

Test Report

Verified code: 201009

Report No.: E20230626950701-1

Customer: Lumi United Technology Co., Ltd

Address: B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

Sample Name: LED Strip T1

Sample Model: LEDS-K02

Receive Sample Date: Jun.29,2023

Test Date: Jul.05,2023 ~ Jul.06,2023

Reference Document: CFR 47 FCC Part 15 Subpart C
RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators
§15.207 (a) Conducted Emissions
§15.247(d) Radiated spurious emissions

Test Result: Pass

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GRG METROLOGY & TEST GROUP CO., LTD.

Issued Date: 2023-09-08

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20230626950701-1	Original Issue	2023-09-06

Note: This report is based on report E20221122027601-1 for revised LED drive chip model in LED strip, the difference descriptions as below:

The EUT (LED Strip T1) add an alternative LED drive chip SM16703SP3 with same manufacture. The model no. LEDS-K01, LEDS-K02, RLS-K01D, RLS-K02D have the same technical construction including circuit diagram, PCB LAYOUT, hardware version and software version identical, except sales area and packaging are different.

The Original LED drive chip model	The New LED drive chip model
SM16703PB	SM16703SP3

After evaluated the Radiated spurious emissions(30MHz to 1GHz) and Conducted Emissions test results has revised, the other test data refer to report E20221122027601-1.

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1. TEST RESULT SUMMARY

Technical Requirements		
CFR 47 FCC Part 15 Subpart C (§15.247)		
Limit / Severity	Item	Result
§15.207 (a)	Conducted Emissions	Pass
§15.247(d) & §15.209 & §15.205	Radiated spurious emissions	Pass

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2. GENERAL DESCRIPTION OF EUT

2.1 APPLICANT

Name: Lumi United Technology Co., Ltd
Address: B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

2.2 MANUFACTURER

Name: Lumi United Technology Co., Ltd
Address: B1, Chongwen Park, Nanshan iPark, Liuxian Avenue, Taoyuan Residential District, Nanshan District, Shenzhen, China

2.3 BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment: LED Strip T1
Model No.: LEDS-K02
Adding Model: LEDS-K01, RLS-K01D, RLS-K02D
Difference descriptions: Except sales area and packaging are different. The circuit diagram, PCB LAYOUT, hardware version and software version identical are all the same.
Trade Name: Aqara
FCC ID: 2AKIT-LEDSK02
Power Supply: DC 24V
Frequency Range: 2405MHz-2475MHz
Modulation type: O-QPSK
Antenna Specification: PCB printed antenna with 0.5dBi gain (Max)
Temperature Range: -10 ℃~40 ℃
Hardware Version: X1
Software Version: 0.0.0_2224
Sample No: E20230626950701-0001

Note: The model LEDS-K02 is the test sample.
The EUT antenna gain 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.

2.4 CHANNEL LIST

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
11	2405	12	2410	13	2415	14	2420
15	2425	16	2430	17	2435	18	2440
19	2445	20	2450	21	2455	22	2460
23	2465	24	2470	25	2475	/	/

2.5 TEST OPERATION MODE

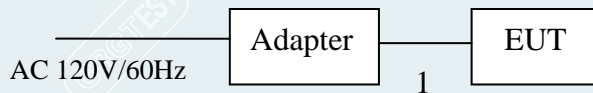
Mode No.	Description of the modes
1	Zigbee fixed frequency transmitting

2.6 LOCAL SUPPORTIVE

Name of Equipment	Manufacturer	Model	Serial Number	Note
Adapter	Shenzhen Cenwell technology Co., Ltd.	CW2401500RE	/	/

No.	Cable Type	Qty.	Shielded Type	Ferrite Core(Qty.)	Length
1	DC cable	1	No	0	1.5m

2.7 CONFIGURATION OF SYSTEM UNDER TEST



Test software:

Software version	Test level
QCOM_V1.0	80

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3. 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 Guangang Road Xinlan Community, Guanlan Street, Longhua
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4. ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to 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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5. 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	Horizontal	30MHz~200MHz	4.5dB ¹⁾
		200MHz~1000MHz	4.4dB ¹⁾
	Vertical	30MHz~200MHz	4.4dB ¹⁾
		200MHz~1000MHz	4.5dB ¹⁾
Conduction Emission		150kHz~30MHz	3.4dB ¹⁾

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
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 $k=2$.

