FCC TEST REPORT

(Part 15, Subpart C)

Applicant:	DONGGUAN TOGRAN ELECTRONICS TECHNOLOGY CO.,LTD
Address:	No.110, shijie, shidan Mid Rd, shijie Town,Dongguan,Guangdong,China

Manufacturer or Supplier:	DONGGUAN TOGRAN ELECTRONICS TECHNOLOGY CO.,LTD
Address:	No.110, shijie, shidan Mid Rd, shijie Town,Dongguan,Guangdong,China
Product:	Wireless Mouse
Model Name	TM273G, TK-MS019, TR-MS019
FCC ID:	2AGLG-TM273G
Date of tests:	Jul. 30, 2024 ~ Aug. 15, 2024

The tests have been carried out according to the requirements of the following standard:

☒ **FCC Part 15, Subpart C, Section 15.247**

☒ **ANSI C63.10-2020**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

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Engineer / Mobile Department	Manager / Mobile Department
Simon Wang	Luke Lu
Date: Aug. 15, 2024	Date: Aug. 15, 2024

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
W7L-P24070012RF01	Original release	Aug. 15, 2024

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1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C		
STANDARD	**TEST TYPE AND LIMIT**	**RESULT**
15.207	AC Power Conducted Emission	NA (See note3)
15.247(a)(1)(iii)	Number of Hopping Frequency Used	Compliance
15.247(a)(1)(iii)	Dwell Time on Each Channel	Compliance
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Compliance
15.247(b)	Maximum Peak Output Power	Compliance
15.247(d)& 15.209	Transmitter Radiated Emissions	Compliance
15.247(d)	Out of band Measurement	Compliance
15.203	Antenna Requirement	Compliance

NOTE:

1. If the Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.
2. 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.
3. The Sample is powered by battery, so it’s no need to test the ac power conducted emission.

1.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

MEASUREMENT	UNCERTAINTY
AC Power Conducted emissions	±2.70dB
Radiated emissions (9KHz~30MHz)	±2.68dB
Radiated emissions (30MHz~1GHz)	±4.98dB
Radiated emissions (1GHz ~6GHz)	±4.70dB
Radiated emissions (6GHz ~18GHz)	±4.60dB
Radiated emissions (18GHz ~40GHz)	±4.12dB
Conducted emissions	±4.01dB
Occupied Channel Bandwidth	±43.58KHz
Conducted Output power	±2.06dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2 GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Wireless Mouse
MODEL NAME	TM273G, TK-MS019, TR-MS019
NOMINAL VOLTAGE	3.0V (battery)
MODULATION TECHNOLOGY	FHSS
MODULATION TYPE	GFSK
OPERATING FREQUENCY	2403MHz~2479MHz
NUMBER OF CHANNEL	16
MAX. OUTPUT POWER	1.85mW (Max. Measured)
ANTENNA TYPE	PCB Antenna with 0.81dBi gain
HW VERSION	A01
SW VERSION	A01
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	N/A

NOTE:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
3. The only difference of TM273G, TK-MS019, TR-MS019 is model name.
4. Antenna gain and EUT conducted cable loss are provided by the customer, and the laboratory will record the results based on these items that involve these two parameters.

2.2 DESCRIPTION OF TEST MODES

16 channels are provided to this EUT:

1	2	3	4	5	6	7	8
2403	2422	2441	2463	2407	2436	2459	2466
9	10	11	12	13	14	15	16
2414	2419	2439	2453	2426	2445	2473	2479

2.2.1 CONFIGURATION OF SYSTEM UNDER TEST

Please see section 4 photograph of the test configuration for reference.

2.2.2 TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports.
The worst case was found when positioned on X axis for radiated emission.
Following channel(s) was (were) selected for the final test as listed below:

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
-	√	√	-	√	-

Where **RE<1G:** Radiated Emission below 1GHz **RE≥1G:** Radiated Emission above 1GHz
PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

RADIATED EMISSION TEST (BELOW 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
☒ The following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
-	1 to 16	16	FHSS	GFSK

RADIATED EMISSION TEST (ABOVE 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, XYZ axis, antenna ports (if EUT with antenna diversity architecture) and packet type.
☒ The following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
-	1 to 16	1, 3, 16	FHSS	GFSK

ANTENNA PORT CONDUCTED MEASUREMENT:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, antenna ports (if EUT with antenna diversity architecture), and packet types.

☒ The following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE
1 to 16	1, 3, 16	FHSS	GFSK

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE (SYSTEM)	TESTED BY
RE<1G	23deg. C, 70%RH	DC 3.0V By Battery	Jace Hu
RE≥1G	23deg. C, 70%RH	DC 3.0V By Battery	Jace Hu
APCM	25deg. C, 60%RH	DC 3.0V By Battery	James Fu

2.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C. Section 15.247
ANSI C63.10-2020

NOTE: 1. All test items have been performed and recorded as per the above standards.

2. The EUT is also considered as a kind of computer peripheral, because the connection to computer is necessary for typical use.

2.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Desktop	Lenovo	M73 SFF	PC04GRQV	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	NA

3 TEST TYPES AND RESULTS

3.1 RADIATED EMISSION AND BANDEDGE MEASUREMENT

3.1.1 LIMITS OF RADIATED EMISSION AND BANDEDGE MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a). Other emissions shall be at least 20dB below the highest level of the desired power.

FREQUENCIES (MHz)	FIELD STRENGTH (microvolts/meter)	MEASUREMENT DISTANCE (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

3.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	Euroshieldpn-CT0001143-1216	Nov. 14,23	Nov. 13,26
Bilog Antenna	ETS-LINDGREN	3143B	00161965	Feb. 18,24	Feb. 17,25
Horn Antenna	ETS-LINDGREN	3117	00168692	Feb. 18,24	Feb. 17,25
Horn Antenna (18GHz-40GHz)	N/A	QWH-SL-18-40-K-SG/QMS-00361	15433	Sep.04, 23	Sep.03, 24
Test Software	E3	V 9.160323	N/A	N/A	N/A
Test Software	JS1120-3	3.2.06	N/A	N/A	N/A
10dB Attenuator	JFW/USA	50HF-010-SMA	N/A	May. 06,24	May. 05,25
MXE EMI Receiver	KEYSIGHT	N9038A-544	MY54450026	Mar. 28,24	Mar. 27,25
Signal Pre-Amplifier	EMSI	EMC 9135	980249	May. 06,24	May. 05,25
Signal Pre-Amplifier	EMSI	EMC 012645B	980257	May.10,24	May.09,25
Signal Pre-Amplifier	EMSI	EMC 184045B	980259	Feb. 17,24	Feb. 16,25
DC Source	Kikusui/JP	PMX18-5A	0000001	Aug. 12,23	Aug. 11,24
DC Source	Kikusui/JP	PMX18-5A	0000001	Aug. 11,24	Aug. 10,25
Power Meter	Anritsu	ML2495A	1506002	Feb. 14,24	Feb. 13,25
Power Sensor	Anritsu	MA2411B	1339352	Feb. 14,24	Feb. 13,25
Loop Antenna	Schwarzbeck	FMZB 1519B	00173	Sep.03,23	Sep.02,24

NOTE: 1. The calibration interval of the above test instruments is 12 months or 36 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

2. The test was performed in 3m Chamber.

3. The FCC Site Registration No. is 525120; The Designation No. is CN1171.

3.1.3 TEST PROCEDURES

a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

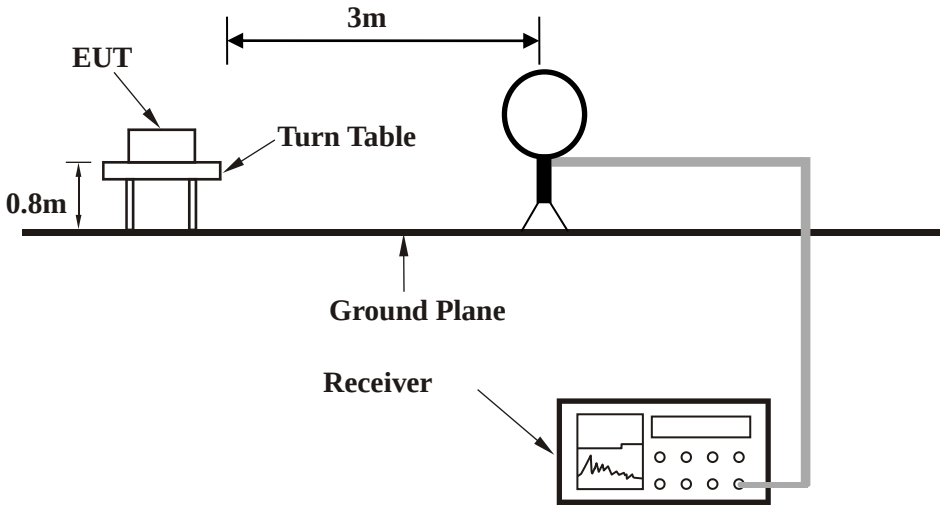
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz for Average detection (AV) at frequency above 1GHz.
4. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit.
5. All modes of operation were investigated and the worst-case emissions are reported.

