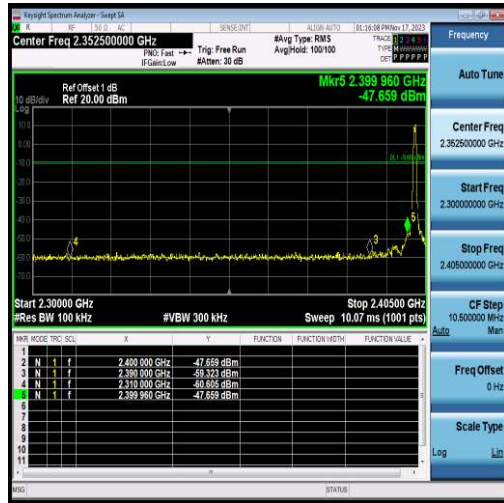
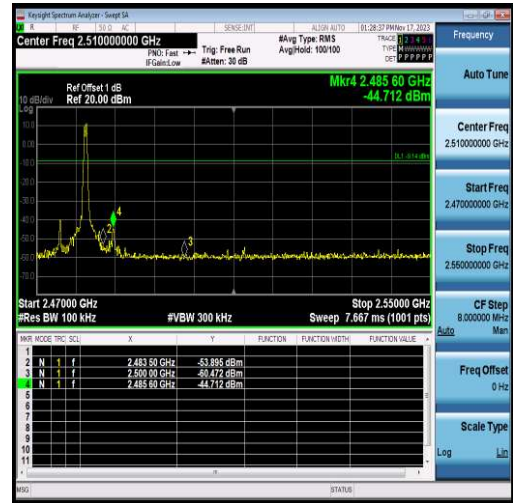


