Test Report

Date : 2022-09-01
No. : HMD2070011

Applicant	:	HORI Co., Ltd. 640 Saedo-Cho, Tsuzuki-ku, Yokohama 224-0054, Japan
Supplier / Manufacturer	:	HORI Co., Ltd. 640 Saedo-Cho, Tsuzuki-ku, Yokohama 224-0054, Japan
Description of Sample(s)	:	Submitted sample(s) said to be Product: TACTICAL ASSAULT COMMANDER MECHANICAL KEY PAD for PlayStation5, PlayStation4, PC Brand Name: HORI Model No.: SPF-030 FCC ID: RQZSPF-030A
Date Samples Received	:	2022-07-22
Date Tested	:	2022-07-22 to 2022-08-16
Investigation Requested	:	Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15: 2017 and ANSI C63.10:2013 for FCC Certification.
Conclusions	:	The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.
Remarks	:	Bluetooth DTS (GFSK) For additional model(s) details, please see page 3.

Dr.CHAN Kwok Hung, Brian
Authorized Signatory

Test Report

CONTENT:

1.0 General Details

1.1 Test Laboratory

The Hong Kong Standards and Testing Centre Ltd.
EMC Laboratory
10 Dai Wang Street, Taipo Industrial Estate, New Territories, Hong Kong
Telephone: 852 2666 1888
Fax: 852 2664 4353

1.2 Equipment Under Test [EUT]

Description of Sample(s)

Product:	TACTICAL ASSAULT COMMANDER MECHANICAL KEY PAD for PlayStation5, PlayStation4, PC
Manufacturer:	HORI Co., Ltd. 640 Saedo-Cho, Tsuzuki-ku, Yokohama 224-0054, Japan
Brand Name:	HORI
Model Number:	SPF-030
Additional Model Number:	SPF-030U, SPF-030E, SPF-030A
Rating:	5Vd.c. by USB Port

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1.2.1 Description of EUT Operation

The Equipment Under Test (EUT) is a TACTICAL ASSAULT COMMANDER MECHANICAL KEY PAD for PlayStation®5, PlayStation®4, PC. The transmission signal is digital modulated with channel frequency range 2402-2480MHz. The R.F. signal was modulated by IC; the type of modulation used was digital transmission Modulation.

1.3 Date of Order

2022-07-14

1.4 Submitted Sample(s):

1 Sample

1.5 Test Duration

2022-07-02 to 2022-08-16

1.6 Country of Origin

China

1.7 RF Module Details

Module Model Number: H70001
Module FCC ID: N/A
Module Transmission Type: Bluetooth V5.0 BLE
Modulation: GFSK
Data Rates: 1Mbps
Frequency Range: 2400-2483.5MHz
Carrier Frequencies: 2402MHz – 2480MHz

Module Specification (specification provided by manufacturer)

1.8 Antenna Details

Antenna Type: PCB antenna
Antenna Gain: 0dBi

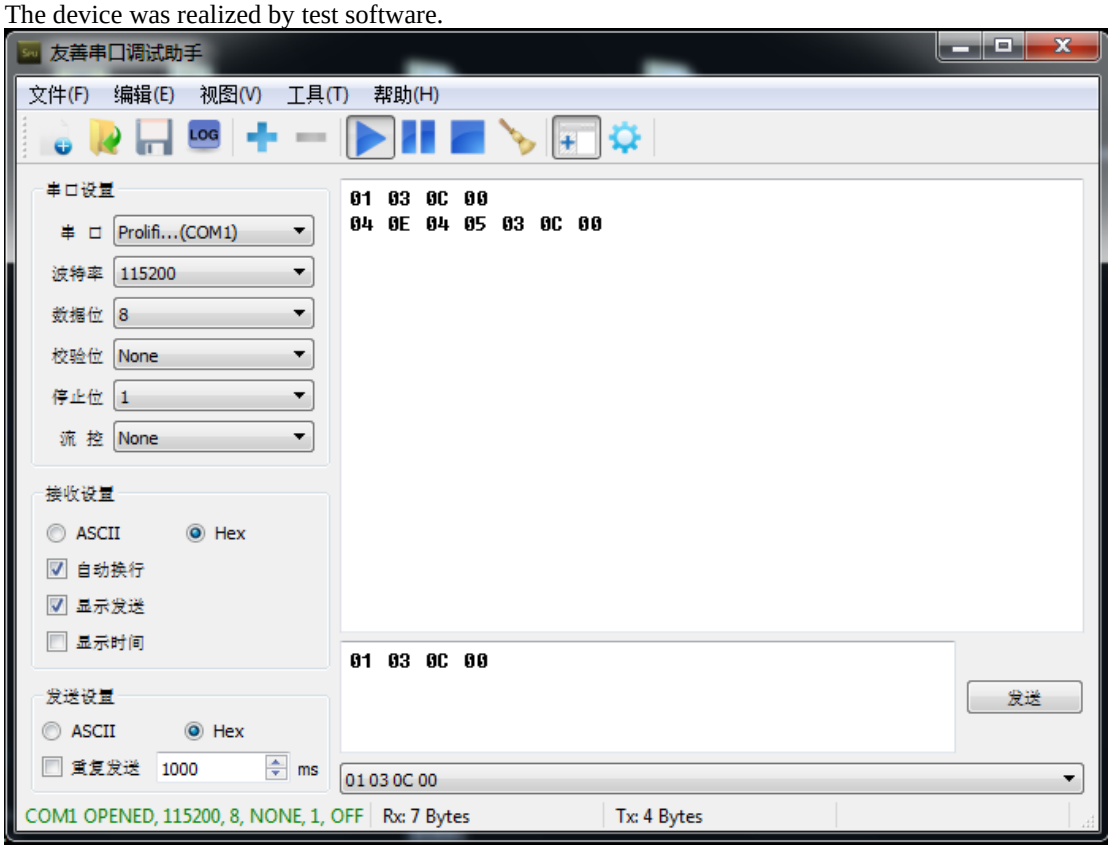
1.9 Channel List

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

2.0 Technical Details

2.1 Investigations Requested

Perform Electromagnetic Interference measurements in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 Regulations and ANSI C63.10:2013for FCC Certification.
The device was realized by test software.



2.2 Test Standards and Results Summary Tables

EMISSION Results Summary						
Test Condition	Test Requirement	Test Method	Class / Severity	Test Result		
				Pass	Failed	N/A
Maximum Peak Output Power	FCC 47CFR 15.247(b)(3)	ANSI C63.10: 2013	N/A	☒	☐	☐
Radiated Spurious Emissions	FCC 47CFR 15.209 FCC 47CFR 15.205	ANSI C63.10: 2013	N/A	☒	☐	☐
AC Mains Conducted Emissions	FCC 47CFR 15.207	ANSI C63.10: 2013	N/A	☒	☐	☐
Conducted Spurious Emissions	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	☒	☐	☐
Power Spectral Density	FCC 47CFR 15.247(e)	ANSI C63.10: 2013	N/A	☒	☐	☐
6dB Bandwidth	FCC 47CFR 15.247(a)(2)	ANSI C63.10: 2013	N/A	☒	☐	☐
Band Edge Emissions (Radiated)	FCC 47CFR 15.247(d)	ANSI C63.10: 2013	N/A	☒	☐	☐
Antenna requirement	FCC 47CFR 15.203	N/A	N/A	☒	☐	☐

Note: N/A - Not Applicable

3.0 Test Results

3.1 Emission

3.1.1 Maximum Peak Output Power

Test Requirement:	FCC 47CFR 15.247(b)(3)
Test Method:	ANSI C63.10: 2013
Test Date:	2022-07-25
Mode of Operation:	Bluetooth DTS Tx mode

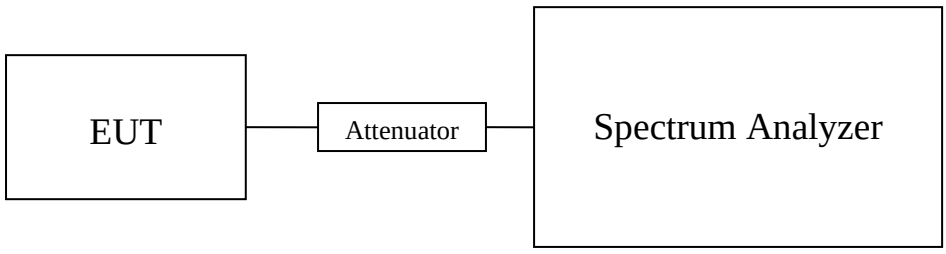
Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:

The RF output of the EUT was connected to the spectrum analyzer. All the attenuation or cable loss will be added to the measured maximum output power. The results are recorded in Watt.

Spectrum Analyzer Setting:
RBW = 3 MHz,
VBW= 10MHz,
Sweep = Auto,
Span = 10MHz
Detector = Peak,
Trace = Max. hold

Test Setup:



Note: a temporary antenna connector was soldered to the RF output.