3.1.4 DEVIATION FROM TEST STANDARD

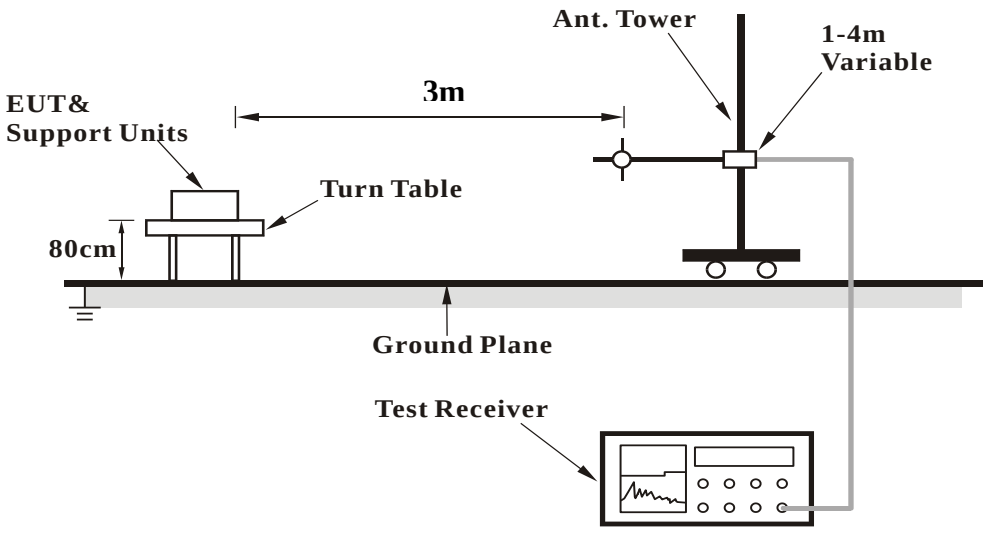
No deviation.

3.1.5 TEST SETUP

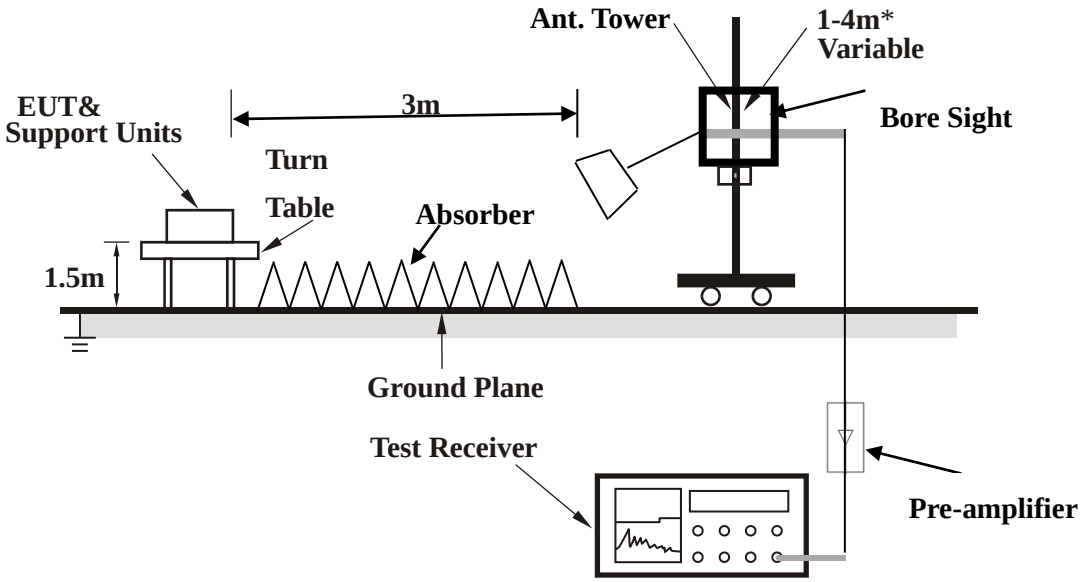
<Frequency Range 9KHz~30MHz >



< Frequency Range 30MHz~1GHz >



<Frequency Range above 1GHz>



Note: Above 1G is a directional antenna

Depends on the EUT height and the antenna 3dB beamwidth both, refer to section 7.3 of CISPR 16-2-3.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.1.6 EUT OPERATING CONDITIONS

a. Set the EUT under full load condition and placed them on a testing table.

b. Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.

c. The necessary accessories enable the EUT in full functions.

3.1.7 TEST RESULTS

NOTE ：The 9K~30MHz amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required in the report.

BELOW 1GHz WORST-CASE DATA:

30 MHz – 1GHz data:

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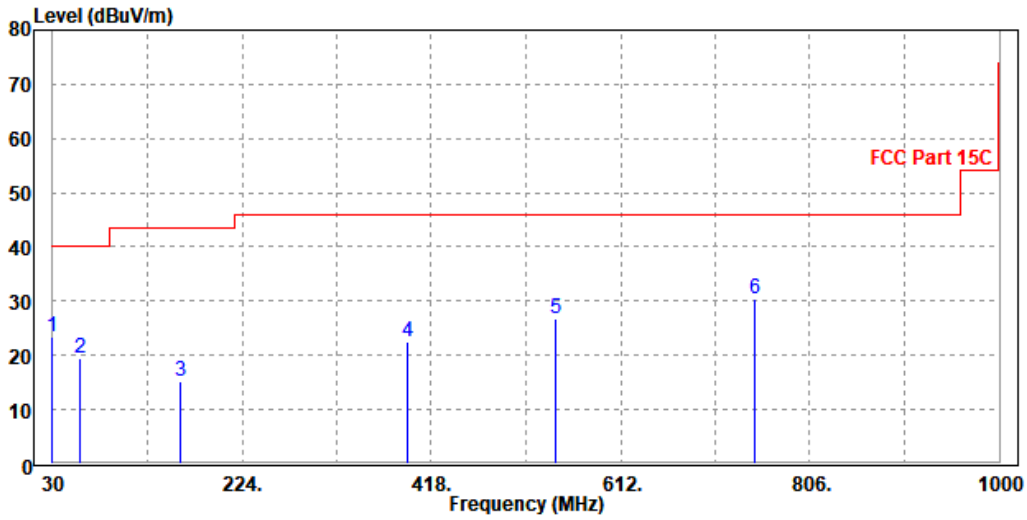
CHANNEL	Channel 16	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
30.000	23.39	35.70	40.00	-16.61	25.00	0.13	37.44	100	0	Peak
57.160	19.50	41.76	40.00	-20.50	14.81	0.30	37.37	100	0	Peak
159.980	15.18	34.48	43.50	-28.32	16.61	0.78	36.69	100	0	Peak
392.780	22.38	34.49	46.00	-23.62	23.01	1.54	36.66	100	0	Peak
546.040	26.71	34.61	46.00	-19.29	27.18	2.07	37.15	100	0	Peak
748.770	30.51	36.63	46.00	-15.49	28.88	2.49	37.49	100	0	Peak

REMARKS:

1. Emission Level(dBuV/m) = Read Level(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

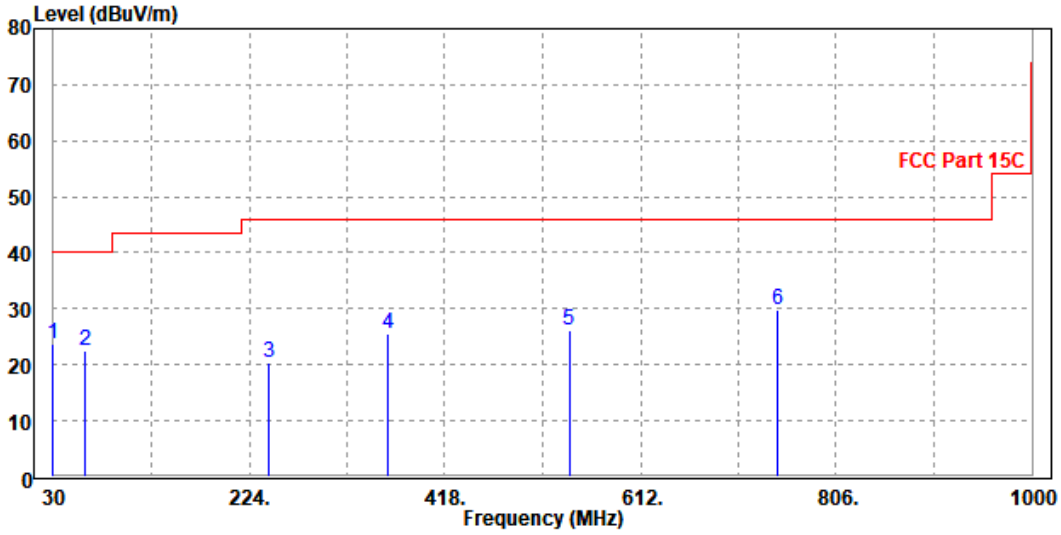


CHANNEL	Channel 16	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	30MHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
30.000	23.77	36.08	40.00	-16.23	25.00	0.13	37.44	100	360	Peak
62.010	22.44	44.48	40.00	-17.56	15.00	0.32	37.36	100	360	Peak
243.400	20.29	37.47	46.00	-25.71	18.27	1.13	36.58	100	360	Peak
361.740	25.61	38.95	46.00	-20.39	21.83	1.47	36.64	100	360	Peak
541.190	26.23	34.27	46.00	-19.77	27.05	2.06	37.15	100	360	Peak
747.800	29.81	35.95	46.00	-16.19	28.86	2.49	37.49	100	360	Peak

REMARKS:

1. Emission Level(dBuV/m) = Read Level(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value



ABOVE 1GHz WORST-CASE DATA:

Note: 1. For radiated emissions testing，the full testing range of different modes have been scanned，only the worst case harmonic data is reported in the sheet.

