TCT 通测检测
TESTING CENTRE TECHNOLOGY

TEST REPORT

FCC ID. ..... :	2AT3DORION	
Test Report No..... :	TCT210204E049	
Date of issue..... :	Jun. 23, 2021	
Testing laboratory ..... :	SHENZHEN TONGCE TESTING LAB	
Testing location/ address:	TCT Testing Industrial Park Fuqiao 5th Industrial Zone, Fuhai Street, Bao'an District Shenzhen, Guangdong, 518103, People's Republic of China	
Applicant's name..... :	CT Cellutions, Inc	
Address..... :	5705 Commerce Blvd, Alpharetta, Georgia 30004, United States	
Manufacturer's name ... :	ZTECH COMMNICATION(SZ) CO LTD	
Address..... :	FL 7 BLOCK D BAO'AN ZHIGU INNOVATION PARK YIN'TIAN ROAD NO.4 XI'XIANG STR' BAO'AN DISTRICT SZ CHINA	
Standard(s) ..... :	FCC CFR Title 47 Part 15 Subpart C Section 15.247 FCC KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013	
Test item description ..... :	Mobile phone	
Trade Mark ..... :	CELLUTION	
Model/Type reference..... :	ORION	
Rating(s)..... :	Refer to EUT description of page 3	
Date of receipt of test item ..... :	Feb. 04, 2021	
Date (s) of performance of test..... :	See dates for each test case	
Tested by (+signature) ... :	Kevin Huang	Kevin Huang
Check by (+signature).... :	Beryl Zhao	Beryl Zhao
Approved by (+signature):	Tomsin	Tomsin

General disclaimer:

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1. General Product Information

1.1. EUT description

Test item description .....:	Mobile phone
Model/Type reference.....:	ORION
Sample Number.....:	TCT210204E021-0101
Operation Frequency .....:	2412MHz~2462MHz (802.11b/802.11g/802.11n(HT20)) 2422MHz~2452MHz (802.11n(HT40))
Channel Separation.....:	5MHz
Number of Channel .....:	11 for 802.11b/802.11g/802.11n(HT20) 7 for 802.11n(HT40)
Modulation Technology .....:	802.11b: Direct Sequence Spread Spectrum (DSSS) 802.11g/802.11n: Orthogonal Frequency Division Multiplexing(OFDM)
Data speed .....:	802.11b: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps 802.11g: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps 802.11n: Up to 150Mbps
Antenna Type.....:	PIFA Antenna
Antenna Gain.....:	1.27dBi
Rating(s).....:	Adapter Information: Model: ORION Input: AC 100-240V, 50/60Hz, 0.2A Output: DC 5V, 1A Rechargeable Li-ion Battery DC 3.8V
Remark.....:	/

Note: The antenna gain listed in this report is provided by applicant, and the test laboratory is not responsible for this parameter.

1.2. Model(s) list

None.

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1.3. Operation Frequency

For 802.11b/g/n(HT20)

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz	--	--

For 802.11n (HT40)

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
--	--	4	2427MHz	7	2442MHz	--	--
--	--	5	2432MHz	8	2447MHz	--	--
3	2422MHz	6	2437MHz	9	2452MHz		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

802.11b/802.11g/802.11n (HT20)

Channel	Frequency
The lowest channel	2412MHz
The middle channel	2437MHz
The Highest channel	2462MHz

802.11n (HT40)

Channel	Frequency
The lowest channel	2422MHz
The middle channel	2437MHz
The Highest channel	2452MHz

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2. Test Result Summary

Requirement	CFR 47 Section	Result
Antenna requirement	§15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	§15.207	PASS
Conducted Peak Output Power	§15.247 (b)(3)	PASS
6dB Emission Bandwidth	§15.247 (a)(2)	PASS
Power Spectral Density	§15.247 (e)	PASS
Band Edge	§15.247(d)	PASS
Spurious Emission	§15.205/§15.209	PASS

Note:

1. PASS: Test item meets the requirement.

2. Fail: Test item does not meet the requirement.

3. N/A: Test case does not apply to the test object.

4. The test result judgment is decided by the limit of test standard.

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3. General Information

3.1. Test environment and mode

Operating Environment:		
Condition	Conducted Emission	Radiated Emission
Temperature:	25.0 °C	25.0 °C
Humidity:	55 % RH	55 % RH
Atmospheric Pressure:	1010 mbar	1010 mbar
Test Mode:		
Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations	
The sample was placed 0.8m & 1.5m for the measurement below & above 1GHz above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case(Z axis) are shown in Test Results of the following pages.		

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.

Mode	Data rate
802.11b	1Mbps
802.11g	6Mbps
802.11n(H20)	6.5Mbps
802.11n(H40)	13.5Mbps

3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
/	/	/	/	/

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3. For conducted measurements (Output Power, 6dB Emission Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

4. Facilities and Accreditations

4.1. Facilities

The test facility is recognized, certified, or accredited by the following organizations:

- FCC - Registration No.: 645098
  SHENZHEN TONGCE TESTING LAB
  Designation Number: CN1205
  The testing lab has been registered and fully described in a report with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.
- IC - Registration No.: 10668A-1
  SHENZHEN TONGCE TESTING LAB
  CAB identifier: CN0031
  The testing lab has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing.

4.2. Location

SHENZHEN TONGCE TESTING LAB
Address: TCT Testing Industrial Park Fuqiao 5th Industrial Zone, Fuhai Street, Bao'an District Shenzhen, Guangdong, 518103, People's Republic of China
TEL: +86-755-27673339

4.3. Measurement Uncertainty

The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	± 3.10 dB
2	RF power, conducted	± 0.12 dB
3	Spurious emissions, conducted	± 0.11 dB
4	All emissions, radiated(<1 GHz)	± 4.56 dB
5	All emissions, radiated(1 GHz - 18 GHz)	± 4.22 dB
6	All emissions, radiated(18 GHz- 40 GHz)	± 4.36 dB

5. Test Results and Measurement Data

5.1. Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.	
E.U.T Antenna:	
The WIFI antenna is PIFA antenna which permanently attached, and the best case gain of the antenna is 1.27dBi.	

Antenna

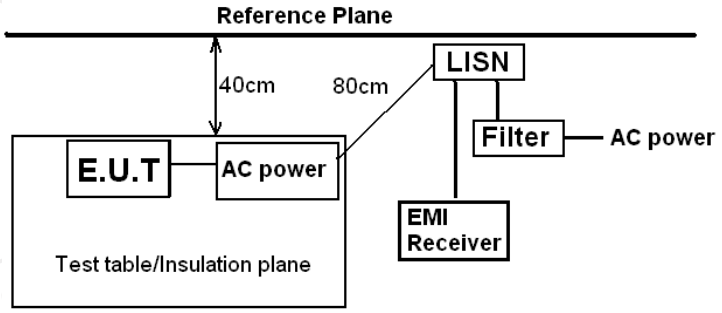
5.2. Conducted Emission

5.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Frequency Range:	150 kHz to 30 MHz
Receiver setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto
Limits:	

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

Test Setup:



Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m

Test Mode: Charging + transmitting with modulation

Test Procedure:

1. The E.U.T is connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.
2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).
3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

Test Result: PASS

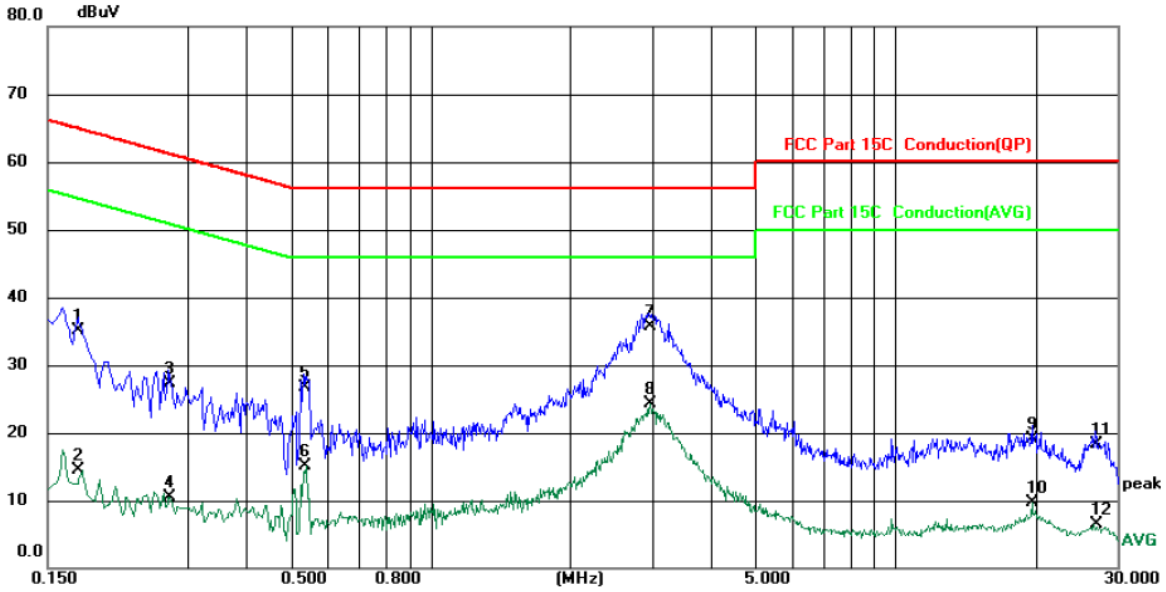
5.2.2. Test Instruments

Conducted Emission Shielding Room Test Site (843)				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Test Receiver	R&S	ESCI3	100898	Jul. 27, 2021
LISN-2	Schwarzbeck	NSLK 8126	8126453	Sep. 11, 2021
Line-5	TCT	CE-05	N/A	Sep. 02, 2021
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

5.2.3. Test data

Please refer to following diagram for individual

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



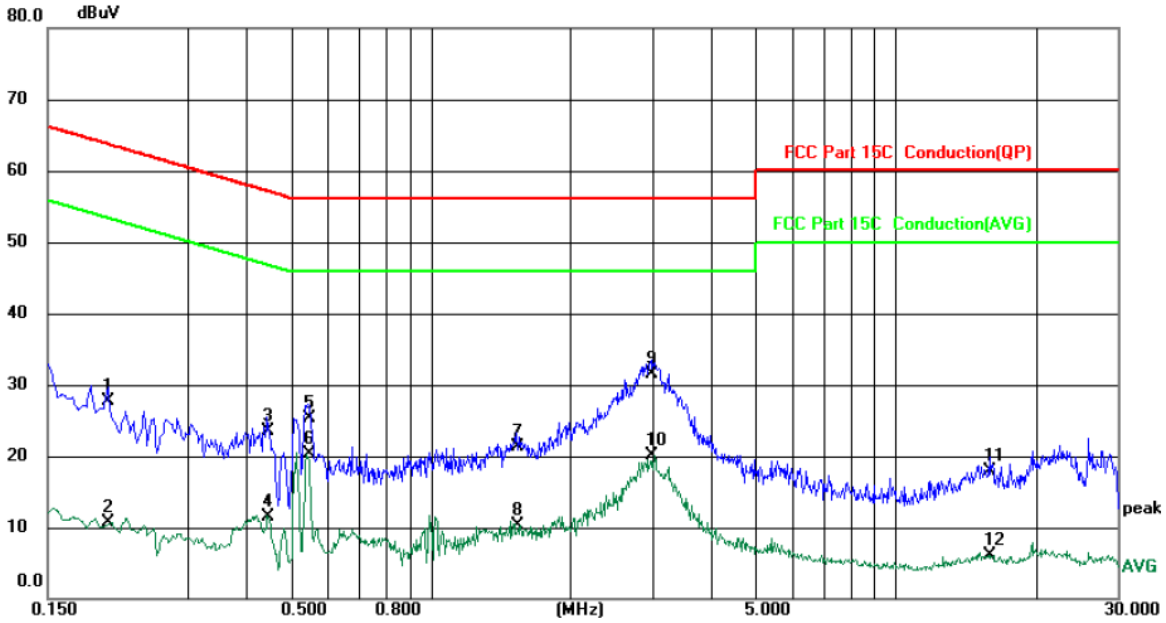
Site	Phase:	L1	Temperature:	25 (C)
Limit: FCC Part 15C Conduction(QP)	Power:	AC 120 V/60 Hz	Humidity:	55 %RH

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1740	25.59	9.42	35.01	64.77	-29.76	QP	
2		0.1740	5.16	9.42	14.58	54.77	-40.19	AVG	
3		0.2740	17.90	9.37	27.27	61.00	-33.73	QP	
4		0.2740	1.14	9.37	10.51	51.00	-40.49	AVG	
5		0.5340	17.39	9.25	26.64	56.00	-29.36	QP	
6		0.5340	5.77	9.25	15.02	46.00	-30.98	AVG	
7	*	2.9500	26.03	9.58	35.61	56.00	-20.39	QP	
8		2.9500	14.65	9.58	24.23	46.00	-21.77	AVG	
9		19.7099	9.11	10.07	19.18	60.00	-40.82	QP	
10		19.7099	-0.35	10.07	9.72	50.00	-40.28	AVG	
11		26.9060	8.33	10.04	18.37	60.00	-41.63	QP	
12		26.9060	-3.50	10.04	6.54	50.00	-43.46	AVG	

Note:

Freq. = Emission frequency in MHz
Reading level (dBµV) = Receiver reading
Corr. Factor (dB) = LISN factor + Cable loss
Measurement (dBµV) = Reading level (dBµV) + Corr. Factor (dB)
Limit (dBµV) = Limit stated in standard
Margin (dB) = Measurement (dBµV) – Limits (dBµV)
Q.P. =Quasi-Peak
AVG =average
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Site	Phase: N	Temperature:	25 (C)
Limit: FCC Part 15C Conduction(QP)	Power: AC 120 V/60 Hz	Humidity:	55 %RH

