

TEST REPORT

Product Name : 2.4G 4CH TX
Model Number : GT16
FCC ID : A6E-GT16

Prepared for : Zhejiang Feishen Vehicle Co., LTD.
Address : North Lake Road Hardware Science And Technology In,
Yong Kang, ZheJiangProvince, 321300 China

Prepared by : EMTEK (NINGBO) CO., LTD.
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1 TEST RESULT CERTIFICATION

Applicant : Zhejiang Feishen Vehicle Co., LTD.

Address : North Lake Road Hardware Science And Technology In, Yong Kang,
ZheJiangProvince, 321300 China

Manufacturer : Zhejiang Feishen Vehicle Co., LTD.

Address : North Lake Road Hardware Science And Technology In, Yong Kang,
ZheJiangProvince, 321300 China

EUT : 2.4G 4CH TX

Model Name : GT16

Trademark : N/A

Measurement Procedure Used:

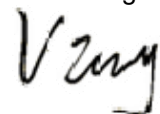
APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 2, Subpart J FCC 47 CFR Part 15, Subpart C	PASS

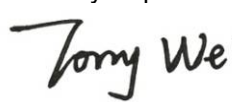
The above equipment was tested by EMTEK(NINGBO) CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 2 and Part 15.247.

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

Date of Test : May 13, 2022 to May 27, 2022

Prepared by : 
June Gao/Engineer

Reviewer : 
Vinay/Supervisor

Approved & Authorized Signer : 
Tony Wei/Manager



2 EUT TECHNICAL DESCRIPTION

Characteristics	Description
Product Name	2.4G 4CH TX
Model number	GT16
Sample number	1#
Data Rate	1Mbps for FSK modulation
Modulation	FSK
Operating Frequency Range	2410-2465MHz
Number of Channels	56 channels
Max Transmit Power	9.67 dBm
Antenna Type	Built-in copper antenna
Gain	2.0 dBi
Power supply	DC 6V for Battery
Temperature Range	-40°C to +85°C

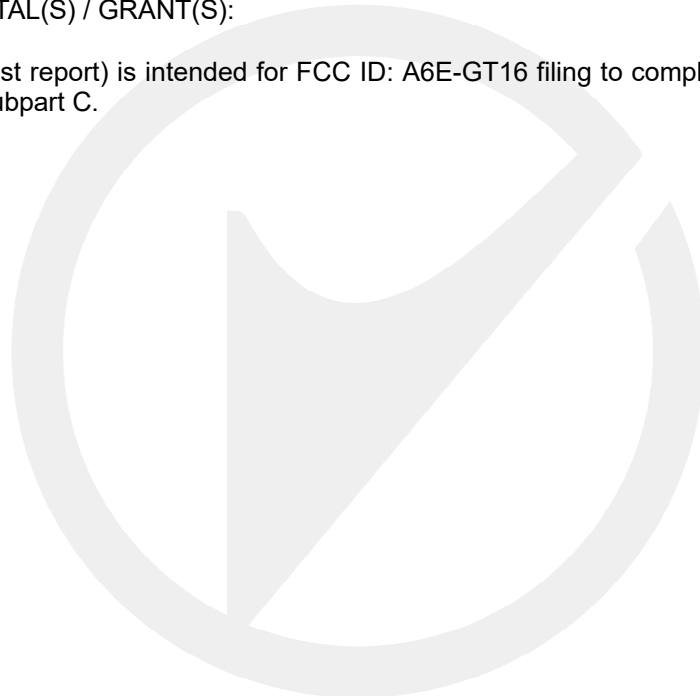
Note: The system works in the frequency range of 2410MHz to 2465MHz. This band has been divided to 56 independent channels. Each radio system uses 16 different channels, the minimum channel separation is ≥ 1 MHz. By using various switch-on times, hopping scheme and channel frequencies, the system can guarantee a jamming free radio transmission.

3 SUMMARY OF TEST RESULT

FCC PartClause	Test Parameter	Verdict	Remark
15.247(a)(1)	20 dB Bandwidth	PASS	
15.247(a)(1)	Carrier Frequency Separation	PASS	
15.247(a)(1)	Number of Hopping Frequencies	PASS	
15.247(a)(1)	Average Time of Occupancy (Dwell Time)	PASS	
15.247(b)(1)	Maximum Peak Conducted Output Power	PASS	
15.247(c)	Conducted Spurious Emissions	PASS	
15.247(d) 15.209	Radiated Spurious Emissions	PASS	
15.207	Conducted Emission	N/A	
15.203	Antenna Application	PASS	
NOTE1:N/A (Not Applicable)			

RELATED SUBMITTAL(S) / GRANT(S):

This submittal(s) (test report) is intended for FCC ID: A6E-GT16 filing to comply with Section 15.247 of the FCC Part 15, Subpart C.



4 TEST METHODOLOGY

4.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:

FCC 47 CFR Part 2, Subpart J

FCC 47 CFR Part 15, Subpart C

558074 D01 15.247 Meas Guidance V05r02

4.2 MEASUREMENT EQUIPMENT USED

4.2.1 Conducted Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LASTCAL.	CAL. INTERVAL
Test Receiver	Rohde & Schwarz	ESCI	101108	July 08, 2021	1 Year
L.I.S.N	Rohde & Schwarz	ENV216	101193	July 08, 2021	1 Year
L.I.S.N	Schwarzbeck	NSLK 8126	8126-462	July 08, 2021	1 Year
Pulse Limiter	MTS-systemtechnik	IMP-136	2611115-001-0033	July 08, 2021	1 Year
RF Switching unit	Compliance Direction Systems Inc.	RSU-M2	38400	July 08, 2021	1 Year

4.2.2 Radiated Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL. INTERVAL
Spectrum Analyzer	Rohde & Schwarz	ESCI	101107	July 08, 2021	1 Year
EMI Test Receiver	Rohde & Schwarz	ESCI	101107	July 08, 2021	1 Year
Pre-Amplifier	CD	PAP-0203	22015	July 08, 2021	1 Year
Bilog Antenna	Schwarzbeck	VULB9163	9163-467	July 12, 2021	2 Year
Cable	HUBER + SUHNER	CBL3-NN-0.5M	101216-2140500-2	July 08, 2021	1 Year
Cable	HUBER + SUHNER	CBL3-NN-3.0M	101216-2143000-2	July 08, 2021	1 Year
Cable	HUBER + SUHNER	CBL3-NN-9.0M	101216-2149000	July 08, 2021	1 Year
EXA Signal Analyzer	KEYSIGHT	N9010B	MY60242457	March 01, 2022	1 Year
Pre-Amplifier	Connphy Microwave Inc.	GLN-1G40G-4165-K	0319104	Nov 22, 2021	1 Year
Horn Antenna	Schwarzbeck	BBHA 9120	9120D-707	April 13, 2021	2 Year
Cable	SMAMSMAM	A50-0.5M	N/A	July 08, 2021	1 Year
Cable	SMAMSMAM	A50-3M	N/A	July 08, 2021	1 Year
Cable	SMAMSMAM	A50-6M	N/A	July 08, 2021	1 Year
Band Reject Filter	O.M.Jones, Inc. dba	BRM50702-0	G049	July 08, 2021	1 Year

4.2.3 Radio Frequency Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL. INTERVAL
EXA Signal Analyzer	KEYSIGHT	N9010B	MY60242457	March 01, 2022	1 Year
Attenuator 10dB	Suzhou talent Microwave	TA10A2-S-18	N/A	July 08, 2021	1 Year

4.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.

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

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

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (1Mbps for FSK modulation) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

The system works in the frequency range of 2410MHz to 2465MHz. This band has been divided to 56 independent channels. Each radio system uses 16 different channels, the minimum channel separation is $\geq 1\text{MHz}$. By using various switch-on times, hopping scheme and channel frequencies, the system can guarantee a jamming free radio transmission. The channel list is below.

Frequency and Channel list

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2410	27	2438	...	...
2	2411	28	2438	54	2463
3	2412	29	2439	55	2464
...	...	...	...	56	2465
Note: $f_c = 2410\text{MHz} + (k-1) \times 1\text{MHz}$ $k=1$ to 57					

Test Frequency and Channel

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2410	27	2438	56	2465

4.4 TEST SOFTWARE

Item	Software
Radiated Emission:	EMC (Ver. EMEC-3A1)
Conducted Emission	EZ-EMC (Ver. CON-03A1)

5 FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

1F Building 4, 1177#, Lingyun Road, Ningbo National Hi-Tech Zone, Ningbo, Zhejiang, China.

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 32.

5.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

EMC Lab.

: **Accredited by CNAS**

The Certificate Registration Number is L6666.

The Laboratory has been assessed and proved to be in compliance with CNAS-CL01:2018 (identical to ISO/IEC 17025:2017)

Accredited by FCC

Designation Number: CN1302

Test Firm Registration Number: 436491

Accredited by A2LA

The certificate is valid until May 31, 2023

Accredited by Industry Canada

The Conformity Assessment Body Identifier is CN0114

Name of Firm

: EMTEK (NINGBO) CO., LTD.

Site Location

: 1F Building 4, 1177#, Lingyun Road, National Hi-Tech Zone, Ningbo, Zhejiang, China

6 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Maximum Peak Output Power Test	$\pm 1.0\text{dB}$
Conducted Emissions Test	$\pm 2.0\text{dB}$
Radiated Emission Test	$\pm 2.0\text{dB}$
Occupied Bandwidth Test	$\pm 1.0\text{dB}$
Band Edge Test	$\pm 3\text{dB}$
All emission, radiated	$\pm 3\text{dB}$
Antenna Port Emission	$\pm 3\text{dB}$
Temperature	$\pm 0.5^{\circ}\text{C}$
Humidity	$\pm 3\%$

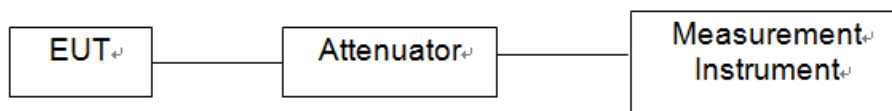
Measurement Uncertainty for a level of Confidence of 95%



7 SETUP OF EQUIPMENT UNDER TEST

7.1 RADIO FREQUENCY TEST SETUP 1

The Product antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



7.2 RADIO FREQUENCY TEST SETUP 2

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

Below 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

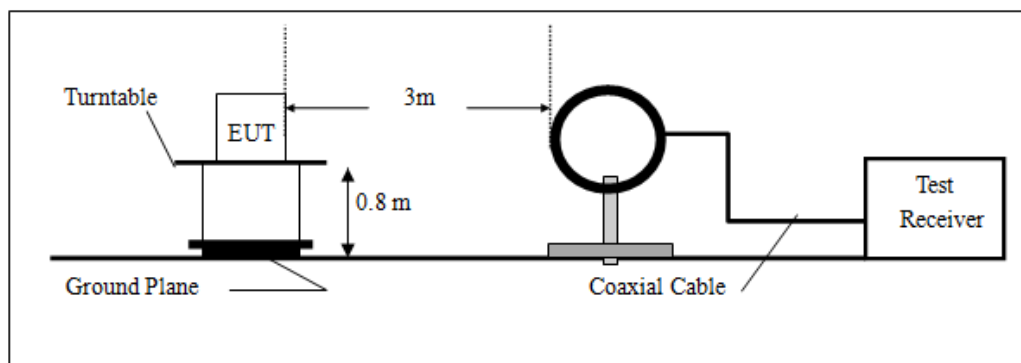
30MHz-1GHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

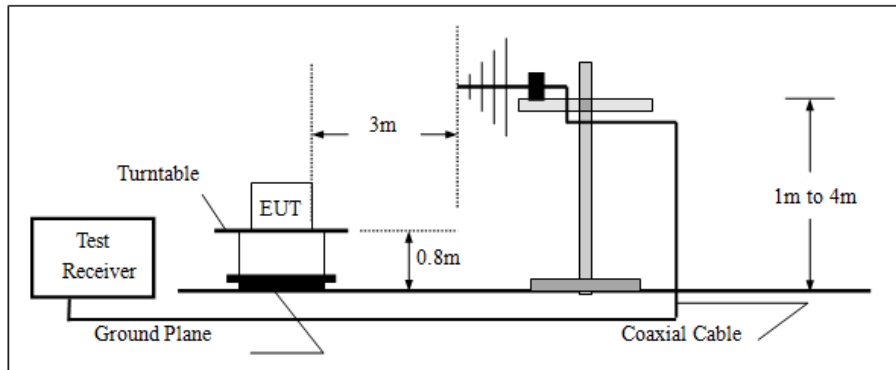
Above 1GHz:

The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

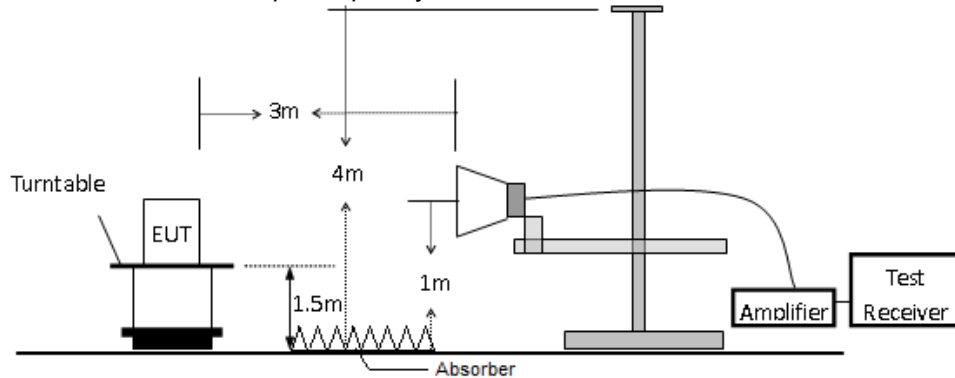
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz

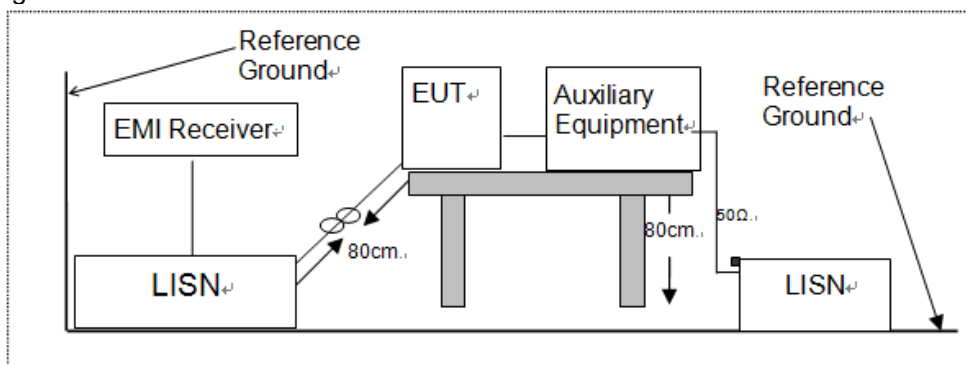


7.3 CONDUCTED EMISSION TEST SETUP

The mains cable of the EUT (Game fitness board) must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.1 m.

