

TEST REPORT

Client Information:

Applicant: Shenzhen Lingdianlingyi Science Co., Ltd
Applicant add.: Rm106, Building A, TG Science Park, Shiyan, Baoan, Shenzhen, Guangdong China
Manufacturer: Shenzhen Lingdianlingyi Science Co., Ltd
Manufacturer add.: Rm106, Building A, TG Science Park, Shiyan, Baoan, Shenzhen, Guangdong China

Product Information:

Product Name: Bluetooth Mechanical Keyboard
Model No.: Modern97
Brand Name: MelGeek
FCC ID: 2A322-MODERN97

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.249

Prepared By:

Dongguan Yaxu (AiT) Technology Limited

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Date of Receipt: July 03, 2023

Date of Test: July 03~ July 11, 2023

Date of Issue: July 12, 2023

Test Result: Pass

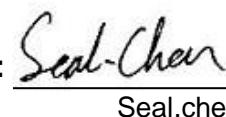
This device described above has been tested by Dongguan Yaxu (AiT) Technology Limited and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Reviewed by:


Simba Huang

Approved by:


Seal.chen

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Revision History

Revision	Issue Date	Revisions	Revised By
000	July 12, 2023	Initial Issue	Seal Chen

2 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	§15.203	Pass
AC Power Line Conducted Emission	§15.207	Pass
Fundamental & Radiated Spurious Emission Measurement	§15.249 (a)/ §15.209	Pass
20dB Channel Bandwidth	15.215(c)	Pass
Band Edge	§15.249 (d)/ §15.205	Pass

Note

1. Test according to ANSI C63.10:2013.
2. The measurement uncertainty is not included in the test result.

2.1 Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the AiT quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

2.2 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	0.009MHz-30MHz	3.10dB	(1)
Radiated Emission	30MHz-1GHz	3.75dB	(1)
Radiated Emission	1GHz-18GHz	3.88dB	(1)
Radiated Emission	18GHz-40GHz	3.88dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	1.20dB	(1)

Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.

3 Test Facility

The test facility is recognized, certified or accredited by the following organizations:

.CNAS- Registration No: L6177

Dongguan Yaxu (AiT) technology Limited is accredited to ISO/IEC 17025:2017 general Requirements for the competence of testing and calibration laboratories (CNAS-CL01 Accreditation Criteria for the competence of testing and calibration laboratories) on April 18, 2022

FCC-Registration No.: 703111 Designation Number: CN1313

Dongguan Yaxu (AiT) technology Limited has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

IC—Registration No.: 6819A CAB identifier: CN0122

The 3m Semi-anechoic chamber of Dongguan Yaxu (AiT) technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 6819A

A2LA-Lab Cert. No.: 6317.01

Dongguan Yaxu (AiT) technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

3.1 Deviation from standard

None

3.2 Abnormalities from standard conditions

None

3.3 Test Location

Dongguan Yaxu (AiT) Technology Limited

Address: No.22, Jinqianling 3rd Street, Jitigang, Huangjiang, Dongguan, Guangdong, China

Tel.: +86-769-8202 0499

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4 General Information

EUT Name:	Bluetooth Mechanical Keyboard
Model No:	Modern97
Serial Model:	N/A
Test sample(s) ID:	23070309
Sample(s) Status:	Engineer sample:
Operation frequency:	2405MHz-2473MHz
Channel Number:	32 channels
Modulation Technology:	GFSK
Antenna Type:	Chip Antenna
Antenna gain:	1.75dBi
H/W No.:	N/A
S/W No.:	N/A
Power supply:	DC5V from adapter or DC3.7V from battery
Model different:	N/A
Note:	For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

4.1 Test frequencies

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2405	13	2431	25	2459
02	2407	14	2433	26	2461
03	2409	15	2435	27	2463
04	2411	16	2439	28	2465
05	2413	17	2441	29	2467
06	2415	18	2443	30	2469
07	2417	19	2445	31	2471
08	2419	20	2447	32	2473
09	2421	21	2449		
10	2423	22	2451		
11	2425	23	2455		
12	2427	24	2457		

4.2 EUT Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	Signal cord
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A

4.3 Test Peripheral List

No.	Equipment	Manufacturer	EMC Compliance	Model No.	Serial No.	Power cord	Signal cord
1	Adapter	NOKIA	CE	AD-10WU	N/A	21/	N/A

4.4 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Dongguan Yaxu (AiT) Technology Limit.

EUT Configuration

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

EUT Exercise

The EUT was operated in the normal operating mode and a continuous transmits mode for other tests.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209, 15.247 under the FCC Rules Part 15 Subpart C and RSS-247 Issue 2, RSS-Gen Issue 5.

General Test Procedures

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013.

4.5 Description of Test Modes

The EUT has been tested under operating condition.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was determined to be TX(1Mbps-Low Channel).

