

Test Report

Verified code: 232291

Report No.: E20220126665001-3-G1

Customer: Lumi United Technology Co., Ltd

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

Sample Name: Hub M1S Gen 2

Sample Model: HM1S-G02

Receive Sample Date: Feb.09,2022

Test Date: Feb.15,2022 ~ Mar.03,2022

Reference Document: CFR 47, FCC Part 15 Subpart C
RADIO FREQUENCY DEVICES:Subpart C—Intentional Radiators
ANSI C63.10-2013
KDB 558074 D01 15.247 Meas Guidance v05r02

Test Result: Pass

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GUANGZHOU GRG METROLOGY & TEST CO., LTD

Issued Date: 2022-03-24

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REPORT ISSUED HISTORY

Report Version	Report No.	Description	Compile Date
1.0	E20220126665001-3	Original Issue	2022/03/09
2.0	E20220126665001-3-G1	Update	2022/03/23

Version 2.0:

1. On the basis of the original report, updated the limit of 802.11n HT20 mode in the power spectral density.
2. This report instead the report E20220126665001-3, and from the date of issuance of this report, the report which being replaced become invalid.

1. TEST RESULT SUMMARY

Standard	Item	Limit / Severity	Result
CFR 47, FCC Part 15 Subpart C (§15.247)	Antenna Requirement	§15.203	PASS
	Conducted Emissions	§15.207 (a)	PASS
	Radiated Spurious Emission	§15.247(d) §15.205 §15.209	PASS
	6 dB Bandwidth	§15.247 (a)(2)	PASS
	Maximum Peak Output Power	§15.247(b)(3)	PASS
	Power Spectral Density	§15.247(e)	PASS
	Conducted band edges and Spurious Emission	§15.247(d)	PASS
	Restricted bands of operation	§15.205 §15.209 §15.247(d)	PASS

The antenna is internal antenna. The max gain of antenna is 1.5dBi, 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: 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

Product Name: Hub M1S Gen 2
Product Model: HM1S-G02
Adding Model: /
Trade Name: Aqara
FCC ID: 2AKIT-HM1S-G02
Power Supply: AC120V/60Hz
Adapter Specification: /
Frequency Band: 2412MHz-2462MHz for 802.11b/g/n HT20
Transmit Power: 18.67dBm for 802.11b mode
24.14dBm for 802.11g mode
23.33dBm for 802.11n HT20 mode
Modulation Type: DSSS for 802.11b mode;
OFDM for 802.11g/n mode
Antenna Specification: Internal with 1.5dBi gain (Max)
Temperature Range: -10°C ~ +40°C
Hardware Version: T0
Software Version: V1.0.1_0001
Sample submitting way: ☒ Provided by customer ☐ Sampling
Sample No: E20220126665001-0002, E20220126665001-0003
Note: /

2.4 CHANNEL LIST

CH01 - CH11 for IEEE 802.11b, IEEE 802.11g, IEEE 802.11n HT20							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	04	2427	07	2442	10	2457
02	2417	05	2432	08	2447	11	2462
03	2422	06	2437	09	2452		

2.5 TEST OPERATION MODE

Mode No.	Description of the modes
1	2.4G Wi-Fi fixed frequency transmitting

2.6 LOCAL SUPPORTIVE INSTRUMENTS

Name of Equipment	Manufacturer	Model	Serial Number	Note
Notebook	LENOVO	TianYi 310-14ISK	MP18DLC6	/
Cable				
Serial port to USB cable	/	/	/	UnShielded, 1.5m

2.7 CONFIGURATION OF SYSTEM UNDER TEST

EUT

Test software:

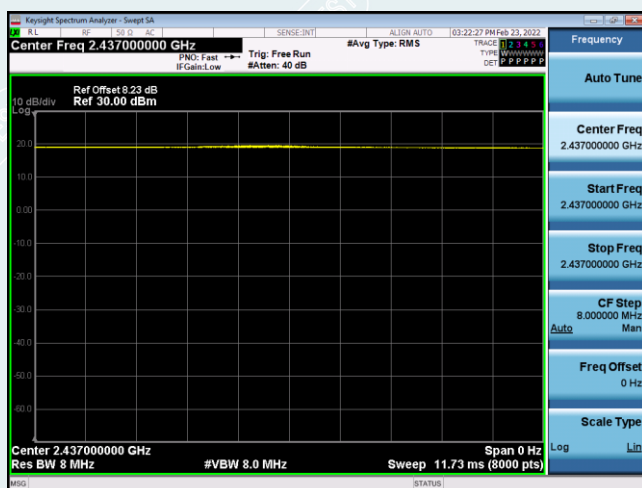
Software version	Power Setting
BLDevCube.exe	802.11b:17; 802.11g:15; 802.11n HT20:14

2.8 DUTY CYCLE

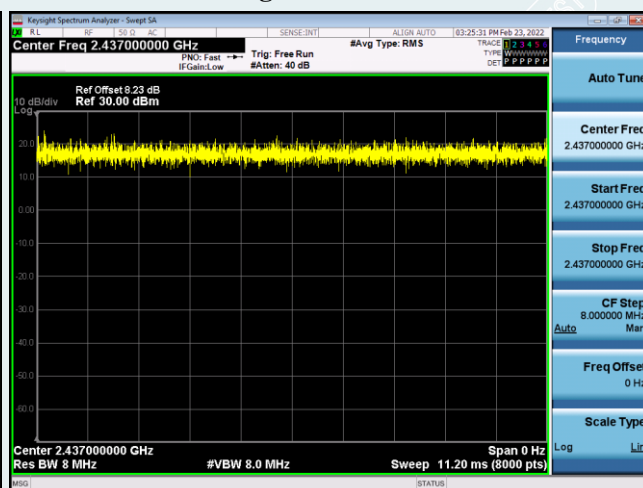
EUT Name	Hub M1S Gen 2	Model	HM1S-G02
Environmental Conditions	23.5°C/48%RH	Test Voltage	AC120V/60Hz
Tested By	Deng Weihao	Tested Date	2022/02/23

Test Mode	Antenna	Frequency (MHz)	Duty Cycle [%]
802.11b	Ant1	2437	100
802.11g	Ant1	2437	100
802.11n HT20	Ant1	2437	100

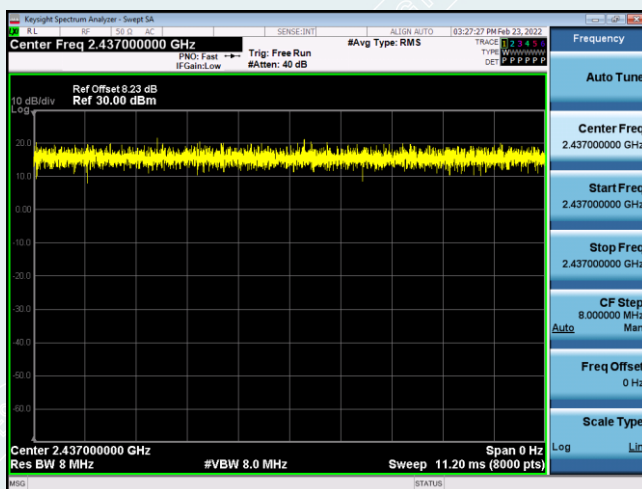
802.11b_Ant1_2437MHz



802.11g_Ant1_2437MHz



802.11n HT20_Ant1_2437MHz



3. LABORATORY AND ACCREDITATIONS

3.1 LABORATORY

The tests & measurements refer to this report were performed by Shenzhen EMC Laboratory of Guangzhou GRG Metrology & Test Co., Ltd.

