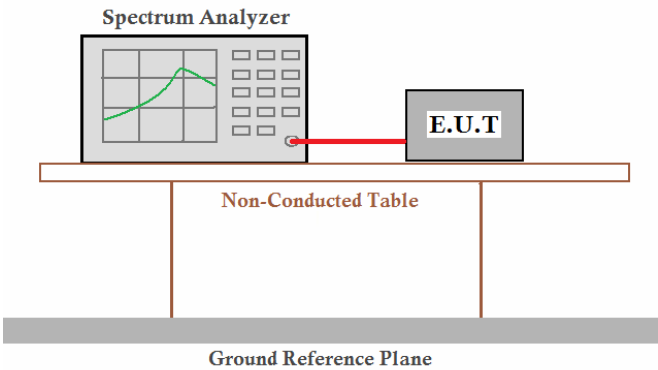


6.6 Hopping Channel Number

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak
Limit:	15 channels
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.0 for details
Test mode:	Refer to section 4.1 for details
Test results:	Pass

Measurement Data:

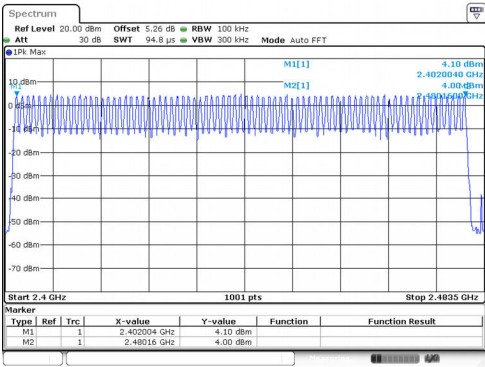
Mode	Hopping channel numbers	Limit	Result
GFSK	79	≥15CH	Pass
8-DPSK	79	≥15CH	Pass

Note:

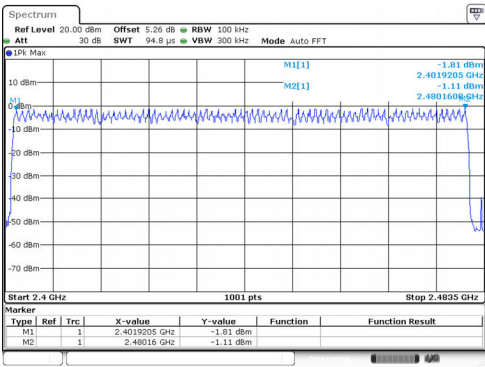
- During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK & 8-DPSK modulation which it is worse case, and show in this report.

Test plot as follows:

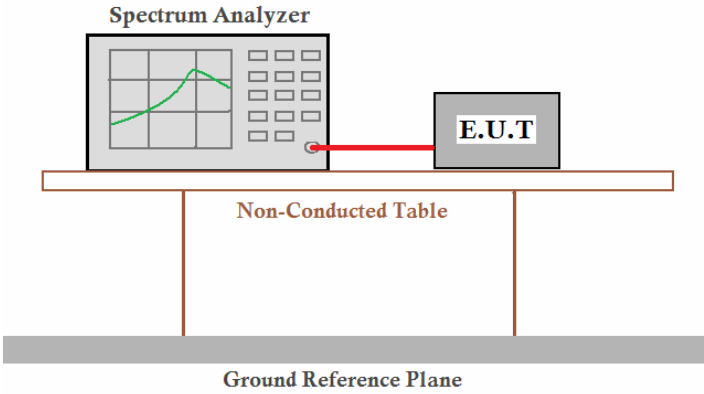
Test mode:	GFSK
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Test mode:	8-DPSK
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6.7 Dwell Time

Test Requirement:	FCC Part15 C Section 15.247 (a)(1)(iii)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak
Limit:	0.4 Second
Test setup:	 The diagram illustrates the test setup. A Spectrum Analyzer is connected to an E.U.T (Equipment Under Test) via a red cable. Both the Spectrum Analyzer and the E.U.T are placed on a Non-Conducted Table. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.0 for details
Test mode:	Refer to section 4.1 for details
Test results:	Pass

Measurement Data

GFSK mode:

Frequency	Packet	Dwell time(ms)	Limit(ms)	Result
2402MHz	DH1	120.08	400	Pass
2402MHz	DH3	256.695	400	Pass
2402MHz	DH5	302.82	400	Pass

Remarks:

The test period: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

Test channel: 2402MHz as blow

DH1 time slot = $0.3817(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 122.14\text{ms}$

DH3 time slot = $1.635(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 261.60\text{ms}$

DH5 time slot = $2.883(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 307.52\text{ms}$

8-DPSK mode:

Frequency	Packet	Dwell time(ms)	Limit(ms)	Result
2402MHz	3DH1	122.535	400	Pass
2402MHz	3DH3	265.842	400	Pass
2402MHz	3DH5	306.34	400	Pass

Remarks:

The test period: $T = 0.4 \text{ Second/Channel} \times 79 \text{ Channel} = 31.6 \text{ s}$

Test channel: 2402MHz as blow

DH1 time slot = $0.390(\text{ms}) \times (1600 / (2 \times 79)) \times 31.6 = 124.80\text{ms}$

DH3 time slot = $1.64(\text{ms}) \times (1600 / (4 \times 79)) \times 31.6 = 262.40\text{ms}$

DH5 time slot = $2.892(\text{ms}) \times (1600 / (6 \times 79)) \times 31.6 = 308.48\text{ms}$

Note:

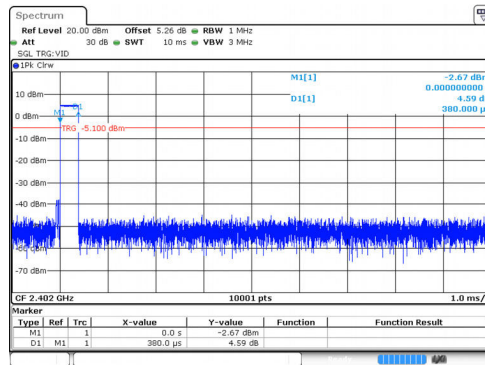
- During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK & 8-DPSK modulation which it is worse case, and show in this report.