According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



7.4 SUPPORT EQUIPMENT

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
/	/	/	/

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

8 FREQUENCY HOPPING SYSTEM REQUIREMENTS

8.1 Standard Applicable

According to FCC Part 15.247(a)(1), 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.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

8.2 EUT Frequency Hopping Sequence

The frequency band used by the device is 2410-2465Mhz, with an interval of $\geq 1\text{Mhz}$, with a total of 56 frequency points. Equipment production will calculate 16 frequency points out of the 56 frequency points legally used by the equipment according to the unique ID contained in each equipment. And according to the unique sequence of 16 frequency points, it will be used as the channel actually used by the equipment. , the 16 frequency points used by the device remain unchanged after leaving the factory, and the device performs FHSS frequency hopping and cycles according to the arrangement order of these 16 frequency points. Once the device determines the 16 frequency points to be used and the arrangement order of the frequency points according to the ID, the 16 frequency points and the frequency hopping order do not change.

9 TEST REQUIREMENTS

9.1 20DB BANDWIDTH

9.1.1 Applicable Standard

According to FCC Part 15.247(a)(1) and 558074 D01 15.247 Meas Guidance V05r02

9.1.2 Conformance Limit

No limit requirement.

9.1.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.1.4 Test Procedure

Set EUT as the channel to be tested. Printed out the test result from the spectrum by hard copy function. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously

Set RBW = 30 kHz.

Set the video bandwidth (VBW) = 100kHz.

Set Span= approximately 2 to 3 times the 20 dB bandwidth

Set Detector = Peak.

Set Trace mode = max hold.

Set Sweep = auto couple.

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

Measure and record the results in the test report.

Test Results

Temperature: 25.5°C

Humidity: 55%

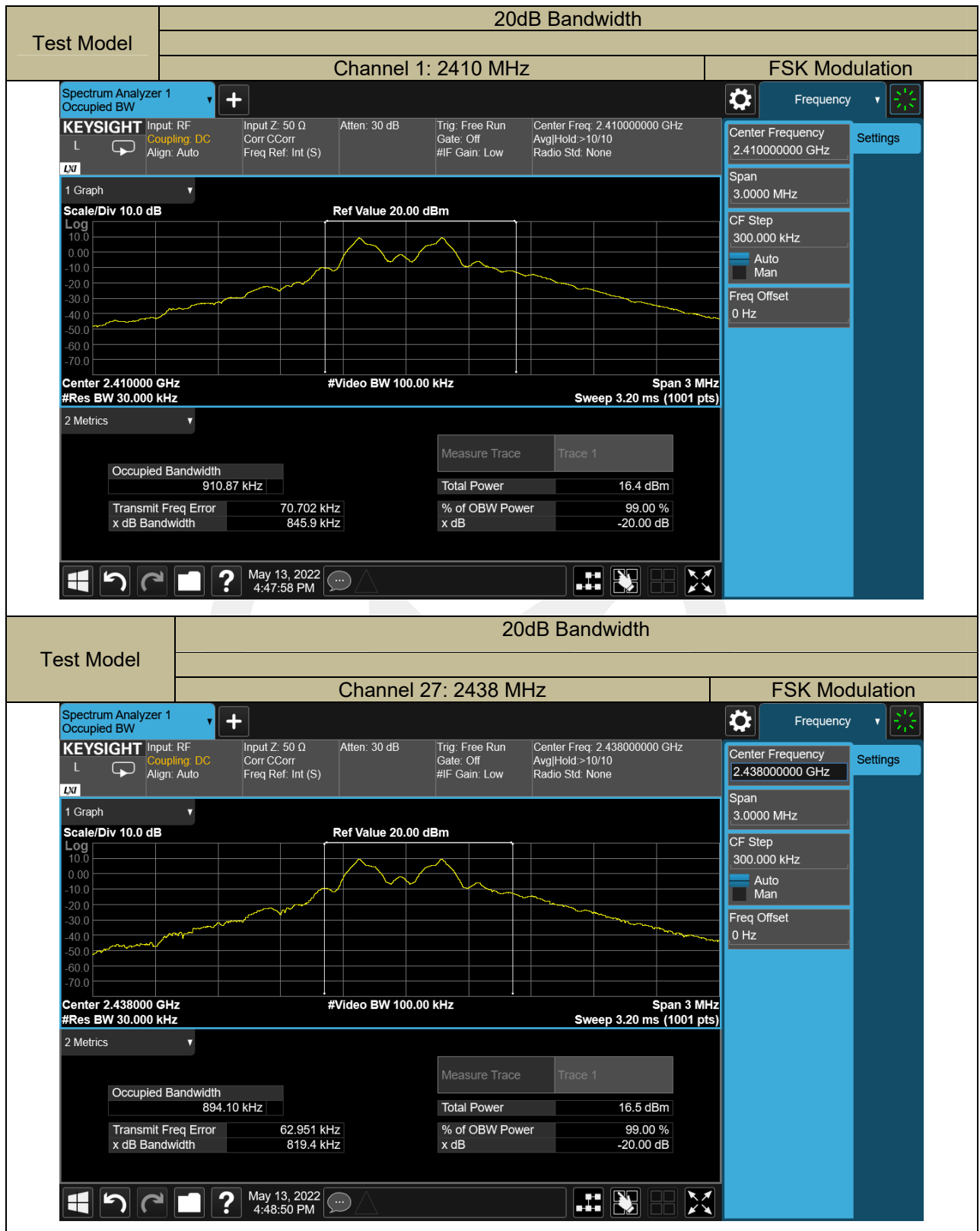
Test Date:

May 13, 2022

Test By:

XSJ

Modulation Mode	Channel Number	Channel Frequency (MHz)	20dB Bandwidth (kHz)
FSK	1	2410	845.900
	27	2438	819.400
	56	2465	785.300





9.2 CARRIER FREQUENCY SEPARATION

9.2.1 Applicable Standard

According to FCC Part 15.247(a)(1) and 558074 D01 15.247 Meas Guidance V05r02

9.2.2 Conformance Limit

Frequency hopping systems operating in the 2400-2483.5MHz band shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

In case of an output power less than 125mW, the frequency hopping system may have channels separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater.

9.2.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.2.4 Test Procedure

■ According to FCC Part 15.247(a)(1)

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

Set the RBW = 100kHz. Set VBW = 300kHz.

Set the span = wide enough to capture the peaks of two adjacent channels

Set Sweep time = auto couple.

Set Detector = peak. Set Trace mode = max hold.

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Test Results

Temperature: 25.5°C

Humidity: 55%

Test Date:

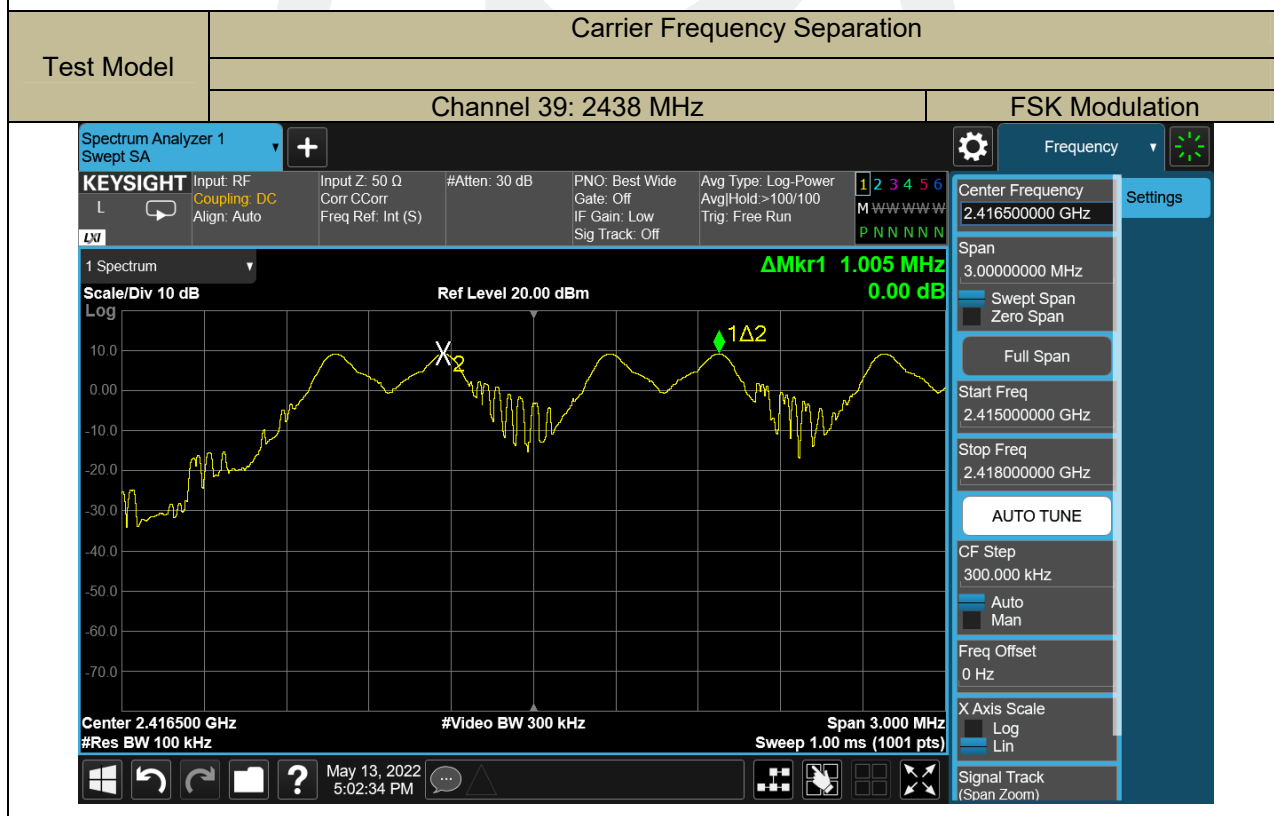
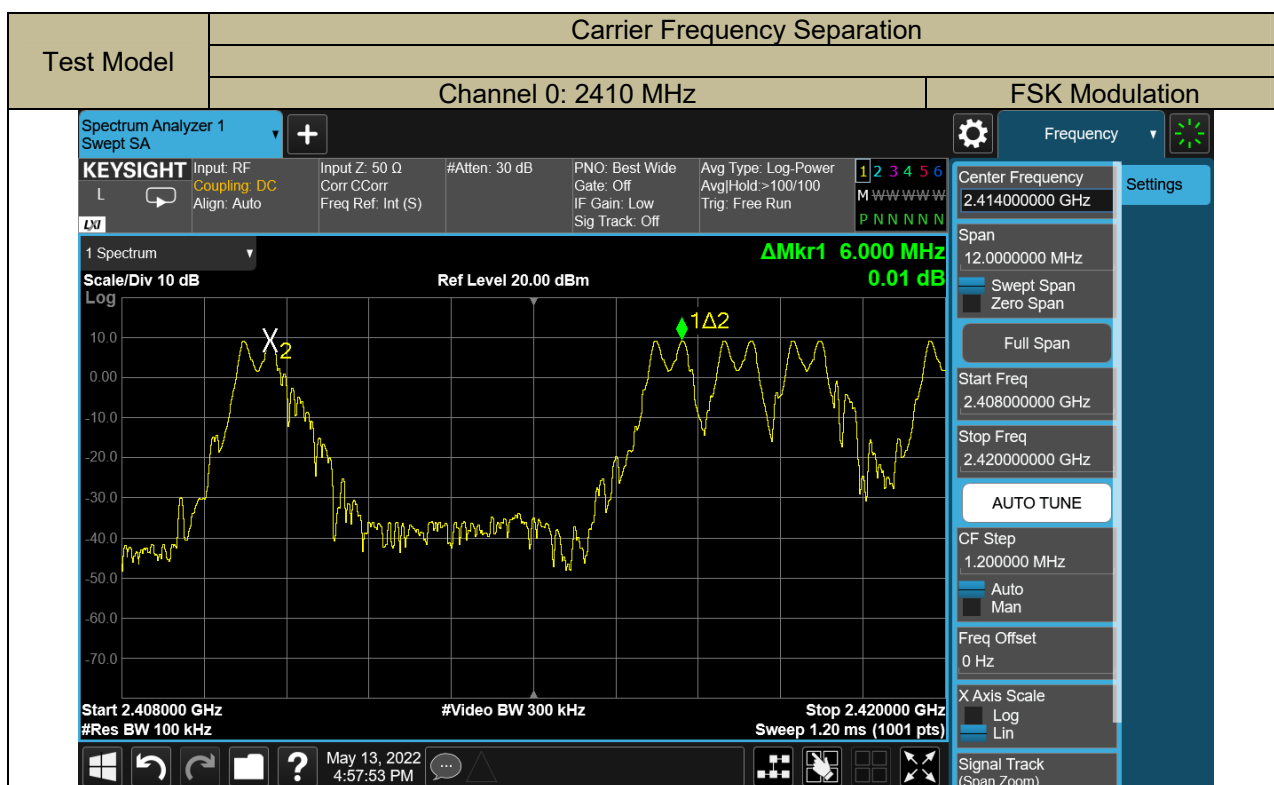
May 13, 2022

Test By:

XSJ

Modulation Mode	Channel Number	Channel Frequency (MHz)	Measurement Bandwidth (MHz)	Limit (kHz)	Verdict
FSK	1	2410	6.000	>563.93	PASS
	27	2438	1.005	>546.27	PASS
	56	2465	4.004	>523.53	PASS

Note: Limit = 20dB bandwidth * 2/3, if it is greater than 25kHz and the output power is less than 125mW (21dBm).