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6. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Radiated Spurious Emission				
Test Receiver	R&S	ESR26	101758	2023-10-27
Bi-log Antenna	Schwarzbeck	VULB 9160	VULB9160-3402	2023-10-23
Amplifier	SHIRONG ELECTRONIC	DLNA-30M1G-G 41	20200928002	2023-08-19
Test S/W	Tonscend	JS32-RE/2.5.2.4		
Conduction Emission				
EMI TESTRECEIVER	R&S	ESCI	100783	2023-08-28
LISN(EUT)	R&S	ENV216	101543	2023-09-13
Test S/W	EZ	CCS-3A1-CE		

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

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7. CONDUCTED EMISSIONS

7.1 LIMITS

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

NOTE: (1) The lower limit shall apply at the transition frequencies.

(2) The limit decreases in line with the logarithm of the frequency in the range of 150 kHz to 0.5MHz.

7.2 TEST PROCEDURES

Procedure of Preliminary Test

Test procedures follow ANSI C63.10:2013.

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.

– Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.

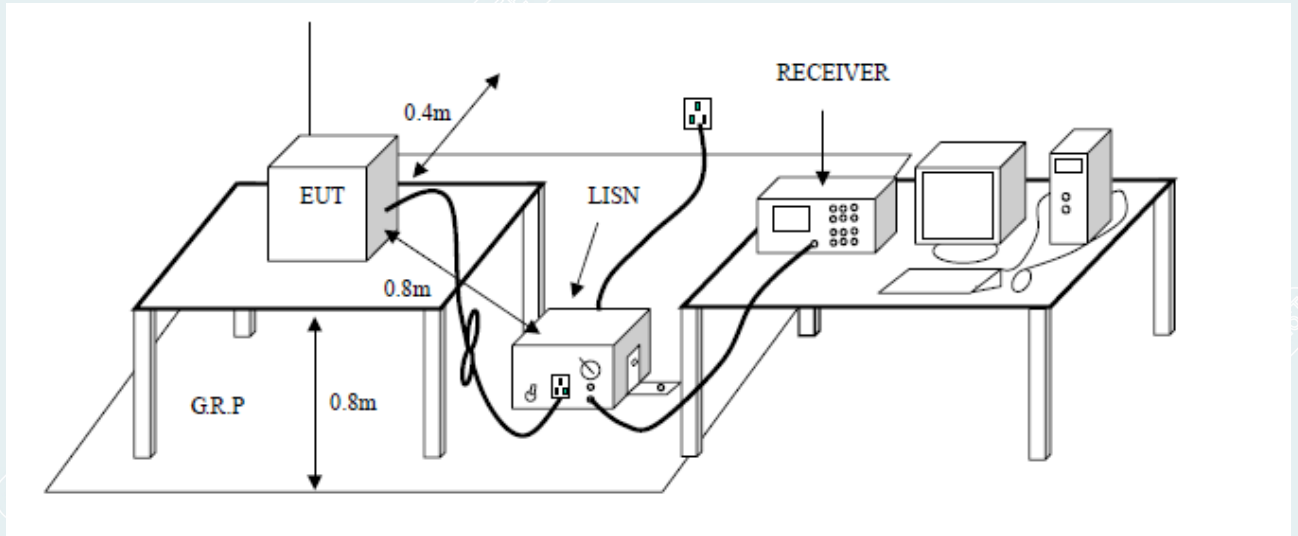
The test mode(s) described in Item 2.6 were scanned during the preliminary test. After the preliminary scan, we found the test mode described in Item 2.6 producing the highest emission level. The EUT configuration and cable configuration of the above highest emission levels were recorded for reference 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.