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P.C. : 518000

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3.2 ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

USA A2LA(Certificate#:2861.01)

China CNAS(L0446)

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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3.3 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	9kHz~30MHz	4.46dB
		30MHz~1000MHz	4.30dB
		1GHz~18GHz	5.60dB
		18GHz~26.5GHz	3.65dB
	Vertical	9kHz~30MHz	4.46dB
		30MHz~1000MHz	4.30dB
		1GHz~18GHz	5.60dB
		18GHz~26.5GHz	3.65dB
Conduction Emission		9 kHz~150kHz	2.80dB
		150kHz~10MHz	2.80dB
		10MHz~30MHz	2.20dB

Measurement	Uncertainty
RF frequency	6.0×10^{-6}
RF power conducted	0.78 dB
Occupied channel bandwidth	0.4 dB
Unwanted emission, conducted	0.68 dB
Humidity	6 %
Temperature	2 °C

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

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4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Conducted Emissions				
EZ-EMC	EZ	CCS-3A1-CE	/	/
EMI Receiver	R&S	ESCI	100783	2022-09-13
LISN(EUT)	R&S	ENV216	101543	2022-03-21
Radiated Spurious Emission&Restricted bands of operation				
Test S/W	EZ	CCS-2ANT		
Loop Antenna	TESEQ	HLA6121	52599	2022-04-21
Test Receiver	R&S	ESCI	100088	2022-10-31
Preamplifier	EMEC	EM330	/	2022-03-21
Bi-log Antenna	TESEQ	CBL6143A	32399	2022-11-25
Spectrum Analyzer	Agilent	N9010A	MY52221469	2022-04-16
Horn Antenna	Schwarzbeck	BBHA9120D(1201)	02143	2022-10-22
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	BBHA 9170-497	2022-10-16
Amplifier	Tonscend	TAP01018048	AP20E8060075	2022-06-07
Amplifier	Tonscend	TAP184050	AP20E806071	2022-05-17
Test S/W	Tonscend	JS32-RE/2.5.1.5		
6 dB Bandwidth				
Spectrum Analyzer	R&S	FSV30	104381	2022-12-10
Output Power				
Pulse power sensor	Agilent	MA2411B	1126150	2022-03-21
Power meter	Anritsu	ML2495A	1204003	2022-03-21
Conducted band edges and Spurious Emission				
Spectrum Analyzer	R&S	FSV30	104381	2022-12-10
Power Spectral Density				
Spectrum Analyzer	R&S	FSV30	104381	2022-12-10

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

5. CONDUCTED EMISSION MEASUREMENT

5.1 LIMITS

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

5.2 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.

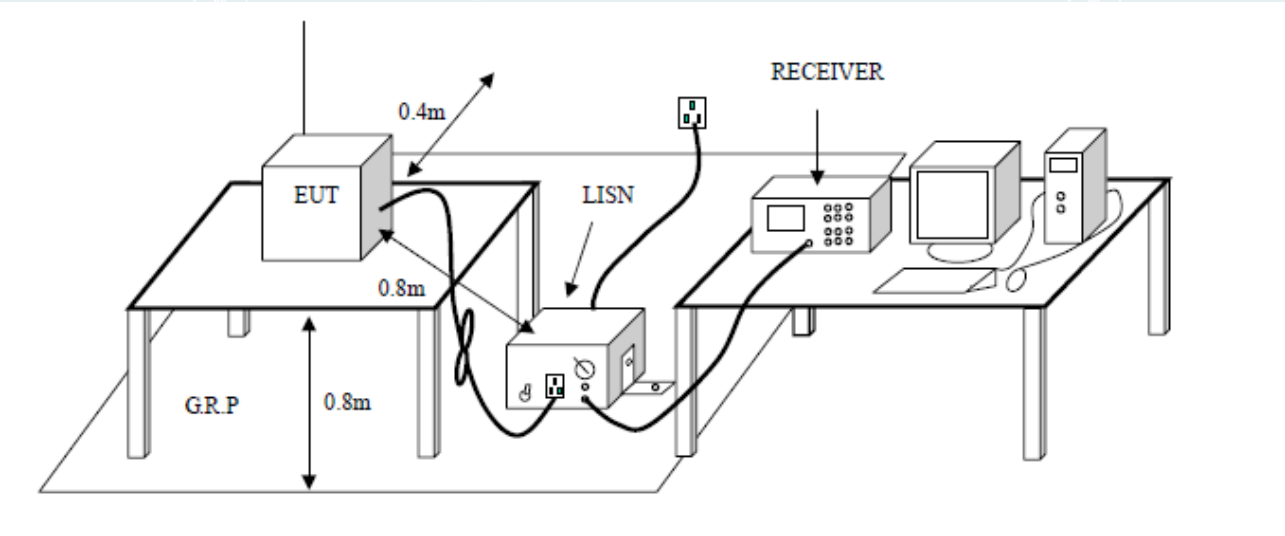
- Use serial board or connecting line to make EUT and notebook to communicate, according to the actual need to make EUT send constant frequency signal continuously.

The test mode(s) described in Item 2.5 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.

5.3 TEST SETUP



5.4 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

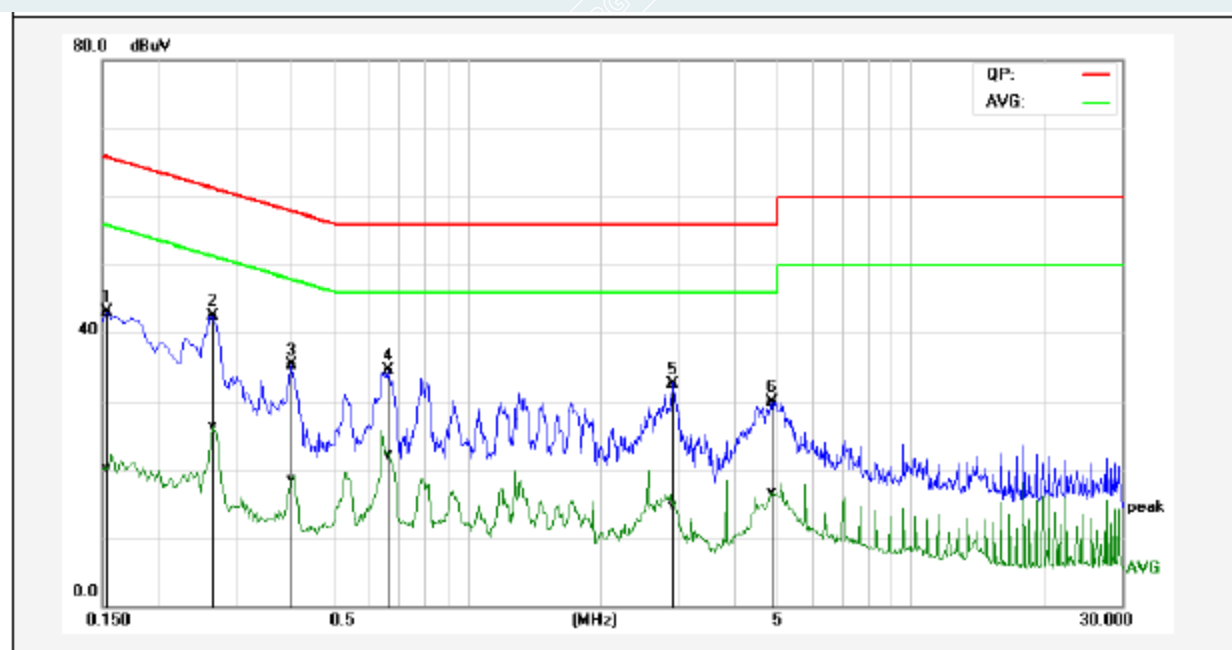
Factor = Insertion loss of LISN + Cable Loss
Result = Quasi-peak Reading/ Average Reading + Factor
Limit = Limit stated in standard
Margin = Result (dBuV) – Limit (dBuV)