9.3 NUMBER OF HOPPING FREQUENCIES

9.3.1 Applicable Standard

According to FCC Part 15.247(a)(1) (iii) and 558074 D01 15.247 Meas Guidance V05r02

9.3.2 Conformance Limit

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

9.3.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.3.4 Test Procedure

■ According to FCC Part 15.247(a)(1)(iii)

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

Span = the frequency band of operation

RBW = 100kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies.

Test Results

Temperature: 25.5°C
Humidity: 55 %

Test Date: May 13, 2022
Test By: XSJ

Hopping Channel Frequency Range	Quantity of Hopping Channel	Quantity of Hopping Channel limit
2410-2465 (FSK)	16	> 15
Note: N/A		



9.4 AVERAGE TIME OF OCCUPANCY (DWELL TIME)

9.4.1 Applicable Standard

According to FCC Part 15.247(a)(1)(iii) and 558074 D01 15.247 Meas Guidance V05r02

9.4.2 Conformance Limit

For frequency hopping systems operating in the 2400-2483.5MHz band, the averagetime of occupancy on any channel shall not be greater than 0.4s within a period of 0.4s multiplied by the number of hopping channels employed.

9.4.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.4.4 Test Procedure

■ According to FCC Part15.247(a)(1)(iii)

The EUT must have its hopping function enabled. Use the following spectrum analyzersettings:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

VBW ≥ RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphsof this Section.

9.4.5 Test Results

Temperature: 25.5℃

Humidity: 55 %

Test Date:

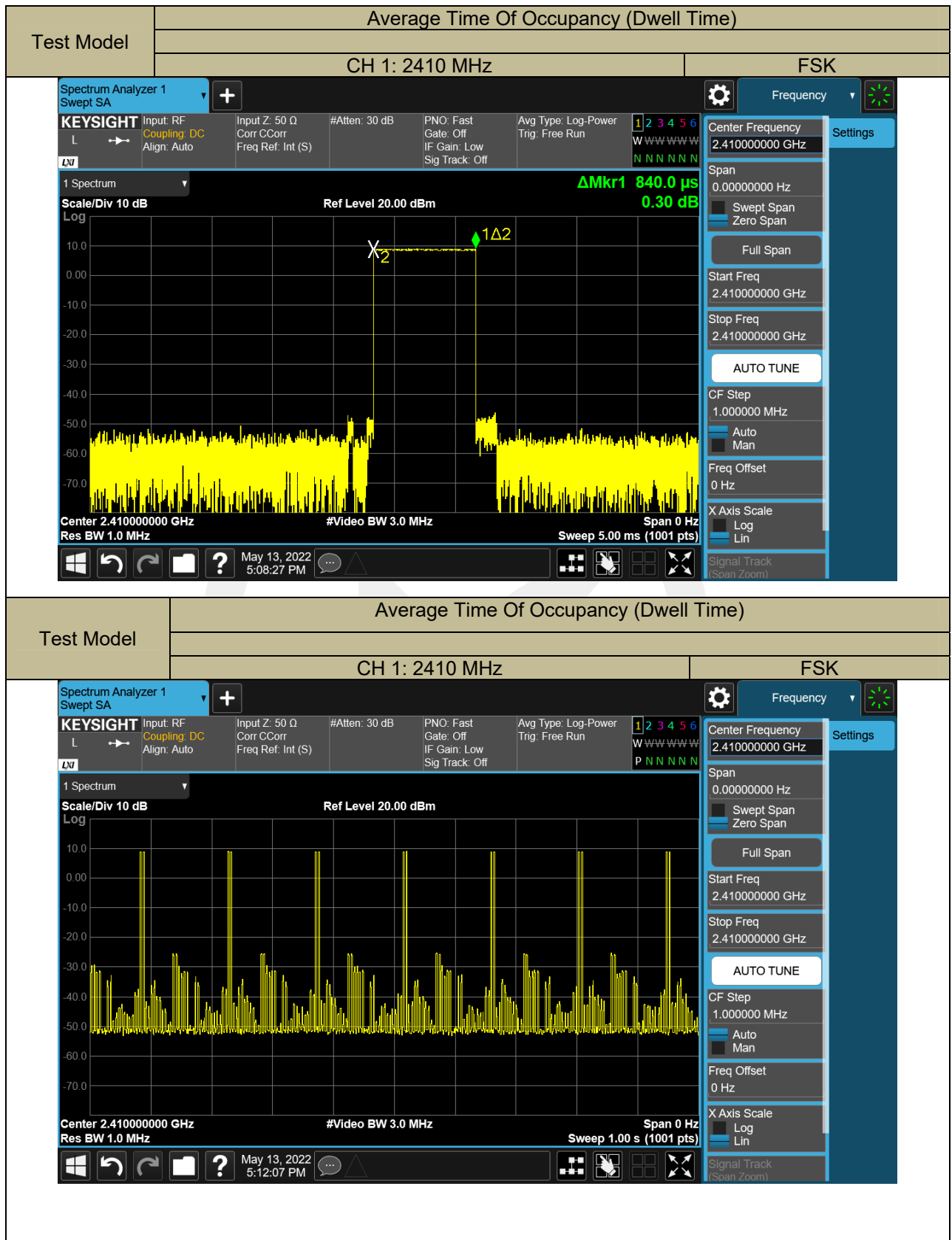
May 13, 2022

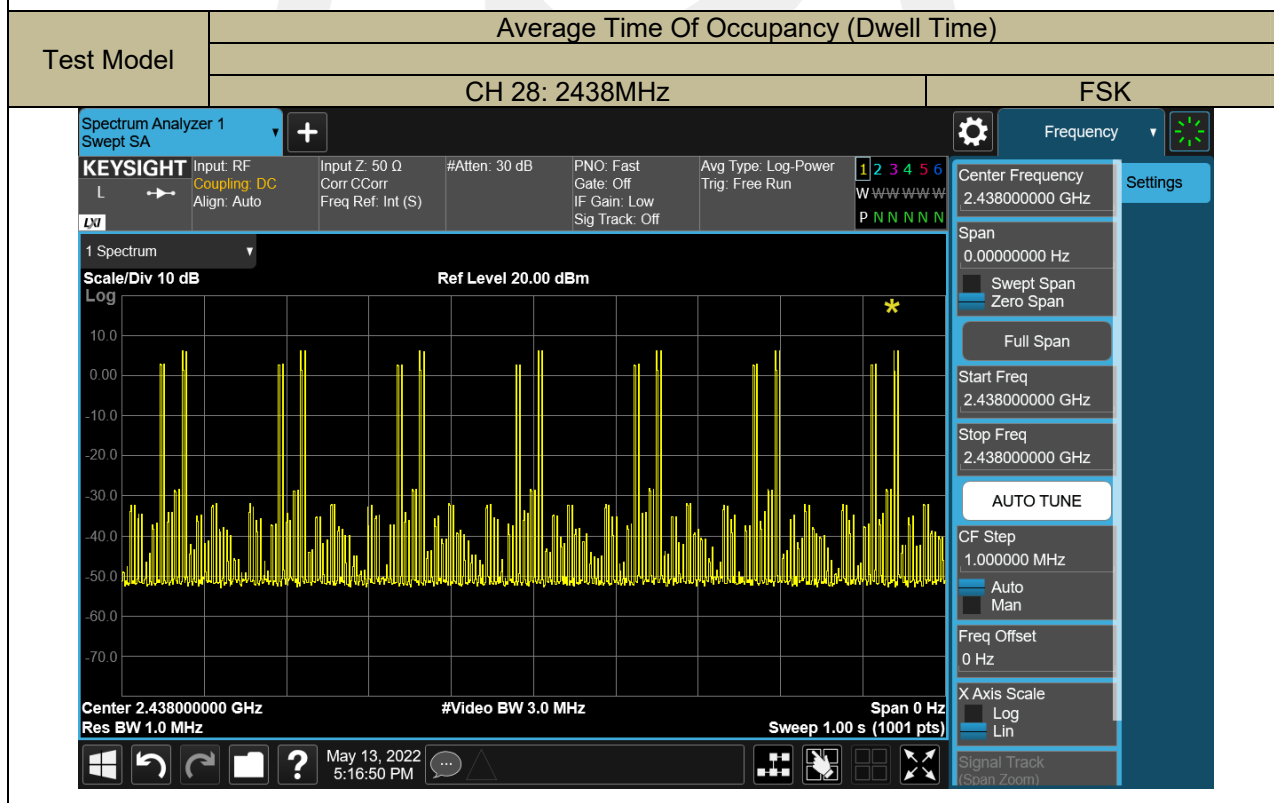
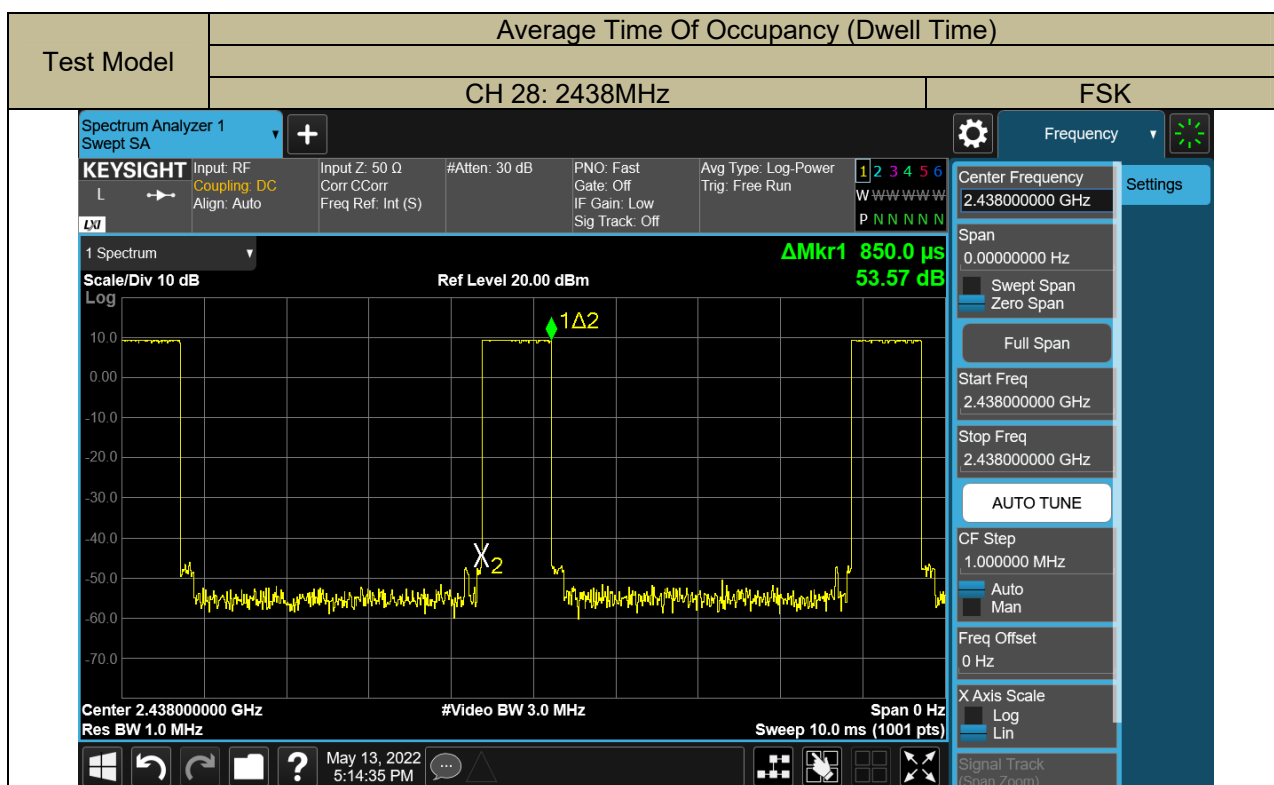
Test By:

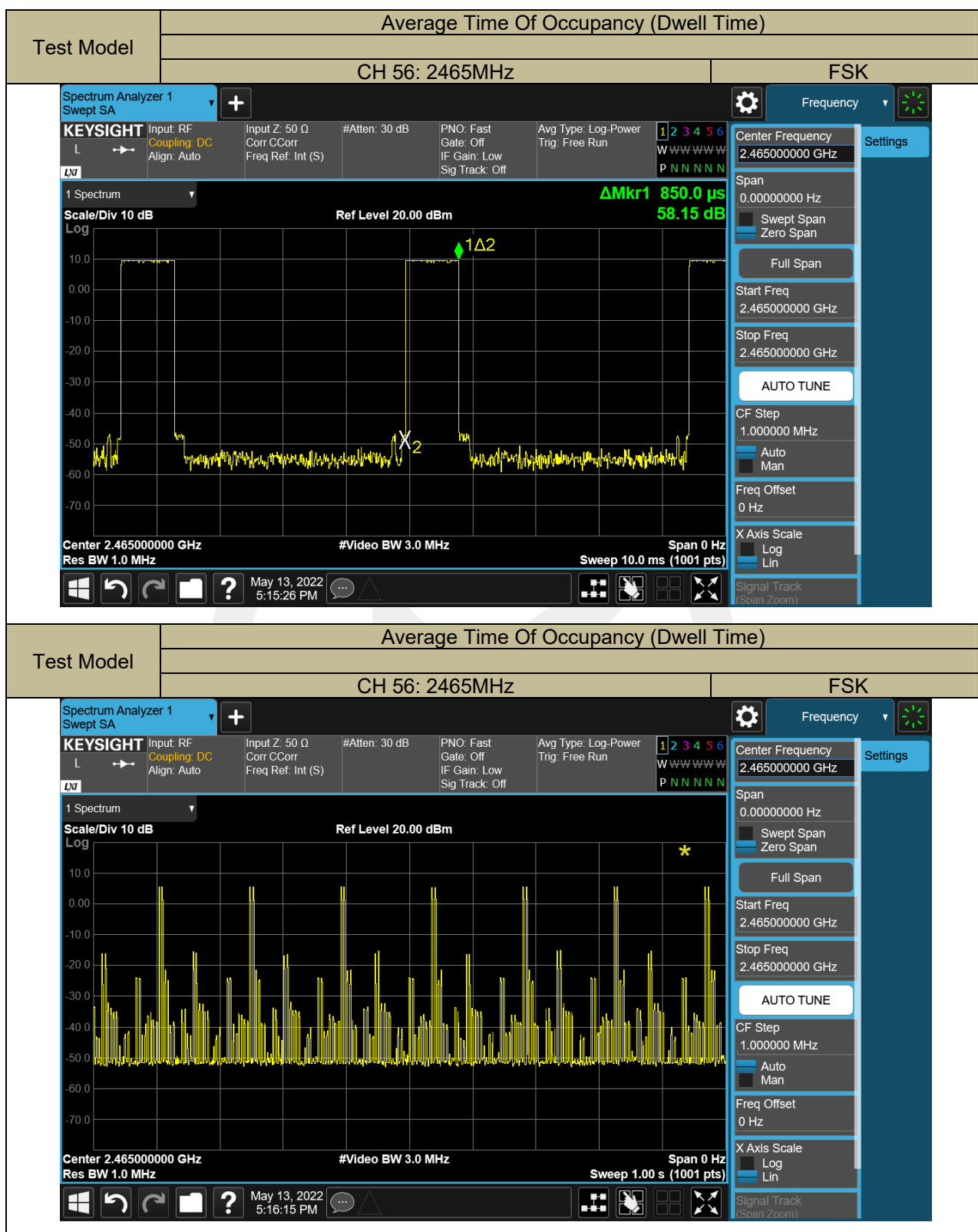
XSJ

Modulation Mode	Channel Number	Channel Frequency (MHz)	Pluse width (ms)	DwellTime (ms)	Limit (ms)	Verdict
FSK	1	2410	0.84	37.63	<400	PASS
	28	2438	0.85	76.16	<400	PASS
	56	2465	0.85	38.08	<400	PASS

Note1: DwellTime(2410 MHz)= Ton*Ton time in 1s*0.4s* Channel Number=0.84*7*0.4*16=37.63
DwellTime(2438 MHz)= Ton*Ton time in 1s*0.4s* Channel Number=0.85*14*0.4*16=76.16
DwellTime(2465 MHz)= Ton*Ton time in 1s*0.4s* Channel Number=0.85*7*0.4*16=38.08
Note2: All mode have been tested, and the worst results has been recorded on the follow page.







9.5 MAXIMUM PEAK CONDUCTED OUTPUT POWER

9.5.1 Applicable Standard

According to FCC Part 15.247(b)(1) and 558074 D01 15.247 Meas Guidance V05r02

9.5.2 Conformance Limit

The max For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

9.5.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.5.4 Test Procedure

■ According to FCC Part15.247(b)(1)

As an alternative to a peak power measurement, compliance with the limit can be based on a measurement of the maximum conducted output power.

Use the following spectrum analyzer settings:

Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel(about 10MHz)

Set RBW > the 20 dB bandwidth of the emission being measured(about 3MHz)

Set VBW $\geq$ RBW

Set Sweep = auto

Set Detector function = peak

Set Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission to determine the peak amplitude level.

Test Results

Temperature: 25.5°C

Humidity: 55 %

Test Date: May 13, 2022

Test By: XSJ

Operation Mode	Channel Number	Channel Frequency (MHz)	MeasurementLevel (dBm)	Limit (dBm)	Verdict
FSK	1	2410	9.17	21	PASS
	28	2438	9.47	21	PASS
	56	2465	9.67	21	PASS
Note:N/A					

Test Model	Maximum PeakConducted Output Power	
	Channel 0: 2410 MHz	FSK



Test Model	Maximum PeakConducted Output Power	
	Channel 39: 2438 MHz	FSK





9.6 CONDUCTED SUPRIIOUS EMISSION

9.6.1 Applicable Standard

According to FCC Part 15.247(d) and 558074 D01 15.247 Meas Guidance V05r02

9.6.2 Conformance Limit

According to FCC Part 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

9.6.3 Test Configuration

Test according to clause 7.1 radio frequency test setup 1

9.6.4 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer

■ Reference level measurement

Establish a reference level by using the following procedure:

Set instrument center frequency to DSS channel center frequency.

Set Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel.

Set the RBW = 100 kHz. Set the VBW $\geq 3 \times$ RBW.

Set Detector = peak. Set Sweep time = auto couple.

Set Trace mode = max hold. Allow trace to fully stabilize.

Use the peak marker function to determine the maximum Maximumconducetedlevel.

Note that the channel found to contain the maximum conduceted level can be used to establish the reference level.

■ Band-edge Compliance of RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation

Set RBW $\geq 1\%$ of the span=100kHzSet VBW $\geq$ RBW

Set Sweep = autoSetDetector function = peakSetTrace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section.

Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

■ ConducetedSpurious RF Conducted Emission

Use the following spectrum analyzer settings:

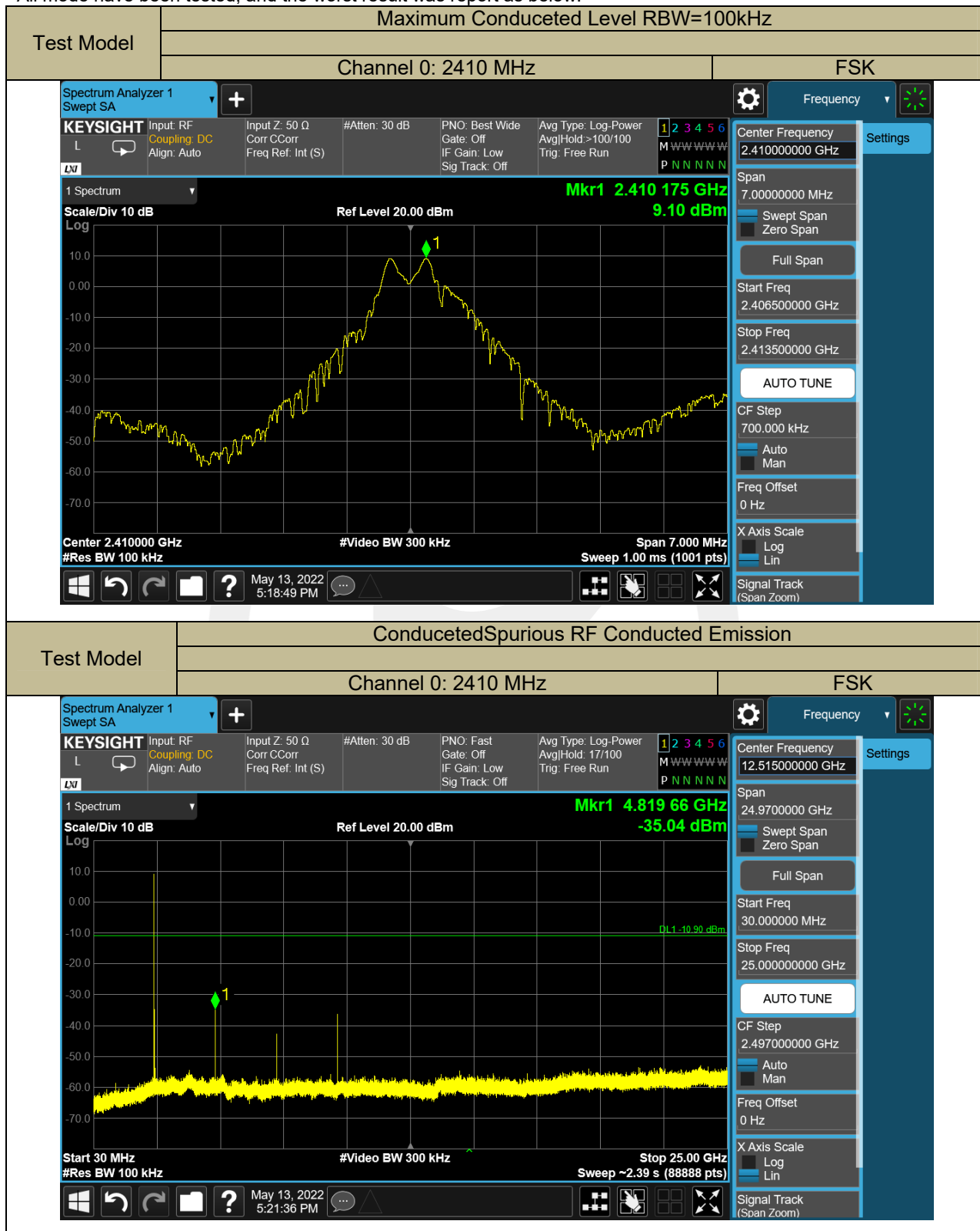
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.(30MHz to 25GHz).Set RBW = 100 kHzSetVBW $\geq$ RBW

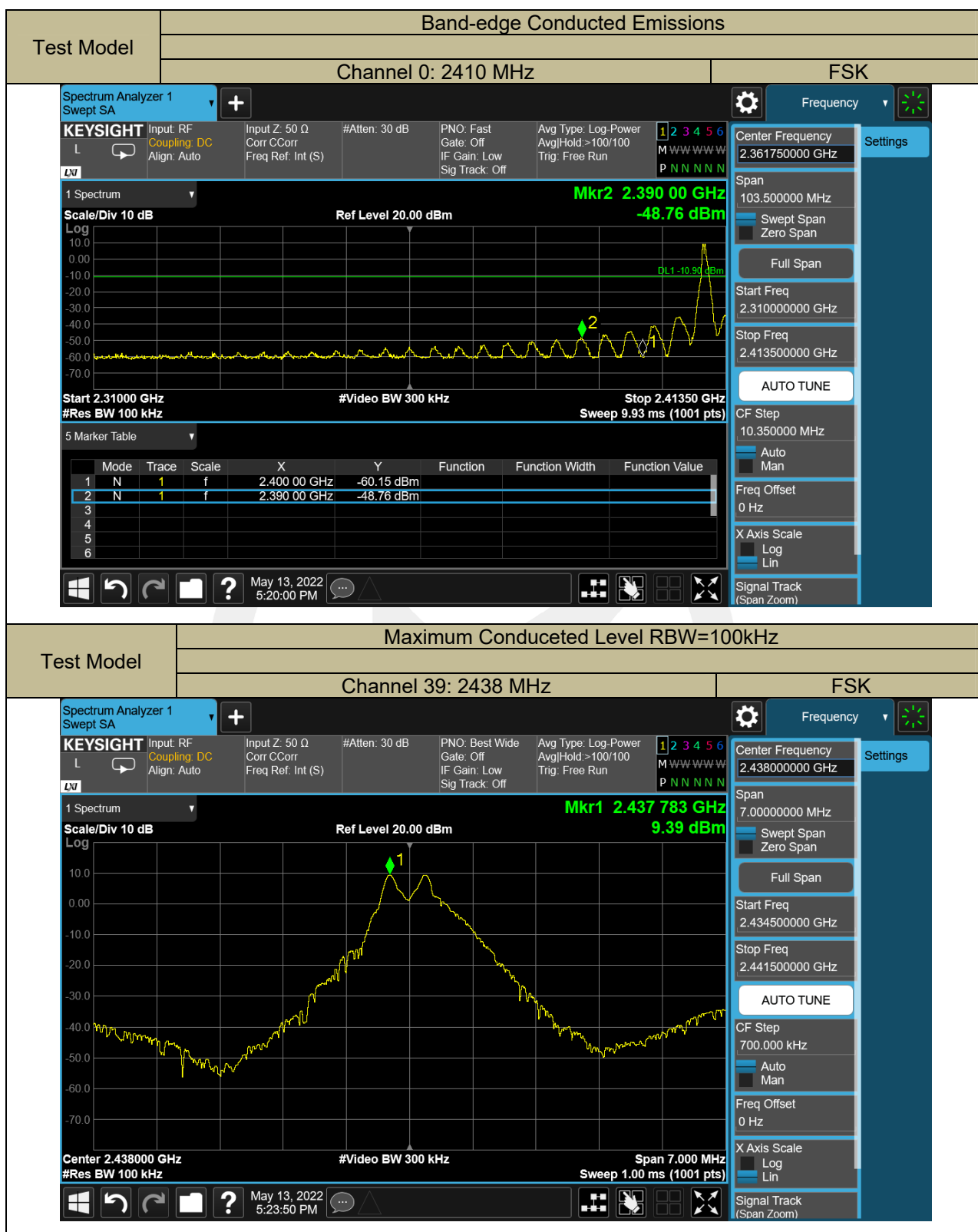
Set Sweep = autoSetDetector function = peakSetTrace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section.

