

FCC Co-Location Test Report

FCC ID : I88EE6601-00
Equipment : Tri-Band Wireless BE19000 10G Ethernet VoIP Gateway with SFP+
Model No. : EE6601-00
Multiple Listing : Refer to item 1.1.1 for more details
Brand Name : ZYXEL
Applicant : Zyxel Communications Corporation
Address : No.2 Industry East RD. IX, Hsinchu Science Park, Hsinchu 30075, Taiwan
Standard : 47 CFR FCC Part 15.247
47 CFR FCC Part 15.407
Received Date : Apr. 08, 2024
Tested Date : Apr. 25 ~ May 03, 2024

We, International Certification Corporation, would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by:

Approved by:

Along Chen / Assistant Manager

Gary Chang / Manager

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Appendix A. Unwanted Emissions Into Restricted Frequency Bands

Release Record

Report No.	Version	Description	Issued Date
FR440801CO	Rev. 01	Initial issue	Jul. 02, 2024

Summary of Test Results

FCC Rules	Test Items	Measured	Result
15.247(d) 15.407(b) 15.209	Radiated Emissions	[dBuV/m at 3m]: 50.37MHz 36.60 (Margin -3.40dB) - PK	Pass

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

1 General Description

1.1 Information

1.1.1 Product Details

The following models are provided to this EUT.

Model Name	Product Name	VOIP	SFP+ cage
EE6601-00	Tri-Band Wireless BE19000 10G Ethernet VoIP Gateway with SFP+	V	V
EE6601-01	Tri-Band Wireless BE19000 10G Ethernet VoIP Gateway	V	X
EE6600-00	Tri-Band Wireless BE19000 10G Ethernet Gateway with SFP+	X	V
EE6600-01	Tri-Band Wireless BE19000 10G Ethernet Gateway	X	X
† The above models, model EE6601-00 was selected as a representative one for the final test and only its data was recorded in this report.			

1.1.2 Specification of the Equipment under Test (EUT)

Operating Frequency	802.11b/g/n/ac/ax/be: 2412 MHz ~ 2462 MHz 802.11a/n/ac/ax/be: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500 MHz ~ 5720 MHz, 5745 ~ 5825 MHz 5925 MHz ~ 6425 MHz; 6425 MHz ~ 6525 MHz; 6525 MHz ~ 6875 MHz; 6875 MHz ~ 7125 MHz
Modulation Type	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac/ax/be: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM / 4096QAM)

1.1.3 Configuration of Equipment under Test (EUT)

Power Supply Type	12Vdc from adapter	
TPC	☒ Support	☐ Not support
Beamforming	☒ Support	☐ Not support
RU Configuration	☒ Full RU	☐ Partial RU
Channel Puncturing	☐ Support	☒ Not support

1.1.4 Chip and Firmware Version

CPU	Model: BCM4916
Wi-Fi 2.4GHz Chip	Model: BCM6726
Wi-Fi 5GHz Chip	Model: BCM6726
Wi-Fi 6GHz Chip	Model: BCM67263
FW Version	V5.19(ACKR.0)b4_20240523

1.1.5 Accessories

Accessories		
No.	Equipment	Description
1	AC adapter	Brand: FRECOM Model: F42L1-120350SPAU Power Rating: I/P: 100-240Vac, 50/60Hz, 1.4A O/P: 12.0Vdc, 3.5A, 42.0W Power line: 1.5m non-shielded without core
2	RJ45 cable	1.5m non-shielded without core