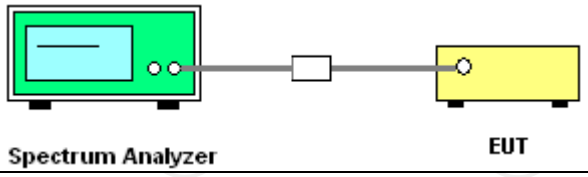
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2020	18.32	9.32	27.64	63.53	-35.89	QP	
2		0.2020	1.35	9.32	10.67	53.53	-42.86	AVG	
3		0.4460	14.16	9.29	23.45	56.95	-33.50	QP	
4		0.4460	2.31	9.29	11.60	46.95	-35.35	AVG	
5		0.5460	16.07	9.27	25.34	56.00	-30.66	QP	
6		0.5460	11.10	9.27	20.37	46.00	-25.63	AVG	
7		1.5300	11.88	9.42	21.30	56.00	-34.70	QP	
8		1.5300	0.90	9.42	10.32	46.00	-35.68	AVG	
9	*	2.9780	21.94	9.48	31.42	56.00	-24.58	QP	
10		2.9780	10.66	9.48	20.14	46.00	-25.86	AVG	
11		15.9540	8.00	9.89	17.89	60.00	-42.11	QP	
12		15.9540	-3.70	9.89	6.19	50.00	-43.81	AVG	

Note:

Freq. = Emission frequency in MHz
Reading level (dBµV) = Receiver reading
Corr. Factor (dB) = LISN factor + Cable loss
Measurement (dBµV) = Reading level (dBµV) + Corr. Factor (dB)
Limit (dBµV) = Limit stated in standard
Margin (dB) = Measurement (dBµV) – Limits (dBµV)
Q.P. =Quasi-Peak
AVG =average
** is meaning the worst frequency has been tested in the frequency range 150 kHz to 30MHz.*

5.3. Maximum Conducted (Average) Output Power

5.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	KDB 558074 D01 v05r02
Limit:	30dBm
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer 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.
Test Result:	PASS

5.3.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2021
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 11, 2021
Antenna Connector	TCT	RFC-01	N/A	Sep. 11, 2021

5.3.3. Test Data

802.11b mode			
Test channel	Maximum Conducted Output Power (dBm)	Limit (dBm)	Result
Lowest	11.14	30.00	PASS
Middle	12.22	30.00	PASS
Highest	12.18	30.00	PASS

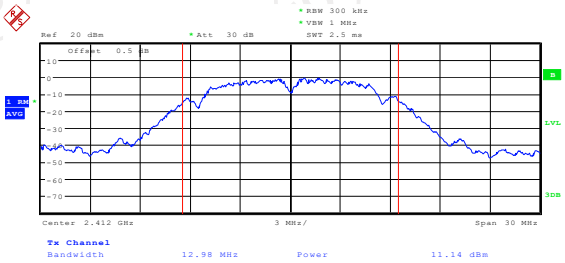
802.11g mode			
Test channel	Maximum Conducted Output Power (dBm)	Limit (dBm)	Result
Lowest	11.72	30.00	PASS
Middle	11.84	30.00	PASS
Highest	11.46	30.00	PASS

802.11n(H20) mode			
Test channel	Maximum Conducted Output Power (dBm)	Limit (dBm)	Result
Lowest	10.53	30.00	PASS
Middle	11.52	30.00	PASS
Highest	11.25	30.00	PASS

802.11n(H40) mode			
Test channel	Maximum Conducted Output Power (dBm)	Limit (dBm)	Result
Lowest	11.65	30.00	PASS
Middle	11.57	30.00	PASS
Highest	10.56	30.00	PASS

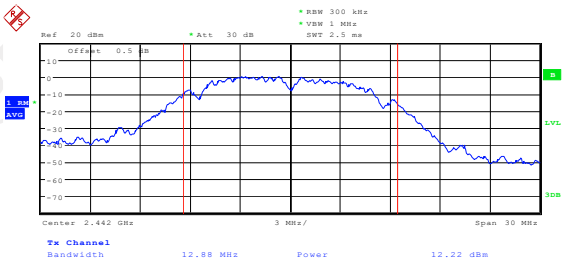
Test plots as follows:
802.11b Modulation

Lowest channel



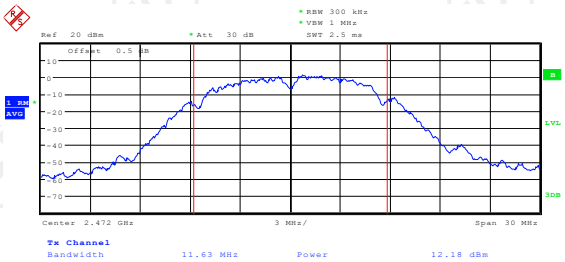
Date: 18.JUN.2021 17:02:15

Middle channel



Date: 18.JUN.2021 17:04:29

Highest channel



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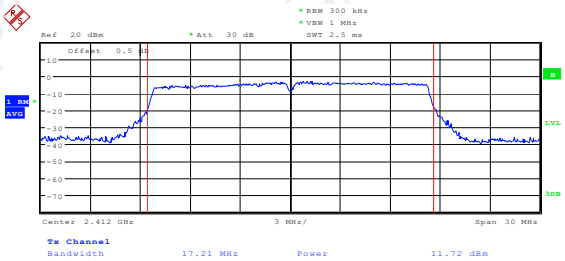
802.11g Modulation

Lowest channel



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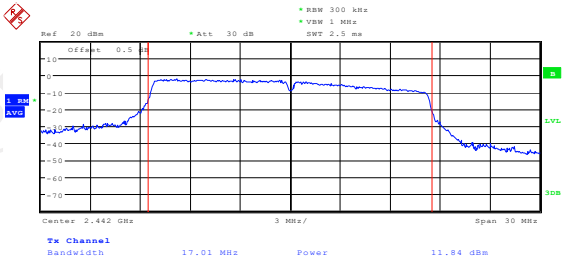
Middle channel



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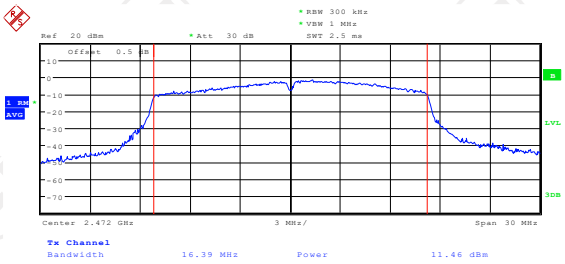
Highest channel



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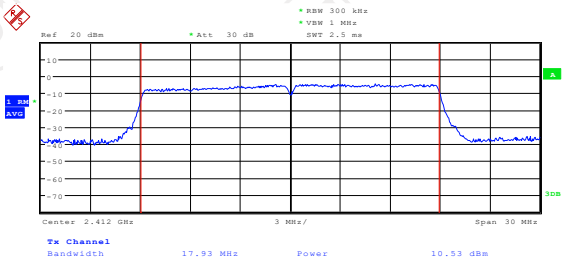
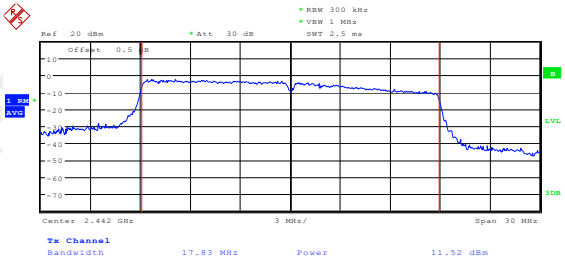
802.11n (HT20) Modulation

Lowest channel



Date: 22.JUN.2021 18:34:29

Middle channel



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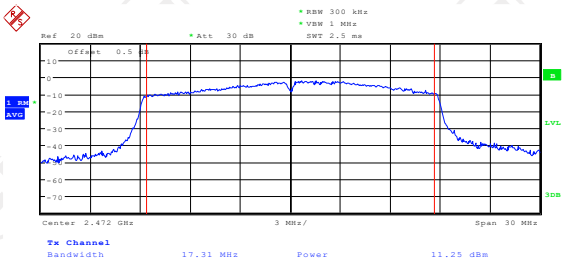
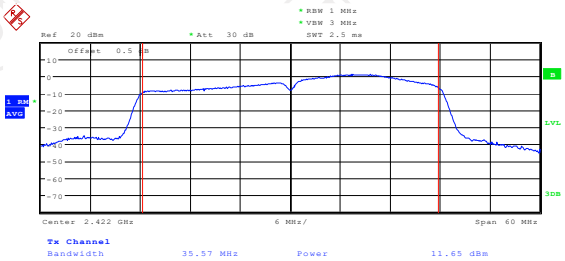
Highest channel



Date: 18.JUN.2021 17:09:03

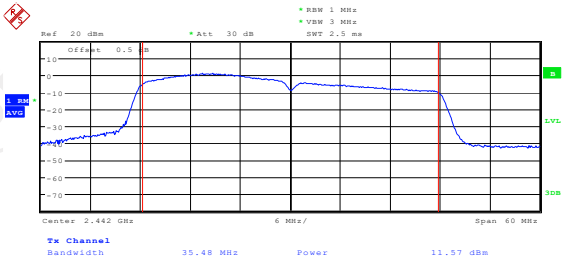
802.11n (HT40) Modulation

Lowest channel



Date: 18.JUN.2021 17:10:13

Middle channel



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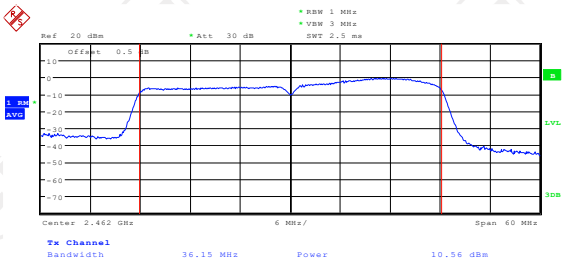
Highest channel



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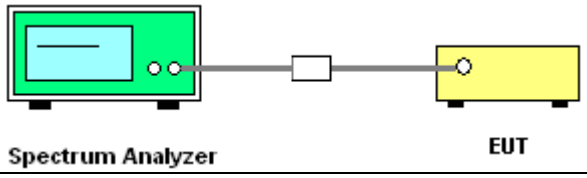
5.4. Emission Bandwidth

5.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(2)
Test Method:	KDB 558074 D01 v05r02
Limit:	>500kHz
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. Set to the maximum power setting and enable the EUT transmit continuously. 2. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz. 3. Measure and record the results in the test report.
Test Result:	PASS

5.4.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2021
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 11, 2021
Antenna Connector	TCT	RFC-01	N/A	Sep. 11, 2021

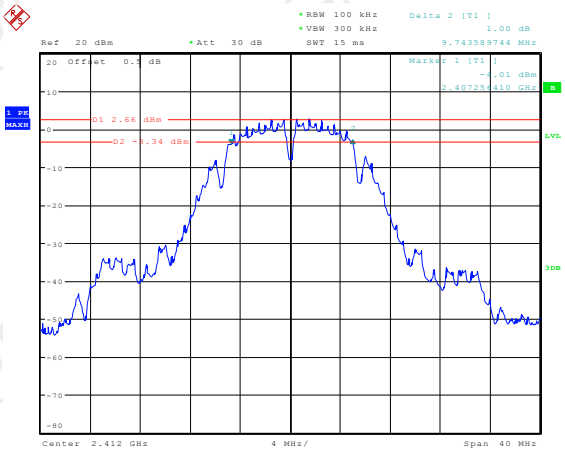
5.4.3. Test data

Test channel	6dB Emission Bandwidth (MHz)			
	802.11b	802.11g	802.11n(H20)	802.11n(H40)
Lowest	9.74	16.41	17.88	22.05
Middle	9.17	13.21	14.62	21.41
Highest	8.46	13.72	14.94	35.64
Limit:	>500k			
Test Result:	PASS			

Test plots as follows:

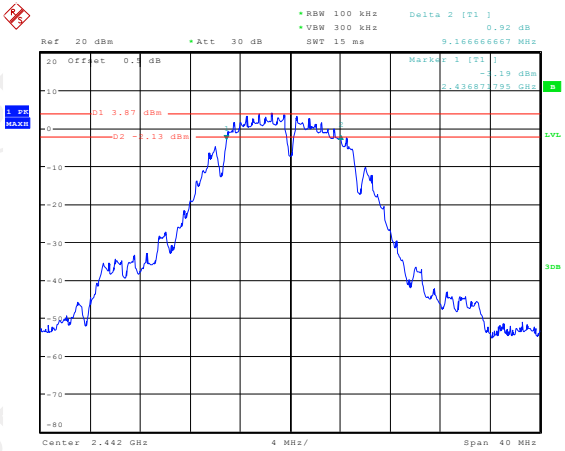
802.11b Modulation

Lowest channel



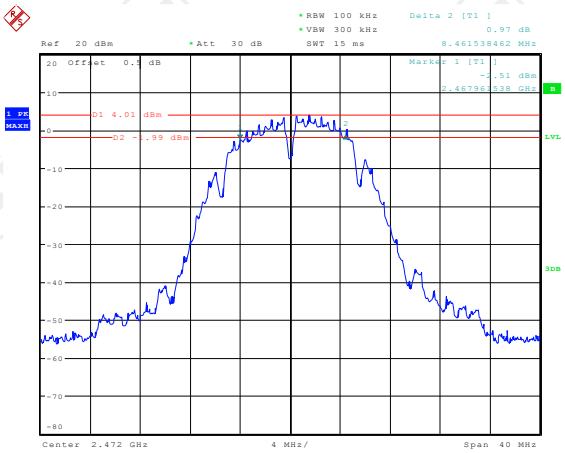
Date: 18.JUN.2021 14:23:51

Middle channel



Date: 18.JUN.2021 14:25:57

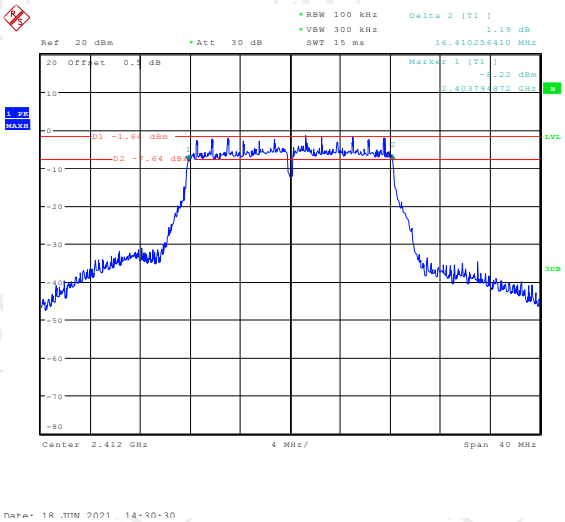
Highest channel



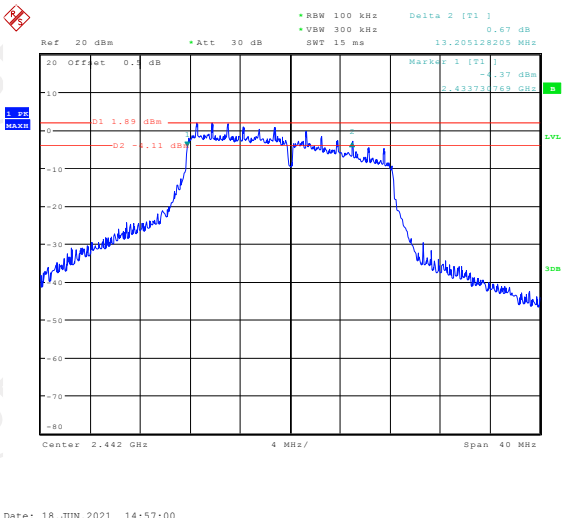
Date: 18.JUN.2021 14:27:25

802.11g Modulation

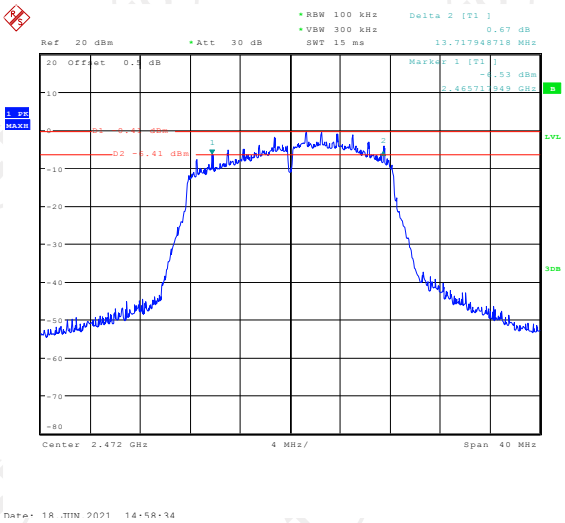
Lowest channel



Middle channel

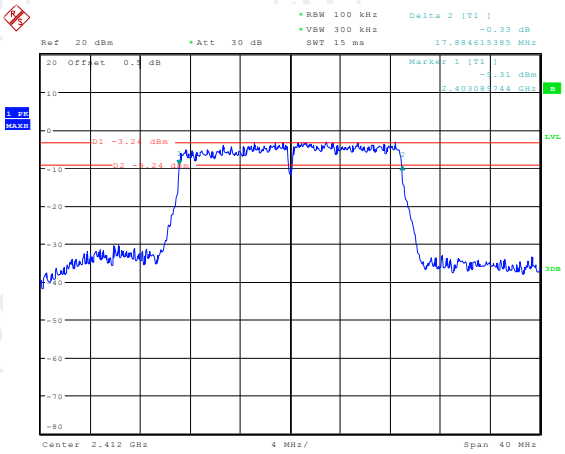


Highest channel



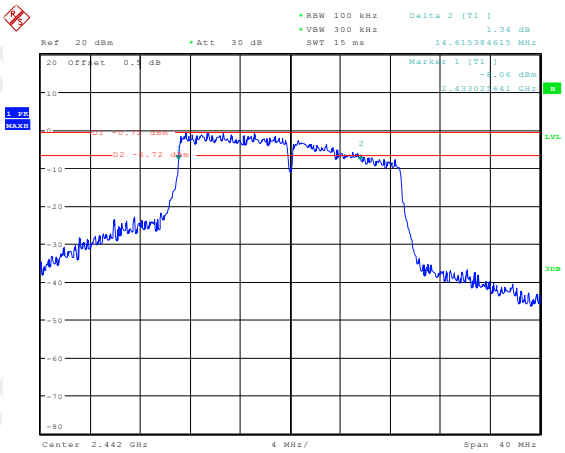
802.11n (HT20) Modulation

Lowest channel



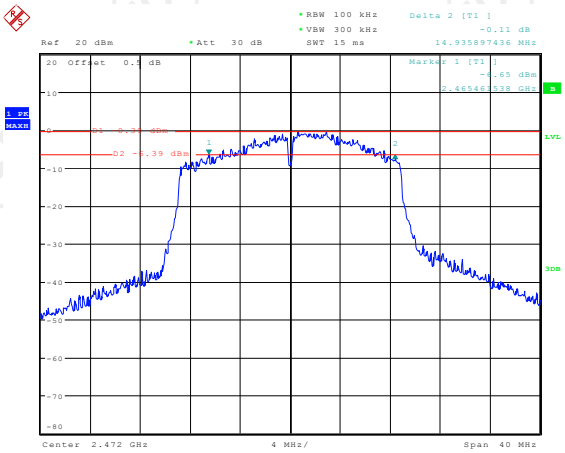
Date: 18.JUN.2021 15:06:44

Middle channel



Date: 18.JUN.2021 15:08:21

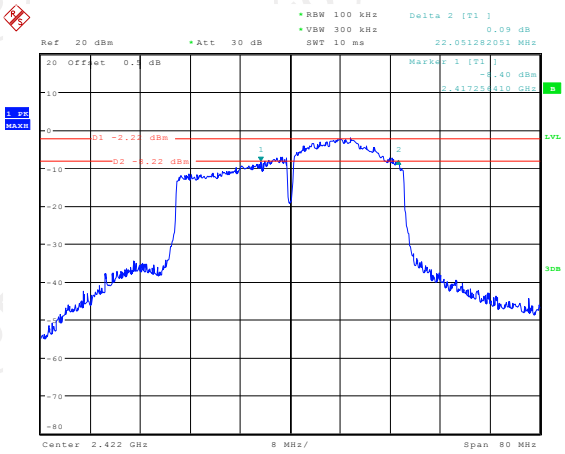
Highest channel



Date: 18.JUN.2021 15:10:00

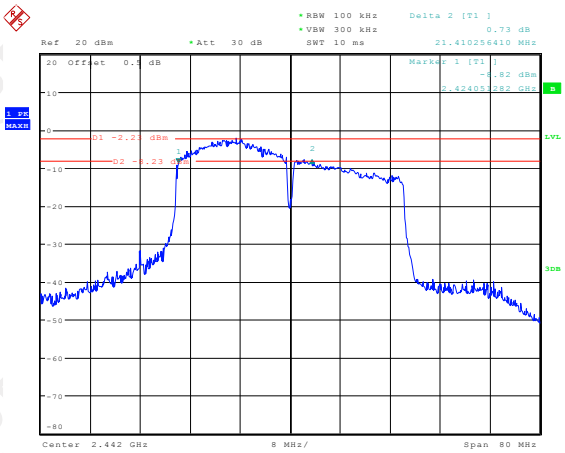
802.11n (HT40) Modulation

Lowest channel



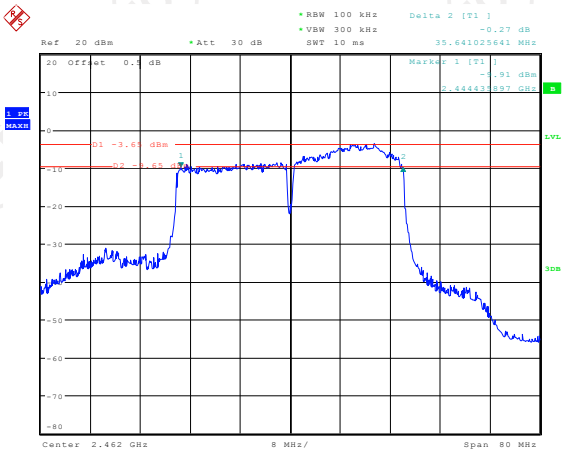
Date: 18.JUN.2021 15:12:42

Middle channel



Date: 18.JUN.2021 15:14:00

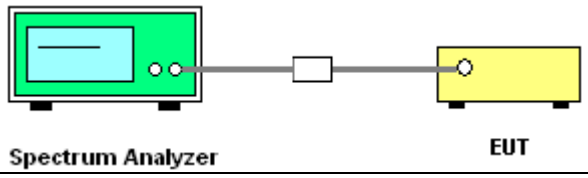
Highest channel



Date: 18.JUN.2021 15:15:45

5.5. Power Spectral Density

5.5.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (e)
Test Method:	KDB 558074
Limit:	The average power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer 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. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW): 3 kHz ≤ RBW ≤ 100 kHz. Video bandwidth VBW ≥ 3 x RBW. Set the span to at least 1.5 times the OBW. 4. Detector = RMS, Sweep time = auto couple. 5. Employ trace averaging (RMS) mode over a minimum of 100 traces. Use the peak marker function to determine the maximum power level. 6. Measure and record the results in the test report.
Test Result:	PASS

5.5.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2021
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 11, 2021
Antenna Connector	TCT	RFC-01	N/A	Sep. 11, 2021

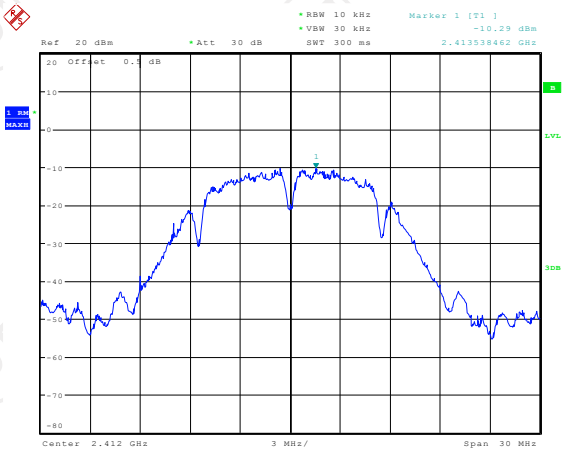
5.5.3. Test data

Test channel	AVG Power Spectral Density (dBm/3kHz)			
	802.11b	802.11g	802.11n(H20)	802.11n(H40)
Lowest	-10.29	-14.87	-15.33	-15.55
Middle	-10.03	-13.44	-12.41	-15.87
Highest	-9.81	-12.38	-12.65	-17.20
Limit:	8dBm/3kHz			
Test Result:	PASS			

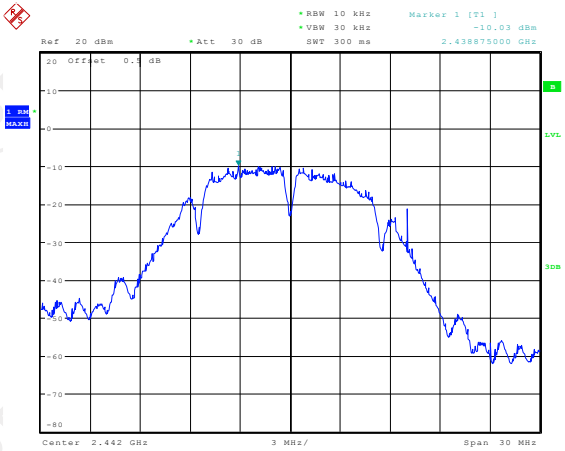
Test plots as follows:

802.11b Modulation

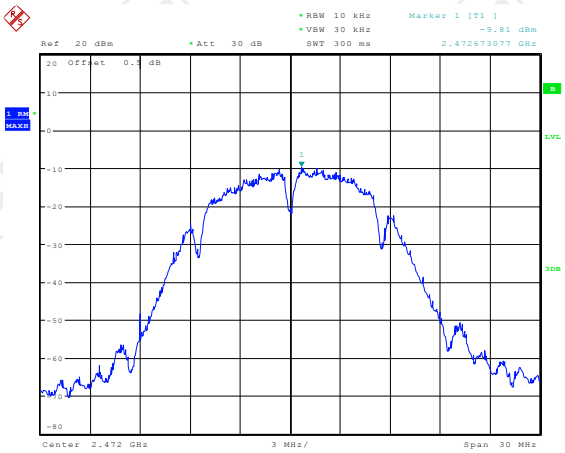
Lowest channel



Middle channel



Highest channel



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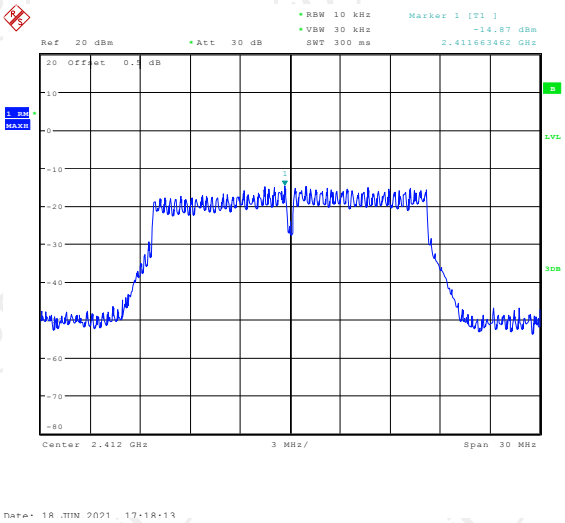
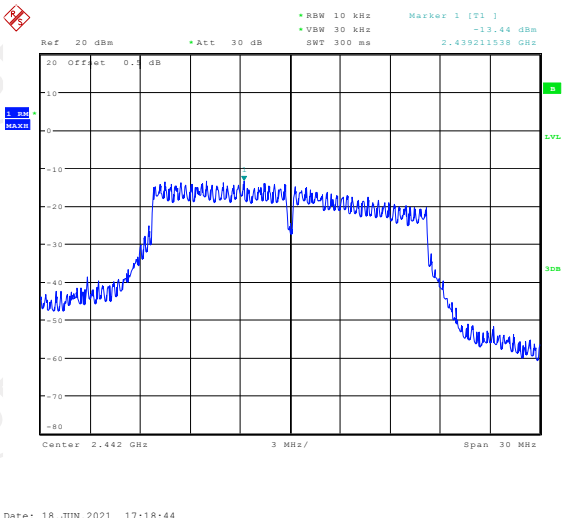
802.11g Modulation