7.3 TEST SETUP



7.4 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

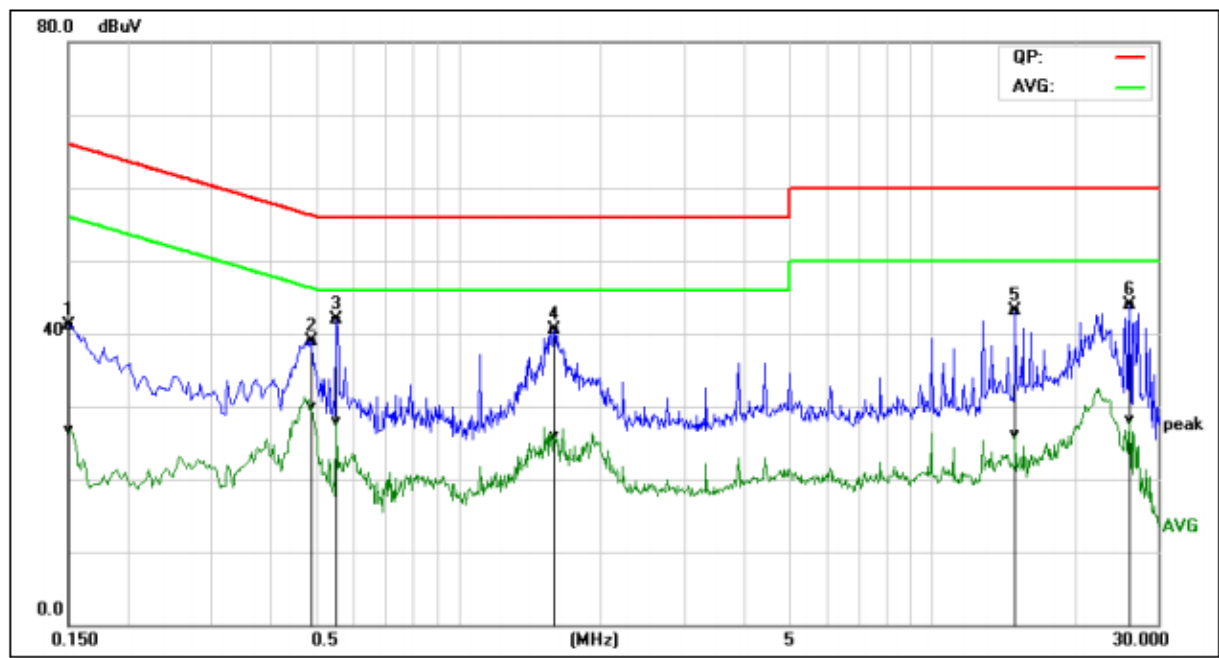
- Factor = Insertion loss of LISN + Cable Loss
- Result = Quasi-peak Reading/ Average Reading + Factor
- Limit = Limit stated in standard
- Margin = Result (dBuV) – Limit (dBuV)

