

EVALUATION REPORT

for Certification

Manufacturer: Summit Technology

130, Digital-ro, Namsung Plaza suite 611,

Geumcheon-gu, Seoul, South Korea

Attn: Mr. Yong-seong Park / Senior Director

Date of Issue: Jan. 11, 2023

Order Number: GETEC-C1-22-731

Test Report Number: GETEC-E3-22-124

Test Site: GUMI UNIVERSITY EMC CENTER

CAB Designation Number: KR0033

RESPONSIBLE PARTY : Summit Technology

ADDRESS : 130, Digital-ro, Namsung Plaza suite 611, Geumcheon-gu, Seoul, South Korea

CONTACT PERSON : Mr. Yong-seong Park / Senior Director

Rule Part(s)	: FCC Part 15 Subpart E-UNII Devices § 15.407
Test Method	: ANSI C63.10 (2013)
Equipment Class	: Unlicensed National Information Infrastructure(NII)
EUT Type	: Remote Controller
Type of Authority	: Certification
Model Name	: TDC-5100

This equipment has been shown to be in compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10 (2013)

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested by,



Jong-Wook Park, Senior Engineer
GUMI UNIVERSITY EMC CENTER

Reviewed by,



Hyun Kim, Technical Manager
GUMI UNIVERSITY EMC CENTER

GETEC-QP-16-008 (Rev.01)

EMC CENTER

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It is not allowed to copy this report even partly without the approval of EMC center

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Version

Test Report No.	Date	Description
GETEC-E3-22-124	Jan. 11, 2023	- First Approval Report





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Scope: Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and / or unintentional radiators for compliance with technical rules and regulations of the Federal Communications Commission.

1. General Information

Applicant: Summit Technology

Applicant Address: 130, Digital-ro, Namsung Plaza suite 611, Geumcheon-gu, Seoul, South Korea

Manufacturer: Summit Technology

Manufacturer Address: 130, Digital-ro, Namsung Plaza suite 611, Geumcheon-gu, Seoul, South Korea

Contact Person: Mr. Yong-seong Park / Senior Director

Telephone Number: +82-2-6929-3161

- **FCC ID.** 2AT6QTDC5100
- **Equipment Class** Unlicensed National Information Infrastructure(NII)
- **EUT Type** Touch Screen Controller
- **Model Name** TDC-5100
- **Rule Part(s)** FCC Part 15 Subpart E-UNII Devices § 15.407
- **Test Method** ANSI C63.10 (2013)
- **Type of Authority** Certification
- **Test Procedure(s)** ANSI C63.10 (2013), KDB789033 D02 General UNII Test Procedures New Rules v01r04(May 2,2017)
- **Dates of Test** Nov. 10, 2020 ~ Jan. 11, 2023
- **Place of Test** **GUMI UNIVERSITY EMC CENTER** (FCC Test firm Registration No.: 269701)
37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Republic of Korea
- **Test Report Number** GETEC-E3-22-124
- **Dates of Issue** Jan. 11, 2023



2. Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Nose Emissions From Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2009) was used in determining radiated and conducted emissions emanating from **Summit Technology Touch Screen Controller (Model name: TDC-5100)**

These measurement tests were conducted at **GUMI UNIVERSITY EMC CENTER**.

The site address is 37 Yaeun-ro, Gumi-si, Gyeongsangbuk-do, 730-711, Republic of Korea

This test site is one of the highest point of GUMI UNIVERSITY at about 200 kilometers away from Seoul city and 40 kilometers away from Daegu city. It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures. The detailed description of the measurement facility was found to be in compliance with the requirements of §2.948 according to ANSI C63.10 (2013)

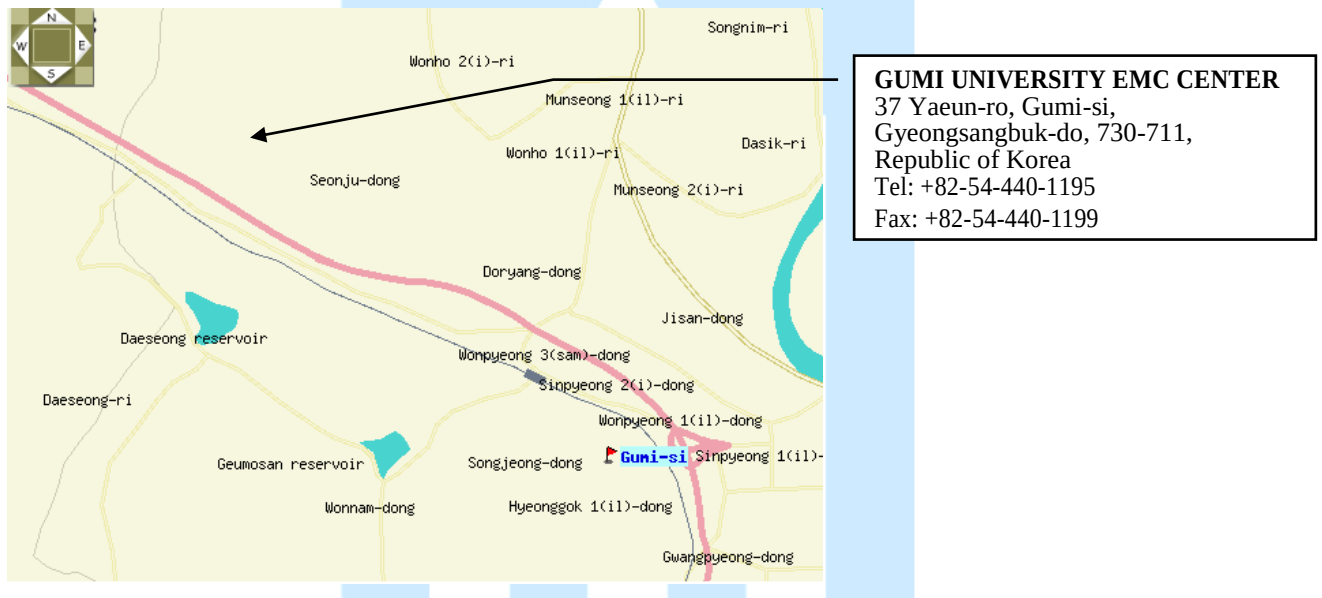


Fig 1. The map above shows the Gumi University in vicinity area.



3. Product Information

3.1 Description of EUT

The Equipment under Test (EUT) is the **Summit Technology Touch Screen Controller (Model Name: TDC-5100)**
FCC ID.: 2AT6QTDC5100

- Equipment	: Touch Screen Controller						
- Model name	: TDC-5100						
- Serial number	: Proto type						
- Electrical Rating	: DC 3.7 V (Lithium-polymer battery)						
- Manufacturer	: Summit Technology						
- Frequency Range (DTS band)	TX 20 MHz BW:	2412 MHz - 2462 MHz					
	40 MHz BW:	2422 MHz - 2462 MHz					
	RX 20 MHz BW:	2412 MHz - 2462 MHz					
	40 MHz BW	2422 MHz - 2462 MHz					
- Frequency Range (UNII band)	TX 20 MHz BW:	5180 MHz - 5240 MHz (UNII 1) / 5260 MHz - 5320 MHz (UNII 2A) 5500 MHz - 5720 MHz (UNII 2C) / 5745 MHz - 5825 MHz (UNII 3)					
	40 MHz BW:	5190 MHz - 5230 MHz (UNII 1) / 5270 MHz - 5310 MHz (UNII 2A) 5510 MHz - 5710 MHz (UNII 2C) / 5755 MHz - 5795 MHz (UNII 3)					
	80 MHz BW:	5210 Mhz (UNII 1) / 5290 MHz (UNII 2A) / 5530 MHz - 5690 MHz (UNII 2C) / 5775 MHz (UNII 3)					
	RX 20 MHz BW:	5180 MHz - 5240 MHz (UNII 1) / 5260 MHz - 5320 MHz (UNII 2A) 5500 MHz - 5720 MHz (UNII 2C) / 5745 MHz - 5825 MHz (UNII 3)					
	40 MHz BW:	5190 MHz - 5230 MHz (UNII 1) / 5270 MHz - 5310 MHz (UNII 2A) 5510 MHz - 5710 MHz (UNII 2C) / 5755 MHz - 5795 MHz (UNII 3)					
	80 MHz BW:	5210 Mhz (UNII 1) / 5290 MHz (UNII 2A) / 5530 MHz - 5690 MHz (UNII 2C) / 5775 MHz (UNII 3)					
- Modulation	: BPSK, QPSK, QAM, CCK, OFDM						
- Antenna Specification	: Antenna type : FPCB antenna Gain :						
	Freq. (MHz)	2400	2420	2440	2460	2480	2500
	Gain (dBi)	3.29	3.44	3.50	3.69	3.55	3.56
	Freq. (MHz)	5150	5250	5350	5490	5725	5825
	Gain (dBi)	3.11	3.36	3.67	3.70	3.06	3.33
- Type (DFS)	: Client (without radar detection)						

3.2 Definition of models

-None.



3.3 Support Equipment / Cables used

3.3.1 Used Support Equipment

Description	Manufacturer	Model Name	S/N & FCC ID.
Notebook Computer ¹⁾	SAMSUNG	NT500R3W	S/N: 0Q2V91JJ100096T FCC ID.: N/A

Note)

1) The Support Equipment use only setting to the test mode.

3.3.2 System configuration

Description	Manufacturer	Model Name	S/N & FCC ID.
-	-	-	-

3.3.3 Used Cable(s)

Cable Name	Condition	Description
-	-	-

3.4 Modification Item(s)

-. None



4. Antenna Requirement - §15.203

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the applicant can be used with the device. The use of permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

4.1 Description of Antenna

The **Summit Technology Touch Screen Controller**, comply with the requirement of §15.203 with a FPCB antenna permanently attached to the transmitter.

5. Description of tests

5.1 Test Condition

The EUT was installed, arranged and operated in a manner that is most representative of equipment as typically used.

The measurements were carried out while varying operating modes and cable positions within typically arrangement to determine maximum emission level.

The representative and worst test mode(s) were noted in the test report.

- Test Voltage / Frequency: 3.7 V / DC
- Operating condition during the test(s) :
 - Continuous RF transmitting mode with nominal maximum RF output power.
 - Operating channel frequency and modulation technology

Mode	Available channel	Frequency	Modulation Technology
NII	802.11a	36 ~ 165	5180 ~ 5825 MHz
	802.11n	36 ~ 165	5180 ~ 5825 MHz
	802.11ac	36 ~ 165	5180 ~ 5825 MHz

- EUT set condition (Test Software)

Test Software	Android Debug Bridge
Test Software version	N/A

6. References Standards

- FCC Part 15 (2009) Subpart E-UNII Devices §15.407
- ANSI C 63.10 (2013): American National Standard for Testing Unlicensed Wireless Devices
- KDB 789033 D02 General UNII Test Procedures New Rules v01r04 (May 2, 2017): Guidance for compliance testing of unlicensed national information infrastructure (UNII) devices (Part 15, Subpart E)



7. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Result
§15.407 (for Power Measurement)	26 dB Bandwidth	Pass
§15.407(e)	6 dB Bandwidth	Pass
§15.407(a)	Maximum Conducted Output Power	Pass
§15.407(h)1	Transmit Power Control (TPC)	N/A ¹⁾
§15.407(a)	Peak Power Spectral Density	Pass
§15.407(g)	Frequency Stability	Pass
§15.207	AC Conducted Emissions 150 kHz - 30 MHz	Pass
§15.407(b)	Undesirable Emissions	Pass
§15.205, § 15.407(b)(5),(6)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Pass

1) E.I.R.P of EUT is less than the 500 mW.

Therefore, TPC test is not required for systems with an e.i.r.p of less than 500 mW

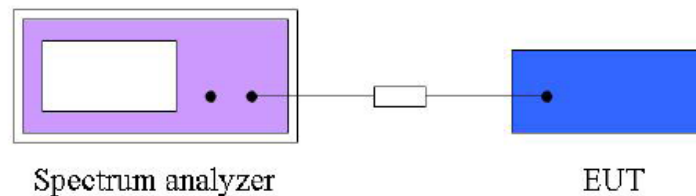


8. 26 dB Bandwidth Measurement

8.1 Operating environment

Temperature : 27.3 °C
Relative Humidity : 32.0 % R.H.

8.2 Test Set-up (Layout)



8.3 Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

8.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSV	Rohde & Schwarz	Spectrum Analyzer	101552	Apr. 06, 2023
■ - OSP120	Rohde & Schwarz	Open Switch and control platform	101329	Jan. 12, 2023
■ - J12J103539-00-2	JUNFLON	RF Test Cable (OSP_DUT1)	AUG-03-21-066	N/A
■ - J12J103539-00-3	JUNFLON	RF Test Cable (OSP_RX)	AUG-03-21-074	N/A
■ - WMS 32	Rohde & Schwarz	Testing Software	VER10.40.10	N/A

8.5 Test Test Procedure

- Set RBW = 200 kHz
- Set the video bandwidth (VBW) $\geq$ 600 kHz
- Detector = Max Peak
- Trace mode = Max Hold
- Sweep = Auto
- Allow the trace to stabilize
- Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.



8.6 Test result

- Test Date : Nov. 10, 2022 ~ Dec. 07, 2022
- Reference Standard : Part 15 Subpart E, Sec. 15.407(for power measurement)
- Test Procedure(s) : ANSI C63.10 (2013), KDB 789033 D02 general UNII test procedures new rules v01r04 (May 2, 2017)
- Operating Condition : 802.11a/n/ac
- Power Source : DC 3.7 V

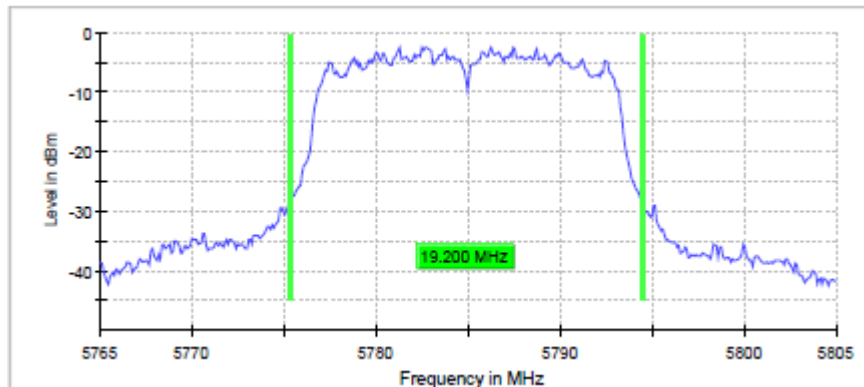
802.11a

Frequency (MHz)	Channel No.	26 dB Bandwidth (MHz)	Min. Limit (MHz)	Result
5180	36	19.70	N/A	Complies
5200	40	19.60	N/A	Complies
5240	48	19.30	N/A	Complies
5260	52	19.60	N/A	Complies
5300	60	19.70	N/A	Complies
5320	64	20.10	N/A	Complies
5500	100	19.90	N/A	Complies
5580	116	19.80	N/A	Complies
5720	144	19.40	N/A	Complies
5745	149	19.30	N/A	Complies
5785	157	19.20	N/A	Complies
5825	165	19.10	N/A	Complies