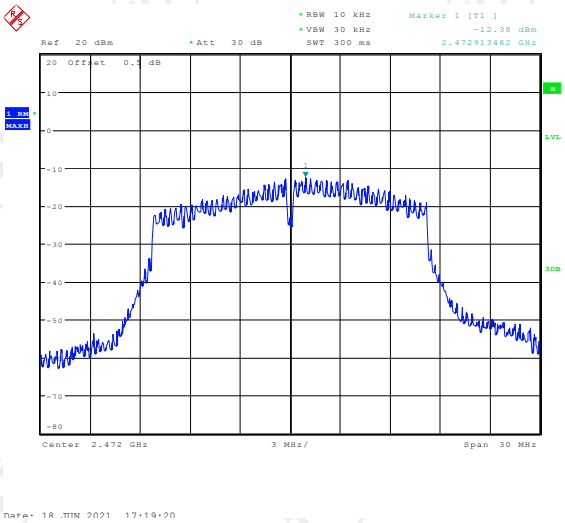
Lowest channel



Middle channel

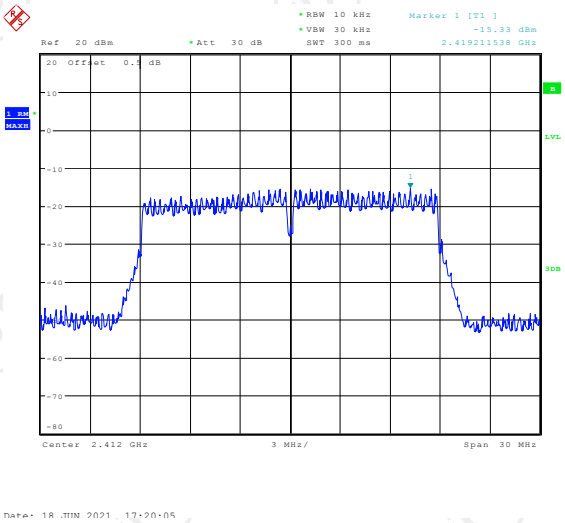


Highest channel



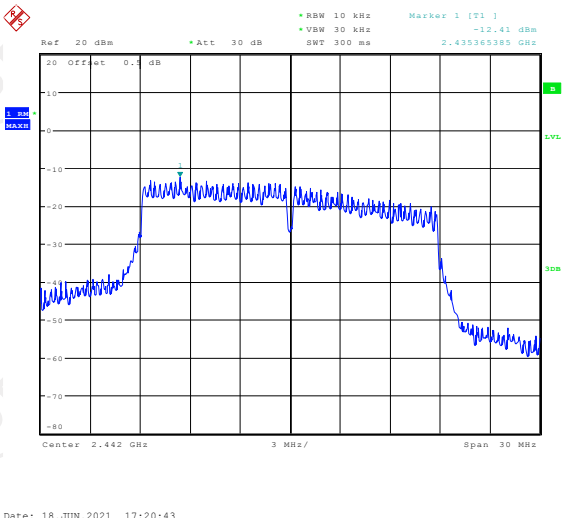
802.11n (HT20) Modulation

Lowest channel



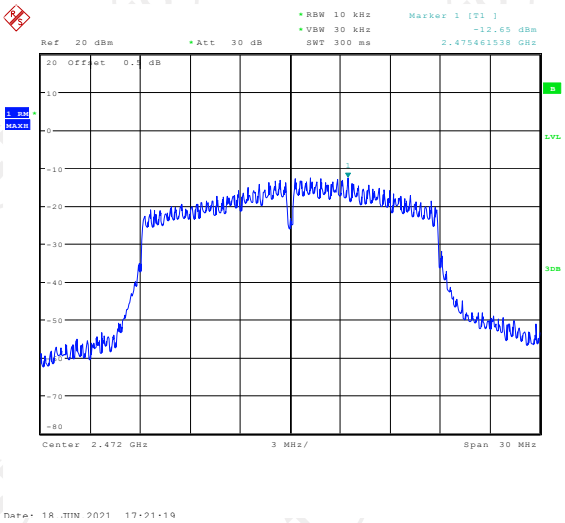
Date: 18.JUN.2021 17:20:05

Middle channel



Date: 18.JUN.2021 17:20:43

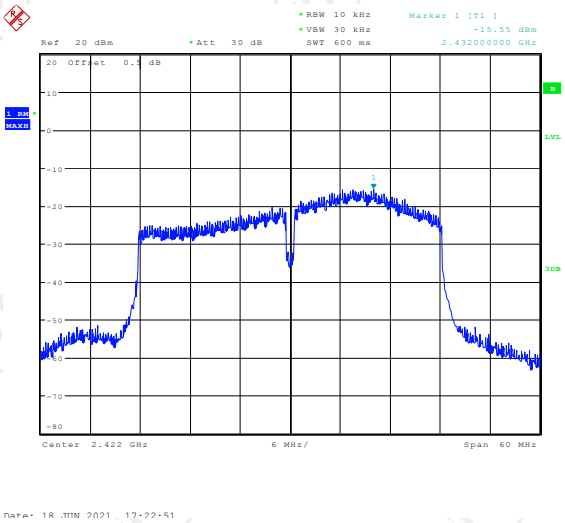
Highest channel



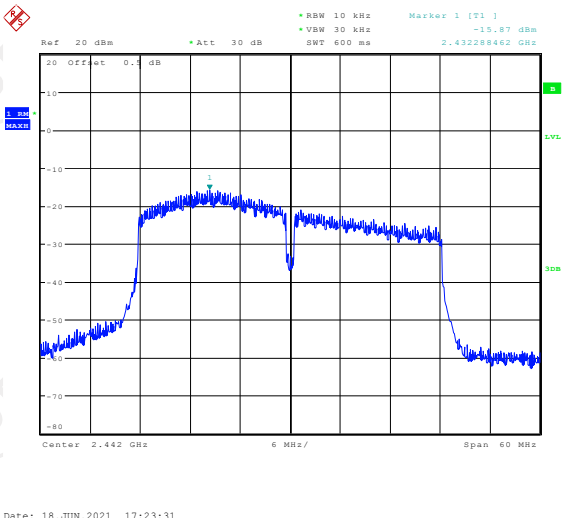
Date: 18.JUN.2021 17:21:19

802.11n (HT40) Modulation

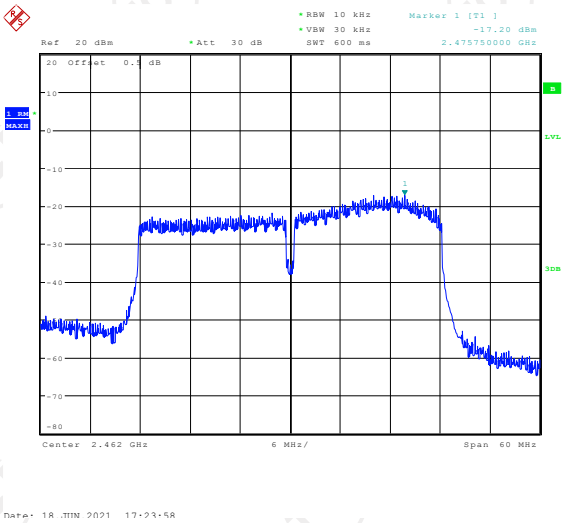
Lowest channel



Middle channel

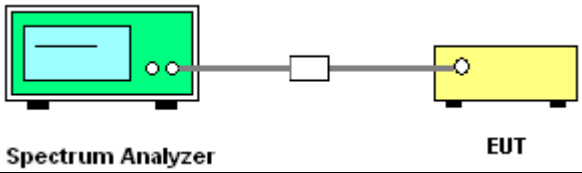


Highest channel



5.6. Conducted Band Edge and Spurious Emission Measurement

5.6.1. Test Specification

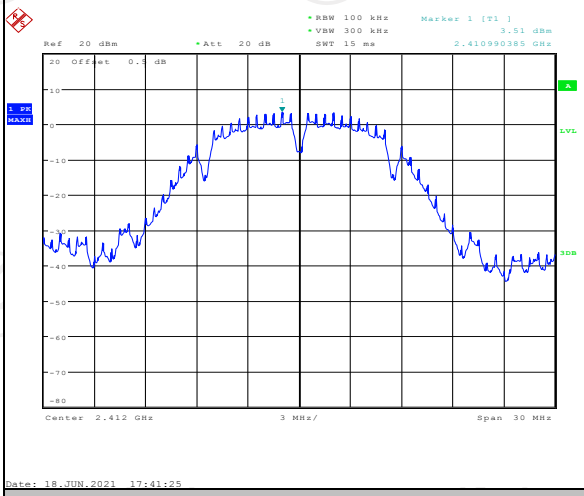
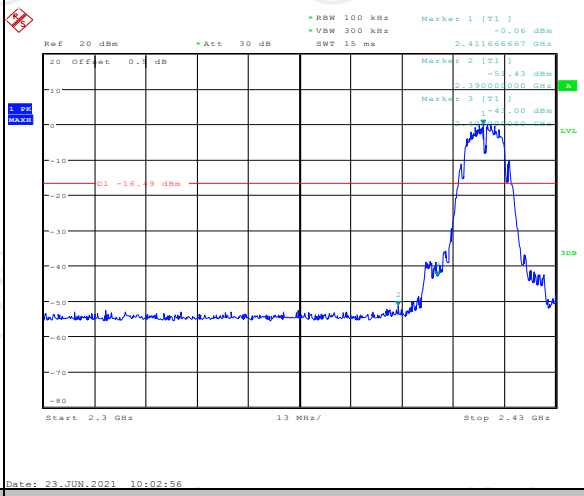
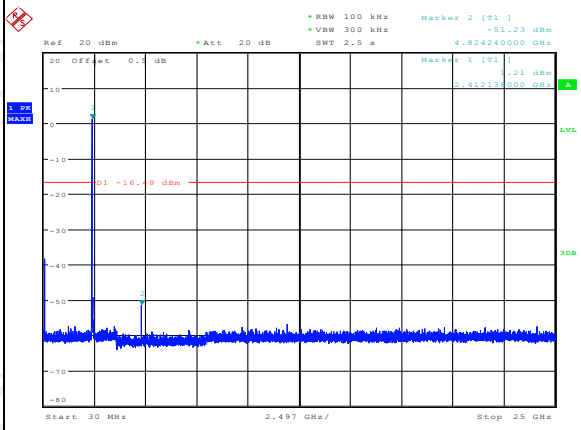
Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB558074
Limit:	In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement and radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The RF output of EUT was connected to the spectrum analyzer 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. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d). 4. Measure and record the results in the test report. 5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
Test Result:	PASS

5.6.2. Test Instruments

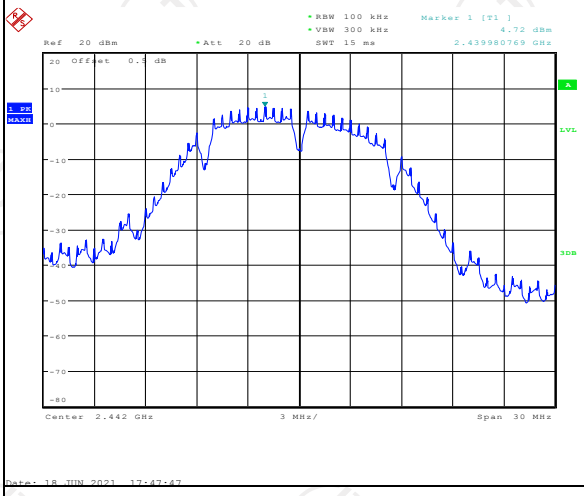
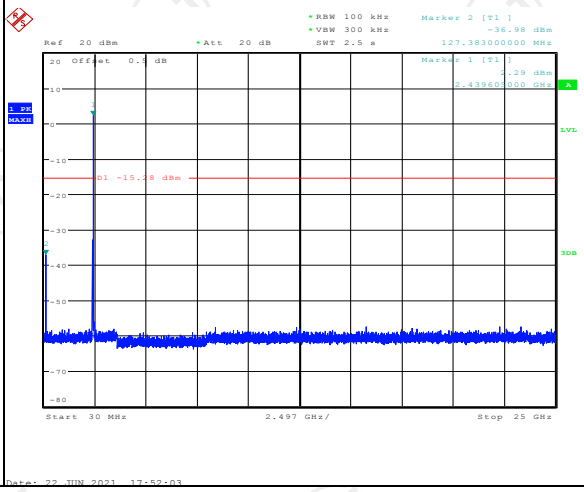
RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum Analyzer	R&S	FSU	200054	Sep. 11, 2021
Spectrum Analyzer	ROHDE&SCHWARZ	FSQ40	200061	Sep. 11, 2021
RF Cable (9KHz-26.5GHz)	TCT	RE-06	N/A	Sep. 11, 2021
Antenna Connector	TCT	RFC-01	N/A	Sep. 11, 2021

5.6.3. Test Data

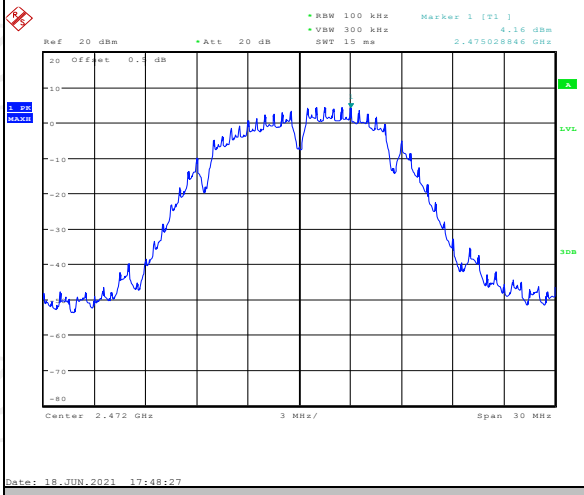
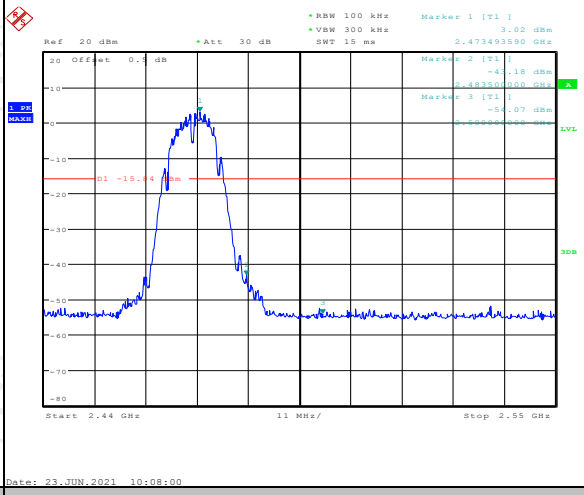
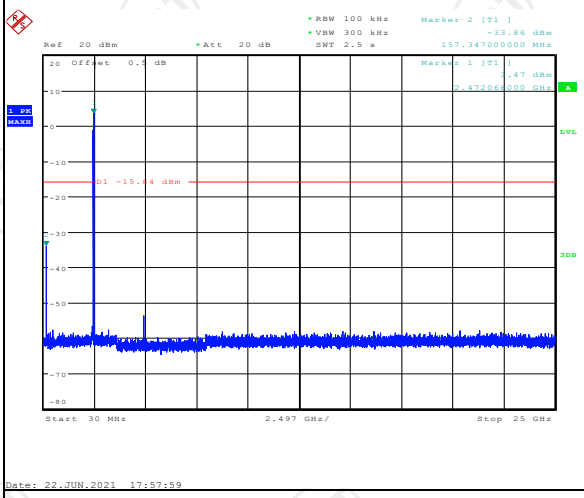
802.11b Modulation

