TEST REPORT

Applicant Name:	Premier Logitech, LLC
Address:	511 S. Royal Lane Coppell TX 75019 United States
Report Number:	2401X96326E-RFA
FCC ID:	2BKIJMQ20
IC:	33218-MQ20

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:	Motorola MQ20 WIFI 6E TRI-BAND MESH ROUTER
Model No.:	MQ20
Multiple Model(s) No.:	N/A
Trade Mark:	Premier Logitech
Date Received:	2024-09-23
Issue Date:	2025-03-31

Test Result:	Pass▲

▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Ekko Wu
RF Engineer

Approved By:

Nancy Wang
RF Supervisor

Note: The information marked# is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401X96326E-RFA	Original Report	2025-03-31

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

HVIN	MQ20
FVIN	01.0001.01
Frequency Range	2402~2480MHz
Maximum Conducted Output Peak Power	11.69dBm
Modulation Technique	GFSK
Antenna Specification#	4.1dBi (provided by the applicant)
Voltage Range	DC 12V from adapter
Sample serial number	2S0O-2 for Conducted and Radiated Emissions Test 2S0O-6 for RF Conducted Test (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	Adapter 1 Manufacture: Chenzhou Frecom Electronics Co., Ltd. Model: F36L7-120300SPAU Input: AC 100-240V, 50/60Hz, 0.9A. Output: DC 12.0V, 3.0A 36.0W Adapter 2 Manufacture: FLYPOWER Model: PS36LA120K3000UD Input: AC 100-240V, 50/60Hz, 1.0A Max. Output: DC 12.0V, 3.0A 36.0W
Note: The EUT charged by two adapters, the worst case Adapter 2 was selected to test for AC line conducted and radiated emission below 1GHz according to 2.4G Wi-Fi report test result.	

Objective

This report is in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.209, 15.247 rules and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247 Issue 3, August 2023 of the Innovation, Science and Economic Development Canada rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247 Issue 3, August 2023.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

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)
Power Spectral Density		0.90dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz~150 kHz	3.63dB(k=2, 95% level of confidence)
	150 kHz ~30MHz	3.66dB(k=2, 95% level of confidence)
Radiated Emissions	9kHz - 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℃
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

For BLE mode, 40 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	**2402**	20	2442
1	2404	21	2444
2	2406	22	2446
3	2408	23	2448
4	2410	24	2450
5	2412	25	2452
6	2414	26	2454
7	2416	27	2456
8	2418	28	2458
9	2420	29	2460
10	2422	30	2462
11	2424	31	2464
12	2426	32	2466
13	2428	33	2468
14	2430	34	2470
15	2432	35	2472
16	2434	36	2474
17	2436	37	2476
18	2438	38	2478
19	**2440**	**39**	**2480**

EUT was tested with Channel 0, 19 and 39.

EUT Exercise Software

Exercise Software#	Authentication tool.exe v2.0.5.0		
Power Level#			
Mode	**Low Channel**	**Middle Channel**	**High Channel**
BLE 1M	10	10	10
BLE 2M	10	10	10

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

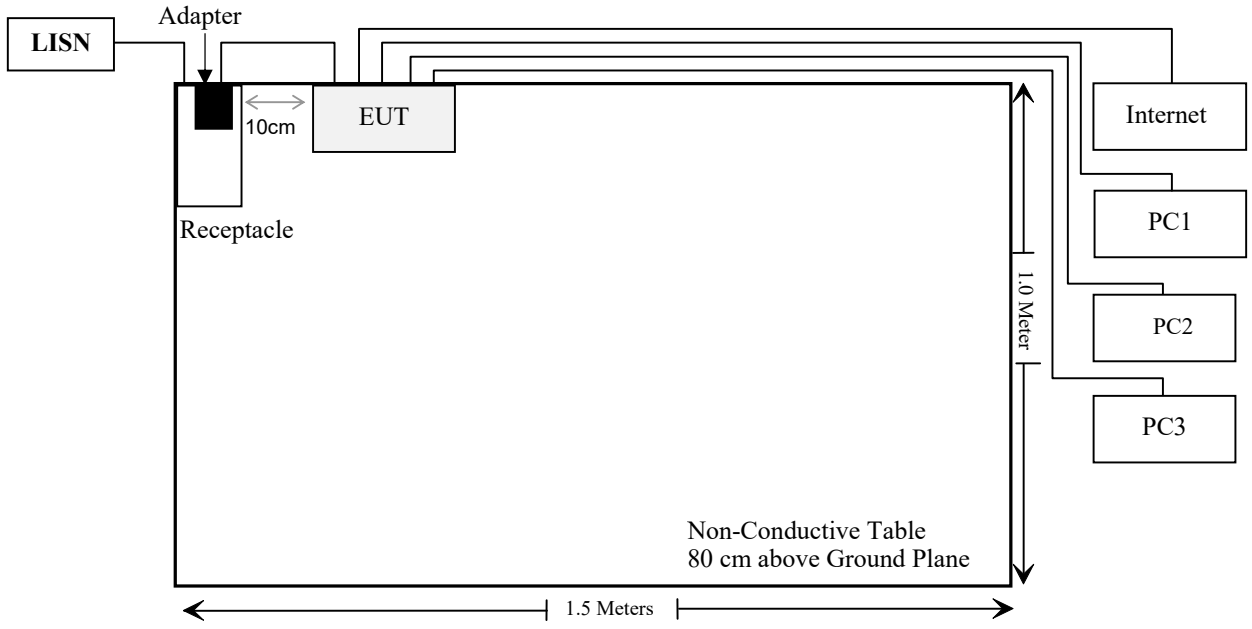
Manufacturer	Description	Model	Serial Number
DELL	PC1	Latitude E6520	DL0ZCS1
DELL	PC2	Latitude E5430	JG3NLV1
DELL	PC3	Latitude E5570	GNDLKC2

External I/O Cable

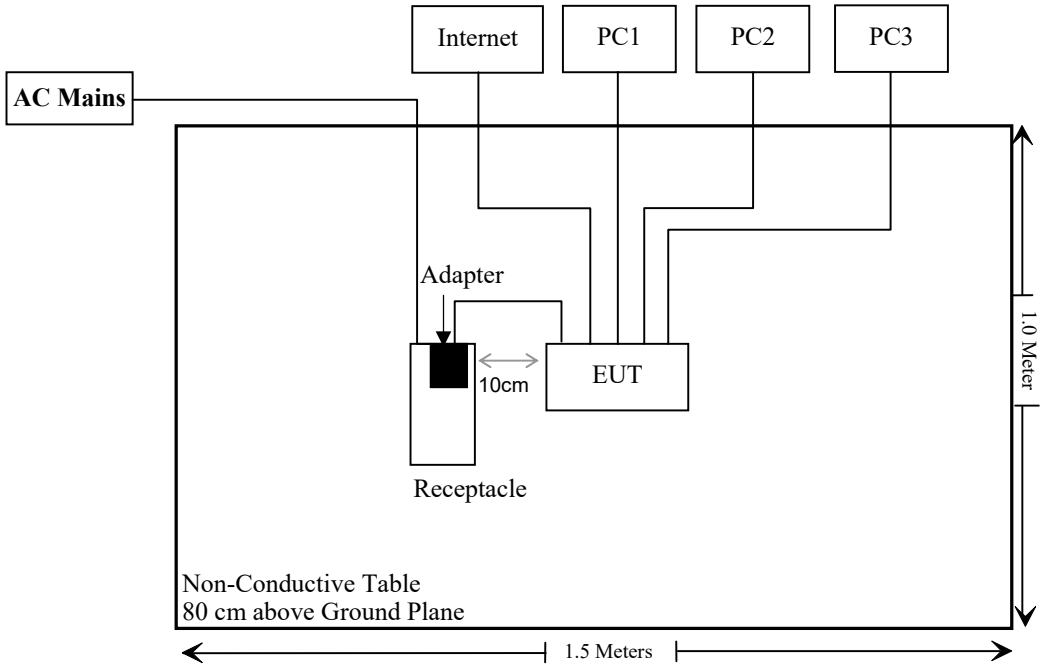
Cable Description	Length (m)	From Port	To
Unshielded Un-detachable AC cable	1.5	Receptacle	LISN/AC Mains
Unshielded Un-detachable DC cable	1.5	Adapter	EUT
Unshielded detachable RJ45 cable*3	5.0	EUT	PC
Unshielded detachable RJ45 cable	8.0	EUT	Internet

Block Diagram of Test Setup

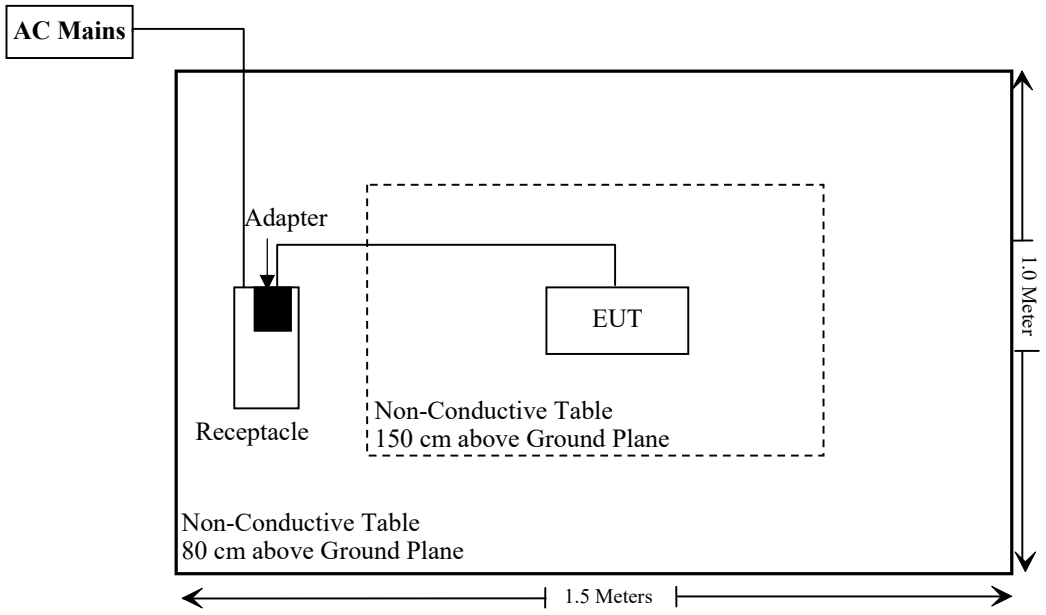
For Conducted Emissions:



For Radiated Emissions below 1GHz:



For Radiated Emissions above 1GHz:



SUMMARY OF TEST RESULTS

FCC Rules	RSS Rules	Description of Test	Result
§1.1310 & §2.1091	/	Maximum Permissible Exposure (MPE)	Compliant
/	RSS-102 §5.3.2	Exposure Limits	Compliant
§15.203	RSS-Gen §6.8	Antenna Requirement	Compliant
§15.207 (a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	RSS-GEN § 8.10 & RSS-247 § 5.5	Spurious Emissions	Compliant
§15.247 (a)(2)	RSS- Gen§6.7 RSS-247 § 5.2 (a)	99% Occupied Bandwidth & 6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	RSS-247 § 5.4(d)	Maximum Conducted Output Power	Compliant
§15.247(e)	RSS-247 § 5.2 (b)	Power Spectral Density	Compliant
§15.247(d)	RSS-247 § 5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
C63.10 §11.6	C63.10 §11.6	Duty Cycle	/

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
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2024/05/21	2025/05/20
Unknown	CE Cable	Unknown	UF A210B-1-0720-504504	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	310 N	186238	2024/05/21	2025/05/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2026/07/19
Unknown	Cable	Chamber A Cable 1	N/A	2024/06/18	2025/06/17
Unknown	Cable	XH500C	J-10M-A	2024/06/18	2025/06/17
BACL	Active Loop Antenna	1313-1A	4031911	2024/05/14	2027/05/13
Unknown	Cable	2Y194	0735	2024/12/04	2025/12/03
Unknown	Cable	PNG214	1354	2024/12/04	2025/12/03
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2024/03/27	2025/03/26
A.H.System	Preamplifier	PAM-0118P	489	2024/11/15	2025/11/14
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2026/07/25
Unknown	RF Cable	KMSE	735	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	Filter Switch Unit	DT7220FSU	DS79906	2024/09/09	2025/09/08
JD	Multiplex Switch Test Control Set	DT7220SCU	DS79903	2024/09/09	2025/09/08
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
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					
R&S	SPECTRUM ANALYZER	FSU26	200120	2024/01/08	2025/01/07
Unknown	10dB Attenuator	Unknown	F-03-EM190	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

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 4 - AC Power Lines Conducted Emission Limits

Frequency range (MHz)	Conducted limit (dBμV)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56[1]	56 to 46[1]
0.5 – 5	56	46
5 – 30	60	50

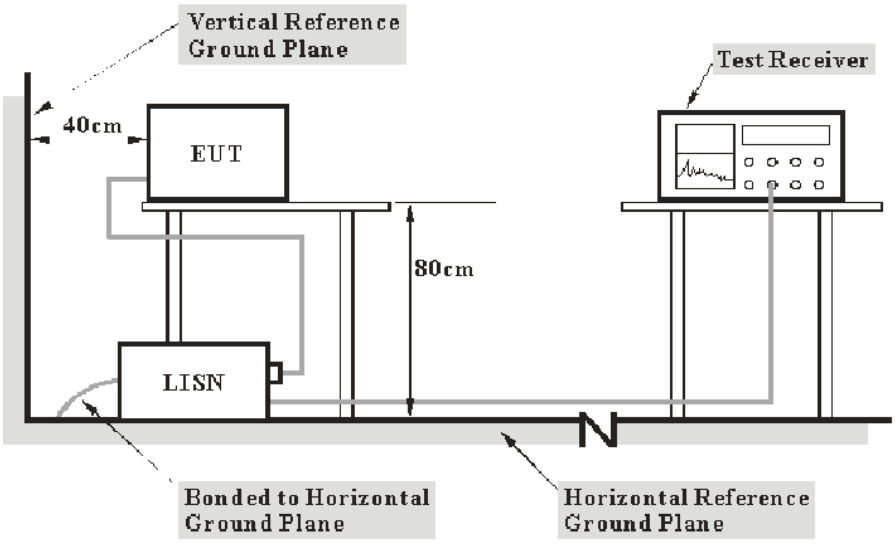
Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

(a) Perform the AC power-line conducted emissions test with the antenna connected to determine compliance with the limits of table 4 outside the transmitter's fundamental emission band.