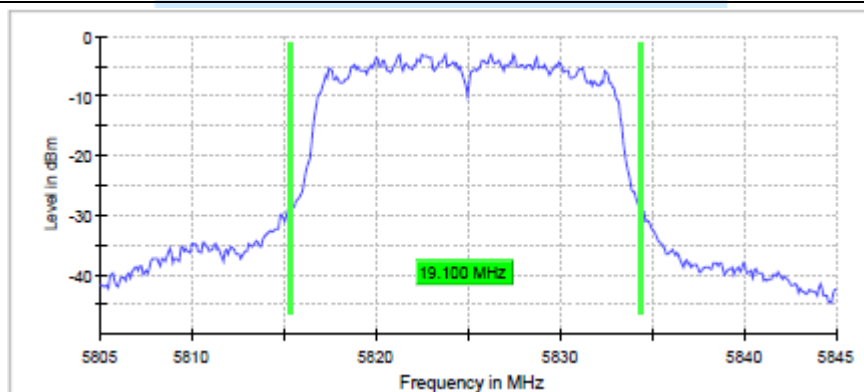


Test Plot on Configuration : 802.11a

5785 MHz (157 ch)



5825 MHz (165 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

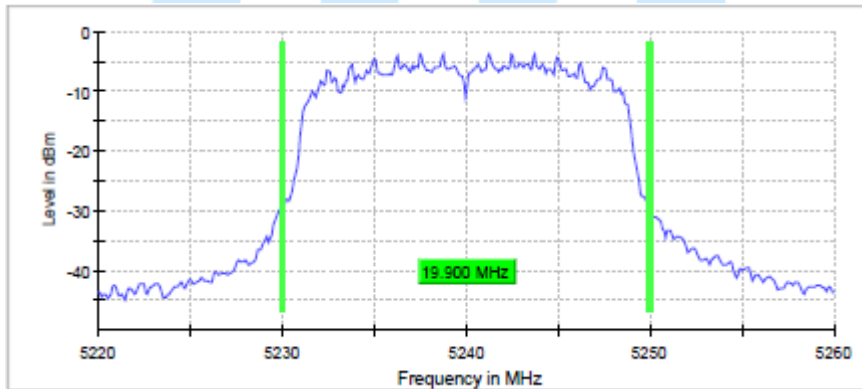


802.11n

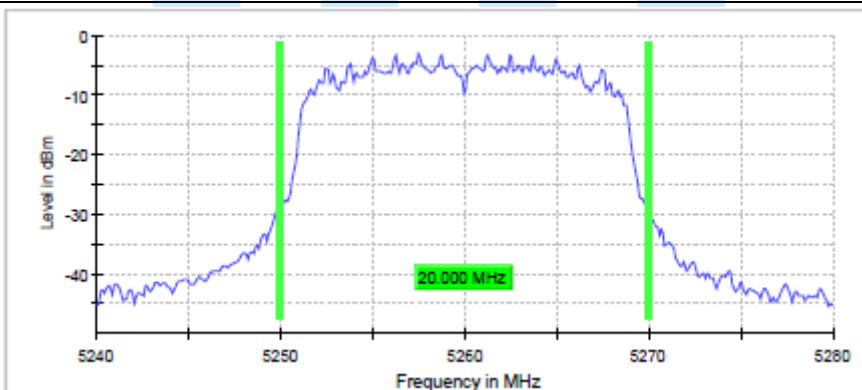
Frequency (MHz)	Channel No.	26 dB Bandwidth (MHz)	Min. Limit (MHz)	Result
5180	36	20.10	N/A	Complies
5200	40	20.30	N/A	Complies
5240	48	19.90	N/A	Complies
5260	52	20.00	N/A	Complies
5300	60	20.30	N/A	Complies
5320	64	20.20	N/A	Complies
5500	100	20.30	N/A	Complies
5580	116	20.40	N/A	Complies
5720	144	20.30	N/A	Complies
5745	149	20.20	N/A	Complies
5785	157	20.30	N/A	Complies
5825	165	20.30	N/A	Complies

Test Plot on Configuration : 802.11n

5240 MHz (48 ch)



5260 MHz (52 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

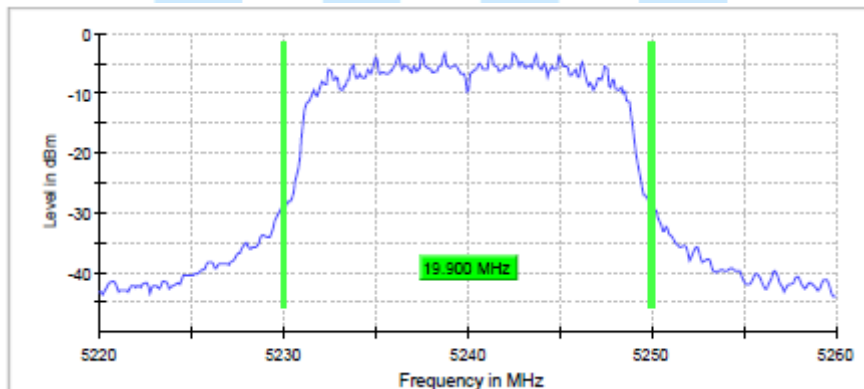


802.11ac

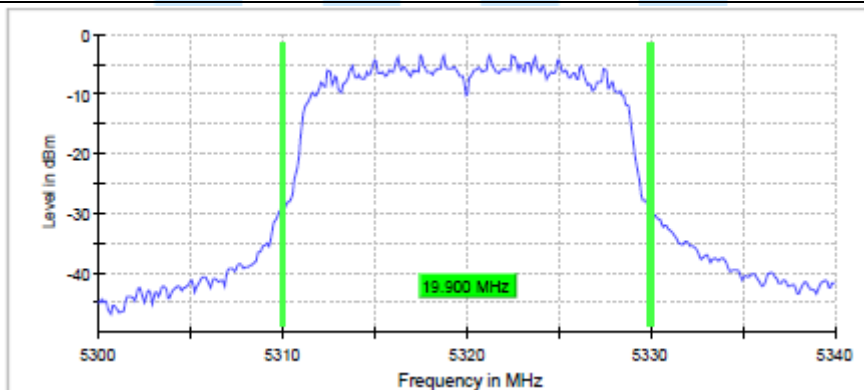
Frequency (MHz)	Channel No.	26 dB Bandwidth (MHz)	Min. Limit (MHz)	Result
5180	36	20.20	N/A	Complies
5200	40	20.20	N/A	Complies
5240	48	19.90	N/A	Complies
5260	52	20.20	N/A	Complies
5300	60	20.30	N/A	Complies
5320	64	19.90	N/A	Complies
5500	100	20.30	N/A	Complies
5580	116	20.30	N/A	Complies
5720	144	20.30	N/A	Complies
5745	149	20.30	N/A	Complies
5785	157	20.40	N/A	Complies
5825	165	20.30	N/A	Complies

Test Plot on Configuration : 802.11n

5240 MHz (48 ch)



5320 MHz (64 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

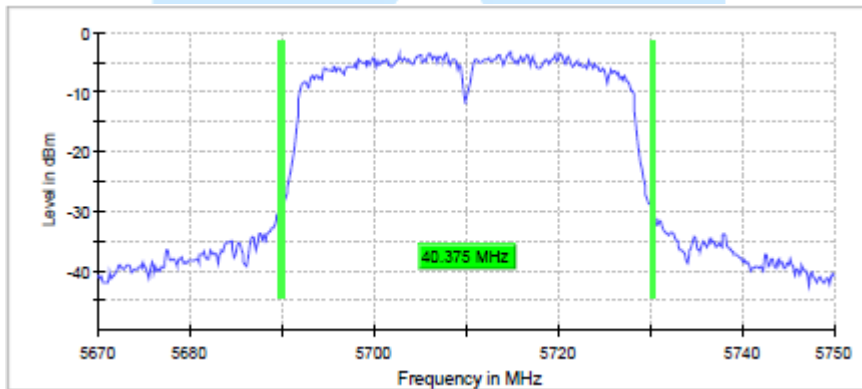


802.11n_HT40

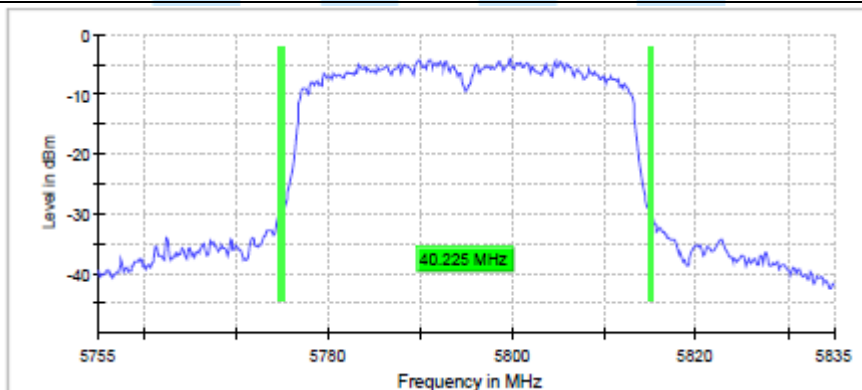
Frequency (MHz)	Channel No.	26 dB Bandwidth (MHz)	Min. Limit (MHz)	Result
5190	38	41.57	N/A	Complies
5230	46	40.97	N/A	Complies
5270	54	40.37	N/A	Complies
5310	62	40.52	N/A	Complies
5510	102	40.67	N/A	Complies
5550	110	41.42	N/A	Complies
5710	142	40.37	N/A	Complies
5755	151	41.12	N/A	Complies
5795	159	40.22	N/A	Complies

Test Plot on Configuration : 802.11n_HT40

5710 MHz (142 ch)



5795 MHz (159 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

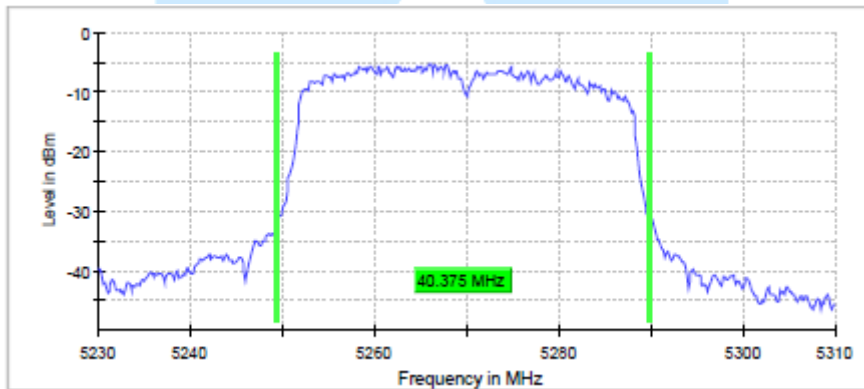


802.11ac_VHT40

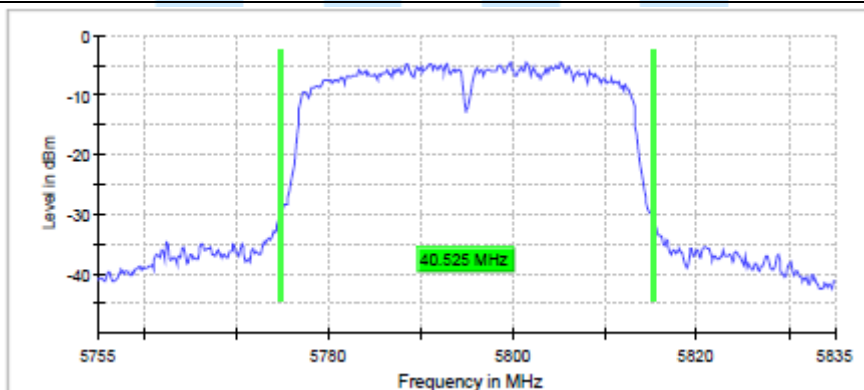
Frequency (MHz)	Channel No.	26 dB Bandwidth (MHz)	Min. Limit (MHz)	Result
5190	38	41.57	N/A	Complies
5230	46	41.72	N/A	Complies
5270	54	40.37	N/A	Complies
5310	62	40.67	N/A	Complies
5510	102	40.67	N/A	Complies
5550	110	42.92	N/A	Complies
5710	142	40.52	N/A	Complies
5755	151	43.07	N/A	Complies
5795	159	40.52	N/A	Complies

Test Plot on Configuration : 802.11n_HT40

5270 MHz (54 ch)



5795 MHz (159 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

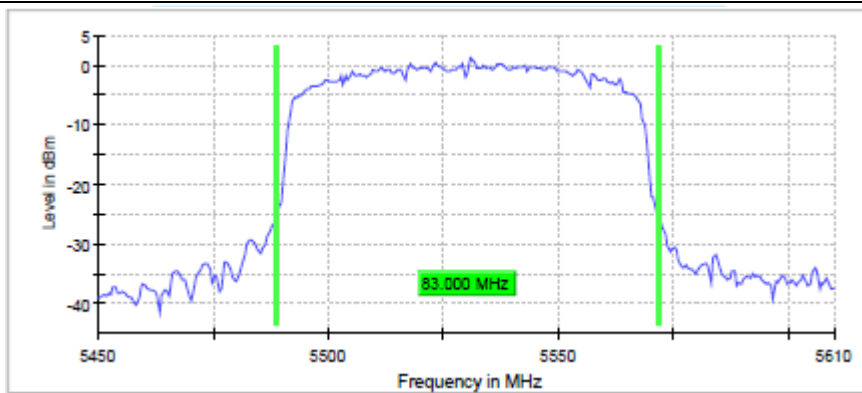


802.11ac_VHT80

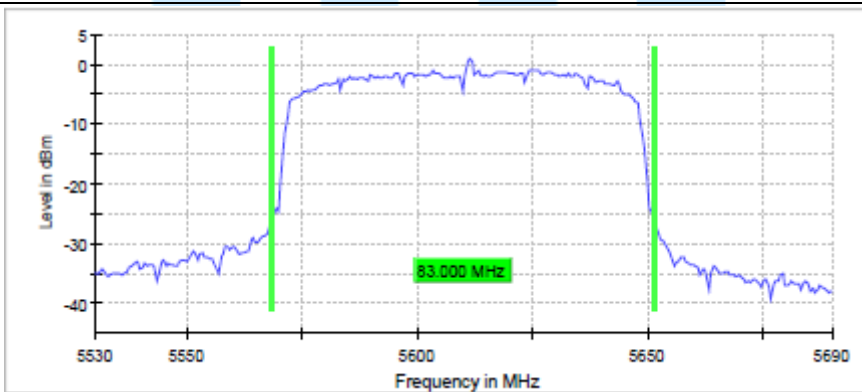
Frequency (MHz)	Channel No.	26 dB Bandwidth (MHz)	Min. Limit (MHz)	Result
5210	42	84.00	N/A	Complies
5290	58	87.00	N/A	Complies
5530	106	83.00	N/A	Complies
5610	122	83.00	N/A	Complies
5690	138	83.50	N/A	Complies
5775	155	85.00	N/A	Complies

Test Plot on Configuration : 802.11n_HT40

5530 MHz (106 ch)



5610 MHz (122 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

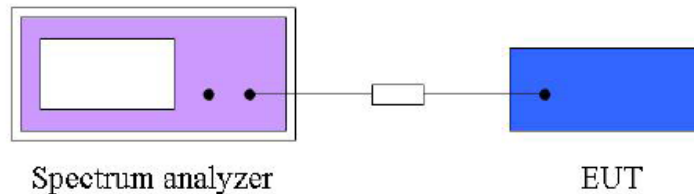


9. 6 dB Bandwidth Measurement

9.1 Operating environment

Temperature : 27.3 °C
Relative Humidity : 32.0 % R.H.