Limits for Peak Output Power of Fundamental & Harmonics Emissions [FCC 47CFR 15.247]:

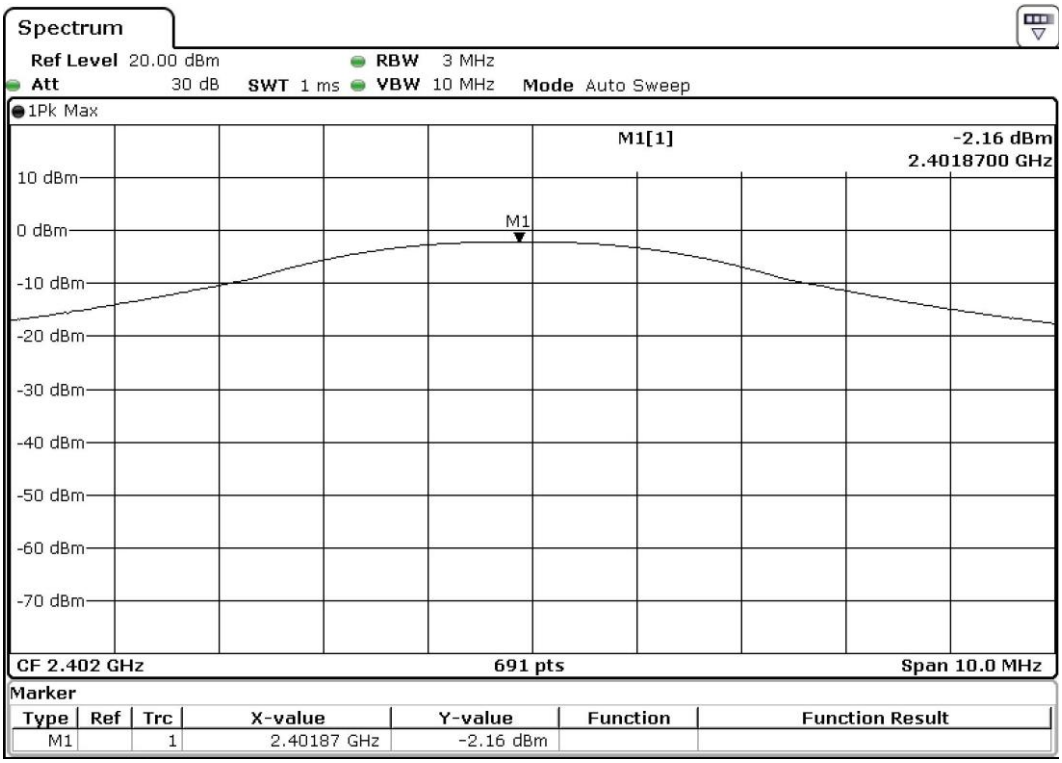
For Digital Transmission systems in 2400-2483.5 MHz Band: 1 Watt (30dBm)

Results of BT DTS Tx Mode (2402MHz to 2480MHz) : Pass (TX Unit) (GFSK)					
Channel	**Frequency(MHz)**	**Conducted power(dBm)**	**Antenna Gain(dBi)**	**E.I.R.P(dBm)**	**E.I.R.P (Watt)**
0	2402	-2.16	0	-2.16	0.000608
19	2440	-1.58	0	-1.58	0.000695
39	2480	-1.41	0	-1.41	0.000723

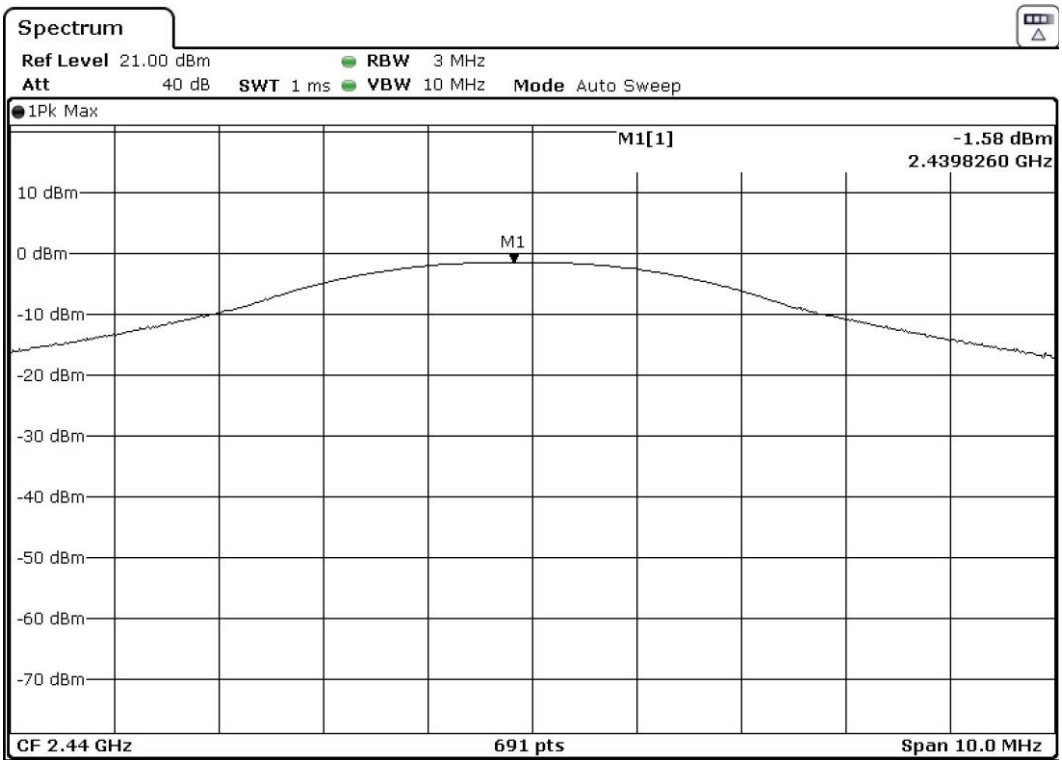
Calculated measurement uncertainty : 30MHz to 1GHz 1.7dB
1GHz to 26GHz 1.7dB

Test plot of Maximum Peak Conducted Output Power :

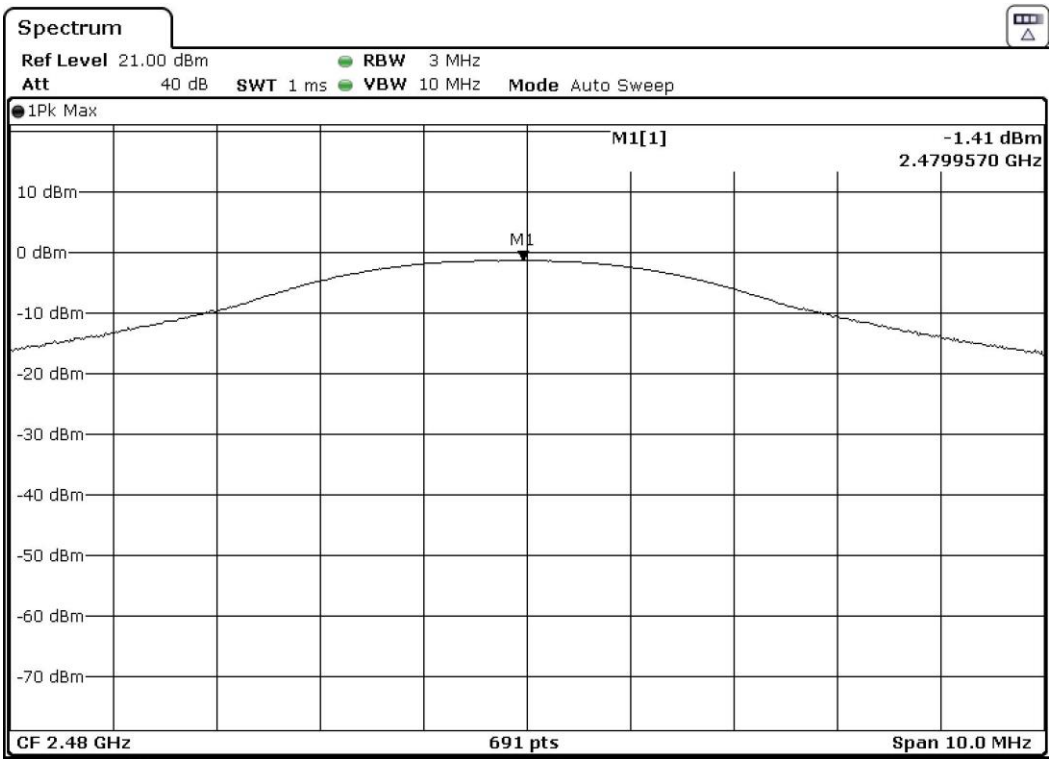
Bluetooth Communication mode (BT DTS-GFSK, 2402MHz)



Bluetooth Communication mode (BT DTS-GFSK, 2440MHz)



Bluetooth Communication mode (BT DTS-GFSK, 2480MHz)



3.1.2 Radiated Emissions

Test Requirement:	FCC 47CFR 15.209
Test Method:	ANSI C63.10:2013
Test Date:	2022-07-22 to 2022-08-16
Mode of Operation:	Tx mode / Bluetooth Communication mode (GFSK)

Ambient Temperature: 25℃ Relative Humidity: 50% Atmospheric Pressure: 101 kPa

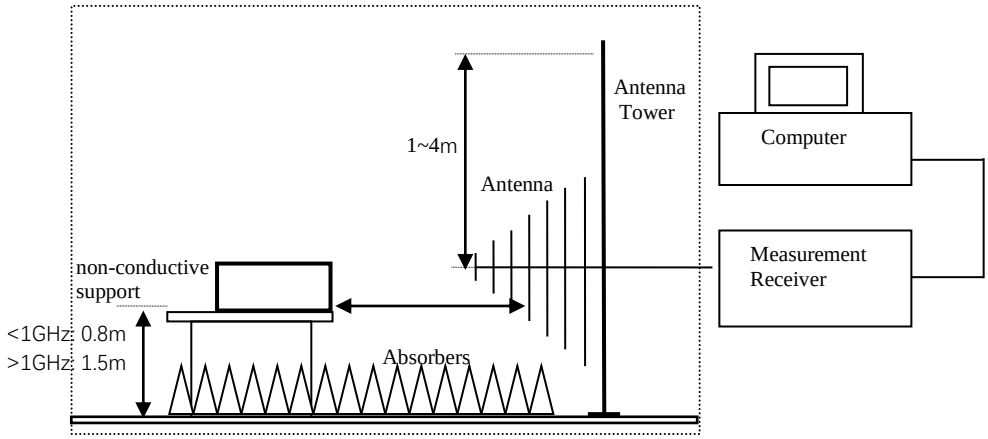
Test Method:
For emission measurements at or below 1 GHz, the sample was placed 0.8m above the ground plane of semi-anechoic Chamber*. For emission measurements above 1 GHz, the sample was placed 1.5m above the ground plane of semi-anechoic Chamber*. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

* Semi-Anechoic chamber located on the G/F of The Hong Kong Standards and Testing Centre Ltd. with a metal ground plane filed with the FCC pursuant to section 2.948 of the FCC rules, with Registration Number: 607756.

