

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



Applicant: Darfon Electronics Czech s.r.o.
Turanka 1315/112, 627 00 Brno, Czech Republic.

Product Name: Dongle

Brand Name: QPAD

Model No.: QH-900-D

Model Difference: N/A

Report Number: E2/2021/30049

FCC ID 2AZDI-QH-900-D

IC: 27074-QH900D

Issue Date: Jun.11 ,2021

Date of Test: Jan.04 , 2021 ~ Apr.16 , 2021

Date of EUT Received: Jan.04 , 2021

Approved By


Jay Lin/Asst. Supervisor

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247, ISSED RSS-247.

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Revision History

Report Number	Revision	Description	Issue Date	Revised By
E2/2021/30049	Rev.00	Original	Jun.11 ,2021	Viola Su

Note:

- 1、Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Dongle
Brand Name:	QPAD
Model No.:	QH-900-D
Model Difference:	N/A
Hardware Version:	R0C
Firmware Version:	1.0.3
EUT Series No.:	N/A
Power Supply:	3.7 Vdc from Li-ion Polymer Battery

1.2 RF Specification

Radio Technology:	2.4GHz
Frequency Range:	2403.35 – 2477.35MHz
Channel number:	38 channels
Modulation type:	DQPSK
Transmit Power:	6.50 dBm

1.3 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)
Multilayer Ceramic Antenna	Walsin Technology Corporation	RFANT3216120AT5T Series	2402 ~2480MHz	2.12

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

RSS-247 issue 2 Feb. 2017

RSS-Gen Issue 5, Amendment 2, February 2021

ANSI C63.10:2013

1.5 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction A	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

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1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 Equipment Modifications

There was no modification incorporated into the EUT.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Measurement Results Explanation Example

2.4.1 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

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

2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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2.5 Configuration of Tested System

Fig. 2-1 Conducted Setup & Radiated Setup & Conduction Setup



Table 2-1 Equipment Used in Tested System

Item	Equipment	MRF/Brand	Model/Type No.	Series No.	Version
1.	Avnera Continue Power	N/A	N/A	N/A	RF Power 2020.11.4.1
2.	Notebook	Lenovo	L420	S0012467	N/A
3.	Notebook	Lenovo	T420	S0012599	N/A
4.	Notebook	Lenovo	T470	P0001293	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	IC Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10 RSS-Gen §6.13	Radiated & Conducted Band Edge and Spurious Emission	Compliant
§15.247(e)	RSS-247 §5.2 b	Power Spectral Density	Compliant
§15.203 §15.247(b)	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operated in 2403.35 ~ 2477.35MHz Band

38 channels are provided for 2.4G

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2403.35 MHz	15	2431.35 MHz	29	2459.35 MHz
2	2405.35 MHz	16	2433.35 MHz	30	2461.35 MHz
3	2407.35 MHz	17	2435.35 MHz	31	2463.35 MHz
4	2409.35 MHz	18	2437.35 MHz	32	2465.35 MHz
5	2411.35 MHz	19	2439.35 MHz	33	2467.35 MHz
6	2413.35 MHz	20	2441.35 MHz	34	2469.35 MHz
7	2415.35 MHz	21	2443.35 MHz	35	2471.35 MHz
8	2417.35MHz	22	2445.35 MHz	36	2473.35 MHz
9	2419.35 MHz	23	2447.35 MHz	37	2475.35 MHz
10	2421.35 MHz	24	2449.35 MHz	38	2477.35 MHz
11	2423.35 MHz	25	2451.35 MHz		
12	2425.35 MHz	26	2453.35 MHz		
13	2427.35 MHz	27	2455.35 MHz		
14	2429.35 MHz	28	2457.35 MHz		

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4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

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4.3 Radiated Emission Test:

RADIATED EMISSION TEST (BELOW 1 GHz)			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	ANTENNA PORT
2.4G	1 to 38	1,20,38	ch0

RADIATED EMISSION TEST (ABOVE 1 GHz)			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	ANTENNA PORT
2.4G	1 to 38	1,20,38	ch0

Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for channel Low, Mid and High, the worst case position was reported.

4.4 Antenna Port Conducted Measurement:

CONDUCTED TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	ANTENNA PORT
2.4G	1 to 38	1,20,38	ch0

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.34 dB
Peak Output Power	+/- 1 dB
6dB Bandwidth	+/- 1.54 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 1.69 dB
Peak Power Density	+/- 1.54 dB
Temperature	+/- 0.4 °C
Humidity	+/- 3.5 %
DC / AC Power Source	DC= +/- 1%, AC= +/- 1%

Radiated Spurious Emission Measurement Uncertainty			
Polarization: Vertical	+/- 2.64 dB	9kHz~30MHz: +/- 2.3dB	
	+/- 4.93 dB	30MHz - 1000MHz: +/- 3.37dB	
	+/- 4.81 dB	1GHz - 18GHz: +/- 4.04dB	
	+/- 4.52 dB	18GHz - 40GHz: +/- 4.04dB	
Polarization: Horizontal	+/- 2.64 dB	9kHz~30MHz: +/- 2.3dB	
	+/- 4.45 dB	30MHz - 1000MHz: +/- 4.22dB	
	+/- 4.81 dB	1GHz - 18GHz: +/- 4.08dB	
	+/- 4.52 dB	18GHz - 40GHz: +/- 4.08dB	

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 CONDUCTED EMISSION TEST

6.1 Standard Applicable

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2 Measurement Equipment Used

Radiated Emission Test Site: Conduction A					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	Ver. 6.11-20180419c	N.C.R	N.C.R
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	973	03/25/2021	03/24/2022
EMI Test Receiver	R&S	ESCI	101342	04/28/2020	04/27/2021
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2021	03/26/2022
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2021	03/26/2022

NOTE: N.C.R refers to Not Calibrated Required.

6.3 EUT Setup

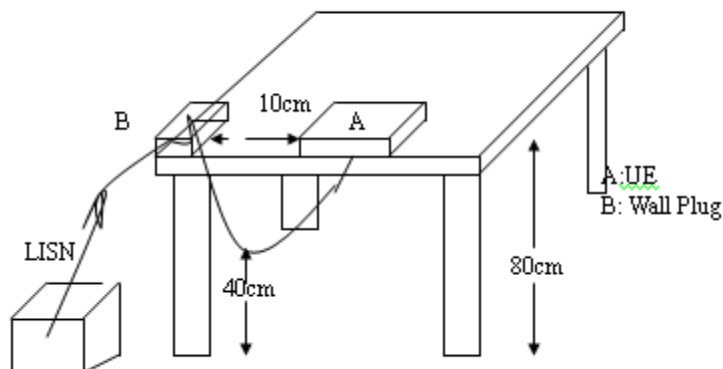
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

6.6 Measurement Result

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number :E2/2021/30049

Test Site :Conduction Room C

Test Mode :2.4G

Test Date :2021-04-13

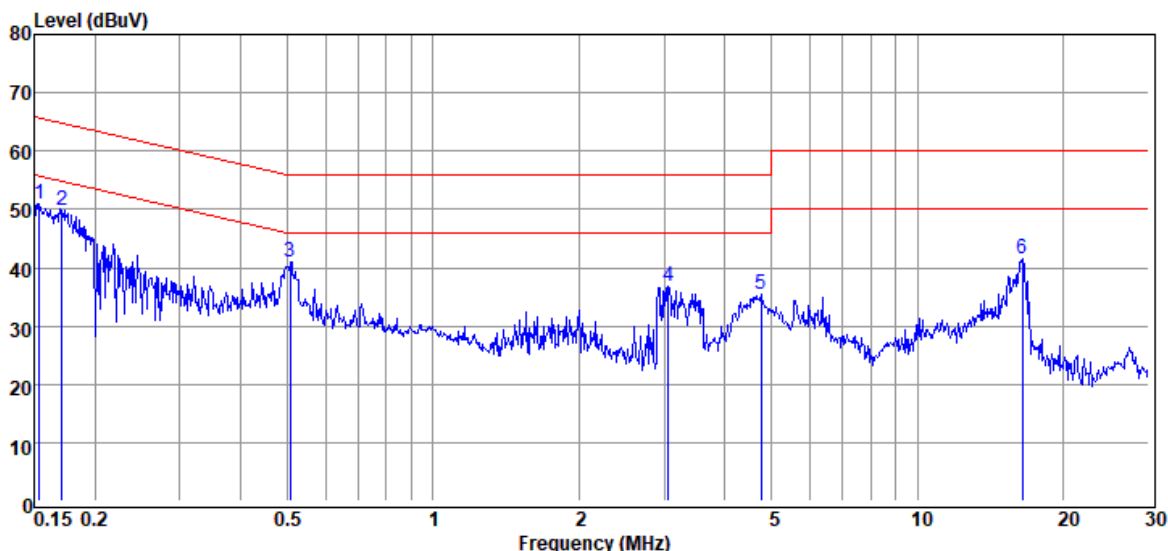
Power :120V/60Hz

Temp./Humi. :23.6/65

Probe :L1

Engineer :Ashton Chiu

Note: : Dongle



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS		
MHz	PK/QP/AV	dBμV	dB	dBμV	dBμV	dB
0.15	Peak	40.67	10.30	50.97	65.78	-14.81
0.17	Peak	39.59	10.30	49.89	64.90	-15.01
0.51	Peak	30.74	10.31	41.05	56.00	-14.95
3.06	Peak	25.97	10.87	36.84	56.00	-19.16
4.75	Peak	24.74	10.58	35.32	56.00	-20.68
16.49	Peak	30.74	10.82	41.56	60.00	-18.44

