

FCC RF Test Report

APPLICANT	:	Qualcomm Technologies, Inc.
		5775 Morehouse Drive, San Diego, CA 92121-1714
EQUIPMENT	:	Qualcomm WiFi 7/BT Combo module
BRAND NAME	:	Qualcomm
MODEL NAME	:	QCNCM825
FCC ID	:	J9C-QCNCM825
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System
TEST DATE(S)	:	Jul. 12, 2024 ~ Jul. 15, 2024

The product was inside of Lenovo Notebook Computer: (Brand Name: Lenovo, Model name: ThinkBook 16 G7 QOY, ThinkBook 16 G7 QOY******* (The"*"in model name can be 0 to 9,A to Z,a to z,"-", blank,or any symbol, for marketing use only, with no impact on RF compliance of the product) during the test, only Conducted power/RSE test items are verified in this report, all the other test results are leveraged from module RF report.

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

JasonJia

Approved by: Jason Jia



Sporton International Inc. (Kunshan) No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China

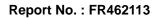
Sporton International Inc. (Kunshan) TEL : +86-512-57900158 FCC ID: J9C-QCNCM825



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR462113	Rev. 01	Initial issue of report	Jul. 29, 2024



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(2)	6dB Bandwidth	\geq 0.5MHz	Pass	1
-	-	99% Bandwidth	-	Report Only	1
3.1	15.247(b)	Power Output Measurement	\leq 30dBm	Pass	2
-	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	1
	45.047(-1)	Conducted Band Edges		Pass	1
-	15.247(d)	Conducted Spurious Emission	≤ 20dBc	Pass	1
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 0.10 dB at 2389.95 MHz
-	15.207	AC Conducted Emission	15.207(a)	Pass	1
3.3	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

Remark:

1. The test items were leveraged from module RF report which can refer to Report No. RFBWIN-WTW-P23020421 R1

 Based on KDB996369 D04, the host product manufacturer performed investigative measurements and confirmed that the final composite system met the limits, only the 2.4G WLAN 802.11be EHT20 242RU CH01 channel need reduce power by software to meet the limit requirements.

Conformity Assessment Condition:

 The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.

2. The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature					
Equipment Qualcomm WiFi 7/BT Combo module					
Brand Name	Qualcomm				
Model Name	QCNCM825				
FCC ID	J9C-QCNCM825				
EUT Stage Identical Prototype					

Remark:

- 1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
- 2. There are four types of EUT, the sample 1 is 1st source with INNOWAVE antenna, the sample 2 is 2nd source with AWAN antenna, the sample 3 is 3rd source with INNOWAVE antenna and the sample 4 is 4th source with AWAN antenna. According to the difference, we choose sample 1 to full test.

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification							
Tx/Rx Channel Frequency Range	2412 MHz ~ 2472 MHz						
Resource Unit (RU)	Single RU: 26-tone, 52-tone, 106-tone, 242-tone, 484-tone Multi-RU(Small RU): 52-tone + 26-tone, 106-tone + 26-tone						
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM) VHT: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM) 802.11ax/be: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM / 4096QAM)						

1.3 Modification of EUT

No modifications are made to the EUT during all test items.



1.4 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International Inc. (Kunshan)						
No. 1098, Pengxi North Road, Kunshan Economic Development Z							
Test Site Location	hina						
	TEL : +86-512-57900158						
	Sporton Sito No	FCC Designation No.	FCC Test Firm				
Test Site No.	Sporton Site No.	FCC Designation No.	Registration No.				
	TH01-KS 03CH08-KS	CN1257	314309				

1.5 Test Software

ltem	Site	Manufacturer	Name	Version	
1.	TH01-KS	SPORTON	FCC 15C-15E Test Tools Ver10.0_210607	10.0	
2.	03CH08-KS	AUDIX	E3	210616	

1.6 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- FCC KDB 996369 D04 Module Integration Guide v02
- ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