Test plot as follows:

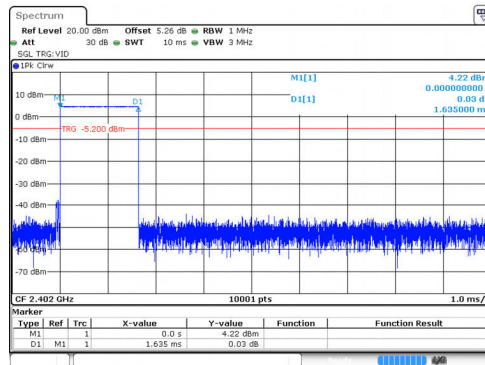
GFSK mode:

Test channel:

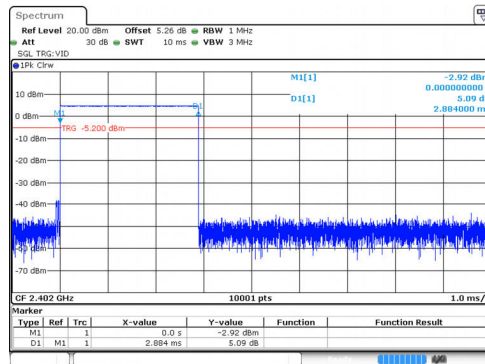
2402MHz



DH1



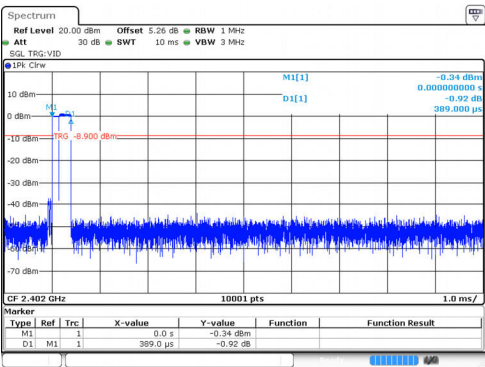
DH3



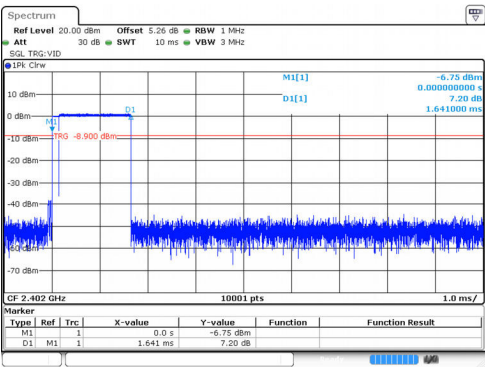
DH5

8-DPSK mode:

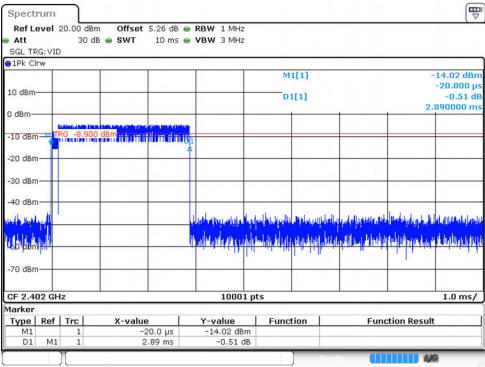
Test channel:	2402MHz
---------------	---------



DH1



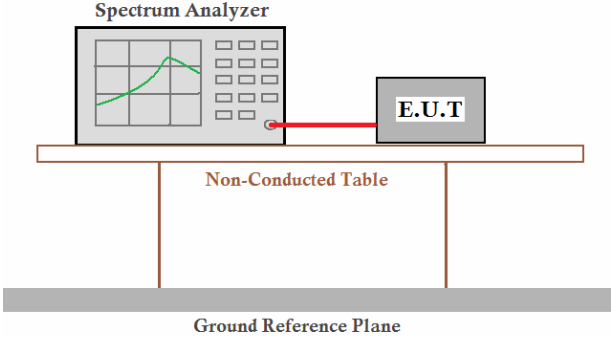
DH3



DH5

6.8 Band Edge

6.8.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector=Peak
Limit:	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 or a radiated measurement.
Test setup:	 The diagram illustrates the test setup for conducted emission measurement. A Spectrum Analyzer is connected via a red cable to an E.U.T. (Equipment Under Test). Both are placed on a Non-Conducted Table, which is supported by a Ground Reference Plane.
Test Instruments:	Refer to section 5.0 for details
Test mode:	Refer to section 4.1 for details
Test results:	Pass