Spectrum Analyzer Setting:

9KHz – 30MHz (Pk & Av)	RBW:	10kHz
	VBW:	30kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
30MHz – 1GHz (QP)	RBW:	120kHz
	VBW:	120kHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Pk)	RBW:	1MHz
	VBW:	1MHz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold
Above 1GHz (Av)	RBW:	1MHz
	VBW:	10Hz
	Sweep:	Auto
	Span:	Fully capture the emissions being measured
	Trace:	Max. hold

Test Setup:



Ground Plane

- Absorbers placed on top of the ground plane are for measurements above 1000MHz only.
- Measurements between 30MHz to 1000MHz made with Bi-log antennas, above 1000MHz horn antennas are used.

Limits for Radiated Emissions FCC 47 CFR 15.209]:

Frequency Range	Quasi-Peak Limits
[MHz]	[μV/m]
0.009-0.490	2400/F (kHz)
0.490-1.705	24000/F (kHz)
1.705-30	30
30-88	100
88-216	150
216-960	200
Above960	500

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Remarks:
No additional spurious emissions found between lowest internal used/generated frequency and 30 MHz
* Denotes restricted band of operation.
Measurements were made using a peak detector. Any emission less than 1000MHz and falling within the restricted bands of FCC Rules Part 15 Section 15.205 and the limits of FCC Rules Part 15 Section 15.209 were applied.

Correction Factor included Antenna Factor and Cable Attenuation.

Calculated measurement uncertainty (9kHz-30MHz): 2.0dB
(30MHz -1GHz): 4.9dB
(1GHz -6GHz): 4.02dB
(6GHz -26.5GHz): 4.03dB

Emissions in the vertical and horizontal polarizations have been investigated and the worst-case test results are recorded in this report.

Result of Tx mode (2402.0 MHz) (GFSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (2402.0 MHz) (GFSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
4804.0	56.3	0.82	57.1	74.0	16.9	Vertical
4804.0	55.5	0.52	56.0	74.0	18.0	Horizontal
7206.0	49.2	7	56.2	74.0	17.9	Vertical
7206.0	48.9	6.5	55.4	74.0	18.6	Horizontal
9608.0	46.3	8.5	54.8	74.0	19.2	Vertical
9608.0	47.1	8.3	55.4	74.0	18.6	Horizontal
12010.0	44.8	10.9	55.7	74.0	18.3	Vertical
12010.0	45.3	10.8	56.1	74.0	17.9	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
4804.0	42.4	0.82	43.2	54.0	10.8	Vertical
4804.0	42.0	0.52	42.5	54.0	11.5	Horizontal
7206.0	34.6	7	41.6	54.0	12.4	Vertical
7206.0	35.0	6.5	41.5	54.0	12.5	Horizontal
9608.0	31.6	8.5	40.1	54.0	13.9	Vertical
9608.0	32.3	8.3	40.6	54.0	13.4	Horizontal
12010.0	31.8	10.9	42.7	54.0	11.3	Vertical
12010.0	31.1	10.8	41.9	54.0	12.1	Horizontal

Result of Tx mode (2440.0 MHz) (GFSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (2440.0 MHz) (GFSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
4880.0	55.2	0.82	56.0	74.0	18.0	Vertical
4880.0	55.1	0.52	55.6	74.0	18.4	Horizontal
7320.0	48.2	7	55.2	74.0	18.8	Vertical
7320.0	48.3	6.5	54.8	74.0	19.2	Horizontal
9760.0	47.0	8.5	55.5	74.0	18.5	Vertical
9760.0	47.7	8.3	56.0	74.0	18.0	Horizontal
12200.0	45.2	10.9	56.1	74.0	17.9	Vertical
12200.0	45.2	10.8	56.0	74.0	18.0	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
4880.0	40.6	0.82	41.4	54.0	12.6	Vertical
4880.0	40.9	0.52	41.5	54.0	12.6	Horizontal
7320.0	33.2	7	40.2	54.0	13.8	Vertical
7320.0	33.1	6.5	39.6	54.0	14.4	Horizontal
9760.0	31.6	8.5	40.1	54.0	13.9	Vertical
9760.0	33.1	8.3	41.4	54.0	12.6	Horizontal
12200.0	31.1	10.9	42.0	54.0	12.0	Vertical
12200.0	30.6	10.8	41.4	54.0	12.6	Horizontal

Result of Tx mode (2480.0 MHz) (GFSK) (9kHz – 30MHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level dBuV	Correction Factor dB/m	Field Strength dBuV/m	Field Strength uV/m	Limit uV/m	E-Field Polarity
Emissions detected are more than 20 dB below the FCC Limits						

Result of Tx mode (2480.0 MHz) (GFSK) (Above 1GHz): Pass

Field Strength of Spurious Emissions Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
4960.0	54.8	0.82	55.6	74.0	18.4	Vertical
4960.0	55.1	0.52	55.6	74.0	18.4	Horizontal
7440.0	48.6	7	55.6	74.0	18.4	Vertical
7440.0	49.6	6.5	56.1	74.0	17.9	Horizontal
9920.0	47.4	8.5	55.9	74.0	18.1	Vertical
9920.0	47.0	8.3	55.3	74.0	18.7	Horizontal
12400.0	45.0	10.9	55.9	74.0	18.1	Vertical
12400.0	44.8	10.8	55.6	74.0	18.4	Horizontal

Field Strength of Spurious Emissions Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
4960.0	39.7	0.82	40.5	54.0	13.5	Vertical
4960.0	40.8	0.52	41.3	54.0	12.7	Horizontal
7440.0	33.5	7	40.5	54.0	13.5	Vertical
7440.0	33.6	6.5	40.1	54.0	13.9	Horizontal
9920.0	32.9	8.5	41.4	54.0	12.7	Vertical
9920.0	31.8	8.3	40.1	54.0	13.9	Horizontal
12400.0	31.0	10.9	41.9	54.0	12.1	Vertical
12400.0	30.8	10.8	41.6	54.0	12.4	Horizontal

Radiated Emissions Measurement:

Limit：

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).

Result： RF Radiated Emissions (Lowest)-GFSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
2390.0	46.6	-4.8	41.8	74.0	32.2	Vertical
2390.0	46.8	-4.7	42.1	74.0	31.9	Horizontal

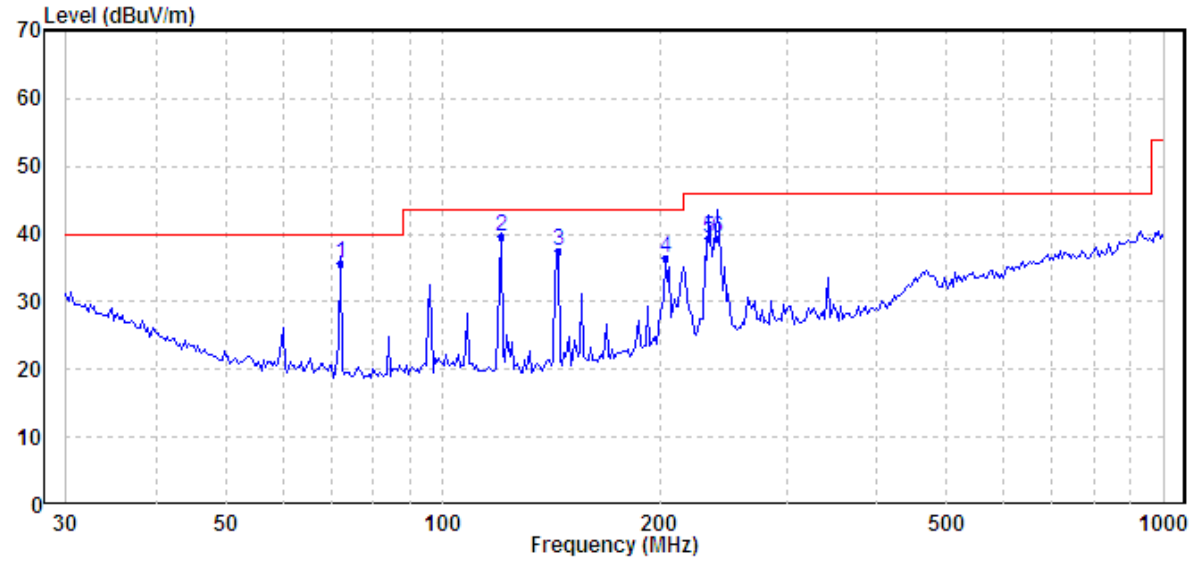
Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
2390.0	41.4	-4.8	36.6	54.0	17.4	Vertical
2390.0	41.8	-4.7	37.1	54.0	16.9	Horizontal

Result： RF Radiated Emissions (Highest) -GFSK

Field Strength of Band-edge Compliance Peak Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
2483.5	55.3	-4.8	50.5	74.0	23.5	Vertical
2483.5	54.1	-4.7	49.4	74.0	24.6	Horizontal

Field Strength of Band-edge Compliance Average Value						
Frequency MHz	Measured Level @3m dBµV	Correction Factor dB/m	Field Strength dBµV/m	Limit @3m dBµV/m	Margin dB	E-Field Polarity
2483.5	43.5	-4.8	38.7	54.0	15.3	Vertical
2483.5	42.1	-4.7	37.4	54.0	16.6	Horizontal

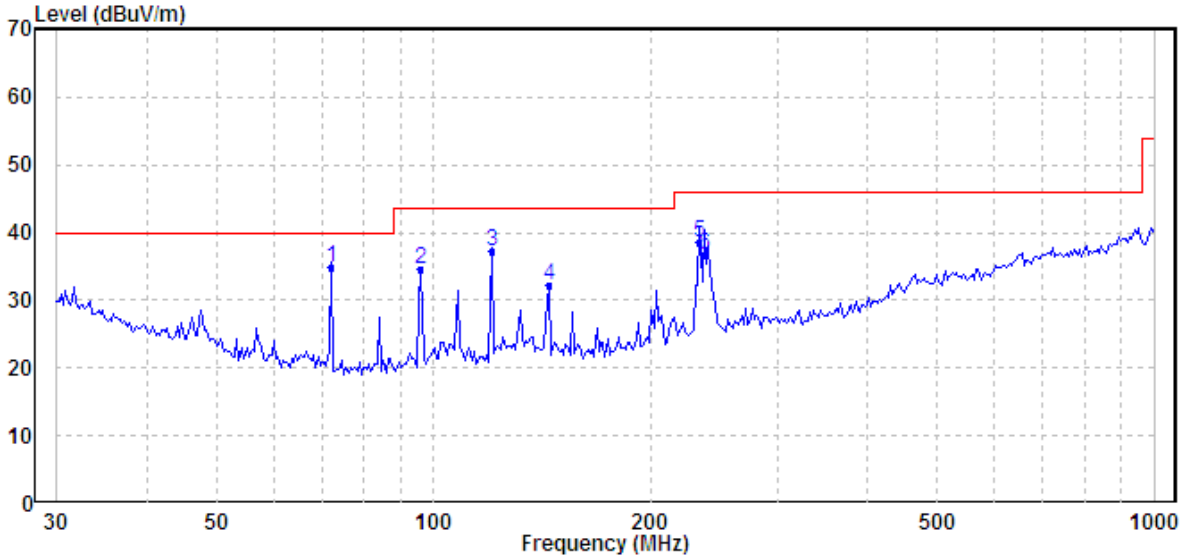
Results of Bluetooth Communication mode (2402.0 MHz) (30MHz – 1GHz): Pass
Please refer to the following table for result details (The data is the worst cases)
Horizontal



Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	72.084	35.68	40.00	-4.32	QP	Horizontal
2	120.277	39.67	43.50	-3.83	QP	Horizontal
3	144.335	37.54	43.50	-5.96	QP	Horizontal
4	203.523	36.53	43.50	-6.97	QP	Horizontal
5	234.168	39.28	46.00	-6.72	QP	Horizontal
6	240.830	39.47	46.00	-6.53	QP	Horizontal

Results of Bluetooth Communication mode (2402.0 MHz) (30MHz – 1GHz): Pass
Please refer to the following table for result details (The data is the worst cases)
Vertical



Ambient Temperature: 25C
Relative Humidity : 50%

	Freq	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB		
1	72.084	34.81	40.00	-5.19	QP	Vertical
2	96.099	34.49	43.50	-9.01	QP	Vertical
3	120.277	37.18	43.50	-6.32	QP	Vertical
4	144.335	32.17	43.50	-11.33	QP	Vertical
5	234.168	38.57	46.00	-7.43	QP	Vertical
6	237.476	36.67	46.00	-9.33	QP	Vertical

3.1.3 AC Mains Conducted Emissions (0.15MHz to 30MHz)

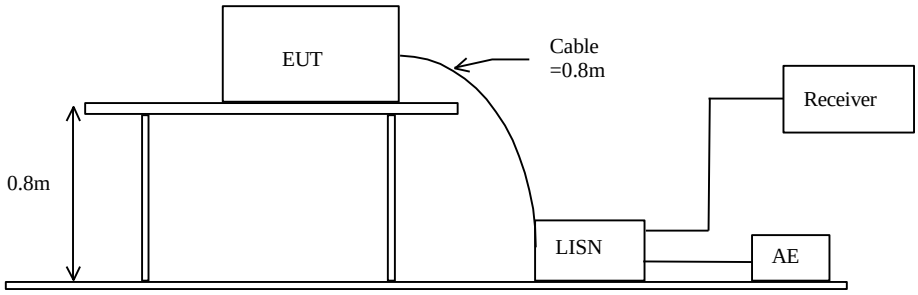
Test Requirement:	FCC 47CFR 15.207
Test Method:	ANSI C63.10:2013
Test Date:	2022-07-28
Mode of Operation:	TX mode
Test Voltage:	120Va.c. 60Hz

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:
The test was performed in accordance with ANSI ANSI C63.10:2013, with the following: an initial measurement was performed in peak and average detection mode on the live line, any emissions recorded within 30dB of the relevant limit line were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

Receiver Setting:
Bandw. = 9 kHz, Meas. Time= 10.0 ms, Step Width = 5.0kHz
Detector = MaxPeak and CISPR AV

Test Setup:

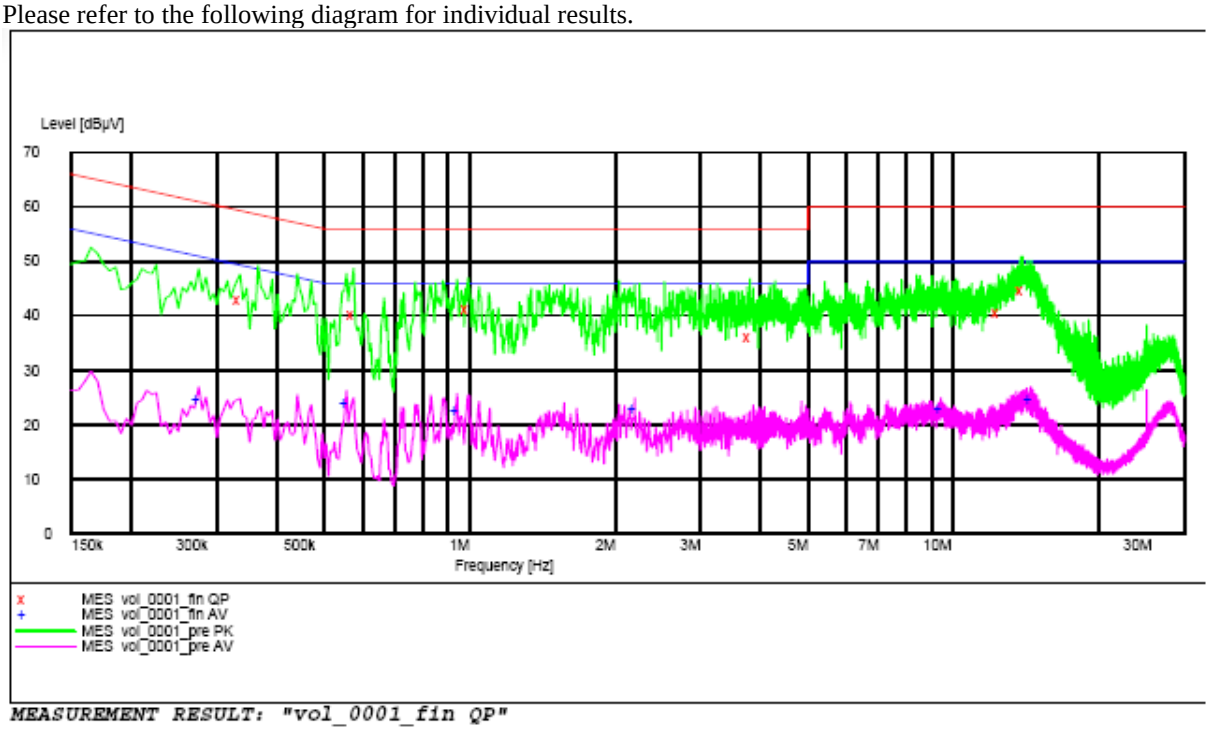


Limits for Conducted Emissions (FCC 47 CFR 15.207):

Frequency Range [MHz]	Quasi-Peak Limits [dBμV]	Average [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.
Remarks:
Calculated measurement uncertainty (0.15MHz – 30MHz): 3.25dB
-*- Emission(s) that is far below the corresponding limit line.

Results of TX mode (connect to PC) (L): PASS
Please refer to the following diagram for individual results.



MEASUREMENT RESULT: "vol_0001_fin QP"

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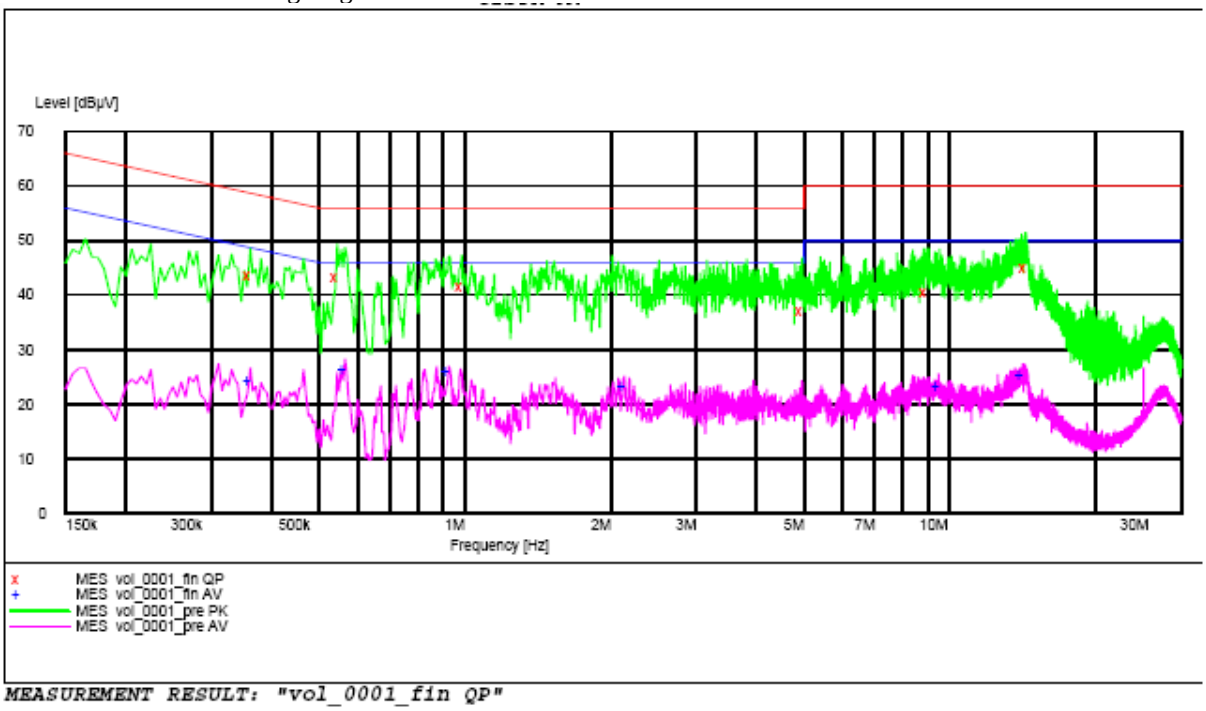
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.335000	43.00	9.7	59	16.4	L1	GND
0.575000	40.10	9.7	56	15.9	L1	GND
0.990000	41.20	9.7	56	14.8	L1	GND
3.795000	36.10	9.8	56	19.9	L1	GND
12.380000	40.40	10.1	60	19.6	L1	GND
13.890000	44.50	10.2	60	15.5	L1	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

7/18/2022 9:14AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.275000	24.70	9.7	51	26.2	L1	GND
0.555000	24.10	9.7	46	21.9	L1	GND
0.940000	22.60	9.7	46	23.4	L1	GND
2.190000	22.90	9.8	46	23.1	L1	GND
9.425000	22.90	10.0	50	27.1	L1	GND
14.435000	24.60	10.2	50	25.4	L1	GND

Results of TX mode (connect to PC) (N): PASS
Please refer to the following diagram for individual results.



