

Tejjer Technology Co., Ltd

RF TEST REPORT

Report Type:

FCC Part 15.249 RF report

Model:

XN297

REPORT NUMBER:

230500186HAN-001

ISSUE DATE:

December 25, 2023

DOCUMENT CONTROL NUMBER:

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Applicant: Tejjer Technology Co., Ltd.
128 Hailiang Road, Sanjia Subdistrict, Jiaojiang, Taizhou, Zhejiang,
318000, China

Manufacturer: Same As Applicant

Factory: Same As Applicant

PRODUCT NAME: RF Module

TYPE/MODEL: XN297

FCC ID: 2AXTW-XN297

IC: 26591-XN297

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

47CFR Part 15 (2020): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-210 Issue 9 (August 2016): Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

RSS-Gen Issue 5 (April 2018): General Requirements for Compliance of Radio Apparatus

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TEST REPORT

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Revision History

Report No.	Version	Description	Issued Date
230500186HAN-001	Rev. 01	Initial issue of report	December 25, 2023

Measurement result summary

TEST ITEM	FCC REFERENCE	IC REFERENCE	RESULT
Radiated emission	15.249 & 15.209	RSS-210 Issue 9 Clause B.10	Pass
Power line conducted emission	15.207	RSS-Gen Issue 5 Clause 8.8	N/A
Assigned bandwidth (20dB bandwidth)	15.215(c)	RSS-Gen Issue 5 Clause 6.7	Pass
Antenna requirement	15.203	-	Pass

Notes: 1: NA =Not Applicable

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1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	RF Module
Type/Model:	XN297
Description of EUT:	The RF module is designed for 2.4GHz ISM band wireless applications using GFSK transceiver. The module has a three-wire SPI interface for communication. The maximum data rate is 4Mbps
Rating:	3VDC
Category of EUT:	Class B
EUT type:	<input checked="" type="checkbox"/> Tabletop <input type="checkbox"/> Floor standing
Software Version:	/
HVIN:	XN297
PWM:	XN297
Sample Identification No.:	/
Sample received date:	June 10, 2023
Date of test:	June 11-12, 2023

1.2 Technical Specification

Operation Frequency:	2410MHz ~ 2470MHz
Support Standards:	SRD
Type of Modulation:	GFSK
Product Type:	<input type="checkbox"/> Mobile <input checked="" type="checkbox"/> Portable <input type="checkbox"/> Fix Location
Channel Number:	7
Antenna Designation:	Integral PCB antenna
Gain of Antenna:	1.22 dBi max

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1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road (North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN0175
	IC Registration Lab CAB identifier.: CN0014
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2020)

ANSI C63.10 (2013)

RSS-210 Issue 9 (August 2016)

RSS-Gen Issue 5 (April 2018)

2.2 Mode of operation during the test

The EUT is a handheld device, so three axes (X, Y, Z) were observed while the test receiver worked as “max hold” continuously and the highest reading among the whole test procedure was recorded.

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

- 1) Radiated test mode: EUT transmitted signal with antenna.

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)	2402 ~ 2480
Channel	Frequency (MHz)
0	2410
1	2420
2	2430
3	2440
4	2450
5	2460
6	2470

The test setting software is offered by the manufactory. The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases.

Test software and Power Setting parameter			
Test Software	None		
Working Mode	SRD		
Test Channel	2410MHz	2440MHz	2470MHz
Power Setting	Default	Default	Default

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

- 1) Radiated test mode: EUT transmitted signal with BT antenna;
- 2) Conducted test mode: EUT transmitted signal from BT RF port connected to SPA directly;

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2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
None	None	None	None

2.5 Test environment condition:

Test items	Temperature	Humidity
Fundamental & spurious emission & Restrict band radiated emission	24°C	53% RH
Power line conducted emission	N/A	N/A
Emission bandwidth & Transmission Time	24°C	49% RH