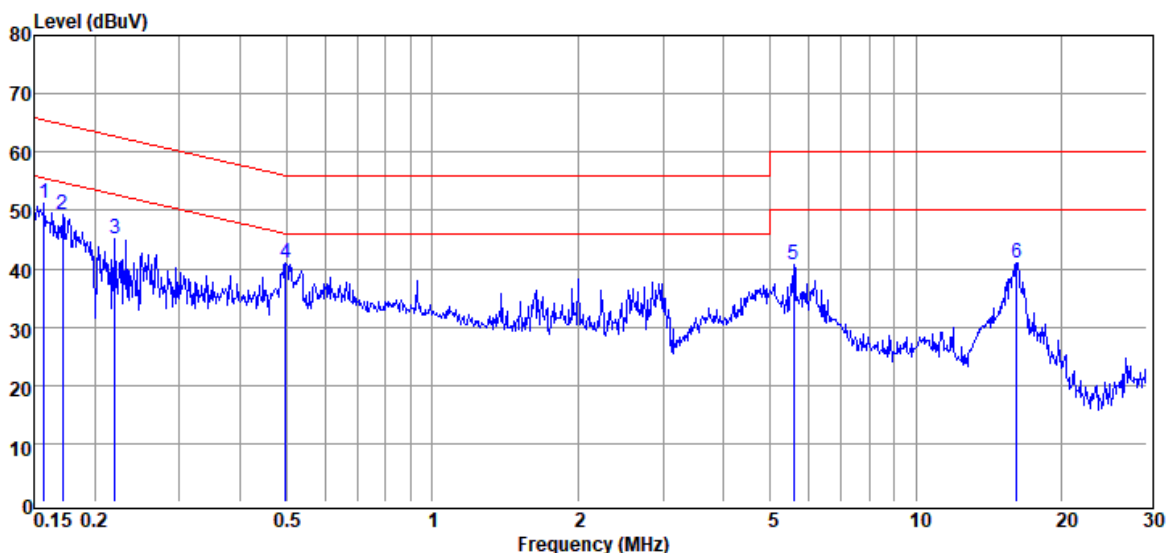
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Report Number :E2/2021/30049
 Test Mode :2.4G
 Power :120V/60Hz
 Probe :N
 Note: : Dongle

Test Site :Conduction Room C
 Test Date :2021-04-13
 Temp./Humi. :23.6/65
 Engineer :Ashton Chiu



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
Mode		Reading Level		FS		
MHz	PK/QP/AV	dBμV	dB	dBμV	dBμV	dB
0.16	Peak	40.98	10.31	51.29	65.60	-14.31
0.17	Peak	38.88	10.31	49.19	64.86	-15.67
0.22	Peak	34.78	10.30	45.08	62.79	-17.71
0.50	Peak	30.76	10.32	41.08	56.05	-14.97
5.59	Peak	30.09	10.61	40.70	60.00	-19.30
16.14	Peak	30.18	10.90	41.08	60.00	-18.92

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7 DUTY CYCLE OF TEST SIGNAL

Pre-analysis Check: While conducting average power measurement, duty cycle of each mode shall be checked to ensure its duty cycle in order to compensate for the loss due to insufficient ratio of duty cycle.

All duty cycle is pre-scanned, and result as obtained below shows only the most representative ones where duty cycle is conducted as the given transmission with given virtual operation that expresses the percentage.

7.1 Measurement Procedure:

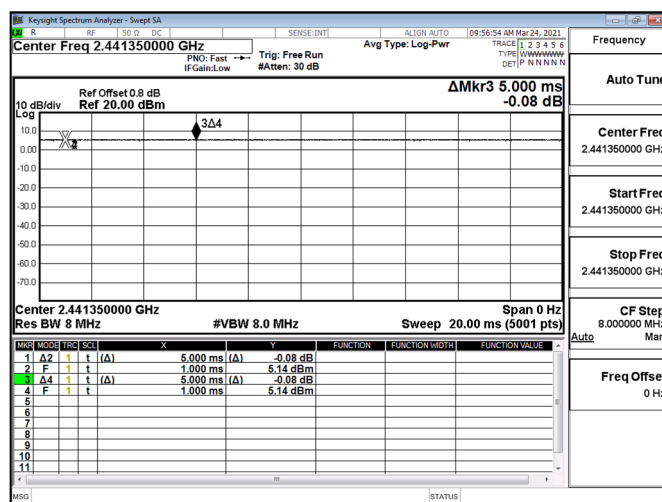
1. Set span = Zero
2. RBW = 8MHz
3. VBW = 8MHz,
4. Detector = Peak

7.2 Duty Cycle:

	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
2.4G	100.00	0.00	0.00	0.01

7.3 Duty Cycle test plots

Duty Cycle_2441.35MHz



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8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W .

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

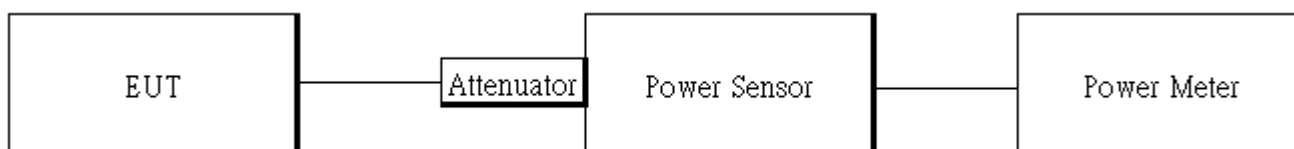
In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1512003	07/23/2020	07/22/2021
Power Sensor	Anritsu	MA2411B	1339378	07/23/2020	07/22/2021
Power Sensor	Anritsu	MA2411B	1339379	07/23/2020	07/22/2021
Coaxial Cables	Woken	00100A1F2A196C	RF51	11/19/2020	11/18/2021

8.3 Test Set-up

Power Meter:



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8.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.

Power Meter:

It is used as the auxiliary test equipment to conduct the output power measurement.

4. Record the max. Reading as observed from Spectrum or Power Meter.

*** Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.**

8.5 Measurement Result

2.4G Ch0						
CH	Freq. (MHz)	Data Rate	Power set	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2403.35	1	default	6.50	30.00	PASS
20	2441.35	1	default	5.96	30.00	PASS
38	2477.35	1	default	5.06	30.00	PASS

*** Note: The duty cycle factor is compensated to obtain the maximum value of measurement in average.**

EIRP

2.4G Ch0							
CH	Freq. (MHz)	Data Rate	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	RESULT
1	2403.35	1	4.46	2.12	6.58	36	PASS
20	2441.35	1	3.90	2.12	6.02	36	PASS
38	2477.35	1	2.96	2.12	5.08	36	PASS

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9 EMISSION BANDWIDTH MEASUREMENT

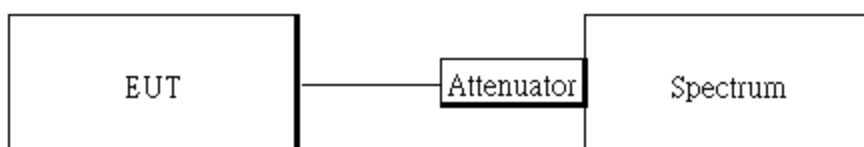
9.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz.