2.4GHz FSK

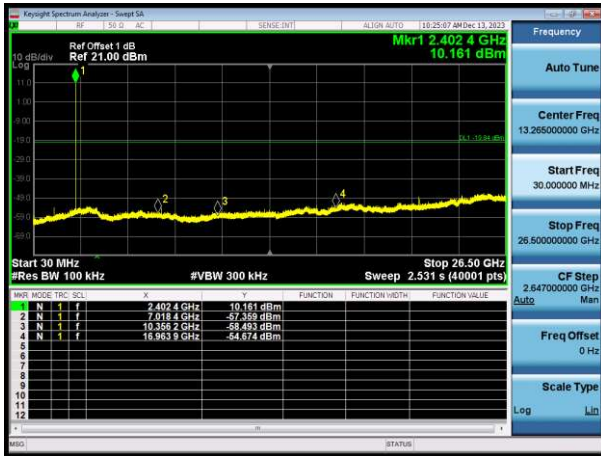
Channel00 2402MHz



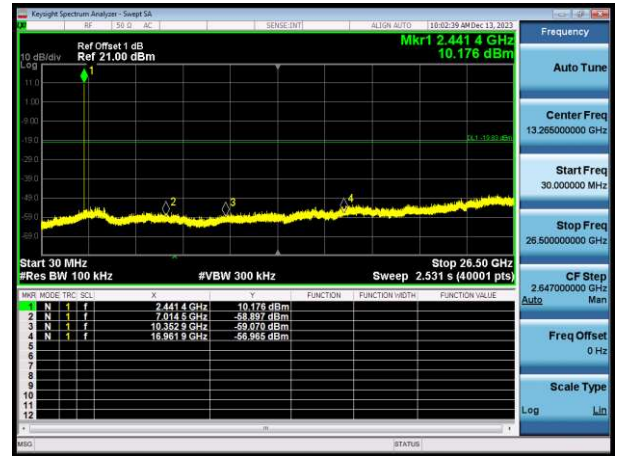
Channel78 2480MHz



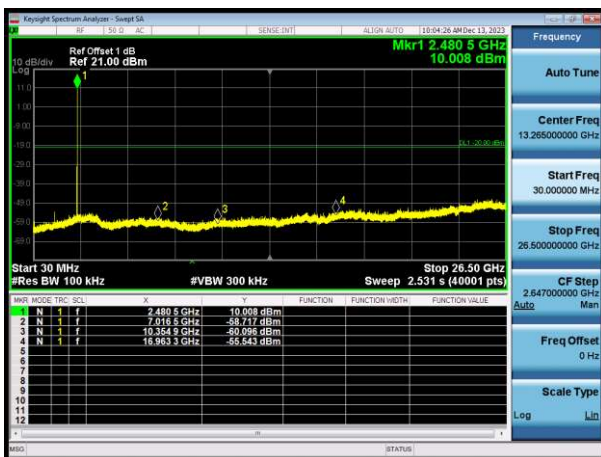
Channel00 2402MHz



Channel39 2441MHz

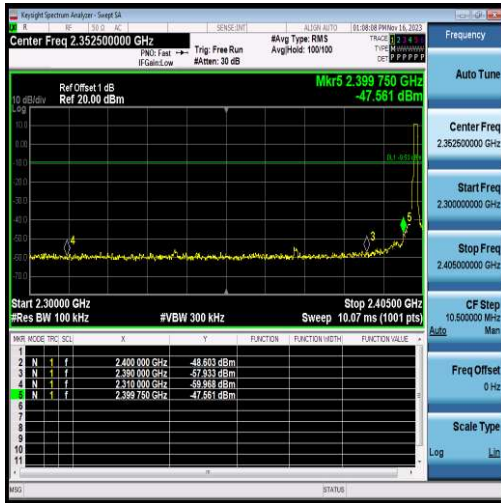


Channel78 2480MHz

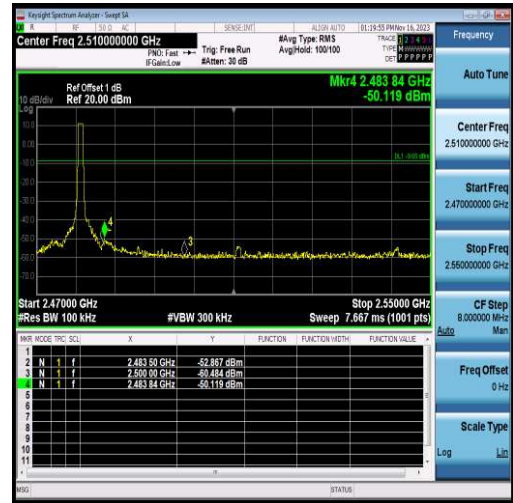


812kHz LoRa

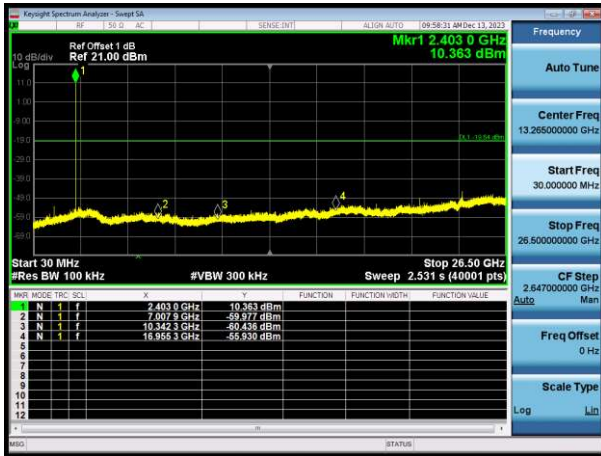
Channel00 2403MHz



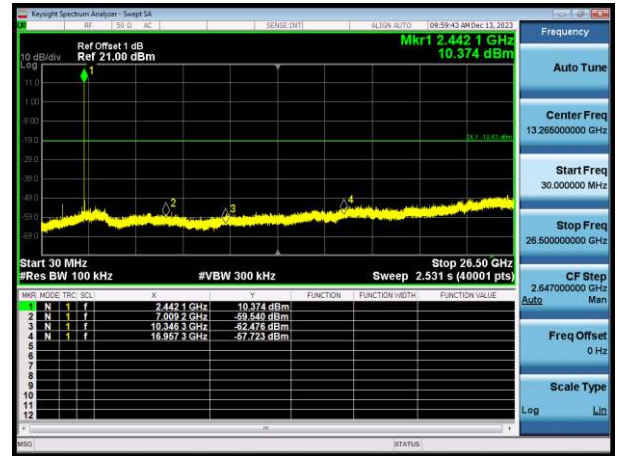
Channel76 2479MHz



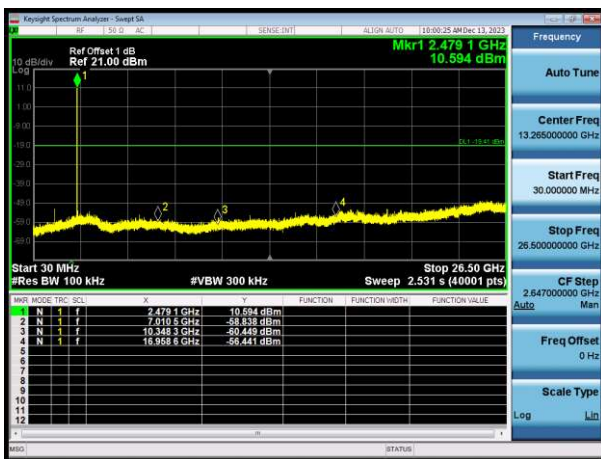
Channel00 2403MHz



Channel39 2442MHz

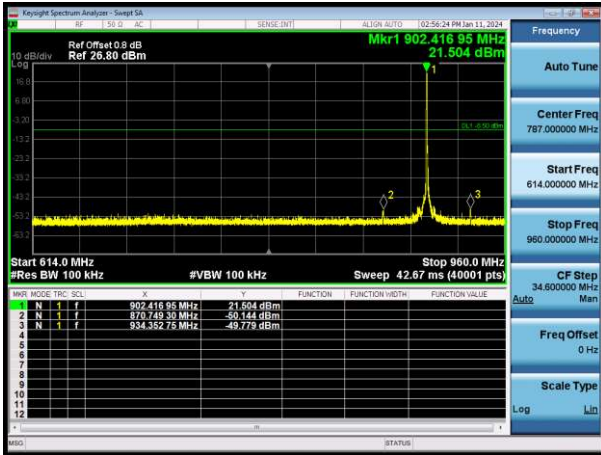


Channel76 2479MHz



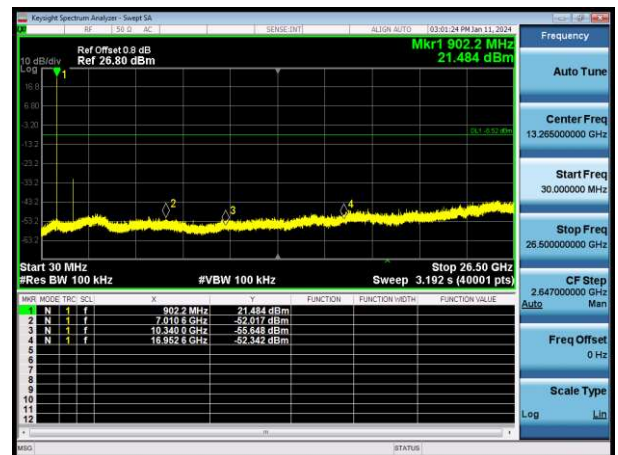
SubG CSS

Channel01 902.5

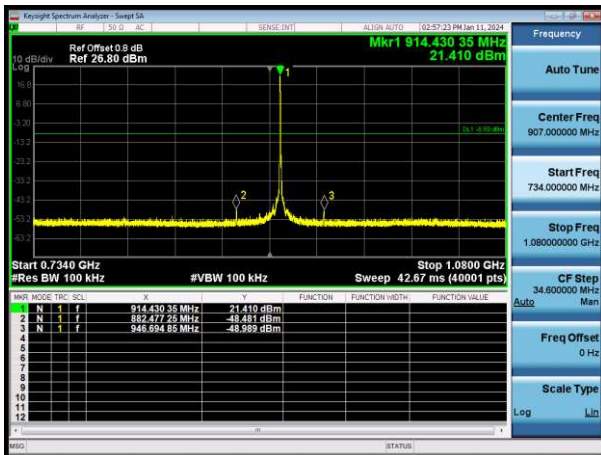


MHz

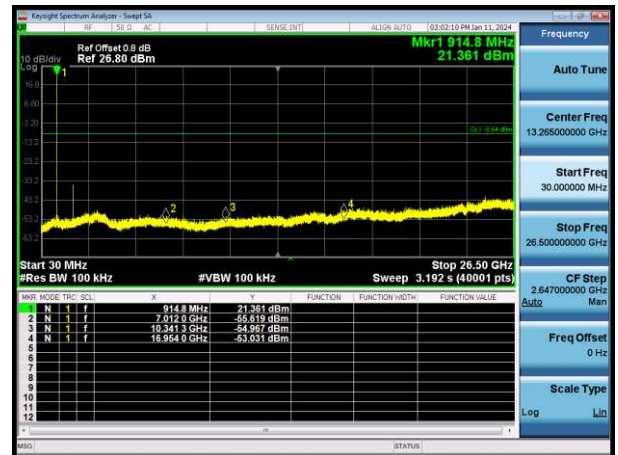
Channel01 902.5MHz



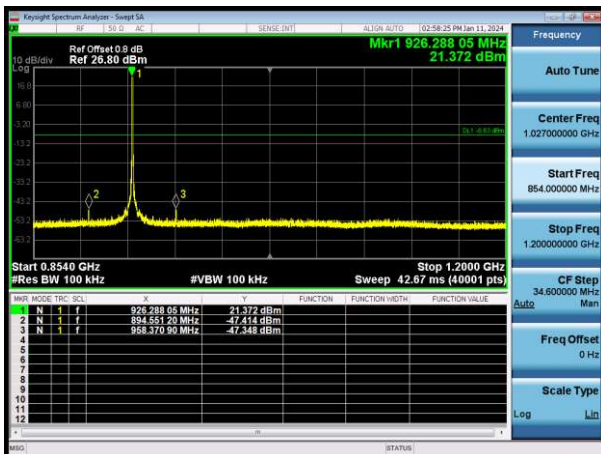
Channel16 914.5MHz



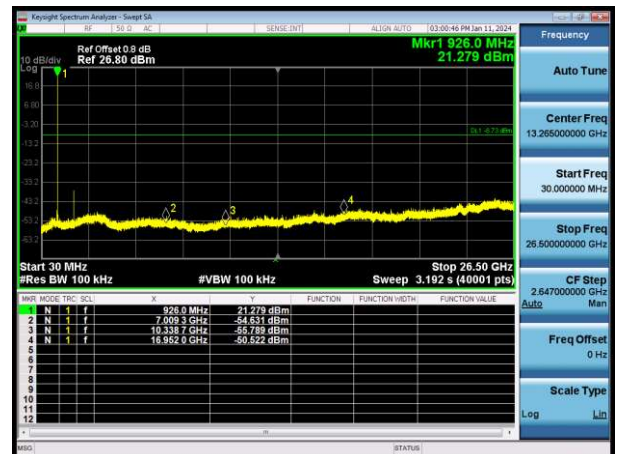
Channel16 914.5MHz



Channel31 926.5MHz

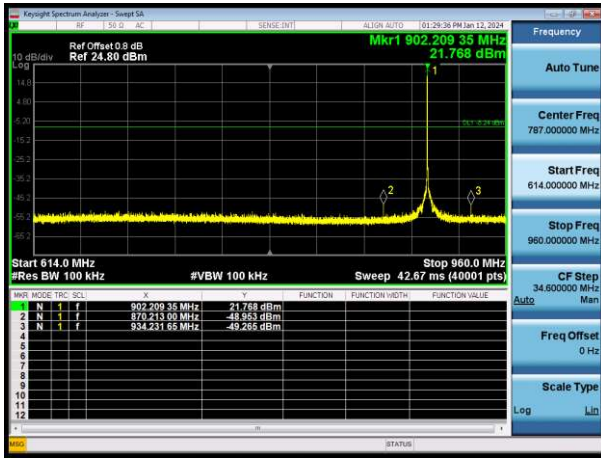


Channel31 926.5MHz

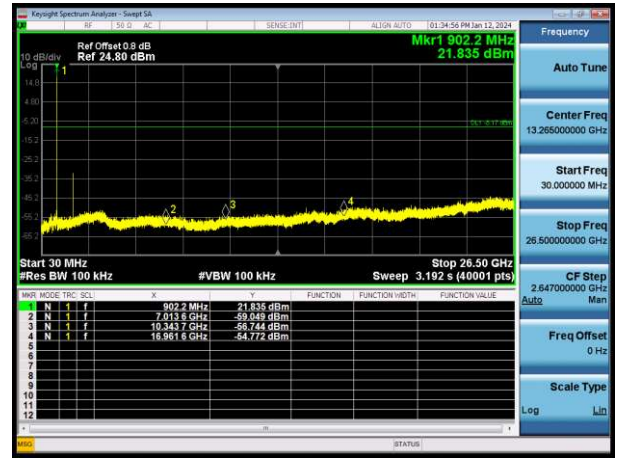


SubG FSK

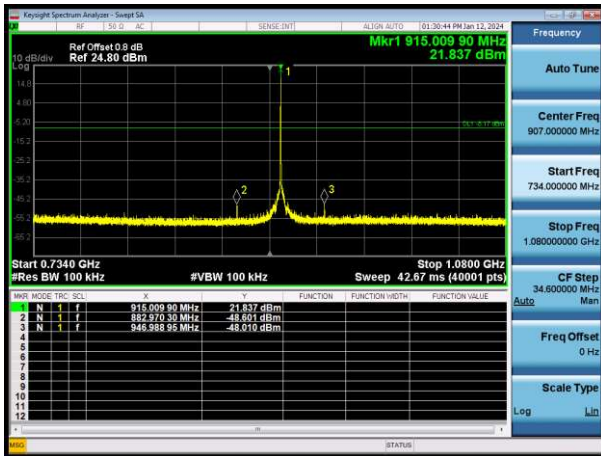
Channel01 902.2MHz



Channel01 902.2MHz



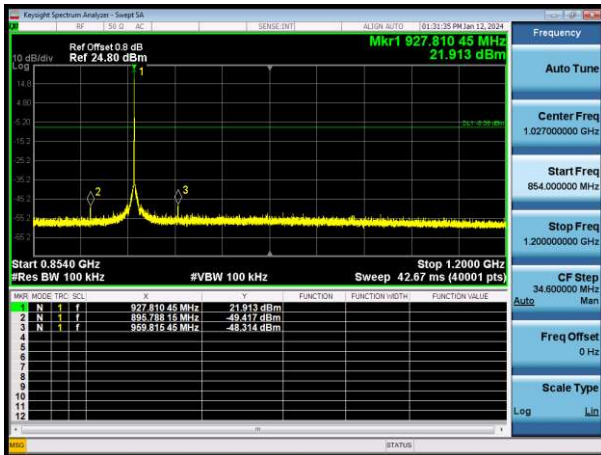
Channel65 915MHz



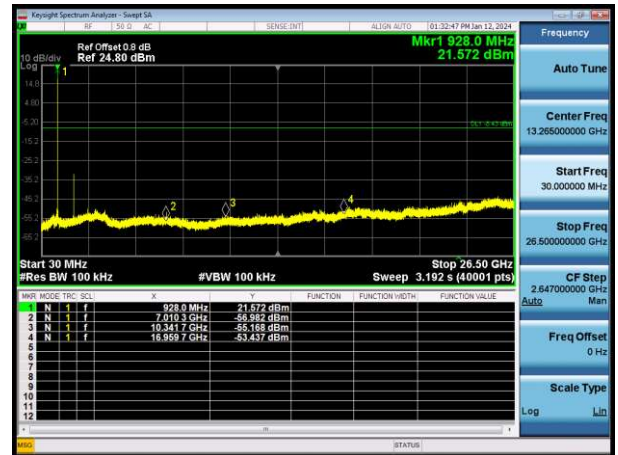
Channel65 915MHz



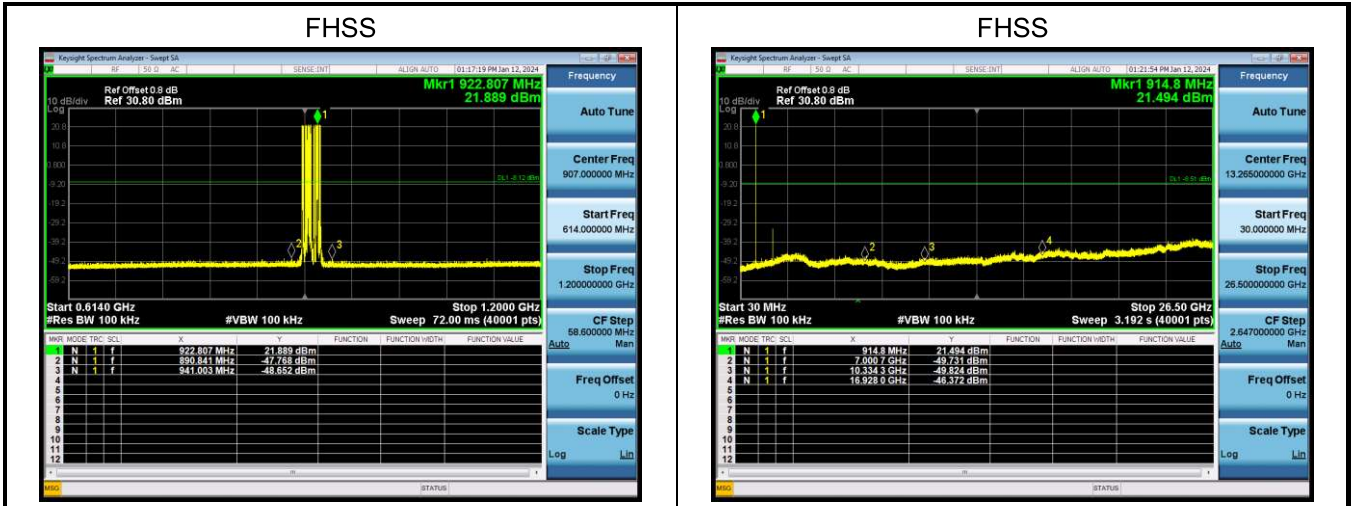
Channel129 927.8MHz



Channel129 927.8MHz







**4.4 Radiated Emission Band Edge** **VERDICT: PASS**

**4.4.1 Limit**

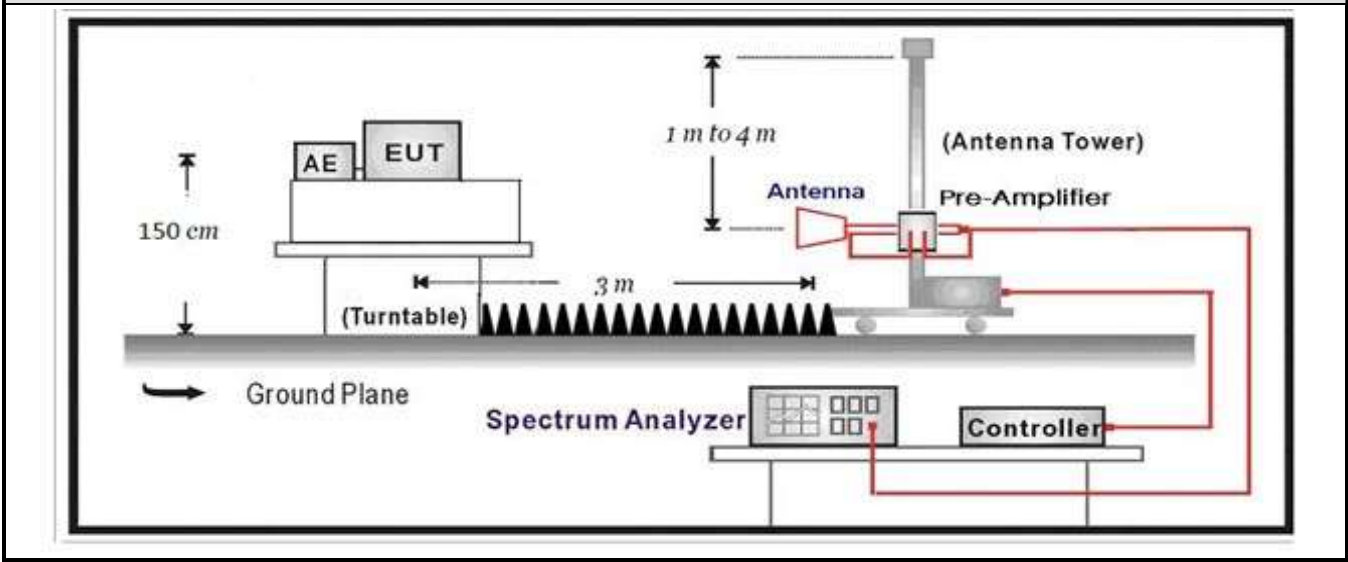
**Standard** FCC Part 15 Subpart C Paragraph 15.247(d) , 15.205, 15.209

Frequency bands (MHz)	Detector	Limit (dB $\mu$ V/m)	RBW (MHz)	Distance (m)
2310-2390	PK	74	1	3
2483.5-2500	AV	54	1	3

Note: The field strength of emissions appearing within these frequency bands shall not exceed the limits.

**4.4.2 Test Setup**

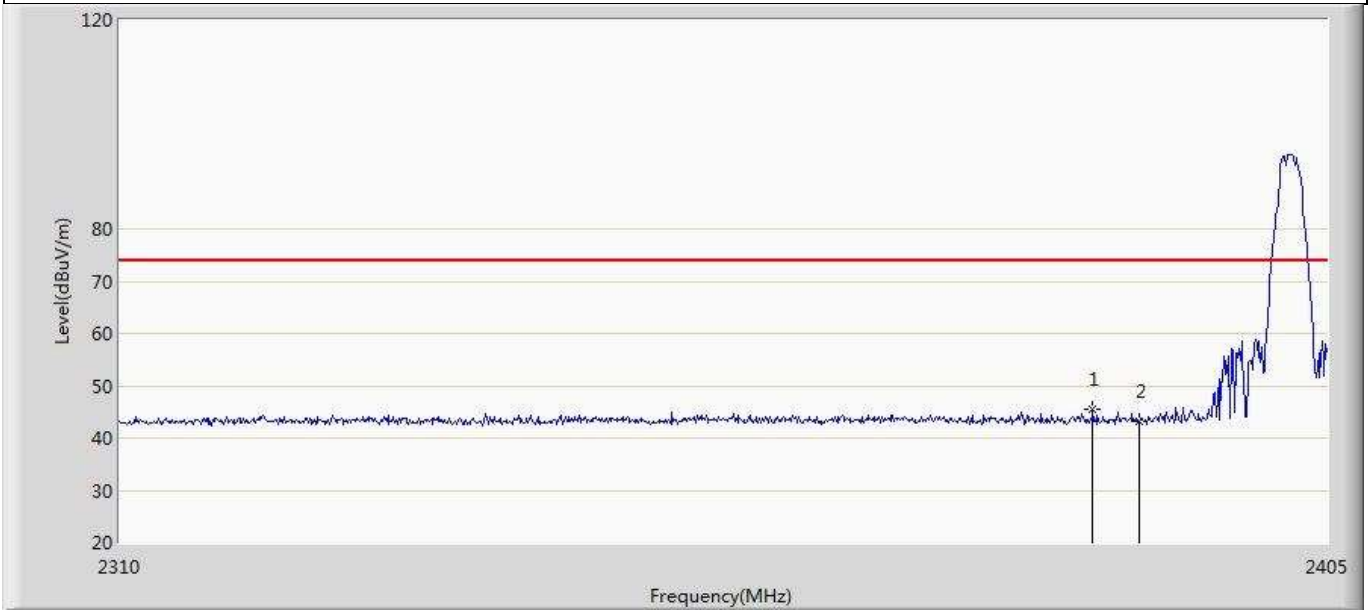
Above 1GHz Test Setup:



4.4.3 Test Procedure			
	References Rule	Chapter	Description