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2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input type="checkbox"/>	Test Receiver	R&S	ESR7	EC 6194	2024-02-08
<input type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2023-11-08
<input type="checkbox"/>	Attenuator	Hua Xiang	Ts5-10db-6g	EC 6194-1	2023-12-07
<input type="checkbox"/>	Shielded room	Zhongyu	-	EC 2838	2024-01-11
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESIB 26	EC 3045	2024-08-24
<input checked="" type="checkbox"/>	Bilog Antenna	TESEQ	CBL 6112B	EC 6411	2024-08-22
<input checked="" type="checkbox"/>	Pre-amplifier	tonscend	tap01018050	EC 6432-1	2023-12-07
<input checked="" type="checkbox"/>	Horn antenna	tonscend	bha9120d	EC 6432-2	2024-02-15
<input type="checkbox"/>	Horn antenna	ETS	3117	EC 4792-1	2024-08-27
<input type="checkbox"/>	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2024-07-28
<input type="checkbox"/>	Pre-amplifier	R&S	AFS42-00301800 -25-S-42	EC 5262	2024-06-15
<input checked="" type="checkbox"/>	Semi-anechoic chamber	Albatross project	-	EC 3048	2024-07-08
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2024-03-05
<input checked="" type="checkbox"/>	Power sensor	Agilent	U2021XA	EC 5338-1	2024-09-12
<input checked="" type="checkbox"/>	Vector Signal Generator	Agilent	N5182B	EC 5175	2024-03-05
<input checked="" type="checkbox"/>	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2024-03-05
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCI 7	EC 4501	2024-03-05
<input type="checkbox"/>	Climate chamber	GWS	MT3065	EC 6021	2024-03-06
<input type="checkbox"/>	Spectrum Analyzer	Keysight	N9030b	EC 6078	2024-06-15
<input type="checkbox"/>	Universal Radio Communication Tester	R&S	CMW500	EC 6209	2024-01-30
<input type="checkbox"/>	Signal generator	Agilent	N5182A	EC 6172	2024-08-08
<input type="checkbox"/>	Signal generator	Agilent	N5181A	EC 6171	2024-08-08
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2024-03-24
<input checked="" type="checkbox"/>	Pressure meter	YM3	Shanghai Mengde	EC 3320	2024-08-16

2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test item	Measurement uncertainty
Maximum peak output power	$\pm 0.68\text{dB}$
Radiated Emissions in restricted frequency bands below 1GHz	$\pm 4.90\text{dB}$
Radiated Emissions in restricted frequency bands above 1GHz	$\pm 4.80\text{dB}$
Emission outside the frequency band	$\pm 4.80\text{dB}$
Power line conducted emission	$\pm 2.7\text{dB}$

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3 Radiated emission

Test result: Pass

3.1 Limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
<input type="checkbox"/> 902 - 928	94	54
<input checked="" type="checkbox"/> 2400 - 2483.5	94	54
<input type="checkbox"/> 5725 - 5875	94	54
<input type="checkbox"/> 24000 - 24250	108	68

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits:

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

3.2 Measurement Procedure

For Radiated emission below 30MHz:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- Both X and Y axes of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

TEST REPORT**For Radiated emission above 30MHz:**

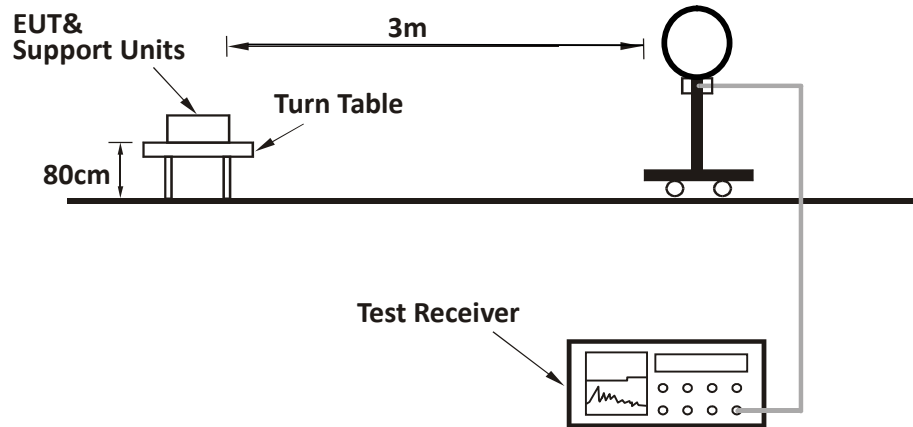
- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The height of antenna 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.
- d) 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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