9.6.5 Test Results

All mode have been tested, and the worst result was report as below:



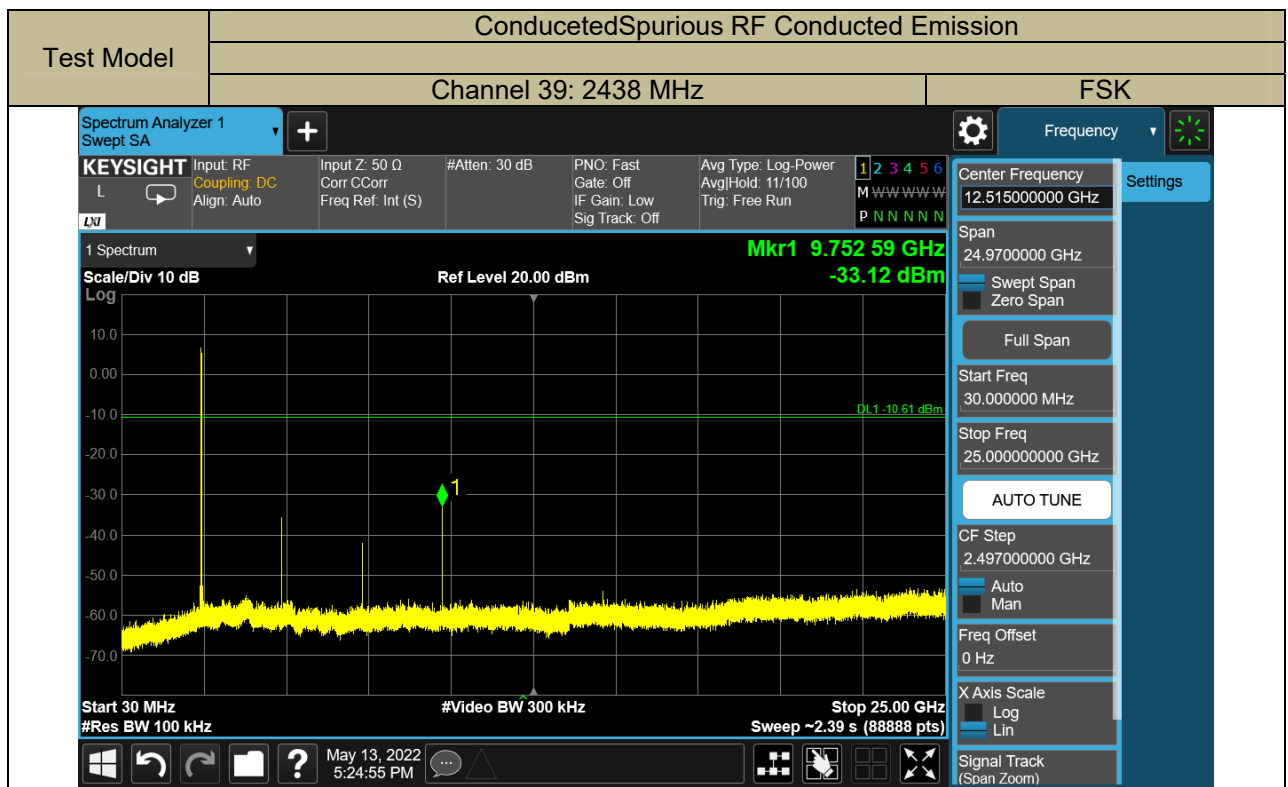


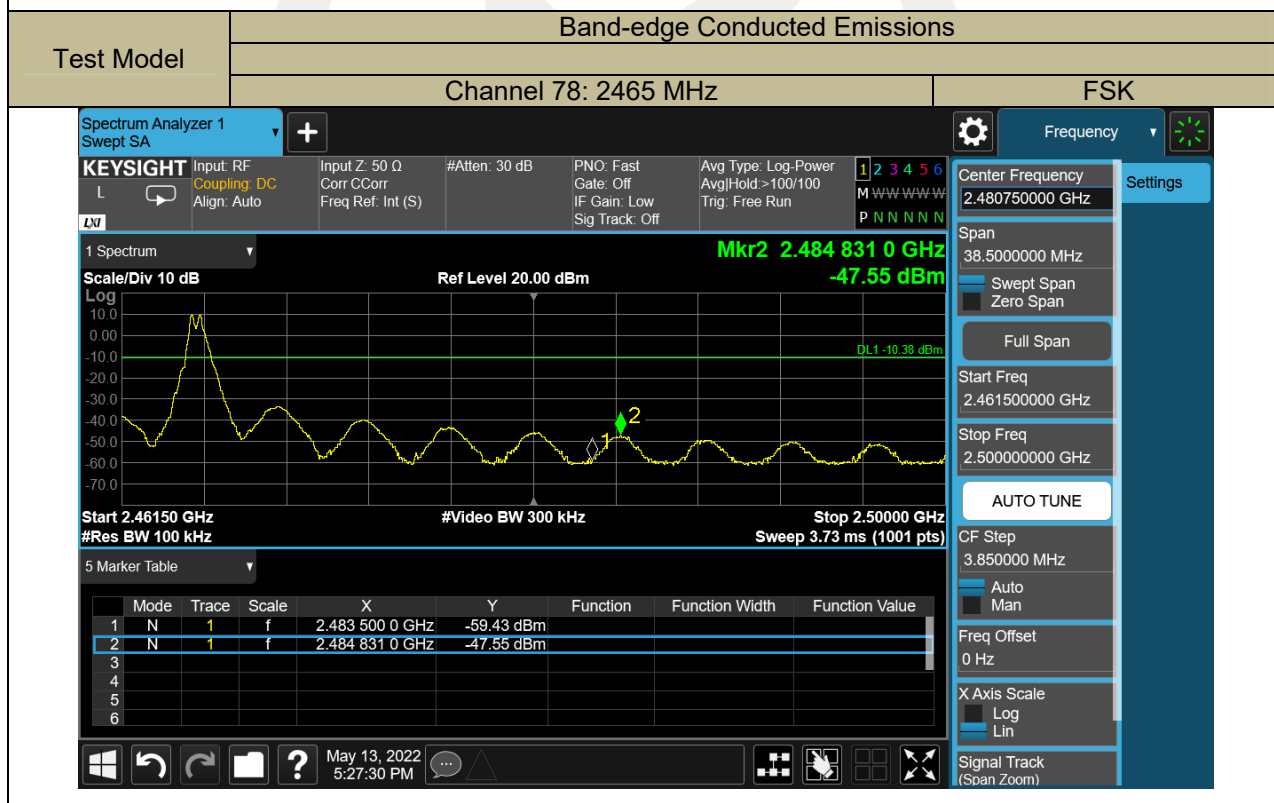
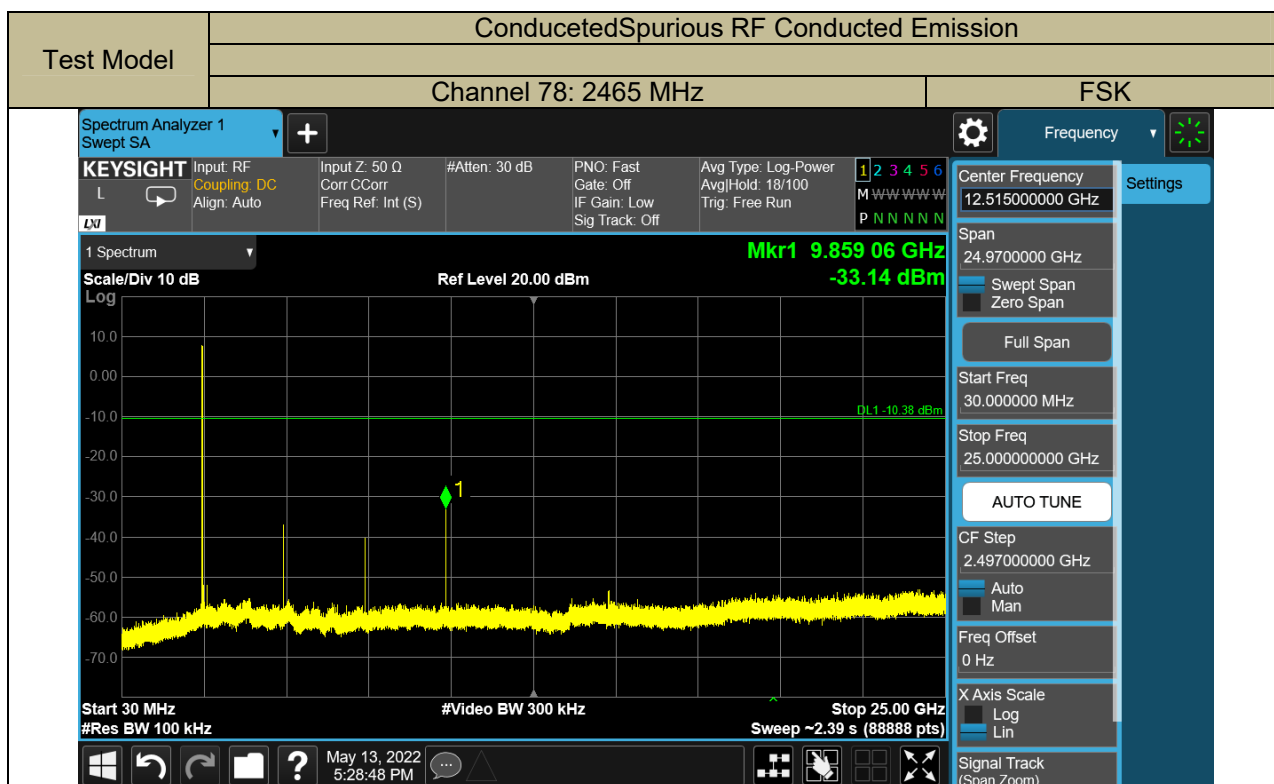
Test Model