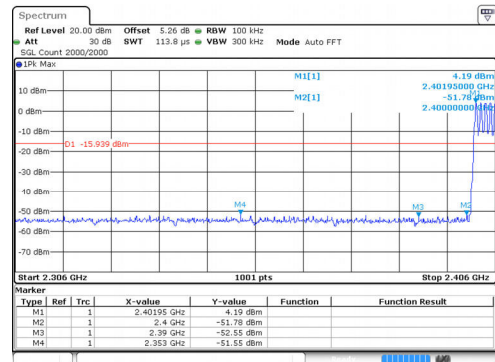
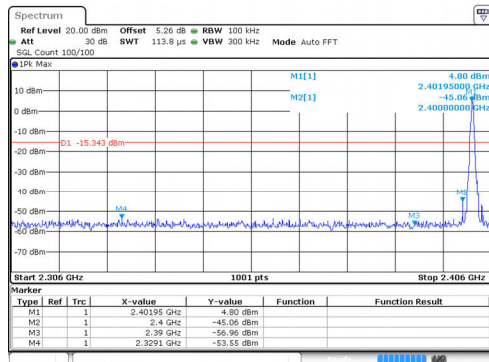
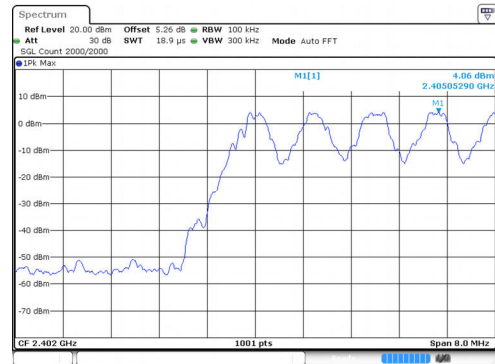
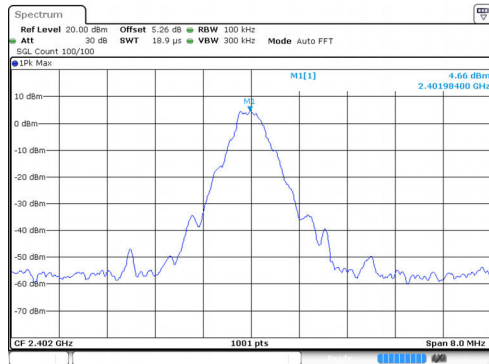
Note:

- During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK & 8-DPSK modulation which it is worse case, and show in this report.

Test plot as follows:

Test channel:

Lowest channel

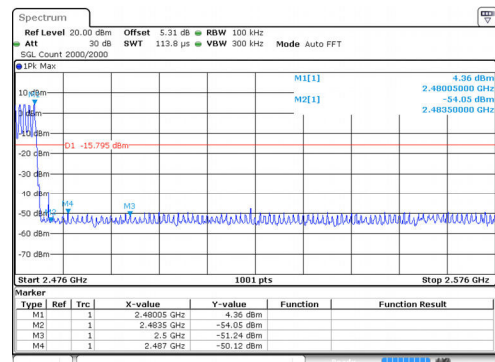
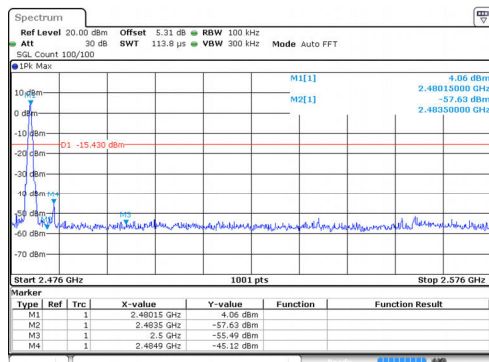
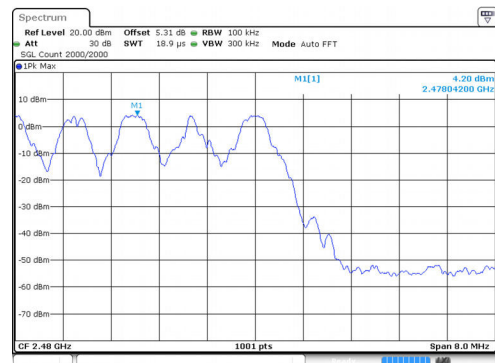
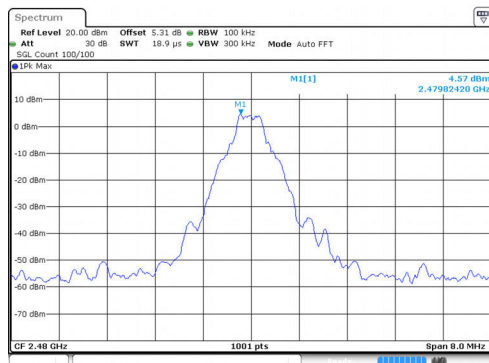


No-hopping mode

Hopping mode

Test channel:

Highest channel



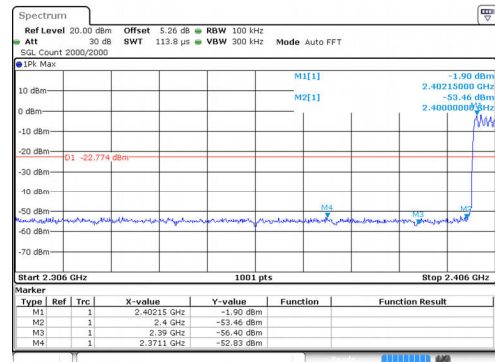
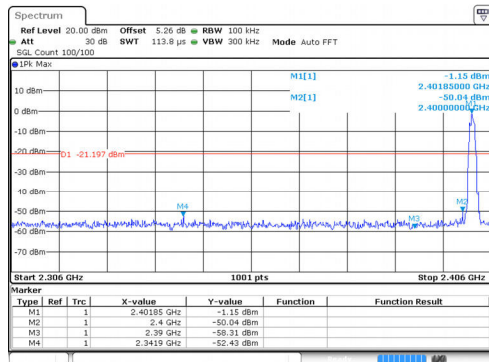
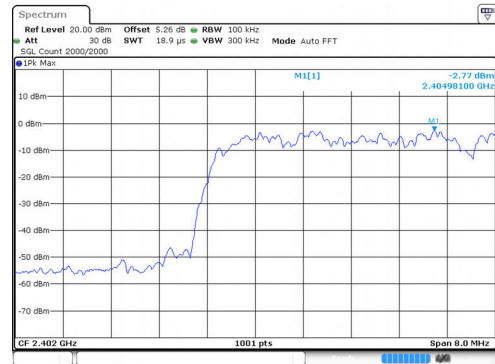
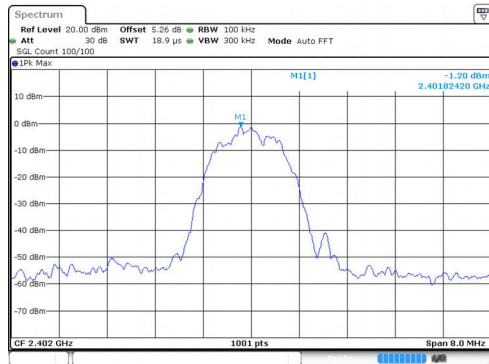
No-hopping mode

