

Test Report

Verified code: 171508

Report No.: E202405222827-2

Customer: Wet Sounds Inc.

Address: 2975 Louise Street, ST Rosenberg, TX 77471

Sample Name: MAL M-LINK

Sample Model: MAL M-LINK

Receive Sample Date: May.27,2024

Test Date: May.31,2024 ~ Jun.13,2024

Reference Document: CFR 47, FCC Part 15 Subpart C
RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators

Test Result: Pass

Prepared by: Wen Wenwen
Wen Wenwen

Reviewed by: Wu Haoting
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Xiao Liang

GRG METROLOGY & TEST GROUP CO., LTD

Issued Date: 2024-07-31

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E202405222827-2	Original Issue	2024-07-31

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1. TEST RESULT SUMMARY

FCC 47 CFR Part 15 Subpart C 15.247, ANSI C63.10-2020 KDB 558074 D01 15.247 measurement guidance v05r02			
Standard	Item	Limit / Severity	Result
FCC 47 CFR Part 15 Subpart C (15.247)	Antenna Requirement	Section 15.203	PASS
	20dB Bandwidth	Section 15.247(a)(1)	PASS
	Carrier Frequencies Separated	Section 15.247(a)(1)	PASS
	Hopping Channel Number	Section 15.247(a)(1)(ii)	PASS
	Dwell Time	Section 15.247(a)(1)(iii)	PASS
	Maximum Peak Output Power	Section 15.247(b)(1)	PASS
	Conducted Emission	Section 15.207	PASS
	Conducted band edges and Spurious Emission	Section 15.209 & 15.247(d)	PASS
	Radiated Spurious Emission	Section 15.209 & 15.247(d)	PASS
	Restricted bands of operation	Section 15.247 (d) & 15.205	PASS

Note: The EUT antenna is PCB printed antenna. The max gain of antenna is 2.30dBi, which accordance 15.203.is considered sufficient to comply with the provisions of this section.

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name: Wet Sounds Inc.
Address: 2975 Louise Street, ST Rosenberg, TX 77471

2.2 MANUFACTURER

Name: Wet Sounds Inc.
Address: 2975 Louise Street, ST Rosenberg, TX 77471

2.3 FACTORY

Name: Dongguan Longjoin Electronics Co. Ltd.
Address: Industrial road No.10, Shuilang Village, Dalingshan Town, Dongguan City, Guangdong Province, PRC

2.4 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: MAL M-LINK
Model No.: MAL M-LINK
Adding Model: /
Trade Name: WET SOUNDS
FCC ID: 2AT9N-MALM-LINK
Power Supply: DC 12V

Frequency Range: 2403.58MHz - 2477.31MHz
Maximum conducted output Power: 16.91dBm
Type of Modulation: FSK
Antenna Specification: PCB printed antenna: with maximum 2.30dBi gain
Temperature Range: -20°C~+80°C
Hardware Version: A0850
Software Version: v2.7.0 -580
Sample No: E202405222827-0001, E202405222827-0002

Note: The basic description of the EUT is provided by the applicant. This report is made Solely on the basis of such data and/or information. We accept no responsibility for the authenticity and completeness of the above data and information and the validity of the results and/or conclusions.

Channel list:

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
00	2403.58	01	2405.12	02	2406.66	03	2408.19
04	2409.73	05	2411.26	06	2412.80	07	2414.34
08	2415.87	09	2417.41	10	2418.94	11	2420.48
12	2422.02	13	2423.55	14	2425.09	15	2426.62
16	2428.16	17	2429.70	18	2431.23	19	2432.77
20	2434.30	21	2435.84	22	2437.38	23	2438.91
24	2440.45	25	2441.98	26	2443.52	27	2445.06
28	2446.59	29	2448.13	30	2449.66	31	2451.20
32	2452.74	33	2454.27	34	2455.81	35	2457.34
36	2458.88	37	2460.42	38	2461.95	39	2463.49
40	2465.02	41	2466.56	42	2468.10	43	2469.63
44	2471.17	45	2472.70	46	2474.24	47	2475.78
48	2477.31	/	/	/	/	/	/

2.5 TEST OPERATION MODE

Mode No.	Description of the modes
1	EUT fixed frequency transmitting
2	EUT hopping frequency transmitting

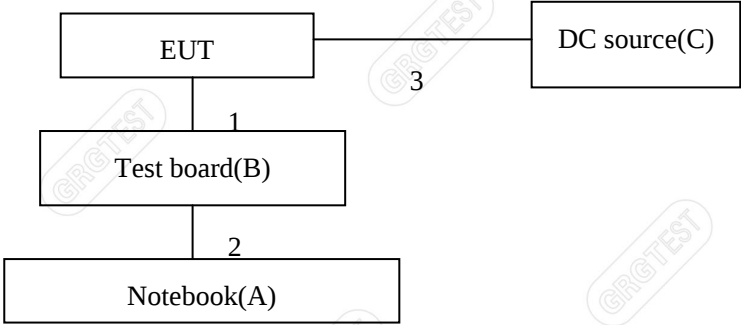
2.6 LOCAL SUPPORTIVE

No.	Name of equipment	Manufacturer	Model	Serial number	Note
A	Notebook	DELL	Latitude3420	4KBCGL3	7#
B	Test board	/	/	/	/
C	DC source	Keysight	E36131A	/	/
D	Adapter	Shenzhen shi yingqin electronic co.,ltd.	YQ-1202000Z	/	/

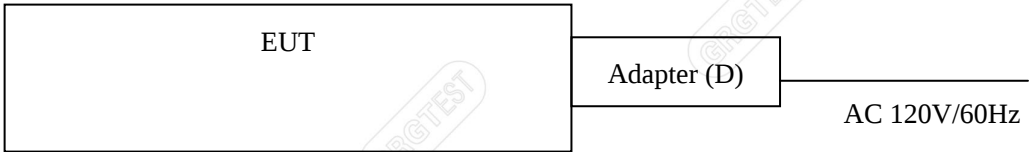
No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	Serial cable	1	No	0	0.2m
2	USB cable	1	No	0	1.0m
3	DC cable	1	No	0	1.0m

2.7 CONFIGURATION OF SYSTEM UNDER TEST

For 20dB bandwidth, Carrier Frequencies Separated, Hopping Channel Number, Dwell Time, Maximum Peak Output Power, Conducted band edges and Spurious Emission measurement:



For Conducted emissions, Radiated Spurious Emission, Restricted bands of operation:



Test software:

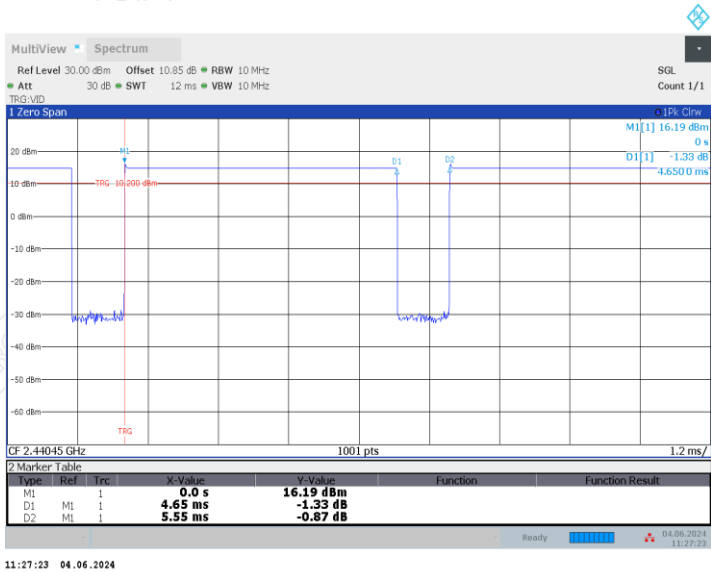
Software version	Test level
Download_Hoff_SXC-XDT_SAT	Lowest channel: 00 Middle chanenl: 00 Highest channel: 02

2.8 DUTY CYCLE

EUT Name	MAL M-LINK	Model	MAL M-LINK
Environmental Conditions	26.2℃/56%RH/101.0kPa	Test Voltage	DC 12V
Tested By	Huang tianmei	Tested Date	2024-06-04

Frequency [MHz]	ON Time [ms]	Period [ms]	DC [%]	T [s]
2440.45	4.65	5.55	83.78	0.00465

2440.45MHz



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3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of GRG METROLOGY & TEST GROUP CO., LTD.

Add : Address: No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China

P.C. : 518110

Tel : 0755-61180008

Fax : 0755-61180008

3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to GB/T 27025(ISO/IEC 17025:2017)

USA A2LA(Certificate #2861.01)

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada ISED (Company Number: 24897, CAB identifier:CN0069)

USA FCC (Registration Number: 759402, Designation Number:CN1198)

Copies of granted accreditation certificates are available for downloading from our web site, <http://www.grgtest.com>

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4. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	X	9kHz~30MHz	4.4dB ¹⁾
	Y	9kHz~30MHz	4.4dB ¹⁾
	Z	9kHz~30MHz	4.4dB ¹⁾
	Horizontal	30MHz~200MHz	4.6dB ¹⁾
		200MHz~1000MHz	4.8dB ¹⁾
		1GHz~18GHz	5.0dB ¹⁾
		18GHz~26.5GHz	5.2dB ¹⁾
	Vertical	30MHz~200MHz	4.7dB ¹⁾
		200MHz~1000MHz	4.7dB ¹⁾
		1GHz~18GHz	5.1dB ¹⁾
		18GHz~26.5GHz	5.4dB ¹⁾

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.80dB
Power spectral density conducted	0.80dB
Occupied channel bandwidth	0.40dB
Unwanted emission, conducted	0.70dB
Humidity	6.0%
Temperature	2.0°C

Note:

¹⁾ This uncertainty represents an expanded uncertainty expressed at approximately the 95%.

This uncertainty represents an expanded uncertainty factor of $k=2$.

5. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Conducted Emissions				
EMI TEST RECEIVER	R&S	ESCI	100783	2024-08-11
LISN(EUT)	R&S	ENV216	101543	2024-08-03
Test S/W	EZ	CCS-3A1-CE		
Hopping Channel Number & Dwell Time & 20 dB Bandwidth & Conducted band edges and Spurious Emission & Conducted band edges and Spurious Emission & Carrier Frequencies Separated				
Spectrum Analyzer	R&S	FSW43	102072	2024-07-09
Automatic power test unit	TONSCEND	JS0806-2	21B8060365	2024-12-28
BT/WIFI System	Tonscend	JS1120-3	/	/
Radiated Spurious Emission & Restricted bands of operation				
Test S/W	Tonscend	JS32-RE/5.0.0		
Loop Antenna	Schwarzbeck	FMZB 1513-60	1513-60-56	2024-07-15
Bi-log Antenna	Schwarzbeck	VULB9160	VULB9160-3402	2024-10-06
Horn Antenna	Schwarzbeck	BBHA 9120D	02143	2024-09-23
Test Receiver	R&S	ESR26	101758	2024-09-22
Board-Band	Schwarzbeck	BBHA 9170	BBHA 9170-497	2024-09-18
Amplifier	SHIRONG	DLNA-30M1G-	20200928001	2025-01-30
Amplifier	Tonscend	TAP01018048	AP20E8060075	2025-03-01
Amplifier	Tonscend	TAP184050	AP20E806071	2025-03-01
Amplifier	SHIRONG	DLNA-1G18G-	20200928005	2024-08-17
Maximum Peak Output Power				
Pulse power sensor	Anritsu	MA2411B	1126150	2025-01-11
Power meter	Anritsu	ML2495A	1204003	2025-01-11

Note: The calibration interval of the above test instruments is 12 months.

6. E.U.T. TEST CONDITIONS

Test frequencies:

According to the 15.31(m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range over which device operates	Number of frequencies	Location in the range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near top and 1 near bottom
More than 10 MHz	3	1 near top 1 near middle and 1 near bottom

EUT channels and frequencies list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2403.58	17	2429.70	34	2455.81
1	2405.12	18	2431.23	35	2457.34
2	2406.66	19	2432.77	36	2458.88
3	2408.19	20	2434.30	37	2460.42
4	2409.73	21	2435.84	38	2461.95
5	2411.26	22	2437.38	39	2463.49
6	2412.80	23	2438.91	40	2465.02
7	2414.34	24	2440.45	41	2466.56
8	2415.87	25	2441.98	42	2468.10
9	2417.41	26	2443.52	43	2469.63
10	2418.94	27	2445.06	44	2471.17
11	2420.48	28	2446.59	45	2472.70
12	2422.02	29	2448.13	46	2474.24
13	2423.55	30	2449.66	47	2475.78
14	2425.09	31	2451.20	48	2477.31
15	2426.62	32	2452.74	/	/
16	2428.16	33	2454.27	/	/

Test frequency is the lowest channel: 0 frequency(2403.58MHz), middle channel: 24 frequency (2440.45MHz) and highest channel: 48 frequency(2477.31MHz).

7. 20dB BANDWIDTH

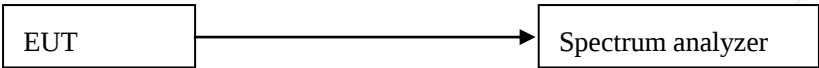
7.1 LIMITS

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
- 2) Set the spectrum analyzer as RBW=30 kHz, VBW=100 kHz, Span=6MHz, Sweep = auto. Allow the trace to stabilize, record 20dB bandwidth value
- 3) Repeat until all the test channels are investigated.