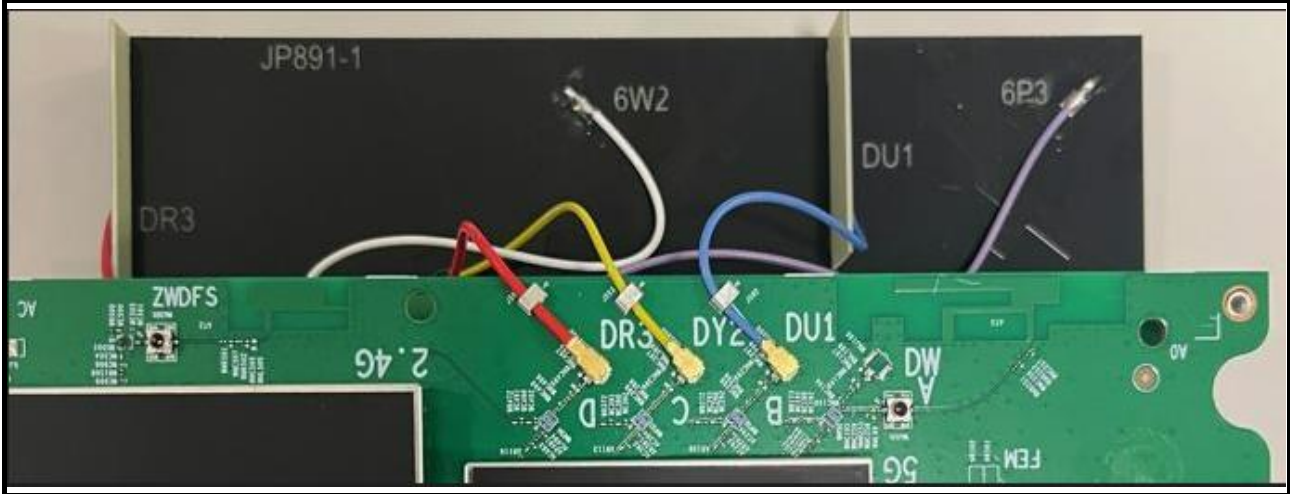
1.1.6 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)				
					2400~2483.5	5150~5250	5250~5350	5470~5725	5725~5850
DW	Aristotle	56-001-000553Z	Dipole	Micro Coaxial Switch	2.24	3.69	3.42	4.29	3.68
DU1				UFL	2.33	4.17	3.35	4.86	3.58
DY2				UFL	2.21	2.87	2.27	4.18	2.91
DR3				UFL	2.08	4.15	3.46	4.89	4.15

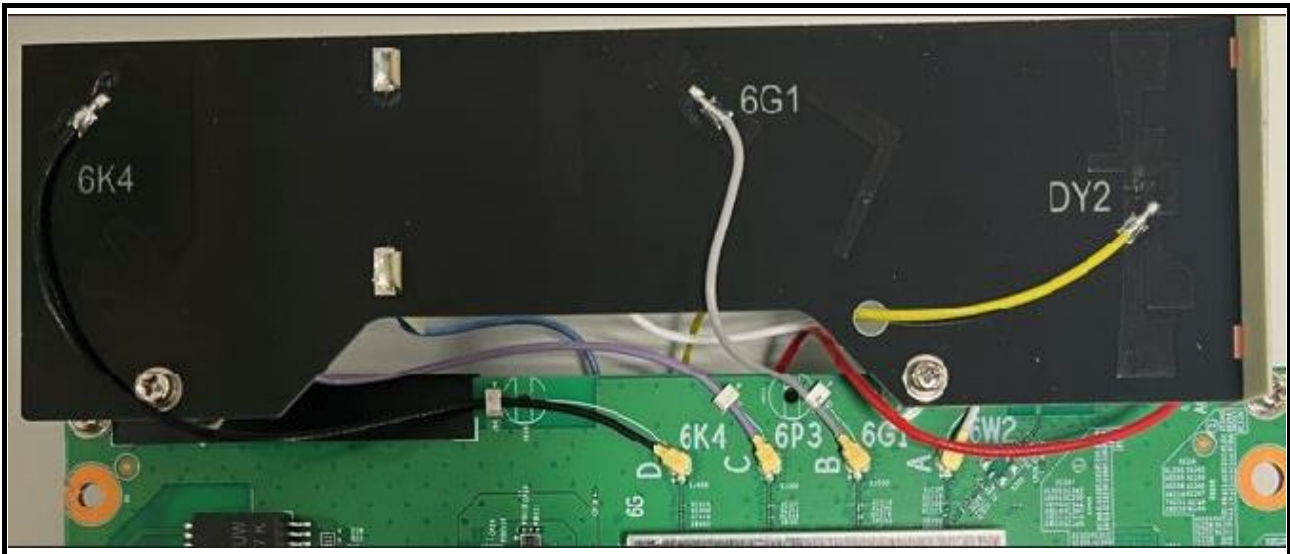
Ant. No.	Brand	Model	Type	Connector	Operating Frequencies (MHz) / Antenna Gain (dBi)			
					5925~6425	6425~6525	6525~6875	6875~7125
6G1	Aristotle	56-001-000553Z	Dipole	UFL	3.59	4.38	4.36	4.78
6K4					4.71	3.49	3.78	3.46
6P3					4.05	5.68	5.92	6.38
6W2					2.59	2.31	3.01	4.47

