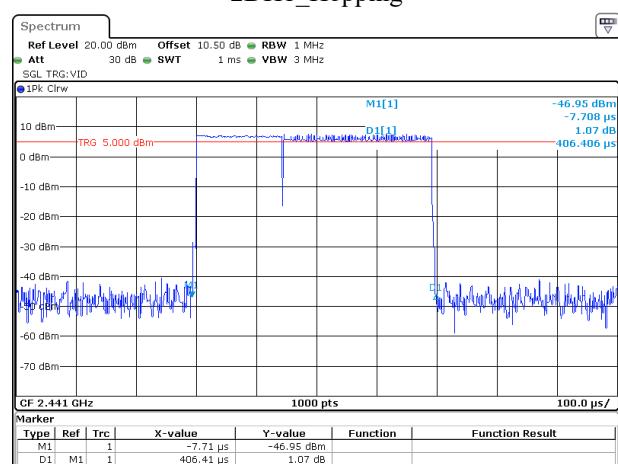
DH3_Hopping



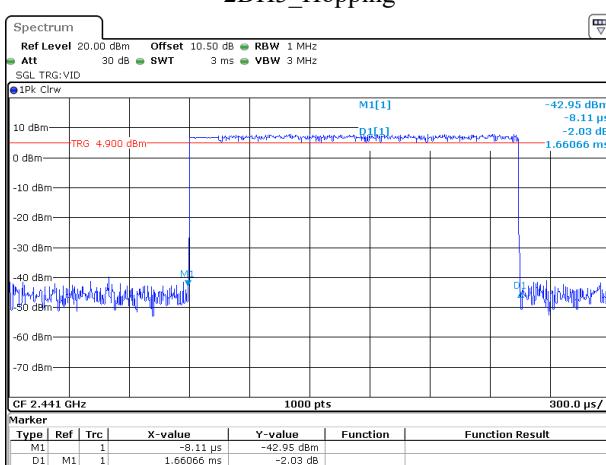
DH5_Hopping



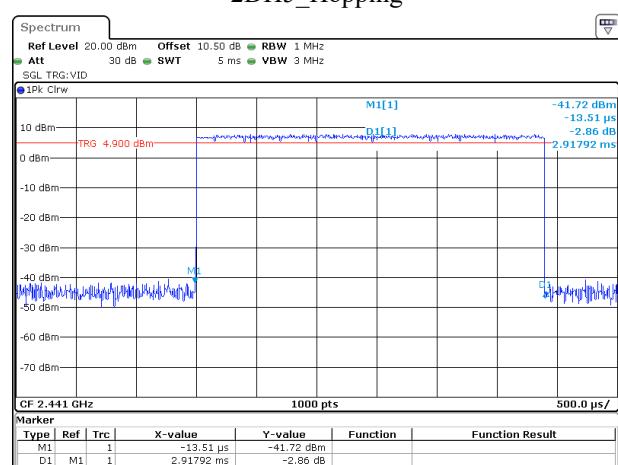
2DH1_Hopping



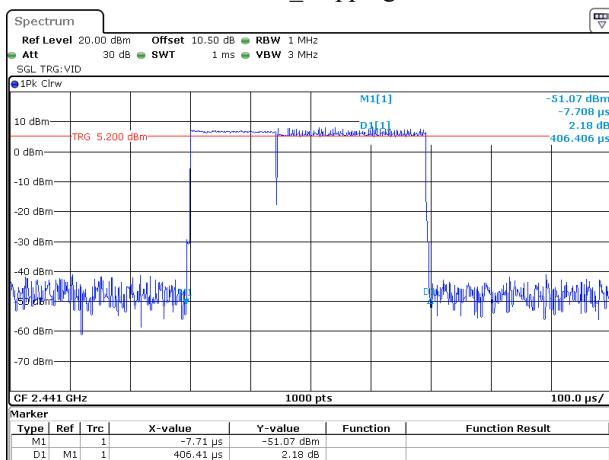
2DH3_Hopping



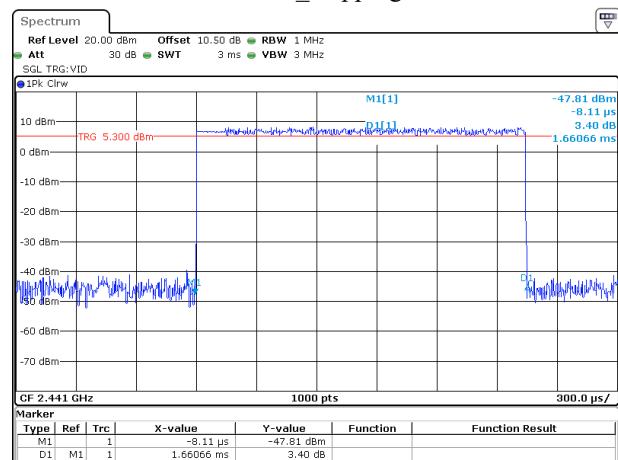
2DH5_Hopping



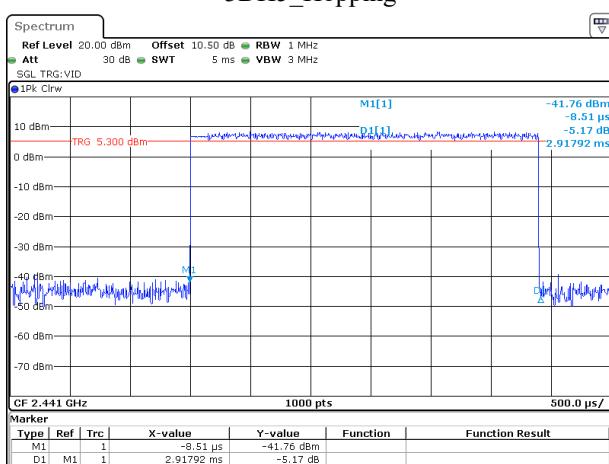
3DH1_Hopping



3DH3_Hopping



3DH5_Hopping



RF EXPOSURE EVALUATION

MPE-Based Exemption

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 v01 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(3)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$.
1.34-30	$3,450 R^2/f^2$.
30-300	$3.83 R^2$.
300-1,500	$0.0128 R^2 f$.
1,500-100,000	$19.2 R^2$.

R is the minimum separation distance in meters

f = frequency in MHz

Result

Mode	Frequency (MHz)	Tune up conducted power#(dBm)	Antenna Gain#		ERP		Evaluation Distance (m)	ERP Limit (W)
			(dBi)	(dBd)	(dBm)	(W)		
Bluetooth	2402-2480	10.50	2.2	0.05	10.55	0.011	0.2	0.768
BLE	2402-2480	7.50	2.2	0.05	7.55	0.006	0.2	0.768

Note: 1. The tune up conducted power# and antenna gain# were declared by the applicant.
 2. $0\text{dBd}=2.15\text{dBi}$

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant

FIELD REFERENCE LEVEL EXPOSURE EXEMPTION LIMITS

Applicable Standard

According to RSS-102 Issue 6§6.6:

Field reference level (FRL) exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm (i.e. mobile devices), except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 1 W (adjusted for tune-up tolerance)
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance)
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $1.31 \times 10^{-2}f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 5 W (adjusted for tune-up tolerance) In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

Test Result:

For worst case:

Mode	Frequency (MHz)	Antenna Gain [#] (dBi)	Conducted output power [#] including Tune-up Tolerance (dBm)	Max tune-up EIRP [#]		Exemption limits (W)	Exemption
				(dBm)	(W)		
Bluetooth	2402-2480	2.2	10.5	12.7	0.0186	2.676	Yes
BLE	2402-2480	2.2	7.5	9.7	0.0093	2.676	Yes

Note 1: The antenna gain[#] and Conducted output power[#] including Tune-up Tolerance was declared and provided by the manufacturer

Result: Compliant

EUT PHOTOGRAPHS

Please refer to the attachment 2501S51596E-RF External photo and 2501S51596E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2501S51596E-RFA Test Setup photo.

******* END OF REPORT *******