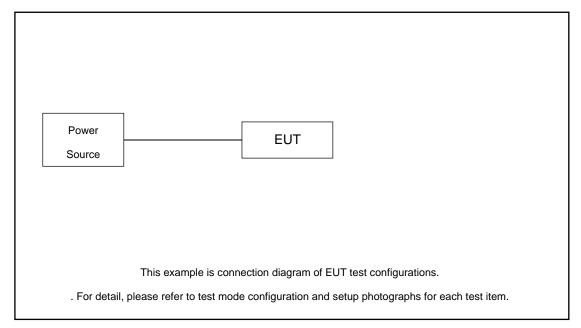
2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
	1	2412	8	2447
	2	2417	9	2452
	3	2422	10	2457
2400-2483.5 MHz	4	2427	11	2462
	5	2432	12	2467
	6	2437	13	2472
	7	2442	-	-

2.2 Connection Diagram of Test System



2.3 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit.



3 Test Result

3.1 Output Power Measurement

3.1.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

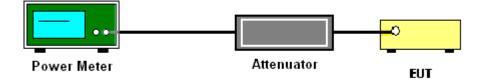
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

- The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
- 2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Measure the conducted output power and record the results in the test report.
- 5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.1.4 Test Setup





3.1.5 Test Result of Peak Output Power

	2.4GHz Band											
Mod.	Data Rate	NTX	СН.	Freq. (MHz)	RU config	Peak Conducted Power (dBm)		D (dl		Elf Pov (dB	wer	
						Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2
EHT20	MCS0	2	1	2412	242RU	22.06 22.48 25.29		22.06 22.48 25.29 2.12		27.	.41	

3.1.6 Test Result of Average Output Power (Reporting Only)

	2.4GHz Band MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Duty Factor (dB)		Average Conducted Power with duty factor (dBm)		DG (dBi)		EIRP Power (dBm)		
						Ant1	Ant2	Ant1	Ant2	SUM	Ant1	Ant2	Ant1	Ant2
EHT20	MCS0	2	1	2412	242RU	0.00	0.00	16.13	16.50	19.33	2.	12	21.	.45

Note: Measured power (dBm) has offset with cable loss.

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



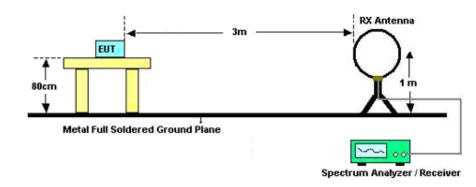
3.2.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- 3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 5. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
- 7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- 8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for f < 1 GHz; VBW \ge RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \ge 1$ GHz for peak measurement. For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

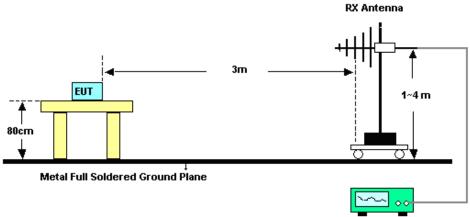


3.2.4 Test Setup

For radiated emissions below 30MHz

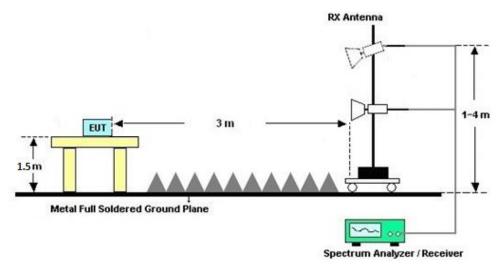


For radiated emissions from 30MHz to 1GHz



Spectrum Analyzer / Receiver





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3.2.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

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

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A.

3.2.7 Duty Cycle

Please refer to Appendix B.

3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix A.



3.3 Antenna Requirements

3.3.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached Antenna or of an Antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = $10 \log(N_{ANT}/N_{SS}=1) dB$.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with GANT set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

For power, the directional gain G_{ANT} is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain "DG" is calculated as following table.