1.1.7 Antenna Location

2.4G/5G



6G



1.2 The Equipment List

Test Item	Radiated Emission				
Test Site	966 chamber3 / (03CH03-WS)				
Tested Date	Apr. 25 ~ May 02, 2024				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Receiver	R&S	ESR3	101657	Mar. 05, 2024	Mar. 04, 2025
Spectrum Analyzer	R&S	FSV40	101499	Apr. 02, 2024	Apr. 01, 2025
Loop Antenna	R&S	HFH2-Z2	100330	Oct. 31, 2023	Oct. 30, 2024
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-685	Jul. 04, 2023	Jul. 03, 2024
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1206	Dec. 14, 2023	Dec. 13, 2024
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170517	Oct. 30, 2023	Oct. 29, 2024
Preamplifier	EMC	EMC02325	980187	Jul. 10, 2023	Jul. 09, 2024
Preamplifier	EMC	EMC118A45SE	980897	Aug. 01, 2023	Jul. 31, 2024
Preamplifier	EMC	EMC184045SE	980903	Jul. 17, 2023	Jul. 16, 2024
Loop Antenna Cable	KOAX KABEL	101354-BW	101354-BW	Oct. 03, 2023	Oct. 02, 2024
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800-001	Sep. 22, 2023	Sep. 21, 2024
LF cable-3M	EMC	EMC8D-NM-NM-3000	131103	Sep. 22, 2023	Sep. 21, 2024
LF cable-13M	EMC	EMC8D-NM-NM-13000	131104	Sep. 22, 2023	Sep. 21, 2024
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22620/4	Sep. 22, 2023	Sep. 21, 2024
RF cable-8M	EMC	EMC104-SM-SM-8000	181107	Sep. 22, 2023	Sep. 21, 2024
Attenuator	Pasternack	PE7005-10	10-3	Sep. 27, 2023	Sep. 26, 2024
HIGHPASS FILTER	WI	WHK3.1-18G-10SS	43	Sep. 27, 2023	Sep. 26, 2024
HIGHPASS FILTER 7.5-18G	STI	STI15-9722	STI-HP7.5G-B	Sep. 27, 2023	Sep. 26, 2024
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Tested Date	May 03, 2024				
Instrument	Brand	Model No.	Serial No.	Calibration Date	Calibration Until
Spectrum Analyzer	R&S	FSV40	101910	Apr. 18, 2024	Apr. 17, 2025
Power Meter	Anritsu	ML2495A	1241002	Nov. 21, 2023	Nov. 20, 2024
Power Sensor	Anritsu	MA2411B	1207366	Nov. 21, 2023	Nov. 20, 2024
Attenuator	Pasternack	PE7005-10	10-2	Oct. 05, 2023	Oct. 04, 2024
Note: Calibration Interval of instruments listed above is one year.					

1.3 Test Standards

47 CFR FCC Part 15.247
47 CFR FCC Part 15.407
ANSI C63.10-2013

1.4 Reference Guidance

FCC KDB 558074 D01 15.247 Meas Guidance v05r02
FCC KDB 662911 D01 Multiple Transmitter Output v02r01
FCC KDB 412172 D01 Determining ERP and EIRP v01r01
FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01
FCC KDB 987594 D02 U-NII 6GHz EMC Measurement v02r01

1.5 Deviation from Test Standard and Measurement Procedure

None

1.6 Measurement Uncertainty

The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor ($k=2$)).

Measurement Uncertainty	
Parameters	Uncertainty
Unwanted Emission $\leq$ 1GHz	± 3.96 dB
Unwanted Emission $>$ 1GHz	± 4.51 dB

2 Test Configuration

2.1 Testing Facility

Test Laboratory	International Certification Corporation
Test Site	03CH03-WS
Address of Test Site	No.14-1, Lane 19, Wen San 3rd St., Kwei Shan Dist., Tao Yuan City 33381, Taiwan (R.O.C.)