7.3 TEST SETUP



7.4 TEST RESULTS

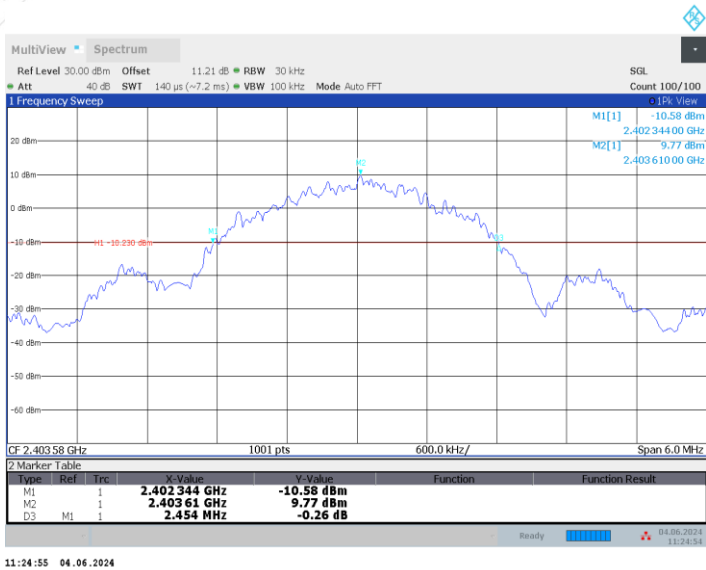
Environment: 26.2°C/56%RH/101.0kPa
Tested By: Huang tianmei

Voltage: DC 12V
Date: 2024-06-04 to 2024-06-13

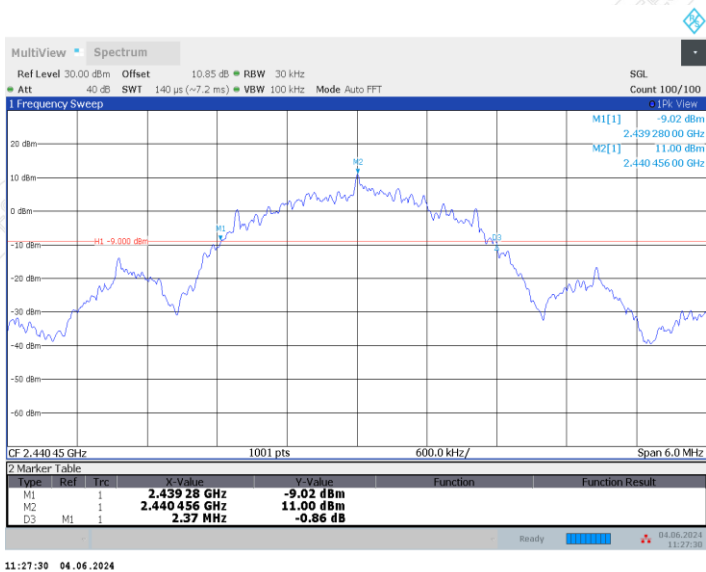
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Lowest	2403.58	2.454
Middle	2440.45	2.370
Highest	2477.31	2.400

Result plot as follows:

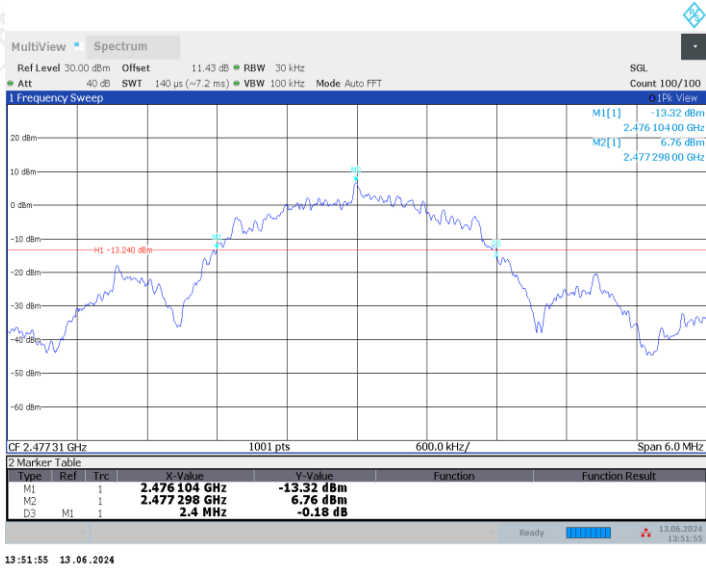
Lowest Channel



Middle Channel



Highest Channel



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8. CARRIER FREQUENCIES SEPARATED

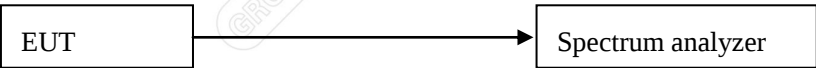
8.1 LIMITS

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

8.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 2) Set the spectrum analyzer start frequency = 2439.685MHz, stop frequency = 2442.745MHz.
- 3) Set the spectrum analyzer as RBW=300kHz, VBW=300kHz, Sweep = auto
- 4) Use the marker-delta function to mark hopping channel carrier frequencies and record the channel separation.

8.3 TEST SETUP



8.4 TEST RESULTS

Environment: 26.2°C/56%RH/101.0kPa
Tested By: Huang tianmei

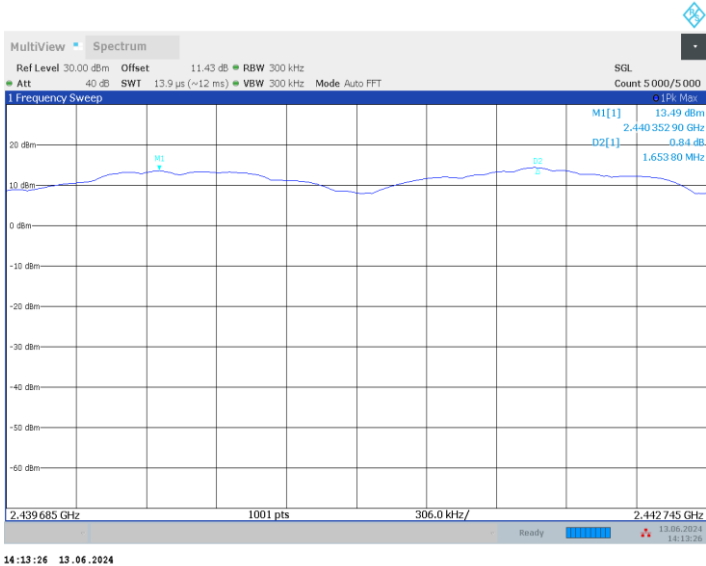
Voltage: DC 12V
Date: 2024-06-13

Channel Separation (MHz)	Two-thirds of the 20 dB Bandwidth (MHz)	Channel Separation Limit	Result
1.654	1.636	> Two-thirds of the 20 dB Bandwidth	Pass

Note: 20 dB Bandwidth=2.454MHz, 2/3*2.454=1.636MHz.

Result plot as follows:

Measurement of Channel Separation



9. HOPPING CHANNEL NUMBER

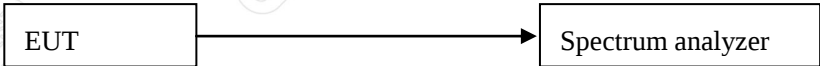
9.1 LIMITS

Regulation 15.247 (a) (1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

9.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 2) Set the spectrum analyzer as RBW=300kHz, VBW=300kHz.
- 3) Set the spectrum analyzer: start frequency = 2400MHz. stop frequency = 2483.5MHz. Submit the test result graph.

9.3 TEST SETUP

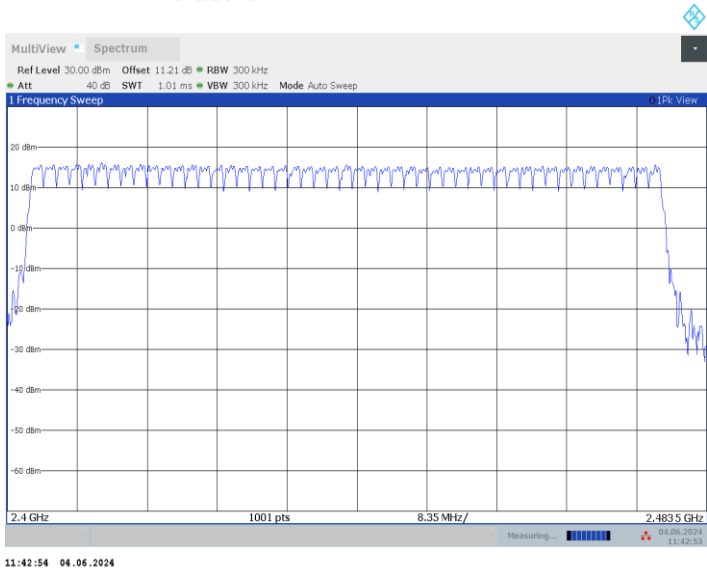


9.4 TEST RESULTS

Environment: 26.2°C/56%RH/101.0kPa
Tested By: Huang tianmei

Voltage: DC 12V
Date: 2024-06-04

Type of Modulation	Result (No. of CH)	Limit (No. of CH)	Result
FSK	49	≥15	PASS



10. DWELL TIME

10.1 LIMITS

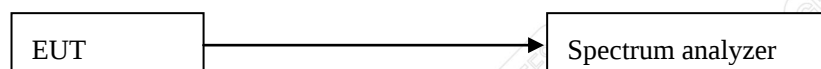
Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2 TEST PROCEDURES

Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

- 1) Set spectrum analyzer span = 0. centered on a hopping channel;
- 2) Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Detector Function = Peak. Trace = Max hold;
- 3) Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.). Repeat this test for each variation.
- 4) Packet maximum duration of the pulse times $0.4s \times 49 = 19.6s$, repeat this test for each channel.

10.3 TEST SETUP



10.4 TEST RESULTS

Environment: 26.2°C/56%RH/101.0kPa
Tested By: Huang tianmei

Voltage: DC 12V
Date: 2024-06-04

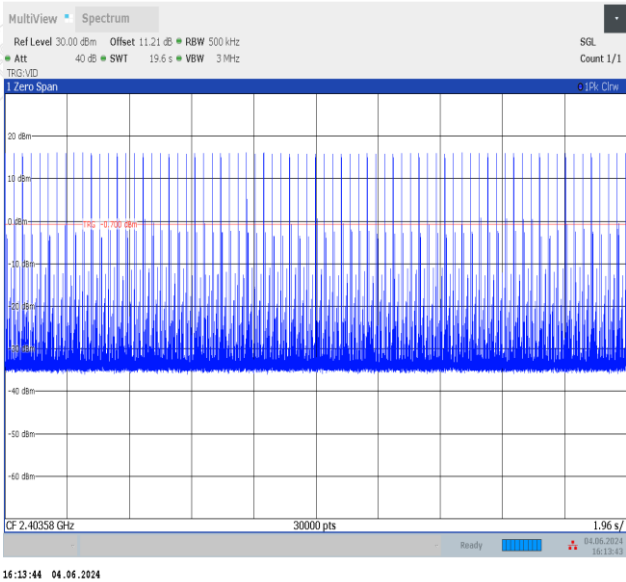
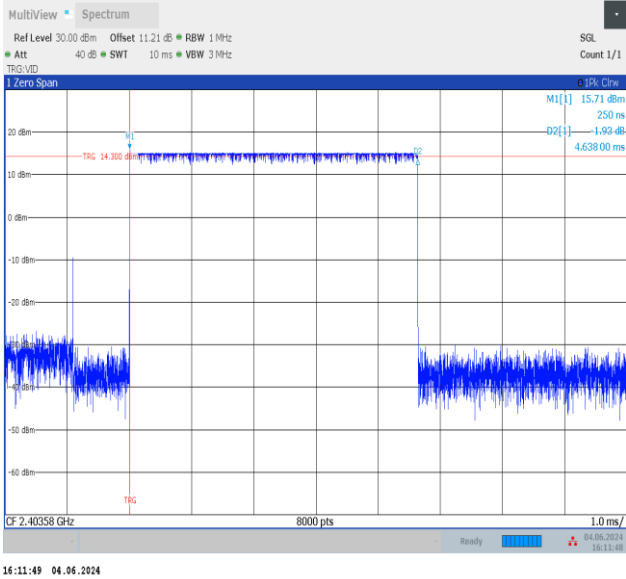
The test period: $T = 0.4s \times 49 \text{ Channel} = 19.6s$

Frequency (MHz)	Burst Width (ms)	Total hopping NO.	Result(s)	Limit(s)	Verdict
2403.58	4.638	73	0.339	≤ 0.4	PASS
2440.45	4.638	73	0.339	≤ 0.4	PASS
2477.31	4.639	73	0.339	≤ 0.4	PASS