Hopping mode

8-DPSK Mode:

Test channel:

Lowest channel

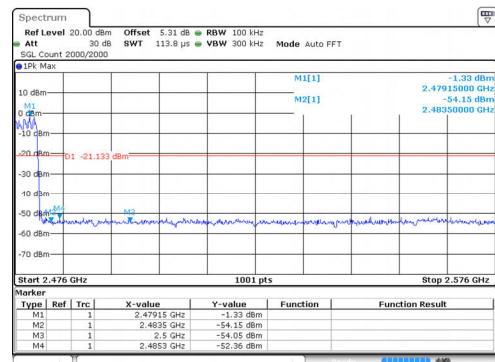
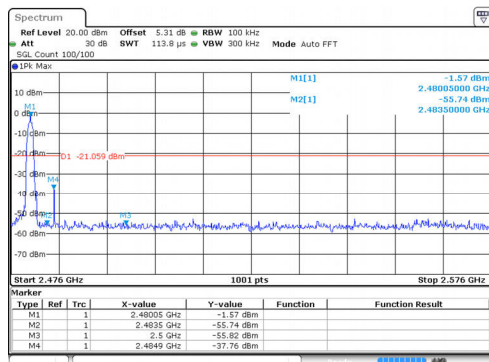
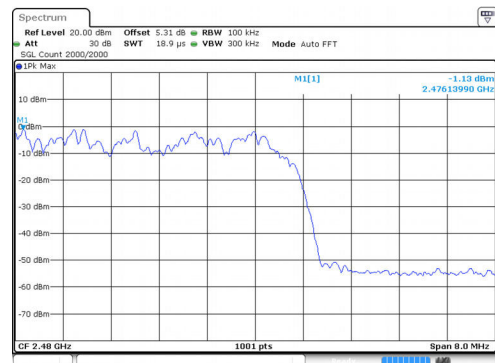
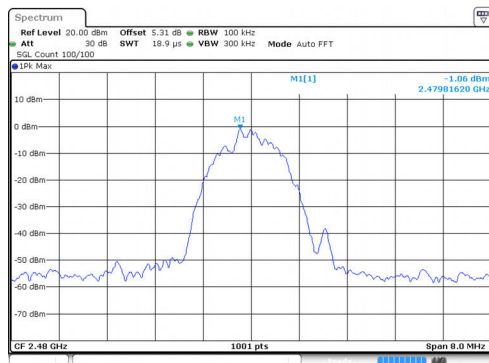


No-hopping mode

Hopping mode

Test channel:

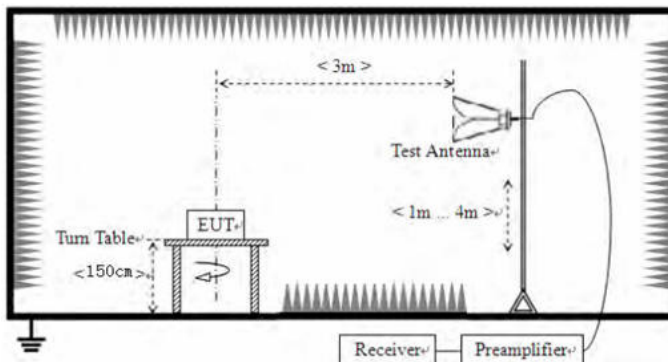
Highest channel



No-hopping mode

Hopping mode

6.8.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209 and 15.205				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed.				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit:	Frequency		Limit (dBuV/m @3m)		Remark
	Above 1GHz		54.00		Average Value
			74.00		Peak Value
Test setup:					
Test Procedure:	1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna 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. 4. 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 rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a				



	data sheet.
Test Instruments:	Refer to section 5.0 for details
Test mode:	Refer to section 4.1 for details
Test results:	Pass

Test channel:	Lowest channel
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Vertical :

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2400.000	40.34	-5.70	34.64	74.00	-39.36	peak
2400.000	29.98	-5.70	24.28	54.00	-29.72	AVG

Horizontal :

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2400.000	42.09	-5.70	36.39	74.00	-37.61	peak
2400.000	29.87	-5.70	24.17	54.00	-29.83	AVG

Test channel:	Highest channel
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Vertical :

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.500	41.92	-4.98	36.94	74.00	-37.06	peak
2483.500	30.87	-4.98	25.89	54.00	-28.11	AVG

Horizontal :

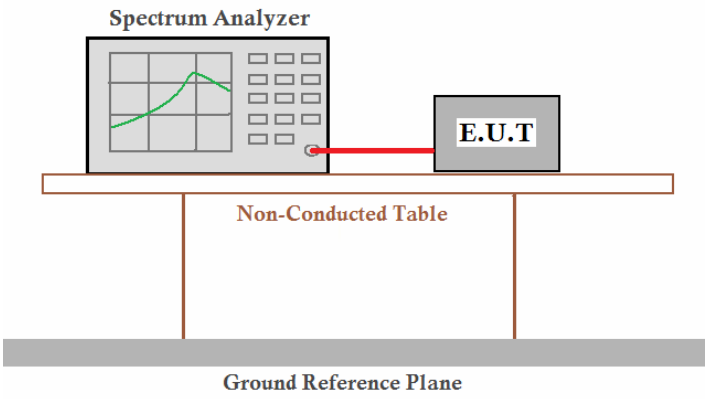
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.500	42.94	-4.98	37.96	74.00	-36.04	peak
2483.500	31.56	-4.98	26.58	54.00	-27.42	AVG