- FCC Designation No.: TW0009
- FCC site registration No.: 207696
- ISED#: 10807C
- CAB identifier: TW2732

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode
Unwanted Emissions	2.4G 11b CH6 + 5G EHT20 CH165 + 6G EHT320 CH63
Conducted Emissions	
NOTE: The selected channel is the maximum power channel of each Wi-Fi mode.	

3 Transmitter Test Results

3.1 Unwanted Emissions into Restricted Frequency Bands

3.1.1 Limit of Unwanted Emissions into Restricted Frequency Bands

Restricted Band Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1:
Qusai-Peak value is measured for frequency below 1GHz except for 9~90 kHz, 110~490 kHz frequency band. Peak and average value are measured for frequency above 1GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit

Note 2:
Measurements may be performed at a distance other than what is specified provided. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, Frequency at or above 30 MHz: 20 dB/decade Frequency below 30 MHz: 40 dB/decade.

Un-restricted band emissions above 1GHz Limit	
Operating Band	Limit
5.15 - 5.25 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.25 - 5.35 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.47 - 5.725 GHz	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
5.725 - 5.850 GHz	All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Note 1: Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Un-restricted band emissions above 1GHz Limit		
Operating Band	PK Limit	AV Limit
5.925 – 7.125 GHz	e.i.r.p. -7 dBm [88.2 dBuV/m@3m]	e.i.r.p. -27 dBm [68.2 dBuV/m@3m]
Note 1: Measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).		

3.1.2 Test Procedures

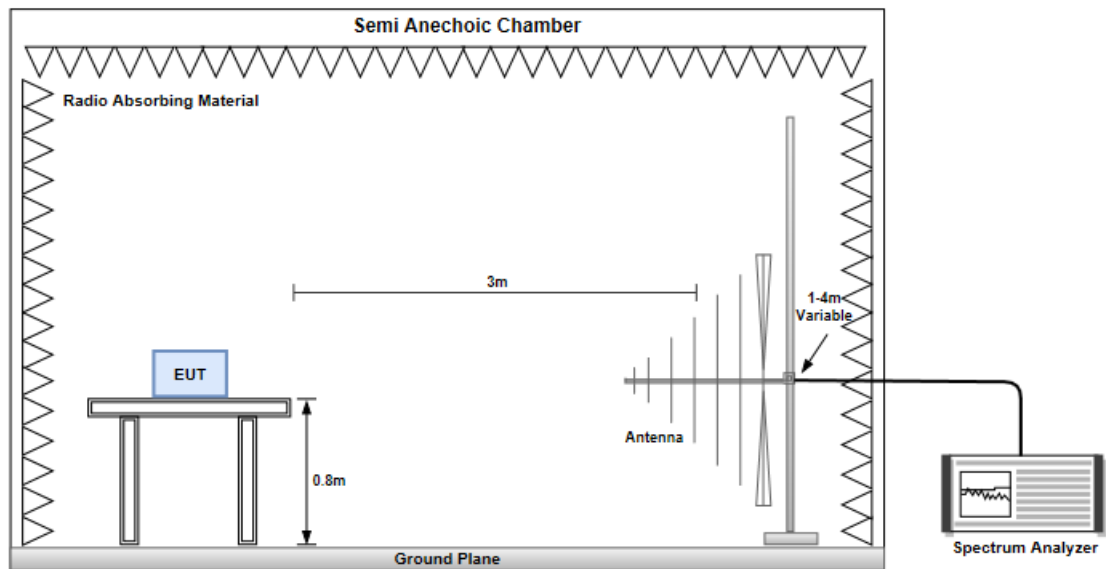
1. Measurement is made at a semi-anechoic chamber that incorporates a turntable allowing a EUT rotation of 360°. A continuously-rotating, remotely-controlled turntable is installed at the test site to support the EUT and facilitate determination of the direction of maximum radiation for each EUT emission frequency. The EUT is placed at test table. For emissions testing at or below 1 GHz, the table height is 80 cm above the reference ground plane. For emission measurements above 1 GHz, the table height is 1.5 m.
2. Measurement is made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna is varied in height (1m ~ 4m) above the reference ground plane to obtain the maximum signal strength. Distance between EUT and antenna is 3 m.
3. This investigation is performed with the EUT rotated 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Note:

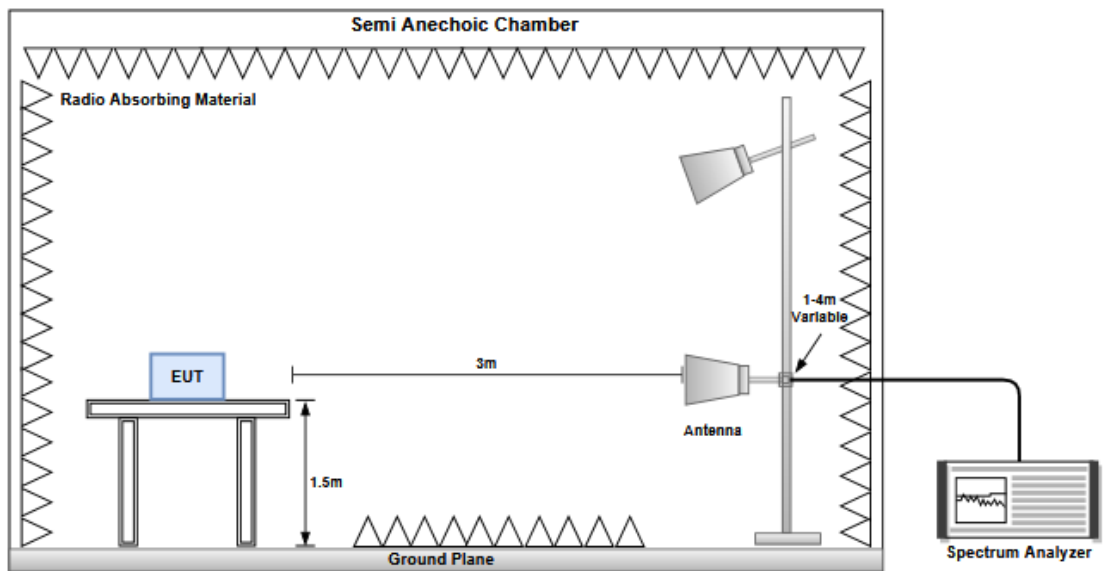
1. 120kHz measurement bandwidth of test receiver and Quasi-peak detector is for radiated emission below 1GHz.
2. RBW=1MHz, VBW=3MHz and Peak detector is for peak measured value of radiated emission above 1GHz.
3. RBW=1MHz, VBW=1/T and Peak detector is for average measured value of radiated emission above 1GHz.

3.1.3 Test Setup

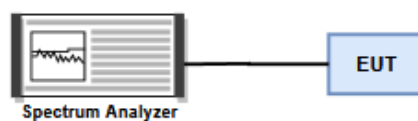
Radiated Emissions below 1 GHz



Radiated Emissions above 1 GHz



Conducted Unwanted Emissions (30MHz~40GHz)



3.1.4 Test Results

Refer to Appendix A.

4 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corporation (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website <http://www.icertifi.com.tw>.

Linkou

Tel: 886-2-2601-1640

No.30-2, Ding Fwu Tsuen, Lin Kou
District, New Taipei City, Taiwan
(R.O.C.)

Kwei Shan

Tel: 886-3-271-8666

No.3-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)
No.2-1, Lane 6, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

Kwei Shan Site II

Tel: 886-3-271-8640

No.14-1, Lane 19, Wen San 3rd
St., Kwei Shan Dist., Tao Yuan
City 33381, Taiwan (R.O.C.)

If you have any suggestion, please feel free to contact us as below information.

Tel: 886-3-271-8666

Fax: 886-3-318-0345

Email: ICC_Service@icertifi.com.tw

==END==



Unwanted Emissions (Below 1GHz)