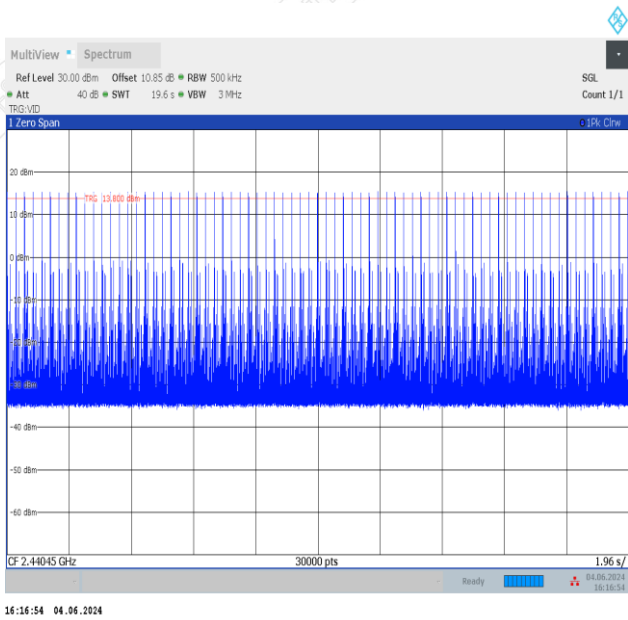
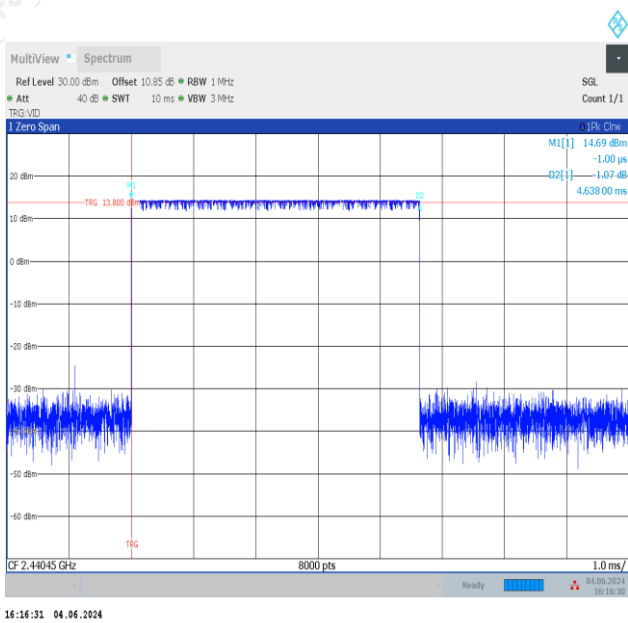
Note: Results=burst width(ms)*total hopping No.= $4.638ms \times 73 = 0.339s$

Please refer the graph as below:

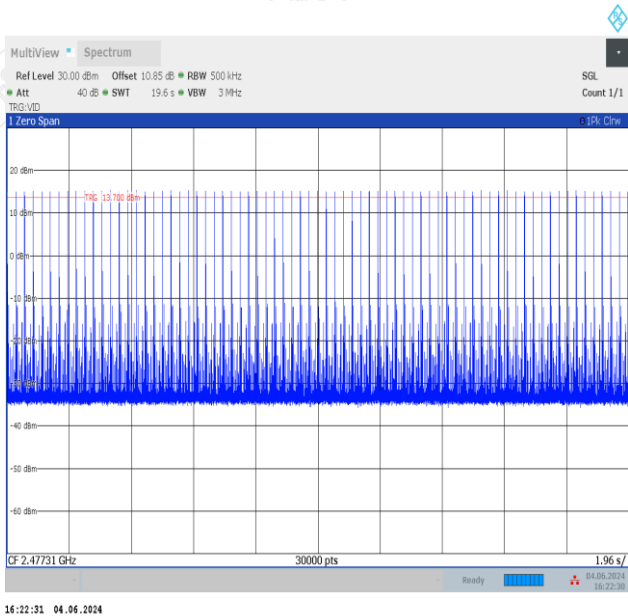
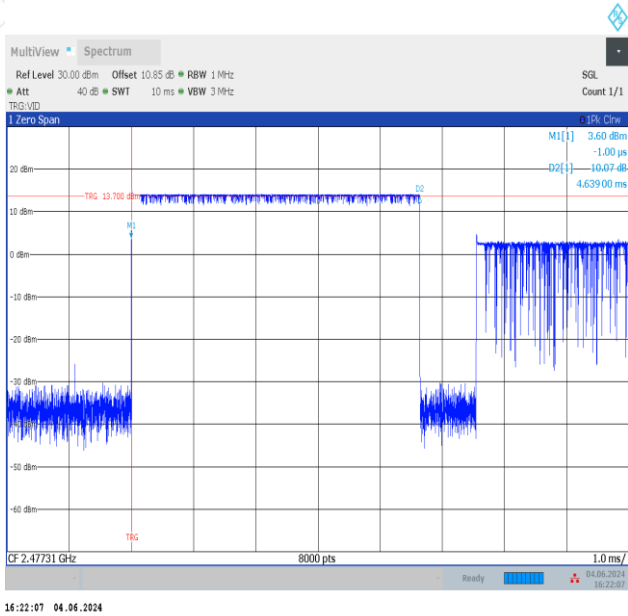
2403.58MHz



2440.45MHz



2477.31MHz



11. CONDUCTED EMISSION

11.1 LIMITS

Frequency range	Limits (dBμV)	
	Quasi-peak	Average
150kHz~0.5MHz	66~56	56~46
0.5MHz~5MHz	56	46
5MHz~30MHz	60	50

11.2 TEST PROCEDURES

Procedure of Preliminary Test

For measurement of the disturbance voltage the equipment under test (EUT) is connected to the power supply mains and any other extended network via one or more artificial network(s). An EUT, whether intended to be grounded or not, and which is to be used on a table is configured as follows:

– Either the bottom or the rear of the EUT shall be at a controlled distance of 40 cm from a reference ground plane. This ground plane is normally the wall or floor of a shielded room. It may also be a grounded metal plane of at least 2 m by 2 m. This is physically accomplished as follows:

1) Place the EUT on a table of non-conducting material which is at least 80 cm high. Place the EUT so that it is 40 cm from the wall of the shielded room, or

2) place the EUT on a table of non-conducting material which is 40 cm high so that the bottom of the EUT is 40 cm above the ground plane;

– All other conductive surfaces of the EUT shall be at least 80 cm from the reference ground plane;

– The EUT are placed on the floor that one side of the housings is 40 cm from the vertical reference ground plane and other metallic parts;

– Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 cm to 40 cm long, hanging approximately in the middle between the ground plane and the table.

– I/O cables that are connected to a peripheral shall be bundled in the centre. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.

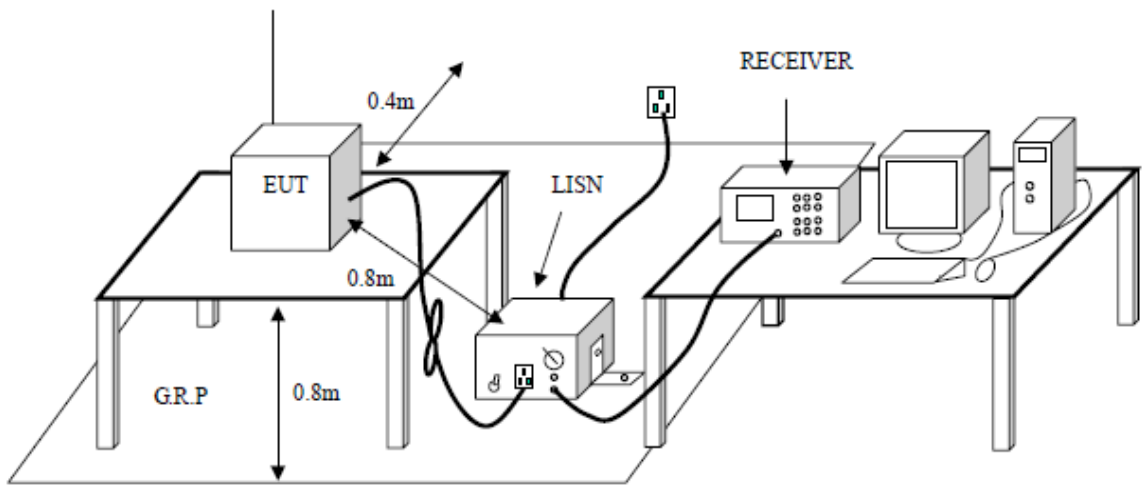
The test mode(s) described in Item 2.5 were scanned during the preliminary test. After the preliminary scan, we found the test mode described in Item 2.5 producing the highest emission level. The EUT configuration and cable configuration of the above highest emission levels were recorded for reference of the final test.

Procedure of Final Test

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test. A scan was taken on both power lines, recording at least the six highest emissions.

Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. The test data of the worst-case condition(s) was recorded.

11.3 TEST SETUP



11.4 DATA SAMPLE

Frequency (MHz)	QuasiPeak Reading (dBuV)	Average Reading (dBuV)	Correction Factor (dB)	QuasiPeak Result (dBuV)	Average Result (dBuV)	QuasiPeak Limit (dBuV)	Average Limit (dBuV)	QuasiPeak Margin (dB)	Average Margin (dB)	Remark (Pass/Fail)
X.XXXX	32.69	25.65	11.52	44.21	37.17	65.78	55.79	-21.57	-18.62	Pass

Factor = Insertion loss of LISN + Cable Loss
Result = Quasi-peak Reading/ Average Reading + Factor
Limit = Limit stated in standard
Margin = Result (dBuV) – Limit (dBuV)

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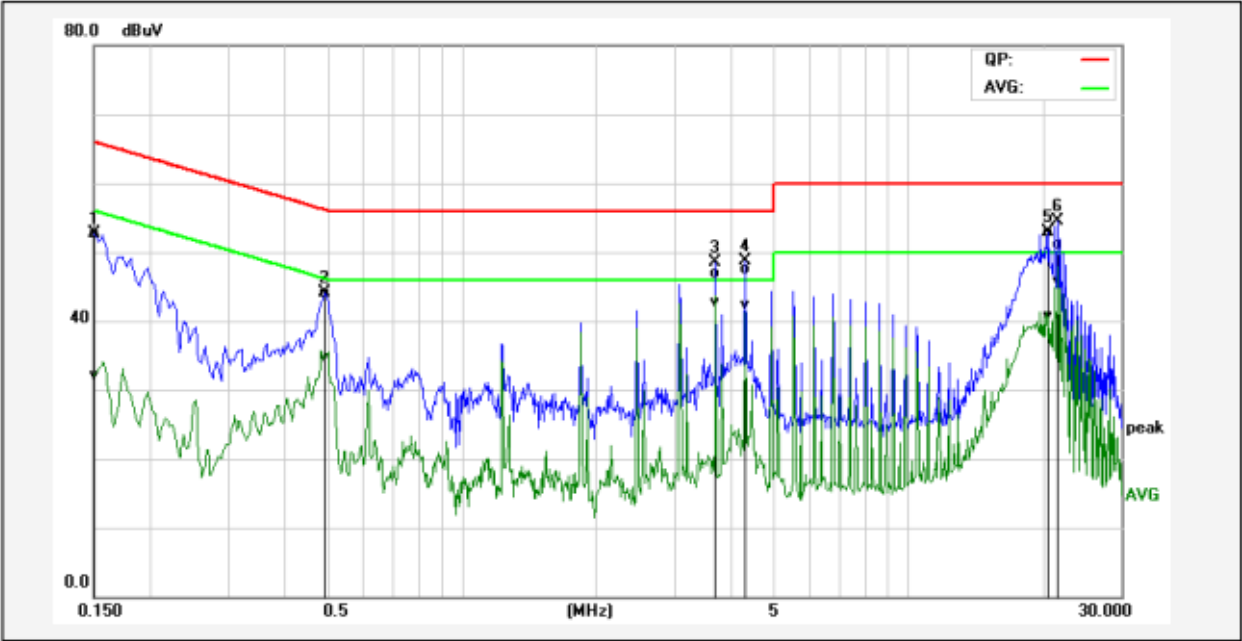
11.5 TEST RESULTS

Note: Pre-scan all test mode, recorded the worst case mode 1 middle channel test results in the report.

EUT Name	MAL M-LINK	Model	MAL M-LINK
Environmental Conditions	25.6℃/66%RH/101.0kPa	Test Mode	Mode 1
Tested By	Wen wenwen	Line	L
Tested Date	2024-05-31	Test Voltage	AC 120V/60Hz

(The chart below shows the highest readings taken from the final data.)