9.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/23/2020	07/22/2021
DC Block	PASTERNAK	PE8210	RF152	11/19/2020	11/18/2021
Coaxial Cables	Woken	00100A1F2A196C	RF51	11/19/2020	11/18/2021

9.3 Test Set-up



9.4 Measurement Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set the spectrum analyzer as
 RBW= 100kHz ,
 VBW = 3 X RBW,
 Span= 2 to 5 times of the OBW,
 Sweep=auto,
 Detector = Peak, and Max hold for -6dB Bandwidth test.
5. Set the spectrum analyzer as
 RBW= 1 % to 5% of 99% Bandwidth ,
 VBW ≥ 3 X RBW,
 Span= large enough to capture all products of the modulation process,
 Sweep=auto,
 Detector = Peak, and Max hold for 99% Bandwidth test.
6. Turn on the 99% bandwidth function, max reading.
7. Repeat above procedures until all test default channel is completed

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9.5 6dB Bandwidth**2.4G Ch0**

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2403.35	1692.00	> 500	PASS
2441.35	1626.00	> 500	PASS
2477.35	1697.00	> 500	PASS

* *Note: Offset 0.8dB for 2.4G*

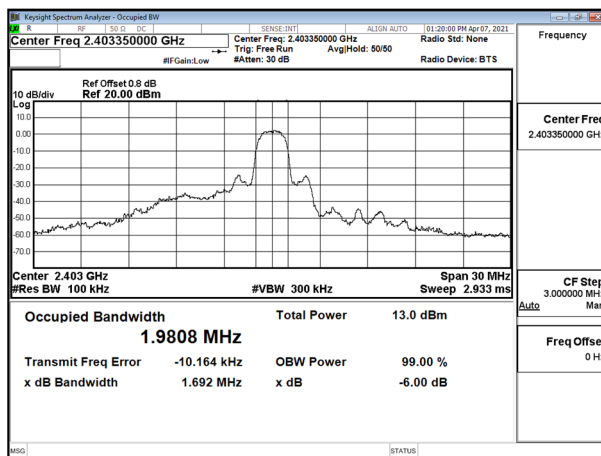
**Refer to next page for plots*

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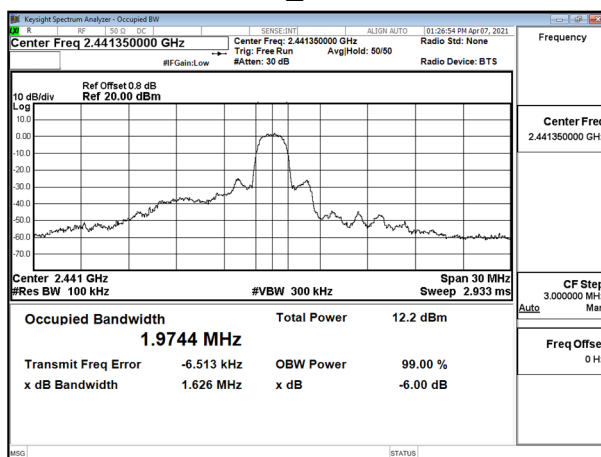
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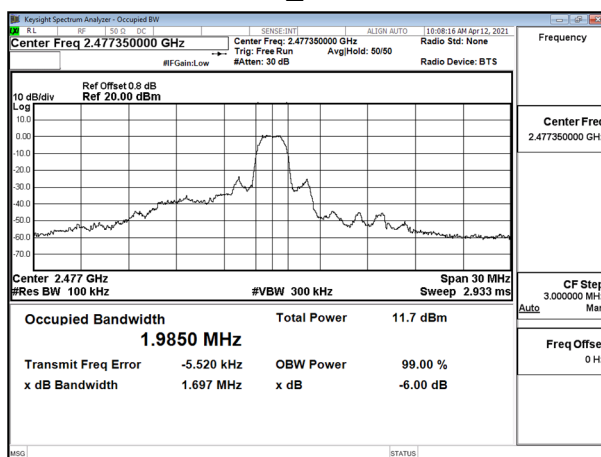
OBW 6dB _2403.35MHz



OBW 6dB _2441.35MHz



OBW 6dB _2477.35MHz



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9.6 99% Bandwidth

2.4G Ch0	
Freq. (MHz)	99% BW (MHz)
2403.35	2.1506
2441.35	2.1506
2477.35	2.1606

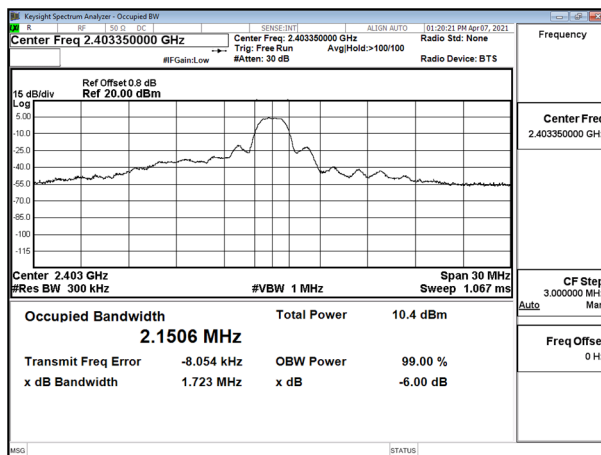
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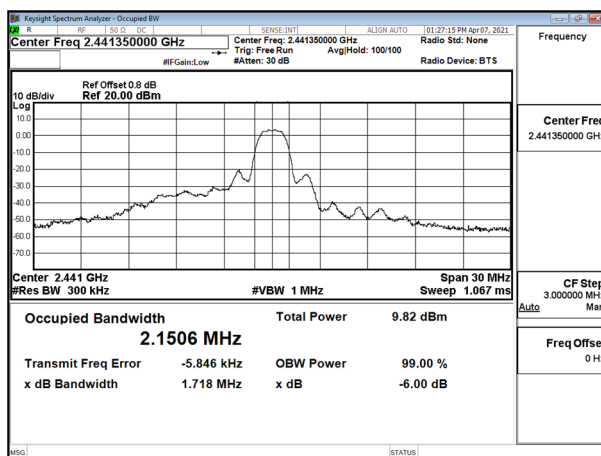
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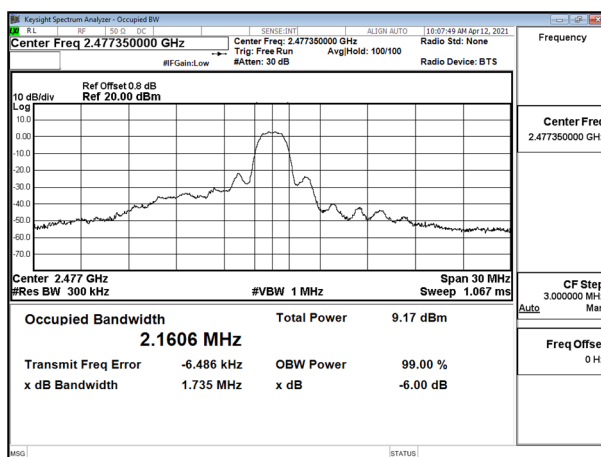
IC OBW 99%_2403.35



IC OBW 99%_2441.35



IC OBW 99%_2477.35



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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

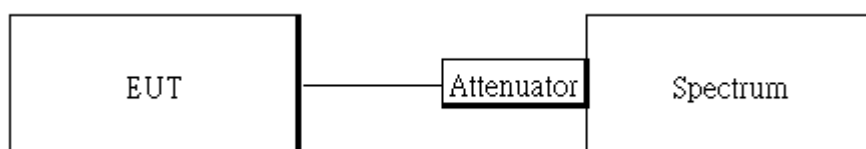
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

10.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/23/2020	07/22/2021
DC Block	PASTERNAK	PE8210	RF152	11/19/2020	11/18/2021
Coaxial Cables	Woken	00100A1F2A196C	RF51	11/19/2020	11/18/2021

10.3 Test SET-UP



10.4 Measurement Procedure

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Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Mark the highest reading of the emission as the reference level measurement.
7. Set DL as the limit = reading on marker of reference level measurement – 20dBm
8. Mark the highest readings of the emissions outside of 2400MHz~2483.5MHz.
9. Repeat above procedures until all default test channel (low, middle, and high) was complete.

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Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set RBW = 100 kHz & VBW= 300 kHz, Detector =Peak, Sweep = Auto.
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.5 Measurement Result

Reference Level of Limit 2.4G mode		
Freq. (MHz)	PSD (dBm)	Reference Level of Limit (dBm)
2403.35	2.34	-17.66
2441.35	1.90	-18.10
2477.35	2.09	-17.91