<cdd modes=""></cdd>						
			DG	DG	Power	PSD
			for	for	Limit	Limit
	Ant. 1	Ant. 2	Power	PSD	Reduction	Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
2.4 GHz	2.12	1.92	2.12	5.03	0.00	0.00



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver	Keysight	N9038A	MY564000 23	3Hz~8.5GHz;M ax 30dBm	Jan. 04, 2024	Jul. 12, 2024	Jan. 03, 2025	Radiation (03CH08-KS)
Spectrum Analyzer	R&S	FSV40	101932	10kHz~40GHz; Max 30dBm	Oct. 10, 2023	Jul. 12, 2024	Oct. 09, 2024	Radiation (03CH08-KS)
Loop Antenna	R&S	HFH2-Z2E	101125	9kHz~30MHz	Oct. 10, 2023	Jul. 12, 2024	Oct. 09, 2024	Radiation (03CH08-KS)
Bilog Antenna	TESEQ& VGT	CBL 61110	59915	30MHz-1GHz	Aug. 12, 2023	Jul. 12, 2024	Aug. 11, 2024	Radiation (03CH08-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75959	1GHz~18GHz	Mar. 01, 2024	Jul. 12, 2024	Feb. 28, 2025	Radiation (03CH08-KS)
high gain Amplifier	EM	EM01G18GA	060845	1Ghz-18Ghz	Jan. 05, 2024	Jul. 12, 2024	Jan. 04, 2025	Radiation (03CH08-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 05, 2024	Jul. 12, 2024	Jan. 04, 2025	Radiation (03CH08-KS)
Amplifier	SONOMA	310N	413741	9KHz-1GHz	Jan. 05, 2024	Jul. 12, 2024	Jan. 04, 2025	Radiation (03CH08-KS)
Amplifier	EM	EM01G18GA	060834	1Ghz-18Ghz	Oct. 10, 2023	Jul. 12, 2024	Oct. 09, 2024	Radiation (03CH08-KS)
Amplifier	MITEQ	EM18G40GG A	060728	18~40GHz	Jan. 04, 2024	Jul. 12, 2024	Jan. 03, 2025	Radiation (03CH08-KS)
AC Power Source	Chroma	61601	616010002 473	N/A	NCR	Jul. 12, 2024	NCR	Radiation (03CH08-KS)
Turn Table	EM	EM 1000-T	N/A	0~360 degree	NCR	Jul. 12, 2024	NCR	Radiation (03CH08-KS)
Antenna Mast	EM	EM 1000-A	N/A	1 m~4 m	NCR	Jul. 12, 2024	NCR	Radiation (03CH08-KS)
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Jul. 15, 2024	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Senor	Anritsu	MA2411B	0917070	300MHz~40GH z	Jan. 02, 2024	Jul. 15, 2024	Jan. 01, 2025	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 02, 2024	Jul. 15, 2024	Jan. 01, 2025	Conducted (TH01-KS)

NCR: No Calibration Required



5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Power	±0.50 dB

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.30 dB
--	---------

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence	6.04 dB
of 95% (U = 2Uc(y))	0.04 UB

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence	5.26 dB
of 95% (U = 2Uc(y))	5.20 GB

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence	5.40 dB
of 95% (U = 2Uc(y))	5.40 ab

----- THE END ------



Appendix A. Radiated Spurious Emission Test Data

Test Engineer :	Koi Ji	Relative Humidity :	51 ~ 53%
root _ngoor r		Temperature :	25.2 ~ 26.5 ℃