2. All other emissions were greater than 20dB below the limit is not recorded.

3. Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

According to section 7.8.8.2 of ANSI C63.10-2020, the average value may be determined From the peak value of the emission: The measured peak value in dBuV/m is corrected by 20log(maximum dwell time in 100 ms / 100).

Maximum dwell time per 1 MHz = dwell time per 100 ms per channel × (channel separation correction +overlapping channel correction) where:

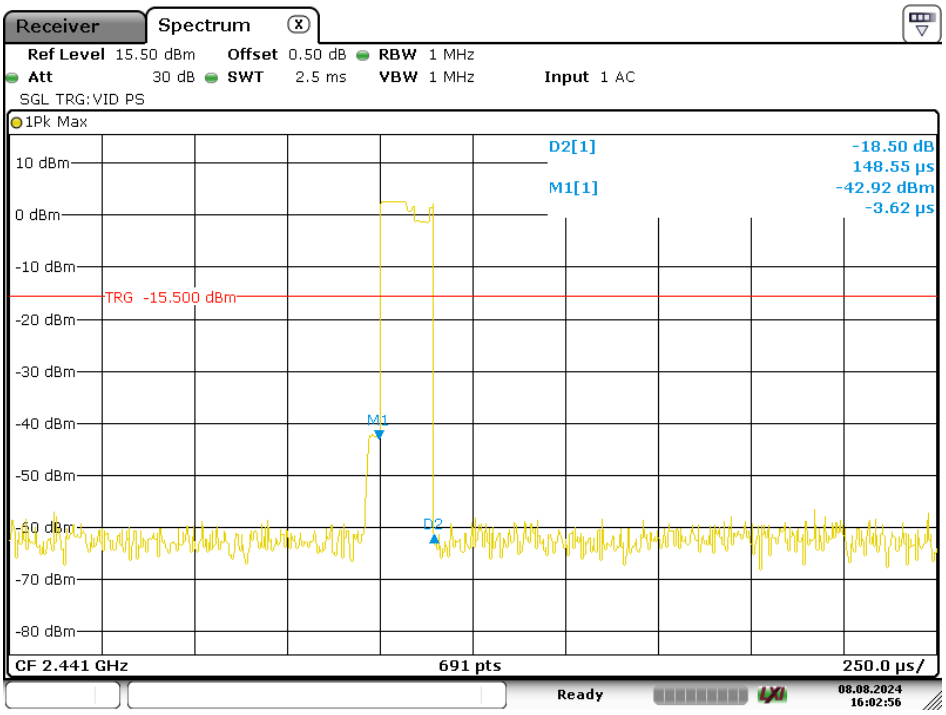
Channel separation correction = [1 / channel separation (MHz)] for channel separation < 1 MHz, and = 1 for channel separation ≥ 1 MHz, as determined using the procedures of 7.8.2. If the average measurements are performed on the *N*th harmonic, the channel separation value is *N* times the separation at the fundamental frequency.

Overlapping channel correction = 0 when the 20 dB channel bandwidth < channel separation and =1 for when the 20 dB channel bandwidth > channel separation.

T_{on}(us)	N_{burst} on 100ms	Maximum dwell time in 100ms (us)	DC in 100ms	DC Corrected Factor
148.55	1	148.55	0.002971	-50.54

For the table above, the Channel separation correction =1 and overlapping channel correction =1, although in some cases the overlapping channel correction should be 0, but it will be stricter for the test when overlapping channel correction =1.

Ton per channel:



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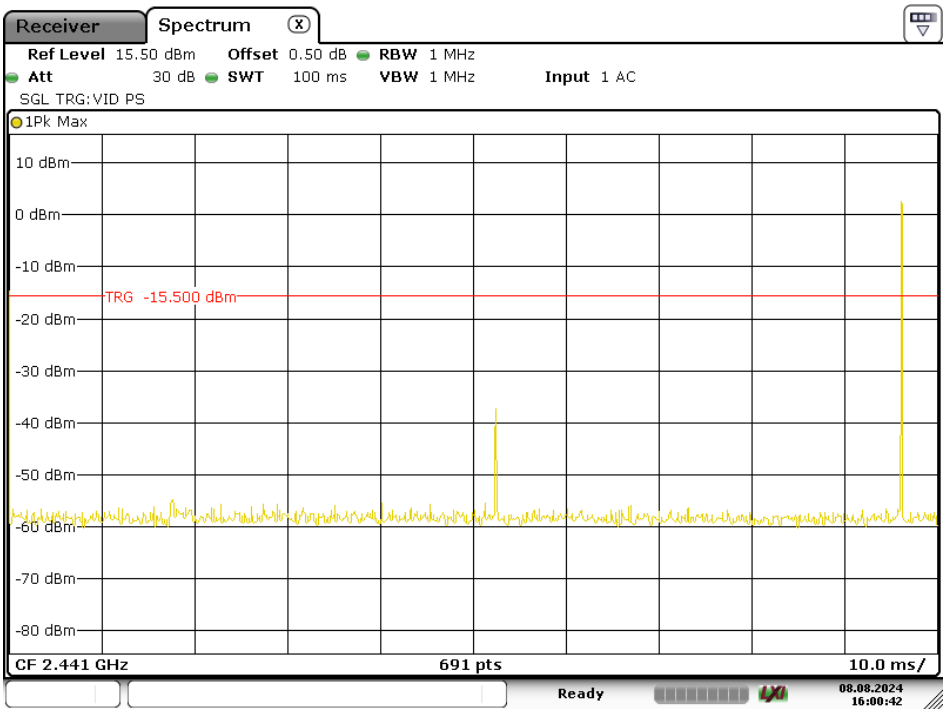
N_{burst} on 100ms:



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CHANNEL	TX Channel 1	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	**EMISSION LEVEL (dBuV/m)**	**READ LEVEL (dBuV)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA FACTOR (dB /m)**	**CABLE LOSS (dB)**	**PREAMP FACTOR (dB)**	**ANTENNA HEIGHT (cm)**	**TABLE ANGLE (Degree)**	**REMARK**
2390	49.8	57.47	74	-24.2	30.8	7.74	46.21	115	70	Peak
2403	94.7	102.05	/	/	31.1	7.76	46.21	115	70	Peak
2403	94.5	101.85	/	/	31.1	7.76	46.21	115	70	Average
2483.5	51.31	57.15	74	-22.69	32.47	7.88	46.19	115	70	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	**EMISSION LEVEL (dBuV/m)**	**READ LEVEL (dBuV)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA FACTOR (dB /m)**	**CABLE LOSS (dB)**	**PREAMP FACTOR (dB)**	**ANTENNA HEIGHT (cm)**	**TABLE ANGLE (Degree)**	**REMARK**
2390	50.91	57.02	74	-23.09	32.36	7.74	46.21	110	150	Peak
2403	90.73	97.05	/	/	32.13	7.76	46.21	110	150	Peak
2403	90.68	97	/	/	32.13	7.76	46.21	110	150	Average
2483.5	50.88	57.86	74	-23.12	31.33	7.88	46.19	110	150	Peak

REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
   Margin value = Emission level – Limit value.
2. 2403MHz: Fundamental frequency.