100kHz PSD reference Level	Band Edge
	
Spurious emission	
	

Lowest Channel

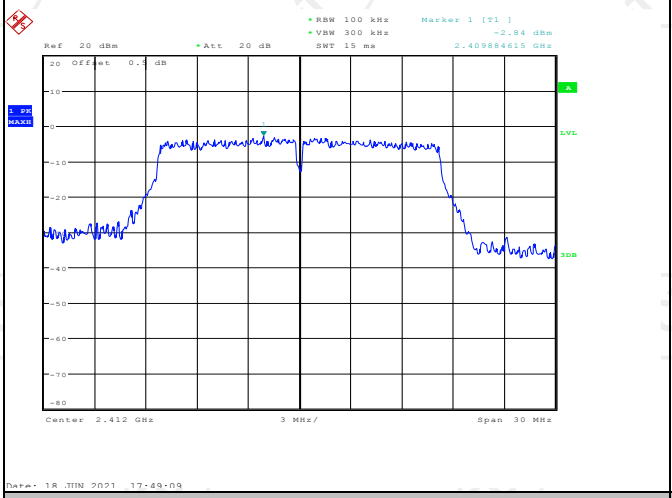
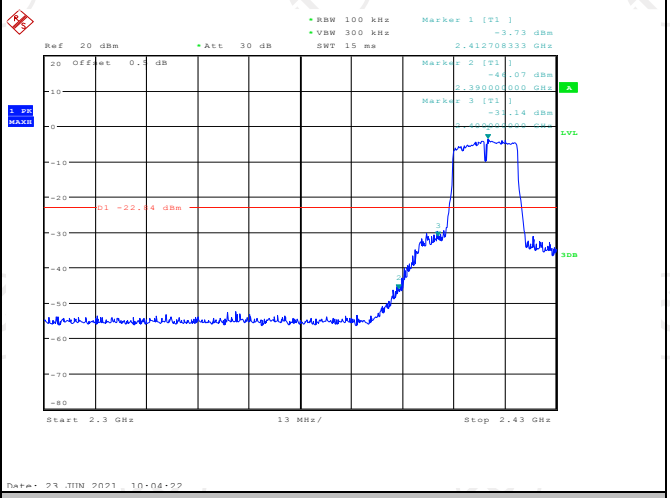
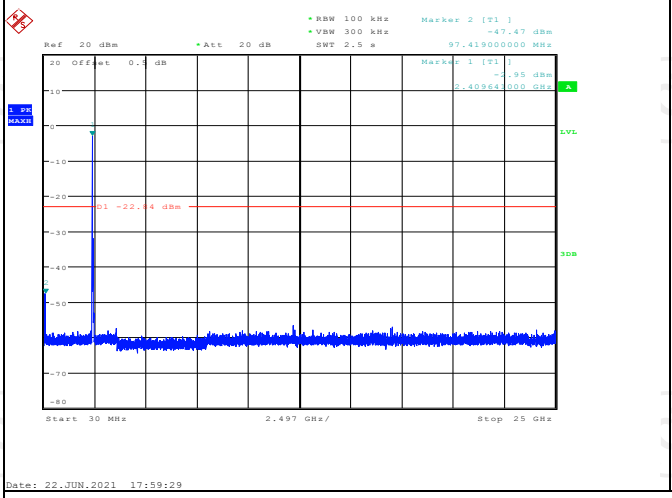
100kHz PSD reference Level	Spurious emission
	

Middle Channel

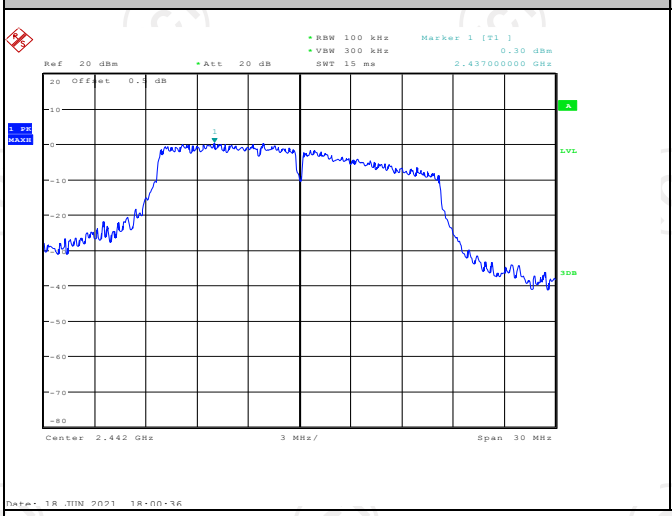
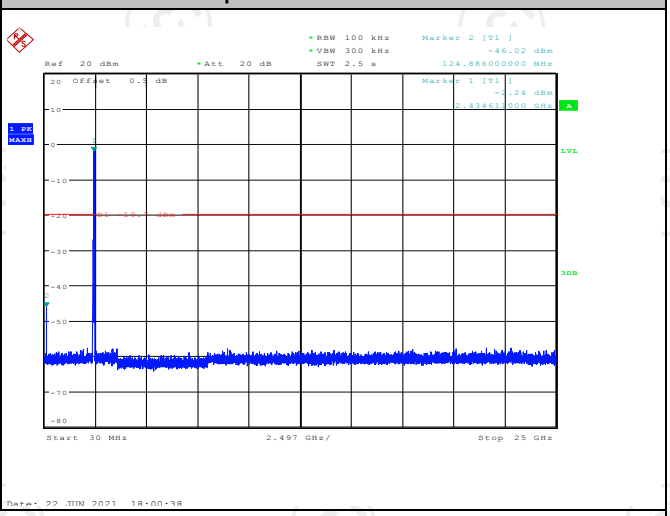
100kHz PSD reference Level	Band Edge
	
Spurious emission	
	

Highest Channel

802.11g Modulation

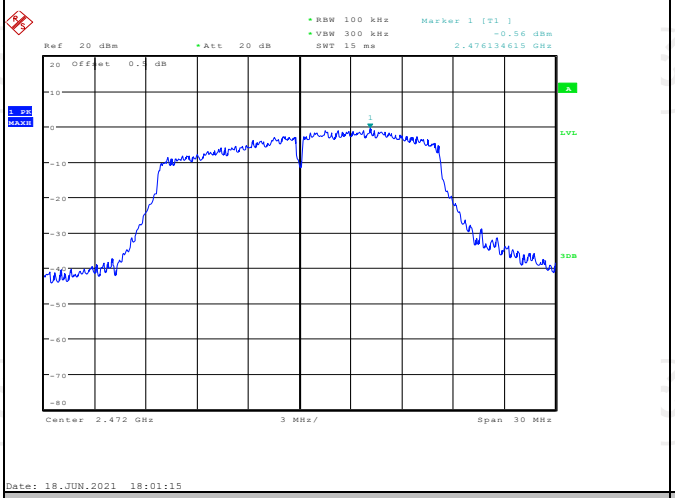
100kHz PSD reference Level	Band Edge
	
Spurious emission	
	

Lowest Channel

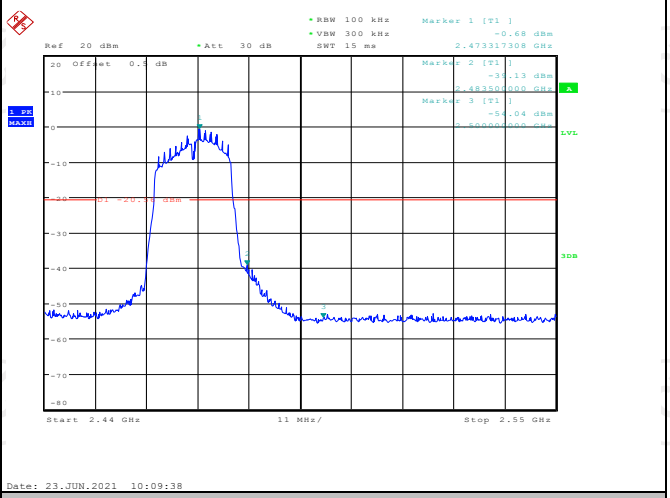
100kHz PSD reference Level	Spurious emission
	

Middle Channel

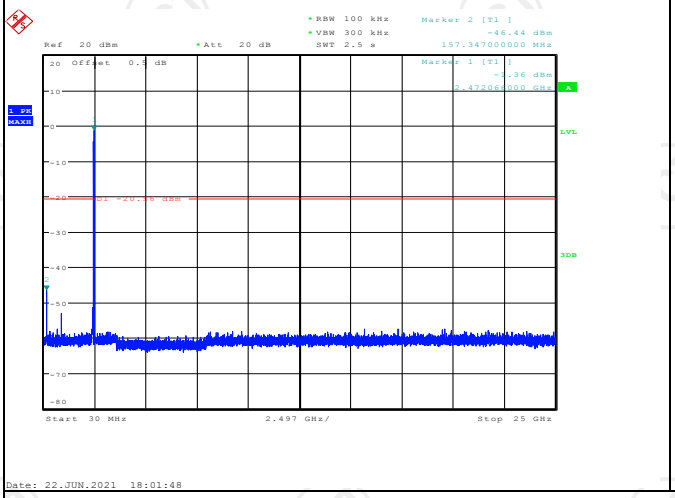
100kHz PSD reference Level



Band Edge



Spurious emission



Highest Channel

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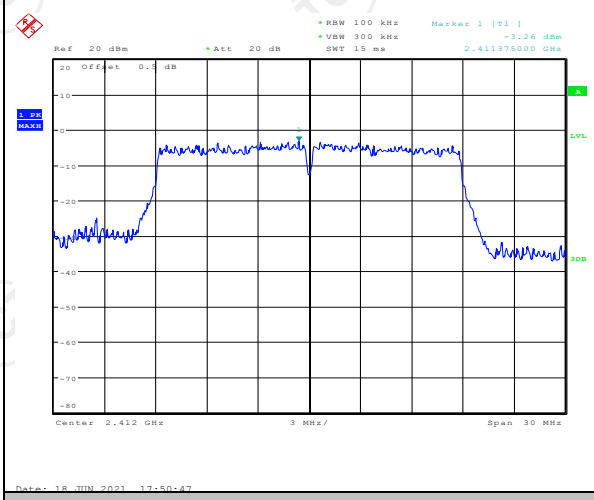
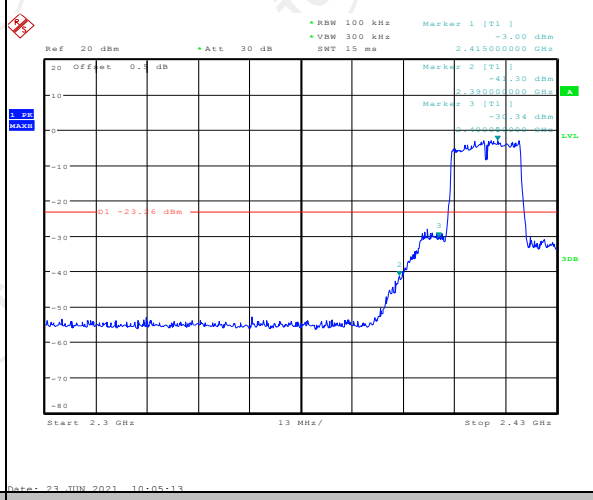
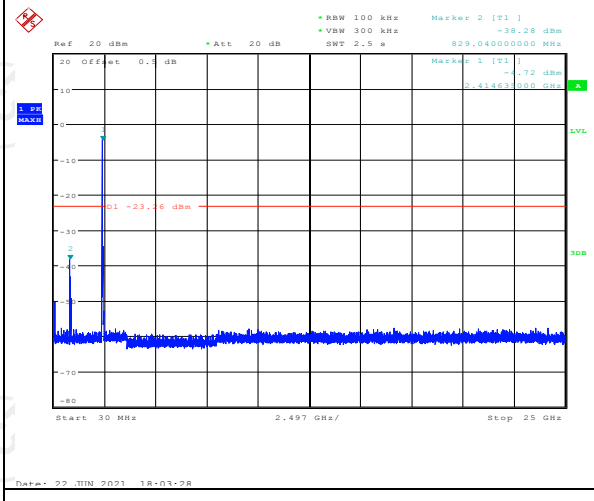
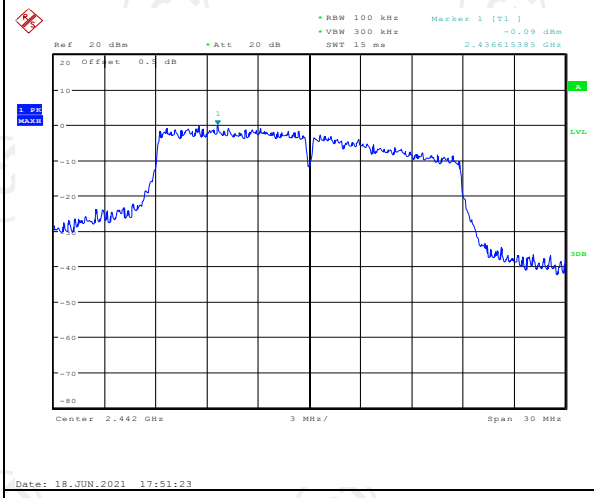
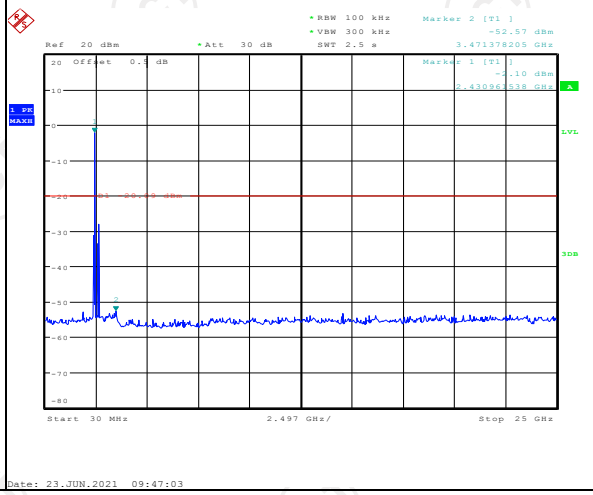
802.11n (HT20) Modulation