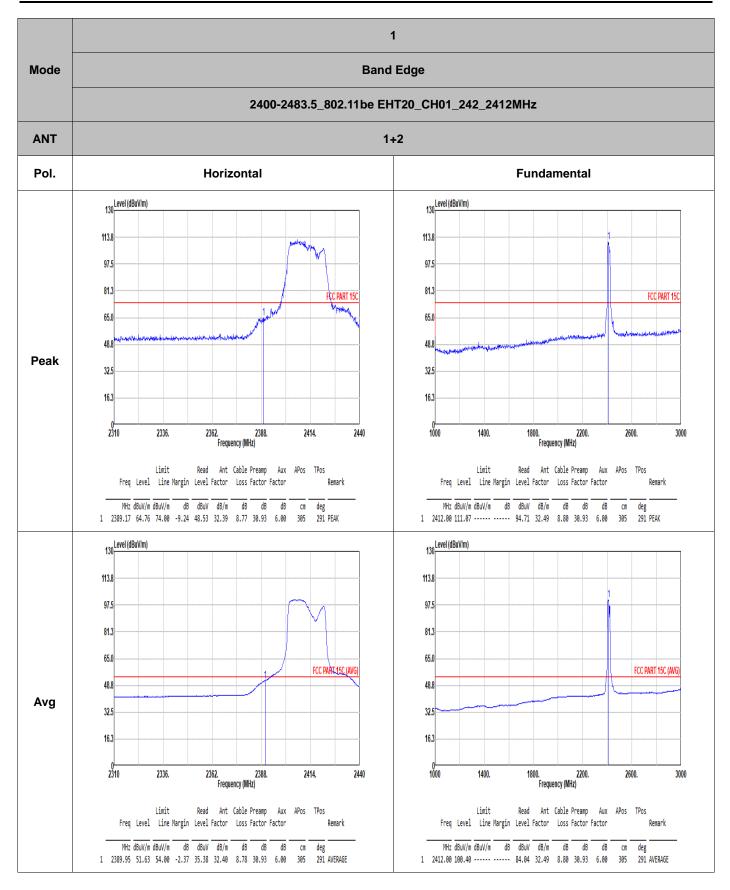
Radiated Spurious Emission Test Modes

Mode	Band (MHz)	Antenna	Modulation	Channel	Frequency	Data Rate	RU	Remark
Mode 1	2400-2483.5	1+2	802.11be EHT20	01	2412	MCS0	242	-

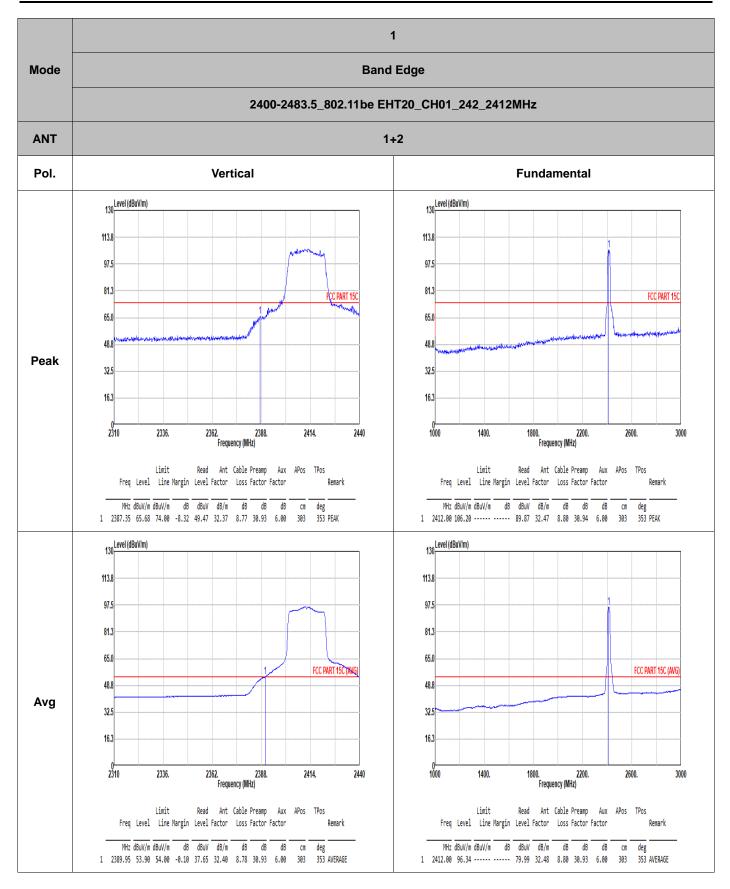
Summary of each worse mode

Mode	Modulation	Ch.	Freq. (MHz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pol.	Peak Avg.	Result	Remark
1	802.11be EHT20	01	2389.95	53.90	54.00	-0.10	V	AVERAGE	Pass	Band Edge
1	802.11be EHT20	01	4824.00	39.39	74.00	-34.61	Н	PEAK	Pass	Harmonic