<input checked="" type="checkbox"/>	ANSI C63.10	6.10	Band-edge testing
	<input checked="" type="checkbox"/> ANSI C63.10	6.10.5	Restricted-band band-edge measurements
	<input type="checkbox"/> ANSI C63.10	6.10.6	Marker-delta method
<input checked="" type="checkbox"/>	ANSI C63.10	11.12	Emissions in restricted frequency bands
	<input checked="" type="checkbox"/> ANSI C63.10	11.12.1	Radiated emission measurements
	<input checked="" type="checkbox"/> ANSI C63.10	6.3	Radiated spurious emission test
<input type="checkbox"/>	ANSI C63.10	6.4	Radiated emissions from unlicensed wireless devices below 30 MHz
<input type="checkbox"/>	ANSI C63.10	6.5	Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz
<input checked="" type="checkbox"/>	ANSI C63.10	6.6	Radiated emissions from unlicensed wireless devices above 1 GHz
	<input type="checkbox"/> ANSI C63.10	11.12.2	Antenna-port conducted measurements
	<input type="checkbox"/> ANSI C63.10	11.12.2.3	Quasi-peak measurement procedure
	<input type="checkbox"/> ANSI C63.10	11.12.2.4	Peak power measurement procedure
	<input type="checkbox"/> ANSI C63.10	11.12.2.5	Average power measurement procedures
	<input type="checkbox"/> ANSI C63.10	11.12.2.5.1	Trace averaging with continuous EUT transmission at full power
	<input type="checkbox"/> ANSI C63.10	11.12.2.5.2	Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction
	<input type="checkbox"/> ANSI C63.10	11.12.2.5.3	Reduced VBW averaging across ON and OFF times of the EUT transmissions with max hold

**4.4.4 Test Data**

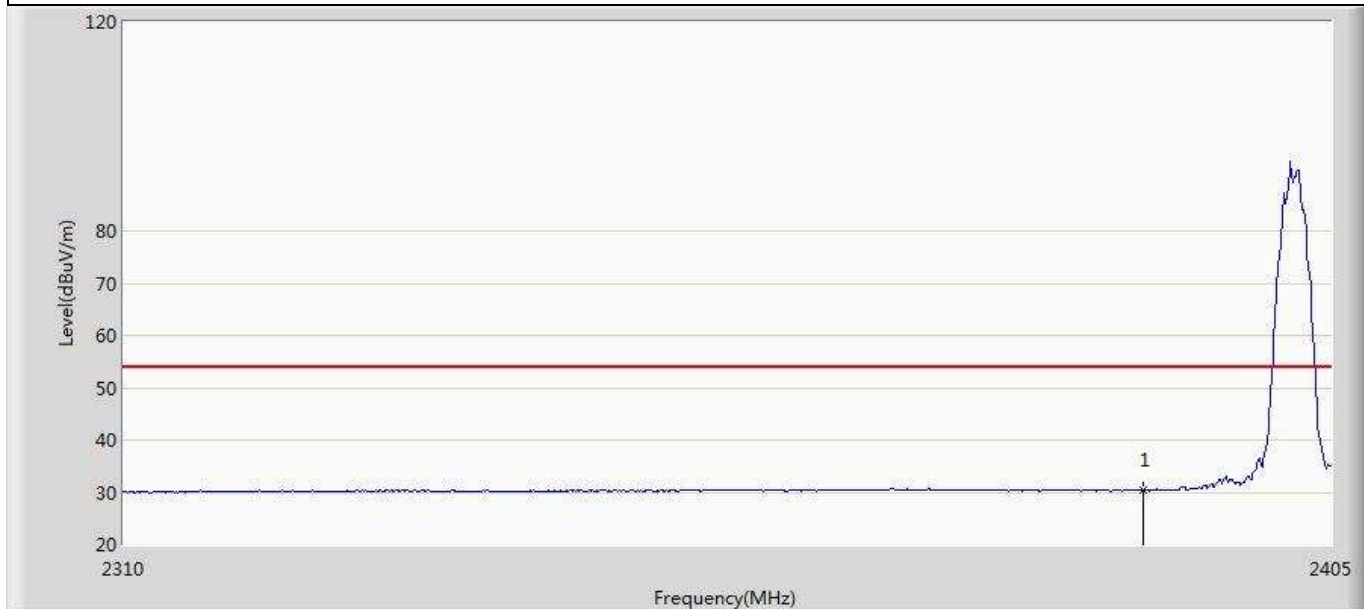
Profile: 23B0020R	Page No.: 9
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:24
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2402MHz by LoRa with 2.4GHz FSK	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2386.285	45.371	13.298	-28.629	74.000	32.073	PK
2		2390.000	43.059	10.979	-30.941	74.000	32.080	PK