REMARKS: L = Live Line

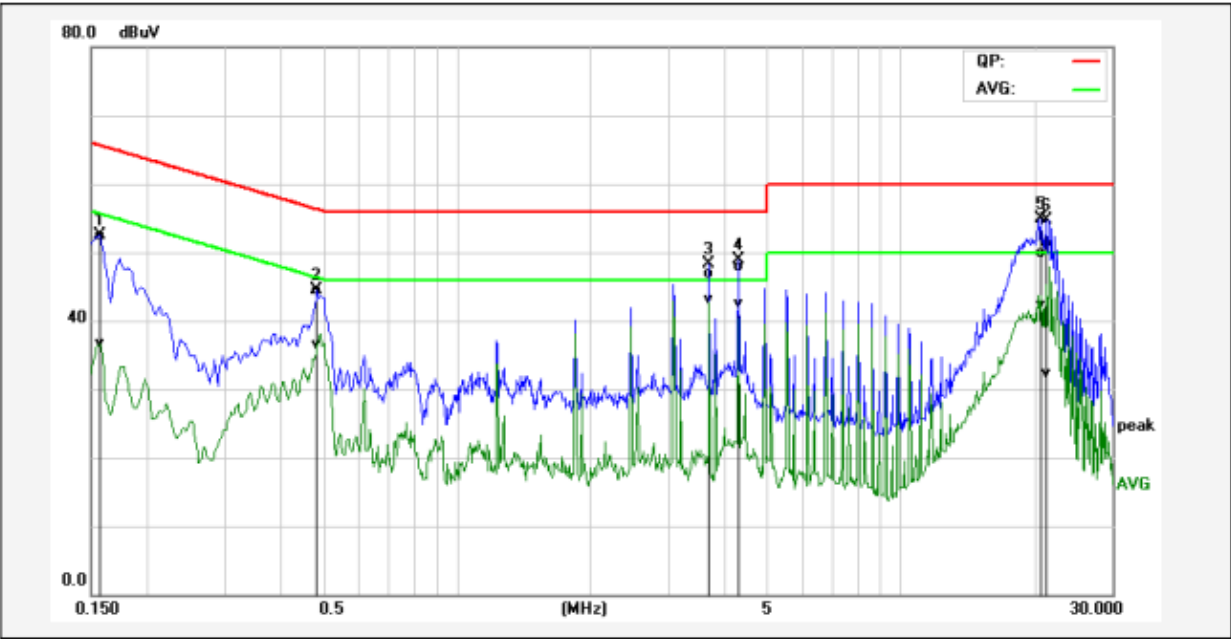


No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1500	43.04	22.38	9.75	52.79	32.13	65.99	56.00	-13.20	-23.87	Pass
2	0.4940	34.32	25.02	9.69	44.01	34.71	56.10	46.10	-12.09	-11.39	Pass
3*	3.7060	37.07	32.97	9.83	46.90	42.80	56.00	46.00	-9.10	-3.20	Pass
4	4.3260	37.85	32.55	9.75	47.60	42.30	56.00	46.00	-8.40	-3.70	Pass
5	20.6980	42.83	30.55	10.13	52.96	40.68	60.00	50.00	-7.04	-9.32	Pass
6	21.6220	41.06	35.66	10.14	51.20	45.80	60.00	50.00	-8.80	-4.20	Pass

EUT Name	MAL M-LINK	Model	MAL M-LINK
Environmental Conditions	25.6°C/66%RH/101.0kPa	Test Mode	Mode 1
Tested By	Wen wenwen	Line	N
Tested Date	2024-05-31	Test Voltage	AC 120V/60Hz

(The chart below shows the highest readings taken from the final data.)

REMARKS: N = Neutral Line.



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1580	42.74	26.97	9.68	52.42	36.65	65.56	55.57	-13.14	-18.92	Pass
2	0.4860	34.76	26.77	9.68	44.44	36.45	56.24	46.24	-11.80	-9.79	Pass
3*	3.7100	37.19	33.29	9.81	47.00	43.10	56.00	46.00	-9.00	-2.90	Pass
4	4.3260	38.15	32.85	9.75	47.90	42.60	56.00	46.00	-8.10	-3.40	Pass
5	20.7060	39.76	32.16	10.24	50.00	42.40	60.00	50.00	-10.00	-7.60	Pass
6	21.3180	41.07	22.10	10.25	51.32	32.35	60.00	50.00	-8.68	-17.65	Pass

12. MAXIMUM PEAK OUTPUT POWER

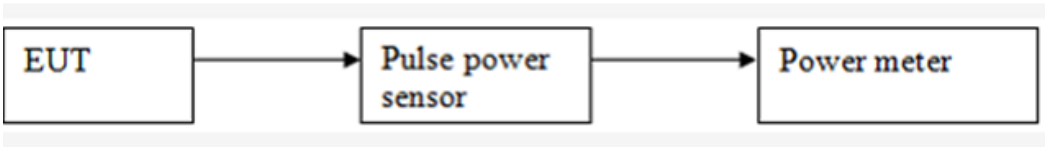
12.1 LIMITS

Regulation 15.247 (b)(1)For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

12.2 TEST PROCEDURES

- 1) Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the power meter and enable the EUT transmit continuously.
- 2) Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

12.3 TEST SETUP



12.4 TEST RESULTS

Environment: 26.2°C/56%RH/101.0kPa
Tested By: Huang tianmei

Voltage: DC 12V
Date: 2024-06-04

Test Channel	Fundamental Frequency (MHz)	Maximum conducted Output Power(dBm)	Limit (dBm)	Peak/ Average	Pass/Fail
Lowest	2403.58	16.78	20.97	Peak	Pass
Middle	2440.45	16.91			Pass
Highest	2477.31	12.05			Pass

13. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

13.1 LIMITS

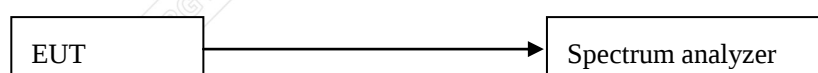
In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB.

13.2 TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Measurement Guidance v05r02.

- 1) Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
- 2) Set the spectrum analyzer: RBW =100kHz; VBW =300kHz, Frequency range = 30MHz to 26.5GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
- 3) Measure and record the results in the test report.
- 4) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

13.3 TEST SETUP



13.4 TEST RESULTS

Environment: 26.2°C/56%RH/101.0kPa
Tested By: Huang tianmei

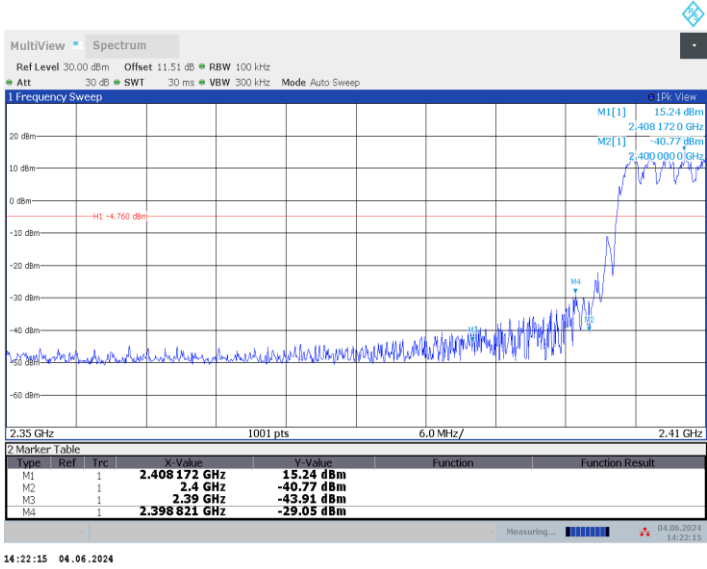
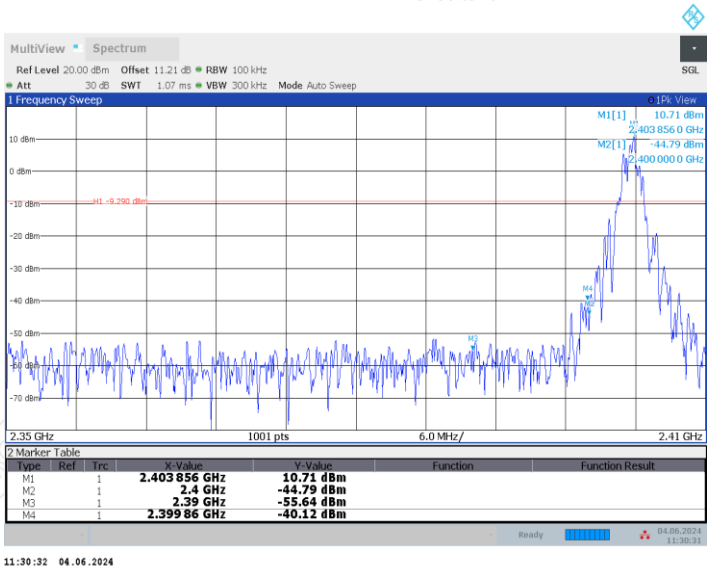
Voltage: DC 12V
Date: 2024-06-04 to 2024-06-13

Test result plot as follows:

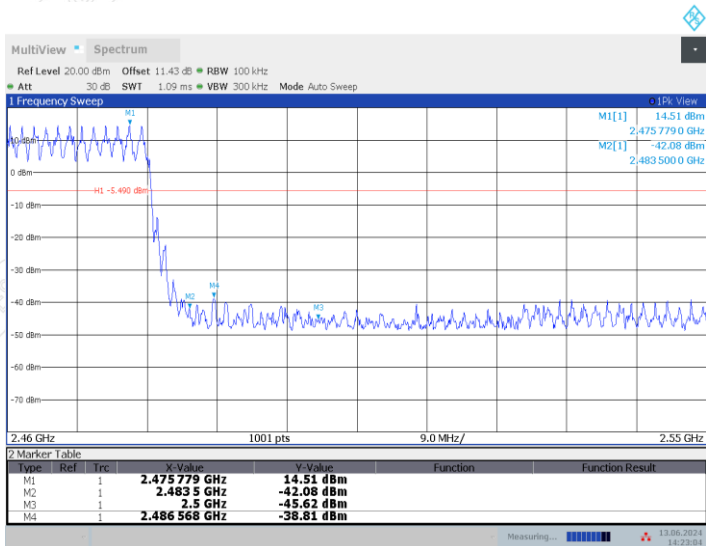
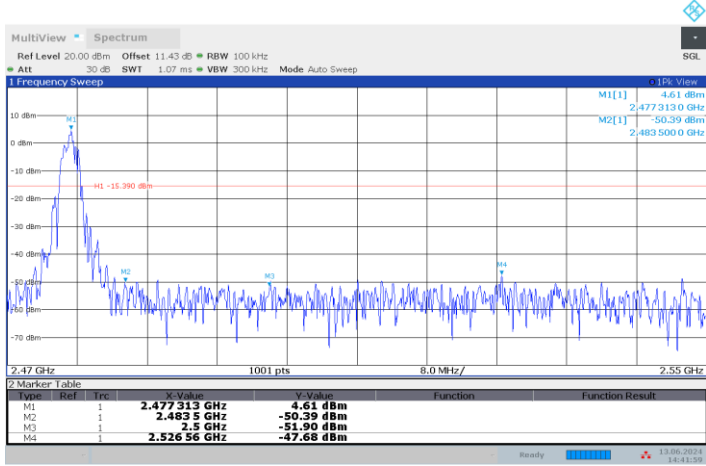
Band Edges

Lowest channel

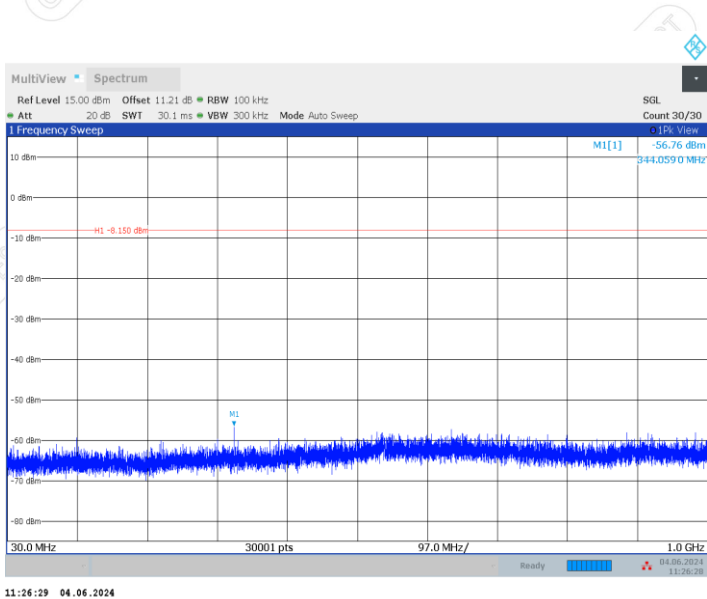
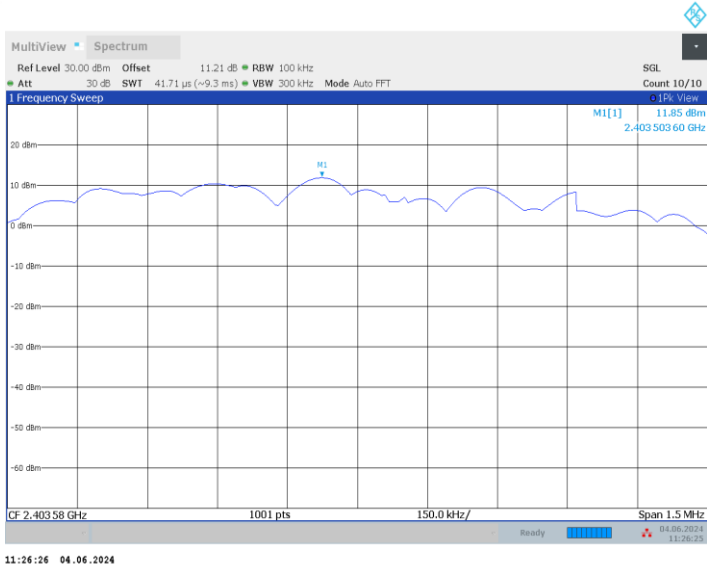
(2.35GHz ~2.41GHz)