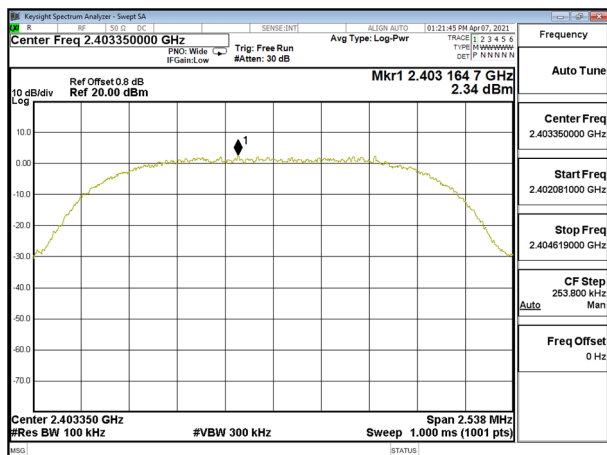
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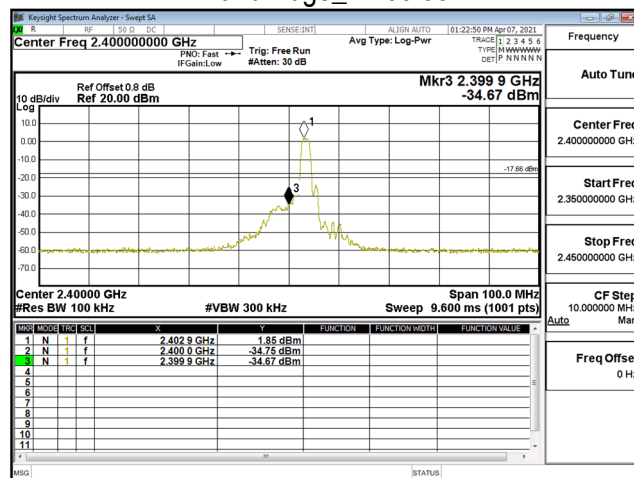
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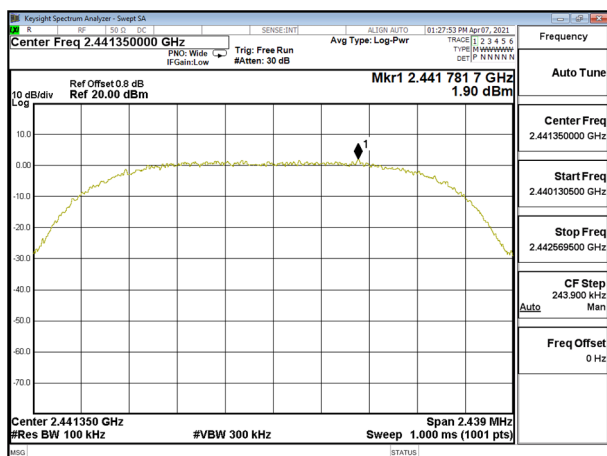
Reference Level _2403.35



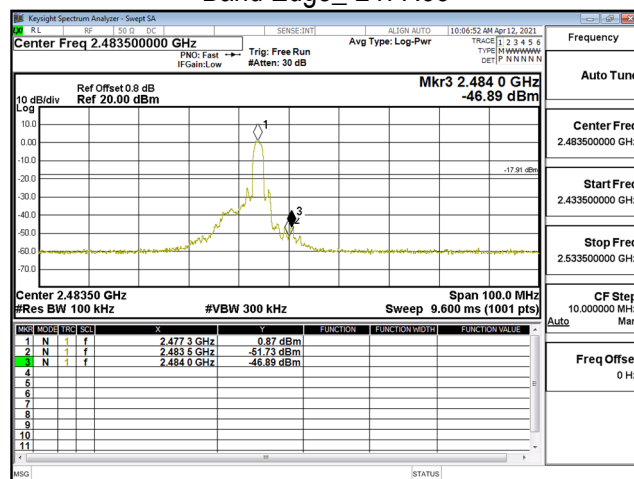
Band Edge _2403.35



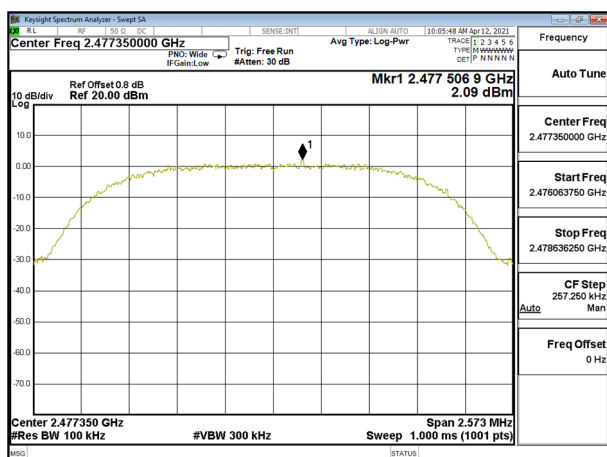
Reference Level _2441.35



Band Edge _2477.35



Reference Level _2477.35



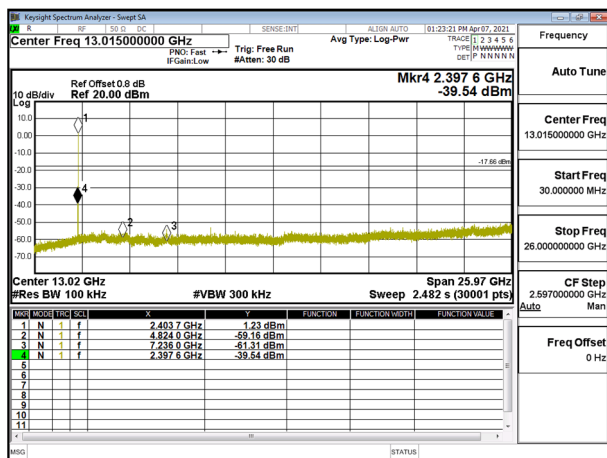
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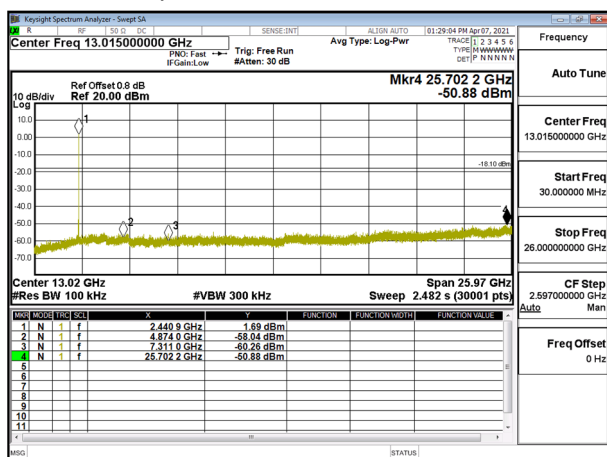
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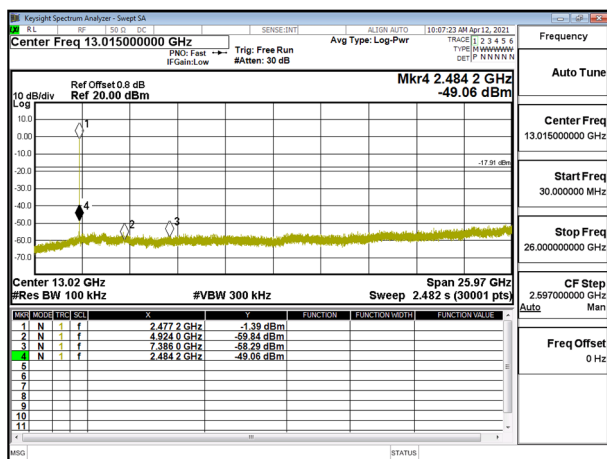
Spurious Emission_ 2403.35



Spurious Emission_ 2441.35



Spurious Emission_ 2477.35



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

Radiated emissions which fall in the restricted bands must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §6.13.2.a, for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m)

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11.2 Measurement Equipment Used:

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Broadband Antenna	TESEQ	CBL 6112D	35240	09/08/2020	09/07/2021
Horn Antenna	Schwarzbeck	BBHA9170	184	12/11/2020	12/10/2021
Horn Antenna	Schwarzbeck	BBHA9120D	1187	01/11/2021	01/10/2022
Loop Antenna	ETS.LINDGREN	6502	143303	04/28/2020	04/27/2021
Test Software	audix	e3	20923 sgs Ver.9	N.C.R	N.C.R
EMI Test Receiver	R&S	ESU 40	100363	04/29/2020	04/28/2021
Pre-Amplifier	EMC Instruments	EMC330	980096	11/19/2020	11/18/2021
Pre-Amplifier	EMC Instruments	EMC0011830	980199	11/19/2020	11/18/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2020	10/26/2021
Attenuator	Woken	WATT-218FS-10	RF03	11/19/2020	11/18/2021
Band Rejection Filter	Micro-Tronics	BRM50701-01	RF201	11/19/2020	11/18/2021
Coaxial Cable	Huber Suhner	SUCOFLEX 104	MY17388/4	11/19/2020	11/18/2021
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	11/19/2020	11/18/2021

NOTE: N.C.R refers to Not Calibrated Required.