(b) Retest with a dummy load instead of the antenna to determine compliance with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

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 setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 & RSS-247/RSS-Gen limits.

The spacing between the peripherals was 10 cm.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

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 B/W
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:

Factor = LISN VDF + 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:

Over Limit = Level – Limit
Level = Read Level + Factor

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

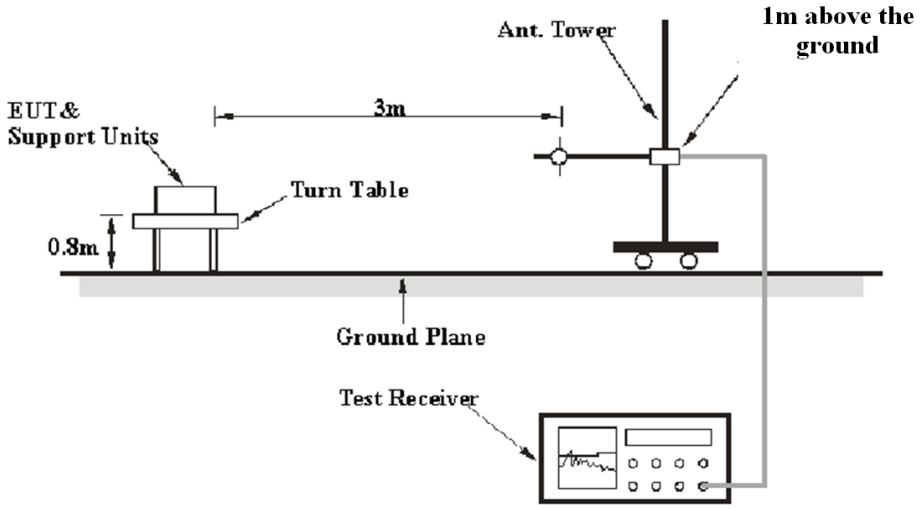
Unwanted Emission Frequencies and Restricted Bands

Applicable Standard

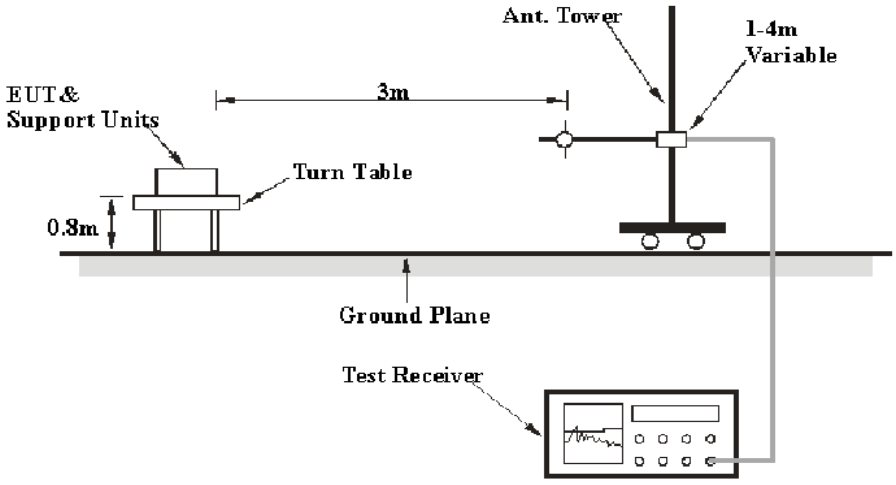
FCC §15.247 (d); §15.209; §15.205; RSS-247 §5.5, RSS-GEN §8.10.

EUT Setup

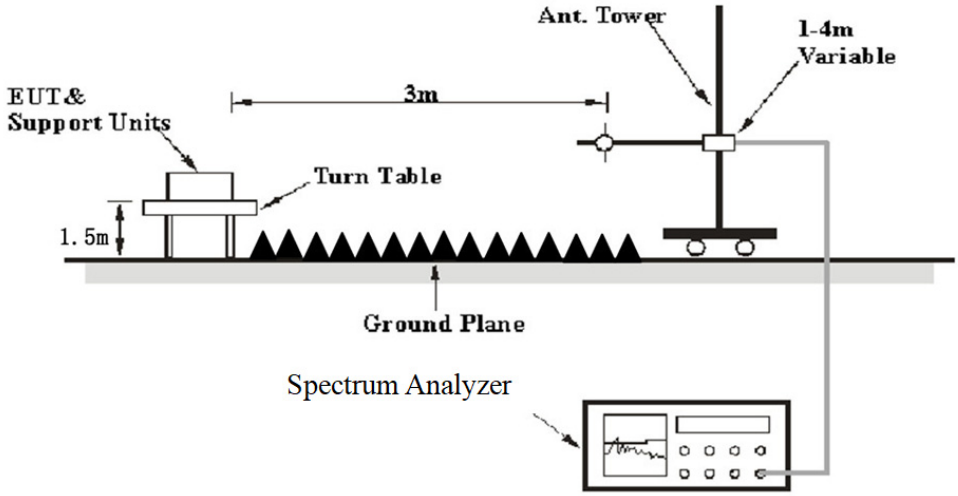
9 kHz-30MHz:



30MHz-1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.205, FCC 15.209, FCC 15.247, RSS-Gen and RSS-247 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

9 kHz-1GHz:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
9 kHz – 150 kHz	/	/	200 Hz	QP
	300 Hz	1 kHz	/	PK
150 kHz – 30 MHz	/	/	9 kHz	QP
	10 kHz	30 kHz	/	PK
30 MHz – 1000 MHz	/	/	120 kHz	QP
	100 kHz	300 kHz	/	PK

1-25GHz:
Pre-scan

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
AV	>98%	1MHz	5 kHz
	<98%	1MHz	≥1/Ton

Final measurement for emission identified during pre-scan

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
AV	>98%	1MHz	10 Hz
	<98%	1MHz	≥1/Ton

Note: Ton is minimum transmission duration

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.

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.

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:

Factor = Antenna Factor + Cable Loss - 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:

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

99% Occupied Bandwidth & 6 dB Emission Bandwidth

Standard Applicable

According to FCC §15.247(a) (2)
Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

According to RSS-247 §5.2 a)
The minimum 6 dB bandwidth shall be 500 kHz.

According to 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 "x 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 x 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.
The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

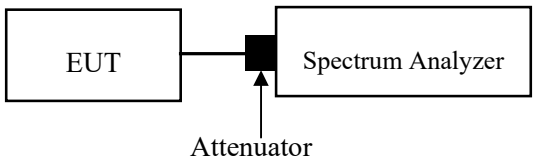
Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.8.1 & Clause 6.9.3& RSS-Gen §6.7

a. Set RBW = 100 kHz.
b. Set the VBW ≥ [3×RBW].
c. Detector = peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize.
g. Measure the maximum width of the emission that is constrained by the frequencies associatedwith the two outermost amplitude points (upper and lower frequencies) that are attenuated by6 dB relative to the maximum level measured in the fundamental emission.

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. Procedure as below

a. The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 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 VBW shall be approximately three times the RBW (for RSS rules, VBW shall not be smaller than three times the 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 (OBW/RBW)] below the reference level.
d. Step a) through step c) might require iteration to adjust within the specified range.
e. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
f. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
g. If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
h. The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data maybe reported in addition to the plot(s).



Peak Output Power Measurement

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

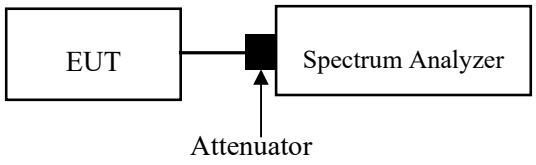
According to RSS-247§5.4 d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(e), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.9.1.1

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
3. Add a correction factor to the display.
4. Set the RBW ≥ DTS bandwidth.
5. Set the VBW ≥ [3×RBW].
6. Set span ≥ [3 × RBW].
7. Sweep time = auto couple.
8. Detector = peak.
9. Trace mode = max hold.
10. Allow the trace to stabilize.
11. Use peak marker function to determine the peak amplitude level.



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

100 kHz Bandwidth of Frequency Band Edge

Applicable Standard

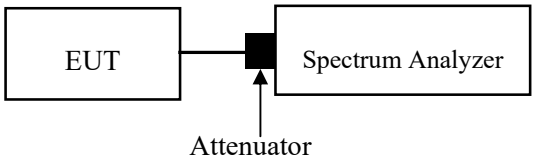
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

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(d), 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 C63.10-2013 Clause 11.11

1. Set the RBW =100 kHz.
2. Set the VBW ≥ 3×RBW.
3. Detector = peak
4. Sweep time = auto couple.
5. Trace mode=max hold
6. All trace to fully stabilize
7. Use the peak marker function to determine the maximum amplitude level.
   Ensure that amplitude of all unwanted emissions outside of the authorized frequency band(excluding restricted frequency bands) is attenuated by at least the minimum requirement specified in 11.11.
   Report the three highest emissions relative to the limit.



Power Spectral Density

Applicable Standard

According to FCC §15.247(e):
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

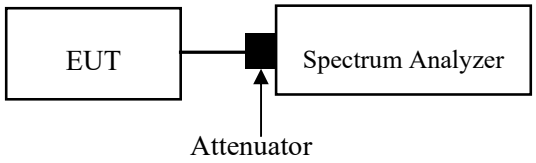
According to RSS-247 §5.2 b):

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power)

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.10.2

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set analyzer center frequency to DTS channel center frequency
3. Set the span to 1.5 times the DTS bandwidth.
4. Set the RBW to: 3kHz≤ RBW≤100 kHz.
5. Set the VBW ≥ 3×RBW.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level within the RBW.
11. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



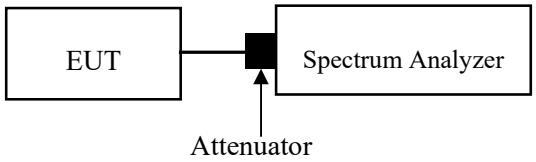
Note: A short RF cable with low cable loss connected to the EUT antenna port,which was provided by client or lab, the cable loss was add with offset into test equipment, the total offset consists of attenuator and/or RF cable loss

Duty Cycle

Test Procedure

According to ANSI C63.10-2013 Section 11.6

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the ON and OFF times of the transmitted signal:
1) Set the center frequency of the instrument to the center frequency of the transmission.
2) Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.
3) Set VBW ≥ RBW. Set detector = peak or average.
4) The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring the duty cycle shall not be used if T ≤ 16.7 μs.)