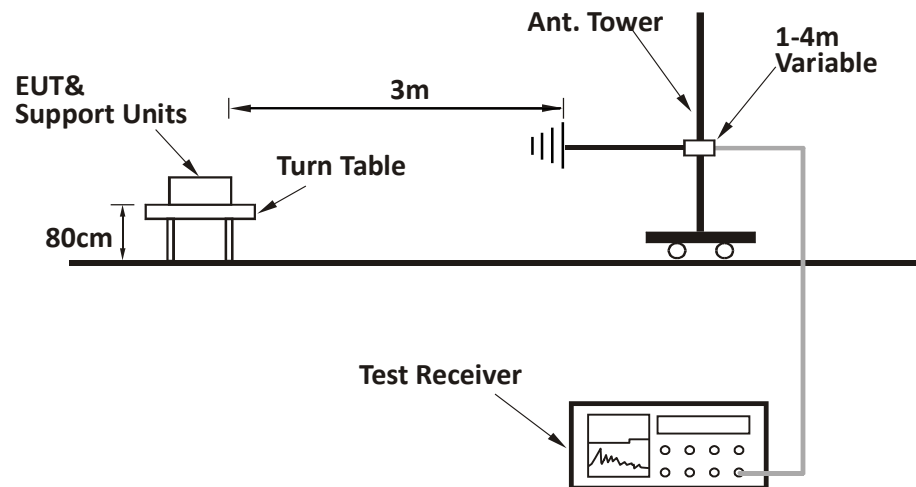
- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- 3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or $3 \times \text{RBW}$ (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
- 4. All modes of operation were investigated and the worst-case emissions are reported

3.3 Test Configuration

For Radiated emission below 30MHz:

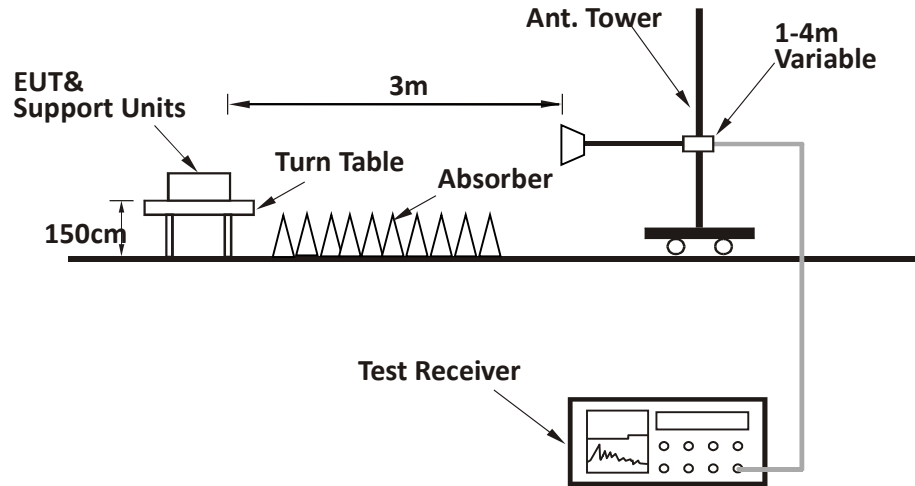


For Radiated emission 30MHz to 1GHz:



TEST REPORT

For Radiated emission above 1GHz:

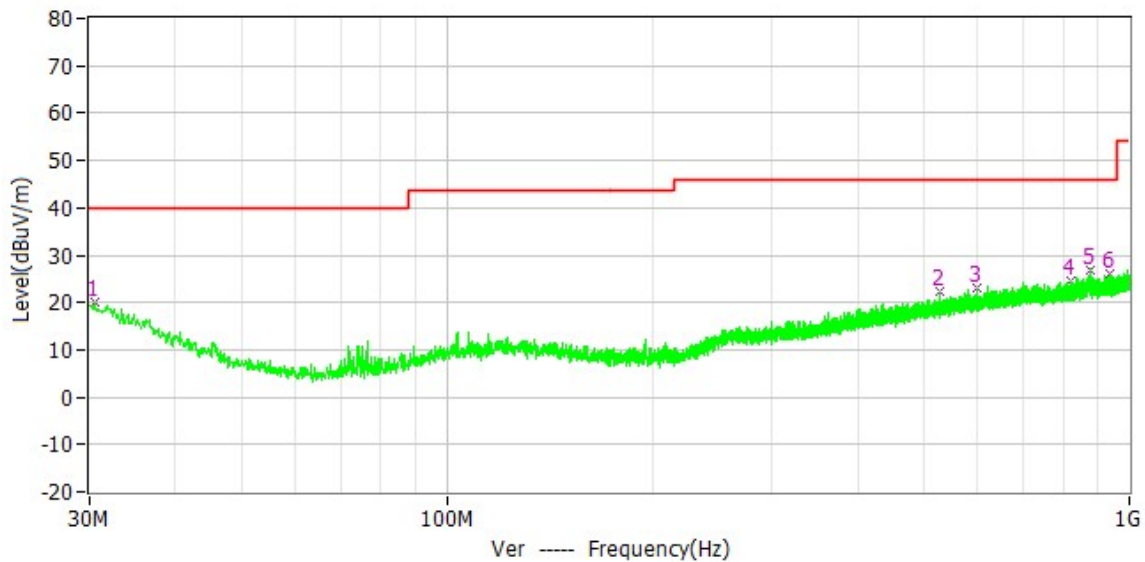
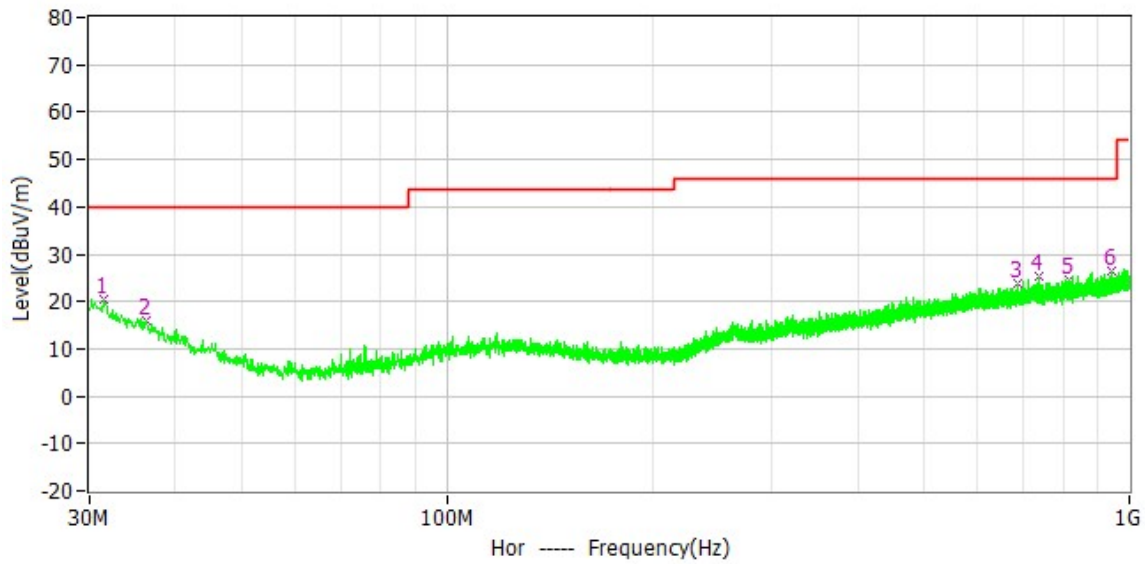


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3.4 Test Results of Radiated Emissions

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

The worst waveform from 30MHz to 1000MHz is listed as below:



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Test data:

Antenna	Frequency (MHz)	Corrected Reading (dBμV/m)	Correct Factor (dB/m)	Limit (dBμV/m)	Margin (dB)	Detector
H	31.552	20.40	20.50	40.00	19.60	PK
H	36.402	16.10	17.40	40.00	23.90	PK
H	685.623	23.80	22.60	46.00	22.20	PK
H	736.063	25.40	23.10	46.00	20.60	PK
H	814.924	24.60	23.80	46.00	21.40	PK
H	944.710	26.30	24.80	46.00	19.70	PK
V	30.485	20.20	21.10	40.00	19.80	PK
V	526.834	22.20	20.80	46.00	23.80	PK
V	597.644	23.10	21.90	46.00	22.90	PK
V	822.878	24.40	23.80	46.00	21.60	PK
V	876.034	27.00	24.10	46.00	19.00	PK
V	938.696	25.90	24.70	46.00	20.10	PK

Remark:

1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example:

Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

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Test result above 1GHz:

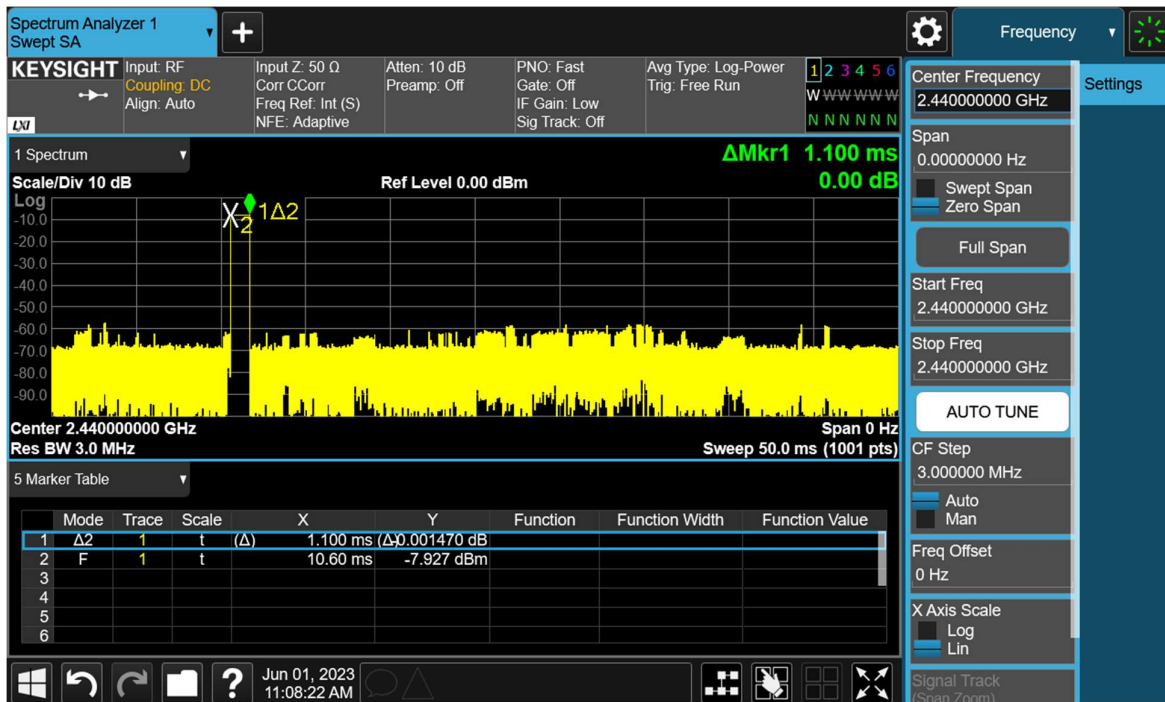
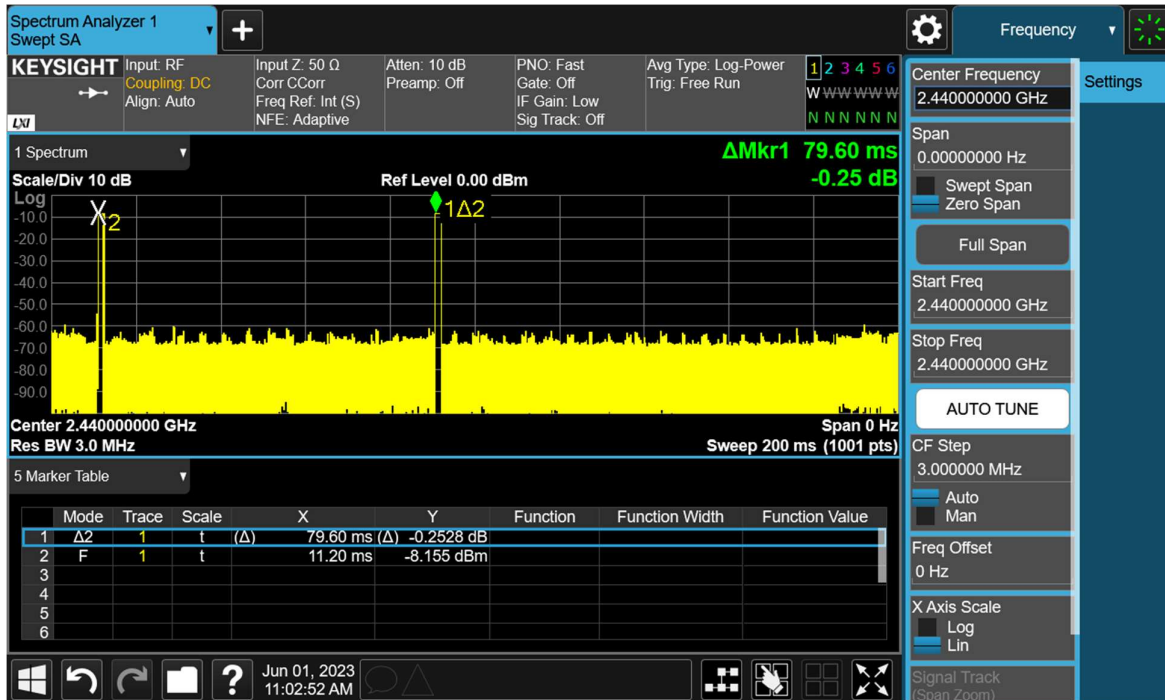
CH	Antenna	Frequency (MHz)	Corrected Reading (dBμV/m)	Correct Factor (dB/m)	Limit (dBμV/m)	Margin (dB)	Detector
L	H	2390.00	60.30	32.50	74.00	13.70	PK
	V	2390.00	60.20	32.50	74.00	13.80	PK