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7.5 TEST RESULTS

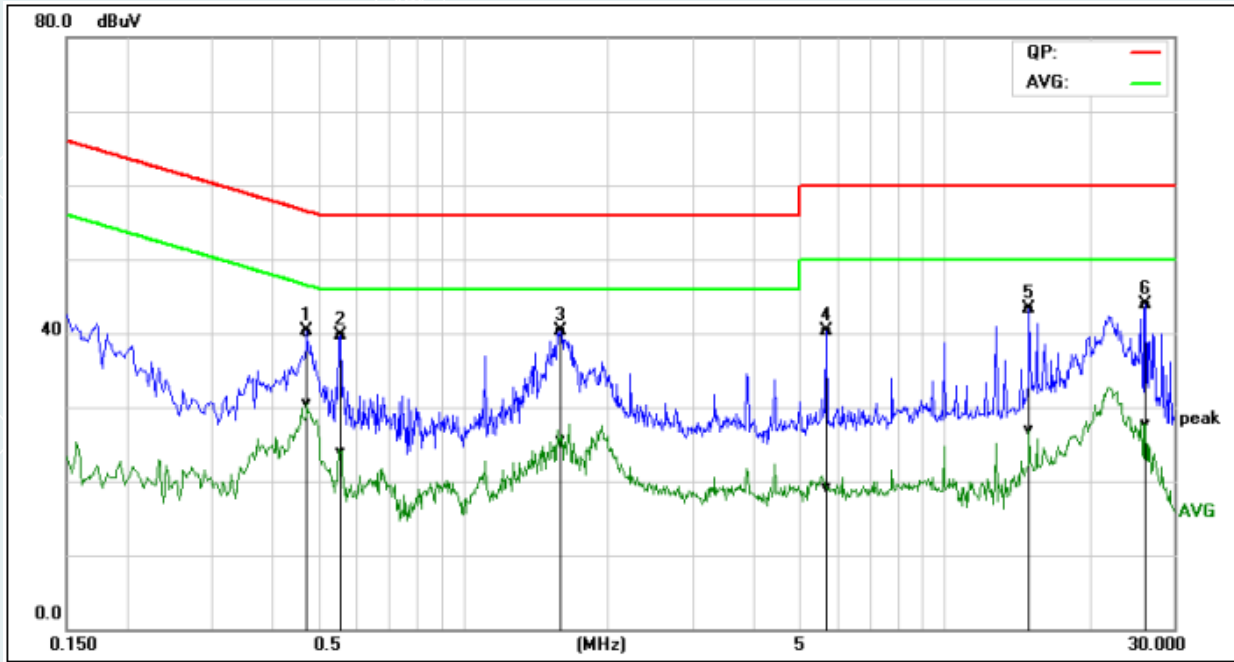
All modes were pretested and only the worst modes and channels were recorded in this report.
(Zigbee 2405MHz)

EUT Name:	LED Strip T1	Test Mode:	Mode 1
Model:	LEDS-K02	Sample No:	E20230626950701-0001
Power supply:	AC 120V/60Hz	Environmental Conditions:	24.7°C/59%RH/101.0kPa
Test Engineer:	Wang xinyuan	Test Date:	2023-07-06
Channel	Lowest channel (2405MHz)	Line:	L



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	31.48	17.07	9.60	41.08	26.67	65.99	56.00	-24.91	-29.33	Pass
2	0.4900	29.31	20.36	9.60	38.91	29.96	56.17	46.17	-17.26	-16.21	Pass
3*	0.5540	32.37	18.28	9.60	41.97	27.88	56.00	46.00	-14.03	-18.12	Pass
4	1.5980	30.82	16.27	9.64	40.46	25.91	56.00	46.00	-15.54	-20.09	Pass
5	15.0180	33.32	16.20	9.87	43.19	26.07	60.00	50.00	-16.81	-23.93	Pass
6	26.1700	33.84	18.03	10.07	43.91	28.10	60.00	50.00	-16.09	-21.90	Pass

EUT Name:	LED Strip T1	Test Mode:	Mode 1
Model:	LEDS-K02	Sample No:	E20230626950701-0001
Power supply:	AC 120V/60Hz	Environmental Conditions:	24.7°C/59%RH/101.0kPa
Test Engineer:	Wang xinyuan	Test Date:	2023-07-06
Channel	Lowest channel (2405MHz)	Line:	N