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 user 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 res ponsible 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 and the maximum antenna gain# is 4.1dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna Type	Antenna Gain#	Impedance	Frequency Range
PCB	4.1dBi	50Ω	2.4~2.5GHz

Result: Compliant

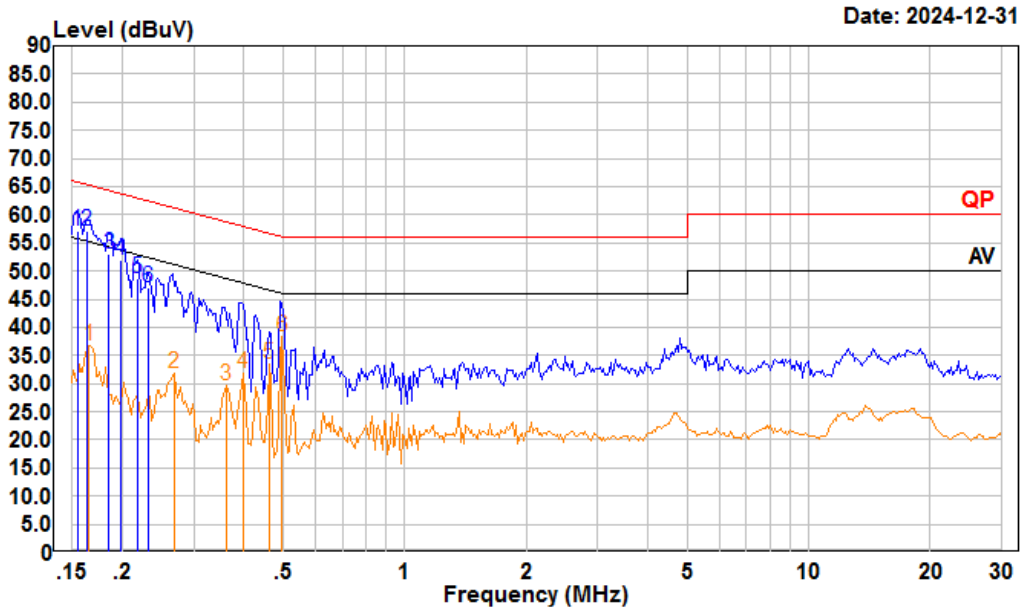
TEST DATA AND RESULTS

AC Line Conducted Emissions

Environmental Conditions

Temperature (℃)	26	**Relative Humidity (%)**	46
ATM Pressure (kPa)	101	**Test engineer**	Macy shi
Test date	2024/12/31		
EUT operation mode	Transmitting (Maximum output power mode, BLE 2M Low channel)		

AC 120V 60 Hz, Line Adapter2



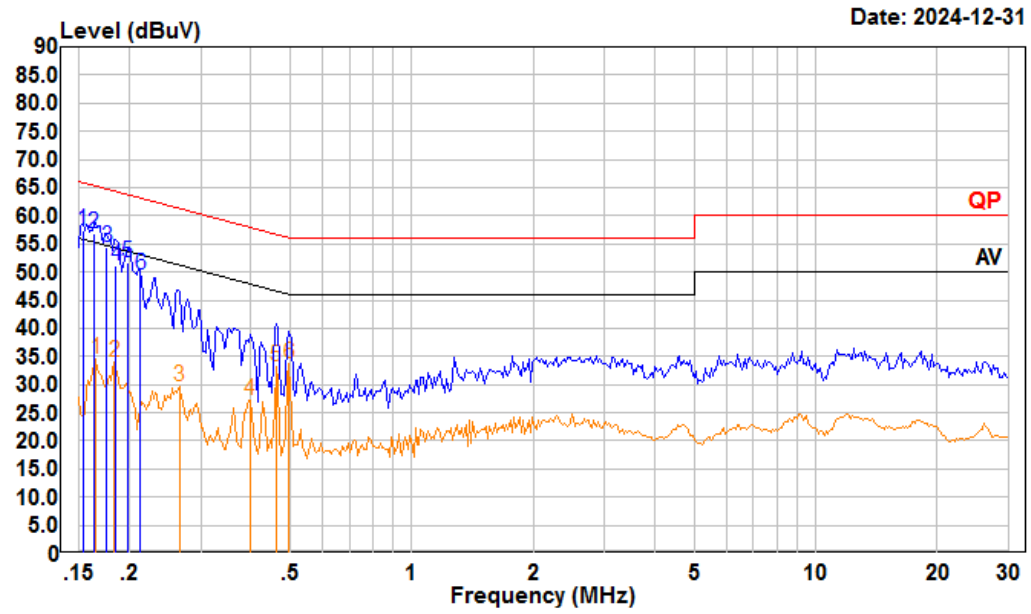
Trace: 1

Condition: Line
Project : 2401X96326E-RF
tester : Macy.shi Note:Transmitting
Setting : RBW:9kHz VBW:Auto SWT:Auto

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.155	36.20	57.21	10.89	10.12	65.74	-8.53	QP
2	0.163	36.00	56.98	10.87	10.11	65.30	-8.32	QP
3	0.185	32.10	53.02	10.83	10.09	64.24	-11.22	QP
4	0.198	31.11	52.00	10.80	10.09	63.71	-11.71	QP
5	0.217	27.90	48.76	10.77	10.09	62.92	-14.16	QP
6	0.232	26.31	47.14	10.75	10.08	62.39	-15.25	QP

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.165	15.81	36.79	10.87	10.11	55.21	-18.42	Average
2	0.269	10.94	31.73	10.70	10.09	51.16	-19.43	Average
3	0.361	9.03	29.76	10.61	10.12	48.69	-18.93	Average
4	0.398	11.08	31.76	10.58	10.10	47.90	-16.14	Average
5	0.461	12.70	33.35	10.53	10.12	46.67	-13.32	Average
6	0.497	17.73	38.37	10.50	10.14	46.05	-7.68	Average

AC 120V 60 Hz, Neutral Adapter2



Trace: 1

Condition: Neutral
Project : 2401X96326E-RF
tester : Macy.shi Note:Transmitting
Setting : RBW:9kHz VBW:Auto SWT:Auto

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.153	36.59	57.31	10.59	10.13	65.82	-8.51	QP
2	0.163	36.10	56.75	10.54	10.11	65.30	-8.55	QP
3	0.176	33.90	54.49	10.49	10.10	64.68	-10.19	QP
4	0.185	30.61	51.15	10.45	10.09	64.24	-13.09	QP
5	0.198	31.10	51.60	10.41	10.09	63.71	-12.11	QP
6	0.213	28.90	49.41	10.42	10.09	63.10	-13.69	QP

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.165	13.89	34.53	10.53	10.11	55.21	-20.68	Average
2	0.183	13.42	33.98	10.46	10.10	54.33	-20.35	Average
3	0.266	9.01	29.59	10.49	10.09	51.25	-21.66	Average
4	0.398	6.59	27.31	10.62	10.10	47.90	-20.59	Average
5	0.461	12.46	33.25	10.67	10.12	46.67	-13.42	Average
6	0.497	12.81	33.65	10.70	10.14	46.05	-12.40	Average

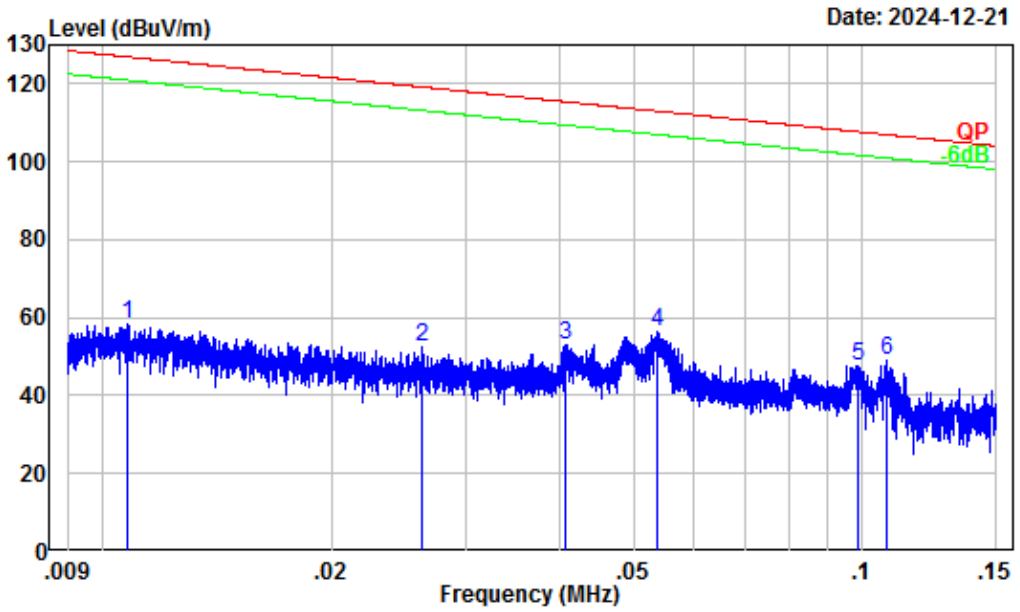
Unwanted Emission Frequencies and Restricted Bands

Environmental Conditions

Temperature (℃)	22.3~25.5	**Relative Humidity (%)**	35~51
ATM Pressure (kPa):	101~101.3	**Test engineer:**	Anson Su&Wing K Ji
Test date:	2024/12/21~2025/02/19		
EUT operation mode:	Below 1GHz: Transmitting (Maximum output power mode, BLE 2M Low channel) Above 1GHz: Transmitting		
Note:	1. For the radiated spurious emission below 30MHz, only the worst case (parallel) was recorded. 2. For the radiated spurious emission below 30MHz, when the test result of peak was less than the limit of QP/Average more than 6dB, just peak value were recorded. 3.The spurious emission from 9 kHz-30MHz of IC RSS-GEN standard, the unit of final result on the test plots are dBμV/m, so the limit should be added by 51,5 dB from dBμA/m to dBμV/m. 4. After pre-scan in the X, Y and Z axes of orientation, the worst case z-axis of orientation were recorded.		

Below 1GHz:

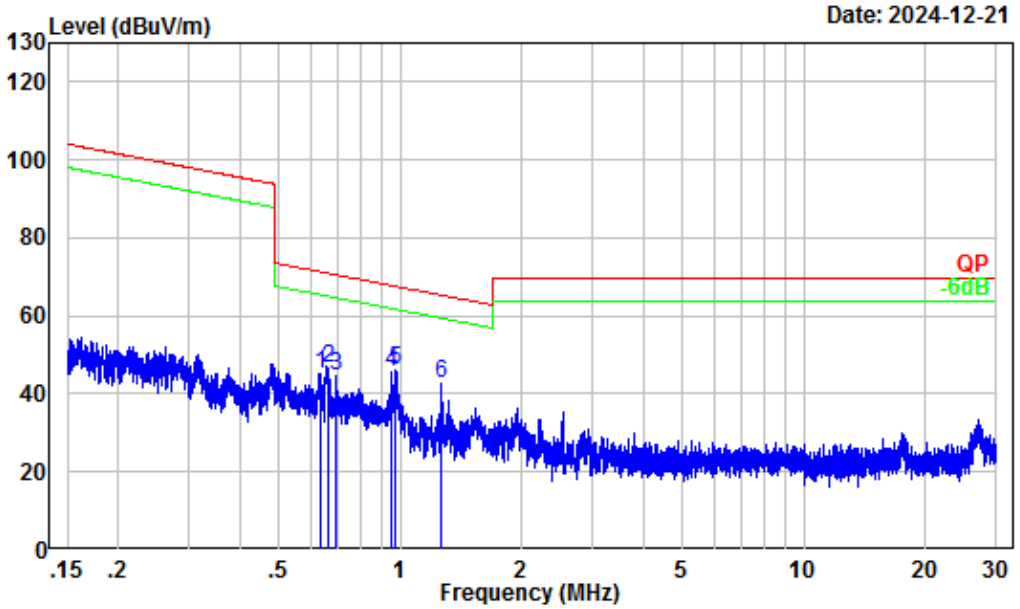
9kHz-150kHz



Site : Chamber A
Condition : 3m
Project Number: 2401X96326E-RF
Test Mode : BLE Transmitting
Setting PK RBW: 0.3KHz VBW:1KHz
Tester : Anson Su

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.01	32.15	26.17	58.32	126.93	-68.61	Peak
2	0.03	29.20	23.45	52.65	119.20	-66.55	Peak
3	0.04	27.38	25.76	53.14	115.42	-62.28	Peak
4	0.05	26.04	30.38	56.42	113.02	-56.60	Peak
5	0.10	22.09	25.54	47.63	107.71	-60.08	Peak
6	0.11	21.54	27.51	49.05	106.95	-57.90	Peak

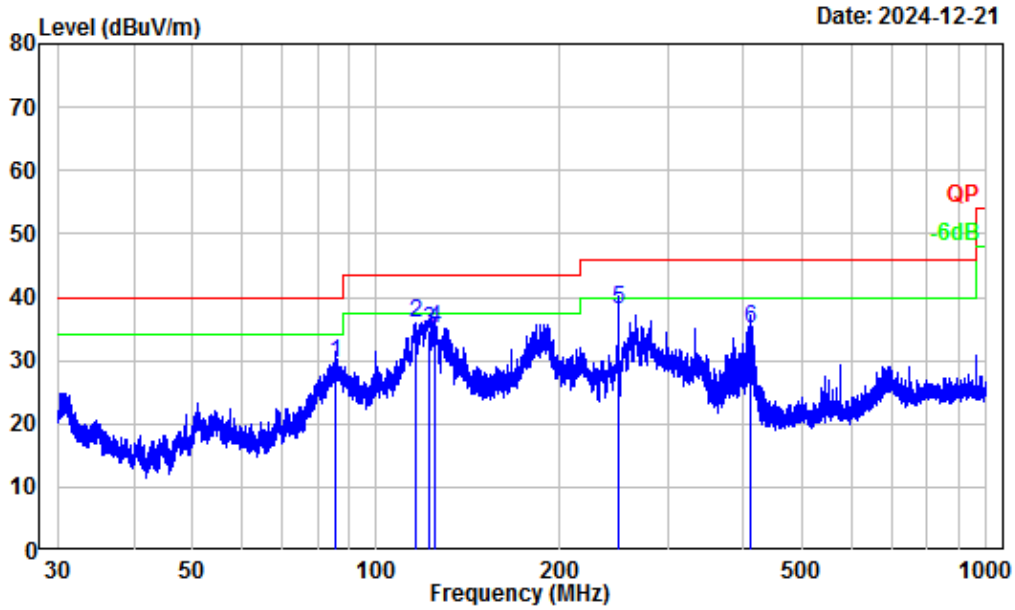
150kHz-30MHz



Site : Chamber A
Condition : 3m
Project Number: 2401X96326E-RF
Test Mode : BLE Transmitting
Setting PK RBW: 10KHz VBW:30KHz
Tester : Anson Su