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5.5 TEST RESULTS

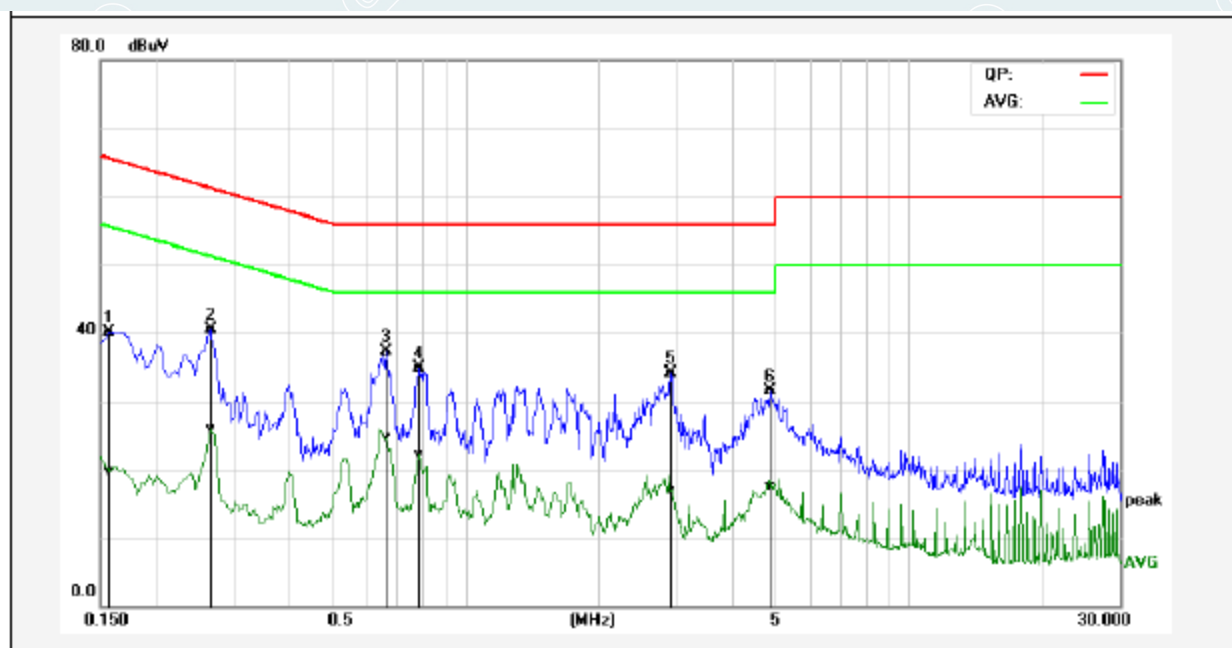
All models were pretested and only the worst modes and channels were recorded in this report. (IEEE 802.11g 2412MHz)

EUT Name	Hub M1S Gen 2	Model	HM1S-G02
Environmental Conditions	23.5°C/47%RH	Test Mode	802.11g 2412MHz
Tested By	Zeng Xianglong	Line	L1
Tested Date	2022/02/16	Test Voltage	AC120V/60Hz



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	0.1539	33.69	10.62	9.51	43.20	20.13	65.78	55.79	-22.58	-35.66	Pass
2*	0.2660	32.97	16.71	9.60	42.57	26.31	61.24	51.24	-18.67	-24.93	Pass
3	0.4020	25.70	8.88	9.66	35.36	18.54	57.81	47.81	-22.45	-29.27	Pass
4	0.6620	24.76	12.38	9.67	34.43	22.05	56.00	46.00	-21.57	-23.95	Pass
5	2.9140	23.00	5.08	9.60	32.60	14.68	56.00	46.00	-23.40	-31.32	Pass
6	4.8540	20.27	7.08	9.66	29.93	16.74	56.00	46.00	-26.07	-29.26	Pass

EUT Name	Hub M1S Gen 2	Model	HM1S-G02
Environmental Conditions	23.5°C/47%RH	Test Mode	802.11g 2412MHz
Tested By	Zeng Xianglong	Line	N
Tested Date	2022/02/16	Test Voltage	AC120V/60Hz



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	30.65	10.18	9.51	40.16	19.69	65.56	55.57	-25.40	-35.88	Pass
2	0.2660	30.95	16.21	9.60	40.55	25.81	61.24	51.24	-20.69	-25.43	Pass
3*	0.6620	27.53	15.08	9.67	37.20	24.75	56.00	46.00	-18.80	-21.25	Pass
4	0.7900	25.33	12.46	9.65	34.98	22.11	56.00	46.00	-21.02	-23.89	Pass
5	2.9140	24.56	7.24	9.60	34.16	16.84	56.00	46.00	-21.84	-29.16	Pass
6	4.8820	21.90	7.92	9.66	31.56	17.58	56.00	46.00	-24.44	-28.42	Pass

6. RADIATED SPURIOUS EMISSIONS

6.1 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($\mu\text{V/m}$)	Measurement distance(m)	Quasi-peak(dB $\mu\text{V/m}$)@distance 3m
0.009-0.490	2400/F(kHz)	300	53.8~88.5
0.490-1.705	24000/F(kHz)	30	43~53.8
1.705-30.0	30	30	49.5
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 9-90 kHz and 110-490 kHz 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 PeakLimit=74+20*log(3/1)=83.54 (dB $\mu\text{V/m}$).
The Avg Limit=54+20*log(3/1)=63.54 (dB $\mu\text{V/m}$).

6.2 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.
- 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 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.

--- 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 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.
- 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 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 premeasurement 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.
- 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 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 premeasurements with Peak and Average detector.

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

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.