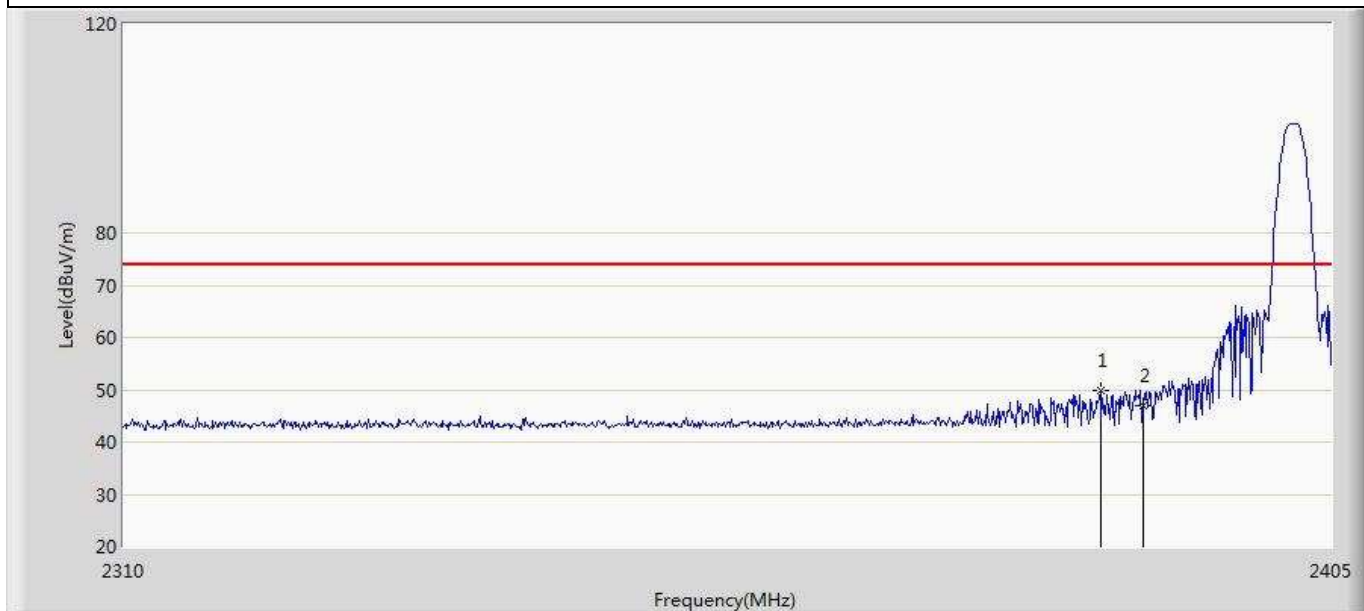


Profile: 23B0020R	Page No.: 10
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:26
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2402MHz by LoRa with 2.4GHz FSK	



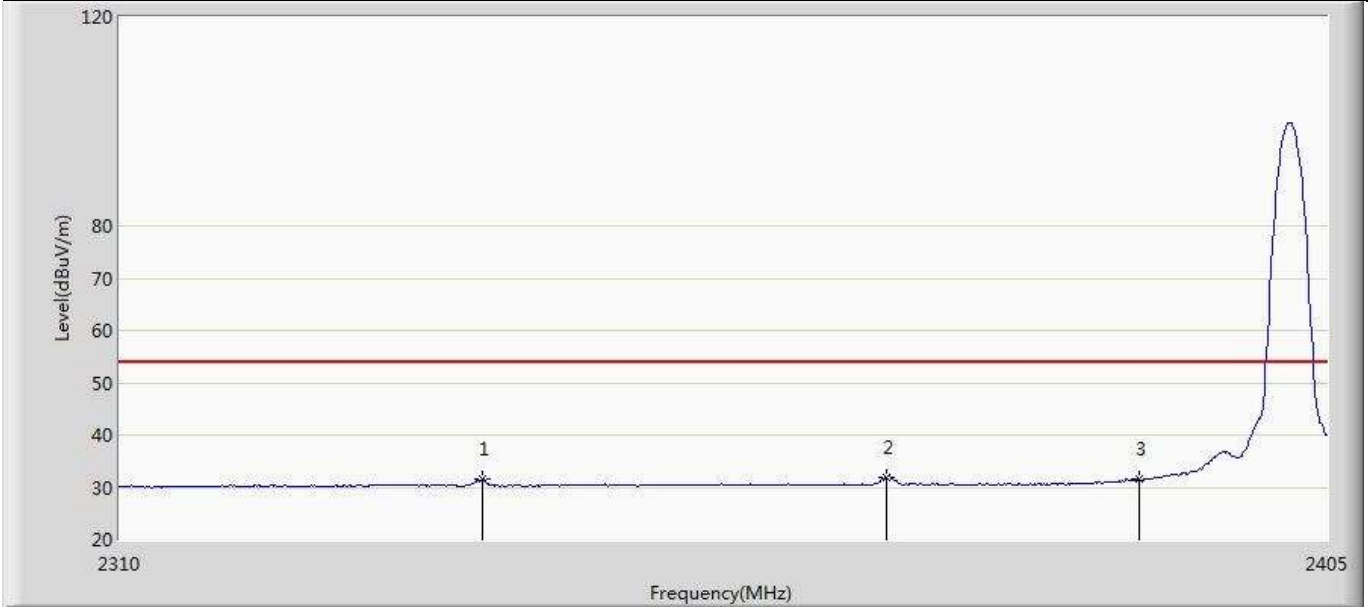
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2390.000	30.317	-1.763	-23.683	54.000	32.080	AV

Profile: 23B0020R	Page No.: 11
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:27
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2402MHz by LoRa with 2.4GHz FSK	



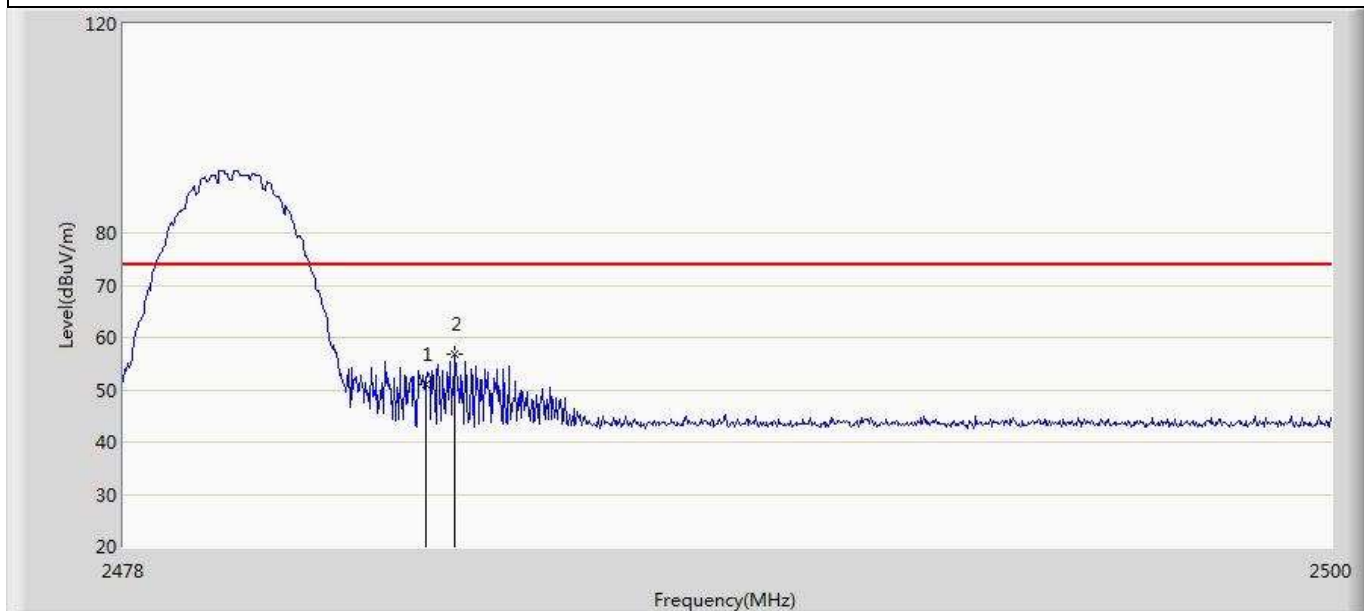
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2386.570	49.818	17.744	-24.182	74.000	32.074	PK
2		2390.000	47.057	14.977	-26.943	74.000	32.080	PK

Profile: 23B0020R	Page No.: 12
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:28
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2402MHz by LoRa with 2.4GHz FSK	



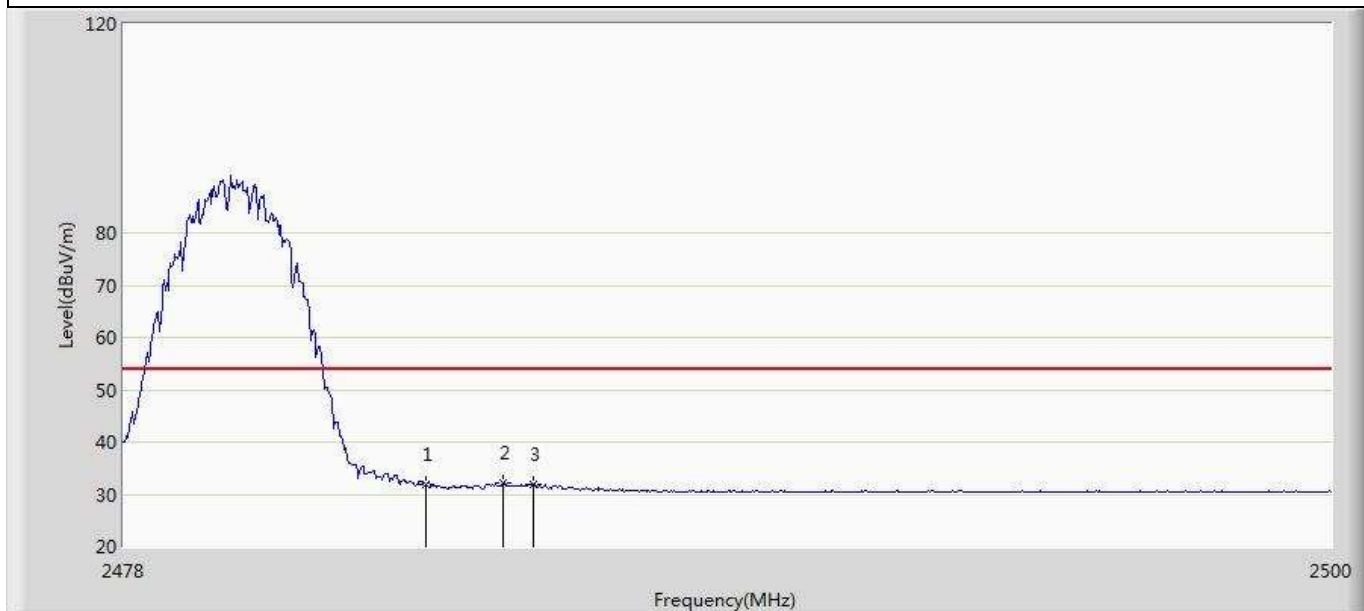
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2338.215	31.506	-0.474	-22.494	54.000	31.980	AV
2	*	2369.945	32.013	-0.028	-21.987	54.000	32.041	AV
3		2390.000	31.464	-0.616	-22.536	54.000	32.080	AV

Profile: 23B0020R	Page No.: 13
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:29
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2480MHz by LoRa with 2.4GHz FSK	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2483.500	51.143	19.013	-22.857	74.000	32.130	PK
2	*	2484.028	56.841	24.711	-17.159	74.000	32.130	PK