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.63	4.77	40.50	45.27	71.54	-26.27	Peak
2	0.66	4.41	42.31	46.72	71.14	-24.42	Peak
3	0.69	4.03	40.64	44.67	70.74	-26.07	Peak
4	0.95	1.55	43.85	45.40	67.90	-22.50	Peak
5	0.98	1.38	44.52	45.90	67.69	-21.79	Peak
6	1.27	0.46	42.41	42.87	65.38	-22.51	Peak

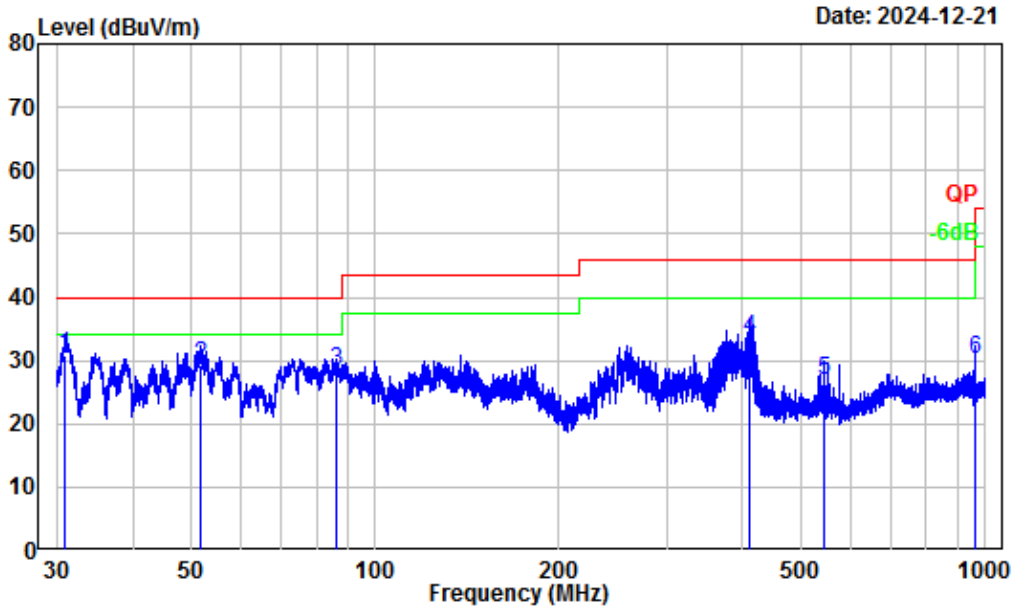
30MHz-1GHz_Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: 2401X96326E-RF
Test Mode : BLE Transmitting
Setting QP RBW: 120kHz
Tester : Anson Su

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	85.90	-18.09	47.61	29.52	40.00	-10.48	QP
2	116.23	-11.95	48.00	36.05	43.50	-7.45	QP
3	122.40	-11.20	45.81	34.61	43.50	-8.89	QP
4	124.95	-11.14	46.05	34.91	43.50	-8.59	QP
5	249.97	-13.09	51.27	38.18	46.00	-7.82	QP
6	411.28	-8.13	43.19	35.06	46.00	-10.94	QP

30MHz-1GHz_Vertical



Site : Chamber A
Condition : 3m Vertical
Project Number: 2401X96326E-RF
Test Mode : BLE Transmitting
Setting QP RBW: 120kHz
Tester : Anson Su

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	31.04	-6.50	37.33	30.83	40.00	-9.17	QP
2	51.59	-18.18	47.60	29.42	40.00	-10.58	QP
3	86.01	-18.08	46.37	28.29	40.00	-11.71	QP
4	409.66	-8.19	41.63	33.44	46.00	-12.56	QP
5	543.99	-5.78	32.70	26.92	46.00	-19.08	QP
6	960.06	-0.86	31.18	30.32	54.00	-23.68	QP

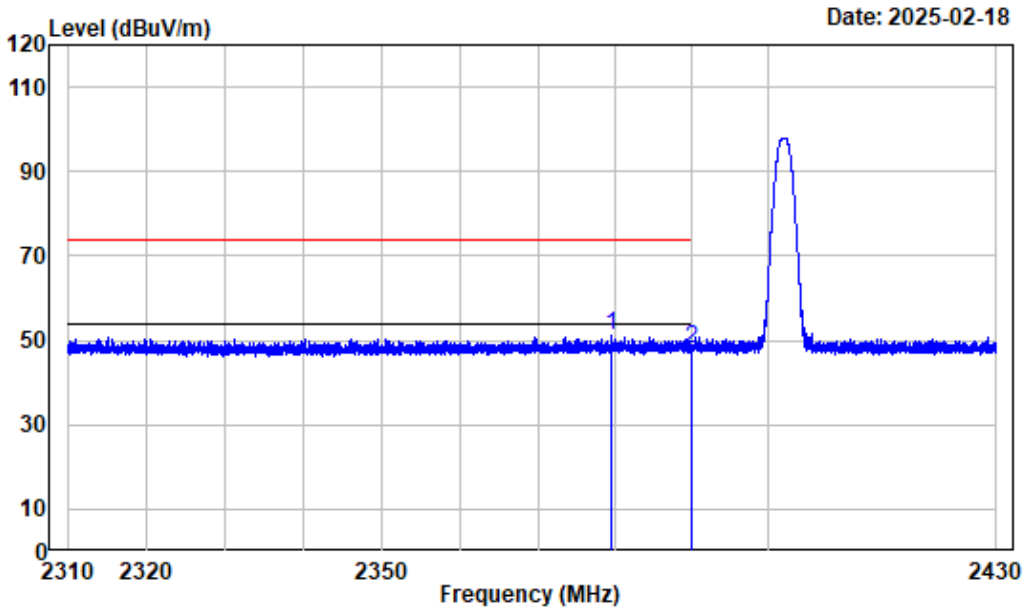
Above 1GHz:

Frequency (MHz)	Reading (dBµV)	PK/Ave	Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
BLE 1M							
Low Channel							
2379.47	61.93	PK	H	-10.98	50.95	74	-23.05
2388.87	62.26	PK	V	-10.98	51.28	74	-22.72
4804	51.62	PK	H	-7.79	43.83	74	-30.17
4804	52.32	PK	V	-7.79	44.53	74	-29.47
Middle Channel							
4880	52.25	PK	H	-7.59	44.66	74	-29.34
4880	51.80	PK	V	-7.59	44.21	74	-29.79
High Channel							
2485.56	63.22	PK	H	-10.97	52.25	74	-21.75
2487.02	63.64	PK	V	-10.97	52.67	74	-21.33
4960	52.07	PK	H	-7.56	44.51	74	-29.49
4960	51.85	PK	V	-7.56	44.29	74	-29.71
BLE 2M							
Low Channel							
2390.00	62.13	PK	H	-10.98	51.15	74	-22.85
2390.00	61.96	PK	V	-10.98	50.98	74	-23.02
4804	52.40	PK	H	-7.79	44.61	74	-29.39
4804	52.17	PK	V	-7.79	44.38	74	-29.62
Middle Channel							
4880	51.39	PK	H	-7.59	43.8	74	-30.20
4880	51.45	PK	V	-7.59	43.86	74	-30.14
High Channel							
2483.50	62.10	PK	H	-10.97	51.13	74	-22.87
2483.50	61.84	PK	V	-10.97	50.87	74	-23.13
4960	50.92	PK	H	-7.56	43.36	74	-30.64
4960	52.51	PK	V	-7.56	44.95	74	-29.05

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was less than the limit of average, so just peak values were recorded.

Test plots

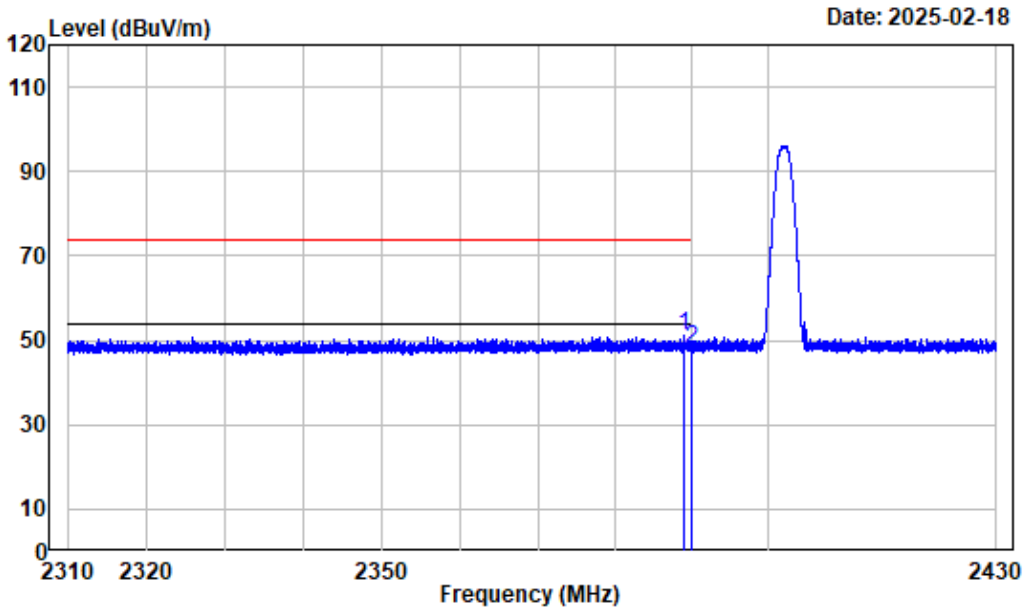
Left Band edge_Horizontal



Condition : Horizontal
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_1M_2402

	Freq	Factor	Read Level	Limit Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2379.474	-10.98	61.93	50.95	74.00	-23.05	Peak
2	2390.000	-10.98	59.08	48.10	74.00	-25.90	Peak

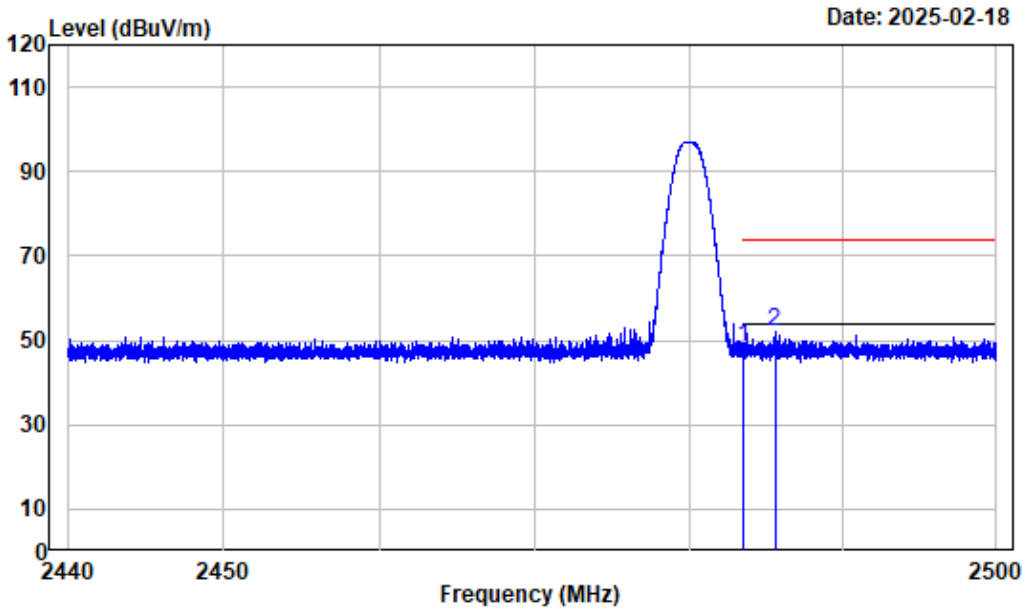
Left Band edge_Vertical



Condition : Vertical
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_1M_2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2388.865	-10.98	62.26	51.28	74.00	-22.72	Peak
2	2390.000	-10.98	58.96	47.98	74.00	-26.02	Peak