9.2 Test Set-up (Layout)



9.3 Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

9.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSV	Rohde & Schwarz	Spectrum Analyzer	101552	Apr. 11, 2020
■ - 10 dB Attenuator	Rohde & Schwarz	Attenuator 10 dB	SEP-10-14-046	Apr. 10. 2020
■ - WMS 32	Rohde & Schwarz	Testing Software	VER10.20.01	N/A

9.5 Test Procedure

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



9.6 Test result

- Test Date : Nov. 10, 2022 ~ Dec. 07, 2022
- Reference Standard : Part 15 Subpart E, Sec. 15.407(e)
- Test Procedure(s) : ANSI C63.10 (2013), KDB 789033 D02 general UNII test procedures new rules v01r04 (May 2, 2017)
- Operating Condition : 802.11a/n/ac
- Power Source : DC 3.7 V

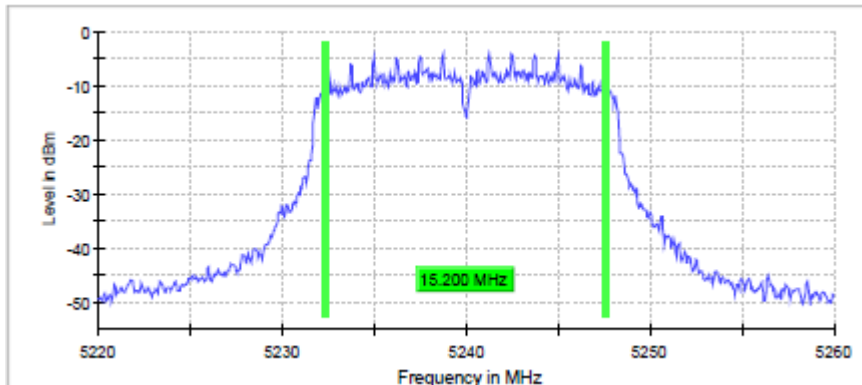
802.11a

Frequency (MHz)	Channel No.	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
5180	36	15.40	N/A	Complies
5200	40	15.40	N/A	Complies
5240	48	15.20	N/A	Complies
5260	52	15.20	N/A	Complies
5300	60	15.20	N/A	Complies
5320	64	15.20	N/A	Complies
5500	100	15.20	N/A	Complies
5580	116	15.40	N/A	Complies
5720	144	15.20	N/A	Complies
5745	149	15.40	N/A	Complies
5785	157	15.20	N/A	Complies
5825	165	15.40	N/A	Complies

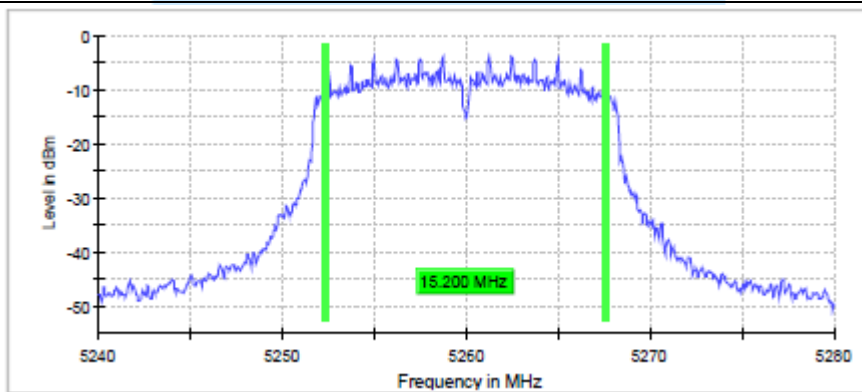


Test Plot on Configuration : 802.11a

5240 MHz (48 ch)



5260 MHz (52 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

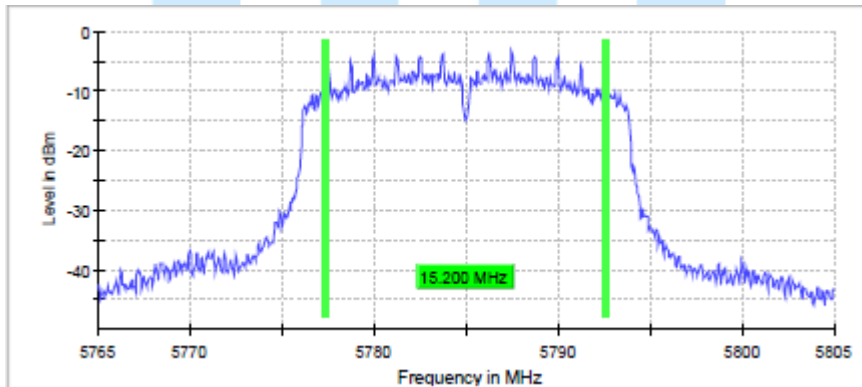


802.11n

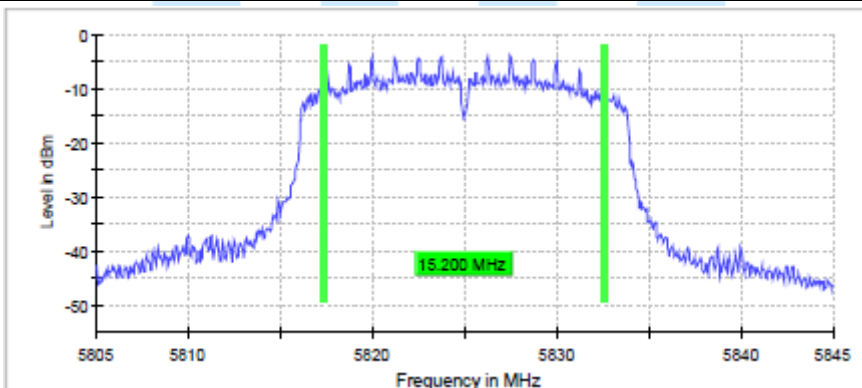
Frequency (MHz)	Channel No.	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
5180	36	15.20	N/A	Complies
5200	40	15.20	N/A	Complies
5240	48	15.20	N/A	Complies
5260	52	15.20	N/A	Complies
5300	60	15.20	N/A	Complies
5320	64	15.20	N/A	Complies
5500	100	15.20	N/A	Complies
5580	116	15.20	N/A	Complies
5720	144	15.20	N/A	Complies
5745	149	15.20	N/A	Complies
5785	157	15.20	N/A	Complies
5825	165	15.20	N/A	Complies

Test Plot on Configuration : 802.11n

5785 MHz (157 ch)



5825 MHz (165 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

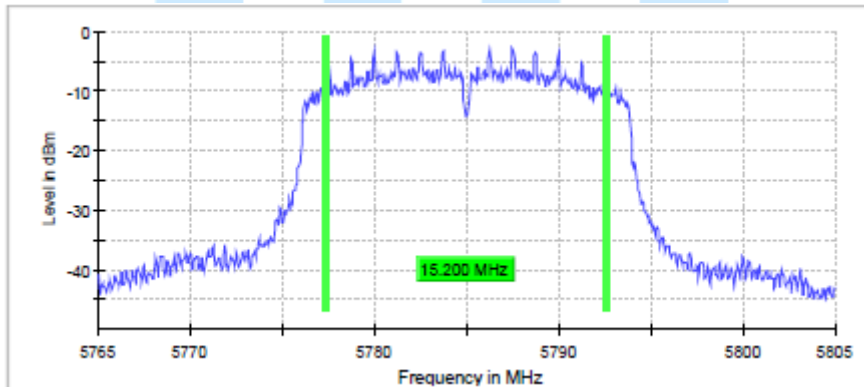


802.11ac

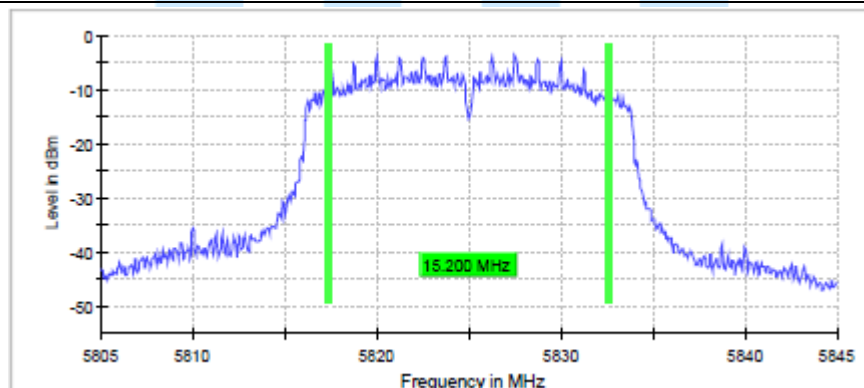
Frequency (MHz)	Channel No.	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
5180	36	15.20	N/A	Complies
5200	40	15.20	N/A	Complies
5240	48	15.20	N/A	Complies
5260	52	15.20	N/A	Complies
5300	60	15.20	N/A	Complies
5320	64	15.20	N/A	Complies
5500	100	15.20	N/A	Complies
5580	116	15.20	N/A	Complies
5720	144	15.20	N/A	Complies
5745	149	15.20	N/A	Complies
5785	157	15.20	N/A	Complies
5825	165	15.20	N/A	Complies

Test Plot on Configuration : 802.11n

5785 MHz (157 ch)



5825 MHz (165 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

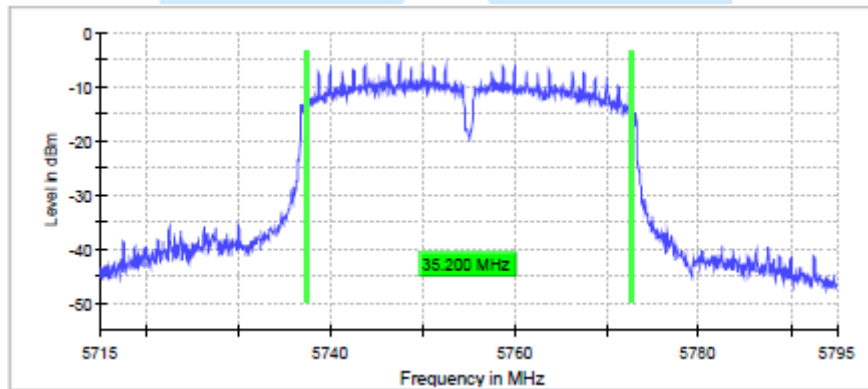


802.11n_HT40

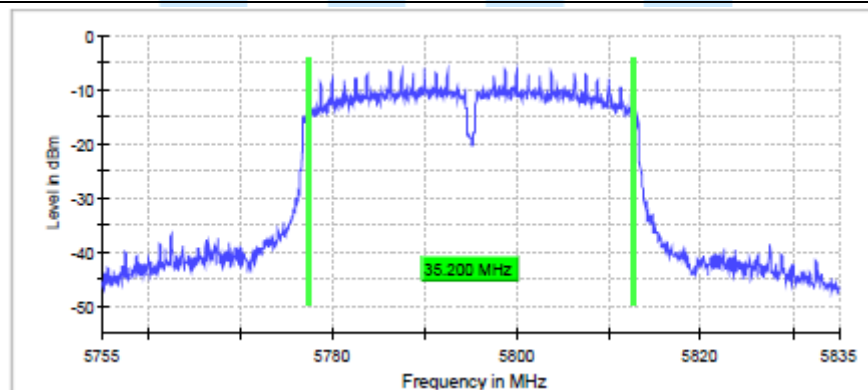
Frequency (MHz)	Channel No.	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
5190	38	35.20	N/A	Complies
5230	46	35.20	N/A	Complies
5270	54	35.20	N/A	Complies
5310	62	35.20	N/A	Complies
5510	102	35.20	N/A	Complies
5550	110	35.20	N/A	Complies
5710	142	35.20	N/A	Complies
5755	151	35.20	N/A	Complies
5795	159	35.20	N/A	Complies

Test Plot on Configuration : 802.11n_HT40

5755 MHz (151 ch)



5795 MHz (159 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

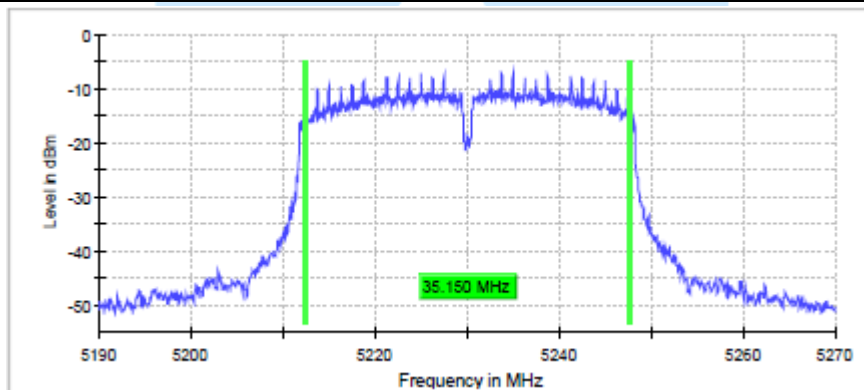


802.11ac_VHT40

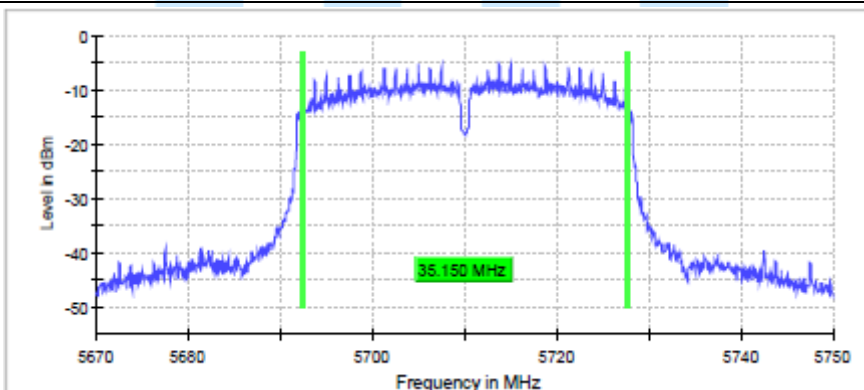
Frequency (MHz)	Channel No.	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
5190	38	35.20	N/A	Complies
5230	46	35.15	N/A	Complies
5270	54	35.20	N/A	Complies
5310	62	35.20	N/A	Complies
5510	102	35.20	N/A	Complies
5550	110	35.20	N/A	Complies
5710	142	35.15	N/A	Complies
5755	151	35.20	N/A	Complies
5795	159	35.20	N/A	Complies

Test Plot on Configuration : 802.11n_HT40

5230 MHz (46 ch)



5710 MHz (142 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

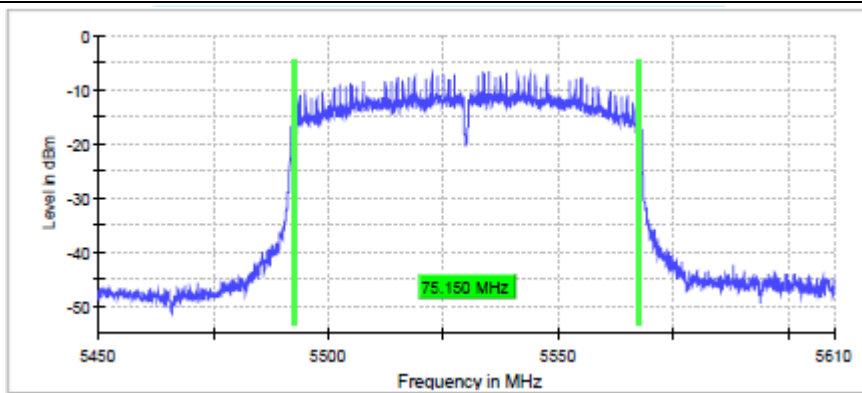


802.11ac_VHT80

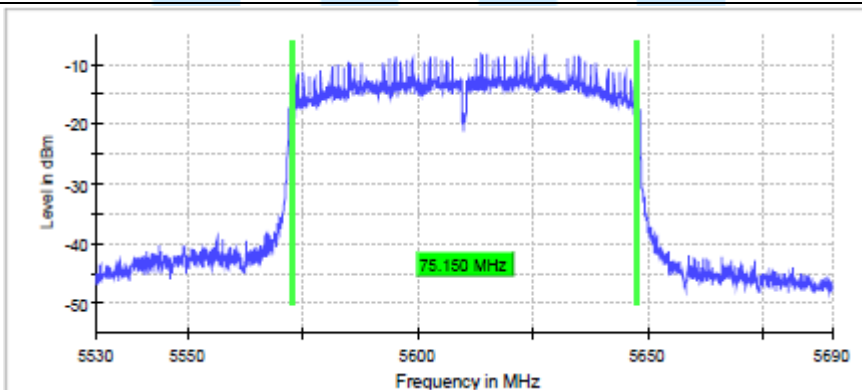
Frequency (MHz)	Channel No.	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Result
5210	42	75.20	N/A	Complies
5290	58	75.20	N/A	Complies
5530	106	75.15	N/A	Complies
5610	122	75.15	N/A	Complies
5690	138	75.20	N/A	Complies
5775	155	75.20	N/A	Complies

Test Plot on Configuration : 802.11n_HT40

5530 MHz (106 ch)



5610 MHz (122 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

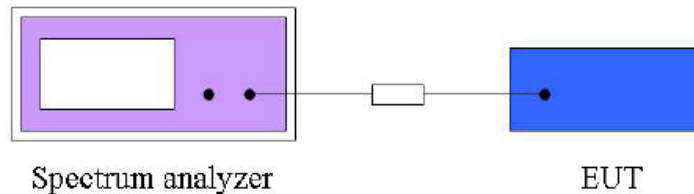


10. Maximum Conducted Output Power

10.1 Operating environment

Temperature : 27.3 °C
Relative Humidity : 32.0 % R.H.