CHANNEL	TX Channel 3	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2390	49.28	56.95	74	-24.72	30.8	7.74	46.21	115	70	Peak
2441	94.38	100.46	/	/	32.31	7.81	46.2	115	70	Peak
2441	94.2	100.28	/	/	32.31	7.81	46.2	115	70	Average
2483.5	51.28	57.12	74	-22.72	32.47	7.88	46.19	115	70	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2390	51.08	57.19	74	-22.92	32.36	7.74	46.21	110	150	Peak
2441	89.29	96.46	/	/	31.22	7.81	46.2	110	150	Peak
2441	88.86	96.03	/	/	31.22	7.81	46.2	110	150	Average
2483.5	50.06	57.04	74	-23.94	31.33	7.88	46.19	110	150	Peak

REMARKS:

1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
   Margin value = Emission level – Limit value.
2. 2441MHz: Fundamental frequency.

CHANNEL	TX Channel 16	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2390	49.49	57.16	74	-24.51	30.8	7.74	46.21	115	70	Peak
2479	95.18	101.02	/	/	32.48	7.87	46.19	115	70	Peak
2479	95.12	100.96	/	/	32.48	7.87	46.19	115	70	Average
2483.5	52.71	58.55	74	-21.29	32.47	7.88	46.19	115	70	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2390	50.73	56.84	74	-23.27	32.36	7.74	46.21	110	150	Peak
2479	88.12	95.15	/	/	31.29	7.87	46.19	110	150	Peak
2479	87.86	94.89	/	/	31.29	7.87	46.19	110	150	Average
2483.5	50.45	57.43	74	-23.55	31.33	7.88	46.19	110	150	Peak

REMARKS:

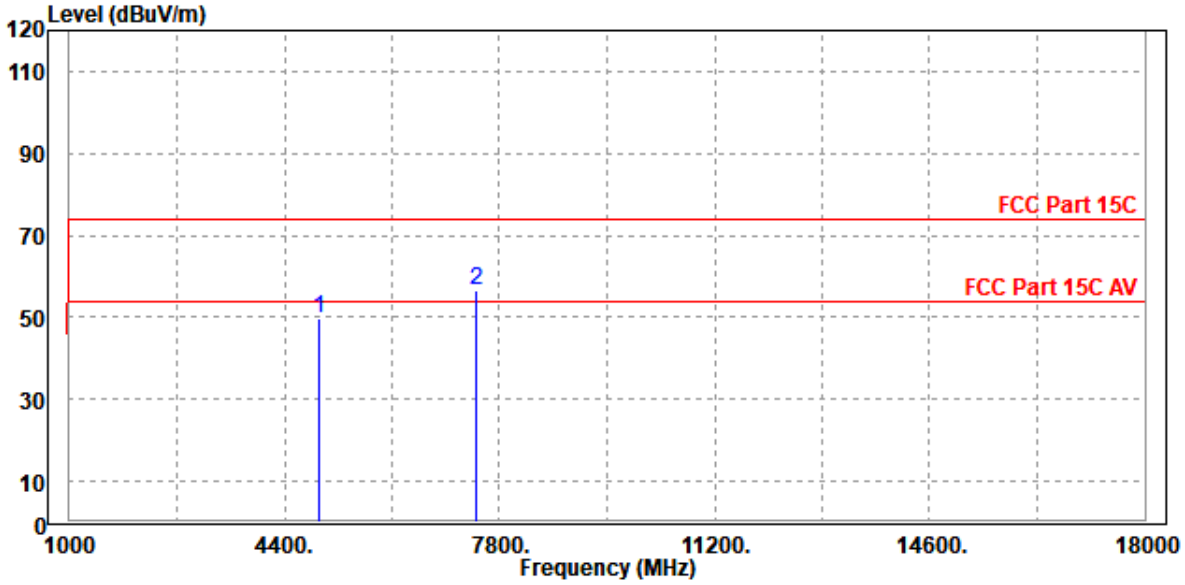
1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
   Margin value = Emission level – Limit value.
2. 2479MHz: Fundamental frequency.

Worst case harmonic:

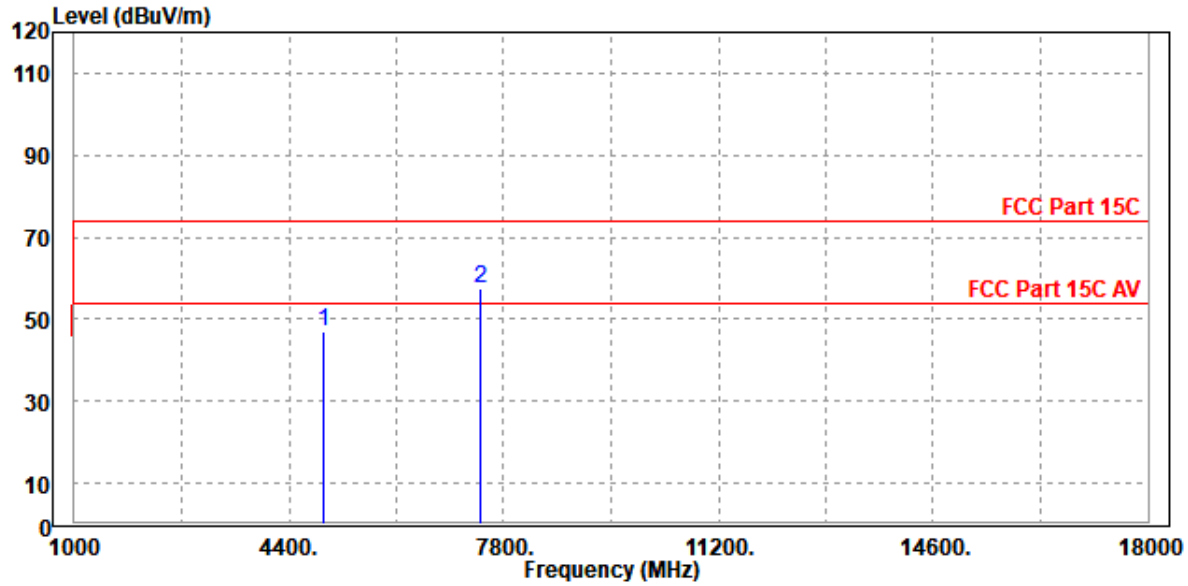
SRD

CHANNEL	TX Channel 16	**DETECTOR FUNCTION**	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
4958	49.78	51.48	74	-24.22	33.92	10.95	46.57	100	0	Peak
7443	56.62	54.06	74	-17.38	35.3	13.32	46.06	100	0	Peak
7443	6.08	-	54	-47.92	35.3	13.32	46.06	100	0	Average



ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB /m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
4961	47.16	49.09	74	-26.84	33.68	10.95	46.56	100	360	Peak
7437	57.49	54.97	74	-16.51	35.28	13.31	46.07	100	360	Peak
7437	6.95	-	54	-47.05	35.28	13.31	46.07	100	360	Average



REMARKS:

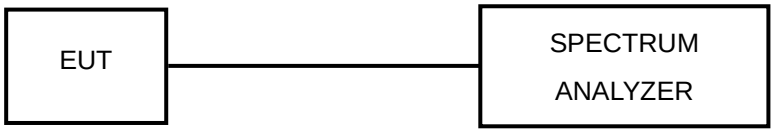
1. Emission Level = Read Level+ Antenna Factor + Cable Loss- Preamp Factor
   Margin value = Emission level – Limit value.
   Average Emission=Peak Emission + DC Corrected Factor, where DC Corrected Factor is -50.54db.
2. 2479MHz: Fundamental frequency.
3. For frequency above 18GHz, the emission was tested 20db below the limit so the data not recorded in the sheet.

3.2 NUMBER OF HOPPING FREQUENCY USED

3.2.1 LIMIT OF HOPPING FREQUENCY USED

At least 15 channels frequencies, and should be equally spaced.

3.2.2 TEST SETUP



3.2.3 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Power Meter	ANRITSU	ML2495A	1506002	Feb. 14,24	Feb. 13,25
EXA Signal Analyzer	KEYSIGHT	N9010A-526	MY54510523	Feb. 14,24	Feb. 13,25
EXA Signal Analyzer	KEYSIGHT	N9010A-544	MY54510355	May. 09,24	May. 08,25
Power Sensor	ANRITSU	MA2411B	1339352	Feb. 14,24	Feb. 13,25

NOTE:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
2. The test was performed in RF Oven room.

3.2.4 TEST PROCEDURES

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.

d. Set the SA on View mode and then plot the result on SA screen.

e. Repeat above procedures until all frequencies measured were completed.

3.2.5 DEVIATION FROM TEST STANDARD

No deviation.

3.2.6 TEST RESULTS

There are 16 hopping frequencies in the hopping mode. Please refer to next two pages for the test result.

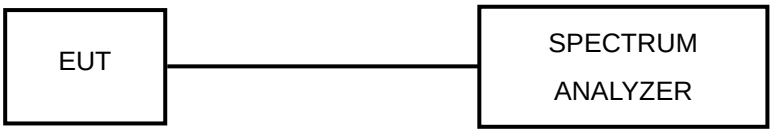
Please Refer to Appendix A.

3.3 DWELL TIME ON EACH CHANNEL

3.3.1 LIMIT OF DWELL TIME USED

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.