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Transmitting mode	Keep the EUT in continuously transmitting mode.		
Test software:	putty		
Frequency	2405 MHz	2441 MHz	2473 MHz
Parameters	Default	Default	Default

5 Equipment Used during Test

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	Spectrum Analyzer	R&S	FSV40	101470	2022.09.02	2023.09.01
2	EMI Measuring Receiver	R&S	ESR	101160	2022.09.02	2023.09.01
3	Low Noise Pre Amplifier	HP	HP8447E	1937A01855	2022.09.02	2023.09.01
4	Low Noise Pre Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2022.09.02	2023.09.01
5	Passive Loop	ETS	6512	00165355	2022.09.04	2024.09.03
6	TRILOG Super Broadband test Antenna	SCHWARZBECK	VULB9160	9160-3206	2021.08.29	2024.08.28
7	Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	452	2021.08.29	2024.08.28
8	SHF-EHF Horn Antenna 15-40GHz	SCHWARZBECK	BBHA9170	BBHA917036 7d	2020.11.24	2023.11.23
9	EMI Test Receiver	R&S	ESCI	100124	2022.09.02	2023.09.01
10	LISN	Kyoritsu	KNW-242	8-837-4	2022.09.02	2023.09.01
11	LISN	R&S	ESH3-Z2	0357.8810.54-101161-S2	2022.09.02	2023.09.01
12	Pro.Temp&Humi.chamber	MENTEK	MHP-150-1C	MAA0811250 1	2022.09.02	2023.09.01
13	RF Automatic Test system	MW	MW100-RFCB	21033016	2022.09.02	2023.09.01
14	Signal Generator	Agilent	N5182A	MY50143009	2022.09.02	2023.09.01
15	Wideband Radio communication tester	R&S	CMW500	1201.0002K5 0	2022.09.02	2023.09.01
16	RF Automatic Test system	MW	MW100-RFCB	21033016	2022.09.02	2023.09.01
17	DC power supply	ZHAOXIN	RXN-305D-2	2807000255 9	N/A	N/A
18	RE Software	EZ	EZ-EMC_RE	Ver.AIT-03A	N/A	N/A
19	CE Software	EZ	EZ-EMC_CE	Ver.AIT-03A	N/A	N/A
20	RF Software	MW	MTS 8310	2.0.0.0	N/A	N/A
21	temporary antenna connector(Note)	NTS	R001	N/A	N/A	N/A

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

6 Test Results and Measurement Data

6.1 Antenna requirement

6.1.1 Standard requirement:

15.203 requirement:

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, 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.

6.1.2 EUT Antenna:

The antenna is Chip Antenna, the best case gain of the antenna is 1.75dBi, reference to the appendix for details

6.2 20 dB Spectrum Bandwidth Measurement

6.4.1 Standard requirement:

FCC Part15 C Section part 15.249/15.215(c):

FCC Part15 (15.249) , Subpart C			
Section	Test Item	Frequency Range (MHz)	Result
Part 15.215(c)	Bandwidth	2400-2483.5	PASS

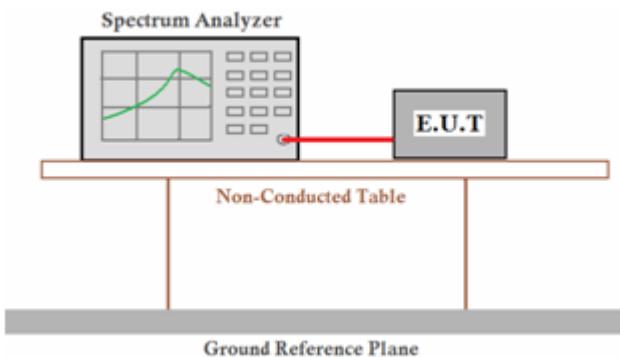
6.4.2 Measuring Instruments:

Please refer to equipment's list in this report.

6.4.3 Test Procedures

1. Set resolution bandwidth (RBW) = 1-5% or DTS BW, not to exceed 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 20 dB relative to the maximum level measured in the fundamental emission.