10.2 Test Set-up (Layout)



10.3 Limit

For the 5.15-5.25 GHz band, 5.25-5.35 GHz and 5.47-5.725 GHz the maximum conducted output power over the frequency band of operation shall not exceed 250 mW.

5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

10.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSV	Rohde & Schwarz	Spectrum Analyzer	101552	Apr. 06, 2023
■ - OSP120	Rohde & Schwarz	Open Switch and control platform	101329	Jan. 12, 2023
■ - J12J103539-00-2	JUNFLON	RF Test Cable (OSP_DUT1)	AUG-03-21-066	N/A
■ - J12J103539-00-3	JUNFLON	RF Test Cable (OSP_RX)	AUG-03-21-074	N/A
■ - WMS 32	Rohde & Schwarz	Testing Software	VER10.40.10	N/A

10.5 Test Procedure

- Measure the duty cycle.
- Set span to encompass the 26 dB EBW of the signal.
- RBW = 1 MHz.
- VBW $\geq$ 3 MHz.
- Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$.
- Sweep time = auto.
- Detector = RMS.
- Do not use sweep triggering. Allow the sweep to “free run”.
- Trace average at least 100 traces in power averaging(RMS) mode
- Integrated bandwidth = OBW
- Add $10\log(1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.



10.6 Test Result

- Test Date : Nov. 10, 2022 ~ Dec. 07, 2022
- Reference Standard : Part 15 Subpart E, Sec. 15.407(a)
- Test Procedure(s) : ANSI C63.10 (2013), KDB 789033 D02 general UNII test procedures new rules v01r04 (May 2, 2017)
- Operating Condition : 802.11a/n/ac
- Power Source : DC 3.7 V

802.11a

Frequency (MHz)	Channel No.	Measured Power (dBm)	DutyCycle (%)	Limit (dBm)	Result
5180	36	4.6	96.11	23.98	Complies
5200	40	4.2	96.10	23.98	Complies
5240	48	6.2	96.10	23.98	Complies
5260	52	6.8	96.10	23.98	Complies
5300	60	6.2	96.10	23.98	Complies
5320	64	6.3	96.10	23.98	Complies
5500	100	6.4	96.10	23.98	Complies
5580	116	5.5	96.10	23.98	Complies
5720	144	5.3	96.11	23.98	Complies
5745	149	6.3	95.87	30	Complies
5785	157	3.7	95.87	30	Complies
5825	165	4.5	96.10	30	Complies

802.11n_HT20

Frequency (MHz)	Channel No.	Measured Power (dBm)	DutyCycle (%)	Limit (dBm)	Result
5180	36	4.8	95.86	23.98	Complies
5200	40	4.0	95.86	23.98	Complies
5240	48	5.7	95.86	23.98	Complies
5260	52	6.4	95.86	23.98	Complies
5300	60	5.7	95.86	23.98	Complies
5320	64	5.8	95.86	23.98	Complies
5500	100	5.8	95.86	23.98	Complies
5580	116	5.3	95.86	23.98	Complies
5720	144	4.8	95.86	23.98	Complies
5745	149	6.2	95.61	30	Complies
5785	157	2.8	95.62	30	Complies
5825	165	3.9	95.86	30	Complies



802.11ac_VHT20

Frequency (MHz)	Channel No.	Measured Power (dBm)	DutyCycle (%)	Limit (dBm)	Result
5180	36	4.4	95.87	23.98	Complies
5200	40	3.8	95.88	23.98	Complies
5240	48	5.6	95.87	23.98	Complies
5260	52	6.3	95.87	23.98	Complies
5300	60	5.6	95.88	23.98	Complies
5320	64	5.6	95.88	23.98	Complies
5500	100	5.7	95.88	23.98	Complies
5580	116	4.8	95.88	23.98	Complies
5720	144	4.9	95.88	23.98	Complies
5745	149	6.3	95.87	30	Complies
5785	157	3.2	95.60	30	Complies
5825	165	4.0	95.88	30	Complies

802.11n_HT40

Frequency (MHz)	Channel No.	Measured Power (dBm)	DutyCycle (%)	Limit (dBm)	Result
5190	38	4.1	92.02	23.98	Complies
5230	46	5.1	92.02	23.98	Complies
5270	54	6.0	92.02	23.98	Complies
5310	62	5.9	92.01	23.98	Complies
5510	102	5.6	92.02	23.98	Complies
5590	118	4.3	92.03	23.98	Complies
5710	142	4.7	92.03	23.98	Complies
5755	151	5.7	92.02	30	Complies
5795	159	2.8	91.53	30	Complies

802.11ac_VHT40

Frequency (MHz)	Channel No.	Measured Power (dBm)	DutyCycle (%)	Limit (dBm)	Result
5190	38	4.0	92.03	23.98	Complies
5230	46	5.1	92.02	23.98	Complies
5270	54	6.1	92.02	23.98	Complies
5310	62	5.9	92.02	23.98	Complies
5510	102	5.5	92.03	23.98	Complies
5590	118	4.4	92.02	23.98	Complies
5710	142	4.7	92.03	23.98	Complies
5755	151	5.6	92.03	30	Complies
5795	159	3.0	91.55	30	Complies



802.11ac_VHT80

Frequency (MHz)	Channel No.	Measured Power (dBm)	DutyCycle (%)	Limit (dBm)	Result
5210	42	4.8	85.07	23.98	Complies
5290	58	6.4	85.06	23.98	Complies
5530	106	5.4	85.07	23.98	Complies
5610	122	4.6	85.08	23.98	Complies
5690	138	5.2	85.07	23.98	Complies
5775	155	4.3	85.08	30	Complies



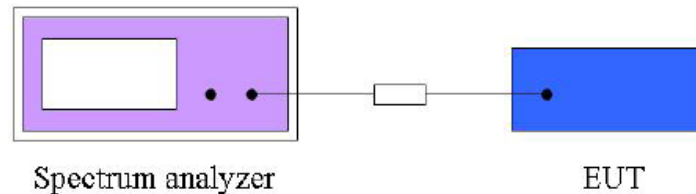


11. Power Spectral Density Measurement

11.1 Operating Environment

Temperature : 27.3 °C
Relative Humidity : 32.0 % R.H.

11.2 Test Set-up (Layout)



11.3 Limit

For the 5.15-5.25 GHz band, 5.25-5.35 GHz and 5.47-5.725 GHz the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

5.725-5.85 GHz the maximum power spectral density shall not exceed 30 dBm in any 1 megahertz band.

11.4 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - FSV	Rohde & Schwarz	Spectrum Analyzer	101552	Apr. 11, 2020
■ - 10 dB Attenuator	Rohde & Schwarz	Attenuator 10 dB	SEP-10-14-046	Apr. 10. 2020
■ - WMS 32	Rohde & Schwarz	Testing Software	VER10.20.01	N/A

11.5 Test Procedure

- Set span to encompass the entire emission bandwidth(EBW) of the signal.
- RBW = 1 MHz(510 kHz for UNII 3)
- VBW $\geq$ 3 MHz
- Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$.
- Sweep time = auto.
- Detector = RMS(i.e., power averaging), if available. Otherwise, use sample detector mode.
- Do not use sweep triggering. Allow the sweep to “free run”.
- Trace average at least 100 traces in power averaging(RMS) mode
- Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
- If Method SA-2 was used, add $10 \log(1/x)$, where x is the duty cycle, to the peak of the spectrum.



11.6 Test Result

- Test Date : Nov. 10, 2022 ~ Dec. 07, 2022
- Reference Standard : Part 15 Subpart E, Sec. 15.407(a)
- Test Procedure(s) : ANSI C63.10 (2013), KDB 789033 D02 general UNII test procedures new rules v01r04 (May 2, 2017)
- Operating Condition : 802.11a/n/ac
- Power Source : DC 3.7 V

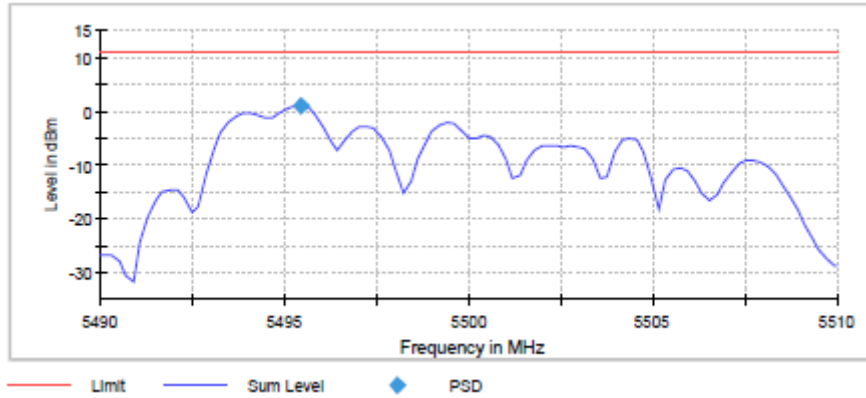
802.11a

Frequency (MHz)	Channel No.	Measured Power Density (dBm)	DutyCycle (%)	Limit (dBm)	Result
5180	36	0.710	96.09	11	Complies
5200	40	-0.984	96.08	11	Complies
5240	48	-2.006	96.08	11	Complies
5260	52	0.134	96.08	11	Complies
5300	60	-2.103	96.07	11	Complies
5320	64	-1.215	96.08	11	Complies
5500	100	1.008	96.08	11	Complies
5580	116	0.938	96.08	11	Complies
5720	144	0.994	96.08	11	Complies
5745	149	-1.546	96.08	30	Complies
5785	157	-1.376	95.80	30	Complies
5825	165	-5.597	96.08	30	Complies

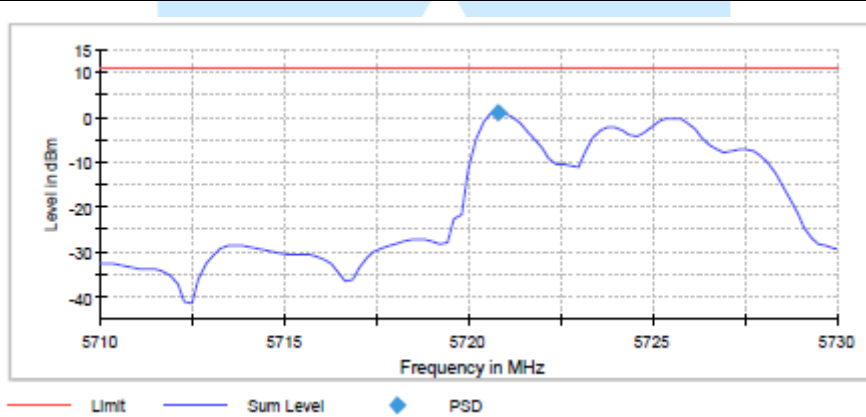


Test Plot on Configuration : 802.11a

5500 MHz (100 ch)



5720 MHz (144 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

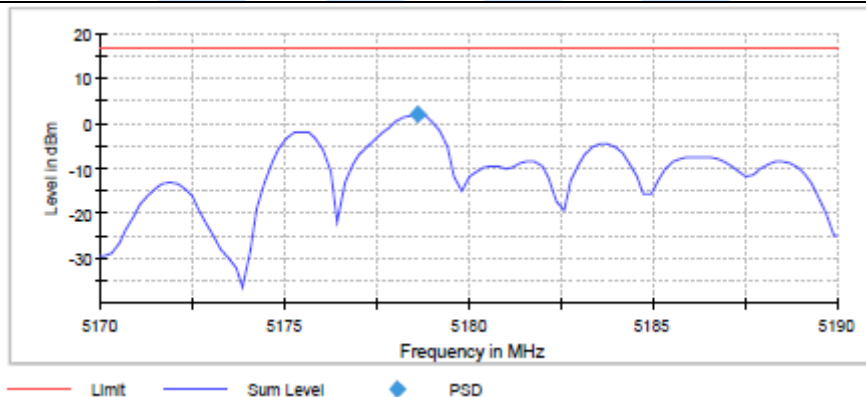


802.11n_HT20

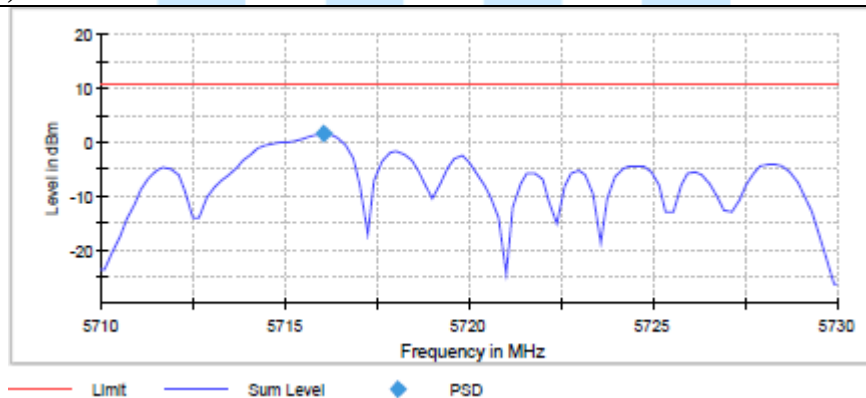
Frequency (MHz)	Channel No.	Measured Power Density (dBm)	DutyCycle (%)	Limit (dBm)	Result
5180	36	2.081	95.84	11	Complies
5200	40	-6.377	95.84	11	Complies
5240	48	-2.396	95.84	11	Complies
5260	52	-0.783	95.84	11	Complies
5300	60	0.342	95.84	11	Complies
5320	64	-3.041	95.84	11	Complies
5500	100	-0.685	95.84	11	Complies
5580	116	-1.560	95.84	11	Complies
5720	144	1.472	95.84	11	Complies
5745	149	-1.446	95.84	30	Complies
5785	157	-1.724	95.49	30	Complies
5825	165	-2.321	95.84	30	Complies