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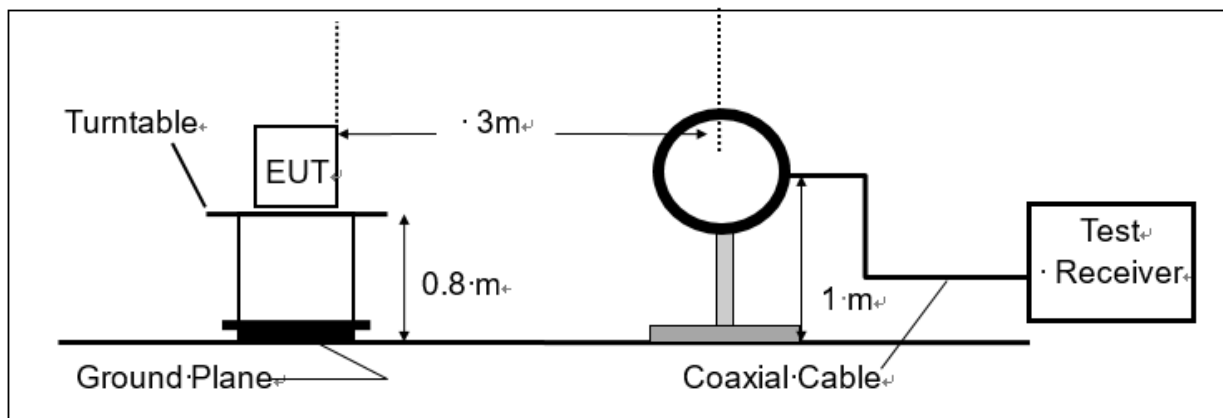
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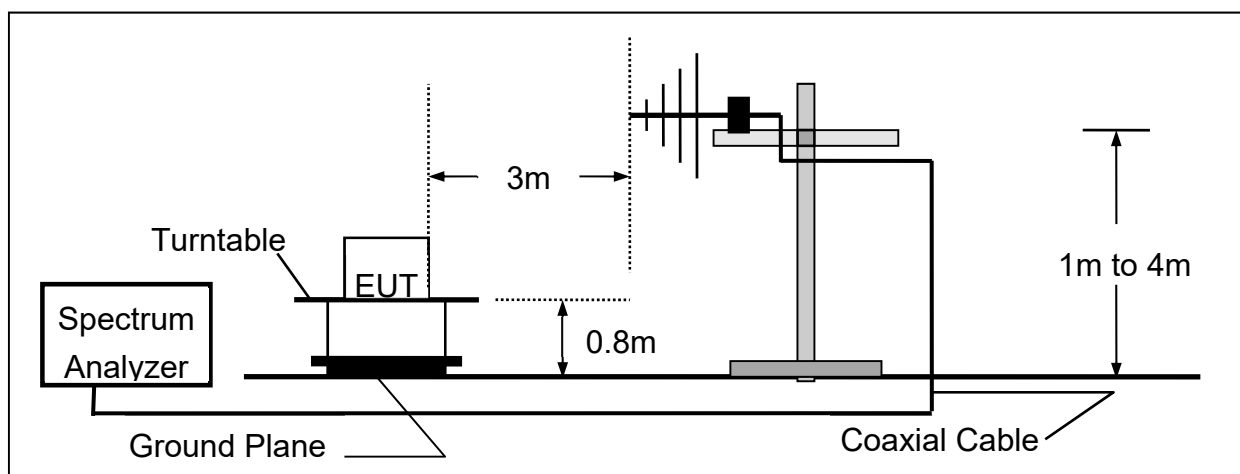
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11.3 Test SET-UP

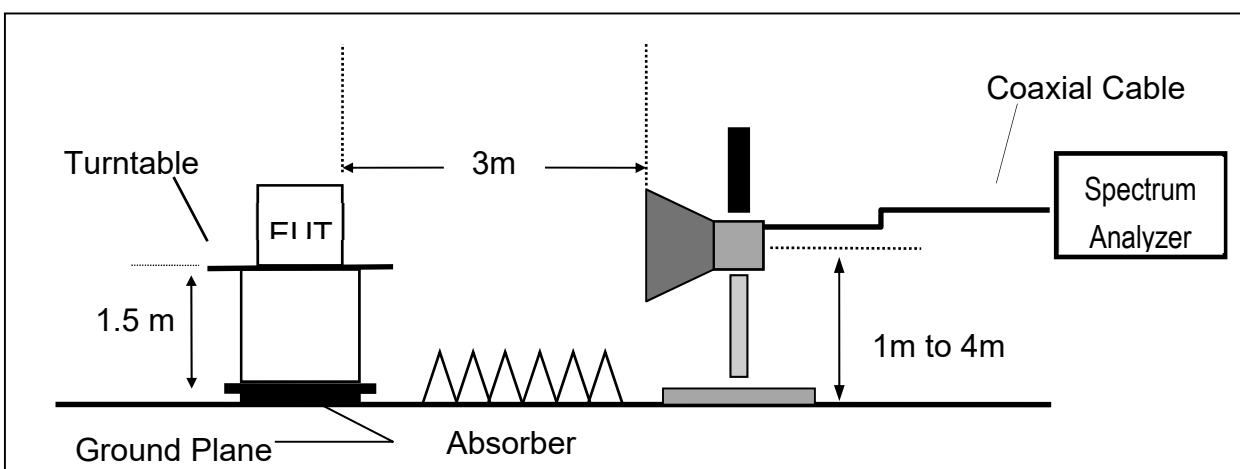
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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11.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
6. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
9. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
12. Repeat above procedures until all default test channel measured were complete.

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11.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where *FS* = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(uV/m)$

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

11.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) & RSS-GEN §6.13.2 was not reported.

11.7 Measurement Result

Note:

1. Refer to next page spectrum analyzer data chart and tabular data sheets.
2. Measurements are completed at peak and average level, the mark of average is the highest emission in restricted bands

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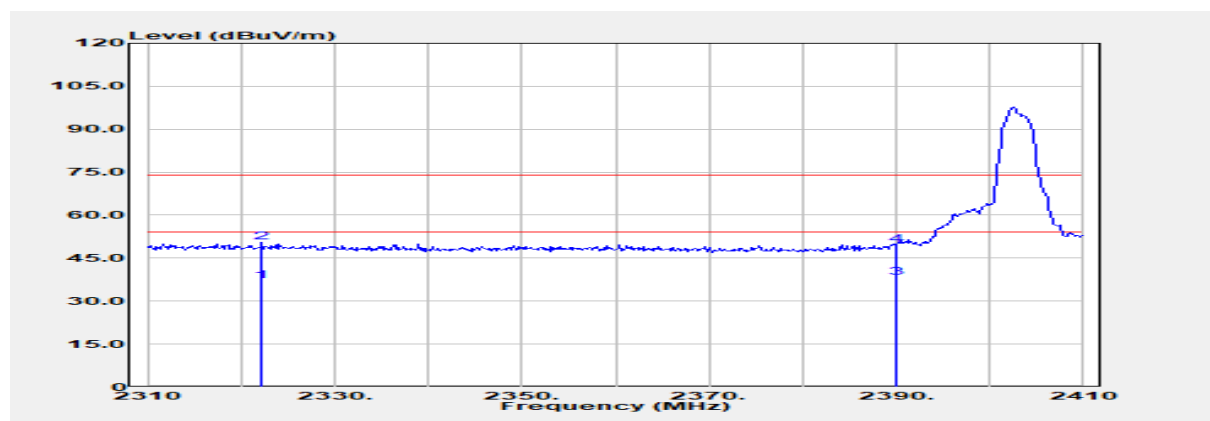
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11.7.1 Radiated Band Edge Measurement Result

Report Number	:E2/2021/30049	Test Site	:966 Chamber C
Operation Mode	:2.4G	Test Date	:2021-04-08
Test Frequency	:2403.35 MHz	Temp./Humi.	:22.5/67
Test Mode	:BE CH LOW	Antenna Pol.	:Vertical
EUT Pol	:E1 Plane	Engineer	:Ashton Chiu



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
2322.179	Average	31.31	5.79	37.10	54.00	-16.90
2322.179	Peak	44.70	5.79	50.49	74.00	-23.51
2390.000	Average	32.87	5.18	38.05	54.00	-15.95
2390.000	Peak	44.44	5.18	49.62	74.00	-24.38

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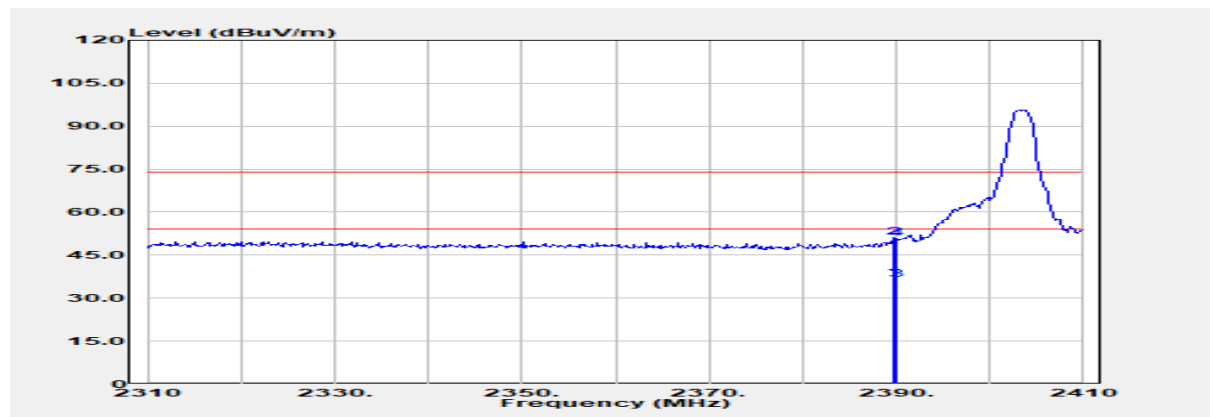
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2403.35 MHz
 Test Mode :BE CH LOW
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.5/67
 Antenna Pol. :Horizontal
 Engineer :Ashton Chiu