6.4.4 Test Setup Layout



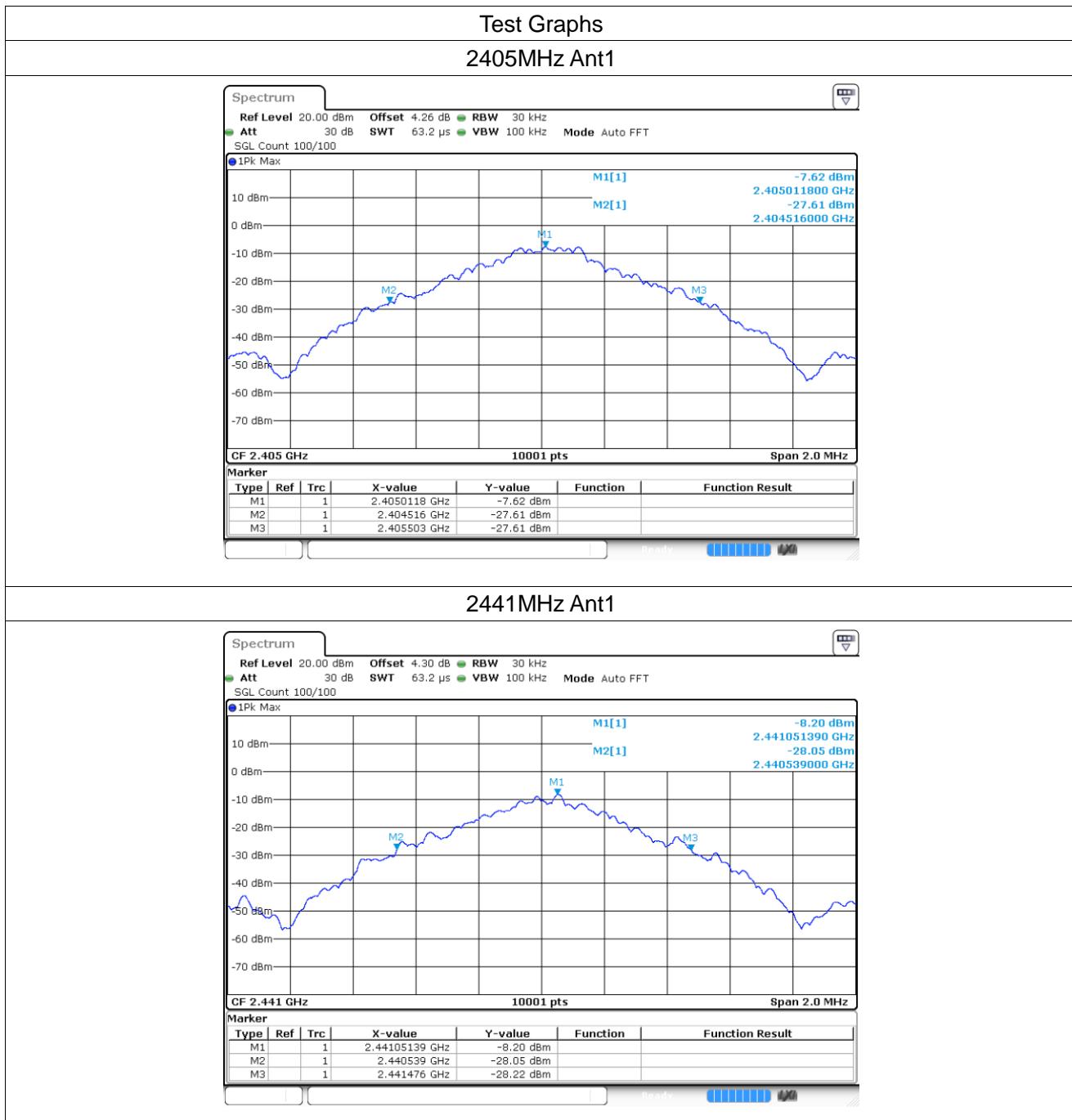
6.4.5 EUT Operation during Test

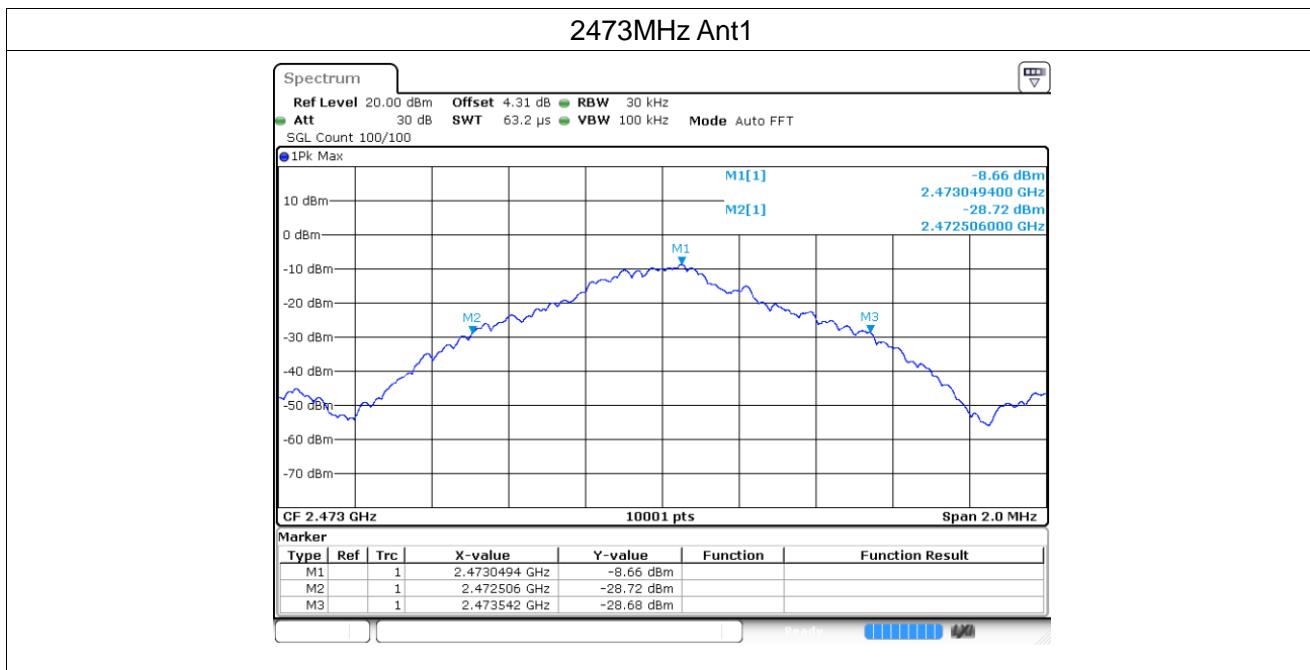
The EUT was programmed to be in continuously transmitting mode.