	H	2410.00	91.30	34.20	114.00	22.70	PK
	V	2410.00	90.50	34.20	114.00	23.50	PK
	H	4820.00	56.70	-14.20	74.00	17.30	PK
	V	4820.00	55.90	-14.20	74.00	18.10	PK
	H	7230.00	61.10	-8.60	74.00	12.90	PK
	V	7230.00	63.50	-8.60	74.00	10.50	PK
M	H	2440.00	91.30	34.40	114.00	22.70	PK
	V	2440.00	90.80	34.40	114.00	23.20	PK
	H	4880.00	58.40	-14.00	74.00	15.60	PK
	V	4880.00	54.00	-14.00	74.00	20.00	PK
	H	7320.00	64.20	-8.40	74.00	9.80	PK
	H	7320.00	39.00	-8.40	54.00	15.00	AV
	V	7320.00	63.80	-8.40	74.00	10.20	PK
H	H	2470.00	91.50	34.40	114.00	22.50	PK
	V	2470.00	90.30	34.40	114.00	23.70	PK
	H	2483.50	64.70	32.90	74.00	9.30	PK
	H	2483.50	46.70	32.90	54.00	7.30	AV
	V	2483.50	65.10	32.90	74.00	8.90	PK
	V	2483.50	47.20	32.90	54.00	6.80	AV
	H	4940.00	55.60	-13.70	74.00	18.40	PK
	V	4940.00	56.20	-13.70	74.00	17.80	PK
	H	7410.00	64.30	-8.40	74.00	9.70	PK
	H	7410.00	42.00	-8.40	54.00	12.00	AV
	V	7410.00	63.80	-8.40	74.00	10.20	PK

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Duty Cycle:

The test data with maximum duty cycle was listed below.