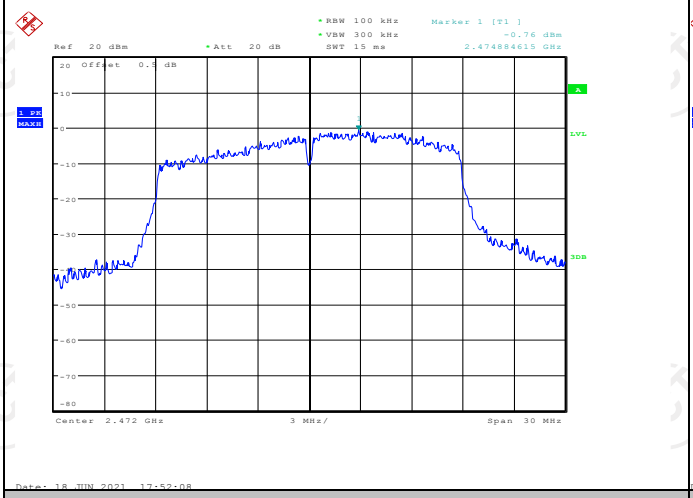
100kHz PSD reference Level	Band Edge
	
Spurious emission	
	

Lowest Channel

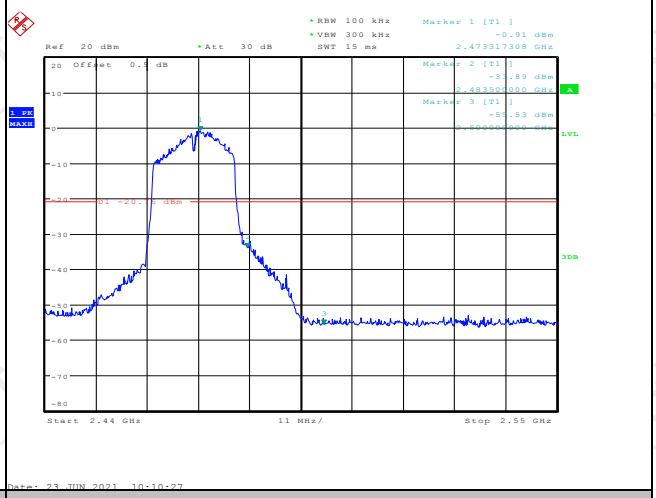
100kHz PSD reference Level	Spurious emission
	

Middle Channel

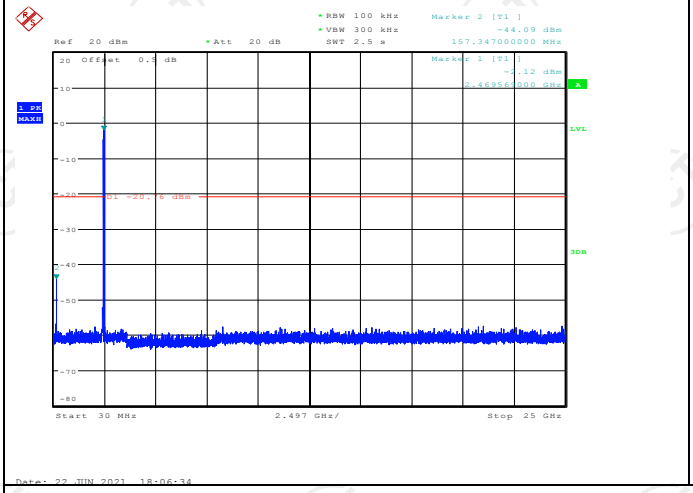
100kHz PSD reference Level



Band Edge



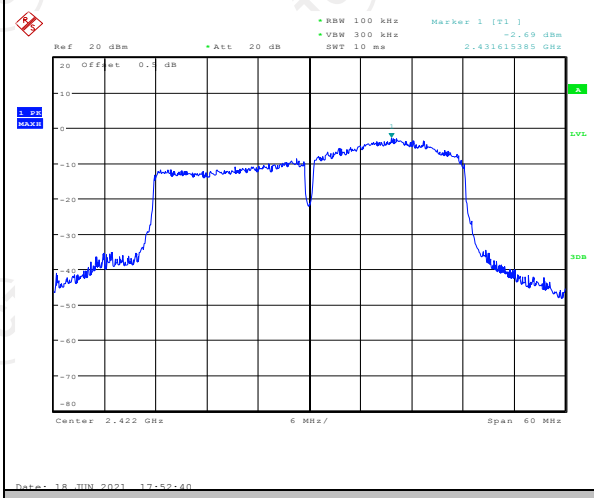
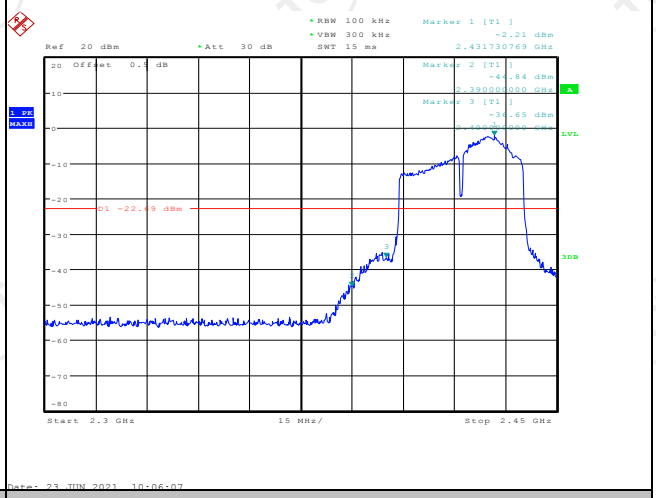
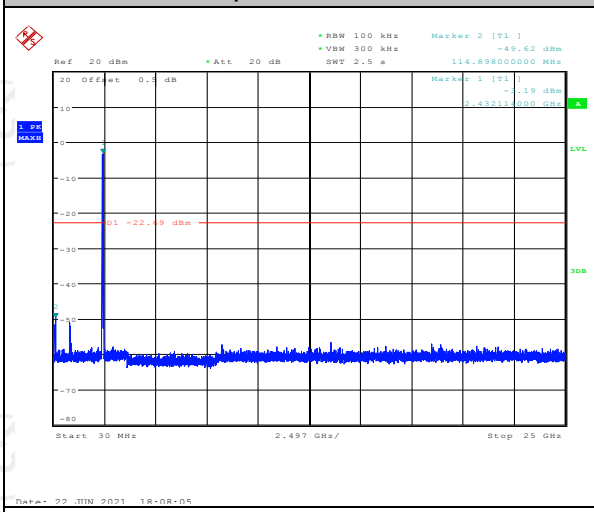
Spurious emission



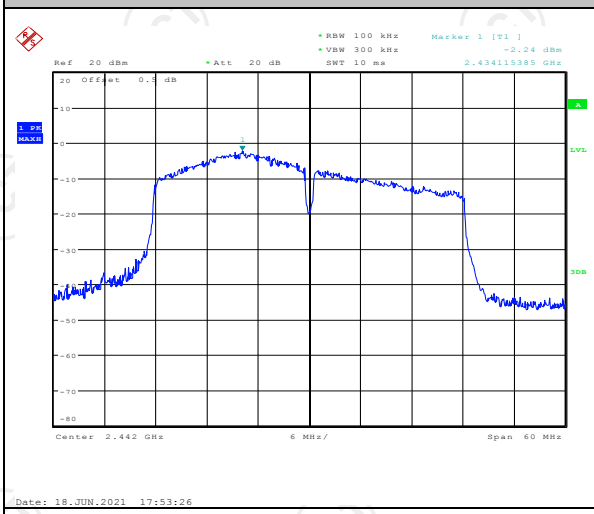
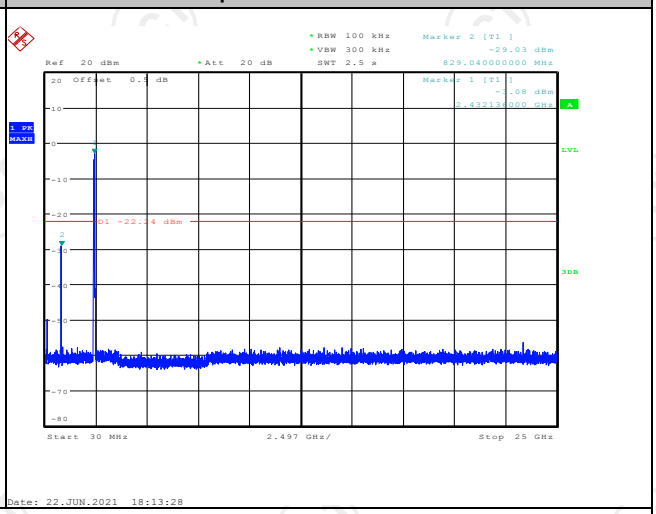
Highest Channel

Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com

802.11n (HT40) Modulation

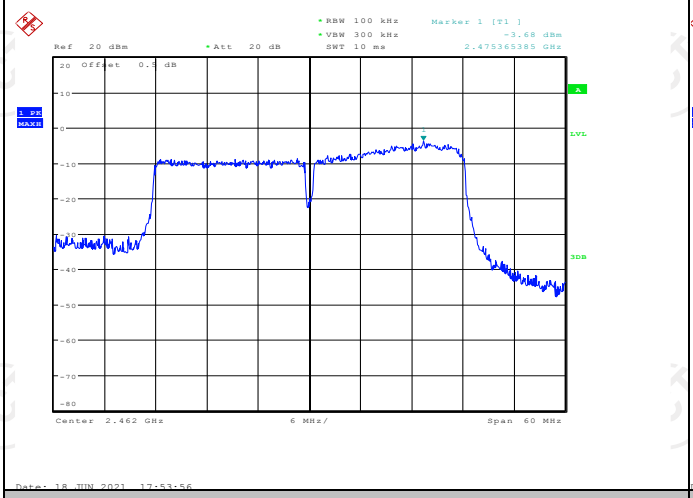
100kHz PSD reference Level	Band Edge
	
Spurious emission	
	

Lowest Channel

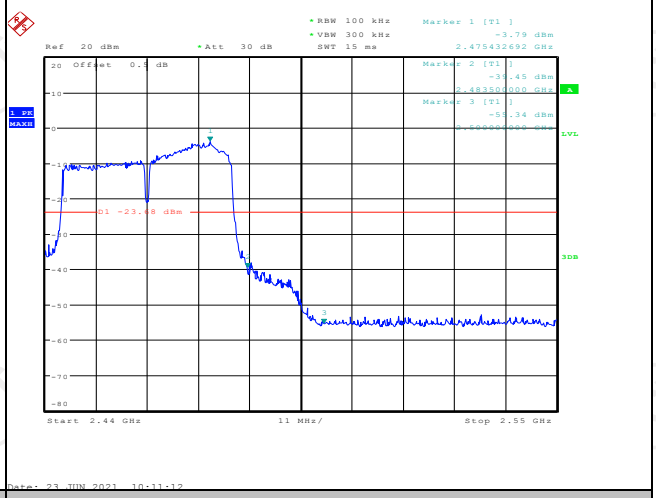
100kHz PSD reference Level	Spurious emission
	

Middle Channel

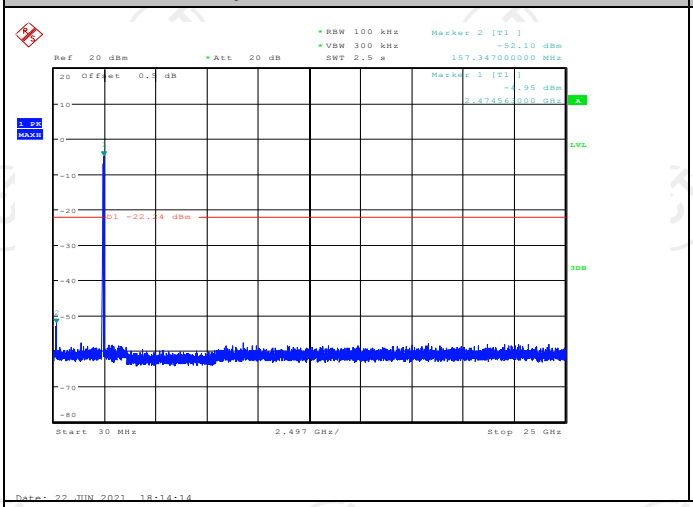
100kHz PSD reference Level



Band Edge



Spurious emission



Highest Channel

Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 http://www.tct-lab.com

5.7. Radiated Spurious Emission Measurement

5.7.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209
Test Method:	ANSI C63.10: 2013
Frequency Range:	9 kHz to 25 GHz
Measurement Distance:	3 m
Antenna Polarization:	Horizontal & Vertical
Operation mode:	Transmitting mode with modulation

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
150kHz-30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
Above 1GHz	Peak	1MHz	3MHz	Peak Value
	Peak	1MHz	10Hz	Average Value

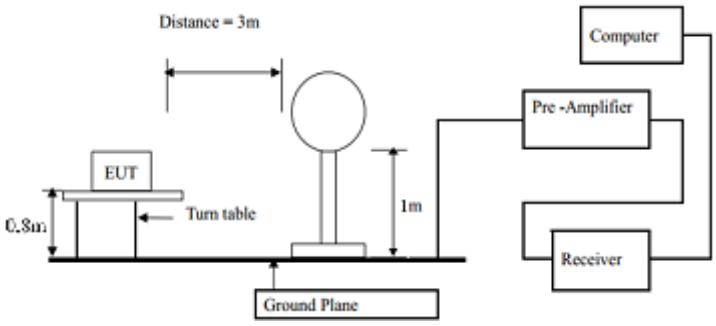
Limit:

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

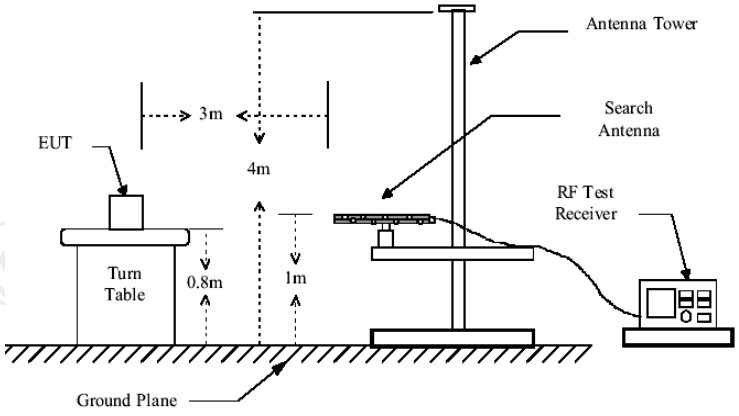
Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
Above 1GHz	500	3	Average
	5000	3	Peak

Test setup:

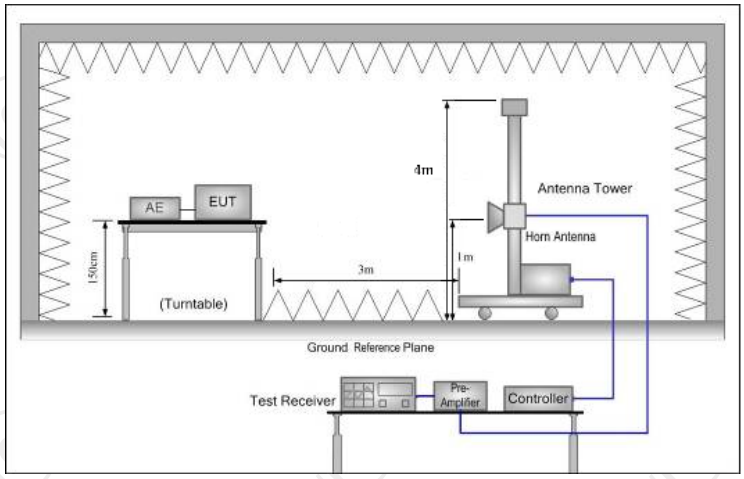
For radiated emissions below 30MHz



30MHz to 1GHz



Above 1GHz



Test Procedure:

1. For the radiated emission test below 1GHz:
   The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. 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.
   For the radiated emission test above 1GHz:
   Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which

	maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. 3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level 4. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported. 5. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=120 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold; (3) Set RBW = 1 MHz, VBW= 3MHz for f >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.
Test results:	PASS

5.7.2. Test Instruments

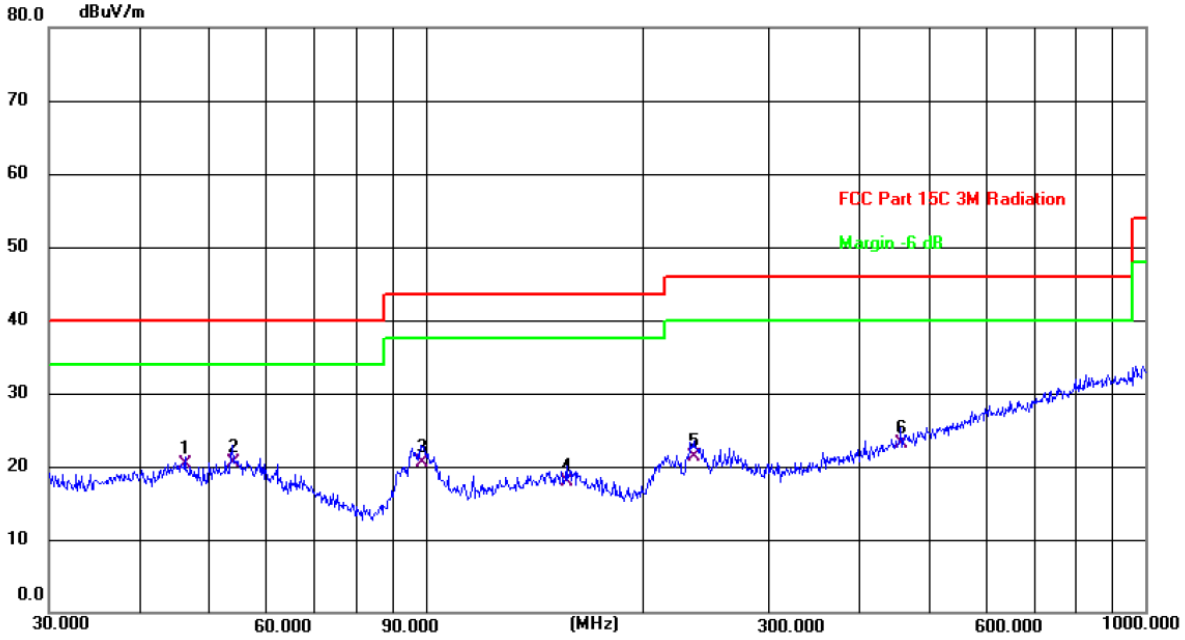
Radiated Emission Test Site (966)				
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Test Receiver	ROHDE&SCHWARZ	ESIB7	100197	Jul. 27, 2021
Spectrum Analyzer	ROHDE&SCHWARZ	FSQ40	200061	Sep. 11, 2021
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Sep. 02, 2021
Pre-amplifier	HP	8447D	2727A05017	Sep. 02, 2021
Loop antenna	ZHINAN	ZN30900A	12024	Sep. 05, 2022
Broadband Antenna	Schwarzbeck	VULB9163	340	Sep. 04, 2022
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Sep. 04, 2022
Horn Antenna	A-INFO	LB-180400-KF	J211020657	Sep. 04, 2022
Antenna Mast	Keleto	RE-AM	N/A	N/A
Line-4	TCT	RE-high-04	N/A	Sep. 02, 2021
Line-8	TCT	RE-01	N/A	Jul. 27, 2021
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

5.7.3. Test Data

Please refer to following diagram for individual

Below 1GHz

Horizontal:

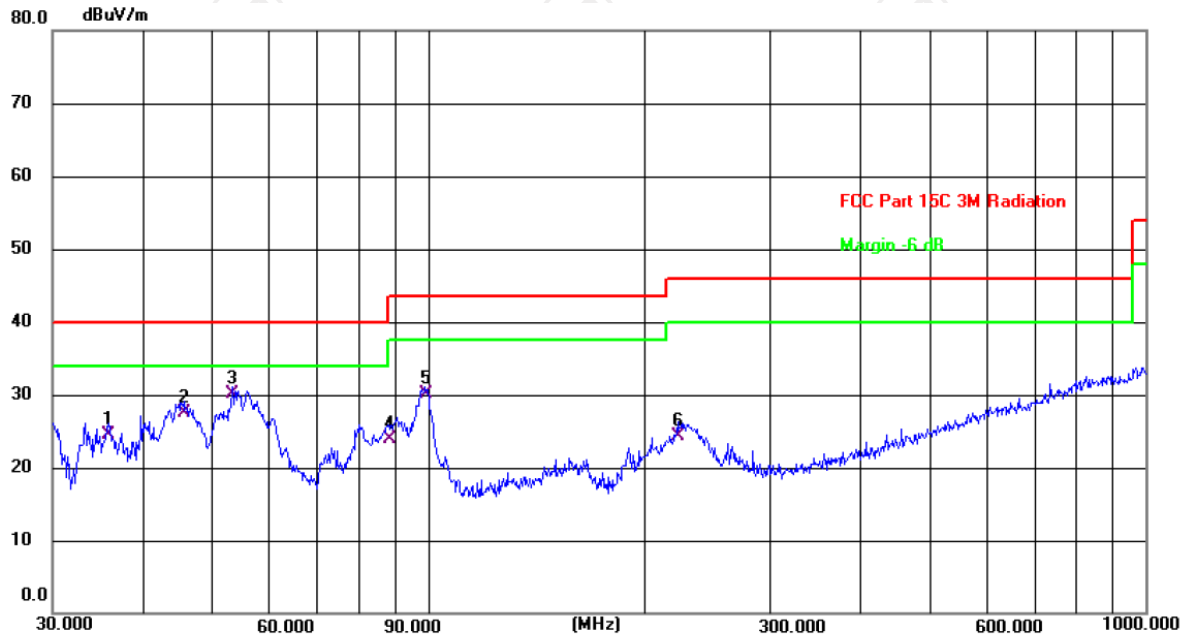


Site | Polarization: ***Horizontal*** | Temperature: 25(C)

Limit: FCC Part 15C 3M Radiation | Power: DC 3.8 V | Humidity: 55 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	46.3402	6.45	13.85	20.30	40.00	-19.70	QP	P	
2 *	53.8818	7.21	13.29	20.50	40.00	-19.50	QP	P	
3	98.4866	10.31	10.19	20.50	43.50	-23.00	QP	P	
4	157.0074	4.21	13.79	18.00	43.50	-25.50	QP	P	
5	235.8164	8.96	12.44	21.40	46.00	-24.60	QP	P	
6	457.5073	5.22	17.98	23.20	46.00	-22.80	QP	P	

Vertical:



Site

Limit: FCC Part 15C 3M Radiation

Polarization: ***Vertical***

Power: DC 3.8 V

Temperature: 25(C)

Humidity: 55 %

No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	P/F	Remark
1	35.8746	11.04	13.56	24.60	40.00	-15.40	QP	P	
2	45.6948	13.64	13.86	27.50	40.00	-12.50	QP	P	
3 *	53.5052	16.78	13.32	30.10	40.00	-9.90	QP	P	
4	88.0329	14.82	9.08	23.90	43.50	-19.60	QP	P	
5	99.1797	19.82	10.28	30.10	43.50	-13.40	QP	P	
6	222.9502	12.72	11.58	24.30	46.00	-21.70	QP	P	

Note: *1.The low frequency, which started from 9KHz~30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported*

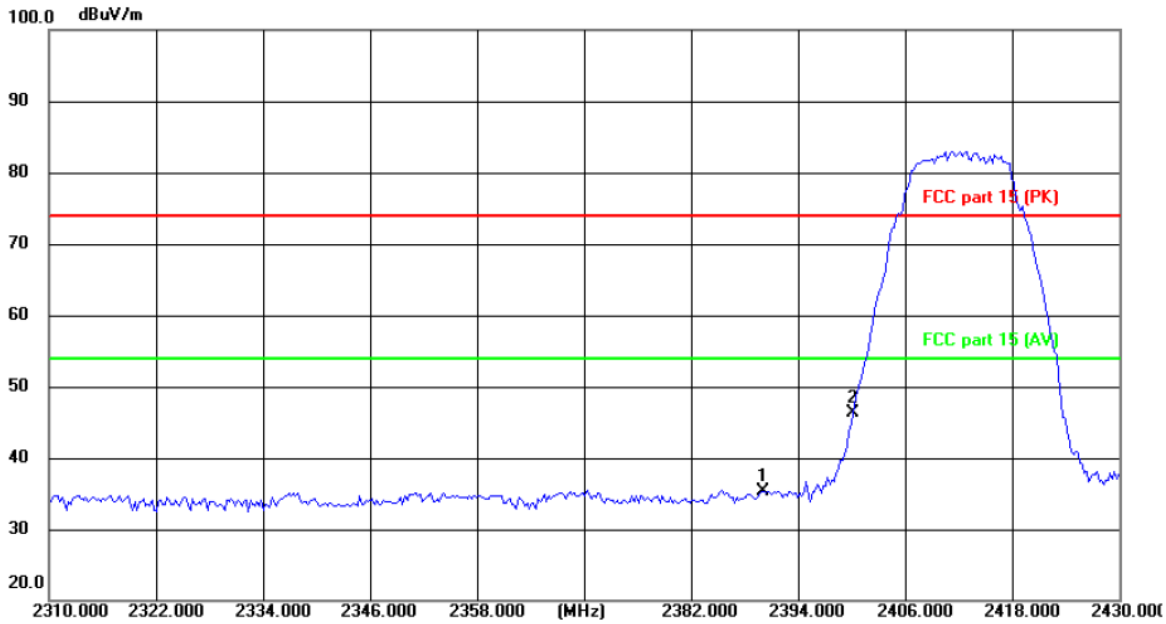
2. Measurements were conducted in all three channels (high, middle, low) and all modulation(802.11b, 802.11g, 802.11n(HT20), 802.11n(HT40)), and the worst case Mode (Middle channel and 802.11b) was submitted only.