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2389.647	Average	31.95	5.16	37.11	54.00	-16.89
2389.647	Peak	45.86	5.16	51.03	74.00	-22.97
2390.000	Average	31.24	5.18	36.42	54.00	-17.58
2390.000	Peak	45.67	5.18	50.85	74.00	-23.15

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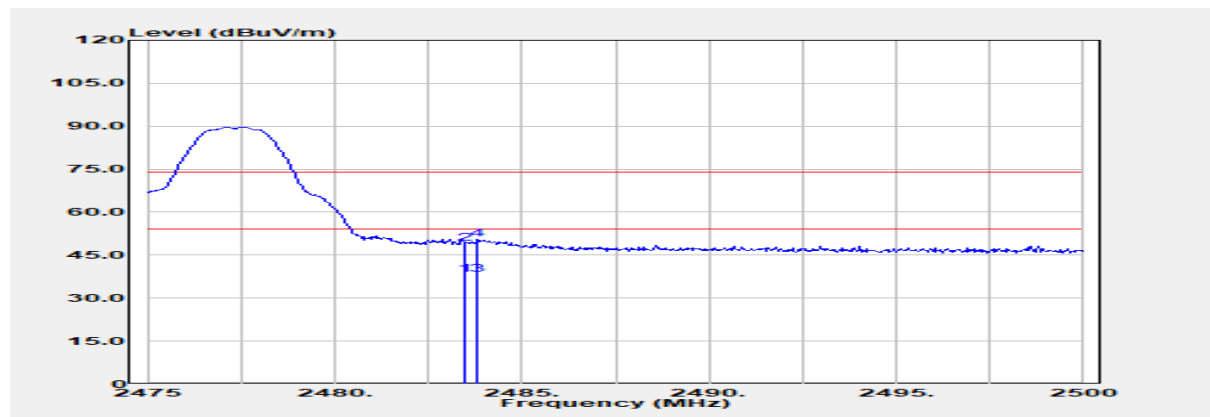
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2477.35 MHz
 Test Mode :BE CH HIGH
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.5/67
 Antenna Pol. :Vertical
 Engineer :Ashton Chiu



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.500	Average	34.27	4.04	38.31	54.00	-15.69
2483.500	Peak	44.90	4.04	48.93	74.00	-25.07
2483.814	Average	34.28	4.03	38.31	54.00	-15.69
2483.814	Peak	46.46	4.03	50.49	74.00	-23.51

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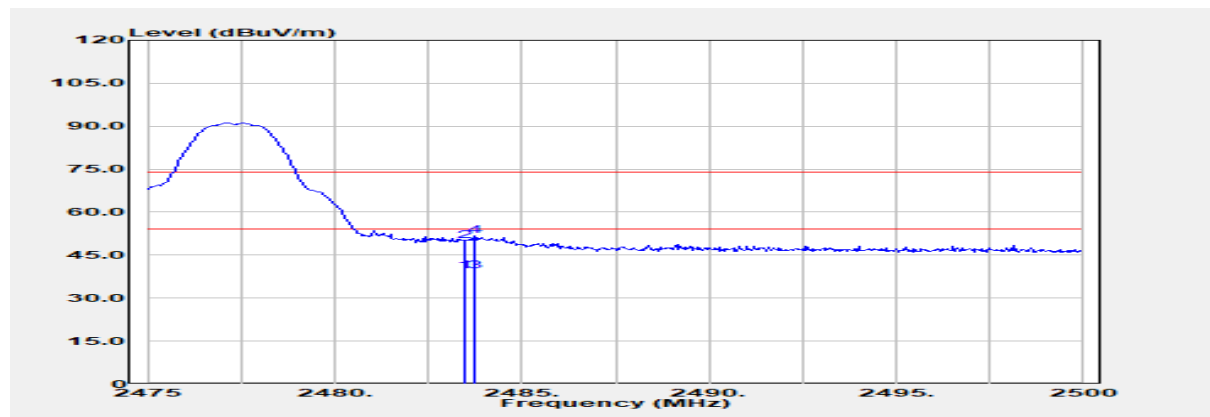
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2477.35 MHz
 Test Mode :BE CH HIGH
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.5/67
 Antenna Pol. :Horizontal
 Engineer :Ashton Chiu



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
2483.500	Average	35.36	4.04	39.40	54.00	-14.60
2483.500	Peak	45.77	4.04	49.80	74.00	-24.20
2483.734	Average	35.37	4.03	39.40	54.00	-14.60
2483.734	Peak	47.55	4.03	51.58	74.00	-22.42

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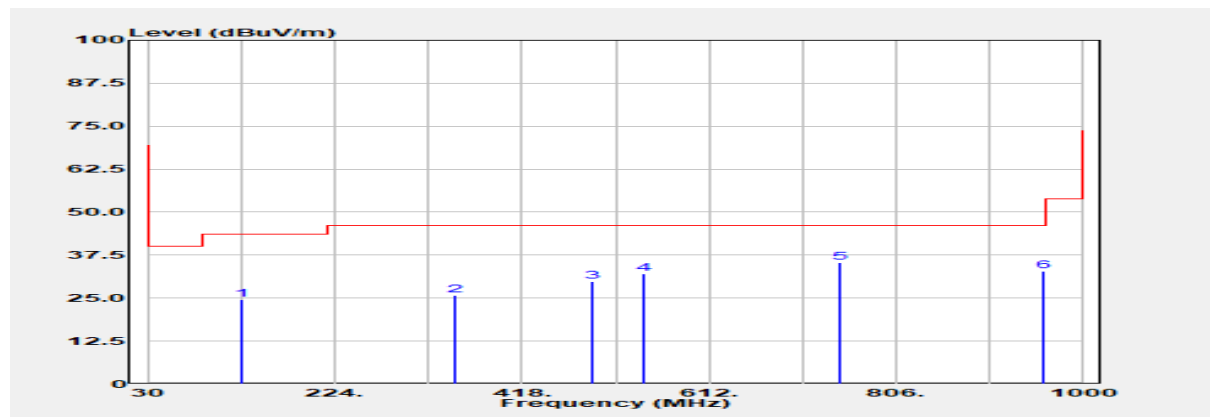
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11.7.2 Below 1GHz Worst-Case Emission:

Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2441.35 MHz
 Test Mode :TX CH MID
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-12
 Temp./Humi. :22.5/64
 Antenna Pol. :Vertical
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
127.933	Peak	41.53	-16.91	24.62	43.50	-18.88
348.670	Peak	39.98	-14.15	25.82	46.00	-20.18
490.128	Peak	40.49	-10.56	29.93	46.00	-16.07
544.535	Peak	41.25	-9.28	31.97	46.00	-14.03
748.173	Peak	42.85	-7.54	35.31	46.00	-10.69
958.029	Peak	38.57	-5.74	32.83	46.00	-13.17

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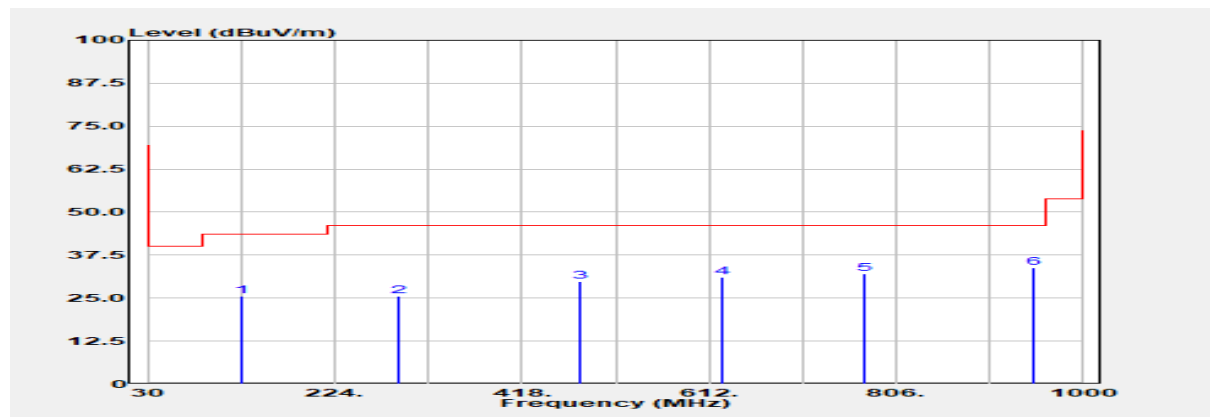
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2441.35 MHz
 Test Mode :TX CH MID
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-12
 Temp./Humi. :22.5/64
 Antenna Pol. :Horizontal
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBuV	dB	dBuV/m	dBuV/m	dB
126.378	Peak	42.27	-16.78	25.49	43.50	-18.01
289.599	Peak	41.07	-15.51	25.56	46.00	-20.44
477.692	Peak	40.49	-10.60	29.89	46.00	-16.11
625.369	Peak	39.25	-8.26	30.99	46.00	-15.01
773.045	Peak	39.48	-7.42	32.06	46.00	-13.94
948.702	Peak	39.12	-5.30	33.82	46.00	-12.18