----- The following blanks -----

6.3 TEST SETUP

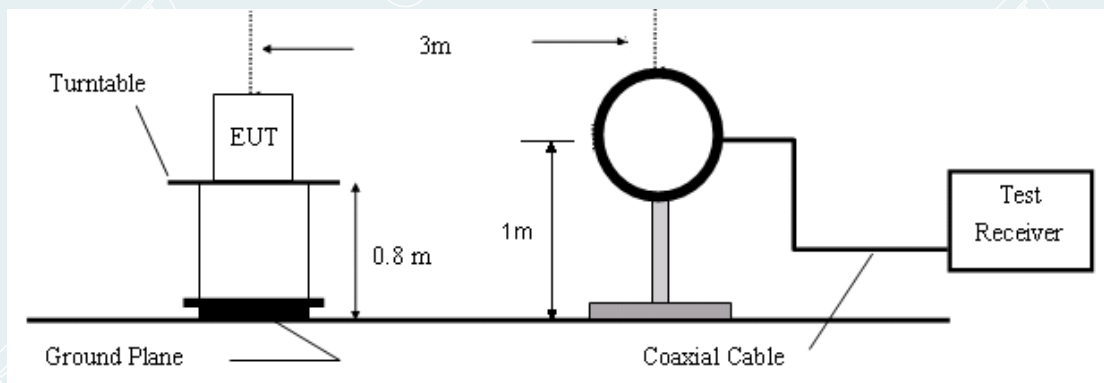


Figure 1. 9kHz to 30MHz radiated emissions test configuration

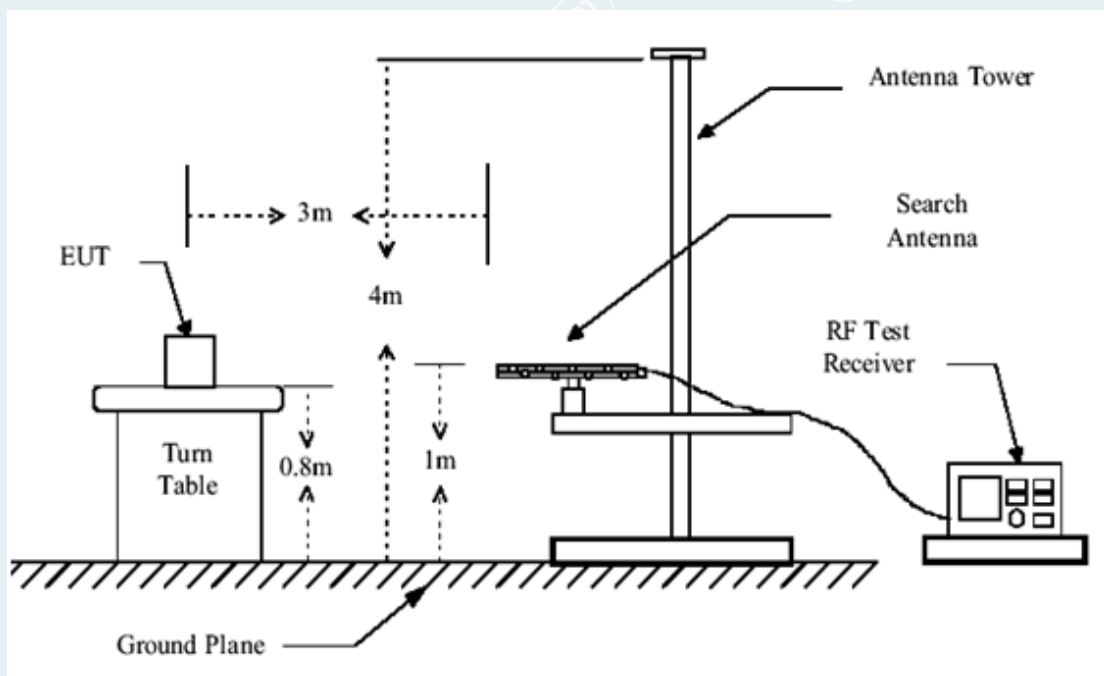


Figure 2. 30MHz to 1GHz radiated emissions test configuration

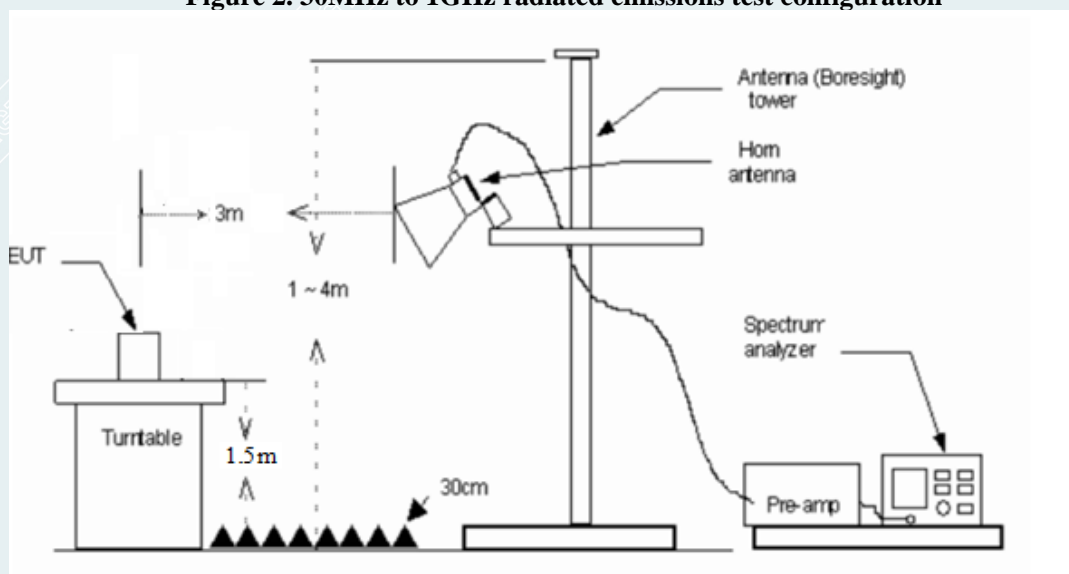


Figure 3. 1GH to 18GHz radiated emissions test configuration

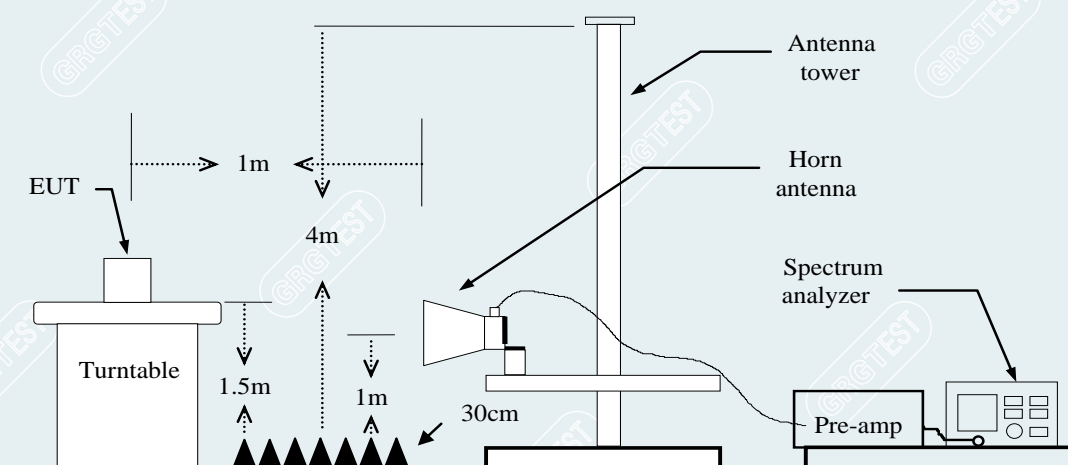


Figure 4.18GHz to 26.5GHz radiated emissions test configuration

6.4 DATA SAMPLE

30MHz to 1GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	37.06	-15.48	21.58	40.00	-18.42	QP	Vertical

1GHz-18GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	65.45	-11.12	54.33	74.00	-19.67	peak	Vertical
xxx	xxx	63.00	-11.12	51.88	54.00	-2.12	AVG	Vertical

Above 18GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	68.86	57.66	-11.20	83.54	25.88	peak	Vertical
xxx	xxx	68.89	-11.20	57.69	63.54	5.85	AVG	Vertical

Frequency (MHz) = Emission frequency in MHz

Ant.Pol. (H/V) = Antenna polarization

Reading (dBuV) = Uncorrected Analyzer / Receiver reading

Correction Factor (dB/m) = Antenna factor + Cable loss – Amplifier gain

Result (dBuV/m) = Reading (dBuV) + Correction Factor (dB/m)

Limit (dBuV/m) = Limit stated in standard

Margin (dB) = Remark Result (dBuV/m) – Limit (dBuV/m)