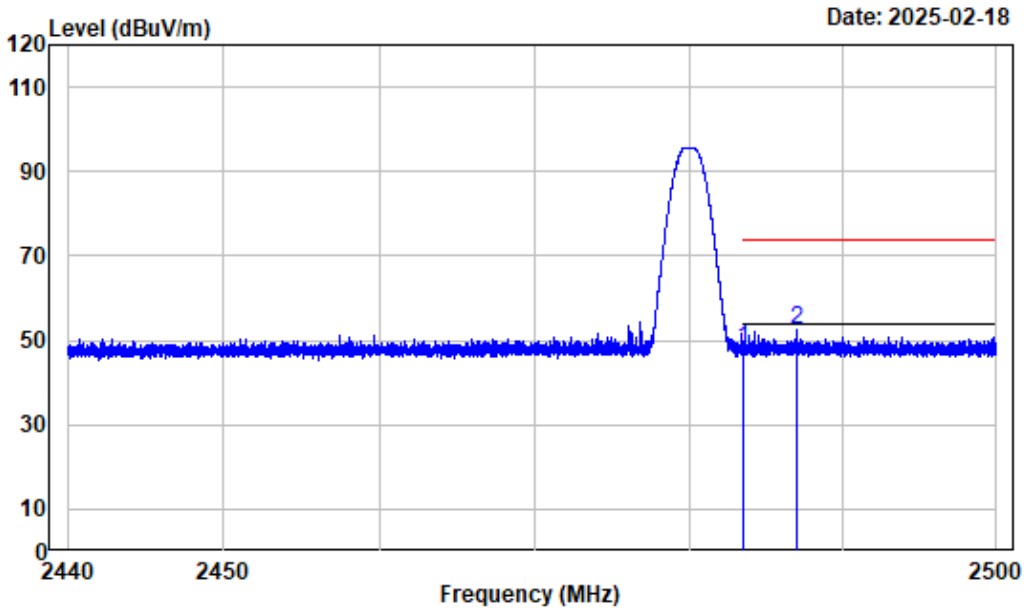
Right Band edge_Horizontal



Condition : Horizontal
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_1M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.500	-10.97	59.34	48.37	74.00	-25.63	Peak
2	2485.561	-10.97	63.22	52.25	74.00	-21.75	Peak

Right Band edge_Vertical

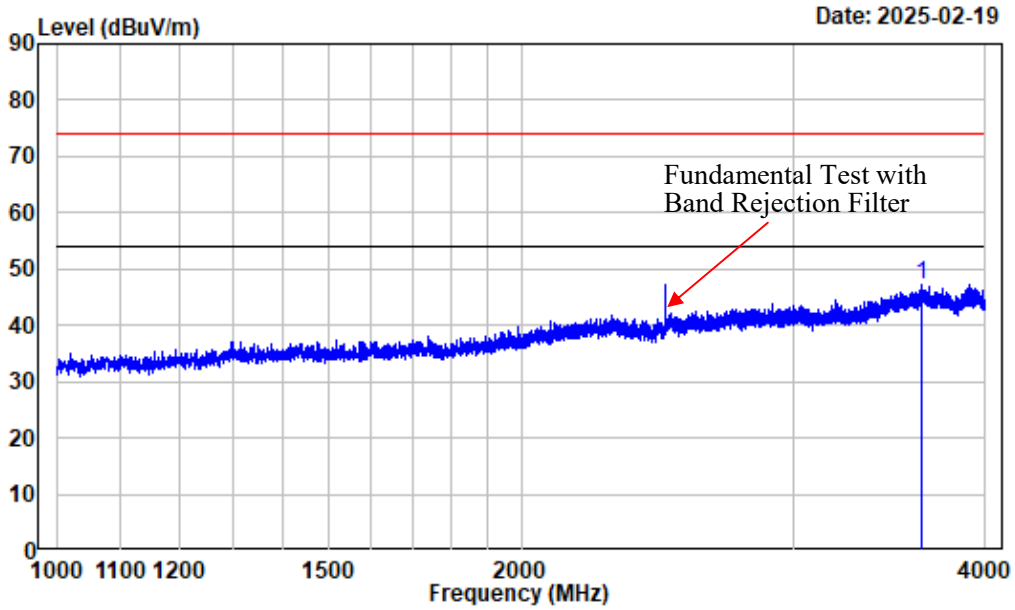


Condition : Vertical
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_1M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.500	-10.97	58.85	47.88	74.00	-26.12	Peak
2	2487.016	-10.97	63.64	52.67	74.00	-21.33	Peak

Listed with the worst harmonic margin test plot

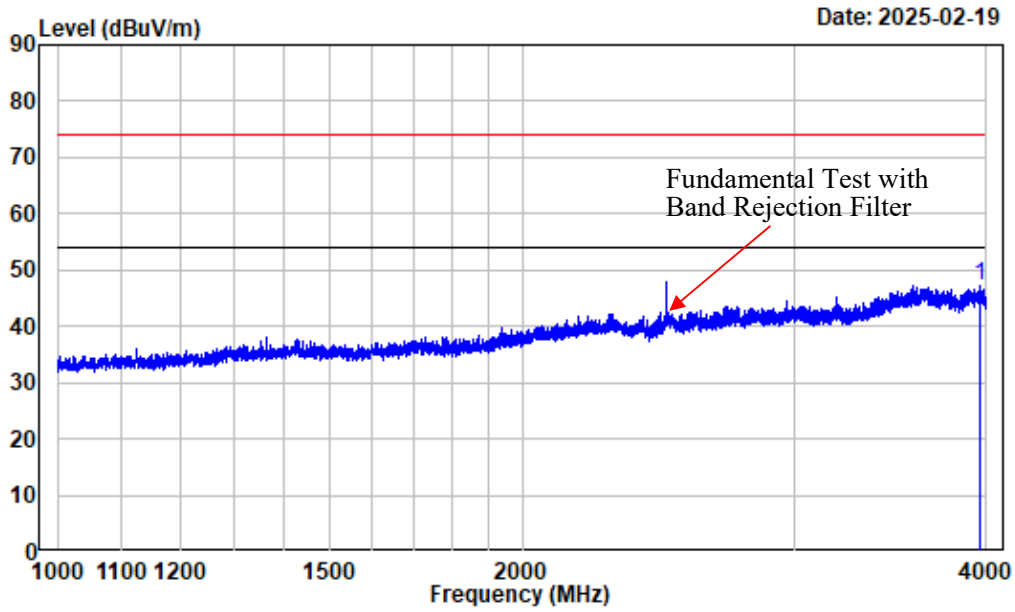
1-4GHz_Horizontal




```
Condition        : Horizontal
Project No.      : 2401X96326E-RF
Tester           : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note             : BLE_2M_2480
```

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	3642.205	-9.84	57.15	47.31	74.00	-26.69	Peak

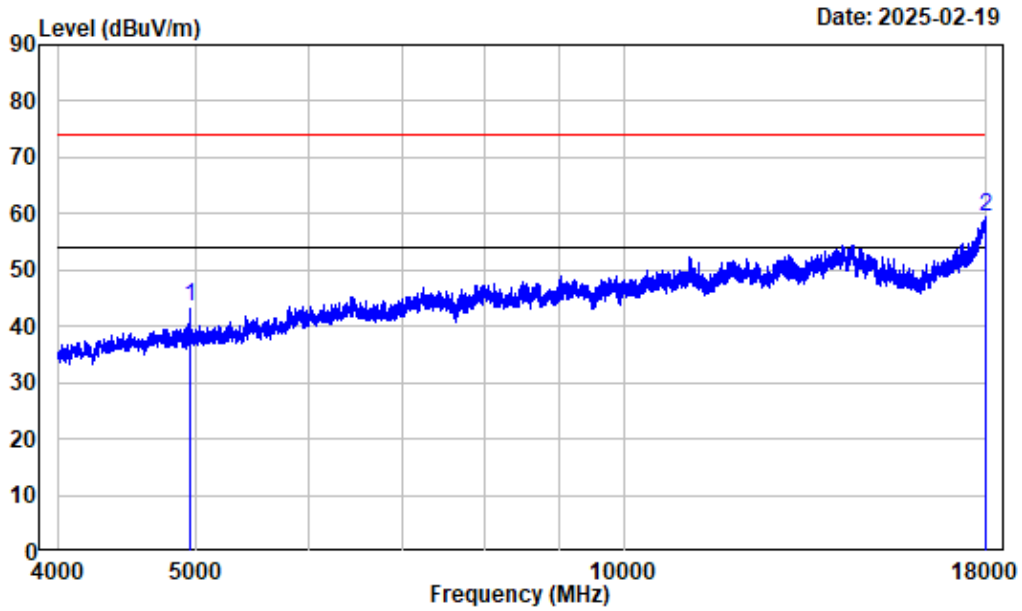
1-4GHz_Vertical



Condition : Vertical
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	3963.620	-9.31	56.54	47.23	74.00	-26.77	Peak

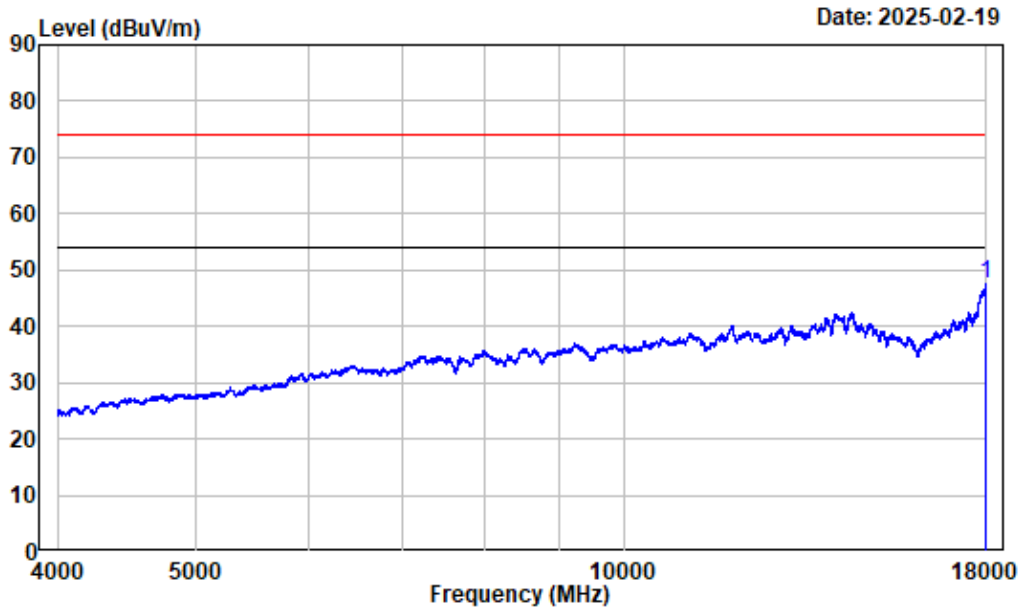
4-18GHz_Horizontal_Peak



Condition : Horizontal
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4960.000	-7.56	50.92	43.36	74.00	-30.64	Peak
2	17999.520	13.20	46.27	59.47	74.00	-14.53	Peak

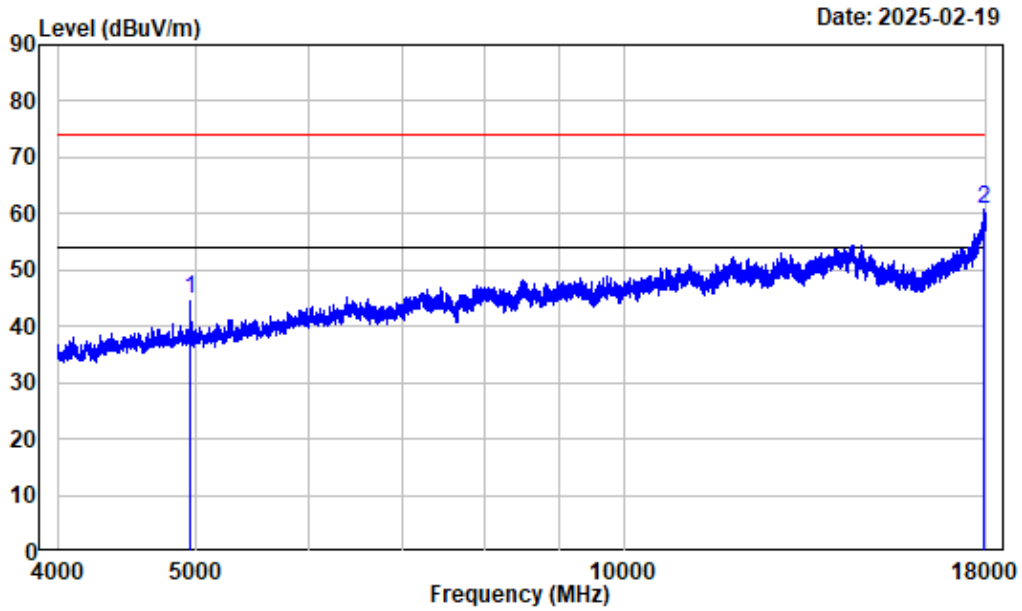
4-18GHz_Horizontal_Average



Condition : Horizontal
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Average reading: RBW:1MHz VBW:5kHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	17994.750	13.17	34.42	47.59	54.00	-6.41	Average