MEASUREMENT RESULT: "vol_0001_fin QP"

7/28/2022 9:17AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.360000	43.80	9.7	59	14.9	N	GND
0.545000	43.30	9.7	56	12.7	N	GND
0.985000	41.50	9.7	56	14.5	N	GND
4.960000	37.20	9.8	56	18.8	N	GND
8.935000	40.50	10.0	60	19.5	N	GND
14.370000	44.90	10.2	60	15.1	N	GND

MEASUREMENT RESULT: "vol_0001_fin AV"

7/28/2022 9:17AM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Line	PE
0.360000	24.40	9.7	49	24.3	N	GND
0.565000	26.60	9.7	46	19.4	N	GND
0.925000	26.00	9.7	46	20.0	N	GND
2.130000	23.40	9.8	46	22.6	N	GND
9.480000	23.40	10.0	50	26.6	N	GND
14.095000	25.40	10.2	50	24.6	N	GND

3.1.4 Power Spectral Density

Test Requirement:	FCC 47CFR 15.247(e)
Test Method:	ANSI C63.10:2013
Test Date:	2022-07-25
Mode of Operation:	Tx mode

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:

The RF output of the EUT was connected to the spectrum analyzer. Set the fundamental frequency as the center frequency of the spectral analyzer. Use RBW=3kHz, VBW= 10KHz, Set the span to 1.5 times the DTS channel bandwidth. Detector = peak, Sweep time = auto couple, Trace mode = max hold. Measure the Power Spectral Density (PSD) and record the results in dBm.

Test Setup:

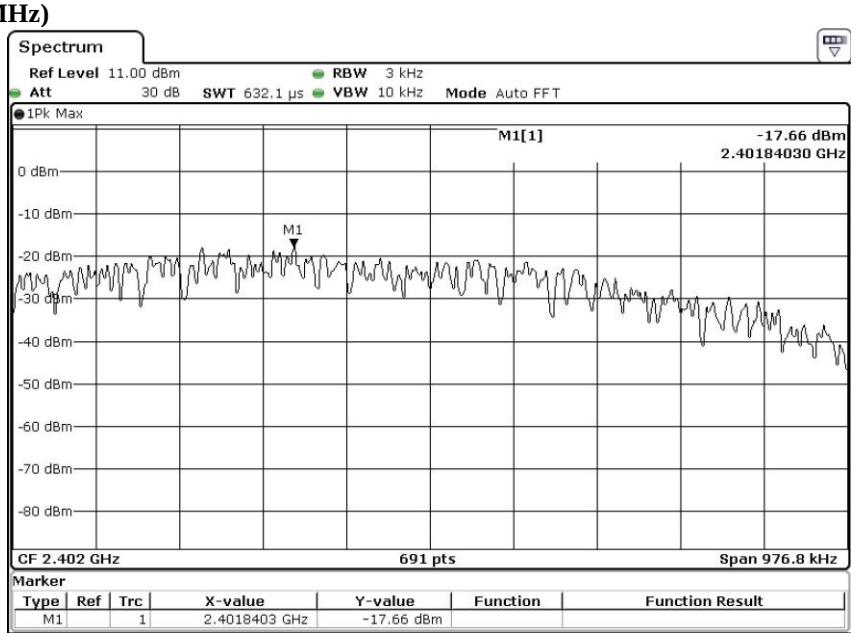
As Test Setup of clause 3.1.1 in this test report.

Test Limit:
The maximum power spectral density (PSD) shall not exceeded 8dBm in any 3kHz band.

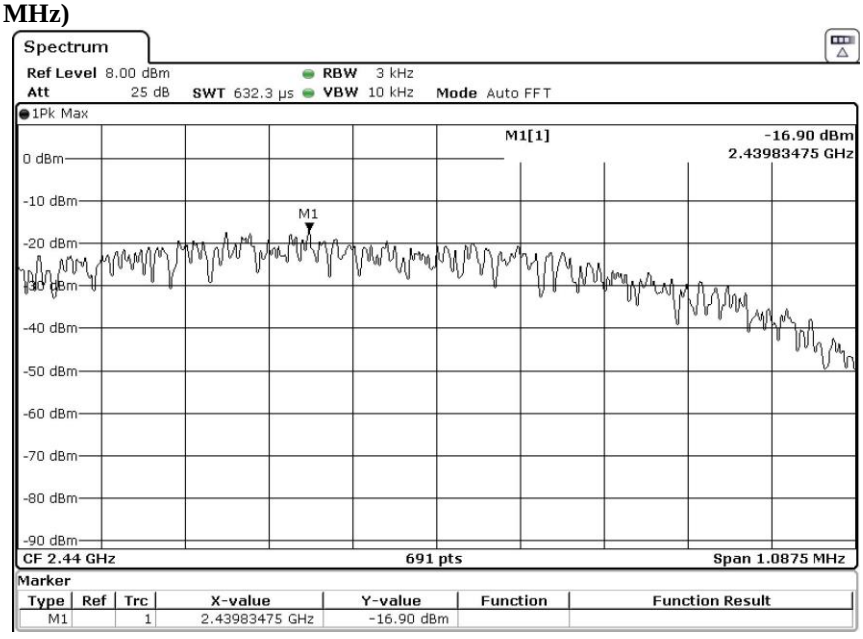
Results of Tx Mode GFSK (Tx:2402MHz to 2480MHz) : Pass (Tx Unit)
Maximum power spectral density

Transmitter Frequency (MHz)	Maximum Power spectral density level / 3kHz band (dBm)	Maximum Power spectral density / 3kHz band limit
2402.0	-17.66	**8dBm**
2440.0	-16.90	**8dBm**
2480.0	-16.67	**8dBm**

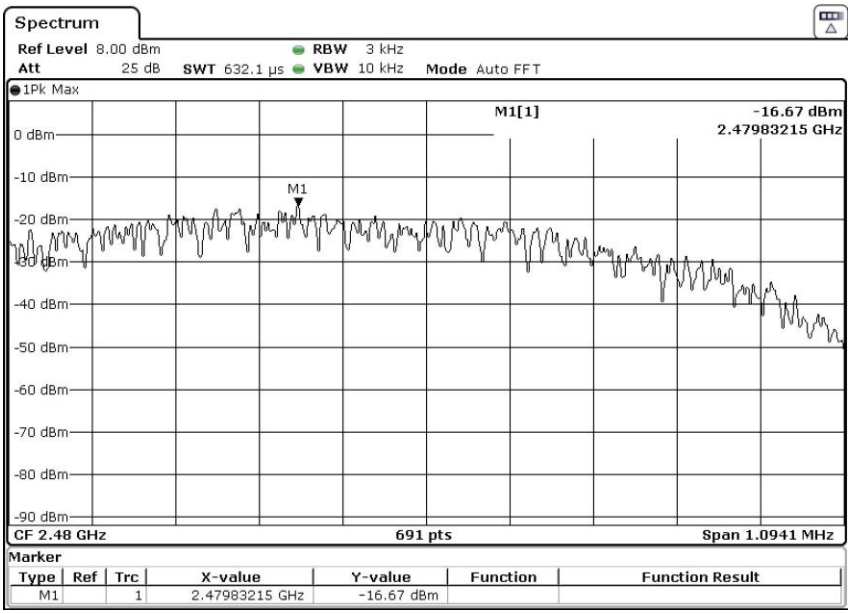
Tx mode GFSK (Tx: 2402MHz to 2480MHz)
CH 0 (2402.0 MHz)



CH 19 (2440.0 MHz)



CH 39 (2480.0 MHz)



3.1.5 6dB Spectrum Bandwidth Measurement

Test Requirement:	FCC 47CFR 15.247(a)(2)
Test Method:	ANSI C63.10:2013
Test Date:	2022-07-26
Mode of Operation:	Tx mode

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. Once the reference level is established, the equipment is conditioned with typical modulating signal to produce the worst-case (i.e. the widest) bandwidth.

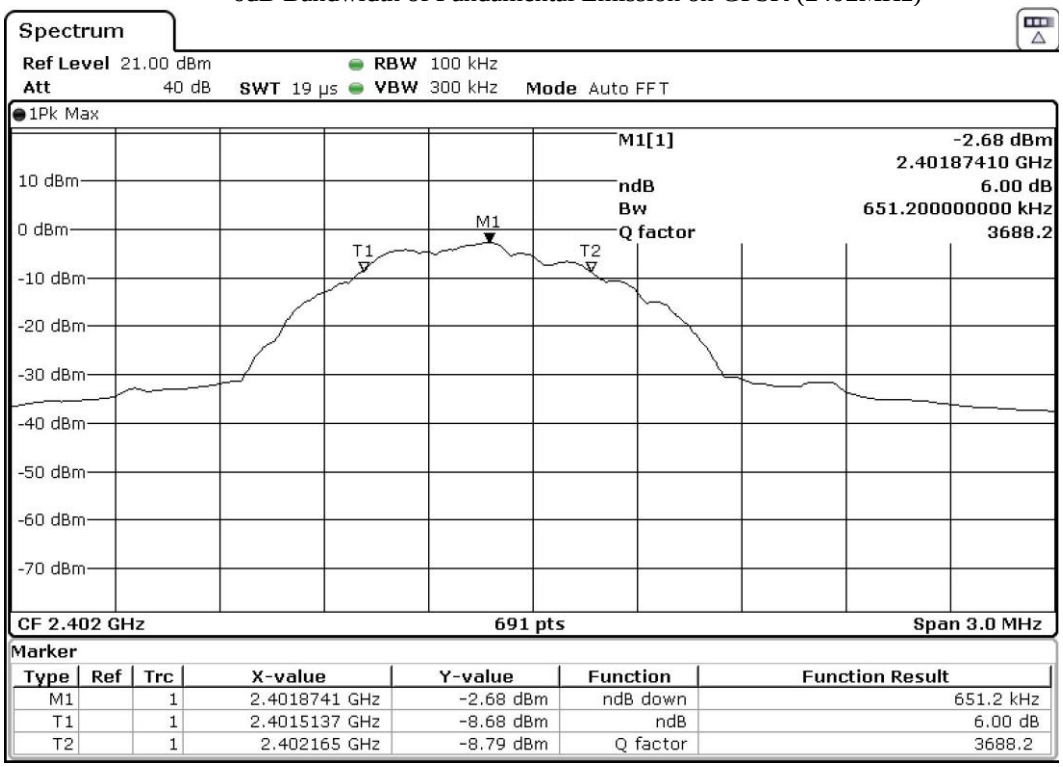
Test Setup:

As Test Setup of clause 3.1.1 in this test report.