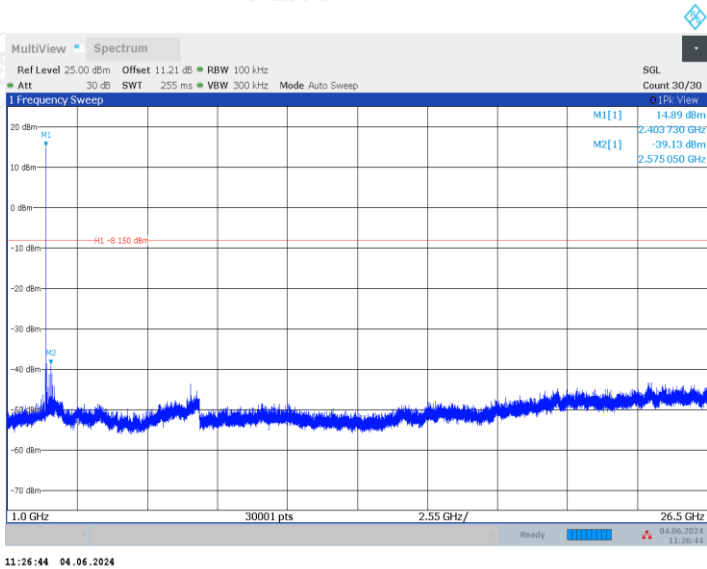


Highest channel
(2.47GHz ~ 2.55GHz)

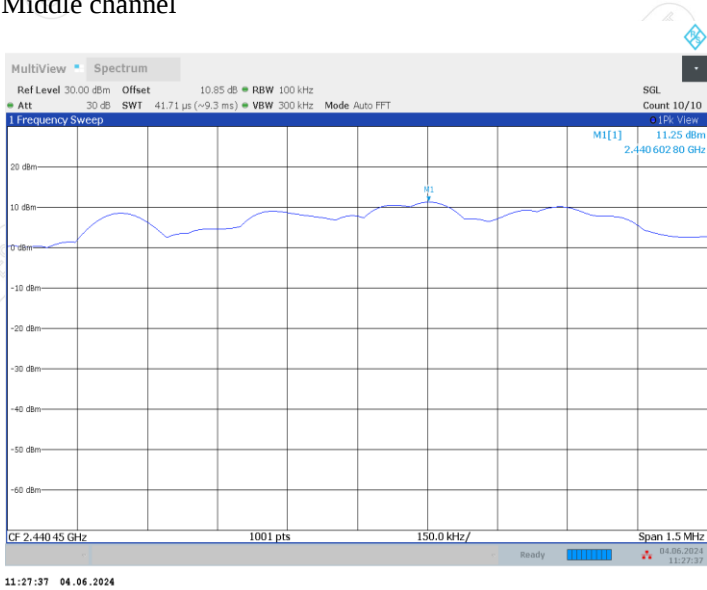


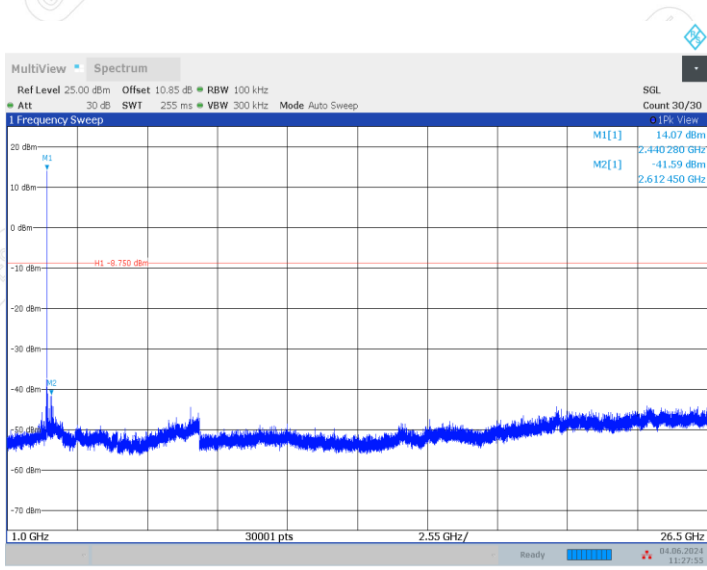
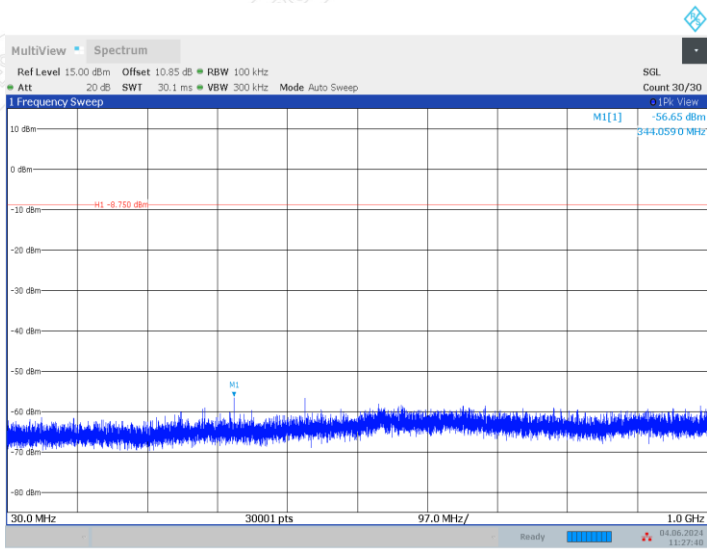
Spurious Emissions
Lowest channel



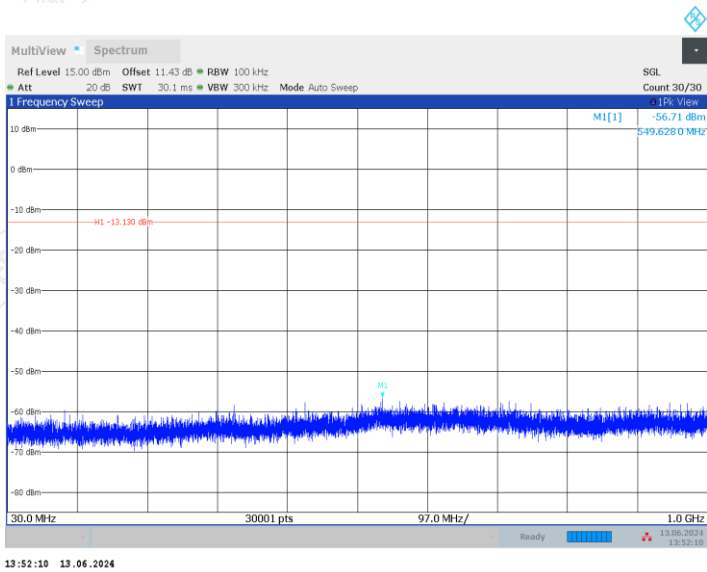
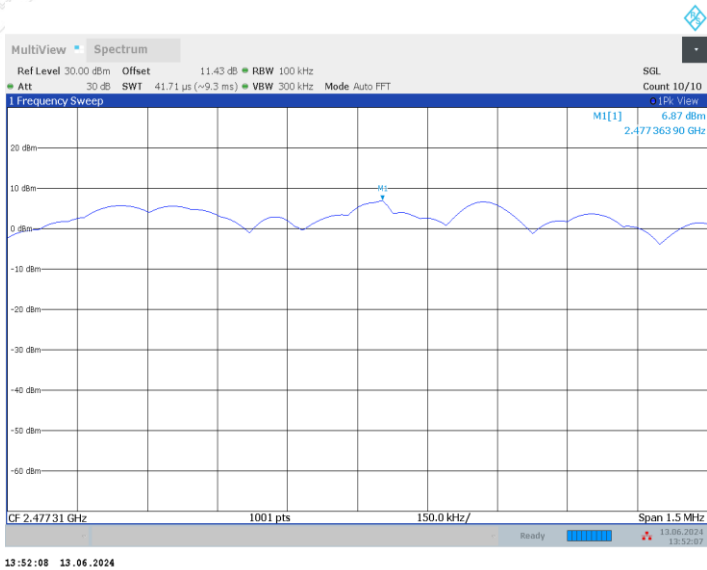


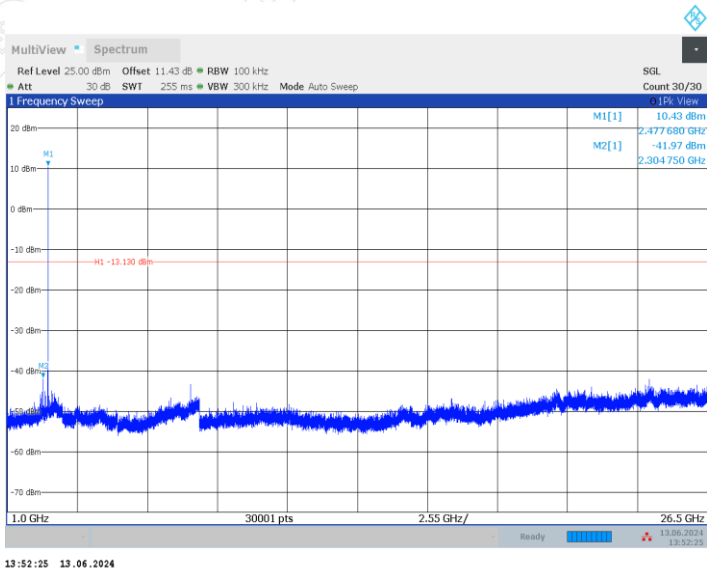
Middle channel





Highest channel





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14. RADIATED SPURIOUS EMISSIONS

14.1 LIMITS

In any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak($\mu\text{V/m}$)	Measurement distance(m)	Quasi-peak(dB $\mu\text{V/m}$)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE:

- (1) The emission limits for the ranges 9-90kHz and 110-490kHz are based on measurements employing a linear average detector.
- (2) The lower limit shall apply at the transition frequencies.
- (3) Above 18GHz test distance is 1m, so the Peak Limit=74+20*log(3/1)=83.54 (dB $\mu\text{V/m}$).
The Avg Limit=54+20*log(3/1)=63.54 (dB $\mu\text{V/m}$).

14.2 TEST PROCEDURES

1) Sequence of testing 9kHz to 30MHz

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.

Pre measurement:

- The turntable rotates from 0 ° to 360 °.
- 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 pre measurement 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 QP 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 pre measurement and the limit will be stored.

2) Sequence of testing 30MHz to 1GHz

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.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 4 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 rotates from 0 °to 360 °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 1GHz to 18GHz

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.

Pre measurement:

--- The turntable rotates from 0 °to 360 °.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 4 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 pre measurement the software maximize the peaks by changing turntable rotates from 0 °to 360 °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 pre measurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18GHz

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.

Pre measurement:

--- 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 pre measurements 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 pre measurement and the limit will be stored.

NOTE:

(a).The frequency from 9kHz to 150kHz, Set RBW=300Hz(for Peak&AVG), RBW=300Hz(for Peak&AVG). the frequency from 150kHz to 30MHz, Set RBW=9kHz, RBW=9kHz, (for QP Detector).

(b).The frequency from 30MHz to 1GHz, Set RBW=120kHz, RBW=300kHz, (for QP Detector).

(c).The frequency above 1GHz, for Peak detector: Set RBW=1MHz, RBW=3MHz.

(d).The frequency above 1GHz, for Avg detector: Set RBW=1MHz, if the EUT is configured to transmit with duty cycle $\geq 98\%$, set $VBW \leq RBW/100$ (i.e., 10kHz) but not less than 10 Hz. if the EUT duty cycle is $< 98\%$, set $VBW \geq 1/T$, Where T is defined in section 2.8.