Peak = Peak Reading

QP = Quasi-peak Reading

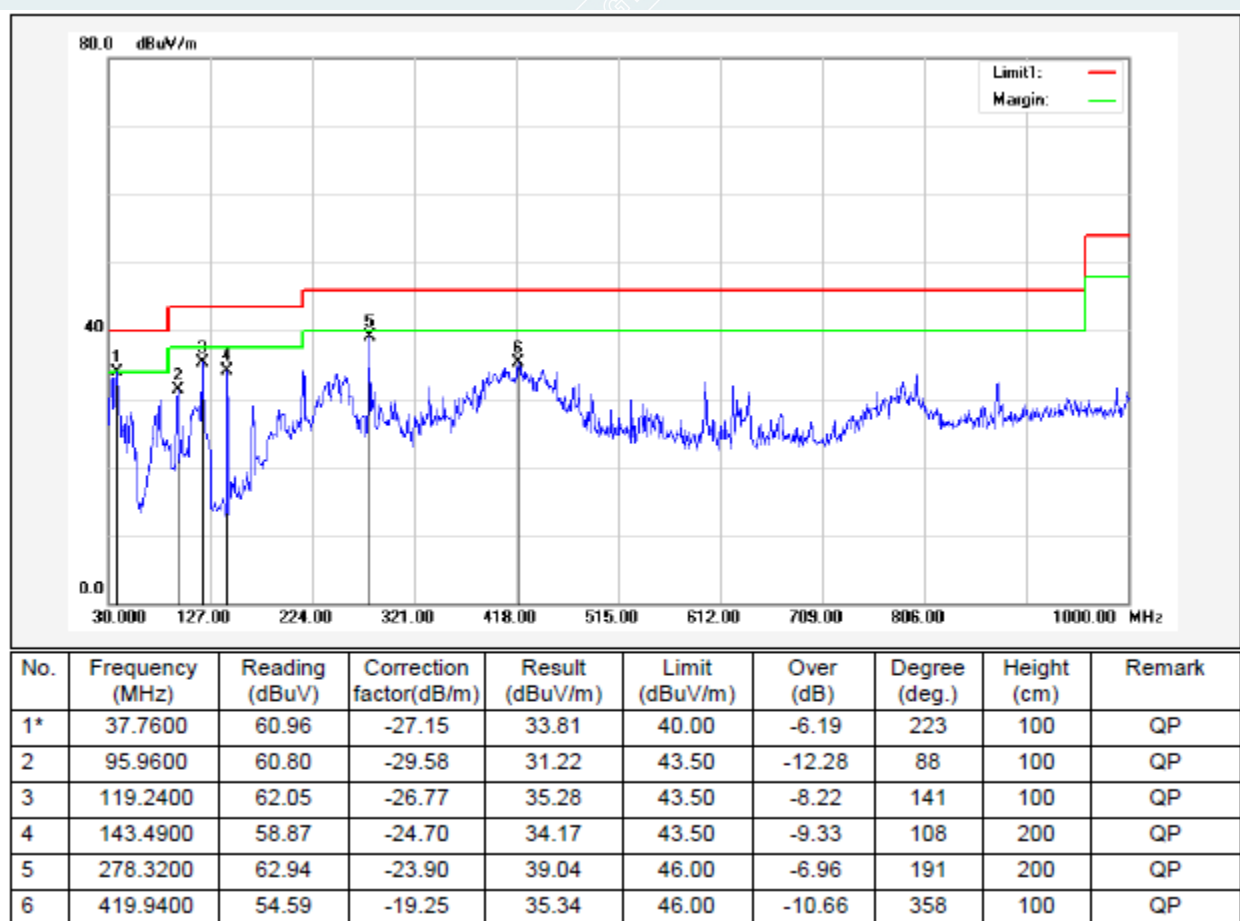
AVG = Average Reading

6.5 TEST RESULTS

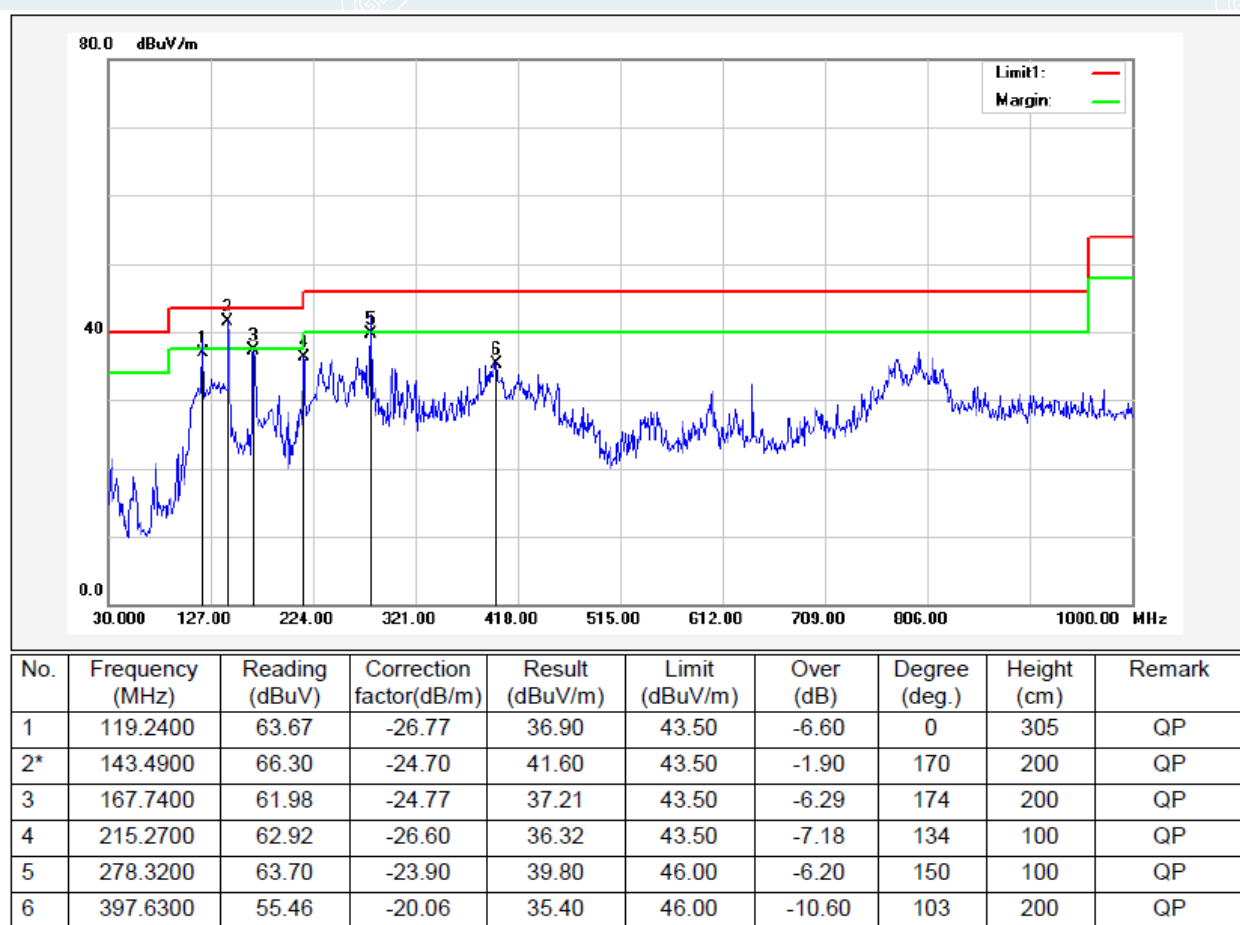
Below 1GHz

All models were pretested and only the worst modes and channels were recorded in this report. (IEEE 802.11g 2412MHz)

EUT Name	Hub M1S Gen 2	Model	HM1S-G02
Environmental Conditions	23.7°C/49%RH	Test Voltage	AC120V/60Hz
Test Mode	IEEE 802.11g Frequency (2412MHz)	Polarity	Vertical
Tested By	Tang Shenghui	Tested Date	2022/02/16



EUT Name	Hub M1S Gen 2	Model	HM1S-G02
Environmental Conditions	23.7°C/49%RH	Test Voltage	AC120V/60Hz
Test Mode	IEEE 802.11g Frequency (2412MHz)	Polarity	Horizontal
Tested By	Tang Shenghui	Tested Date	2022/02/16

**Remark:**

- 1 No emission found between lowest internal used/generated frequency to 30MHz.
- 2 Radiated emissions measured in frequency range from 9 kHz to 1GHz were made with an instrument using Quasi-peak detector mode.
- 3 Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- 4 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

1GHz-18GHz:

Mode: IEEE 802.11b

Lowest Frequency (2412MHz)

Environment: 25°C/60%RH

Tested By:Zhang Zishan

Date: 2022/02/23

Voltage:AC120V/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	1038.5048	56.96	31.87	-25.09	74.00	42.13	200	48	Horizontal
2	1747.3434	61.39	38.95	-22.44	74.00	35.05	100	34	Horizontal
3	3487.5609	53.70	38.29	-15.41	74.00	35.71	100	28	Horizontal
4	4824.6031	59.02	49.31	-9.71	74.00	24.69	200	18	Horizontal
5	7236.1545	47.51	43.98	-3.53	74.00	30.02	100	225	Horizontal
6	8582.5728	45.01	44.46	-0.55	74.00	29.54	200	257	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	4823.9277	-9.71	57.66	47.95	54.00	6.05	195	60	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	1157.2697	58.02	33.44	-24.58	74.00	40.56	200	1	Vertical
2	1762.3453	58.89	36.54	-22.35	74.00	37.46	200	143	Vertical
3	3605.7007	52.84	38.52	-14.32	74.00	35.48	100	312	Vertical
4	4824.6031	57.07	47.36	-9.71	74.00	26.64	200	115	Vertical
5	7236.1545	49.55	46.02	-3.53	74.00	27.98	200	190	Vertical
6	10221.5277	43.73	46.16	2.43	74.00	27.84	100	251	Vertical