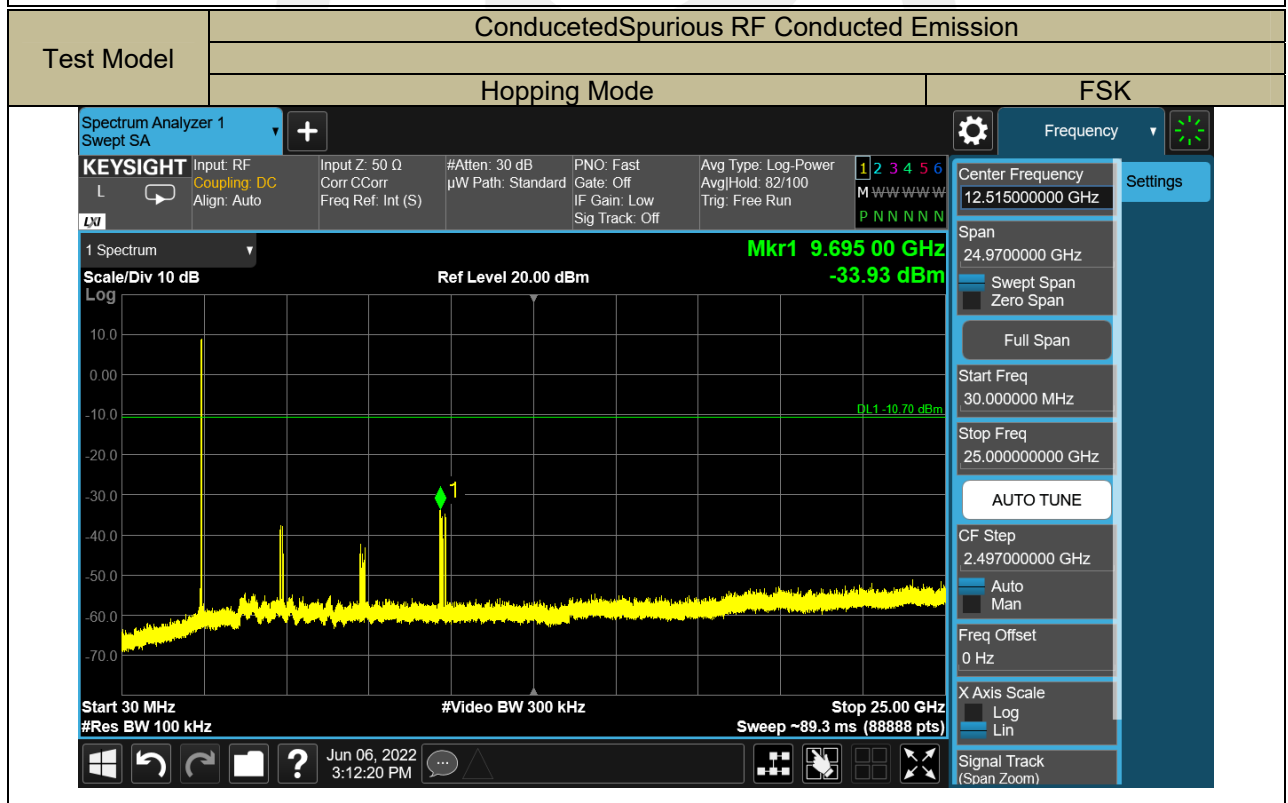
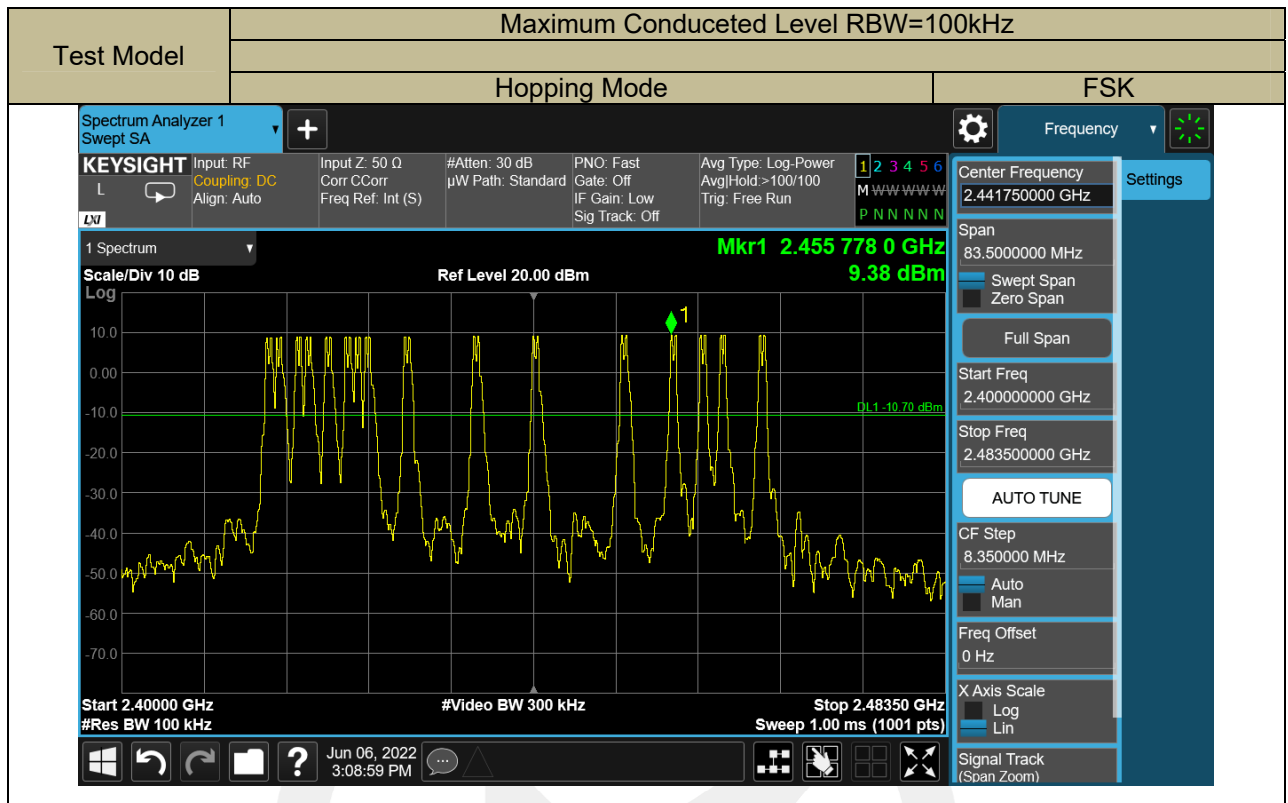
Maximum Conducted Level RBW=100kHz

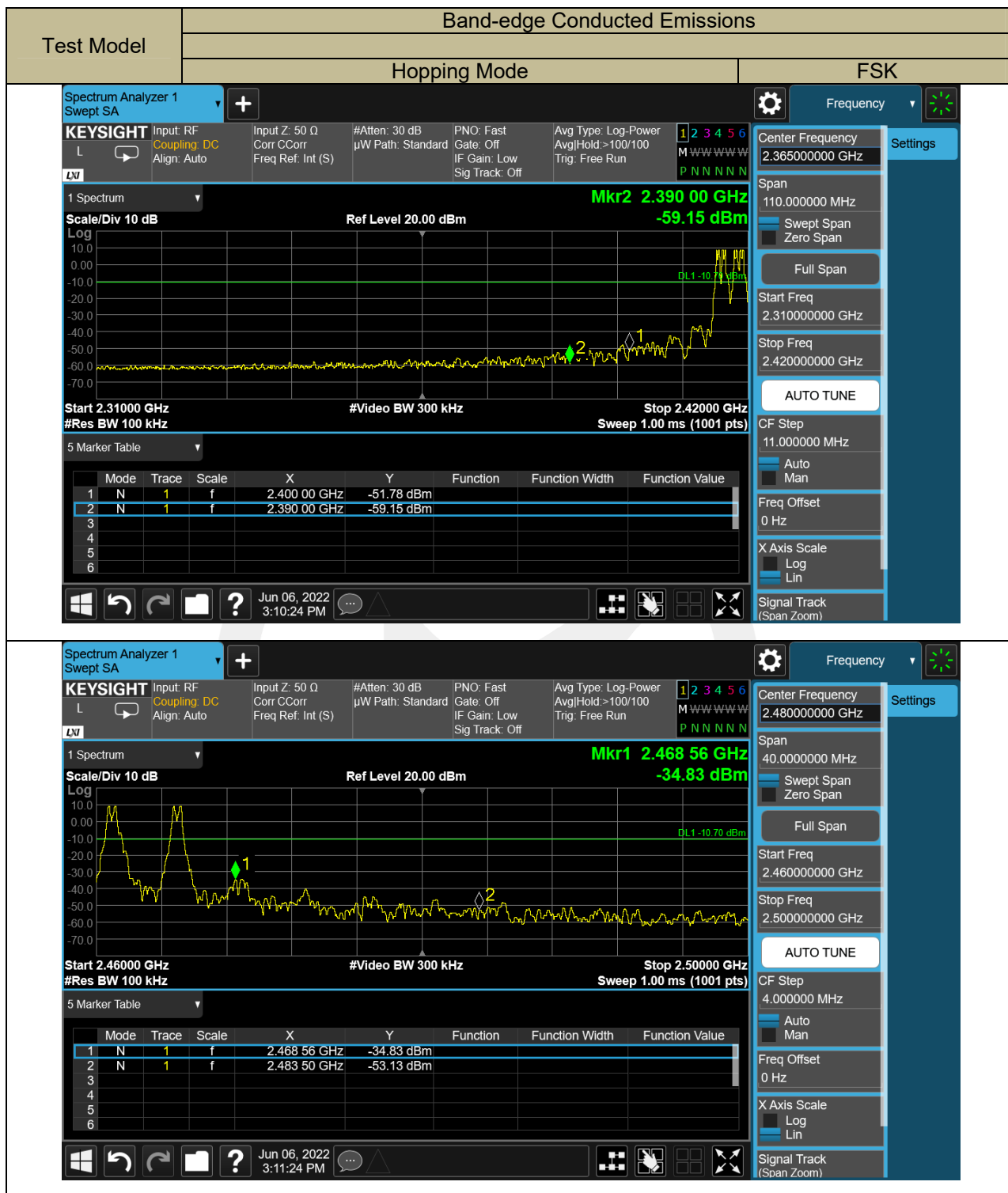
Channel 39: 2438 MHz

FSK









9.7 RADIATED SPURIOUS EMISSION

9.7.1 Applicable Standard

According to FCC Part 15.247(d) and 15.209 and 558074 D01 15.247 Meas Guidance V05r02

9.7.2 Conformance Limit

According to FCC Part 15.247(d): radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
According to FCC Part 15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to FCC Part 15.209, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (uV/m)	300
0.490-1.705	24000/F(KHz)	20 log (uV/m)	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

9.7.3 Test Configuration

Test according to clause 7.2 radio frequency test setup 2

9.7.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz (1GHz to 25GHz), 100 kHz for $f < 1$ GHz (30MHz to 1GHz)

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10-2013 respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. 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 $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Repeat above procedures until all frequency measured was complete.

9.7.5 Test Results

■ Spurious Emission below 30MHz(9KHz to 30MHz)

Temperature: 24°C Test Date: May 13, 2022
Humidity: 55 % Test By: XSJ
Test mode: TX Mode

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance}/\text{test distance})$ (dB);

Limit line = Specific limits(dBuV) + distance extrapolation factor

■ Spurious Emission Above 1GHz(1GHz to 25GHz)

Temperature: 24°C Test Date: May 13, 2022
Humidity: 55 % Test By: XSJ
Test mode: FSK Frequency: Channel 0: 2410 MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4825.000	V	55.98	41.58	74.00	54.00	-18.02	-12.42
7222.000	V	58.55	44.36	74.00	54.00	-15.45	-9.64
13903.00	V	58.92	45.85	74.00	54.00	-15.08	-8.15
4825.000	H	59.88	44.69	74.00	54.00	-14.12	-9.31
7239.000	H	59.87	46.35	74.00	54.00	-14.13	-7.65
11421.00	H	54.12	41.25	74.00	54.00	-19.88	-12.75

Temperature: 24℃
Humidity: 55 %
Test mode: FSK

Test Date: May 13, 2022
Test By: XSJ
Frequency: Channel 39: 2438 MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4876.000	V	56.98	42.96	74.00	54.00	-17.02	-11.04
7307.000	V	58.12	44.75	74.00	54.00	-15.88	-9.25
10809.00	V	53.98	40.31	74.00	54.00	-20.02	-13.69
4876.000	H	59.95	45.25	74.00	54.00	-14.05	-8.75
7307.000	H	58.59	44.63	74.00	54.00	-15.41	-9.37
13631.00	H	58.39	44.83	74.00	54.00	-15.61	-9.17

Temperature: 24℃
Humidity: 55 %
Test mode: FSK

Test Date: May 13, 2022
Test By: XSJ
Frequency: Channel 78: 2465 MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4927.000	V	58.25	46.72	74.00	54.00	-15.75	-7.28
7392.000	V	59.67	45.36	74.00	54.00	-14.33	-8.64
11353.00	V	54.65	40.74	74.00	54.00	-19.35	-13.26
4927.000	H	59.60	43.97	74.00	54.00	-14.40	-10.03
7392.000	H	60.79	46.64	74.00	54.00	-13.21	-7.36
10809.00	H	53.97	40.29	74.00	54.00	-20.03	-13.71

Note: (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).
(2) Emission Level= Reading Level+Correct Factor +Cable Loss.
(3) Correct Factor= Ant_F + Cab_L - Preamp
(4) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

■ Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

Temperature: 24℃ Test Date: May 13, 2022
Humidity: 55% Test By: XSJ
Test mode: FSK Frequency: Channel 0: 2410 MHz

Frequency (MHz)	Polarity H/V	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)	Over (dB)
2389.864	H	59.63	74.00	-14.37	45.92	54.00	-8.08
2389.796	V	67.19	74.00	-6.81	52.3	54.00	-1.70

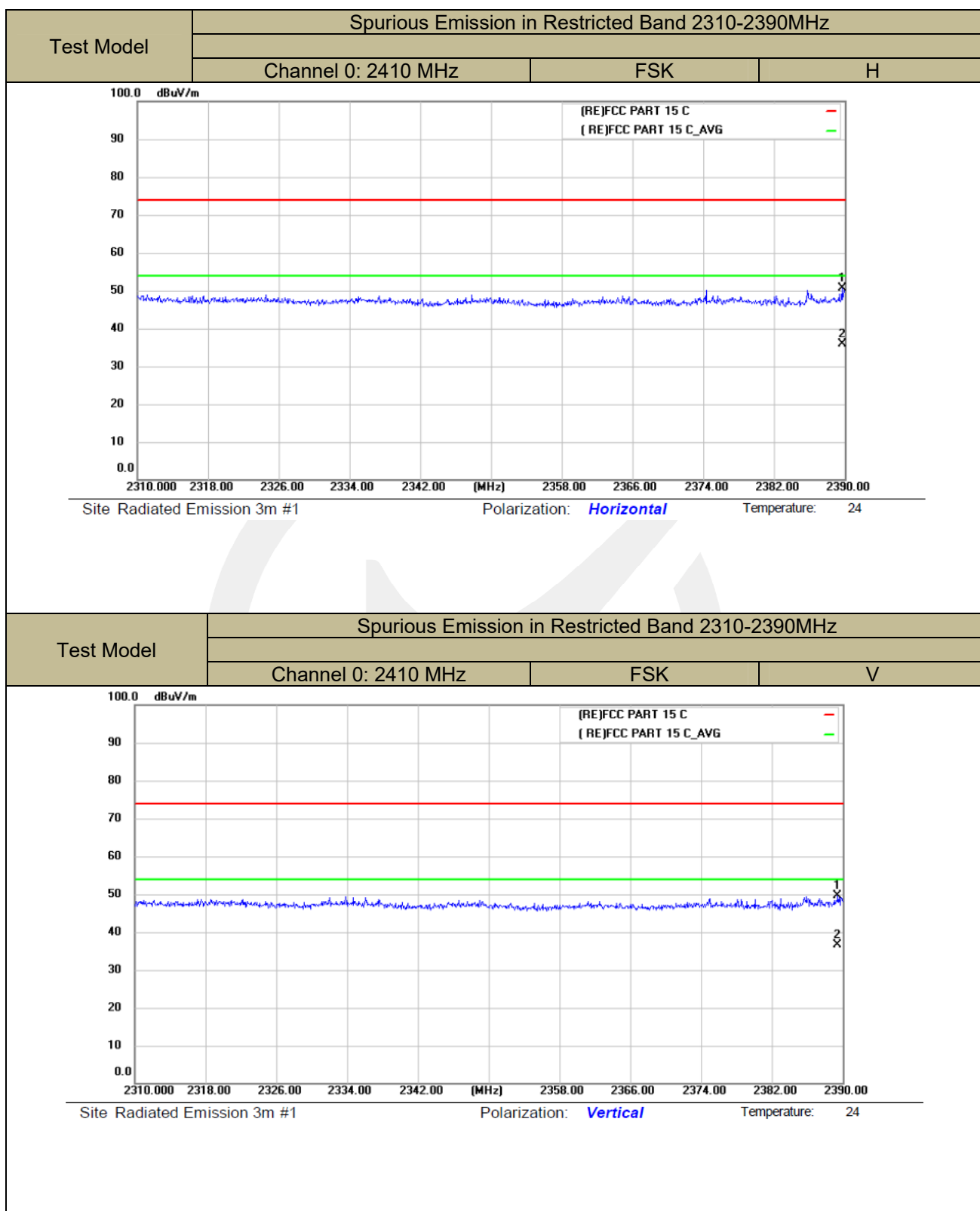
Temperature: 24℃ Test Date: May 13, 2022
Humidity: 55% Test By: XSJ
Test mode: FSK Frequency: Channel 78: 2465 MHz