Test Plot on Configuration : 802.11n_HT40

5180 MHz (36 ch)



5720 MHz (144 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

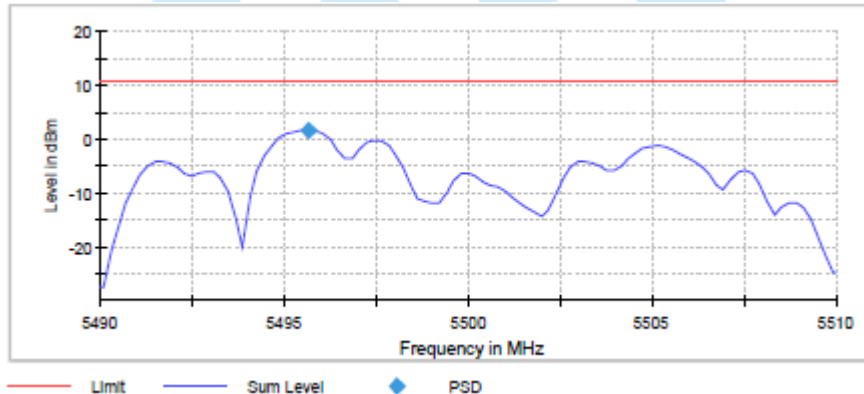


802.11ac_VHT20

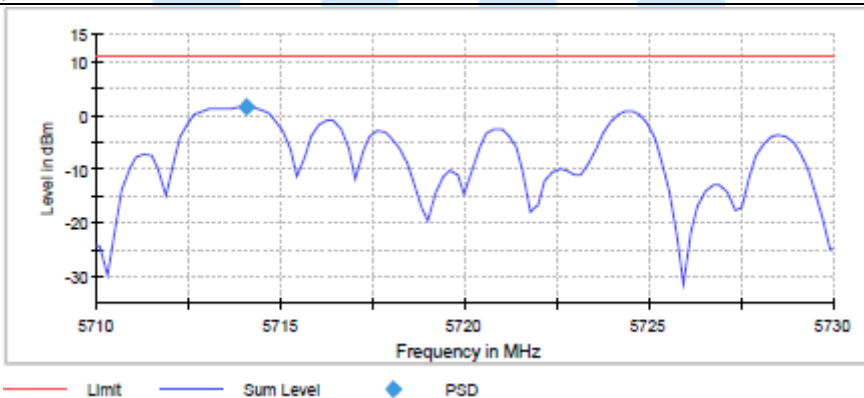
Frequency (MHz)	Channel No.	Measured Power Density (dBm)	DutyCycle (%)	Limit (dBm)	Result
5180	36	-2.884	95.85	11	Complies
5200	40	-2.259	95.86	11	Complies
5240	48	-4.626	95.85	11	Complies
5260	52	0.314	95.86	11	Complies
5300	60	-0.883	95.85	11	Complies
5320	64	-2.779	95.86	11	Complies
5500	100	1.615	95.86	11	Complies
5580	116	1.412	95.85	11	Complies
5720	144	1.469	95.85	11	Complies
5745	149	-3.807	95.85	30	Complies
5785	157	-3.401	94.91	30	Complies
5825	165	-3.459	95.85	30	Complies

Test Plot on Configuration : 802.11n_HT40

5500 MHz (100 ch)



5720 MHz (144 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

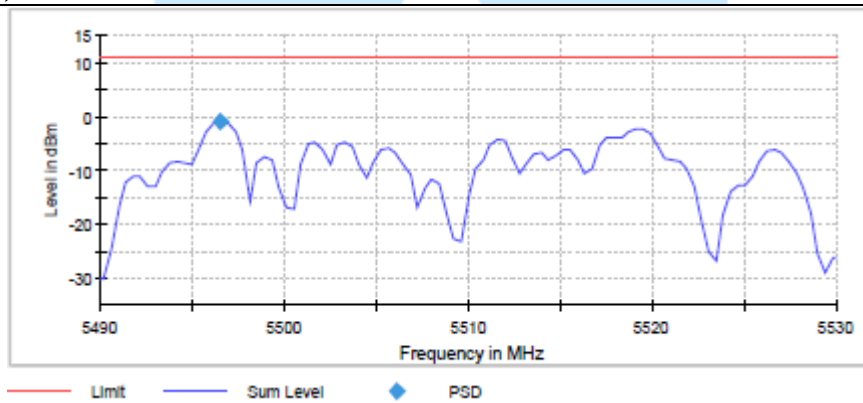


802.11n_HT40

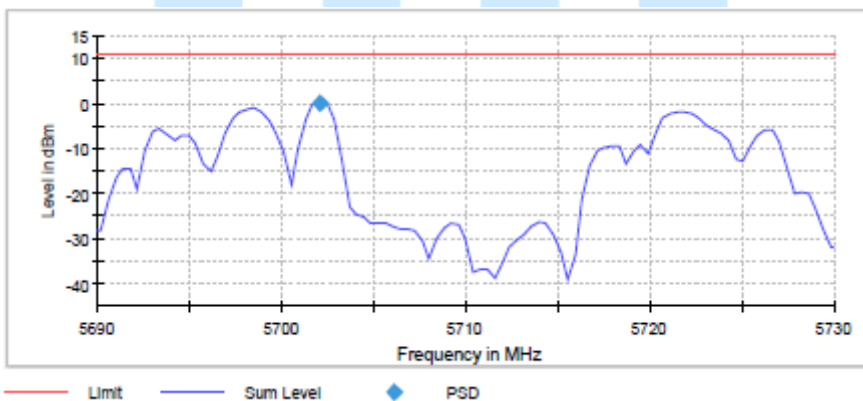
Frequency (MHz)	Channel No.	Measured Power Density (dBm)	DutyCycle (%)	Limit (dBm)	Result
5190	38	-2.908	91.97	11	Complies
5230	46	-4.276	91.97	11	Complies
5270	54	-3.066	91.97	11	Complies
5310	62	-4.023	91.98	11	Complies
5510	102	-0.982	91.97	11	Complies
5550	110	-1.755	91.96	11	Complies
5710	142	0.235	91.97	11	Complies
5755	151	-3.245	91.97	30	Complies
5795	159	-3.671	91.36	30	Complies

Test Plot on Configuration : 802.11n_HT40

5510 MHz (102 ch)



5710 MHz (142 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

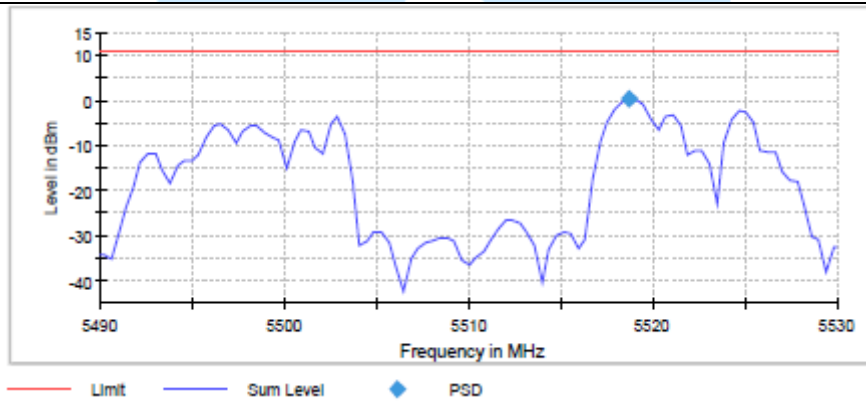


802.11ac_VHT40

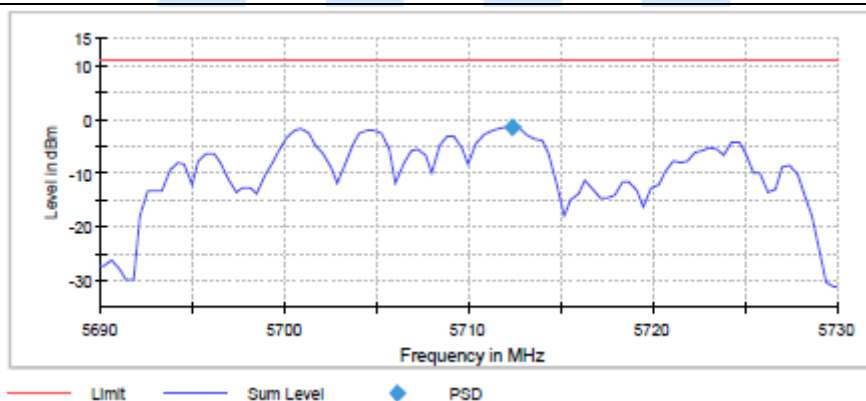
Frequency (MHz)	Channel No.	Measured Power Density (dBm)	DutyCycle (%)	Limit (dBm)	Result
5190	38	-2.139	91.87	11	Complies
5230	46	-1.404	91.87	11	Complies
5270	54	-2.972	91.86	11	Complies
5310	62	-4.562	91.86	11	Complies
5510	102	0.335	91.87	11	Complies
5550	110	-1.755	91.84	11	Complies
5710	142	-1.385	91.86	11	Complies
5755	151	-4.050	91.86	30	Complies
5795	159	-4.766	90.66	30	Complies

Test Plot on Configuration : 802.11n_HT40

5510 MHz (102 ch)



5710 MHz (142 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.

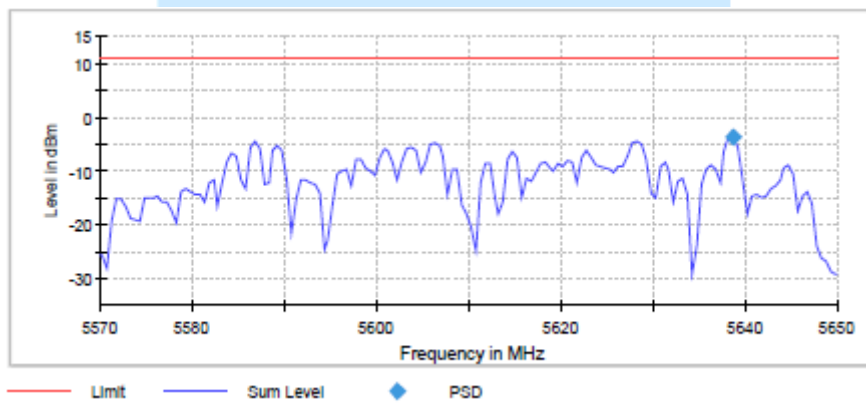


802.11ac_VHT80

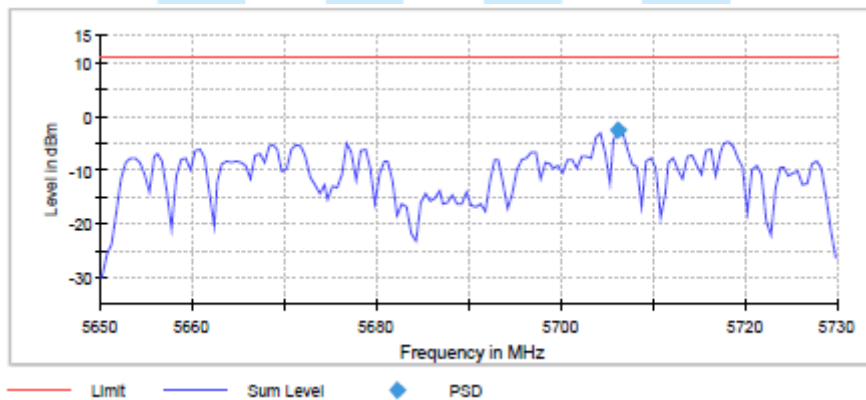
Frequency (MHz)	Channel No.	Measured Power Density (dBm)	DutyCycle (%)	Limit (dBm)	Result
5210	42	-5.894	84.87	11	Complies
5290	58	-6.138	84.87	11	Complies
5530	106	-4.873	84.87	11	Complies
5610	122	-3.592	84.87	11	Complies
5690	138	-2.701	84.86	11	Complies
5775	155	-7.911	84.86	30	Complies

Test Plot on Configuration : 802.11n_HT40

5610 MHz (122 ch)



5690 MHz (138 ch)



Note: In order to simplify the report, attached plots were only the most wide channel.



12. Frequency Stability

The EUT was placed inside an environmental chamber as the temperature in the chamber was varied between 0 °C and 40 °C. The temperature was incremented by 10 °C intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.

802.11ac (VHT 20)_Startup (UNII 1 / 5 180 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5180002170	
		10	5179990590	
		20	5179987700	
		30	5179980460	
		40	5179973230	
Min.	4.5	20	5179986250	
Max	5.5	20	5179989150	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_2 minutes (UNII 1 / 5 180 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5180005790	
		10	5179997110	
		20	5179984080	
		30	5179978290	
		40	5179972500	
Min.	4.5	20	5179984800	
Max	5.5	20	5179984080	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_5 minutes (UNII 1 / 5 180 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5180008680	
		10	5179996380	
		20	5179984080	
		30	5179975400	
		40	5179972500	
Min.	4.5	20	5179984080	
Max	5.5	20	5179984080	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_10 minutes (UNII 1 / 5 180 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5180010850	
		10	5179995660	
		20	5179984800	
		30	5179974670	
		40	5179973230	
Min.	4.5	20	5179984800	
Max	5.5	20	5179985530	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_Startup (UNII 2A / 5 260 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5260003620	
		10	5259997830	
		20	5259985530	
		30	5259978290	
		40	5259971780	
Min.	4.5	20	5259984800	
Max	5.5	20	5259985530	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_2 minutes (UNII 2A / 5 260 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5260006510	
		10	5259996380	
		20	5259984080	
		30	5259976120	
		40	5259971780	
Min.	4.5	20	5259984080	
Max	5.5	20	5259984080	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_5 minutes (UNII 2A / 5 260 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5260009410	
		10	5259996380	
		20	5259984080	
		30	5259974670	
		40	5259971780	
Min.	4.5	20	5259984080	
Max	5.5	20	5259983360	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_10 minutes (UNII 2A / 5 260 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5260011580	
		10	5259995660	
		20	5259984800	
		30	5259974670	
		40	5259971780	
Min.	4.5	20	5259985530	
Max	5.5	20	5259984800	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_Startup (UNII 2C / 5 500 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5500006510	
		10	5499998550	
		20	5499986250	
		30	5499981190	
		40	5499971060	
Min.	4.5	20	5499985530	
Max	5.5	20	5499986250	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_2 minutes (UNII 2C / 5 500 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5500009410	
		10	5499998550	
		20	5499984800	
		30	5499978290	
		40	5499970330	
Min.	4.5	20	5499984080	
Max	5.5	20	5499984800	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_5 minutes (UNII 2C / 5 500 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5500012300	
		10	5499999280	
		20	5499984080	
		30	5499976120	
		40	5499970330	
Min.	4.5	20	5499984080	
Max	5.5	20	5499984080	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_10 minutes (UNII 2C / 5 500 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5500014470	
		10	5499998550	
		20	5499983360	
		30	5499975400	
		40	5499970330	
Min.	4.5	20	5499983360	
Max	5.5	20	5499983360	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_Startup (UNII 3 / 5 745 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5745010130	
		10	5745000000	
		20	5744986250	
		30	5744981910	
		40	5744970330	
Min.	4.5	20	5744986250	
Max	5.5	20	5744986250	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_2 minutes (UNII 3 / 5 745 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5745013020	
		10	5745000720	
		20	5744985530	
		30	5744981190	
		40	5744969610	
Min.	4.5	20	5744985530	
Max	5.5	20	5744985530	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_5 minutes (UNII 3 / 5 745 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5745015200	
		10	5745000720	
		20	5744984800	
		30	5744979020	
		40	5744968890	
Min.	4.5	20	5744984800	
Max	5.5	20	5744984800	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



802.11ac (VHT 20)_10 minutes (UNII 3 / 5 745 000 000 Hz)

Voltage (%)	Power (VDC)	Temp. (°C)	Frequency (Hz)	Frequency Error (Hz)
100	5	0	5745017370	
		10	5745000000	
		20	5744984080	
		30	5744977570	
		40	5744969610	
Min.	4.5	20	5744984080	
Max	5.5	20	5744984080	

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.