Modulation	2.4G 11b CH6 + 5G EHT20 CH165 + 6G EHT320 CH63																																																																																																		
Polarization	Horizontal																																																																																																		
Test By :Brad Wu Temperature(°C):23 Humidity(%):66																																																																																																			
Level (dBuV/m) Frequency (MHz) <table><tr><th></th><th>Freq.</th><th>Emission</th><th>Limit</th><th>Margin</th><th>SA</th><th>Factor</th><th>Remark</th><th>ANT</th><th>Turn</th></tr><tr><th></th><th>MHz</th><th>level</th><th></th><th></th><th>reading</th><th></th><th></th><th>High</th><th>Table</th></tr><tr><th></th><th></th><th>dBuV/m</th><th>dBuV/m</th><th>dB</th><th>dBuV</th><th>dB/m</th><th></th><th>cm</th><th>deg</th></tr><tr><td>1</td><td>45.52</td><td>26.15</td><td>40.00</td><td>-13.85</td><td>34.13</td><td>-7.98</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>2</td><td>101.78</td><td>29.22</td><td>43.50</td><td>-14.28</td><td>41.91</td><td>-12.69</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>3</td><td>133.79</td><td>25.97</td><td>43.50</td><td>-17.53</td><td>35.58</td><td>-9.61</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>4</td><td>315.18</td><td>28.20</td><td>46.00</td><td>-17.80</td><td>35.50</td><td>-7.30</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>5</td><td>386.96</td><td>27.94</td><td>46.00</td><td>-18.06</td><td>33.20</td><td>-5.26</td><td>Peak</td><td>---</td><td>---</td></tr><tr><td>6</td><td>429.64</td><td>29.29</td><td>46.00</td><td>-16.71</td><td>33.40</td><td>-4.11</td><td>Peak</td><td>---</td><td>---</td></tr></table>											Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn		MHz	level			reading			High	Table			dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg	1	45.52	26.15	40.00	-13.85	34.13	-7.98	Peak	---	---	2	101.78	29.22	43.50	-14.28	41.91	-12.69	Peak	---	---	3	133.79	25.97	43.50	-17.53	35.58	-9.61	Peak	---	---	4	315.18	28.20	46.00	-17.80	35.50	-7.30	Peak	---	---	5	386.96	27.94	46.00	-18.06	33.20	-5.26	Peak	---	---	6	429.64	29.29	46.00	-16.71	33.40	-4.11	Peak	---	---
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn																																																																																										
	MHz	level			reading			High	Table																																																																																										
		dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg																																																																																										
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3	133.79	25.97	43.50	-17.53	35.58	-9.61	Peak	---	---																																																																																										
4	315.18	28.20	46.00	-17.80	35.50	-7.30	Peak	---	---																																																																																										
5	386.96	27.94	46.00	-18.06	33.20	-5.26	Peak	---	---																																																																																										
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Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB/m) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m). Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.																																																																																																			



Modulation	2.4G 11b CH6 + 5G EHT20 CH165 + 6G EHT320 CH63								
Polarization	Vertical								
Test By :Brad Wu			Temperature(°C):23			Humidity(%):66			
Level (dBuV/m) Frequency (MHz)									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level			reading			High	Table
		dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg
1	32.91	34.85	40.00	-5.15	45.20	-10.35	Peak	---	---
2	46.49	35.33	40.00	-4.67	43.40	-8.07	Peak	---	---
3	50.37	36.60	40.00	-3.40	44.61	-8.01	Peak	---	---
4	89.17	34.01	43.50	-9.49	48.59	-14.58	Peak	---	---
5	430.61	33.68	46.00	-12.32	37.77	-4.09	Peak	---	---
6	465.53	32.47	46.00	-13.53	35.49	-3.02	Peak	---	---
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB/m) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m). Note 3: All spurious emissions below 30MHz are more than 20 dB below the limit.									



Unwanted Emissions (Above 1GHz)

Modulation	2.4G 11b CH6 + 5G EHT20 CH165 + 6G EHT320 CH63								
Polarization	Horizontal								
Test By :Brad Wu Temperature(°C):25 Humidity(%):63									
Level (dBuV/m) Frequency (MHz)									
	Freq.	Emission	Limit	Margin	SA	Factor	Remark	ANT	Turn
	MHz	level			reading			High	Table
		dBuV/m	dBuV/m	dB	dBuV	dB/m		cm	deg
1	3388.00	28.36	54.00	-25.64	30.98	-2.62	Average	100	25
2	3388.00	42.35	74.00	-31.65	44.97	-2.62	Peak	100	25
3	8262.00	37.35	54.00	-16.65	31.94	5.41	Average	100	34
4	8262.00	50.30	74.00	-23.70	44.89	5.41	Peak	100	34
Note 1: Emission Level (dBuV/m) = SA Reading (dBuV/m) + Factor* (dB/m) *Factor includes antenna factor , cable loss and amplifier gain Note 2: Margin (dB) = Emission level (dBuV/m) – Limit (dBuV/m).									