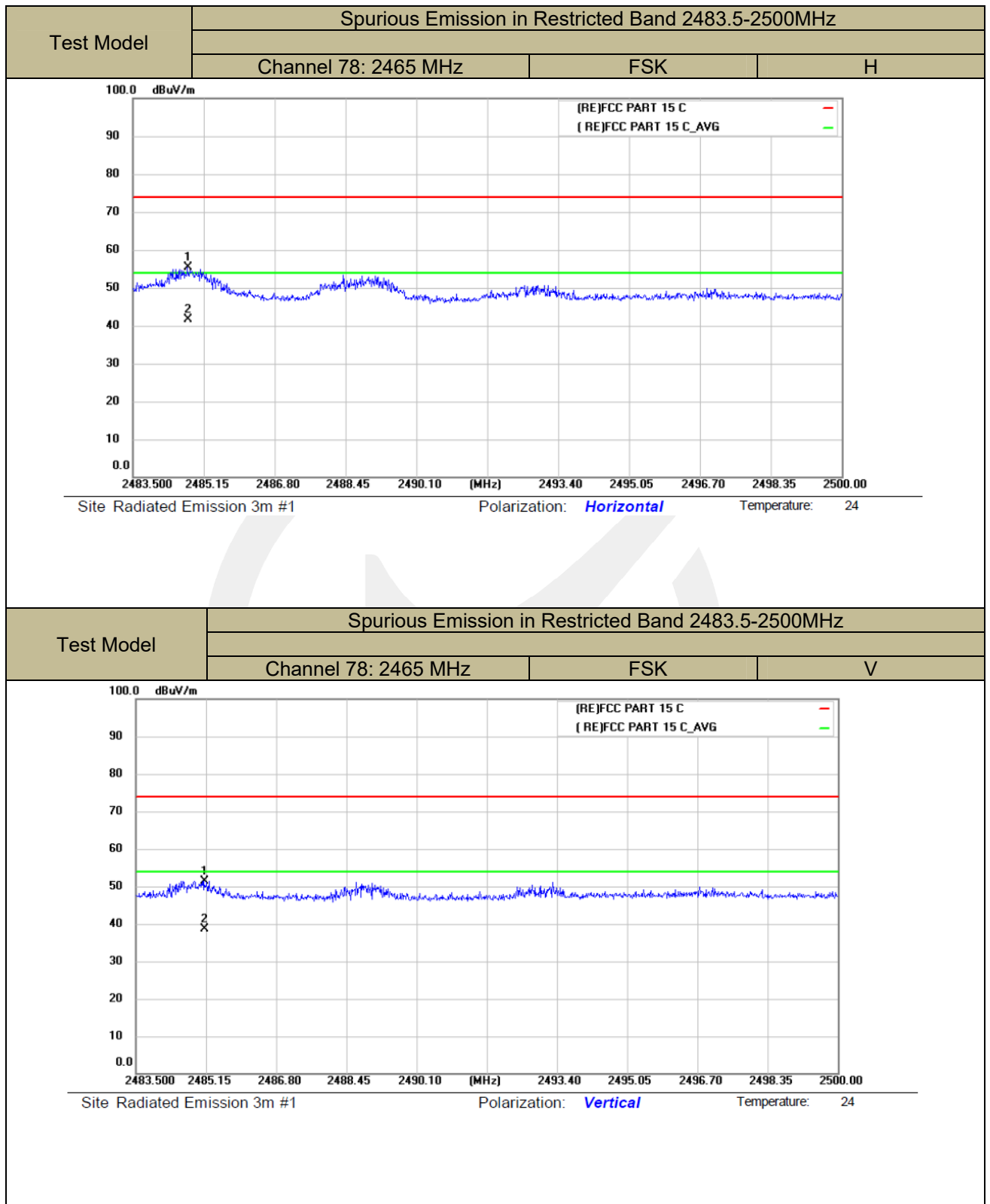
Frequency (MHz)	Polarity H/V	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)	Over (dB)
2484.771	H	55.45	74.00	-18.55	41.68	54.00	-12.32
2485.101	V	51.44	74.00	-22.56	38.74	54.00	-15.26

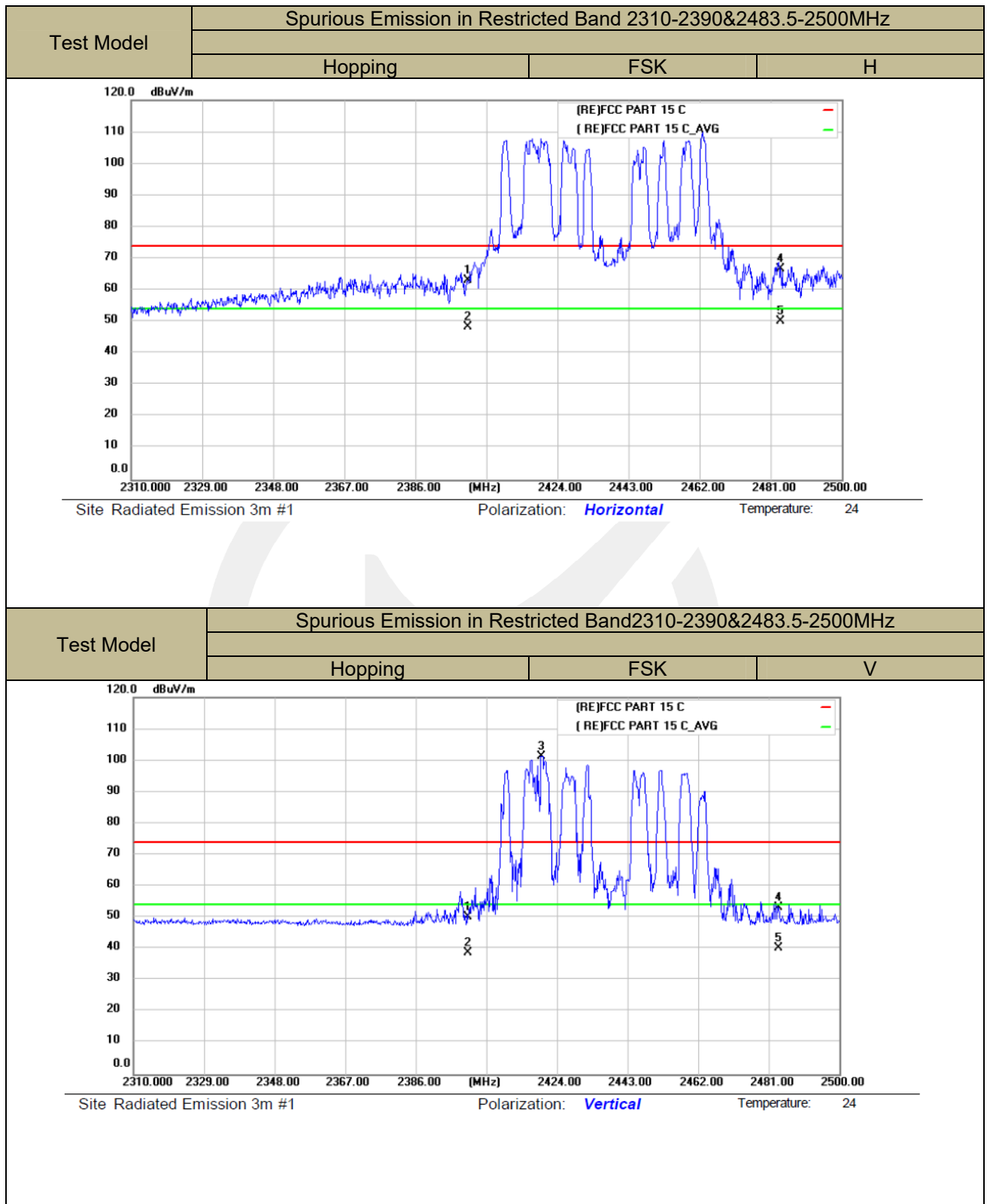
Temperature: 24℃ Test Date: May 13, 2022
Humidity: 55% Test By: XSJ
Test mode: FSK Frequency: Hopping

Frequency (MHz)	Polarity H/V	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)	Over (dB)
2400.000	H	63.23	74.00	-10.77	48.57	54.00	-5.43
2483.500	H	66.83	74.00	-7.17	50.24	54.00	-3.76
2400.000	V	50.34	74.00	-23.66	38.74	54.00	-15.26
2483.500	V	53.16	74.00	-20.84	40.22	54.00	-13.78

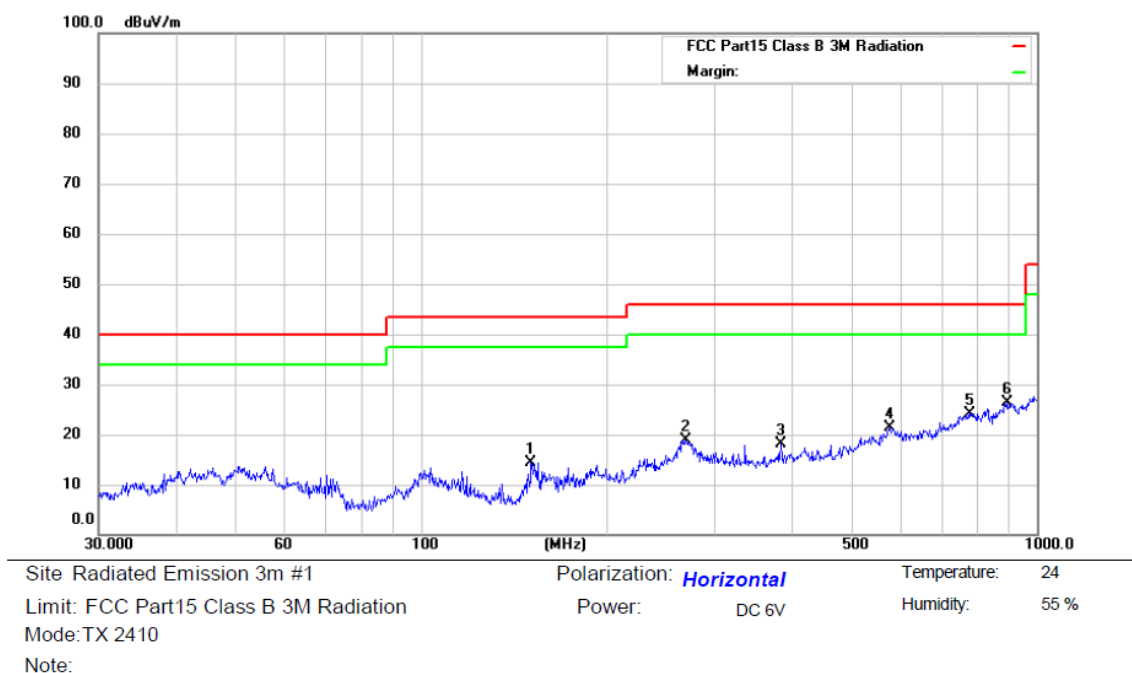
- Note:** (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).
(2) Emission Level= Reading Level+Correct Factor +Cable Loss.
(3) Correct Factor= Ant_F + Cab_L - Preamp
(4) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.