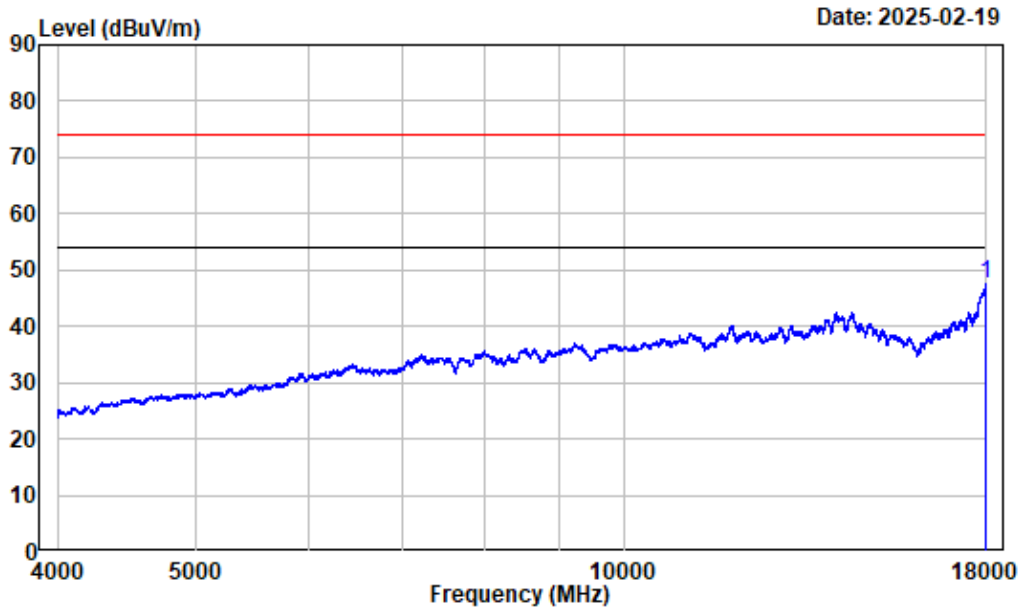
4-18GHz_Vertical_Peak



Condition : Vertical
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4960.000	-7.56	52.51	44.95	74.00	-29.05	Peak
2	17917.740	12.79	47.84	60.63	74.00	-13.37	Peak

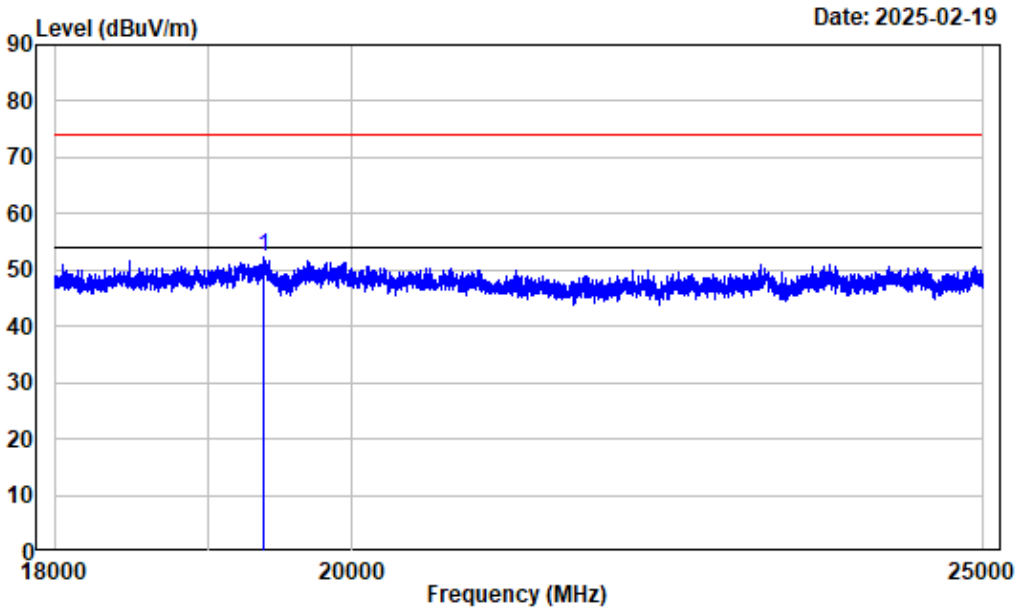
4-18GHz_Vertical_Average



Condition : Vertical
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Average reading: RBW:1MHz VBW:5kHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	17999.670	13.20	34.29	47.49	54.00	-6.51	Average

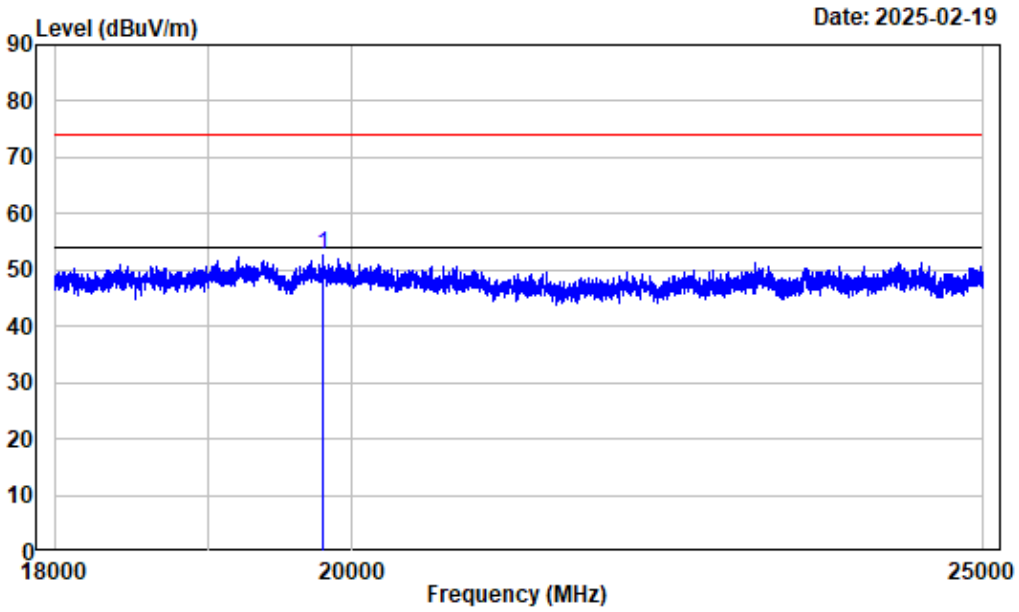
18-25GHz_Horizontal



Condition : Horizontal
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	19375.670	15.12	37.22	52.34	74.00	-21.66	Peak

18-25GHz_Vertical



Condition : Vertical
Project No. : 2401X96326E-RF
Tester : Wing K Ji
Spectrum setting: Peak reading: RBW:1MHz VBW:3MHz Detector:Peak
Note : BLE_2M_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	19788.220	15.38	37.10	52.48	74.00	-21.52	Peak

6dB Emission Bandwidth

Test Information:

Sample No.:	2S0O-6	**Test Date:**	2024/11/19
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Rainbow Zhu	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C)	25	**Relative Humidity: (%)**	42	**ATM Pressure: (kPa)**	101

Test Data:

BLE 1M

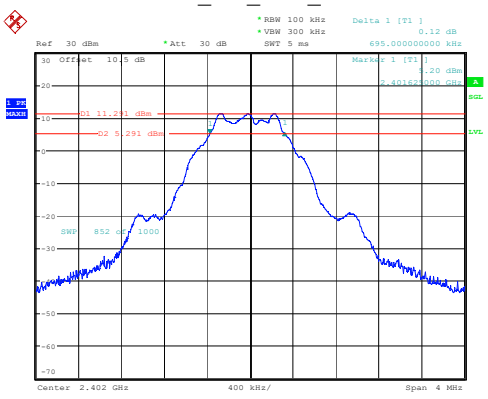
Channel	Result (MHz)	Limit (MHz)	Verdict
Low Channel	0.695	≥0.5	Pass
Middle Channel	**0.700**	≥0.5	Pass
High Channel	**0.700**	≥0.5	Pass

BLE 2M

Channel	Result (MHz)	Limit (MHz)	Verdict
Low Channel	**1.260**	≥0.5	Pass
Middle Channel	**1.260**	≥0.5	Pass
High Channel	**1.260**	≥0.5	Pass

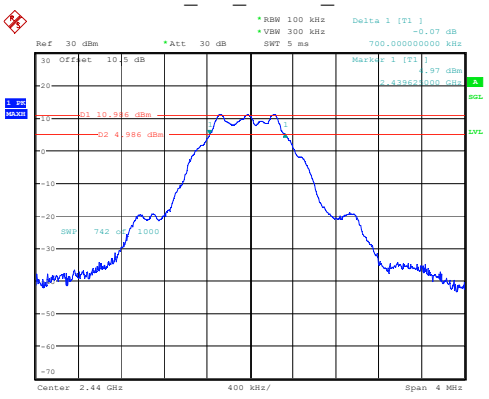
BLE 1M

BLE_1M_Low_Channel



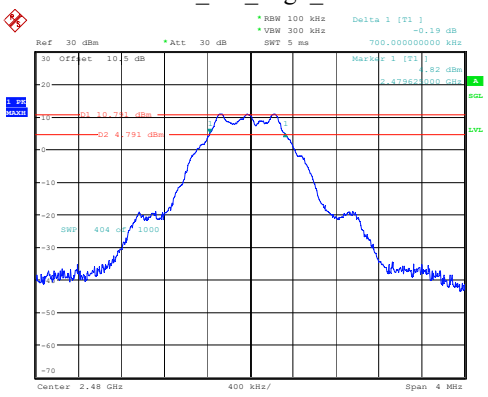
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:30:24

BLE_1M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:33:28

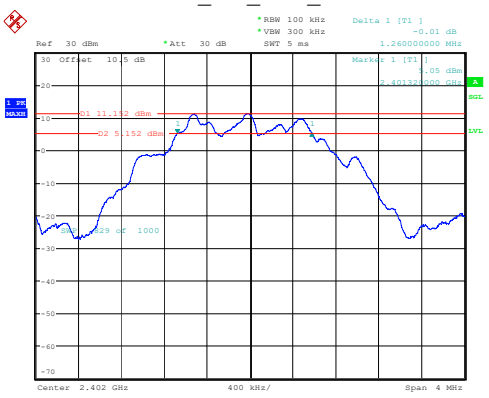
BLE_1M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:37:29

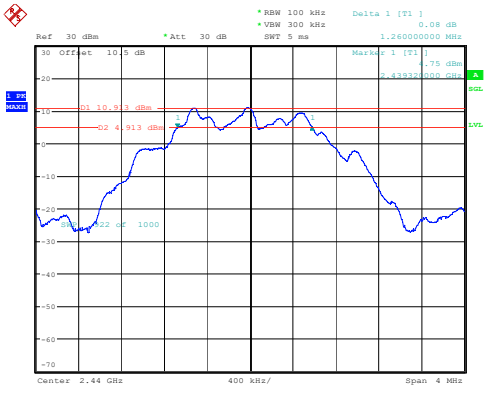
BLE 2M

BLE_2M_Low_Channel



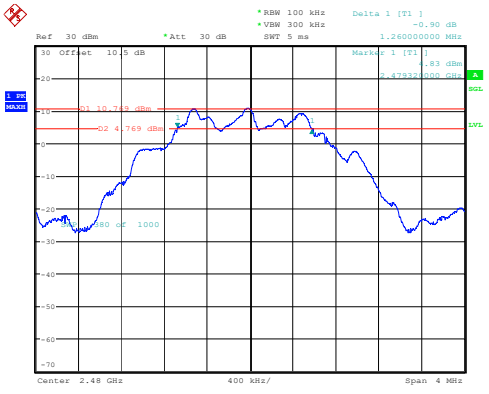
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:41:00

BLE_2M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:45:37

BLE_2M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:50:57

99% Occupied Bandwidth

Test Information:

Sample No.:	2S0O-6	**Test Date:**	2024/11/19
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Rainbow Zhu	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C)	25	**Relative Humidity: (%)**	42	**ATM Pressure: (kPa)**	101

Test Data:

BLE 1M

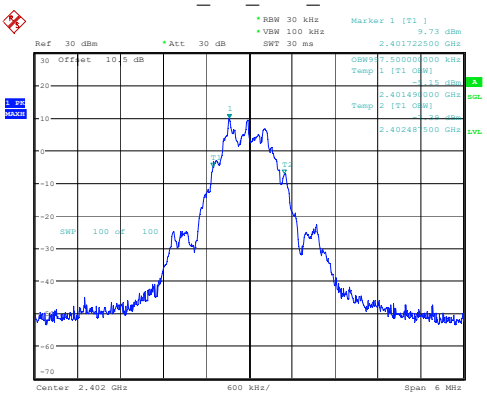
Channel	99% OBW (MHz)
Low Channel	0.998
Middle Channel	**1.005**
High Channel	**1.005**

BLE 2M

Channel	99% OBW (MHz)
Low Channel	2.003
Middle Channel	**2.010**
High Channel	**2.010**