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	0.4740	30.60	20.82	9.60	40.20	30.42	56.44	46.44	-16.24	-16.02	Pass
2	0.5580	30.10	14.24	9.60	39.70	23.84	56.00	46.00	-16.30	-22.16	Pass
3*	1.5980	30.66	15.87	9.64	40.30	25.51	56.00	46.00	-15.70	-20.49	Pass
4	5.6979	30.68	9.46	9.72	40.40	19.18	60.00	50.00	-19.60	-30.82	Pass
5	15.0380	33.36	17.09	9.87	43.23	26.96	60.00	50.00	-16.77	-23.04	Pass
6	26.1500	33.81	17.72	10.07	43.88	27.79	60.00	50.00	-16.12	-22.21	Pass

8. RADIATED SPURIOUS EMISSIONS

8.1 LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, 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 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak($\mu\text{V}/\text{m}$)	Measurement distance(m)	Quasi-peak($\text{dB}\mu\text{V}/\text{m}$)@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

NOTE: (1) The lower limit shall apply at the transition frequencies.

(2) Above 18GHz test distance is 1m, so the Peak Limit= $74+20*\log(3/1)=83.54$ ($\text{dB}\mu\text{V}/\text{m}$).

The Avg Limit= $54+20*\log(3/1)=63.54$ ($\text{dB}\mu\text{V}/\text{m}$).

8.2 TEST PROCEDURES

1) 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.

--- Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.

--- The EUT is placed on a desktop position in the center of 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 pre measurement 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 pre measurement with marked maximum final measurements and the limit will be stored.

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

8.3 TEST SETUP

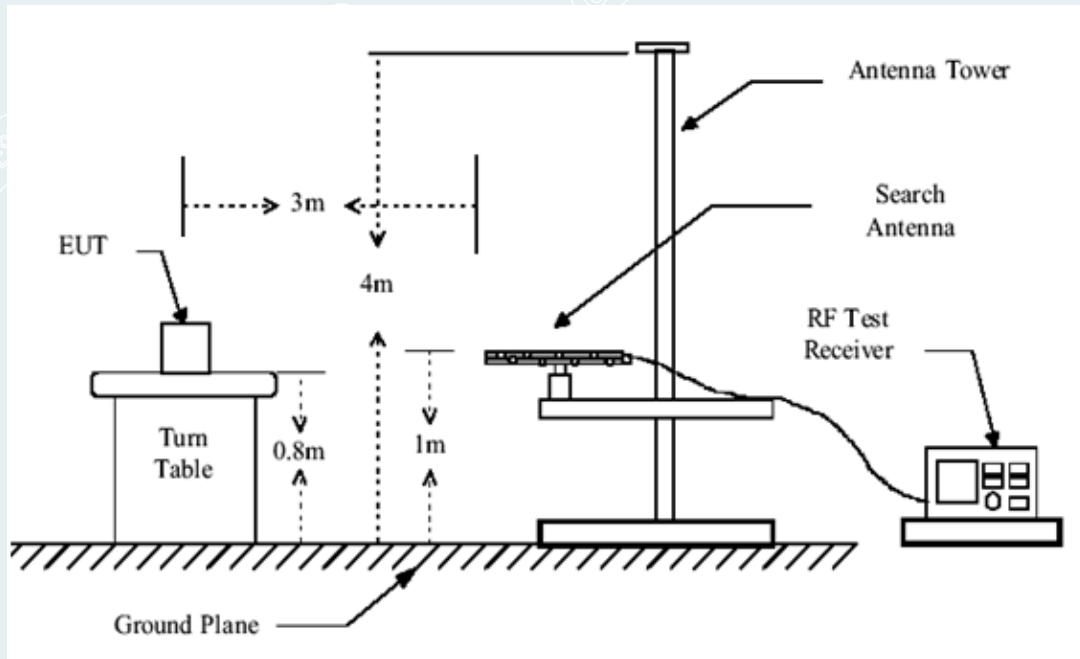


Figure 2. 30MHz to 1GHz radiated emissions test configuration

8.4 DATA SAMPLE

30MHz to 1GHz

Suspected Data List									
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Factor [dB]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
xxx	xxx	55.83	27.19	-28.64	40.00	12.81	100	94	Vertical