3.3.2 TEST SETUP



3.3.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

3.3.4 TEST PROCEDURES

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.

d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.

e. Repeat above procedures until all different time-slot modes have been completed.

3.3.5 DEVIATION FROM TEST STANDARD

No deviation.

3.3.6 TEST RESULTS

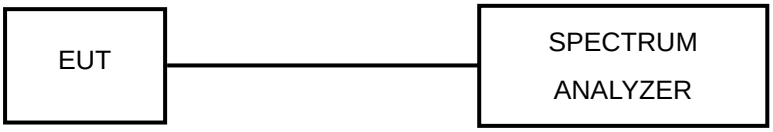
Please Refer to Appendix A.

3.4 CHANNEL BANDWIDTH

3.4.1 LIMITS OF CHANNEL BANDWIDTH

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dBbandwidth of hopping channel shell be a minimum limit for the hopping channel separation.

3.4.2 TEST SETUP



3.4.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

3.4.4 TEST PROCEDURE

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.

d. Repeat above procedures until all frequencies measured were complete.

3.4.5 DEVIATION FROM TEST STANDARD

No deviation.

3.4.6 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.4.7 TEST RESULTS

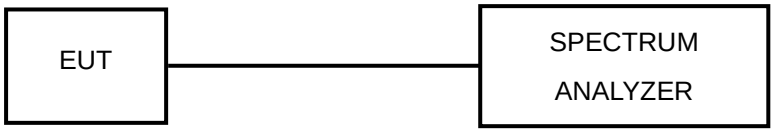
Please Refer to Appendix A.

3.5 HOPPING CHANNEL SEPARATION

3.5.1 LIMIT OF HOPPING CHANNEL SEPARATION

At least 25kHz or two-third of 20dB hopping channel bandwidth (whichever is greater).

3.5.2 TEST SETUP



3.5.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

3.5.4 TEST PROCEDURES

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. By using the MaxHold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

3.5.5 DEVIATION FROM TEST STANDARD

No deviation.

3.5.6 TEST RESULTS

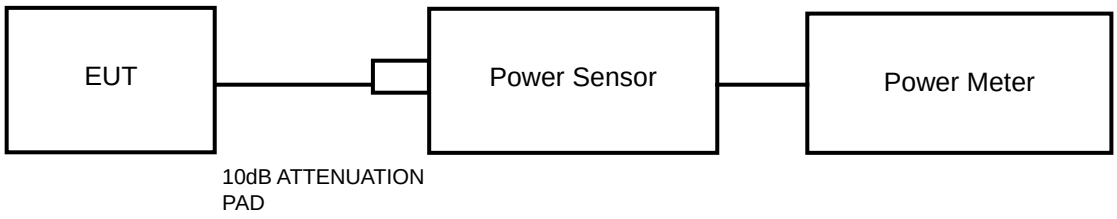
Please Refer to Appendix A.

3.6 MAXIMUM OUTPUT POWER

3.6.1 LIMITS OF MAXIMUM OUTPUT POWER MEASUREMENT

The Maximum Output Power Measurement is 125mW.

3.6.2 TEST SETUP



3.6.3 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

3.6.4 TEST PROCEDURES

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

3.6.5 DEVIATION FROM TEST STANDARD

No deviation.

3.6.6 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.6.7 TEST RESULTS

3.6.7.1 MAXIMUM PEAK OUTPUT POWER

Please Refer to Appendix A.

3.7 OUT OF BAND MEASUREMENT

3.7.1 LIMITS OF OUT OF BAND MEASUREMENT

Below –20dB of the highest emission level of operating band (in 100KHz RBW).

3.7.2 TEST INSTRUMENTS

Refer to section 3.3.3 to get information of above instrument.

3.7.3 TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer via a low loss cable. Spectrum Analyzer was set RBW to 100 kHz and VBW to 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. Detector = PEAK and Trace mode = Max Hold. The band edges was measured and recorded.

3.7.4 DEVIATION FROM TEST STANDARD

No deviation.

3.7.5 EUT OPERATING CONDITION

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.7.6 TEST RESULTS

The spectrum plots are attached on the following images. D1 line indicates the highest level. D2 line indicates the 20dB offset below D1. It shows compliance to the requirement.

Please Refer to Appendix A.

4 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).

5 MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

6 APPENDIX

20DB EMISSION BANDWIDTH

TEST RESULT

TestMode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
FHSS	Ant1	2403	2.044	2401.980	2404.024	---	---
FHSS	Ant1	2441	2.036	2439.984	2442.020	---	---
FHSS	Ant1	2479	2.056	2477.976	2480.012	---	---

TEST GRAPHS

FHSS-Ant1-2403

FHSS-Ant1-2441

FHSS-Ant1-2479

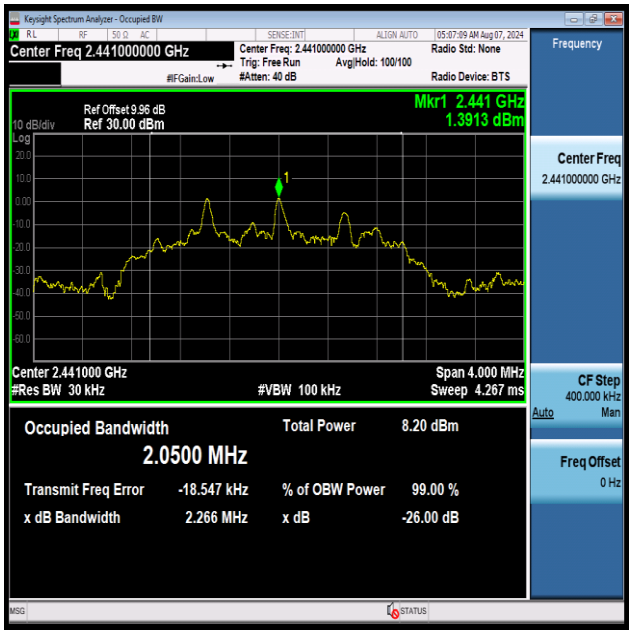
OCCUPIED CHANNEL BANDWIDTH

TEST RESULT

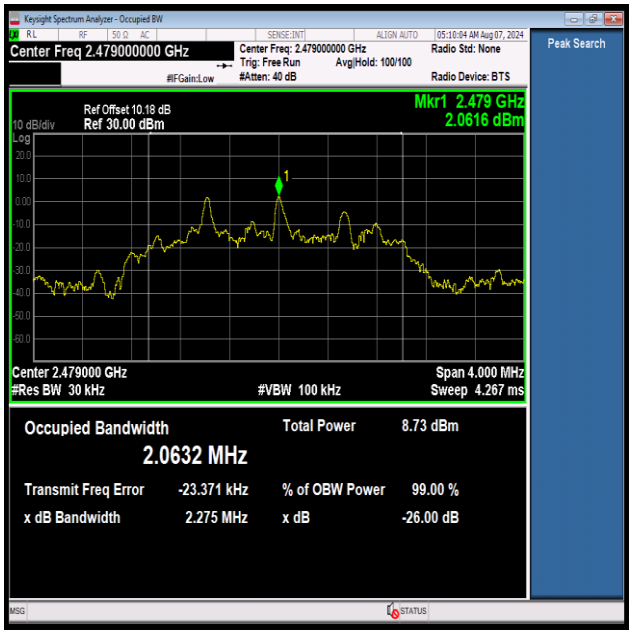
TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
FHSS	Ant1	2403	2.0476	2402.0355	2404.0831	---	---
FHSS	Ant1	2441	2.0500	2439.5002	2442.0552	---	---
FHSS	Ant1	2479	2.0632	2477.9450	2480.0082	---	---