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14.3 TEST SETUP

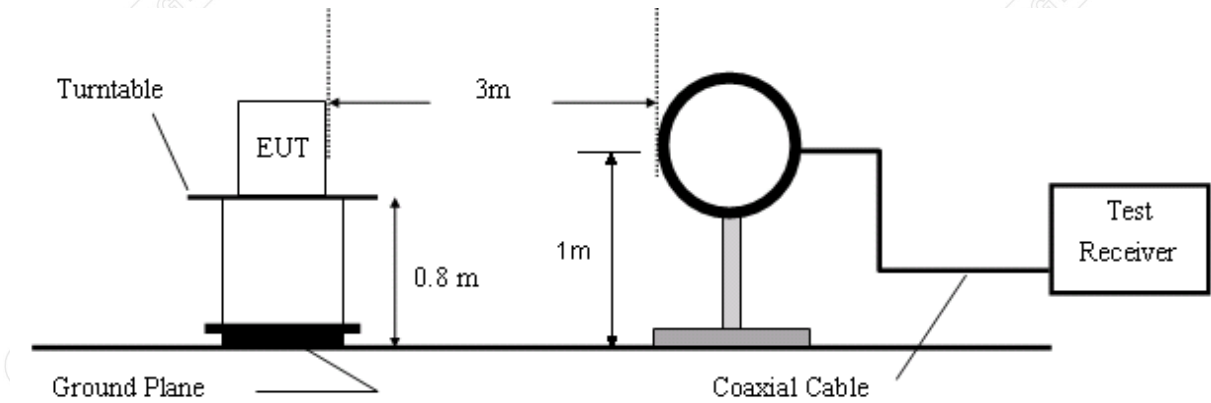


Figure 1. 9kHz to 30MHz radiated emissions test configuration

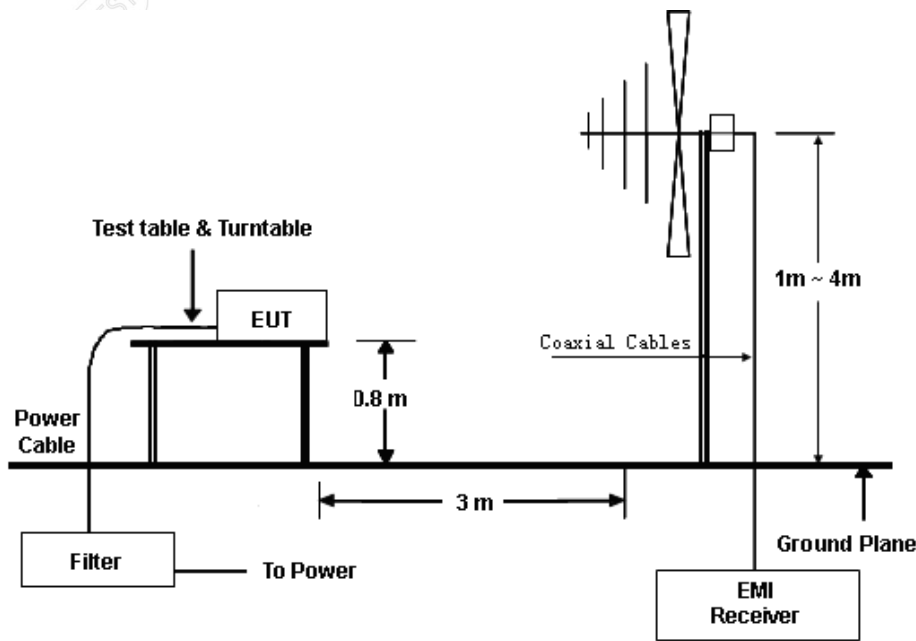


Figure 2. 30MHz to 1GHz radiated emissions test configuration

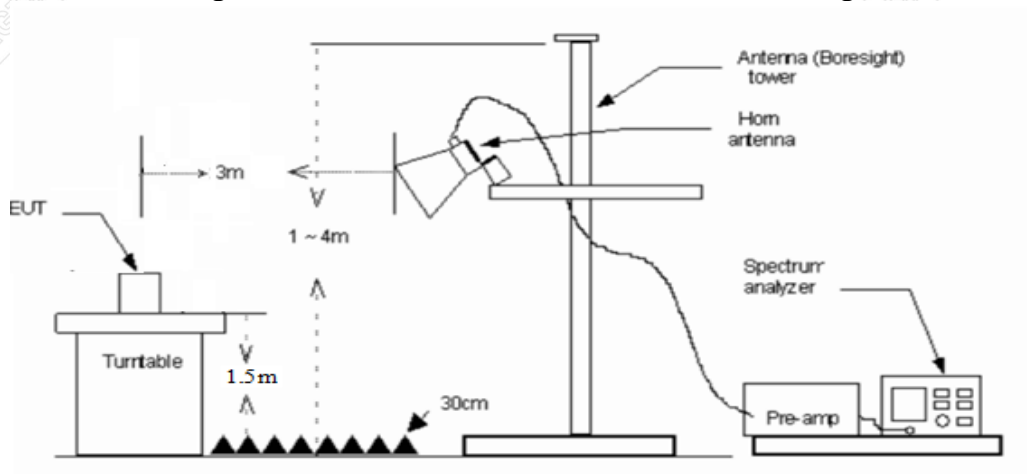


Figure 3. 1GH to 18GHz radiated emissions test configuration

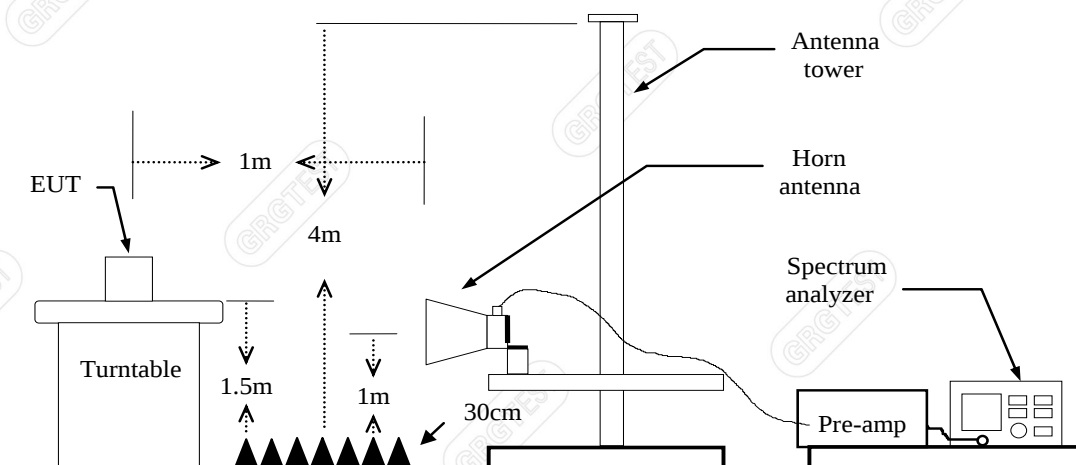


Figure 4. 18GHz to 26.5GHz radiated emissions test configuration

14.4 DATA SAMPLE

Below 1GHz

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
xxx	xxx	45.30	15.56	-29.74	40.00	24.44	PK	100	16	Horizontal	PASS

Frequency (MHz)

= Emission frequency in MHz

Reading (dBμV/m)

= Uncorrected Analyzer / Receiver reading

Factor (dB)

= Antenna factor + Cable loss – Amplifier gain

Level (dBμV/m)

= Reading (dBμV/m) + Factor (dB)

Limit (dBμV/m)

= Limit stated in standard

Margin(dB)

= Limit(dBμV/m) - Level(dBμV/m)

Polarity

= Vertical/ Horizontal

1GHz-18GHz

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	xxx	57.45	49.56	-7.89	74.00	24.44	200	3	Horizontal

Frequency (MHz)

= Emission frequency in MHz

Reading (dBμV/m)

= Uncorrected Analyzer / Receiver reading

Factor (dB)

= Antenna factor + Cable loss – Amplifier gain

Level (dBμV/m)

= Reading (dBμV/m) + Factor (dB)

Limit (dBμV/m)

= Limit stated in standard

Margin(dB)

= Limit(dBμV/m) - Level(dBμV/m)

Polarity

= Vertical/ Horizontal

Above 18GHz

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
xxx	xxx	63.16	46.07	-17.09	83.54	37.47	100	180	Vertical

- Frequency (MHz)

= Emission frequency in MHz
- Ant.Pol. (H/V)

= Antenna polarization
- Reading (dBμV/m)

= Uncorrected Analyzer / Receiver reading
- Factor (dB)

= Antenna factor + Cable loss – Amplifier gain
- Level (dBμV/m)

= Reading (dBμV/m) + Factor (dB)
- Limit (dBμV/m)

= Limit stated in standard
- Margin (dB)

= Remark Result (dBμV/m) – Limit (dBμV/m)
- Peak

= Peak Reading
- QP

= Quasi-peak Reading
- AVG

= Average Reading

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14.5 TEST RESULTS

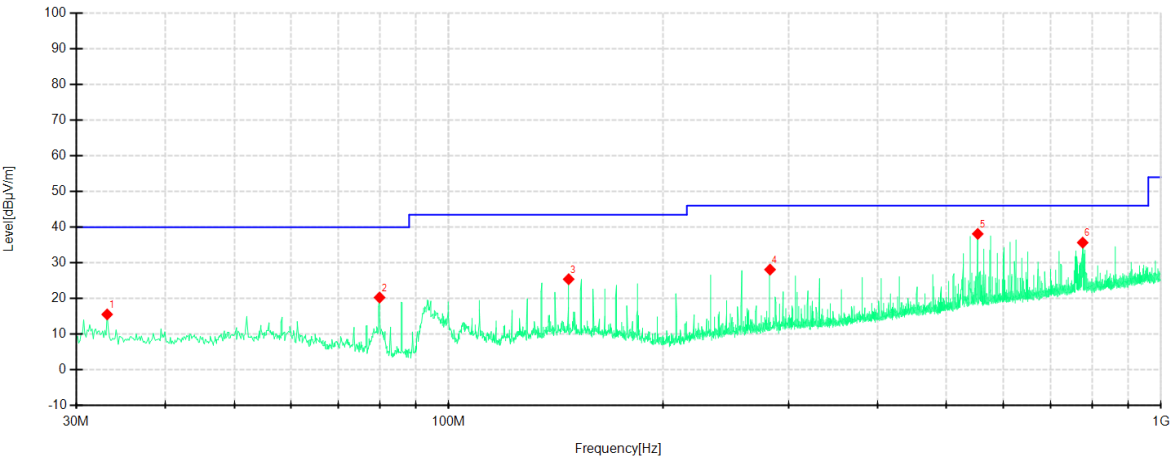
Note: The test is according to the typical placement method of the product.

Below 1GHz

Note: Pre-scan all test modes and recorded the worst case middle frequency 2403.58MHz test results in the report.

Middle Frequency (2403.58MHz)
Environment: 24.5°C/60%RH/101.0kPa
Test Engineer: Wen wenwen

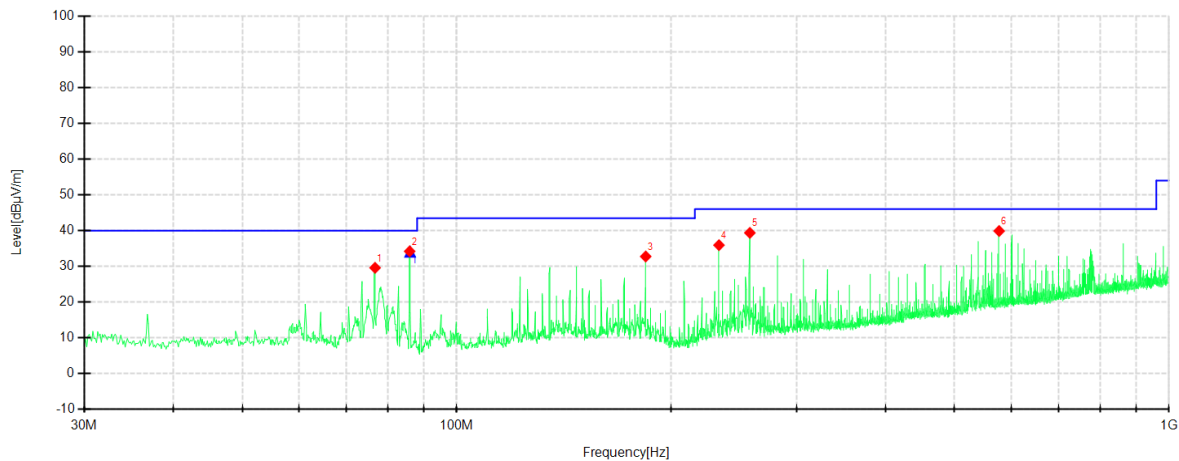
Date: 2024-06-04
Test Voltage:AC 120V/60Hz
Probe : Horizontal



NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
1	33.1529	45.30	15.56	-29.74	40.00	24.44	QP	100	16	Horizontal	PASS
2	79.9612	54.01	20.30	-33.71	40.00	19.70	QP	200	210	Horizontal	PASS
3	147.3847	53.65	25.43	-28.22	43.50	18.07	QP	100	296	Horizontal	PASS
4	282.5953	56.13	28.12	-28.01	46.00	17.88	QP	100	239	Horizontal	PASS
5	553.0166	58.56	38.12	-20.44	46.00	7.88	QP	100	133	Horizontal	PASS
6	776.3870	52.60	35.68	-16.92	46.00	10.32	QP	100	109	Horizontal	PASS

Middle Frequency (2403.58MHz)
Environment: 24.5°C/60%RH/101.0kPa
Test Engineer: Wen wenwen

Date: 2024-06-04
Test Voltage: AC 120V/60Hz
Probe : Vertical



NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Trace	Height [cm]	Angle [°]	Polarity	Verdict
1	76.8084	62.47	29.61	-32.86	40.00	10.39	QP	100	239	Vertical	PASS
2	85.9032	67.94	34.22	-33.72	40.00	5.78	QP	100	105	Vertical	PASS
3	184.2493	63.13	32.78	-30.35	43.50	10.72	QP	100	239	Vertical	PASS
4	233.4829	65.86	35.94	-29.92	46.00	10.06	QP	200	111	Vertical	PASS
5	257.9785	68.65	39.38	-29.27	46.00	6.62	QP	100	37	Vertical	PASS
6	577.5122	59.66	39.90	-19.76	46.00	6.10	QP	100	326	Vertical	PASS

Final Data List										
NO.	Freq. [MHz]	Factor [dB]	QP Reading [dBμV/m]	Level [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity	Verdict
1	86.0213	-33.72	67.80	34.08	40.00	5.92	152	97.9	Vertical	PASS

Remark:

- 1 No emission found between lowest internal used/generated frequency to 30MHz.
- 2 Measuring frequencies from 9kHz to the 1GHz.
- 3 Radiated emissions measured in frequency range from 30MHz to 1GHz were made with an instrument using Peak/Quasi-peak detector mode.
- 4 The IF bandwidth of SPA between 30MHz to 1GHz was 120kHz.