6.4.6 Test result

PASS

Frequency (MHz)	Ant.	-20 dB Bandwidth (MHz)	Limit -20 dB Bandwidth (MHz)	Verdict
2405	Ant1	0.987	/	Pass
2441	Ant1	0.937	/	Pass
2473	Ant1	1.035	/	Pass





Remark:

- 1). Measured 20dB Bandwidth at difference data rate for each mode and recorded worst case for each mode.
- 2). Test results including cable loss;

6.3 Radiated Emissions Measurement

6.8.1 Standard requirement:

FCC Part15 C Section 15.209 :

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

Band-edge Measurements

According to §15.249 (d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation

6.8.2 Measuring Instruments and Setting:

Please refer to equipment list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10 th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average
RB / VB (Emission in non-restricted band)	1MHz / 1MHz for Peak, 1 MHz / 1/B kHz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1kHz for QP/AVG
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30kHz for QP/AVG
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

6.8.3 Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.0 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Premeasurement:

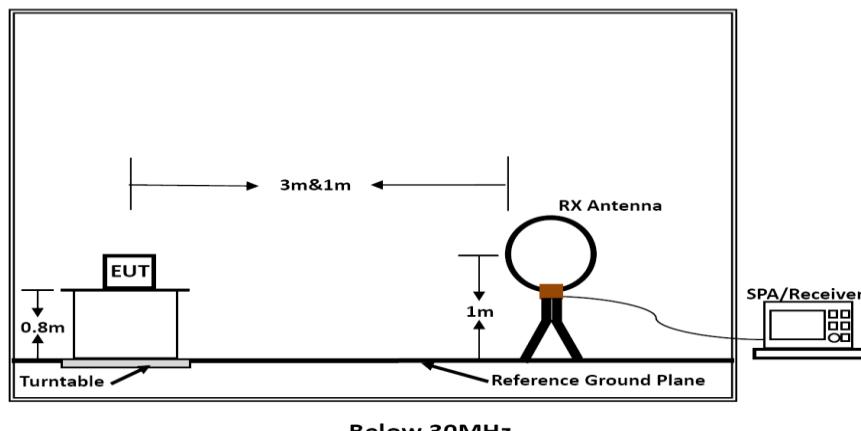
--- The antenna is moved spherical over the EUT in different polarisations of the antenna.

Final measurement:

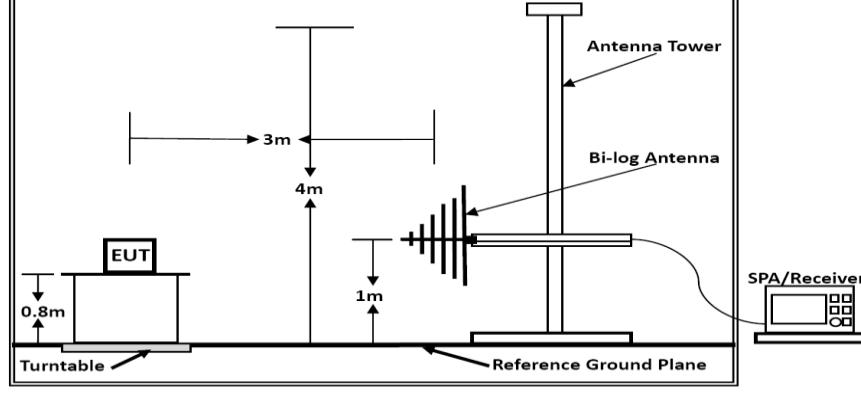
--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.

--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

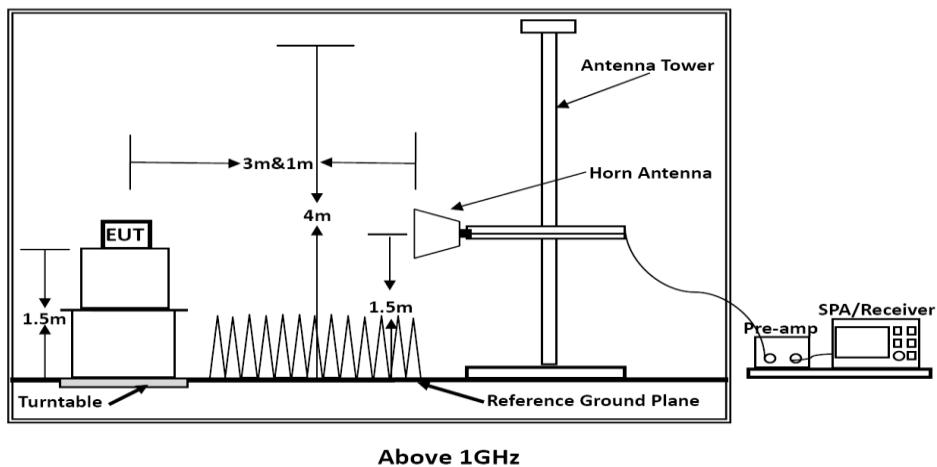
6.8.4 Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1m]})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

6.8.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

6.8.6 Test result

Temperature	25.8°C	Humidity	52.4%
Test Engineer	Simba Huang	Configurations	TX

Remarks:

1. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which is worse case.