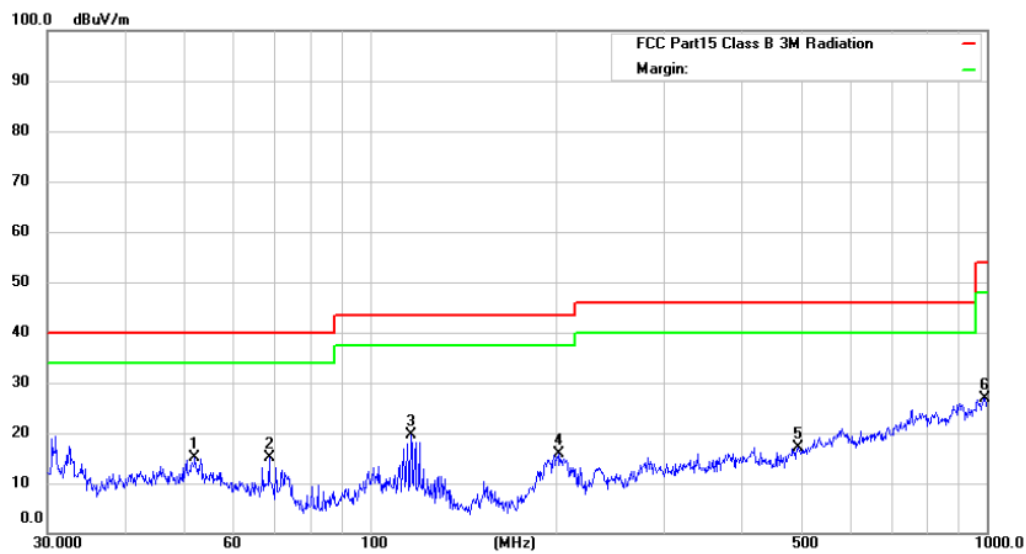




■ Spurious Emission below 1GHz(30MHz to 1GHz)



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		151.0665	40.90	-26.40	14.50	43.50	-29.00	QP		
2		269.4282	40.43	-21.53	18.90	46.00	-27.10	QP		
3		383.9318	36.33	-18.13	18.20	46.00	-27.80	QP		
4		576.6443	34.35	-13.05	21.30	46.00	-24.70	QP		
5		776.8778	33.86	-9.66	24.20	46.00	-21.80	QP		
6	*	893.8566	34.83	-8.43	26.40	46.00	-19.60	QP		



Site Radiated Emission 3m #1

Polarization: **Vertical**

Temperature: 24

Limit: FCC Part15 Class B 3M Radiation

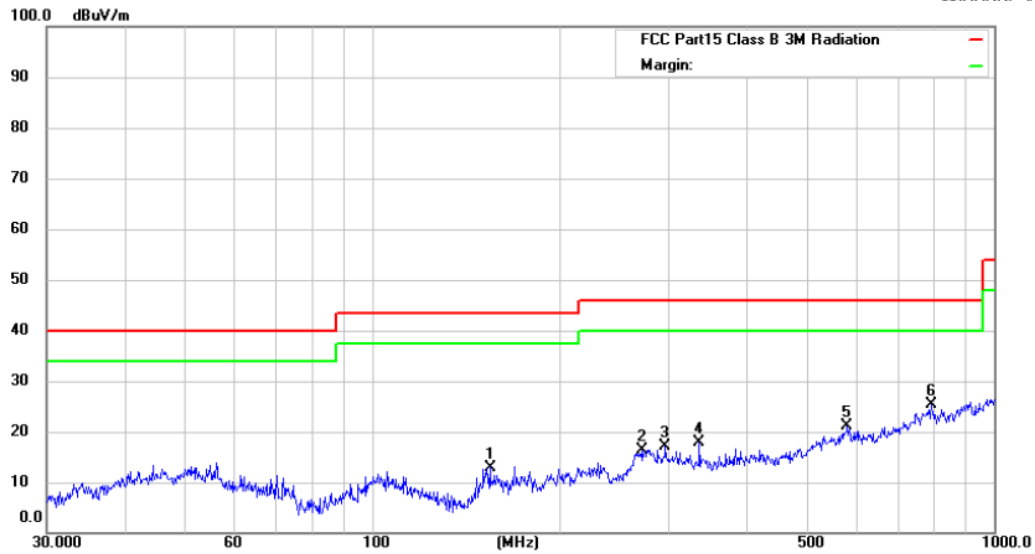
Power: DC 6V

Humidity: 55 %

Mode: TX 2410

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		52.0251	36.22	-21.02	15.20	40.00	-24.80	QP		
2		68.6310	40.38	-25.18	15.20	40.00	-24.80	QP		
3	*	116.5400	44.02	-24.42	19.60	43.50	-23.90	QP		
4		202.1004	39.54	-23.74	15.80	43.50	-27.70	QP		
5		494.1984	33.58	-16.38	17.20	46.00	-28.80	QP		
6		993.0114	33.61	-6.81	26.80	54.00	-27.20	QP		



Site Radiated Emission 3m #1

Polarization: **Horizontal**

Temperature: 24

Limit: FCC Part15 Class B 3M Radiation

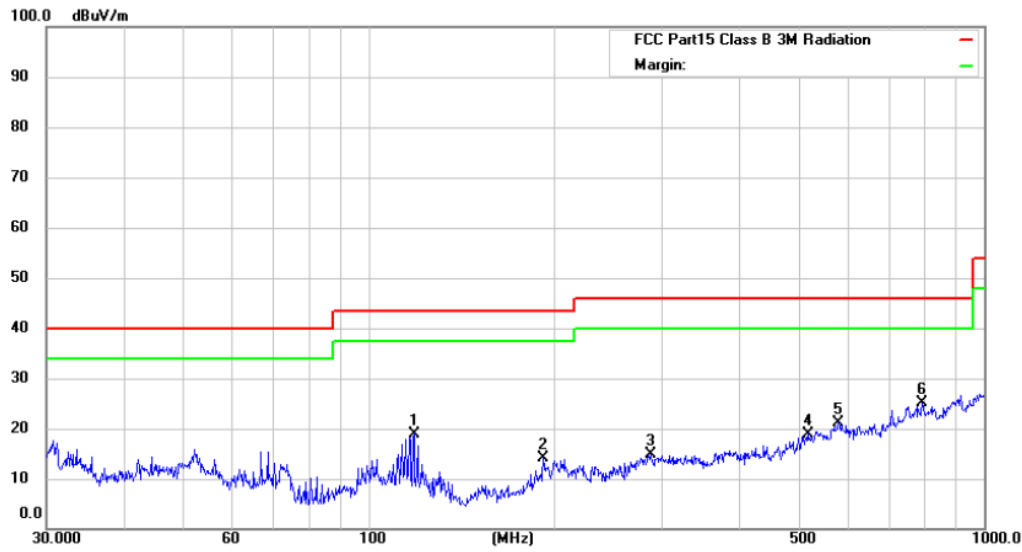
Power: DC 6V

Humidity: 55 %

Mode: TX 2438

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		154.8204	39.98	-26.98	13.00	43.50	-30.50	QP		
2		271.3245	37.57	-21.27	16.30	46.00	-29.70	QP		
3		296.1836	37.30	-20.20	17.10	46.00	-28.90	QP		
4		336.0351	36.94	-19.04	17.90	46.00	-28.10	QP		
5		580.7026	34.06	-12.86	21.20	46.00	-24.80	QP		
6	*	793.3958	35.07	-9.77	25.30	46.00	-20.70	QP		



Site Radiated Emission 3m #1

Polarization: **Vertical**

Temperature: 24

Limit: FCC Part15 Class B 3M Radiation

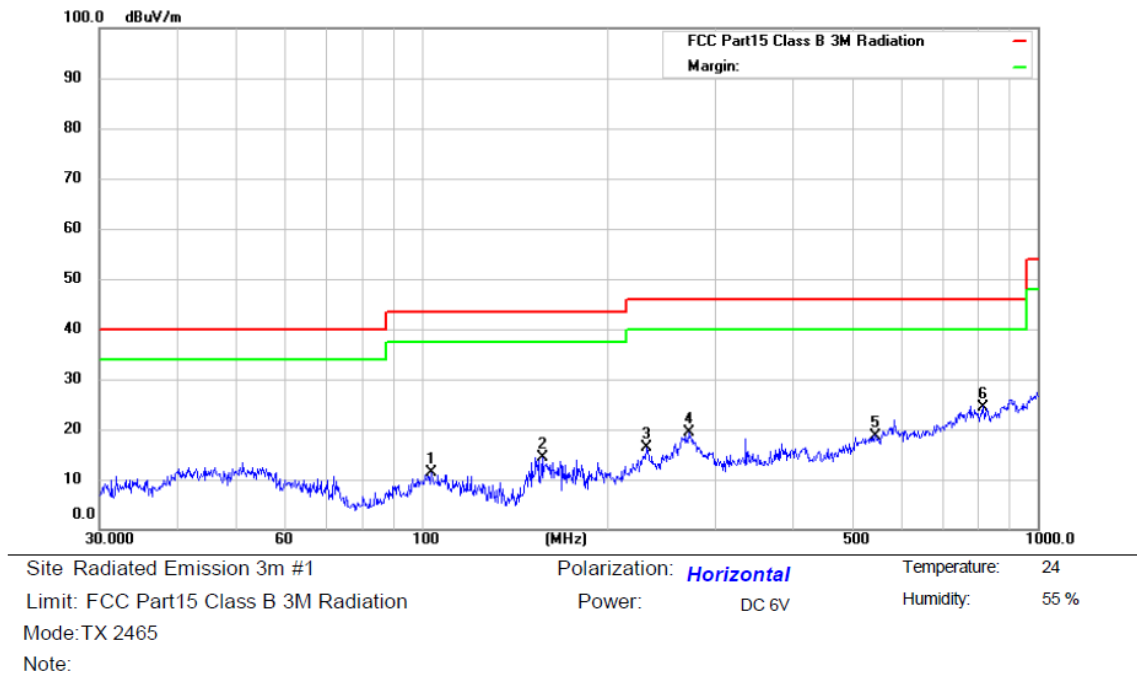
Power: DC 6V

Humidity: 55 %

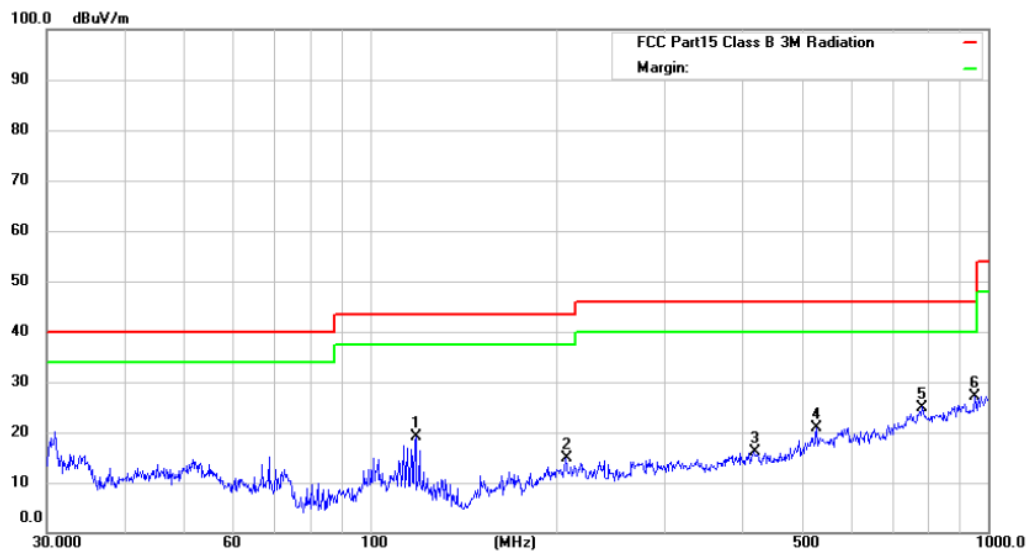
Mode: TX 2438

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		118.6013	43.82	-24.82	19.00	43.50	-24.50	QP		
2		192.4185	37.51	-23.31	14.20	43.50	-29.30	QP		
3		286.9823	35.43	-20.53	14.90	46.00	-31.10	QP		
4		517.2479	33.97	-14.97	19.00	46.00	-27.00	QP		
5		578.6700	34.12	-12.92	21.20	46.00	-24.80	QP		
6	*	793.3958	34.87	-9.77	25.10	46.00	-20.90	QP		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		103.8054	33.97	-22.67	11.30	43.50	-32.20	QP		
2		157.0073	41.30	-27.00	14.30	43.50	-29.20	QP		
3		231.7178	38.88	-22.58	16.30	46.00	-29.70	QP		
4		271.3245	40.57	-21.27	19.30	46.00	-26.70	QP		
5		545.1825	33.30	-14.60	18.70	46.00	-27.30	QP		
6	*	815.9678	34.32	-9.82	24.50	46.00	-21.50	QP		



Site Radiated Emission 3m #1

Polarization: **Vertical**

Temperature: 24

Limit: FCC Part15 Class B 3M Radiation

Power: DC 6V

Humidity: 55 %

Mode: TX 2465

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		118.6014	44.02	-24.82	19.20	43.50	-24.30	QP		
2		207.1226	38.50	-23.70	14.80	43.50	-28.70	QP		
3		417.6411	34.08	-17.98	16.10	46.00	-29.90	QP		
4		528.2458	35.38	-14.58	20.80	46.00	-25.20	QP		
5		782.3453	34.64	-9.64	25.00	46.00	-21.00	QP		
6	*	952.0937	35.32	-8.12	27.20	46.00	-18.80	QP		

9.8 CONDUCTED EMISSION TEST

9.8.1 Applicable Standard

According to FCC Part 15.207(a)

9.8.2 Conformance Limit

Frequency(MHz)	Conducted Emission Limit	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

9.8.3 Test Configuration

Test according to clause 7.3 conducted emission test setup

9.8.4 Test Procedure

The EUT was placed on a table which is 0.1m above ground plane.
Maximum procedure was performed on the highest emissions to ensure EUT compliance.
Repeat above procedures until all frequency measured were complete.

9.8.5 Test Results

N/A.

This product is powered by DC 6V battery.

9.9 ANTENNA APPLICATION

9.9.1 Antenna Requirement

Standard	Requirement
FCC CRF Part15.203	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

For intentional device, according to FCC 47 CFR Section 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. And according to FCC 47 CFR Section 15.247 (b), if 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 6dBi.

9.9.2 Result

Pass.

The EUT has 1 Fixed External Antenna: The Fixed External Antenna Gain is 2.0 dBi;

- Note:
- ☒ Antenna use a permanently attached antenna which is not replaceable.
 - ☐ Not using a standard antenna jack or electrical connector for antenna replacement
 - ☐ The antenna has to be professionally installed (please provide method of installation)

which in accordance to section 15.203, please refer to the internal photos.

*** End of Report ***

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