1GHz to 18GHz

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Lowest Frequency (2403.58MHz)
Environment: 24.6°C/62%RH
Test Engineer: Wen wenwen

Date: 2024-06-07
Test Voltage:AC 120V/60Hz

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1296.0000	51.36	42.68	-8.68	74.00	31.32	200	235	Horizontal
2	2631.2000	49.97	47.45	-2.52	74.00	26.55	200	87	Horizontal
3	4807.5000	57.34	50.21	-7.13	74.00	23.79	200	231	Horizontal
4	7212.0000	50.38	51.34	0.96	74.00	22.66	200	339	Horizontal
5	12138.0000	36.86	50.87	14.01	74.00	23.13	100	22	Horizontal
6	15663.0000	38.23	50.52	12.29	74.00	23.48	200	162	Horizontal

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1295.8000	51.22	43.33	-7.89	74.00	30.67	200	358	Vertical
2	1894.4000	47.81	44.40	-3.41	74.00	29.60	200	48	Vertical
3	2578.0000	51.85	49.03	-2.82	74.00	24.97	200	115	Vertical
4	4807.5000	49.70	42.53	-7.17	74.00	31.47	200	339	Vertical
5	7209.0000	44.66	45.55	0.89	74.00	28.45	100	0	Vertical
6	12087.0000	36.94	50.10	13.16	74.00	23.90	200	339	Vertical

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Lowest Frequency (2440.45MHz)
Environment: 24.6°C/62%RH
Test Engineer: Wen wenwen

Date: 2024-06-07
Test Voltage: AC 120V/60Hz

NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1296.0000	51.13	42.45	-8.68	74.00	31.55	100	170	Horizontal
2	2067.2000	48.33	44.31	-4.02	74.00	29.69	200	21	Horizontal
3	2758.6000	49.19	47.29	-1.90	74.00	26.71	100	22	Horizontal
4	4879.5000	61.53	54.64	-6.89	74.00	19.36	200	216	Horizontal
5	7320.0000	49.42	50.79	1.37	74.00	23.21	100	272	Horizontal
6	12105.0000	37.71	51.22	13.51	74.00	22.78	200	176	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4880.8415	-6.89	54.87	47.98	54.00	6.02	179	212.9	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1296.2000	51.03	43.13	-7.90	74.00	30.87	100	282	Vertical
2	1921.6000	48.44	44.60	-3.84	74.00	29.40	100	360	Vertical
3	2796.8000	48.39	47.02	-1.37	74.00	26.98	200	143	Vertical
4	4879.5000	55.07	47.76	-7.31	74.00	26.24	200	311	Vertical
5	7320.0000	46.99	48.44	1.45	74.00	25.56	200	298	Vertical
6	17998.5000	38.13	51.60	13.47	74.00	22.40	100	176	Vertical

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Lowest Frequency (2477.31MHz)
 Environment: 24.6°C/62%RH
 Test Engineer: Wen wenwen

Date: 2024-06-07
 Test Voltage: AC 120V/60Hz

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2092.4000	49.68	45.64	-4.04	74.00	28.36	200	259	Horizontal
2	2610.8000	52.50	50.06	-2.44	74.00	23.94	200	41	Horizontal
3	4954.5000	60.49	54.14	-6.35	74.00	19.86	200	304	Horizontal
4	7432.5000	48.49	50.10	1.61	74.00	23.90	200	358	Horizontal
5	9907.5000	41.56	49.93	8.37	74.00	24.07	200	20	Horizontal
6	12114.0000	36.73	50.37	13.64	74.00	23.63	200	262	Horizontal

AV Final Data List									
NO.	Freq. [MHz]	Factor [dB]	AV Reading [dBμV/m]	AV Value [dBμV/m]	AV Limit [dBμV/m]	AV Margin [dB]	Height [cm]	Angle [°]	Polarity
1	4954.6435	-6.35	53.98	47.63	54.00	6.37	200	259.6	Horizontal

Suspected Data List									
NO.	Freq. [MHz]	Reading [dBμV/m]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	1906.0000	48.51	45.07	-3.44	74.00	28.93	100	151	Vertical
2	2629.6000	52.93	50.19	-2.74	74.00	23.81	100	124	Vertical
3	4954.5000	58.29	51.56	-6.73	74.00	22.44	200	33	Vertical
4	7431.0000	49.61	51.41	1.80	74.00	22.59	200	263	Vertical
5	10563.0000	39.09	49.19	10.10	74.00	24.81	200	74	Vertical
6	13122.0000	36.32	50.40	14.08	74.00	23.60	100	211	Vertical

Remark:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
- Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode.
- Spectrum setting:
 - Peak Setting 1GHz–26.5GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = auto.
 - AV Setting 1GHz–26.5GHz, Set RBW=1MHz, if the EUT is configured to transmit with duty cycle ≥98% , set VBW≤RBW/100 (i.e.,10kHz) but not less than 10 Hz. if the EUT duty cycle is <98% , set VBW≥1/T, Where T is defined in section 2.8.

18GHz to 26.5GHz

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Environment: 25.3℃/59%RH
Test Engineer: Wen wenwen

Date: 2024-06-08
Test Voltage:AC 120V/60Hz

Lowest Frequency (2403.58MHz)

NO.	Freq. [MHz]	Reading [dBμV/m]	Level in 1m [dBμV/m]	Level in 3m [dBμV/m]	Factor [dB]	Limit in 1m [dBμV/m]	Limit in 3m [dBμV/m]	Margin in 1m [dB]	Margin in 3m [dB]	Height [cm]	Angle [°]	Polarity
1	19025.1000	63.77	46.82	37.28	-16.95	83.54	74	36.72	36.72	100	307	Horizontal
2	19938.0000	62.15	45.61	36.07	-16.54	83.54	74	37.93	37.93	150	140	Horizontal
3	20934.6250	61.01	44.85	35.31	-16.16	83.54	74	38.69	38.69	100	206	Horizontal
4	22160.7500	63.02	47.38	37.84	-15.64	83.54	74	36.16	36.16	150	78	Horizontal
5	23139.1000	63.05	48.18	38.64	-14.87	83.54	74	35.36	35.36	100	307	Horizontal
6	24610.8750	63.54	49.41	39.87	-14.13	83.54	74	34.13	34.13	100	275	Horizontal

NO.	Freq. [MHz]	Reading [dBμV/m]	Level in 1m [dBμV/m]	Level in 3m [dBμV/m]	Factor [dB]	Limit in 1m [dBμV/m]	Limit in 3m [dBμV/m]	Margin in 1m [dB]	Margin in 3m [dB]	Height [cm]	Angle [°]	Polarity
1	18914.1750	63.09	45.99	36.45	-17.10	83.54	74	37.55	37.55	100	309	Vertical
2	19763.7500	62.34	45.43	35.89	-16.91	83.54	74	38.11	38.11	100	115	Vertical
3	22612.9500	63.90	48.74	39.20	-15.16	83.54	74	34.80	34.80	150	146	Vertical
4	24049.4500	64.45	49.89	40.35	-14.56	83.54	74	33.65	33.65	100	21	Vertical
5	24989.5500	63.71	49.78	40.24	-13.93	83.54	74	33.76	33.76	100	53	Vertical
6	25907.5500	64.48	50.13	40.59	-14.35	83.54	74	33.41	33.41	150	177	Vertical

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Middle Frequency (2440.45MHz)

NO.	Freq. [MHz]	Reading [dBμV/m]	Level in 1m [dBμV/m]	Level in 3m [dBμV/m]	Factor [dB]	Limit in 1m [dBμV/m]	Limit in 3m [dBμV/m]	Margin in 1m [dB]	Margin in 3m [dB]	Height [cm]	Angle [°]	Polarity
1	18940.9500	63.15	46.12	36.58	-17.03	83.54	74	37.42	37.42	100	19	Horizontal
2	19843.6500	62.82	46.19	36.65	-16.63	83.54	74	37.35	37.35	150	19	Horizontal
3	21073.6000	61.68	45.69	36.15	-15.99	83.54	74	37.85	37.85	100	180	Horizontal
4	22077.0250	63.20	47.52	37.98	-15.68	83.54	74	36.02	36.02	150	19	Horizontal
5	23660.1500	64.32	49.58	40.04	-14.74	83.54	74	33.96	33.96	100	242	Horizontal
6	26373.3500	64.09	50.10	40.56	-13.99	83.54	74	33.44	33.44	100	342	Horizontal

NO.	Freq. [MHz]	Reading [dBμV/m]	Level in 1m [dBμV/m]	Level in 3m [dBμV/m]	Factor [dB]	Limit in 1m [dBμV/m]	Limit in 3m [dBμV/m]	Margin in 1m [dB]	Margin in 3m [dB]	Height [cm]	Angle [°]	Polarity
1	18955.4000	62.75	45.67	36.13	-17.08	83.54	74	37.87	37.87	100	89	Vertical
2	19499.8250	63.07	46.00	36.46	-17.07	83.54	74	37.54	37.54	100	345	Vertical
3	22032.4000	62.96	47.14	37.6	-15.82	83.54	74	36.40	36.40	150	220	Vertical
4	23259.8000	63.49	48.70	39.16	-14.79	83.54	74	34.84	34.84	100	314	Vertical
5	24239.8500	64.30	50.00	40.46	-14.30	83.54	74	33.54	33.54	100	314	Vertical
6	25380.5500	64.02	49.91	40.37	-14.11	83.54	74	33.63	33.63	150	89	Vertical

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Highest Frequency (2477.31MHz)

NO.	Freq. [MHz]	Reading [dBμV/m]	Level in 1m [dBμV/m]	Level in 3m [dBμV/m]	Factor [dB]	Limit in 1m [dBμV/m]	Limit in 3m [dBμV/m]	Margin in 1m [dB]	Margin in 3m [dB]	Height [cm]	Angle [°]	Polarity
1	19048.0500	62.32	45.38	35.84	-16.94	83.54	74	38.16	38.16	100	116	Horizontal
2	19671.9500	63.50	46.73	37.19	-16.77	83.54	74	36.81	36.81	150	19	Horizontal
3	20382.1250	61.58	45.01	35.47	-16.57	83.54	74	38.53	38.53	100	178	Horizontal
4	22067.2500	62.95	47.26	37.72	-15.69	83.54	74	36.28	36.28	150	178	Horizontal
5	24162.5000	63.52	49.26	39.72	-14.26	83.54	74	34.28	34.28	100	147	Horizontal
6	26008.2750	64.43	50.00	40.46	-14.43	83.54	74	33.54	33.54	100	342	Horizontal

NO.	Freq. [MHz]	Reading [dBμV/m]	Level in 1m [dBμV/m]	Level in 3m [dBμV/m]	Factor [dB]	Limit in 1m [dBμV/m]	Limit in 3m [dBμV/m]	Margin in 1m [dB]	Margin in 3m [dB]	Height [cm]	Angle [°]	Polarity
1	18929.9000	63.16	46.07	36.53	-16.94	83.54	74	38.16	38.16	100	116	Vertical
2	19835.1500	62.39	45.52	35.98	-16.77	83.54	74	36.81	36.81	150	19	Vertical
3	21442.5000	61.93	46.04	36.50	-16.57	83.54	74	38.53	38.53	100	178	Vertical
4	22750.6500	63.77	48.59	39.05	-15.69	83.54	74	36.28	36.28	150	178	Vertical
5	23844.6000	64.05	49.45	39.91	-14.26	83.54	74	34.28	34.28	100	147	Vertical
6	25838.2750	65.62	51.34	41.80	-14.43	83.54	74	33.54	33.54	100	342	Vertical

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15. RESTRICTED BANDS OF OPERATION

15.1 LIMITS

Section 15.247(d) In addition, Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

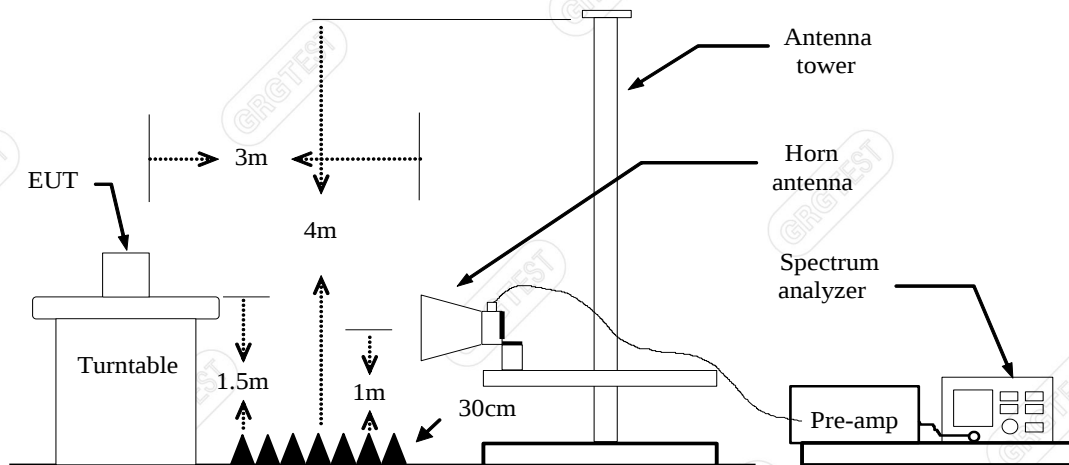
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			

Frequency (MHz)	Quasi-peak($\mu\text{V}/\text{m}$)	Measurement distance(m)	Quasi-peak(dB $\mu\text{V}/\text{m}$)@distance 3m
0.009-0.490	2400/F(kHz)	300	128.5~93.8
0.490-1.705	24000/F(kHz)	30	73.8~63
1.705-30.0	30	30	69.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

15.2 TEST PROCEDURES

- 1) The EUT is placed on a turntable, which is 1.5m above the ground plane.
- 2) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 3) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
- 4) Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
 - a) PEAK: RBW=1MHz / VBW=1MHz / Sweep=AUTO.
 - b) AVERAGE: RBW=1MHz / VBW=1/T / Sweep=AUTO. Where T is defined in section 2.8.
- 5) Repeat the procedures until all the PEAK and AVERAGE versus polarization are measured.