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	4823.9277	-9.71	55.74	46.03	54.00	7.97	173	335	Vertical
2	7235.2138	-3.53	44.87	41.34	54.00	12.66	193	188	Vertical

Mode: IEEE 802.11b
 Middle Frequency (2437 MHz)
 Environment: 25°C/60%RH
 Tested By:Zhang Zishan

Date: 2022/02/23
 Voltage:AC120V/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	1250.0313	56.82	32.66	-24.16	74.00	41.34	100	231	Horizontal
2	1763.3454	58.53	36.19	-22.34	74.00	37.81	100	340	Horizontal
3	3748.2185	53.66	39.05	-14.61	74.00	34.95	100	62	Horizontal
4	4873.3592	58.63	48.81	-9.82	74.00	25.19	100	20	Horizontal
5	7755.5944	46.49	44.55	-1.94	74.00	29.45	200	116	Horizontal
6	10161.5202	43.93	46.83	2.90	74.00	27.17	200	61	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	4873.8953	-9.83	57.11	47.28	54.00	6.72	107	12	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	1128.2660	57.84	33.12	-24.72	74.00	40.88	200	359	Vertical
2	1747.3434	63.48	41.04	-22.44	74.00	32.96	200	356	Vertical
3	3607.5759	52.87	38.53	-14.34	74.00	35.47	200	272	Vertical
4	4873.3592	59.41	49.59	-9.82	74.00	24.41	200	333	Vertical
5	7618.7023	47.37	45.00	-2.37	74.00	29.00	100	41	Vertical
6	10420.3025	42.88	46.16	3.28	74.00	27.84	100	190	Vertical

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	4873.8953	-9.83	57.28	47.45	54.00	6.55	184	322	Vertical

Mode: IEEE 802.11b
 Highest Frequency (2462MHz)
 Environment: 25°C/60%RH
 Tested By:Zhang Zishan

Date: 2022/02/23
 Voltage:AC120V/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	1293.7867	56.50	32.52	-23.98	74.00	41.48	200	204	Horizontal
2	1752.0940	59.77	37.35	-22.42	74.00	36.65	200	1	Horizontal
3	3631.9540	53.46	38.91	-14.55	74.00	35.09	100	169	Horizontal
4	4923.9905	59.26	49.19	-10.07	74.00	24.81	200	197	Horizontal
5	7206.1508	47.37	44.18	-3.19	74.00	29.82	200	204	Horizontal
6	11157.2697	41.81	46.22	4.41	74.00	27.78	200	48	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	4923.9413	-10.07	58.14	48.07	54.00	5.93	188	315	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	1370.7964	57.04	33.40	-23.64	74.00	40.60	100	170	Vertical
2	1762.8454	55.67	33.33	-22.34	74.00	40.67	100	123	Vertical
3	3748.2185	53.86	39.25	-14.61	74.00	34.75	200	352	Vertical
4	4923.9905	61.65	51.58	-10.07	74.00	22.42	200	332	Vertical
5	7386.1733	49.12	45.61	-3.51	74.00	28.39	200	74	Vertical
6	10789.7237	42.47	46.23	3.76	74.00	27.77	200	121	Vertical

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	4923.8920	-10.07	60.93	50.86	54.00	3.14	174	338	Vertical

Mode: IEEE 802.11g
Lowest Frequency (2412MHz)
Environment: 25°C/60%RH
Tested By:Lu Qiang

Date: 2022/02/15
Voltage:AC120V/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	1042.5053	57.55	32.47	-25.08	74.00	41.53	200	76	Horizontal
2	1642.0803	55.77	33.18	-22.59	74.00	40.82	200	83	Horizontal
3	3601.9502	52.50	38.21	-14.29	74.00	35.79	100	134	Horizontal
4	4826.4783	54.73	45.03	-9.70	74.00	28.97	200	12	Horizontal
5	7166.7708	48.48	45.28	-3.20	74.00	28.72	200	141	Horizontal
6	10806.6008	44.42	48.26	3.84	74.00	25.74	200	73	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	1032.0040	57.19	32.09	-25.10	74.00	41.91	100	282	Vertical
2	1553.5692	56.42	33.57	-22.85	74.00	40.43	100	282	Vertical
3	3601.9502	52.24	37.95	-14.29	74.00	36.05	200	161	Vertical
4	4824.6031	54.24	44.53	-9.71	74.00	29.47	200	93	Vertical
5	7174.2718	48.51	45.33	-3.18	74.00	28.67	100	134	Vertical
6	10872.2340	43.57	47.55	3.98	74.00	26.45	200	6	Vertical

Mode: IEEE 802.11g
 Middle Frequency (2437 MHz)
 Environment: 25°C/60%RH
 Tested By: Lu Qiang

Date: 2022/02/15
 Voltage: AC120V/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	1073.7592	57.09	32.11	-24.98	74.00	41.89	100	239	Horizontal
2	1547.5684	56.45	33.60	-22.85	74.00	40.40	200	246	Horizontal
3	3264.4081	54.14	37.75	-16.39	74.00	36.25	100	2	Horizontal
4	4869.6087	58.00	48.21	-9.79	74.00	25.79	200	11	Horizontal
5	7194.8994	48.46	45.33	-3.13	74.00	28.67	200	25	Horizontal
6	10611.5764	43.98	47.51	3.53	74.00	26.49	200	340	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	4873.6992	-9.79	44.43	34.64	54.00	19.36	160	27	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	1032.0040	57.18	32.08	-25.10	74.00	41.92	100	41	Vertical
2	1381.5477	56.26	32.68	-23.58	74.00	41.32	100	82	Vertical
3	1778.0973	55.67	33.44	-22.23	74.00	40.56	100	68	Vertical
4	3616.9521	52.59	38.17	-14.42	74.00	35.83	200	6	Vertical
5	4873.3592	55.16	45.34	-9.82	74.00	28.66	200	86	Vertical
6	7176.1470	48.44	45.26	-3.18	74.00	28.74	200	12	Vertical

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	4873.7491	-9.83	45.10	35.27	54.00	18.73	172	101	Vertical

Mode: IEEE 802.11g
 Highest Frequency (2462MHz)
 Environment: 25°C/60%RH
 Tested By:Lu Qiang

Date: 2022/02/15
 Voltage:AC120V/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	1040.5051	57.70	32.61	-25.09	74.00	41.39	200	321	Horizontal
2	1716.5896	54.83	32.44	-22.39	74.00	41.56	200	354	Horizontal
3	3622.5778	52.81	38.34	-14.47	74.00	35.66	200	346	Horizontal
4	4922.1153	56.54	46.47	-10.07	74.00	27.53	200	12	Horizontal
5	7193.0241	48.23	45.09	-3.14	74.00	28.91	200	258	Horizontal
6	10806.6008	43.64	47.48	3.84	74.00	26.52	200	100	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	4924.1826	-10.07	45.72	35.65	54.00	18.35	179	26	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	1079.5099	57.55	32.59	-24.96	74.00	41.41	100	360	Vertical
2	1665.8332	59.19	36.71	-22.48	74.00	37.29	200	48	Vertical
3	2607.4509	58.92	39.72	-19.20	74.00	34.28	100	192	Vertical
4	4925.8657	57.64	47.57	-10.07	74.00	26.43	200	85	Vertical
5	7179.8975	48.25	45.08	-3.17	74.00	28.92	100	78	Vertical
6	10735.3419	44.02	47.59	3.57	74.00	26.41	100	216	Vertical

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	4924.9790	-10.07	47.49	37.42	54.00	16.58	166	91	Vertical