13. AC Power line Conducted emission

-Test Description

The Line conducted emission test facility is inside a 4 m × 8 m × 2.5 m shielded enclosure. (Test firm Registration Number: 269701)

The EUT was placed on a non-conducting 1.0 m by 1.5 m table, which is 0.8 m in height and 0.4 m away from the vertical wall of the shielded enclosure.

The EUT is powered from the Rohde & Schwarz LISN (ENV216) and the support equipment is powered from the Rohde & Schwarz LISN (ENV216). Powers to the LISN are filtered by high-current high insertion loss power line filter.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

The RF output of the LISN was connected to the EMI test receiver (Rohde & Schwarz, ESCI).

Exploratory measurements were conducted to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Exploratory measurements were scanned using Peak mode of EMI Test receiver from 150 kHz to 30 MHz with 20 ms sweep time. The final measurements were measured with Quasi-Peak and Average mode.

The bandwidth of EMI Test Receiver was set to 9 kHz. Interface cables were connected to the available interface ports of the test unit. Excess cable lengths were bundled at center with 30 cm ~ 40 cm.

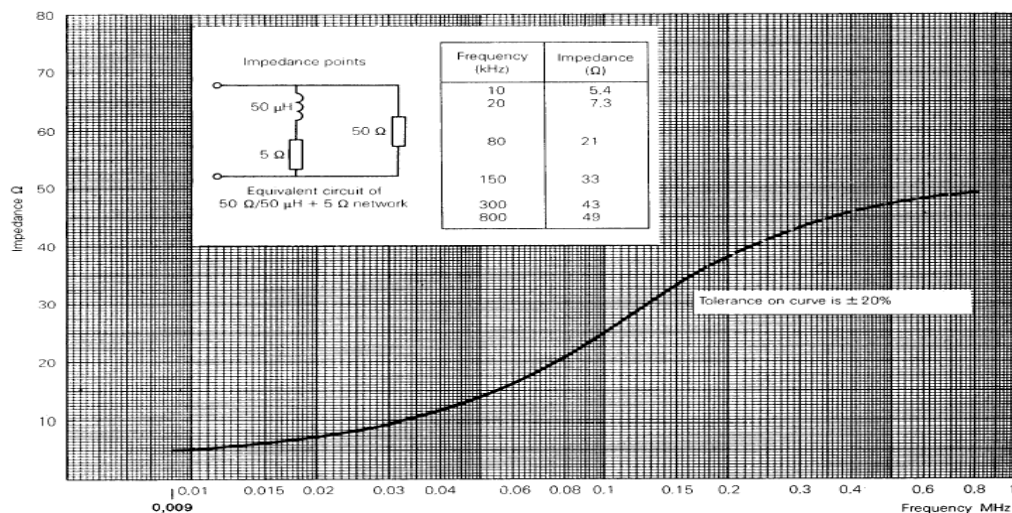


Fig 2. Impedance of LISN



13.1 Operating Environment

Temperature : 20.8 °C
Relative Humidity : 21.9 % R.H.

13.2 Test Set-up

The conducted emission measurements were performed in the shielded room.

The EUT was placed on wooden table, 0.8 m heights above the floor, 0.4 m from the reference ground plane (GRP) wall and 0.8 m from AMN & ISN.

AMN is bonded on horizontal reference ground plane.

The ground plane, which was electrically bonded to the shield room, ground system and all power lines entering the shield room, were filtered.

13.3 Measurement Uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement.”

The measurement uncertainty was given with a confidence of 95 %.

Test Items	Uncertainty	Remark
Conducted emission (9 kHz ~ 150 kHz)	3.69 dB	Confidence level of approximately 95 % ($k = 2$)
Conducted emission (150 kHz ~ 30 MHz)	3.32 dB	Confidence level of approximately 95 % ($k = 2$)

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

The listed uncertainties are the worst case uncertainty for the entire range of measurement. please note that the uncertainty values are provided for informational purposes only are not used in determining the PASS/FAIL results



13.4 Limit

RFI Conducted	FCC Limit(dBμV/m) Class B	
Freq. Range	Quasi-Peak	Average
150 kHz ~ 0.5 MHz	66 ~ 56*	56 ~ 46*
0.5 MHz ~ 5 MHz	56	46
5 MHz ~ 30 MHz	60	50
*Limits decreases linearly with the logarithm of frequency.		

13.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■- ESCI	Rohde & Schwarz	EMI test receiver	100237	Apr. 05, 2023
□- ENV216	Rohde & Schwarz	LISN	100172	Apr. 05, 2023
■- ENV216	Rohde & Schwarz	LISN	100173	Apr. 05, 2023
■- EMC 32	Rohde & Schwarz	Testing Software	VER8.53	N/A
■- ESCI	Rohde & Schwarz	EMI test receiver	100237	Apr. 13, 2020

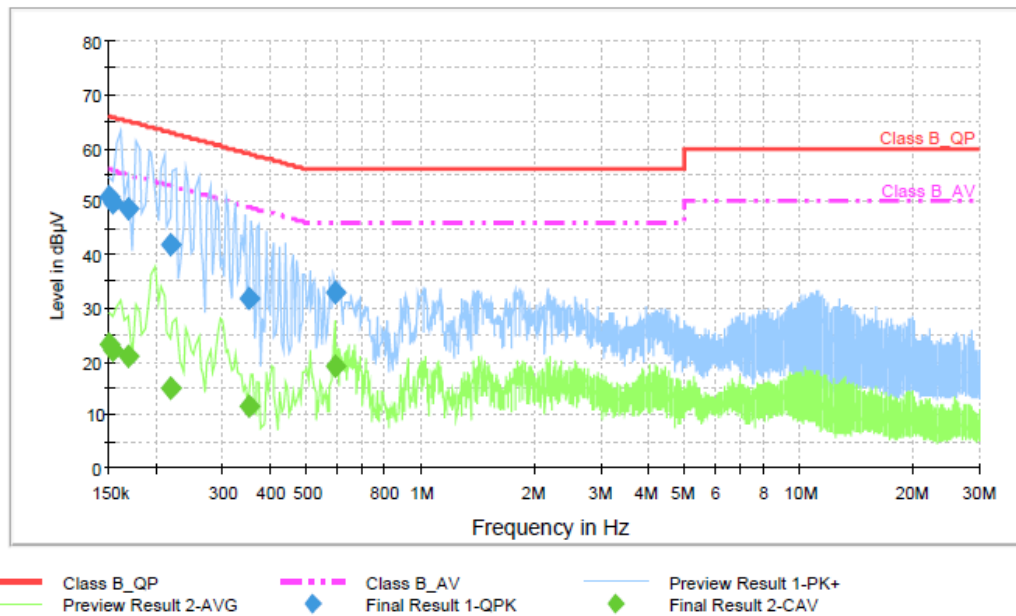
13.6 Test data for Conducted Emission

- Test Date	: Jan. 11, 2023
- Reference Standard	: Part 15 Subpart C, Sec. 15.207
- Test Procedure(s)	: ANSI C63.10 (2013)
- Operating Condition	: Charging mode
- Power Source	: AC 120 V / 60 Hz
- Frequency rage	: 0.15 MHz to 30 MHz
- Line	: AC Power Line (Live and Neutral)
- Comment	:



AC/DC adapter_DSA-18QFB FUS A

EUT with cradle



Final Result 1

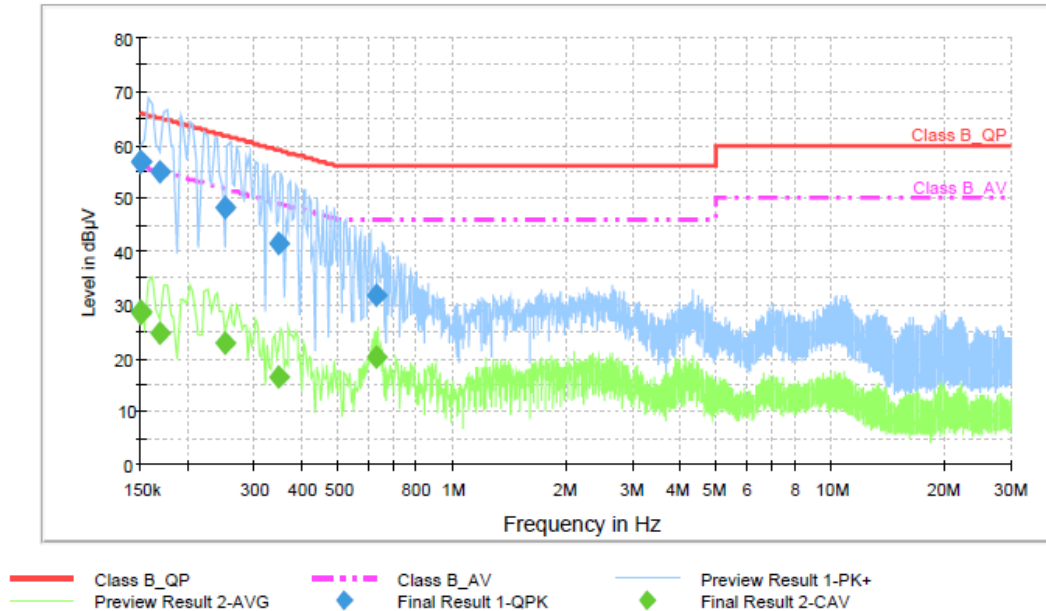
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	50.9	1000.0	9.000	Off	N	9.7	15.1	66.0	
0.154000	49.8	1000.0	9.000	Off	N	9.7	16.0	65.8	
0.168206	48.6	1000.0	9.000	Off	N	9.7	16.4	65.0	
0.216712	42.0	1000.0	9.000	Off	L1	9.7	20.9	62.9	
0.351038	31.7	1000.0	9.000	Off	N	9.7	27.2	58.9	
0.592288	32.9	1000.0	9.000	Off	N	9.7	23.1	56.0	

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	23.3	1000.0	9.000	Off	N	9.7	32.7	56.0	
0.154000	22.0	1000.0	9.000	Off	N	9.7	33.8	55.8	
0.168206	21.0	1000.0	9.000	Off	N	9.7	34.1	55.0	
0.216712	14.9	1000.0	9.000	Off	L1	9.7	38.1	52.9	
0.351038	11.5	1000.0	9.000	Off	N	9.7	37.4	48.9	
0.592288	19.2	1000.0	9.000	Off	N	9.7	26.8	46.0	



EUT without cradle



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	56.7	1000.0	9.000	Off	N	9.7	9.3	66.0	
0.150000	56.8	1000.0	9.000	Off	N	9.7	9.2	66.0	
0.168206	55.1	1000.0	9.000	Off	L1	9.7	9.9	65.0	
0.250294	48.2	1000.0	9.000	Off	L1	9.7	13.5	61.7	
0.347306	41.5	1000.0	9.000	Off	N	9.7	17.5	59.0	
0.633062	31.7	1000.0	9.000	Off	N	9.7	24.3	56.0	

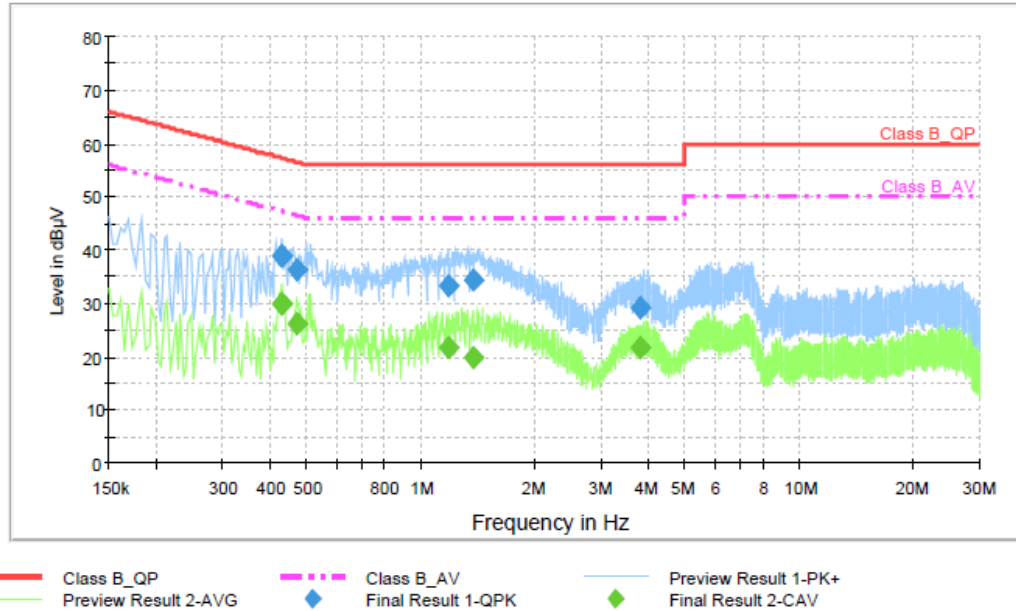
Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.150000	28.3	1000.0	9.000	Off	N	9.7	27.7	56.0	
0.150000	28.7	1000.0	9.000	Off	N	9.7	27.3	56.0	
0.168206	24.8	1000.0	9.000	Off	L1	9.7	30.3	55.0	
0.250294	22.8	1000.0	9.000	Off	L1	9.7	28.9	51.7	
0.347306	16.5	1000.0	9.000	Off	N	9.7	32.5	49.0	
0.633062	20.2	1000.0	9.000	Off	N	9.7	25.8	46.0	