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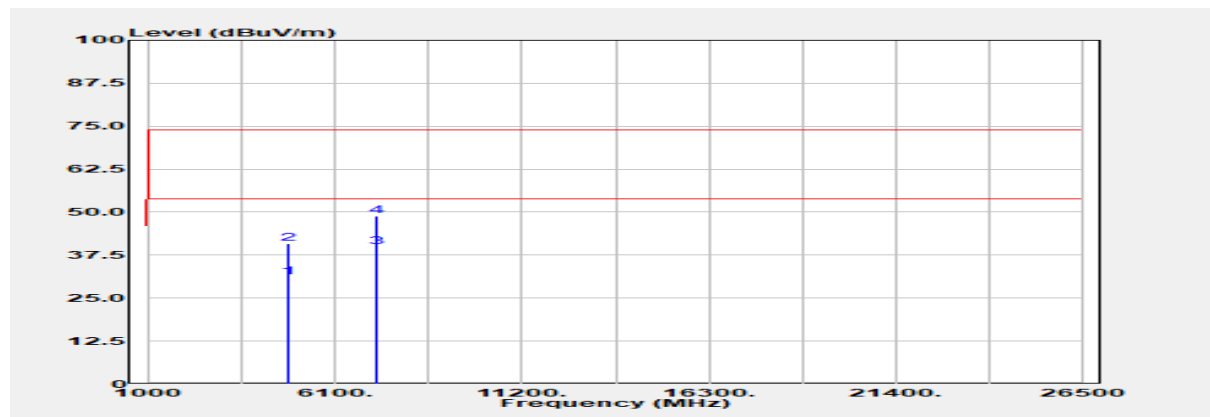
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11.7.3 Above 1GHz Emission:

Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2403.35MHz
 Test Mode :TX CH LOW
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.8/62
 Antenna Pol. :Vertical
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4806.700	Average	20.17	10.93	31.10	54.00	-22.90
4806.700	Peak	29.85	10.93	40.78	74.00	-33.22
7210.050	Average	22.75	17.01	39.76	54.00	-14.24
7210.050	Peak	31.82	17.01	48.83	74.00	-25.17

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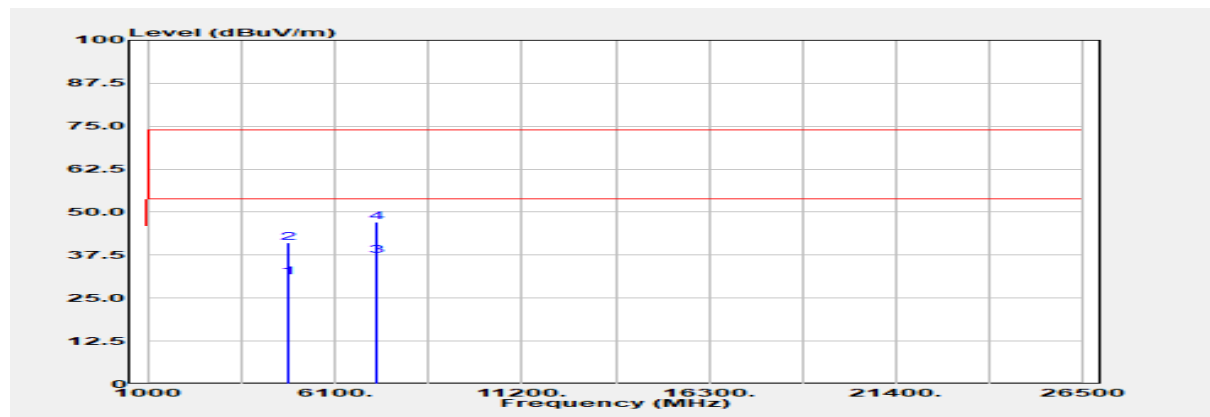
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2403.35MHz
 Test Mode :TX CH LOW
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.8/62
 Antenna Pol. :Horizontal
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4806.700	Average	20.11	10.93	31.04	54.00	-22.96
4806.700	Peak	30.05	10.93	40.98	74.00	-33.02
7210.050	Average	20.32	17.01	37.33	54.00	-16.67
7210.050	Peak	30.08	17.01	47.09	74.00	-26.91

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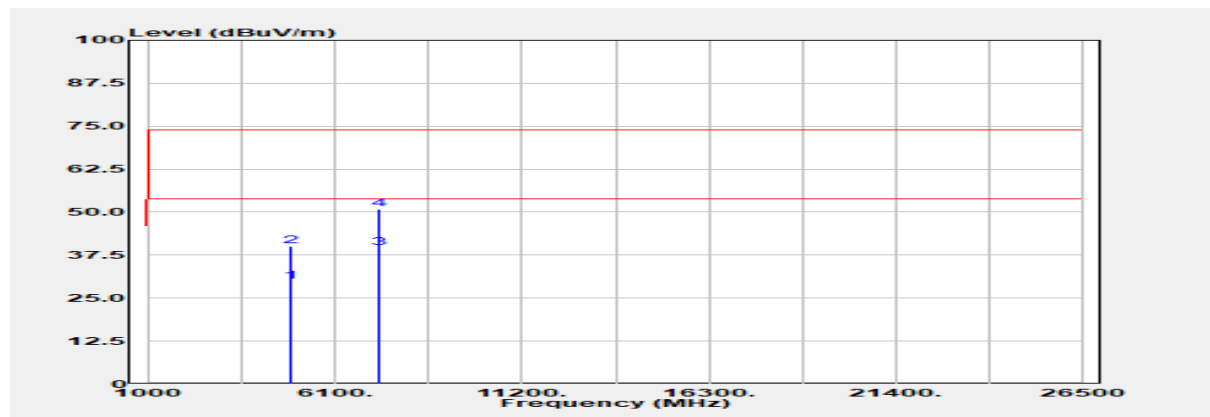
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2441.35 MHz
 Test Mode :TX CH MID
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.8/62
 Antenna Pol. :Vertical
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4882.700	Average	19.74	10.13	29.87	54.00	-24.13
4882.700	Peak	30.05	10.13	40.18	74.00	-33.82
7324.050	Average	21.23	18.39	39.62	54.00	-14.38
7324.050	Peak	32.47	18.39	50.85	74.00	-23.15

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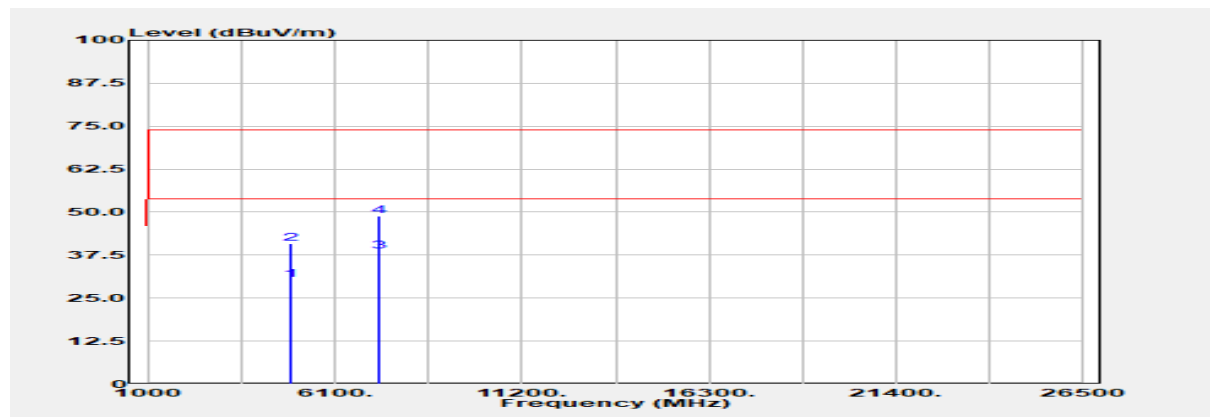
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2441.35 MHz
 Test Mode :TX CH MID
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.8/62
 Antenna Pol. :Horizontal
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4882.700	Average	20.13	10.13	30.26	54.00	-23.74
4882.700	Peak	30.74	10.13	40.87	74.00	-33.13
7324.050	Average	20.27	18.39	38.66	54.00	-15.34
7324.050	Peak	30.40	18.39	48.79	74.00	-25.21