Remarks:

2. *Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *The pre-test were performed on lowest, middle and highest frequencies, only the worst case's (lowest and highest frequencies) data was showed.*
5. *During the test, pre-scan the GFSK, π/4-DQPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.*

6.9 Spurious Emission

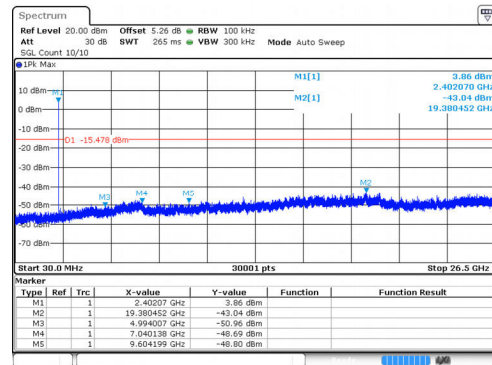
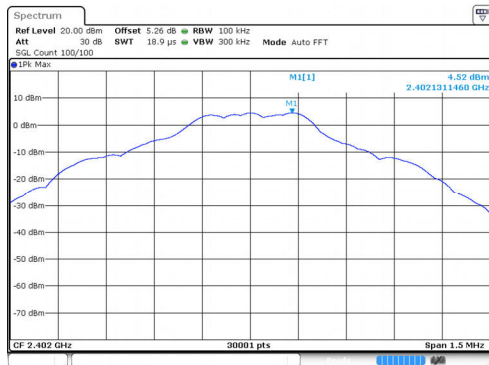
6.9.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Limit:	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 or a radiated measurement.
Test setup:	 The diagram illustrates the test setup for conducted emissions. A Spectrum Analyzer is connected to an Equipment Under Test (E.U.T.) via a red cable. Both the Spectrum Analyzer and the E.U.T. are placed on a Non-Conducted Table, which is supported by two vertical legs. Below the table is a Ground Reference Plane.
Test Instruments:	Refer to section 5.0 for details
Test mode:	Refer to section 4.1 for details
Test results:	Pass

GFSK mode:

Test channel:

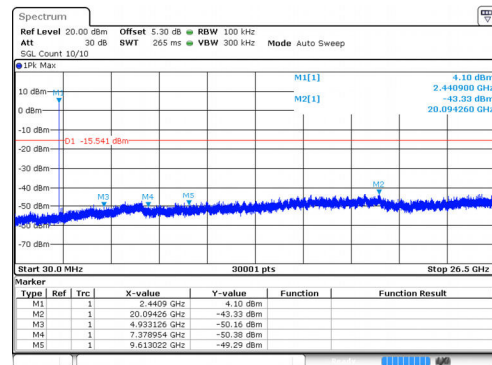
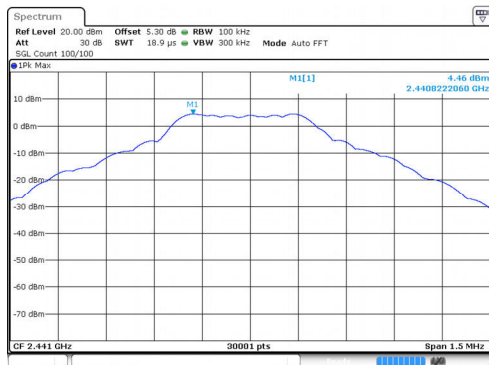
Lowest channel



30MHz~25GHz

Test channel:

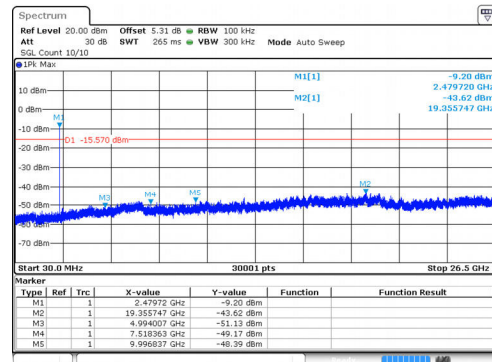
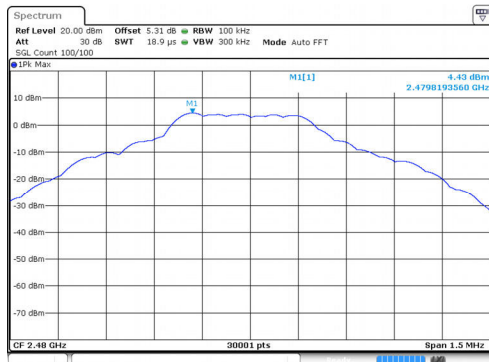
Middle channel



30MHz~25GHz

Test channel:

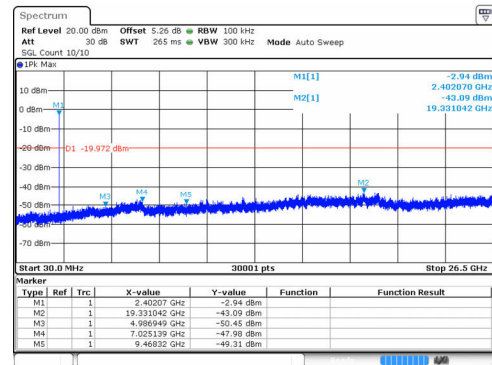
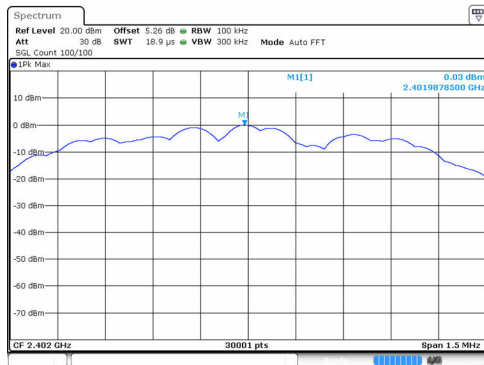
Highest channel