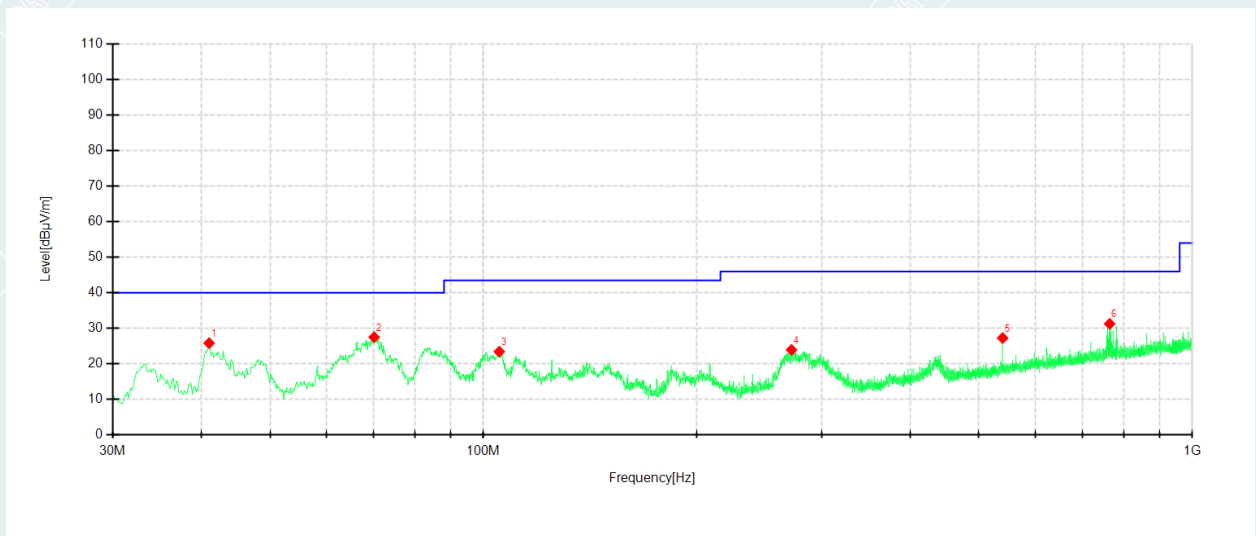
- Frequency (MHz) = Emission frequency in MHz
- Ant.Pol. (H/V) = Antenna polarization
- Reading (dB μ V/m) = Uncorrected Analyzer / Receiver reading
- Level (dB μ V/m) = Reading (dB μ V/m) + Factor (dB)
- Limit (dB μ V/m) = Limit stated in standard
- Margin (dB) = Limit (dB μ V/m) - Level (dB μ V/m)
- Polarity = Vertical/Horizontal