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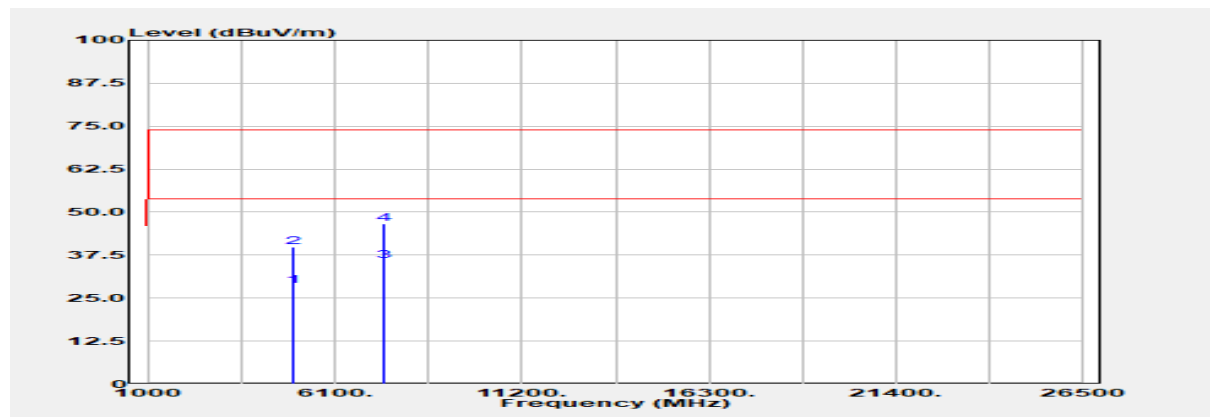
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 Test Frequency :2477.35 MHz
 Test Mode :TX CH HIGH
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.8/62
 Antenna Pol. :Vertical
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4954.700	Average	18.52	9.96	28.49	54.00	-25.51
4954.700	Peak	29.86	9.96	39.82	74.00	-34.18
7432.050	Average	18.70	17.25	35.96	54.00	-18.04
7432.050	Peak	29.34	17.25	46.59	74.00	-27.41

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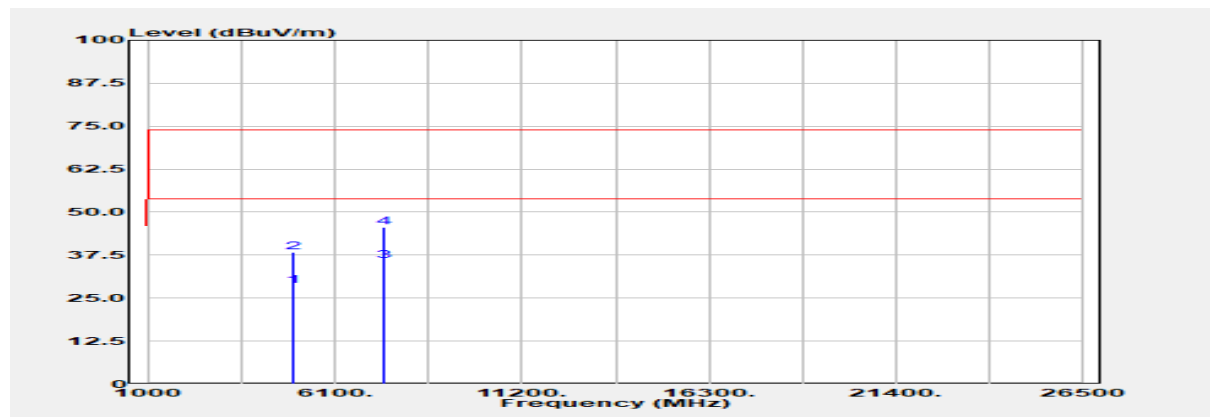
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Report Number :E2/2021/30049
 Operation Mode :2.4G
 Test Frequency :2477.35 MHz
 Test Mode :TX CH HIGH
 EUT Pol :E1 Plane

Test Site :966 Chamber C
 Test Date :2021-04-08
 Temp./Humi. :22.8/62
 Antenna Pol. :Horizontal
 Engineer :Andy Wang



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	Mode	Reading Level		FS	@3m	
	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
4954.700	Average	18.48	9.96	28.45	54.00	-25.55
4954.700	Peak	28.45	9.96	38.41	74.00	-35.59
7432.050	Average	18.66	17.25	35.92	54.00	-18.08
7432.050	Peak	28.46	17.25	45.72	74.00	-28.28

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12 POWER SPECTRAL DENSITY

12.1 Standard Applicable

Per Part 15.247 (e)

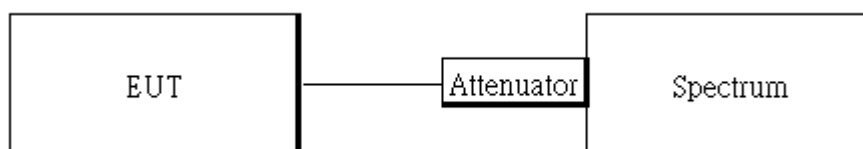
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

12.2 Measurement Equipment Used

Conducted Emission Test Site: Conducted C					
EQUIPMENT TYPE	MFR/BRAND	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/23/2020	07/22/2021
DC Block	PASTERNAK	PE8210	RF152	11/19/2020	11/18/2021
Coaxial Cables	Woken	00100A1F2A196C	RF51	11/19/2020	11/18/2021

12.3 Test Set-up



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12.4 Measurement Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance .
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz & VBW = 10 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

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12.5 Power spectral density

Gain			2.12	dB
Mimo support			SISO	
POWER DENSITY 2.4G_Ch0				
Freq. (MHz)	Ch0 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2403.35	-11.4	-11.40	8.00	PASS
2441.35	-12.8	-12.80	8.00	PASS
2477.35	-12.93	-12.93	8.00	PASS

Note

Cable Loss: 0.80 dB

**Refer to next page for plots*

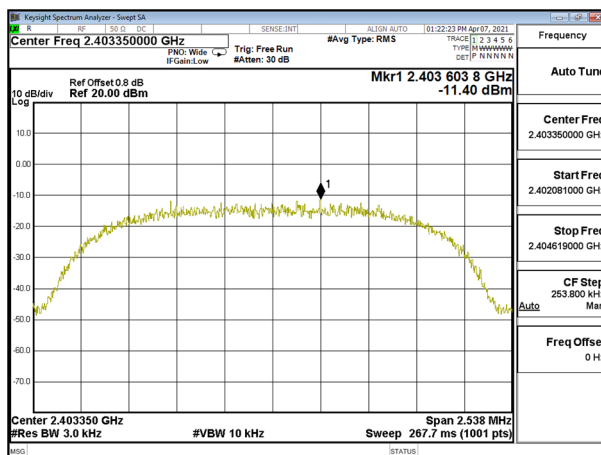
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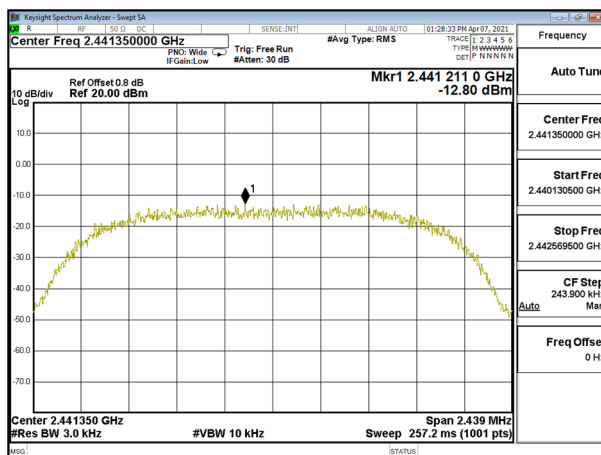
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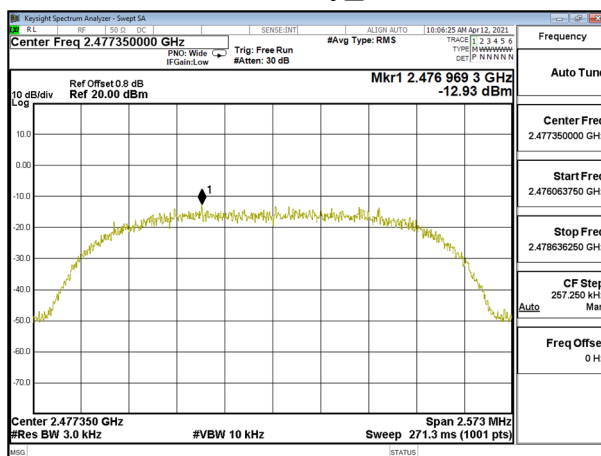
Power Density_2403.35



Power Density_2441.35



Power Density_2477.35



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13 ANTENNA REQUIREMENT

13.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

13.2 Antenna Connected Construction

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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