AC/DC adapter_DSA-12PF11-05 FUS 050200

EUT with cradle



Final Result 1

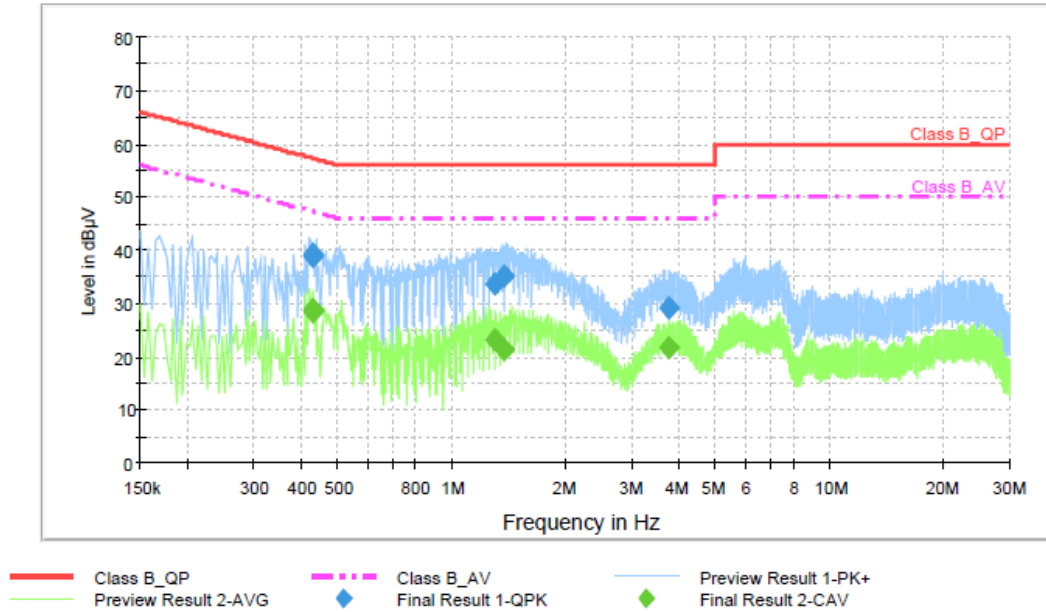
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.427006	38.8	1000.0	9.000	Off	L1	9.7	18.5	57.3	
0.427844	38.7	1000.0	9.000	Off	L1	9.7	18.6	57.3	
0.469694	36.2	1000.0	9.000	Off	N	9.7	20.4	56.5	
1.185825	33.2	1000.0	9.000	Off	L1	9.7	22.8	56.0	
1.372625	34.2	1000.0	9.000	Off	N	9.8	21.8	56.0	
3.822175	29.0	1000.0	9.000	Off	L1	9.9	27.0	56.0	

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.427006	29.7	1000.0	9.000	Off	L1	9.7	17.6	47.3	
0.427844	29.8	1000.0	9.000	Off	L1	9.7	17.5	47.3	
0.469694	26.3	1000.0	9.000	Off	N	9.7	20.2	46.5	
1.185825	21.6	1000.0	9.000	Off	L1	9.7	24.4	46.0	
1.372625	19.9	1000.0	9.000	Off	N	9.8	26.1	46.0	
3.822175	21.5	1000.0	9.000	Off	L1	9.9	24.5	46.0	



EUT without cradle



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.427306	38.9	1000.0	9.000	Off	L1	9.7	18.4	57.3	
0.428650	39.2	1000.0	9.000	Off	L1	9.7	18.1	57.3	
0.430469	39.0	1000.0	9.000	Off	L1	9.7	18.3	57.2	
1.300450	33.8	1000.0	9.000	Off	L1	9.8	22.2	56.0	
1.374238	35.1	1000.0	9.000	Off	N	9.8	20.9	56.0	
3.779550	29.3	1000.0	9.000	Off	L1	9.9	26.7	56.0	

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.427306	28.8	1000.0	9.000	Off	L1	9.7	18.5	47.3	
0.428650	28.7	1000.0	9.000	Off	L1	9.7	18.6	47.3	
0.430469	28.3	1000.0	9.000	Off	L1	9.7	18.9	47.2	
1.300450	23.1	1000.0	9.000	Off	L1	9.8	22.9	46.0	
1.374238	21.2	1000.0	9.000	Off	N	9.8	24.8	46.0	
3.779550	21.8	1000.0	9.000	Off	L1	9.9	24.2	46.0	

14. Radiated Spurious & Restricted Band Edge Emission

Exploratory Radiated measurements were conducted at the 3m semi anechoic chamber in order to identify the highest emission by operating the EUT in a range of typical modes of operation, cable positions, system configuration and arrangement.

Based on exploratory measurements, the final measurements were conducted at the worst test conditions.

Final measurements of below 1GHz were made at 3m or 10 m Chamber that complies with CISPR 16/ANSI C63.10. Above 1GHz final measurements were conducted at the 3m Chamber only.

For measurements above 1GHz, the bottom side of 3m chamber was installed with absorbers in order to meet SVSWR Limit.

Exploratory measurements were scanned using Peak mode of EMI Test receiver and final measurements were measured with Quasi-Peak mode (Below 1GHz) and Peak & Average mode (Above 1GHz).

The measurements were performed by rotating the EUT 360° and adjusting the receive antenna height from 1.0 m to 4.0 m. All frequencies were investigated in both horizontal and vertical antenna polarity.

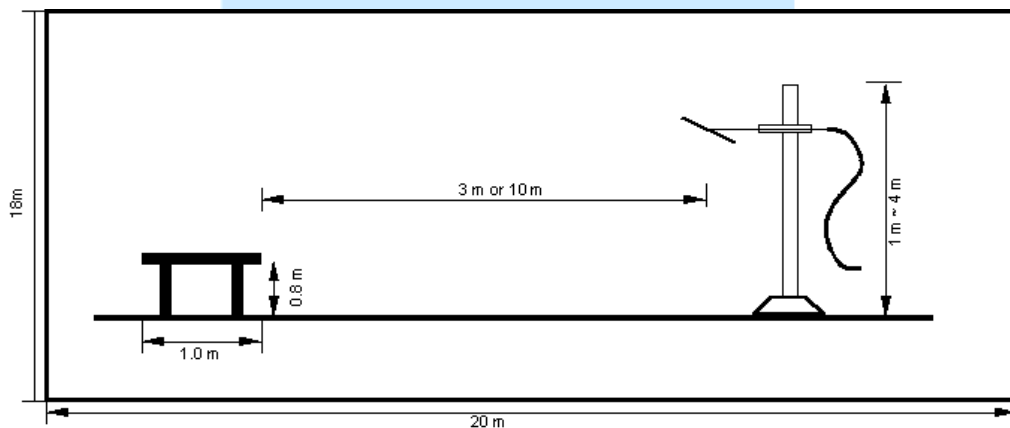


Fig 3. Dimensions of test site (Below 1GHz)

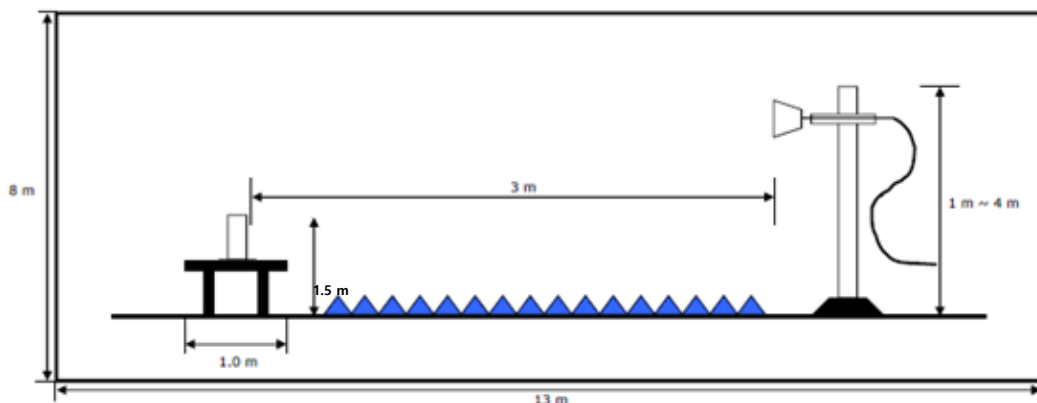


Fig 4. Dimensions of test site (Above 1GHz)



14.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 35.2 % R.H.

14.2 Test set-up

A preliminary and final measurement was at 3 m anechoic chamber.

The EUT was placed on a non-conducting 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 above the reference ground plane.

The turntable with EUT was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels.

This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

14.3 Measurement uncertainty

The measurement uncertainty was calculated in accordance with ISO “Guide to the expression of uncertainty in measurement”.

The measurement uncertainty was given with a confidence of 95 %.

Test items(Anechoic Chamber)	Uncertainty	Remark
Radiated emission (30 MHz ~ 300 MHz, 3 m, Vertical)	4.78 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (30 MHz ~ 300 MHz, 3 m, Horizontal)	4.77 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Vertical)	6.20 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (300 MHz ~ 1 000 MHz, 3 m, Horizontal)	5.12 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (1 000 MHz ~ 6 000 MHz, 3 m, V/H)	5.77 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (6 000 MHz ~ 18 000 MHz, 3 m, V/H)	4.88 dB	Confidence level of approximately 95 % ($k = 2$)
Radiated emission (18 000 MHz ~ 26 000 MHz, 3 m, V/H)	5.03 dB	Confidence level of approximately 95 % ($k = 2$)

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

The listed uncertainties are the worst case uncertainty for the entire range of measurement. please note that the uncertainty values are provided for informational purposes only are not used in determining the PASS/FAIL results



14.4 Limit

20 dB in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2 400/F (kHz)	300
0.490 ~ 1.705	2 400/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

14.5 Test Equipment used

Model Name	Manufacturer	Description	Serial Number	Due to Calibration
■ - ESU40	Rohde & Schwarz	EMI Test Receiver	100266	Apr. 06, 2023
■ - HFH2-Z2	Rohde & Schwarz	Loop Antenna	100041	Apr. 14, 2023
■ - VULB9160	Schwarzbeck	Broadband Test Antenna	3313	Apr. 05, 2023
■ - BBHA9120D	Schwarzbeck	Horn Antenna	207	Sep. 05, 2023
■ - BBHA9170	Schwarzbeck	Horn Antenna	766	Apr. 25, 2023
■ - MCU066	maturo GmbH	Position Controller	1390306	N/A
■ - TT2.5SI	maturo GmbH	Turntable	1390307	N/A
■ - CO3000	Innco system GmbH	Position Controller	CO3000/1804/4	N/A
			2760218/P	
■ - MA4640-XP-ET	Innco system GmbH	Antenna Mast	5580916	N/A
■ - TK-PA18H	TESTEK	Low Noise Amplifier	180001-L	Apr. 06, 2023
■ - TK-PA1840H	TESTEK	Amplifier	170007-L	May 17, 2023
■ - WHKX3.0/18G-10SS	WAINWRIGHT INSTRUMENTS	High pass filter	SN31	Apr. 07, 2023
■ - EMC 32	Rohde & Schwarz	Testing Software	VER10.50.10	N/A



14.6 Test data for Radiated Spurious Emission

- Test Date : Nov. 03 , 2022 ~ Dec. 06, 2022
- Reference Standard : Part 15 Subpart E, Sec. 15.407(b)
- Measuring Distance : 3 m
- Resolution Bandwidth : 200 Hz, 9 kHz(Below 30 MHz) / 120 kHz(30 MHz ~ 1GHz) / 1 MHz(Above 1GHz)
- Detector mode : Quasi Peak detector mode / Peak detector mode / Average detector mode
- Power Source : DC 3.7 V
- Note : Through three orthogonal axes were investigated and the worst case is report

Radiated Spurious Emission (9 kHz to 30 MHz)

※ The reading of emissions are attenuated more than 10 dB below the permissible limits.

Radiated Spurious Emission (30 MHz to 1 000 MHz)

802.11 Standard	Ch.	Frequency [MHz]	Pol.	Reading [dBuV]	Transducer Factor [dB]	Test Result [dBuV/m]	Limits [dBuV/m]	Margin [dB]	Detector Type
A	48	874.81	H	6.79	30.4	37.19	46.00	8.83	PK
n (HT20)					N/A ¹⁾				
n (HT40)					N/A ¹⁾				
ac (VHT20)					N/A ¹⁾				
ac (VHT40)					N/A ¹⁾				
ac (VHT80)					N/A ¹⁾				

Note:

1) The reading of emissions are attenuated more than 10 dB below the permissible limits.