3. Freq. = Emission frequency in MHz
Measurement (dBµV/m) = Reading level (dBµV) + Corr. Factor (dB)
Correction Factor= Antenna Factor + Cable loss – Pre-amplifier
Limit (dBµV/m) = Limit stated in standard
Margin (dB) = Measurement (dBµV/m) – Limits (dBµV/m)
** is meaning the worst frequency has been tested in the test frequency range*

Test Result of Radiated Spurious at Band edges

Lowest channel 2412:

Horizontal:

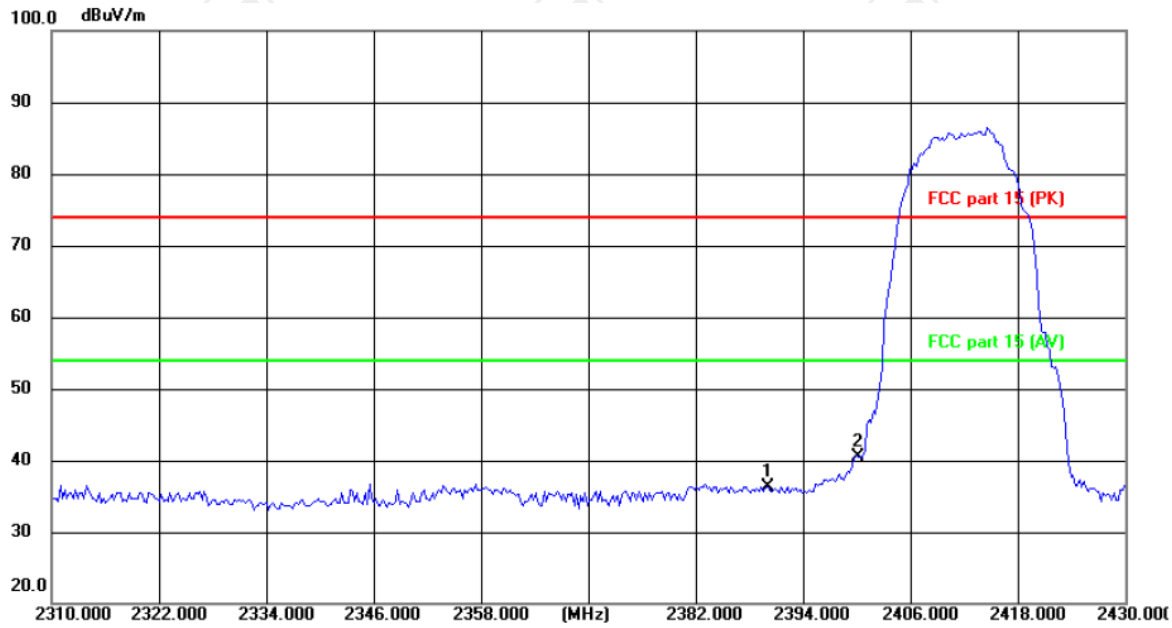


Site | Polarization: *Horizontal* | Temperature: 25(C)

Limit: FCC part 15 (PK) | Power: | Humidity: 55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		2390.000	48.39	-13.15	35.24	74.00	-38.76	peak
2	*	2400.000	59.41	-13.12	46.29	74.00	-27.71	peak

Vertical:



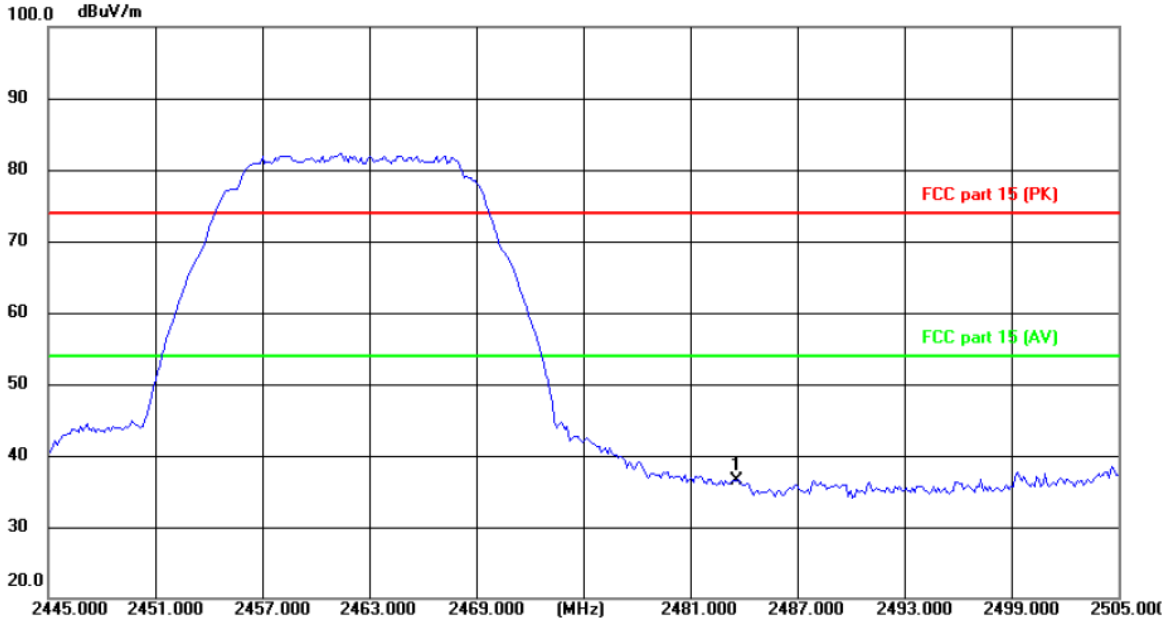
Site | Polarization: *Vertical* | Temperature: 25(C)

Limit: FCC part 15 (PK) | Power: | Humidity: 55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		2390.000	49.46	-13.15	36.31	74.00	-37.69	peak
2	*	2400.000	53.69	-13.12	40.57	74.00	-33.43	peak

Highest channel 2462:

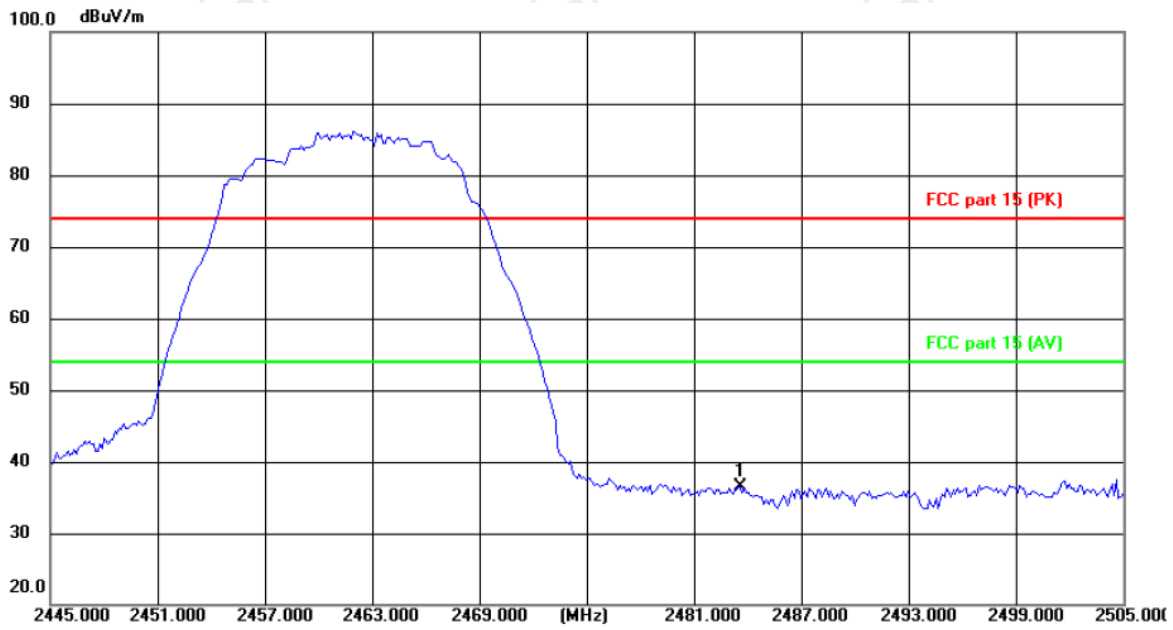
Horizontal:



Site	Polarization: *Horizontal*	Temperature: 25(C)
Limit: FCC part 15 (PK)	Power:	Humidity: 55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	*	2483.500	49.15	-12.74	36.41	74.00	-37.59	peak

Vertical:



Site	Polarization: *Vertical*	Temperature:	25(C)
Limit: FCC part 15 (PK)	Power:	Humidity:	55 %

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1	*	2483.500	49.18	-12.74	36.44	74.00	-37.56	peak

Note:

1. *Peak Final Emission Level=Peak Reading + Correction Factor;*
2. *Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
3. *Measurements were conducted in all modulation(802.11b, 802.11g, 802.11n(HT20), 802.11n(HT40)), and the worst case Mode 802.11b) was submitted only.*

Above 1GHz

Modulation Type: 802.11b

Low channel: 2412 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBµV)	AV reading (dBuV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBµV/m)	AV limit (dBµV/m)	Margin (dB)
					Peak (dBµV/m)	AV (dBµV/m)			
4824	H	45.18	---	0.75	45.93	---	74	54	-8.07
7236	H	35.96	---	9.87	45.83	---	74	54	-8.17
---	H	---	---	---	---	---	---	---	---
4824	V	43.37	---	0.75	44.12	---	74	54	-9.88
7236	V	33.09	---	9.87	42.96	---	74	54	-11.04
---	V	---	---	---	---	---	---	---	---

Middle channel: 2437MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBµV)	AV reading (dBµV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBµV/m)	AV limit (dBµV/m)	Margin (dB)
					Peak (dBµV/m)	AV (dBµV/m)			
4874	H	45.25	---	0.97	46.22	---	74	54	-7.78
7311	H	35.80	---	9.83	45.63	---	74	54	-8.37
---	H	---	---	---	---	---	---	---	---
4874	V	45.45	---	0.97	46.42	---	74	54	-7.58
7311	V	35.96	---	9.83	45.79	---	74	54	-8.21
---	V	---	---	---	---	---	---	---	---

High channel: 2462 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBµV)	AV reading (dBµV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBµV/m)	AV limit (dBµV/m)	Margin (dB)
					Peak (dBµV/m)	AV (dBµV/m)			
4924	H	44.21	---	1.18	45.39	---	74	54	-8.61
7386	H	32.88	---	10.07	42.95	---	74	54	-11.05
---	H	---	---	---	---	---	---	---	---
4924	V	45.97	---	1.18	47.15	---	74	54	-6.85
7386	V	34.62	---	10.07	44.69	---	74	54	-9.31
---	V	---	---	---	---	---	---	---	---

Note:

1. *Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
2. *Margin (dB) = Emission Level (Peak) (dBµV/m)-Average limit (dBµV/m)*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency. The highest test frequency is 25GHz.*
5. *Data of measurement shown "---"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.*
6. *All the restriction bands are compliance with the limit of 15.209.*

Modulation Type: 802.11g

Low channel: 2412 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBuV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4824	H	45.37	---	0.75	46.12	---	74	54	-7.88
7236	H	34.48	---	9.87	44.35	---	74	54	-9.65
---	H	---	---	---	---	---	---	---	---
4824	V	44.23	---	0.75	44.98	---	74	54	-9.02
7236	V	32.96	---	9.87	42.83	---	74	54	-11.17
---	V	---	---	---	---	---	---	---	---

Middle channel: 2437MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4874	H	44.84	---	0.97	45.81	---	74	54	-8.19
7311	H	34.03	---	9.83	43.86	---	74	54	-10.14
---	H	---	---	---	---	---	---	---	---
4874	V	45.15	---	0.97	46.12	---	74	54	-7.88
7311	V	35.89	---	9.83	45.72	---	74	54	-8.28
---	V	---	---	---	---	---	---	---	---

High channel: 2462 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4924	H	44.26	---	1.18	45.44	---	74	54	-8.56
7386	H	35.97	---	10.07	46.04	---	74	54	-7.96
---	H	---	---	---	---	---	---	---	---
4924	V	45.40	---	1.18	46.58	---	74	54	-7.42
7386	V	32.81	---	10.07	42.88	---	74	54	-11.12
---	V	---	---	---	---	---	---	---	---

Note:

1. *Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
2. *Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency. The highest test frequency is 25GHz.*
5. *Data of measurement shown "---"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.*
6. *All the restriction bands are compliance with the limit of 15.209.*

Modulation Type: 802.11n (HT20)

Low channel: 2412 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBuV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4824	H	46.24	---	0.75	46.99	---	74	54	-7.01
7236	H	36.67	---	9.87	46.54	---	74	54	-7.46
---	H	---	---	---	---	---	---	---	---
4824	V	45.66	---	0.75	46.41	---	74	54	-7.59
7236	V	34.95	---	9.87	44.82	---	74	54	-9.18
---	V	---	---	---	---	---	---	---	---

Middle channel: 2437MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4874	H	45.49	---	0.97	46.46	---	74	54	-7.54
7311	H	35.53	---	9.83	45.36	---	74	54	-8.64
---	H	---	---	---	---	---	---	---	---
4874	V	45.04	---	0.97	46.01	---	74	54	-7.99
7311	V	35.51	---	9.83	45.34	---	74	54	-8.66
---	V	---	---	---	---	---	---	---	---

High channel: 2462 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4924	H	44.60	---	1.18	45.78	---	74	54	-8.22
7386	H	35.41	---	10.07	45.48	---	74	54	-8.52
---	H	---	---	---	---	---	---	---	---
4924	V	46.69	---	1.18	47.87	---	74	54	-6.13
7386	V	34.12	---	10.07	44.19	---	74	54	-9.81
---	V	---	---	---	---	---	---	---	---

Note:

1. *Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
2. *Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency. The highest test frequency is 25GHz.*
5. *Data of measurement shown "---"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.*
6. *All the restriction bands are compliance with the limit of 15.209.*

Modulation Type: 802.11n (HT40)

Low channel: 2422 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBuV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4844	H	43.30	---	0.75	44.05	---	74	54	-9.95
7266	H	34.72	---	9.87	44.59	---	74	54	-9.41
---	H	---	---	---	---	---	---	---	---
4824	V	45.93	---	0.75	46.68	---	74	54	-7.32
7236	V	36.82	---	9.87	46.69	---	74	54	-7.31
---	V	---	---	---	---	---	---	---	---

Middle channel: 2437MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4874	H	45.27	---	0.97	46.24	---	74	54	-7.76
7311	H	36.08	---	9.83	45.91	---	74	54	-8.09
---	H	---	---	---	---	---	---	---	---
4874	V	46.90	---	0.97	47.87	---	74	54	-6.13
7311	V	35.22	---	9.83	45.05	---	74	54	-8.95
---	V	---	---	---	---	----	---	---	---

High channel: 2452 MHz									
Frequency (MHz)	Ant. Pol. H/V	Peak reading (dBμV)	AV reading (dBμV)	Correction Factor (dB/m)	Emission Level		Peak limit (dBμV/m)	AV limit (dBμV/m)	Margin (dB)
					Peak (dBμV/m)	AV (dBμV/m)			
4904	H	48.08	---	1.18	49.26	---	74	54	-4.74
7356	H	36.62	---	10.07	46.69	---	74	54	-7.31
---	H	---	---	---	---	---	---	---	---
4904	V	45.14	---	1.18	46.32	---	74	54	-7.68
7356	V	34.70	---	10.07	44.77	---	74	54	-9.23
---	V	---	---	---	---	---	---	---	---

Note:

1. *Emission Level=Peak Reading + Correction Factor; Correction Factor= Antenna Factor + Cable loss – Pre-amplifier*
2. *Margin (dB) = Emission Level (Peak) (dBμV/m)-Average limit (dBμV/m)*
3. *The emission levels of other frequencies are very lower than the limit and not show in test report.*
4. *Measurements were conducted from 1 GHz to the 10th harmonic of highest fundamental frequency. The highest test frequency is 25GHz.*
5. *Data of measurement shown "---"in the above table mean that the reading of emissions is attenuated more than 20 dB below the limits or the field strength is too small to be measured.*
6. *All the restriction bands are compliance with the limit of 15.209.*

Appendix A: Photographs of Test Setup

Refer to the test report No. TCT210204E021

Appendix B: Photographs of EUT

Refer to the test report No. TCT210204E021

********END OF REPORT********