6.3.1 Field Strength of the Fundamental Signal

Peak value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2405	94.44	-5.63	88.81	114.00	-25.19	Vertical
2405	96.64	-5.63	91.01	114.00	-22.99	Horizontal
2441	93.07	-5.35	87.72	114.00	-26.28	Vertical
2441	94.52	-5.35	89.17	114.00	-24.83	Horizontal
2473	93.02	-5.06	87.96	114.00	-26.04	Vertical
2473	94.91	-5.06	89.85	114.00	-24.15	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2405	76.83	-5.53	71.30	94.00	-22.70	Vertical
2405	81.91	-5.53	76.38	94.00	-17.62	Horizontal
2441	77.42	-5.36	72.06	94.00	-21.94	Vertical
2441	81.62	-5.36	76.26	94.00	-17.74	Horizontal
2473	76.89	-5.18	71.71	94.00	-22.29	Vertical
2473	77.80	-5.18	72.62	94.00	-21.38	Horizontal

Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

6.3.2 Spurious emissions

■ Results of Radiated Emissions (9 KHz~30MHz)

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dBuV)	Remark
-	-	-	-	See Note

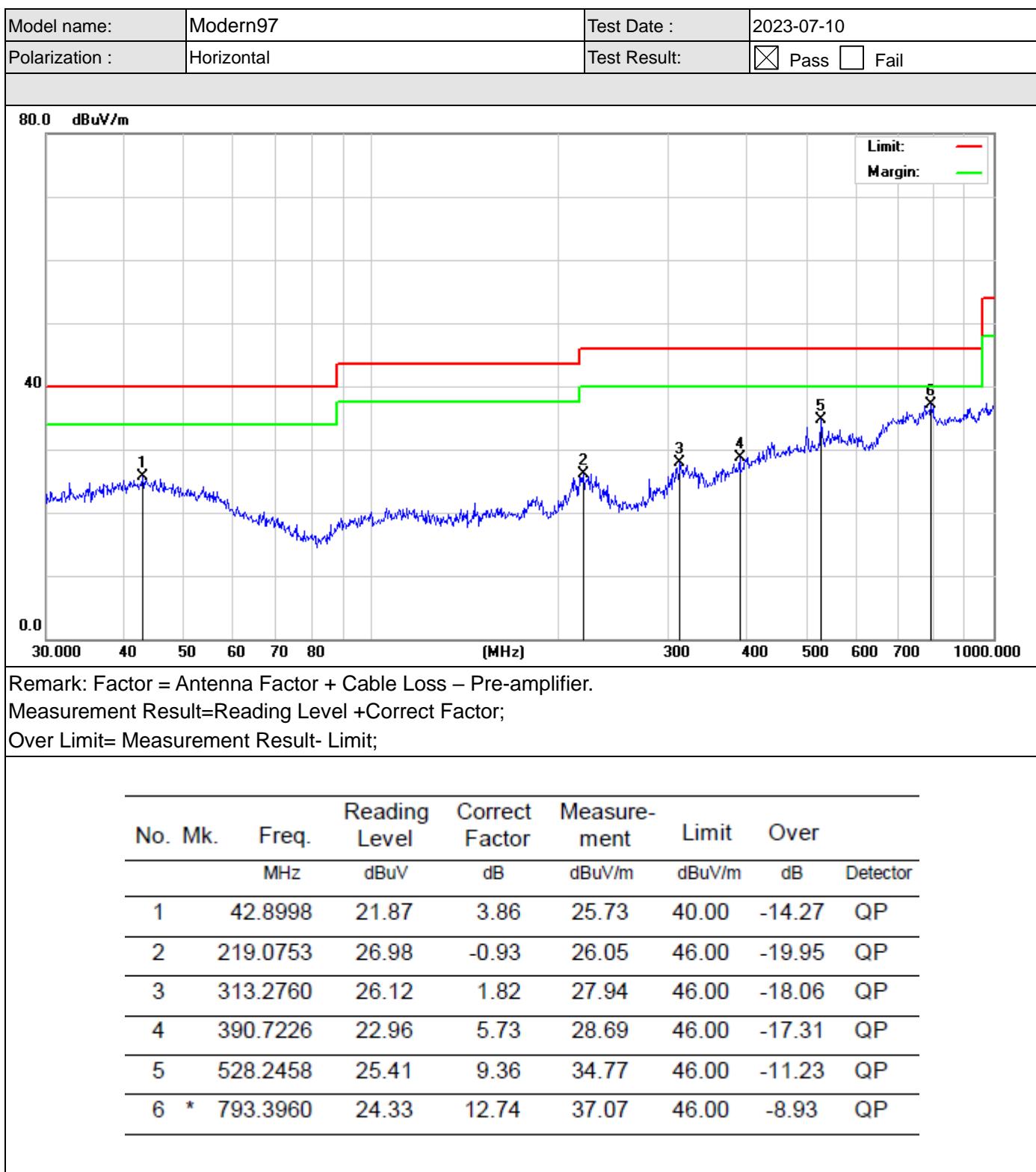
Note:

The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and the permissible value has no need to be reported.