Limits for 6dB Spectrum Bandwidth Measurement:

Center Frequency [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
2402.0	651.2	> 500

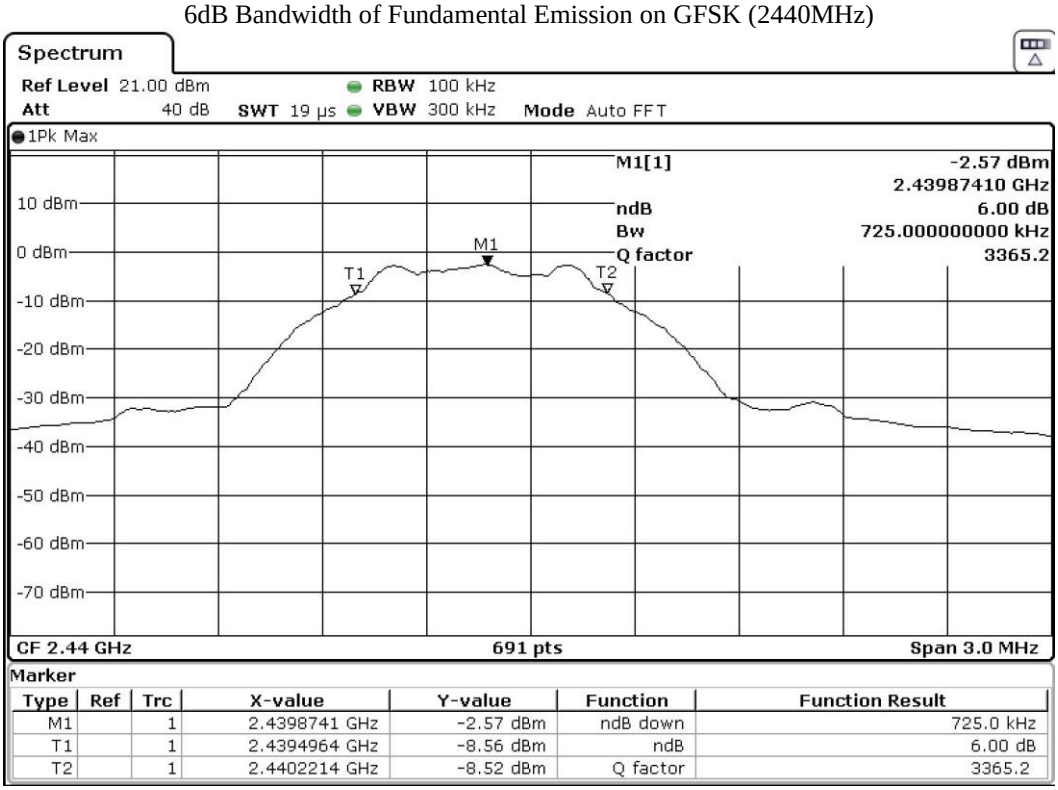
6dB Bandwidth of Fundamental Emission on GFSK (2402MHz)



Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
2440.0	725.0	> 500

6dB Bandwidth of Fundamental Emission on GFSK (2440MHz)

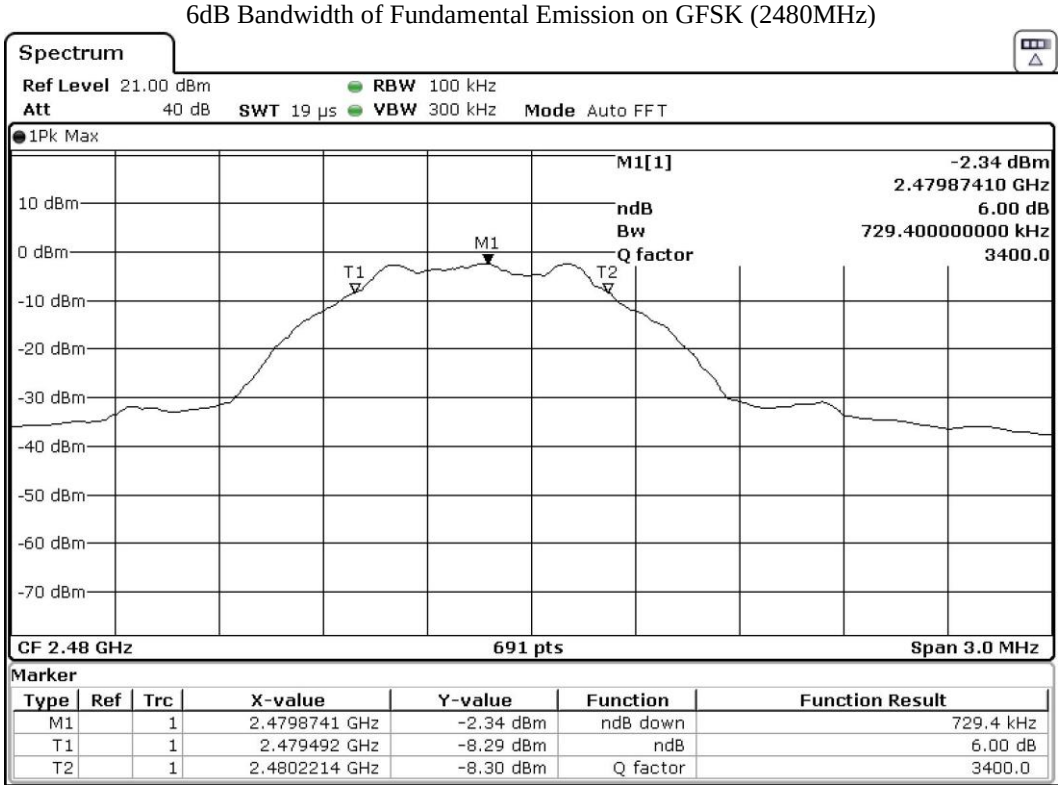


Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4398741 GHz	-2.57 dBm	ndB down	725.0 kHz
T1		1	2.4394964 GHz	-8.56 dBm	ndB	6.00 dB
T2		1	2.4402214 GHz	-8.52 dBm	Q factor	3365.2

Limits for 6dB Spectrum Bandwidth Measurement:

Frequency Range [MHz]	6dB Bandwidth [KHz]	FCC Limits [kHz]
2480.0	729.4	> 500

6dB Bandwidth of Fundamental Emission on GFSK (2480MHz)



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4798741 GHz	-2.34 dBm	ndB down	729.4 kHz
T1		1	2.479492 GHz	-8.29 dBm	ndB	6.00 dB
T2		1	2.4802214 GHz	-8.30 dBm	Q factor	3400.0

3.1.6 Band Edges Measurement

Test Requirement:	FCC 47CFR 15.247
Test Method:	ANSI C63.10:2013
Test Date:	2022-07-27
Mode of Operation:	Tx mode

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Method:

The band edge is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency. The RBW are set to 100kHz and VBW are set to 300kHz for this measurement.

Test Setup:

As Test Setup of clause 3.1.2 in this test report.

Band-edge Compliance of RF Conducted Emissions Measurement:

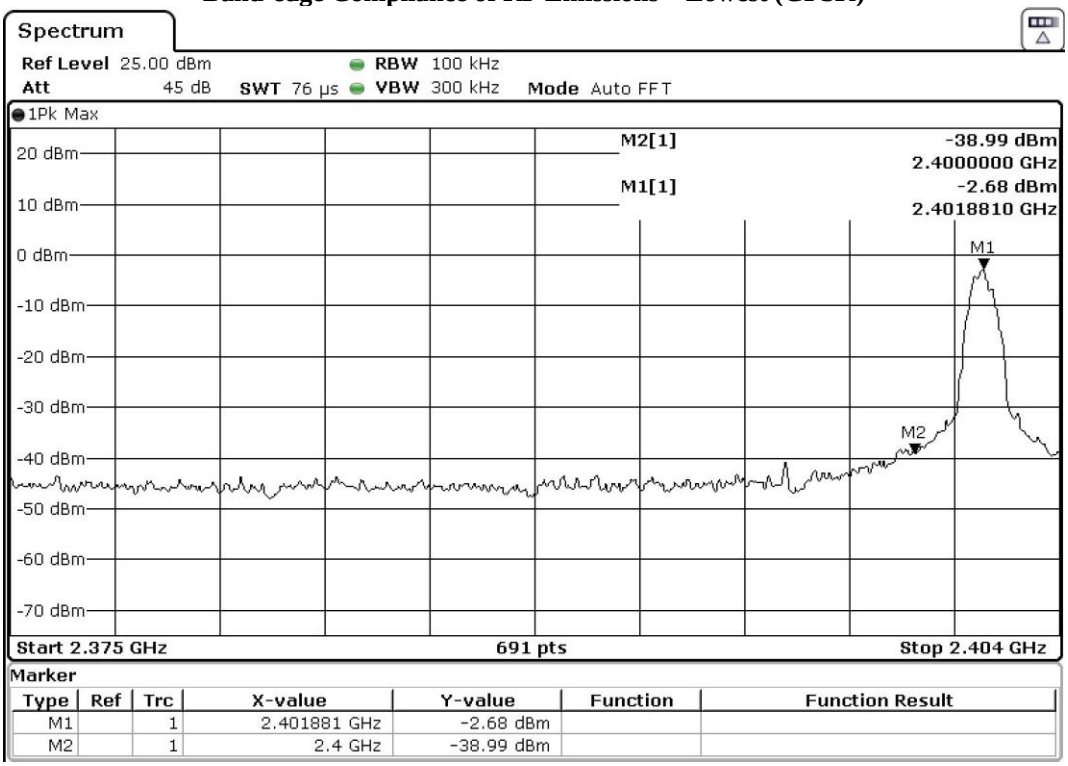
Limit：
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Reference level [dBm]	Limit [dBm]	The highest conducted band edge emission [dBm]	Result
2400 – Lowest Fundamental (2402)	-2.68	-22.68	-38.99	PASS