6.1.1 TEST GRAPHS

FHSS-Ant1-2403



FHSS-Ant1-2441



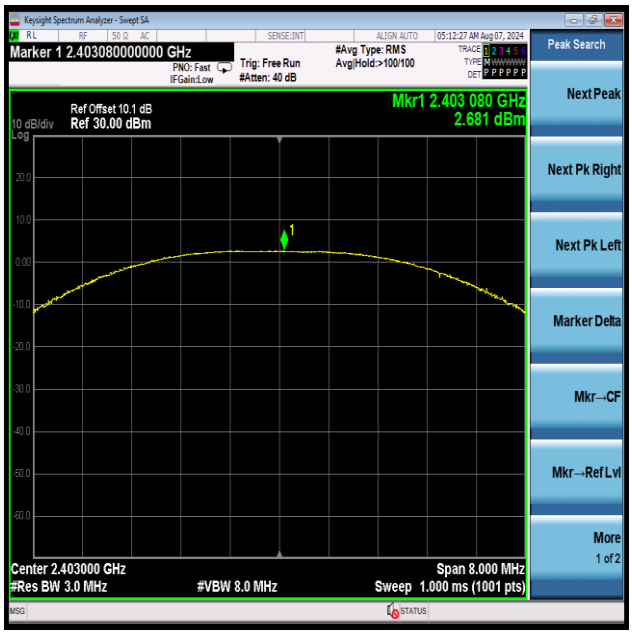
FHSS-Ant1-2479

MAXIMUM CONDUCTED OUTPUT POWER

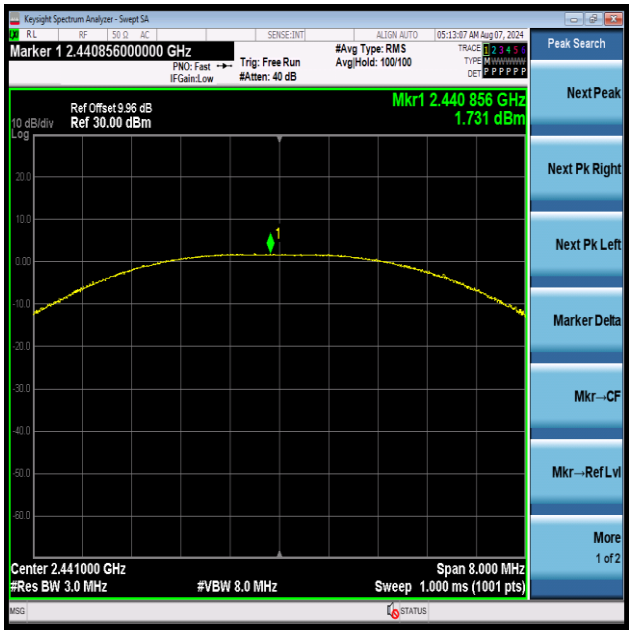
TEST RESULT PEAK

Test Mode	Antenna	Frequency[MHz]	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	Verdict
FHSS	Ant1	2403	2.68	≤20.97	PASS
FHSS	Ant1	2441	1.73	≤20.97	PASS
FHSS	Ant1	2479	2.49	≤20.97	PASS

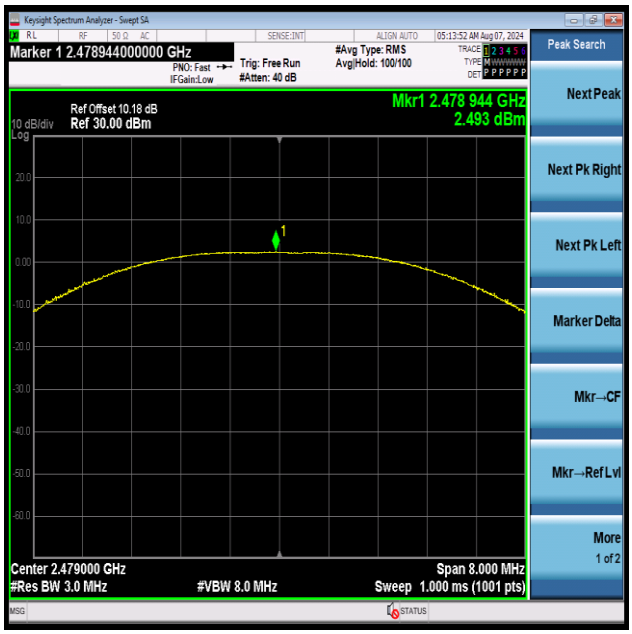
TEST GRAPHS



FHSS-Ant1-2403-PASS



FHSS-Ant1-2441-PASS



FHSS-Ant1-2479-PASS

CARRIER FREQUENCY SEPARATION

TEST RESULT

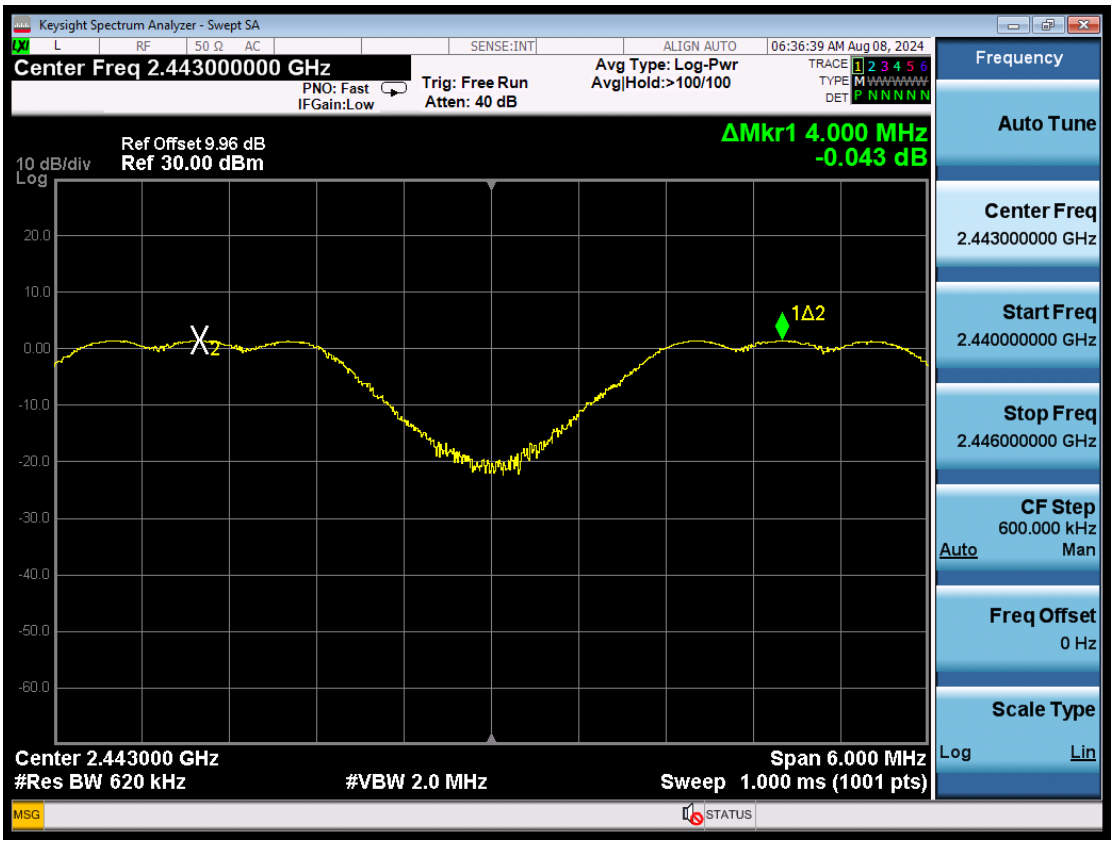
TestMode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
FHSS	Ant1	Hop	2	≥1.371	Pass
FHSS	Ant1	Hop	3	≥1.371	Pass
FHSS	Ant1	Hop	4	≥1.371	Pass
FHSS	Ant1	Hop	5	≥1.371	Pass
FHSS	Ant1	Hop	6	≥1.371	Pass
FHSS	Ant1	Hop	7	≥1.371	Pass
FHSS	Ant1	Hop	8	≥1.371	Pass
FHSS	Ant1	Hop	10	≥1.371	Pass