The worst Duty cycle= $1.10 / 79.60 \text{ ms} = 1.382\%$



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Calculating the AV value according to the duty cycle

Antenna	Frequency (MHz)	PK Reading (dBμV/m)	Correct Factor (dB)	AV Reading (dBμV/m)	Limit (dBμV/m)	Margin (dB)
H	2410.00	91.30	-37.12	54.18	94.00	39.82
V	2410.00	90.50		53.38	94.00	40.62
H	2440.00	91.30		54.18	94.00	39.82
V	2440.00	90.80		53.68	94.00	40.32
H	2470.00	91.50		54.38	94.00	39.62
V	2470.00	90.30		53.18	94.00	40.82

Remark:

1. Correct Factor = $20\lg(\text{duty cycle}) = 20\lg(0.01382) = -37.12$
2. AV Reading = PK Reading + Correct Factor
3. Margin = limit - AV Reading.

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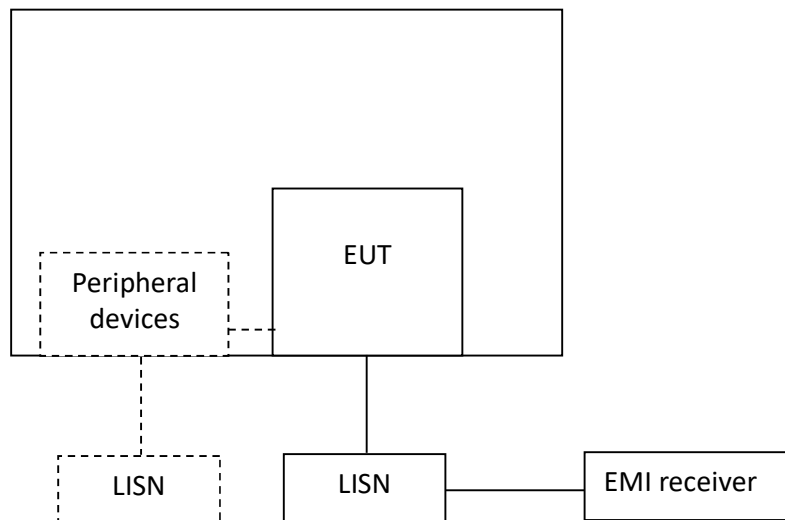
4 Power line conducted emission

Test result: N/A

4.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

4.2 Test Configuration



TEST REPORT**4.3 Measurement Procedure**

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

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4.4 Test Results of Power line conducted emission

Test Data:

None

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Corrected Reading = Original Receiver Reading + Correct Factor

3. Margin = Limit - Corrected Reading

4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

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5 Assigned bandwidth (20dB bandwidth)

Test result: Pass

5.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band.

If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

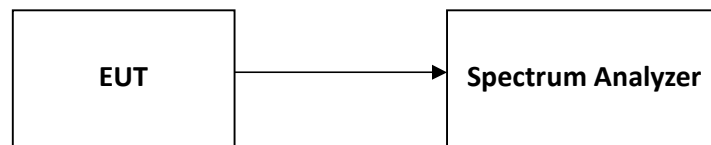
5.2 Measurement Procedure

The 20dB Bandwidth is measured using the Spectrum Analyzer.

Set Span = 2 to 3 times the 20 dB bandwidth, RBW = approximately 1% of the 20 dB bandwidth, VBW>RBW, Sweep = auto, Detector = peak, Trace = max hold.

The test was performed at 3 channels (lowest, Middle and highest channel).

5.3 Test Configuration



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5.4 The results

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)	F _L at 20dB BW (MHz)	F _H at 20dB BW (MHz)
2410	25.718	25.383	>2400.00	/
2440	20.304	17.806	/	/
2470	20.124	19.066	/	<2483.50
Limit	N/A	N/A	F _L >2400	F _H <2483.5
Result	Complied			

Channel L



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Channel M



Channel H



6 Antenna requirement

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 shall be considered sufficient to comply with the provisions of this section.

Result:

EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.

***** END *****