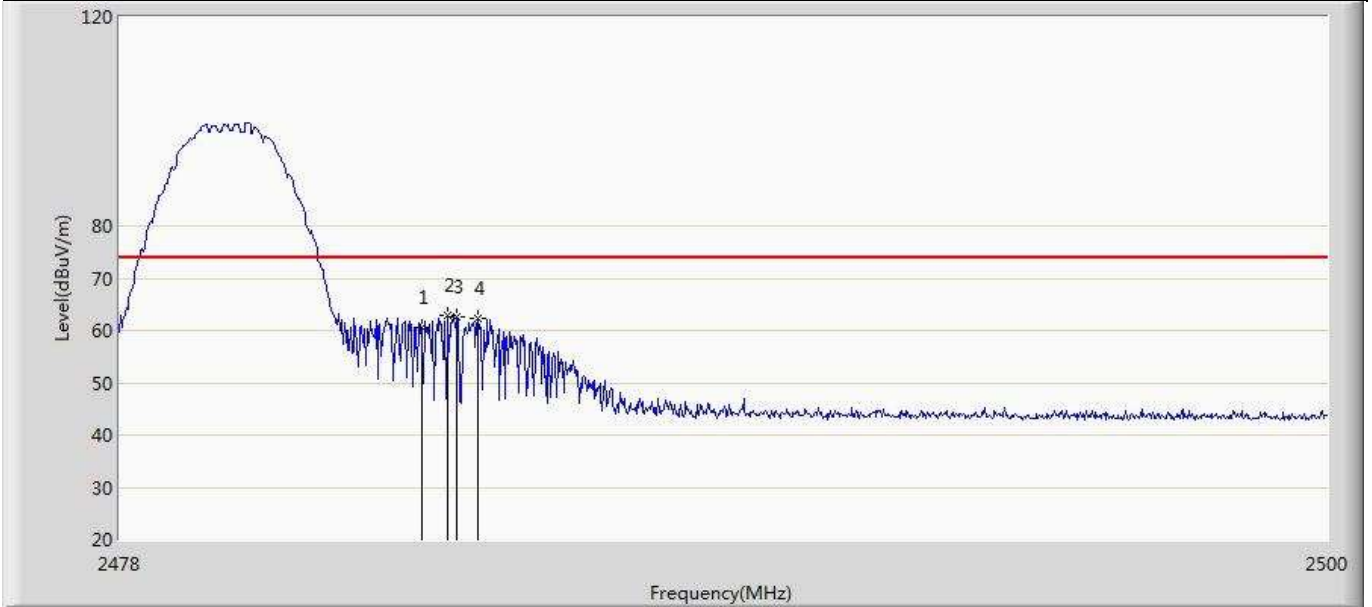
Profile: 23B0020R	Page No.: 14
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:31
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2480MHz by LoRa with 2.4GHz FSK	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2483.500	31.768	-0.362	-22.232	54.000	32.130	AV
2	*	2484.908	32.029	-0.101	-21.971	54.000	32.130	AV
3		2485.436	32.006	-0.124	-21.994	54.000	32.130	AV

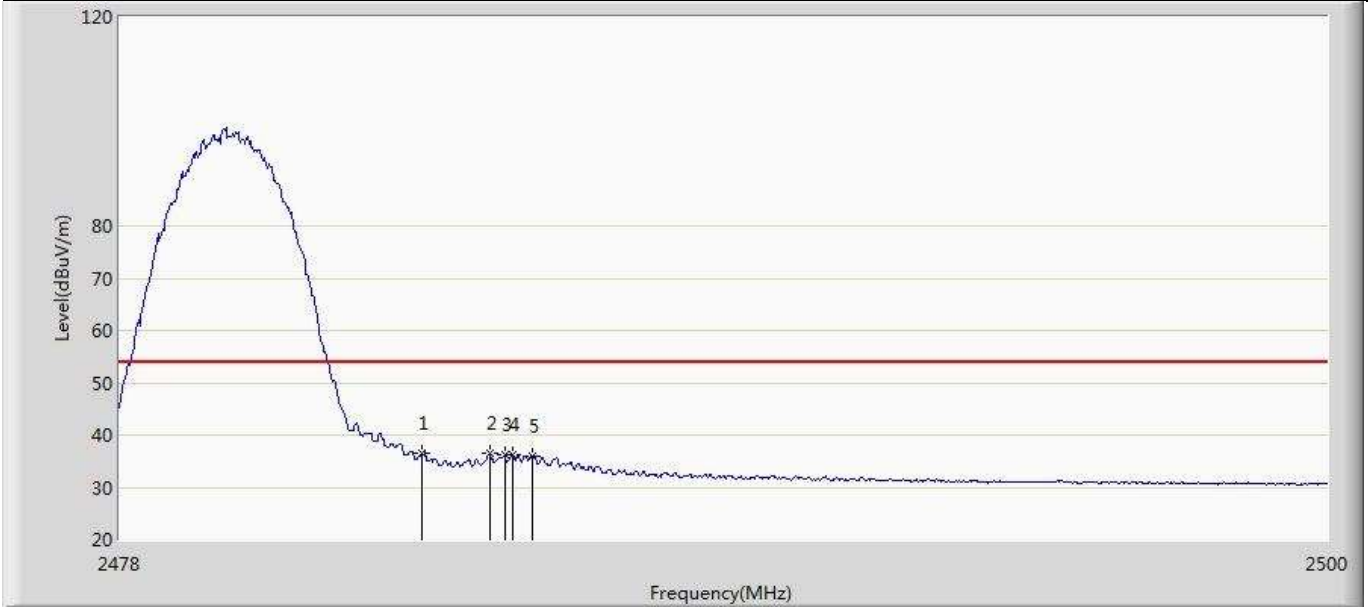


Profile: 23B0020R	Page No.: 15
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:32
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2480MHz by LoRa with 2.4GHz FSK	



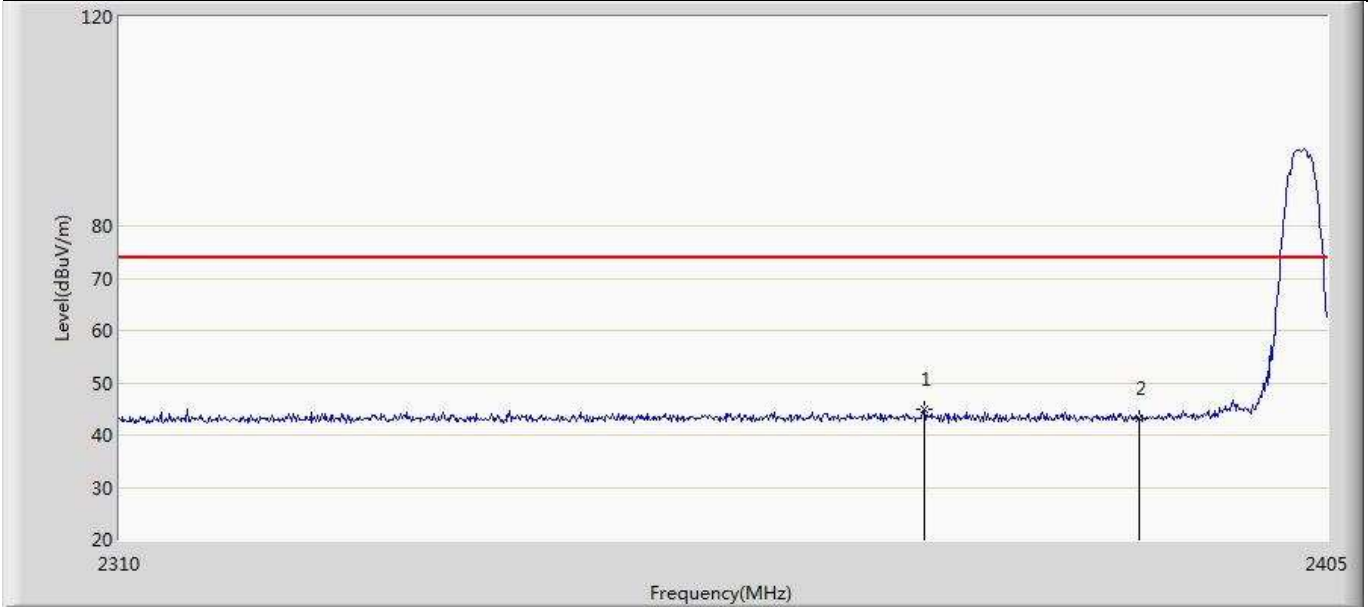
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2483.500	60.635	28.505	-13.365	74.000	32.130	PK
2	*	2483.962	62.797	30.667	-11.203	74.000	32.130	PK
3		2484.138	62.498	30.368	-11.502	74.000	32.130	PK
4		2484.512	62.393	30.263	-11.607	74.000	32.130	PK

Profile: 23B0020R	Page No.: 16
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:33
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 4:Transmit at 2480MHz by LoRa with 2.4GHz FSK	



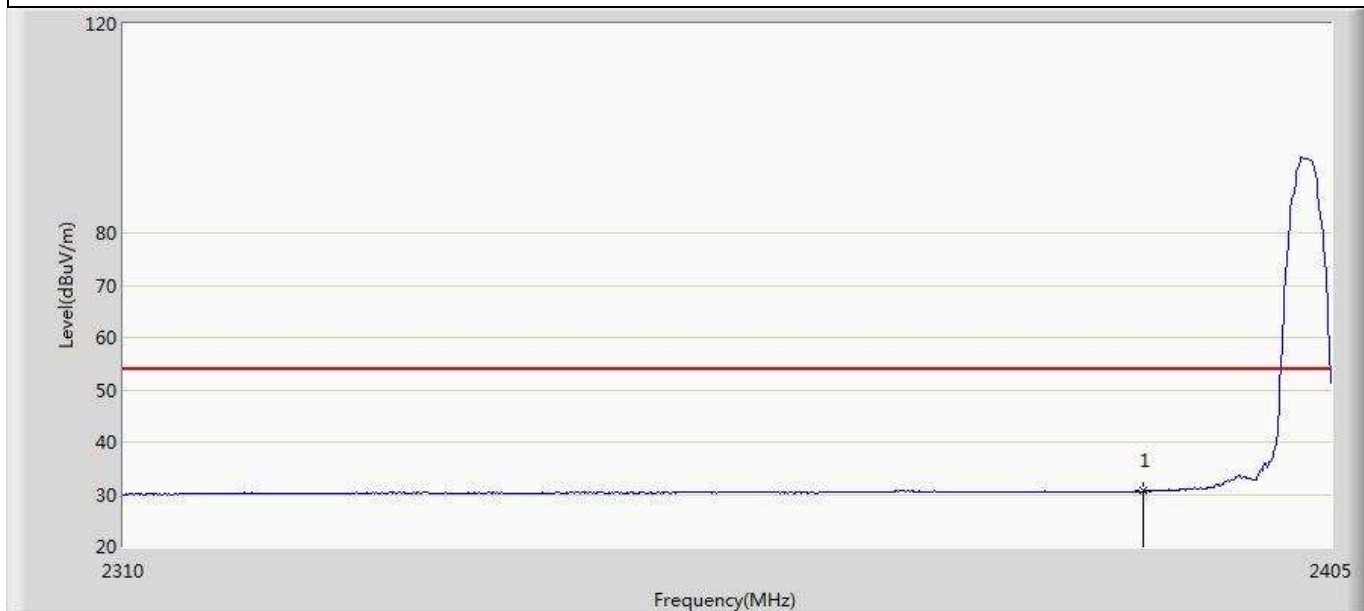
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	36.622	4.492	-17.378	54.000	32.130	AV
2		2484.732	36.476	4.346	-17.524	54.000	32.130	AV
3		2484.996	36.304	4.174	-17.696	54.000	32.130	AV
4		2485.150	36.340	4.210	-17.660	54.000	32.130	AV
5		2485.502	36.077	3.947	-17.923	54.000	32.130	AV