6.1.1 TEST GRAPHS

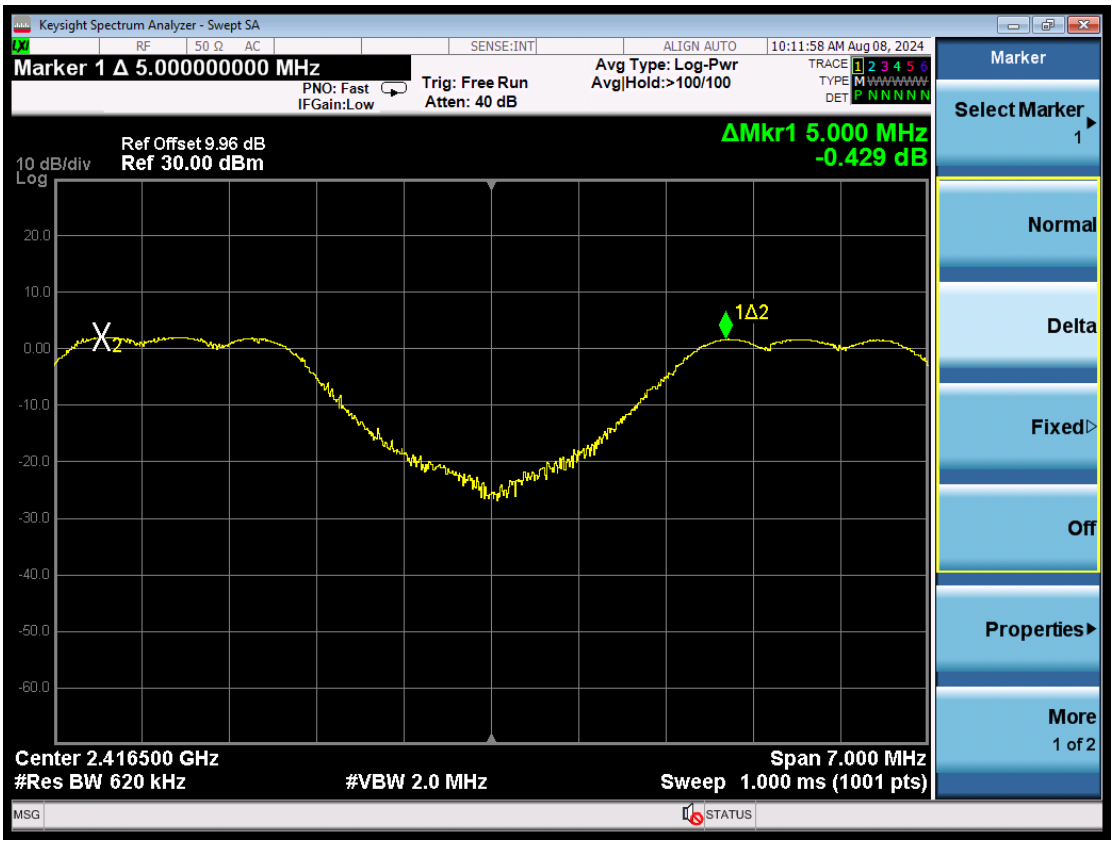
FHSS_Ant1_Hop 2MHz

FHSS_Ant1_Hop 3MHz

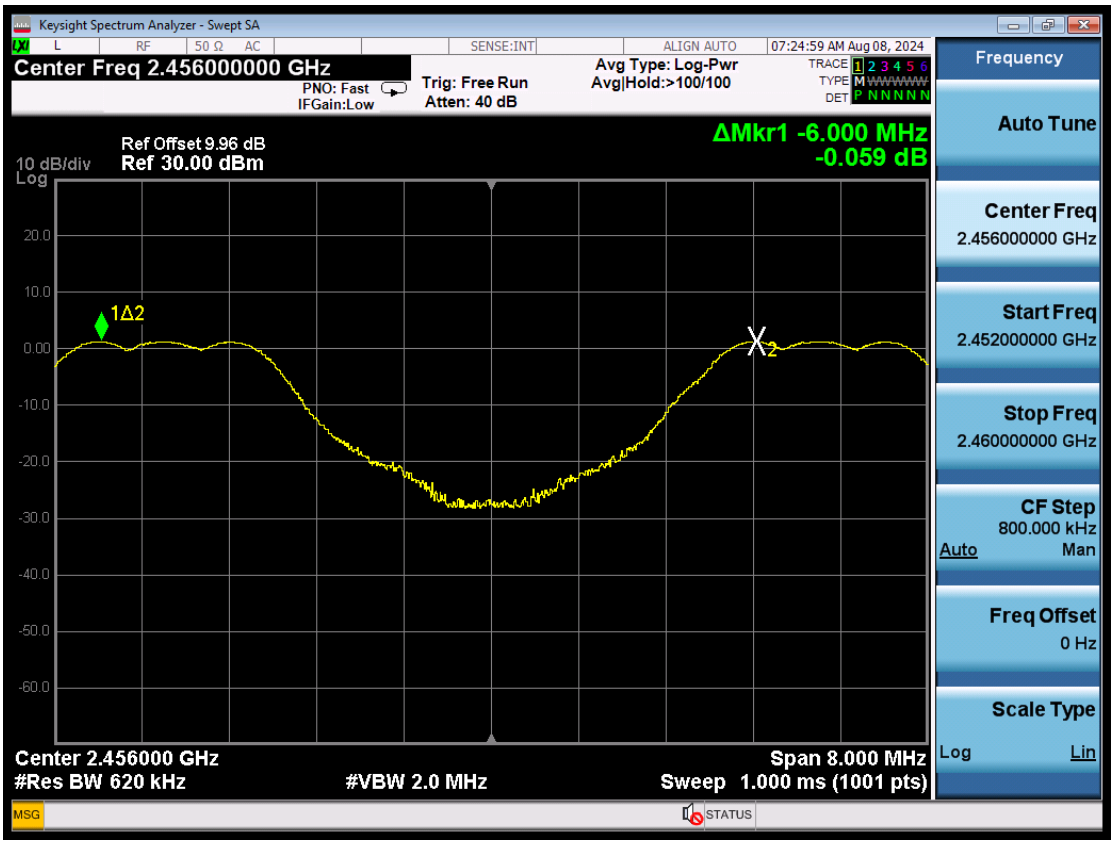
FHSS_Ant1_Hop 4MHz



FHSS_Ant1_Hop 5MHz



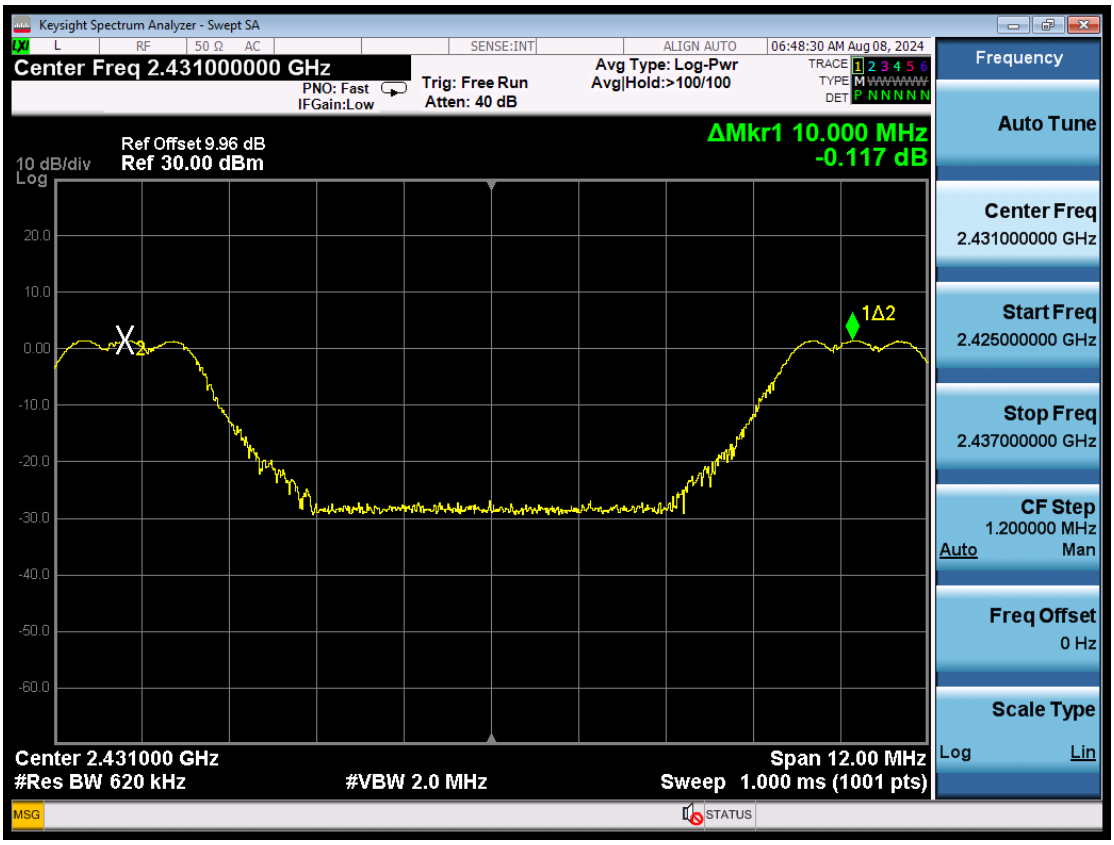
FHSS_Ant1_Hop 6MHz



FHSS_Ant1_Hop 7MHz

FHSS_Ant1_Hop 8MHz

FHSS_Ant1_Hop 10MHz

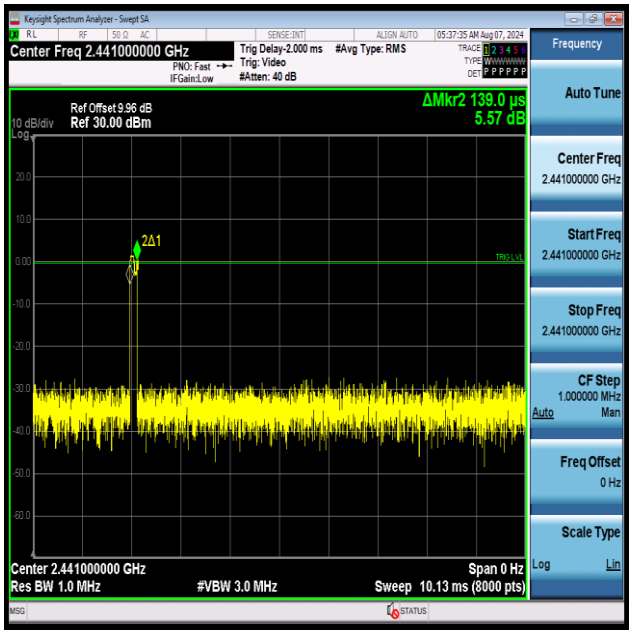

Keysight Spectrum Analyzer - Swept SA
L
RF
50 Ω
AC
SENSE:INT
ALIGN AUTO
06:48:30 AM Aug 08, 2024
Center Freq 2.431000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 40 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 9.96 dB
10 dB/div
Log
Ref 30.00 dBm
ΔMkr1 10.000 MHz
-0.117 dB
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
1Δ2
Center 2.431000 GHz
#Res BW 620 kHz
#VBW 2.0 MHz
Span 12.00 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
2.431000000 GHz
Start Freq
2.425000000 GHz
Stop Freq
2.437000000 GHz
CF Step
1.200000 MHz
Auto
Man
Freq Offset
0 Hz
Scale Type
Log
Lin
MSG
STATUS