8.5 TEST RESULTS

Below 1GHz

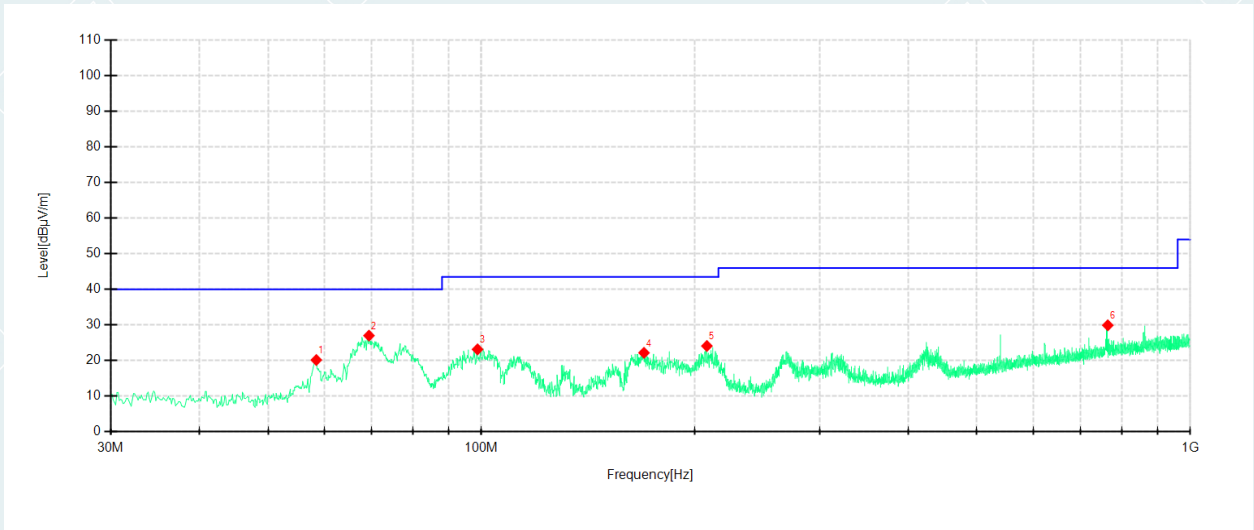
Pretest all case, only the worst mode and channel were recorded in this report. (Zigbee 2405MHz)

EUT Name:	LED Strip T1	Test Mode:	Mode 1
Model:	LEDS-K02	Sample No:	E20230626950701-0001
Power supply:	AC 120V/60Hz	Environmental Conditions:	23.3°C/63%RH/101.0kPa
Test Engineer:	Zhang zishan	Test Date:	2023-07-05
Channel	Lowest channel (2405MHz)	/	/



Suspected Data List									
NO.	Frequency. [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	41.0351	54.50	25.85	-28.65	40.00	14.15	100	84	Vertical
2	70.1388	58.45	27.51	-30.94	40.00	12.49	100	84	Vertical
3	105.3057	54.34	23.46	-30.88	43.50	20.04	100	94	Vertical
4	272.0453	52.52	23.95	-28.57	46.00	22.05	100	253	Vertical
5	540.0413	47.89	27.28	-20.61	46.00	18.72	100	124	Vertical
6	764.6243	47.96	31.28	-16.68	46.00	14.53	100	294	Vertical

EUT Name:	LED Strip T1	Test Mode:	Mode 1
Model:	LEDS-K02	Sample No:	E20230626950701-0001
Power supply:	AC 120V/60Hz	Environmental Conditions:	23.3°C/63%RH/101.0kPa
Test Engineer:	Zhang zishan	Test Date:	2023-07-05
Channel	Lowest channel (2405MHz)	/	/



Suspected Data List									
NO.	Frequency [MHz]	Reading [dBµV/m]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	58.4973	49.14	20.17	-28.97	40.00	18.79	100	156	Horizontal
2	69.4112	57.82	27.02	-30.80	40.00	12.98	100	345	Horizontal
3	98.7573	54.87	23.16	-31.71	43.50	20.17	100	186	Horizontal
4	169.5762	50.95	22.19	-28.76	43.50	21.31	100	57	Horizontal
5	208.0173	55.26	24.11	-31.15	43.50	19.39	100	145	Horizontal
6	764.9881	46.58	29.91	-16.67	46.00	16.09	100	345	Horizontal

Remark:

- 1 Radiated emissions measured in frequency range from 30MHz to 1GHz were made with an instrument using Quasi-peak detector mode.
- 2 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

APPENDIX A. PHOTOGRAPH OF THE TEST CONNECTION DIAGRAM

Please refer to the attached document E20230626950701-3 test setup photo-FCC+IC.

APPENDIX B. PHOTOGRAPH OF THE EUT

Please refer to the attached document E20230626950701-4 EUT Photo-FCC+IC.

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