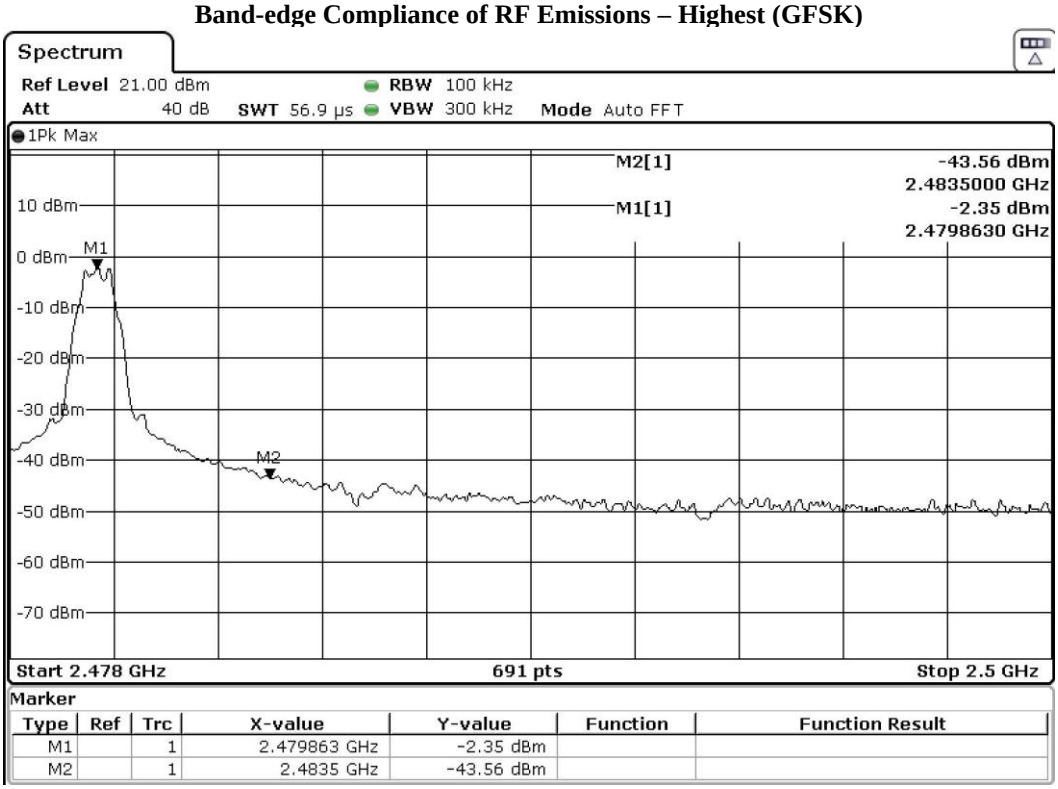
Band-edge Compliance of RF Emissions – Lowest (GFSK)



Band-edge Compliance of RF Conducted Emissions Measurement:

Frequency Range [MHz]	Reference level [dBm]	Limit [dBm]	The highest conducted band edge emission [dBm]	Result
2483.5 - Highest Fundamental (2480)	-2.35	-22.35	-43.56	PASS

Band-edge Compliance of RF Emissions – Highest (GFSK)



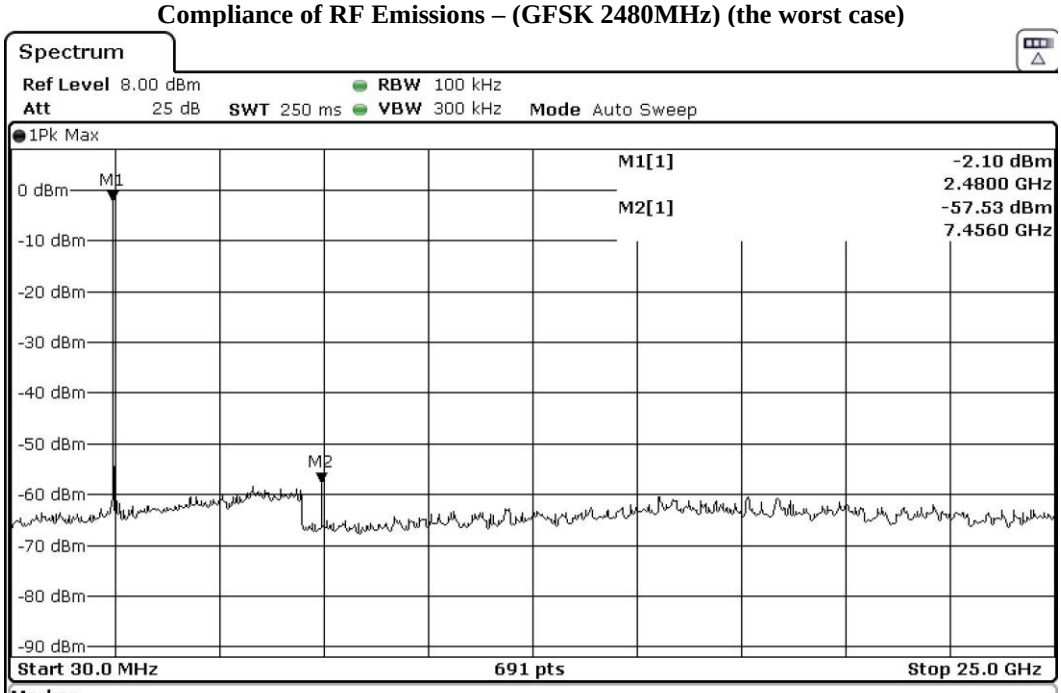
Compliance of RF Emissions Measurement:

Limit：

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

Remark: Emissions under the fixed frequency mode and hopping mode have been investigated, the worst-case measurement results were recorded in the test report

Compliance of RF Emissions – (GFSK 2480MHz) (the worst case)



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48 GHz	-2.10 dBm		
M2		1	7.456 GHz	-57.53 dBm		

3.1.7 Antenna Requirement

Ambient Temperature: 25℃ Relative Humidity: 51% Atmospheric Pressure: 101 kPa

Test Requirements: § 15.203

Test Specification:

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.

Test Results:

This is PCB antenna. There is no external antenna, the antenna gain = 0dBi. User is unable to remove or changed the Antenna.

Appendix A

List of Measurement Equipment

Radiated Emission

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A
EM217	ELECTRIC POWERED TURNTABLE	EMCO	2088	00029144	N/A	N/A
EM218	ANECHOIC CHAMBER	ETS-LINDGREN	FACT-3	--	2019/04/16	2024/04/16
EM356	ANTENNA POSITIONING TOWER	ETS-LINDGREN	2171B	00150346	N/A	N/A
EM293	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	N9020A	MY50510152	2020/11/25	2022/11/25
EM299	BROADBAND HORN ANTENNA	ETS-LINDGREN	3115	00114120	2020/11/24	2022/11/24
EM300	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-09	00130130	2020/11/25	2022/11/25
EM301	PYRAMIDAL STANDARD GAIN HORN ANTENNA	ETS-LINDGREN	3160-10	00130988	2020/11/25	2022/11/25
EM353	LOOP ANTENNA	ETS_LINDGREN	6502	00206533	2020/06/10	2022/09/10
EM355	Biconilog Antenna	ETS-Lindgren	3143B	00094856	2020/06/17	2022/09/17
EM200	DUAL CHANNEL POWER METER	R & S	NRVD	100592	2019/10/11	2022/10/11
EM012	PRE-AMPLIFIER	HP	HP8448B	3008A00262	2019/11/08	2022/11/08
EM215	MULTIDEVICE CONTROLLER	EMCO	2090	00024676	N/A	N/A

Line Conducted

EQP NO.	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CAL	DUE CAL
EM232	LISN	SCHAFFNER	NNB41	04/100082	2021/07/20	2022/07/20
EM181	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	100072	2022/05/30	2023/05/30
EM233	PULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	100314	2021/01/18	2023/01/18
EM154	SHIELDING ROOM	SIEMENS MATSUSHITA COMPONENTS	N/A	803-740-057-99A	2022/02/02	2027/02/02
N/A	MEASUREMENT AND EVALUATION SOFTWARE	ROHDE & SCHWARZ	BSIB-K1	V1.20	N/A	N/A