15.3 TEST SETUP



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15.4 TEST RESULTS

Note: The test is according to the typical placement method of the product.

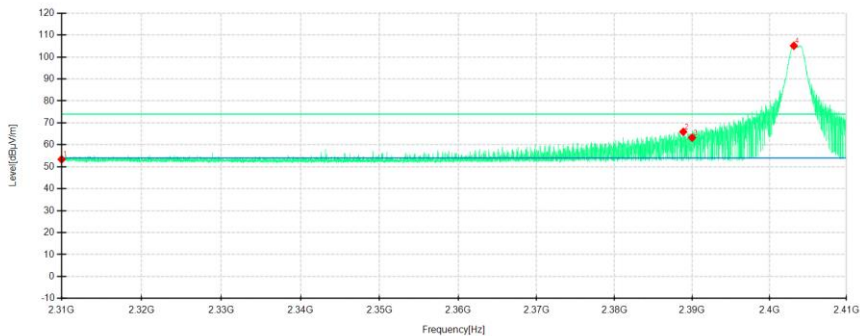
Environment: 22.0°C/60%RH/101.0kPa
Tested By: Wen wenwen

Voltage:AC 120V/60Hz
Date: 2024-06-07

Lowest Channel

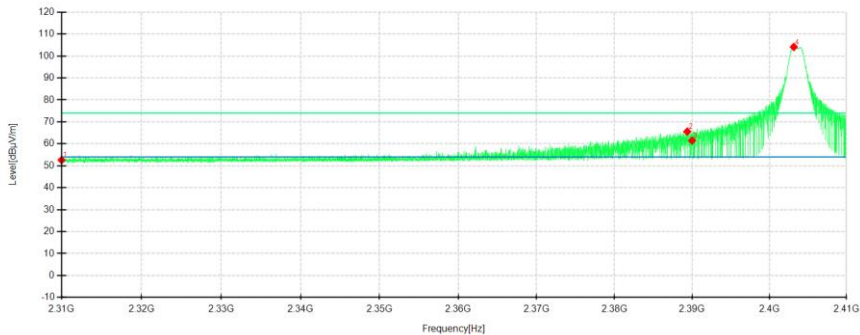
Frequency 2403.58MHz
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical

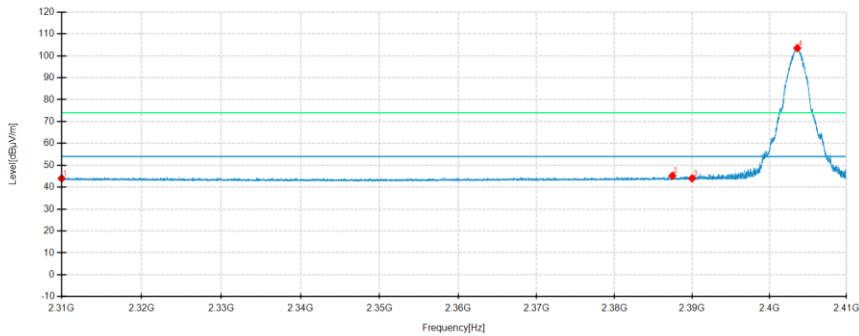


No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310.0000	58.34	53.38	-4.96	74.00	20.62	200	249	Horizontal	/
2	2388.8625	71.75	65.92	-5.83	74.00	8.08	100	46	Horizontal	/
3	2390.0000	69.08	63.25	-5.83	74.00	10.75	200	27	Horizontal	/
4	2403.1750	110.98	105.12	-5.86	---	---	200	53	Horizontal	No limit
1	2310.0000	58.27	52.61	-5.66	74.00	21.39	100	310	Vertical	/
2	2389.3750	70.96	65.55	-5.41	74.00	8.45	200	228	Vertical	/
3	2390.0000	66.89	61.48	-5.41	74.00	12.52	100	232	Vertical	/
4	2403.1625	109.46	104.11	-5.35	---	---	200	188	Vertical	No limit

Lowest Channel

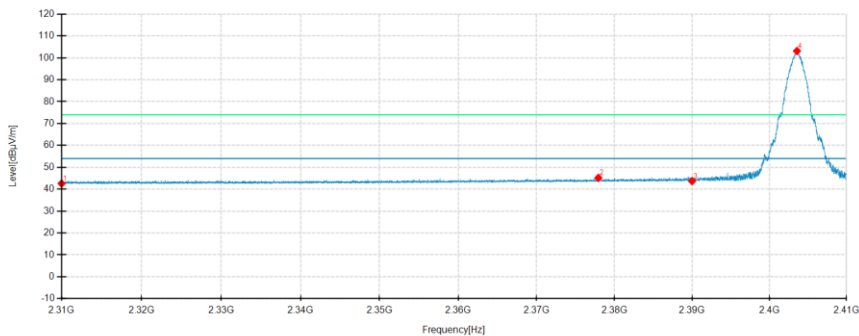
Frequency 2403.58MHz
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



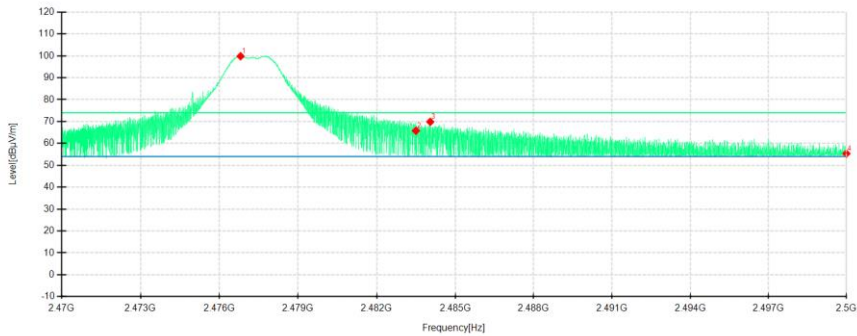
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2310.0000	48.97	44.01	-4.96	54.00	9.99	200	262	Horizontal	/
2	2387.4625	51.01	45.19	-5.82	54.00	8.81	200	54	Horizontal	/
3	2390.0000	49.84	44.01	-5.83	54.00	9.99	200	67	Horizontal	/
4	2403.6250	109.40	103.54	-5.86	---	---	200	67	Horizontal	No limit
1	2310.0000	48.26	42.60	-5.66	54.00	11.40	200	18	Vertical	/
2	2377.9375	50.64	45.18	-5.46	54.00	8.82	100	129	Vertical	/
3	2390.0000	49.10	43.69	-5.41	54.00	10.31	100	300	Vertical	/
4	2403.5750	108.49	103.14	-5.35	---	---	200	162	Vertical	No limit

Highest Channel

Frequency 2477.31MHz

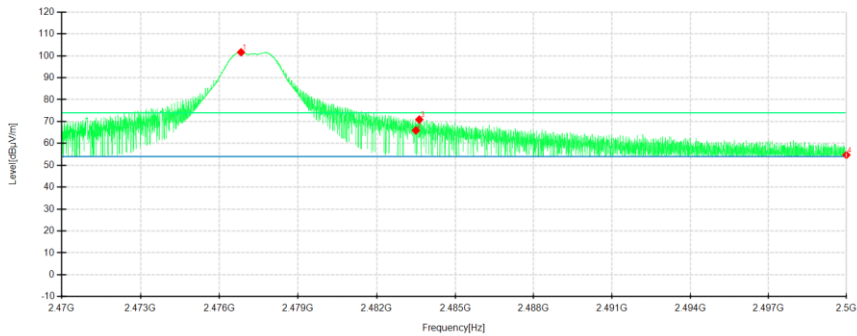
Detector mode: Peak

Polarity: Horizontal



Detector mode: Peak

Polarity: Vertical



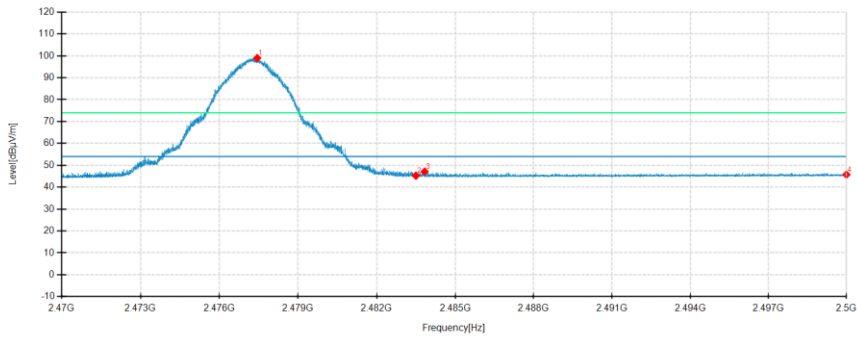
No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBμV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2476.8100	105.06	99.83	-5.23	---	---	100	70	Horizontal	No limit
2	2483.5000	70.88	65.78	-5.10	74.00	8.22	200	92	Horizontal	/
3	2484.0475	74.96	69.87	-5.09	74.00	4.13	200	27	Horizontal	/
4	2500.0000	60.15	55.36	-4.79	74.00	18.64	100	20	Horizontal	/
1	2476.8288	106.69	101.63	-5.06	---	---	100	118	Vertical	No limit
2	2483.5000	70.94	65.91	-5.03	74.00	8.09	200	72	Vertical	/
3	2483.6275	75.92	70.89	-5.03	74.00	3.11	100	118	Vertical	/
4	2500.0000	59.71	54.72	-4.99	74.00	19.28	200	320	Vertical	/

Highest Channel

Frequency 2477.31MHz

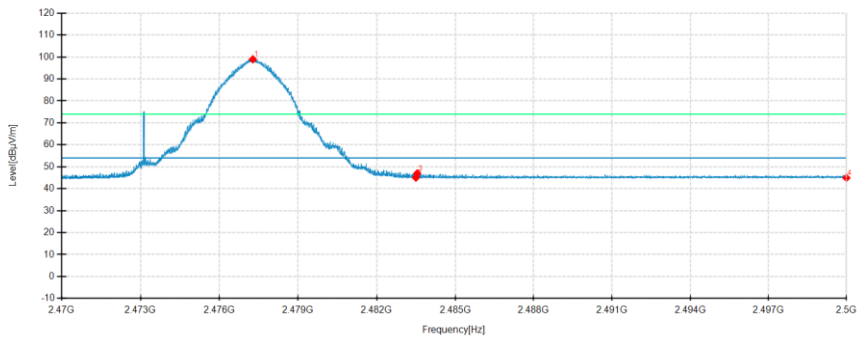
Detector mode: Average

Polarity: Horizontal



Detector mode: Average

Polarity: Vertical



No.	Frequency MHz	Reading dBμV/m	Level dBμV/m	Factor dB	Limit dBuV/m	Margin dB	Height cm	Angle °	Pole	Remark
1	2477.4438	104.21	98.99	-5.22	---	---	100	217	Horizontal	No limit
2	2483.5000	50.35	45.25	-5.10	54.00	8.75	100	75	Horizontal	/
3	2483.8338	52.20	47.11	-5.09	54.00	6.89	100	152	Horizontal	/
4	2500.0000	50.52	45.73	-4.79	54.00	8.27	100	138	Horizontal	/
1	2477.2788	104.02	98.96	-5.06	---	---	200	125	Vertical	No limit
2	2483.5000	50.10	45.07	-5.03	54.00	8.93	200	319	Vertical	/
3	2483.5488	51.95	46.92	-5.03	54.00	7.08	200	97	Vertical	/
4	2500.0000	49.93	44.94	-4.99	54.00	9.06	200	19	Vertical	/

Remark:

- 1) Max field strength in 3m distance. No any other emission which falls in restricted bands can be detected and be reported.

APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM

Please refer to the attached document E202405222827-test setup photo.

APPENDIX B. PHOTOGRAPH OF THE EUT

Please refer to the attached document E202405222827-EUT photo.

----- End of Report -----