Mode: IEEE 802.11n HT20
 Lowest Frequency (2412MHz)
 Environment: 25°C/60%RH
 Tested By:Lu Qiang

Date: 2022/02/15
 Voltage:AC120V/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	1033.0041	57.26	32.16	-25.10	74.00	41.84	200	130	Horizontal
2	2021.8777	54.88	33.37	-21.51	74.00	40.63	100	358	Horizontal
3	3588.8236	52.22	37.55	-14.67	74.00	36.45	100	237	Horizontal
4	4820.8526	53.30	43.58	-9.72	74.00	30.42	200	25	Horizontal
5	7200.5251	47.74	44.61	-3.13	74.00	29.39	100	176	Horizontal
6	11136.6421	43.44	47.92	4.48	74.00	26.08	100	155	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	1036.0045	56.95	31.85	-25.10	74.00	42.15	200	315	Vertical
2	1536.3170	56.68	33.82	-22.86	74.00	40.18	100	143	Vertical
3	3013.1266	54.17	37.39	-16.78	74.00	36.61	100	196	Vertical
4	4828.3535	53.77	44.08	-9.69	74.00	29.92	200	94	Vertical
5	7202.4003	48.09	44.94	-3.15	74.00	29.06	200	19	Vertical
6	7725.5907	48.25	45.87	-2.38	74.00	28.13	200	128	Vertical

Mode: IEEE 802.11n HT20
Middle Frequency (2437 MHz)
Environment: 25°C/60%RH
Tested By:Lu Qiang

Date: 2022/02/15
Voltage:AC120V/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	1038.7548	58.23	33.14	-25.09	74.00	40.86	100	1038.7	Horizontal
2	1541.5677	56.07	33.21	-22.86	74.00	40.79	200	1541.5	Horizontal
3	2052.6316	54.88	33.41	-21.47	74.00	40.59	200	2052.6	Horizontal
4	3590.6988	53.12	38.52	-14.60	74.00	35.48	100	3590.6	Horizontal
5	4871.4839	56.08	46.27	-9.81	74.00	27.73	200	4871.4	Horizontal
6	7804.3505	47.13	45.17	-1.96	74.00	28.83	100	7804.3	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	1075.5094	57.09	32.12	-24.97	74.00	41.88	100	212	Vertical
2	1465.5582	55.69	32.61	-23.08	74.00	41.39	200	301	Vertical
3	1998.6248	57.43	35.87	-21.56	74.00	38.13	100	55	Vertical
4	4873.3592	52.90	43.08	-9.82	74.00	30.92	200	87	Vertical
5	7209.9012	48.33	45.10	-3.23	74.00	28.90	100	277	Vertical
6	7789.3487	47.07	45.21	-1.86	74.00	28.79	100	100	Vertical

Mode: IEEE 802.11n HT20
 Highest Frequency (2462MHz)
 Environment: 25°C/60%RH
 Tested By:Lu Qiang

Date: 2022/02/15
 Voltage:AC120V/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	1036.5046	57.13	32.04	-25.09	74.00	41.96	200	123	Horizontal
2	1450.3063	56.34	33.18	-23.16	74.00	40.82	200	1	Horizontal
3	3496.9371	53.70	38.32	-15.38	74.00	35.68	200	128	Horizontal
4	4923.9905	55.22	45.15	-10.07	74.00	28.85	200	128	Horizontal
5	7219.2774	48.37	45.03	-3.34	74.00	28.97	200	251	Horizontal
6	10596.5746	43.66	47.24	3.58	74.00	26.76	100	176	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	1032.2540	57.53	32.43	-25.10	74.00	41.57	100	247	Vertical
2	1665.8332	58.30	35.82	-22.48	74.00	38.18	100	192	Vertical
3	3600.0750	53.27	39.00	-14.27	74.00	35.00	100	1	Vertical
4	4923.9905	55.06	44.99	-10.07	74.00	29.01	200	85	Vertical
5	7729.3412	47.68	45.36	-2.32	74.00	28.64	100	271	Vertical
6	10817.8522	43.61	47.47	3.86	74.00	26.53	100	121	Vertical

Remark:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- The amplitude of 18GHz to 26.5GHz spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.
- 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 and average detector mode of the emission shown in Actual FS column.
- Spectrum setting:
 - Peak Setting 1GHz – 26.5GHz, RBW = 1MHz, VBW = 1MHz, Sweep time = auto.
 - AV Setting 1GHz – 26.5GHz, RBW = 1MHz, VBW = 10Hz (if the EUT duty cycle is <98% , set VBW≥1/T),Sweep time = auto.

Test result: The unit does meet the requirements.

7. 6DB BANDWIDTH

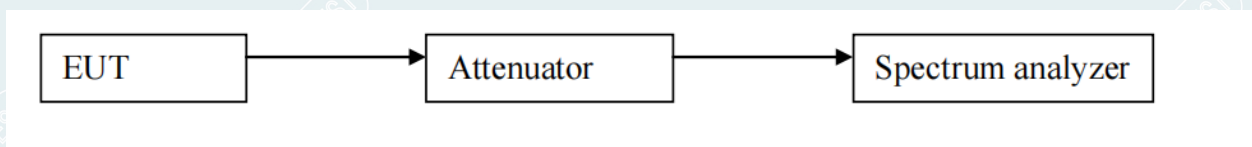
7.1 LIMITS

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

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 resolution bandwidth (RBW) = 100kHz. Set the video bandwidth (VBW) $\geq 3 \times$ RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 6dB bandwidth value.
- 3) Repeat above procedures until all frequencies measured were complete.