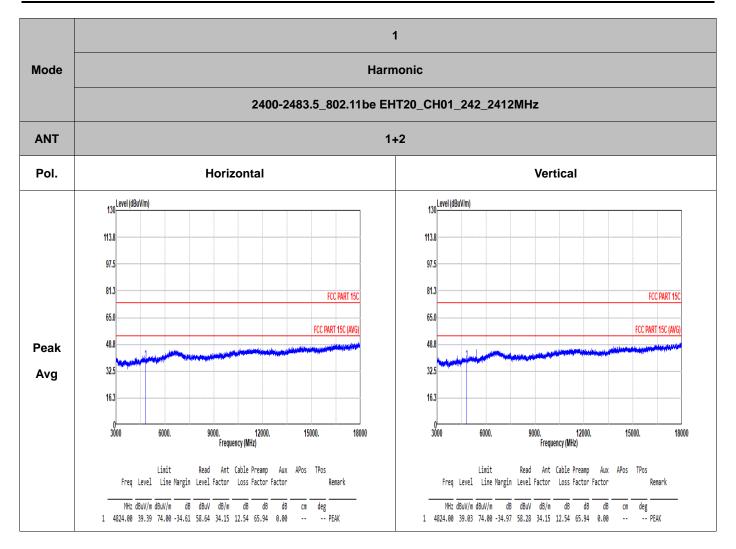




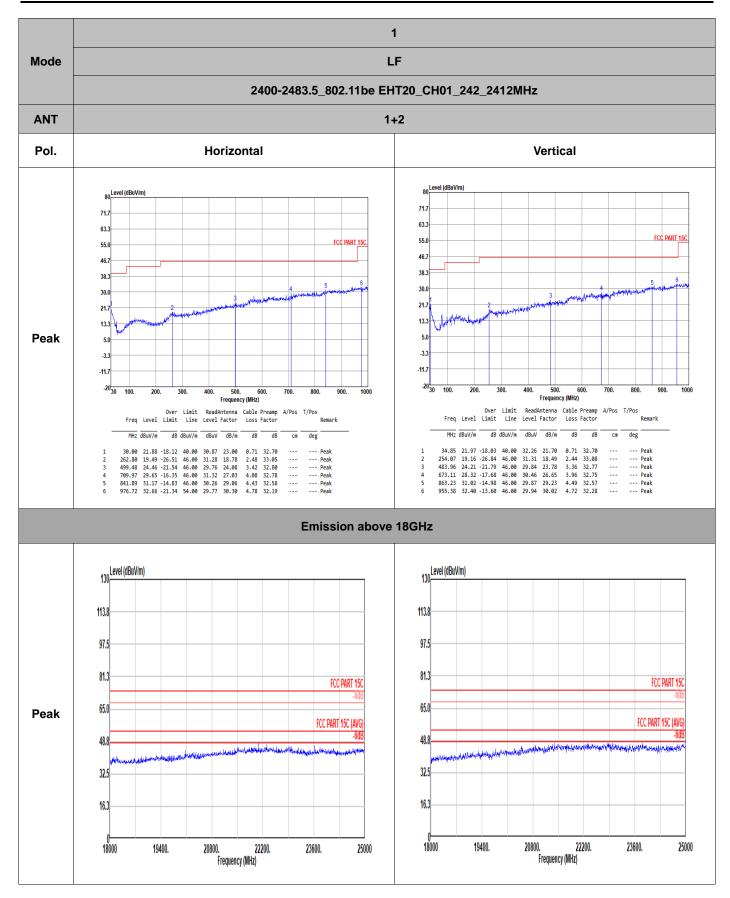












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Appendix B. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1+2	802.11be EHT20 RU242	100	-	-	10Hz

802.11be EHT20 RU242

Spectrum	'n								
Ref Level	26.00 dBm	Offset	6.00 dB 👄	RBW 10 MH	łz				
Att 🗧	30 dB	👄 SWT	20 ms 👄	VBW 10 MH	łz				
SGL									
∋1Pk Max									
20 dBm									
10 dBm	en and and and and and and and and and an	njantimun	www.www.	unner	mutur	muterenterent	un market	man	manta
0 dBm									
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
-70 dBm-				601	nte				2.0 ms/
GF 2.412 G				691	prs				2.0 ms/
	Л					Read	У 📲		