TIME OF OCCUPANCY

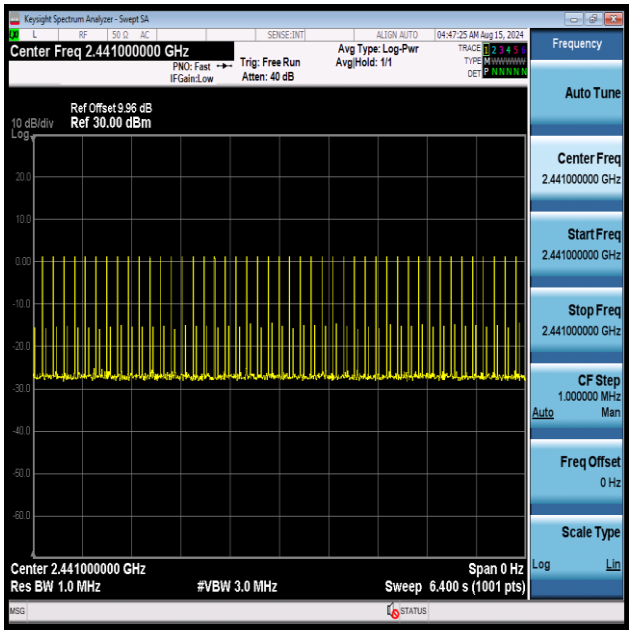
TEST RESULT

TestMode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
FHSS	Ant1	Hop	0.139	45	0.006	≤0.4	PASS

TEST GRAPHS



FHSS-Ant1-Hop-PASS



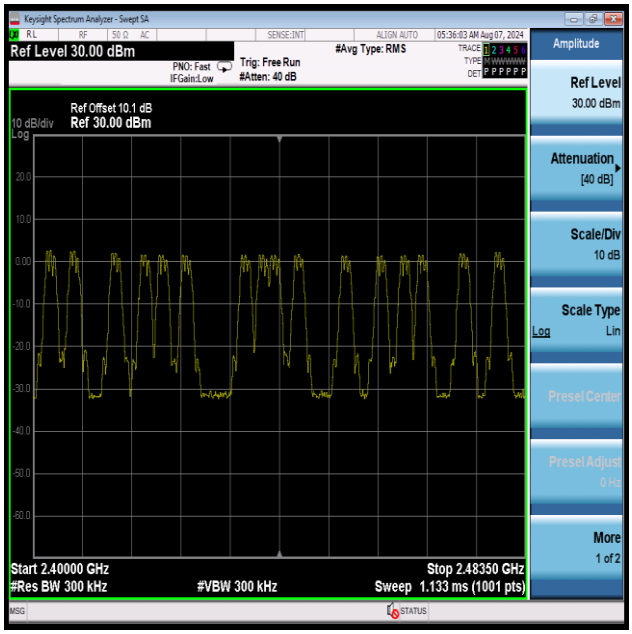
FHSS-Ant1- TotalHops

NUMBER OF HOPPING CHANNELS

TEST RESULT

TestMode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
FHSS	Ant1	Hop	16	≥15	PASS

TEST GRAPHS



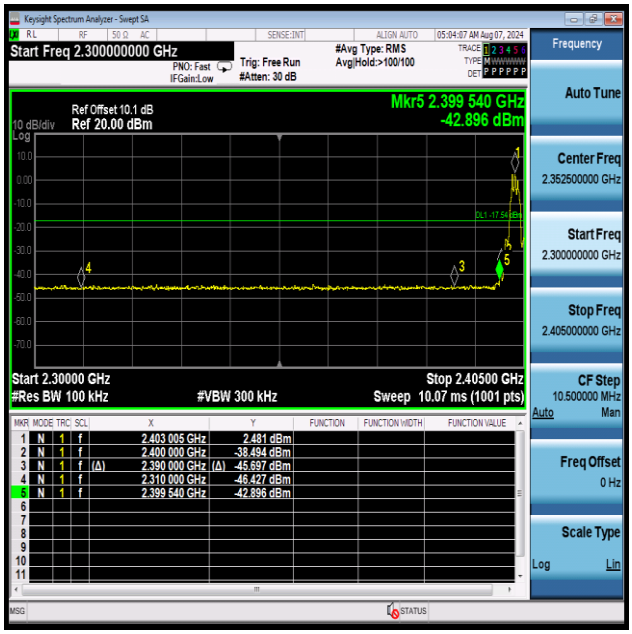
FHSS-Ant1-Hop-PASS

BAND EDGE MEASUREMENTS

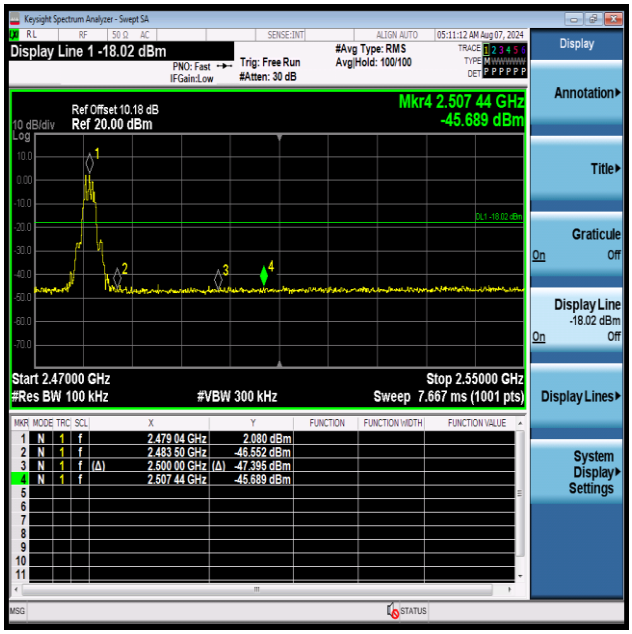
TEST RESULT

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
FHSS	Ant1	Low	2403	0.52	-42.9	≤-19.48	PASS
FHSS	Ant1	High	2479	1.96	-45.69	≤-18.05	PASS
FHSS	Ant1	Low	Hop_2402	2.01	-41.27	≤-17.99	PASS
FHSS	Ant1	High	Hop_2480	1.98	-45.06	≤-18.02	PASS

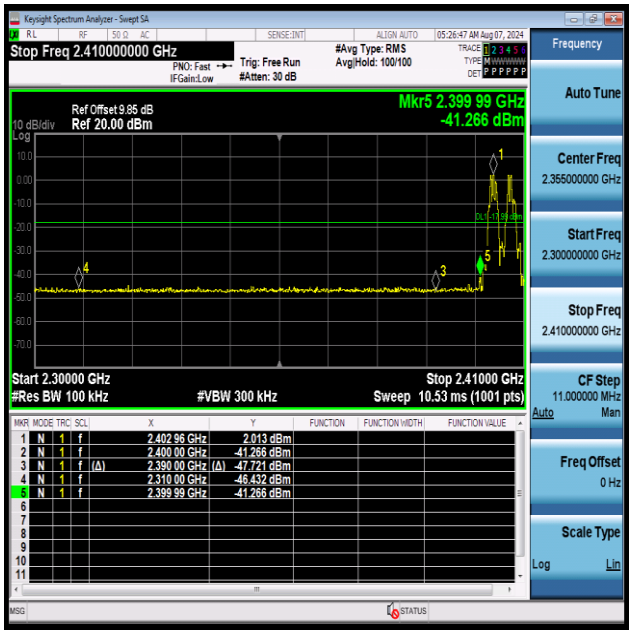
TEST GRAPHS



FHSS-Ant1-2403-PASS



FHSS-Ant1-2479-PASS



FHSS-Ant1-Hop_2402-PASS

FHSS-Ant1-Hop_2480-PASS

--END--