Remarks:-

CM CORRECTIVE MAINTENANCE
N/A NOT APPLICABLE
TBD TO BE DETERMINED

Appendix B

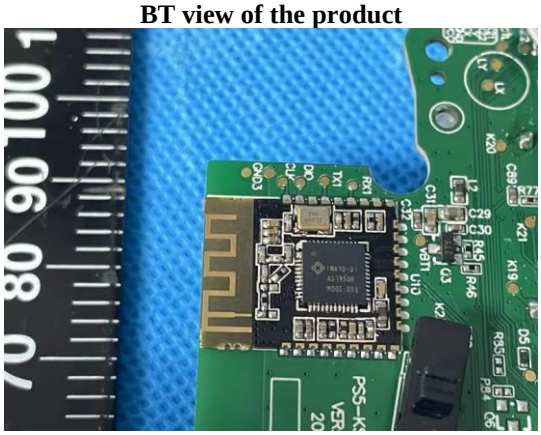
Photographs of EUT

View of the product

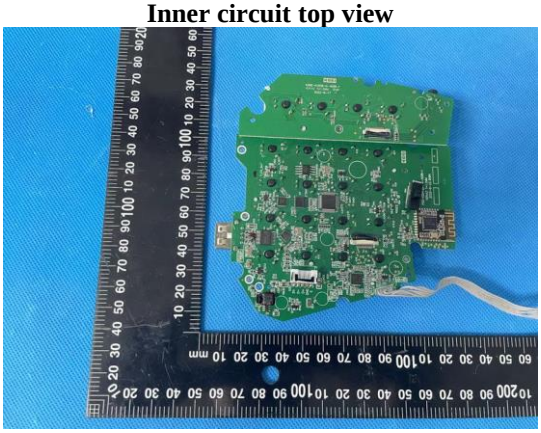
View of the product

Inside View of the product

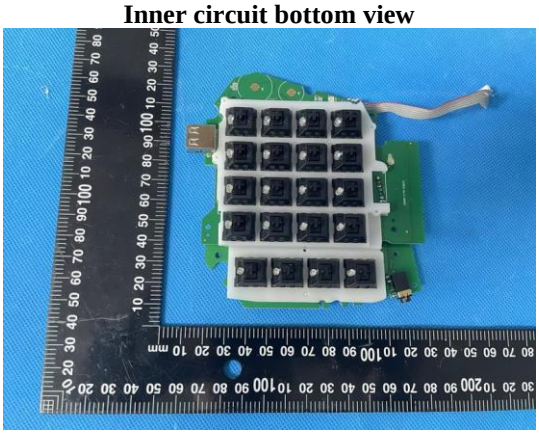
BT view of the product



Inner circuit top view

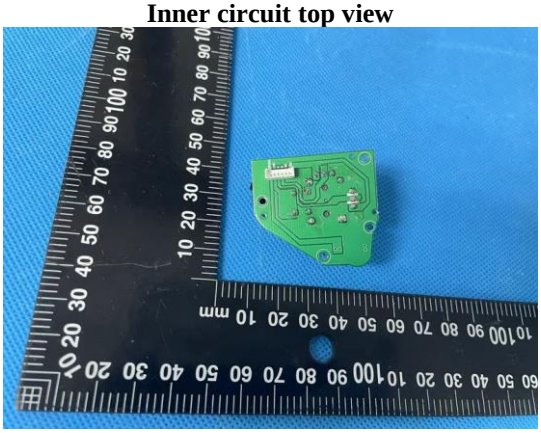


Inner circuit bottom view

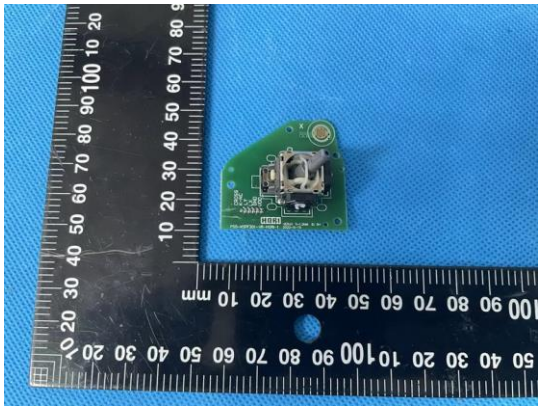


Photographs of EUT

Inner circuit top view

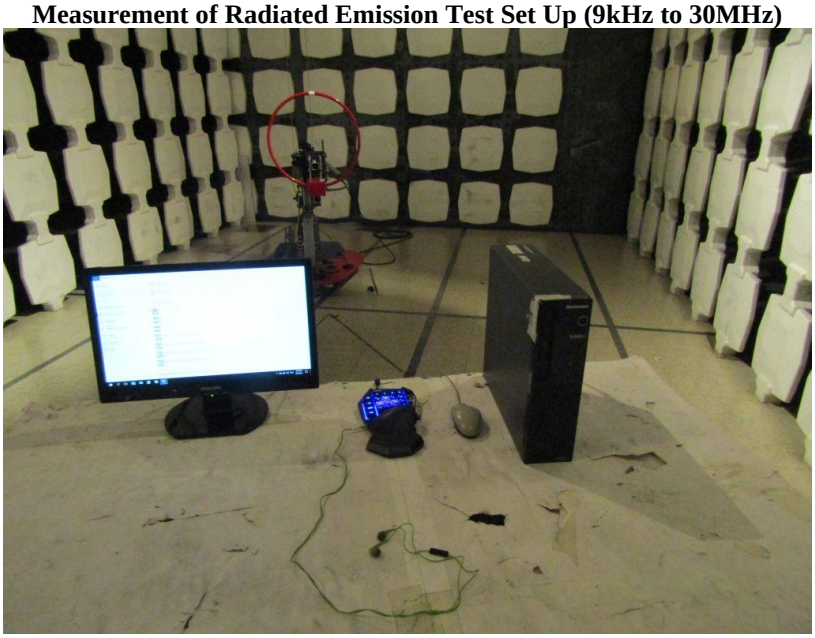


Inner circuit bottom view

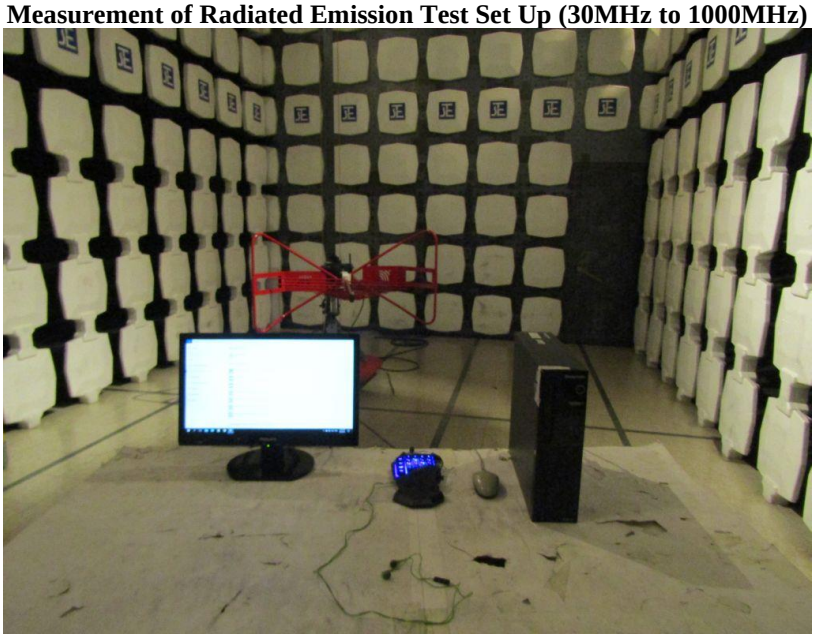


Photographs of EUT

Measurement of Radiated Emission Test Set Up (9kHz to 30MHz)

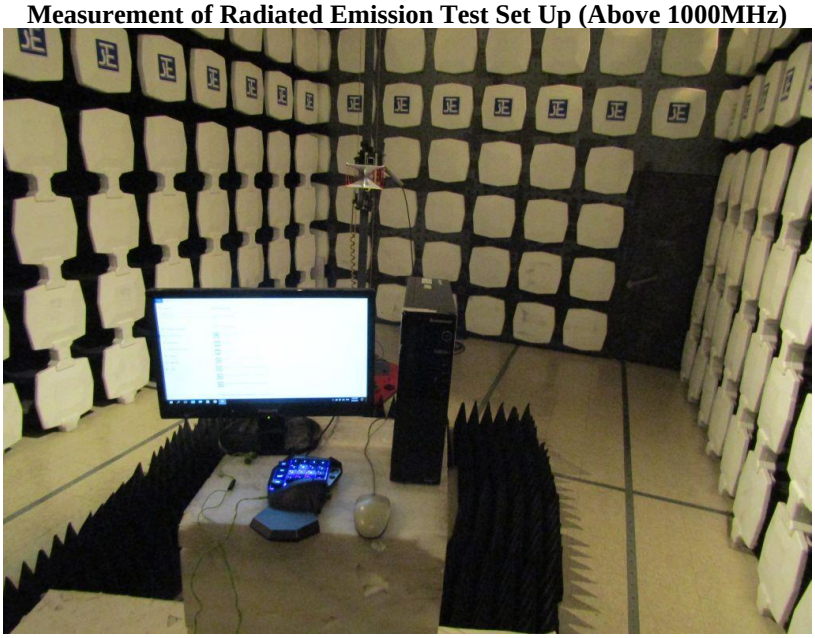


Measurement of Radiated Emission Test Set Up (30MHz to 1000MHz)

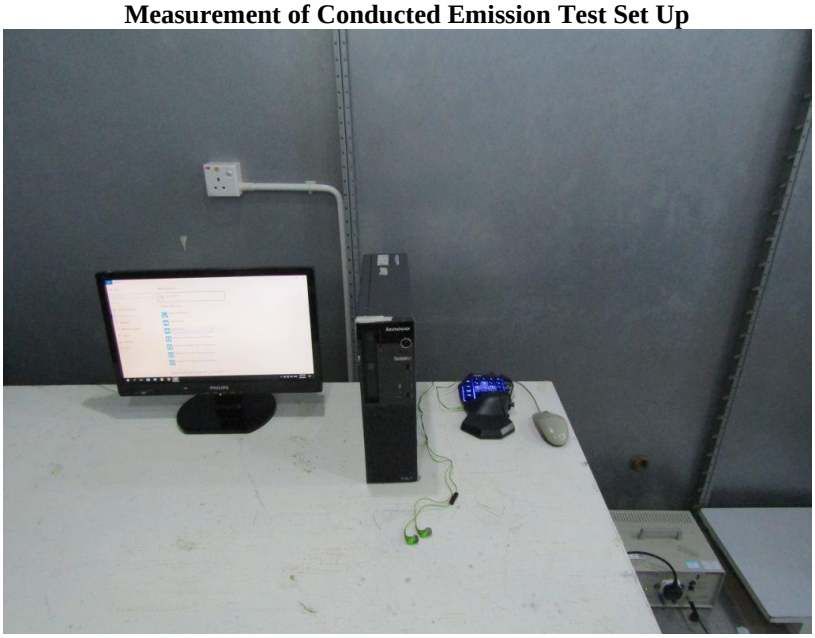


Photographs of EUT

Measurement of Radiated Emission Test Set Up (Above 1000MHz)



Measurement of Conducted Emission Test Set Up



******* End of Test Report *******

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