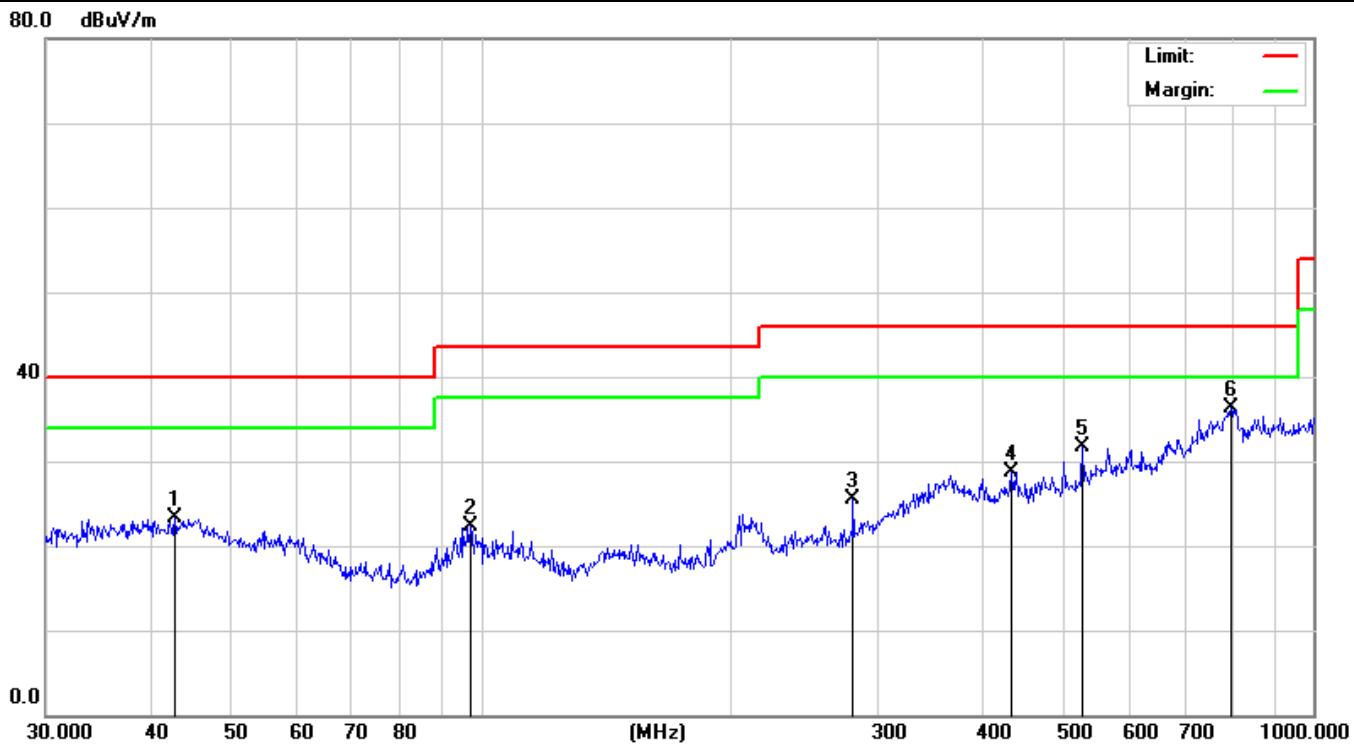
Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);
Limit line = specific limits (dBuV) + distance extrapolation factor.

■ Results of Radiated Emissions (30MHz~1GHz)

Pre-scan all test modes, found worst case at GFSK (LCH), and so only show the test result of GFSK (LCH).



Model name:	Modern97	Test Date :	2023-07-10
Polarization :	Vertical	Test Result:	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> 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		42.8998	21.88	1.47	23.35	40.00	-16.65	QP
2		97.1148	25.70	-3.36	22.34	43.50	-21.16	QP
3		280.0237	25.03	0.45	25.48	46.00	-20.52	QP
4		434.0651	23.90	4.83	28.73	46.00	-17.27	QP
5		528.2458	25.85	5.85	31.70	46.00	-14.30	QP
6	*	796.1830	23.39	12.89	36.28	46.00	-9.72	QP

Results for Radiated Emissions (1- 26 GHz)

Test channel:	Lowest
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Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4810.000	48.02	5.07	52.59	74.00	-21.41	Vertical
7215.000	39.43	7.07	45.51	74.00	-28.49	Vertical
4810.000	47.10	5.07	51.86	74.00	-22.14	Horizontal
7215.000	40.44	7.07	46.59	74.00	-27.41	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4810.000	33.27	5.07	37.48	54.00	-16.52	Vertical
7215.000	30.57	7.07	37.33	54.00	-16.67	Vertical
4810.000	37.31	5.07	41.94	54.00	-12.06	Horizontal
7215.000	32.07	7.07	38.32	54.00	-15.68	Horizontal

Test channel:	Middle
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4882.000	47.51	5.14	52.50	74.00	-21.50	Vertical
7323.000	42.36	7.52	49.77	74.00	-24.23	Vertical
4882.000	49.07	5.14	53.31	74.00	-20.69	Horizontal
7323.000	42.62	7.52	49.88	74.00	-24.12	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4882.000	34.76	5.14	39.41	54.00	-14.59	Vertical
7323.000	33.35	7.52	39.96	54.00	-14.04	Vertical
4882.000	36.98	5.14	41.37	54.00	-12.63	Horizontal
7323.000	32.65	7.52	39.57	54.00	-14.43	Horizontal

Test channel:	Highest
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4946.000	47.42	5.21	52.63	74.00	-21.37	Vertical
7419.000	44.47	7.96	51.55	74.00	-22.45	Vertical
4946.000	48.48	5.21	53.54	74.00	-20.46	Horizontal
7419.000	43.67	7.96	50.70	74.00	-23.30	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
4946.000	33.03	5.21	37.62	54.00	-16.38	Vertical
7419.000	31.77	7.96	39.32	54.00	-14.68	Vertical
4946.000	34.36	5.21	39.50	54.00	-14.50	Horizontal
7419.000	31.93	7.96	39.23	54.00	-14.77	Horizontal

Remarks:

- 1). Measuring frequencies from 9 KHz - 10th harmonic or 26.5GHz (which is less), No emission found between lowest internal used/generated frequency to 30MHz.
- 2). Radiated emissions measured in frequency range from 9 KHz~10th harmonic or 26.5GHz (which is less) were made with an instrument using Peak detector mode.
- 3). Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 4). Margin= Final Level – Limit
- 5).Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
- 6). All the modes have been tested and the only shows the worst case GFSK mode

6.3.3 Band-edge Measurements

All of the restriction bands were tested, and only the data of worst case was exhibited.