30MHz~25GHz

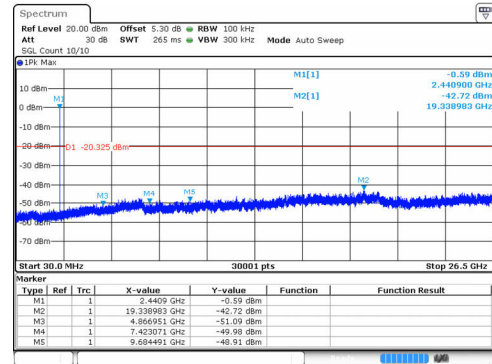
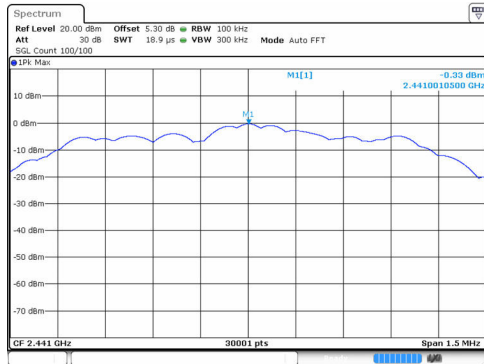
8-DPSK mode:

Test channel:	Lowest channel
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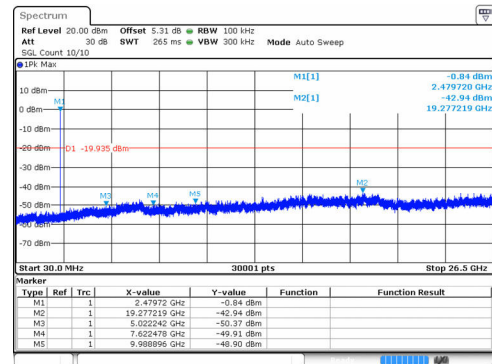
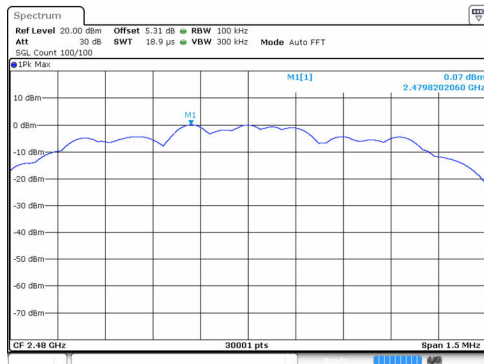
30MHz~25GHz

Test channel:	Middle channel
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30MHz~25GHz

Test channel:	Highest channel
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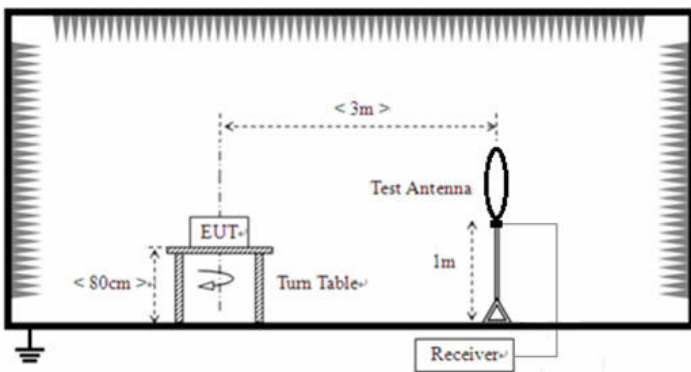


30MHz~25GHz

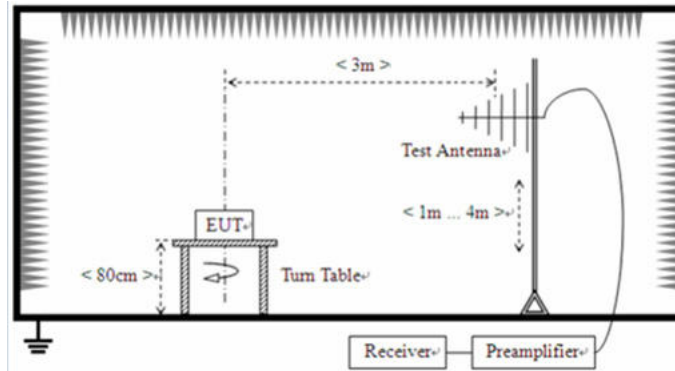
Note:

- During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK & 8-DPSK modulation which it is worse case, and show in this report.