7.3 TEST SETUP



----- The following blanks -----

7.4 TEST RESULTS

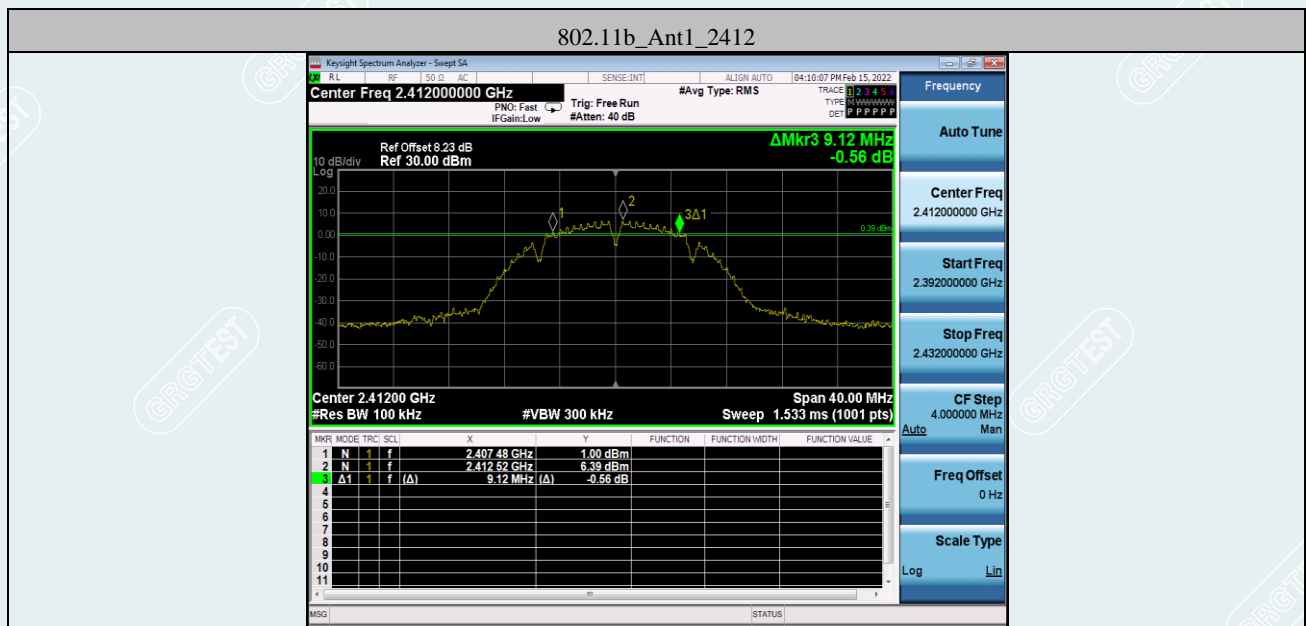
Environment: 25°C/60%RH

Tested By:Deng Weihao

Voltage:AC120V/60Hz

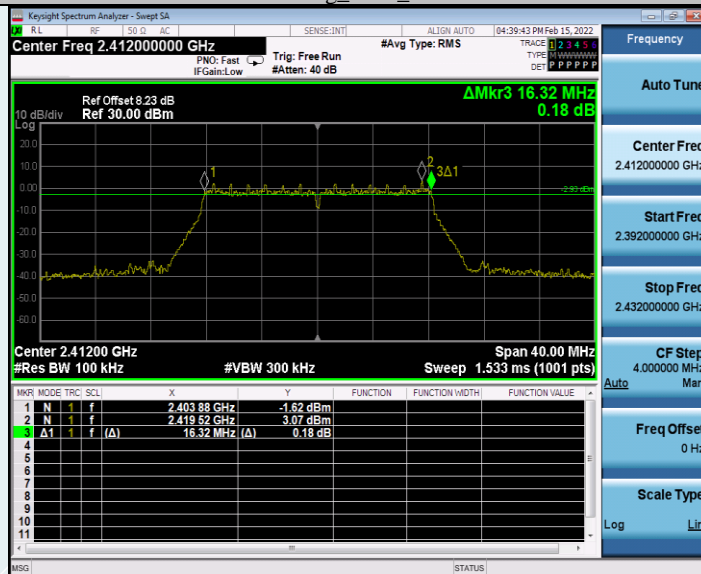
Date: 2022/02/15

Test Mode	Antenna	Frequency[MHz]	DTS BW[MHz]	Limit[MHz]	Verdict
802.11b	Ant1	2412	9.120	≥ 0.5	PASS
	Ant1	2437	9.120	≥ 0.5	PASS
	Ant1	2462	9.080	≥ 0.5	PASS
802.11g	Ant1	2412	16.320	≥ 0.5	PASS
	Ant1	2437	16.320	≥ 0.5	PASS
	Ant1	2462	16.360	≥ 0.5	PASS
802.11n HT20	Ant1	2412	17.040	≥ 0.5	PASS
	Ant1	2437	17.160	≥ 0.5	PASS
	Ant1	2462	17.040	≥ 0.5	PASS

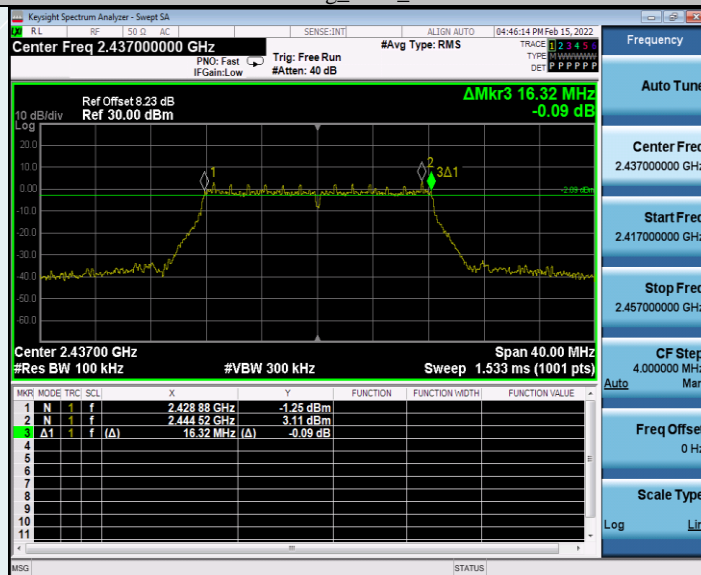




802.11g_Ant1_2412

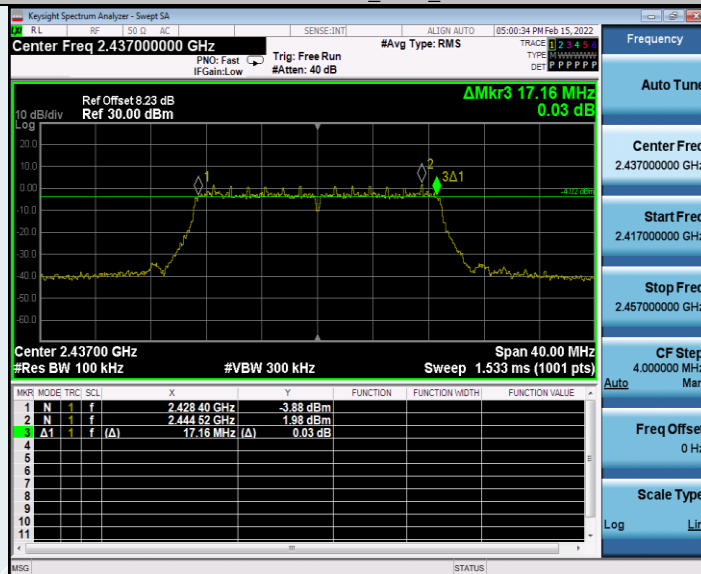


802.11g_Ant1_2437

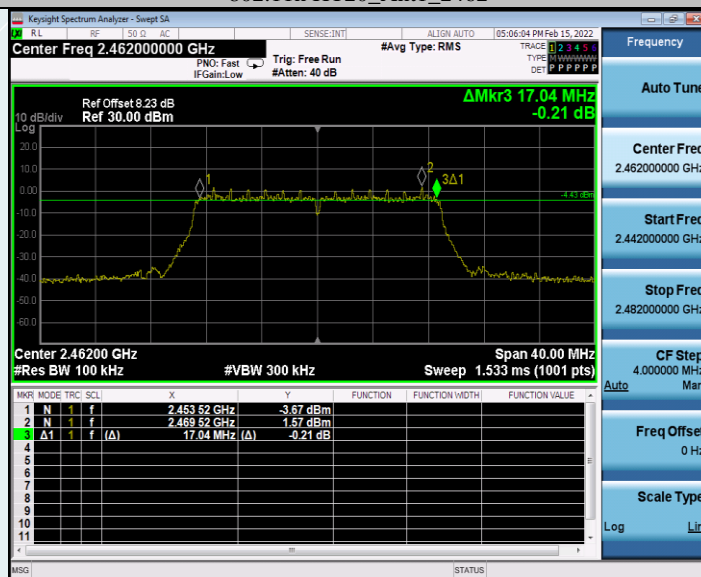




802.11n HT20_Ant1_2437



802.11n HT20_Ant1_2462



8. MAXIMUM PEAK OUTPUT POWER

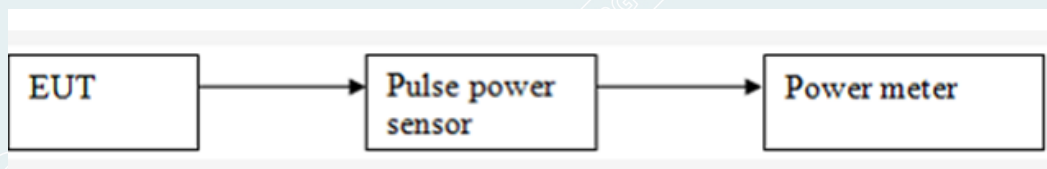
8.1 LIMITS

The maximum Peak output power measurement is 1W

8.2 TEST PROCEDURES

- 1) RF output of EUT was connected to the broadband peak RF power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 2) Set to the maximum power setting and enable the EUT transmit continuously.
- 3) Measure the conducted output power and record the results in the test report.

8.3 TEST SETUP



----- The following blanks -----