Profile: 23B0020R	Page No.: 1
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 00:13
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2403MHz by LoRa with 812kHz LoRa	



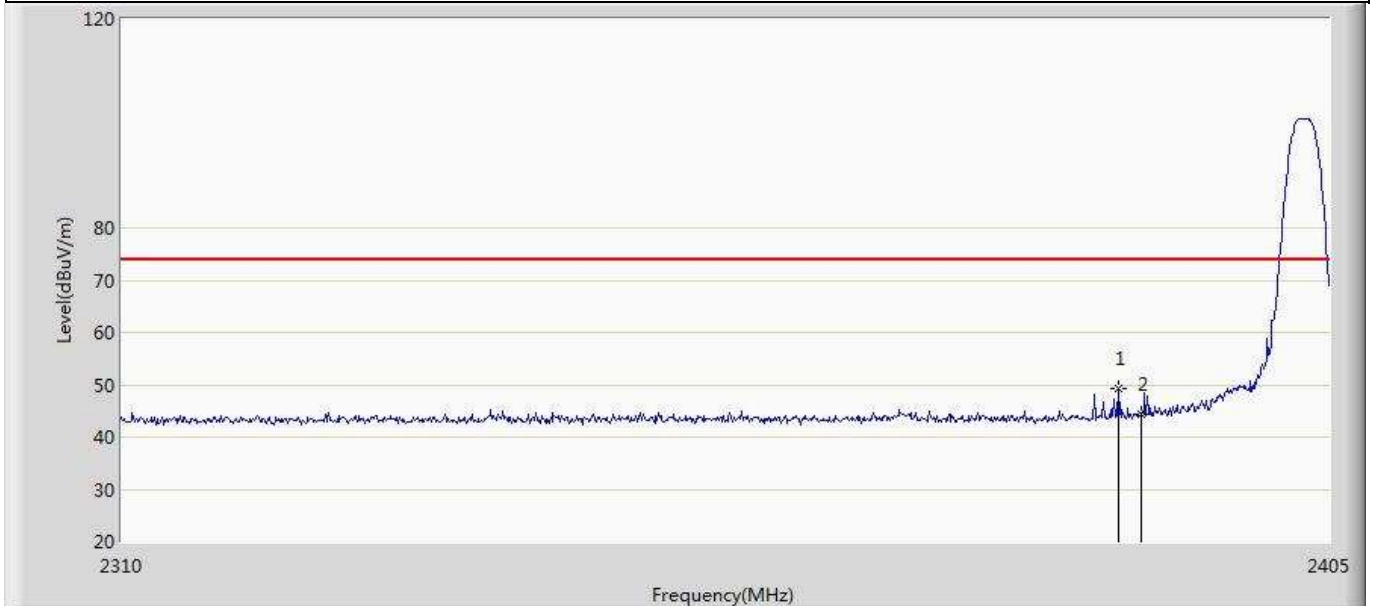
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2372.890	45.004	12.957	-28.996	74.000	32.047	PK
2		2390.000	43.101	11.021	-30.899	74.000	32.080	PK

Profile: 23B0020R	Page No.: 2
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 00:19
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2403MHz by LoRa with 812kHz LoRa	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2390.000	30.586	-1.494	-23.414	54.000	32.080	AV

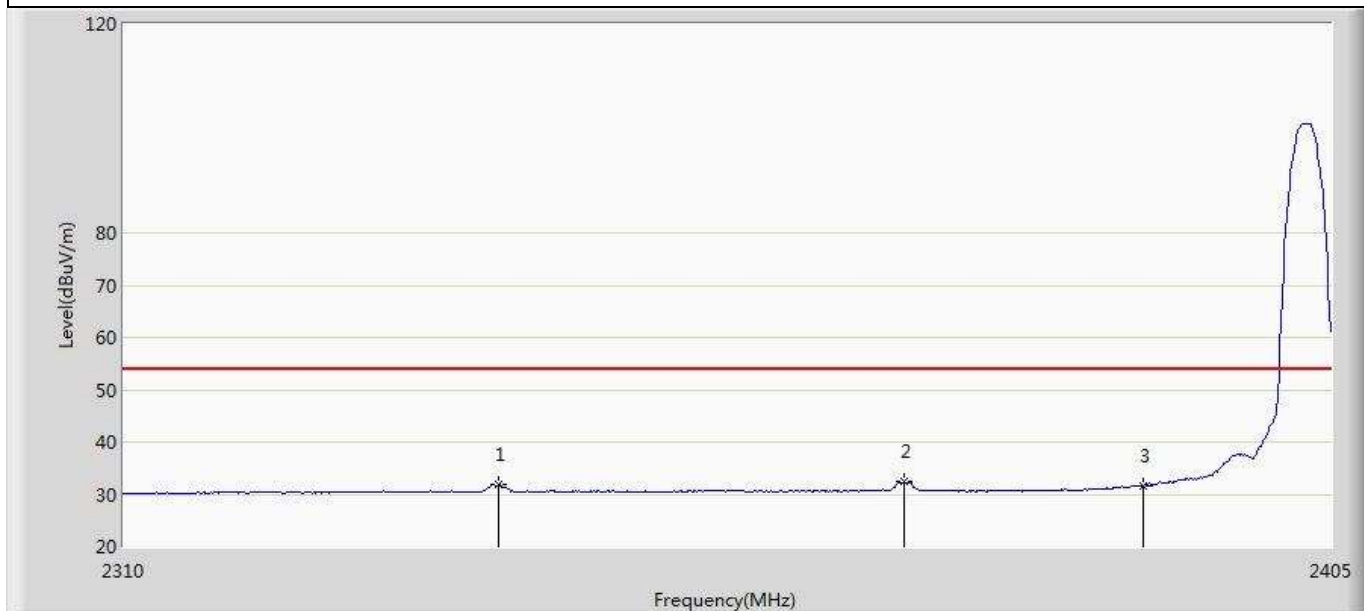
Profile: 23B0020R	Page No.: 3
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 00:20
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2403MHz by LoRa with 812kHz LoRa	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2388.185	49.243	17.166	-24.757	74.000	32.077	PK
2		2390.000	44.302	12.222	-29.698	74.000	32.080	PK

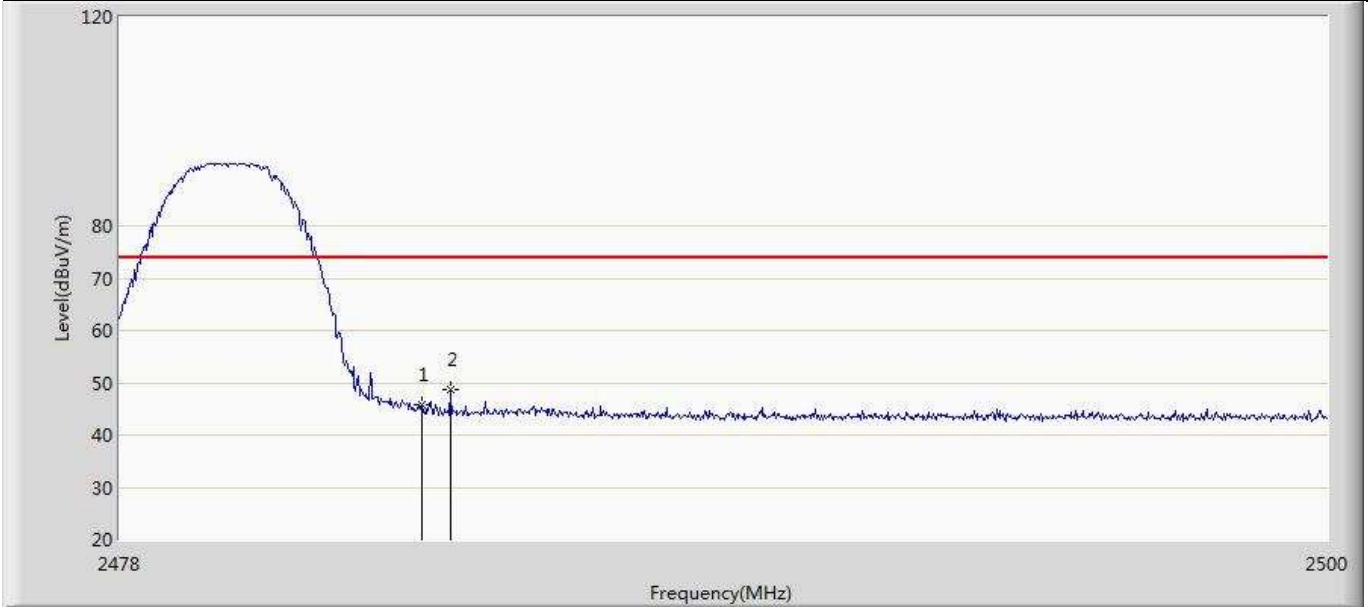


Profile: 23B0020R	Page No.: 4
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 00:21
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2403MHz by LoRa with 812kHz LoRa	



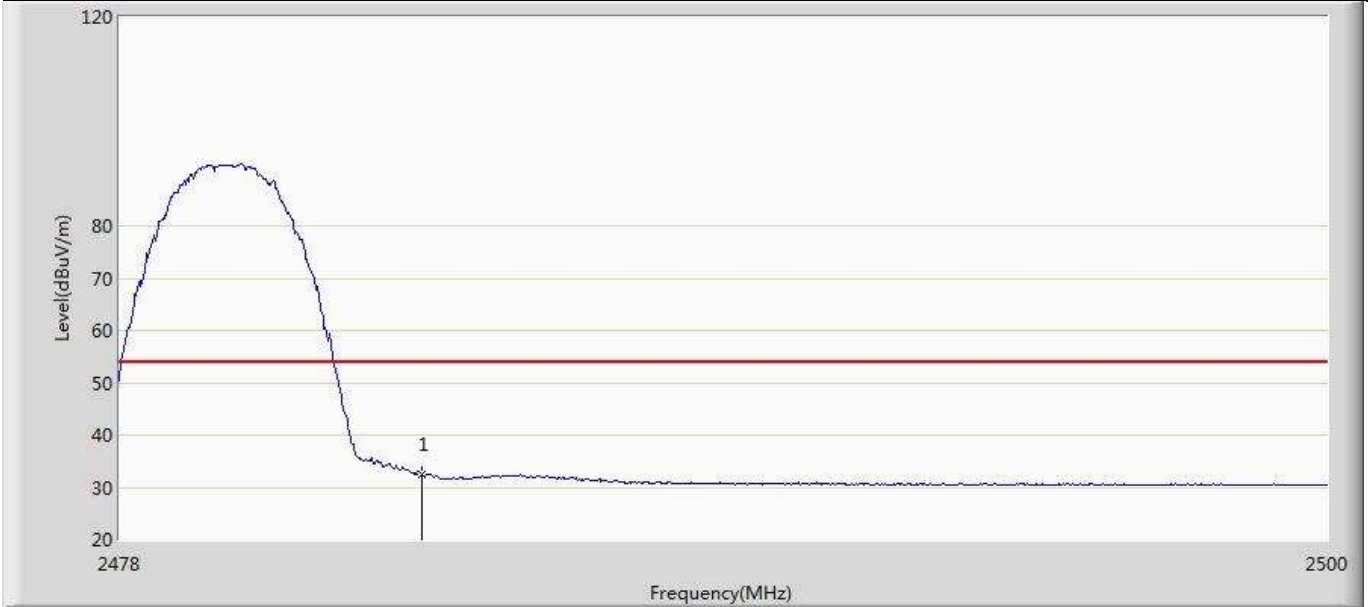
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2339.070	32.009	0.028	-21.991	54.000	31.981	AV
2	*	2370.990	32.349	0.306	-21.651	54.000	32.043	AV
3		2390.000	31.707	-0.373	-22.293	54.000	32.080	AV