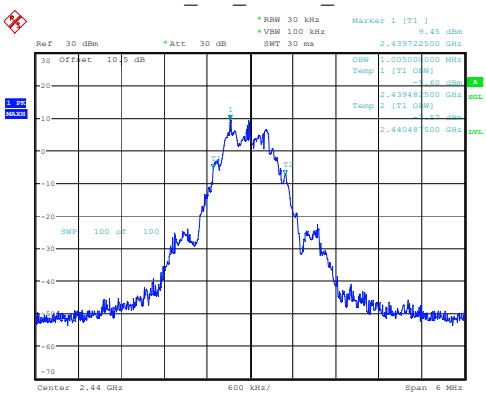
BLE 1M

BLE_1M_Low_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:30:43

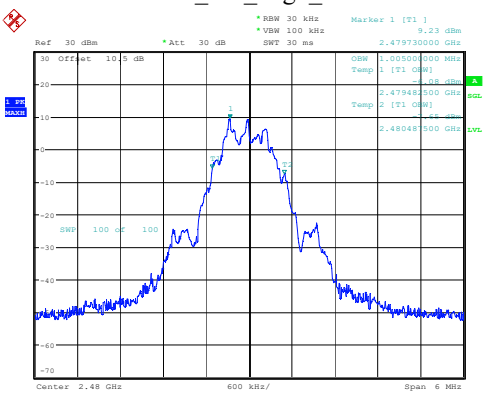
BLE_1M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:33:47

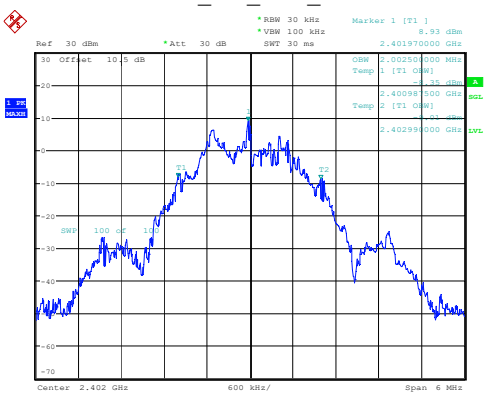
BLE 2M

BLE_1M_High_Channel



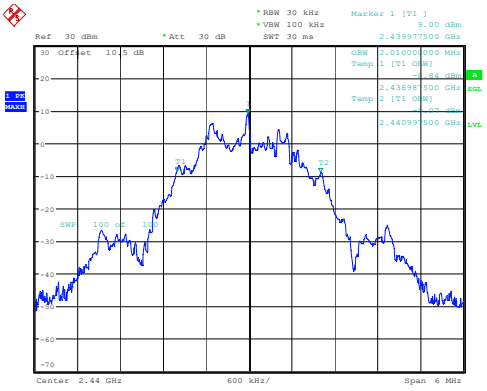
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:56:32

BLE_2M_Low_Channel



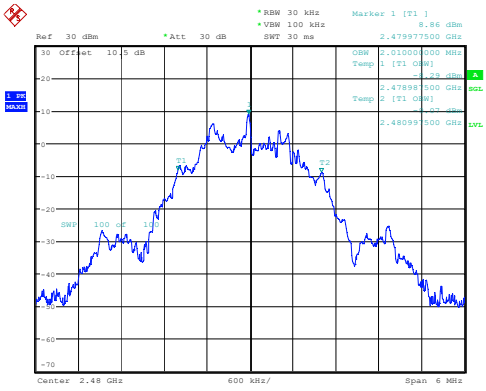
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:41:19

BLE_2M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:46:21

BLE_2M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:51:38

Maximum Conducted Output Power

Test Information:

Sample No.:	2S0O-6	**Test Date:**	2024/11/19
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Rainbow Zhu	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C)	25	**Relative Humidity: (%)**	42	**ATM Pressure: (kPa)**	101

Test Data:

BLE 1M

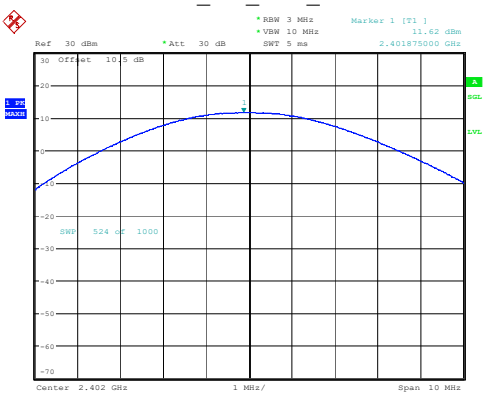
Channel	Result (dBm)	Limit (dBm)	Antenna Gain (dBi)	EIRP(dBm)	Limit (dBm)	Verdict
Low Channel	**11.62**	30.00	4.1	15.72	36.00	Pass
Middle Channel	11.32	30.00	4.1	15.42	36.00	Pass
High Channel	11.15	30.00	4.1	15.25	36.00	Pass

BLE 2M

Channel	Result (dBm)	Limit (dBm)	Antenna Gain (dBi)	EIRP(dBm)	Limit (dBm)	Verdict
Low Channel	**11.69**	30.00	4.1	15.79	36.00	Pass
Middle Channel	11.39	30.00	4.1	15.49	36.00	Pass
High Channel	11.23	30.00	4.1	15.33	36.00	Pass

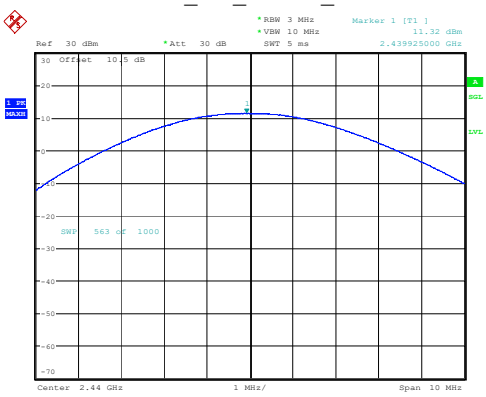
BLE 1M

BLE_1M_Low_Channel



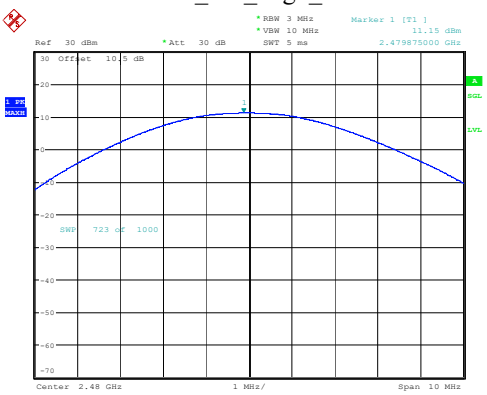
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:21:01

BLE_1M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:21:53

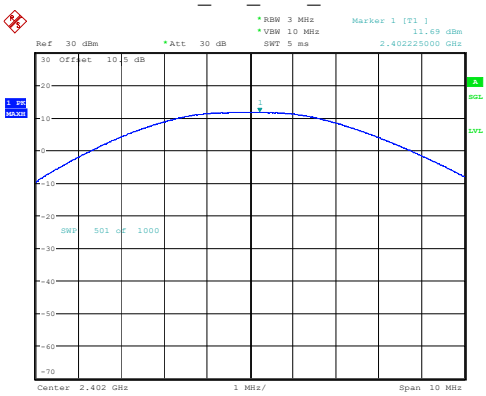
BLE_1M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:22:52

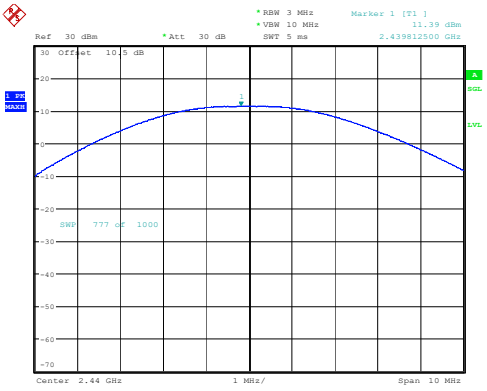
BLE 2M

BLE_2M_Low_Channel



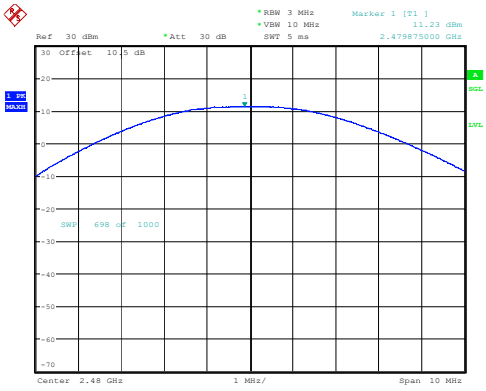
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:24:03

BLE_2M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:24:58

BLE_2M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:26:13

Power Spectral Density

Test Information:

Sample No.:	2S0O-6	**Test Date:**	2024/11/19
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Rainbow Zhu	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C)	25	**Relative Humidity: (%)**	42	**ATM Pressure: (kPa)**	101

Test Data:

BLE 1M

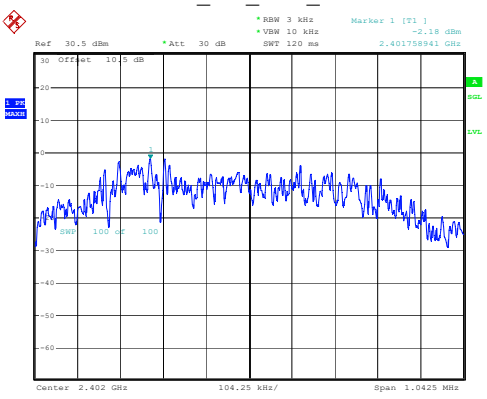
Channel	Result (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	**-2.18**	8	Pass
Middle Channel	-2.58	8	Pass
High Channel	-2.62	8	Pass

BLE 2M

Channel	Result (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
Low Channel	**-5.42**	8	Pass
Middle Channel	-6.07	8	Pass
High Channel	-5.95	8	Pass

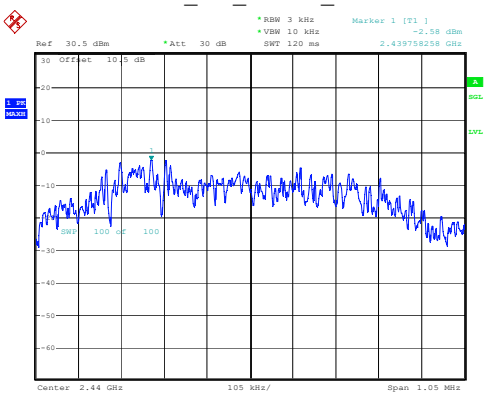
BLE 1M

BLE_1M_Low_Channel



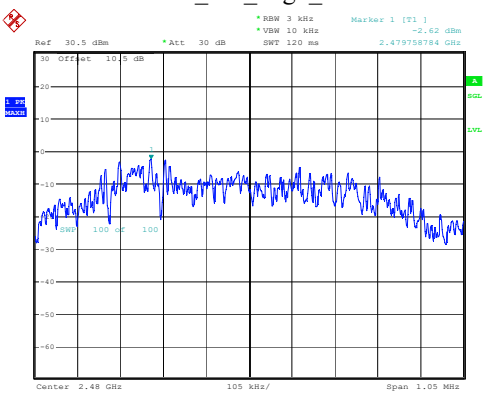
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:32:35

BLE_1M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:36:15

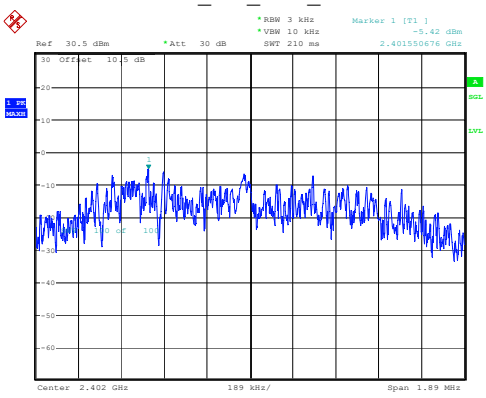
BLE_1M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:39:24

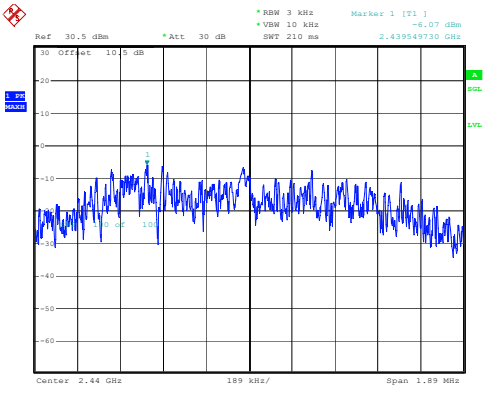
BLE 2M

BLE_2M_Low_Channel



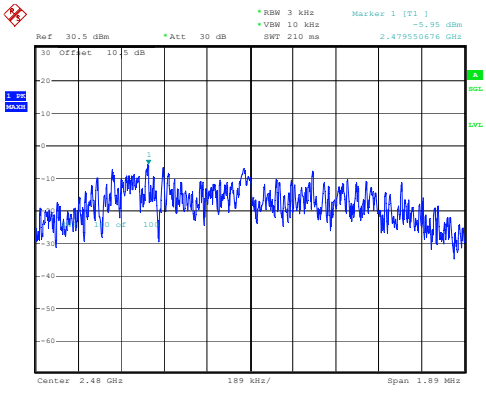
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:44:42

BLE_2M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:48:56

BLE_2M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:53:35

100 kHz Bandwidth of Frequency Band Edge

Test Information:

Sample No.:	2S0O-6	**Test Date:**	2024/11/19
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Rainbow Zhu	**Test Result:**	Pass

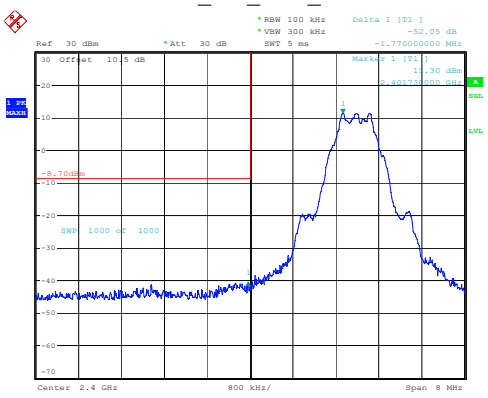
Environmental Conditions:

Temperature: (°C)	25	**Relative Humidity: (%)**	42	**ATM Pressure: (kPa)**	101

Test Data:

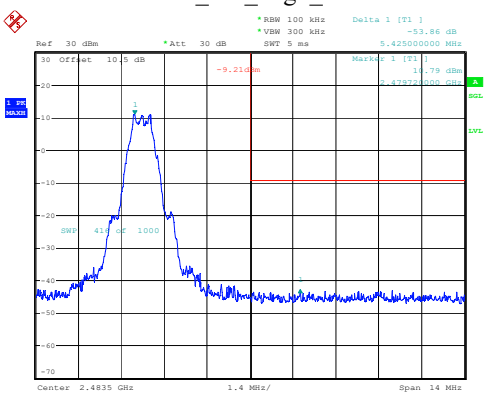
BLE 1M

BLE_1M_Low_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:29:48

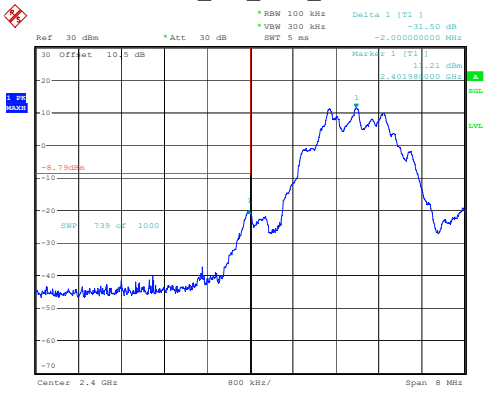
BLE_1M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:37:07

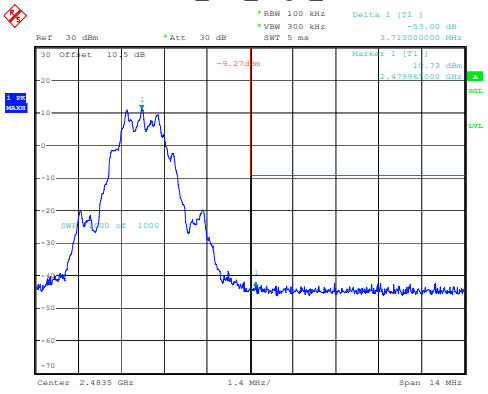
BLE 2M

BLE_2M_Low_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:40:34

BLE_2M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:50:34

Duty Cycle

Test Information:

Sample No.:	2S0O-6	**Test Date:**	2024/11/19
Test Site:	RF	**Test Mode:**	Transmitting
Tester:	Rainbow Zhu	**Test Result:**	Pass

Environmental Conditions:

Temperature: (°C)	25	**Relative Humidity: (%)**	42	**ATM Pressure: (kPa)**	101

Test Data:

BLE 1M

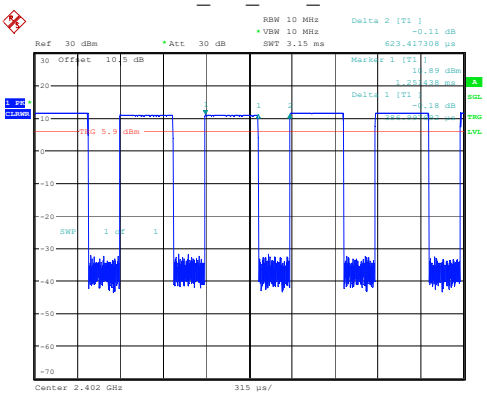
Channel	Ton (ms)	Ton+Toff (ms)	Duty Cycle (%)	Duty Cycle Factor(dB)	1/Ton (Hz)	VBW Setting (kHz)
Low Channel	0.387	0.623	62.12	2.07	2584	3
Middle Channel	0.385	0.625	61.60	2.10	2597	3
High Channel	**0.389**	0.623	62.44	2.05	2571	3

BLE 2M

Channel	Ton (ms)	Ton+Toff (ms)	Duty Cycle (%)	Duty Cycle Factor(dB)	1/Ton (Hz)	VBW Setting (kHz)
Low Channel	0.204	0.629	32.43	4.89	4902	5
Middle Channel	**0.205**	0.625	32.80	4.84	4878	5
High Channel	0.203	0.624	32.53	4.88	4926	5

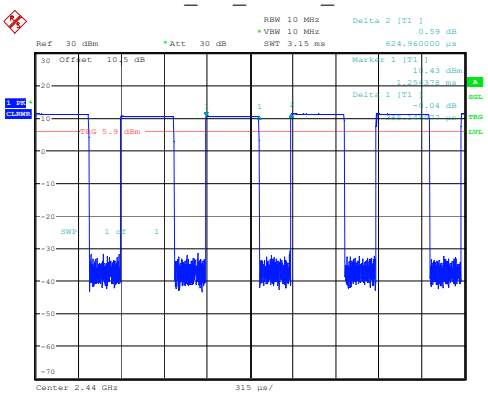
BLE 1M

BLE_1M_Low_Channel



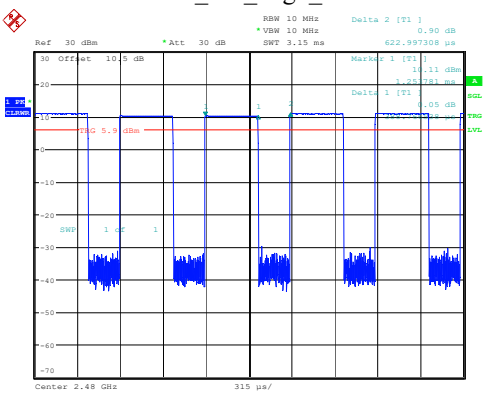
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:32:15

BLE_1M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:35:55

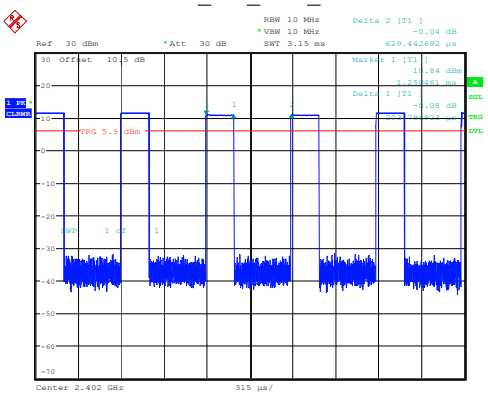
BLE_1M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:39:05

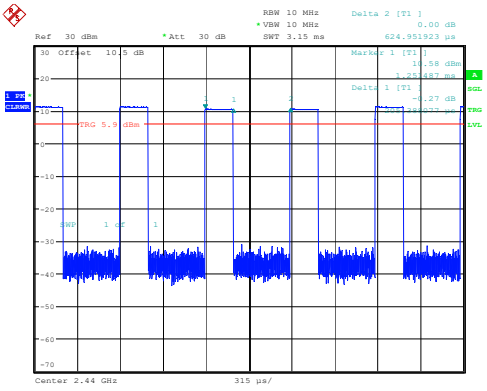
BLE 2M

BLE_2M_Low_Channel



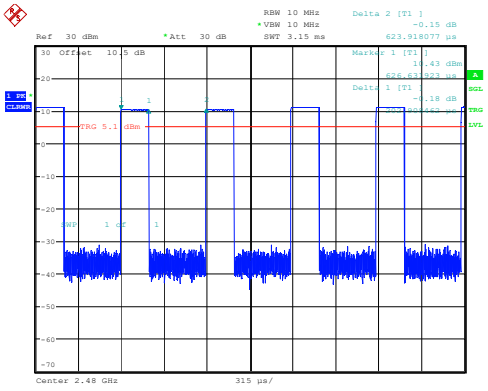
ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:44:13

BLE_2M_Middle_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:48:27

BLE_2M_High_Channel



ProjectNo.:2401X96326E-RF Tester:Rainbow Zhu
Date: 19.NOV.2024 08:53:07

RF EXPOSURE EVALUATION

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Result

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

For worst case:

Mode	Frequency (MHz)	Antenna Gain#		Max Tune-up Power#		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	4.10	2.57	12.0	15.85	30	0.0036	1.0
2.4G Wi-Fi	2412-2462	7.78	6.00	29.0	794.33	30	0.4214	1.0
5G Wi-Fi	5150-5250	6.04	4.02	28.5	707.95	30	0.2516	1.0
	5250-5350	6.55	4.52	23.5	223.87	30	0.0895	1.0
	5470-5725	5.74	3.75	24.0	251.19	30	0.0833	1.0
	5725-5850	5.36	3.44	27.5	562.34	30	0.1710	1.0
6G Wi-Fi	5925-6425	7.38	5.47	16.5	44.67	30	0.0216	1.0
	6425-6525	6.79	4.78	17.0	50.12	30	0.0212	1.0
	6525-6875	7.68	5.86	17.0	50.12	30	0.0260	1.0
	6875-7125	8.24	6.67	16.0	39.81	30	0.0235	1.0

Note:
1) The tune up conducted power and antenna gain was declared by the applicant.
2) For the Wi-Fi mode, the antenna gain should be the directional gain.
3) The BLE, 2.4G Wi-Fi, 5G Wi-Fi and 6G Wi-Fi can simultaneous transmitting.

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BLE}/limit+ $MPE_{2.4G\ Wi\text{-}Fi}$/limit+$MPE_{5G\ Wi\text{-}Fi}$/limit +$MPE_{6G\ Wi\text{-}Fi}$/limit

= 0.0036/1.0+0.4214/1.0+0.2516/1.0+0.0260/1.0 =0.703<1.0

So simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 30cm from nearby persons.

Result: Compliant.

EXPOSURE LIMITS

Applicable Standard

According to RSS-102 issue 6 §5.3.2:

Table 7: RF field strength and power density limits for devices used by the general public (uncontrolled environment)

Frequency range (MHz)	Electric field (V_{RMS}/m)	Magnetic field (A_{RMS}/m)	Power density (W/m^2)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/ f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21\times10^{-4} f^{0.5}$	$6.67\times10^{-5} f$	$616000/ f^{1.2}$

Note: f is frequency in MHz.

Result:

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. W/m^2)
P = power input to the antenna (in appropriate units, e.g., W).
G = power gain of the antenna in the direction of interest relative to an isotropic radiator,the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \le 1$$

For worst case:

Mode	Frequency (MHz)	Antenna Gain#		Max Tune-up Power#		Evaluation Distance (cm)	Power Density (W/m^2)	MPE Limit (W/m^2)
		(dBi)	(numeric)	(dBm)	(mW)			
BLE	2402-2480	4.10	2.57	12.0	15.85	30	0.036	5.35
2.4G Wi-Fi	2412-2462	7.78	6.00	29.0	794.33	30	4.214	5.37
5G Wi-Fi	5150-5250	6.04	4.02	16.5	44.67	30	0.159	9.01
	5250-5350	6.55	4.52	16.5	44.67	30	0.179	9.13
	5470-5725	5.74	3.75	24.0	251.19	30	0.833	9.39
	5725-5850	5.36	3.44	27.5	562.34	30	1.710	9.69
6G Wi-Fi	5925-6425	7.38	5.47	16.5	44.67	30	0.216	9.92
	6425-6525	6.79	4.78	17.0	50.12	30	0.212	10.00
	6525-6875	7.68	5.86	17.0	50.12	30	0.260	10.00
	6875-7125	8.24	6.67	16.0	39.81	30	0.235	10.00

Note:
1) The tune up conducted power and antenna gain was declared by the applicant.
2) For the Wi-Fi mode, the antenna gain should be the directional gain.
3) The BLE, 2.4G Wi-Fi, 5G Wi-Fi and 6G Wi-Fi can simultaneous transmitting.

Simultaneous transmitting consideration (worst case):

The ratio=MPE_{BLE}/limit+ $MPE_{2.4G\ Wi\text{-}Fi}$/limit+$MPE_{5G\ Wi\text{-}Fi}$/limit +$MPE_{6G\ Wi\text{-}Fi}$/limit

= 0.036/5.35+4.214/5.37+1.710/9.69+0.260/10.00 =0.994<1.0

So simultaneous exposure is compliant.

Result: Compliant.

Note: To maintain compliance with the RF exposure guidelines, place the equipment at least 30cm from nearby persons.

EUT PHOTOGRAPHS

Please refer to the attachment 2401X96326E-RF External photo and 2401X96326E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2401X96326E-RFA Test Setup photo.

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