Test Result = Reading + AF+AMP / CL

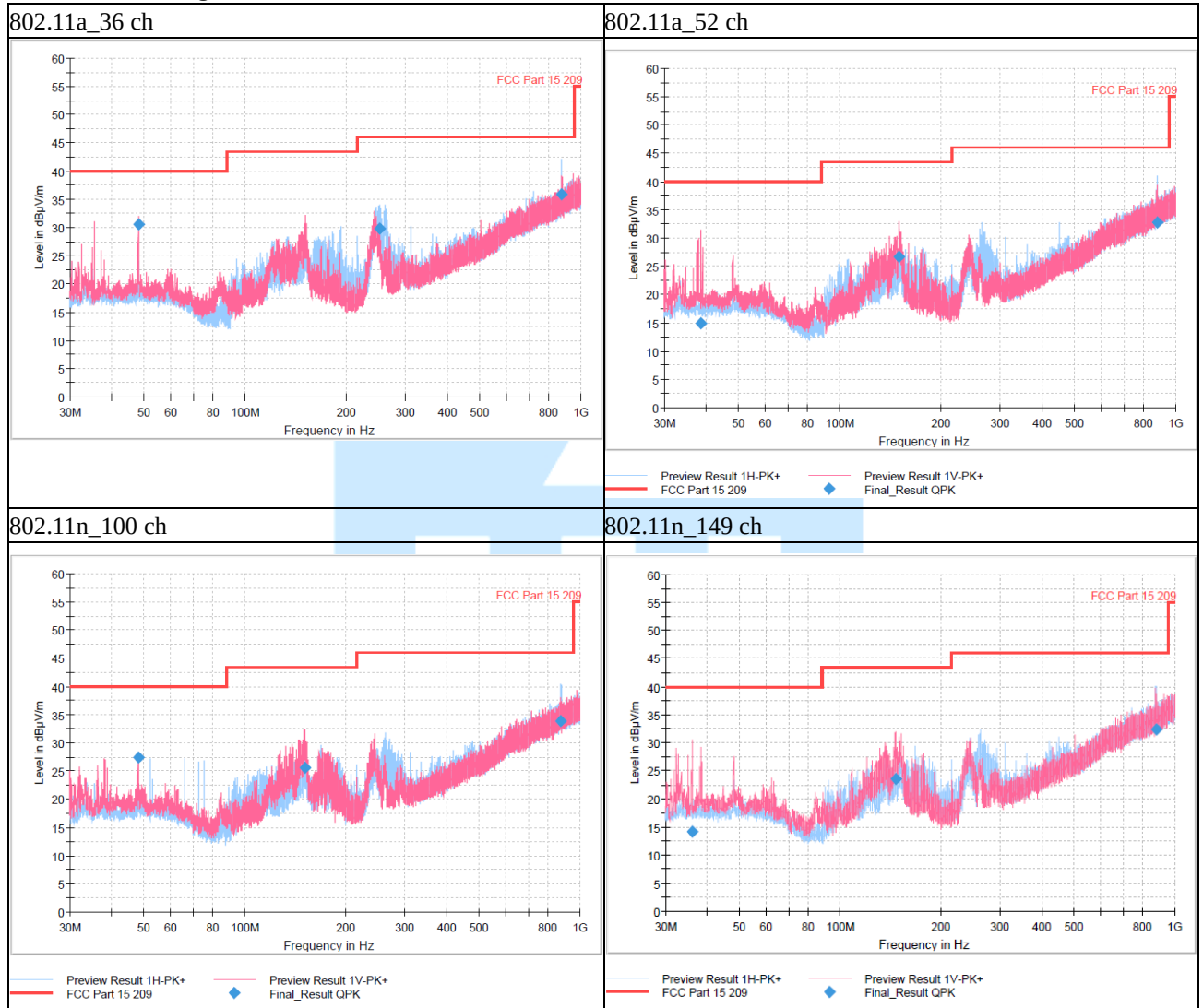
Where, ACF : Antenna Collection Factor,

AMP / CL = Cable loss + Preamplifier gain + High Pass Filter

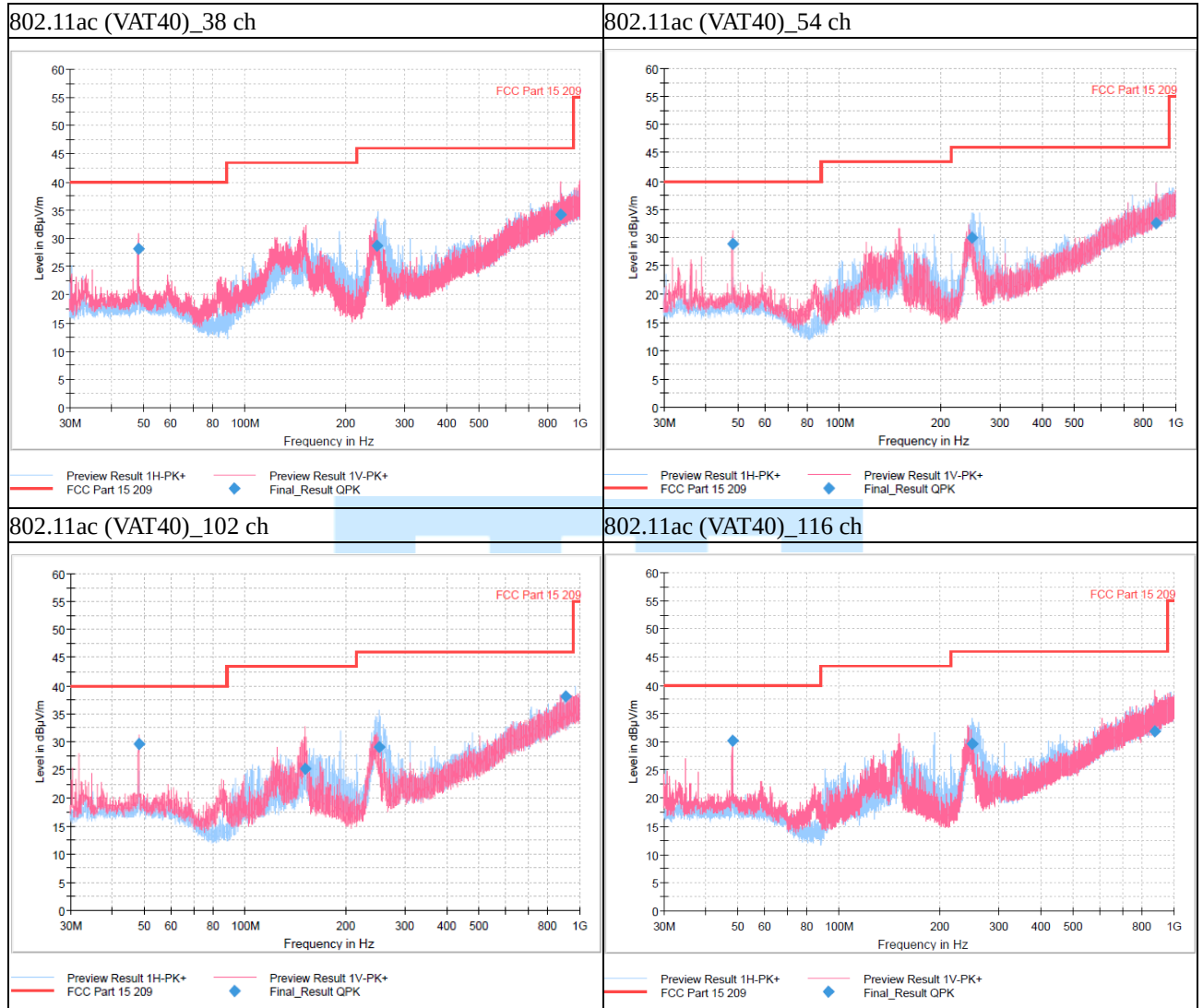
Pol.: H(Horizontal), V(Vertical)



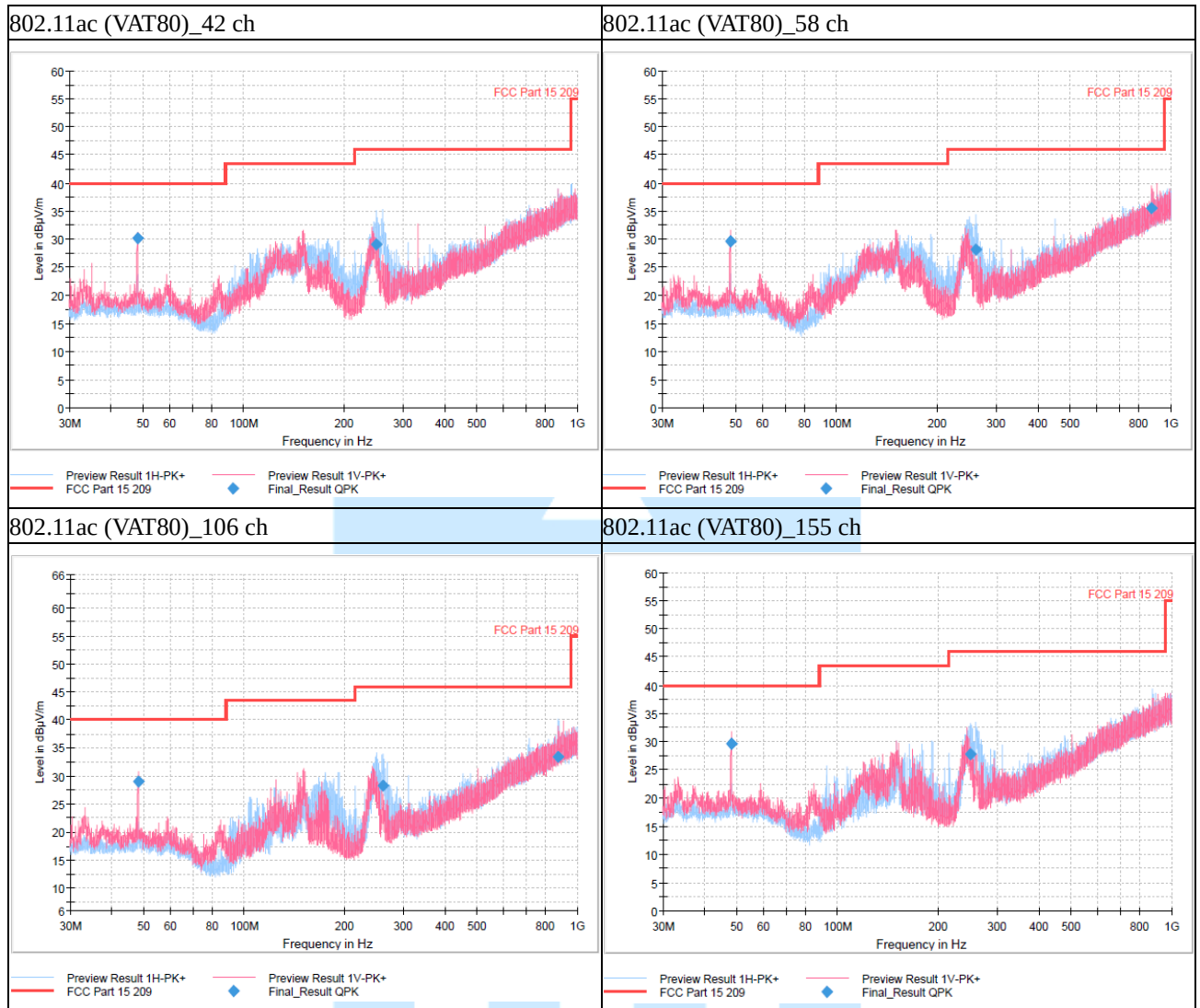
Test Plot on Configuration



Note: To simplify the report, only plots of representative channels are attached.



Note: To simplify the report, only plots of representative channels are attached.



Note: To simplify the report, only plots of representative channels are attached.

Radiated Spurious Emission (1 GHz to 25 GHz)

※ If the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.



14.7 Test data for Radiated Restricted Band Edge Emission

- Test Date : Dec. 07, 2022
- Reference Standard : Part 15 subpart E, Sec. 15.407(b)
- Measuring Distance : 3 m
- Resolution Bandwidth : 1 MHz
- Detector mode : Peak detector mode
- Power Source : DC 3.7 V
- Note : Through three orthogonal axes were investigated and the worst case is report

Conducted Out of Band(Band Edge) Emission

IEEE 802.11a

Operating Frequency (MHz)	Bandwidth (MHz)	Band Edge Type	Fundamental Level (dBm)	Bandedge Level (dBm)	Limits (dBm/MHz)	Result
5180	20	Low	-0.4	-39.8	-27.00	Complies
5320	20	High	1.5	-38.0		Complies
5500	20	Low	1.1	-37.2		Complies
5720	20	High	0.6	-31.3		Complies
5745	20	Low	0.6	-52.4		Complies
5825	20	High	-1.4	-57.0		Complies

IEEE 802.11n

Operating Frequency (MHz)	Bandwidth (MHz)	Band Edge Type	Fundamental Level (dBm)	Bandedge Level (dBm)	Limits (dBm/MHz)	Result
5180	20	Low	-1.3	-39.3	-27.00	Complies
5320	20	High	0.6	-38.9		Complies
5500	20	Low	0.4	-36.8		Complies
5720	20	High	-0.2	-32.4		Complies
5745	20	Low	-0.2	-52.1		Complies
5825	20	High	-2.2	-57.3		Complies
5190	40	Low	-4.1	-36.6		Complies
5310	40	High	-3.1	-35.2		Complies
5510	40	Low	-2.1	-33.6		Complies
5710	40	High	-3.7	-31.2		Complies
5755	40	Low	-3.1	-47.2		Complies
5795	40	High	-5.4	-55.4		Complies



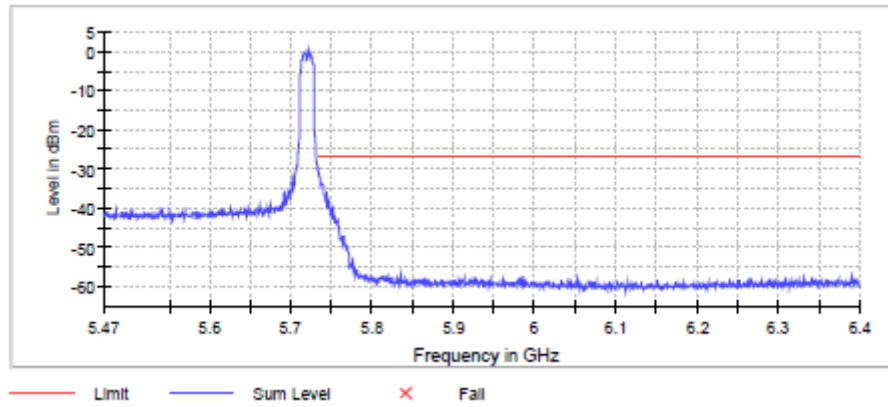
IEEE 802.11ac

Operating Frequency (MHz)	Bandwidth (MHz)	Band Edge Type	Fundamental Level (dBm)	Bandedge Level (dBm)	Limits (dBm/MHz)	Result
5180	20	Low	-1.3	-39.7	-27.00	Complies
5320	20	High	0.7	-38.5		Complies
5500	20	Low	0.7	-37.0		Complies
5720	20	High	-0.7	-31.7		Complies
5745	20	Low	0.1	-52.0		Complies
5825	20	High	-2.2	-57.2		Complies
5190	40	Low	-4.1	-36.5		Complies
5310	40	High	-2.6	-35.0		Complies
5510	40	Low	-2.7	-32.0		Complies
5710	40	High	-3.3	-30.9		Complies
5755	40	Low	-3.0	-47.1		Complies
5795	40	High	-5.2	-53.7		Complies
5210	80	Low	-5.8	-39.9		Complies
5290	80	High	-3.0	-38.1		Complies
5530	80	Low	-2.2	-37.2		Complies
5690	80	High	-4.6	-35.4		Complies
5775	80	Low	-6.0	-45.8		Complies
5775	80	High	-5.3	-54.4		Complies

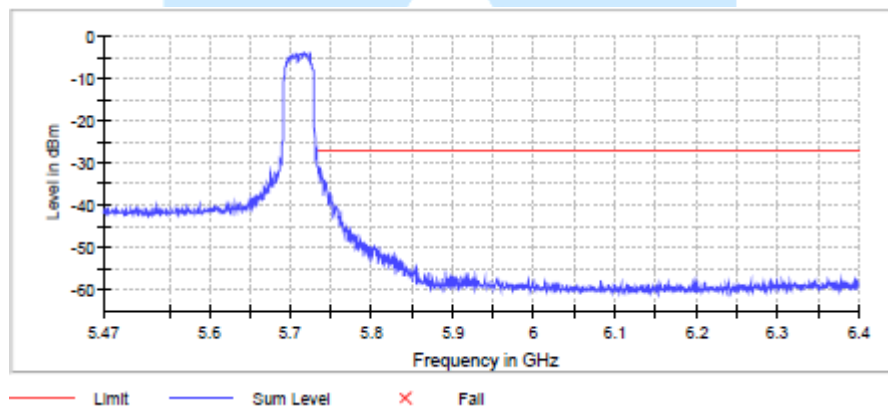


Test Plot on Configuration

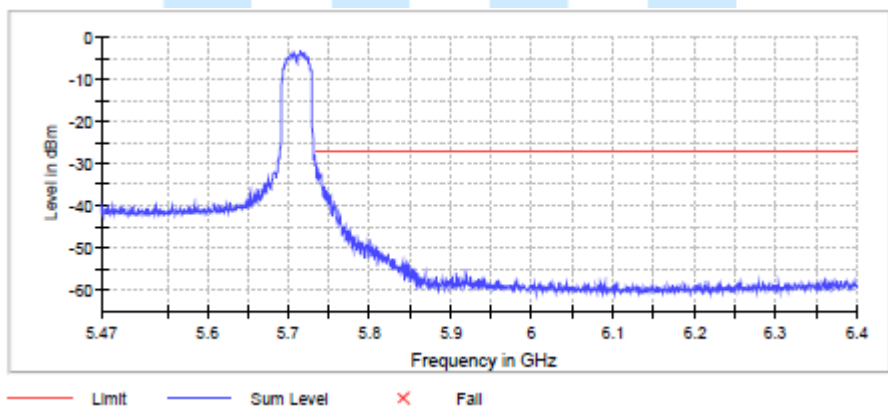
802.11a_144 ch



802.11n_142 ch



802.11ac_142 ch



Note: To simplify the report, only worst case plots are attached.



15. Sample Calculations

$$\begin{aligned} \text{dB}\mu\text{V} &= 20 \text{ Log}_{10}(\mu\text{V}/\text{m}) \\ \text{dB}\mu\text{V} &= \text{dBm} + 107 \\ \mu\text{V} &= 10^{(\text{dB}\mu\text{V}/20)} \end{aligned}$$

15.1 Example 1 :

■ 20.3 MHz

Class B Limit	= 250 μV = 48 dB μV
Reading	= 39.2 dB μV
$10^{(39.2\text{dB}\mu\text{V}/20)}$	= 91.2 μV
Margin	= 48 dB μV - 39.2 dB μV
	= 8.8 dB

15.2 Example 2 :

■ 66.7 MHz

Class B Limit	= 100 $\mu\text{V}/\text{m}$ = 40.0 dB $\mu\text{V}/\text{m}$
Reading	= 31.0 dB μV
Antenna Factor + Cable Loss	= 5.8 dB
Total	= 36.8 dB $\mu\text{V}/\text{m}$
Margin	= 40.0 dB $\mu\text{V}/\text{m}$ - 36.8 dB $\mu\text{V}/\text{m}$
	= 3.2 dB



16. Recommendation & Conclusion

The data collected shows that the **Summit Technology Touch Screen Controller (Model Name: TDC-5100)** was complies with §15.407 of the FCC Rules.

- The end -