Profile: 23B0020R	Page No.: 5
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:20
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2479MHz by LoRa with 812kHz LoRa	



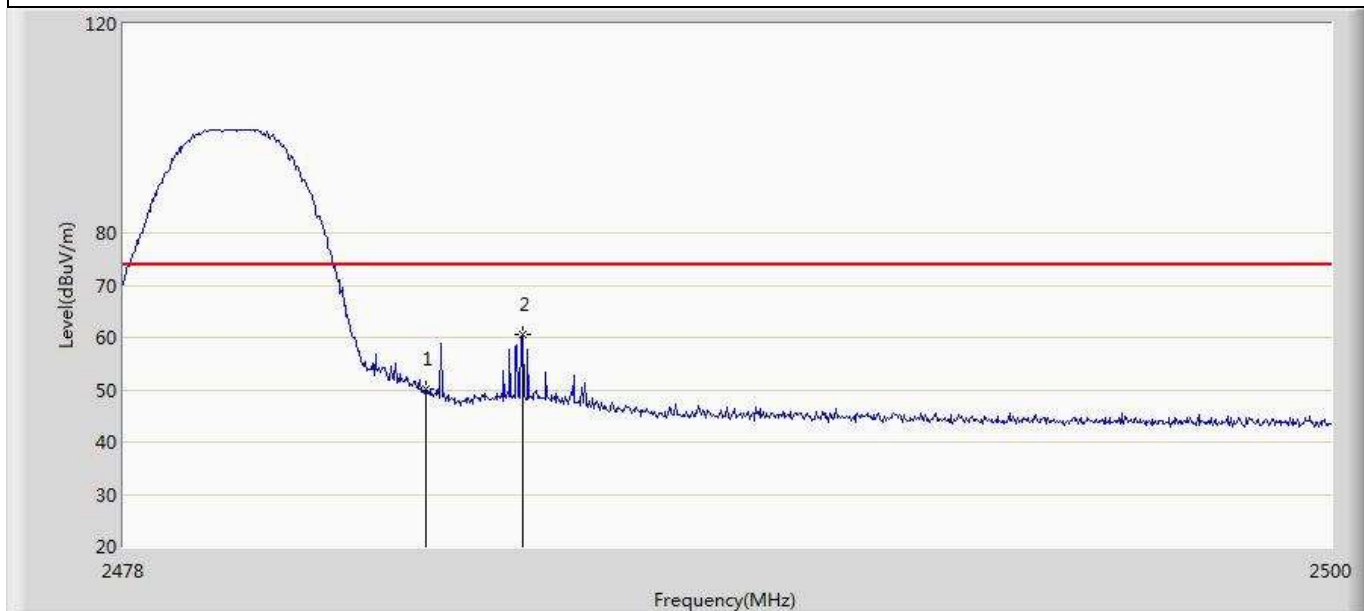
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2483.500	45.656	13.526	-28.344	74.000	32.130	PK
2	*	2484.006	48.683	16.553	-25.317	74.000	32.130	PK

Profile: 23B0020R	Page No.: 6
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:21
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Horizontal
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2479MHz by LoRa with 812kHz LoRa	



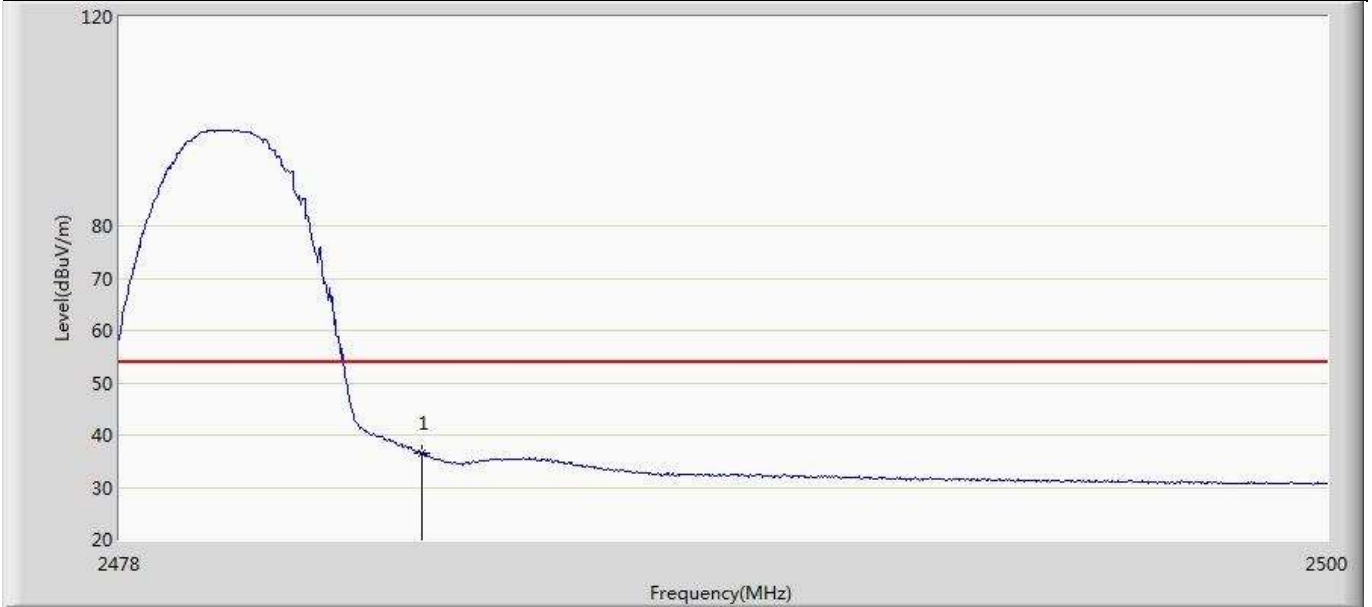
No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	32.363	0.233	-21.637	54.000	32.130	AV

Profile: 23B0020R	Page No.: 7
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:22
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2479MHz by LoRa with 812kHz LoRa	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		2483.500	50.013	17.883	-23.987	74.000	32.130	PK
2	*	2485.260	60.723	28.593	-13.277	74.000	32.130	PK

Profile: 23B0020R	Page No.: 8
Engineer: Pengchengyang	
Site: AC5	Time: 2023/11/25 - 21:23
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: Horn_3117_00123988(1-18GHz)	Polarity: Vertical
EUT: LoRa Module	Power: DC 3.3V
Note: Mode 5:Transmit at 2479MHz by LoRa with 812kHz LoRa	



No	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1	*	2483.500	36.417	4.287	-17.583	54.000	32.130	AV

Remark	No restricted band in the range $\pm 2$ channel bandwidths of the Band-edges of the specified emission band! (608 MHz – 614 MHz and 960 MHz – 1240 MHz).
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<b>4.5 6dB and 20dB Bandwidth</b>	<b>VERDICT: PASS</b>
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**4.5.1 Limit**

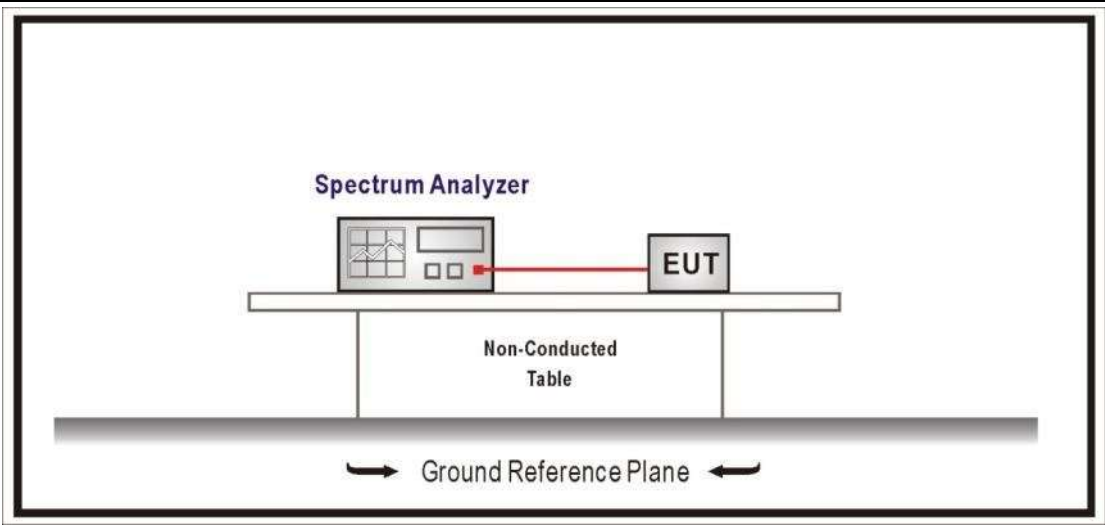
<b>Standard</b>	FCC Part 15 Subpart C Paragraph 15.247 (a)(1)(2)
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- (1) Systems using digital modulation techniques operate in the 2400-2483.5 MHz. The minimum 6 dB bandwidth shall be at least 500 kHz
- (2) For frequency hopping systems operating in 902-928 MHz band, the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

<b>Standard</b>	ANSI C63.10 Paragraph 6.7
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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. The occupied bandwidth should be within the required frequency range.