Test channel:	Lowest channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2310.000	43.50	-5.92	37.58	74.00	-36.42	Vertical
2390.000	43.48	-5.79	37.69	74.00	-36.31	Vertical
2310.000	44.38	-5.92	38.46	74.00	-35.54	Horizontal
2390.000	44.10	-5.79	38.31	74.00	-35.69	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2310.000	30.35	-5.92	24.43	54.00	-29.57	Vertical
2390.000	30.05	-5.79	24.26	54.00	-29.74	Vertical
2310.000	29.20	-5.92	23.28	54.00	-30.72	Horizontal
2390.000	29.37	-5.79	23.58	54.00	-30.42	Horizontal

Test channel:	Highest channel
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Peak value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2483.500	45.65	-4.98	40.67	74.00	-33.33	Vertical
2500.00	46.08	-4.83	41.25	74.00	-32.75	Vertical
2483.500	44.65	-4.98	39.67	74.00	-34.33	Horizontal
2500.000	44.86	-4.83	40.03	74.00	-33.97	Horizontal

Average value:

Frequency (MHz)	Read Level (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2483.500	34.43	-4.98	29.45	54.00	-24.55	Vertical
2500.00	34.37	-4.83	29.54	54.00	-24.46	Vertical
2483.500	32.58	-4.98	27.60	54.00	-26.40	Horizontal
2500.000	28.52	-4.83	23.69	54.00	-30.31	Horizontal

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

6.4 Conducted Emissions

6.9.1 Standard requirement:

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

6.9.2 Measuring Instruments and Setting:

Please refer to equipment list in this report. The following table is the setting of the spectrum analyzer.

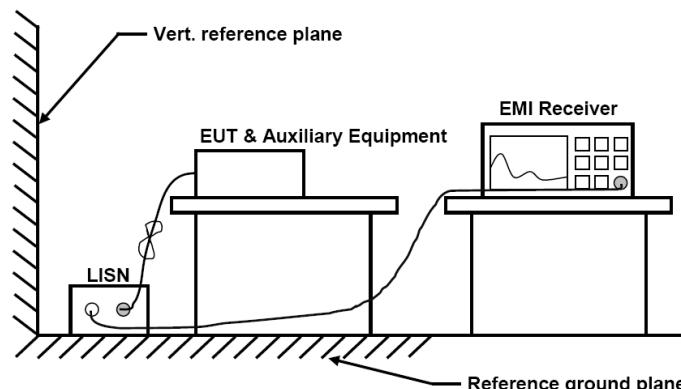
Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
RB / VB (Emission in restricted band)	100KHz/300KHz
RB / VB (Emission in non-restricted band)	100KHz/300KHz

6.9.3 Test Procedures

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz

The spectrum from 9 kHz to 26.5GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

6.9.4 Test Setup Layout



6.9.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

6.9.6 Test result

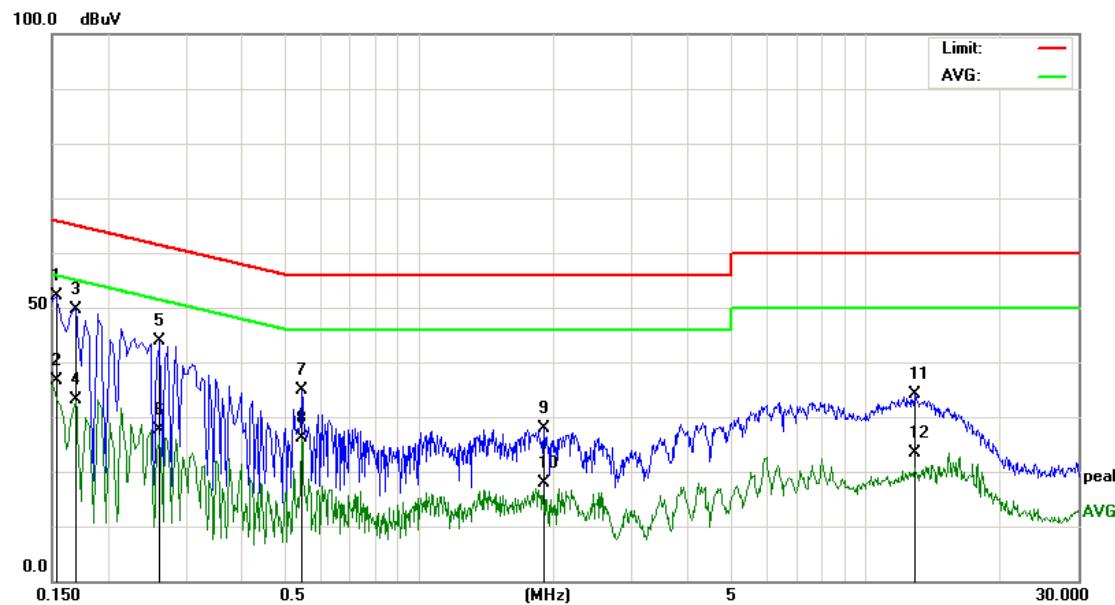
PASS

The test data please refer to following page

Measurement data:

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

Model name:	Modern97	Test Date :	2023-07-10
Temperature:	25.8C	Relative Humidity:	52.4%
ATM Pressure:	101 kPa	Test by:	Simba Huang
Phase :	Line	Test Result:	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail



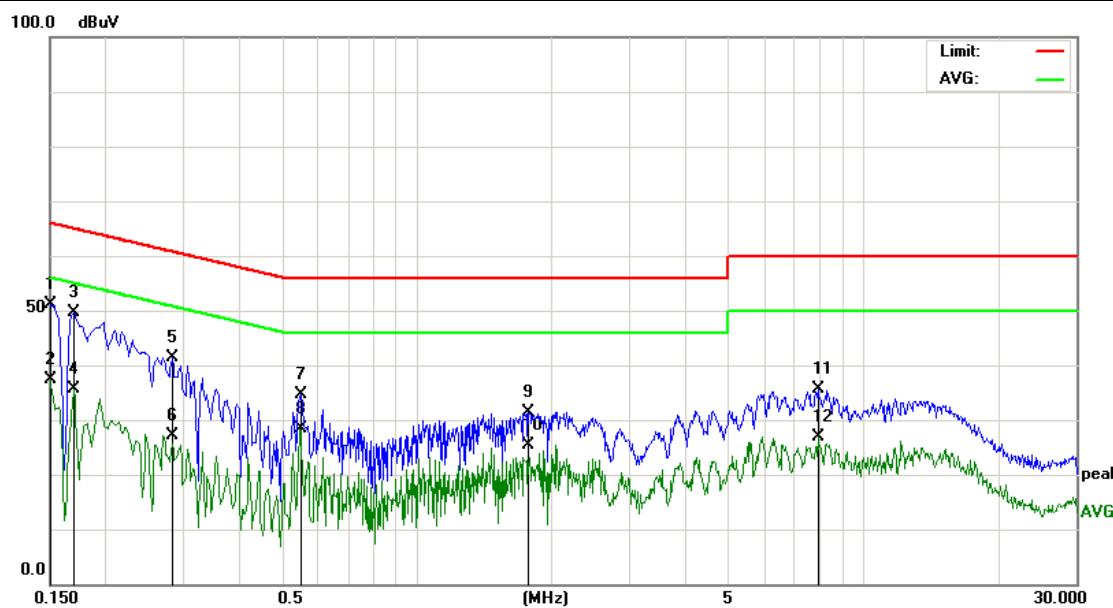
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over
			Level	Factor	ment		
		MHz	dBuV	dB	dBuV	dB	Detector
1	*	0.1539	40.23	11.84	52.07	65.78	-13.71 QP
2		0.1539	24.73	11.84	36.57	55.78	-19.21 AVG
3		0.1700	38.14	11.55	49.69	64.96	-15.27 QP
4		0.1700	21.68	11.55	33.23	54.96	-21.73 AVG
5		0.2620	32.98	10.85	43.83	61.36	-17.53 QP
6		0.2620	16.76	10.85	27.61	51.36	-23.75 AVG
7		0.5460	24.97	10.00	34.97	56.00	-21.03 QP
8		0.5460	16.10	10.00	26.10	46.00	-19.90 AVG
9		1.8980	17.77	9.99	27.76	56.00	-28.24 QP
10		1.8980	7.78	9.99	17.77	46.00	-28.23 AVG
11		12.9819	23.82	10.36	34.18	60.00	-25.82 QP
12		12.9819	13.14	10.36	23.50	50.00	-26.50 AVG

Model name:	Modern97	Test Date :	2023-07-10
Temperature:	25.8° C	Relative Humidity:	52.4%
ATM Pressure:	101 kPa	Test by:	Simba Huang
Phase :	Neutral	Test Result:	<input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail



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

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over
			Level	Factor	ment		
		MHz	dBuV	dB	dBuV	dB	Detector
1	*	0.1500	39.08	11.94	51.02	65.99	-14.97 QP
2		0.1500	25.49	11.94	37.43	55.99	-18.56 AVG
3		0.1700	38.18	11.55	49.73	64.96	-15.23 QP
4		0.1700	23.97	11.55	35.52	54.96	-19.44 AVG
5		0.2819	30.74	10.73	41.47	60.76	-19.29 QP
6		0.2819	16.29	10.73	27.02	50.76	-23.74 AVG
7		0.5500	24.71	10.00	34.71	56.00	-21.29 QP
8		0.5500	18.46	10.00	28.46	46.00	-17.54 AVG
9		1.7740	21.52	9.98	31.50	56.00	-24.50 QP
10		1.7740	15.42	9.98	25.40	46.00	-20.60 AVG
11		7.9180	25.34	10.19	35.53	60.00	-24.47 QP
12		7.9180	16.77	10.19	26.96	50.00	-23.04 AVG

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level =Receiver Read level + LISN Factor + Cable Loss
4. *If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.*

7 Test Setup Photo

Reference to the **appendix Setup photo** for details.

8 EUT Constructional Details

Reference to the appendix **External EUT photo & Internal EUT photo** for details.

-----End-----