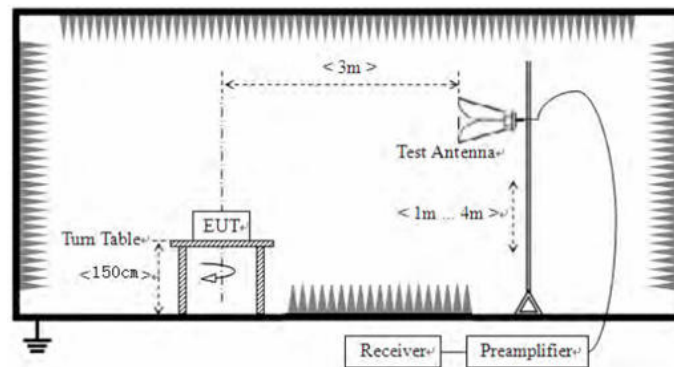
6.9.2 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	9kHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Value
	9KHz-150KHz	Quasi-peak	200Hz	600Hz	Quasi-peak
	150KHz-30MHz	Quasi-peak	9KHz	30KHz	Quasi-peak
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit:	Frequency	Limit (uV/m)		Value	Measurement Distance
	0.009MHz-0.490MHz	2400/F(KHz)		QP	300m
	0.490MHz-1.705MHz	24000/F(KHz)		QP	30m
	1.705MHz-30MHz	30		QP	30m
	30MHz-88MHz	100		QP	3m
	88MHz-216MHz	150		QP	
	216MHz-960MHz	200		QP	
	960MHz-1GHz	500		QP	
	Above 1GHz	500		Average	
		5000		Peak	
Test setup:	For radiated emissions from 9kHz to 30MHz				
					

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



Test Procedure:

1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna 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.
4. 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 rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test Instruments:	Refer to section 5.0 for details					
Test mode:	Refer to section 4.1 for details					
Test environment:	Temp.:	24.6 °C	Humid.:	52.4%	Press.:	101mbar
Test voltage:	AC 120V, 60Hz					
Test results:	Pass					

Measurement data:

Remarks:

1. During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.
2. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

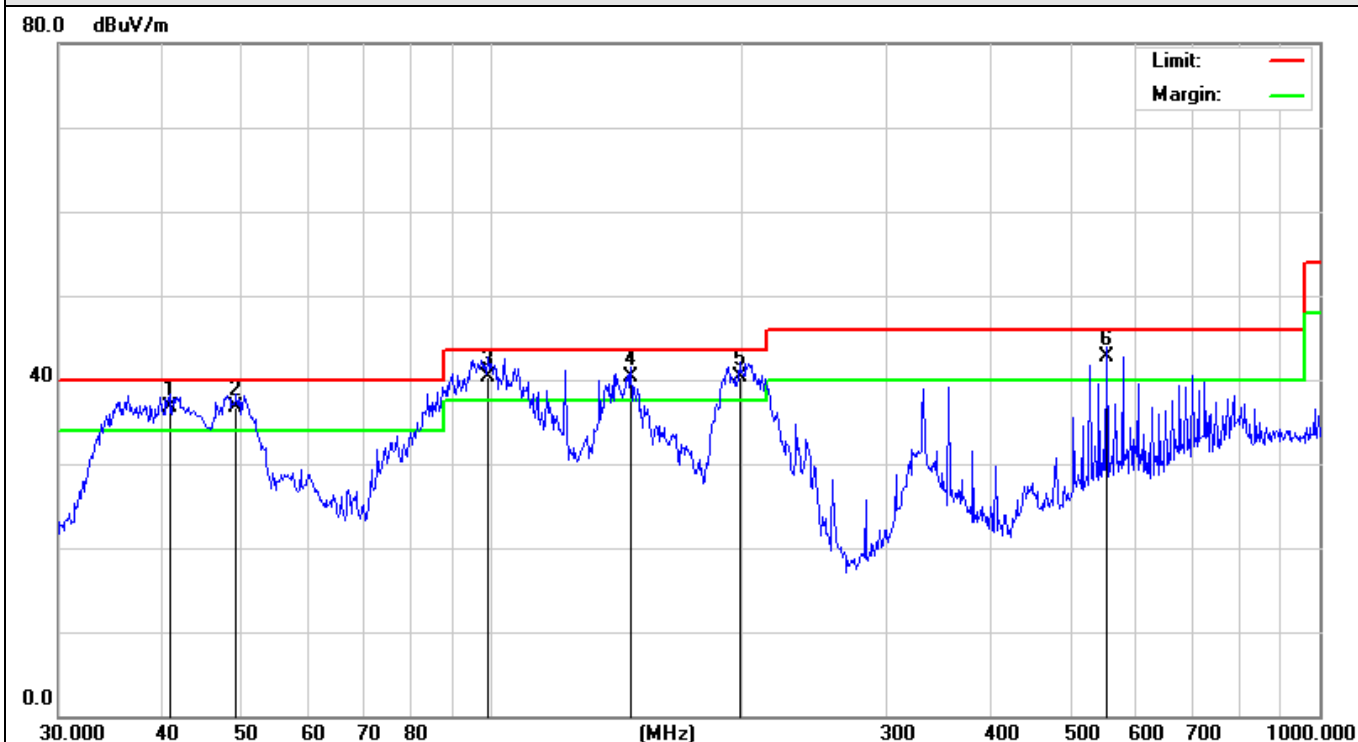
■ 9kHz~30MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Below 1GHz

Pre-scan all test modes, found worst case at GFSK 2480MHz, and so only show the test result of GFSK 2480MHz

Model name:	LV12	Test Date :	2021-08-26
Polarization :	Vertical	Test Result:	☒ Pass ☐ Fail



Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

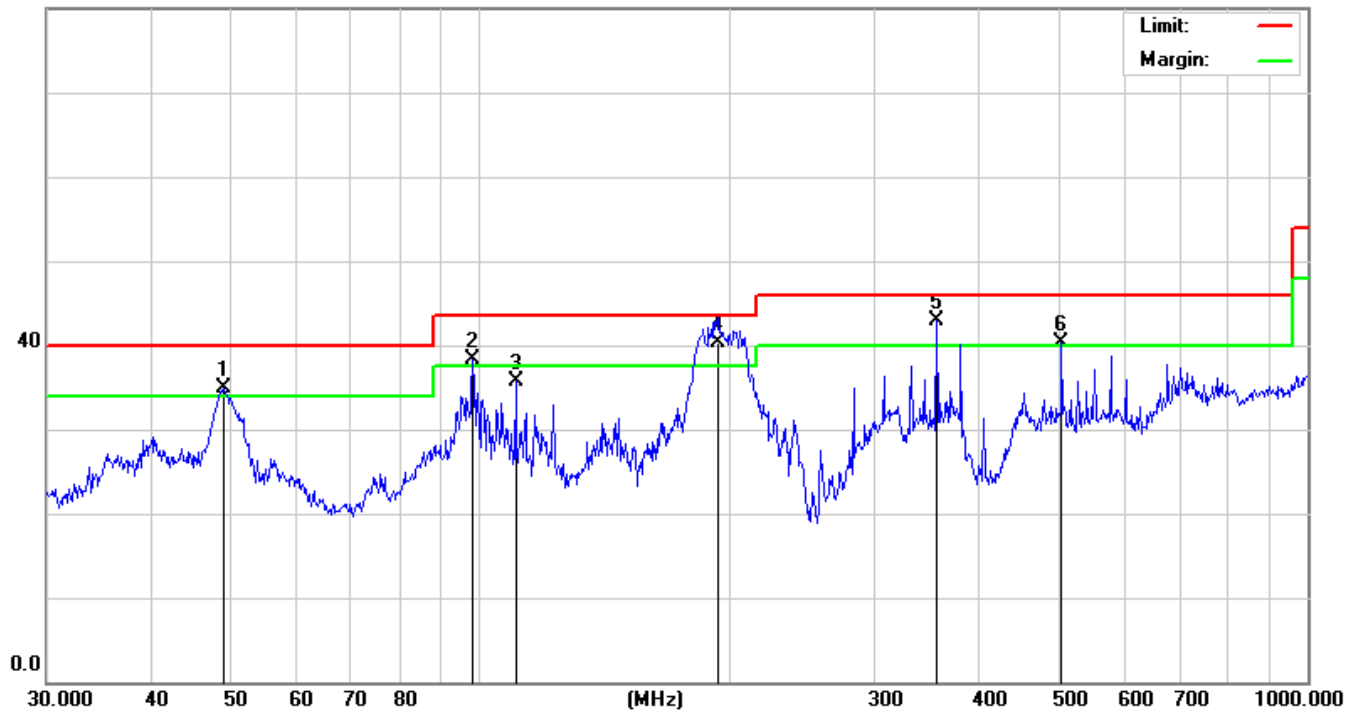
Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	!	40.8445	40.90	-4.25	36.65	40.00	-3.35	QP
2	!	49.1865	42.60	-5.80	36.80	40.00	-3.20	QP
3	*	99.1796	49.10	-8.79	40.31	43.50	-3.19	QP
4	!	147.4036	47.70	-7.41	40.29	43.50	-3.21	QP
5	!	199.2855	46.80	-6.59	40.21	43.50	-3.29	QP
6	!	552.8831	40.90	1.78	42.68	46.00	-3.32	QP

Model name:	LV12	Test Date :	2021-08-26
Polarization :	Vertical	Test Result:	☒ Pass ☐ Fail

80.0 dBuV/m



Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1	!	49.0144	38.08	-3.11	34.97	40.00	-5.03	QP
2	!	98.1419	46.27	-8.03	38.24	43.50	-5.26	QP
3		110.5687	42.83	-7.08	35.75	43.50	-7.75	QP
4	!	193.7727	47.80	-7.56	40.24	43.50	-3.26	QP
5	*	356.6757	49.68	-6.84	42.84	46.00	-3.16	QP
6	!	504.7062	38.58	1.80	40.38	46.00	-5.62	QP

■ Above 1GHz

Test channel:	Lowest channel
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H

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4804.000	51.03	5.06	56.09	74.00	-17.91	PEAK
4804.000	40.10	5.06	45.16	54.00	-8.84	AVG
7206.000	43.29	7.03	50.32	74.00	-23.68	PEAK
7206.000	32.41	7.03	39.44	54.00	-14.56	AVG

V

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4804.000	50.89	5.06	55.95	74.00	-18.05	PEAK
4804.000	41.80	5.06	46.86	54.00	-7.14	AVG
7206.000	43.36	7.03	50.39	74.00	-23.61	PEAK
7206.000	32.00	7.03	39.03	54.00	-14.97	AVG

Test channel:	Middle channel
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H

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4882.000	50.03	5.14	55.17	74.00	-18.83	PEAK
4882.000	41.95	5.14	47.09	54.00	-6.91	AVG
7323.000	45.01	7.52	52.53	74.00	-21.47	PEAK
7323.000	31.09	7.52	38.61	54.00	-15.39	AVG

V

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4882.000	49.21	5.14	54.35	74.00	-19.65	PEAK
4882.000	41.54	5.14	46.68	54.00	-7.32	AVG
7323.000	43.77	7.52	51.29	74.00	-22.71	PEAK
7323.000	32.99	7.52	40.51	54.00	-13.49	AVG

Test channel:	Highest channel
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H

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4960.000	50.91	5.22	56.13	74.00	-17.87	PEAK
4960.000	40.50	5.22	45.72	54.00	-8.28	AVG
7440.000	44.20	8.06	52.26	74.00	-21.74	PEAK
7440.000	31.81	8.06	39.87	54.00	-14.13	AVG

V

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4960.000	49.78	5.22	55.00	74.00	-19.00	PEAK
4960.000	41.08	5.22	46.30	54.00	-7.70	AVG
7440.000	43.68	8.06	51.74	74.00	-22.26	PEAK
7440.000	32.17	8.06	40.23	54.00	-13.77	AVG

Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “*”, means this data is the too weak instrument of signal is unable to test.
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. The test data shows only the worst case GFSK mode

7 Test Setup Photo

Reference to the **appendix I** for details.

8 EUT Constructional Details

Reference to the **appendix II** for details.

****End of report****