**4.5.2 Test Setup**



**4.5.3 Test Procedure**

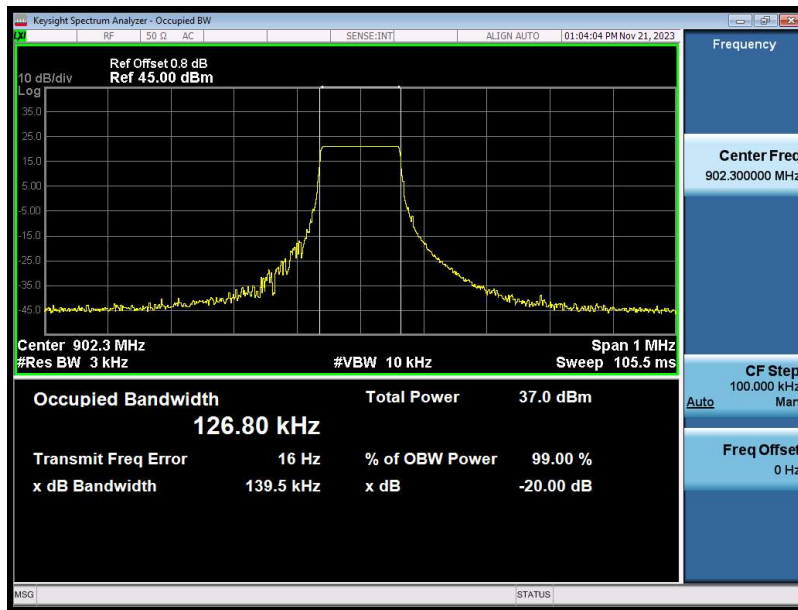
	Reference Rule	Chapter	Description
<input checked="" type="checkbox"/>	ANSI C63.10	11.8	DTS bandwidth
<input type="checkbox"/>	ANSI C63.10	11.8.1	Option 1
<input checked="" type="checkbox"/>	ANSI C63.10	11.8.2	Option 2
<input checked="" type="checkbox"/>	ANSI C63.10	6.9	Occupied bandwidth
<input type="checkbox"/>	ANSI C63.10	6.9.2	relative measurement procedure
<input checked="" type="checkbox"/>	ANSI C63.10	6.9.3	power bandwidth (99%) measurement procedure

**4.5.4 Test Data**

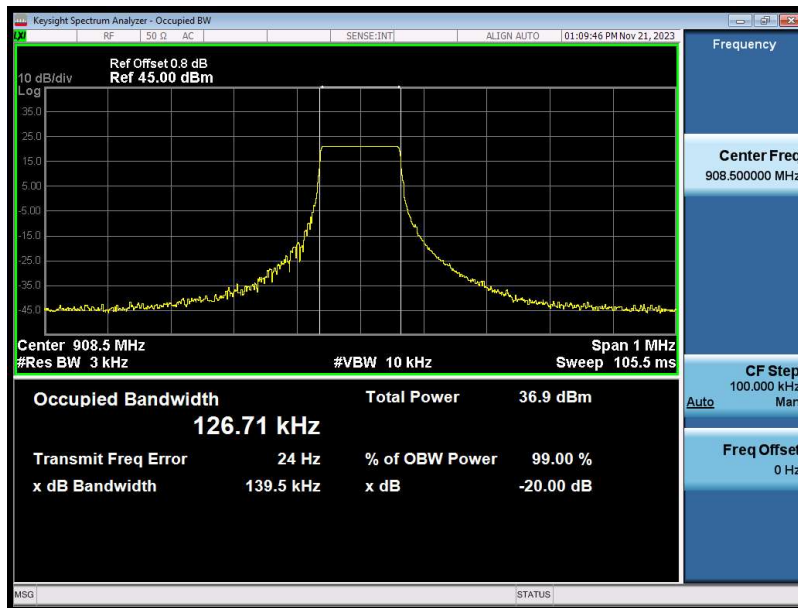
Mode	CH.	Test Freq. (MHz)	20dB Occupied Bandwidth (kHz)	Limit (kHz)	Result
1	00	902.3	139.5	≤250	Pass
	31	908.5	139.5	≤250	Pass
	63	914.9	143.2	≤250	Pass

20dB Occupied Bandwidth

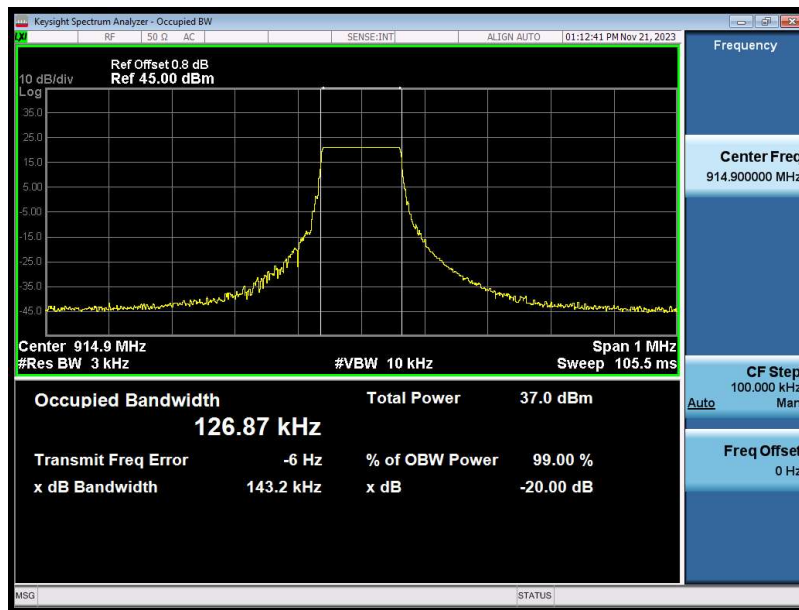
**CH00 (902.3MHz)**



**CH31 (908.5MHz)**



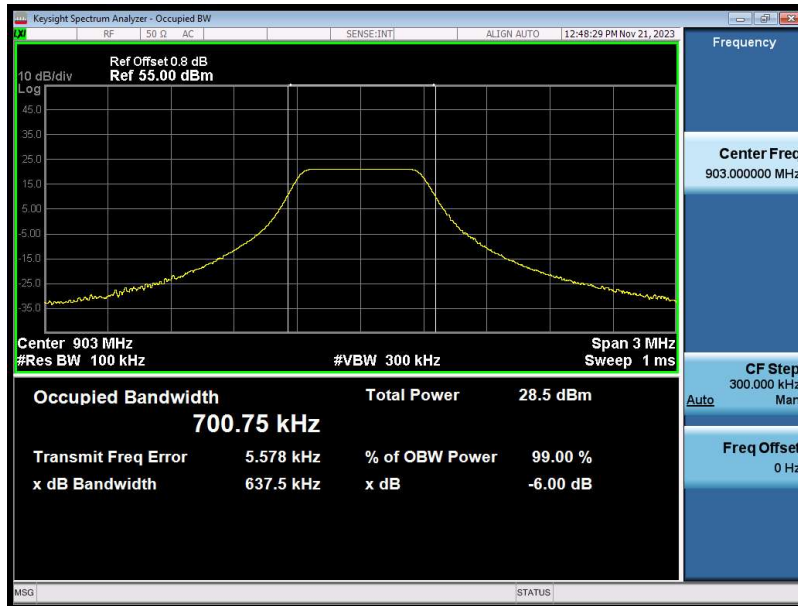
CH63 (914.9MHz)



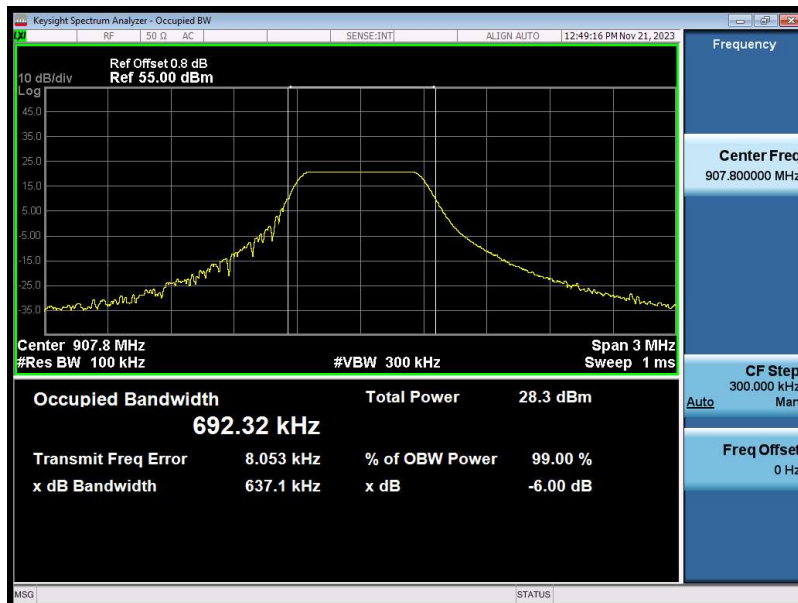
Mode	CH.	Test Freq. (MHz)	6dB Occupied Bandwidth (KHz)	Limit (kHz)	Result
2	64	903	637.5	≥500	Pass
	67	907.8	637.1	≥500	Pass
	71	914.2	635.7	≥500	Pass

6dB Occupied Bandwidth

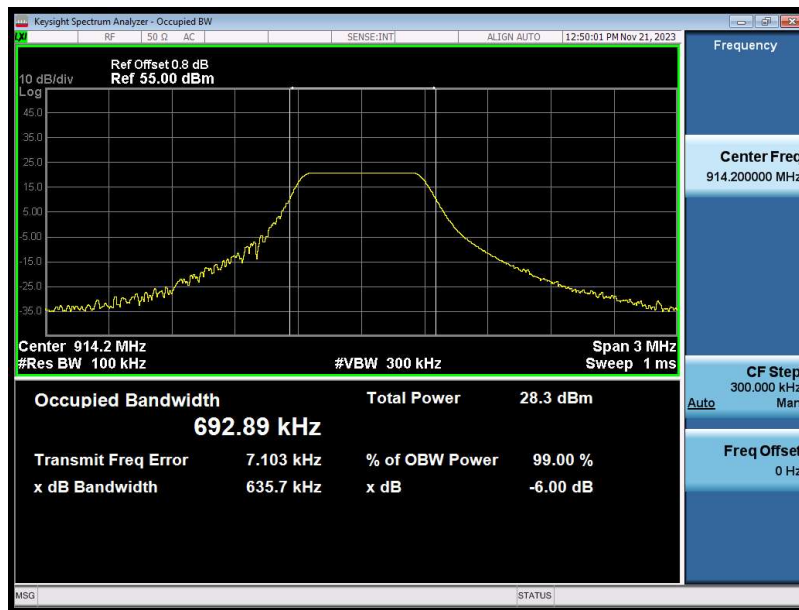
CH64 (903MHz)



CH67 (907.8MHz)



### CH71 (914.2MHz)

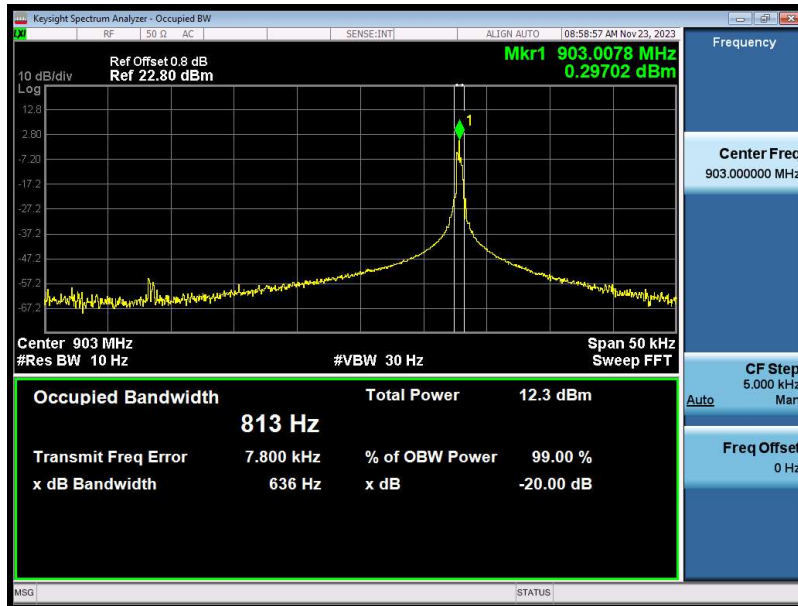




Mode	CH.	Test Freq. (MHz)	20dB Occupied Bandwidth (Hz)	Limit (kHz)	Result
3	64	903	636	≤250	Pass
	67	907.8	678	≤250	Pass
	71	914.2	584	≤250	Pass

20dB Occupied Bandwidth

CH64 (903MHz)



CH67 (907.8MHz)