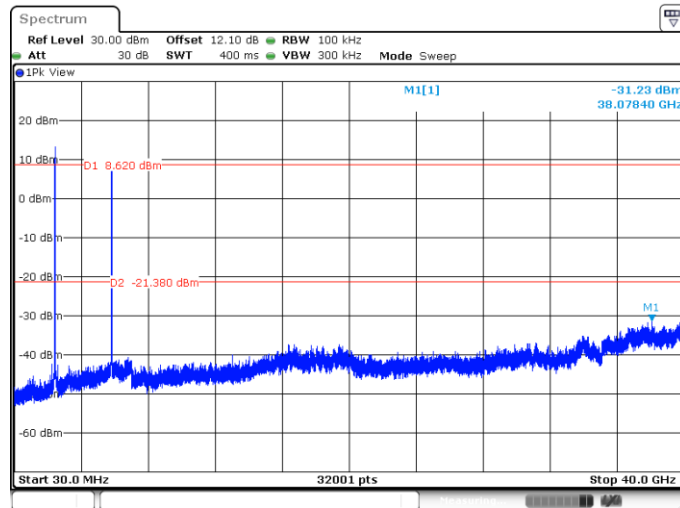


Modulation	2.4G 11b CH6 + 5G EHT20 CH165 + 6G EHT320 CH63								
Polarization	Vertical								
Test By :Brad Wu Temperature(°C):25 Humidity(%):63									
Level (dBUV/m)									

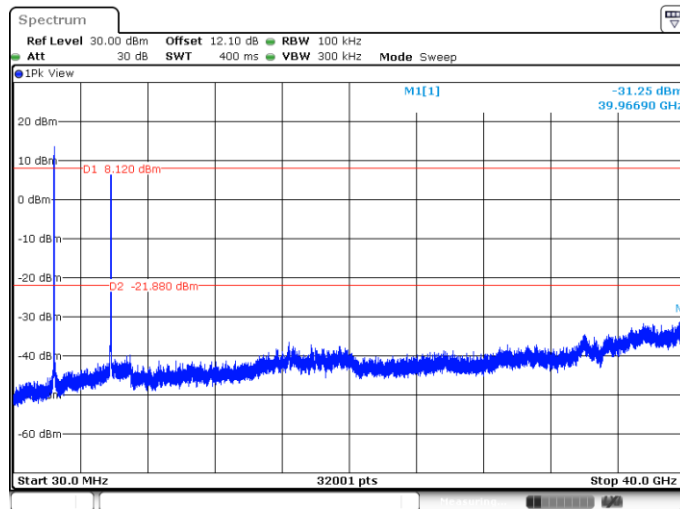


Ambient Condition	24°C / 62%	Tested By	Roger Lu
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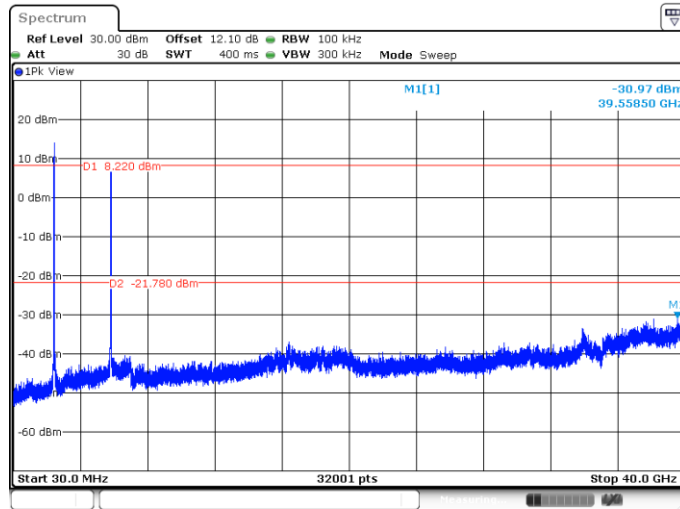
C0



C1



C2



C3

